Easergy MiCOM P74x
(P741, P742 & P743)

Numerical Busbar Protection Relay

P74x/EN M/Qd9

Software Version	B1
Hardware Suffix	L (P742) and M (P741 & P743)
Issue Date	02/2017

Technical Manual

Schneider Electric

CONTENTS

Date:	02/2017
Products covered by this chapter:	This chapter covers the specific versions of the MiCOM products listed below. This includes ***only*** the following combinations of Software Version and Hardware Suffix.
Hardware Suffix:	L (P742) & M (P741 & P743)
Software Version:	B1 - P74x (P741, P742 & P743)
Connection Diagrams:	10P740xx (xx = 01 to 07)

SAFETY INFORMATION

CHAPTER SI

Date:	07/2016	
Products covered by this chapter:	This chapter covers the specific versions of the MiCOM products listed below. This includes ***only*** the following combinations of Software Version and Hardware Suffix.	
Hardware Suffix:	All MiCOM Px4x products	
Software Version:	All MiCOM Px4x products	
Connection Diagrams:	P14x (P141, P142, P143 & P145): 10P141xx (xx = 01 to 02) 10P142xx (xx = 01 to 05) 10P143xx (xx = 01 to 11) 10P145xx (xx = 01 to 11) P24x (P241, P242 & P243): 10P241xx (xx = 01 to 02) 10P242xx (xx = 01) 10P243xx (xx = 01) P34x (P342, P343, P344, P345 & P391): 10P342xx (xx = 01 to 17) 10P343xx (xx = 01 to 19) 10P344xx (xx = 01 to 12) 10P345xx (xx = 01 to 07) 10P391xx (xx = 01 to 02) P445: 10P445xx (xx = 01 to 04) P44x (P442 & P444): 10P44101 (SH 1 & 2) 10P44201 (SH 1 & 2) 10P44202 (SH 1) 10P44203 (SH 1 & 2) 10P44401 (SH 1) 10P44402 (SH 1) 10P44403 (SH 1 & 2) 10P44404 (SH 1) 10P44405 (SH 1) 10P44407 (SH 1 & 2) P44y (P443 & P446): 10P44303 (SH 01 and 03) 10P44304 (SH 01 and 03) 10P44305 (SH 01 and 03) 10P44306 (SH 01 and 03) 10P44600 10P44601 (SH 1 to 2) 10P44602 (SH 1 to 2) 10P44603 (SH 1 to 2)	P54x (P543, P544, P545 & P546): 10P54302 (SH 1 to 2) 10P54303 (SH 1 to 2) 10P54400 10P54404 (SH 1 to 2) 10P54405 (SH 1 to 2) 10P54502 (SH 1 to 2) 10P54503 (SH 1 to 2) 10P54600 10P54604 (SH 1 to 2) 10P54605 (SH 1 to 2) 10P54606 (SH 1 to 2) P547: 10P54702xx (xx = 01 to 02) 10P54703xx (xx = 01 to 02) 10P54704xx (xx = 01 to 02) 10P54705xx (xx = 01 to 02) P64x (P642, P643 & P645): 10P642xx (xx = 1 to 10) 10P643xx (xx = 1 to 6) 10P645xx (xx = 1 to 9) P74x (P741, P742 & P743): 10P740xx (xx = 01 to 07) P746: 10P746xx (xx = 00 to 21) P841: 10P84100 10P84101 (SH 1 to 2) 10P84102 (SH 1 to 2) 10P84103 (SH 1 to 2) 10P84104 (SH 1 to 2) 10P84105 (SH 1 to 2) P849: 10P849xx (xx = 01 to 06)

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Notes:

1 INTRODUCTION

This document and the relevant equipment documentation provide full information on safe handling, installation, testing, commissioning and operation of this equipment. This document also includes reference to typical equipment label markings.

Documentation for equipment ordered from Schneider Electric is dispatched separately from manufactured goods and may not be received at the same time as the equipment. Therefore this guide is provided to ensure that printed information which may be present on the equipment is fully understood by the recipient.

The technical data in this document provides typical information and advice, which covers a variety of different products. You must also refer to the Technical Data section of the relevant product publication(s) as this includes additional information which is specific to particular equipment.

Warning	**Before carrying out any work on the equipment, you should be familiar with the contents of the Safety Information chapter/Safety Guide SFTY/5L M/L11 or later issue, the Technical Data chapter and the ratings on the equipment rating label.**

You also need to make reference to the external connection diagram(s) before the equipment is installed, commissioned or serviced.

Language-specific, self-adhesive User Interface labels are provided in a bag for some equipment.

The manuals within the MiCOM P40 range include notices, which contain safety-related information. These are ranked in terms of their importance (from high to low) as follows:

DANGER	**THIS INDICATES AN IMMINENTLY HAZARDOUS SITUATION WHICH, IF NOT AVOIDED, WILL RESULT IN DEATH OR SERIOUS INJURY.**

WARNING	**This indicates an potentially hazardous situation which, if not avoided, can result in death or serious injury.**

Caution	**This indicates an potentially hazardous situation which, if not avoided, can result in minor or moderate injury.**

Important	**This indicates an potentially hazardous situation which, if not avoided, can result in equipment damage.**

Note	*This indicates an explanation or gives information which is useful to know, but which is not directly concerned with any of the above.*

These may appear with relevant Symbols (possibly electrical hazard, safety alert, disposal concern, etc) to denote the nature of the notice.

These notices appear at the relevant place in the remainder of this manual.

2 HEALTH AND SAFETY

The information in this part of the equipment documentation is intended to ensure that equipment is properly installed and handled in order to maintain it in a safe condition.

People

Schneider Electric assume that everyone who will be associated with installing, testing, commissioning, operating or working on the equipment (and any system to which it may be connected) will be completely familiar with the contents of the Safety Information chapter and the Safety Guide. We also assume that everyone working with the equipment (and any connected systems) will have sufficient qualifications, knowledge and experience of electrical systems. We also assume that they will work with a complete understanding of the equipment they are working on and the health and safety issues of the location in which they are working. All people must be able to perform tasks in accordance with accepted safety engineering practices. They must also be suitably authorised to energize and de-energize equipment and to isolate, ground (earth) and label it. Given the risks of working on electrical systems and the environments in which they may be located, they must be trained in the care and use of safety apparatus in accordance with safety engineering practices; and they should be trained in emergency first aid procedures.

Receipt, Handling, Storage and Unpacking Relays

Although relays are of a robust construction, we recommend that you become familiar with the Installation chapter, as this describes important issues associated with receiving, handling, storage and unpacking relays.

Planning

We recommend that a detailed plan is developed before equipment is installed into a location, to make sure that all of the work can be done safely. Such a plan needs to determine how relevant equipment can be isolated from the electrical supply in such as way that there is no possibility of accidental contact with any electrical live equipment, wiring or busbars. It also needs to take into account the requirements for people to work with tools/equipment a safe distance away from any hazards. The plan also needs to be aware of the risk of falling devices; such as equipment being knocked over, units being accidentally dropped or protruding units being knocked out of rack-mounted cabinets. Safety shoes are recommended, as well as other protective clothing such as safety hats and gloves.

Live and Stored Voltages

When electrical equipment is in operation, dangerous voltages will be present in certain parts of the equipment. Even if electrical power is no longer being supplied, some items of equipment may retain enough electrical energy inside them to pose a potentially serious risk of electrocution or damage to other equipment.

Important	**Remember that placing equipment in a “test” position does not normally isolate it from the power supply or discharge any stored electrical energy.**

Warnings and Barricades

Everyone must observe all warning notices. This is because the incorrect use of equipment, or improper use may endanger personnel and equipment and also cause personal injury or physical damage.
Unauthorized entry should also be prevented with suitably marked fixed barricades which will notify people of any dangers and screen off work areas.

People should not enter electrical equipment cubicles or cable troughs until it has been confirmed that all equipment/cables have been isolated and de-energised.

Electrical Isolation

Before working in the terminal strip area, all equipment which has the potential to provide damaging or unsafe levels of electrical energy must be isolated. You will need to isolate and de-energize the specific item of equipment which is being worked on.

Depending on the location, you may also need to isolate and de-energize other items which are electrically connected to it as well as those which are close enough to pose a risk of electrocution in the event of accidental physical or electrical contact.
Remember too that, where necessary, both load and line sides should be de-energized.
Before you make contact with any equipment use an approved voltage detection device to reduce the risk of electric shock.

Risk of Accidental Contact or Arc Flash

Be aware of the risk of accidental contact with hands, long hair, tools or other equipment; and be aware of the possibility of the increased risk of arc flash from areas of high voltage.
Always wear appropriate shock and arc flash personal protective equipment while isolating and de-energizing electrical equipment and until a de-energized state is confirmed.

Temporary Protection

Consider the use of temporary protective Earthing Clamps. This is required to establish and maintain de-energization when electrical equipment operates at greater than 1000 volts or there is potential for back-feed at any voltage.
Temporary protective earthing can be accomplished by installing cables designed for that purpose or by the use of intrinsic earthing clamp equipment. Temporary protective earthing clamp equipment must be able to carry maximum fault current available and have an impedance low enough to cause the applicable protective device to operate.

Restoring Power

To reduce the risks, the work plan should have a check list of things which must be completed and checks made before electrical power can be restored.
Be aware of the risk that electrical systems may have power restored to them at a remote location (possibly by the customer or a utility company). You should consider the use of lockouts so that the electrical system can be restored only when you unlock it. In any event, you should be aware of and be part of the process which determines when electrical power can be restored; and that people working on the system have control over when power is restored.
Inspect and test the electrical equipment to ensure it has been restored to a “safe” condition prior re-energizing. Replace all devices, doors and covers before turning on the power to any device.

Qualified Personnel

Proper and safe operation of the equipment depends on appropriate shipping and handling, proper storage, installation and commissioning, and on careful operation, maintenance and servicing. For this reason only qualified personnel may work on or operate the equipment.
Qualified personnel are individuals who:

- Are familiar with the installation, commissioning, and operation of the equipment and of the system to which it is being connected
- Are able to safely perform switching operations in accordance with accepted safety engineering practices and are authorized to energize and de-energize equipment and to isolate, ground, and label it
- Are trained in the care and use of safety apparatus in accordance with safety engineering practices
- Are trained in emergency procedures (first aid)

Documentation

The equipment documentation gives instructions for its installation, commissioning, and operation. However, the manuals cannot cover all conceivable circumstances or include detailed information on all topics. In the event of questions or specific problems, do not take any action without proper authorization. Contact the appropriate Schneider Electric technical sales office and request the necessary information.

3 SYMBOLS AND LABELS ON THE EQUIPMENT

For safety reasons the following symbols and external labels, which may be used on the equipment or referred to in the equipment documentation, should be understood before the equipment is installed or commissioned.

3.1 Symbols

Caution: refer to equipment documentation

Caution: risk of electric shock

Protective Conductor (*Earth) terminal

Functional/Protective Conductor (*Earth) terminal

Note	*This symbol may also be used for a Protective Conductor (Earth) Terminal if that terminal is part of a terminal block or sub-assembly e.g. power supply.*

***CAUTION**	**The term “Earth” used throughout this technical manual is the direct equivalent of the North American term “Ground”.**

3.2 Labels

See Safety Guide (SFTY/5L M) for typical equipment labeling information.

4 INSTALLING, COMMISSIONING AND SERVICING

Manual Handling

Plan carefully, identify any possible hazards and determine whether the load needs to be moved at all. Look at other ways of moving the load to avoid manual handling. Use the correct lifting techniques and Personal Protective Equipment to reduce the risk of injury.

Many injuries are caused by:

- Lifting heavy objects
- Lifting things incorrectly
- Pushing or pulling heavy objects
- Using the same muscles repetitively

Follow the Health and Safety at Work, etc Act 1974, and the Management of Health and Safety at Work Regulations 1999.

Equipment Connections

Personnel undertaking installation, commissioning or servicing work for this equipment should be aware of the correct working procedures to ensure safety.

The equipment documentation should be consulted before installing, commissioning, or servicing the equipment.

Terminals exposed during installation, commissioning and maintenance may present a hazardous voltage unless the equipment is electrically isolated.

The clamping screws of all terminal block connectors, for field wiring, using M4 screws shall be tightened to a nominal torque of 1.3 Nm.

Equipment intended for rack or panel mounting is for use on a flat surface of a Type 1 enclosure, as defined by Underwriters Laboratories (UL).

Any disassembly of the equipment may expose parts at hazardous voltage, also electronic parts may be damaged if suitable ElectroStatic voltage Discharge (ESD) precations are not taken.

If there is unlocked access to the rear of the equipment, care should be taken by all personnel to avoid electric shock or energy hazards.

Caution	*Voltage and current connections shall be made using insulated crimp terminations to ensure that terminal block insulation requirements are maintained for safety.*

Watchdog (self-monitoring) contacts are provided in numerical relays to indicate the health of the device. Schneider Electric strongly recommends that these contacts are hardwired into the substation's automation system, for alarm purposes.

To ensure that wires are correctly terminated the correct crimp terminal and tool for the wire size should be used.

The equipment must be connected in accordance with the appropriate connection diagram.

Protection Class I Equipment

- **Before energizing the equipment it must be earthed using the protective conductor terminal, if provided, or the appropriate termination of the supply plug in the case of plug connected equipment.**
- The protective conductor (earth) connection must not be removed since the protection against electric shock provided by the equipment would be lost.

- When the protective (earth) conductor terminal (PCT) is also used to terminate cable screens, etc., it is essential that the integrity of the protective (earth) conductor is checked after the addition or removal of such functional earth connections. For M4 stud PCTs the integrity of the protective (earth) connections should be ensured by use of a locknut or similar.

The recommended minimum protective conductor (earth) wire size is 2.5 mm^2 (3.3 mm^2 for North America) unless otherwise stated in the technical data section of the equipment documentation, or otherwise required by local or country wiring regulations.

The protective conductor (earth) connection must be low-inductance and as short as possible.

All connections to the equipment must have a defined potential. Connections that are pre-wired, but not used, should preferably be grounded when binary inputs and output relays are isolated. When binary inputs and output relays are connected to common potential, the pre-wired but unused connections should be connected to the common potential of the grouped connections.

Pre-Energization Checklist

Before energizing the equipment, the following should be checked:

- Voltage rating/polarity (rating label/equipment documentation)
- CT circuit rating (rating label) and integrity of connections
- Protective fuse rating
- Integrity of the protective conductor (earth) connection (where applicable)
- Voltage and current rating of external wiring, applicable to the application

Accidental Touching of Exposed Terminals

If working in an area of restricted space, such as a cubicle, where there is a risk of electric shock due to accidental touching of terminals which do not comply with IP20 rating, then a suitable protective barrier should be provided.

Equipment Use

If the equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

Removal of the Equipment Front Panel/Cover

Removal of the equipment front panel/cover may expose hazardous live parts, which must not be touched until the electrical power is removed.

UL and CSA/CUL Listed or Recognized Equipment

To maintain UL and CSA/CUL Listing/Recognized status for North America the equipment should be installed using UL or CSA Listed or Recognized parts for the following items: connection cables, protective fuses/fuseholders or circuit breakers, insulation crimp terminals and replacement internal battery, as specified in the equipment documentation.

For external protective fuses a UL or CSA Listed fuse shall be used. The Listed type shall be a Class J time delay fuse, with a maximum current rating of 15 A and a minimum d.c. rating of 250 Vd.c., for example type AJT15.

Where UL or CSA Listing of the equipment is not required, a high rupture capacity (HRC) fuse type with a maximum current rating of 16 Amps and a minimum d.c. rating of 250 Vd.c. may be used, for example Red Spot type NIT or TIA.

Equipment Operating Conditions

The equipment should be operated within the specified electrical and environmental limits. This includes humidity as well as temperature limits.

Current Transformer Circuits

Do not open the secondary circuit of a live CT since the high voltage produced may be lethal to personnel and could damage insulation. Generally, for safety, the secondary of the line CT must be shorted before opening any connections to it.

For most equipment with ring-terminal connections, the threaded terminal block for current transformer termination has automatic CT shorting on removal of the module. Therefore external shorting of the CTs may not be required, the equipment documentation should be checked to see if this applies.

For equipment with pin-terminal connections, the threaded terminal block for current transformer termination does NOT have automatic CT shorting on removal of the module.

External Resistors, including Voltage Dependent Resistors (VDRs)

Where external resistors, including Voltage Dependent Resistors (VDRs), are fitted to the equipment, these may present a risk of electric shock or burns, if touched.

Battery Replacement

Where internal batteries are fitted they should be replaced with the recommended type and be installed with the correct polarity to avoid possible damage to the equipment, buildings and persons.

Insulation and Dielectric Strength Testing

Insulation testing may leave capacitors charged up to a hazardous voltage. At the end of each part of the test, the voltage should be gradually reduced to zero, to discharge capacitors, before the test leads are disconnected.

Insertion of Modules and PCB Cards

Modules and PCB cards must not be inserted into or withdrawn from the equipment whilst it is energized, since this may result in damage.

Insertion and Withdrawal of Extender Cards

Extender cards are available for some equipment. If an extender card is used, this should not be inserted or withdrawn from the equipment whilst it is energized. This is to avoid possible shock or damage hazards. Hazardous live voltages may be accessible on the extender card.

External Test Blocks and Test Plugs

Great care should be taken when using external test blocks and test plugs such as the Easergy Test Block, Easergy Test Plug and MiCOM P99x types, as hazardous voltages may be accessible when using these. CT shorting links must be in place before the insertion or removal of Easergy test plugs, to avoid potentially lethal voltages.

**Note:*	*When a MiCOM P992 Test Plug is inserted into the MiCOM P991 Test Block, the secondaries of the line CTs are automatically shorted, making them safe.*

Fiber Optic Communication

Where fiber optic communication devices are fitted, these use laser light. These laser-light sources should not be viewed directly, as they can cause permanent damage to eyesight. Optical power meters should be used to determine the operation or signal level of the device.

Cleaning

The equipment may be cleaned using a lint free cloth dampened with clean water, when no connections are energized. Contact fingers of test plugs are normally protected by petroleum jelly, which should not be removed.

5 DE-COMMISSIONING AND DISPOSAL

De-Commissioning

The supply input (auxiliary) for the equipment may include capacitors across the supply or to earth. To avoid electric shock or energy hazards, after completely isolating the supplies to the equipment (both poles of any dc supply), the capacitors should be safely discharged via the external terminals prior to de-commissioning.

Disposal

It is recommended that incineration and disposal to water courses is avoided. The equipment should be disposed of in a safe manner. Any equipment containing batteries should have them removed before disposal, taking precautions to avoid short circuits. Particular regulations within the country of operation, may apply to the disposal of the equipment.

6 TECHNICAL SPECIFICATIONS FOR SAFETY

Unless otherwise stated in the equipment technical manual, the following data is applicable.

6.1 Protective Fuse Rating

The recommended maximum rating of the external protective fuse for equipments is 16A, High Rupture Capacity (HRC) Red Spot type NIT, or TIA, or equivalent. Unless otherwise stated in equipment technical manual, the following data is applicable. The protective fuse should be located as close to the unit as possible.

DANGER **CTs must NOT be fused since open circuiting them may produce lethal hazardous voltages.**

6.2 Protective Class

IEC 60255-27: 2005	Class I (unless otherwise specified in the equipment documentation).
EN 60255-27: 2006	This equipment requires a protective conductor (earth) connection to ensure user safety.

6.3 Installation Category

IEC 60255-27: 2013	Installation Category III (Overvoltage Category III)
EN 60255-27: 2014	Distribution level, fixed installation.

Equipment in this category is qualification tested at 5 kV peak, 1.2/50 µs, 500 Ω, 0.5 J, between all supply circuits and earth and also between independent circuits.

6.4 Environment

The equipment is intended for indoor installation and use only. If it is required for use in an outdoor environment then it must be mounted in a specific cabinet of housing which will enable it to meet the requirements of IEC 60529 with the classification of degree of protection IP54 (dust and splashing water protected).

Pollution Degree	Pollution Degree 2 Compliance is demonstrated by reference to safety standards.
Altitude	Operation up to 2000m

INTRODUCTION

CHAPTER 1

Date:	02/2017
Products covered by this chapter:	This chapter covers the specific versions of the MiCOM products listed below. This includes ***only*** the following combinations of Software Version and Hardware Suffix.
Hardware Suffix:	L (P742) & M (P741 & P743)
Software Version:	B1
Connection Diagrams:	10P740xx (xx = 01 to 07)

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FIGURES

TABLES

Notes:

1 MICOM DOCUMENTATION STRUCTURE

This manual provides a functional and technical description of this MiCOM device, and gives a comprehensive set of instructions for it's use and application. A summary of the different chapters of this manual is given here:

	Description	Chapter Code
	Safety Information	**Px4x/EN SI**
	A guide to the safe handling, commissioning and testing of equipment. This provides typical information and advice which covers a range of MiCOM Px4x products. It explains how to work with equipment safely.	
1	**Introduction**	**P74x/EN IT**
	A guide to the MiCOM range of relays and the documentation structure. General safety aspects of handling Electronic Equipment are discussed with particular reference to relay safety symbols. Also a general functional overview of the relay and brief application summary is given.	
2	**Technical Data**	**P74x/EN TD**
	Technical data including setting ranges, accuracy limits, recommended operating conditions, ratings and performance data. Compliance with norms and international standards is quoted where appropriate.	
3	**Getting Started**	**P74x/EN GS**
	A guide to the different user interfaces of the IED describing how to start using it. This chapter provides detailed information regarding the communication interfaces of the IED, including a detailed description of how to access the settings database stored within the IED.	
4	**Settings**	**P74x/EN ST**
	List of all relay settings, including ranges, step sizes and defaults, together with a brief explanation of each setting.	
5	**Operation**	**P74x/EN OP**
	A comprehensive and detailed functional description of all protection and non-protection functions.	
6	**Application Notes**	**P74x/EN AP**
	This section includes a description of common power system applications of the relay, calculation of suitable settings, some typical worked examples, and how to apply the settings to the relay.	
7	**Using the PSL Editor**	**Px4x/EN SE**
	This provides a short introduction to using the PSL Editor application.	
8	**Programmable Logic**	**P74x/EN PL**
	Overview of the Programmable Scheme Logic (PSL) and a description of each logical node. This chapter includes the factory default and an explanation of typical applications.	
9	**Measurements and Recording**	**P74x/EN MR**
	Detailed description of the relays recording and measurements functions including the configuration of the event and disturbance recorder and measurement functions.	
10	**Product Design**	**P74x/EN PD**
	Overview of the operation of the relay's hardware and software. This chapter includes information on the self-checking features and diagnostics of the relay.	
11	**Commissioning**	**P74x/EN CM**
	Instructions on how to commission the relay, comprising checks on the calibration and functionality of the relay.	
12	**Test and Setting Records**	**P74x/EN RC**
	This is a list of the tests made and the settings stored on the MiCOM IED.	

	Description	Chapter Code
13	**Maintenance**	**Px4x/EN MT**
	A general maintenance policy for the relay is outlined.	
14	**Troubleshooting**	**Px4x/EN TS**
	Advice on how to recognize failure modes and the recommended course of action. Includes guidance on whom within Schneider Electric to contact for advice.	
15	**SCADA Communications**	**P74x/EN SC**
	This chapter provides an overview regarding the SCADA communication interfaces of the relay. Detailed protocol mappings, semantics, profiles and interoperability tables are not provided within this manual. Separate documents are available per protocol, available for download from our website.	
16	**Installation**	**Px4x/EN IN**
	Recommendations on unpacking, handling, inspection and storage of the relay. A guide to the mechanical and electrical installation of the relay is provided, incorporating earthing recommendations.	
17	**Connection Diagrams**	**P74x/EN CD**
	A list of connection diagrams, which show the relevant wiring details for this relay.	
18	**Cyber Security**	**Px4x/EN CS**
	An overview of cyber security protection (to secure communication and equipment within a substation environment). Relevant cyber security standards and implementation are described too.	
19	**Dual Redundant Ethernet Board (DREB)**	**P74x/EN REB**
	Information about how MiCOM products can be equipped with Dual Redundant Ethernet Boards (DREBs) and the different protocols which are available. Also covers how to configure and commission these types of boards.	
20	**Parallel Redundancy Protocol (PRP) Notes**	**P74x/EN PR**
	Includes an introduction to Parallel Redundancy Protocols (PRP) and the different networks PRP can be used with. Also includes details of PRP and MiCOM functions.	
21	**High-availability Seamless Redundancy (HSR)**	**P74x/EN HS**
	Introduction to the High-availability Seamless Redundancy (HSR); and how it is implemented on MiCOM-based products manufactured by Schneider Electric.	
22	**Menu Maps (MM)**	**P74x/EN MM**
	This is a series of charts of the various menus which are contained in this IED. This shows you how to move from one menu option to another, if you are using the IED at the front panel.	
23	**Version History (of Firmware and Service Manual)**	**P74x/EN VH**
	This is a history of all hardware and software releases for this product.	
	Symbols and Glossary	**P74x/EN SG**
	List of common technical terms, abbreviations and symbols found in this documentation.	

Some of these chapters are *Specific* to a particular MiCOM product. Others are *Generic* – meaning that they cover more than one MiCOM product. The generic chapters have a Chapter Code which starts with Px4x.

2 INTRODUCTION TO MICOM

About MiCOM Range

MiCOM is a comprehensive solution capable of meeting all electricity supply requirements. It comprises a range of components, systems and services from Schneider Electric.

Central to the MiCOM concept is flexibility. MiCOM provides the ability to define an application solution and, through extensive communication capabilities, integrate it with your power supply control system.

The components within MiCOM are:

- P range protection relays
- C range control products
- M range measurement products for accurate metering and monitoring
- S range versatile PC support and substation control packages

MiCOM products include extensive facilities for recording information on the state and behaviour of the power system using disturbance and fault records. They can also provide measurements of the system at regular intervals to a control centre enabling remote monitoring and control to take place.

For up-to-date information, please see:

www.schneider-electric.com

Note	*During 2011, the International Electrotechnical Commission classified the voltages into different levels (IEC 60038). The IEC defined LV, MV, HV and EHV as follows: LV is up to 1000V. MV is from 1000V up to 35 kV. HV is from 110 kV or 230 kV. EHV is above 230 KV.* *There is still ambiguity about where each band starts and ends. A voltage level defined as LV in one country or sector, may be described as MV in a different country or sector. Accordingly, LV, MV, HV and EHV suggests a possible range, rather than a fixed band. Please refer to your local Schneider Electric office for more guidance.*

3 PRODUCT SCOPE

The MiCOM P74X differential busbar protection relays have been designed for the protection of a wide range of substation busbars from distribution to transmission voltage levels. The relays include a comprehensive range of non-protection features to aid with system diagnosis and fault analysis. The P74X offers integral biased differential busbar, breaker failure, dead zone, overcurrent and earth-fault protection and is suitable for application on solidly grounded, impedance grounded, Petersen coil grounded and isolated systems. The relays are especially suitable where a complete scheme solution is required.

The scheme consists of these relays:

- MiCOM P741 (Central Unit),
- MiCOM P742 and P743 (Peripheral Units).

Which, together with the topology configuration software and the dynamic synoptic monitoring tool, allow full flexibility for all configurations.

3.1 Functional Overview

The device contains a wide variety of communication functions and extension facilities which are summarized below:

Protection Functions Overview					
ANSI	**IEC 61850**	**Function**	**P741**	**P742**	**P743**
87BB / P	PhsPDIF	Phase segregated biased current differential high speed and delayed busbar protection	Yes	-	-
87CZ / P	CzPPDIF	Check Zone segregated biased phase current differential high speed and delayed busbar protection	Yes	-	-
87BB / N	NeuPDIF	Sensitive earth fault bias current controlled busbar protection	Yes	-	-
87 CZ/ N	CzNPDIF	Check Zone segregated biased earth current controlled busbar protection	Yes	-	-
50 / 51 / P	OcpPTOC	Phase overcurrent protection (2 stages)	-	Yes	Yes
50 / 51 / N	EfmPTOC	Earth overcurrent protection (2 stages)	-	Yes	Yes
50ST / P	DzpPhsPTOC	Dead zone phase protection (short zone between CTs and open CBs)	-	Yes	Yes
50ST / N	DzpEfmPTOC	Dead zone earth protection (short zone between CTs and open CBs)	-	Yes	Yes
CTS		Current transformer supervision	Yes	Yes	Yes
50BF	RBRF	Breaker failure protection (LBB)	Yes	Yes	Yes
ISL		Isolator discrepancy alarm	-	Yes	Yes
		Fibre optic signalling channel	Yes	Yes	Yes
	OptGGIO	Digital inputs (according to product) *	8	8/16	16/24
	RlyGGIO	Output relays (according to product) *	8	8/12	12/16/20
		High Break relays (according to product) *		4	4/8
		Virtual Digital inputs (via fibre communication)	16	16	16
		Virtual Output relays (via fibre communication)	16	16	16
		Front communication port (EIA(RS)232)	Yes	Yes	Yes
		Rear communication port (Kbus/EIA(RS)485)	Yes	Yes	Yes

Protection Functions Overview					
ANSI	IEC 61850	Function	P741	P742	P743
		Second Rear communication port (Kbus/EIA(RS)485)	Yes	-	Yes
		Rear communication port (Ethernet) *	Option	-	Option
		Time synchronisation port (IRIG-B) *	Option	Via CU	Via CU
		Redundant Ethernet port	Option	-	Option
	FnkGGIO	Function keys	10	-	10
	LedGGIO	Programmable tri-colour LEDs	18	-	18
	Note	** Refer to the data sheet for model selection*			

Table 1 - Functional overview

The relay supports these relay management functions as well as the ones shown above.

- Measurement of all instantaneous & integrated values
- Circuit breaker, status & condition monitoring
- Programmable Scheme Logic (PSL)
- Trip circuit and coil supervision (using PSL)
- Alternative setting groups (model dependent)
- Programmable function keys (model dependent)
- Control inputs
- Programmable allocation of digital inputs and outputs
- Sequence of event recording
- Comprehensive disturbance recording (waveform capture)
- Fault recording
- Fully customizable menu texts
- Power-up diagnostics and continuous self-monitoring of relay
- Commissioning test facilities
- Real time clock/time synchronization - time synchronization possible from IRIG-B input, opto input or communications
- Simple password management:
  CSL0 - No Security Administration Tool (SAT) required
- Advanced Cyber Security:
  CSL1 - Security Administration Tool (SAT) required
- Read only mode

3.1.1 Application Overview

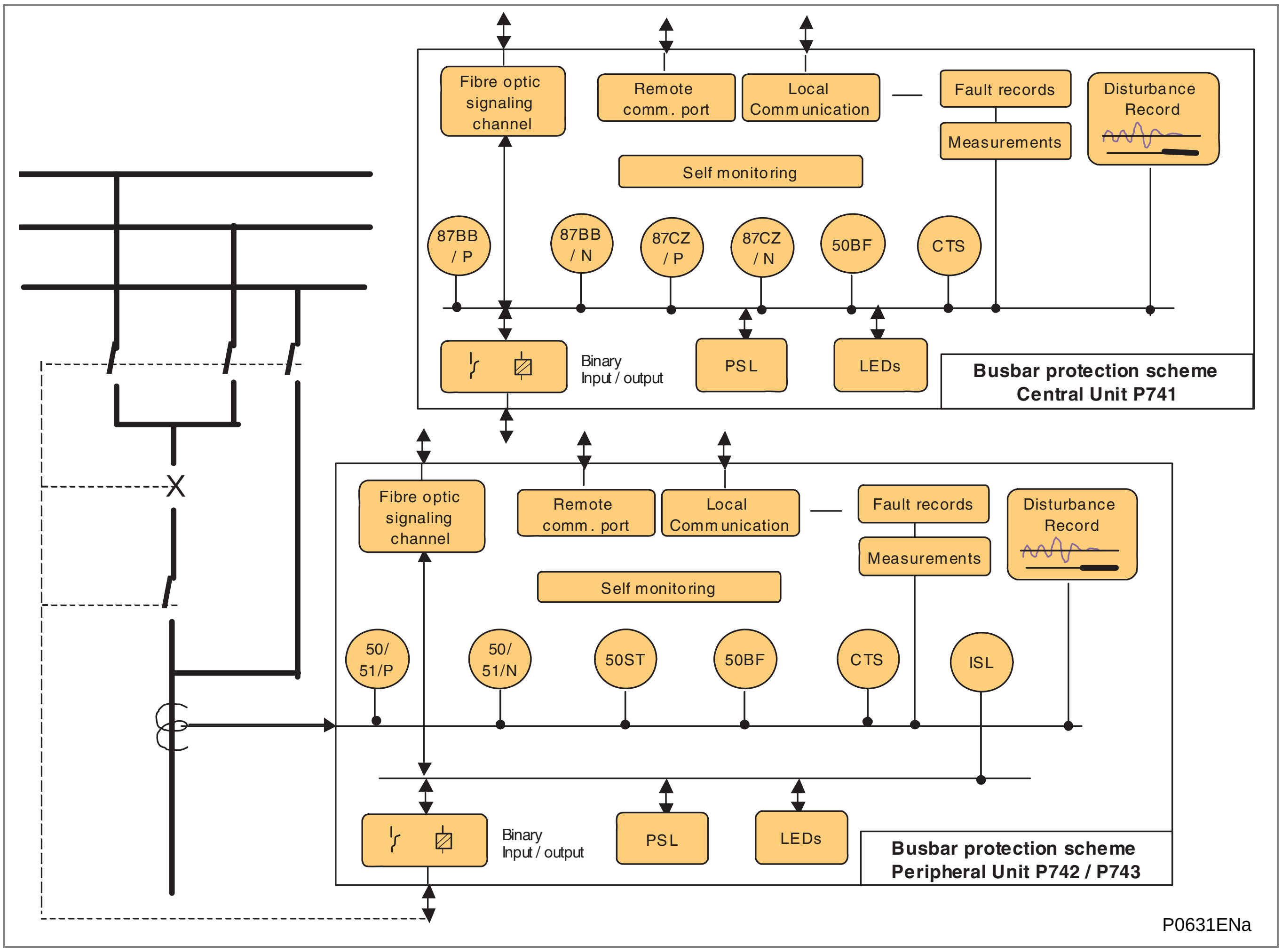

Figure 1 – Functional diagram

Note	*A summary of ANSI codes for protection devices is given in the Symbols and Glossary chapter.*

4 ORDERING OPTIONS

For each product there are range of ordering options. The options vary from one product to another, and from one Software Version to another.

The information required with your order is given in these sections:

The following information is required with an equipment order:

- MiCOM P741
- MiCOM P742
- MiCOM P743

Note	*The Cortec table(s) list the options available as of the date of this documentation. The most up-to-date versions of these tables can be found on our web site (www.schneider-electric.com). It may not be possible to select ALL of the options shown here within a single item of equipment.*

4.1.1 MiCOM P741

Numerical Busbar Differential Protection		P741				A		M				
Vx Auxiliary Rating												
24 - 32Vdc			9									
48 - 110Vdc			2									
110 - 250Vdc (100 - 240Vac)			3									
Communication Boards												
1 communication board (4 peripheral units)				1								
2 communication boards (8 peripheral units)				2								
3 communication boards (12 peripheral units)				3								
4 communication boards (16 peripheral units)				4								
5 communication boards (20 peripheral units)				5								
6 communication boards (24 peripheral units)				6								
7 communication boards (28 peripheral units)				7								
Hardware Options	Protocol Compatibility											
Standard - None	1				1							
IRIG-B Only (modulated)	1				2							
Ethernet (100Mbps)	6				6							
Ethernet (100Mhz) plus IRIG-B (Modulated)	6				A							
Ethernet (100Mhz) plus IRIG-B (De-modulated)	6				B							
2nd Rear Port & interMiCOM	1				E							
2nd Rear Port & inteMiCOM & IRIG-B (modulated)	1				F							
Redundant Ethernet Self-Healing Ring, 2 multi-mode fibre ports + Modulated IRIG-B	6				G							
Redundant Ethernet Self-Healing Ring, 2 multi-mode fibre ports + Un-modulated IRIG-B	6				H							
Redundant Ethernet RSTP, 2 multi-mode fibre ports + Modulated IRIG-B	6				J							
Redundant Ethernet RSTP, 2 multi-mode fibre ports + Un-modulated IRIG-B	6				K							
Redundant Ethernet Dual-Homing Star, 2 multi-mode fibre ports + Modulated IRIG-B	6				L							
Redundant Ethernet Dual-Homing Star, 2 multi-mode fibre ports + Un-modulated IRIG-B	6				M							
Redundant Ethernet Parallel Redundancy Protocol (PRP), 2 multimode fibre ports + Modulated IRIG-B	6				N							
Redundant Ethernet Parallel Redundancy Protocol (PRP), 2 multimode fibre ports + Un-modulated IRIG-B	6				P							
Redundant Ethernet (100Mbit/s) PRP or HSR and Dual IP, 2 LC ports + 1 RJ 45 port + Modulated/Un-modulated IRIG-B	6				Q							
Redundant Ethernet (100Mbit/s) PRP or HSR and Dual IP, 3 RJ45 ports + Modulated/Un-modulated IRIG-B	6				R							
Ethernet (100Mbit/s), 1 RJ45 port + Modulated/Un-modulated IRIG-B	6				S							
Protocol / Communications Options	Hardware Compatibility											
Courier (KBus) or IEC 103 via KITZ274	1, 2, C, E, F						1					
Courier (KBus) or IEC 103 via KITZ274 + Additional IEC61850 OR IEC 61850 Edition 1 and Edition 2 and Courier via rear K-Bus/RS485	6, A, B, G, H, J, K, L, M, N, P, Q, R, S						6					

Numerical Busbar Differential Protection		**P741**				**A**		**M**				
Mounting Option												
Flush Panel Mounting								M				
Multilingual Language Option	Design Suffix Compatibility											
English, French, German, Spanish	All								0			
English, French, German, Russian	K+M								5			
Software Issue										**		
Customisation												
Default											8	
Customer specific											9	
Design Suffix												
M: Extended Phase 3 CPU												M
K: Extended Phase 2 CPU												K

4.1.2 MiCOM P742

Numerical Busbar Differential Protection			P742		1	1			M				
Vx Auxiliary Rating													
24 - 32Vdc				9									
48 - 110Vdc				2									
110 - 250Vdc (100 - 240Vac)				3									
Hardware Options													
With In = 1/5A CT Input					1								
Communications Options													
None						1							
Product Specific Options	Software Compatibility												
8 Relays Outputs and 16 Status Inputs	All						A						
8 Relays Outputs, 4 High Break and 8 Status Inputs	From '51' onwards						B						
Protocol Options													
K-Bus or IEC 103 via KITZ274								1					
Mounting Option													
Flush Panel Mounting,									M				
Multilingual Language Option													
English, French, German, Spanish										0			
English, French, German, Russian										5			
Software Issue											**		
Customisation													
Default												8	
Customer specific												9	
Design Suffix													
Phase 3 CPU													L
Phase 2 CPU													J

4.1.3 MiCOM P743

Numerical Busbar Differential Protection			P743		1				M				
Vx Auxiliary Rating													
24 - 32Vdc				9									
48 - 110Vdc				2									
110 - 250Vdc (100 - 240Vac)				3									
Hardware Options													
With In = 1/5A CT Input					1								
Communications Options	Protocol Compatibility												
Standard - None	1					1							
Ethernet (100Mbit/s)	6					6							
2nd Rear Port & intermicom (No Irig-B)	1					E							
Redundant Ethernet Self-Healing Ring, 2 multi-mode fibre ports + Modulated IRIG-B	6					G							
Redundant Ethernet Self-Healing Ring, 2 multi-mode fibre ports + Un-modulated IRIG-B	6					H							
Redundant Ethernet RSTP, 2 multi-mode fibre ports + Modulated IRIG-B	6					J							
Redundant Ethernet RSTP, 2 multi-mode fibre ports + Un-modulated IRIG-B	6					K							
Redundant Ethernet Dual-Homing Star, 2 multi-mode fibre ports + Modulated IRIG-B	6					L							
Redundant Ethernet Dual-Homing Star, 2 multi-mode fibre ports + Un-modulated IRIG-B	6					M							
Redundant Ethernet Parallel Redundancy Protocol (PRP), 2 multimode fibre ports + Modulated IRIG-B	6					N							
Redundant Ethernet Parallel Redundancy Protocol (PRP), 2 multimode fibre ports + Un-modulated IRIG-B	6					P							
Redundant Ethernet (100Mbit/s) PRP or HSR and Dual IP, 2 LC ports + 1 RJ 45 port + Modulated/Un-modulated IRIG-B	6					Q							
Redundant Ethernet (100Mbit/s) PRP or HSR and Dual IP, 3 RJ45 ports + Modulated/Un-modulated IRIG-B	6					R							
Ethernet (100Mbit/s), 1 RJ45 port + Modulated/Un-modulated IRIG-B	6					S							
Product Specific Options													
16 Relays Outputs and 24 Status Inputs							A						
16 Relays Outputs, 4 High Break and 16 Status Inputs							B						
8 Relays Outputs, 4 High Break and 24 Status Inputs							C						
8 Relays Outputs, 8 High Break and 16 Status Inputs							D						
Protocol / Communications Options	Hardware Compatibility												
Courier (KBus) or IEC 103 via KITZ274	1, E							1					
Courier (KBus) or IEC 103 via KITZ274 + Additional IEC61850 OR IEC 61850 Edition 1 and Edition 2 and Courier via rear K-Bus/RS485	6, G, H, J, K, L, M, N, P, Q, R, S							6					
Mounting Option													
Flush Panel Mounting,									M				
Multilingual Language Option													

Numerical Busbar Differential Protection			P743		1				M				
English, French, German, Spanish										0			
English, French, German, Russian										5			
Software Issue											**		
Customisation													
Default												8	
Customer specific												9	
Design Suffix													
Extended Phase 3 CPU													M
Extended Phase 2 CPU													K

TECHNICAL DATA

CHAPTER 2

Date:	02/2017
Products covered by this chapter:	This chapter covers the specific versions of the MiCOM products listed below. This includes ***only*** the following combinations of Software Version and Hardware Suffix.
Hardware Suffix:	L (P742) & M (P741 & P743)
Software Version:	B1
Connection Diagrams:	10P740xx (xx = 01 to 07)

CONTENTS

1 MECHANICAL SPECIFICATION

1.1 Design

Modular MiCOM Px40 platform relay:
P741: Size 16“ case (80TE)
P742: Size 8“ case (40TE)
P743: Size 12“ case (60TE)
Mounting is front of panel flush mounting.

1.2 Enclosure Protection

Per IEC 60529:

- IP 52 Protection (front panel) against dust and dripping water.
- IP 50 Protection for the rear and sides of the case against dust.
- IP 10 Product safety protection for the rear due to live connections on the terminal block.

1.3 Weight

P741 with 7 comm. boards	7.4 kg
P741 with 1 comm. board	6.2 kg
P742	7.5 kg
P743	9.2 kg

2 TERMINALS

2.1 AC Current and Voltage Measuring Inputs

P742 and P743 only

Located on heavy duty (black) terminal block:
Threaded M4 terminals, for ring terminal connection.
CT inputs have integral safety shorting, upon removal of the terminal block.

2.2 General Input/Output Terminals

For power supply, opto inputs, output contacts and RP1, COM1 and optional COM2 rear communications.
Located on general purpose (grey) blocks:
Threaded M4 terminals, for ring lug/terminal connection.

2.3 Case Protective Earth Connection

Two rear stud connections, threaded M4.
Must be earthed (grounded) using the protective (earth) conductor for safety, minimum earth wire size 2.5mm^2.

Note	*There are two rear stud connections for the P741, and one for the P742/P743.*

2.4 Front Port Serial PC Interface

EIA(RS)-232 DCE, 9 pin D-type female connector Socket SK1.
Courier protocol for interface to MiCOM S1 Studio software.
Isolation to SELV/ELV (Safety/Extra Low Voltage) level / PEB (Protective Equipotential Bonded).
Maximum cable length 15m.

2.5 Front Download/Monitor Port

EIA(RS)-232, 25 pin D-type female connector Socket SK2.
For firmware and menu text downloads.
Isolation to SELV/PEB level.

2.6 Rear Communications Port

K-Bus/EIA (RS)485 signal levels, two-wire connections located on general purpose block, M4 screw.
For screened twisted-pair cable, multidrop, 1000 m max.
Ethernet (copper and fibre). Courier protocol SELV* rated circuit

2.7 Optional Second Rear Communication Port (RP2)

EIA(RS)-232, 9 pin D-type female connector, socket SK4.
Courier protocol: K-Bus, EIA(RS)-232, or EIA(RS)485 connection.
Isolation to SELV level.
Maximum cable length 15m.

2.8 Optional Rear EIA(RS)232 InterMiCOM Port

For “MODEM” InterMiCOM teleprotection schemes.
EIA(RS)232, 9 pin D-type female connector, socket SK5.
Isolation to SELV (Separated Extra Low Voltage) level.
Maximum cable run length to MODEM 15m.

2.9 Optional Rear IRIG-B Interface Modulated or Un-modulated

P741
Separated Extra Low Voltage (SELV)
Both PEB and SELV circuits are safe to touch after a single fault condition.

2.10 Optical Fiber Connection

BFOC 2.5 (ST) interface for multi-mode glass fibre type 62.5/125 μm, as per IEC 874-10, 850 nm short-haul fibres, one Tx and one Rx.
Optical budget: 5.6 dB
Data rate:2.5 Mbits
Max Length: 1000 m

2.11 Optional Rear Ethernet Connection for IEC61850

2.11.1 10BaseT / 100BaseTX Communications

Interface in accordance with IEEE802.3 and IEC 61850

Isolation:	1.5 kV
Connector type:	RJ45
Cable type:	Screened Twisted Pair (STP)
Max. cable length:	100 m

2.11.2 100 Base FX Interface

Interface in accordance with IEEE802.3 and IEC 61850

Wavelength:	1310 nm
Fiber:	multi-mode 50/125 µm or 62.5/125 µm
Connector type:	ST/LC Connector Optical Interface (depending on model)

2.12 Optional Rear Redundant Ethernet Connection for IEC 61850

2.12.1 100 Base FX Interface

Interface in accordance with IEEE802.3 and IEC 61850

Wavelength:	1310 nm
Fiber:	multi-mode 50/125 µm or 62.5/125 µm
Connector type:	ST/LC Connector Optical Interface (depending on model)

2.12.2 Transmitter Optical Characteristics (100Base FX Interface)

Transmitter Optical Characteristics – 100 base FX interface
(T_A = 0°C to 70°C, V_{CC} = 4.75 V to 5.25 V)

Parameter	Sym	Min.	Typ.	Max	Unit
Output Optical Power BOL: 62.5/125 µm, NA = 0.275 Fiber EOL	P_{OUT}	–19 –20	–16.8	–14	dBm avg.
Output Optical Power BOL: 50/125 µm, NA = 0.20 Fiber EOL	P_{OUT}	–22.5 –23.5	–20.3	–14	dBm avg.
Optical Extinction Ratio				10 –10	% dB
Output Optical Power at Logic “0” State	P_{OUT} (“0”)			–45	dBm avg.
BOL – Beginning of life EOL – End of life					

Transmitter Optical Characteristics – 100 base FX interface

Table 1 - Interface Transmitter optical characteristics 100 base FX interface

2.12.3 Receiver Optical Characteristics (100Base FX Interface)

Receiver Optical Characteristics – 100 base FX interface
(T_A = 0°C to 70°C, V_{CC} = 4.75 V to 5.25 V)

Parameter	Sym	Min.	Typ.	Max.	Unit
Input Optical Power Minimum at Window Edge	P_{IN} Min. (W)		–33.5	–31	dBm avg.
Input Optical Power Minimum at Eye Center	P_{IN} Min. (C)		–34.5	–31.8	dBm avg.
Input Optical Power Maximum	P_{IN} Max.	–14	–11.8		dBm avg.

Receiver Optical Characteristics – 100 base FX interface

Table 2 - Receiver optical characteristics 100 base FX interface

2.13 Fiber Defect Connector (Watchdog Relay) – Redundant Ethernet Board

Connector (3 terminals):	2 NC contacts
Rated voltage:	250 V
Continuous current:	5 A
Short duration current:	30 A for 3 s
Breaking Capacity	DC: 50 W resistive DC: 25 W resistive AC: 1500 VA resistive (cos ϕ = unity) AC: 1500 VA inductive (cos ϕ = unity) Subject to maxima of 5 A and 250 V

3 RATINGS

3.1 AC Measuring Inputs

Nominal frequency:	50 and 60 Hz (settable)
Operating range:	45 to 66 Hz
Phase rotation:	ABC or ACB

3.2 AC Current

Nominal current (In):	1 and 5 A dual rated.
Nominal burden per phase 1 A:	<0.04VA at rated current
Impedance per phase 1 A:	<40mΩ over 0 - 30In
Nominal burden per phase 5 A:	<0.30VA at rated current
Impedance per phase 5 A:	<8mΩ over 0 - 30In
Thermal withstand:	continuous, 4 In for 10 s: 30 In for 1 s; 100 In

Linear to 64 In (non-offset AC current).

Note *1A and 5A inputs use different transformer tap connections, check correct terminals are wired).*

4 POWER SUPPLY

4.1 Auxiliary Voltage (Vx)

Three ordering options:
(i) Vx: 24 to 32 Vdc
(ii) Vx: 48 to 110 Vdc,
(iii) Vx: 110 to 250 Vdc, and 100 to 240 Vac (rms).

4.2 Operating Range

(i) 19 to 38Vdc (dc only for this variant)
(ii) 37 to 150V (dc only for this variant)
(iii) 87 to 300V (dc), 80 to 265 V (ac).

With a tolerable ac ripple of up to 15% for a dc supply, per EN / IEC 60255-11, EN / IEC 60255-26.

4.3 Nominal Burden

Quiescent burden:	P741: 37 to 41 W P742: 16 to 23 W P743: 22 to 32 W
Additions for energised binary inputs/outputs:	Per opto input: 0.09 W…(24 to 54 V), 0.12 W…(110/125 V), 0.19 W…(220/250 V).
Per energised output relay:	0.13 W
Per energised high break output relay:	* 0.73W

4.4 Power-up Time

Main Processor including User Interface and front access port < 30s.
Ethernet Communications <120 s.

4.5 Power Supply Interruption

Per IEC 60255-11: 1979

The relay will withstand a 20 ms interruption in the DC auxiliary supply, without de-energizing.

Per IEC 61000-4-11: 1994

The relay will withstand a 20 ms interruption in an AC auxiliary supply, without de-energizing.

Note	*The use of an E124 extends these limits.*

4.6 Battery Backup

Front panel mounted.
Type ½ AA, 3.6 V Lithium Thionyl Chloride (SAFT advanced battery reference LS14250).
Battery life (assuming relay energized for 90% time) >10 years.

4.7 Field Voltage Output

Regulated 48 Vdc
Current limited at 112 mA maximum output

4.8 Digital ("Opto") Inputs

Universal opto inputs with programmable voltage thresholds. May be energized from the 48V field voltage, or the external battery supply.

Rated nominal voltage:	24 to 250Vdc
Operating range:	19 to 265Vdc
Withstand:	300Vdc.
Nominal pick-up and reset thresholds:	
Pick-up:	approx. 70% of battery nominal set,
Reset:	approx. 66% of battery nominal set.
Recognition time:	7ms

5 OUTPUT CONTACTS

5.1 Standard Contacts

General purpose relay outputs for signalling, tripping and alarming:

Rated voltage:	300 V	
Continuous current:	10 A	
Short-duration current:	30 A for 3 s	
Making capacity:	250A for 30 ms	
Breaking capacity:	DC:	50W resistive
	DC:	62.5W inductive (L/R = 50ms)
	AC:	2500VA resistive (cos ϕ = unity)
	AC:	2500VA inductive (cos ϕ = 0.7)
Response to command:	< 5ms	
Durability:	Loaded contact: 10000 operations minimum,	
	Unloaded contact: 100000 operations minimum.	

5.2 Fast Operation and High Break Contacts

Dedicated purpose relay outputs for tripping: Uses IGBT technology

Make and Carry:	30 Amps for 3 sec, 30A @ 250V resistive
Carry:	250 Amps dc for 30ms
Continuous Carry:	10 Amps dc
Break Capacity:	10 Amps @ 250V resistive (10,000 operations)
	10 Amps @ 250V L/R=40ms
Operating time:	<200us & Reset time: 7.5ms

5.3 Watchdog Contacts

Non-programmable contacts for relay healthy or relay fail indication:

Breaking capacity:	DC: 30 W resistive
	DC: 15 W inductive (L/R = 40 ms)
	AC: 375 VA inductive (cos ϕ = 0.7)

5.4 IRIG-B 12X Interface (Modulated)

External clock synchronization to IRIG standard 200-98, format B12x
Input impedance 6 kΩ at 1000 Hz
Modulation ratio: 3:1 to 6:1
Input signal, peak-peak: 200 mV to 20 V

5.5 IRIG-B 00X Interface (Un-modulated)

External clock synchronization to IRIG standard 200-98, format B00X.
Input signal TTL level
Input impedance at dc 10 kΩ

6 ENVIRONMENTAL CONDITIONS

6.1 Ambient Temperature Range

Per IEC 60255-6: 1988

Operating temperature range:	-25°C to +55°C (or -13°F to +131°F).
Storage and transit:	-25°C to +70°C (or -13°F to +158°F).
Tested as per IEC 60068-2-1: 2007	-25°C (-13°F) storage (96 hours)
	-40°C (-40°F) operation (96 hours)
IEC 60068-2-2: 2007	+85°C (+185°F) storage (96 hours)

6.2 Ambient Humidity Range

Per IEC 60068-2-78: 2001:

56 days at 93% relative humidity and +40°C

Per IEC 60068-2-30: 2005:

Damp heat cyclic, six (12 + 12) hour cycles, 93% RH, +25 to +55°C

6.3 Corrosive Environments

Per IEC 60068-2-60: 1995, Part 2, Test Ke, Method (class) 3
Industrial corrosive environment/poor environmental control, mixed gas flow test.
21 days at 75% relative humidity and +30°C
Exposure to elevated concentrations of H_2S, NO_2, Cl_2 and SO_2.

7 TYPE TESTS

7.1 Insulation

Per IEC 60255-5: 2000,
Insulation resistance > 100 MΩ at 500 Vdc (Using only electronic/brushless insulation tester).

7.2 Creepage Distances and Clearances

Per IEC 60255-27: 2005	Pollution degree 3 overvoltage category III impulse test voltage 5 kV

7.3 High Voltage (Dielectric) Withstand

EIA(RS)232 ports excepted.

Per IEC 60255-27: 2005, 2 kV rms AC, 1 minute:

Between all case terminals connected together, and the case earth.
Also, between all terminals of independent circuits.
1 kV rms AC for 1 minute, across open watchdog contacts.
1 kV rms AC for 1 minute, across open contacts of changeover output relays.

Per ANSI/IEEE C37.90-1989 (reaffirmed 1994):

1.5 kV rms AC for 1 minute, across open contacts of changeover output relays.

7.4 Impulse Voltage Withstand Test

Per IEC 60255-27: 2005

Front time:	1.2 µs, Time to half-value: 50 µs,
Peak value:	5 kV, 0.5 J

Between all terminals, and all terminals and case earth.

8 ELECTROMAGNETIC COMPATIBILITY (EMC)

8.1 1 MHz Burst High Frequency Disturbance Test

As for EN 60255-22-1: 2008, Class III,

Common-mode test voltage:	2.5 kV,
Differential test voltage:	1.0 kV,
Test duration:	2 s
Source impedance:	200 Ω

(EIA(RS)-232 ports excepted).

8.2 Immunity to Electrostatic Discharge

Per IEC 60255-22-2: 1997, Class 4,

15kV discharge in air to user interface, display, and exposed metalwork.

Per IEC 60255-22-2: 1997, Class 3,

8kV discharge in air to all communication ports.

6kV point contact discharge to any part of the front of the product.

8.3 Electrical Fast Transient or Burst Requirements

Per IEC 60255-22-4: 2002.

Test severity:	Class III and IV:
Amplitude:	2 kV, burst frequency 5 kHz (Class III),
Amplitude:	4 kV, burst frequency 2.5 kHz (Class IV).

Applied directly to auxiliary supply, and applied to all other inputs. EIA(RS)232 ports excepted.

8.4 Surge Immunity Test

EIA(RS)232 ports excepted.

Per IEC 61000-4-5: 2005 Level 4.

Time to half-value:	1.2/50 µs.
Amplitude:	4 kV between all groups and protective (earth) conductor terminal.
Amplitude:	2 kV between terminals of each group.

8.5 Immunity to Radiated Electromagnetic Energy

IEC 60255-22-3: 2000, Class III:

Test field strength, frequency band 80 to 1000 MHz:	10 V/m,
Test using AM:	1 kHz / 80%,

Spot tests at 80, 160, 450, 900 MHz

IEEE/ANSI C37.90.2: 1995:

25 MHz to 1000 MHz, zero and 100% square wave modulated.

Field strength of 35 V/m.

8.6 Radiated Immunity from Digital Communications

EN61000-4-3: 2002, Level 4:

Test field strength, frequency band 800 to 960 MHz, and 1.4 to 2.0 GHz: 30 V/m,

Test using AM: 1 kHz / 80%.

8.7 Radiated Immunity from Digital Radio Telephones

ENV 50204: 1995 10 V/m, 900 MHz and 1.89 GHz.

8.8 Immunity to Conducted Disturbances Induced by Radio Frequency Fields

IEC 61000-4-6: 1996, Level 3, Disturbing test voltage: 10 V

8.9 Power Frequency Magnetic Field Immunity

IEC 61000-4-8: 1994, Level 5: 100 A/m applied continuously,
1000 A/m applied for 3 s.
IEC 61000-4-9: 1993, Level 5: 1000 A/m applied in all planes.
IEC 61000-4-10: 1993, Level 5:
100 A/m applied in all planes at 100 kHz/1MHz with a burst duration of 2 s.

8.10 Conducted Emissions

EN 55022: 1998: Class A:

0.15 - 0.5 MHz, 79 dBμV (quasi peak) 66 dBμV (average)
0.5 – 30 MHz, 73 dBμV (quasi peak) 60 dBμV (average).

8.11 Radiated Emissions

EN 55022: 1998: Class A:

30 – 230 MHz, 40 dBμV/m at 10 m measurement distance
230 – 1 GHz, 47 dBμV/m at 10 m measurement distance.

9 EU DIRECTIVES

9.1 EMC Compliance

Per 89/336/EEC:

Compliance to the European Commission Directive on EMC is claimed via the Technical Construction File route. Product Specific Standards were used to establish conformity with EN50263: 2000

9.2 Product Safety

Per 2006/95/EC:

Compliance to the European Commission Low Voltage Directive (LVD) is demonstrated using a Technical File. A product-specific standard was used to establish conformity.

CE EN 60255-27

10 MECHANICAL ROBUSTNESS

10.1 Vibration Test

Per EN / IEC 60255-21-1	Response Class 2 Endurance Class 2

10.2 Shock and Bump

Per EN / IEC 60255-21-2	Shock response Class 2 Shock withstand Class 1 Bump Class 1

10.3 Seismic Test

Per EN / IEC 60255-21-3:	Class 2

11 PERFORMANCE DATA

11.1 Timings and Accuracy

All quoted operating times include the closure of the standard trip output contact.

11.2 Busbar Protection

11.2.1 Busbar Fault Accuracy

Pick-up:	Setting ± 5% or 20 A up to 8 Pus, or 50 A from 8 Pus whichever is greater
Drop-off:	>0.95 x Setting or 20 A up to 8 Pus or 50 A from 8 Pus whichever is greater
Busbar trip:	11 ms (min) & 13 ms (typical) at1.4 x tripping threshold at 50Hz and at 1.7 x tripping threshold at 60Hz

11.2.2 Circuitry Fault Accuracy

Pick-up:	Setting ± 5% or	20 A up to 8 Pus, or 50 A from 8 Pus, Whichever Is Greater (WIG)
Drop-off:	>0.95 x Setting or	20 A up to 8 Pus, or 50 A from 8 Pus, WIG
DT operation:	±5 % or	40 ms WIG

11.3 Dead Zone Protection

Accuracy

Pick-up:	Setting ± 5% or 10 mA whichever is greater
Drop-off:	>0.95 x Setting or 10 mA whichever is greater
Min. trip level:	1.05 x Setting ± 5% or 10 mA whichever is greater
DT operation:	±5 % or 20 ms whichever is greater

11.4 Three Phase Overcurrent Protection

Accuracy

Pick-up:		Setting ±5 % or 10 mA whichever is greater
Drop-off:		0.95 x Setting ±5 % or 10 mA whichever is greater
Min. trip level of IDMT elements:		1.05 x Setting ±5 % or 10 mA whichever is greater
IDMT shape:		±5 % or 40 ms whichever is greater (under reference conditions)*
IEEE reset:		±5 % or 40 ms whichever is greater
DT operation:		±5 % or 50 ms whichever is greater
DT reset:		Setting ±5 % or 20 ms whichever is greater
Characteristic:	UK curves:	IEC 60255-3 …1998
	US curves:	IEEE C37.112 …1996

11.5 Earth Fault Protection

Accuracy

Pick-up:	Setting ± 5% or 10 mA whichever is greater
Drop-off:	>0.95 x Setting or 10 mA whichever is greater
Min. trip level of IDMT elements:	1.05 x Setting ± 5% or 10 mA whichever is greater
IDMT characteristic shape:	±5% or 40 ms whichever is greater (under reference conditions)*
IEEE reset:	±10% or 40 ms whichever is greater
DT operation:	±5% or 50 ms whichever is greater
DT reset:	±5% or 50 ms whichever is greater

11.6 Transient Overreach and Overshoot

Accuracy

Additional tolerance due to increasing X/R ratios:	±5% over X/R 1 to 90
Overshoot of overcurrent elements:	<40 ms

12 PROGRAMMABLE SCHEME LOGIC

Output conditioner timer:	Setting ±2% or 50 ms whichever is greater
Dwell conditioner timer:	Setting ±2% or 50 ms whichever is greater
Pulse conditioner timer:	Setting ±2% or 50 ms whichever is greater

13 IRIG-B AND REAL TIME CLOCK

13.1 Modulated IRIG-B

Modulation ratio:	1/3 or 1/6
Input signal peak-peak amplitude:	200 mV to 20 V
Input impedance at 1000Hz:	6000 Ω
External clock synchronization:	Conforms to IRIG standard 200-98, format B

13.2 Un-modulated IRIG-B

Input signal TTL level
Input impedance at dc 10kΩ
External clock synchronization per IRIG standard 200-98, format B00X.

13.3 Performance Accuracy (for modulated and un-modulated versions)

Real time clock accuracy: < ±2 seconds/day

14 MEASUREMENTS

Accuracy

Phase current:	±1.0 % of Reading or ±1.0% CT Ratio (RorCTR)
Phase local current:	±1.0 % of RorCTR or ±(f-fn)/fn %
Phase remote current:	±1.0 % of RorCTR or ±(f-fn)/fn %
Phase differential current:	±5.0 %
Bias current:	±5.0 %
Frequency:	±1 %

15 DISTURBANCE RECORDS

Accuracy

Waveshape:	Comparable with applied quantities
Magnitude and relative phases:	±5% of applied quantities
Duration:	±2%
Trigger position:	±2% (minimum trigger 100ms)

16 IEC 61850 ETHERNET DATA

16.1 10 Base T /100 Base TX Communications

Interface in accordance with IEEE802.3 and IEC61850

Isolation: 1.5kV

Cable type: Screened Twisted Pair (STP)

Max length: 100m

16.2 100 Base FX Interface

Interface in accordance with IEEE802.3 and IEC61850

Wavelength: 1310nm

Fibre: multi-mode 50/125µm or 62.5/125µm

Connector style: ST

16.2.1 Transmitter Optical Characteristics

Transmitter Optical Characteristics – 100 base FX interface

(T_A = 0°C to 70°C, V_{CC} = 4.75 V to 5.25 V)

Parameter	Sym	Min.	Typ.	Max	Unit
Output Optical Power BOL: 62.5/125 µm, NA = 0.275 Fiber EOL	P_{OUT}	–19 –20	–16.8	–14	dBm avg.
Output Optical Power BOL: 50/125 µm, NA = 0.20 Fiber EOL	P_{OUT}	–22.5 –23.5	–20.3	–14	dBm avg.
Optical Extinction Ratio				10 –10	% dB
Output Optical Power at Logic “0” State	P_{OUT} (“0”)			–45	dBm avg.
BOL – Beginning of life EOL – End of life					

Transmitter Optical Characteristics – 100 base FX interface

16.2.2 Receiver Optical Characteristics

Receiver Optical Characteristics – 100 base FX interface

(T_A = 0°C to 70°C, V_{CC} = 4.75 V to 5.25 V)

Parameter	Sym	Min.	Typ.	Max.	Unit
Input Optical Power Minimum at Window Edge	P_{IN} Min. (W)		–33.5	–31	dBm avg.
Input Optical Power Minimum at Eye Center	P_{IN} Min. (C)		–34.5	–31.8	dBm avg.
Input Optical Power Maximum	P_{IN} Max.	–14	–11.8		dBm avg.

Receiver Optical Characteristics – 100 base FX interface

Note	*The 10BaseFL connection will no longer be supported as IEC 61850 does not specify this interface*

16.3 Reference Conditions

Ambient temperature: 20°C

16.4 Breaker Failure

Accuracy

Reset time	= 25 ms from:	start to [(TBF2 or TBF4) - 30ms]
	= 15 ms from:	[(TBF2 or TBF4) - 30ms] to [TBF2 or TBF4]
	±2 % or 10 ms whichever is greater	
Thresholds:	settings ±5 % or 10 mA whichever is greater	

17 PROTECTION FUNCTIONS

17.1 Settings List

Global Settings (System Data)

Language: English/French/German/Spanish
Frequency: 50/60 Hz

17.2 Common Conventional Ratios (CU)

Primary basis current (virtual) Ibp: 1000A

17.3 Current Transformers (PU)

Phase CT Primary: 1…30.000A (step 1A)
Phase CT Secondary In: 1A or 5A

17.4 Phase Fault Elements (CU)

Phase current slope adjustment k2:	0.20…0.90 (step 0.1)
Phase differential current threshold ID>2:	50A…30kA (step 10A)
Check Zone slope adjustment kCZ:	0.00…0.90 (step 0.01)
Check Zone differential current threshold IDCZ >2:	50A…30kA (step 10A)
Circuitry fault slope adjustment ID>1:	10…500A (step 10A)
Circuitry fault threshold k1:	0.00…0.50 (step 0.01)
Circuitry fault alarm timer ID>1 tCF:	0.1…600.0s (step 0.1s)

17.5 Sensitive Earth Fault

Option for high neutral impedance: Disabled/Enabled
Threshold for sensitive Earth fault with flowing current control:
IbiasPh>Cur.: 50A…30kA (step 10A)
Residual current slope adjustment kN2: 0.00…0.90 (step 0.01)
Residual differential current threshold:
IDN>2: 10A…30kA (step 10A)
Residual Check Zone current slope adjustment kNCZ: 0.00…0.90 (step 0.01)
Residual Check Zone differential current threshold:
IDNCZ>2: 10A…30kA (step 10A)
Circuitry fault slope adjustment kN1: 0.00…0.50 (step 0.01)
Circuitry fault threshold:
IDN>1: 10…500A (step 10A) Circuitry fault alarm timer
IDN>1 tCF: 0.1…600.0s (step 0.1s)

17.6 Current Transformer and Feeder Characteristics

Class: 5P (IEC185) X (BS3958) TPX (IEC 44-6) TPY (IEC 44-6) TPZ (IEC 44-6)

Min. Knee point voltage (BS 3958):
Vk: $100/I_n$ V…$5k/I_n$ V (step $10/I_n$ V)

Rated Burden (IEC 44-6):
S: 5VA…100VA (step 1VA)

Rated Resistive Burden (IEC 44-6):
$5…100/I_n^2$? (step $1/I_n$?)

rRB: data calculated from rated burden

Rated short-circuit current factor:
Kscc: 10…50 (step 5) Secondary resistance (?)

Secondary Resistance (?)
R_{CT}: 0.1…50.0 ? (step 0.1?)

External loop resistance Eff. Burden (?):
RB: 0.1…200.0/ I ^{2}? (step 1/ I 2 ?)

External loop resistance Eff. Burden VA
(Data calculated from Eff. Burden Ohm)

Blocking of 87BB on phase-phase feeder fault
for external ph-ph fault detection - (>1.5 max ph-ph fault current infeed) with Ultra high speed detection <1 ms:
I>BB: 0.05…4×In (step 0.01×In)

Blocking of 87BB on earth/feeder fault
(external earth fault detection) - (>1.5 max earth fault current infeed.

Ultra high speed detection required <1 ms):
IN>BB: 0.05…4×In (step 0.01×In)

Supervision of I0 calculation:
Kce: 0.01…1.00 (step 0.01)

I0 error alarm time delay:
Tce: 0.0…10.0s (step 0.1s)

I0 supervision blocking: 87BB (P&N) /None

CTS Timer alarm: 0.1s…10.0s (step 0.1s)

Note	*In is the CT nominal current*

17.7 Dead Zone Protection (PU)

Phase threshold
I>DZ: 0.05…4.00×In (step 0.01×In)
Time delay: 0.00…100.00s (step 10ms)
Dead Zone Earth: Disabled/Enabled

Neutral threshold
IN>DZ: 0.05…4.00×In (step 0.01×In)
Time delay: 0.00…100.00 s (step 10ms)

Note	*In is the CT nominal current*

17.8 Breaker Failure Protection (PU)

Caution	***The following current set values are expressed in multiple of the local CT's nominal rated current Inp (primary) or Ins (secondary).***

Breaker Failure

1st phase O/C threshold
(dead pole detection for 50BF): I<: 0.05…4.00×I_n (step 0.01×I_n)
Confirmation I>: Disabled/Enabled
2nd phase O/C threshold: I>: 0.05…4.00×I_n (step 0.01×I_n)
Confirmation IN>: Disabled/Enabled
2nd residual O/C threshold: IN>: 0.05…4.00×I_n (step 0.01×I_n)

Timers for 50BF internal tripping

CB fail 1 timer: tBF1: 0.00…10.00s (step 10ms)
CB fail 2 timer: tBF2: 0.00…10.00s (step 10ms)

Timers for 50BF external tripping (orders from 21 or 87T etc.)

CB fail 3 timer: tBF3: 0.00…10.00 s (step 10ms)
CB fail 4 timer: tBF4: 0.00…10.00 s (step 10ms)

17.9 Overcurrent Protection (PU)

17.9.1 Phase Fault Protection (50/51)

3-phase Overcurrent Function Status I>1:
0. Disabled, 1. DT, 2. IEC S Inverse, 3. IEC V Inverse, 4. IEC E Inverse,
5. UK LT Inverse, 6. IEEE M Inverse, 7. IEEE V Inverse, 8. IEEE E Inverse,
9. US Inverse or 10. US ST Inverse
If "function status" ?0
I>1 Current Set:0.10…32.00×In (step 0.01×In)
If "function status" =1
I>1 Time delay: 0.00…100.00s (step 10ms)
If "function status" =5
I>1: 0.025…1.200 (step 0.025)
If "function status" =6
I>1 time Dial: 0.5…15.0 (step 0.1) I>1
Reset Char: DT or inverse
If "function status" =5 or "I>1 Reset Char."=DT and "function status" =6
I>1: 0.0…100.0 (step 0.1)
I>2 Function:
Disabled, 87BBP&N blocking, High Set I>2, I>2 & 87BBP&N, 87BB/P blocking, 87BB/N blocking, I>2 & 87BB/P or I>2 & 87BB/N
I>2 Current Set (if "I>2 function" enabled)
0.10…32.00×In (step 0.01×In)
If "I>2 function" = high set I>2
I>2 Time Delay: 0.00…100.00s (step 10ms)
If "I>2 function" = 87BB (P and/or N)
I>2 Time Delay: 0.2…6.00s (step 0.1s)

17.9.2 Earth Fault Protection (50N/51N)

Residual Overcurrent Function Status IN>1:
    0. Disabled, 1. DT, 2. IEC S Inverse, 3. IEC V Inverse, 4. IEC E Inverse,
    5. UK LT Inverse, 6. IEEE M Inverse, 7. IEEE V Inverse, 8. IEEE E Inverse,
    9. US Inverse or 10. US ST Inverse

If “function status” ?0
    “IN >1 current set”: 0.10…32.00×In (step 0.01×In)

If “function status” =1
    “IN >1 Time delay”: 0.00…100.00s (step 10ms)

If “function status” =5
    “IN >1 TMS”: 0.025…1.200 (step 0.025)

If “function status” =6
    “IN >1 Time Dial”: 0.5…15.0 (step 0.1) “IN >1
    Reset Char”: DT or Inverse

If “function status” =5 or
    “IN>1 Reset Char.”=DT & “function status” =6
    IN >1 tReset: 0.0…100.0 (step 0.1)

IN >2 Function:
    Disabled, 87BBP&N blocking, High Set I>2, I>2 & 87BBP&N, 87BB/P blocking, 87BB/N blocking, I>2 & 87BB/P or I>2 & 87BB/N

IN>2 Current Set (if “IN>2 function” enabled):
    0.10…32.00 xIn (step 0.01×In)

If “IN>2 function” = high set I>2
    IN>2 Time Delay:

17.10 CB Control (PU)

Prot Trip Pulse:	0.05…2.00s (step 10ms)
Trip Latched:	Disabled/Enabled
Rest Trip Latch:	Yes/No
CB Control by:	Disabled, Local and/or Remote and /or Opto
Man Close Pulse:	0.1…10.0s (step 10ms)
Man Trip Pulse:	0.1…5.0s (step 10ms)
Man Close Delay:	0…600s (step 10ms)
87BB Trip Delay:	0…400ms (step 5ms)
CB Superv Timer:	10…400ms (step 5ms)

17.11 Date and Time

IRIG-B Sync:	Disabled/Enabled
Battery Alarm:	Disabled/Enabled
LocalTime Enable:	Disabled/Fixed/Flexible
DST Enable:	Disabled/Enabled

17.12 Configuration

Setting Group:	Select via Menu	or	Select via Opto
Active Settings:	Group 1/2/3/4		
Setting Group 1:	Disabled/Enabled		
Setting Group 2:	Disabled/Enabled		
Setting Group 3:	Disabled/Enabled		
Setting Group 4:	Disabled/Enabled		

CU Only

Diff Busbar Prot:	Disabled/Enabled
Differential phase fault	
Sensitive earth fault	

PU Only

Dead Zone Prot:	Disabled/Enabled
CB Fail & I>:	Disabled/Enabled BB Trip
Confirm:	Disabled/Enabled
Overcurrent Prot:	Disabled/Enabled
Earth Fault Prot:	Disabled/Enabled

CU & PU

Setting Values:	Primary/Secondary
LCD Contrast:	(Factory pre-set)

18 SETTINGS AND RECORDS LIST

18.1 Fault Recorder

Records for the last 5 faults:

Central Unit

Active setting group
Faulty phase
Protection started/operated (87BB, 50BF, Dead Zone, …)
Fault occurrence time and duration
Check Zone values (Diff. & Bias for A, B, C, N)
Faulty zone(s)
Topology prior the fault occurrence

Peripheral Unit

Active setting group
Indication of the tripped phases
Protection started/operated (87BB, 50BF, Dead Zone…)
Relay Trip Time and duration
Relay Trip Time
Faulty phase currents (A, B, C, N)

18.2 Event Recorder

Records for the last 512 events

18.3 Oscillography (Disturbance Recorder)

Central Unit:

Duration:	Fixed value 1.2 s
Trigger Position:	0…100% (step 33.3%)
Analogue Channel 1:	(up to 8)
Digital Input 1:	(up to 32)

Peripheral Unit:

Duration:	Settable from 1.2 to 10.5s
Trigger Position:	0…100% (step 0.1%)
Trigger Mode:	Single / Extended
Analogue Channel 1:	(up to 4):
Digital Input 1:	(up to 32): Selected binary channel assignment from any DDB status point within the relay (opto input, output contact, alarms, starts, trips, controls, logic…).
Sampling frequency:	600Hz

18.4 Communications

RP1 Protocol: Courier

18.4.1 Courier Protocol

RP1 Address:	6 to 34 (step 1)
RP1 Inactiv timer:	1min to 30 mins (step 1min)

RP1 Physical link: Copper/Fibre optic
RP1 Port configuration: K-Bus/EIA485 (RS485)
RP1 comms mode: IEC60870 FT1.2/10-Bit No Parity
RP1 Baud Rate: 9600/19200/38400 bits/s

18.4.2 IEC61850 Protocol (Ethernet)

Ethernet port, IEC61850 Protocol: Protocol,
NIC MAC address(es),
Redundancy IP address,
Subnet mask and
Gateway address indicated
ETH tunnel timeout: 1min to 30min (step 1min)

18.4.3 Second Rear Port Connection Setting

RP2 Protocol:	Courier (fixed)
RP2 Port Config:	Courier over EIA(RS)232 / Courier over EIA(RS)485 / K-Bus
RP2 Comms. Mode:	IEC60870 FT1.2 Frame / 10-Bit NoParity
RP2 Address:	0…255
RP2 InactivTimer:	1…30 mins
RP2 Baud Rate:	9600 / 19200 / 38400 bits/s

Note *If RP2 Port Config is K Bus the baud rate is fixed at 64 kbits/s*

RP1 Protocol:	Courier
RP1 Address (courier):	6…34
Inactivity Timer:	1…30 minutes
RP1 Port Config (Courier):	K Bus / EIA485 (RS485)
RP1 Comms Mode (EIA485 (RS485)):	IEC60870 FT1.2 Frame 10-Bit NoParity
RP1 Baud Rate (EIA485 (RS485)):	9600 / 19200 / 38400 bits/s
RP1 Read Only:	Disabled/Enabled

18.5 Optional Second Rear Communication

RP2 Protocol: Courier (fixed)
RP2 Port Config: Courier over EIA(RS)232 / Courier over EIA(RS)485 / K-Bus
RP2 Comms. Mode: IEC60870 FT1.2 Frame / 10-Bit NoParity
RP2 Address: 0…255
RP2 InactivTimer: 1…30 mins
RP2 Baud Rate: 9600 / 19200 / 38400 bits/s

Note *If RP2 Port Config is K Bus the baud rate is fixed at 64 kbits/s*

RP2 Read Only: Disabled/Enabled

18.6 Optional Ethernet Port

NIC Tunl Timeout: 1...30 mins
NIC Link Report: Alarm/Event/None
NIC Link Timeout: 0.1...60 s

NIC Read Only: Disabled/Enabled

18.7 Commission Tests

Monitor bit 1: Selects which DDB signals have their status visible
(up to): in the Test Port Status.
Monitor bit 8:

Test Mode (CU): Disabled/Out of Service
Test Mode (PU): Disabled/Disable 50BF/Overhaul Mode
87BB Trip Order (CU): No operation/Apply test

Test Pattern: Configuration of which output contacts are to be energized when the contact test is applied

Contact Test: No Operation, Apply Test, Remove Test

Test LEDs: No Operation, Apply Test

19 FUNCTION KEYS AND LABELS

19.1 Function Keys

Fn. Key Status 1 (up to) 10:	Disable / Lock / Unlock / Enable
Fn. Key 1 Mode (up to) 10:	Toggled/Normal
Fn. Key 1 Label (up to) 10:	User defined text string to describe the function of the particular function key.

19.2 Opto Input Labels

19.2.1 P741

Opto Input 1 to 8 (depending on the model): Input L1 to Input L8
User-defined text string to describe the function of the particular opto input.

19.2.2 P742

Opto Input 1…16: Opto 1…Opto 16
User defined text string to describe the function of the particular opto input.

19.2.3 P743

Opto Input 1 to 24: Input L1 to Input L24
User-defined text string to describe the function of the particular opto input.

19.3 Output Labels

19.3.1 P741 & P742

Relay 1 to Relay 8:
User-defined text string to describe the function of the particular relay output contact.

19.3.2 P743

Relay 1…16: Relay 1…Relay 16
User defined text string to describe the function of the particular relay output contact.

19.4 Control Input Labels

Control Input 1 (up to): Control Input 32:	User defined text string to describe the function of the particular control input.
Settable Control Input 33 (up to): Settable Control Input 48:	User defined text string to describe the function of the particular settable control input.

19.5 Virtual Input Labels

Virtual Input 1 to Virtual Input 32:
User defined text string to describe the function of the particular virtual input.

19.6 Virtual Output Labels

Virtual Output 1 to Virtual Output 32:
User defined text string to describe the function of the particular virtual output.

19.7 SR/MR User Alarm Labels

SR User Alarm 1 to SR User Alarm 7:
User-defined text string to describe the function of the particular self-reset user alarm.
MR User Alarm 8 to MR User Alarm 14:
User-defined text string to describe the function of the particular manual reset user alarm.

GETTING STARTED

CHAPTER 3

Date:	02/2017
Products covered by this chapter:	This chapter covers the specific versions of the MiCOM products listed below. This includes ***only*** the following combinations of Software Version and Hardware Suffix.
Hardware Suffix:	L (P742) & M (P741 & P743)
Software Version:	B1
Connection Diagrams:	10P740xx (xx = 01 to 07)

CONTENTS

FIGURES

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1 INTRODUCTION TO THE RELAY

Warning **Before carrying out any work on the equipment, you should be familiar with the contents of the Safety Information chapter/Safety Guide SFTY/5L M/L11 or later issue, the Technical Data chapter and the ratings on the equipment rating label.**

1.1 User Interfaces and Menu Structure

The settings and functions of the MiCOM protection relay can be accessed both from the front panel keypad and LCD, and via the front and rear communication ports. Information on each of these methods is given in this section to describe how to start using the relay.

1.2 Front Panel

Figure 1 shows P742 and Figure 2 shows P741 or P743.

The following figure shows the front panel of the relay; the hinged covers at the top and bottom of the front panel are shown open. An optional transparent front cover physically protects the front panel. With the cover in place, access to the user interface is read-only. Removing the cover allows access to the relay settings and does not compromise the protection of the product from the environment.

When editing relay settings, full access to the relay keypad is needed. To remove the front cover:

1. Open the top and bottom covers, then unclip and remove the transparent cover. If the lower cover is secured with a wire seal, remove the seal.
2. Using the side flanges of the transparent cover, pull the bottom edge away from the relay front panel until it is clear of the seal tab.
3. Move the cover vertically down to release the two fixing lugs from their recesses in the front panel.

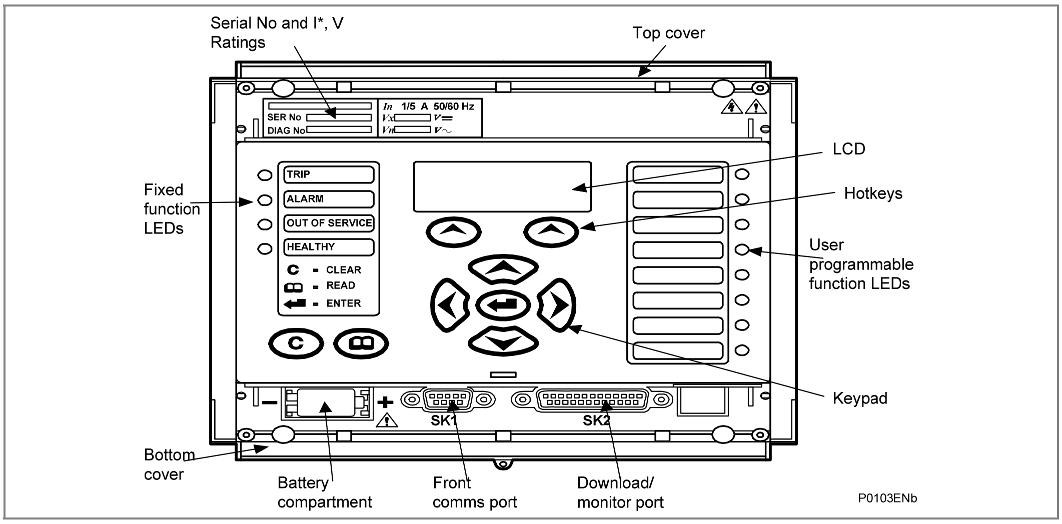

Figure 1 - Relay front view (example for P742 – 40TE)

The front panel of the relay includes the following, as shown in the previous figures:

- A 16-character by 3-line alphanumeric Liquid Crystal Display (LCD).
- A 9-key keypad with 4 arrow keys (, , and), an enter key (), a clear key (C), a read key (), 2 hot keys ().
- 12 LEDs; 4 fixed function LEDs on the left hand side of the front panel and 8 programmable function LEDs on the right hand side.

Under the top hinged cover:

- The relay serial number, and the relay's current and voltage rating information

Under the bottom hinged cover:

- Battery compartment to hold the 1/2 AA size battery which is used for memory back-up for the real time clock, event, fault and disturbance records
- A 9-pin female D-type front port for communication with a PC locally to the relay (up to 15m distance) via an EIA(RS)232 serial data connection
- A 25-pin female D-type port providing internal signal monitoring and high speed local downloading of software and language text via a parallel data connection

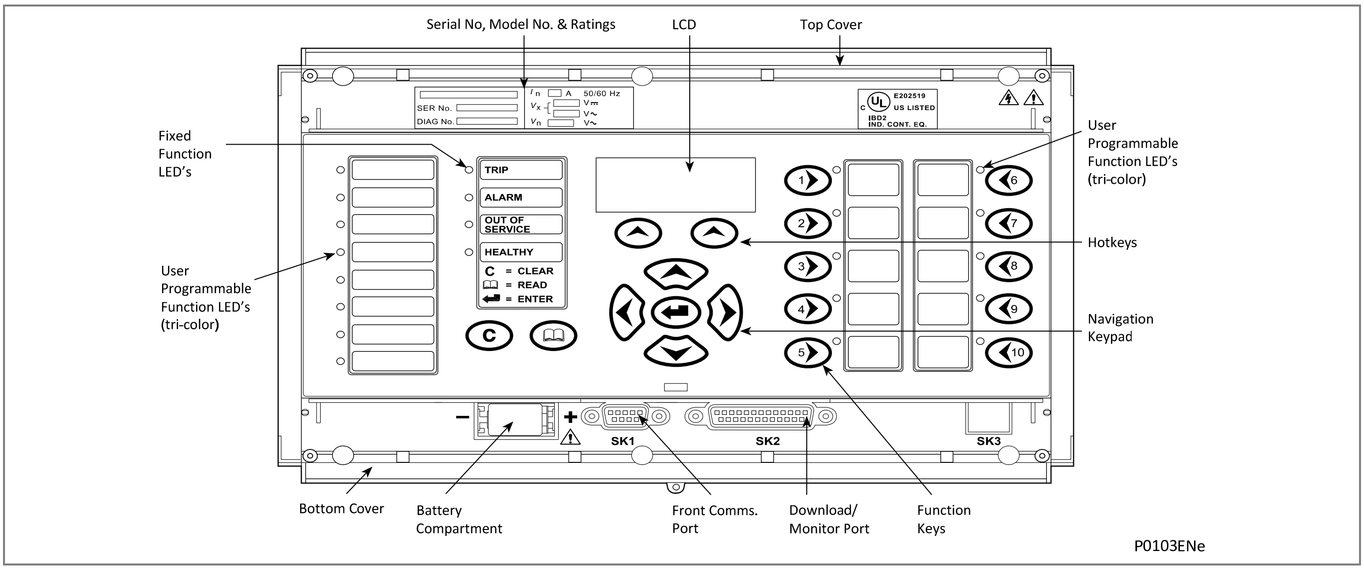

Figure 2 - Relay front view (example for P743 – 60TE)

The front panel of the relay includes the following, as shown in the previous figure:

- a 16-character by 3-line alphanumeric Liquid Crystal Display (LCD)
- a 19-key keypad comprising:
    - 4 arrow keys (and), an enter key (), a clear key (C), a read key (), 2 hot keys () and 10 (1 – 10) programmable function keys
- The relay front panel has control keys with programmable LEDs for local control. Factory default settings associate specific relay functions with these 10 direct-action keys and LEDs e.g. reset indications. Using programmable scheme logic, the user can change the default functions of the keys and LEDs to fit specific needs.
- Hotkey functionality: When the functionality is disabled:
    - SCROLL Starts scrolling through the various default displays.
    - STOP Stops scrolling the default display.

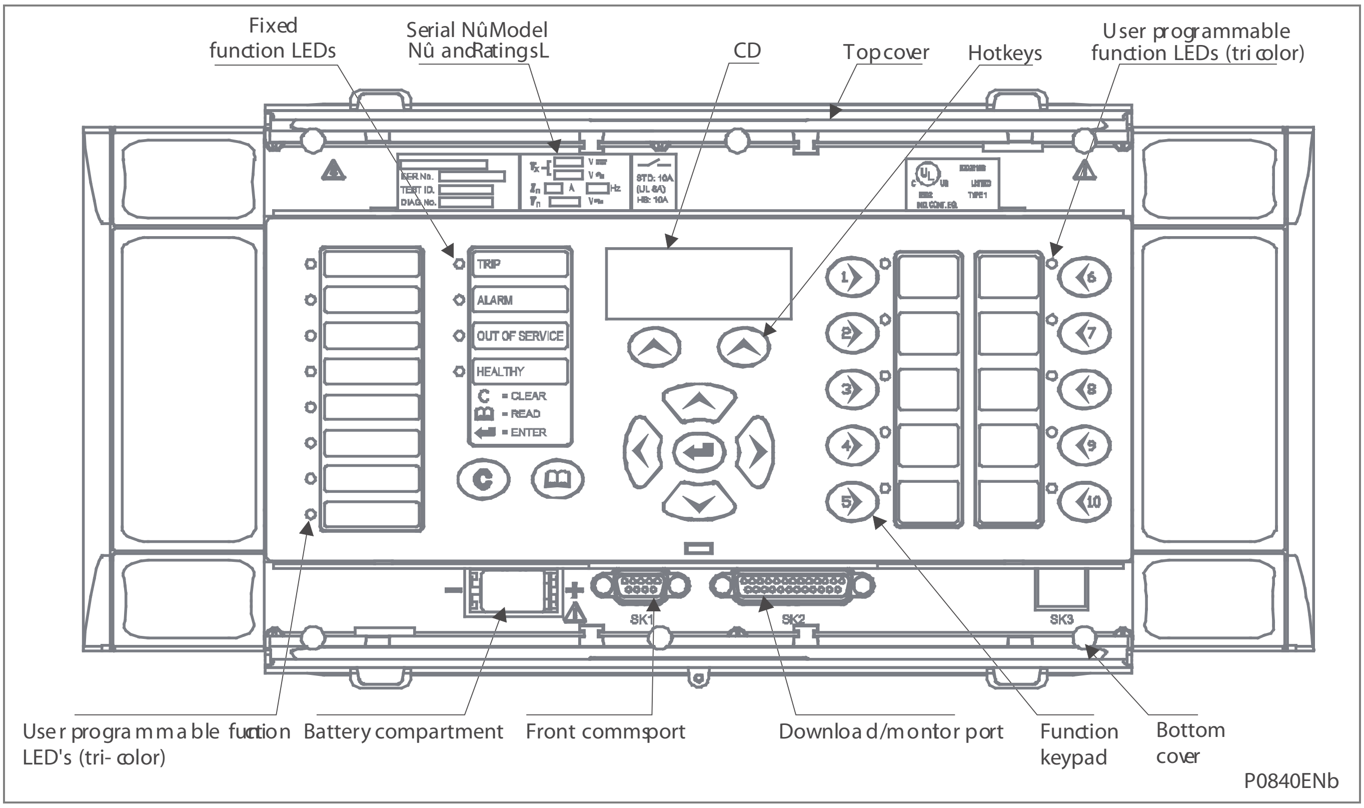

Figure 3 - Relay front view (example for P741 – 80TE)

When the functionality is disabled:

For control of setting groups, control inputs and circuit breaker operation:

- 22 LEDs; 4 fixed function LEDs, 8 tri-colour programmable function LEDs on the left hand side of the front panel and 10 tri-colour programmable function LEDs on the right hand side associated with the function keys

Under the top hinged cover:

- The relay serial number, and the relay's current and voltage rating information

Under the bottom hinged cover:

- Battery compartment to hold the 1/2 AA size battery which is used for memory back-up for the real time clock, event, fault and disturbance records
- A 9-pin female D-type front port for communication with a PC locally to the relay (up to 15m distance) via an EIA(RS)232 serial data connection
- A 25-pin female D-type port providing internal signal monitoring and high speed local downloading of software and language text via a parallel data connection

1.2.1 LED Indications

1.2.1.1 Fixed Function

The Fixed Function LEDs on the left-hand side of the front panel show these conditions:

- **Trip (Red)** indicates that the relay has issued a trip signal. It is reset when the associated fault record is cleared from the front display.
- **Alarm (Yellow)** flashes when the relay has registered an alarm. This may be triggered by a fault, event or maintenance record. The LED will flash until the alarms have been accepted (read), after which the LED will change to constant illumination, and will extinguish, when the alarms have been cleared.
- **Out of Service** (Yellow) is ON when the relay is not fully operational.
- **Healthy (Green)** indicates that the relay is in correct working order, and should be on at all times. It will be extinguished if the relay’s self-test facilities show that there is an error with the relay’s hardware or software. The state of the healthy LED is reflected by the watchdog contact at the back of the relay.

To improve the visibility of the settings via the front panel, the LCD contrast can be adjusted using the “LCD Contrast” setting in the CONFIGURATION column. This should only be necessary in very hot or cold ambient temperatures.

1.2.1.2 Programmable LEDs

All the programmable LEDs are tri-colour and can be programmed to show red, yellow or green depending on the requirements. The eight programmable LEDs on the left are suitable for programming alarm indications. The 10 programmable LEDs associated with the function keys, are used to show the status of the key’s function. The default behaviour and mappings for each of the programmable LEDs are as shown in this table:

Central Unit P741:

LED Number	LED Input Connection/Text	Latched	P740 LED Function Indication
1	LED1 Red LED1 Yellow LED1 Green	Yes	87BB fault on phase A Not used Not used
2	LED2 Red LED2 Yellow LED2 Green	Yes	87BB fault on phase B Not used Not used
3	LED3 Red LED3 Yellow LED3 Green	Yes	87BB fault on phase C Not used Not used
4	LED4 Red LED4 Yellow LED4 Green	Yes	50BF Trip Zone 1 87BB & 50BF Trip Zone 1 87BB Trip Zone 1
5	LED5 Red LED5 Yellow LED5 Green	Yes	50BF Trip Zone 2 87BB & 50BF Trip Zone 2 87BB Trip Zone 2
6	LED6 Red LED6 Yellow LED6 Green	No	Zone 1 blocked by itself Zone 1 blocked by Check Zone Zone 1 protected
7	LED7 Red LED7 Yellow LED7 Green	No	Zone 2 blocked by itself Zone 2 blocked by Check Zone Zone 2 protected
8	LED8 Red LED8 Yellow LED8 Green	No	Fiber communication Error Fiber communication to change Fiber communication healthy
9	FnKey LED1 Red FnKey LED1 Yellow FnKey LED1 Green	No	Zone or CZ circuitry fault block. Zone or CZ circuitry fault alarm No Zone or CZ circuitry fault

LED Number	LED Input Connection/Text	Latched	P740 LED Function Indication
10	FnKey LED2 Red FnKey LED2 Yellow FnKey LED2 Green	No	Zone or CZ PU error fault block. Zone or CZ PU error fault alarm No Zone or CZ PU error fault
11	FnKey LED3 Red FnKey LED3 Yellow FnKey LED3 Green	No	All protections Disabled Not used All protections Not Disabled
12	FnKey LED4 Red FnKey LED4 Yellow FnKey LED4 Green	No	Zone 1: 87BB & 50BF blocked Zone 1: 50BF blocked Zone 1: protected
13	FnKey LED5 Red FnKey LED5 Yellow FnKey LED5 Green	No	Zone 2: 87BB & 50BF blocked Zone 2: 50BF blocked Zone 2: protected
14	FnKey LED6 Red FnKey LED6 Yellow FnKey LED6 Green	No	Not used Not used Reset CU Indications
15	FnKey LED7 Red FnKey LED7 Yellow FnKey LED7 Green	No	Not used Not used Reset CU & PU Indications
16	FnKey LED8 Red FnKey LED8 Yellow FnKey LED8 Green	No	Not used Not used Reset PU Trip Latch
17	FnKey LED9 Red FnKey LED9 Yellow FnKey LED9 Green	No	Not used Not used Manual DR trigger
18	FnKey LED10 Red FnKey LED10 Yellow FnKey LED10 Green	No	Not used Dead Zone fault Not used

Peripheral Unit P742:

LED Number	LED Input Connection/Text	Latched	P740 LED Function Indication
1	LED 1 Red	No	Isolator 1 Closed
2	LED 2 Red	No	Isolator 2 Closed
3	LED 3 Red	No	Isolator 3 Closed
4	LED 4 Red	Yes	Trip on CU 50BF backtrip order
5	LED 5 Red	Yes	Trip on CU 87BB trip order
6	LED 6 Red	Yes	Dead Zone fault
7	LED 7 Red	No	Circuit Breaker out of service
8	LED 8 Red	No	Fiber communication Error

Peripheral Unit P743:

LED Number	LED Input Connection/Text	Latched	P740 LED Function Indication
1	LED1 Red LED1 Yellow LED1 Green	No	Isolator 1 Closed Isolator 1 Status Alarm Isolator 1 Open
2	LED2 Red LED2 Yellow LED2 Green	No	Isolator 2 Closed Isolator 2 Status Alarm Isolator 2 Open

LED Number	LED Input Connection/Text	Latched	P740 LED Function Indication
3	LED3 Red LED3 Yellow LED3 Green	No	Isolator 3 Closed Isolator 3 Status Alarm Isolator 3 Open
4	LED4 Red LED4 Yellow LED4 Green	Yes	Trip on CU 50BF backtrip order Not used Not used
5	LED5 Red LED5 Yellow LED5 Green	Yes	Trip on CU 87BB trip order Not used Not used
6	LED6 Red LED6 Yellow LED6 Green	Yes	Dead Zone fault Not used Not used
7	LED7 Red LED7 Yellow LED7 Green	No	Circuit Breaker out of service Not used Circuit Breaker healthy
8	LED8 Red LED8 Yellow LED8 Green	No	Fiber communication Error Fiber communication to change Fiber communication healthy
9	FnKey LED1 Red FnKey LED1 Yellow FnKey LED1 Green	No	Not used Not used Reset PU Indications
10	FnKey LED2 Red FnKey LED2 Yellow FnKey LED2 Green	No	Not used Not used Reset PU Trip Latch
11	FnKey LED3 Red FnKey LED3 Yellow FnKey LED3 Green	No	Not used
12	FnKey LED4 Red FnKey LED4 Yellow FnKey LED4 Green	No	Not used Mode 50BF disabled Mode normal
13	FnKey LED5 Red FnKey LED5 Yellow FnKey LED5 Green	No	Mode overhaul Not used Mode normal
14	FnKey LED6 Red FnKey LED6 Yellow FnKey LED6 Green	No	Not used
15	FnKey LED7 Red FnKey LED7 Yellow FnKey LED7 Green	No	Not used
16	FnKey LED8 Red FnKey LED8 Yellow FnKey LED8 Green	No	Not used
17	FnKey LED9 Red FnKey LED9 Yellow FnKey LED9 Green	No	Not used
18	FnKey LED10 Red FnKey LED10 Yellow FnKey LED10 Green	No	Not used

1.3 Rear Panel

Examples of the rear panel of the relay are shown in following figures. All current signals, digital logic input signals and output contacts are connected at the rear of the relay. Also connected at the rear is the twisted pair wiring for the rear EIA(RS)485 communication port; the IRIG-B time synchronising input is optional in the P741, the Ethernet rear communication board with copper and fiber optic connections or the second communication and InterMiCOM board are optional in the P741 and P743.

Refer to the wiring diagrams in 'Connection Diagrams' chapter for further details.

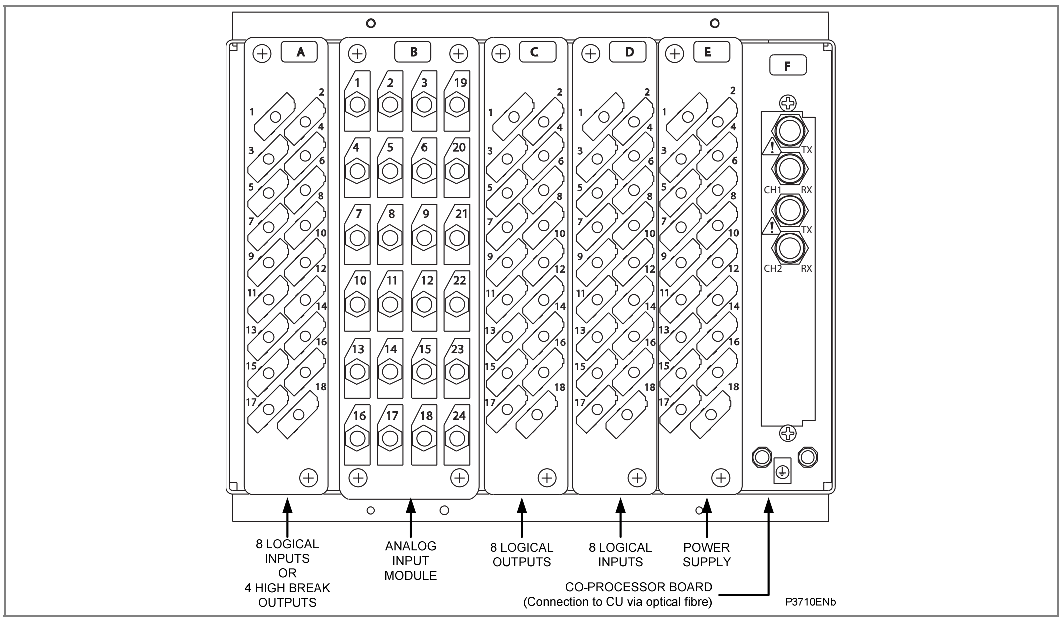

Figure 4 - P742 relay rear view 40TE

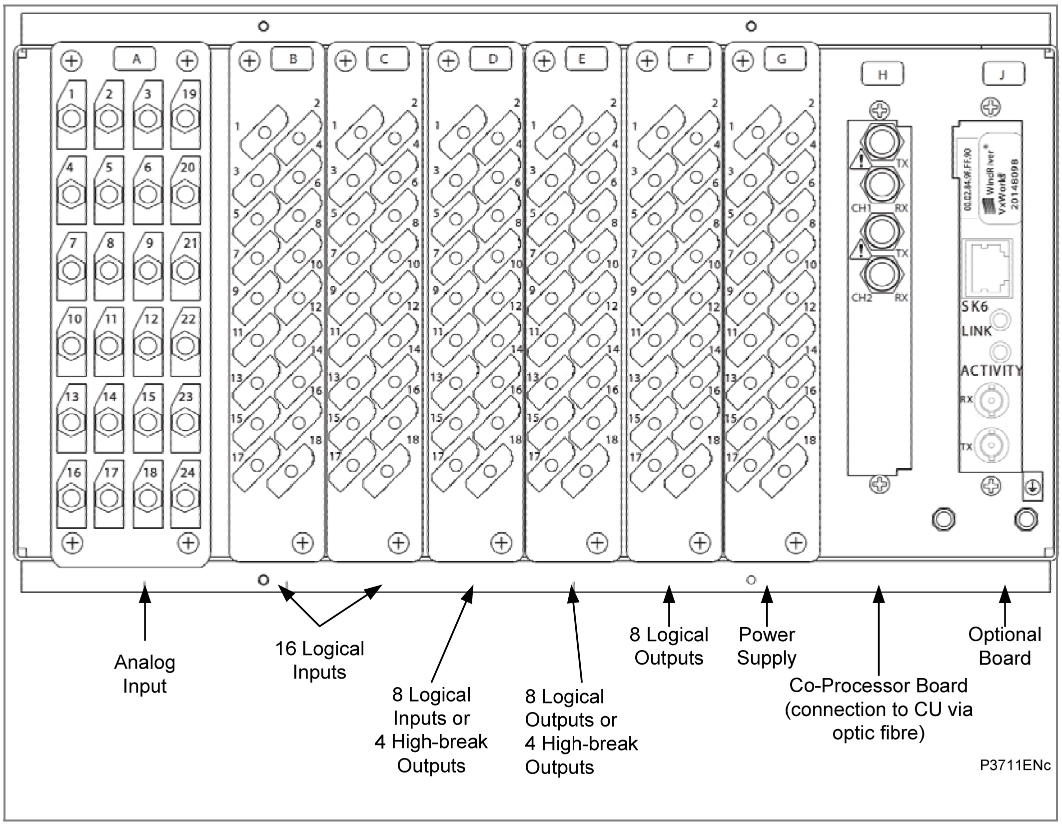

Figure 5 - P743 relay rear view 60TE

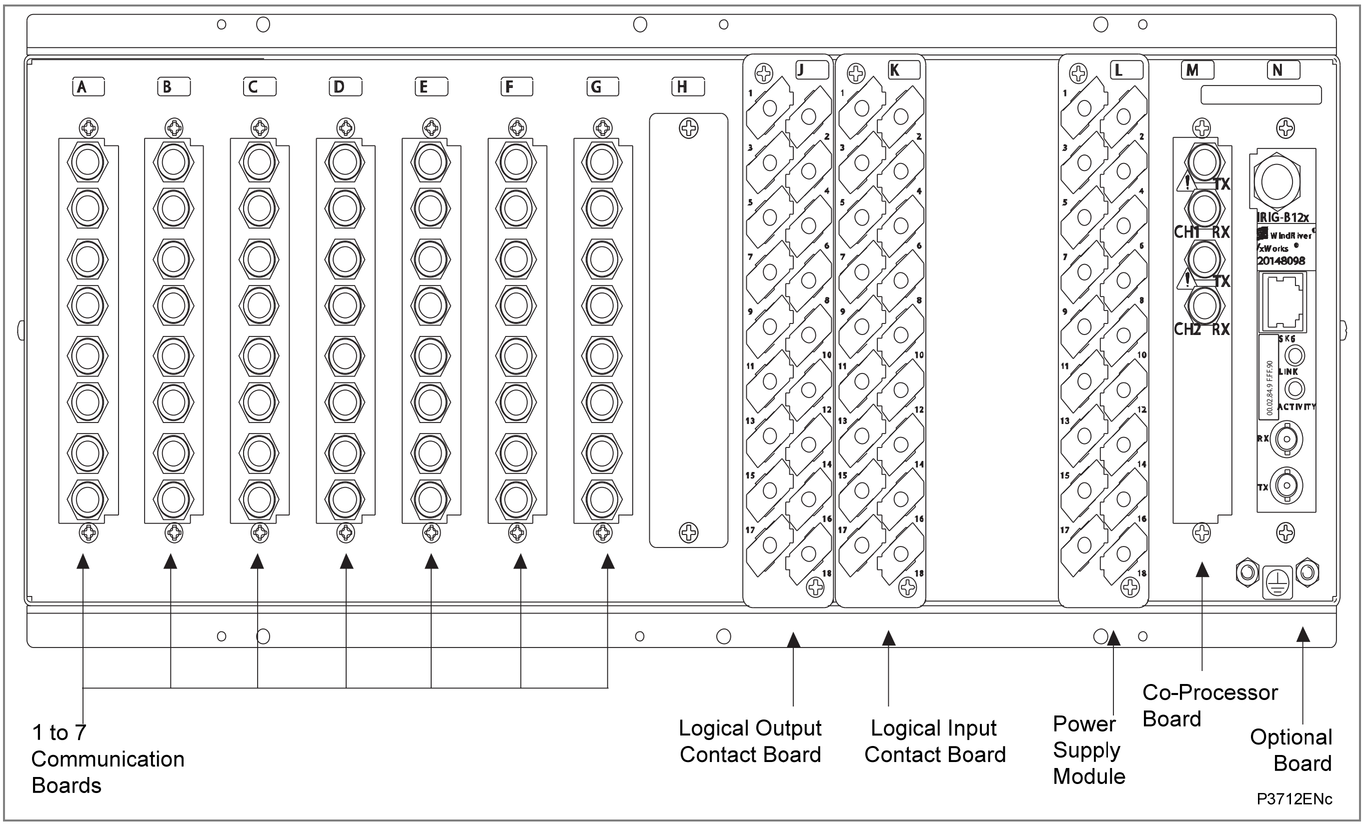

Figure 6 - P741 relay rear view 80TE

1.4 Relay Connection and Power-Up

Before powering-up the relay, confirm that the relay power supply voltage and nominal ac signal magnitudes are appropriate for your application. The relay serial number, and the relay's current and voltage rating, power rating information can be viewed under the top hinged cover. The relay is available in the auxiliary voltage versions shown in this table:

Nominal Ranges		Operative Ranges	
dc	**ac**	**dc**	**ac**
24 – 32 V dc	-	19 - 38 V dc	-
48 – 110 V dc	-	37 - 150 V dc	-
110 – 250 V dc **	100 – 240 V ac rms **	87 - 300 V dc	80 - 265 V ac
** rated for ac or dc operation			

Table 1 – Nominal and Operative dc and ac Ranges

Please note that the label does not specify the logic input ratings. These relays are fitted with universal opto isolated logic inputs that can be programmed for the nominal battery voltage of the circuit of which they are a part. See 'Universal Opto input' in the Product Design (Firmware) section for more information on logic input specifications.

Note	*The opto inputs have a maximum input voltage rating of 300V dc at any setting.*

Once the ratings have been verified for the application, connect external power capable of delivering the power requirements specified on the label to perform the relay familiarization procedures. Previous diagrams show the location of the power supply terminals - please refer to the ***Installation*** and ***Connection Diagrams*** chapters for all the details, ensuring that the correct polarities are observed in the case of dc supply.

2 USER INTERFACES AND SETTINGS OPTIONS

The relay has these user interfaces:

- The front panel using the LCD and keypad.
- The front port which supports Courier communication.
- The rear port which supports this protocol:
  - Courier
    (IEC 60870-5-103 is converted from Courier using a KITZ274)
- The optional Ethernet port supports IEC 61850.

The measurement information and relay settings that can be accessed from the different interfaces are shown in this table:

	Keypad or LCD	Courier	MODBUS	IEC870-5-103	DNP3.0	IEC61850
Display & modification of all settings	Yes	Yes				
Digital I/O signal status	Yes	Yes		Yes		Yes
Display/extraction of measurements	Yes	Yes		Yes		Yes
Display/extraction of fault records	Yes	Yes				Yes
Extraction of disturbance records		Yes		Yes		Yes
Programmable scheme logic settings		Yes				
Reset of fault & alarm records	Yes	Yes		Yes		
Clear event & fault records	Yes	Yes				
Time synchronization		Yes		Yes		Yes
Control commands	Yes	Yes		Yes		

Table 2 – Measurement information and relay settings

3 MENU STRUCTURE

The relay's menu is arranged in a table. Each setting in the menu is referred to as a cell, and each cell in the menu may be accessed using a row and column address. The settings are arranged so that each column contains related settings, for example all the disturbance recorder settings are contained within the same column. As shown in the following diagram, the top row of each column contains the heading that describes the settings contained within that column. Movement between the columns of the menu can only be made at the column heading level.

A complete list of all of the menu settings is given in the Menu Maps chapter.

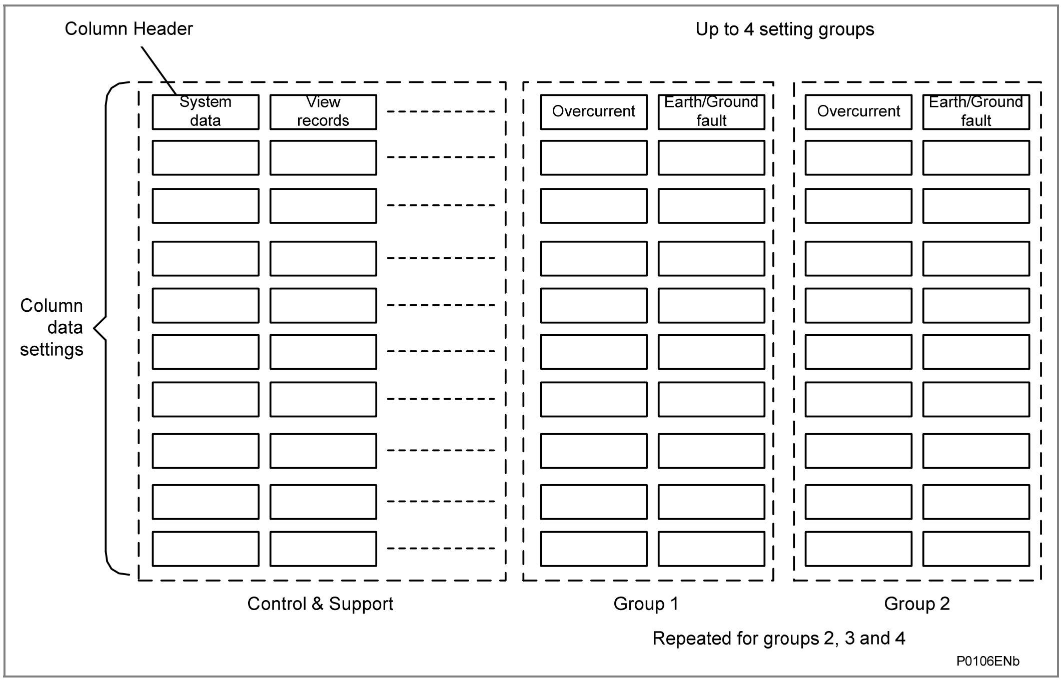

Figure 7 - Menu structure

The settings in the menu fall into one of these categories:

- Protection Settings
- Disturbance Recorder settings
- Control and Support (C&S) settings.

Different methods are used to change a setting depending on which category the setting falls into.

- C&S settings are stored and used by the relay immediately after they are entered.
- For either protection settings or disturbance recorder settings, the relay stores the new setting values in a temporary 'scratchpad'. It activates all the new settings together, but only after it has been confirmed that the new settings are to be adopted. This technique is employed to provide extra security, and so that several setting changes that are made within a group of protection settings will all take effect at the same time.

3.1 Protection Settings

The protection settings include the following items:

- Protection element settings
- Scheme logic settings

There are four groups of protection settings (only two groups for the P24x), with each group containing the same setting cells. One group of protection settings is selected as the active group, and is used by the protection elements.

3.2 Disturbance Recorder Settings

The Disturbance Recorder (DR) settings include the record duration and trigger position, selection of analogue and digital signals to record, and the signal sources that trigger the recording.

3.3 Control and Support Settings

The control and support settings include:

- Relay configuration settings
- Open/close circuit breaker (may vary according to relay type or model)
- CT & VT ratio settings
- Reset LEDs
- Active protection setting group
- Password & language settings
- Communications settings
- Measurement settings
- Event & fault record settings
- User interface settings
- Commissioning settings

4 CYBER SECURITY

4.1 Cyber Security Settings

A detailed description of Schneider Electric Cyber Security features is provided in the *Cyber Security* chapter.

Important	**We would strongly recommend that you understand the contents of the Cyber Security chapter before you use any cyber security features or make any changes to the settings.**

Each MiCOM P40 IED includes a large number of possible settings. These settings are very important in determining how the device works.

A detailed description of the settings is given in the *Cyber Security* chapter.

4.2 Role Based Access Control (RBAC)

The Role Based Access Control (RBAC) is a method to restrict resource access to authorized users. RBAC is an alternative to traditional Mandatory Access Control (MAC) and Discretionary Access Control (DAC).

A key feature of RBAC model is that all access is through roles. A role is essentially a collection of permissions, and all users receive permissions only through the roles to which they are assigned, or through roles they inherit through the role hierarchy.

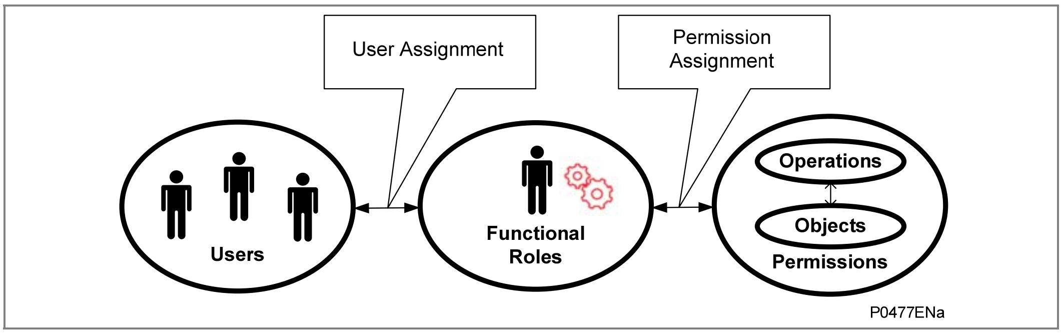

Figure 8 - RBAC Role structure

Roles are created for various job activities. The ***Permissions***, to perform certain operations, are assigned to specific roles. ***Users*** are assigned particular roles, and through those role assignments acquire the computer permissions to perform particular computer-system functions. Since ***users*** are not assigned permissions directly, but only acquire them through their role (or roles), management of individual user rights becomes a matter of simply assigning appropriate roles to the user's account; this simplifies common operations, such as adding a user, or changing user's account.

4.3 User Roles and Rights

Different named roles are associated with different access rights. Roles and Rights are setup in a pre-defined arrangement, according to the IEC62351 standard, but customized to the MiCOM Px4x equipment.

When the user tries to access an IED, they need to login using their own username and their own password. The username/password combination is then checked against the records stored on the IED. If they are allowed to login, a message appears which shows them what Role they have been assigned to. It is the role that defines their access to the relevant parts of the system.

In a similar way in which a set of pre-defined Roles have been created, a pre-defined set of Rights have been created.

These Rights give different permissions to look at what devices may be present, what those devices may contain, manage data within those devices (directly or by using files) and configure rights for other people.

5 RELAY CONFIGURATION

The relay is a multi-function device that supports numerous different protection, control and communication features. To simplify the setting of the relay, there is a configuration settings column which can be used to enable or disable many of the functions of the relay. The settings associated with any function that is disabled are made invisible, i.e. they are not shown in the menu. To disable a function change the relevant cell in the '**Configuration'** column from '**Enabled'** to '**Disabled'**.

The configuration column controls which of the protection settings groups is selected as active through the '**Active settings**' cell. A protection setting group can also be disabled in the configuration column, provided it is not the present active group. Similarly, a disabled setting group cannot be set as the active group.

The column also allows all of the setting values in one group of protection settings to be copied to another group.

To do this firstly set the 'Copy from' cell to the protection setting group to be copied, then set the 'Copy to' cell to the protection group where the copy is to be placed. The copied settings are initially placed in the temporary scratchpad, and will only be used by the relay following confirmation.

To restore the default values to the settings in any protection settings group, set the 'Restore defaults' cell to the relevant group number. Alternatively it is possible to set the 'Restore defaults' cell to 'All settings' to restore the default values to all of the relay's settings, not just the protection groups' settings. The default settings will initially be placed in the scratchpad and will only be used by the relay after they have been confirmed. Note that restoring defaults to all settings includes the rear communication port settings, which may result in communication via the rear port being disrupted if the new (default) settings do not match those of the master station.

6 FRONT PANEL USER INTERFACE (KEYPAD AND LCD)

When the keypad is exposed it provides full access to the menu options of the relay, with the information displayed on the LCD.

The ⟨, ⟩, ⌃ and ⌄ keys which are used for menu navigation and setting value changes include an auto-repeat function that comes into operation if any of these keys are held continually pressed. This can speed up both setting value changes and menu navigation; the longer the key is held depressed, the faster the rate of change or movement becomes.

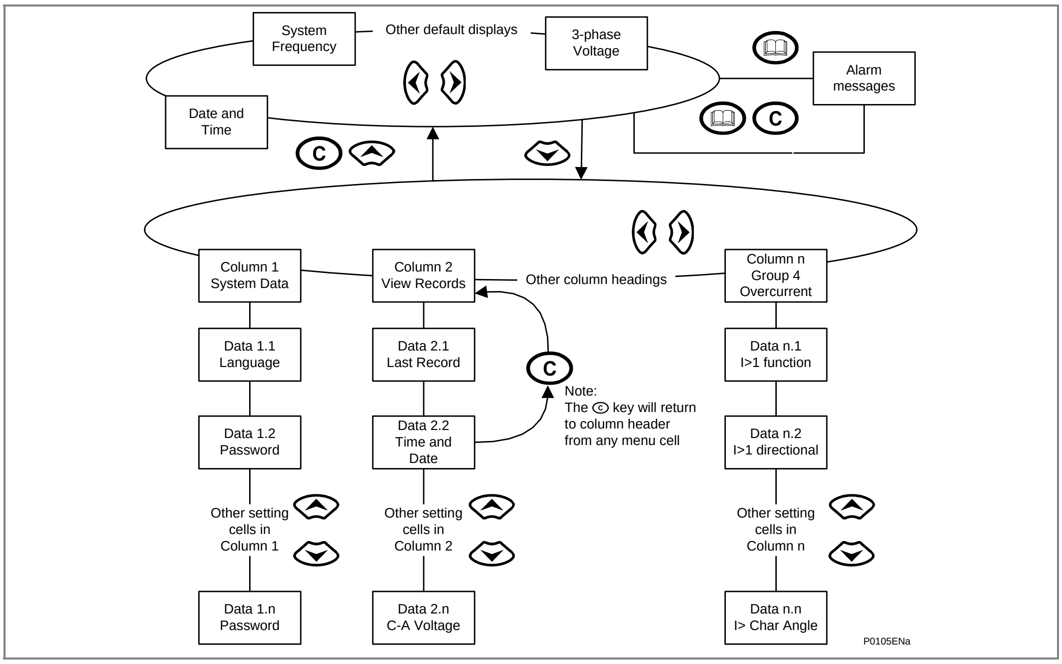

Figure 9 - Front panel user interface

6.1 Default Display and Menu Time-Out

The front panel menu has a default display. To change it, the Engineer Role will be required and the following items can be selected:

- Date and time
- Relay description (user defined)
- Plant reference (user defined)
- System frequency
- 3-phase voltage
- 3-phase and neutral current
- Power
- Access level

From the default display, the user can switch the default display to other default display items using the and keys. The default display will be saved as the last viewed items automatically. If the user tries to change the default display, Engineer Role will be requested (if the current access role is not that of an Engineer).

When user is browsing the relay menu structure with default access right, if there is no keypad activity for the 15 minutes (i.e. the timeout period), the default display will revert from the last viewed menu structure (can be any location from the menu structure) and the LCD backlight will turn off.

When user is logged in with Engineer Role, the menu timeout time may be shorter than 15 minutes. This depends on the value of inactive timer (e.g. if the inactive timer is set to shorter than 15 minutes). If menu timeout happens, any setting changes that have not been confirmed will be lost and the original setting values maintained.

Whenever there is an uncleared alarm present in the relay (e.g. fault record, protection alarm, control alarm etc.) the default display will be replaced by:

```
Alarms/Faults
Present
```

Entry to the menu structure of the relay is made from the default display and is not affected if the display is showing the Alarms/Faults present message.

6.2 Menu Navigation and Setting Browsing

Use the four arrow keys to browse the menu, following the menu structure shown above.

1. Starting at the default display, press the key to show the first column heading.
2. Use the and keys to select the required column heading.
3. Use the and keys to view the setting data in the column.
4. To return to the column header, either hold the key down or press the clear key c once. It is only possible to move across columns at the column heading level.
5. To return to the default display, press the key or the clear key c from any of the column headings. If you use the auto-repeat function of the key, you cannot go straight to the default display from one of the column cells because the auto-repeat stops at the column heading.
6. Press the key again to go to the default display.

6.3 Navigating the Hotkey Menu

To access the hotkey menu from the default display:

1. Press the key directly below the **HOTKEY** text on the LCD.
2. Once in the hotkey menu, use the and keys to scroll between the available options, then use the hotkeys to control the function currently displayed.
   If neither the or keys are pressed within 20 seconds of entering a hotkey sub menu, the relay reverts to the default display.
3. Press the clear key c to return to the default menu from any page of the hotkey menu.

The layout of a typical page of the hotkey menu is as follows:

- The top line shows the contents of the previous and next cells for easy menu navigation
- The center line shows the function
- The bottom line shows the options assigned to the direct access keys

The functions available in the hotkey menu are listed in the following sections.

6.3.1 Setting Group Selection

The user can either scroll using <<NXT GRP>> through the available setting groups or <<SELECT>> the setting group that is currently displayed.

When the SELECT button is pressed a screen confirming the current setting group is displayed for 2 seconds before the user is prompted with the <<NXT GRP>> or <<SELECT>> options again. The user can exit the sub menu by using the left and right arrow keys.

For more information on setting group selection refer to “Setting group selection” section in the Operation chapter.

6.3.2 Control Inputs – User Assignable Functions

The number of control inputs (user assignable functions – USR ASS) represented in the hotkey menu is user configurable in the “CTRL I/P CONFIG” column. The chosen inputs can be SET/RESET using the hotkey menu.

For more information refer to the “Control Inputs” section in the Operation chapter.

6.4 How to Login

The password entry method varies slightly between CSL0 and CSL1 Versions.

6.4.1 Local Default Access

In CSL0 models the user can access the relay menu without the need to login.
In CSL1 models this can be enabled/disabled using SAT.
If the Local Default Access is enabled, the user may login to the front panel with associated roles.

See Table 3 for the applied cases.

6.4.2 Auto Login

Auto login means the user will login the IED automatically and no need to select the user name and enter the password. In this case, the user will be authorized with relevant rights. The auto login will be applied in these cases:

<table>
<tr><th>CS Version</th><th>Interface</th><th>RBAC/PW Cases</th><th>Login Process</th></tr>
<tr><td rowspan="3">CSL1</td><td rowspan="2">Front panel</td><td>Factory RBAC</td><td>Auto login with EngineerLevel</td></tr>
<tr><td>Customized RBAC</td><td>Local Default Access Enabled: Login with Local Default Access
Local Default Access Disabled: Login with Prompt User List</td></tr>
<tr><td>Courier Interface</td><td>All cases</td><td>Login with Prompt User List</td></tr>
<tr><td rowspan="4">CSL0</td><td rowspan="2">Front panel</td><td>Factory RBAC</td><td>Auto login with EngineerLevel</td></tr>
<tr><td>Password changed</td><td>EngineerLevel password is “AAAA” or is disabled/blank: Auto login with EngineerLevel
OperatorLevel password is “AAAA” or is disabled/blank: Auto login with OperatorLevel
EngineerLevel and OperatorLevel password changed: Auto login with ViewerLevel Access</td></tr>
<tr><td rowspan="2">Courier Interface</td><td>Factory RBAC</td><td>Auto login with EngineerLevel</td></tr>
<tr><td>Password changed</td><td>EngineerLevel password is “AAAA” or is disabled/blank: Auto login with EngineerLevel
OperatorLevel password is “AAAA” or is disabled/blank: Auto login with OperatorLevel
EngineerLevel and OperatorLevel password changed: Login with Prompt User List</td></tr>
</table>

Table 3 – Auto Login process

For more details about the Factory RBAC, please refer to the Cyber Security chapter.

6.4.3 Login with Prompt User List

This login process will happen if:

- The Auto login process is not applied.
- Or high authorization is required for the current operation.

In this case, the IED will prompt the user list, and the user needs to select proper user name and enter the password to login.

6.5 Reading and Clearing of Alarm Messages and Fault Records

One or more alarm messages appear on the default display and the yellow alarm LED flashes. The alarm messages can either be self-resetting or latched, in which case they must be cleared manually.

1. To view the alarm messages, press the read key ⓘ. When all alarms have been viewed but not cleared, the alarm LED change from flashing to constantly ON and the latest fault record appears (if there is one).
2. Scroll through the pages of the latest fault record, using the ⓘ key. When all pages of the fault record have been viewed, the following prompt appears.

```
Press clear to
reset alarms
```

3. To clear all alarm messages, press ⓒ. To return to the display showing alarms or faults present, and leave the alarms uncleared, press ⓘ.
4. Depending on the password configuration settings, you may need to enter a password before the alarm messages can be cleared. See the ***How to Access the IED/Relay*** section.
5. When all alarms are cleared, the yellow alarm LED switches OFF; also the red trip LED switches OFF if it was switched ON after a trip.
6. To speed up the procedure, enter the alarm viewer using the ⓘ key, then press the ⓒ key. This goes straight to the fault record display. Press ⓒ again to move straight to the alarm reset prompt, then press ⓒ again to clear all alarms.

6.6 Setting Changes

1. To change the value of a setting, go to the relevant cell in the menu, then press the enter key ↵ to change the cell value. A flashing cursor on the LCD shows the value can be changed. If a password is required to edit the cell value, a password prompt appears.
2. To change the setting value, press the ▽ or △ keys. If the setting to be changed is a binary value or a text string, select the required bit or character to be changed using the ◁ and ▷ keys.
3. Press ↵ to confirm the new setting value or the clear key ⓒ to discard it. The new setting is automatically discarded if it is not confirmed in 15 minutes.
4. For protection group settings and disturbance recorder settings, the changes must be confirmed before they are used by the relay.
5. To do this, when all required changes have been entered, return to the column heading level and press the ▽ key. Before returning to the default display, the following prompt appears.

```
Update settings?
Enter or clear
```

6. Press ↵ to accept the new settings or press ⓒ to discard the new settings.

Note	*If the menu time-out occurs before the setting changes have been confirmed, the setting values are also discarded.*

Control and support settings are updated immediately after they are entered, without the **Update settings**? prompt.

6.7 How to Logout (at the Front Panel)

If you have been configuring the IED, you should 'log out'. You do this by going up to the top of the menu tree. When you are at the Column Heading level and you press the Up button, you may be prompted to log out with the following display:

```
ENTER TO LOG OUT
CLEAR TO CANCEL
```

You will only be asked this question if your password level is higher than the fallback level.

If you confirm, the following message is displayed for 2 seconds:

```
LOGGED OUT
Access Level <x>
```

Where x is the current fallback level.

If you decide not to log out (i.e. you cancel), the following message is displayed for 2 seconds.

```
LOGOUT CANCELLED
Access Level <x>
```

Where x is the current access level.

7 FRONT COMMUNICATION PORT USER INTERFACE

The front communication port is provided by a 9-pin female D-type connector located under the bottom hinged cover. It provides EIA(RS)232 serial data communication and is intended for use with a PC locally to the relay (up to 15m distance) as shown in the following diagram. This port supports the Courier communication protocol only. Courier is the communication language developed by Schneider Electric to allow communication with its range of protection relays. The front port is particularly designed for use with the relay settings program Easergy Studio (MiCOM S1 Studio).

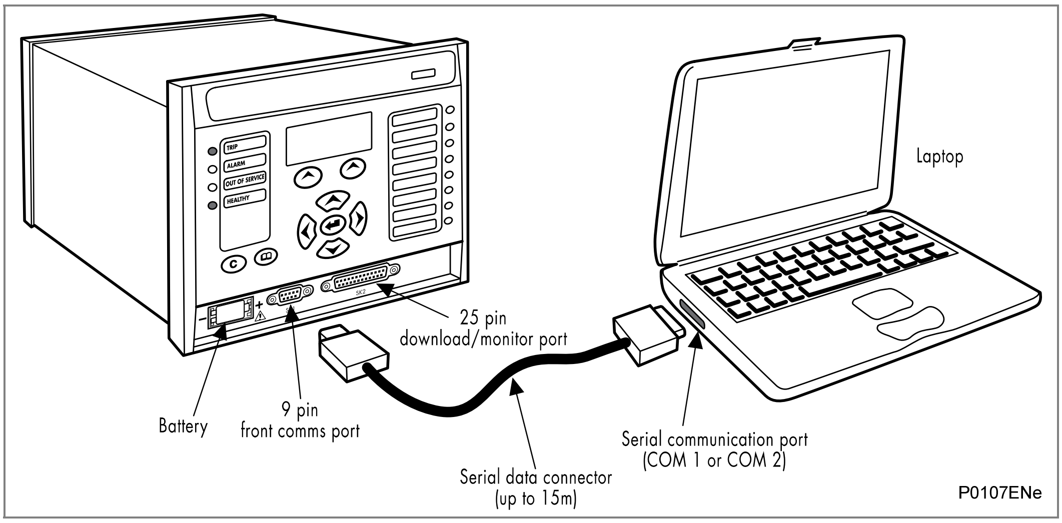

Figure 10 - Front port connection

The IED is a Data Communication Equipment (DCE) device. The pin connections of the 9-pin front port are as follows:

Pin no.	Description
2	Tx Transmit data
3	Rx Receive data
5	0V Zero volts common

Table 4 - 9-pin front port connections

None of the other pins are connected in the relay. The relay should be connected to the serial port of a PC, usually called COM1 or COM2. PCs are normally Data Terminal Equipment (DTE) devices which have a serial port pin connection as below (if in doubt check your PC manual):

Pin	25 Way	9 Way	Description
Pin no. 2	3	2	Rx Receive data
Pin no. 3	2	3	Tx Transmit data
Pin no. 5	7	5	0V Zero volts common

Table 5 - 25-way and 9-way serial pin connections

For successful data communication, the Tx pin on the relay must be connected to the Rx pin on the PC, and the Rx pin on the relay must be connected to the Tx pin on the PC, as shown in the diagram. Therefore, providing that the PC is a DTE with pin connections as given above, a 'straight through' serial connector is required, i.e. one that connects pin 2 to pin 2, pin 3 to pin 3, and pin 5 to pin 5.

Note	*A common cause of difficulty with serial data communication is connecting Tx to Tx and Rx to Rx. This could happen if a 'cross-over' serial connector is used, i.e. one that connects pin 2 to pin 3, and pin 3 to pin 2, or if the PC has the same pin configuration as the relay.*

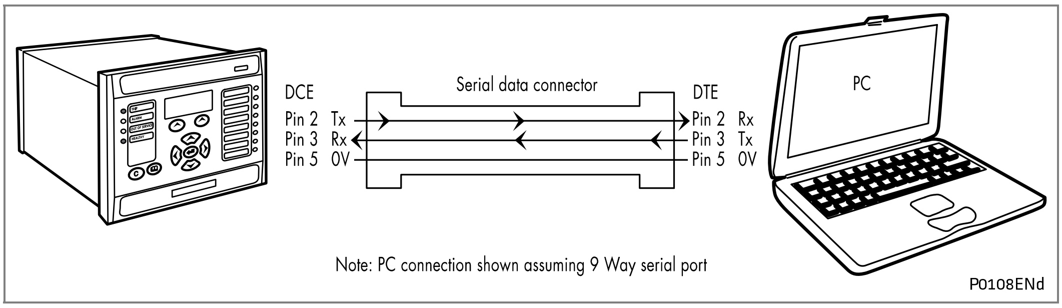

Figure 11 - PC - relay signal connection

Having made the physical connection from the relay to the PC, the PCs communication settings must be configured to match those of the relay. The relays communication settings for the front port are fixed as shown below:

Protocol	Baud rate	Courier address	Message format
Courier	19,200 bits/s	1	11 bit - 1 start bit, 8 data bits, 1 parity bit (even parity), 1 stop bit

Table 6 - Communication settings for front port

The inactivity timer for the front port is set at 15 minutes. This controls how long the relay will maintain its password access on the front port. If no messages are received on the front port for 15 minutes then any password access that has been enabled will be revoked.

7.1 Front Courier Port

The front EIA(RS)232 9-pin port supports the Courier protocol for one to one communication.

Note	*The front port is actually compliant to EIA(RS)574; the 9-pin version of EIA(RS)232, see www.tiaonline.org.*

The front port is designed for use during installation and commissioning/maintenance and is not suitable for permanent connection. Since this interface will not be used to link the relay to a substation communication system, some of the features of Courier are not implemented. These are as follows:

- Automatic Extraction of Event Records:
  - Courier Status byte does not support the Event flag
  - Send Event/Accept Event commands are not implemented
- Automatic Extraction of Disturbance Records:
  - Courier Status byte does not support the Disturbance flag
- Busy Response Layer: Courier Status byte does not support the Busy flag, the only response to a request will be the final data
- Fixed Address: The address of the front courier port is always 1, the Change Device address command is not supported.
- Fixed Baud Rate: 19200 bps

Note	*Although automatic extraction of event and disturbance records is not supported, this data can be manually accessed using the front port.*

8 MICOM S1 RELAY COMMUNICATIONS BASICS

The EIA(RS)232 front communication port is particularly designed for use with the relay settings program Easergy Studio (MiCOM S1 Studio). Easergy Studio (MiCOM S1 Studio) is the universal MiCOM IED Support Software and provide users a direct and convenient access to all stored data in any MiCOM IED using the EIA(RS)232 front communication port.

Easergy Studio (MiCOM S1 Studio) provides full access to MiCOM Px10, Px20, Px30, Px40 and Mx20 measurements units.

The Easergy Studio (MiCOM S1 Studio) product is updated periodically. These updates provide support for new features (such as allowing you to manage new MiCOM products, as well as using new software releases and hardware suffixes). The updates may also include fixes. **Accordingly, we strongly advise customers to use the latest Schneider Electric version of Easergy Studio (MiCOM S1 Studio).**

8.1 PC Requirements

The minimum and recommended hardware requirements for Easergy Studio (MiCOM S1 Studio) (v5.1.0) are shown below. These include the Studio application and other tools which are included: UPCT, P746 RHMI, P740 Topology Tool:

Minimum requirements:				
Platform	**Processor**	**RAM**	**HDD1**	**HDD2**
Windows XP x86	1 GHz	512 MB	900 MB	1.5 GB
Windows 7 x86	1 GHz	1 GB	900 MB	1.9 GB
Windows 7 x64	1 GHz	2 GB	900 MB	2.1 GB
Windows Server 2008 x86 Sp1	1 GHz	512 MB	900 MB	1.7 GB

Recommended requirements:				
Platform	**Processor**	**RAM**	**HDD1**	**HDD2**
Windows XP x86	1 GHz	1 GB	900 MB	1.5 GB
Windows 7 x86	1 GHz	2 GB	900 MB	1.9 GB
Windows 7 x64	1 GHz	4 GB	900 MB	2.1 GB
Windows Server 2008 x86 Sp1	1 GHz	4 GB	900 MB	1.7 GB

Note 1 *Operating system with Windows Updates updated on 2015/05.*
Note 2 *Operating system without Windows Updates installed.*

Both configurations do not include Data Models HDD requirements.
Screen resolution for minimum requirements: Super VGA (800 x 600).
Screen resolution for recommended requirements: XGA (1024x768) and higher.
Easergy Studio (MiCOM S1 Studio) must be started with Administrator privileges.

8.2 Connecting to the Relay using MiCOM S1 Studio

This section is a quick start guide to using Easergy Studio (MiCOM S1 Studio) and assumes this is installed on your PC. See the Easergy Studio (MiCOM S1 Studio) program online help for more detailed information.

1. Make sure the EIA(RS)232 serial cable is properly connected between the port on the front panel of the relay and the PC.
2. To start MiCOM S1 Studio, select **Programs** > **Schneider Electric** > **MiCOM S1 Studio** > **MiCOM S1 Studio**.
3. Click the **Quick Connect** tab and select **Create a New System**.
4. Check the **Path to System file** is correct, then enter the name of the system in the **Name** field. To add a description of the system, use the **Comment** field.
5. Click **OK**.
6. Select the device type.
7. Select the communications port, and open a connection with the device.
8. Once connected, select the language for the settings file, the device name, then click **Finish**. The configuration is updated.
9. In the **Studio Explorer** window, select **Device** > **Supervise Device**… to control the relay directly. (User Login necessary)

8.3 Off-Line Use of MiCOM S1 Studio

Easergy Studio (MiCOM S1 Studio) can also be used as an off-line tool to prepare settings, without access to the relay.

1. If creating a new system, in the Studio Explorer, select **create new** system. Then right-click the new system and select **New substation**.
2. Right-click the new substation and select **New voltage level**.
3. Then right-click the new voltage level and select **New bay**.
4. Then right-click the new bay and select **New device**.

   You can add a device at any level, whether it is a system, substation, voltage or bay.
5. Select a device type from the list, then enter the relay type. Click **Next**.
6. Enter the full model number and click **Next**.
7. Select the **Language** and **Model**, then click **Next**.
8. If the IEC61850 protocol is selected, and an Ethernet board with hardware option Q, R or S is selected, select IEC 61850 Edition:
IEC 61850 Edition 2 Mode or
IEC 61850 Edition 1 Compatible Mode.
9. Enter a unique device name, then click **Finish**.
10. Right-click the **Settings** folder and select **New File**. A default file **000** is added.
11. Right-click file **000** and select click **Open**. You can then edit the settings. See the Easergy Studio (MiCOM S1 Studio) program online help for more information.

Notes:

SETTINGS

CHAPTER 4

Date:	02/2017
Products covered by this chapter:	This chapter covers the specific versions of the MiCOM products listed below. This includes ***only*** the following combinations of Software Version and Hardware Suffix.
Hardware Suffix:	L (P742) & M (P741 & P743)
Software Version:	B1
Connection Diagrams:	10P740xx (xx = 01 to 07)

CONTENTS

1 INTRODUCTION

The IED must be configured to the system and the application by means of appropriate settings.

The sequence in which the settings are listed and described in this chapter will be the protection setting, control and configuration settings and the disturbance recorder settings.

The IED is supplied with a factory-set configuration of default settings.

Important	***The following tables provide information about the different settings for this range of MiCOM products. Unless otherwise stated in these tables, the settings apply to the whole range of products covered by this manual. Where a setting applies to anything other than the whole range, the individual products to which it applies are listed accordingly.***

Important	**Throughout this manual, you may see references to products as follows:** **P741 = Central Unit or CU** **P742/P743 = Peripheral Unit or PU**

2 RELAY SETTINGS

The IED is a multi-function device that supports numerous different control and communication features. The settings associated with any function that is disabled are made invisible; i.e. they are not shown in the menu. To disable a function change the relevant cell in the '**Configuration'** column from '**Enabled'** to '**Disabled'**.

To simplify the setting of the IED, there is a configuration settings column, used to enable or disable many of the IED functions. The aim of the configuration column is to allow general configuration from a single point in the menu.

The configuration column controls which of the four settings groups is selected as active through the '**Active settings**' cell. A setting group can also be disabled in the configuration column, provided it is not the present active group. Similarly, a disabled setting group cannot be set as the active group.

The column also allows all of the setting values in one group of settings to be copied to another group.

To do this firstly set the '**Copy from**' cell to the setting group to be copied, then set the '**Copy to**' cell to the group where the copy is to be placed. The copied settings are initially placed in the temporary scratchpad, and will only be used by the IED following confirmation.

2.1 Default Settings Restore

To restore the default values to the settings in any protection settings group, set the 'restore defaults' cell to the relevant group number. Alternatively, it is possible to set the 'restore defaults' cell to 'all settings' to restore the default values to all of the IEDs settings, not just the protection groups' settings. The default settings will initially be placed in the scratchpad and will only be used by the IED after they have been confirmed.

Important	***Restoring defaults to all settings includes the rear communication port settings, which may result in communication via the rear port being disrupted if the new (default) settings do not match those of the master station.***

Important	***If you restore settings, the settings for the IEC 61850 Edition and the Communications Mode will not be restored, even if "Restore All Settings" is set.***

3 CONFIGURATION MENU

The aim of the configuration column is to allow general configuration from a single point in the menu. Items that are disabled or made invisible do not appear in the main relay menu.

The Configuration menu settings vary between products. The options are:

- Configuration Menu (P741)
- Configuration Menu (P742/P743)

3.1 Configuration Menu (P741)

Col	Row	Menu Text	Default Setting	Available Setting
Description				
09	00	CONFIGURATION		
This column contains all the general configuration options				
09	01	Restore Defaults	No Operation	0 = No Operation, 1 = All Settings, 2 = Setting Group 1, 3 = Setting Group 2, 4 = Setting Group 3, 5 = Setting Group 4
Setting to restore a setting group to factory default settings. To restore the default values to the settings in any Group settings, set the ‘restore defaults’ cell to the relevant Group number. Alternatively it is possible to set the ‘restore defaults’ cell to ‘all settings’ to restore the default values to all of the IED’s settings, not just the Group settings. The default settings will initially be placed in the scratchpad and will only be used by the IED after they have been confirmed by the user. Note: Restoring defaults to all settings includes the rear communication port settings, which may result in communication via the rear port being disrupted if the new (default) settings do not match those of the master station.				
09	02	Setting Group	Select via Menu	0 = Select via Menu or 1 = Select via Opto
Allows setting group changes to be initiated via Opto Input or via Menu				
09	03	Active Settings	Group 1	0 = Group 1, 1 = Group 2, 2 = Group 3, 3 = Group 4
Selects the active setting group.				
09	04	Save Changes	No Operation	0 = No Operation, 1 = Save, 2 = Abort
Saves all IED settings.				
09	05	Copy From	Group 1	0 = Group 1, 1 = Group 2, 2 = Group 3, 3 = Group 4
Allows displayed settings to be copied from a selected setting group				
09	06	Copy to	No Operation	0 = No Operation, 1 = Group 1, 2 = Group 2, 3 = Group 3
Allows displayed settings to be copied to a selected setting group				
09	07	Setting Group 1	Enabled	0 = Disabled or 1 = Enabled
Enables or disables Group 1 settings. If the setting is disabled from the configuration, then all associated settings and signals are hidden, with the exception of this setting.				
09	08	Setting Group 2	Disabled	0 = Disabled or 1 = Enabled
Enables or disables Group 2 settings. If the setting is disabled from the configuration, then all associated settings and signals are hidden, with the exception of this setting.				
09	09	Setting Group 3	Disabled	0 = Disabled or 1 = Enabled
Enables or disables Group 3 settings. If the setting is disabled from the configuration, then all associated settings and signals are hidden, with the exception of this setting.				
09	0A	Setting Group 4	Disabled	0 = Disabled or 1 = Enabled

Col	Row	Menu Text	Default Setting	Available Setting
Description				
Enables or disables Group 4 settings. If the setting is disabled from the configuration, then all associated settings and signals are hidden, with the exception of this setting.				
09	0F	Busbar Option	Invisible	0 = Disabled or 1 = Enabled
09	10	Diff Busbar Prot	Enabled	0 = Disabled or 1 = Enabled
09	25	Input Labels	Visible	0 = Invisible, 1 = Visible
Sets the Input Labels menu visible further on in the IED setting menu.				
09	26	Output Labels	Visible	0 = Invisible, 1 = Visible
Sets the Output Labels menu visible further on in the IED setting menu.				
09	29	Record Control	Visible	0 = Invisible, 1 = Visible
Sets the Record Control menu visible further on in the IED settings menu.				
09	2A	Disturb Recorder	Visible	0 = Invisible, 1 = Visible
Sets the Disturbance Recorder menu visible further on in the IED settings menu.				
09	2B	Measure't Setup	Visible	0 = Invisible, 1 = Visible
Sets the Measurement Setup menu visible further on in the IED settings menu.				
09	2C	Comms Settings	Invisible	0 = Invisible, 1 = Visible
Sets the Communications Settings menu visible further on in the IED settings menu. These are the settings associated with the 1st and 2nd rear communications ports				
09	2D	Commission Tests	Visible	0 = Invisible, 1 = Visible
Sets the Commissioning Tests menu visible further on in the IED settings menu.				
09	2E	Setting Values	Primary	0 = Primary, 1 = Secondary
This affects all protection settings that are dependent upon CT and VT ratios. All subsequent settings input must be based in terms of this reference.				
09	2F	Control Inputs	Visible	0 = Invisible, 1 = Visible
Activates the Control Input status and operation menu further on in the IED setting menu.				
09	35	Ctrl I/P Config	Visible	0 = Invisible, 1 = Visible
Sets the Control Input Configuration menu visible further on in the IED setting menu.				
09	36	Ctrl I/P Labels	Visible	0 = Invisible, 1 = Visible
Sets the Control Input Labels menu visible further on in the IED setting menu.				
09	39	Direct Acces	Enable	0 = Disabled or 1 = Enabled
Defines whether direct access is allowed or not. The front direct access keys that are used as a short cut function of the menu may be: Disabled – No function visible on the LCD. Enabled – All control functions mapped to the Hotkeys and Control Trip/Close are available. Not available on Chinese version relays.				
09	40	InterMiCOM	Disabled	0 = Disabled or 1 = Enabled
To enable (activate) or disable (turn off) InterMiCOM.				
09	50	Function Key	Visible	0 = Invisible, 1 = Visible
Sets the Function Key menu visible further on in the IED setting menu.				
09	70	VIR I/P Labels	Invisible	0 = Invisible, 1 = Visible
This makes the virtual inputs label settings visible or invisible.				
09	80	VIR O/P Labels	Invisible	0 = Invisible, 1 = Visible
This makes the virtual outputs label settings visible or invisible.				
09	90	Usr Alarm Labels	Invisible	0 = Invisible, 1 = Visible

Col	Row	Menu Text	Default Setting	Available Setting
Description				
This makes the user alarm labels settings visible or invisible.				
09	FB	RP1 Read Only	Disabled	0 = Disabled or 1 = Enabled
Enable Remote Read Only Mode on RP1 courier or IEC60870-5-103 communication protocol. Visible when comms options are: 1 – Courier, 3 – CS103, 6&G – IEC61850 with 1st Rear Courier, 7&H – IEC61850 with 1st Rear CS103.				
09	FC	RP2 Read Only	Disabled	0 = Disabled or 1 = Enabled
Enable Remote Read Only Mode on RP2 courier communication protocol. Visible when hardware options are: 7, 8, E or F.				
09	FD	NIC Read Only	Disabled	0 = Disabled or 1 = Enabled
Enable Remote Read Only Mode on the Network Interface card (IEC 61850 tunneled courier). Visible when comms options are: 6&G – IEC61850 with 1st Rear Courier, 7&H – IEC61850 with 1st Rear CS103, B&L– IEC61850 with DNPoE with DNP .				
09	FF	LCD Contrast	11	0 to 31 (step 1)
Sets the LCD contrast.				

3.2 Configuration Menu (P742/P743)

Col	Row	Menu Text	Default Setting	Available Setting	74	74
Description						
09	00	CONFIGURATION			*	*
This column contains all the general configuration options						
09	01	Restore Defaults	No Operation	0 = No Operation, 1 = All Settings, 2 = Setting Group 1, 3 = Setting Group 2, 4 = Setting Group 3, 5 = Setting Group 4	*	*
Setting to restore a setting group to factory default settings. To restore the default values to the settings in any Group settings, set the ‘restore defaults’ cell to the relevant Group number. Alternatively it is possible to set the ‘restore defaults’ cell to ‘all settings’ to restore the default values to all of the IED’s settings, not just the Group settings. The default settings will initially be placed in the scratchpad and will only be used by the IED after they have been confirmed by the user. Note: Restoring defaults to all settings includes the rear communication port settings, which may result in communication via the rear port being disrupted if the new (default) settings do not match those of the master station.						
09	02	Setting Group	Select via Menu	0 = Select via Menu or 1 = Select via Opto	*	*
Allows setting group changes to be initiated via Opto Input or via Menu						
09	03	Active Settings	Group 1	0 = Group 1, 1 = Group 2, 2 = Group 3, 3 = Group 4	*	*
Selects the active setting group.						
09	04	Save Changes	No Operation	0 = No Operation, 1 = Save, 2 = Abort	*	*
Saves all IED settings.						
09	05	Copy From	Group 1	0 = Group 1, 1 = Group 2, 2 = Group 3, 3 = Group 4	*	*
Allows displayed settings to be copied from a selected setting group						
09	06	Copy to	No Operation	0 = No Operation, 1 = Group 1, 2 = Group 2, 3 = Group 3	*	*
Allows displayed settings to be copied to a selected setting group						
09	07	Setting Group 1	Enabled	0 = Disabled or 1 = Enabled	*	*

Col	Row	Menu Text	Default Setting	Available Setting	[illegible]	[illegible]
Description						
Enables or disables Group 1 settings. If the setting is disabled from the configuration, then all associated settings and signals are hidden, with the exception of this setting.						
09	08	Setting Group 2	Disabled	0 = Disabled or 1 = Enabled	*	*
Enables or disables Group 2 settings. If the setting is disabled from the configuration, then all associated settings and signals are hidden, with the exception of this setting.						
09	09	Setting Group 3	Disabled	0 = Disabled or 1 = Enabled	*	*
Enables or disables Group 3 settings. If the setting is disabled from the configuration, then all associated settings and signals are hidden, with the exception of this setting.						
09	0A	Setting Group 4	Disabled	0 = Disabled or 1 = Enabled	*	*
Enables or disables Group 4 settings. If the setting is disabled from the configuration, then all associated settings and signals are hidden, with the exception of this setting.						
09	0F	Dead Zone Prot	Enabled	0 = Disabled or 1 = Enabled	*	*
To enable (activate) or disable (turn off) the Dead Zone Protection function.						
09	10	BB Trip Confirm	Disabled	0 = Disabled or 1 = Enabled	*	*
To enable (activate) or disable (turn off) the 87BB Trip Confirm.						
09	12	Overcurrent Prot	Disabled	0 = Disabled or 1 = Enabled	*	*
To enable (activate) or disable (turn off) the Overcurrent Protection function.						
09	13	Earth Fault Prot	Disabled	0 = Disabled or 1 = Enabled	*	*
To enable (activate) or disable (turn off) the back up Earth Fault Protection function. IN >stages: ANSI 50N/51N/67N						
09	14	CB Fail & I<	Disabled	0 = Disabled or 1 = Enabled	*	*
To enable (activate) or disable (turn off) the Circuit Breaker Fail Protection function: ANSI 50BF.						
09	25	Input Labels	Visible	0 = Invisible, 1 = Visible	*	*
Sets the Input Labels menu visible further on in the IED setting menu.						
09	26	Output Labels	Visible	0 = Invisible, 1 = Visible	*	*
Sets the Output Labels menu visible further on in the IED setting menu.						
09	28	CT & VT Ratios	Visible	0 = Invisible, 1 = Visible	*	*
Sets the Current & Voltage Transformer Ratios menu visible further on in the IED settings menu.						
09	29	Record Control	Visible	0 = Invisible, 1 = Visible	*	*
Sets the Record Control menu visible further on in the IED settings menu.						
09	2A	Disturb Recorder	Visible	0 = Invisible, 1 = Visible	*	*
Sets the Disturbance Recorder menu visible further on in the IED settings menu.						
09	2B	Measure't Setup	Visible	0 = Invisible, 1 = Visible	*	*
Sets the Measurement Setup menu visible further on in the IED settings menu.						
09	2C	Comms Settings	Invisible	0 = Invisible, 1 = Visible	*	*
Sets the Communications Settings menu visible further on in the IED settings menu. These are the settings associated with the 1st and 2nd rear communications ports						
09	2D	Commission Tests	Visible	0 = Invisible, 1 = Visible	*	*
Sets the Commissioning Tests menu visible further on in the IED settings menu.						
09	2E	Setting Values	Secondary	0 = Primary, 1 = Secondary	*	*
This affects all protection settings that are dependent upon CT and VT ratios. All subsequent settings input must be based in terms of this reference.						
09	2F	Control Inputs	Visible	0 = Invisible, 1 = Visible	*	*
Activates the Control Input status and operation menu further on in the IED setting menu.						
09	35	Ctrl I/P Config	Visible	0 = Invisible, 1 = Visible	*	*
Sets the Control Input Configuration menu visible further on in the IED setting menu.						

Col	Row	Menu Text	Default Setting	Available Setting		
Description						
09	36	Ctrl I/P Labels	Visible	0 = Invisible, 1 = Visible	*	*
Sets the Control Input Labels menu visible further on in the IED setting menu.						
09	39	Direct Acces	Enable	0 = Disabled or 1 = Enabled	*	*
Defines whether direct access is allowed or not. The front direct access keys that are used as a short cut function of the menu may be: Disabled – No function visible on the LCD. Enabled – All control functions mapped to the Hotkeys and Control Trip/Close are available. Not available on Chinese version relays.						
09	40	InterMiCOM	Disabled	0 = Disabled or 1 = Enabled		*
To enable (activate) or disable (turn off) InterMiCOM.						
09	50	Function Key	Visible	0 = Invisible, 1 = Visible		*
Sets the Function Key menu visible further on in the IED setting menu.						
09	70	VIR I/P Labels	Invisible	0 = Invisible, 1 = Visible		*
This makes the virtual inputs label settings visible or invisible.						
09	80	VIR O/P Labels	Invisible	0 = Invisible, 1 = Visible		*
This makes the virtual outputs label settings visible or invisible.						
09	90	Usr Alarm Labels	Invisible	0 = Invisible, 1 = Visible		*
This makes the user alarm labels settings visible or invisible.						
09	FB	RP1 Read Only	Disabled	0 = Disabled or 1 = Enabled	*	*
Enable Remote Read Only Mode on RP1 courier or IEC60870-5-103 communication protocol. Visible when comms options are: 1 – Courier, 3 – CS103, 6&G – IEC61850 with 1st Rear Courier, 7&H – IEC61850 with 1st Rear CS103.						
09	FC	RP2 Read Only	Disabled	0 = Disabled or 1 = Enabled	*	*
Enable Remote Read Only Mode on RP2 courier communication protocol. Visible when hardware options are: 7, 8, E or F.						
09	FD	NIC Read Only	Disabled	0 = Disabled or 1 = Enabled	*	*
Enable Remote Read Only Mode on the Network Interface card (IEC 61850 tunneled courier). Visible when comms options are: 6&G – IEC61850 with 1st Rear Courier, 7&H – IEC61850 with 1st Rear CS103, B&L– IEC61850 with DNPoE with DNP .						
09	FF	LCD Contrast	11	0 to 31 (step 1)	*	*
Sets the LCD contrast.						

4 GROUPED PROTECTION SETTINGS

The grouped protection settings include all the following items that become active once enabled in the configuration column of the relay menu database:

- Protection Element Settings.
- Programmable Scheme Logic (PSL).

There are four groups of protection settings, with each group containing the same setting cells. One group of protection settings is selected as the active group, and is used by the protection elements. The settings for group 1 are shown. The settings are discussed in the same order in which they are displayed in the menu.

However, there are some differences between the different products within the P74x range. These are:

	P741	P742 and P743
Protection element settings	Differential Phase and Earth fault Protection (“Diff Busbar Prot” menu)	Busbar Trip (87BB) or Central Breaker Fail BackTrip Confirmation (50BF) (“BB Trip Confirm” menu)
	Differential protection configuration (“Busbar option” menu)	Dead Zone configuration (“Dead Zone Prot” menu)
		Non-directional Phase overcurrrent protection (“Overcurrent” menu)
		Non-Directional Earth Fault Overcurrent Protection and External Fault Detection by High-Set Overcurrent (“Earth Fault” menu)
		Circuit breaker fail and undercurrent function (“CB Fail” column)
		Supervision CTS (“Supervision” menu)

For the P74x range the PSL also includes InterMiCOM signals mapping.

4.1 Differential Protection (Diff Busbar Prot) (P741)

Differential Elements 87BB

The differential element has independent settings for phase and earth (sensitive) faults, which are used for all zones and the check zone independently.

Col	Row	Menu Text	Default Setting	Available Setting
Description				
30	00	GROUP 1: DIFF BUSBAR PROT		
GROUP 1: DIFF BUSBAR PROT				
30	01	Diff Phase Fault		
Diff Phase Fault (Diff busbar protection menu first part for Differential Phase Fault Configuration)				
30	02	CZ parameters		
30	04	Phase Slope kCZ	30%	From 0% to 90% step 1%
Slope angle setting for the check zone biased differential element.				
30	05	IDCZ>2 Current	1200A	From 50 A to 30 kA step 10 A
Setting that determines the minimum differential operating current for the check zone biased differential element				
30	06	Zone parameters		
30	08	Phase Slope k2	60%	From 0% to 90% step 1%
Slope angle setting for all discriminating zone biased differential elements				
30	09	ID>2 Current	1000A	From 50 A to 30 kA step 10 A
Setting that determines the minimum differential operating current for all the discriminating zone biased differential elements				
30	0A	Common		
30	0B	ID>1 Current	100A	From 10 A to 500 A step 10 A
Setting for the phase circuitry fault monitoring characteristic for the minimum pickup				
30	0C	Phase Slope k1	10%	From 0% to 90% step 1%
Slope angle setting for the phase circuitry fault monitoring characteristic.				
30	0D	ID>1 Alarm Timer	5s	From 100ms to 600s step 100ms
Setting for the operating time delay of the phase circuitry fault monitoring				
30	10	Diff Earth Fault	Disabled	Disabled or Enabled
To enable (activate) or disable (turn off) the differential earth fault protection function. When activated, the following functions are accessible.				
30	11	IBiasPh> Cur.	2000A	From 50 A to 30 kA step 10 A
Setting that determines the Earth fault element blocking characteristic				
30	12	CZ parameters		
30	14	Earth Slope kNCZ	10%	From 0% to 90% step 1%
Slope angle setting for the check zone biased differential Earth element.				
30	15	IDNCZ>2 Current	1200A	From 10 A to 30 kA step 10 A
Setting that determines the minimum differential operating current for the check zone biased differential Earth element				

Col	Row	Menu Text	Default Setting	Available Setting
Description				
30	16	Zone parameters		
30	18	Earth Slope kN2	10%	From 0% to 90% step 1%
Slope angle setting for all discriminating zone biased differential Earth elements				
30	19	IDN>2 Current	1000A	From 10 A to 30 kA step 10 A
Setting that determines the minimum differential operating current for all the discriminating zone biased differential Earth elements				
30	1B	IDN>1 Current	100A	From 10 A to 500 A step 10 A
Setting for the Neutral circuitry fault monitoring characteristic for the minimum pickup				
30	1C	Earth Slope kN1	5%	From 0% to 90% step 1%
Slope angle setting for the Neutral circuitry fault monitoring characteristic.				
30	1D	IDN>1 Alarm Tim.	5s	From 100ms to 600s step 100ms
Setting for the Neutral circuitry fault monitoring minimum pickup timer				

4.2 Busbar Element (BB Trip Confirm) (P742/P743)

The peripheral units can be enabled to control the trip command issue by the central unit (87BB or 50BF) if a local fault threshold, either phase or earth (i.e. I>BB or IN>BB), is exceeded.

This criterion provides additional scheme stability. Should the command proceed, and a trip be issued to the circuit breaker this element can confirm the evolution of a circuit breaker failure condition. If the element is still operated after a set time delay a breaker failure condition must exist.

Col	Row	Menu Text	Default Setting	Available Setting	74	74
Description						
30	00	GROUP 1: BB TRIP CONFIRM			*	*
GROUP 1: BUSBAR ELEMENT (BB TRIP CONFIRM)						
30	01	I>BB Current Set	1.2*I2 A	From 0.05*I2 A to 4*I2 A step 0.01*I2 A	*	*
Setting for the minimum pickup phase fault element trip authorization						
30	02	IN>BB Current	0.2*I2 A	From 0.05*I2 A to 4*I2 A step 0.01*I2 A	*	*
Setting for the minimum pickup Earth fault element trip authorization						

4.3 Differential Protection (Busbar Option) (P741)

The differential element blockings and alarms can be configured to fit optimum operability, they are used for all zones and the check zone independently.

This column is visible when the “Busbar Option” setting (“Configuration” column) = “visible”.

Important	Information about the following Menu Text options/settings is incuded in note below the following table: CZ Circ Flt Mode Zx Circ Flt Mode

Col	Row	Menu Text	Default Setting	Available Setting
Description				
31	00	GROUP 1: BUSBAR OPTION		
GROUP 1: BUSBAR OPTION				
31	01	CZ Circ Flt Mode	Alarm & No Block	Blocking Latched, Alarm Latched, Self-Reset, Alarm & No Block or AlarmSR&No Block
Options for the Check Zone differential element faulty calculation due to wrong position of CB or isolator or CT failure are described in more detail in the "Check Zone Circuitry Fault" Note in the Settings chapter of the P74x Technical Manual.				
31	02	Zx Circ Flt Mode	Blocking Latched	Blocking Latched, Alarm Latched, Self-Reset, Alm&NoBlock !!! Or AlmSR&NoBlck !!!
Options for all the Zones differential element faulty calculation due to wrong position of CB or isolator or CT failure are described in more detail in the "Zone x Circuitry Fault" Note in the Settings chapter of the P74x Technical Manual.				
31	03	Circuitry tReset	60s	From 5s to 600s step 1s
Setting for the reset time delay of the circuitry fault reset options				
31	04	Circ Block Mode	3phase Blocking	3phase Blocking or Blocking / phase
Options for all the Zones and Check Zone differential element faulty calculation due to wrong position of CB or isolator or CT failure are as follow: 3phase Blocking: If the faulty calculation occurs on one phase only, the Zone and/or Check Zone is blocked for the 3 phases. Blocking / phase: If the faulty calculation occurs on one phase only, the Zone and/or Check Zone is blocked for this phase only.				
31	05	CZ PU Err.Mode	Alarm & No Block	Blocking Latched, Alarm Latched, Self-Reset, Alarm & No Block or AlarmSR&No Block
Check Zone Peripheral Unit error mode: options for the Check Zone differential element faulty calculation due to a loss of a Peripheral Unit (PU) information are as follow: AlarmSR&No Block (Alarm Self Reset and No blocking): The CZ does not block any zone trip and the alarm disappears as soon as the CZ calculation is right. Alarm & No Block (Alarm and No blocking): The CZ does not block any zone trip and the alarm disappears only after manual reset. Self-Reset: The CZ blocks any zone trip and both the blocking and the alarm disappear as soon as the CZ calculation is right. Alarm Latched: The CZ blocks any zone trip, the blocking disappears as soon as the CZ calculation is right but the alarm disappears only after manual reset. Blocking Latched: The CZ blocks any zone trip and both the blocking and the alarm disappear only after manual reset.				
31	06	Zx PU Error Mode	Blocking Latched	Blocking Latched, Alarm Latched or Self-Reset
Options for all the Zones differential element faulty calculation due to a loss of a Peripheral Unit (PU) information are as follows: Self-Reset: The Zone is blocked and both the blocking and the alarm disappear as soon as the Zone calculation is right. Alarm Latched: The Zone is blocked, the blocking disappears as soon as the Zone calculation is right but the alarm disappears only after manual reset. Blocking Latched: The Zone is blocked and both the blocking and the alarm disappear only after manual reset.				
31	07	PU Error Timer	5s	From 2s to 600s step 100ms
Setting for the operating time delay of the PU error options				

Col	Row	Menu Text	Default Setting	Available Setting
Description				
31	08	PU Error tReset	60s	From 5s to 600s step 1s
Setting for the reset time delay of the PU information error.				
31	09	SEF Block Alarm	Enabled	Disabled or Enabled
Options for Sensitive Differential Earth Fault (SEF) Protection (87BB/N) only are as follow: Enabled: If the Sensitive Differential Earth Fault Protection (87BB/N) is blocked, the associated alarm is raised and is flashing on the front panel of the P741. Disabled: If the Sensitive Differential Earth Fault Protection (87BB/N) is blocked, the associated alarm is not raised and is not present on the front panel of the P741.				
31	0A	Reset PU Error	Without Comm Err	Without Comm Err or Always Permitted
Enables or disables the PU error auto- reset.				
31	0B	3Ph Block Alarm	Enabled	Disabled or Enabled
When enabled, an alarm is displayed when one zone is blocked by a Differential Busbar Protection function (87BB).				
31	10	Delay Trip Status	Disabled	Disabled or Enabled
Activate or deactivate a time delay before 87BB (phase differential busbar protection) trip. When activated, the settable delay time (using 'Delay Trip Timer' menu) is used to confirm the fault or to clear the fault before zone trip.				
31	11	Delay Trip Timer	100ms	From 50ms to 5s step 10ms
'Delay Trip Timer' sets the delay time to confirm a phase differential busbar protection (87BB) trip when 'Delay Trip Status' is enabled. This delay time must be shorter than the time delay of phase circuitry fault monitoring ('DIFF BUSBAR PROT / ID>1 Alarm timer' menu).				
31	20	Diff Display Min	0A	From 0A to 500A step 10A
Sets a minimum threshold to display a differential current ('Measurement' column). When the differential current is less than this threshold on the 3 phases, the displayed current is forced to 0.				

The following notes provided additional information about Menu Text settings/options in the above table.

Check Zone Circuitry Fault

Options for the Check Zone differential element faulty calculation due to wrong position of CB or isolator or CT failure are as follows:	
AlarmSR&No Block (Alarm Self Reset and No blocking):	The CZ does not block any zone trip and the alarm disappears as soon as the CZ calculation is right.
Alarm & No Block (Alarm and No blocking):	The CZ does not block any zone trip and the alarm disappears only after manual reset.
Self-Reset:	The CZ blocks any zone trip and both the blocking and the alarm disappear as soon as the CZ calculation is right.
Alarm Latched:	The CZ blocks any zone trip, the blocking disappears as soon as the CZ calculation is right but the alarm disappears only after manual reset.
Blocking Latched:	The CZ blocks any zone trip and both the blocking and the alarm disappear only after manual reset.

Zone x Circuitry Fault

Options for all the Zones differential element faulty calculation due to wrong position of CB or isolator or CT failure are as follows:	
Self-Reset:	The Zone is blocked and both the blocking and the alarm disappear as soon as the Zone calculation is right.
Alarm Latched:	The Zone is blocked, the blocking disappears as soon as the Zone calculation is right but the alarm disappears only after manual reset.
Blocking Latched:	The Zone is blocked and both the blocking and the alarm disappear only after manual reset.
AlarmSR&No Blck !!! (Alarm Self Reset and No blocking):	The Zone is not blocked and alarm disappears as soon as the zone calculation is right.
Alarm & No Block !!!:	The Zone is not blocked and alarm disappears only after manual reset.

Caution	**The selection of “AlarmSR&No Blck !!!” or “Alarm & No Block !!!” modes is effective only if no blocking zone is selected for Check zone circuitry fault (CZ).** **When “AlarmSR&No Blck !!!” or “Alarm & No Block !!!” setting is selected, the protection will trip the related zone in case of an external trip.**

4.4 Dead Zone Configuration (Dead Zone Prot) (P742/P743)

Col	Row	Menu Text	Default Setting	Available Setting	7 4	7 4
Description						
31	00	GROUP 1: DEAD ZONE PROT			*	*
GROUP 1: DEAD ZONE PROT						
31	01	I>DZ Current Set	1.2*I2 A	0.05*I2 A to 4*I2 A step 0.01*I2 A	*	*
Setting for the tripping characteristic for the minimum pickup phase dead zone element						
31	02	I>DZ Time Delay	1s	From 0s to 100s step 10ms	*	*
Setting for the minimum pickup phase dead zone element timer						
31	03	Dead Zone Earth	Disabled	Disabled or Enabled	*	*
Activates or deactivates the neutral dead zone protection. When activated, the following menus are displayed.						
31	04	IN>DZ Cur. Set	1.2*I2 A	0.05*I2 A to 4*I2 A step 0.01*I2 A	*	*
Setting for the tripping characteristic for the minimum pickup neutral dead zone element						
31	05	IN>DZ Time Delay	1s	From 0s to 100s step 10ms	*	*
Setting for the minimum pickup neutral dead zone element timer						

4.5 Non-Directional Phase Overcurrent Protection (Backup Overcurrent) (P742/P743)

The overcurrent protection included in the relay provides two stages non- directional three-phase overcurrent protection with independent time delay characteristics. All overcurrent settings apply to all three phases but are independent for each of the four stages.

The first stage of overcurrent protection has time-delayed characteristics which are selectable between Inverse Definite Minimum Time (IDMT), or Definite Time (DT). The second stage has DT characteristics only.

Col	Row	Menu Text	Default Setting	Available Setting	7 4	7 4
Description						
35	00	GROUP 1: OVERCURRENT			*	*
GROUP 1: BACKUP OVERCURRENT						
35	01	I>1 Function	Disabled	Disabled, DT, IEC S Inverse, IEC V Inverse, IEC E Inverse, UK LT Inverse, IEEE M Inverse, IEEE V Inverse, IEEE E Inverse, US Inverse or US ST Inverse	*	*
Sets the first backup overcurrent threshold (I>1) characteristic.						
35	02	I>1 Current Set	3*I2 A	From 0.1*I2 A to 32*I2 A step 0.01*I2 A	*	*
Sets the value for the first stage current threshold.						
35	03	I>1 Time Delay	1s	From 0s to 100s step 10ms	*	*
Sets the time delay associated with I>1. The setting is available only when DT function is selected.						
35	04	I>1 TMS	1s	From 25ms to 1.2s step 25ms	*	*
Sets the Time Multiplier Setting (TMS), to adjust the operating time of the IEC/UK IDMT characteristics.						
35	05	I>1 Time Dial	7s	From 500ms to 15s step 100ms	*	*
Sets the time dial settings, to adjust the operating time of the IEEE/ US IDMT curves. The Time Dial is a multiplier of the standard curve equation, in order to achieve the required tripping time. The reference curve is based on Time Dial = 1. Care: Certain manufacturer's use a mid-range value of time dial = 5 or 7. So; it may be necessary to divide by 5 or 7 to achieve parity.						
35	06	I>1 Reset Char	DT	DT or Inverse	*	*
Setting to determine the type of reset / release characteristics of IEEE / US curves.						
35	07	I>1 tReset	0s	From 0s to 100s step 100ms	*	*
Setting that determines the reset/release time for definite time reset characteristic.						
35	08	I>2 Function	Disabled	Disabled, 87BBP&N blocking, High Set I>2, I>2 & 87BBP&N, 87BB/P blocking, 87BB/N blocking, I>2 & 87BB/P or I>2 & 87BB/N	*	*
Sets the second negtive sequence overcurrent threshold (I>2) characteristic.						
35	09	I>2 Current Set	20*I2 A	From 0.10*I2 A to 32*I2 A step 0.01*I2 A	*	*
Sets the value for the second stage backup current threshold.						
35	0A	I>2 Time Delay	1s	From 0s to 100s step 10ms	*	*
Sets the time delay associated with I2>4.						
35	0B	Block Drop-Off	300ms	From 200ms to 6s step 100ms	*	*
Sets the block drop-off time.						

4.6 Non-Directional Earth Fault Overcurrent Protection and External Fault Detection by High-Set Overcurrent (Earth Fault) (P742/P743)

The relays which include these functions include extra or backup non-directional earth fault protection. The earth fault element has two stages of protection. The earth fault element needs to be co- ordinated with any other protection elements on the system, in order to provide discriminative fault clearance. The inverse time characteristics available for the earth fault protection, are the same as those for the Overcurrent element.

Note	*In is the CT nominal current.*

Col	Row	Menu Text	Default Setting	Available Setting	7 4	7 4
Description						
38	00	GROUP 1: EARTH FAULT			*	*
GROUP 1: EARTH FAULT						
38	01	IN>1 Function	Disabled	Disabled, DT, IEC S Inverse, IEC V Inverse, IEC E Inverse, UK LT Inverse, IEEE M Inverse, IEEE V Inverse, IEEE E Inverse, US Inverse, US ST Inverse	*	*
Sets the first earth fault overcurrent threshold (IN>1) characteristic.						
38	02	IN>1 Current Set	0.3*I2 A	From 0.10*I2 A to 32*I2 A step 0.01*I2 A	*	*
Sets the value for the negative sequence current threshold.						
38	03	IN>1 Time Delay	1s	From 0s to 100s step 10ms	*	*
Sets the time delay associated with IN>1. The setting is available only when DT function is selected.						
38	04	IN>1 TMS	1s	From 25ms to 1.2s step 25ms	*	*
Sets the Time Multiplier Setting (TMS), to adjust the operating time of the IEC/UK IDMT characteristics.						
38	05	IN>1 Time Dial	7s	From 500ms to 15s step 100ms	*	*
Sets the time dial settings, to adjust the operating time of the IEEE/ US IDMT curves. The Time Dial is a multiplier of the standard curve equation, in order to achieve the required tripping time. The reference curve is based on Time Dial = 1. Care: Certain manufacturer's use a mid-range value of time dial = 5 or 7. So; it may be necessary to divide by 5 or 7 to achieve parity.						
38	06	IN>1 Reset Char	DT	DT or Inverse	*	*
Setting that determines the reset / release time reset characteristics.						
38	07	IN>1 tReset	0s	From 0s to 100s step 100ms	*	*
Setting that determines the reset/release time for definite time reset characteristic.						
38	08	IN>2 Function	Disabled	Disabled, 87BBP&N blocking, High Set I>2, I>2 & 87BBP&N, 87BB/P blocking, 87BB/N blocking, I>2 & 87BB/P or I>2 & 87BB/N	*	*
Sets the second earth fault overcurrent threshold (IN>2) characteristic.						
38	09	IN>2 Current Set	20*I2 A	From 0.10*I2 A to 32*I2 A step 0.01*I2 A	*	*
Sets the value for the negative sequence current threshold.						
38	0A	IN>2 Time Delay	1s	From 0s to 100s step 100ms	*	*
Sets the time delay associated with IN>2. The setting is available only when DT function is selected.						
38	0B	Block Drop-Off	300ms	From 200ms to 6s step 100ms	*	*
Sets the block drop-off time.						

4.7 Circuit Breaker Fail Function (CB Fail) (P742/P743)

This function consists of two-stage circuit breaker fail functions that can be initiated by:

- Internal protection element initiation.
- External protection element initiation.

For current-based protection, the reset condition is based on undercurrent operation to determine that the CB has opened. For the non-current based protection, the reset criteria may be selected by means of a setting for determining a CB Failure condition.

It is common practice to use low set undercurrent elements in protection relays to indicate that circuit breaker poles have interrupted the fault or load current, as required.

Col	Row	Menu Text	Default Setting	Available Setting	7 4	7 4
Description						
45	00	GROUP 1: CB FAIL			*	*
GROUP 1: CB FAIL						
45	01	Control by	I<	I<, 52a or I< and 52a	*	*
Setting which determines the elements that will reset the circuit breaker fail time protection function. Both means that 52a and current criteria have to indicate open to reset the CB fail.						
45	02	I< Current Set	0.05*I2 A	From 0.05*I2 A to 1*I2 A step 0.01*I2 A	*	*
Setting that determines the circuit breaker fail reset criteria.						
45	03	I> Status	Disabled	Disabled or Enabled	*	*
To enable (activate) or disable (turn off) the overcurrent confirmation for the start of the circuit breaker fail function						
45	04	I> Current Set	1.2*I2 A	From 0.05*I2 A to 4*I2 A step 0.01*I2 A	*	*
If "I> Status" is enabled, pick-up setting for overcurrent confirmation						
45	05	IN> Current Set	0.2*I2 A	From 0.05*I2 A to 4*I2 A step 0.01*I2 A	*	*
If "I> Status" is enabled, pick-up setting for neutral overcurrent confirmation						
45	06	Internal Trip			*	*
45	07	CB Fail Timer 1	50ms	From 0s to 10s step 5ms	*	*
Setting for the circuit breaker fail timer stage 1 (retrip) for internal initiation.						
45	08	CB Fail Timer 2	200ms	From 0s to 10s step 5ms	*	*
Setting for the circuit breaker fail timer stage 2 (backtrip) for internal initiation. Must be at least 40ms greater than CB Fail 1 Timer						
45	09	External Trip			*	*
45	0A	CB Fail Timer 3	50ms	From 0s to 10s step 5ms	*	*
Setting for the circuit breaker fail timer stage 1 (retrip) for external initiation.						
45	0B	CB Fail Timer 4	200ms	From 0s to 10s step 5ms	*	*
Setting for the circuit breaker fail timer stage 2 (backtrip) for external initiation. Must be at least 40ms greater than CB Fail 3 Timer						

4.8 CT Supervision (Supervision) (P742/P743)

The CT Supervision (CTS) feature operates on detection of derived zero sequence current.

Col	Row	Menu Text	Default Setting	Available Setting	7 4	7 4
Description						
46	00	GROUP 1: SUPERVISION			*	*
GROUP 1: SUPERVISION						
46	01	VT Status	Disabled	Disabled or Enabled	*	*
Sets Voltage Transformer Supervision (VTS) operation. The relay respond as follows, on operation of any VTS element: VTS set to provide alarm indication only or blocking of voltage dependent protection elements.						
46	02	VT SUPERVISION			*	*
This setting determines the operating time-delay of the element upon detection of a voltage transformer supervision condition.						
46	03	VTS Time Delay	5s	From 1 to 20s step 1s	*	*
46	04	VTS I2 & I0 Inh	0.05*I2 A	From 0 A to 1.0*I2 A step 0.01*I2 A	*	*
46	05	Detect 3P	Disabled	Disabled or Enabled	*	*
46	06	Threshold 3P	30V	From 10V to 70V step 1V	*	*
46	07	Delta I>	0.1*I2 A	From 0.01*I2 A to 5*I2 A step 0.01*I2 A	*	*
46	08	CT SUPERVISION			*	*
46	09	CTS Status	Disabled	Disabled or Enabled	*	*
Sets Current Transformer Supervision (VTS) operation. The relay respond as follows, on operation of any CTS element: CTS set to provide alarm indication only or blocking of current dependent protection elements.						
46	0A	CTS VN< Inhibit	1	From 0.5 to 22 step 0.5	*	*
46	0B	CTS IN> Set	0.1*I2 A	From 0.08*I2 A to 4*I2 A step 0.01*I2 A	*	*
46	0C	CTS Time Delay	200ms	From 0 to 10s step 1s	*	*
46	0D	I0 SUPERVISION			*	*
46	0E	Error Factor Kce	40%	From 1% to 100% step 1%	*	*
Setting for the supervision characteristic for the slope (error coefficient). IMPORTANT The Error Factor KCE setting must not be changed.						
46	0F	Alarm Delay Tce	5s	From 0s to 10s step 100ms	*	*
Setting that determines the operating time-delay of the element upon detection of a current transformer supervision condition.						

Col	Row	Menu Text	Default Setting	Available Setting	7 4	7 4
Description						
46	10	I0 sup. blocking	87BBP & 87BBN	None or 87BBP & 87BBN	*	*
When IN is measured (application with a dedicated measurement CT to measure neutral current), and when discrepancies between measured and derived values are identified, the IO supervision can block the differential busbar protection (87BB — phase and neutral) protection or does not block any protection.						
46	18	CT SUPERVISION			*	*
46	19	CTS Timer Alarm	5s	From 100ms to 10s step 100ms	*	*
Setting that determines the alarm time-delay of the element upon detection of a current transformer supervision condition (current >10% IN present in the CT and difference between the magnitude of the current measured by two phases > 50%).						

5 CONTROL AND SUPPORT SETTINGS

The control and support settings are part of the main menu and are used to configure the global configuration for the relay. It includes submenu settings as shown here.

- Circuit breaker control
- CT & VT ratio settings
- Record control settings
- Measurement settings
- Communications settings
- Commissioning settings
- Opto inputs and control inputs settings
- When present, InterMiCOM communication and configuration settings
- User interface (function keys, control input labels) settings

5.1 System Data

The System Data menu settings vary between products. The options are:

- System Data Menu for Central Unit (P741
- System Data Menu for Peripheral Units (P742/P743

5.1.1 System Data Menu for Central Unit (P741)

This menu provides information for the device and general status of the P741 relay.

Col	Row	Menu Text	Default Setting	Available Setting
Description				
00	00	SYSTEM DATA		
This column contains general system settings				
00	01	Language	English	English , Français, Deutsche, Español, РУССКИЙ
The default language used by the device. Selectable as English, French, German, Spanish and Russian.				
00	04	Description	MiCOM P741	From 32 to 234 step 1
Editable 16-character description of the unit				
00	05	Plant Reference	MiCOM	From 32 to 234 step 1
Plant description: Can be edited				
00	06	Model Number	Model number	<Model number>
Displays the model number. This can not be edited				
00	08	Serial Number	Serial number	<Serial number>
Displays the serial number. This can not be edited.				
00	09	Frequency	50 Hz	50Hz or 60 Hz
Sets the main frequency				
00	0A	Comms Level	2	<conformance level displayed>
Displays the conformance of the relay to the Courier Level 2 comms				
00	0B	Relay Address	6	From 6 to 6 step 1
Sets the first rear port relay address. Build = Courier (Address available via LCD)				
00	0C	Plant Status		Not Settable
Displays the circuit breaker plant status.				
00	0D	Control Status		Not Settable
Not used				

<table>
<tr><th>Col</th><th>Row</th><th>Menu Text</th><th>Default Setting</th><th>Available Setting</th></tr>
<tr><th colspan="5">Description</th></tr>
<tr><td>00</td><td>0E</td><td>Active Group</td><td>1</td><td>Not Settable</td></tr>
<tr><td colspan="5">Displays the active settings group</td></tr>
<tr><td>00</td><td>11</td><td>Software Ref. 1</td><td></td><td><Software Ref. 1></td></tr>
<tr><td colspan="5">Displays the relay software version including protocol and relay model.</td></tr>
<tr><td>00</td><td>12</td><td>Software Ref. 2</td><td></td><td><Software Ref. 2></td></tr>
<tr><td colspan="5">Relay Ethernet card software reference. Visible when Ethernet card fitted.</td></tr>
<tr><td>00</td><td>14</td><td>NIC Platform Ref</td><td></td><td><NIC platform reference></td></tr>
<tr><td colspan="5">Displays the relay NIC platform reference. Visible when Ethernet card fitted.</td></tr>
<tr><td>00</td><td>15</td><td>IEC61850 Edition</td><td>2</td><td>1 or 2</td></tr>
<tr><td colspan="5">Selects IEC 61850 Editions, Edition 1 or Edition 2. This setting can only be changed via HMI and the changes will cause the Ethernet board to reboot.</td></tr>
<tr><td>00</td><td>16</td><td>ETH COMM Mode</td><td>Dual IP</td><td>Dual IP, PRP, HSR</td></tr>
<tr><td colspan="5">Sets the redundancy protocol. This setting can only be changed via the HMI and the changes will cause the Ethernet board to reboot.</td></tr>
<tr><td>00</td><td>20</td><td>Opto I/P Status</td><td></td><td>Not Settable</td></tr>
<tr><td colspan="5">Display the status of the available opto inputs fitted.</td></tr>
<tr><td>00</td><td>21</td><td>Relay O/P Status</td><td></td><td>Not Settable</td></tr>
<tr><td colspan="5">Displays the status of all available output relays fitted. Not Valid if Contacts Blocked.</td></tr>
<tr><td>00</td><td>22</td><td>Alarm Status 1</td><td></td><td>Not Settable</td></tr>
<tr><td colspan="5">Displays the status of the first 32 alarms as a binary string.</td></tr>
<tr><td>00</td><td>40</td><td>Relay O/P Status</td><td></td><td>Not Settable</td></tr>
<tr><td colspan="5">Displays the status of all available output relays fitted. Not Valid if Contacts Blocked.</td></tr>
<tr><td>00</td><td>50</td><td>Alarm Status 1</td><td></td><td>Not Settable</td></tr>
<tr><td colspan="5">Displays the status of the first 32 alarms as a binary string.</td></tr>
<tr><td>00</td><td>51</td><td>Alarm Status 2</td><td></td><td>Not Settable</td></tr>
<tr><td colspan="5">Displays the status of the next 32 alarms as a binary string.</td></tr>
<tr><td>00</td><td>52</td><td>Alarm Status 3</td><td></td><td>Not Settable</td></tr>
<tr><td colspan="5">Displays the status of the next 32 alarms as a binary string.</td></tr>
<tr><td>00</td><td>53</td><td>Usr Alarm Status</td><td></td><td>Not Settable</td></tr>
<tr><td colspan="5">Displays the status of 32 user alarms as a binary string.</td></tr>
<tr><td>00</td><td>D0</td><td>Access Level</td><td>ENGINEER</td><td>Not Settable</td></tr>
<tr><td colspan="5">Display the Role(s) of the current logged in user, if no one logged in, it shall be "NONE".</td></tr>
<tr><td>00</td><td>D3</td><td>New Eng.Level PW</td><td></td><td>ASCII 33 to 122</td></tr>
<tr><td colspan="5">Allows user to change password for EngineerLevel. Visible on UI only.</td></tr>
<tr><td>00</td><td>D4</td><td>New Op.Level PW</td><td></td><td>ASCII 33 to 122</td></tr>
<tr><td colspan="5">Allows user to change password for OperatorLevel. Visible on UI only.</td></tr>
<tr><td>00</td><td>DF</td><td>Security Features</td><td>3</td><td>Not Settable</td></tr>
<tr><td colspan="5">Displays the level of cyber security inmplemented.</td></tr>
<tr><td>00</td><td>E1</td><td>Password</td><td></td><td><Password></td></tr>
<tr><td colspan="5">Used to send encrypted password. Not visible on UI</td></tr>
<tr><td>00</td><td>E5</td><td>Encryption Salt</td><td></td><td><Encryption Salt></td></tr>
<tr><td colspan="5">Random data used with encrypted password. Not visible on UI</td></tr>
<tr><td>00</td><td>F1</td><td>Enter username</td><td></td><td><User Name></td></tr>
<tr><td colspan="5">User selection for login. Not visible on UI</td></tr>
</table>

Col	Row	Menu Text	Default Setting	Available Setting
Description				
00	F2	Number of users	2	Not Settable
Shows the number of users configured within the relays RBAC				
00	F3	New UI pwd		<Second Simple Password>
Hidden cell reserved for second password modification. Not in use currently.				
00	F4	New password		<Encrpted Password>
Allow password change if engineer or operator logged in and CSL0 model. Not visible on UI.				

5.1.2 System Data Menu for Peripheral Units (P742/P743)

Col	Row	Menu Text	Default Setting	Available Setting	7 4	7 4
Description						
00	00	SYSTEM DATA			*	*
This column contains general system settings						
00	01	Language	English	English , Français, Deutsche, Español, РУССКИЙ	*	*
The default language used by the device. Selectable as English, French, German, Spanish and Russian.						
00	04	Description	MiCOM P742/P743	From 32 to 234 step 1	*	*
Editable 16-character description of the unit						
00	05	Plant Reference	MiCOM	From 32 to 234 step 1	*	*
Plant description: Can be edited						
00	06	Model Number	Model number	<Model number>	*	*
Displays the model number. This can not be edited						
00	08	Serial Number	Serial number	<Serial number>	*	*
Displays the serial number. This can not be edited.						
00	09	Frequency	50 Hz	50Hz or 60 Hz	*	*
Sets the main frequency						
00	0A	Comms Level	2	<conformance level displayed>	*	*
Displays the conformance of the relay to the Courier Level 2 comms						
00	0B	Relay Address	7	From 7 to 34 step 1	*	*
Sets the first rear port relay address.						
00	0C	Plant Status		Not Settable	*	*
Displays the circuit breaker plant status.						
00	0D	Control Status		Not Settable	*	*
00	0E	Active Group	1	Not Settable	*	*
Displays the active settings group						
00	10	CB Trip/Close	No Operation	0 = No Operation, 1 = Trip, 2 = Close	*	*
Supports trip and close commands if enabled in the Circuit Breaker Control menu.						
00	11	Software Ref. 1		<Software Ref. 1>	*	*
Displays the relay software version including protocol and relay model.						
00	12	Software Ref. 2		<Software Ref. 2>		*
Relay Ethernet card software reference. Visible when Ethernet card fitted.						

Col	Row	Menu Text	Default Setting	Available Setting	74	74
Description						
00	14	NIC Platform Ref		<NIC platform reference>		*
Displays the relay NIC platform reference. Visible when Ethernet card fitted.						
00	15	IEC61850 Edition	Dual IP	1 or 2		*
Selects IEC 61850 Editions, Edition 1 or Edition 2. This setting can only be changed via HMI and the changes will cause the Ethernet board to reboot.						
00	16	ETH COMM Mode		Dual IP, PRP, HSR		*
Sets the redundancy protocol. This setting can only be changed via the HMI and the changes will cause the Ethernet board to reboot.						
00	20	Opto I/P Status		Not Settable	*	*
Display the status of the available opto inputs fitted.						
00	21	Relay O/P Status		Not Settable	*	*
Displays the status of all available output relays fitted. Not Valid if Contacts Blocked.						
00	22	Alarm Status 1		Not Settable	*	*
Displays the status of the first 32 alarms as a binary string.						
00	40	Relay O/P Status		Not Settable	*	*
Displays the status of all available output relays fitted. Not Valid if Contacts Blocked.						
00	50	Alarm Status 1		Not Settable	*	*
Displays the status of the first 32 alarms as a binary string.						
00	51	Alarm Status 2		Not Settable	*	*
Displays the status of the next 32 alarms as a binary string.						
00	52	Alarm Status 3		Not Settable	*	*
Displays the status of the next 32 alarms as a binary string.						
00	53	Usr Alarm Status		Not Settable	*	*
Displays the status of 32 user alarms as a binary string.						
00	D0	Access Level	ENGINEER	Not Settable	*	*
Display the Role(s) of the current logged in user, if no one logged in, it shall be "NONE".						
00	D3	New Eng.Level PW		ASCII 33 to 122	*	*
Allows user to change password for EngineerLevel. Visible on UI only.						
00	D4	New Op.Level PW		ASCII 33 to 122	*	*
Allows user to change password for OperatorLevel. Visible on UI only.						
00	DF	Security Features	3	Not Settable	*	*
Displays the level of cyber security inmplemented.						
00	E1	Password		<Password>	*	*
Used to send encrypted password. Not visible on UI						
00	E5	Encryption Salt		<Encryption Salt>	*	*
Random data used with encrypted password. Not visible on UI						
00	F1	Enter username		<User Name>	*	*
User selection for login. Not visible on UI						
00	F2	Number of users	2	Not Settable	*	*
Shows the number of users configured within the relays RBAC						
00	F3	New UI pwd		<Second Simple Password>	*	*
Hidden cell reserved for second password modification. Not in use currently.						
00	F4	New password		<Encrpted Password>	*	*
Allow password change if engineer or operator logged in and CSL0 model. Not visible on UI.						

5.2 PU Conf & Status Menu (P741)

In the central unit, an additional configuration column “PU Conf & Status” is present to configure the hardware to the software topology.

Col	Row	Menu Text	Default Setting	Available Setting
Description				
06	00	PU CONF & STATUS		
This column contains PU configuration				
06	01	PU in service	0000000000000000000000000000(bin)	Bit 0000000=PU Address 34 to Bit FFFFFFF=PU Address 07
Displays PU declared in use				
06	02	PU connected		Not Settable
Displays connected PU status				
06	03	PU topo valid		Not Settable
Displays PU whose topology parameters are valid				
06	04	Reset Circt Flt	No	No or Yes
Reset command after wiring fault				
06	05	Circuitry Fault		Not Settable
Displays wiring failure by zone				
06	06	Circ Fault Phase		Not Settable
Displays wiring failure per phase				
06	07	Reset PU Error	No	No or Yes
Reset command after block error				
06	08	PU Error Block		Not Settable
Displays blocking after com error by zone				
06	09	87BB monitoring		Not Settable
Displays 87BB status				
06	0A	87BB&50BF disabl		Not Settable
Displays 87BB&50BF disabled status				

5.3 Date and Time Menu

Display the date and time as well as the battery condition.

The Date and Time menu settings vary between products. The options are:

- Date and Time Menu (P741)
- Date and Time Menu (P742/P743)

5.3.1 Date and Time Menu (P741)

Col	Row	Menu Text	Default Setting	Available Setting
Description				
08	00	DATE AND TIME		
This column contains Date and Time settings				
08	01	Date/Time		Not Settable
Displays the IED's current date and time.				
08	04	IRIG-B Sync	Disabled	0 = Disabled or 1 = Enabled
Enable IRIG-B time synchronization.				
08	05	IRIG-B Status		Not Settable
Displays the status of IRIG-B				
08	06	Battery Status		Not Settable
Displays whether the battery is healthy or not				
08	07	Battery Alarm	Enabled	0 = Disabled or 1 = Enabled
Enables or disables battery alarm. The battery alarm needs to be disabled when a battery is removed or not used				
08	13	SNTP Status		Not Settable
IEC61850 or DNP3.0 over Ethernet versions only. Displays information about the SNTP time synchronization status				
08	20	LocalTime Enable	Fixed	0 = Disabled, 1 = Fixed or 2 = Flexible
Setting to turn on/off local time adjustments. Disabled - No local time zone will be maintained. Time synchronization from any interface will be used to directly set the master clock and all displayed (or read) times on all interfaces will be based on the master clock with no adjustment. Fixed - A local time zone adjustment can be defined using the LocalTime offset setting and all interfaces will use local time except SNTP time synchronization and IEC 61850 timestamps. Flexible - A local time zone adjustment can be defined using the LocalTime offset setting and each interface can be assigned to the UTC zone or local time zone with the exception of the local interfaces which will always be in the local time zone and IEC 61850/SNTP which will always be in the UTC zone.				
08	21	LocalTime Offset	0min	From -720min to 720min step 15min
Setting to specify an offset of -12 to +12 hrs in 15 minute intervals for local time zone. This adjustment is applied to the time based on the master clock which is UTC/GMT				
08	22	DST Enable	Enabled	0 = Disabled or 1 = Enabled
Setting to turn on/off daylight saving time adjustment to local time.				
08	23	DST Offset	60min	From 30min to 60min step 30min
Setting to specify daylight saving offset which will be used for the time adjustment to local time.				
08	24	DST Start	Last	0 = First, 1 = Second, 2 = Third, 3 = Fourth or 4 = Last
Setting to specify the week of the month in which daylight saving time adjustment starts				
08	25	DST Start Day	Sunday	0 = Sunday, 1 = Monday, 2 = Tuesday, 3 = Wednesday, 4 = Thursday, 5 = Friday or 6 = Saturday
Setting to specify the day of the week in which daylight saving time adjustment starts				

Col	Row	Menu Text	Default Setting	Available Setting
Description				
08	26	DST Start Month	March	0 = January, 1 = February, 2 = March, 3 = April, 4 = May, 5 = June, 6 = July, 7 = August, 8 = September, 9 = October, 10 = November or 11 = December
Setting to specify the month in which daylight saving time adjustment starts				
08	27	DST Start Mins	60min	From 0min to 1425min step 15min
Setting to specify the time of day in which daylight saving time adjustment starts. This is set relative to 00:00 hrs on the selected day when time adjustment is to start				
08	28	DST End	Last	0 = First, 1 = Second, 2 = Third, 3 = Fourth or 4 = Last
Setting to specify the week of the month in which daylight saving time adjustment ends				
08	29	DST End Day	Sunday	0 = Sunday, 1 = Monday, 2 = Tuesday, 3 = Wednesday, 4 = Thursday, 5 = Friday or 6 = Saturday
Setting to specify the day of the week in which daylight saving time adjustment ends				
08	2A	DST End Month	October	0 = January, 1 = February, 2 = March, 3 = April, 4 = May, 5 = June, 6 = July, 7 = August, 8 = September, 9 = October, 10 = November or 11 = December
Setting to specify the month in which daylight saving time adjustment ends				
08	2B	DST End Mins	60min	From 0min to 1425min step 15min
Setting to specify the time of day in which daylight saving time adjustment ends. This is set relative to 00:00 hrs on the selected day when time adjustment is to end				
08	30	RP1 Time Zone	Local	0 = UTC or 1 = Local
Setting for the rear port 1 interface to specify if time synchronization received will be local or universal time co-ordinated				
08	31	RP2 Time Zone	Local	0 = UTC or 1 = Local
Setting for the rear port 2 interface to specify if time synchronization received will be local or universal time co-ordinated				
08	32	DNPOE Time Zone	Local	0 = UTC or 1 = Local
IEC61850+DNP3oE versions only. Setting to specify if time synchronisation received will be local or universal time co-ordinated.				
08	33	Tunnel Time Zone	Local	0 = UTC or 1 = Local
Ethernet versions only for tunnelled courier. Setting to specify if time synchronization received will be local or universal time co-ordinated				

5.3.2 Date and Time Menu (P742/P743)

Col	Row	Menu Text	Default Setting	Available Setting	[illegible]	[illegible]
Description						
08	00	DATE AND TIME			*	*
This column contains Date and Time settings						
08	01	Date/Time		Not Settable	*	*
Displays the IED’s current date and time.						
08	02	Date		<Date>	*	*
Front Panel Menu only						
08	03	Time		<Time>	*	*
Front Panel Menu only						
08	06	Battery Status		Not Settable	*	*
Displays whether the battery is healthy or not						
08	07	Battery Alarm	Enabled	0 = Disabled or 1 = Enabled	*	*
Enables or disables battery alarm. The battery alarm needs to be disabled when a battery is removed or not used						

Col	Row	Menu Text	Default Setting	Available Setting	[illegible]	[illegible]
Description						
08	13	SNTP Status		Not Settable	*	*
IEC61850 or DNP3.0 over Ethernet versions only. Displays information about the SNTP time synchronization status						
08	20	LocalTime Enable	Fixed	0 = Disabled, 1 = Fixed or 2 = Flexible	*	*
Setting to turn on/off local time adjustments. Disabled - No local time zone will be maintained. Time synchronization from any interface will be used to directly set the master clock and all displayed (or read) times on all interfaces will be based on the master clock with no adjustment. Fixed - A local time zone adjustment can be defined using the LocalTime offset setting and all interfaces will use local time except SNTP time synchronization and IEC 61850 timestamps. Flexible - A local time zone adjustment can be defined using the LocalTime offset setting and each interface can be assigned to the UTC zone or local time zone with the exception of the local interfaces which will always be in the local time zone and IEC 61850/SNTP which will always be in the UTC zone.						
08	21	LocalTime Offset	0min	From -720min to 720min step 15min	*	*
Setting to specify an offset of -12 to +12 hrs in 15 minute intervals for local time zone. This adjustment is applied to the time based on the master clock which is UTC/GMT						
08	22	DST Enable	Enabled	0 = Disabled or 1 = Enabled	*	*
Setting to turn on/off daylight saving time adjustment to local time.						
08	23	DST Offset	60min	From 30min to 60min step 30min	*	*
Setting to specify daylight saving offset which will be used for the time adjustment to local time.						
08	24	DST Start	Last	0 = First, 1 = Second, 2 = Third, 3 = Fourth or 4 = Last	*	*
Setting to specify the week of the month in which daylight saving time adjustment starts						
08	25	DST Start Day	Sunday	0 = Sunday, 1 = Monday, 2 = Tuesday, 3 = Wednesday, 4 = Thursday, 5 = Friday or 6 = Saturday	*	*
Setting to specify the day of the week in which daylight saving time adjustment starts						
08	26	DST Start Month	March	0 = January, 1 = February, 2 = March, 3 = April, 4 = May, 5 = June, 6 = July, 7 = August, 8 = September, 9 = October, 10 = November or 11 = December	*	*
Setting to specify the month in which daylight saving time adjustment starts						
08	27	DST Start Mins	60min	From 0min to 1425min step 15min	*	*
Setting to specify the time of day in which daylight saving time adjustment starts. This is set relative to 00:00 hrs on the selected day when time adjustment is to start						
08	28	DST End	Last	0 = First, 1 = Second, 2 = Third, 3 = Fourth or 4 = Last	*	*
Setting to specify the week of the month in which daylight saving time adjustment ends						
08	29	DST End Day	Sunday	0 = Sunday, 1 = Monday, 2 = Tuesday, 3 = Wednesday, 4 = Thursday, 5 = Friday or 6 = Saturday	*	*
Setting to specify the day of the week in which daylight saving time adjustment ends						
08	2A	DST End Month	October	0 = January, 1 = February, 2 = March, 3 = April, 4 = May, 5 = June, 6 = July, 7 = August, 8 = September, 9 = October, 10 = November or 11 = December	*	*
Setting to specify the month in which daylight saving time adjustment ends						
08	2B	DST End Mins	60min	From 0min to 1425min step 15min	*	*
Setting to specify the time of day in which daylight saving time adjustment ends. This is set relative to 00:00 hrs on the selected day when time adjustment is to end						
08	30	RP1 Time Zone	Local	0 = UTC or 1 = Local	*	*
Setting for the rear port 1 interface to specify if time synchronization received will be local or universal time co-ordinated						

Col	Row	Menu Text	Default Setting	Available Setting	[illegible]	[illegible]
Description						
08	31	RP2 Time Zone	Local	0 = UTC or 1 = Local	*	*
Setting for the rear port 2 interface to specify if time synchronization received will be local or universal time co-ordinated						
08	32	DNPOE Time Zone	Local	0 = UTC or 1 = Local	*	*
IEC61850+DNP3oE versions only. Setting to specify if time synchronisation received will be local or universal time co-ordinated.						
08	33	Tunnel Time Zone	Local	0 = UTC or 1 = Local	*	*
Ethernet versions only for tunnelled courier. Setting to specify if time synchronization received will be local or universal time co-ordinated						

5.4 Circuit Breaker Control (P742/P743)

The IED/relay includes the following options for control of a single circuit breaker:

- Local tripping and closing, via the relay menu or hotkeys
- Local tripping and closing, via relay opto-isolated inputs
- Remote tripping and closing, using the relay communications

Col	Row	Menu Text	Default Setting	Available Setting	7 4	7 4
Description						
07	00	CB CONTROL			*	*
This column controls the circuit Breaker Control configuration						
07	01	Prot Trip Pulse	200ms	From 50ms to 5s step 10ms	*	*
Protection trip pulse time						
07	02	Trip Latched	Disabled	Disabled or Enabled	*	*
To hold relay closed after trip						
07	03	Reset Trip Latch	No	0=No, 1=Yes	*	*
Cde to reset upholding						
07	04	CB Control by	Disabled	0=Disabled 1=Local 2=Remote 3=Local+Remote 4=Opto 5=Opto+Local 6=Opto+Remote 7=Opto+Rem+Local	*	*
Selects the type of circuit breaker control to be used						
07	05	Man Close Pulse	500ms	From 100ms to 5s step 100ms	*	*
Defines the duration of the close pulse within which CB should close when close command is issued. If CB fails to close after elapse of this time, CB close fail alarm is set.						
07	06	Man Trip Pulse	500ms	From 100ms to 5s step 100ms	*	*
Defines the duration of the trip pulse within which CB should trip when manual or protection trip command is issued. If CB does not trip within set Trip Pulse Time, CB failed to trip alarm is set.						
07	07	Man Close Delay	10s	From 0s to 60s step 1s	*	*
This defines the delay time before the close pulse is executed.						
07	11	87BB Trip Delay	0s	From 0ms to 400ms step 5ms	*	*
This defines the delay time before 87BB trip.						
07	12	CB Superv Timer	150ms	From 10ms to 400ms step 5ms	*	*
This defines the CB supervise time.						

5.5 CT and VT Ratios (P742/P743)

This column is visible when the “CT & VT ratios” setting (“Configuration” column) = “visible”.

Col	Row	Menu Text	Default Setting	Available Setting	7 4	7 4
Description						
0A	00	CT AND VT RATIOS			*	*
This column contains settings for Current and Voltage Transformer ratios						
0A	01	Main VT Primary	110V	From 100V to 1MV step 1V	*	*
Sets the main voltage transformer input primary voltage. Label V1=VT Primary Rating						
0A	02	Main VT Sec'y	110V	From 80V to 140V step 1V	*	*
Sets the main voltage transformer input secondary voltage. Label V2=VT Secondary Rating, Multiplier M1=[0A01]/[0A02]						
0A	07	Phase CT Primary	1000A	From 1A to 30kA step 1A	*	*
Sets the phase current transformer input primary current rating. Label I2=Phase CT Primary Rating						
0A	08	Phase CT Sec'y	1A	From 1A to 5A step 4A	*	*
Sets the phase current transformer input secondary current rating. Label I2=Phase CT Secondary Rating, Multiplier M2=[0A07]/[0A08]						
0A	21	RBPh / RBN	1	From 0.5 to 10 step 0.1	*	*
Sets the blocking duration						
0A	22	Sec'y Time Cst	1000s	From 100s to 10000s step 100s	*	*
Sets the second time constant						
0A	23	Power Parameters			*	*
Set power parameters in the following settings						
0A	24	Standard Input	British Standard	British Standard or IEC	*	*
Sets the input type to British Standard or IEC						
0A	25	Knee Voltage Vk	250V	From 20V to 5000V step 1V	*	*
Sets knee voltage						
0A	26	Rated Burden VA	25VA	From 5VA to 200VA step 5VA	*	*
Sets the rated burden in apparent power						
0A	27	Rated Burden Ohm		Not Settable	*	*
Displays the rated burden in impedance						
0A	28	KSCC	10	From 10 to 50 step 5	*	*
0A	29	RCT Sec'y	0.5Ω	From 0.1Ω to 50Ω step 0.01Ω	*	*
Sets the secondary RCT parameter						
0A	2B	Eff. Burden Ohm	1Ω	From 0.1Ω to 200Ω step 0.01Ω	*	*
Sets the effective burden in impedance						
0A	2C	Eff. Burden VA		Not Settable	*	*
Displays the effective burden in apparent power						

5.6 Record Control

The Record Control menu settings vary between products. The options are:

- Record Control (P741)
- Record Control (P742/P743)

5.6.1 Record Control (P741)

It is possible to disable the reporting of events from all interfaces that support setting changes. The settings that control the various types of events are in the Record Control column. The effect of setting each to disabled is as follows:

This column is visible when the “Record Control” setting (“Configuration” column) = “visible”.

Col	Row	Menu Text	Default Setting	Available Setting
Description				
0B	00	RECORD CONTROL		
This column contains settings for Record Controls				
0B	01	Clear Events	No	0 = No or 1 = Yes
Selecting “Yes” will cause the existing event log to be cleared and an event will be generated indicating that the events have been erased.				
0B	02	Clear Faults	No	0 = No or 1 = Yes
Selecting “Yes” will cause the existing fault records to be erased from the relay.				
0B	03	Clear Maint	No	0 = No or 1 = Yes
Selecting “Yes” will cause the existing maintenance records to be erased from the relay.				
0B	04	Alarm Event	Enabled	0 = Disabled or 1 = Enabled
Disabling this setting means that no event is generated for alarms				
0B	05	Relay O/P Event	Enabled	0 = Disabled or 1 = Enabled
Disabling this setting means that no event will be generated for any change in logic output state.				
0B	06	Opto Input Event	Enabled	0 = Disabled or 1 = Enabled
Disabling this setting means that no event will be generated for any change in logic input state.				
0B	07	General Event	Enabled	0 = Disabled or 1 = Enabled
Disabling this setting means that no General Events are generated				
0B	08	Fault Rec Event	Enabled	0 = Disabled or 1 = Enabled
Disabling this setting means that no event will be generated for any fault that produces a fault record				
0B	09	Maint Rec Event	Enabled	0 = Disabled or 1 = Enabled
Disabling this setting means that no event will be generated for any occurrence that produces a maintenance record.				
0B	0A	Protection Event	Enabled	0 = Disabled or 1 = Enabled
Disabling this setting means that any operation of protection elements will not be logged as an event				
0B	30	Clear Dist Recs	No	0 = No or 1 = Yes
Selecting “Yes” will cause the existing disturbance records to be cleared and an event will be generated indicating that the disturbance records have been erased.				
0B	31	Security Event	Enabled	0 = Disabled or 1 = Enabled
Disabling this setting means that any operation of security elements will not be logged as an event				
0B	40	DDB element 31 - 0	11111111111111111111111111111111(bin)	32-bit binary setting: 1 = event recording Enabled, 0 = event recording Disabled

Col	Row	Menu Text	Default Setting	Available Setting
Description				
Choses whether any individual DDB's should be deselected as a stored event, by setting the relevant bit to 0 (zero). Typically used for repetitive recurrent changes such as an Opto input assigned for Minute Pulse clock synchronizing.				
0B	41	DDB element 63 - 32	11111111111111111111111111111111(bin)	32-bit binary setting: 1 = event recording Enabled, 0 = event recording Disabled
Chooses whether any individual DDB's should be deselected as a stored event, by setting the relevant bit to 0 (zero). Typically used for repetitive recurrent changes such as an Opto input assigned for Minute Pulse clock synchronizing.				
0B	42	DDB element 95 - 64	11111111111111111111111111111111(bin)	32-bit binary setting: 1 = event recording Enabled, 0 = event recording Disabled
Chooses whether any individual DDB's should be deselected as a stored event, by setting the relevant bit to 0 (zero). Typically used for repetitive recurrent changes such as an Opto input assigned for Minute Pulse clock synchronizing.				
0B	43	DDB element 127 - 96	11111111111111111111111111111111(bin)	32-bit binary setting: 1 = event recording Enabled, 0 = event recording Disabled
Chooses whether any individual DDB's should be deselected as a stored event, by setting the relevant bit to 0 (zero). Typically used for repetitive recurrent changes such as an Opto input assigned for Minute Pulse clock synchronizing.				
0B	44	DDB element 159 - 128	11111111111111111111111111111111(bin)	32-bit binary setting: 1 = event recording Enabled, 0 = event recording Disabled
Chooses whether any individual DDB's should be deselected as a stored event, by setting the relevant bit to 0 (zero). Typically used for repetitive recurrent changes such as an Opto input assigned for Minute Pulse clock synchronizing.				
0B	45	DDB element 191 - 160	11111111111111111111111111111111(bin)	32-bit binary setting: 1 = event recording Enabled, 0 = event recording Disabled
Chooses whether any individual DDB's should be deselected as a stored event, by setting the relevant bit to 0 (zero). Typically used for repetitive recurrent changes such as an Opto input assigned for Minute Pulse clock synchronizing.				
0B	46	DDB element 223 - 192	11111111111111111111111111111111(bin)	32-bit binary setting: 1 = event recording Enabled, 0 = event recording Disabled
Chooses whether any individual DDB's should be deselected as a stored event, by setting the relevant bit to 0 (zero). Typically used for repetitive recurrent changes such as an Opto input assigned for Minute Pulse clock synchronizing.				
0B	47	DDB element 255 - 224	11111111111111111111111111111111(bin)	32-bit binary setting: 1 = event recording Enabled, 0 = event recording Disabled
Chooses whether any individual DDB's should be deselected as a stored event, by setting the relevant bit to 0 (zero). Typically used for repetitive recurrent changes such as an Opto input assigned for Minute Pulse clock synchronizing.				
0B	48	DDB element 287 - 256	11111111111111111111111111111111(bin)	32-bit binary setting: 1 = event recording Enabled, 0 = event recording Disabled
Chooses whether any individual DDB's should be deselected as a stored event, by setting the relevant bit to 0 (zero). Typically used for repetitive recurrent changes such as an Opto input assigned for Minute Pulse clock synchronizing.				
0B	49	DDB element 319 - 288	11111111111111111111111111111111(bin)	32-bit binary setting: 1 = event recording Enabled, 0 = event recording Disabled
Chooses whether any individual DDB's should be deselected as a stored event, by setting the relevant bit to 0 (zero). Typically used for repetitive recurrent changes such as an Opto input assigned for Minute Pulse clock synchronizing.				
0B	4A	DDB element 351 - 320	11111111111111111111111111111111(bin)	32-bit binary setting: 1 = event recording Enabled, 0 = event recording Disabled
Chooses whether any individual DDB's should be deselected as a stored event, by setting the relevant bit to 0 (zero). Typically used for repetitive recurrent changes such as an Opto input assigned for Minute Pulse clock synchronizing.				
0B	4B	DDB element 383 - 352	11111111111111111111111111111111(bin)	32-bit binary setting: 1 = event recording Enabled, 0 = event recording Disabled
Chooses whether any individual DDB's should be deselected as a stored event, by setting the relevant bit to 0 (zero). Typically used for repetitive recurrent changes such as an Opto input assigned for Minute Pulse clock synchronizing.				
0B	4C	DDB element 415 - 384	11111111111111111111111111111111(bin)	32-bit binary setting: 1 = event recording Enabled, 0 = event recording Disabled
Chooses whether any individual DDB's should be deselected as a stored event, by setting the relevant bit to 0 (zero). Typically used for repetitive recurrent changes such as an Opto input assigned for Minute Pulse clock synchronizing.				

<table>
<tr><th>Col</th><th>Row</th><th>Menu Text</th><th>Default Setting</th><th>Available Setting</th></tr>
<tr><th colspan="5">Description</th></tr>
<tr><td>0B</td><td>4D</td><td>DDB element 447 - 415</td><td>11111111111111111111111111111111(bin)</td><td>32-bit binary setting: 1 = event recording Enabled, 0 = event recording Disabled</td></tr>
<tr><td colspan="5">Chooses whether any individual DDB's should be deselected as a stored event, by setting the relevant bit to 0 (zero). Typically used for repetitive recurrent changes such as an Opto input assigned for Minute Pulse clock synchronizing.</td></tr>
<tr><td>0B</td><td>4E</td><td>DDB element 479 - 448</td><td>11111111111111111111111111111111(bin)</td><td>32-bit binary setting: 1 = event recording Enabled, 0 = event recording Disabled</td></tr>
<tr><td colspan="5">Chooses whether any individual DDB's should be deselected as a stored event, by setting the relevant bit to 0 (zero). Typically used for repetitive recurrent changes such as an Opto input assigned for Minute Pulse clock synchronizing.</td></tr>
<tr><td>0B</td><td>4F</td><td>DDB element 511 - 480</td><td>11111111111111111111111111111111(bin)</td><td>32-bit binary setting: 1 = event recording Enabled, 0 = event recording Disabled</td></tr>
<tr><td colspan="5">Chooses whether any individual DDB's should be deselected as a stored event, by setting the relevant bit to 0 (zero). Typically used for repetitive recurrent changes such as an Opto input assigned for Minute Pulse clock synchronizing.</td></tr>
<tr><td>0B</td><td>50</td><td>DDB element 543 - 512</td><td>11111111111111111111111111111111(bin)</td><td>32-bit binary setting: 1 = event recording Enabled, 0 = event recording Disabled</td></tr>
<tr><td colspan="5">Chooses whether any individual DDB's should be deselected as a stored event, by setting the relevant bit to 0 (zero). Typically used for repetitive recurrent changes such as an Opto input assigned for Minute Pulse clock synchronizing.</td></tr>
<tr><td>0B</td><td>51</td><td>DDB element 575 - 544</td><td>11111111111111111111111111111111(bin)</td><td>32-bit binary setting: 1 = event recording Enabled, 0 = event recording Disabled</td></tr>
<tr><td colspan="5">Chooses whether any individual DDB's should be deselected as a stored event, by setting the relevant bit to 0 (zero). Typically used for repetitive recurrent changes such as an Opto input assigned for Minute Pulse clock synchronizing.</td></tr>
<tr><td>0B</td><td>52</td><td>DDB element 607 - 575</td><td>11111111111111111111111111111111(bin)</td><td>32-bit binary setting: 1 = event recording Enabled, 0 = event recording Disabled</td></tr>
<tr><td colspan="5">Chooses whether any individual DDB's should be deselected as a stored event, by setting the relevant bit to 0 (zero). Typically used for repetitive recurrent changes such as an Opto input assigned for Minute Pulse clock synchronizing.</td></tr>
<tr><td>0B</td><td>53</td><td>DDB element 639 - 608</td><td>11111111111111111111111111111111(bin)</td><td>32-bit binary setting: 1 = event recording Enabled, 0 = event recording Disabled</td></tr>
<tr><td colspan="5">Chooses whether any individual DDB's should be deselected as a stored event, by setting the relevant bit to 0 (zero). Typically used for repetitive recurrent changes such as an Opto input assigned for Minute Pulse clock synchronizing.</td></tr>
<tr><td>0B</td><td>54</td><td>DDB element 671 - 640</td><td>11111111111111111111111111111111(bin)</td><td>32-bit binary setting: 1 = event recording Enabled, 0 = event recording Disabled</td></tr>
<tr><td colspan="5">Chooses whether any individual DDB's should be deselected as a stored event, by setting the relevant bit to 0 (zero). Typically used for repetitive recurrent changes such as an Opto input assigned for Minute Pulse clock synchronizing.</td></tr>
<tr><td>0B</td><td>55</td><td>DDB element 703 - 672</td><td>11111111111111111111111111111111(bin)</td><td>32-bit binary setting: 1 = event recording Enabled, 0 = event recording Disabled</td></tr>
<tr><td colspan="5">Chooses whether any individual DDB's should be deselected as a stored event, by setting the relevant bit to 0 (zero). Typically used for repetitive recurrent changes such as an Opto input assigned for Minute Pulse clock synchronizing.</td></tr>
<tr><td>0B</td><td>56</td><td>DDB element 735 - 704</td><td>11111111111111111111111111111111(bin)</td><td>32-bit binary setting: 1 = event recording Enabled, 0 = event recording Disabled</td></tr>
<tr><td colspan="5">Chooses whether any individual DDB's should be deselected as a stored event, by setting the relevant bit to 0 (zero). Typically used for repetitive recurrent changes such as an Opto input assigned for Minute Pulse clock synchronizing.</td></tr>
<tr><td>0B</td><td>57</td><td>DDB element 767 - 736</td><td>11111111111111111111111111111111(bin)</td><td>32-bit binary setting: 1 = event recording Enabled, 0 = event recording Disabled</td></tr>
<tr><td colspan="5">Chooses whether any individual DDB's should be deselected as a stored event, by setting the relevant bit to 0 (zero). Typically used for repetitive recurrent changes such as an Opto input assigned for Minute Pulse clock synchronizing.</td></tr>
<tr><td>0B</td><td>58</td><td>DDB element 799 - 768</td><td>11111111111111111111111111111111(bin)</td><td>32-bit binary setting: 1 = event recording Enabled, 0 = event recording Disabled</td></tr>
<tr><td colspan="5">Chooses whether any individual DDB's should be deselected as a stored event, by setting the relevant bit to 0 (zero). Typically used for repetitive recurrent changes such as an Opto input assigned for Minute Pulse clock synchronizing.</td></tr>
<tr><td>0B</td><td>59</td><td>DDB element 831 - 800</td><td>11111111111111111111111111111111(bin)</td><td>32-bit binary setting: 1 = event recording Enabled, 0 = event recording Disabled</td></tr>
</table>

Col	Row	Menu Text	Default Setting	Available Setting
Description				
Choose whether any individual DDB's should be deselected as a stored event, by setting the relevant bit to 0 (zero). Typically used for repetitive recurrent changes such as an Opto input assigned for Minute Pulse clock synchronizing.				
0B	5A	DDB element 863 - 832	11111111111111111111111111111111(bin)	32-bit binary setting: 1 = event recording Enabled, 0 = event recording Disabled
Choose whether any individual DDB's should be deselected as a stored event, by setting the relevant bit to 0 (zero). Typically used for repetitive recurrent changes such as an Opto input assigned for Minute Pulse clock synchronizing.				
0B	5B	DDB element 895 - 864	11111111111111111111111111111111(bin)	32-bit binary setting: 1 = event recording Enabled, 0 = event recording Disabled
Choose whether any individual DDB's should be deselected as a stored event, by setting the relevant bit to 0 (zero). Typically used for repetitive recurrent changes such as an Opto input assigned for Minute Pulse clock synchronizing.				
0B	5C	DDB element 927 - 896	11111111111111111111111111111111(bin)	32-bit binary setting: 1 = event recording Enabled, 0 = event recording Disabled
Choose whether any individual DDB's should be deselected as a stored event, by setting the relevant bit to 0 (zero). Typically used for repetitive recurrent changes such as an Opto input assigned for Minute Pulse clock synchronizing.				
0B	5D	DDB element 959 - 928	11111111111111111111111111111111(bin)	32-bit binary setting: 1 = event recording Enabled, 0 = event recording Disabled
Choose whether any individual DDB's should be deselected as a stored event, by setting the relevant bit to 0 (zero). Typically used for repetitive recurrent changes such as an Opto input assigned for Minute Pulse clock synchronizing.				
0B	5E	DDB element 991 - 960	11111111111111111111111111111111(bin)	32-bit binary setting: 1 = event recording Enabled, 0 = event recording Disabled
Choose whether any individual DDB's should be deselected as a stored event, by setting the relevant bit to 0 (zero). Typically used for repetitive recurrent changes such as an Opto input assigned for Minute Pulse clock synchronizing.				
0B	5F	DDB element 1023 - 992	11111111111111111111111111111111(bin)	32-bit binary setting: 1 = event recording Enabled, 0 = event recording Disabled
Choose whether any individual DDB's should be deselected as a stored event, by setting the relevant bit to 0 (zero). Typically used for repetitive recurrent changes such as an Opto input assigned for Minute Pulse clock synchronizing.				
0B	60	DDB element 1055 - 1024	11111111111111111111111111111111(bin)	32-bit binary setting: 1 = event recording Enabled, 0 = event recording Disabled
Choose whether any individual DDB's should be deselected as a stored event, by setting the relevant bit to 0 (zero). Typically used for repetitive recurrent changes such as an Opto input assigned for Minute Pulse clock synchronizing.				
0B	61	DDB element 1087 - 1056	11111111111111111111111111111111(bin)	32-bit binary setting: 1 = event recording Enabled, 0 = event recording Disabled
Choose whether any individual DDB's should be deselected as a stored event, by setting the relevant bit to 0 (zero). Typically used for repetitive recurrent changes such as an Opto input assigned for Minute Pulse clock synchronizing.				
0B	62	DDB element 1119 - 1088	11111111111111111111111111111111(bin)	32-bit binary setting: 1 = event recording Enabled, 0 = event recording Disabled
Choose whether any individual DDB's should be deselected as a stored event, by setting the relevant bit to 0 (zero). Typically used for repetitive recurrent changes such as an Opto input assigned for Minute Pulse clock synchronizing.				
0B	63	DDB element 1151 - 1120	11111111111111111111111111111111(bin)	32-bit binary setting: 1 = event recording Enabled, 0 = event recording Disabled
Choose whether any individual DDB's should be deselected as a stored event, by setting the relevant bit to 0 (zero). Typically used for repetitive recurrent changes such as an Opto input assigned for Minute Pulse clock synchronizing.				
0B	64	DDB element 1183 - 1152	11111111111111111111111111111111(bin)	32-bit binary setting: 1 = event recording Enabled, 0 = event recording Disabled
Choose whether any individual DDB's should be deselected as a stored event, by setting the relevant bit to 0 (zero). Typically used for repetitive recurrent changes such as an Opto input assigned for Minute Pulse clock synchronizing.				
0B	65	DDB element 1215 - 1184	11111111111111111111111111111111(bin)	32-bit binary setting: 1 = event recording Enabled, 0 = event recording Disabled
Choose whether any individual DDB's should be deselected as a stored event, by setting the relevant bit to 0 (zero). Typically used for repetitive recurrent changes such as an Opto input assigned for Minute Pulse clock synchronizing.				

Col	Row	Menu Text	Default Setting	Available Setting
Description				
0B	66	DDB element 1247 - 1216	11111111111111111111111111111111(bin)	32-bit binary setting: 1 = event recording Enabled, 0 = event recording Disabled
Chooses whether any individual DDB's should be deselected as a stored event, by setting the relevant bit to 0 (zero). Typically used for repetitive recurrent changes such as an Opto input assigned for Minute Pulse clock synchronizing.				
0B	67	DDB element 1279 - 1248	11111111111111111111111111111111(bin)	32-bit binary setting: 1 = event recording Enabled, 0 = event recording Disabled
Chooses whether any individual DDB's should be deselected as a stored event, by setting the relevant bit to 0 (zero). Typically used for repetitive recurrent changes such as an Opto input assigned for Minute Pulse clock synchronizing.				
0B	68	DDB element 1311 - 1280	11111111111111111111111111111111(bin)	32-bit binary setting: 1 = event recording Enabled, 0 = event recording Disabled
Chooses whether any individual DDB's should be deselected as a stored event, by setting the relevant bit to 0 (zero). Typically used for repetitive recurrent changes such as an Opto input assigned for Minute Pulse clock synchronizing.				
0B	69	DDB element 1343 - 1312	11111111111111111111111111111111(bin)	32-bit binary setting: 1 = event recording Enabled, 0 = event recording Disabled
Chooses whether any individual DDB's should be deselected as a stored event, by setting the relevant bit to 0 (zero). Typically used for repetitive recurrent changes such as an Opto input assigned for Minute Pulse clock synchronizing.				
0B	6A	DDB element 1375 - 1344	11111111111111111111111111111111(bin)	32-bit binary setting: 1 = event recording Enabled, 0 = event recording Disabled
Chooses whether any individual DDB's should be deselected as a stored event, by setting the relevant bit to 0 (zero). Typically used for repetitive recurrent changes such as an Opto input assigned for Minute Pulse clock synchronizing.				
0B	6B	DDB element 1407 - 1376	11111111111111111111111111111111(bin)	32-bit binary setting: 1 = event recording Enabled, 0 = event recording Disabled
Chooses whether any individual DDB's should be deselected as a stored event, by setting the relevant bit to 0 (zero). Typically used for repetitive recurrent changes such as an Opto input assigned for Minute Pulse clock synchronizing.				
0B	6C	DDB element 1439 - 1408	11111111111111111111111111111111(bin)	32-bit binary setting: 1 = event recording Enabled, 0 = event recording Disabled
Chooses whether any individual DDB's should be deselected as a stored event, by setting the relevant bit to 0 (zero). Typically used for repetitive recurrent changes such as an Opto input assigned for Minute Pulse clock synchronizing.				
0B	6D	DDB element 1471 - 1440	11111111111111111111111111111111(bin)	32-bit binary setting: 1 = event recording Enabled, 0 = event recording Disabled
Chooses whether any individual DDB's should be deselected as a stored event, by setting the relevant bit to 0 (zero). Typically used for repetitive recurrent changes such as an Opto input assigned for Minute Pulse clock synchronizing.				
0B	6E	DDB element 1503 - 1472	11111111111111111111111111111111(bin)	32-bit binary setting: 1 = event recording Enabled, 0 = event recording Disabled
Chooses whether any individual DDB's should be deselected as a stored event, by setting the relevant bit to 0 (zero). Typically used for repetitive recurrent changes such as an Opto input assigned for Minute Pulse clock synchronizing.				
0B	6F	DDB element 1535 - 1504	11111111111111111111111111111111(bin)	32-bit binary setting: 1 = event recording Enabled, 0 = event recording Disabled
Chooses whether any individual DDB's should be deselected as a stored event, by setting the relevant bit to 0 (zero). Typically used for repetitive recurrent changes such as an Opto input assigned for Minute Pulse clock synchronizing.				
0B	70	DDB element 1567 - 1536	11111111111111111111111111111111(bin)	32-bit binary setting: 1 = event recording Enabled, 0 = event recording Disabled
Chooses whether any individual DDB's should be deselected as a stored event, by setting the relevant bit to 0 (zero). Typically used for repetitive recurrent changes such as an Opto input assigned for Minute Pulse clock synchronizing.				
0B	71	DDB element 1599 - 1568	11111111111111111111111111111111(bin)	32-bit binary setting: 1 = event recording Enabled, 0 = event recording Disabled
Chooses whether any individual DDB's should be deselected as a stored event, by setting the relevant bit to 0 (zero). Typically used for repetitive recurrent changes such as an Opto input assigned for Minute Pulse clock synchronizing.				
0B	72	DDB element 1631 - 1600	11111111111111111111111111111111(bin)	32-bit binary setting: 1 = event recording Enabled, 0 = event recording Disabled

Col	Row	Menu Text	Default Setting	Available Setting
Description				
Choose whether any individual DDB's should be deselected as a stored event, by setting the relevant bit to 0 (zero). Typically used for repetitive recurrent changes such as an Opto input assigned for Minute Pulse clock synchronizing.				
0B	73	DDB element 1663 - 1632	11111111111111111111111111111111(bin)	32-bit binary setting: 1 = event recording Enabled, 0 = event recording Disabled
Chooses whether any individual DDB's should be deselected as a stored event, by setting the relevant bit to 0 (zero). Typically used for repetitive recurrent changes such as an Opto input assigned for Minute Pulse clock synchronizing.				
0B	74	DDB element 1695 - 1664	11111111111111111111111111111111(bin)	32-bit binary setting: 1 = event recording Enabled, 0 = event recording Disabled
Chooses whether any individual DDB's should be deselected as a stored event, by setting the relevant bit to 0 (zero). Typically used for repetitive recurrent changes such as an Opto input assigned for Minute Pulse clock synchronizing.				
0B	75	DDB element 1727 - 1696	11111111111111111111111111111111(bin)	32-bit binary setting: 1 = event recording Enabled, 0 = event recording Disabled
Chooses whether any individual DDB's should be deselected as a stored event, by setting the relevant bit to 0 (zero). Typically used for repetitive recurrent changes such as an Opto input assigned for Minute Pulse clock synchronizing.				
0B	76	DDB element 1759 - 1728	11111111111111111111111111111111(bin)	32-bit binary setting: 1 = event recording Enabled, 0 = event recording Disabled
Chooses whether any individual DDB's should be deselected as a stored event, by setting the relevant bit to 0 (zero). Typically used for repetitive recurrent changes such as an Opto input assigned for Minute Pulse clock synchronizing.				
0B	77	DDB element 1791 - 1760	11111111111111111111111111111111(bin)	32-bit binary setting: 1 = event recording Enabled, 0 = event recording Disabled
Chooses whether any individual DDB's should be deselected as a stored event, by setting the relevant bit to 0 (zero). Typically used for repetitive recurrent changes such as an Opto input assigned for Minute Pulse clock synchronizing.				
0B	78	DDB element 1823 - 1792	11111111111111111111111111111111(bin)	32-bit binary setting: 1 = event recording Enabled, 0 = event recording Disabled
Chooses whether any individual DDB's should be deselected as a stored event, by setting the relevant bit to 0 (zero). Typically used for repetitive recurrent changes such as an Opto input assigned for Minute Pulse clock synchronizing.				
0B	79	DDB element 1855 - 1824	11111111111111111111111111111111(bin)	32-bit binary setting: 1 = event recording Enabled, 0 = event recording Disabled
Chooses whether any individual DDB's should be deselected as a stored event, by setting the relevant bit to 0 (zero). Typically used for repetitive recurrent changes such as an Opto input assigned for Minute Pulse clock synchronizing.				
0B	7A	DDB element 1887 - 1856	11111111111111111111111111111111(bin)	32-bit binary setting: 1 = event recording Enabled, 0 = event recording Disabled
Chooses whether any individual DDB's should be deselected as a stored event, by setting the relevant bit to 0 (zero). Typically used for repetitive recurrent changes such as an Opto input assigned for Minute Pulse clock synchronizing.				
0B	7B	DDB element 1919 - 1888	11111111111111111111111111111111(bin)	32-bit binary setting: 1 = event recording Enabled, 0 = event recording Disabled
Chooses whether any individual DDB's should be deselected as a stored event, by setting the relevant bit to 0 (zero). Typically used for repetitive recurrent changes such as an Opto input assigned for Minute Pulse clock synchronizing.				
0B	7C	DDB element 1951 - 1920	11111111111111111111111111111111(bin)	32-bit binary setting: 1 = event recording Enabled, 0 = event recording Disabled
Chooses whether any individual DDB's should be deselected as a stored event, by setting the relevant bit to 0 (zero). Typically used for repetitive recurrent changes such as an Opto input assigned for Minute Pulse clock synchronizing.				
0B	7D	DDB element 1983 - 1952	11111111111111111111111111111111(bin)	32-bit binary setting: 1 = event recording Enabled, 0 = event recording Disabled
Chooses whether any individual DDB's should be deselected as a stored event, by setting the relevant bit to 0 (zero). Typically used for repetitive recurrent changes such as an Opto input assigned for Minute Pulse clock synchronizing.				
0B	7E	DDB element 2015 - 1984	11111111111111111111111111111111(bin)	32-bit binary setting: 1 = event recording Enabled, 0 = event recording Disabled
Chooses whether any individual DDB's should be deselected as a stored event, by setting the relevant bit to 0 (zero). Typically used for repetitive recurrent changes such as an Opto input assigned for Minute Pulse clock synchronizing.				

Col	Row	Menu Text	Default Setting	Available Setting
Description				
0B	7F	DDB element 2047 - 2016	11111111111111111111111111111111(bin)	32-bit binary setting: 1 = event recording Enabled, 0 = event recording Disabled
Chooses whether any individual DDB's should be deselected as a stored event, by setting the relevant bit to 0 (zero). Typically used for repetitive recurrent changes such as an Opto input assigned for Minute Pulse clock synchronizing.				

5.6.2 Record Control (P742/P743)

It is possible to disable the reporting of events from all interfaces that support setting changes. The settings that control the various types of events are in the Record Control column. The effect of setting each to disabled is as follows:

This column is visible when the “Record Control” setting (“Configuration” column) = “visible”.

Col	Row	Menu Text	Default Setting	Available Setting	74	74
Description						
0B	00	RECORD CONTROL			*	*
This column contains settings for Record Controls						
0B	04	Alarm Event	Enabled	0 = Disabled or 1 = Enabled		*
Disabling this setting means that no event is generated for alarms						
0B	05	Relay O/P Event	Enabled	0 = Disabled or 1 = Enabled		*
Disabling this setting means that no event will be generated for any change in logic output state.						
0B	06	Opto Input Event	Enabled	0 = Disabled or 1 = Enabled		*
Disabling this setting means that no event will be generated for any change in logic input state.						
0B	07	General Event	Enabled	0 = Disabled or 1 = Enabled		*
Disabling this setting means that no General Events are generated						
0B	08	Fault Rec Event	Enabled	0 = Disabled or 1 = Enabled		*
Disabling this setting means that no event will be generated for any fault that produces a fault record						
0B	09	Maint Rec Event	Enabled	0 = Disabled or 1 = Enabled		*
Disabling this setting means that no event will be generated for any occurrence that produces a maintenance record.						
0B	0A	Protection Event	Enabled	0 = Disabled or 1 = Enabled		*
Disabling this setting means that any operation of protection elements will not be logged as an event						
0B	30	Clear Dist Recs	No	0 = No or 1 = Yes		*
Selecting “Yes” will cause the existing disturbance records to be cleared and an event will be generated indicating that the disturbance records have been erased.						
0B	31	Security Event	Enabled	0 = Disabled or 1 = Enabled		*
Disabling this setting means that any operation of security elements will not be logged as an event						

5.7 Measurements (Measure’t Setup)

This column is visible when the “Measure’t Setup” setting (“Configuration” column) = “visible”.

The Measurements (Measure’t Setup) menu settings vary between products. The options are:

- Measurements (Measure’t Setup) (P741)
- Measurements (Measure’t Setup) (P742/P743)

5.7.1 Measurements (Measure’t Setup) (P741)

Col	Row	Menu Text		Default Setting	Available Setting
			Description		
0D	00	MEASURE'T SETUP			
			This column contains settings for the measurement setup		
0D	01	Default Display		Banner	0 = Banner, 1 = Date and Time, 2 = Description, 3 = PlantReference, 4 = IDiff CZ, 5 = IBias CZ, 6 = Access Level
			This indicates the default display which can only be changed whilst at the default display using the arrow keys for operator or higher level roles. Only visible on UI.		
0D	02	Local Values		Primary	0 = Primary or 1 = Secondary
			Local Measurement Values.This setting controls whether measured values via the front panel user interface and the front courier port are displayed as primary or secondary quantities.		
0D	03	Remote Values		Primary	0 = Primary or 1 = Secondary
			Remote Measurement Values.This setting controls whether measured values via the rear communication port are displayed as primary or secondary quantities.		
0D	04	Ibp Base Cur Pri		1000A	From 1A to 10kA step 1A
0D	0B	Remote2 Values		Primary	0 = Primary or 1 = Secondary
			Remote Measurement Values.This setting controls whether measured values via the rear communication port are displayed as primary or secondary quantities.		

5.7.2 Measurements (Measure’t Setup) (P742/P743)

Col	Row	Menu Text	Default Setting	Available Setting	74	74
Description						
0D	00	MEASURE'T SETUP			*	*
This column contains settings for the measurement setup						
0D	02	Local Values	Secondary	0 = Primary or 1 = Secondary	*	*
Local Measurement Values.This setting controls whether measured values via the front panel user interface and the front courier port are displayed as primary or secondary quantities.						
0D	03	Remote Values	Primary	0 = Primary or 1 = Secondary	*	*
Remote Measurement Values.This setting controls whether measured values via the rear communication port are displayed as primary or secondary quantities.						
0D	0B	Remote2 Values	Primary	0 = Primary or 1 = Secondary	*	*

Col	Row	Menu Text	Default Setting	Available Setting	7 4	7 4
Description						
Remote 2 Measurement Values.This setting controls whether measured values via the rear communication port are displayed as primary or secondary quantities.						

5.8 Communications

The communications settings apply to the rear communications ports only and will depend upon the particular protocol being used. Further details are given in the SCADA Communications chapter.

Depending on the values stored, the available settings may change too. The applicability of each setting is given in the description or available setting cell. These settings are available in the menu '**Communications'** column and are displayed.

These settings potentially cover a variety of different protocols and ports, including:

- Courier Protocol
- Ethernet Port
- Rear Port 2 Connection Settings

The Communications menu settings vary between products. The options are:

- Communications (P741)
- Communications (P742/P743)

5.8.1 Communications (P741)

Col	Row	Menu Text	Default Setting	Available Setting
Description				
0E	00	COMMUNICATIONS		
This column contains general communications settings				
0E	01	RP1 Protocol		Not Settable
Indicates the communications protocol that will be used on the rear communications port.				
0E	02	RP1 Address	6	From 6 to 6 step 1
Rear Port 1 Courier Protocol device address. This cell sets the unique address for the relay such that only one relay is accessed by master station software.				
0E	03	RP1 InactivTimer	15min	From 1min to 30min step 1min
Rear Port 1 Protocol inactivity timer. This cell controls how long the relay will wait without receiving any messages on the rear port before it reverts to its default state, including resetting any password access that was enabled.				
0E	0B	RP1 Card Status		Not Settable
Rear Port 1 Courier Protocol Status. This cell indicates the status of the communication card.				
0E	0C	RP1 Port Config	K-Bus	0 = K-Bus or 1 = EIA485 (RS485)
Rear Port 1 Courier Protocol copper port configuration; K-Bus or EIA485. This cell defines whether an electrical KBus or EIA(RS)485 is being used for communication between the master station and relay.				
0E	0D	RP1 Comms Mode	IEC60870 FT1.2	0 = IEC60870 FT1.2 Frame or 1 = 10-bit no parity
Rear Port 1 Courier Protocol EIA485 mode. The choice is either IEC60870 FT1.2 for normal operation with 11-bit modems, or 10-bit no parity.				
0E	0E	RP1 Baud Rate	19200 bits/s	0 = 9600 bits/s, 1 = 19200 bits/s, 2 = 38400 bits/s
Rear Port 1 Courier Protocol EIA485 bit/baud rate. This cell controls the communication speed between relay and master station. It is important that both relay and master station are set at the same speed setting.				
0E	1F	ETH Protocol		Not Settable
Indicates the protocol used on the Network Interface Card. Visible when Ethernet card fitted				

Col	Row	Menu Text	Default Setting	Available Setting
Description				
0E	22	MAC Addr 1		Not Settable
Shows the MAC address of the 1st Ethernet port. Visible when Ethernet card fitted.				
0E	23	MAC Addr 2		Not Settable
Shows the MAC address of the 2nd Ethernet port. Visible when Ethernet card fitted.				
0E	64	ETH Tunl Timeout	15min	From 1min to 30min step 1min
Duration of time to wait before an inactive tunnel to Easergy Studio is reset. Visible when Ethernet card fitted.				
0E	70	Redundancy Conf	Sub-Heading	
NIOS PARAMETERS. The redundant agency device configuration is used for SNMP server. This does not affect IEC61850 communications. Visible when redundant Ethernet card fitted and Comm Mode=PRP or HSR				
0E	71	MAC Address		Not Settable
MAC address for the NIOS. The redundant agency device configuration is used for SNMP server. This does not affect IEC61850 communications. Visible when redundant Ethernet card fitted and Comm Mode=PRP or HSR				
0E	72	IP Address	000.000.000.000	Not Settable
A default IP address which is encoded from MAC address 169.254.2.zzz, zzz = mod (The last byte of MAC address % 128 + 1) The redundant agency device configuration is used for SNMP server. This does not affect IEC61850 communications. Visible when redundant Ethernet card fitted and Comm Mode=PRP or HSR.				
0E	73	Subnet Mask	000.000.000.000	Not Settable
Subnet Mask for the NIOS. The redundant agency device configuration is used for SNMP server. This does not affect IEC61850 communications. Visible when redundant Ethernet card fitted and Comm Mode=PRP or HSR				
0E	74	Gateway	000.000.000.000	Not Settable
Gateway for the NIOS. The redundant agency device configuration is used for SNMP server. This does not affect IEC61850 communications. Visible when redundant Ethernet card fitted and Comm Mode=PRP or HSR				
0E	80	REAR PORT2 (RP2)		
Visible when Rear Port 2 fitted.				
0E	81	RP2 Protocol	Courier	Not Settable
Rear Port 2 Protocol - "Courier". Indicates the communications protocol that will be used on the rear communications port.				
0E	84	RP2 Card Status		Not Settable
Rear Port 2 Courier Protocol Status				
0E	88	RP2 Port Config	EIA232 (RS232)	0 = EIA232 (RS232), 1 = EIA485 (RS485), 2 = K-Bus
Rear Port 2 Courier Protocol port configuration. This cell defines whether an electrical EIA(RS)232, EIA(RS)485 or KBus is being used for communication.				
0E	8A	RP2 Comms Mode	IEC60870 FT1.2	0 = IEC60870 FT1.2 Frame or 1 = 10-bit no parity
Rear Port 2 Courier Protocol EIA485 mode. The choice is either IEC60870 FT1.2 for normal operation with 11-bit modems, or 10-bit no parity.				
0E	90	RP2 Address	255	From 0 to 255 step 1
Rear Port 2 Courier Protocol device address. This cell sets the unique address for the relay such that only one relay is accessed by master station software.				
0E	92	RP2 InactivTimer	15min	From 1min to 30min step 1min
Rear Port 2 Courier Protocol inactivity timer. This cell controls how long the relay will wait without receiving any messages on the rear port before it reverts to its default state, including resetting any password access that was enabled.				
0E	94	RP2 Baud Rate	19200 bits/s	0=9600 bits/s 1=19200 bits/s
Rear Port 2 Courier Protocol EIA485 bit/baud rate. This cell controls the communication speed between relay and master station. It is important that both relay and master station are set at the same speed setting.				

5.8.2 Communications (P742/P743)

Col	Row	Menu Text	Default Setting	Available Setting	74	74
Description						
0E	00	COMMUNICATIONS			*	*
This column contains general communications settings						
0E	01	RP1 Protocol		Not Settable	*	*
Indicates the communications protocol that will be used on the rear communications port.						
0E	02	RP1 Address	7	From 7 to 34 step 1	*	*
Rear Port 1 Courier Protocol device address. This cell sets the unique address for the relay such that only one relay is accessed by master station software.						
0E	03	RP1 InactivTimer	15min	From 1min to 30min step 1min	*	*
Rear Port 1 Protocol inactivity timer. This cell controls how long the relay will wait without receiving any messages on the rear port before it reverts to its default state, including resetting any password access that was enabled.						
0E	0B	RP1 Card Status		Not Settable	*	*
Rear Port 1 Courier Protocol Status. This cell indicates the status of the communication card.						
0E	0C	RP1 Port Config	K-Bus	0 = K-Bus or 1 = EIA485 (RS485)	*	*
Rear Port 1 Courier Protocol copper port configuration; K-Bus or EIA485. This cell defines whether an electrical KBus or EIA(RS)485 is being used for communication between the master station and relay.						
0E	0D	RP1 Comms Mode	IEC60870 FT1.2	0 = IEC60870 FT1.2 Frame or 1 = 10-bit no parity	*	*
Rear Port 1 Courier Protocol EIA485 mode. The choice is either IEC60870 FT1.2 for normal operation with 11-bit modems, or 10-bit no parity.						
0E	0E	RP1 Baud Rate	19200 bits/s	0 = 9600 bits/s, 1 = 19200 bits/s, 2 = 38400 bits/s	*	*
Rear Port 1 Courier Protocol EIA485 bit/baud rate. This cell controls the communication speed between relay and master station. It is important that both relay and master station are set at the same speed setting.						
0E	1F	ETH Protocol		Not Settable	*	*
Indicates the protocol used on the Network Interface Card. Visible when Ethernet card fitted						
0E	22	MAC Addr 1		Not Settable	*	*
Shows the MAC address of the 1st Ethernet port. Visible when Ethernet card fitted.						
0E	23	MAC Addr 2		Not Settable	*	*
Shows the MAC address of the 2nd Ethernet port. Visible when Ethernet card fitted.						
0E	64	ETH Tunl Timeout	15min	From 1min to 30min step 1min	*	*
Duration of time to wait before an inactive tunnel to Easergy Studio is reset. Visible when Ethernet card fitted.						
0E	70	Redundancy Conf			*	*
NIOS PARAMETERS. The redundant agency device configuration is used for SNMP server. This does not affect IEC61850 communications. Visible when redundant Ethernet card fitted and Comm Mode=PRP or HSR						
0E	71	MAC Address		Not Settable	*	*
MAC address for the NIOS. The redundant agency device configuration is used for SNMP server. This does not affect IEC61850 communications. Visible when redundant Ethernet card fitted and Comm Mode=PRP or HSR						
0E	72	IP Address	000.000.000.000	Not Settable	*	*
A default IP address which is encoded from MAC address 169.254.2.zzz, zzz = mod (The last byte of MAC address % 128 + 1) The redundant agency device configuration is used for SNMP server. This does not affect IEC61850 communications. Visible when redundant Ethernet card fitted and Comm Mode=PRP or HSR.						
0E	73	Subnet Mask	000.000.000.000	Not Settable	*	*

Col	Row	Menu Text	Default Setting	Available Setting	7 4	7 4
Description						
Subnet Mask for the NIOS. The redundant agency device configuration is used for SNMP server. This does not affect IEC61850 communications. Visible when redundant Ethernet card fitted and Comm Mode=PRP or HSR						
0E	74	Gateway	000.000.000.000	Not Settable	*	*
Gateway for the NIOS. The redundant agency device configuration is used for SNMP server. This does not affect IEC61850 communications. Visible when redundant Ethernet card fitted and Comm Mode=PRP or HSR						

5.9 Commissioning Tests

To help minimising the time required to test MiCOM relays the relay provides several test facilities under the 'COMMISSION TESTS' menu heading.

There are menu cells which allow the status of the opto-isolated inputs, output relay contacts, internal Digital Data Bus (DDB) signals and user-programmable LEDs to be monitored. Additionally there are cells to test the operation of the output contacts, user-programmable LEDs.

This column is visible when the "Commission tests" setting ("Configuration" column) = "visible".

The Commissioning Tests menu settings vary between products. The options are:

- Commissioning Tests (P741)
- Commissioning Tests (P742/P743)

5.9.1 Commissioning Tests (P741)

Col	Row	Menu Text	Default Setting	Available Setting
Description				
0F	00	COMMISSION TESTS		
This column contains commissioning test settings				
0F	01	Opto I/P Status		Not Settable
This menu cell displays the status of the available IED's opto-isolated inputs as a binary string, a '1' indicating an energized opto-isolated input and a '0' a de-energized one.				
0F	02	Relay O/P Status		Not Settable
Displays the status of all available output relays fitted. Not Valid if Contacts Blocked.				
0F	03	Test Port Status		Not Settable
This menu cell displays the status of the eight digital data bus (DDB) signals that have been allocated in the 'Monitor Bit' cells.				
0F	05	Monitor Bit 1	Relay Label 01	All DDB Points
The eight 'Monitor Bit' cells allow the user to select the status of which digital data bus signals can be observed in the 'Test Port Status' cell or via the monitor/download port.				
0F	06	Monitor Bit 2	Relay Label 02	All DDB Points
The eight 'Monitor Bit' cells allow the user to select the status of which digital data bus signals can be observed in the 'Test Port Status' cell or via the monitor/download port.				
0F	07	Monitor Bit 3	Relay Label 03	All DDB Points
The eight 'Monitor Bit' cells allow the user to select the status of which digital data bus signals can be observed in the 'Test Port Status' cell or via the monitor/download port.				
0F	08	Monitor Bit 4	Relay Label 04	All DDB Points
The eight 'Monitor Bit' cells allow the user to select the status of which digital data bus signals can be observed in the 'Test Port Status' cell or via the monitor/download port.				
0F	09	Monitor Bit 5	Relay Label 05	All DDB Points
The eight 'Monitor Bit' cells allow the user to select the status of which digital data bus signals can be observed in the 'Test Port Status' cell or via the monitor/download port.				
0F	0A	Monitor Bit 6	Relay Label 06	All DDB Points
The eight 'Monitor Bit' cells allow the user to select the status of which digital data bus signals can be observed in the 'Test Port Status' cell or via the monitor/download port.				

Col	Row	Menu Text	Default Setting	Available Setting
Description				
0F	0B	Monitor Bit 7	Relay Label 07	All DDB Points
The eight ‘Monitor Bit’ cells allow the user to select the status of which digital data bus signals can be observed in the ‘Test Port Status’ cell or via the monitor/download port.				
0F	0C	Monitor Bit 8	Relay Label 08	All DDB Points
The eight ‘Monitor Bit’ cells allow the user to select the status of which digital data bus signals can be observed in the ‘Test Port Status’ cell or via the monitor/download port.				
0F	0D	Test Mode	Disabled	0 = Disabled, 1 = Out of Service
The Test Mode menu cell is used to allow secondary injection testing to be performed on the IED without operation of the trip contacts. It also enables a facility to directly test the output contacts by applying menu controlled test signals. To select test mode the Test Mode menu cell should be set to ‘Test Mode’, which takes the IED out of service . It also causes an alarm condition to be recorded and the yellow ‘Out of Service’ LED to illuminate and an alarm message ‘Prot’n. Disabled’ is given. In IEC 60870-5-103 builds changes the Cause of Transmission, COT, to Test Mode. To enable testing of output contacts the Test Mode cell should be set to Blocked. This blocks the protection from operating the contacts and enables the test pattern and contact test functions which can be used to manually operate the output contacts. This mode also blocks maintenance, counters and freezes any information stored in the Circuit Breaker Condition column. Also in IEC 60870-5-103 builds changes the Cause of Transmission, COT, to Test Mode. Once testing is complete the cell must be set back to ‘Disabled’ to restore the IED back to service. In IEC61850 models using edition 2 mode, selecting Test Mode or Blocked will change the behaviour of all active logical nodes to test. The quality of all data will also indicate test.				
0F	0E	Test Pattern	00000000(bin)	0=Not Operated or 1=Operated
This cell is used to select the output relay contacts that will be tested when the ‘Contact Test’ cell is set to ‘Apply Test’.				
0F	0F	Contact Test	No operation	0 = No operation or 1 = Apply Test
When the ‘Apply Test’ command in this cell is issued the contacts set for operation (set to ‘1’) in the ‘Test Pattern’ cell are energised. After the test has been applied the command text on the LCD will change to ‘No Operation’ and the contacts will remain in the Test State until reset issuing the ‘Remove Test’ command. The command text on the LCD will again revert to ‘No Operation’ after the ‘Remove Test’ command has been issued. Note: When the ‘Test Mode’ cell is set to ‘Contacts Blocked’ the ‘Relay O/P Status’ cell does not show the current status of the output relays and hence can not be used to confirm operation of the output relays. Therefore it will be necessary to physically monitor the state of each contact in turn.				
0F	10	Test LEDs	No operation	0 = No operation or 1 = Apply Test
When the ‘Apply Test’ command in this cell is issued, the eighteen user-programmable LEDs will illuminate for approximately 2 seconds before they extinguish and the command text on the LCD reverts to ‘No Operation’.				
0F	12	87BB monitoring		Not Settable
0F	13	87BB&50BF disabl		Not Settable
0F	14	87BBTrip Pattern		Not Settable
0F	15	87BB Trip Order	No operation	0 = No operation or 1 = Apply Test
0F	16	Red LED Status		Not Settable
This cell is an eighteen bit binary string that indicates which of the user-programmable LEDs on the relay are illuminated with the Red LED input active when accessing the relay from a remote location, a ‘1’ indicating a particular LED is lit and a ‘0’ not lit.				
0F	17	Green LED Status		Not Settable
This cell is an eighteen bit binary string that indicates which of the user-programmable LEDs on the relay are illuminated with the Green LED input active when accessing the relay from a remote location, a ‘1’ indicating a particular LED is lit and a ‘0’ not lit.				
0F	20	DDB 31 - 0		Not Settable
Displays the status of signals DDB 31 - 0				
0F	21	DDB 63 - 32		Not Settable

Col	Row	Menu Text	Default Setting	Available Setting
Description				
Displays the status of signals DDB 63 - 32				
0F	22	DDB 95 - 64		Not Settable
Displays the status of signals DDB 95 - 64				
0F	23	DDB 127 - 96		Not Settable
Displays the status of signals DDB 127 - 96				
0F	24	DDB 159 - 128		Not Settable
Displays the status of signals DDB 159 - 128				
0F	25	DDB 191 - 160		Not Settable
Displays the status of signals DDB 191 - 160				
0F	26	DDB 223 - 192		Not Settable
Displays the status of signals DDB 223 - 192				
0F	27	DDB 255 - 224		Not Settable
Displays the status of signals DDB 255 - 224				
0F	28	DDB 287 - 256		Not Settable
Displays the status of signals DDB 287 - 256				
0F	29	DDB 319 - 288		Not Settable
Displays the status of signals DDB 319 - 288				
0F	2A	DDB 351 - 320		Not Settable
Displays the status of signals DDB 351 - 320				
0F	2B	DDB 383 - 352		Not Settable
Displays the status of signals DDB 383 - 352				
0F	2C	DDB 415 - 384		Not Settable
Displays the status of signals DDB 415 - 384				
0F	2D	DDB 447 - 415		Not Settable
Displays the status of signals DDB 447 - 415				
0F	2E	DDB 479 - 448		Not Settable
Displays the status of signals DDB 479 - 448				
0F	2F	DDB 511 - 480		Not Settable
Displays the status of signals DDB 511 - 480				
0F	30	DDB 543 - 512		Not Settable
Displays the status of signals DDB 543 - 512				
0F	31	DDB 575 - 544		Not Settable
Displays the status of signals DDB 575 - 544				
0F	32	DDB 607 - 575		Not Settable
Displays the status of signals DDB 607 - 575				
0F	33	DDB 639 - 608		Not Settable
Displays the status of signals DDB 639 - 608				
0F	34	DDB 671 - 640		Not Settable
Displays the status of signals DDB 671 - 640				
0F	35	DDB 703 - 672		Not Settable
Displays the status of signals DDB 703 - 672				
0F	36	DDB 735 - 704		Not Settable
Displays the status of signals DDB 735 - 704				

Col	Row	Menu Text	Default Setting	Available Setting
Description				
0F	37	DDB 767 - 736		Not Settable
Displays the status of signals DDB 767 - 736				
0F	38	DDB 799 - 768		Not Settable
Displays the status of signals DDB 799 - 768				
0F	39	DDB 831 - 800		Not Settable
Displays the status of signals DDB 831 - 800				
0F	3A	DDB 863 - 832		Not Settable
Displays the status of signals DDB 863 - 832				
0F	3B	DDB 895 - 864		Not Settable
Displays the status of signals DDB 895 - 864				
0F	3C	DDB 927 - 896		Not Settable
Displays the status of signals DDB 927 - 896				
0F	3D	DDB 959 - 928		Not Settable
Displays the status of signals DDB 959 - 928				
0F	3E	DDB 991 - 960		Not Settable
Displays the status of signals DDB 991 - 960				
0F	3F	DDB 1023 - 992		Not Settable
Displays the status of signals DDB 1023 - 992				
0F	40	DDB 1055 - 1024		Not Settable
Displays the status of signals DDB 1055 - 1024				
0F	41	DDB 1087 - 1056		Not Settable
Displays the status of signals DDB 1087 - 1056				
0F	42	DDB 1119 - 1088		Not Settable
Displays the status of signals DDB 1119 - 1088				
0F	43	DDB 1151 - 1120		Not Settable
Displays the status of signals DDB 1151 - 1120				
0F	44	DDB 1183 - 1152		Not Settable
Displays the status of signals DDB 1183 - 1152				
0F	45	DDB 1215 - 1184		Not Settable
Displays the status of signals DDB 1215 - 1184				
0F	46	DDB 1247 - 1216		Not Settable
Displays the status of signals DDB 1247 - 1216				
0F	47	DDB 1279 - 1248		Not Settable
Displays the status of signals DDB 1279 - 1248				
0F	48	DDB 1311 - 1280		Not Settable
Displays the status of signals DDB 1311 - 1280				
0F	49	DDB 1343 - 1312		Not Settable
Displays the status of signals DDB 1343 - 1312				
0F	4A	DDB 1375 - 1344		Not Settable
Displays the status of signals DDB 1375 - 1344				
0F	4B	DDB 1407 - 1376		Not Settable
Displays the status of signals DDB 1407 - 1376				
0F	4C	DDB 1439 - 1408		Not Settable

Col	Row	Menu Text	Default Setting	Available Setting
Description				
Displays the status of signals DDB 1439 - 1408				
0F	4D	DDB 1471 - 1440		Not Settable
Displays the status of signals DDB 1471 - 1440				
0F	4E	DDB 1503 - 1472		Not Settable
Displays the status of signals DDB 1503 - 1472				
0F	4F	DDB 1535 - 1504		Not Settable
Displays the status of signals DDB 1535 - 1504				
0F	50	DDB 1567 - 1536		Not Settable
Displays the status of signals DDB 1567 - 1536				
0F	51	DDB 1599 - 1568		Not Settable
Displays the status of signals DDB 1599 - 1568				
0F	52	DDB 1631 - 1600		Not Settable
Displays the status of signals DDB 1631 - 1600				
0F	53	DDB 1663 - 1632		Not Settable
Displays the status of signals DDB 1663 - 1632				
0F	54	DDB 1695 - 1664		Not Settable
Displays the status of signals DDB 1695 - 1664				
0F	55	DDB 1727 - 1696		Not Settable
Displays the status of signals DDB 1727 - 1696				
0F	56	DDB 1759 - 1728		Not Settable
Displays the status of signals DDB 1759 - 1728				
0F	57	DDB 1791 - 1760		Not Settable
Displays the status of signals DDB 1791 - 1760				
0F	58	DDB 1823 - 1792		Not Settable
Displays the status of signals DDB 1823 - 1792				
0F	59	DDB 1855 - 1824		Not Settable
Displays the status of signals DDB 1855 - 1824				
0F	5A	DDB 1887 - 1856		Not Settable
Displays the status of signals DDB 1887 - 1856				
0F	5B	DDB 1919 - 1888		Not Settable
Displays the status of signals DDB 1919 - 1888				
0F	5C	DDB 1951 - 1920		Not Settable
Displays the status of signals DDB 1951 - 1920				
0F	5D	DDB 1983 - 1952		Not Settable
Displays the status of signals DDB 1983 - 1952				
0F	5E	DDB 2015 - 1984		Not Settable
Displays the status of signals DDB 2015 - 1984				
0F	5F	DDB 2047 - 2016		Not Settable
Displays the status of signals DDB 2047 - 2016. Supported for 1 read would be 1696 DDBs.				

5.9.2 Commissioning Tests (P742/P743)

<table>
<tr><th>Col</th><th>Row</th><th>Menu Text</th><th>Default Setting</th><th>Available Setting</th><th>P742</th><th>P743</th></tr>
<tr><th colspan="7">Description</th></tr>
<tr><td>0F</td><td>00</td><td>COMMISSION TESTS</td><td></td><td></td><td>*</td><td>*</td></tr>
<tr><td colspan="7">This column contains commissioning test settings</td></tr>
<tr><td>0F</td><td>01</td><td>Opto I/P Status</td><td></td><td>Not Settable</td><td>*</td><td>*</td></tr>
<tr><td colspan="7">This menu cell displays the status of the available IED’s opto-isolated inputs as a binary string, a ‘1’ indicating an energized opto-isolated input and a ‘0’ a de-energized one.</td></tr>
<tr><td>0F</td><td>02</td><td>Relay O/P Status</td><td></td><td>Not Settable</td><td>*</td><td>*</td></tr>
<tr><td colspan="7">Displays the status of all available output relays fitted. Not Valid if Contacts Blocked.</td></tr>
<tr><td>0F</td><td>03</td><td>Test Port Status</td><td></td><td>Not Settable</td><td>*</td><td>*</td></tr>
<tr><td colspan="7">This menu cell displays the status of the eight digital data bus (DDB) signals that have been allocated in the ‘Monitor Bit’ cells.</td></tr>
<tr><td>0F</td><td>04</td><td>LED Status</td><td></td><td>Not Settable</td><td>*</td><td></td></tr>
<tr><td colspan="7">This cell is an eight bit binary string that indicates which of the user-programmable LEDs on the relay are illuminated, a ‘1’ indicating a particular LED is lit and a ‘0’ not lit.</td></tr>
<tr><td>0F</td><td>05</td><td>Monitor Bit 1</td><td>Relay Label 01</td><td>All DDB Points</td><td>*</td><td>*</td></tr>
<tr><td colspan="7">The eight ‘Monitor Bit’ cells allow the user to select the status of which digital data bus signals can be observed in the ‘Test Port Status’ cell or via the monitor/download port.</td></tr>
<tr><td>0F</td><td>06</td><td>Monitor Bit 2</td><td>Relay Label 02</td><td>All DDB Points</td><td>*</td><td>*</td></tr>
<tr><td colspan="7">The eight ‘Monitor Bit’ cells allow the user to select the status of which digital data bus signals can be observed in the ‘Test Port Status’ cell or via the monitor/download port.</td></tr>
<tr><td>0F</td><td>07</td><td>Monitor Bit 3</td><td>Relay Label 03</td><td>All DDB Points</td><td>*</td><td>*</td></tr>
<tr><td colspan="7">The eight ‘Monitor Bit’ cells allow the user to select the status of which digital data bus signals can be observed in the ‘Test Port Status’ cell or via the monitor/download port.</td></tr>
<tr><td>0F</td><td>08</td><td>Monitor Bit 4</td><td>Relay Label 04</td><td>All DDB Points</td><td>*</td><td>*</td></tr>
<tr><td colspan="7">The eight ‘Monitor Bit’ cells allow the user to select the status of which digital data bus signals can be observed in the ‘Test Port Status’ cell or via the monitor/download port.</td></tr>
<tr><td>0F</td><td>09</td><td>Monitor Bit 5</td><td>Relay Label 05</td><td>All DDB Points</td><td>*</td><td>*</td></tr>
<tr><td colspan="7">The eight ‘Monitor Bit’ cells allow the user to select the status of which digital data bus signals can be observed in the ‘Test Port Status’ cell or via the monitor/download port.</td></tr>
<tr><td>0F</td><td>0A</td><td>Monitor Bit 6</td><td>Relay Label 06</td><td>All DDB Points</td><td>*</td><td>*</td></tr>
<tr><td colspan="7">The eight ‘Monitor Bit’ cells allow the user to select the status of which digital data bus signals can be observed in the ‘Test Port Status’ cell or via the monitor/download port.</td></tr>
<tr><td>0F</td><td>0B</td><td>Monitor Bit 7</td><td>Relay Label 07</td><td>All DDB Points</td><td>*</td><td>*</td></tr>
<tr><td colspan="7">The eight ‘Monitor Bit’ cells allow the user to select the status of which digital data bus signals can be observed in the ‘Test Port Status’ cell or via the monitor/download port.</td></tr>
<tr><td>0F</td><td>0C</td><td>Monitor Bit 8</td><td>Relay Label 08</td><td>All DDB Points</td><td>*</td><td>*</td></tr>
<tr><td colspan="7">The eight ‘Monitor Bit’ cells allow the user to select the status of which digital data bus signals can be observed in the ‘Test Port Status’ cell or via the monitor/download port.</td></tr>
<tr><td>0F</td><td>0D</td><td>Test Mode</td><td>Disabled</td><td>0 = Disabled, 1 = Disable 50BF, 2 = Overhaul Mode</td><td>*</td><td>*</td></tr>
</table>

Col	Row	Menu Text	Default Setting	Available Setting	74	P743
Description						
The Test Mode menu cell is used to allow secondary injection testing to be performed on the IED without operation of the trip contacts. It also enables a facility to directly test the output contacts by applying menu controlled test signals. To select test mode the Test Mode menu cell should be set to 'Test Mode', which takes the IED out of service . It also causes an alarm condition to be recorded and the yellow 'Out of Service' LED to illuminate and an alarm message 'Prot'n. Disabled' is given. In IEC 60870-5-103 builds changes the Cause of Transmission, COT, to Test Mode. To enable testing of output contacts the Test Mode cell should be set to Blocked. This blocks the protection from operating the contacts and enables the test pattern and contact test functions which can be used to manually operate the output contacts. This mode also blocks maintenance, counters and freezes any information stored in the Circuit Breaker Condition column. Also in IEC 60870-5-103 builds changes the Cause of Transmission, COT, to Test Mode. Once testing is complete the cell must be set back to 'Disabled' to restore the IED back to service. In IEC61850 models using edition 2 mode, selecting Test Mode or Blocked will change the behaviour of all active logical nodes to test. The quality of all data will also indicate test.						
0F	0E	Test Pattern	00000000000000000000000000000000(bin)	0=Not Operated or 1=Operated	*	*
This cell is used to select the output relay contacts that will be tested when the 'Contact Test' cell is set to 'Apply Test'.						
0F	0F	Contact Test	No operation	0 = No operation or 1 = Apply Test	*	*
When the 'Apply Test' command in this cell is issued the contacts set for operation (set to '1') in the 'Test Pattern' cell are energised. After the test has been applied the command text on the LCD will change to 'No Operation' and the contacts will remain in the Test State until reset issuing the 'Remove Test' command. The command text on the LCD will again revert to 'No Operation' after the 'Remove Test' command has been issued. Note: When the 'Test Mode' cell is set to 'Contacts Blocked' the 'Relay O/P Status' cell does not show the current status of the output relays and hence can not be used to confirm operation of the output relays. Therefore it will be necessary to physically monitor the state of each contact in turn.						
0F	10	Test LEDs	No operation	0 = No operation or 1 = Apply Test	*	*
When the 'Apply Test' command in this cell is issued, the eighteen user-programmable LEDs will illuminate for approximately 2 seconds before they extinguish and the command text on the LCD reverts to 'No Operation'.						
0F	12	Position Pattern	00000000(bin)	0x01 - IS_1_POSITION (0 openned, 1 closed) 0x02 - IS_2_POSITION (0 openned, 1 closed) 0x04 - IS_3_POSITION (0 openned, 1 closed) 0x08 - IS_4_POSITION (0 openned, 1 closed) 0x10 - IS_5_POSITION (0 openned, 1 closed) 0x20 - IS_6_POSITION (0 openned, 1 closed) 0x40 - CB_POSITION (0 openned, 1 closed)	*	*
This sets the forced position for Isolators and Circuit Breaker						
0F	16	Red LED Status		Not Settable		*
This cell is an eighteen bit binary string that indicates which of the user-programmable LEDs on the relay are illuminated with the Red LED input active when accessing the relay from a remote location, a '1' indicating a particular LED is lit and a '0' not lit.						
0F	17	Green LED Status		Not Settable		*
This cell is an eighteen bit binary string that indicates which of the user-programmable LEDs on the relay are illuminated with the Green LED input active when accessing the relay from a remote location, a '1' indicating a particular LED is lit and a '0' not lit.						
0F	20	DDB 31 - 0		Not Settable	*	*
Displays the status of signals DDB 31 - 0						
0F	21	DDB 63 - 32		Not Settable	*	*
Displays the status of signals DDB 63 - 32						

Col	Row	Menu Text	Default Setting	Available Setting	P741	P743
Description						
0F	22	DDB 95 - 64		Not Settable	*	*
Displays the status of signals DDB 95 - 64						
0F	23	DDB 127 - 96		Not Settable	*	*
Displays the status of signals DDB 127 - 96						
0F	24	DDB 159 - 128		Not Settable	*	*
Displays the status of signals DDB 159 - 128						
0F	25	DDB 191 - 160		Not Settable	*	*
Displays the status of signals DDB 191 - 160						
0F	26	DDB 223 - 192		Not Settable	*	*
Displays the status of signals DDB 223 - 192						
0F	27	DDB 255 - 224		Not Settable	*	*
Displays the status of signals DDB 255 - 224						
0F	28	DDB 287 - 256		Not Settable	*	*
Displays the status of signals DDB 287 - 256						
0F	29	DDB 319 - 288		Not Settable	*	*
Displays the status of signals DDB 319 - 288						
0F	2A	DDB 351 - 320		Not Settable	*	*
Displays the status of signals DDB 351 - 320						
0F	2B	DDB 383 - 352		Not Settable	*	*
Displays the status of signals DDB 383 - 352						
0F	2C	DDB 415 - 384		Not Settable	*	*
Displays the status of signals DDB 415 - 384						
0F	2D	DDB 447 - 415		Not Settable	*	*
Displays the status of signals DDB 447 - 415						
0F	2E	DDB 479 - 448		Not Settable	*	*
Displays the status of signals DDB 479 - 448						
0F	2F	DDB 511 - 480		Not Settable	*	*
Displays the status of signals DDB 511 - 480						
0F	30	DDB 543 - 512		Not Settable	*	*
Displays the status of signals DDB 543 - 512						
0F	31	DDB 575 - 544		Not Settable	*	*
Displays the status of signals DDB 575 - 544						
0F	32	DDB 607 - 575		Not Settable	*	*
Displays the status of signals DDB 607 - 575						
0F	33	DDB 639 - 608		Not Settable	*	*
Displays the status of signals DDB 639 - 608						
0F	34	DDB 671 - 640		Not Settable	*	*
Displays the status of signals DDB 671 - 640						
0F	35	DDB 703 - 672		Not Settable	*	*
Displays the status of signals DDB 703 - 672						
0F	36	DDB 735 - 704		Not Settable	*	*
Displays the status of signals DDB 735 - 704						
0F	37	DDB 767 - 736		Not Settable	*	*

Col	Row	Menu Text	Default Setting	Available Setting	P741	P743
Description						
Displays the status of signals DDB 767 - 736						
0F	38	DDB 799 - 768		Not Settable	*	*
Displays the status of signals DDB 799 - 768						
0F	39	DDB 831 - 800		Not Settable	*	*
Displays the status of signals DDB 831 - 800						
0F	3A	DDB 863 - 832		Not Settable	*	*
Displays the status of signals DDB 863 - 832						
0F	3B	DDB 895 - 864		Not Settable	*	*
Displays the status of signals DDB 895 - 864						
0F	3C	DDB 927 - 896		Not Settable	*	*
Displays the status of signals DDB 927 - 896						
0F	3D	DDB 959 - 928		Not Settable	*	*
Displays the status of signals DDB 959 - 928						
0F	3E	DDB 991 - 960		Not Settable	*	*
Displays the status of signals DDB 991 - 960						
0F	3F	DDB 1023 - 992		Not Settable	*	*
Displays the status of signals DDB 1023 - 992						
0F	40	DDB 1055 - 1024		Not Settable	*	*
Displays the status of signals DDB 1055 - 1024						
0F	41	DDB 1087 - 1056		Not Settable	*	*
Displays the status of signals DDB 1087 - 1056						
0F	42	DDB 1119 - 1088		Not Settable	*	*
Displays the status of signals DDB 1119 - 1088						
0F	43	DDB 1151 - 1120		Not Settable	*	*
Displays the status of signals DDB 1151 - 1120						
0F	44	DDB 1183 - 1152		Not Settable	*	*
Displays the status of signals DDB 1183 - 1152						
0F	45	DDB 1215 - 1184		Not Settable	*	*
Displays the status of signals DDB 1215 - 1184						
0F	46	DDB 1247 - 1216		Not Settable	*	*
Displays the status of signals DDB 1247 - 1216						
0F	47	DDB 1279 - 1248		Not Settable	*	*
Displays the status of signals DDB 1279 - 1248						
0F	48	DDB 1311 - 1280		Not Settable	*	*
Displays the status of signals DDB 1311 - 1280						
0F	49	DDB 1343 - 1312		Not Settable	*	*
Displays the status of signals DDB 1343 - 1312						
0F	4A	DDB 1375 - 1344		Not Settable	*	*
Displays the status of signals DDB 1375 - 1344						
0F	4B	DDB 1407 - 1376		Not Settable	*	*
Displays the status of signals DDB 1407 - 1376						
0F	4C	DDB 1439 - 1408		Not Settable	*	*
Displays the status of signals DDB 1439 - 1408						

Col	Row	Menu Text	Default Setting	Available Setting	P742	P743
Description						
0F	4D	DDB 1471 - 1440		Not Settable	*	*
Displays the status of signals DDB 1471 - 1440						
0F	4E	DDB 1503 - 1472		Not Settable	*	*
Displays the status of signals DDB 1503 - 1472						
0F	4F	DDB 1535 - 1504		Not Settable	*	*
Displays the status of signals DDB 1535 - 1504						
0F	50	DDB 1567 - 1536		Not Settable	*	*
Displays the status of signals DDB 1567 - 1536						
0F	51	DDB 1599 - 1568		Not Settable	*	*
Displays the status of signals DDB 1599 - 1568						
0F	52	DDB 1631 - 1600		Not Settable	*	*
Displays the status of signals DDB 1631 - 1600						
0F	53	DDB 1663 - 1632		Not Settable	*	*
Displays the status of signals DDB 1663 - 1632						
0F	54	DDB 1695 - 1664		Not Settable	*	*
Displays the status of signals DDB 1695 - 1664						
0F	55	DDB 1727 - 1696		Not Settable	*	*
Displays the status of signals DDB 1727 - 1696						
0F	56	DDB 1759 - 1728		Not Settable	*	*
Displays the status of signals DDB 1759 - 1728						
0F	57	DDB 1791 - 1760		Not Settable	*	*
Displays the status of signals DDB 1791 - 1760						
0F	58	DDB 1823 - 1792		Not Settable	*	*
Displays the status of signals DDB 1823 - 1792						
0F	59	DDB 1855 - 1824		Not Settable	*	*
Displays the status of signals DDB 1855 - 1824						
0F	5A	DDB 1887 - 1856		Not Settable	*	*
Displays the status of signals DDB 1887 - 1856						
0F	5B	DDB 1919 - 1888		Not Settable	*	*
Displays the status of signals DDB 1919 - 1888						
0F	5C	DDB 1951 - 1920		Not Settable	*	*
Displays the status of signals DDB 1951 - 1920						
0F	5D	DDB 1983 - 1952		Not Settable	*	*
Displays the status of signals DDB 1983 - 1952						
0F	5E	DDB 2015 - 1984		Not Settable	*	*
Displays the status of signals DDB 2015 - 1984						
0F	5F	DDB 2047 - 2016		Not Settable	*	*
Displays the status of signals DDB 2047 - 2016. Supported for 1 read would be 1696 DDBs.						

5.10 Opto Configuration (Opto Config)

The Opto Config menu settings vary between products. The options are:

- Opto Configuration (P741)
- Opto Configuration (P742/P743)

5.10.1 Opto Configuration (P741)

Col	Row	Menu Text	Default Setting	Available Setting
Description				
11	00	OPTO CONFIG		
This column contains opto-input configuration settings				
11	01	Global threshold	48/54V	0 = 24/27V, 1 = 30/34V, 2 = 48/54V, 3 = 110/125V, 4 = 220/250V or 5 = Custom
Sets the nominal battery voltage for all opto inputs by selecting one of the five standard ratings in the Global Nominal V settings. If Custom is selected then each opto input can individually be set to a nominal voltage value.				
11	02	Opto Input 1	48/54V	0 = 24/27V, 1 = 30/34V, 2 = 48/54V, 3 = 110/125V or 4 = 220/250V
Each opto input can individually be set to a nominal voltage value if custom is selected for the global setting. The number of inputs may be up to 40, depending on the IED and I/O configuration.				
11	03	Opto Input 2	48/54V	0 = 24/27V, 1 = 30/34V, 2 = 48/54V, 3 = 110/125V or 4 = 220/250V
Each opto input can individually be set to a nominal voltage value if custom is selected for the global setting. The number of inputs may be up to 40, depending on the IED and I/O configuration.				
11	04	Opto Input 3	48/54V	0 = 24/27V, 1 = 30/34V, 2 = 48/54V, 3 = 110/125V or 4 = 220/250V
Each opto input can individually be set to a nominal voltage value if custom is selected for the global setting. The number of inputs may be up to 40, depending on the IED and I/O configuration.				
11	05	Opto Input 4	48/54V	0 = 24/27V, 1 = 30/34V, 2 = 48/54V, 3 = 110/125V or 4 = 220/250V
Each opto input can individually be set to a nominal voltage value if custom is selected for the global setting. The number of inputs may be up to 40, depending on the IED and I/O configuration.				
11	06	Opto Input 5	48/54V	0 = 24/27V, 1 = 30/34V, 2 = 48/54V, 3 = 110/125V or 4 = 220/250V
Each opto input can individually be set to a nominal voltage value if custom is selected for the global setting. The number of inputs may be up to 40, depending on the IED and I/O configuration.				
11	07	Opto Input 6	48/54V	0 = 24/27V, 1 = 30/34V, 2 = 48/54V, 3 = 110/125V or 4 = 220/250V
Each opto input can individually be set to a nominal voltage value if custom is selected for the global setting. The number of inputs may be up to 40, depending on the IED and I/O configuration.				
11	08	Opto Input 7	48/54V	0 = 24/27V, 1 = 30/34V, 2 = 48/54V, 3 = 110/125V or 4 = 220/250V
Each opto input can individually be set to a nominal voltage value if custom is selected for the global setting. The number of inputs may be up to 40, depending on the IED and I/O configuration.				
11	09	Opto Input 8	48/54V	0 = 24/27V, 1 = 30/34V, 2 = 48/54V, 3 = 110/125V or 4 = 220/250V
Each opto input can individually be set to a nominal voltage value if custom is selected for the global setting. The number of inputs may be up to 40, depending on the IED and I/O configuration.				

Col	Row	Menu Text	Default Setting	Available Setting
Description				
11	0A	Opto Input 9	48/54V	0 = 24/27V, 1 = 30/34V, 2 = 48/54V, 3 = 110/125V or 4 = 220/250V
Each opto input can individually be set to a nominal voltage value if custom is selected for the global setting. The number of inputs may be up to 40, depending on the IED and I/O configuration.				
11	0B	Opto Input 10	48/54V	0 = 24/27V, 1 = 30/34V, 2 = 48/54V, 3 = 110/125V or 4 = 220/250V
Each opto input can individually be set to a nominal voltage value if custom is selected for the global setting. The number of inputs may be up to 40, depending on the IED and I/O configuration.				
11	0C	Opto Input 11	48/54V	0 = 24/27V, 1 = 30/34V, 2 = 48/54V, 3 = 110/125V or 4 = 220/250V
Each opto input can individually be set to a nominal voltage value if custom is selected for the global setting. The number of inputs may be up to 40, depending on the IED and I/O configuration.				
11	0D	Opto Input 12	48/54V	0 = 24/27V, 1 = 30/34V, 2 = 48/54V, 3 = 110/125V or 4 = 220/250V
Each opto input can individually be set to a nominal voltage value if custom is selected for the global setting. The number of inputs may be up to 40, depending on the IED and I/O configuration.				
11	0E	Opto Input 13	48/54V	0 = 24/27V, 1 = 30/34V, 2 = 48/54V, 3 = 110/125V or 4 = 220/250V
Each opto input can individually be set to a nominal voltage value if custom is selected for the global setting. The number of inputs may be up to 40, depending on the IED and I/O configuration.				
11	0F	Opto Input 14	48/54V	0 = 24/27V, 1 = 30/34V, 2 = 48/54V, 3 = 110/125V or 4 = 220/250V
Each opto input can individually be set to a nominal voltage value if custom is selected for the global setting. The number of inputs may be up to 40, depending on the IED and I/O configuration.				
11	10	Opto Input 15	48/54V	0 = 24/27V, 1 = 30/34V, 2 = 48/54V, 3 = 110/125V or 4 = 220/250V
Each opto input can individually be set to a nominal voltage value if custom is selected for the global setting. The number of inputs may be up to 40, depending on the IED and I/O configuration.				
11	11	Opto Input 16	48/54V	0 = 24/27V, 1 = 30/34V, 2 = 48/54V, 3 = 110/125V or 4 = 220/250V
Each opto input can individually be set to a nominal voltage value if custom is selected for the global setting. The number of inputs may be up to 40, depending on the IED and I/O configuration.				
11	12	Opto Input 17	48/54V	0 = 24/27V, 1 = 30/34V, 2 = 48/54V, 3 = 110/125V or 4 = 220/250V
Each opto input can individually be set to a nominal voltage value if custom is selected for the global setting. The number of inputs may be up to 40, depending on the IED and I/O configuration.				
11	13	Opto Input 18	48/54V	0 = 24/27V, 1 = 30/34V, 2 = 48/54V, 3 = 110/125V or 4 = 220/250V
Each opto input can individually be set to a nominal voltage value if custom is selected for the global setting. The number of inputs may be up to 40, depending on the IED and I/O configuration.				
11	14	Opto Input 19	48/54V	0 = 24/27V, 1 = 30/34V, 2 = 48/54V, 3 = 110/125V or 4 = 220/250V
Each opto input can individually be set to a nominal voltage value if custom is selected for the global setting. The number of inputs may be up to 40, depending on the IED and I/O configuration.				
11	15	Opto Input 20	48/54V	0 = 24/27V, 1 = 30/34V, 2 = 48/54V, 3 = 110/125V or 4 = 220/250V
Each opto input can individually be set to a nominal voltage value if custom is selected for the global setting. The number of inputs may be up to 40, depending on the IED and I/O configuration.				
11	16	Opto Input 21	48/54V	0 = 24/27V, 1 = 30/34V, 2 = 48/54V, 3 = 110/125V or 4 = 220/250V

Col	Row	Menu Text	Default Setting	Available Setting
Description				
Each opto input can individually be set to a nominal voltage value if custom is selected for the global setting. The number of inputs may be up to 40, depending on the IED and I/O configuration.				
11	17	Opto Input 22	48/54V	0 = 24/27V, 1 = 30/34V, 2 = 48/54V, 3 = 110/125V or 4 = 220/250V
Each opto input can individually be set to a nominal voltage value if custom is selected for the global setting. The number of inputs may be up to 40, depending on the IED and I/O configuration.				
11	18	Opto Input 23	48/54V	0 = 24/27V, 1 = 30/34V, 2 = 48/54V, 3 = 110/125V or 4 = 220/250V
Each opto input can individually be set to a nominal voltage value if custom is selected for the global setting. The number of inputs may be up to 40, depending on the IED and I/O configuration.				
11	19	Opto Input 24	48/54V	0 = 24/27V, 1 = 30/34V, 2 = 48/54V, 3 = 110/125V or 4 = 220/250V
Each opto input can individually be set to a nominal voltage value if custom is selected for the global setting. The number of inputs may be up to 40, depending on the IED and I/O configuration.				
11	80	Characteristic	Standard 60% to 80%	0 = Standard 60% to 80% or 1 = 50% to 70%
Selects the pick-up and drop-off characteristics of the opto's. Selecting the standard setting means they nominally provide a Logic 1 or On value for Voltages ≥80% of the set lower nominal voltage and a Logic 0 or Off value for the voltages ≤60% of the set higher nominal voltage.				

5.10.2 Opto Configuration (P742/P743)

Col	Row	Menu Text	Default Setting	Available Setting	P742	P743
Description						
11	00	OPTO CONFIG			*	*
This column contains opto-input configuration settings						
11	01	Global threshold	48/54V	0 = 24/27V, 1 = 30/34V, 2 = 48/54V, 3 = 110/125V, 4 = 220/250V or 5 = Custom	*	*
Sets the nominal battery voltage for all opto inputs by selecting one of the five standard ratings in the Global Nominal V settings. If Custom is selected then each opto input can individually be set to a nominal voltage value.						
11	02	Opto Input 1	48/54V	0 = 24/27V, 1 = 30/34V, 2 = 48/54V, 3 = 110/125V or 4 = 220/250V	*	*
Each opto input can individually be set to a nominal voltage value if custom is selected for the global setting. The number of inputs may be up to 40, depending on the IED and I/O configuration.						
11	03	Opto Input 2	48/54V	0 = 24/27V, 1 = 30/34V, 2 = 48/54V, 3 = 110/125V or 4 = 220/250V	*	*
Each opto input can individually be set to a nominal voltage value if custom is selected for the global setting. The number of inputs may be up to 40, depending on the IED and I/O configuration.						
11	04	Opto Input 3	48/54V	0 = 24/27V, 1 = 30/34V, 2 = 48/54V, 3 = 110/125V or 4 = 220/250V	*	*
Each opto input can individually be set to a nominal voltage value if custom is selected for the global setting. The number of inputs may be up to 40, depending on the IED and I/O configuration.						
11	05	Opto Input 4	48/54V	0 = 24/27V, 1 = 30/34V, 2 = 48/54V, 3 = 110/125V or 4 = 220/250V	*	*
Each opto input can individually be set to a nominal voltage value if custom is selected for the global setting. The number of inputs may be up to 40, depending on the IED and I/O configuration.						
11	06	Opto Input 5	48/54V	0 = 24/27V, 1 = 30/34V, 2 = 48/54V, 3 = 110/125V or 4 = 220/250V	*	*
Each opto input can individually be set to a nominal voltage value if custom is selected for the global setting. The number of inputs may be up to 40, depending on the IED and I/O configuration.						

Col	Row	Menu Text	Default Setting	Available Setting	P742	P743
Description						
11	07	Opto Input 6	48/54V	0 = 24/27V, 1 = 30/34V, 2 = 48/54V, 3 = 110/125V or 4 = 220/250V	*	*
Each opto input can individually be set to a nominal voltage value if custom is selected for the global setting. The number of inputs may be up to 40, depending on the IED and I/O configuration.						
11	08	Opto Input 7	48/54V	0 = 24/27V, 1 = 30/34V, 2 = 48/54V, 3 = 110/125V or 4 = 220/250V	*	*
Each opto input can individually be set to a nominal voltage value if custom is selected for the global setting. The number of inputs may be up to 40, depending on the IED and I/O configuration.						
11	09	Opto Input 8	48/54V	0 = 24/27V, 1 = 30/34V, 2 = 48/54V, 3 = 110/125V or 4 = 220/250V	*	*
Each opto input can individually be set to a nominal voltage value if custom is selected for the global setting. The number of inputs may be up to 40, depending on the IED and I/O configuration.						
11	0A	Opto Input 9	48/54V	0 = 24/27V, 1 = 30/34V, 2 = 48/54V, 3 = 110/125V or 4 = 220/250V	*	*
Each opto input can individually be set to a nominal voltage value if custom is selected for the global setting. The number of inputs may be up to 40, depending on the IED and I/O configuration.						
11	0B	Opto Input 10	48/54V	0 = 24/27V, 1 = 30/34V, 2 = 48/54V, 3 = 110/125V or 4 = 220/250V	*	*
Each opto input can individually be set to a nominal voltage value if custom is selected for the global setting. The number of inputs may be up to 40, depending on the IED and I/O configuration.						
11	0C	Opto Input 11	48/54V	0 = 24/27V, 1 = 30/34V, 2 = 48/54V, 3 = 110/125V or 4 = 220/250V	*	*
Each opto input can individually be set to a nominal voltage value if custom is selected for the global setting. The number of inputs may be up to 40, depending on the IED and I/O configuration.						
11	0D	Opto Input 12	48/54V	0 = 24/27V, 1 = 30/34V, 2 = 48/54V, 3 = 110/125V or 4 = 220/250V	*	*
Each opto input can individually be set to a nominal voltage value if custom is selected for the global setting. The number of inputs may be up to 40, depending on the IED and I/O configuration.						
11	0E	Opto Input 13	48/54V	0 = 24/27V, 1 = 30/34V, 2 = 48/54V, 3 = 110/125V or 4 = 220/250V	*	*
Each opto input can individually be set to a nominal voltage value if custom is selected for the global setting. The number of inputs may be up to 40, depending on the IED and I/O configuration.						
11	0F	Opto Input 14	48/54V	0 = 24/27V, 1 = 30/34V, 2 = 48/54V, 3 = 110/125V or 4 = 220/250V	*	*
Each opto input can individually be set to a nominal voltage value if custom is selected for the global setting. The number of inputs may be up to 40, depending on the IED and I/O configuration.						
11	10	Opto Input 15	48/54V	0 = 24/27V, 1 = 30/34V, 2 = 48/54V, 3 = 110/125V or 4 = 220/250V	*	*
Each opto input can individually be set to a nominal voltage value if custom is selected for the global setting. The number of inputs may be up to 40, depending on the IED and I/O configuration.						
11	11	Opto Input 16	48/54V	0 = 24/27V, 1 = 30/34V, 2 = 48/54V, 3 = 110/125V or 4 = 220/250V	*	*
Each opto input can individually be set to a nominal voltage value if custom is selected for the global setting. The number of inputs may be up to 40, depending on the IED and I/O configuration.						
11	12	Opto Input 17	48/54V	0 = 24/27V, 1 = 30/34V, 2 = 48/54V, 3 = 110/125V or 4 = 220/250V		*
Each opto input can individually be set to a nominal voltage value if custom is selected for the global setting. The number of inputs may be up to 40, depending on the IED and I/O configuration.						
11	13	Opto Input 18	48/54V	0 = 24/27V, 1 = 30/34V, 2 = 48/54V, 3 = 110/125V or 4 = 220/250V		*

<table>
<tr><th>Col</th><th>Row</th><th>Menu Text</th><th>Default Setting</th><th>Available Setting</th><th>P742</th><th>P743</th></tr>
<tr><th colspan="7">Description</th></tr>
<tr><td colspan="7">Each opto input can individually be set to a nominal voltage value if custom is selected for the global setting. The number of inputs may be up to 40, depending on the IED and I/O configuration.</td></tr>
<tr><td>11</td><td>14</td><td>Opto Input 19</td><td>48/54V</td><td>0 = 24/27V, 1 = 30/34V, 2 = 48/54V, 3 = 110/125V or 4 = 220/250V</td><td></td><td>*</td></tr>
<tr><td colspan="7">Each opto input can individually be set to a nominal voltage value if custom is selected for the global setting. The number of inputs may be up to 40, depending on the IED and I/O configuration.</td></tr>
<tr><td>11</td><td>15</td><td>Opto Input 20</td><td>48/54V</td><td>0 = 24/27V, 1 = 30/34V, 2 = 48/54V, 3 = 110/125V or 4 = 220/250V</td><td></td><td>*</td></tr>
<tr><td colspan="7">Each opto input can individually be set to a nominal voltage value if custom is selected for the global setting. The number of inputs may be up to 40, depending on the IED and I/O configuration.</td></tr>
<tr><td>11</td><td>16</td><td>Opto Input 21</td><td>48/54V</td><td>0 = 24/27V, 1 = 30/34V, 2 = 48/54V, 3 = 110/125V or 4 = 220/250V</td><td></td><td>*</td></tr>
<tr><td colspan="7">Each opto input can individually be set to a nominal voltage value if custom is selected for the global setting. The number of inputs may be up to 40, depending on the IED and I/O configuration.</td></tr>
<tr><td>11</td><td>17</td><td>Opto Input 22</td><td>48/54V</td><td>0 = 24/27V, 1 = 30/34V, 2 = 48/54V, 3 = 110/125V or 4 = 220/250V</td><td></td><td>*</td></tr>
<tr><td colspan="7">Each opto input can individually be set to a nominal voltage value if custom is selected for the global setting. The number of inputs may be up to 40, depending on the IED and I/O configuration.</td></tr>
<tr><td>11</td><td>18</td><td>Opto Input 23</td><td>48/54V</td><td>0 = 24/27V, 1 = 30/34V, 2 = 48/54V, 3 = 110/125V or 4 = 220/250V</td><td></td><td>*</td></tr>
<tr><td colspan="7">Each opto input can individually be set to a nominal voltage value if custom is selected for the global setting. The number of inputs may be up to 40, depending on the IED and I/O configuration.</td></tr>
<tr><td>11</td><td>19</td><td>Opto Input 24</td><td>48/54V</td><td>0 = 24/27V, 1 = 30/34V, 2 = 48/54V, 3 = 110/125V or 4 = 220/250V</td><td></td><td>*</td></tr>
<tr><td colspan="7">Each opto input can individually be set to a nominal voltage value if custom is selected for the global setting. The number of inputs may be up to 40, depending on the IED and I/O configuration.</td></tr>
</table>

5.11 Control Input Setting (Control Input)

The MiCOM P74x offers 32 control inputs which can be set or reset locally or remotely. This column is visible when the “Control Inputs” setting (“Configuration” column) = “visible”.

The Control Inputs menu settings vary between products. The options are:

- Control Input Setting (Control Input) (P741)
- Control Input Setting (Control Input) (P742/P743)

5.11.1 Control Input Setting (Control Input) (P741)

<table>
<tr><th>Col</th><th>Row</th><th>Menu Text</th><th>Default Setting</th><th>Available Setting</th></tr>
<tr><th colspan="5">Description</th></tr>
<tr><td>12</td><td>00</td><td>CONTROL INPUTS</td><td></td><td></td></tr>
<tr><td colspan="5">This column contains settings for the type of control input (32 in all)</td></tr>
<tr><td>12</td><td>01</td><td>Ctrl I/P Status</td><td>00000000000000000000000000000000(bin)</td><td>32-bit binary setting: 0=Reset or 1=Set</td></tr>
<tr><td colspan="5">Cell that is used to set (1) and reset (0) the selected Control Input by simply scrolling and changing the status of selected bits. This command will be then recognized and executed in the PSL. Alternatively, each of the 32 Control input can also be set and reset using the individual menu setting cells as follows:</td></tr>
<tr><td>12</td><td>02</td><td>Control Input 1</td><td>No Operation</td><td>0 = No Operation, 1 = SET , 2 = RESET</td></tr>
<tr><td colspan="5">Setting to allow Control Inputs 1 set/ reset.</td></tr>
<tr><td>12</td><td>03</td><td>Control Input 2</td><td>No Operation</td><td>0 = No Operation, 1 = SET , 2 = RESET</td></tr>
<tr><td colspan="5">Setting to allow Control Inputs 1 set/ reset.</td></tr>
<tr><td>12</td><td>04</td><td>Control Input 3</td><td>No Operation</td><td>0 = No Operation, 1 = SET , 2 = RESET</td></tr>
<tr><td colspan="5">Setting to allow Control Inputs 1 set/ reset.</td></tr>
<tr><td>12</td><td>05</td><td>Control Input 4</td><td>No Operation</td><td>0 = No Operation, 1 = SET , 2 = RESET</td></tr>
<tr><td colspan="5">Setting to allow Control Inputs 1 set/ reset.</td></tr>
<tr><td>12</td><td>06</td><td>Control Input 5</td><td>No Operation</td><td>0 = No Operation, 1 = SET , 2 = RESET</td></tr>
<tr><td colspan="5">Setting to allow Control Inputs 1 set/ reset.</td></tr>
<tr><td>12</td><td>07</td><td>Control Input 6</td><td>No Operation</td><td>0 = No Operation, 1 = SET , 2 = RESET</td></tr>
<tr><td colspan="5">Setting to allow Control Inputs 1 set/ reset.</td></tr>
<tr><td>12</td><td>08</td><td>Control Input 7</td><td>No Operation</td><td>0 = No Operation, 1 = SET , 2 = RESET</td></tr>
<tr><td colspan="5">Setting to allow Control Inputs 1 set/ reset.</td></tr>
<tr><td>12</td><td>09</td><td>Control Input 8</td><td>No Operation</td><td>0 = No Operation, 1 = SET , 2 = RESET</td></tr>
<tr><td colspan="5">Setting to allow Control Inputs 1 set/ reset.</td></tr>
<tr><td>12</td><td>0A</td><td>Control Input 9</td><td>No Operation</td><td>0 = No Operation, 1 = SET , 2 = RESET</td></tr>
<tr><td colspan="5">Setting to allow Control Inputs 1 set/ reset.</td></tr>
<tr><td>12</td><td>0B</td><td>Control Input 10</td><td>No Operation</td><td>0 = No Operation, 1 = SET , 2 = RESET</td></tr>
<tr><td colspan="5">Setting to allow Control Inputs 1 set/ reset.</td></tr>
<tr><td>12</td><td>0C</td><td>Control Input 11</td><td>No Operation</td><td>0 = No Operation, 1 = SET , 2 = RESET</td></tr>
<tr><td colspan="5">Setting to allow Control Inputs 1 set/ reset.</td></tr>
<tr><td>12</td><td>0D</td><td>Control Input 12</td><td>No Operation</td><td>0 = No Operation, 1 = SET , 2 = RESET</td></tr>
<tr><td colspan="5">Setting to allow Control Inputs 1 set/ reset.</td></tr>
<tr><td>12</td><td>0E</td><td>Control Input 13</td><td>No Operation</td><td>0 = No Operation, 1 = SET , 2 = RESET</td></tr>
</table>

Col	Row	Menu Text	Default Setting	Available Setting
Description				
Setting to allow Control Inputs 1 set/ reset.				
12	0F	Control Input 14	No Operation	0 = No Operation, 1 = SET , 2 = RESET
Setting to allow Control Inputs 1 set/ reset.				
12	10	Control Input 15	No Operation	0 = No Operation, 1 = SET , 2 = RESET
Setting to allow Control Inputs 1 set/ reset.				
12	11	Control Input 16	No Operation	0 = No Operation, 1 = SET , 2 = RESET
Setting to allow Control Inputs 1 set/ reset.				
12	12	Control Input 17	No Operation	0 = No Operation, 1 = SET , 2 = RESET
Setting to allow Control Inputs 1 set/ reset.				
12	13	Control Input 18	No Operation	0 = No Operation, 1 = SET , 2 = RESET
Setting to allow Control Inputs 1 set/ reset.				
12	14	Control Input 19	No Operation	0 = No Operation, 1 = SET , 2 = RESET
Setting to allow Control Inputs 1 set/ reset.				
12	15	Control Input 20	No Operation	0 = No Operation, 1 = SET , 2 = RESET
Setting to allow Control Inputs 1 set/ reset.				
12	16	Control Input 21	No Operation	0 = No Operation, 1 = SET , 2 = RESET
Setting to allow Control Inputs 1 set/ reset.				
12	17	Control Input 22	No Operation	0 = No Operation, 1 = SET , 2 = RESET
Setting to allow Control Inputs 1 set/ reset.				
12	18	Control Input 23	No Operation	0 = No Operation, 1 = SET , 2 = RESET
Setting to allow Control Inputs 1 set/ reset.				
12	19	Control Input 24	No Operation	0 = No Operation, 1 = SET , 2 = RESET
Setting to allow Control Inputs 1 set/ reset.				
12	1A	Control Input 25	No Operation	0 = No Operation, 1 = SET , 2 = RESET
Setting to allow Control Inputs 1 set/ reset.				
12	1B	Control Input 26	No Operation	0 = No Operation, 1 = SET , 2 = RESET
Setting to allow Control Inputs 1 set/ reset.				
12	1C	Control Input 27	No Operation	0 = No Operation, 1 = SET , 2 = RESET
Setting to allow Control Inputs 1 set/ reset.				
12	1D	Control Input 28	No Operation	0 = No Operation, 1 = SET , 2 = RESET
Setting to allow Control Inputs 1 set/ reset.				
12	1E	Control Input 29	No Operation	0 = No Operation, 1 = SET , 2 = RESET
Setting to allow Control Inputs 1 set/ reset.				
12	1F	Control Input 30	No Operation	0 = No Operation, 1 = SET , 2 = RESET
Setting to allow Control Inputs 1 set/ reset.				
12	20	Control Input 31	No Operation	0 = No Operation, 1 = SET , 2 = RESET
Setting to allow Control Inputs 1 set/ reset.				
12	21	Control Input 32	No Operation	0 = No Operation, 1 = SET , 2 = RESET
Setting to allow Control Inputs 1 set/ reset.				

5.11.2 Control Input Setting (Control Input) (P742/P743)

Col	Row	Menu Text	Default Setting	Available Setting	7 4	7 4
Description						
12	00	CONTROL INPUTS			*	*
This column contains settings for the type of control input (32 in all)						
12	01	Ctrl I/P Status	00000000000000000000000000000000(bin)	32-bit binary setting: 0=Reset or 1=Set	*	*
Cell that is used to set (1) and reset (0) the selected Control Input by simply scrolling and changing the status of selected bits. This command will be then recognized and executed in the PSL. Alternatively, each of the 32 Control input can also be set and reset using the individual menu setting cells as follows:						
12	02	Control Input 1	No Operation	0 = No Operation, 1 = SET , 2 = RESET	*	*
Setting to allow Control Inputs 1 set/ reset.						
12	03	Control Input 2	No Operation	0 = No Operation, 1 = SET , 2 = RESET	*	*
Setting to allow Control Inputs 1 set/ reset.						
12	04	Control Input 3	No Operation	0 = No Operation, 1 = SET , 2 = RESET	*	*
Setting to allow Control Inputs 1 set/ reset.						
12	05	Control Input 4	No Operation	0 = No Operation, 1 = SET , 2 = RESET	*	*
Setting to allow Control Inputs 1 set/ reset.						
12	06	Control Input 5	No Operation	0 = No Operation, 1 = SET , 2 = RESET	*	*
Setting to allow Control Inputs 1 set/ reset.						
12	07	Control Input 6	No Operation	0 = No Operation, 1 = SET , 2 = RESET	*	*
Setting to allow Control Inputs 1 set/ reset.						
12	08	Control Input 7	No Operation	0 = No Operation, 1 = SET , 2 = RESET	*	*
Setting to allow Control Inputs 1 set/ reset.						
12	09	Control Input 8	No Operation	0 = No Operation, 1 = SET , 2 = RESET	*	*
Setting to allow Control Inputs 1 set/ reset.						
12	0A	Control Input 9	No Operation	0 = No Operation, 1 = SET , 2 = RESET	*	*
Setting to allow Control Inputs 1 set/ reset.						
12	0B	Control Input 10	No Operation	0 = No Operation, 1 = SET , 2 = RESET	*	*
Setting to allow Control Inputs 1 set/ reset.						
12	0C	Control Input 11	No Operation	0 = No Operation, 1 = SET , 2 = RESET	*	*
Setting to allow Control Inputs 1 set/ reset.						
12	0D	Control Input 12	No Operation	0 = No Operation, 1 = SET , 2 = RESET	*	*
Setting to allow Control Inputs 1 set/ reset.						
12	0E	Control Input 13	No Operation	0 = No Operation, 1 = SET , 2 = RESET	*	*
Setting to allow Control Inputs 1 set/ reset.						

Col	Row	Menu Text	Default Setting	Available Setting	7 4	7 4
Description						
12	0F	Control Input 14	No Operation	0 = No Operation, 1 = SET , 2 = RESET	*	*
Setting to allow Control Inputs 1 set/ reset.						
12	10	Control Input 15	No Operation	0 = No Operation, 1 = SET , 2 = RESET	*	*
Setting to allow Control Inputs 1 set/ reset.						
12	11	Control Input 16	No Operation	0 = No Operation, 1 = SET , 2 = RESET	*	*
Setting to allow Control Inputs 1 set/ reset.						
12	12	Control Input 17	No Operation	0 = No Operation, 1 = SET , 2 = RESET	*	*
Setting to allow Control Inputs 1 set/ reset.						
12	13	Control Input 18	No Operation	0 = No Operation, 1 = SET , 2 = RESET	*	*
Setting to allow Control Inputs 1 set/ reset.						
12	14	Control Input 19	No Operation	0 = No Operation, 1 = SET , 2 = RESET	*	*
Setting to allow Control Inputs 1 set/ reset.						
12	15	Control Input 20	No Operation	0 = No Operation, 1 = SET , 2 = RESET	*	*
Setting to allow Control Inputs 1 set/ reset.						
12	16	Control Input 21	No Operation	0 = No Operation, 1 = SET , 2 = RESET	*	*
Setting to allow Control Inputs 1 set/ reset.						
12	17	Control Input 22	No Operation	0 = No Operation, 1 = SET , 2 = RESET	*	*
Setting to allow Control Inputs 1 set/ reset.						
12	18	Control Input 23	No Operation	0 = No Operation, 1 = SET , 2 = RESET	*	*
Setting to allow Control Inputs 1 set/ reset.						
12	19	Control Input 24	No Operation	0 = No Operation, 1 = SET , 2 = RESET	*	*
Setting to allow Control Inputs 1 set/ reset.						
12	1A	Control Input 25	No Operation	0 = No Operation, 1 = SET , 2 = RESET	*	*
Setting to allow Control Inputs 1 set/ reset.						
12	1B	Control Input 26	No Operation	0 = No Operation, 1 = SET , 2 = RESET	*	*
Setting to allow Control Inputs 1 set/ reset.						
12	1C	Control Input 27	No Operation	0 = No Operation, 1 = SET , 2 = RESET	*	*
Setting to allow Control Inputs 1 set/ reset.						
12	1D	Control Input 28	No Operation	0 = No Operation, 1 = SET , 2 = RESET	*	*
Setting to allow Control Inputs 1 set/ reset.						
12	1E	Control Input 29	No Operation	0 = No Operation, 1 = SET , 2 = RESET	*	*
Setting to allow Control Inputs 1 set/ reset.						

Col	Row	Menu Text	Default Setting	Available Setting	7 4	7 4
Description						
12	1F	Control Input 30	No Operation	0 = No Operation, 1 = SET , 2 = RESET	*	*
Setting to allow Control Inputs 1 set/ reset.						
12	20	Control Input 31	No Operation	0 = No Operation, 1 = SET , 2 = RESET	*	*
Setting to allow Control Inputs 1 set/ reset.						
12	21	Control Input 32	No Operation	0 = No Operation, 1 = SET , 2 = RESET	*	*
Setting to allow Control Inputs 1 set/ reset.						

5.12 Control Input Configuration (Ctrl I/P Config)

The control inputs function as software switches that can be set or reset either locally or remotely. These inputs can be used to trigger any function that they are connected to as part of the PSL.
This column is visible when the “Control I/P Config” setting (“Configuration” column) = “visible”.

The Ctrl I/P Config menu settings vary between products. The options are:

- Control Input Configuration (Ctrl I/P Config) (P741)
- Control Input Configuration (Ctrl I/P Config) (P742/P743)

5.12.1 Control Input Configuration (Ctrl I/P Config) (P741)

<table>
<tr><th>Col</th><th>Row</th><th>Menu Text</th><th>Default Setting</th><th>Available Setting</th></tr>
<tr><th colspan="5">Description</th></tr>
<tr><td>13</td><td>00</td><td>CTRL I/P CONFIG</td><td></td><td></td></tr>
<tr><td colspan="5">This column contains settings for the type of control input (32 in all)</td></tr>
<tr><td>13</td><td>01</td><td>Hotkey Enabled</td><td>11111111111111111111111111111111(bin)</td><td>32-bit binary setting: 0=Not accessible via Hotkey Menu or 1=Accessible via Hotkey Menu</td></tr>
<tr><td colspan="5">Setting to allow the control inputs to be individually assigned to the Hotkey menu by setting ‘1’ in the appropriate bit in the Hotkey Enabled cell. The hotkey menu allows the control inputs to be set, reset or pulsed without the need to enter the CONTROL INPUTS column.
Not available on Chinese version relays.</td></tr>
<tr><td>13</td><td>10</td><td>Control Input 1</td><td>Latched</td><td>0 = Latched or 1 = Pulsed</td></tr>
<tr><td colspan="5">Configures the control inputs as either ‘latched’ or ‘pulsed’. A latched control input will remain in the set state until a reset command is given, either by the menu or the serial communications. A pulsed control input, however, will remain energized for 10 ms after the set command is given and will then reset automatically (i.e. no reset command required).</td></tr>
<tr><td>13</td><td>11</td><td>Ctrl Command 1</td><td>SET/RESET</td><td>0 = ON/OFF, 1 = SET/RESET, 2 = IN/OUT, 3 = ENABLED/DISABLED</td></tr>
<tr><td colspan="5">Allows the SET / RESET text, displayed in the hotkey menu, to be changed to something more suitable for the application of an individual control input, such as ON / OFF, IN / OUT etc.</td></tr>
<tr><td>13</td><td>14</td><td>Control Input 2</td><td>Latched</td><td>0 = Latched or 1 = Pulsed</td></tr>
<tr><td colspan="5">Configures the control inputs as either ‘latched’ or ‘pulsed’. A latched control input will remain in the set state until a reset command is given, either by the menu or the serial communications. A pulsed control input, however, will remain energized for 10 ms after the set command is given and will then reset automatically (i.e. no reset command required).</td></tr>
<tr><td>13</td><td>15</td><td>Ctrl Command 2</td><td>SET/RESET</td><td>0 = ON/OFF, 1 = SET/RESET, 2 = IN/OUT, 3 = ENABLED/DISABLED</td></tr>
<tr><td colspan="5">Allows the SET / RESET text, displayed in the hotkey menu, to be changed to something more suitable for the application of an individual control input, such as ON / OFF, IN / OUT etc.</td></tr>
<tr><td>13</td><td>18</td><td>Control Input 3</td><td>Latched</td><td>0 = Latched or 1 = Pulsed</td></tr>
<tr><td colspan="5">Configures the control inputs as either ‘latched’ or ‘pulsed’. A latched control input will remain in the set state until a reset command is given, either by the menu or the serial communications. A pulsed control input, however, will remain energized for 10 ms after the set command is given and will then reset automatically (i.e. no reset command required).</td></tr>
<tr><td>13</td><td>19</td><td>Ctrl Command 3</td><td>SET/RESET</td><td>0 = ON/OFF, 1 = SET/RESET, 2 = IN/OUT, 3 = ENABLED/DISABLED</td></tr>
<tr><td colspan="5">Allows the SET / RESET text, displayed in the hotkey menu, to be changed to something more suitable for the application of an individual control input, such as ON / OFF, IN / OUT etc.</td></tr>
<tr><td>13</td><td>1C</td><td>Control Input 4</td><td>Latched</td><td>0 = Latched or 1 = Pulsed</td></tr>
</table>

Col	Row	Menu Text	Default Setting	Available Setting
Description				
Configures the control inputs as either 'latched' or 'pulsed'. A latched control input will remain in the set state until a reset command is given, either by the menu or the serial communications. A pulsed control input, however, will remain energized for 10 ms after the set command is given and will then reset automatically (i.e. no reset command required).				
13	1D	Ctrl Command 4	SET/RESET	0 = ON/OFF, 1 = SET/RESET, 2 = IN/OUT, 3 = ENABLED/DISABLED
Allows the SET / RESET text, displayed in the hotkey menu, to be changed to something more suitable for the application of an individual control input, such as ON / OFF, IN / OUT etc.				
13	20	Control Input 5	Latched	0 = Latched or 1 = Pulsed
Configures the control inputs as either 'latched' or 'pulsed'. A latched control input will remain in the set state until a reset command is given, either by the menu or the serial communications. A pulsed control input, however, will remain energized for 10 ms after the set command is given and will then reset automatically (i.e. no reset command required).				
13	21	Ctrl Command 5	SET/RESET	0 = ON/OFF, 1 = SET/RESET, 2 = IN/OUT, 3 = ENABLED/DISABLED
Allows the SET / RESET text, displayed in the hotkey menu, to be changed to something more suitable for the application of an individual control input, such as ON / OFF, IN / OUT etc.				
13	24	Control Input 6	Latched	0 = Latched or 1 = Pulsed
Configures the control inputs as either 'latched' or 'pulsed'. A latched control input will remain in the set state until a reset command is given, either by the menu or the serial communications. A pulsed control input, however, will remain energized for 10 ms after the set command is given and will then reset automatically (i.e. no reset command required).				
13	25	Ctrl Command 6	SET/RESET	0 = ON/OFF, 1 = SET/RESET, 2 = IN/OUT, 3 = ENABLED/DISABLED
Allows the SET / RESET text, displayed in the hotkey menu, to be changed to something more suitable for the application of an individual control input, such as ON / OFF, IN / OUT etc.				
13	28	Control Input 7	Latched	0 = Latched or 1 = Pulsed
Configures the control inputs as either 'latched' or 'pulsed'. A latched control input will remain in the set state until a reset command is given, either by the menu or the serial communications. A pulsed control input, however, will remain energized for 10 ms after the set command is given and will then reset automatically (i.e. no reset command required).				
13	29	Ctrl Command 7	SET/RESET	0 = ON/OFF, 1 = SET/RESET, 2 = IN/OUT, 3 = ENABLED/DISABLED
Allows the SET / RESET text, displayed in the hotkey menu, to be changed to something more suitable for the application of an individual control input, such as ON / OFF, IN / OUT etc.				
13	2C	Control Input 8	Latched	0 = Latched or 1 = Pulsed
Configures the control inputs as either 'latched' or 'pulsed'. A latched control input will remain in the set state until a reset command is given, either by the menu or the serial communications. A pulsed control input, however, will remain energized for 10 ms after the set command is given and will then reset automatically (i.e. no reset command required).				
13	2D	Ctrl Command 8	SET/RESET	0 = ON/OFF, 1 = SET/RESET, 2 = IN/OUT, 3 = ENABLED/DISABLED
Allows the SET / RESET text, displayed in the hotkey menu, to be changed to something more suitable for the application of an individual control input, such as ON / OFF, IN / OUT etc.				
13	30	Control Input 9	Latched	0 = Latched or 1 = Pulsed
Configures the control inputs as either 'latched' or 'pulsed'. A latched control input will remain in the set state until a reset command is given, either by the menu or the serial communications. A pulsed control input, however, will remain energized for 10 ms after the set command is given and will then reset automatically (i.e. no reset command required).				
13	31	Ctrl Command 9	SET/RESET	0 = ON/OFF, 1 = SET/RESET, 2 = IN/OUT, 3 = ENABLED/DISABLED
Allows the SET / RESET text, displayed in the hotkey menu, to be changed to something more suitable for the application of an individual control input, such as ON / OFF, IN / OUT etc.				
13	34	Control Input 10	Latched	0 = Latched or 1 = Pulsed
Configures the control inputs as either 'latched' or 'pulsed'. A latched control input will remain in the set state until a reset command is given, either by the menu or the serial communications. A pulsed control input, however, will remain energized for 10 ms after the set command is given and will then reset automatically (i.e. no reset command required).				

Col	Row	Menu Text	Default Setting	Available Setting
Description				
13	35	Ctrl Command 10	SET/RESET	0 = ON/OFF, 1 = SET/RESET, 2 = IN/OUT, 3 = ENABLED/DISABLED
Allows the SET / RESET text, displayed in the hotkey menu, to be changed to something more suitable for the application of an individual control input, such as ON / OFF, IN / OUT etc.				
13	38	Control Input 11	Latched	0 = Latched or 1 = Pulsed
Configures the control inputs as either 'latched' or 'pulsed'. A latched control input will remain in the set state until a reset command is given, either by the menu or the serial communications. A pulsed control input, however, will remain energized for 10 ms after the set command is given and will then reset automatically (i.e. no reset command required).				
13	39	Ctrl Command 11	SET/RESET	0 = ON/OFF, 1 = SET/RESET, 2 = IN/OUT, 3 = ENABLED/DISABLED
Allows the SET / RESET text, displayed in the hotkey menu, to be changed to something more suitable for the application of an individual control input, such as ON / OFF, IN / OUT etc.				
13	3C	Control Input 12	Latched	0 = Latched or 1 = Pulsed
Configures the control inputs as either 'latched' or 'pulsed'. A latched control input will remain in the set state until a reset command is given, either by the menu or the serial communications. A pulsed control input, however, will remain energized for 10 ms after the set command is given and will then reset automatically (i.e. no reset command required).				
13	3D	Ctrl Command 12	SET/RESET	0 = ON/OFF, 1 = SET/RESET, 2 = IN/OUT, 3 = ENABLED/DISABLED
Allows the SET / RESET text, displayed in the hotkey menu, to be changed to something more suitable for the application of an individual control input, such as ON / OFF, IN / OUT etc.				
13	40	Control Input 13	Latched	0 = Latched or 1 = Pulsed
Configures the control inputs as either 'latched' or 'pulsed'. A latched control input will remain in the set state until a reset command is given, either by the menu or the serial communications. A pulsed control input, however, will remain energized for 10 ms after the set command is given and will then reset automatically (i.e. no reset command required).				
13	41	Ctrl Command 13	SET/RESET	0 = ON/OFF, 1 = SET/RESET, 2 = IN/OUT, 3 = ENABLED/DISABLED
Allows the SET / RESET text, displayed in the hotkey menu, to be changed to something more suitable for the application of an individual control input, such as ON / OFF, IN / OUT etc.				
13	44	Control Input 14	Latched	0 = Latched or 1 = Pulsed
Configures the control inputs as either 'latched' or 'pulsed'. A latched control input will remain in the set state until a reset command is given, either by the menu or the serial communications. A pulsed control input, however, will remain energized for 10 ms after the set command is given and will then reset automatically (i.e. no reset command required).				
13	45	Ctrl Command 14	SET/RESET	0 = ON/OFF, 1 = SET/RESET, 2 = IN/OUT, 3 = ENABLED/DISABLED
Allows the SET / RESET text, displayed in the hotkey menu, to be changed to something more suitable for the application of an individual control input, such as ON / OFF, IN / OUT etc.				
13	48	Control Input 15	Latched	0 = Latched or 1 = Pulsed
Configures the control inputs as either 'latched' or 'pulsed'. A latched control input will remain in the set state until a reset command is given, either by the menu or the serial communications. A pulsed control input, however, will remain energized for 10 ms after the set command is given and will then reset automatically (i.e. no reset command required).				
13	49	Ctrl Command 15	SET/RESET	0 = ON/OFF, 1 = SET/RESET, 2 = IN/OUT, 3 = ENABLED/DISABLED
Allows the SET / RESET text, displayed in the hotkey menu, to be changed to something more suitable for the application of an individual control input, such as ON / OFF, IN / OUT etc.				
13	4C	Control Input 16	Latched	0 = Latched or 1 = Pulsed
Configures the control inputs as either 'latched' or 'pulsed'. A latched control input will remain in the set state until a reset command is given, either by the menu or the serial communications. A pulsed control input, however, will remain energized for 10 ms after the set command is given and will then reset automatically (i.e. no reset command required).				
13	4D	Ctrl Command 16	SET/RESET	0 = ON/OFF, 1 = SET/RESET, 2 = IN/OUT, 3 = ENABLED/DISABLED

Col	Row	Menu Text	Default Setting	Available Setting
Description				
Allows the SET / RESET text, displayed in the hotkey menu, to be changed to something more suitable for the application of an individual control input, such as ON / OFF, IN / OUT etc.				
13	50	Control Input 17	Latched	0 = Latched or 1 = Pulsed
Configures the control inputs as either ‘latched’ or ‘pulsed’. A latched control input will remain in the set state until a reset command is given, either by the menu or the serial communications. A pulsed control input, however, will remain energized for 10 ms after the set command is given and will then reset automatically (i.e. no reset command required).				
13	51	Ctrl Command 17	SET/RESET	0 = ON/OFF, 1 = SET/RESET, 2 = IN/OUT, 3 = ENABLED/DISABLED
Allows the SET / RESET text, displayed in the hotkey menu, to be changed to something more suitable for the application of an individual control input, such as ON / OFF, IN / OUT etc.				
13	54	Control Input 18	Latched	0 = Latched or 1 = Pulsed
Configures the control inputs as either ‘latched’ or ‘pulsed’. A latched control input will remain in the set state until a reset command is given, either by the menu or the serial communications. A pulsed control input, however, will remain energized for 10 ms after the set command is given and will then reset automatically (i.e. no reset command required).				
13	55	Ctrl Command 18	SET/RESET	0 = ON/OFF, 1 = SET/RESET, 2 = IN/OUT, 3 = ENABLED/DISABLED
Allows the SET / RESET text, displayed in the hotkey menu, to be changed to something more suitable for the application of an individual control input, such as ON / OFF, IN / OUT etc.				
13	58	Control Input 19	Latched	0 = Latched or 1 = Pulsed
Configures the control inputs as either ‘latched’ or ‘pulsed’. A latched control input will remain in the set state until a reset command is given, either by the menu or the serial communications. A pulsed control input, however, will remain energized for 10 ms after the set command is given and will then reset automatically (i.e. no reset command required).				
13	59	Ctrl Command 19	SET/RESET	0 = ON/OFF, 1 = SET/RESET, 2 = IN/OUT, 3 = ENABLED/DISABLED
Allows the SET / RESET text, displayed in the hotkey menu, to be changed to something more suitable for the application of an individual control input, such as ON / OFF, IN / OUT etc.				
13	5C	Control Input 20	Latched	0 = Latched or 1 = Pulsed
Configures the control inputs as either ‘latched’ or ‘pulsed’. A latched control input will remain in the set state until a reset command is given, either by the menu or the serial communications. A pulsed control input, however, will remain energized for 10 ms after the set command is given and will then reset automatically (i.e. no reset command required).				
13	5D	Ctrl Command 20	SET/RESET	0 = ON/OFF, 1 = SET/RESET, 2 = IN/OUT, 3 = ENABLED/DISABLED
Allows the SET / RESET text, displayed in the hotkey menu, to be changed to something more suitable for the application of an individual control input, such as ON / OFF, IN / OUT etc.				
13	60	Control Input 21	Latched	0 = Latched or 1 = Pulsed
Configures the control inputs as either ‘latched’ or ‘pulsed’. A latched control input will remain in the set state until a reset command is given, either by the menu or the serial communications. A pulsed control input, however, will remain energized for 10 ms after the set command is given and will then reset automatically (i.e. no reset command required).				
13	61	Ctrl Command 21	SET/RESET	0 = ON/OFF, 1 = SET/RESET, 2 = IN/OUT, 3 = ENABLED/DISABLED
Allows the SET / RESET text, displayed in the hotkey menu, to be changed to something more suitable for the application of an individual control input, such as ON / OFF, IN / OUT etc.				
13	64	Control Input 22	Latched	0 = Latched or 1 = Pulsed
Configures the control inputs as either ‘latched’ or ‘pulsed’. A latched control input will remain in the set state until a reset command is given, either by the menu or the serial communications. A pulsed control input, however, will remain energized for 10 ms after the set command is given and will then reset automatically (i.e. no reset command required).				
13	65	Ctrl Command 22	SET/RESET	0 = ON/OFF, 1 = SET/RESET, 2 = IN/OUT, 3 = ENABLED/DISABLED
Allows the SET / RESET text, displayed in the hotkey menu, to be changed to something more suitable for the application of an individual control input, such as ON / OFF, IN / OUT etc.				
13	68	Control Input 23	Latched	0 = Latched or 1 = Pulsed

Col	Row	Menu Text	Default Setting	Available Setting
Description				
Configures the control inputs as either 'latched' or 'pulsed'. A latched control input will remain in the set state until a reset command is given, either by the menu or the serial communications. A pulsed control input, however, will remain energized for 10 ms after the set command is given and will then reset automatically (i.e. no reset command required).				
13	69	Ctrl Command 23	SET/RESET	0 = ON/OFF, 1 = SET/RESET, 2 = IN/OUT, 3 = ENABLED/DISABLED
Allows the SET / RESET text, displayed in the hotkey menu, to be changed to something more suitable for the application of an individual control input, such as ON / OFF, IN / OUT etc.				
13	6C	Control Input 24	Latched	0 = Latched or 1 = Pulsed
Configures the control inputs as either 'latched' or 'pulsed'. A latched control input will remain in the set state until a reset command is given, either by the menu or the serial communications. A pulsed control input, however, will remain energized for 10 ms after the set command is given and will then reset automatically (i.e. no reset command required).				
13	6D	Ctrl Command 24	SET/RESET	0 = ON/OFF, 1 = SET/RESET, 2 = IN/OUT, 3 = ENABLED/DISABLED
Allows the SET / RESET text, displayed in the hotkey menu, to be changed to something more suitable for the application of an individual control input, such as ON / OFF, IN / OUT etc.				
13	70	Control Input 25	Latched	0 = Latched or 1 = Pulsed
Configures the control inputs as either 'latched' or 'pulsed'. A latched control input will remain in the set state until a reset command is given, either by the menu or the serial communications. A pulsed control input, however, will remain energized for 10 ms after the set command is given and will then reset automatically (i.e. no reset command required).				
13	71	Ctrl Command 25	SET/RESET	0 = ON/OFF, 1 = SET/RESET, 2 = IN/OUT, 3 = ENABLED/DISABLED
Allows the SET / RESET text, displayed in the hotkey menu, to be changed to something more suitable for the application of an individual control input, such as ON / OFF, IN / OUT etc.				
13	74	Control Input 26	Latched	0 = Latched or 1 = Pulsed
Configures the control inputs as either 'latched' or 'pulsed'. A latched control input will remain in the set state until a reset command is given, either by the menu or the serial communications. A pulsed control input, however, will remain energized for 10 ms after the set command is given and will then reset automatically (i.e. no reset command required).				
13	75	Ctrl Command 26	SET/RESET	0 = ON/OFF, 1 = SET/RESET, 2 = IN/OUT, 3 = ENABLED/DISABLED
Allows the SET / RESET text, displayed in the hotkey menu, to be changed to something more suitable for the application of an individual control input, such as ON / OFF, IN / OUT etc.				
13	78	Control Input 27	Latched	0 = Latched or 1 = Pulsed
Configures the control inputs as either 'latched' or 'pulsed'. A latched control input will remain in the set state until a reset command is given, either by the menu or the serial communications. A pulsed control input, however, will remain energized for 10 ms after the set command is given and will then reset automatically (i.e. no reset command required).				
13	79	Ctrl Command 27	SET/RESET	0 = ON/OFF, 1 = SET/RESET, 2 = IN/OUT, 3 = ENABLED/DISABLED
Allows the SET / RESET text, displayed in the hotkey menu, to be changed to something more suitable for the application of an individual control input, such as ON / OFF, IN / OUT etc.				
13	7C	Control Input 28	Latched	0 = Latched or 1 = Pulsed
Configures the control inputs as either 'latched' or 'pulsed'. A latched control input will remain in the set state until a reset command is given, either by the menu or the serial communications. A pulsed control input, however, will remain energized for 10 ms after the set command is given and will then reset automatically (i.e. no reset command required).				
13	7D	Ctrl Command 28	SET/RESET	0 = ON/OFF, 1 = SET/RESET, 2 = IN/OUT, 3 = ENABLED/DISABLED
Allows the SET / RESET text, displayed in the hotkey menu, to be changed to something more suitable for the application of an individual control input, such as ON / OFF, IN / OUT etc.				
13	80	Control Input 29	Latched	0 = Latched or 1 = Pulsed
Configures the control inputs as either 'latched' or 'pulsed'. A latched control input will remain in the set state until a reset command is given, either by the menu or the serial communications. A pulsed control input, however, will remain energized for 10 ms after the set command is given and will then reset automatically (i.e. no reset command required).				

Col	Row	Menu Text	Default Setting	Available Setting
Description				
13	81	Ctrl Command 29	SET/RESET	0 = ON/OFF, 1 = SET/RESET, 2 = IN/OUT, 3 = ENABLED/DISABLED
Allows the SET / RESET text, displayed in the hotkey menu, to be changed to something more suitable for the application of an individual control input, such as ON / OFF, IN / OUT etc.				
13	84	Control Input 30	Latched	0 = Latched or 1 = Pulsed
Configures the control inputs as either 'latched' or 'pulsed'. A latched control input will remain in the set state until a reset command is given, either by the menu or the serial communications. A pulsed control input, however, will remain energized for 10 ms after the set command is given and will then reset automatically (i.e. no reset command required).				
13	85	Ctrl Command 30	SET/RESET	0 = ON/OFF, 1 = SET/RESET, 2 = IN/OUT, 3 = ENABLED/DISABLED
Allows the SET / RESET text, displayed in the hotkey menu, to be changed to something more suitable for the application of an individual control input, such as ON / OFF, IN / OUT etc.				
13	88	Control Input 31	Latched	0 = Latched or 1 = Pulsed
Configures the control inputs as either 'latched' or 'pulsed'. A latched control input will remain in the set state until a reset command is given, either by the menu or the serial communications. A pulsed control input, however, will remain energized for 10 ms after the set command is given and will then reset automatically (i.e. no reset command required).				
13	89	Ctrl Command 31	SET/RESET	0 = ON/OFF, 1 = SET/RESET, 2 = IN/OUT, 3 = ENABLED/DISABLED
Allows the SET / RESET text, displayed in the hotkey menu, to be changed to something more suitable for the application of an individual control input, such as ON / OFF, IN / OUT etc.				
13	8C	Control Input 32	Latched	0 = Latched or 1 = Pulsed
Configures the control inputs as either 'latched' or 'pulsed'. A latched control input will remain in the set state until a reset command is given, either by the menu or the serial communications. A pulsed control input, however, will remain energized for 10 ms after the set command is given and will then reset automatically (i.e. no reset command required).				
13	8D	Ctrl Command 32	SET/RESET	0 = ON/OFF, 1 = SET/RESET, 2 = IN/OUT, 3 = ENABLED/DISABLED
Allows the SET / RESET text, displayed in the hotkey menu, to be changed to something more suitable for the application of an individual control input, such as ON / OFF, IN / OUT etc.				

5.12.2 Control Input Configuration (Ctrl I/P Config) (P742/P743)

Col	Row	Menu Text	Default Setting	Available Setting	.74	P743
Description						
13	00	CTRL I/P CONFIG			*	*
This column contains settings for the type of control input (32 in all)						
13	01	Hotkey Enabled	11111111111111111111111111111111(bin)	32-bit binary setting: 0=Not accessible via Hotkey Menu or 1=Accessible via Hotkey Menu	*	*
Setting to allow the control inputs to be individually assigned to the Hotkey menu by setting '1' in the appropriate bit in the Hotkey Enabled cell. The hotkey menu allows the control inputs to be set, reset or pulsed without the need to enter the CONTROL INPUTS column. Not available on Chinese version relays.						
13	10	Control Input 1	Latched	0 = Latched or 1 = Pulsed	*	*
Configures the control inputs as either 'latched' or 'pulsed'. A latched control input will remain in the set state until a reset command is given, either by the menu or the serial communications. A pulsed control input, however, will remain energized for 10 ms after the set command is given and will then reset automatically (i.e. no reset command required).						

Col	Row	Menu Text	Default Setting	Available Setting	P742	P743
Description						
13	11	Ctrl Command 1	SET/RESET	0 = ON/OFF, 1 = SET/RESET, 2 = IN/OUT, 3 = ENABLED/DISABLED	*	*
Allows the SET / RESET text, displayed in the hotkey menu, to be changed to something more suitable for the application of an individual control input, such as ON / OFF, IN / OUT etc.						
13	14	Control Input 2	Latched	0 = Latched or 1 = Pulsed	*	*
Configures the control inputs as either ‘latched’ or ‘pulsed’. A latched control input will remain in the set state until a reset command is given, either by the menu or the serial communications. A pulsed control input, however, will remain energized for 10 ms after the set command is given and will then reset automatically (i.e. no reset command required).						
13	15	Ctrl Command 2	SET/RESET	0 = ON/OFF, 1 = SET/RESET, 2 = IN/OUT, 3 = ENABLED/DISABLED	*	*
Allows the SET / RESET text, displayed in the hotkey menu, to be changed to something more suitable for the application of an individual control input, such as ON / OFF, IN / OUT etc.						
13	18	Control Input 3	Latched	0 = Latched or 1 = Pulsed	*	*
Configures the control inputs as either ‘latched’ or ‘pulsed’. A latched control input will remain in the set state until a reset command is given, either by the menu or the serial communications. A pulsed control input, however, will remain energized for 10 ms after the set command is given and will then reset automatically (i.e. no reset command required).						
13	19	Ctrl Command 3	SET/RESET	0 = ON/OFF, 1 = SET/RESET, 2 = IN/OUT, 3 = ENABLED/DISABLED	*	*
Allows the SET / RESET text, displayed in the hotkey menu, to be changed to something more suitable for the application of an individual control input, such as ON / OFF, IN / OUT etc.						
13	1C	Control Input 4	Latched	0 = Latched or 1 = Pulsed	*	*
Configures the control inputs as either ‘latched’ or ‘pulsed’. A latched control input will remain in the set state until a reset command is given, either by the menu or the serial communications. A pulsed control input, however, will remain energized for 10 ms after the set command is given and will then reset automatically (i.e. no reset command required).						
13	1D	Ctrl Command 4	SET/RESET	0 = ON/OFF, 1 = SET/RESET, 2 = IN/OUT, 3 = ENABLED/DISABLED	*	*
Allows the SET / RESET text, displayed in the hotkey menu, to be changed to something more suitable for the application of an individual control input, such as ON / OFF, IN / OUT etc.						
13	20	Control Input 5	Latched	0 = Latched or 1 = Pulsed	*	*
Configures the control inputs as either ‘latched’ or ‘pulsed’. A latched control input will remain in the set state until a reset command is given, either by the menu or the serial communications. A pulsed control input, however, will remain energized for 10 ms after the set command is given and will then reset automatically (i.e. no reset command required).						
13	21	Ctrl Command 5	SET/RESET	0 = ON/OFF, 1 = SET/RESET, 2 = IN/OUT, 3 = ENABLED/DISABLED	*	*
Allows the SET / RESET text, displayed in the hotkey menu, to be changed to something more suitable for the application of an individual control input, such as ON / OFF, IN / OUT etc.						
13	24	Control Input 6	Latched	0 = Latched or 1 = Pulsed	*	*
Configures the control inputs as either ‘latched’ or ‘pulsed’. A latched control input will remain in the set state until a reset command is given, either by the menu or the serial communications. A pulsed control input, however, will remain energized for 10 ms after the set command is given and will then reset automatically (i.e. no reset command required).						
13	25	Ctrl Command 6	SET/RESET	0 = ON/OFF, 1 = SET/RESET, 2 = IN/OUT, 3 = ENABLED/DISABLED	*	*
Allows the SET / RESET text, displayed in the hotkey menu, to be changed to something more suitable for the application of an individual control input, such as ON / OFF, IN / OUT etc.						
13	28	Control Input 7	Latched	0 = Latched or 1 = Pulsed	*	*

Col	Row	Menu Text	Default Setting	Available Setting	.74	P743
Description						
Configures the control inputs as either ‘latched’ or ‘pulsed’. A latched control input will remain in the set state until a reset command is given, either by the menu or the serial communications. A pulsed control input, however, will remain energized for 10 ms after the set command is given and will then reset automatically (i.e. no reset command required).						
13	29	Ctrl Command 7	SET/RESET	0 = ON/OFF, 1 = SET/RESET, 2 = IN/OUT, 3 = ENABLED/DISABLED	*	*
Allows the SET / RESET text, displayed in the hotkey menu, to be changed to something more suitable for the application of an individual control input, such as ON / OFF, IN / OUT etc.						
13	2C	Control Input 8	Latched	0 = Latched or 1 = Pulsed	*	*
Configures the control inputs as either ‘latched’ or ‘pulsed’. A latched control input will remain in the set state until a reset command is given, either by the menu or the serial communications. A pulsed control input, however, will remain energized for 10 ms after the set command is given and will then reset automatically (i.e. no reset command required).						
13	2D	Ctrl Command 8	SET/RESET	0 = ON/OFF, 1 = SET/RESET, 2 = IN/OUT, 3 = ENABLED/DISABLED	*	*
Allows the SET / RESET text, displayed in the hotkey menu, to be changed to something more suitable for the application of an individual control input, such as ON / OFF, IN / OUT etc.						
13	30	Control Input 9	Latched	0 = Latched or 1 = Pulsed	*	*
Configures the control inputs as either ‘latched’ or ‘pulsed’. A latched control input will remain in the set state until a reset command is given, either by the menu or the serial communications. A pulsed control input, however, will remain energized for 10 ms after the set command is given and will then reset automatically (i.e. no reset command required).						
13	31	Ctrl Command 9	SET/RESET	0 = ON/OFF, 1 = SET/RESET, 2 = IN/OUT, 3 = ENABLED/DISABLED	*	*
Allows the SET / RESET text, displayed in the hotkey menu, to be changed to something more suitable for the application of an individual control input, such as ON / OFF, IN / OUT etc.						
13	34	Control Input 10	Latched	0 = Latched or 1 = Pulsed	*	*
Configures the control inputs as either ‘latched’ or ‘pulsed’. A latched control input will remain in the set state until a reset command is given, either by the menu or the serial communications. A pulsed control input, however, will remain energized for 10 ms after the set command is given and will then reset automatically (i.e. no reset command required).						
13	35	Ctrl Command 10	SET/RESET	0 = ON/OFF, 1 = SET/RESET, 2 = IN/OUT, 3 = ENABLED/DISABLED	*	*
Allows the SET / RESET text, displayed in the hotkey menu, to be changed to something more suitable for the application of an individual control input, such as ON / OFF, IN / OUT etc.						
13	38	Control Input 11	Latched	0 = Latched or 1 = Pulsed	*	*
Configures the control inputs as either ‘latched’ or ‘pulsed’. A latched control input will remain in the set state until a reset command is given, either by the menu or the serial communications. A pulsed control input, however, will remain energized for 10 ms after the set command is given and will then reset automatically (i.e. no reset command required).						
13	39	Ctrl Command 11	SET/RESET	0 = ON/OFF, 1 = SET/RESET, 2 = IN/OUT, 3 = ENABLED/DISABLED	*	*
Allows the SET / RESET text, displayed in the hotkey menu, to be changed to something more suitable for the application of an individual control input, such as ON / OFF, IN / OUT etc.						
13	3C	Control Input 12	Latched	0 = Latched or 1 = Pulsed	*	*
Configures the control inputs as either ‘latched’ or ‘pulsed’. A latched control input will remain in the set state until a reset command is given, either by the menu or the serial communications. A pulsed control input, however, will remain energized for 10 ms after the set command is given and will then reset automatically (i.e. no reset command required).						
13	3D	Ctrl Command 12	SET/RESET	0 = ON/OFF, 1 = SET/RESET, 2 = IN/OUT, 3 = ENABLED/DISABLED	*	*

Col	Row	Menu Text	Default Setting	Available Setting	.74	P743
Description						
Allows the SET / RESET text, displayed in the hotkey menu, to be changed to something more suitable for the application of an individual control input, such as ON / OFF, IN / OUT etc.						
13	40	Control Input 13	Latched	0 = Latched or 1 = Pulsed	*	*
Configures the control inputs as either 'latched' or 'pulsed'. A latched control input will remain in the set state until a reset command is given, either by the menu or the serial communications. A pulsed control input, however, will remain energized for 10 ms after the set command is given and will then reset automatically (i.e. no reset command required).						
13	41	Ctrl Command 13	SET/RESET	0 = ON/OFF, 1 = SET/RESET, 2 = IN/OUT, 3 = ENABLED/DISABLED	*	*
Allows the SET / RESET text, displayed in the hotkey menu, to be changed to something more suitable for the application of an individual control input, such as ON / OFF, IN / OUT etc.						
13	44	Control Input 14	Latched	0 = Latched or 1 = Pulsed	*	*
Configures the control inputs as either 'latched' or 'pulsed'. A latched control input will remain in the set state until a reset command is given, either by the menu or the serial communications. A pulsed control input, however, will remain energized for 10 ms after the set command is given and will then reset automatically (i.e. no reset command required).						
13	45	Ctrl Command 14	SET/RESET	0 = ON/OFF, 1 = SET/RESET, 2 = IN/OUT, 3 = ENABLED/DISABLED	*	*
Allows the SET / RESET text, displayed in the hotkey menu, to be changed to something more suitable for the application of an individual control input, such as ON / OFF, IN / OUT etc.						
13	48	Control Input 15	Latched	0 = Latched or 1 = Pulsed	*	*
Configures the control inputs as either 'latched' or 'pulsed'. A latched control input will remain in the set state until a reset command is given, either by the menu or the serial communications. A pulsed control input, however, will remain energized for 10 ms after the set command is given and will then reset automatically (i.e. no reset command required).						
13	49	Ctrl Command 15	SET/RESET	0 = ON/OFF, 1 = SET/RESET, 2 = IN/OUT, 3 = ENABLED/DISABLED	*	*
Allows the SET / RESET text, displayed in the hotkey menu, to be changed to something more suitable for the application of an individual control input, such as ON / OFF, IN / OUT etc.						
13	4C	Control Input 16	Latched	0 = Latched or 1 = Pulsed	*	*
Configures the control inputs as either 'latched' or 'pulsed'. A latched control input will remain in the set state until a reset command is given, either by the menu or the serial communications. A pulsed control input, however, will remain energized for 10 ms after the set command is given and will then reset automatically (i.e. no reset command required).						
13	4D	Ctrl Command 16	SET/RESET	0 = ON/OFF, 1 = SET/RESET, 2 = IN/OUT, 3 = ENABLED/DISABLED	*	*
Allows the SET / RESET text, displayed in the hotkey menu, to be changed to something more suitable for the application of an individual control input, such as ON / OFF, IN / OUT etc.						
13	50	Control Input 17	Latched	0 = Latched or 1 = Pulsed	*	*
Configures the control inputs as either 'latched' or 'pulsed'. A latched control input will remain in the set state until a reset command is given, either by the menu or the serial communications. A pulsed control input, however, will remain energized for 10 ms after the set command is given and will then reset automatically (i.e. no reset command required).						
13	51	Ctrl Command 17	SET/RESET	0 = ON/OFF, 1 = SET/RESET, 2 = IN/OUT, 3 = ENABLED/DISABLED	*	*
Allows the SET / RESET text, displayed in the hotkey menu, to be changed to something more suitable for the application of an individual control input, such as ON / OFF, IN / OUT etc.						
13	54	Control Input 18	Latched	0 = Latched or 1 = Pulsed	*	*
Configures the control inputs as either 'latched' or 'pulsed'. A latched control input will remain in the set state until a reset command is given, either by the menu or the serial communications. A pulsed control input, however, will remain energized for 10 ms after the set command is given and will then reset automatically (i.e. no reset command required).						

Col	Row	Menu Text	Default Setting	Available Setting	P742	P743
Description						
13	55	Ctrl Command 18	SET/RESET	0 = ON/OFF, 1 = SET/RESET, 2 = IN/OUT, 3 = ENABLED/DISABLED	*	*
Allows the SET / RESET text, displayed in the hotkey menu, to be changed to something more suitable for the application of an individual control input, such as ON / OFF, IN / OUT etc.						
13	58	Control Input 19	Latched	0 = Latched or 1 = Pulsed	*	*
Configures the control inputs as either ‘latched’ or ‘pulsed’. A latched control input will remain in the set state until a reset command is given, either by the menu or the serial communications. A pulsed control input, however, will remain energized for 10 ms after the set command is given and will then reset automatically (i.e. no reset command required).						
13	59	Ctrl Command 19	SET/RESET	0 = ON/OFF, 1 = SET/RESET, 2 = IN/OUT, 3 = ENABLED/DISABLED	*	*
Allows the SET / RESET text, displayed in the hotkey menu, to be changed to something more suitable for the application of an individual control input, such as ON / OFF, IN / OUT etc.						
13	5C	Control Input 20	Latched	0 = Latched or 1 = Pulsed	*	*
Configures the control inputs as either ‘latched’ or ‘pulsed’. A latched control input will remain in the set state until a reset command is given, either by the menu or the serial communications. A pulsed control input, however, will remain energized for 10 ms after the set command is given and will then reset automatically (i.e. no reset command required).						
13	5D	Ctrl Command 20	SET/RESET	0 = ON/OFF, 1 = SET/RESET, 2 = IN/OUT, 3 = ENABLED/DISABLED	*	*
Allows the SET / RESET text, displayed in the hotkey menu, to be changed to something more suitable for the application of an individual control input, such as ON / OFF, IN / OUT etc.						
13	60	Control Input 21	Latched	0 = Latched or 1 = Pulsed	*	*
Configures the control inputs as either ‘latched’ or ‘pulsed’. A latched control input will remain in the set state until a reset command is given, either by the menu or the serial communications. A pulsed control input, however, will remain energized for 10 ms after the set command is given and will then reset automatically (i.e. no reset command required).						
13	61	Ctrl Command 21	SET/RESET	0 = ON/OFF, 1 = SET/RESET, 2 = IN/OUT, 3 = ENABLED/DISABLED	*	*
Allows the SET / RESET text, displayed in the hotkey menu, to be changed to something more suitable for the application of an individual control input, such as ON / OFF, IN / OUT etc.						
13	64	Control Input 22	Latched	0 = Latched or 1 = Pulsed	*	*
Configures the control inputs as either ‘latched’ or ‘pulsed’. A latched control input will remain in the set state until a reset command is given, either by the menu or the serial communications. A pulsed control input, however, will remain energized for 10 ms after the set command is given and will then reset automatically (i.e. no reset command required).						
13	65	Ctrl Command 22	SET/RESET	0 = ON/OFF, 1 = SET/RESET, 2 = IN/OUT, 3 = ENABLED/DISABLED	*	*
Allows the SET / RESET text, displayed in the hotkey menu, to be changed to something more suitable for the application of an individual control input, such as ON / OFF, IN / OUT etc.						
13	68	Control Input 23	Latched	0 = Latched or 1 = Pulsed	*	*
Configures the control inputs as either ‘latched’ or ‘pulsed’. A latched control input will remain in the set state until a reset command is given, either by the menu or the serial communications. A pulsed control input, however, will remain energized for 10 ms after the set command is given and will then reset automatically (i.e. no reset command required).						
13	69	Ctrl Command 23	SET/RESET	0 = ON/OFF, 1 = SET/RESET, 2 = IN/OUT, 3 = ENABLED/DISABLED	*	*
Allows the SET / RESET text, displayed in the hotkey menu, to be changed to something more suitable for the application of an individual control input, such as ON / OFF, IN / OUT etc.						
13	6C	Control Input 24	Latched	0 = Latched or 1 = Pulsed	*	*

Col	Row	Menu Text	Default Setting	Available Setting	. 7 4	P743
Description						
Configures the control inputs as either ‘latched’ or ‘pulsed’. A latched control input will remain in the set state until a reset command is given, either by the menu or the serial communications. A pulsed control input, however, will remain energized for 10 ms after the set command is given and will then reset automatically (i.e. no reset command required).						
13	6D	Ctrl Command 24	SET/RESET	0 = ON/OFF, 1 = SET/RESET, 2 = IN/OUT, 3 = ENABLED/DISABLED	*	*
Allows the SET / RESET text, displayed in the hotkey menu, to be changed to something more suitable for the application of an individual control input, such as ON / OFF, IN / OUT etc.						
13	70	Control Input 25	Latched	0 = Latched or 1 = Pulsed	*	*
Configures the control inputs as either ‘latched’ or ‘pulsed’. A latched control input will remain in the set state until a reset command is given, either by the menu or the serial communications. A pulsed control input, however, will remain energized for 10 ms after the set command is given and will then reset automatically (i.e. no reset command required).						
13	71	Ctrl Command 25	SET/RESET	0 = ON/OFF, 1 = SET/RESET, 2 = IN/OUT, 3 = ENABLED/DISABLED	*	*
Allows the SET / RESET text, displayed in the hotkey menu, to be changed to something more suitable for the application of an individual control input, such as ON / OFF, IN / OUT etc.						
13	74	Control Input 26	Latched	0 = Latched or 1 = Pulsed	*	*
Configures the control inputs as either ‘latched’ or ‘pulsed’. A latched control input will remain in the set state until a reset command is given, either by the menu or the serial communications. A pulsed control input, however, will remain energized for 10 ms after the set command is given and will then reset automatically (i.e. no reset command required).						
13	75	Ctrl Command 26	SET/RESET	0 = ON/OFF, 1 = SET/RESET, 2 = IN/OUT, 3 = ENABLED/DISABLED	*	*
Allows the SET / RESET text, displayed in the hotkey menu, to be changed to something more suitable for the application of an individual control input, such as ON / OFF, IN / OUT etc.						
13	78	Control Input 27	Latched	0 = Latched or 1 = Pulsed	*	*
Configures the control inputs as either ‘latched’ or ‘pulsed’. A latched control input will remain in the set state until a reset command is given, either by the menu or the serial communications. A pulsed control input, however, will remain energized for 10 ms after the set command is given and will then reset automatically (i.e. no reset command required).						
13	79	Ctrl Command 27	SET/RESET	0 = ON/OFF, 1 = SET/RESET, 2 = IN/OUT, 3 = ENABLED/DISABLED	*	*
Allows the SET / RESET text, displayed in the hotkey menu, to be changed to something more suitable for the application of an individual control input, such as ON / OFF, IN / OUT etc.						
13	7C	Control Input 28	Latched	0 = Latched or 1 = Pulsed	*	*
Configures the control inputs as either ‘latched’ or ‘pulsed’. A latched control input will remain in the set state until a reset command is given, either by the menu or the serial communications. A pulsed control input, however, will remain energized for 10 ms after the set command is given and will then reset automatically (i.e. no reset command required).						
13	7D	Ctrl Command 28	SET/RESET	0 = ON/OFF, 1 = SET/RESET, 2 = IN/OUT, 3 = ENABLED/DISABLED	*	*
Allows the SET / RESET text, displayed in the hotkey menu, to be changed to something more suitable for the application of an individual control input, such as ON / OFF, IN / OUT etc.						
13	80	Control Input 29	Latched	0 = Latched or 1 = Pulsed	*	*
Configures the control inputs as either ‘latched’ or ‘pulsed’. A latched control input will remain in the set state until a reset command is given, either by the menu or the serial communications. A pulsed control input, however, will remain energized for 10 ms after the set command is given and will then reset automatically (i.e. no reset command required).						
13	81	Ctrl Command 29	SET/RESET	0 = ON/OFF, 1 = SET/RESET, 2 = IN/OUT, 3 = ENABLED/DISABLED	*	*

Col	Row	Menu Text	Default Setting	Available Setting	P742	P743
Description						
Allows the SET / RESET text, displayed in the hotkey menu, to be changed to something more suitable for the application of an individual control input, such as ON / OFF, IN / OUT etc.						
13	84	Control Input 30	Latched	0 = Latched or 1 = Pulsed	*	*
Configures the control inputs as either ‘latched’ or ‘pulsed’. A latched control input will remain in the set state until a reset command is given, either by the menu or the serial communications. A pulsed control input, however, will remain energized for 10 ms after the set command is given and will then reset automatically (i.e. no reset command required).						
13	85	Ctrl Command 30	SET/RESET	0 = ON/OFF, 1 = SET/RESET, 2 = IN/OUT, 3 = ENABLED/DISABLED	*	*
Allows the SET / RESET text, displayed in the hotkey menu, to be changed to something more suitable for the application of an individual control input, such as ON / OFF, IN / OUT etc.						
13	88	Control Input 31	Latched	0 = Latched or 1 = Pulsed	*	*
Configures the control inputs as either ‘latched’ or ‘pulsed’. A latched control input will remain in the set state until a reset command is given, either by the menu or the serial communications. A pulsed control input, however, will remain energized for 10 ms after the set command is given and will then reset automatically (i.e. no reset command required).						
13	89	Ctrl Command 31	SET/RESET	0 = ON/OFF, 1 = SET/RESET, 2 = IN/OUT, 3 = ENABLED/DISABLED	*	*
Allows the SET / RESET text, displayed in the hotkey menu, to be changed to something more suitable for the application of an individual control input, such as ON / OFF, IN / OUT etc.						
13	8C	Control Input 32	Latched	0 = Latched or 1 = Pulsed	*	*
Configures the control inputs as either ‘latched’ or ‘pulsed’. A latched control input will remain in the set state until a reset command is given, either by the menu or the serial communications. A pulsed control input, however, will remain energized for 10 ms after the set command is given and will then reset automatically (i.e. no reset command required).						
13	8D	Ctrl Command 32	SET/RESET	0 = ON/OFF, 1 = SET/RESET, 2 = IN/OUT, 3 = ENABLED/DISABLED	*	*
Allows the SET / RESET text, displayed in the hotkey menu, to be changed to something more suitable for the application of an individual control input, such as ON / OFF, IN / OUT etc.						

5.13 InterMiCOM Comm and Conf

The settings necessary for the implementation of InterMiCOM are contained within two columns of the relay menu structure: “InterMiCOM comms” and “InterMiCOM conf”. The two columns are visible when the “InterMiCOM” setting (“Configuration” column) = “enabled”, with the InterMiCOM option present.

The “INTERMICOM COMMS” column contains all the information to configure the communication channel and also contains the channel statistics and diagnostic facilities. The InterMiCOM communication can be enabled or disabled in the “Configuration” column.

The “INTERMICOM CONF” column selects the format of each signal and its fallback operation mode.
InterMiCOM provides 8 commands over a single communications link, with the mode of operation of each command being individually selectable within the “IM# Cmd Type” cell (# = 1 to 8).

The InterMiCOM Comms menu settings vary between products. The options are:

- InterMiCOM Communications (P741)
- InterMiCOM Communications (P742/P743)
- InterMiCOM Configuration

5.13.1 InterMiCOM Communications (P741)

Col	Row	Menu Text	Default Setting	Available Setting
Description				
15	00	INTERMiCOM COMMS		
This column contains settings for InterMiCOM Communications (second rear comms board is fitted)				
15	01	IM Input Status		Not Settable
Displays the status of each InterMiCOM input signal, with IM1 signal starting from the right. When loop back mode is set, all bits will display zero.				
15	02	IM Output Status		Not Settable
Displays the status of each InterMiCOM output signal.				
15	10	Source Address	1	From 0 to 10 step 1
Setting for the unique IED address that is encoded in the InterMiCOM sent message.				
15	11	Receive Address	2	From 0 to 10 step 1
The aim of setting addresses is to establish pairs of IED's which will only communicate with each other. Should an inadvertent channel misrouting or spurious loopback occur, an error will be logged, and the erroneous received data will be rejected. As an example, in a 2 ended scheme the following address setting would be correct: Local IED: Source Address = 1, Receive Address = 2 Remote IED: Source Address = 2, Receive Address = 1				
15	12	Baud Rate	9600	0 = 600, 1 = 1200, 2 = 2400, 3 = 4800, 4 = 9600 or 5 = 19200
Setting of the signalling speed in terms of number of bits per second. The speed will match the capability of the MODEM or other characteristics of the channel provided.				
15	20	Ch Statistics	Invisible	Not Settable
Settings that makes visible or invisible Channel Statistics on the LCD. The statistic is reset by either IED’s powering down or using the ‘Reset Statistics’ cell.				

Col	Row	Menu Text	Default Setting	Available Setting
Description				
15	21	Rx Direct Count		Not Settable
Displays the number of valid Direct Tripping messages since last counter reset.				
15	22	Rx Perm Count		Not Settable
Displays the number of valid Permissive Tripping messages since last counter reset.				
15	23	Rx Block Count		Not Settable
Displays the number of valid Blocking messages since last counter reset.				
15	24	Rx NewDataCount		Not Settable
Displays the number of different messages (change events) since last counter reset.				
15	25	Rx ErroredCount		Not Settable
Displays the number of invalid received messages since last counter reset.				
15	26	Lost Messages		Not Settable
Displays the difference between the number of messages that were supposed to be received (based on set Baud Rate) and actual valid received messages since last reset.				
15	30	Elapsed Time		Not Settable
Displays the time in seconds since last counter reset.				
15	31	Reset Statistics	No	0 = No, 1 = Yes
Command that allows all Statistics and Channel Diagnostics to be reset.				
15	40	Ch Diagnostics	Invisible	0 = Invisible, 1 = Visible
Setting that makes visible or invisible Channel Diagnostics on the LCD. The diagnostic is reset by either IED’s powering down or using the ‘Reset Statistics’ cell.				
15	41	Data CD Status		Not Settable
Indicates when the DCD line (pin 1 on EIA232 Connector) is energized. OK = DCD is energized FAIL = DCD is de-energized Absent = 2nd Rear port board is not fitted				
15	42	FrameSync Status		Not Settable
Indicates when the message structure and synchronization is valid. OK = Valid message structure and synchronization FAIL = Synchronization has been lost Absent = 2nd Rear port board is not fitted Unavailable = Hardware error present				
15	43	Message Status		Not Settable
Indicates when the percentage of received valid messages has fallen below the ‘IM Msg Alarm Lvl’ setting within the alarm time period. OK = Acceptable ratio of lost messages FAIL = Unacceptable ratio of lost messages Absent = 2nd Rear port board is not fitted Unavailable = Hardware error present				
15	44	Channel Status		Not Settable
Indicates the state of the InterMiCOM communication channel. OK = Channel healthy FAIL = Channel failure Absent = 2nd Rear port board is not fitted Unavailable = Hardware error present				
15	45	IM H/W Status		Not Settable
Indicates the state of InterMiCOM hardware OK = InterMiCOM hardware healthy Read or Write Error = InterMiCOM failure Absent = 2nd Rear port is not fitted or failed to initialize.				
15	50	Loopback Mode	Disabled	0 = Disabled, 1 = Internal or 2 = External

Col	Row	Menu Text	Default Setting	Available Setting
Description				
Setting to allow testing of the InterMiCOM channel. When 'Internal' is selected, only the local InterMiCOM software functionality is tested, whereby the IED will receive its own sent data. 'External' setting allows a hardware and software check, with an external link required to jumper the sent data onto the receive channel. During normal service condition Loopback mode must be disabled.				
15	51	Test Pattern	11111111(bin)	Allows specific bit statuses to be inserted directly into the InterMiCOM message, to substitute real data. This is used for testing purposes.
Allows specific bit statuses to be inserted directly into the InterMiCOM message, to substitute real data. This is used for testing purposes.				
15	52	Loopback Status		Not Settable
Indicates the status of the InterMiCOM loopback mode OK = Loopback software (and hardware) is working correctly FAIL = Loopback mode failure Unavailable = Hardware error present.				

5.13.2 InterMiCOM Communications (P742/P743)

Col	Row	Menu Text	Default Setting	Available Setting	7 4	7 4
Description						
15	00	INTERMiCOM COMMS				*
This column contains settings for InterMiCOM Communications (second rear comms board is fitted)						
15	01	IM Input Status		Not Settable		*
Displays the status of each InterMiCOM input signal, with IM1 signal starting from the right. When loop back mode is set, all bits will display zero.						
15	02	IM Output Status		Not Settable		*
Displays the status of each InterMiCOM output signal.						
15	10	Source Address	1	From 0 to 10 step 1		*
Setting for the unique IED address that is encoded in the InterMiCOM sent message.						
15	11	Receive Address	2	From 0 to 10 step 1		*
The aim of setting addresses is to establish pairs of IED's which will only communicate with each other. Should an inadvertent channel misrouting or spurious loopback occur, an error will be logged, and the erroneous received data will be rejected. As an example, in a 2 ended scheme the following address setting would be correct: Local IED: Source Address = 1, Receive Address = 2 Remote IED: Source Address = 2, Receive Address = 1						
15	12	Baud Rate	9600	0 = 600, 1 = 1200, 2 = 2400, 3 = 4800, 4 = 9600 or 5 = 19200		*
Setting of the signalling speed in terms of number of bits per second. The speed will match the capability of the MODEM or other characteristics of the channel provided.						
15	20	Ch Statistics	Invisible	0 = Invisible, 1 = Visible		*
Settings that makes visible or invisible Channel Statistics on the LCD. The statistic is reset by either IED's powering down or using the 'Reset Statistics' cell.						
15	21	Rx Direct Count		Not Settable		*
Displays the number of valid Direct Tripping messages since last counter reset.						
15	22	Rx Perm Count		Not Settable		*
Displays the number of valid Permissive Tripping messages since last counter reset.						
15	23	Rx Block Count		Not Settable		*
Displays the number of valid Blocking messages since last counter reset.						

Col	Row	Menu Text	Default Setting	Available Setting	7 4	7 4
Description						
15	24	Rx NewData Count		Not Settable		*
Displays the number of different messages (change events) since last counter reset.						
15	25	Rx Errored Count		Not Settable		*
Displays the number of invalid received messages since last counter reset.						
15	26	Lost Messages		Not Settable		*
Displays the difference between the number of messages that were supposed to be received (based on set Baud Rate) and actual valid received messages since last reset.						
15	30	Elapsed Time		Not Settable		*
Displays the time in seconds since last counter reset.						
15	31	Reset Statistics	No	0 = No, 1 = Yes		*
Command that allows all Statistics and Channel Diagnostics to be reset.						
15	40	Ch Diagnostics	Invisible	0 = Invisible, 1 = Visible		*
Setting that makes visible or invisible Channel Diagnostics on the LCD. The diagnostic is reset by either IED's powering down or using the 'Reset Statistics' cell.						
15	41	Data CD Status		Not Settable		*
Indicates when the DCD line (pin 1 on EIA232 Connector) is energized. OK = DCD is energized FAIL = DCD is de-energized Absent = 2nd Rear port board is not fitted						
15	42	FrameSync Status		Not Settable		*
Indicates when the message structure and synchronization is valid. OK = Valid message structure and synchronization FAIL = Synchronization has been lost Absent = 2nd Rear port board is not fitted Unavailable = Hardware error present						
15	43	Message Status		Not Settable		*
Indicates when the percentage of received valid messages has fallen below the 'IM Msg Alarm Lvl' setting within the alarm time period. OK = Acceptable ratio of lost messages FAIL = Unacceptable ratio of lost messages Absent = 2nd Rear port board is not fitted Unavailable = Hardware error present						
15	44	Channel Status		Not Settable		*
Indicates the state of the InterMiCOM communication channel. OK = Channel healthy FAIL = Channel failure Absent = 2nd Rear port board is not fitted Unavailable = Hardware error present						
15	45	IM H/W Status		Not Settable		*
Indicates the state of InterMiCOM hardware OK = InterMiCOM hardware healthy Read or Write Error = InterMiCOM failure Absent = 2nd Rear port is not fitted or failed to initialize.						
15	50	Loopback Mode	Disabled	0 = Disabled, 1 = Internal or 2 = External		*
Setting to allow testing of the InterMiCOM channel. When 'Internal' is selected, only the local InterMiCOM software functionality is tested, whereby the IED will receive its own sent data. 'External' setting allows a hardware and software check, with an external link required to jumper the sent data onto the receive channel. During normal service condition Loopback mode must be disabled.						

Col	Row	Menu Text	Default Setting	Available Setting	7 4	7 4
Description						
15	51	Test Pattern	11111111(bin)	Allows specific bit statuses to be inserted directly into the InterMiCOM message, to substitute real data. This is used for testing purposes.		*
Allows specific bit statuses to be inserted directly into the InterMiCOM message, to substitute real data. This is used for testing purposes.						
15	52	Loopback Status		Not Settable		*
Indicates the status of the InterMiCOM loopback mode OK = Loopback software (and hardware) is working correctly FAIL = Loopback mode failure Unavailable = Hardware error present.						

5.14 InterMiCOM Configuration

The InterMiCOM Conf menu settings vary between products. The options are:

- InterMiCOM Configuration (P741)
- InterMiCOM Configuration (P742/P743)

5.14.1 InterMiCOM Configuration (P741)

Col	Row	Menu Text	Default Setting	Available Setting
Description				
16	00	INTERMiCOM CONF		
This column contains settings for InterMiCOM Configuration (second rear comms board is fitted)				
16	01	IM Msg Alarm Lvl	25%	From 0% to 100% step 0.1%
Setting that is used to alarm for poor channel quality. If during the fixed 1.6s window the ratio of invalid messages to the total number of messages that should be received (based upon the ‘Baud Rate’ setting) exceeds the above threshold, a ‘Message Fail’ alarm will be issued.				
16	10	IM1 Cmd Type	Direct	0 = Disabled, 1 = Direct or 2 = Blocking
Setting that defines the operative mode of the InterMiCOM_1 signal. Selecting the channel response for this bit to Blocking allows fastest signalling, whereas setting to Direct offers higher security at the expense of speed. Selecting the channel response for this bit to Permissive offers higher dependability				
16	11	IM1 FallBackMode	Default	0 = Default or 1 = Latched
Setting that defines the status of IM1 signal in case of heavy noise and message synchronization being lost. If set to ‘Latching’ the last valid IM1 status will be maintained until the new valid message is received. If set to ‘Default’, the IM1 status, pre-defined by the user in ‘IM1 DefaultValue’ cell will be set. A new valid message will replace ‘IM1 DefaultValue’, once the channel recovers.				
16	12	IM1 DefaultValue	0	0 to 1 step 1
Setting that defines the IM1 fallback status.				
16	13	IM1 FrameSyncTim	1.5s	From 10ms to 1.5s step 10ms
Time delay after which ’IM1 DefaultValue’ is applied, providing that no valid message is received in the meantime.				
16	18	IM2 Cmd Type	Direct	0 = Disabled, 1 = Direct or 2 = Blocking
Setting that defines the operative mode of the InterMiCOM_2 signal. Selecting the channel response for this bit to Blocking allows fastest signalling, whereas setting to Direct offers higher security at the expense of speed. Selecting the channel response for this bit to Permissive offers higher dependability				
16	19	IM2 FallBackMode	Default	0 = Default or 1 = Latched
Setting that defines the status of IM2 signal in case of heavy noise and message synchronization being lost. If set to ‘Latching’ the last valid IM2 status will be maintained until the new valid message is received. If set to ‘Default’, the IM2 status, pre-defined by the user in ‘IM2 DefaultValue’ cell will be set. A new valid message will replace ‘IM2 DefaultValue’, once the channel recovers.				
16	1A	IM2 DefaultValue	0	0 to 1 step 1
Setting that defines the IM2 fallback status.				
16	1B	IM2 FrameSyncTim	1.5s	From 10ms to 1.5s step 10ms
Time delay after which ’IM2 DefaultValue’ is applied, providing that no valid message is received in the meantime.				
16	20	IM3 Cmd Type	Direct	0 = Disabled, 1 = Direct or 2 = Blocking

Col	Row	Menu Text	Default Setting	Available Setting
Description				
Setting that defines the operative mode of the InterMiCOM_3 signal. Selecting the channel response for this bit to Blocking allows fastest signalling, whereas setting to Direct offers higher security at the expense of speed. Selecting the channel response for this bit to Permissive offers higher dependability				
16	21	IM3 FallBackMode	Default	0 = Default or 1 = Latched
Setting that defines the status of IM3 signal in case of heavy noise and message synchronization being lost. If set to ‘Latching’ the last valid IM3 status will be maintained until the new valid message is received. If set to ‘Default’, the IM3 status, pre-defined by the user in ‘IM3 DefaultValue’ cell will be set. A new valid message will replace ‘IM3 DefaultValue’, once the channel recovers.				
16	22	IM3 DefaultValue	0	0 to 1 step 1
Setting that defines the IM3 fallback status.				
16	23	IM3 FrameSyncTim	1.5s	From 10ms to 1.5s step 10ms
Time delay after which ’IM3 DefaultValue’ is applied, providing that no valid message is received in the meantime.				
16	28	IM4 Cmd Type	Direct	0 = Disabled, 1 = Direct or 2 = Blocking
Setting that defines the operative mode of the InterMiCOM_4 signal. Selecting the channel response for this bit to Blocking allows fastest signalling, whereas setting to Direct offers higher security at the expense of speed. Selecting the channel response for this bit to Permissive offers higher dependability				
16	29	IM4 FallBackMode	Default	0 = Default or 1 = Latched
Setting that defines the status of IM4 signal in case of heavy noise and message synchronization being lost. If set to ‘Latching’ the last valid IM4 status will be maintained until the new valid message is received. If set to ‘Default’, the IM4 status, pre-defined by the user in ‘IM4 DefaultValue’ cell will be set. A new valid message will replace ‘IM4 DefaultValue’, once the channel recovers.				
16	2A	IM4 DefaultValue	0	0 to 1 step 1
Setting that defines the IM4 fallback status.				
16	2B	IM4 FrameSyncTim	1.5s	From 10ms to 1.5s step 10ms
Time delay after which ’IM4 DefaultValue’ is applied, providing that no valid message is received in the meantime.				
16	30	IM5 Cmd Type	Direct	0 = Disabled, 1 = Direct or 2 = Blocking
Setting that defines the operative mode of the InterMiCOM_5 signal. Selecting the channel response for this bit to Blocking allows fastest signalling, whereas setting to Direct offers higher security at the expense of speed. Selecting the channel response for this bit to Permissive offers higher dependability				
16	31	IM5 FallBackMode	Default	0 = Default or 1 = Latched
Setting that defines the status of IM5 signal in case of heavy noise and message synchronization being lost. If set to ‘Latching’ the last valid IM5 status will be maintained until the new valid message is received. If set to ‘Default’, the IM5 status, pre-defined by the user in ‘IM5 DefaultValue’ cell will be set. A new valid message will replace ‘IM5 DefaultValue’, once the channel recovers.				
16	32	IM5 DefaultValue	0	0 to 1 step 1
Setting that defines the IM5 fallback status.				
16	33	IM5 FrameSyncTim	1.5s	From 10ms to 1.5s step 10ms
Time delay after which ‘IM5 DefaultValue’ is applied.				
16	38	IM6 Cmd Type	Direct	0 = Disabled, 1 = Direct or 2 = Blocking
Setting that defines the operative mode of the InterMiCOM_6 signal. Selecting the channel response for this bit to Blocking allows fastest signalling, whereas setting to Direct offers higher security at the expense of speed. Selecting the channel response for this bit to Permissive offers higher dependability				
16	39	IM6 FallBackMode	Default	0 = Default or 1 = Latched
Setting that defines the status of IM6 signal in case of heavy noise and message synchronization being lost. If set to ‘Latching’ the last valid IM6 status will be maintained until the new valid message is received. If set to ‘Default’, the IM6 status, pre-defined by the user in ‘IM6 DefaultValue’ cell will be set. A new valid message will replace ‘IM6 DefaultValue’, once the channel recovers.				

Col	Row	Menu Text	Default Setting	Available Setting
Description				
16	3A	IM6 DefaultValue	0	0 to 1 step 1
Setting that defines the IM6 fallback status.				
16	3B	IM6 FrameSyncTim	1.5s	From 10ms to 1.5s step 10ms
Time delay after which ‘IM6 DefaultValue’ is applied.				
16	40	IM7 Cmd Type	Direct	0 = Disabled, 1 = Direct or 2 = Blocking
Setting that defines the operative mode of the InterMiCOM_7 signal. Selecting the channel response for this bit to Blocking allows fastest signalling, whereas setting to Direct offers higher security at the expense of speed. Selecting the channel response for this bit to Permissive offers higher dependability				
16	41	IM7 FallBackMode	Default	0 = Default or 1 = Latched
Setting that defines the status of IM7 signal in case of heavy noise and message synchronization being lost. If set to ‘Latching’ the last valid IM7 status will be maintained until the new valid message is received. If set to ‘Default’, the IM7 status, pre-defined by the user in ‘IM7 DefaultValue’ cell will be set. A new valid message will replace ‘IM7 DefaultValue’, once the channel recovers.				
16	42	IM7 DefaultValue	0	0 to 1 step 1
Setting that defines the IM7 fallback status.				
16	43	IM7 FrameSyncTim	1.5s	From 10ms to 1.5s step 10ms
Time delay after which ‘IM7 DefaultValue’ is applied.				
16	48	IM8 Cmd Type	Direct	0 = Disabled, 1 = Direct or 2 = Blocking
Setting that defines the operative mode of the InterMiCOM_8 signal. Selecting the channel response for this bit to Blocking allows fastest signalling, whereas setting to Direct offers higher security at the expense of speed. Selecting the channel response for this bit to Permissive offers higher dependability				
16	49	IM8 FallBackMode	Default	0 = Default or 1 = Latched
Setting that defines the status of IM8 signal in case of heavy noise and message synchronization being lost. If set to ‘Latching’ the last valid IM8 status will be maintained until the new valid message is received. If set to ‘Default’, the IM8 status, pre-defined by the user in ‘IM8 DefaultValue’ cell will be set. A new valid message will replace ‘IM8 DefaultValue’, once the channel recovers.				
16	4A	IM8 DefaultVa+C358ue	0	0 to 1 step 1
Setting that defines the IM8 fallback status.				
16	4B	IM8 FrameSyncTim	1.5s	From 10ms to 1.5s step 10ms
Time delay after which ‘IM8 DefaultValue’ is applied.				

5.14.2 InterMiCOM Configuration (P742/P743)

Col	Row	Menu Text	Default Setting	Available Setting	7 4	7 4
Description						
16	00	INTERMiCOM CONF				*
This column contains settings for InterMiCOM Configuration (second rear comms board is fitted)						
16	01	IM Msg Alarm Lvl	25%	From 0% to 100% step 0.1%		*
Setting that is used to alarm for poor channel quality. If during the fixed 1.6s window the ratio of invalid messages to the total number of messages that should be received (based upon the ‘Baud Rate’ setting) exceeds the above threshold, a ‘Message Fail’ alarm will be issued.						
16	10	IM1 Cmd Type	Direct	0 = Disabled, 1 = Direct, 2 = Permissive or 3 = Blocking		*

Col	Row	Menu Text	Default Setting	Available Setting	7 4	7 4
Description						
Setting that defines the operative mode of the InterMiCOM_1 signal. Selecting the channel response for this bit to Blocking allows fastest signalling, whereas setting to Direct offers higher security at the expense of speed. Selecting the channel response for this bit to Permissive offers higher dependability						
16	11	IM1 FallBackMode	Default	0 = Default or 1 = Latched		*
Setting that defines the status of IM1 signal in case of heavy noise and message synchronization being lost. If set to 'Latching' the last valid IM1 status will be maintained until the new valid message is received. If set to 'Default', the IM1 status, pre-defined by the user in 'IM1 DefaultValue' cell will be set. A new valid message will replace 'IM1 DefaultValue', once the channel recovers.						
16	12	IM1 DefaultValue	0	0 to 1 step 1		*
Setting that defines the IM1 fallback status.						
16	13	IM1 FrameSyncTim	1.5s	From 10ms to 1.5s step 10ms		*
Time delay after which 'IM1 DefaultValue' is applied, providing that no valid message is received in the meantime.						
16	18	IM2 Cmd Type	Direct	0 = Disabled, 1 = Direct, 2 = Permissive or 3 = Blocking		*
Setting that defines the operative mode of the InterMiCOM_2 signal. Selecting the channel response for this bit to Blocking allows fastest signalling, whereas setting to Direct offers higher security at the expense of speed. Selecting the channel response for this bit to Permissive offers higher dependability						
16	19	IM2 FallBackMode	Default	0 = Default or 1 = Latched		*
Setting that defines the status of IM2 signal in case of heavy noise and message synchronization being lost. If set to 'Latching' the last valid IM2 status will be maintained until the new valid message is received. If set to 'Default', the IM2 status, pre-defined by the user in 'IM2 DefaultValue' cell will be set. A new valid message will replace 'IM2 DefaultValue', once the channel recovers.						
16	1A	IM2 DefaultValue	0	0 to 1 step 1		*
Setting that defines the IM2 fallback status.						
16	1B	IM2 FrameSyncTim	1.5s	From 10ms to 1.5s step 10ms		*
Time delay after which 'IM2 DefaultValue' is applied, providing that no valid message is received in the meantime.						
16	20	IM3 Cmd Type	Direct	0 = Disabled, 1 = Direct, 2 = Permissive or 3 = Blocking		*
Setting that defines the operative mode of the InterMiCOM_3 signal. Selecting the channel response for this bit to Blocking allows fastest signalling, whereas setting to Direct offers higher security at the expense of speed. Selecting the channel response for this bit to Permissive offers higher dependability						
16	21	IM3 FallBackMode	Default	0 = Default or 1 = Latched		*
Setting that defines the status of IM3 signal in case of heavy noise and message synchronization being lost. If set to 'Latching' the last valid IM3 status will be maintained until the new valid message is received. If set to 'Default', the IM3 status, pre-defined by the user in 'IM3 DefaultValue' cell will be set. A new valid message will replace 'IM3 DefaultValue', once the channel recovers.						
16	22	IM3 DefaultValue	0	0 to 1 step 1		*
Setting that defines the IM3 fallback status.						
16	23	IM3 FrameSyncTim	1.5s	From 10ms to 1.5s step 10ms		*
Time delay after which 'IM3 DefaultValue' is applied, providing that no valid message is received in the meantime.						
16	28	IM4 Cmd Type	Direct	0 = Disabled, 1 = Direct, 2 = Permissive or 3 = Blocking		*
Setting that defines the operative mode of the InterMiCOM_4 signal. Selecting the channel response for this bit to Blocking allows fastest signalling, whereas setting to Direct offers higher security at the expense of speed. Selecting the channel response for this bit to Permissive offers higher dependability						
16	29	IM4 FallBackMode	Default	0 = Default or 1 = Latched		*

Col	Row	Menu Text	Default Setting	Available Setting	7 4	7 4
Description						
Setting that defines the status of IM4 signal in case of heavy noise and message synchronization being lost. If set to ‘Latching’ the last valid IM4 status will be maintained until the new valid message is received. If set to ‘Default’, the IM4 status, pre-defined by the user in ‘IM4 DefaultValue’ cell will be set. A new valid message will replace ‘IM4 DefaultValue’, once the channel recovers.						
16	2A	IM4 DefaultValue	0	0 to 1 step 1		*
Setting that defines the IM4 fallback status.						
16	2B	IM4 FrameSyncTim	1.5s	From 10ms to 1.5s step 10ms		*
Time delay after which ’IM4 DefaultValue’ is applied, providing that no valid message is received in the meantime.						
16	30	IM5 Cmd Type	Direct	0 = Disabled, 1 = Direct, 2 = Permissive or 3 = Blocking		*
Setting that defines the operative mode of the InterMiCOM_5 signal. Selecting the channel response for this bit to Blocking allows fastest signalling, whereas setting to Direct offers higher security at the expense of speed. Selecting the channel response for this bit to Permissive offers higher dependability						
16	31	IM5 FallBackMode	Default	0 = Default or 1 = Latched		*
Setting that defines the status of IM5 signal in case of heavy noise and message synchronization being lost. If set to ‘Latching’ the last valid IM5 status will be maintained until the new valid message is received. If set to ‘Default’, the IM5 status, pre-defined by the user in ‘IM5 DefaultValue’ cell will be set. A new valid message will replace ‘IM5 DefaultValue’, once the channel recovers.						
16	32	IM5 DefaultValue	0	0 to 1 step 1		*
Setting that defines the IM5 fallback status.						
16	33	IM5 FrameSyncTim	1.5s	From 10ms to 1.5s step 10ms		*
Time delay after which ‘IM5 DefaultValue’ is applied.						
16	38	IM6 Cmd Type	Direct	0 = Disabled, 1 = Direct, 2 = Permissive or 3 = Blocking		*
Setting that defines the operative mode of the InterMiCOM_6 signal. Selecting the channel response for this bit to Blocking allows fastest signalling, whereas setting to Direct offers higher security at the expense of speed. Selecting the channel response for this bit to Permissive offers higher dependability						
16	39	IM6 FallBackMode	Default	0 = Default or 1 = Latched		*
Setting that defines the status of IM6 signal in case of heavy noise and message synchronization being lost. If set to ‘Latching’ the last valid IM6 status will be maintained until the new valid message is received. If set to ‘Default’, the IM6 status, pre-defined by the user in ‘IM6 DefaultValue’ cell will be set. A new valid message will replace ‘IM6 DefaultValue’, once the channel recovers.						
16	3A	IM6 DefaultValue	0	0 to 1 step 1		*
Setting that defines the IM6 fallback status.						
16	3B	IM6 FrameSyncTim	1.5s	From 10ms to 1.5s step 10ms		*
Time delay after which ‘IM6 DefaultValue’ is applied.						
16	40	IM7 Cmd Type	Direct	0 = Disabled, 1 = Direct, 2 = Permissive or 3 = Blocking		*
Setting that defines the operative mode of the InterMiCOM_7 signal. Selecting the channel response for this bit to Blocking allows fastest signalling, whereas setting to Direct offers higher security at the expense of speed. Selecting the channel response for this bit to Permissive offers higher dependability						
16	41	IM7 FallBackMode	Default	0 = Default or 1 = Latched		*
Setting that defines the status of IM7 signal in case of heavy noise and message synchronization being lost. If set to ‘Latching’ the last valid IM7 status will be maintained until the new valid message is received. If set to ‘Default’, the IM7 status, pre-defined by the user in ‘IM7 DefaultValue’ cell will be set. A new valid message will replace ‘IM7 DefaultValue’, once the channel recovers.						
16	42	IM7 DefaultValue	0	0 to 1 step 1		*
Setting that defines the IM7 fallback status.						

Col	Row	Menu Text	Default Setting	Available Setting	7 4	7 4
Description						
16	43	IM7 FrameSyncTim	1.5s	From 10ms to 1.5s step 10ms		*
Time delay after which 'IM7 DefaultValue' is applied.						
16	48	IM8 Cmd Type	Direct	0 = Disabled, 1 = Direct, 2 = Permissive or 3 = Blocking		*
Setting that defines the operative mode of the InterMiCOM_8 signal. Selecting the channel response for this bit to Blocking allows fastest signalling, whereas setting to Direct offers higher security at the expense of speed. Selecting the channel response for this bit to Permissive offers higher dependability						
16	49	IM8 FallBackMode	Default	0 = Default or 1 = Latched		*
Setting that defines the status of IM8 signal in case of heavy noise and message synchronization being lost. If set to 'Latching' the last valid IM8 status will be maintained until the new valid message is received. If set to 'Default', the IM8 status, pre-defined by the user in 'IM8 DefaultValue' cell will be set. A new valid message will replace 'IM8 DefaultValue', once the channel recovers.						
16	4A	IM8 DefaultVa+C358ue	0	0 to 1 step 1		*
Setting that defines the IM8 fallback status.						
16	4B	IM8 FrameSyncTim	1.5s	From 10ms to 1.5s step 10ms		*
Time delay after which 'IM8 DefaultValue' is applied.						

5.15 Function Keys

Available in the Central Unit P741 and the Peripheral Unit P743

The Function Keys menu settings vary between products. The options are:

- Function Keys (P741)
- Function Keys (P742/P743)

5.15.1 Function Keys (P741)

Col	Row	Menu Text	Default Setting	Available Setting
Description				
17	00	FUNCTION KEYS		
This column contains the function key definitions				
17	01	Fn Keys Status		Not Settable
Displays the status of each function key.				
17	02	Fn Key 1	Unlocked	0 = Disabled, 1 = Unlocked, 2 = Locked
Setting to activate function key. The ‘Lock’ setting allows a function key output that is set to toggle mode to be locked in its current active state.				
17	03	Fn Key 1 Mode	Normal	0 = Normal or 1 = Toggled
Sets the function key in toggle or normal mode. In ‘Toggle’ mode, a single key press will set/latch the function key output as ‘high’ or ‘low’ in programmable scheme logic. This feature can be used to enable/disable IED functions. In the ‘Normal’ mode the function key output will remain ‘high’ as long as key is pressed.				
17	04	Fn Key 1 Label	Function Key 1	From 32 to 234 step 1
Allows the text of the function key to be changed to something more suitable for the application.				
17	05	Fn Key 2	Unlocked	0 = Disabled, 1 = Unlocked, 2 = Locked
Same description as Fn Key 1				
17	06	Fn Key 2 Mode	Normal	0 = Normal or 1 = Toggled
Same description as Fn Key 1 Mode				
17	07	Fn Key 2 Label	Function Key 2	From 32 to 234 step 1
Same description as Fn Key 1 Label				
17	08	Fn Key 3	Unlocked	0 = Disabled, 1 = Unlocked, 2 = Locked
Same description as Fn Key 1				
17	09	Fn Key 3 Mode	Normal	0 = Normal or 1 = Toggled
Same description as Fn Key 1 Mode				
17	0A	Fn Key 3 Label	Function Key 3	From 32 to 234 step 1
Same description as Fn Key 1 Label				
17	0B	Fn Key 4	Unlocked	0 = Disabled, 1 = Unlocked, 2 = Locked
Same description as Fn Key 1				
17	0C	Fn Key 4 Mode	Normal	0 = Normal or 1 = Toggled
Same description as Fn Key 1 Mode				
17	0D	Fn Key 4 Label	Function Key 4	From 32 to 234 step 1
Same description as Fn Key 1 Label				
17	0E	Fn Key 5	Unlocked	0 = Disabled, 1 = Unlocked, 2 = Locked
Same description as Fn Key 1				

Col	Row	Menu Text	Default Setting	Available Setting
Description				
17	0F	Fn Key 5 Mode	Normal	0 = Normal or 1 = Toggled
Same description as Fn Key 1 Mode				
17	10	Fn Key 5 Label	Function Key 5	From 32 to 234 step 1
Same description as Fn Key 1 Label				
17	11	Fn Key 6	Unlocked	0 = Disabled, 1 = Unlocked, 2 = Locked
Same description as Fn Key 1				
17	12	Fn Key 6 Mode	Normal	0 = Normal or 1 = Toggled
Same description as Fn Key 1 Mode				
17	13	Fn Key 6 Label	Function Key 6	From 32 to 234 step 1
Same description as Fn Key 1 Label				
17	14	Fn Key 7	Unlocked	0 = Disabled, 1 = Unlocked, 2 = Locked
Same description as Fn Key 1				
17	15	Fn Key 7 Mode	Normal	0 = Normal or 1 = Toggled
Same description as Fn Key 1 Mode				
17	16	Fn Key 7 Label	Function Key 7	From 32 to 234 step 1
Same description as Fn Key 1 Label				
17	17	Fn Key 8	Unlocked	0 = Disabled, 1 = Unlocked, 2 = Locked
Same description as Fn Key 1				
17	18	Fn Key 8 Mode	Normal	0 = Normal or 1 = Toggled
Same description as Fn Key 1 Mode				
17	19	Fn Key 8 Label	Function Key 8	From 32 to 234 step 1
Same description as Fn Key 1 Label				
17	1A	Fn Key 9	Unlocked	0 = Disabled, 1 = Unlocked, 2 = Locked
Same description as Fn Key 1				
17	1B	Fn Key 9 Mode	Normal	0 = Normal or 1 = Toggled
Same description as Fn Key 1 Mode				
17	1C	Fn Key 9 Label	Function Key 9	From 32 to 234 step 1
Same description as Fn Key 1 Label				
17	1D	Fn Key 10	Unlocked	0 = Disabled, 1 = Unlocked, 2 = Locked
Same description as Fn Key 1				
17	1E	Fn Key 10 Mode	Normal	0 = Normal or 1 = Toggled
Same description as Fn Key 1 Mode				
17	1F	Fn Key 10 Label	Function Key 10	From 32 to 234 step 1
Same description as Fn Key 1 Label				

5.15.2 Function Keys (P742/P743)

Col	Row	Menu Text	Default Setting	Available Setting	7 4	7 4
Description						
17	00	FUNCTION KEYS				*
This column contains the function key definitions						
17	01	Fn Keys Status		Not Settable		*

Col	Row	Menu Text	Default Setting	Available Setting	74	74
Description						
Displays the status of each function key.						
17	02	Fn Key 1	Unlocked	0 = Disabled, 1 = Unlocked, 2 = Locked		*
Setting to activate function key. The ‘Lock’ setting allows a function key output that is set to toggle mode to be locked in its current active state.						
17	03	Fn Key 1 Mode	Normal	0 = Normal or 1 = Toggled		*
Sets the function key in toggle or normal mode. In ‘Toggle’ mode, a single key press will set/latch the function key output as ‘high’ or ‘low’ in programmable scheme logic. This feature can be used to enable/disable IED functions. In the ‘Normal’ mode the function key output will remain ‘high’ as long as key is pressed.						
17	04	Fn Key 1 Label	Function Key 1	From 32 to 234 step 1		*
Allows the text of the function key to be changed to something more suitable for the application.						
17	05	Fn Key 2	Unlocked	0 = Disabled, 1 = Unlocked, 2 = Locked		*
Same description as Fn Key 1						
17	06	Fn Key 2 Mode	Normal	0 = Normal or 1 = Toggled		*
Same description as Fn Key 1 Mode						
17	07	Fn Key 2 Label	Function Key 2	From 32 to 234 step 1		*
Same description as Fn Key 1 Label						
17	08	Fn Key 3	Unlocked	0 = Disabled, 1 = Unlocked, 2 = Locked		*
Same description as Fn Key 1						
17	09	Fn Key 3 Mode	Normal	0 = Normal or 1 = Toggled		*
Same description as Fn Key 1 Mode						
17	0A	Fn Key 3 Label	Function Key 3	From 32 to 234 step 1		*
Same description as Fn Key 1 Label						
17	0B	Fn Key 4	Unlocked	0 = Disabled, 1 = Unlocked, 2 = Locked		*
Same description as Fn Key 1						
17	0C	Fn Key 4 Mode	Normal	0 = Normal or 1 = Toggled		*
Same description as Fn Key 1 Mode						
17	0D	Fn Key 4 Label	Function Key 4	From 32 to 234 step 1		*
Same description as Fn Key 1 Label						
17	0E	Fn Key 5	Unlocked	0 = Disabled, 1 = Unlocked, 2 = Locked		*
Same description as Fn Key 1						
17	0F	Fn Key 5 Mode	Normal	0 = Normal or 1 = Toggled		*
Same description as Fn Key 1 Mode						
17	10	Fn Key 5 Label	Function Key 5	From 32 to 234 step 1		*
Same description as Fn Key 1 Label						
17	11	Fn Key 6	Unlocked	0 = Disabled, 1 = Unlocked, 2 = Locked		*
Same description as Fn Key 1						
17	12	Fn Key 6 Mode	Normal	0 = Normal or 1 = Toggled		*
Same description as Fn Key 1 Mode						
17	13	Fn Key 6 Label	Function Key 6	From 32 to 234 step 1		*
Same description as Fn Key 1 Label						

Col	Row	Menu Text	Default Setting	Available Setting	7 4	7 4
Description						
17	14	Fn Key 7	Unlocked	0 = Disabled, 1 = Unlocked, 2 = Locked		*
Same description as Fn Key 1						
17	15	Fn Key 7 Mode	Normal	0 = Normal or 1 = Toggled		*
Same description as Fn Key 1 Mode						
17	16	Fn Key 7 Label	Function Key 7	From 32 to 234 step 1		*
Same description as Fn Key 1 Label						
17	17	Fn Key 8	Unlocked	0 = Disabled, 1 = Unlocked, 2 = Locked		*
Same description as Fn Key 1						
17	18	Fn Key 8 Mode	Normal	0 = Normal or 1 = Toggled		*
Same description as Fn Key 1 Mode						
17	19	Fn Key 8 Label	Function Key 8	From 32 to 234 step 1		*
Same description as Fn Key 1 Label						
17	1A	Fn Key 9	Unlocked	0 = Disabled, 1 = Unlocked, 2 = Locked		*
Same description as Fn Key 1						
17	1B	Fn Key 9 Mode	Normal	0 = Normal or 1 = Toggled		*
Same description as Fn Key 1 Mode						
17	1C	Fn Key 9 Label	Function Key 9	From 32 to 234 step 1		*
Same description as Fn Key 1 Label						
17	1D	Fn Key 10	Unlocked	0 = Disabled, 1 = Unlocked, 2 = Locked		*
Same description as Fn Key 1						
17	1E	Fn Key 10 Mode	Normal	0 = Normal or 1 = Toggled		*
Same description as Fn Key 1 Mode						
17	1F	Fn Key 10 Label	Function Key 10	From 32 to 234 step 1		*
Same description as Fn Key 1 Label						

5.16 IED Configurator

The contents of the IED CONFIGURATOR column (for IEC 61850 configuration) are mostly data cells, displayed for information but not editable. To edit the configuration, you need to use the IED (Intelligent Electronic Device) configurator tool within the Schneider Electric MiCOM S1 Studio software.

The IED Configurator menu settings vary between products. The options are:

- IED Configurator (P741)
- IED Configurator (P742/P743)

5.16.1 IED Configurator (P741)

Col	Row	Menu Text	Default Setting	Available Setting
Description				
19	00	IED CONFIGURATOR		
This column contains IED Configurator settings (IEC61850 builds)				
19	05	Switch Conf.Bank	No action	0 = No action or 1 = Switch banks
Setting which allows the user to switch between the current configuration, held in the Active Memory Bank (and partly displayed below), to the configuration sent to and held in the Inactive Memory Bank.				
19	0A	Restore Conf.	No action	0 = No action or 1 = Restore Conf.
Used to restore data from MCL(MiCOM Configuration Language)/CID (Configured IED Descriptor) file. This file is specific, containing a single devices IEC61850 configuration information, and used for transferring data to/from the MiCOM IED.				
19	10	Active Conf.Name		Not Settable
The name of the configuration in the Active Memory Bank, usually taken from the SCL file.				
19	11	Active Conf.Rev		Not Settable
Configuration Revision number of the configuration in the Active Memory Bank, usually taken from the SCL file.				
19	20	Inact.Conf.Name		Not Settable
The name of the configuration in the Inactive Memory Bank, usually taken from the SCL file.				
19	21	Inact.Conf.Rev		Not Settable
Configuration Revision number of the configuration in the Inactive Memory Bank, usually taken from the SCL file.				
19	30	IP PARAMETERS		
IP PARAMETERS				
19	31	IP address 1		Not Settable
Displays the unique network IP address that identifies the relay on interface 1. A default IP address is encoded from MAC address 169.254.0.xxx, xxx = mod (The last byte of MAC1, 128) + 1.				
19	32	Subnet mask 1		Not Settable
Displays the sub-network mask for interface 1.				
19	33	Gateway 1		Not Settable
Displays the IP address of the gateway (proxy) that interface 1 is connected to.				
19	34	IP address 2		Not Settable
Displays the unique network IP address that identifies the relay on interface 2. A default IP address is encoded from MAC address 169.254.0.xxx, xxx = mod (The last byte of MAC1, 128) + 1. Visible when redundant Ethernet card fitted.				
19	35	Subnet mask 2		Not Settable
Displays the sub-network mask for interface 2. Visible when redundant Ethernet card fitted.				
19	36	Gateway 2		Not Settable

Col	Row	Menu Text	Default Setting	Available Setting
Description				
Displays the IP address of the gateway (proxy) that interface 2 is connected to. Visible when redundant Ethernet card fitted.				
19	40	SNTP PARAMETERS		
SNTP PARAMETERS				
19	41	SNTP Server 1		Not Settable
Displays the IP address of the primary SNTP server.				
19	42	SNTP Server 2		Not Settable
Displays the IP address of the secondary SNTP server. Visible when Ethernet card fitted.				
19	50	IEC61850 SCL		
IEC 61850 SCL				
19	51	IED Name		Not Settable
IED name, which is the unique name on the IEC 61850 network for the IED, usually taken from the SCL (Substation Configuration Language for XML) file.				
19	60	IEC61850 GOOSE		
IEC 61850 GOOSE				
19	70	GoEna	0000000000000000(bin)	Bit 00=gcb01 GoEna to Bit FF=gcb16 GoEna
Setting to enable GOOSE publisher settings.				
19	71	Pub.Simul.Goose	0000000000000000(bin)	Bit 00=gcb01 Sim Mode to Bit FF=gcb16 Sim Mode
The Pub.Simul.GOOSE cell controls whether GOOSE are sent as Normal or Simulated GOOSE. When a GOOSE control block is set to Sim Mode its GOOSE is published as simulated. Simulated GOOSE are usually published by test equipment and this setting allows a test IED to be set up to simulate the IEDs in a substation.				
19	73	Sub.Simul.Goose	No	0 = No or 1 = Yes
In edition 2 mode when Sub.Simul.GOOSE is set to Yes the relay will look for simulated GOOSE. If a simulated GOOSE is found the relay will subscribe to it and will not respond to its normal GOOSE until Sub.Simul.GOOSE is set to No. Other GOOSE signals that are not being simulated will remain subscribing to normal GOOSE. In edition 1 mode the relay will respond to both normal and test GOOSE.				

5.16.2 IED Configurator (P742/P743)

Col	Row	Menu Text	Default Setting	Available Setting	74	74
Description						
19	00	IED CONFIGURATOR			*	*
This column contains IED Configurator settings (IEC61850 builds)						
19	05	Switch Conf.Bank	No action	0 = No action or 1 = Switch banks		*
Setting which allows the user to switch between the current configuration, held in the Active Memory Bank (and partly displayed below), to the configuration sent to and held in the Inactive Memory Bank.						
19	0A	Restore Conf.	No action	0 = No action or 1 = Restore Conf.		*
Used to restore data from MCL(MiCOM Configuration Language)/CID (Configured IED Descriptor) file. This file is specific, containing a single devices IEC61850 configuration information, and used for transferring data to/from the MiCOM IED.						
19	10	Active Conf.Name		Not Settable		*
The name of the configuration in the Active Memory Bank, usually taken from the SCL file.						
19	11	Active Conf.Rev		Not Settable		*
Configuration Revision number of the configuration in the Active Memory Bank, usually taken from the SCL file.						
19	20	Inact.Conf.Name		Not Settable		*
The name of the configuration in the Inactive Memory Bank, usually taken from the SCL file.						
19	21	Inact.Conf.Rev		Not Settable		*

Col	Row	Menu Text	Default Setting	Available Setting	7 4	7 4
Description						
Configuration Revision number of the configuration in the Inactive Memory Bank, usually taken from the SCL file.						
19	30	IP PARAMETERS				*
IP PARAMETERS						
19	31	IP address 1		Not Settable		*
Displays the unique network IP address that identifies the relay on interface 1. A default IP address is encoded from MAC address 169.254.0.xxx, xxx = mod (The last byte of MAC1, 128) + 1.						
19	32	Subnet mask 1		Not Settable		*
Displays the sub-network mask for interface 1.						
19	33	Gateway 1		Not Settable		*
Displays the IP address of the gateway (proxy) that interface 1 is connected to.						
19	34	IP address 2		Not Settable		*
Displays the unique network IP address that identifies the relay on interface 2. A default IP address is encoded from MAC address 169.254.0.xxx, xxx = mod (The last byte of MAC1, 128) + 1. Visible when redundant Ethernet card fitted.						
19	35	Subnet mask 2		Not Settable		*
Displays the sub-network mask for interface 2. Visible when redundant Ethernet card fitted.						
19	36	Gateway 2		Not Settable		*
Displays the IP address of the gateway (proxy) that interface 2 is connected to. Visible when redundant Ethernet card fitted.						
19	40	SNTP PARAMETERS				*
SNTP PARAMETERS						
19	41	SNTP Server 1		Not Settable		*
Displays the IP address of the primary SNTP server.						
19	42	SNTP Server 2		Not Settable		*
Displays the IP address of the secondary SNTP server. Visible when Ethernet card fitted.						
19	50	IEC61850 SCL				*
IEC 61850 SCL						
19	51	IED Name		Not Settable		*
IED name, which is the unique name on the IEC 61850 network for the IED, usually taken from the SCL (Substation Configuration Language for XML) file.						
19	60	IEC61850 GOOSE				*
IEC 61850 GOOSE						
19	70	GoEna	0000000000000000(bin)	Bit 00=gcb01 GoEna to Bit FF=gcb16 GoEna		*
Setting to enable GOOSE publisher settings.						
19	71	Pub.Simul.Goose	0000000000000000(bin)	Bit 00=gcb01 Sim Mode to Bit FF=gcb16 Sim Mode		*
The Pub.Simul.GOOSE cell controls whether GOOSE are sent as Normal or Simulated GOOSE. When a GOOSE control block is set to Sim Mode its GOOSE is published as simulated. Simulated GOOSE are usually published by test equipment and this setting allows a test IED to be set up to simulate the IEDs in a substation.						
19	73	Sub.Simul.Goose	No	0 = No or 1 = Yes		*
In edition 2 mode when Sub.Simul.GOOSE is set to Yes the relay will look for simulated GOOSE. If a simulated GOOSE is found the relay will subscribe to it and will not respond to its normal GOOSE until Sub.Simul.GOOSE is set to No. Other GOOSE signals that are not being simulated will remain subscribing to normal GOOSE. In edition 1 mode the relay will respond to both normal and test GOOSE.						

5.17 Control I/P (Input) Labels

The Ctrl I/P Labels menu settings vary between products. The options are:

- Control I/P (Input) Labels (P741)
- Control I/P (Input) Labels (P742/P743)

5.17.1 Control I/P (Input) Labels (P741)

This column is visible when the “Control I/P Labels” setting (“Configuration” column) = “visible”.

Col	Row	Menu Text	Default Setting	Available Setting
Description				
29	00	CTRL I/P LABELS		
This column contains settings for Control Input Labels				
29	01	Control Input 1	Control Input 1	From 32 to 234 step 1
Text label to describe each individual control input. This text is displayed when a control input is accessed by the hotkey menu. It is displayed in the programmable scheme logic description of the control input				
29	02	Control Input 2	Control Input 2	From 32 to 234 step 1
Text label to describe each individual control input. This text is displayed when a control input is accessed by the hotkey menu. It is displayed in the programmable scheme logic description of the control input				
29	03	Control Input 3	Control Input 3	From 32 to 234 step 1
Text label to describe each individual control input. This text is displayed when a control input is accessed by the hotkey menu. It is displayed in the programmable scheme logic description of the control input				
29	04	Control Input 4	Control Input 4	From 32 to 234 step 1
Text label to describe each individual control input. This text is displayed when a control input is accessed by the hotkey menu. It is displayed in the programmable scheme logic description of the control input				
29	05	Control Input 5	Control Input 5	From 32 to 234 step 1
Text label to describe each individual control input. This text is displayed when a control input is accessed by the hotkey menu. It is displayed in the programmable scheme logic description of the control input				
29	06	Control Input 6	Control Input 6	From 32 to 234 step 1
Text label to describe each individual control input. This text is displayed when a control input is accessed by the hotkey menu. It is displayed in the programmable scheme logic description of the control input				
29	07	Control Input 7	Control Input 7	From 32 to 234 step 1
Text label to describe each individual control input. This text is displayed when a control input is accessed by the hotkey menu. It is displayed in the programmable scheme logic description of the control input				
29	08	Control Input 8	Control Input 8	From 32 to 234 step 1
Text label to describe each individual control input. This text is displayed when a control input is accessed by the hotkey menu. It is displayed in the programmable scheme logic description of the control input				
29	09	Control Input 9	Control Input 9	From 32 to 234 step 1
Text label to describe each individual control input. This text is displayed when a control input is accessed by the hotkey menu. It is displayed in the programmable scheme logic description of the control input				
29	0A	Control Input 10	Control Input 10	From 32 to 234 step 1
Text label to describe each individual control input. This text is displayed when a control input is accessed by the hotkey menu. It is displayed in the programmable scheme logic description of the control input				
29	0B	Control Input 11	Control Input 11	From 32 to 234 step 1

Col	Row	Menu Text	Default Setting	Available Setting
Description				
Text label to describe each individual control input. This text is displayed when a control input is accessed by the hotkey menu. It is displayed in the programmable scheme logic description of the control input				
29	0C	Control Input 12	Control Input 12	From 32 to 234 step 1
Text label to describe each individual control input. This text is displayed when a control input is accessed by the hotkey menu. It is displayed in the programmable scheme logic description of the control input				
29	0D	Control Input 13	Control Input 13	From 32 to 234 step 1
Text label to describe each individual control input. This text is displayed when a control input is accessed by the hotkey menu. It is displayed in the programmable scheme logic description of the control input				
29	0E	Control Input 14	Control Input 14	From 32 to 234 step 1
Text label to describe each individual control input. This text is displayed when a control input is accessed by the hotkey menu. It is displayed in the programmable scheme logic description of the control input				
29	0F	Control Input 15	Control Input 15	From 32 to 234 step 1
Text label to describe each individual control input. This text is displayed when a control input is accessed by the hotkey menu. It is displayed in the programmable scheme logic description of the control input				
29	10	Control Input 16	Control Input 16	From 32 to 234 step 1
Text label to describe each individual control input. This text is displayed when a control input is accessed by the hotkey menu. It is displayed in the programmable scheme logic description of the control input				
29	11	Control Input 17	Control Input 17	From 32 to 234 step 1
Text label to describe each individual control input. This text is displayed when a control input is accessed by the hotkey menu. It is displayed in the programmable scheme logic description of the control input				
29	12	Control Input 18	Control Input 18	From 32 to 234 step 1
Text label to describe each individual control input. This text is displayed when a control input is accessed by the hotkey menu. It is displayed in the programmable scheme logic description of the control input				
29	13	Control Input 19	Control Input 19	From 32 to 234 step 1
Text label to describe each individual control input. This text is displayed when a control input is accessed by the hotkey menu. It is displayed in the programmable scheme logic description of the control input				
29	14	Control Input 20	Control Input 20	From 32 to 234 step 1
Text label to describe each individual control input. This text is displayed when a control input is accessed by the hotkey menu. It is displayed in the programmable scheme logic description of the control input				
29	15	Control Input 21	Control Input 21	From 32 to 234 step 1
Text label to describe each individual control input. This text is displayed when a control input is accessed by the hotkey menu. It is displayed in the programmable scheme logic description of the control input				
29	16	Control Input 22	Control Input 22	From 32 to 234 step 1
Text label to describe each individual control input. This text is displayed when a control input is accessed by the hotkey menu. It is displayed in the programmable scheme logic description of the control input				
29	17	Control Input 23	Control Input 23	From 32 to 234 step 1
Text label to describe each individual control input. This text is displayed when a control input is accessed by the hotkey menu. It is displayed in the programmable scheme logic description of the control input				
29	18	Control Input 24	Control Input 24	From 32 to 234 step 1
Text label to describe each individual control input. This text is displayed when a control input is accessed by the hotkey menu. It is displayed in the programmable scheme logic description of the control input				
29	19	Control Input 25	Control Input 25	From 32 to 234 step 1
Text label to describe each individual control input. This text is displayed when a control input is accessed by the hotkey menu. It is displayed in the programmable scheme logic description of the control input				
29	1A	Control Input 26	Control Input 26	From 32 to 234 step 1
Text label to describe each individual control input. This text is displayed when a control input is accessed by the hotkey menu. It is displayed in the programmable scheme logic description of the control input				
29	1B	Control Input 27	Control Input 27	From 32 to 234 step 1

Col	Row	Menu Text	Default Setting	Available Setting
Description				
Text label to describe each individual control input. This text is displayed when a control input is accessed by the hotkey menu. It is displayed in the programmable scheme logic description of the control input				
29	1C	Control Input 28	Control Input 28	From 32 to 234 step 1
Text label to describe each individual control input. This text is displayed when a control input is accessed by the hotkey menu. It is displayed in the programmable scheme logic description of the control input				
29	1D	Control Input 29	Control Input 29	From 32 to 234 step 1
Text label to describe each individual control input. This text is displayed when a control input is accessed by the hotkey menu. It is displayed in the programmable scheme logic description of the control input				
29	1E	Control Input 30	Control Input 30	From 32 to 234 step 1
Text label to describe each individual control input. This text is displayed when a control input is accessed by the hotkey menu. It is displayed in the programmable scheme logic description of the control input				
29	1F	Control Input 31	Control Input 31	From 32 to 234 step 1
Text label to describe each individual control input. This text is displayed when a control input is accessed by the hotkey menu. It is displayed in the programmable scheme logic description of the control input				
29	20	Control Input 32	Control Input 32	From 32 to 234 step 1
Text label to describe each individual control input. This text is displayed when a control input is accessed by the hotkey menu. It is displayed in the programmable scheme logic description of the control input				

5.17.2 Control I/P (Input) Labels (P742/P743)

This column is visible when the “Control I/P Labels” setting (“Configuration” column) = “visible”.

Col	Row	Menu Text	Default Setting	Available Setting	P742	P743
Description						
29	00	CTRL I/P LABELS			*	*
This column contains settings for Control Input Labels						
29	01	Control Input 1	Control Input 1	From 32 to 234 step 1		*
Text label to describe each individual control input. This text is displayed when a control input is accessed by the hotkey menu. It is displayed in the programmable scheme logic description of the control input						
29	02	Control Input 2	Control Input 2	From 32 to 234 step 1		*
Text label to describe each individual control input. This text is displayed when a control input is accessed by the hotkey menu. It is displayed in the programmable scheme logic description of the control input						
29	03	Control Input 3	Control Input 3	From 32 to 234 step 1		*
Text label to describe each individual control input. This text is displayed when a control input is accessed by the hotkey menu. It is displayed in the programmable scheme logic description of the control input						
29	04	Control Input 4	Control Input 4	From 32 to 234 step 1		*
Text label to describe each individual control input. This text is displayed when a control input is accessed by the hotkey menu. It is displayed in the programmable scheme logic description of the control input						
29	05	Control Input 5	Control Input 5	From 32 to 234 step 1		*
Text label to describe each individual control input. This text is displayed when a control input is accessed by the hotkey menu. It is displayed in the programmable scheme logic description of the control input						
29	06	Control Input 6	Control Input 6	From 32 to 234 step 1		*
Text label to describe each individual control input. This text is displayed when a control input is accessed by the hotkey menu. It is displayed in the programmable scheme logic description of the control input						
29	07	Control Input 7	Control Input 7	From 32 to 234 step 1		*

Col	Row	Menu Text	Default Setting	Available Setting	P742	P743
Description						
Text label to describe each individual control input. This text is displayed when a control input is accessed by the hotkey menu. It is displayed in the programmable scheme logic description of the control input						
29	08	Control Input 8	Control Input 8	From 32 to 234 step 1		*
Text label to describe each individual control input. This text is displayed when a control input is accessed by the hotkey menu. It is displayed in the programmable scheme logic description of the control input						
29	09	Control Input 9	Control Input 9	From 32 to 234 step 1		*
Text label to describe each individual control input. This text is displayed when a control input is accessed by the hotkey menu. It is displayed in the programmable scheme logic description of the control input						
29	0A	Control Input 10	Control Input 10	From 32 to 234 step 1		*
Text label to describe each individual control input. This text is displayed when a control input is accessed by the hotkey menu. It is displayed in the programmable scheme logic description of the control input						
29	0B	Control Input 11	Control Input 11	From 32 to 234 step 1		*
Text label to describe each individual control input. This text is displayed when a control input is accessed by the hotkey menu. It is displayed in the programmable scheme logic description of the control input						
29	0C	Control Input 12	Control Input 12	From 32 to 234 step 1		*
Text label to describe each individual control input. This text is displayed when a control input is accessed by the hotkey menu. It is displayed in the programmable scheme logic description of the control input						
29	0D	Control Input 13	Control Input 13	From 32 to 234 step 1		*
Text label to describe each individual control input. This text is displayed when a control input is accessed by the hotkey menu. It is displayed in the programmable scheme logic description of the control input						
29	0E	Control Input 14	Control Input 14	From 32 to 234 step 1		*
Text label to describe each individual control input. This text is displayed when a control input is accessed by the hotkey menu. It is displayed in the programmable scheme logic description of the control input						
29	0F	Control Input 15	Control Input 15	From 32 to 234 step 1		*
Text label to describe each individual control input. This text is displayed when a control input is accessed by the hotkey menu. It is displayed in the programmable scheme logic description of the control input						
29	10	Control Input 16	Control Input 16	From 32 to 234 step 1		*
Text label to describe each individual control input. This text is displayed when a control input is accessed by the hotkey menu. It is displayed in the programmable scheme logic description of the control input						
29	11	Control Input 17	Control Input 17	From 32 to 234 step 1		*
Text label to describe each individual control input. This text is displayed when a control input is accessed by the hotkey menu. It is displayed in the programmable scheme logic description of the control input						
29	12	Control Input 18	Control Input 18	From 32 to 234 step 1		*
Text label to describe each individual control input. This text is displayed when a control input is accessed by the hotkey menu. It is displayed in the programmable scheme logic description of the control input						
29	13	Control Input 19	Control Input 19	From 32 to 234 step 1		*
Text label to describe each individual control input. This text is displayed when a control input is accessed by the hotkey menu. It is displayed in the programmable scheme logic description of the control input						
29	14	Control Input 20	Control Input 20	From 32 to 234 step 1		*
Text label to describe each individual control input. This text is displayed when a control input is accessed by the hotkey menu. It is displayed in the programmable scheme logic description of the control input						
29	15	Control Input 21	Control Input 21	From 32 to 234 step 1		*
Text label to describe each individual control input. This text is displayed when a control input is accessed by the hotkey menu. It is displayed in the programmable scheme logic description of the control input						
29	16	Control Input 22	Control Input 22	From 32 to 234 step 1		*
Text label to describe each individual control input. This text is displayed when a control input is accessed by the hotkey menu. It is displayed in the programmable scheme logic description of the control input						
29	17	Control Input 23	Control Input 23	From 32 to 234 step 1		*

Col	Row	Menu Text	Default Setting	Available Setting	P742	P743
Description						
Text label to describe each individual control input. This text is displayed when a control input is accessed by the hotkey menu. It is displayed in the programmable scheme logic description of the control input						
29	18	Control Input 24	Control Input 24	From 32 to 234 step 1		*
Text label to describe each individual control input. This text is displayed when a control input is accessed by the hotkey menu. It is displayed in the programmable scheme logic description of the control input						
29	19	Control Input 25	Control Input 25	From 32 to 234 step 1		*
Text label to describe each individual control input. This text is displayed when a control input is accessed by the hotkey menu. It is displayed in the programmable scheme logic description of the control input						
29	1A	Control Input 26	Control Input 26	From 32 to 234 step 1		*
Text label to describe each individual control input. This text is displayed when a control input is accessed by the hotkey menu. It is displayed in the programmable scheme logic description of the control input						
29	1B	Control Input 27	Control Input 27	From 32 to 234 step 1		*
Text label to describe each individual control input. This text is displayed when a control input is accessed by the hotkey menu. It is displayed in the programmable scheme logic description of the control input						
29	1C	Control Input 28	Control Input 28	From 32 to 234 step 1		*
Text label to describe each individual control input. This text is displayed when a control input is accessed by the hotkey menu. It is displayed in the programmable scheme logic description of the control input						
29	1D	Control Input 29	Control Input 29	From 32 to 234 step 1		*
Text label to describe each individual control input. This text is displayed when a control input is accessed by the hotkey menu. It is displayed in the programmable scheme logic description of the control input						
29	1E	Control Input 30	Control Input 30	From 32 to 234 step 1		*
Text label to describe each individual control input. This text is displayed when a control input is accessed by the hotkey menu. It is displayed in the programmable scheme logic description of the control input						
29	1F	Control Input 31	Control Input 31	From 32 to 234 step 1		*
Text label to describe each individual control input. This text is displayed when a control input is accessed by the hotkey menu. It is displayed in the programmable scheme logic description of the control input						
29	20	Control Input 32	Control Input 32	From 32 to 234 step 1		*
Text label to describe each individual control input. This text is displayed when a control input is accessed by the hotkey menu. It is displayed in the programmable scheme logic description of the control input						

6 DISTURBANCE RECORDER SETTINGS

The disturbance recorder settings include the record duration and trigger position, selection of analog and digital signals to record, and the signal sources that trigger the recording.

The precise event recorder column (“Disturb. Recorder” menu) is visible when the “Disturb recorder” setting (“Configuration” column) = “visible”.

The "DISTURBANCE RECORDER" menu columns are different for the Central Unit and the Peripheral Units as shown in the configuration columns below:

- Disturbance Recorder Settings (P741
- Disturbance Recorder Settings (P742 or P743)

6.1 Disturbance Recorder Settings (P741)

Col	Row	Menu Text	Default Setting	Available Setting
Description				
0C	00	DISTURB RECORDER		
This column contains settings for the Disturbance Recorder				
0C	01	Duration	1.2s	From 100 ms to 10.5 s step 10 ms
This sets the overall recording time.				
0C	02	Trigger Position	33.34%	From 0% to 50.01% step 16.67%
This sets the trigger point as a percentage of the duration. For example, the default settings show that the overall recording time is set to 1.5 s with the trigger point being at 33.3% of this, giving 0.5 s pre-fault and 1s post fault recording times.				
0C	03	Trigger Mode	Single	0 = Single or 1 = Extended
If set to single mode, if a further trigger occurs whilst a recording is taking place, the recorder will ignore the trigger. However, if this has been set to Extended, the post trigger timer will be reset to zero, thereby extending the recording time.				
0C	04	Analog Channel 1	IA diff	0 - VA, 1 - VB, 2 - VC, 3 - VN, 4 - IA, 5 - IB, 6 - IC, 7 - IN, 8 - IM, 9 - V Checksync1, 10 - unassigned, 11 - V Checksync 2
Selects any available analogue input to be assigned to this channel.				
0C	05	Analog Channel 2	IB diff	0 - VA, 1 - VB, 2 - VC, 3 - VN, 4 - IA, 5 - IB, 6 - IC, 7 - IN, 8 - IM, 9 - V Checksync1, 10 - unassigned, 11 - V Checksync 2
Selects any available analogue input to be assigned to this channel.				
0C	06	Analog Channel 3	IC diff	0 - VA, 1 - VB, 2 - VC, 3 - VN, 4 - IA, 5 - IB, 6 - IC, 7 - IN, 8 - IM, 9 - V Checksync1, 10 - unassigned, 11 - V Checksync 2
Selects any available analogue input to be assigned to this channel.				
0C	07	Analog Channel 4	IN diff	0 - VA, 1 - VB, 2 - VC, 3 - VN, 4 - IA, 5 - IB, 6 - IC, 7 - IN, 8 - IM, 9 - V Checksync1, 10 - unassigned, 11 - V Checksync 2
Selects any available analogue input to be assigned to this channel.				
0C	08	Analog Channel 5	IA bias	0 - VA, 1 - VB, 2 - VC, 3 - VN, 4 - IA, 5 - IB, 6 - IC, 7 - IN, 8 - IM, 9 - V Checksync1, 10 - unassigned, 11 - V Checksync 2
Selects any available analogue input to be assigned to this channel.				
0C	09	Analog Channel 6	IB bias	0 - VA, 1 - VB, 2 - VC, 3 - VN, 4 - IA, 5 - IB, 6 - IC, 7 - IN, 8 - IM, 9 - V Checksync1, 10 - unassigned, 11 - V Checksync 2
Selects any available analogue input to be assigned to this channel.				
0C	0A	Analog Channel 7	IC bias	0 - VA, 1 - VB, 2 - VC, 3 - VN, 4 - IA, 5 - IB, 6 - IC, 7 - IN, 8 - IM, 9 - V Checksync1, 10 - unassigned, 11 - V Checksync 2
Selects any available analogue input to be assigned to this channel.				

Col	Row	Menu Text	Default Setting	Available Setting
Description				
0C	0B	Analog Channel 8	IN bias	0 - VA, 1 - VB, 2 - VC, 3 - VN, 4 - IA, 5 - IB, 6 - IC, 7 - IN, 8 - IM, 9 - V Checksync1, 10 - unassigned, 11 - V Checksync 2
Selects any available analogue input to be assigned to this channel.				
0C	0C	Digital Input 1	Circt Flt Alm z1	See Data Types - G32
The digital channels may monitor any of the opto isolated inputs or output contacts, in addition to a number of internal IED digital signals, such as protection starts, LEDs etc.				
0C	0D	Digital Input 2	Circt Flt Alm z2	See Data Types - G32
The digital channels may monitor any of the opto isolated inputs or output contacts, in addition to a number of internal IED digital signals, such as protection starts, LEDs etc.				
0C	0E	Digital Input 3	INP Block 3Ph z5	See Data Types - G32
The digital channels may monitor any of the opto isolated inputs or output contacts, in addition to a number of internal IED digital signals, such as protection starts, LEDs etc.				
0C	0F	Digital Input 4	Ext Start DR	See Data Types - G32
The digital channels may monitor any of the opto isolated inputs or output contacts, in addition to a number of internal IED digital signals, such as protection starts, LEDs etc.				
0C	10	Digital Input 5	Fault Check Zone	See Data Types - G32
The digital channels may monitor any of the opto isolated inputs or output contacts, in addition to a number of internal IED digital signals, such as protection starts, LEDs etc.				
0C	11	Digital Input 6	SEF Blocked	See Data Types - G32
The digital channels may monitor any of the opto isolated inputs or output contacts, in addition to a number of internal IED digital signals, such as protection starts, LEDs etc.				
0C	12	Digital Input 7	Topology valid	See Data Types - G32
The digital channels may monitor any of the opto isolated inputs or output contacts, in addition to a number of internal IED digital signals, such as protection starts, LEDs etc.				
0C	13	Digital Input 8	87BB 3Ph Blocked	See Data Types - G32
The digital channels may monitor any of the opto isolated inputs or output contacts, in addition to a number of internal IED digital signals, such as protection starts, LEDs etc.				
0C	14	Digital Input 9	Fibre Com Worn	See Data Types - G32
The digital channels may monitor any of the opto isolated inputs or output contacts, in addition to a number of internal IED digital signals, such as protection starts, LEDs etc.				
0C	15	Digital Input 10	Trip 87BB Zone 1	See Data Types - G32
The digital channels may monitor any of the opto isolated inputs or output contacts, in addition to a number of internal IED digital signals, such as protection starts, LEDs etc.				
0C	16	Digital Input 11	Trip 87BB Zone 2	See Data Types - G32
The digital channels may monitor any of the opto isolated inputs or output contacts, in addition to a number of internal IED digital signals, such as protection starts, LEDs etc.				
0C	17	Digital Input 12	INP Block 3Ph z8	See Data Types - G32
The digital channels may monitor any of the opto isolated inputs or output contacts, in addition to a number of internal IED digital signals, such as protection starts, LEDs etc.				
0C	18	Digital Input 13	General Alarm	See Data Types - G32
The digital channels may monitor any of the opto isolated inputs or output contacts, in addition to a number of internal IED digital signals, such as protection starts, LEDs etc.				
0C	19	Digital Input 14	Circt Flt Alm Zx	See Data Types - G32
The digital channels may monitor any of the opto isolated inputs or output contacts, in addition to a number of internal IED digital signals, such as protection starts, LEDs etc.				
0C	1A	Digital Input 15	INP Block SEF z1	See Data Types - G32
The digital channels may monitor any of the opto isolated inputs or output contacts, in addition to a number of internal IED digital signals, such as protection starts, LEDs etc.				

Col	Row	Menu Text	Default Setting	Available Setting
Description				
0C	1B	Digital Input 16	INP Block SEF z2	See Data Types - G32
The digital channels may monitor any of the opto isolated inputs or output contacts, in addition to a number of internal IED digital signals, such as protection starts, LEDs etc.				
0C	1C	Digital Input 17	Man.Trip Zone 1	See Data Types - G32
The digital channels may monitor any of the opto isolated inputs or output contacts, in addition to a number of internal IED digital signals, such as protection starts, LEDs etc.				
0C	1D	Digital Input 18	Man.Trip Zone 2	See Data Types - G32
The digital channels may monitor any of the opto isolated inputs or output contacts, in addition to a number of internal IED digital signals, such as protection starts, LEDs etc.				
0C	1E	Digital Input 19	PU Error Alm z1	See Data Types - G32
The digital channels may monitor any of the opto isolated inputs or output contacts, in addition to a number of internal IED digital signals, such as protection starts, LEDs etc.				
0C	1F	Digital Input 20	PU Error Alm z2	See Data Types - G32
The digital channels may monitor any of the opto isolated inputs or output contacts, in addition to a number of internal IED digital signals, such as protection starts, LEDs etc.				
0C	20	Digital Input 21	unused	See Data Types - G32
The digital channels may monitor any of the opto isolated inputs or output contacts, in addition to a number of internal IED digital signals, such as protection starts, LEDs etc.				
0C	21	Digital Input 22	unused	See Data Types - G32
The digital channels may monitor any of the opto isolated inputs or output contacts, in addition to a number of internal IED digital signals, such as protection starts, LEDs etc.				
0C	22	Digital Input 23	unused	See Data Types - G32
The digital channels may monitor any of the opto isolated inputs or output contacts, in addition to a number of internal IED digital signals, such as protection starts, LEDs etc.				
0C	23	Digital Input 24	unused	See Data Types - G32
The digital channels may monitor any of the opto isolated inputs or output contacts, in addition to a number of internal IED digital signals, such as protection starts, LEDs etc.				
0C	24	Digital Input 25	unused	See Data Types - G32
The digital channels may monitor any of the opto isolated inputs or output contacts, in addition to a number of internal IED digital signals, such as protection starts, LEDs etc.				
0C	25	Digital Input 26	unused	See Data Types - G32
The digital channels may monitor any of the opto isolated inputs or output contacts, in addition to a number of internal IED digital signals, such as protection starts, LEDs etc.				
0C	26	Digital Input 27	unused	See Data Types - G32
The digital channels may monitor any of the opto isolated inputs or output contacts, in addition to a number of internal IED digital signals, such as protection starts, LEDs etc.				
0C	27	Digital Input 28	unused	See Data Types - G32
The digital channels may monitor any of the opto isolated inputs or output contacts, in addition to a number of internal IED digital signals, such as protection starts, LEDs etc.				
0C	28	Digital Input 29	unused	See Data Types - G32
The digital channels may monitor any of the opto isolated inputs or output contacts, in addition to a number of internal IED digital signals, such as protection starts, LEDs etc.				
0C	29	Digital Input 30	unused	See Data Types - G32
The digital channels may monitor any of the opto isolated inputs or output contacts, in addition to a number of internal IED digital signals, such as protection starts, LEDs etc.				
0C	2A	Digital Input 31	unused	See Data Types - G32
The digital channels may monitor any of the opto isolated inputs or output contacts, in addition to a number of internal IED digital signals, such as protection starts, LEDs etc.				

Col	Row	Menu Text	Default Setting	Available Setting
Description				
0C	2B	Digital Input 32	unused	See Data Types - G32
The digital channels may monitor any of the opto isolated inputs or output contacts, in addition to a number of internal IED digital signals, such as protection starts, LEDs etc.				
0C	2C	Manual Trigger	No	0 = No Trigger, 1 = Trigger L/H, 2 = Trigger H/L
Any of the digital channels may be selected to trigger the disturbance recorder on either a low to high or a high to low transition.				
0C	2D	Zone To Record	10000000(bin)	Bit 00=Zone 8 to Bit FF=Zone 1
Select the protection zone needs to record the disturbance				

6.2 Disturbance Recorder Settings (P742 or P743))

Col	Row	Menu Text	Default Setting	Available Setting	7 4	7 4
Description						
0C	00	DISTURB RECORDER			*	*
This column contains settings for the Disturbance Recorder						
0C	01	Duration	1.2s	From 100ms to 10.5s step 10ms	*	*
This sets the overall recording time.						
0C	02	Trigger Position	33.3%	From 0 % to 100% step 33.3%	*	*
This sets the trigger point as a percentage of the duration. For example, the default settings show that the overall recording time is set to 1.5 s with the trigger point being at 33.3% of this, giving 0.5 s pre-fault and 1s post fault recording times.						
0C	03	Trigger Mode	Extended	0 = Single or 1 = Extended	*	*
If set to single mode, if a further trigger occurs whilst a recording is taking place, the recorder will ignore the trigger. However, if this has been set to Extended, the post trigger timer will be reset to zero, thereby extending the recording time.						
0C	04	Analog Channel 1	IA	0-VA, 1-VB, 2-VC, 3-VN, 4-IA, 5-IB, 6-IC, 7-IN, 8-IM, 9-V Checksync, 10-Unasigned	*	*
Selects any available analogue input to be assigned to this channel.						
0C	05	Analog Channel 2	IB	0-VA, 1-VB, 2-VC, 3-VN, 4-IA, 5-IB, 6-IC, 7-IN, 8-IM, 9-V Checksync, 10-Unasigned	*	*
Selects any available analogue input to be assigned to this channel.						
0C	06	Analog Channel 3	IC	0-VA, 1-VB, 2-VC, 3-VN, 4-IA, 5-IB, 6-IC, 7-IN, 8-IM, 9-V Checksync, 10-Unasigned	*	*
Selects any available analogue input to be assigned to this channel.						
0C	07	Analog Channel 4	IN	0-VA, 1-VB, 2-VC, 3-VN, 4-IA, 5-IB, 6-IC, 7-IN, 8-IM, 9-V Checksync, 10-Unasigned	*	*
Selects any available analogue input to be assigned to this channel.						
0C	08	Analog Channel 5	Unassigned	0-VA, 1-VB, 2-VC, 3-VN, 4-IA, 5-IB, 6-IC, 7-IN, 8-IM, 9-V Checksync, 10-Unasigned	*	*
Selects any available analogue input to be assigned to this channel.						
0C	09	Analog Channel 6	Unassigned	0-VA, 1-VB, 2-VC, 3-VN, 4-IA, 5-IB, 6-IC, 7-IN, 8-IM, 9-V Checksync, 10-Unasigned	*	*
Selects any available analogue input to be assigned to this channel.						
0C	0A	Analog Channel 7	Unassigned	0-VA, 1-VB, 2-VC, 3-VN, 4-IA, 5-IB, 6-IC, 7-IN, 8-IM, 9-V Checksync, 10-Unasigned	*	*
Selects any available analogue input to be assigned to this channel.						
0C	0B	Analog Channel 8	Unassigned	0-VA, 1-VB, 2-VC, 3-VN, 4-IA, 5-IB, 6-IC, 7-IN, 8-IM, 9-V Checksync, 10-Unasigned	*	*
Selects any available analogue input to be assigned to this channel.						
0C	0C	Digital Input 1	Bad TCP/IP Cfg.	See Data Types - G32	*	*
The digital channels may monitor any of the opto isolated inputs or output contacts, in addition to a number of internal IED digital signals, such as protection starts, LEDs etc.						
0C	0D	Input 1 Trigger	No Trigger	0 = No Trigger, 1 = Trigger L/H, 2 = Trigger H/L	*	*
Any of the digital channels may be selected to trigger the disturbance recorder on either a low to high or a high to low transition.						
0C	0E	Digital Input 2	87BB Fault Ph C	See Data Types - G32	*	*
The digital channels may monitor any of the opto isolated inputs or output contacts, in addition to a number of internal IED digital signals, such as protection starts, LEDs etc.						
0C	0F	Input 2 Trigger	Trigger L/H	0 = No Trigger, 1 = Trigger L/H, 2 = Trigger H/L	*	*
Any of the digital channels may be selected to trigger the disturbance recorder on either a low to high or a high to low transition.						
0C	10	Digital Input 3	Q6 Status Forced	See Data Types - G32	*	*

Col	Row	Menu Text	Default Setting	Available Setting	7 4	7 4
Description						
The digital channels may monitor any of the opto isolated inputs or output contacts, in addition to a number of internal IED digital signals, such as protection starts, LEDs etc.						
0C	11	Input 3 Trigger	No Trigger	0 = No Trigger, 1 = Trigger L/H, 2 = Trigger H/L	*	*
Any of the digital channels may be selected to trigger the disturbance recorder on either a low to high or a high to low transition.						
0C	12	Digital Input 4	I>2 Start A	See Data Types - G32	*	*
The digital channels may monitor any of the opto isolated inputs or output contacts, in addition to a number of internal IED digital signals, such as protection starts, LEDs etc.						
0C	13	Input 4 Trigger	No Trigger	0 = No Trigger, 1 = Trigger L/H, 2 = Trigger H/L	*	*
Any of the digital channels may be selected to trigger the disturbance recorder on either a low to high or a high to low transition.						
0C	14	Digital Input 5	CB not available	See Data Types - G32	*	*
The digital channels may monitor any of the opto isolated inputs or output contacts, in addition to a number of internal IED digital signals, such as protection starts, LEDs etc.						
0C	15	Input 5 Trigger	No Trigger	0 = No Trigger, 1 = Trigger L/H, 2 = Trigger H/L	*	*
Any of the digital channels may be selected to trigger the disturbance recorder on either a low to high or a high to low transition.						
0C	16	Digital Input 6	I>1 Trip	See Data Types - G32	*	*
The digital channels may monitor any of the opto isolated inputs or output contacts, in addition to a number of internal IED digital signals, such as protection starts, LEDs etc.						
0C	17	Input 6 Trigger	Trigger L/H	0 = No Trigger, 1 = Trigger L/H, 2 = Trigger H/L	*	*
Any of the digital channels may be selected to trigger the disturbance recorder on either a low to high or a high to low transition.						
0C	18	Digital Input 7	IN>1 Trip	See Data Types - G32	*	*
The digital channels may monitor any of the opto isolated inputs or output contacts, in addition to a number of internal IED digital signals, such as protection starts, LEDs etc.						
0C	19	Input 7 Trigger	Trigger L/H	0 = No Trigger, 1 = Trigger L/H, 2 = Trigger H/L	*	*
Any of the digital channels may be selected to trigger the disturbance recorder on either a low to high or a high to low transition.						
0C	1A	Digital Input 8	Topology valid	See Data Types - G32	*	*
The digital channels may monitor any of the opto isolated inputs or output contacts, in addition to a number of internal IED digital signals, such as protection starts, LEDs etc.						
0C	1B	Input 8 Trigger	Trigger L/H	0 = No Trigger, 1 = Trigger L/H, 2 = Trigger H/L	*	*
Any of the digital channels may be selected to trigger the disturbance recorder on either a low to high or a high to low transition.						
0C	1C	Digital Input 9	Ext. CB Fail	See Data Types - G32	*	*
The digital channels may monitor any of the opto isolated inputs or output contacts, in addition to a number of internal IED digital signals, such as protection starts, LEDs etc.						
0C	1D	Input 9 Trigger	Trigger L/H	0 = No Trigger, 1 = Trigger L/H, 2 = Trigger H/L	*	*
Any of the digital channels may be selected to trigger the disturbance recorder on either a low to high or a high to low transition.						
0C	1E	Digital Input 10	Ext. 3 ph Trip	See Data Types - G32	*	*
The digital channels may monitor any of the opto isolated inputs or output contacts, in addition to a number of internal IED digital signals, such as protection starts, LEDs etc.						
0C	1F	Input 10 Trigger	Trigger L/H	0 = No Trigger, 1 = Trigger L/H, 2 = Trigger H/L	*	*
Any of the digital channels may be selected to trigger the disturbance recorder on either a low to high or a high to low transition.						
0C	20	Digital Input 11	Dead Zone Earth	See Data Types - G32	*	*
The digital channels may monitor any of the opto isolated inputs or output contacts, in addition to a number of internal IED digital signals, such as protection starts, LEDs etc.						
0C	21	Input 11 Trigger	Trigger L/H	0 = No Trigger, 1 = Trigger L/H, 2 = Trigger H/L	*	*
Any of the digital channels may be selected to trigger the disturbance recorder on either a low to high or a high to low transition.						
0C	22	Digital Input 12	Q4 Status Alarm	See Data Types - G32	*	*

Col	Row	Menu Text	Default Setting	Available Setting	7 4	7 4
Description						
The digital channels may monitor any of the opto isolated inputs or output contacts, in addition to a number of internal IED digital signals, such as protection starts, LEDs etc.						
0C	23	Input 12 Trigger	No Trigger	0 = No Trigger, 1 = Trigger L/H, 2 = Trigger H/L	*	*
Any of the digital channels may be selected to trigger the disturbance recorder on either a low to high or a high to low transition.						
0C	24	Digital Input 13	Q5 Status Alarm	See Data Types - G32	*	*
The digital channels may monitor any of the opto isolated inputs or output contacts, in addition to a number of internal IED digital signals, such as protection starts, LEDs etc.						
0C	25	Input 13 Trigger	No Trigger	0 = No Trigger, 1 = Trigger L/H, 2 = Trigger H/L	*	*
Any of the digital channels may be selected to trigger the disturbance recorder on either a low to high or a high to low transition.						
0C	26	Digital Input 14	Q6 Status Alarm	See Data Types - G32	*	*
The digital channels may monitor any of the opto isolated inputs or output contacts, in addition to a number of internal IED digital signals, such as protection starts, LEDs etc.						
0C	27	Input 14 Trigger	No Trigger	0 = No Trigger, 1 = Trigger L/H, 2 = Trigger H/L	*	*
Any of the digital channels may be selected to trigger the disturbance recorder on either a low to high or a high to low transition.						
0C	28	Digital Input 15	Config. Valid	See Data Types - G32	*	*
The digital channels may monitor any of the opto isolated inputs or output contacts, in addition to a number of internal IED digital signals, such as protection starts, LEDs etc.						
0C	29	Input 15 Trigger	Trigger L/H	0 = No Trigger, 1 = Trigger L/H, 2 = Trigger H/L	*	*
Any of the digital channels may be selected to trigger the disturbance recorder on either a low to high or a high to low transition.						
0C	2A	Digital Input 16	Relay Label 01	See Data Types - G32	*	*
The digital channels may monitor any of the opto isolated inputs or output contacts, in addition to a number of internal IED digital signals, such as protection starts, LEDs etc.						
0C	2B	Input 16 Trigger	No Trigger	0 = No Trigger, 1 = Trigger L/H, 2 = Trigger H/L	*	*
Any of the digital channels may be selected to trigger the disturbance recorder on either a low to high or a high to low transition.						
0C	2C	Digital Input 17	Relay Label 02	See Data Types - G32	*	*
The digital channels may monitor any of the opto isolated inputs or output contacts, in addition to a number of internal IED digital signals, such as protection starts, LEDs etc.						
0C	2D	Input 17 Trigger	No Trigger	0 = No Trigger, 1 = Trigger L/H, 2 = Trigger H/L	*	*
Any of the digital channels may be selected to trigger the disturbance recorder on either a low to high or a high to low transition.						
0C	2E	Digital Input 18	Relay Label 03	See Data Types - G32	*	*
The digital channels may monitor any of the opto isolated inputs or output contacts, in addition to a number of internal IED digital signals, such as protection starts, LEDs etc.						
0C	2F	Input 18 Trigger	No Trigger	0 = No Trigger, 1 = Trigger L/H, 2 = Trigger H/L	*	*
Any of the digital channels may be selected to trigger the disturbance recorder on either a low to high or a high to low transition.						
0C	30	Digital Input 19	Offset Chan ABCN	See Data Types - G32	*	*
The digital channels may monitor any of the opto isolated inputs or output contacts, in addition to a number of internal IED digital signals, such as protection starts, LEDs etc.						
0C	31	Input 19 Trigger	No Trigger	0 = No Trigger, 1 = Trigger L/H, 2 = Trigger H/L	*	*
Any of the digital channels may be selected to trigger the disturbance recorder on either a low to high or a high to low transition.						
0C	32	Digital Input 20	Predict err ph A	See Data Types - G32	*	*
The digital channels may monitor any of the opto isolated inputs or output contacts, in addition to a number of internal IED digital signals, such as protection starts, LEDs etc.						
0C	33	Input 20 Trigger	No Trigger	0 = No Trigger, 1 = Trigger L/H, 2 = Trigger H/L	*	*
Any of the digital channels may be selected to trigger the disturbance recorder on either a low to high or a high to low transition.						
0C	34	Digital Input 21	Predict err ph B	See Data Types - G32	*	*

Col	Row	Menu Text	Default Setting	Available Setting	7 4	7 4
Description						
The digital channels may monitor any of the opto isolated inputs or output contacts, in addition to a number of internal IED digital signals, such as protection starts, LEDs etc.						
0C	35	Input 21 Trigger	No Trigger	0 = No Trigger, 1 = Trigger L/H, 2 = Trigger H/L	*	*
Any of the digital channels may be selected to trigger the disturbance recorder on either a low to high or a high to low transition.						
0C	36	Digital Input 22	Config Error	See Data Types - G32	*	*
The digital channels may monitor any of the opto isolated inputs or output contacts, in addition to a number of internal IED digital signals, such as protection starts, LEDs etc.						
0C	37	Input 22 Trigger	Trigger L/H	0 = No Trigger, 1 = Trigger L/H, 2 = Trigger H/L	*	*
Any of the digital channels may be selected to trigger the disturbance recorder on either a low to high or a high to low transition.						
0C	38	Digital Input 23	Operating mode 1	See Data Types - G32	*	*
The digital channels may monitor any of the opto isolated inputs or output contacts, in addition to a number of internal IED digital signals, such as protection starts, LEDs etc.						
0C	39	Input 23 Trigger	Trigger L/H	0 = No Trigger, 1 = Trigger L/H, 2 = Trigger H/L	*	*
Any of the digital channels may be selected to trigger the disturbance recorder on either a low to high or a high to low transition.						
0C	3A	Digital Input 24	Unused	See Data Types - G32	*	*
The digital channels may monitor any of the opto isolated inputs or output contacts, in addition to a number of internal IED digital signals, such as protection starts, LEDs etc.						
0C	3B	Input 24 Trigger	No Trigger	0 = No Trigger, 1 = Trigger L/H, 2 = Trigger H/L	*	*
Any of the digital channels may be selected to trigger the disturbance recorder on either a low to high or a high to low transition.						
0C	3C	Digital Input 25	Unused	See Data Types - G32	*	*
The digital channels may monitor any of the opto isolated inputs or output contacts, in addition to a number of internal IED digital signals, such as protection starts, LEDs etc.						
0C	3D	Input 25 Trigger	No Trigger	0 = No Trigger, 1 = Trigger L/H, 2 = Trigger H/L	*	*
Any of the digital channels may be selected to trigger the disturbance recorder on either a low to high or a high to low transition.						
0C	3E	Digital Input 26	Unused	See Data Types - G32	*	*
The digital channels may monitor any of the opto isolated inputs or output contacts, in addition to a number of internal IED digital signals, such as protection starts, LEDs etc.						
0C	3F	Input 26 Trigger	No Trigger	0 = No Trigger, 1 = Trigger L/H, 2 = Trigger H/L	*	*
Any of the digital channels may be selected to trigger the disturbance recorder on either a low to high or a high to low transition.						
0C	40	Digital Input 27	Unused	See Data Types - G32	*	*
The digital channels may monitor any of the opto isolated inputs or output contacts, in addition to a number of internal IED digital signals, such as protection starts, LEDs etc.						
0C	41	Input 27 Trigger	No Trigger	0 = No Trigger, 1 = Trigger L/H, 2 = Trigger H/L	*	*
Any of the digital channels may be selected to trigger the disturbance recorder on either a low to high or a high to low transition.						
0C	42	Digital Input 28	Unused	See Data Types - G32	*	*
The digital channels may monitor any of the opto isolated inputs or output contacts, in addition to a number of internal IED digital signals, such as protection starts, LEDs etc.						
0C	43	Input 28 Trigger	No Trigger	0 = No Trigger, 1 = Trigger L/H, 2 = Trigger H/L	*	*
Any of the digital channels may be selected to trigger the disturbance recorder on either a low to high or a high to low transition.						
0C	44	Digital Input 29	Unused	See Data Types - G32	*	*
The digital channels may monitor any of the opto isolated inputs or output contacts, in addition to a number of internal IED digital signals, such as protection starts, LEDs etc.						
0C	45	Input 29 Trigger	No Trigger	0 = No Trigger, 1 = Trigger L/H, 2 = Trigger H/L	*	*
Any of the digital channels may be selected to trigger the disturbance recorder on either a low to high or a high to low transition.						
0C	46	Digital Input 30	Unused	See Data Types - G32	*	*

Col	Row	Menu Text	Default Setting	Available Setting	7 4	7 4
Description						
The digital channels may monitor any of the opto isolated inputs or output contacts, in addition to a number of internal IED digital signals, such as protection starts, LEDs etc.						
0C	47	Input 30 Trigger	No Trigger	0 = No Trigger, 1 = Trigger L/H, 2 = Trigger H/L	*	*
Any of the digital channels may be selected to trigger the disturbance recorder on either a low to high or a high to low transition.						
0C	48	Digital Input 31	Unused	See Data Types - G32	*	*
The digital channels may monitor any of the opto isolated inputs or output contacts, in addition to a number of internal IED digital signals, such as protection starts, LEDs etc.						
0C	49	Input 31 Trigger	No Trigger	0 = No Trigger, 1 = Trigger L/H, 2 = Trigger H/L	*	*
Any of the digital channels may be selected to trigger the disturbance recorder on either a low to high or a high to low transition.						
0C	4A	Digital Input 32	Unused	See Data Types - G32	*	*
The digital channels may monitor any of the opto isolated inputs or output contacts, in addition to a number of internal IED digital signals, such as protection starts, LEDs etc.						
0C	4B	Input 32 Trigger	No Trigger	0 = No Trigger, 1 = Trigger L/H, 2 = Trigger H/L	*	*
Any of the digital channels may be selected to trigger the disturbance recorder on either a low to high or a high to low transition.						

Notes:

OPERATION

CHAPTER 5

Date:	02/2017
Products covered by this chapter:	This chapter covers the specific versions of the MiCOM products listed below. This includes ***only*** the following combinations of Software Version and Hardware Suffix.
Hardware Suffix:	L (P742) & M (P741 & P743)
Software Version:	B1 - P74x (P741, P742 & P743)
Connection Diagrams:	10P740xx (xx = 01 to 07)

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FIGURES

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1 OPERATION OF INDIVIDUAL PROTECTION FUNCTIONS

The following sections detail the individual protection functions.

Important	**Not all the protection functions listed below are applicable to every relay.**

1.1 Busbar Biased Current Differential Protection

The primary protection element of the scheme is phase-segregated biased current differential protection. The technique used is purely numerical and uses nodal analysis throughout the scheme, on a per zone and per scheme basis.

The analysis is carried out in the central unit therefore communication between the central unit and all peripheral units is essential. This is achieved via a direct optical connection using a 2.5 Mbits/sec data rate.

1.1.1 Operating Principle

The basic operating principle of the differential protection is based on the application of Kirchhoff's law. This compares the amount of current entering and leaving the protected zone and the check zone. Under normal operation, the amount of current flowing into the area and the check zone concerned is equal in to the amount of the current flowing out of the area. Therefore the currents cancel out. In contrast, when a fault occurs the differential current that arises is equal to the derived fault current.

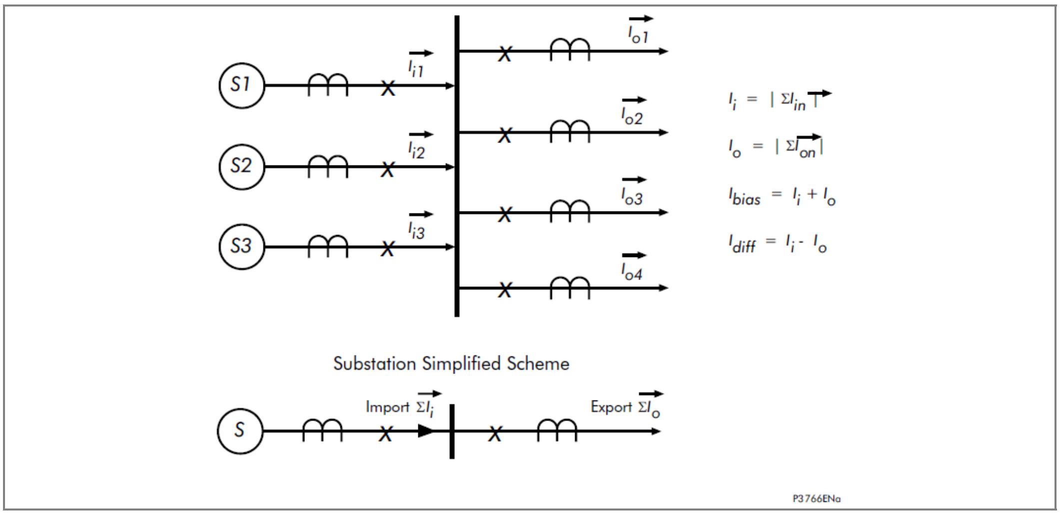

Figure 1 - Differential busbar protection principle

1.1.2 Application of Kirchoff’s Law

Several methods of summation can be used for a differential protection scheme:

- Vector sum
- Instantaneous sum

The algorithms applied in this MiCOM unit use the instantaneous sum method (on samples). This method has the advantage of cancelling the harmonic and DC components of external origin in the calculation and in particular under transformer inrush conditions.

The other advantage of using an instantaneous sum lies in the speed of decision, which in turn is dictated by the sampling frequency.

Differential currents may also be generated under external fault conditions due to CT error. To provide stability for through fault conditions the relay adopts a biasing technique, which effectively raises the setting of the relay in proportion to the through fault current thereby preventing relay maloperation.

The bias current is the scalar sum of the currents in the protected zone and for the check zone. Each of these calculations is done on a per phase basis for each node and then summated.

1.1.2.1 Bias Characteristic and Differential Current

The operation of the busbar differential protection is based on the application of an algorithm having a biased characteristic, (Figure 2) in which a comparison is made between the differential current and a bias or restraining current. A trip is only permitted if this differential current exceeds the set slope of the bias characteristic. This characteristic is intended to guarantee the stability of protection during external faults where the scheme has current transformers with differing characteristics, likely to provide differing performance.

The algorithm operands are as follows:

Differential Current

$$\mathbf{i_{diff}(t) = \left|\Sigma\ i\right|}$$

Bias or Restraining current

$$\mathbf{i_{bias}(t) = \Sigma\ \left|i\right|}$$

Slope of the bias characteristic

$$\mathbf{kx}$$

Tripping permitted by bias element for:

$$\mathbf{i_{diff}x(t) > kx\ x\ i_{bias}(t)}$$

The main differential current element of MiCOM P740 will only be able to operate if the differential current reaches a threshold IDx>2. In general, this setting will be adjusted above the normal full load current.

1.1.2.2 Scheme Supervision by "Check Zone” Element

The use of a "Check Zone" element is based on the principle that in the event of a fault on one of the substation busbars, the differential current measured in the faulty zone will be equal to that measured in the entire scheme.

One of the most frequent causes of maloperation of differential busbar protection schemes is an error in the actual position of an isolator or CB in the substation to that replicated in the scheme (auxiliary contacts discrepancy). This would produce a differential current in one or more current nodes. However, if an element monitors only the currents "entering" and "leaving" the substation, the resultant will remain negligible in the absence of a fault, and the error will lie with the zone’s assumption of the plant position at this particular point in time.

1.2 Busbar Protection

1.2.1 Bias Characteristic and Diffential Current Setting

This diagram shows the characteristics of the scheme phase differential element.

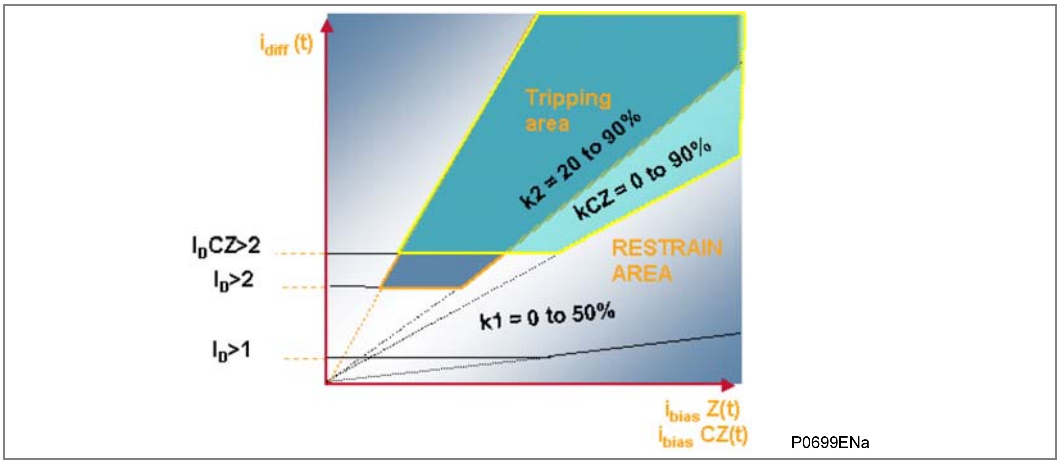

Figure 2 - P740 scheme characteristic

The Phase characteristic is determined from the following protection settings:

- Area above the I_D>2 threshold zone differential current threshold setting and the set slope of the bias characteristic (k2 × I_{bias}) (k2 is the percentage bias setting "slope" for the zone)

Note	*The origin of the bias characteristic slope is 0.*

When an external fault condition causes CT saturation, a differential current is apparent and is equal to the current of the saturated CT. The measured differential current may be determined as an internal fault and initiate an unwanted trip of the bus bar. In order to avoid a risk of tripping under these circumstances, MiCOM P740 uses an ultra fast innovative algorithm based on the prediction of the next samples and the calculation of the image of the flux of the HV CT core. This signal-processing algorithm makes it possible to block a trip sample within a window of 1.7 ms. A timer 'Block Duration' of 150 ms is used to block the differential element in case of CT saturation detection.

1.2.2 Scheme Supervision by "Check Zone" Element

For security, the busbar protection will only trip a particular busbar zone if that zone differential element AND the check zone element are in agreement to trip.

The principal advantage of this element is total insensitivity to topological discrepancies. Under such circumstances the "check zone" element will see two currents with equal amplitude but of opposite sign in adjacent zones.

The Check Zone characteristic is determined from the following protection settings:

- Area above the I_DCZ>2 threshold check zone differential current threshold setting and the set slope of the bias characteristic (kCZ × I_{bias}) (kCZ is the percentage bias setting ("slope") for the Check Zone)

Note	*The origin of the bias characteristic slope is 0.*

The check zone is limited by all the current nodes entering and leaving the substation (feeders).

Scheme differential current = sum of all differential current feeder nodes:

$i_{diff}(t)\ CZ = \left| \Sigma\ i_{diff} \right|$

The Check Zone will operate as the Zone element.

1.2.3 Scheme Earth Characteristic Element

The Earth characteristic is determined from the following protection settings:

- I_DN>2 High-set zone differential current threshold setting which crosses the set slope of the bias characteristic (k × I_{bias})
- I_DNCZ>2 High-set check zone differential current threshold setting which crosses the set slope of the bias characteristic (kCZ × I_{bias})
- KN2 Percentage bias setting (“slope”) for the zone
- kNCZ Percentage bias setting (“slope”) for the check zone

The current control and blocking matrix is shown in Figure 3.

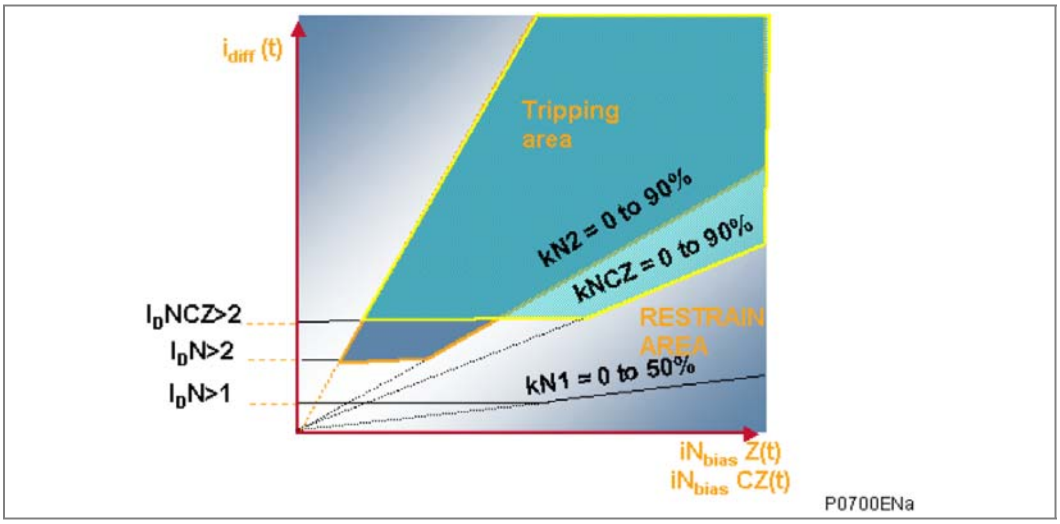

Figure 3 - Sensitive earth fault characteristic

This element is automatically enabled/disabled via the load (flowing) current. The point at which the sensitive earth fault protection is enabled/disabled (IbiasPh>Cur.) is settable in the range. This threshold is usually set to be equal to the minimum phase to phase short circuit current.

Under earth fault conditions the risk of CT saturation is minimal and therefore the slope of the characteristic can be set low, however, should the fault evolve to a phase fault, it is important that the normal characteristic be restored.

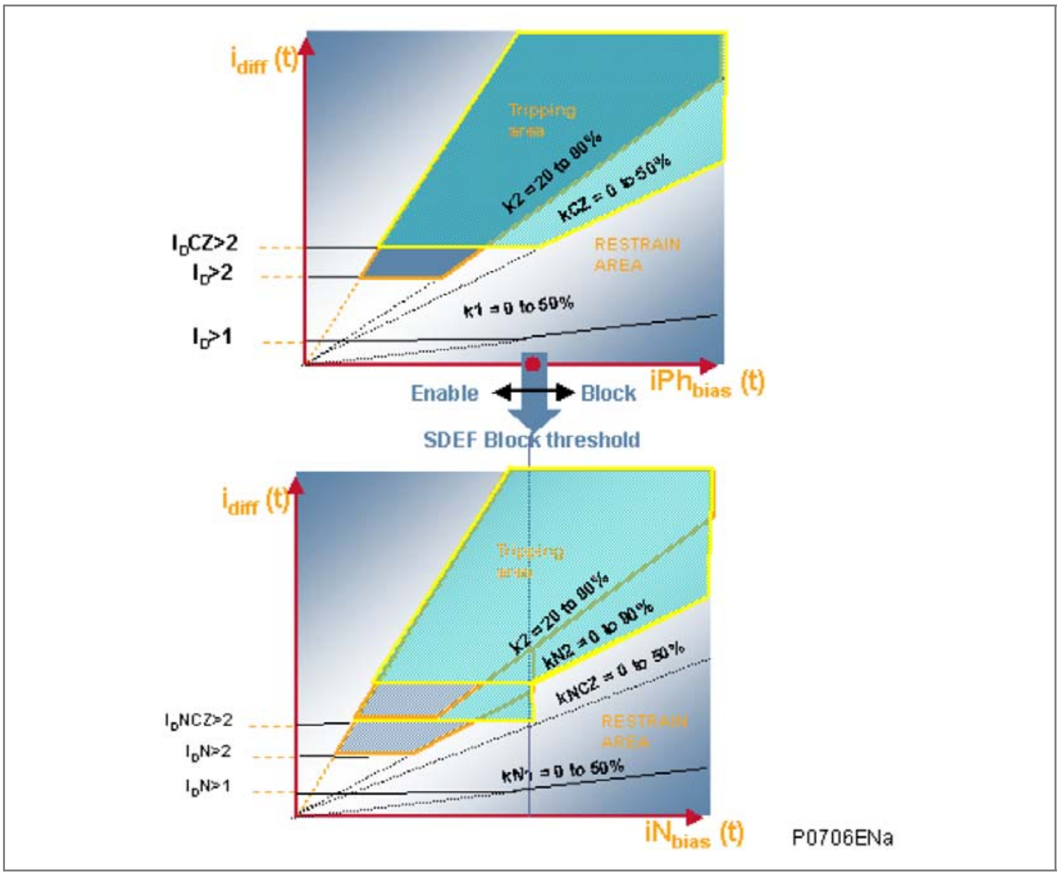

Figure 4 - Sensitive earth fault blocking characteristic

For an external phase fault the SDEF protection will be disabled by the blocking command as long as the 'IbiasPh>Cur.' threshold remains exceeded.

It can be seen that for an internal phase to phase fault the bias current will be sufficient to enable the SDEF blocking order. The SDEF protection is then blocked and no trip issued from this element irrespective of SDEF setting thresholds being exceeded. As the main phase differential protection is always active, it is able to react to the fault and issue a trip command accordingly.

For an external phase to phase fault the SDEF will be disabled via the blocking order.

The sensitive differential earth fault protection is delayed by 20ms to prevent any maloperation during CT saturation condition.

Important	***SDEF should only be used when all the CTs are of the same standard***

1.2.4 Threshold Coherency

The measuring elements have several level detectors for differential current. Upon starting, the protection reacts to any setting inconsistency in the detection of these levels' specific order.

The differential protection is blocked until the thresholds [ID>1and ID>2] and [IDN>1and IDN>2] are set in the correct sequence.

The thresholds must be set so that:

$$(I_D>1) \leqslant (I_D>2)\ ,\ (I_D>1) \leqslant (I_{DCZ}>2) \text{ and } (I_{DN}>1) \leqslant (I_{DN}>2),\ (I_{DN}>1) \leqslant (I_{DNCZ}>2)$$

Table below shows operation depending on the thresholds' status.

ID>1	k1.Ibias	ID>2	Status	Operation
0	0	0	Normal	No operation
1	0	0	Normal	No operation

ID>1	k1.Ibias	ID>2	Status	Operation
0	1	0	Normal	No operation
1	0	1	External fault or circuitry fault	External fault with CT saturation or block circuitry fault alarm after tCF
1	1	0	Circuitry fault	Block and circuitry fault alarm after tCF
1	1	1	Internal fault	Trip

Table 1 - Operation conditions

1.2.5 Signal Quality

An additional check is carried out to confirm that the signals used to determine the previous criteria are satisfactory.

This includes checking for CT saturation conditions (information from peripheral unit, refer to Section 2.1), that no plant discrepancies exist (via check zone as discussed earlier), and that a change (increase or loss) in current flow has been detected by at least two peripheral units (ΔI detection). The latter condition is used, as internal or external faults will cause a change in levels in at least two circuits whereas, a CT fail only affect a single circuit's level (faulty CT).

Note *This condition is used only when there is no dead bus condition.*

When a trip is issued for a bus zone by the central unit a signal is sent to all peripheral units associated (or not) with the faulted bus zone. The peripheral units associated with the faulted zone can carry out a further local confirmation via local Overcurrent protection, I>BB or IN>BB, before allowing a trip to take place.

1.2.6 Tripping Criteria

Before a trip signal is issued 4 trip criterions at the top level, i.e. the Central Unit, and 1 (optional) at the local level, i.e. the Peripheral Units, must be met.

These criterions are:

- Top level (Central Unit)
  - Instantaneous criteria:

    Bias characteristic (Idiff > (ID>2)) and Differential current setting are exceeded (Idiff> k2 Ibias) for the zone for 2 consecutive samples

    Bias characteristic (Idiff > (IDCZ>2)) and Differential current setting are exceeded (Idiff> kCZ Ibias) for the check zone for 2 consecutive samples

    No CT saturation

    Signal quality (CT supervision, , AD converter, etc…)
  - Delayed criteria:

    Bias characteristic (Idiff > (ID>2)) and Differential current setting are exceeded (Idiff> k2 Ibias) for the zone for at least 1 sample

    Bias characteristic (Idiff > (IDCZ>2)) and Differential current setting are exceeded (Idiff> kCZ Ibias) for the check zone for at least 1 sample

    Bias characteristic (Idiff > (ID>2)) and Differential current setting are not exceeded (Idiff> k2 Ibias) for the zone for at least 1 sample in the 4 following samples

    Bias characteristic (Idiff > (IDCZ>2)) and Differential current setting are not exceeded (Idiff> kCZ Ibias) for the check zone for at least 1 sample in the 4 following samples

    Bias characteristic (Idiff > (ID>2)) and Differential current setting are exceeded (Idiff> k2 Ibias) for the zone for all the 7 following samples

    Bias characteristic (Idiff > (IDCZ>2)) and Differential current setting are exceeded (Idiff> kCZ Ibias) for the check zone for all the 7 following samples

    Signal quality (CT supervision, , AD converter, etc…)
- Local Level (Peripheral Unit)

Local confirmation by an instantaneous Overcurrent element (enabled/disabled) (I>BB or IN>BB)

1.2.7 Trip Duration

The 87BB and 50BF trip orders have been hold 200ms by the Central Unit with a drop-off timer of 200ms.

The 50BF trip orders have been hold 250ms integrated in the 50BF logic with a drop-off timer of 250ms.

In case of operation of the 50BF logic of the PU, this CU 200ms drop-off timer is added to the PU 250ms, thus the trip duration will exceed 450ms.

From software E1.0, model 50, the 200ms drop-off timer in the Central Unit has been replaced by a 200ms dwell timer.

The fault recorder has been modified to start from the following tripping time and the fault duration is determined from the:

- 87BB fault for the 87BB protection
- Backtrip signals coming from the PU or opto inputs in the CU for the 50BF protection

1.2.8 Current Circuit Supervision

During normal operation the differential current in the scheme should be zero or negligible. Any anomaly is detected via a given threshold I_D>1.

A biased differential element is used to supervise the current circuit. A differential current will result if the secondary circuit of a CT becomes open circuited, short circuited; the amplitude of this current is proportional to the load current flowing in the circuit monitored by the faulty current circuit.

The setting I_D>1 is chosen to be as low as possible (minimum suggested setting is 2% of the biggest CT primary winding) but also allow for standing differential current for example due to CT mismatch and varying magnetising current losses. 5 to 20% is a typical application range.

The element is typically time delayed for 5 seconds (set greater than the maximum clearance time of an external fault). The time delay allows the relevant protection element (which should be substantially faster) to clear the fault instead i.e. I_D>2 in the case of an internal phase fault.

1.2.8.1 Protection Options for the Zones

Options for a Circuitry Fault

When something happens on the primary equipments that creates a small differential current in a Zone such as CT short-circuited or a closed isolator “seen” open etc…, it is detected by the Central Unit. To deal with this:

There were 3 options:

1. Blocking Latched	An alarm is provided and this alarm can only be reset manually, The zone is blocked and this blocking can only be reset manually.
2. Alarm Latched	An alarm is provided and this alarm can only be reset manually, The zone is blocked and this blocking will be automatically reset once the differential current will disappear and after the set reset timer.
3. Self-Reset	An alarm is provided and this alarm can only be reset manually, The zone is blocked and this blocking will be automatically reset once the differential current will disappear and after the set reset timer.

These 3 options avoid maloperation in case of through fault during a circuitry fault.

From software E1.0, model 50, there are 2 more options:

1. Alarm and No blocking!!!

An alarm is provided and this alarm can only be reset manually,
The zone is not blocked!!!

2. Alarm Self-Reset and No blocking!!!

An alarm is provided.
The zone is not blocked!!!

Important	**THESE TWO OPTIONS WILL TRIP ONE OR MORE ZONE IN CASE OF THROUGH FAULT DURING A CIRCUITRY FAULT:** **The selection of "AlarmSR&No Blck !!!" or "Alarm & No Block !!!" modes is effective only if no blocking zone is selected for Check zone circuitry fault (CZ).** **When "AlarmSR&No Blck !!!" or "Alarm & No Block !!!" setting is selected, the protection will trip the related zone in case of an external trip.**

Options for a PU Error Mode

When something happens on the Peripheral Units that creates a loss of communication for a Zone such as loss of power supply or fibre optic cut etc…, it is detected by the Central Unit.

To deal with this there are 3 options:

1. Blocking Latched

   An alarm is provided and this alarm can only be reset manually,
   The zone is blocked and this blocking can only be reset manually.

2. Alarm Latched

   An alarm is provided and this alarm can only be reset manually,
   The zone is blocked and this blocking will be automatically reset once the communication will be reinstated and after the set reset timer.

3. Self-Reset

   An alarm is provided and the zone is blocked.
   The alarm and the blocking will be automatically reset once the communication will be reinstated and after the set reset timer.

These 3 options avoid maloperation in case of switch on to a through fault during maintenance for example.

1.2.8.2 Protection Options for the Check Zone

Options for a Circuitry Fault

There are 5 options:

1. Blocking Latched

   An alarm is provided and this alarm can only be reset manually, The Check Zone is blocked and this blocking can only be reset manually.

2. Alarm Latched

   An alarm is provided and this alarm can only be reset manually, The Check Zone is blocked and this blocking will be automatically reset once the differential current will disappear and after the set reset timer.

3. Self-Reset

   An alarm is provided and this alarm can only be reset manually, The Check Zone is blocked and this blocking will be automatically reset once the differential current will disappear and after the set reset timer.

These 3 options avoid operation of the other zones in case of internal fault during a circuitry fault in the Check Zone.

4. Alarm and No blocking

   An alarm is provided and this alarm can only be reset manually,
   The Check Zone is not blocked

5. Alarm Self-Reset and No blocking

   An alarm is provided.
   The Check Zone is not blocked

These 2 options allow operation of the other zones in case of internal fault during a circuitry fault in the Check Zone.

Options for a PU Error Mode

There are 5 options:

1. Blocking Latched

   An alarm is provided and this alarm can only be reset manually,
   The zone is blocked and this blocking can only be reset manually.

2. Alarm Latched

   An alarm is provided and this alarm can only be reset manually,
   The Check Zone is blocked and this blocking will be automatically reset once the communication will be reinstated and after the set reset timer.

3. Self-Reset

   An alarm is provided and the Check Zone is blocked.
   The alarm and the blocking will be automatically reset once the communication will be reinstated and after the set reset timer.

These 3 options block the operation of the other zones in case of loss of the Check Zone.

4. Alarm and No blocking

   An alarm is provided and this alarm can only be reset manually,
   The Check Zone is not blocked

5. Alarm Self-Reset and No blocking

   An alarm is provided.
   The Check Zone is not blocked

These 2 options allow the operation of the other zones in case of loss of the Check Zone.

1.2.8.3 Voltage Criteria for Busbar Protection

Where there is a need to use voltage criteria such as undervoltage, zero sequence overvoltage, direct overvoltage or inverse undervoltage, an external device such as a MiCOM P923 must be connected to the VT(s).

VT(s) Connected to the Bar(s) and the Central Unit,

This device calculates the required voltage information and sends the release information to the Central Unit via an output contact to opto input communication link. The required logic is made in the P741 PSL.

The 87BB trip order can be blocked in the CU using 2 logic input sets, one to block the phase element, the second to block the SEF element and that per zone:

- INP Block 3Ph Z1 to Z8
- INP Block SEF Z1 to Z8

If 2 bus section are included in the same zone (isolator bus section or during double switching), an OR gate between the 2 voltage criteria from the different bus sections is used to confirm the fault detection.

Example:

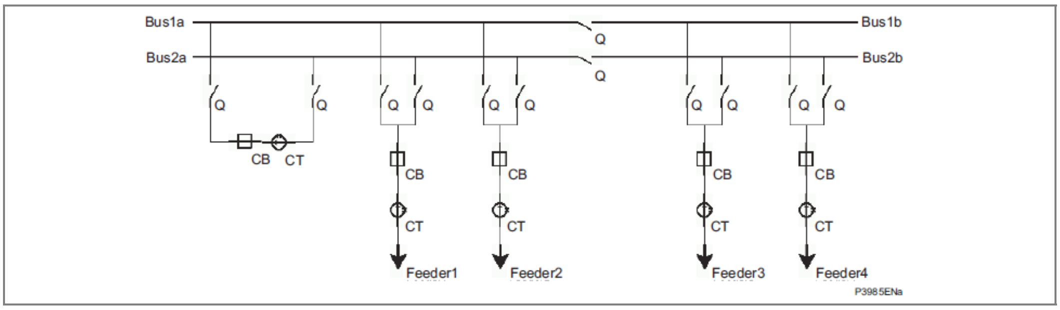

Figure 5 - VT(s) connected to the bar(s) and the central unit

- When the isolator bus sections are open:
  - The faults in zone 1a are confirmed by the VT connected to the bus section 1a
  - The faults in zone 1b are confirmed by the VT connected to the bus section 1b
- When the isolator bus sections are closed:
  - The section 1a and 1b are in the same zone, the faults are confirmed by the VT connected to the bus section 1a OR the VT connected to the bus section 1b
- When the isolator bus sections are open and during double switching, when both isolators of a feeder are closed:
  - The faults in zone 1a / 2a are confirmed by the OR between VT connected to bus 1a and 2a

VT(s) Connected to the Line(s) and a Peripheral Unit,

This device calculates the required voltage information and sends the release information to a Peripheral Unit via an output contact to opto input communication link. The required logic is made in the P742 or P743 PSL.

The 87BB trip order can be blocked in the PU using 2 logic inputs, one to block the phase element, the second to block the SEF element:

- INP Block 87BB/P
- INP Block 87BB/N

If some PUs are connected to Voltage device and not the other ones, some PU can trip whereas the other ones are blocked by the voltage criteria coming from the Voltage device.

1.2.8.4 Busbar Protection Tripping Time delays

Busbar Protection Tripping Time Delay in the CU

In the CU, the 87BB tripping time can be delayed by a settable time, the fault has to be detected by the phase element only.

That allows, for example the clearance of the fault by a fuse on the fault feeder before tripping the whole zone.

Busbar Protection Tripping Time Delay in a PU

In all the PUs, the 87BB tripping time can be delayed by a settable time.

That allows, for example in Generation, a sequential tripping of all feeders connected to the faulty zone.

Busbar Protection Tripping Order PU Logic

In all the PUs, there are options to block the 87BB protection trip order coming from the CU.

The logic is based either on the I>2 high set phase overcurrent function or on the IN>2 high set neutral overcurrent function, each with the following options:

- Phase and earth fault element (87BBP&N blocking),
- Only the 87BB phase element (87BB/P blocking),

- Only the 87BB SEF element (87BB/N blocking),
- A combination of the different functions (I>2 & 87BBP&N, I>2 & 87BB/P, I>2 & 87BB/N). The 87BB blocking function have a settable drop-off timer from 200ms to 6s by step of 100ms.

1.3 Additional Protections

1.3.1 Dead Zone (DZ) Protection

On a feeder, if the isolators or the breaker is open, a dead zone (or end zone) is said to exist between the open element and the CT. The P740 peripheral units can protect this zone with the Dead Zone protection. This is a simple time delayed overcurrent and earth fault element which is only active when a dead zone is identified in the local topology.

1.3.2 Stub Protection

When a one and half breaker scheme is protected by a MiCOM P740, the stub protection can be done using a simple time delayed overcurrent element in each PU.

The activation of this protection has to be set in the PSL and activated when all the associated isolators are open. In the main setting group (usually 1), there is no overcurrent protection, in the next setting group (usually 2) this overcurrent is enabled (on top of the same setting as in the main setting group).

The setting group will be changed from “main” to “next” in the PSL.

1.3.3 Circuit Breaker Fail (CBF)

The detailed logic of the Circuit Breaker Failure (CBF) element follows.

1.3.3.1 Distributed Tripping, Control and Indication Elements (Peripheral Units)

As the P740 scheme has been designed for use as either a centralised or distributed scheme, the hardware corresponds to one circuit breaker and can accommodate 1 or 2 trip coils:

- 1 main trip coil
- 1 back-up trip coil

Furthermore these can be either 3 single-phase trip coils or 1 three-phase trip coil. These can be combined for example 3 single-phase trip coils on the main system and 1 threephase trip coil for the back-up system.

Note	*The backtrip order (coming from the Central Unit) is always given to the relay 1, 2 and 3 even if the CBF is disabled in the Peripheral Units.*

Note	*The retrip has to be done using the PSL.*

1.3.3.2 Circuit Breaker Fail Reset Criteria

Overcurrent Criterion

One of the most common causes of busbar mal-tripping is error introduced in the back tripping of adjacent sections. To prevent such an error it is possible to condition the operation of 50BF protection only when there is presence of a significant current i.e. a short-circuit on the concerned feeder. This confirmation is provided by the I> threshold which is set by default at 1.2 times the nominal rated current of the CT CT and/or by the threshold setting of residual current IN> set by default to 0.2 times the rated current.

Undercurrent Reset Criterion

The criterion normally used for the detection of a circuit breaker pole opening is the disappearance of the current i.e. undercurrent element. This function is generally preferred above other elements due to its very fast response time. In MiCOM P74x/P746, this method of detection may be selected and has the threshold I<.

Note	*The algorithm is applied on a per phase basis.*

These Undercurrent elements have an I< threshold, which is used to supervise that each circuit breaker has opened correctly, when commanded to do so. By use of the I< threshold, it is possible to ensure that all load and fault currents have been interrupted, ensuring that no arcing remains across the circuit breaker primary contacts. Optionally, the user can decide to include 52a supervision in the breaker fail logic (see the *Logic Reset Criterion (Feeder CB Fail only)* section and the *Logic AND Current reset Criterion (Feeder CB Fail only)* section below).

Note	*52a is the setting name, it means CB closed.* *The CB closed position is created in the PSL either using 52b reversed or a combination of (52a and 52b).* *Logic Reset Criteria (52a supervision with or without I< criterion) is settable for Feeder CB Fail only. Coupler CB fails are always reset with current reset (I<) criterion, whatever the choice of 'Fdr CBF Reset by' setting.*

The first function is to compare the current sample to the I< threshold and check for the following sequence:

- positive value of the current
- no current (below the threshold)
- negative value of the current
- no current (below the threshold)
- positive value of the current
- …

The output signal is pl(t), it changes between 0 and 1.

Internal overcurrent signals are available per phase and neutral to confirm that the CB failure algorithm has started to count down.

Internal undercurrent signals are available per phase to confirm that each pole has opened.

To maintain the current criterion active while the signal crosses zero, there is a drop-off timer associated with the pl(t) signal. The latching duration is variable in order to take all cases into account:

- Just after the initiation of the CB fail signal, the waveform can include a DC component, and the time between two successive zero crossings can thus reach one period. Therefore, the resetting time is equal to the period plus a margin of 3ms (23ms at 50Hz, 20ms at 60Hz).

- For the last 30ms before the end of the stage 2 timer, the DC component should have disappeared so that the time between two successive zero crossings should be close to one half-period. Moreover it is important to detect the opening of the circuit breaker quickly because the end of the back trip timer is near. The drop-off duration is therefore equal to one half period + 3ms (13ms at 50Hz, 11.3ms at 60Hz).

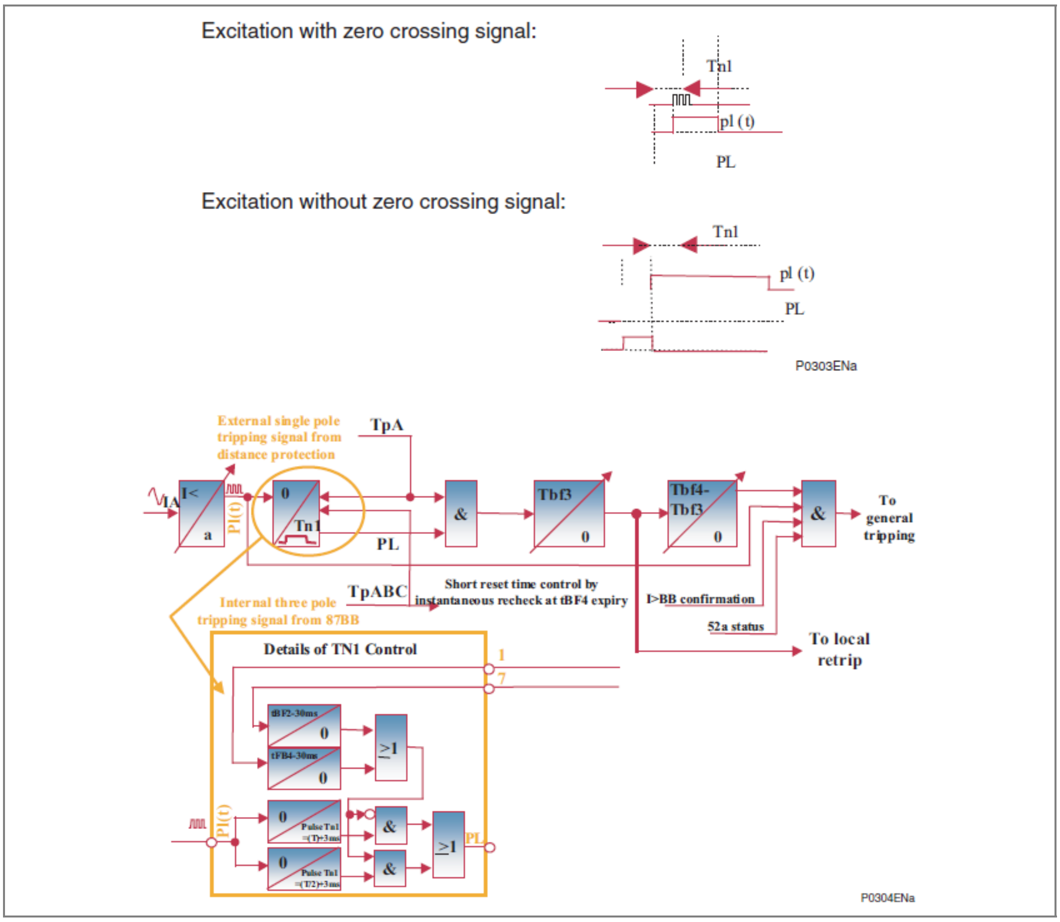

Figure 6 - CB fail element logic – principle of reset time control

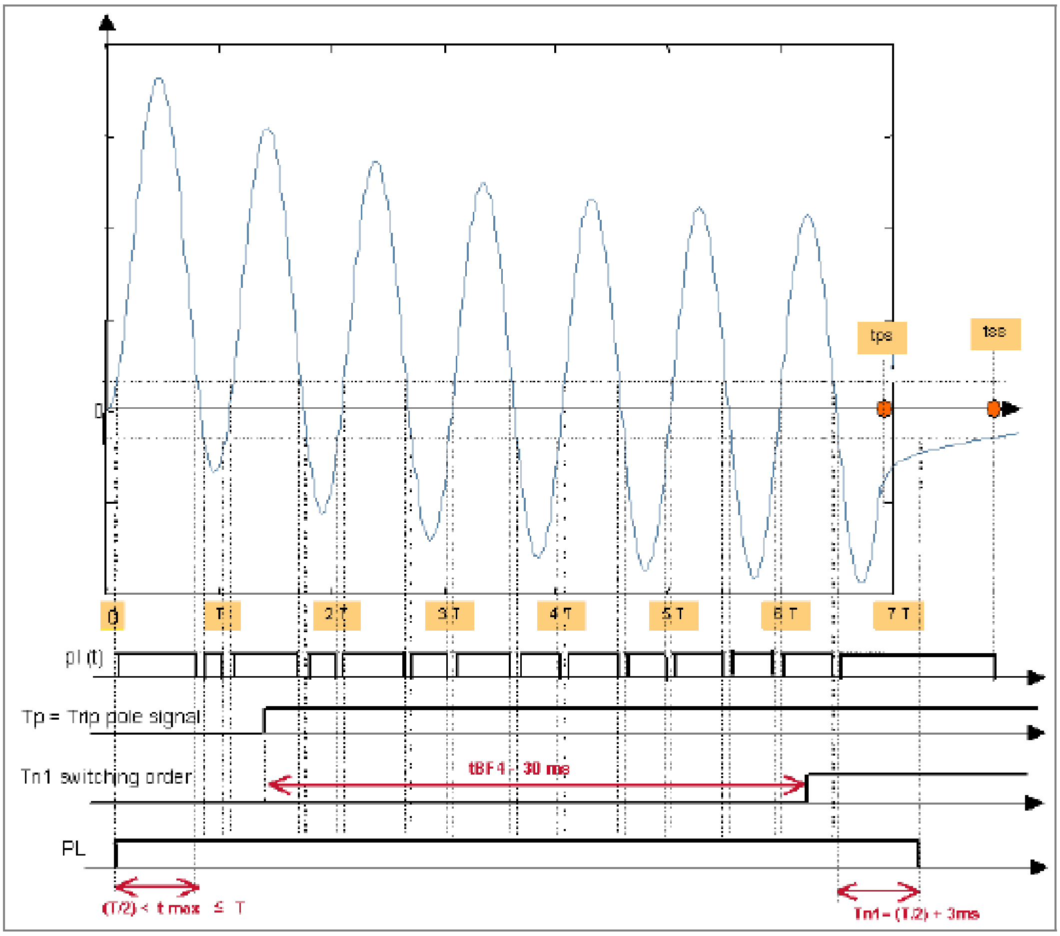

Figure 7 - CB element logic

Principle of the Undercurrent Function

Instantaneous current measurements are taken for both the positive and negative half cycles, ensuring immunity to DC offset waveforms, and CT current ring-down.

The two horizontal dotted lines are instantaneous thresholds, fixed in proportion to the user's I< setting. The instantaneous threshold is at 70 percent of the I< fundamental RMS setting. As any current rises above the dotted line instantaneous threshold, this rising measurement triggers a pulse timer to declare that current is flowing. The duration of the pulse is one full cycle plus 3ms (T+3ms). It does not matter whether the magnitude of the current stays above the dotted line further, as the detector is effectively edge-triggered. Current flow has been declared based on this half cycle, and not until the current falls below the detector setting is the edge-trigger ready to declare an output again. Whilst current is flowing, on the rise of current in each half-cycle the pulse timer is retriggered. This sequential retriggering ensures that current is detected.

The detection of breaker opening is made upon one of two scenarios:

1. The current falls below the instantaneous detection threshold, and does not rise again before the pulse timer expires; or
2. A CT remnance does not change sign, and remains in one polarity sense up until the timer expires.

Note	*The pulse timer length is variable, and adapts according to the anticipated proportion of DC current offset that may be present in the measured waveform. The pulse timer initially is fixed at one cycle plus 3ms, as described previously, as upon fault inception the DC offset could be appreciable. Near the end of the breaker fail time, the pulse length is shortened to half a power cycle plus 3ms (T/2 + 3ms). The presumption is that the DC offset in real fault current has decayed, and that the shorter time is all that is required. The pulse length is reduced 30ms before expiry of the tBF2 timer (for internally-initiated CBF) and 30ms before expiry of the tBF4 timer (for externally-initiated CBF). The reduced pulse length means faster resetting of the current detector.*

1.3.3.3 Logic Reset Criterion

This is for instances where circuits may carry a very low level of load, or even may operate unloaded from time to time. Where 52a contact (CB closed) supervision is set, the relay looks only for the opening of the breaker to stop the breaker fail timers.

This criterion is based on checking the state of the circuit breaker auxiliary contacts. i.e. to see if the 52b reverse or a combination of (52a and 52b) contact is open for open circuit breaker conditions. In the MiCOM P74x/P746 protection system, this detection method is used with the '52a' setting.

Logic AND Current reset Criterion (Feeder CB Fail only)

This is for instances where circuits may carry a very low level of load, or even may operate unloaded from time to time. Where 52a contact (CB closed) supervision is set, the relay looks for I< undercurrent, and the opening of the breaker to stop the breaker fail timers.

This criterion relies on verifying the disappearance of the current AND of the state of the CB auxiliary contacts. In the MiCOM P74x/P746 protection system, this detection method is used with the 'I< AND 52a' (setting) threshold.

Processing a Circuit Breaker Failure Condition

Due to the nature of the busbar protection, the substation topology can manage the system under circuit breaker failure conditions (50BF).

There are several options for circuit breaker failure protection installations. Generally these depend on the substation construction and wiring:

- Internally initiated CBF i.e. Initiation from the differential element (87BB trip issued by the Central Unit),
- Externally initiated, for example by the feeder protection, but using the busbar protection's integral 50BF protection to execute tripping procedure
- Separate 50BF protection to the busbar protection (such as a MiCOM P821)

The breaker failure logic uses fast acting undercurrent elements to provide the required current check. These elements reset within 15ms, thereby allowing the use of the P740 relay at all voltage levels.

Since the Overcurrent element within the peripheral units may also be used in blocking schemes to provide back-up protection, it is possible to reset the Overcurrent start signals after the breaker fail time delay has elapsed. This ensures that the upstream back-up protection can be maintained by removal of the blocking signal. This would also ensure that the possible risk of re-trip on re-closure of the circuit breaker is minimised.

CB Trip 3 ph:

- Triphase Circuit Breaker Trip from CU (Init 50BF TBF1 / TBF2), Logical OR of 87BB, 50BF, Manual Trip Zone X

CB Trip phase A:

- Phase A Circuit Breaker Trip (Init 50BF TBF3 / TBF4), Logical OR of O/C Protection, External Trip A, External Trip 3ph

CB Trip phase B:

- Phase B Circuit Breaker Trip (Init 50BF TBF3 / TBF4), Logical OR of O/C Protection, External Trip A, External Trip 3ph

CB Trip phase C:

- Phase C Circuit Breaker Trip (Init 50BF TBF3 / TBF4), Logical OR of O/C Protection, External Trip A, External Trip 3ph

Note	*The CB fail alarm is raised as soon as tBF1 or tBF2 or tBF3 or tBF4 has been reached (Logical OR of the signals 8, 9, 10, 11, 12, 13 in the following figure).*

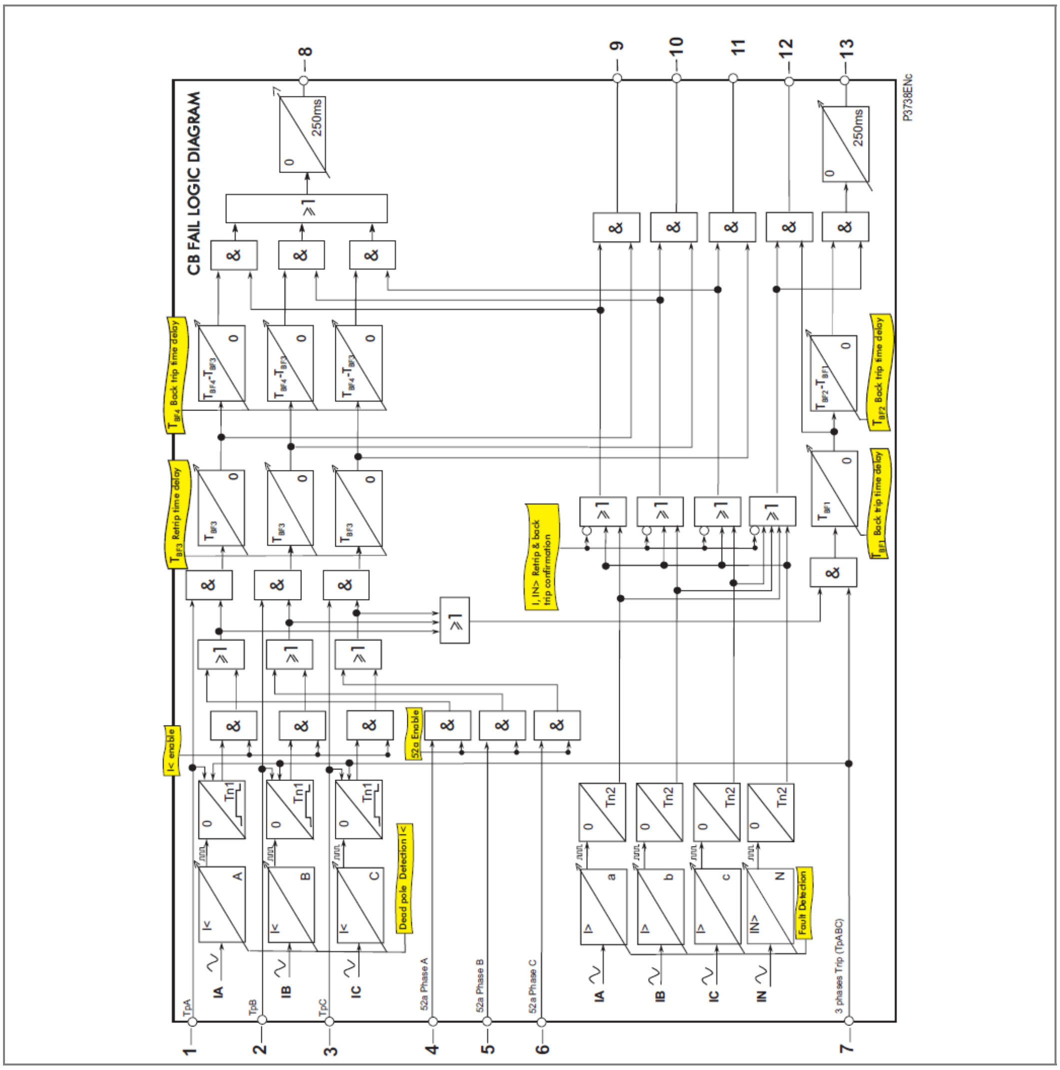

Figure 8 - CB fail logic

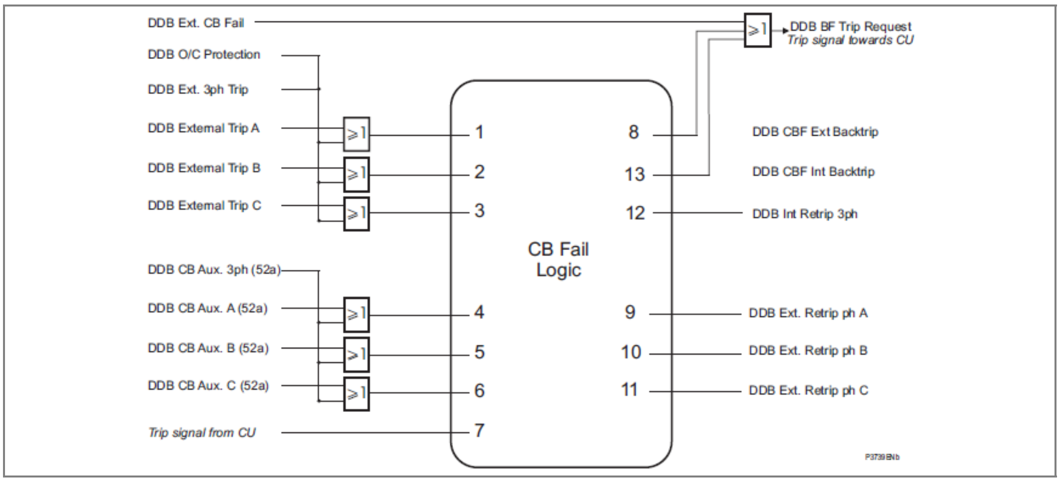

Figure 9 - CB fail logic (DDB inputs & outputs)

1.3.3.4 Internally Initiated CBF i.e. Tripping from the Differential Element 87BB issued by the Central Unit

For internally initiated CB Fail, the CB fail reset only when the reset condition satisfied.

When a tripping order is generated by the busbar protection but not executed due to a circuit breaker failure condition, the following circuit breakers are required to be tripped instead:

All the circuit breakers in the adjacent busbar zone if the faulty circuit breaker is that of a bus coupler or bus section.

Optional: The remote end circuit breaker if the faulty circuit breaker is that of a feeder (line or transformer). This intertripping is done via PSL and may not be required on feeders, which may be serviced automatically via the distance or other line protection.

The tripping order from the busbar protection is referenced as Tp_{ABC}, it is always three-phase and initiates timers tBF1 and tBF2. The first timer is associated with the local re-trip function while the second timer is associated with the conveyance of the signal for tripping of the adjacent zone in the cases of bus coupler/bus section circuit breaker failure.

Note	87BB, 50BF, OC, EF or DZOC can initialize internal CB fail via PSL

Description of the Logic for Internally Initiated CBF

The *CB fail element logic – internally initiated* diagram is shown below.

Note 1	*Signal for back-trip (including adjacent zone(s)) if failed CB is bus section or bus coupler circuit breaker or Terminal circuit breaker*
Note 2	*I>BB and I> could be enabled or disabled (scheme shown is with the 2 functions enhanced)*

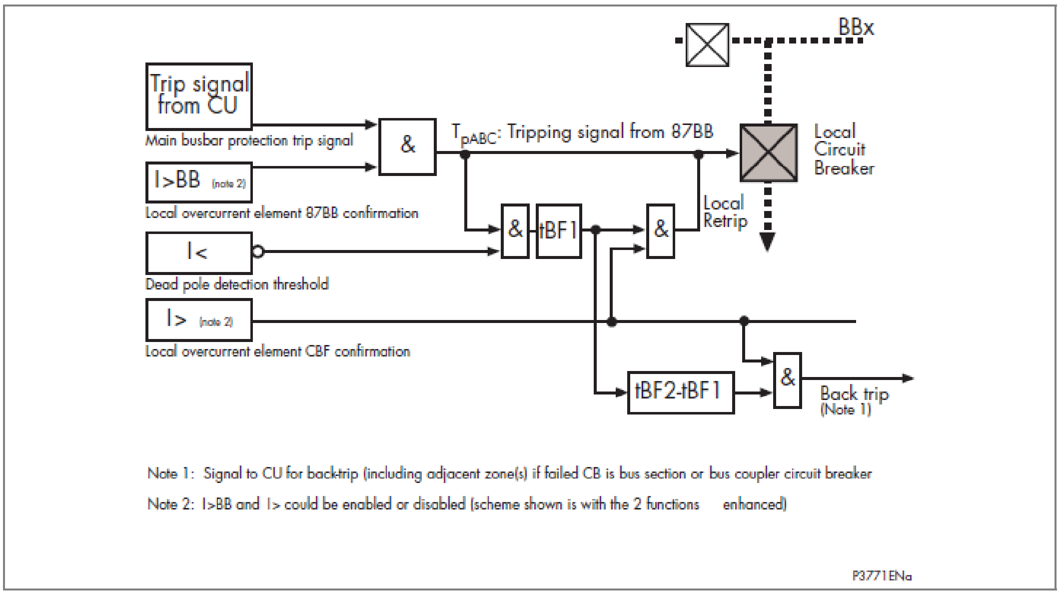

Figure 10 - CB fail element logic – internally initiated

Initial Trip

A trip signal is issued by the central unit and then confirmed by the local peripheral unit. If the (optional) threshold for the local Overcurrent protection setting for busbar protection (I>BB) is exceeded then the local circuit breaker trip coil is energised and subsequently the local circuit breaker is tripped.

Re-Trip after Time tBF1

The peripheral unit's dead pole detection threshold (I<) and external protection initiation (I>) trigger the first breaker failure timer (tBF1). This signal in turn is passed through an AND gate with the signal from the local Overcurrent protection for busbar protection (I>BB) (if a circuit breaker failure condition has evolved this will still be present) and a re-trip command is issued. Re-trip output contacts should be assigned using the PSL editor (including in default PSL settings).

Back-Trip after Time tBF2

A signal from the first circuit breaker timer triggers the second breaker failure timer (tBF2).

This in turn is passed through an AND gate with the signal from the local overcurrent protection for busbar protection (I>BB), if a circuit breaker failure condition has persisted this will still be present, and a general bus-zone back-trip signal issued via the central unit.

In summary tBF1 is used for re-trip and tBF2 for general bus zone back-trip Because the busbar protection scheme uses the substation topology, during circuit breaker failure conditions, circuit breaker operations are executed according to on the current state of the system. It is therefore of paramount importance that should an internally initiated scheme be implemented, the circuit breaker tripping order, must be thoroughly defined within the scheme topology to guarantee correct scheme operation.

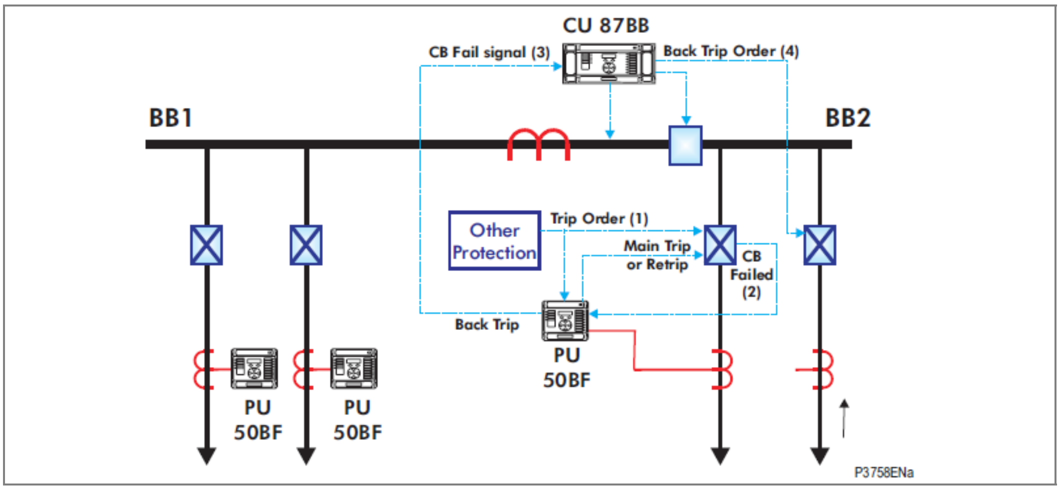

Figure 11 - Circuit breaker failure logic

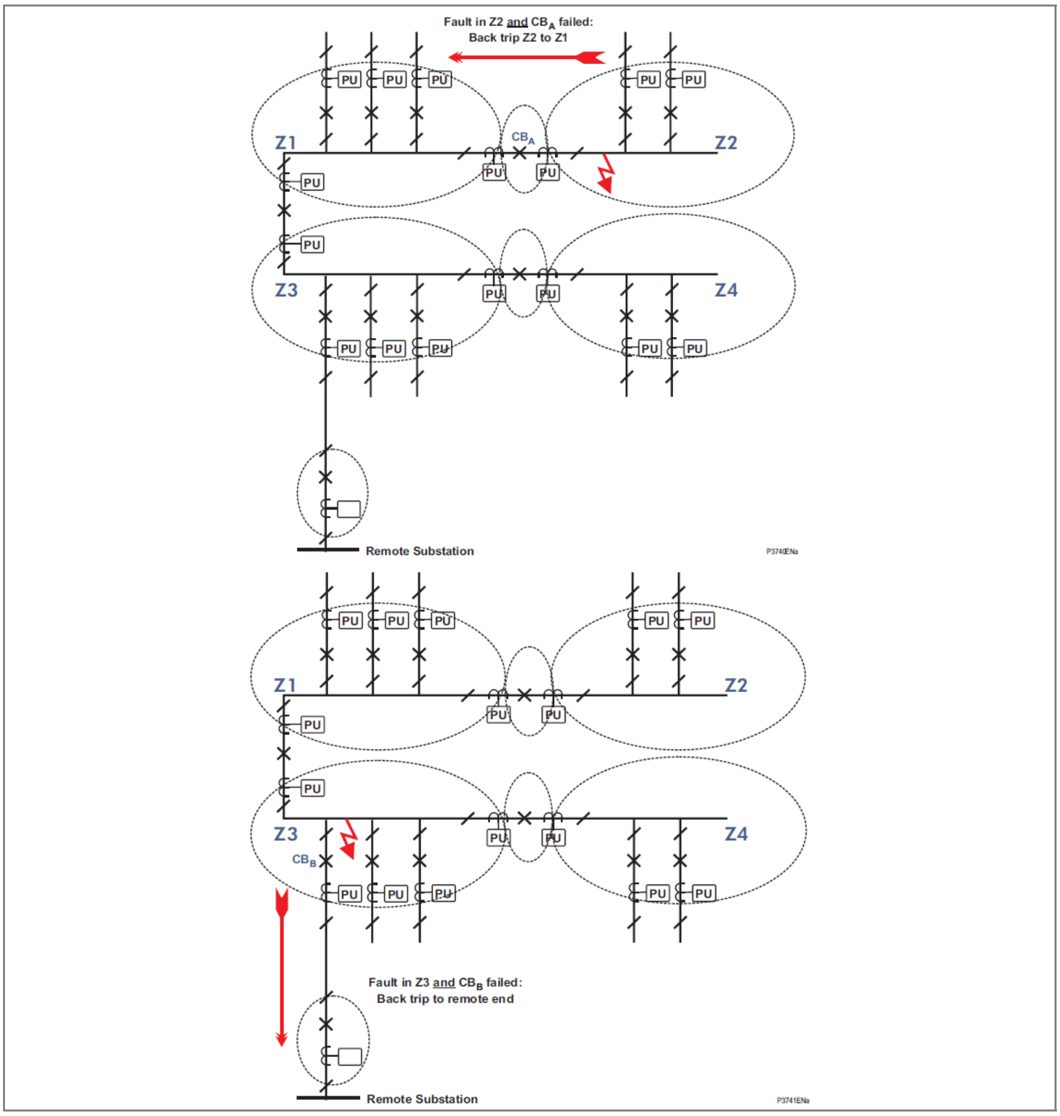

Figure 12 - Examples

Externally Initiated 50BF

For externally initiated CB Fail, the CB fail reset when the external initiation reset OR the reset condition satisfied.

The *CB Fail element logic – externally initiated* diagram is shown below.

Note	*Signal for back-trip (including adjacent zone(s)) if failed CB is bus section or bus coupler circuit breaker or Terminal circuit breaker.*
Note 2	*Optional (refer to the* ***Local re-trip after time tBf3*** *section below).*
Note 3	*I> could be enabled or disabled.*

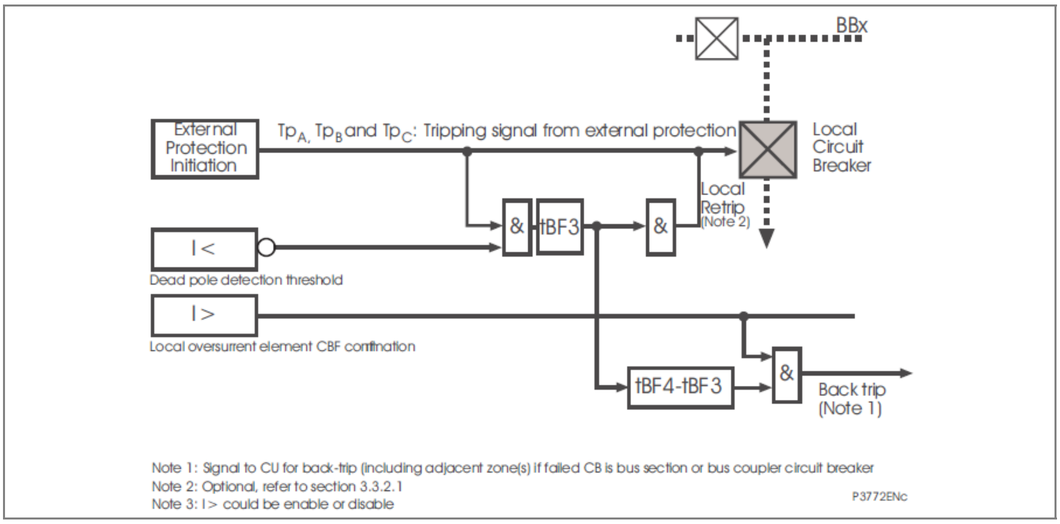

Figure 13 - CB fail element logic – externally initiated

Taking into account the relationship between the busbar protection and the circuit breaker failure protection certain operators prefer an integrated solution where the breaker failure may be initiated by external protection but executed in the busbar scheme. Tripping is then worked out in the section or zone.

On an overhead line for example the external commands may be generated by the distance protection (21). Generally these commands are on a per phase basis and therefore the tripping commands must be to. In the diagrams these signals are labelled TpA, TpB, TpC (Tripping pole A, B or C).

The logic is similar to that for internally initiated CB fail protection but utilises tBf3 for re-trip and tBF4 for back-trip functions.

Local re-trip after time tBf3

This re-trip command can be applied via either the main or back up trip coil. It is possible to choose between the following three modes:

- Local re-trip activated/deactivated via PSL. The relay used for this function can use the same fixed logic for the busbar protection or other independent relays.
- A re-trip can be applied after a time tBF3. This is typically set at 50ms when a single phase trip and re-trip is used. This prevents loss of phase selectivity by allowing the main protection trip to execute via the main CB trip coil before re-trip command is executed by the back-up CB trip coil.
- Single or three phase re-trip is possible. If the feeder protection executes single-phase tripping, the three-phase re-trip must be carried out in time tBF3 and this must be adjusted to have a value higher than the normal operation time of the circuit breaker. Typical setting under this condition is 150ms.

General zone trip after time tBF4

When both the local trip and re-trip have failed, the countdown continues with a second timer adjusted to have a value of tBF4 - tBF3. The end of this time thus corresponds to total time tBF4, beyond which a persistent circuit breaker failure condition is declared.

Information is then relayed to the Central unit for routing to the other peripheral units, and the associated circuit breakers, in the adjacent zone(s) for a general three-phase back-trip.

CB Fail Alarm

The CB Fail alarm is raised on any timer reached (tBF2 or tBF4).

Separate External 50BF Protection to the Busbar Protection

This is the most common solution utilising conventional wiring. The 50BF relay is completely independent of all others. When a circuit breaker failure condition occurs the external protection trips all adjacent circuit breakers as defined in the separate scheme (DDB Ext CBF Zx).

In view of the connection between the functions of the busbar protection and the circuit breaker failure protection some operators prefer one of the more integrated system solutions previously mentioned.

1.4 Three-Phase Overcurrent Protection

1.4.1.1 Inverse Time (IDMT) Characteristic

IDMT characteristics are selectable from a choice of four IEC/UK and five IEEE/US curves as shown in the table below.

The IEC/UK IDMT curves conform to the following formula:

$$t = T \times \left(\frac{K}{(I/Is)^{\alpha} - 1} + L \right)$$

The IEEE/US IDMT curves conform to the following formula:

$$t = \frac{TD}{7} \times \left(\frac{K}{(I/Is)^{\alpha} - 1} + L \right)$$

Where:

t = Operation time
K = Constant
I = Measured current
IS = Current threshold setting
α = Constant
L = ANSI/IEEE constant (zero for IEC/UK curves)
T = Time Multiplier Setting for IEC/UK curves
TD = Time Dial Setting for IEEE/US curves

IDMT Curve description	Standard	K Constant	α Constant	L Constant
Standard Inverse	IEC	0.14	0.02	0
Very Inverse	IEC	13.5	1	0
Extremely Inverse	IEC	80	2	0
Long Time Inverse	UK	120	1	0
Moderately Inverse	IEEE	0.0515	0.02	0.114
Very Inverse	IEEE	19.61	2	0.491
Extremely Inverse	IEEE	28.2	2	0.1217
Inverse	US-C08	5.95	2	0.18

IDMT Curve description	Standard	K Constant	α Constant	L Constant
Short Time Inverse	US-C02	0.02394	0.02	0.01694

1.4.1.2 Reset Characteristics

For all IEC/UK curves, the reset characteristic is definite time only.

For all IEEE/US curves, the reset characteristic can be selected as either inverse curve or definite time.

The definite time can be set (as defined in IEC) to zero. Range 0 to 100 seconds in steps of 0.01 seconds.

The Inverse Reset characteristics are dependent upon the selected IEEE/US IDMT curve as shown in the table below.

All inverse reset curves conform to the following formula:

$$t_{Reset} = \left(\frac{TD}{7}\right) \times \left(\frac{tr}{1-(I/Is)^{\alpha}}\right)$$

Where:

t_{Reset} = Reset time
tr = Constant
I = Measured current
I_S = Current threshold setting
α = Constant
TD = Time Dial Setting (Same setting as that employed by IDMT curve)

IEEE/US IDMT Curve description	Standard	tr Constant	α Constant
Moderately Inverse	IEEE	4.85	2
Very Inverse	IEEE	21.6	2
Extremely Inverse	IEEE	29.1	2
Inverse	US-C08	5.95	2
Short Time Inverse	US-C02	2.261	2

Table 2 - Inverse Reset Characteristics

1.5 Earth Fault Protection

1.5.1 EF Time Delay Characteristics

The earth-fault measuring elements for EF and SEF are followed by an independently selectable time delay. These time delays are identical to those of the Phase Overcurrent time delay. The reset time delay is the same as the Phase overcurrent reset time.

1.5.2 External Fault Detection by High-Set Overcurrent or Earth Fault Element

An ultra high-speed detection is carried out by each of the peripheral units (P742 and P743) and can generate a blocking signal from the moment of the first sample at 0.42 ms.

In this scenario de-saturation may not occur until after the scheme has eliminated the saturation condition for the external fault. This function can be activated independently for phase faults (I>2) and for Earth Faults (IN>2).

1.5.3 Supervision

1.5.4 Zero Sequence Current (IO) Supervision

The four current inputs (A, B, C, N) of the Peripheral Units are used to verify that the calculated zero sequence current is within the correct range for CT supervision purposes.

This then provides continuous supervision of the relay's measuring chain (internal CTs, ADC, etc…).

The residual current 3Io is derived from the three phases Ia + Ib + Ic and compared to the measured value of IN from the neutral CT input.

$$|3I_O - I_N|$$

During an earth fault the two values should be the same and the sum should therefore be equal to zero or below the threshold (CTS IN> Set) and the CT supervision alarm will not be issued.

If an internal CT becomes short-circuited, a difference between the derived and measured value will appear, i.e. a CT problem has been detected and after a user settable time delay (CTS Time delay) the alarm will be issued.

This calculation is then compared to a further criterion to verify and monitor CT connections and associated current circuits.

$$|3I_O - I_N| > 0.05\ I_n + K_{CE} \times (|I_a| + |I_b| + |I_c| + |I_N|)$$

(Where KCE is a calculation error coefficient and In is the nominal current)

The calculation error coefficient in the above formula is set between 0.01 and 1 thereby allowing for small discrepancies and preventing false blocking of the differential elements whilst the constant value of 0.05 In provides stability under no load or low load conditions.

The main causes for alarms from zero sequence current calculations are:

- Commissioning with load current – detection of connection errors (input inverted/rated current incorrect)
- Maintenance with load current – By pass of analogue input, when a separate neutral CT is made available.
- Failure of an analogue channel – e.g. A/D converter failure

Once detected, the alarm will be issued after a user settable time delay (Alarm Delay TCE).

Because the Peripheral Units sample at 2400Hz, discrepancies between the measured and derived values are identified and responded to very quickly. If any anomaly arises for either of the above calculations, the differential elements associated with the faulty Peripheral Unit can be instantaneously blocked (when ‘I0 superv. blocking” is set to 87BBP&87BBN). The blocking signal remains in place for 10ms with an alarm signal sent after the TCE time delay. The time delay is usually set above the time required to trip under fault conditions.

1.5.5 CT Supervision

In addition to the zero sequence (I0) supervision, the CT Supervision detects a CT Failure.If a current is present in the CT (>10% IN), the difference between the magnitude of the current measured by two phases should not exceed 50%. The Peripheral Unit displays an alarm when the “CTS timer alarm” time delay is elapsed.

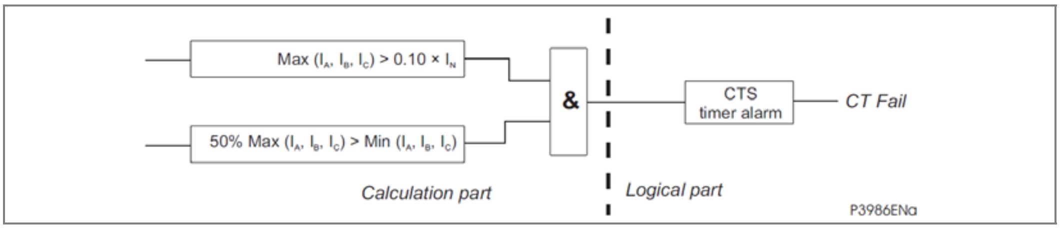

Figure 14 - CT Supervision

1.5.6 InterMiCOM Teleprotection Introduction

There are 2 different types of integrated teleprotection available in the MiCOMho relay:

- InterMiCOM64 - designed to work over 56/64kbit/s fiber optic and multiplexed communications
- EIA(RS)232 InterMiCOM - typically for MODEM applications

Only the second type of teleprotection is available within the P741 and P743, providing that the corresponding hardware is fitted.

1.5.6.1 Protection Signaling

In order to achieve fast fault clearance and correct discrimination for faults anywhere within a high voltage power network, it is necessary to signal between the points at which protection relays are connected. Two distinct types of protection signaling can be identified:

Unit protection Schemes:

In these schemes the signaling channel is used to convey analog data concerning the power system between relays, typically current magnitude and/or phase.

Teleprotection - Channel Aided Schemes:

In these schemes the signaling channel is used to convey simple ON/OFF data (from a local protection device) thereby providing some additional information to a remote device which can be used to accelerate in-zone fault clearance and/or prevent out-of-zone tripping. The InterMiCOM teleprotection provides the ideal means to configure the schemes in the InterMiCOM relays, the selection will mainly depend on communications media availability, system configuration, distances, cost issues and utility practice.

1.5.6.2 Definition of Teleprotection Commands

The decision to send a command is made by a local protective relay operation, and three generic types of InterMiCOM signal are available:

Intertripping: In intertripping (direct or transfer tripping applications), the command is not supervised at the receiving end by any protection relay and simply causes CB operation. Since no checking of the received signal by another protection device is performed, it is absolutely essential that any noise on the signaling channel isn’t seen as being a valid signal. In other words, an intertripping channel must be very secure.

Permissive: In permissive applications, tripping is only permitted when the command coincides with a protection operation at the receiving end. Since this applies a second, independent check before tripping, the signaling channel for permissive schemes do not have to be as secure as for intertripping channels.

Blocking: In blocking applications, tripping is only permitted when no signal is received but a protection operation has occurred. In other words, when a command is transmitted, the receiving end device is blocked from operating even if a protection operation occurs. Since the signal is used to prevent tripping, it is imperative that a signal is received whenever possible and as quickly as possible. In other words, a blocking channel must be fast and dependable.

The requirements for the three channel types are represented pictorially in the following figure:

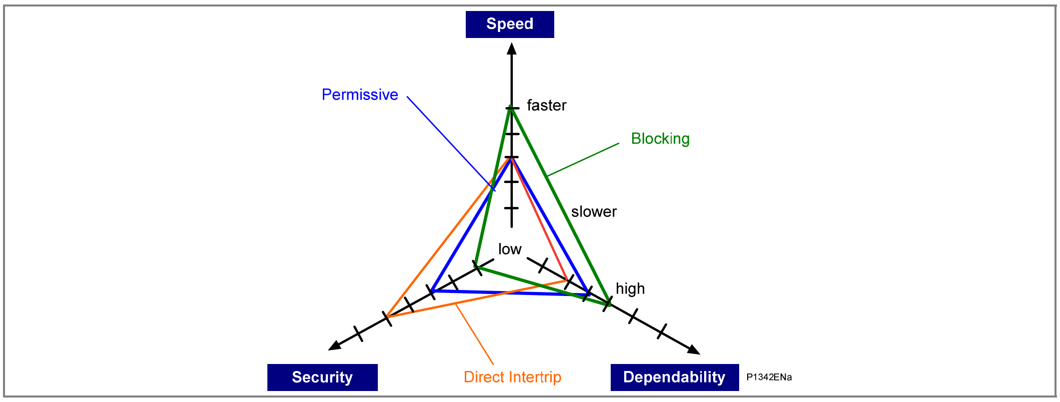

Figure 15 - Pictorial comparison of operating modes

This diagram shows that a blocking signal should be fast and dependable; a direct intertrip signal should be very secure and a permissive signal is an intermediate compromise of speed, security and dependability. In MODEM applications, all three modes can be applied to selected signaling bits within each message.

When InterMiCOM64 is used for teleprotection, only two modes are available: Direct trip and Permissive. Since the full and uncorrupted message has to be received by the relay over fiber, there would be no difference between received Blocking, Permissive and Direct commands in terms of speed, dependability or security, were just one message used. The only difference would be the need for extra security when Intertripping is required and for that reason a Direct trip command will be considered valid and executed only after 2 consecutive received commands (two consecutive messages in agreement instead of just one).

1.5.7 EIA(RS)232 InterMiCOM ("MODEM InterMiCOM")

1.5.7.1 Communications Media

InterMiCOM is capable of transferring up to 8 commands over one communication channel. Due to recent expansions in communication networks, most signaling channels are now digital schemes utilizing multiplexed fiber optics and for this reason, InterMiCOM provides a standard EIA(RS)232 output using digital signaling techniques. This digital signal can then be converted using suitable devices to any communications media as required. The EIA(RS)232 output may alternatively be connected to a MODEM link. Regardless of whether analog or digital systems are being used, all the requirements of teleprotection commands are governed by an international standard IEC60834-1:1999 and InterMiCOM is compliant with the essential requirements of this standard. This standard governs the speed requirements of the commands as well as the probability of unwanted commands being received (security) and the probability of missing commands (dependability).

1.5.7.2 General Features and Implementation

InterMiCOM provides 8 commands over a single communications link, with the mode of operation of each command being individually selectable within the "IM# Cmd Type" cell. "Blocking" mode provides the fastest signaling speed (available on commands 1 - 4), "Direct Intertrip" mode provides the most secure signaling (available on commands 1 - 8) and "Permissive" mode provides the most dependable signaling (available on commands 5 - 8).

Each command can also be disabled so that it has no effect in the logic of the relay.

Since many applications will involve the commands being sent over a multiplexed communications channel, it is necessary to ensure that only data from the correct relay is used. Both relays in the scheme must be programmed with a unique pair of addresses that correspond with each other in the "Source Address" and "Receive Address" cells. For example, at the local end relay if we set the "Source Address" to 1, the "Receive Address" at the remote end relay must also be set to 1. Similarly, if the remote end relay has a "Source Address" set to 2, the "Receive Address" at the local end must also be set to 2.

All four addresses must not be set identical in any given relay scheme if the possibility of incorrect signaling is to be avoided.

It must be ensured that the presence of noise in the communications channel isn't interpreted as valid messages by the relay. For this reason, InterMiCOM uses a combination of unique pair addressing described above, basic signal format checking and for "Direct Intertrip" commands an 8-bit Cyclic Redundancy Check (CRC) is also performed. This CRC calculation is performed at both the sending and receiving end relay for each message and then compared in order to maximize the security of the "Direct Intertrip" commands.

Most of the time the communications will perform adequately and the presence of the various checking algorithms in the message structure will ensure that InterMiCOM signals are processed correctly. However, careful consideration is also required for the periods of extreme noise pollution or the unlikely situation of total communications failure and how the relay should react. During periods of extreme noise, it is possible that the synchronization of the message structure will be lost and it may become impossible to decode the full message accurately. During this noisy period, the last good command can be maintained until a new valid message is received by setting the "IM# FallBackMode" cell to "Latched". Alternatively, if the synchronization is lost for a period of time, a known fallback state can be assigned to the command by setting the "IM# FallBackMode" cell to "Default". In this latter case, the time period will need to be set in the "IM# FrameSynTim" cell and the default value will need to be set in "IM# DefaultValue" cell. As soon as a full valid message is seen by the relay all the timer periods are reset and the new valid command states are used. An alarm is provided if the noise on the channel becomes excessive.

When there is a total communications failure, the relay will use the fallback (failsafe) strategy as described above. Total failure of the channel is considered when no message data is received for four power system cycles or if there is a loss of the DCD line.

1.5.7.3 EIA(RS)232 Physical Connections

InterMiCOM on the Px40 relays is implemented using a 9-pin 'D' type female connector (labeled SK5) located at the bottom of the 2nd Rear communication board. This connector on the Px40 relay is wired in DTE (Data Terminating Equipment) mode, as indicated below:

Pin	Acronym	InterMiCOM Usage
1	DCD	"Data Carrier Detect" is only used when connecting to modems otherwise this should be tied high by connecting to terminal 4.
2	RxD	"Receive Data"
3	TxD	"Transmit Data"
4	DTR	"Data Terminal Ready" is permanently tied high by the hardware since InterMiCOM requires a permanently open communication channel.
5	GND	"Signal Ground"
6	Not used	-
7	RTS	"Ready To Send" is permanently tied high by the hardware since InterMiCOM requires a permanently open communication channel.
8	Not used	-
9	Not used	–

Depending upon whether a direct or modem connection between the two relays in the scheme is being used, the required pin connections are described below.

1.5.7.4 Direct Connection

The EIA(RS)232 protocol only allows for short transmission distances due to the signaling levels used and therefore the connection shown below is limited to less than 15m. However, this may be extended by introducing suitable EIA(RS)232 to fiber optic converters, such as the Schneider Electric T&D CILI203. Depending upon the type of converter and fiber used, direct communication over a few kilometers can easily be achieved.

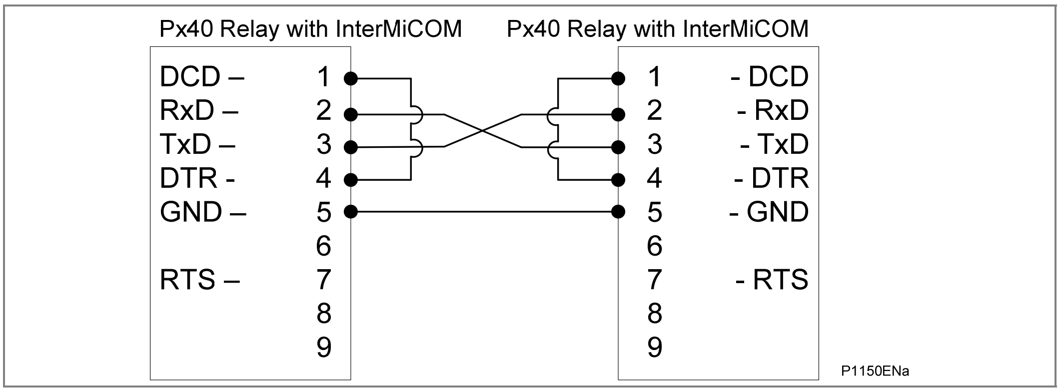

Figure 16 - Direct connection within the local substation

This type of connection should also be used when connecting to multiplexers which have no ability to control the DCD line.

1.5.7.5 Modem Connection

For long distance communication, modems may be used in which the case the following connections should be made.

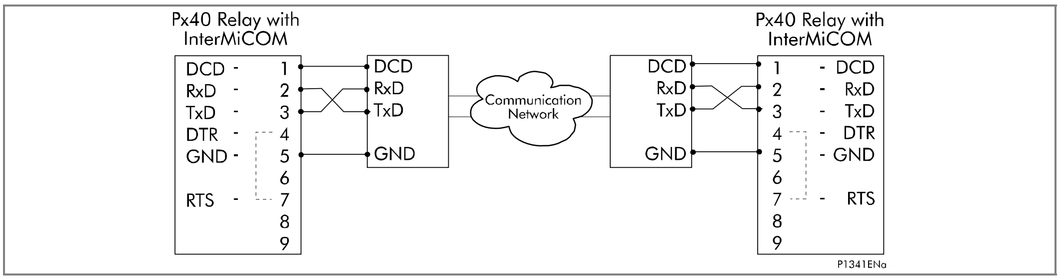

Figure 17 - InterMiCOM teleprotection via a modem link

This type of connection should also be used when connecting to multiplexers which have the ability to control the DCD line. With this type of connection it should be noted that the maximum distance between the Px40 relay and the modem should be 15m, and that a baud rate suitable for the communications path used should be selected.

1.5.7.6 Functional Assignment

Even though settings are made on the relay to control the mode of the intertrip signals, it is necessary to assign InterMiCOM input and output signals in the relay Programmable Scheme Logic (PSL) if InterMiCOM is to be successfully implemented. Two icons are provided on the PSL editor of MiCOM S1 for “Integral tripping In” and “Integral tripping out” which can be used to assign the 8 intertripping commands. The example shown below in figure 18 shows a “Control Input_1” connected to the “Intertrip O/P1” signal which would then be transmitted to the remote end. At the remote end, the “Intertrip I/P1” signal could then be assigned within the PSL. In this example, we can see that when intertrip signal 1 is received from the remote relay, the local end relay would operate an output contact, R1.

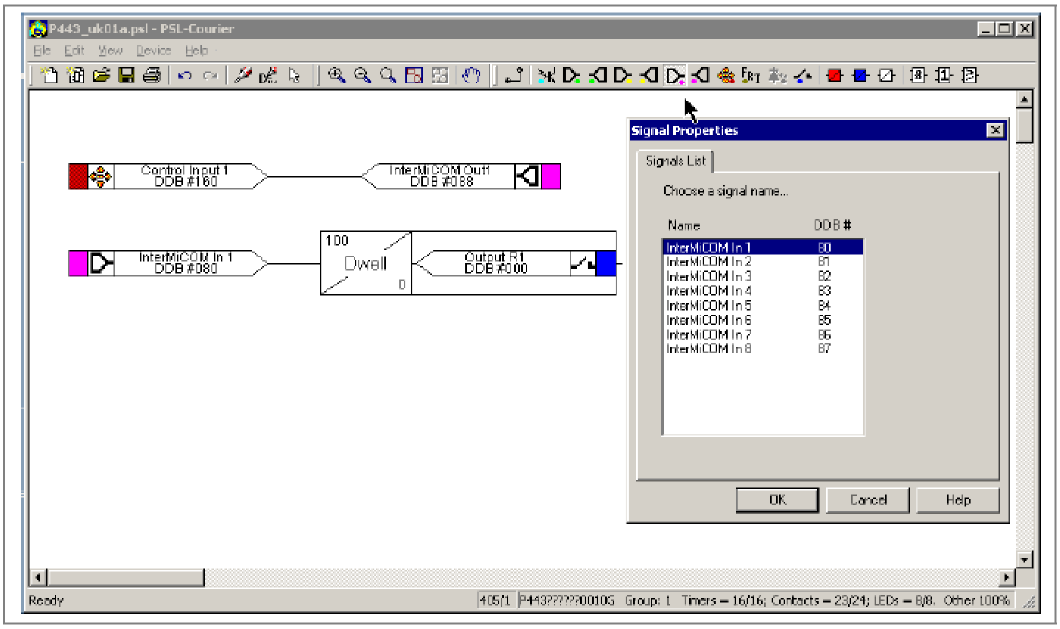

Figure 18 - Example assignment of signals within the PSL

It should be noted that when an InterMiCOM signal is sent from the local relay, only the remote end relay will react to this command. The local end relay will only react to InterMiCOM commands initiated at the remote end. InterMiCOM is thus suitable for teleprotection schemes requiring Duplex signaling.

1.5.8 InterMiCOM Statistics & Diagnostics

It is possible to hide the channel diagnostics and statistics from view by setting the “Ch Statistics” and/or “Ch Diagnostics” cells to “Invisible”. All channel statistics are reset when the relay is powered up, or by user selection using the “Reset Statistics” cell.

2 CURRENT TRANSFORMERS

2.1 CT Saturation Detection

Innovative methods are used to detect CT saturation in the P740. The values associated with the CT saturation algorithms are entered into the Peripheral Unit's CT ratio menu column and are used to define the CT's characteristic. The algorithms for CT saturation detection are executed in the peripheral units.

The first algorithm to be examined is the detection of variation of current.

The PU calculates the derived current and compares it to the magnitude of the waveform. With 2400Hz sampling, maximum variation between 2 successive samples of sinusoidal current can not exceed 14% of the previous period's magnitude.

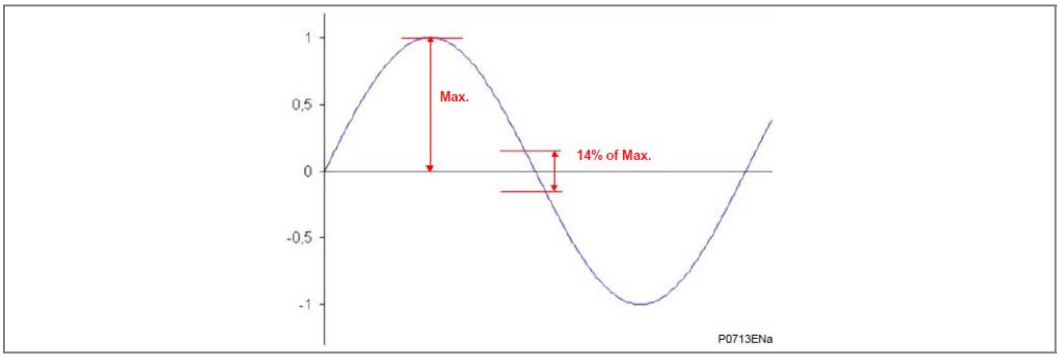

Figure 19 - Current variation

The magnitude of the current is the maximum value of the current measure during the last period with a minimum of 50% of nominal current. A variation is detected is derived current exceed 20% of this magnitude.

This instantaneous value is maintained 150ms for the first variation then 50ms for the next ones, as shown as figure 20.

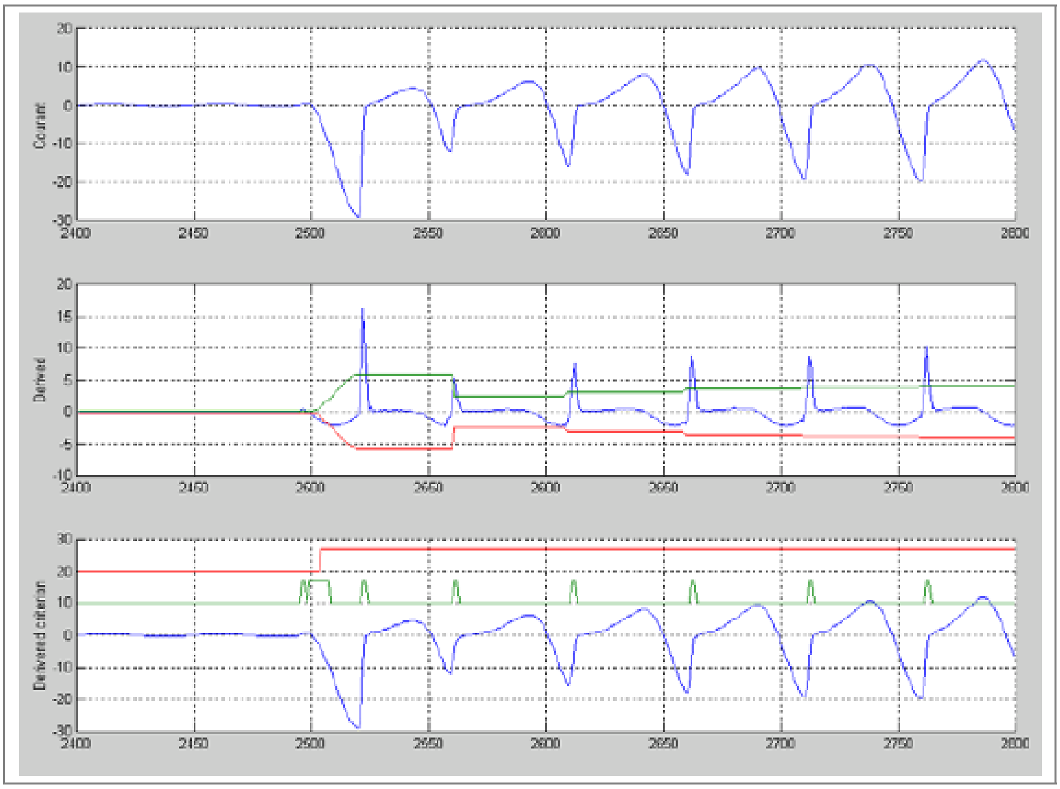

Figure 20 - Current variation criteria

The second algorithm, by integration of the secondary current, presumes of maximum flux in the HV CT core.

The flux calculation starts when the first variation of current is detected, then if the calculated flux reached 20% of the maximum flux, a CT saturation is presumed as shown in figure 21.

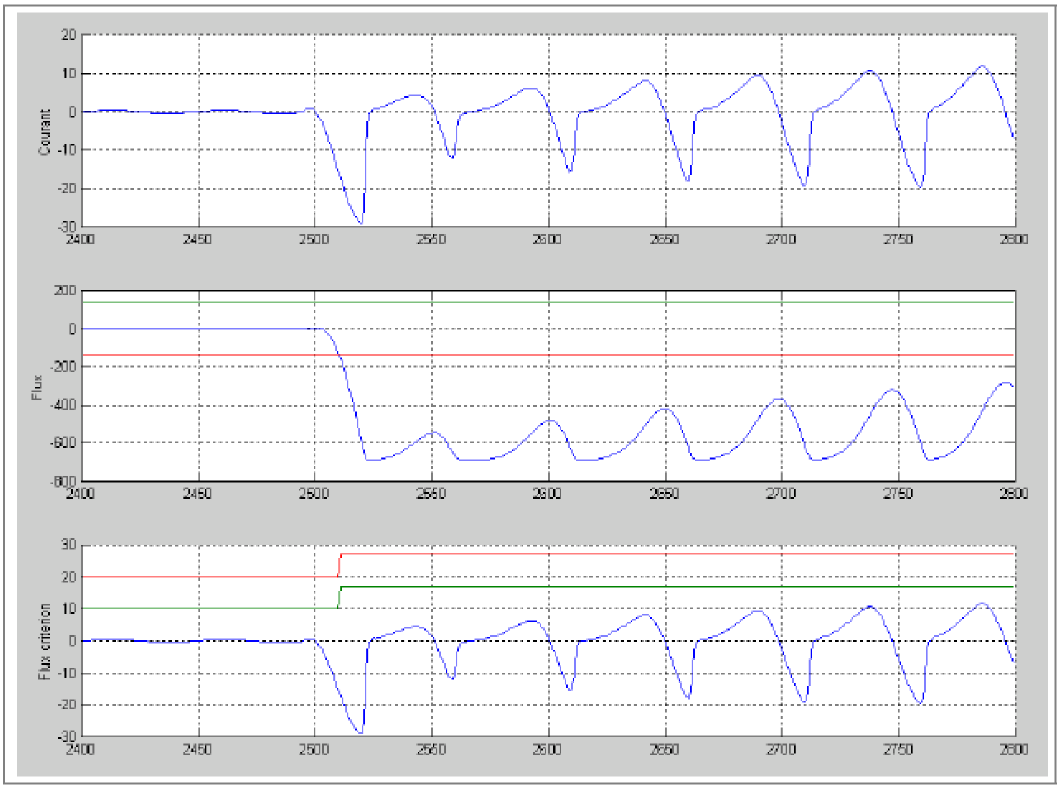

Figure 21 - Determination of signal quality in peripheral unit

CT saturation detection starts at the first variation of current detected and stop if there is no variation during 100ms.

The third algorithm blocks the occurrence of saturation for as long as the current increases during the first half-cycle.

Blocking starts upon detection of the first current variation. Then, as soon as the current is reversed, CT saturation is permitted as shown below in figure 22.

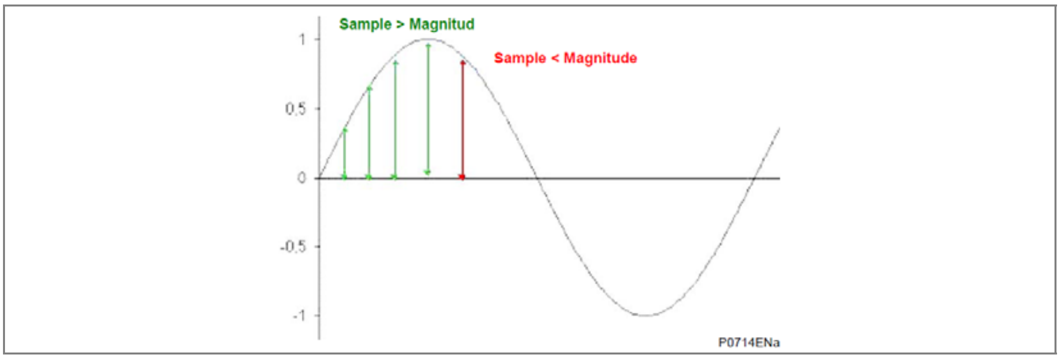

Figure 22 - Determination of signal quality in the peripheral unit

CT saturation is detected after a variation of current, detection of a presumption of maximum flux and current reversal, as shown figure 23. When CT saturation appears, a blocking order is sent to the CU to block all zones (the check zone is blocked).

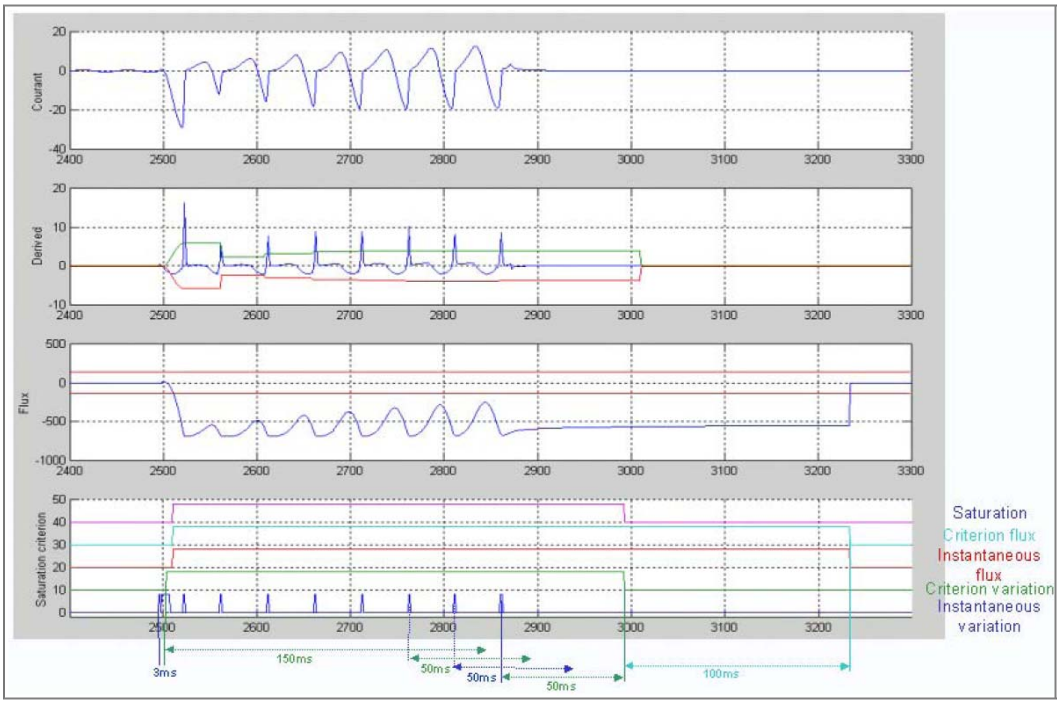

Figure 23 - CT saturation reset

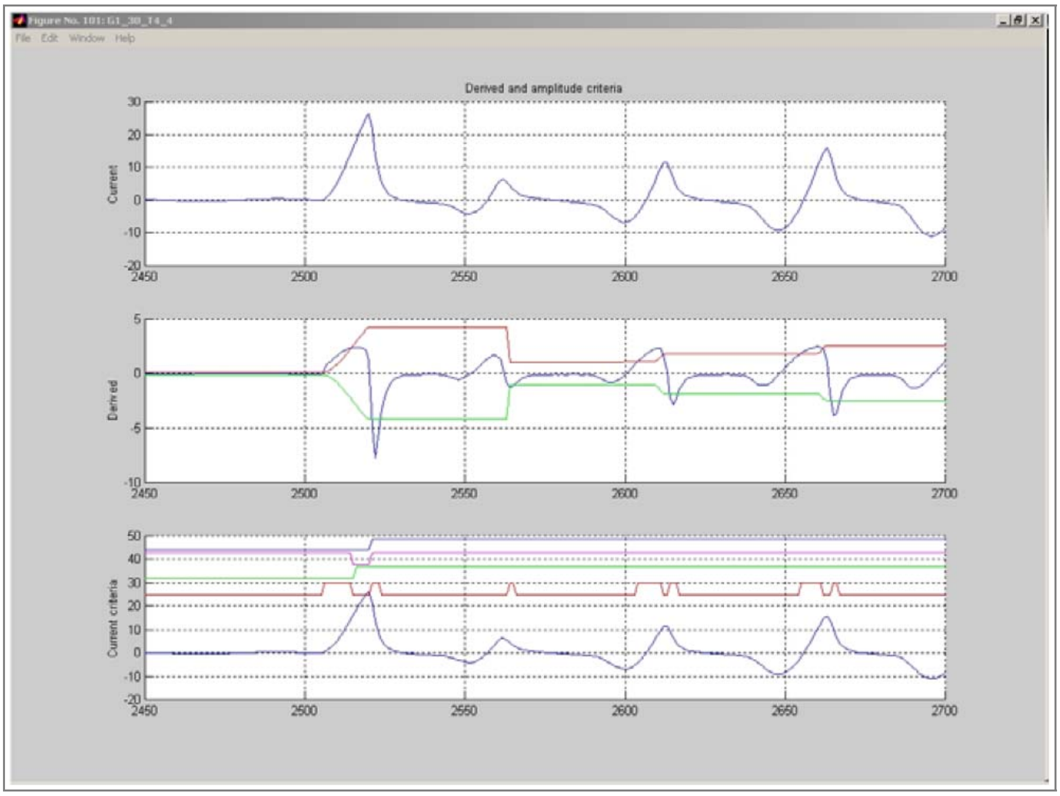

Figure 24 - CT saturation

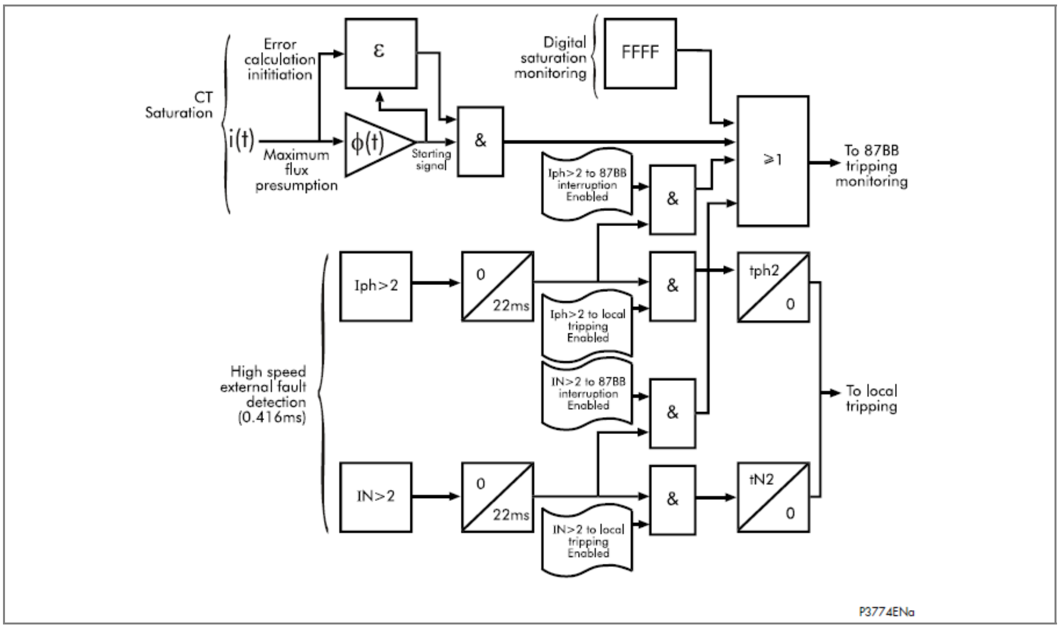

Figure 25 - Determination of signal quality in the peripheral unit

CT Location

There are no restriction imposed as to the location of current transformers within the system, however, when the topological model is created, the position and orientation of the current transformers must be defined correctly to ensure the correct operation of the protection.

A suggested current transformer location is to position the current transformer for the busbar protection, line side of the circuit breaker whilst the line protection current transformers are positioned busbar side of the circuit breaker. This then covers the largest possible busbar zone providing an overlap with the line protection therefore eliminating any possible blind spots. This is shown in Figure below.

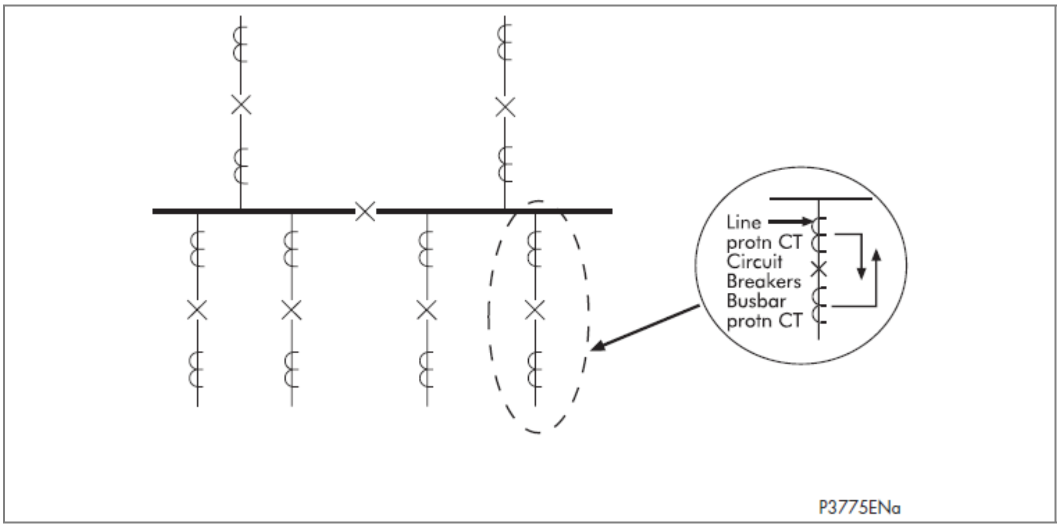

Figure 26 - CT location

3 ISOLATOR AND CIRCUIT BREAKER FUNCTION

3.1 Isolator State Monitoring Features

MiCOM relays can be set to monitor normally open (89A) and normally closed (89B) auxiliary contacts of the isolators. Under healthy conditions, these contacts will be in opposite states.

Should both sets of contacts be open, this would indicate one of the following conditions:

- Auxiliary contacts / wiring defective
- Isolator is defective
- Isolator is in isolated position

Should both sets of contacts be closed, only one of the following two conditions would apply:

- Auxiliary contacts / wiring defective
- Isolator is defective

A normally open / normally closed output contact has to be assigned to this function via the programmable scheme logic (PSL). The time delay is set to avoid unwanted operation during normal switching duties. If any of the above conditions exist, an alarm will be issued after the time delay set in the PSL.

In the PSL Qx must be used following the two options:

- 89A or 89B
- Both 89A and 89B

If both 89A and 89B are used then status information will be available and in addition a discrepancy alarm will be possible. 89A and 89B inputs are assigned to relay opto-isolated inputs via the PSL.

When only one status information can be wired to a Peripheral Unit, it is recommended to use the 89B (open) and link it inversed through a NAND gate or an NOR gate to the Isolator closed position in the PSL.

3.2 Circuit Breaker State Monitoring Features

MiCOM relays can be set to monitor normally open (52A) and normally closed (52B) auxiliary contacts of the circuit breaker. Under healthy conditions, these contacts will be in opposite states. Should both sets of contacts be open, this would indicate one of the following conditions:

- Auxiliary contacts / wiring defective
- Circuit Breaker (CB) is defective
- CB is in isolated position

Should both sets of contacts be closed, only one of the following two conditions would apply:

- Auxiliary contacts / wiring defective
- Circuit Breaker (CB) is defective

If any of the above conditions exist, an alarm will be issued after a 200ms time delay. A normally open / normally closed output contact can be assigned to this function via the programmable scheme logic (PSL). The time delay is set to avoid unwanted operation during normal switching duties.

In the PSL CB AUX could be used or not, following these options:

- None
- Both 52A and 52B (triphase - 2 optos)
- Both 52A and 52B (per phase - 6 optos)

No CB status available directly affects any function within the relay that requires this signal, for example CB control, Topology for buscoupler, etc.

If both 52A and 52B are used then status information will be available and in addition a discrepancy alarm will be possible, according to the following table. 52A and 52B inputs are assigned to relay opto-isolated inputs via the PSL.

Auxiliary Contact Position		CB State Detected	Action
52A	52B		
Open	Closed	Breaker Open	Circuit breaker healthy
Closed	Open	Breaker Closed	Circuit breaker healthy
Closed	Closed	State Unknown	Alarm raised if the condition persists for longer than “CB supervision timer” delay time setting
Open	Open	State Unknown	Alarm raised if the condition persists for longer than “CB supervision timer” delay time setting

Table 3 – Contact positions, CB states detected and actions

In the bus sections and bus couplers, the position used in the topology algorithm is open when the ‘CB State Detected’ is ‘Breaker Open’. In all others cases, the position closed will be used to calculate the topology. CB auxiliary contacts and Manual CB closed command are definitely required for all bus-sections and bus-couplers.

They are not definitely required for feeders, but if the information is supplied to the scheme, better operation is possible:

- Dead Zone fault, the CB position is required (send remote trip order to the other end of the line).
- CB supervision.

In that case the best is to provide the Manual CB closing order.

No specific auxiliary contacts are required but ideally one 52a and one 52b should be available.

The faster these contacts operate (following real CB operation) the better it is.

When 52a=52b=0 or 52a=52b=1 (most of the time during operation of the CB, but not only), the CB is considered as closed in the topology.

In the PSL:

If 52a is per pole, 52b should be per pole;

If 52a is 3phase, 52b should be 3-phase too.

It is recommended to use early make late break contacts for the coupler breaker.

If they do not exist, the CB Close command shall be used to force closed the breaker during the closing process; this choice is made in the PSL.

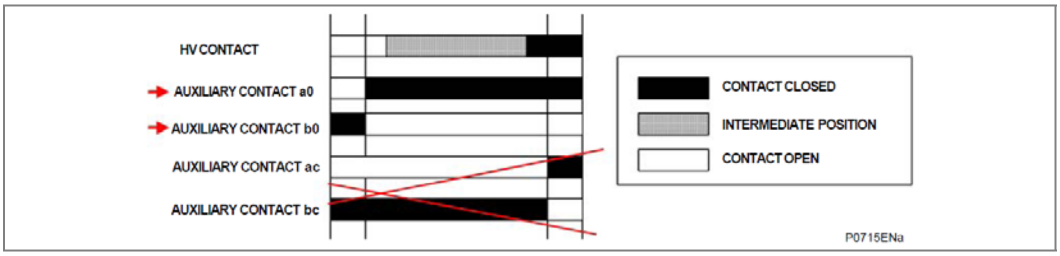

Figure 27 - CB state monitoring features

3.3 Circuit Breaker Control

The relay includes the following options for control of a single circuit breaker:

- Local tripping and closing, via the relay menu
- Local tripping and closing, via relay opto-isolated inputs

It is recommended that separate relay output contacts are allocated for remote circuit breaker control and protection tripping. This enables the control outputs to be selected via a local/remote selector switch as shown below. Where this feature is not required the same output contact(s) can be used for both protection and remote tripping.

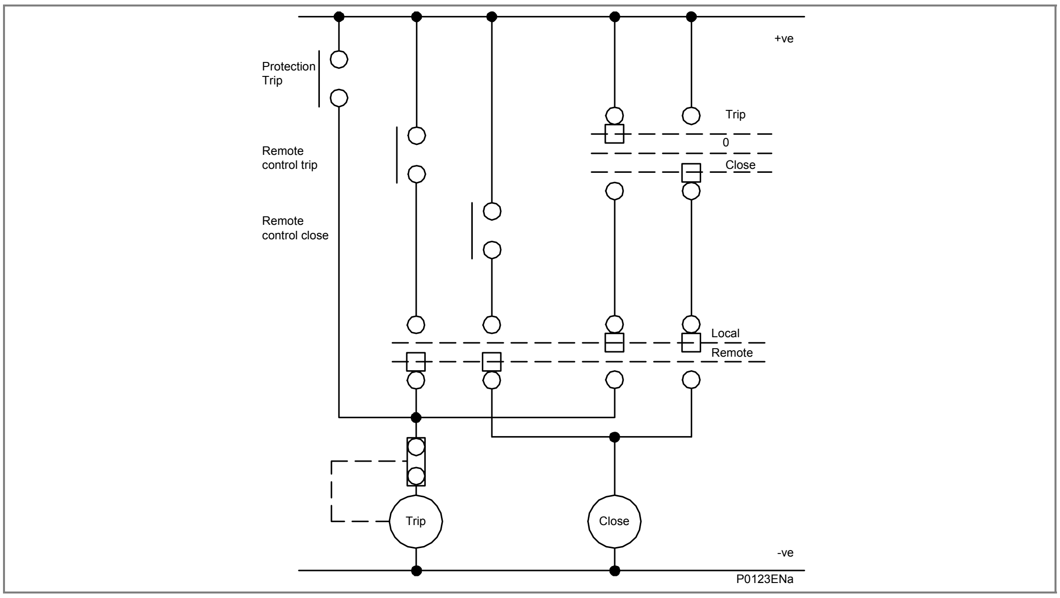

Figure 28 - Remote control of circuit breaker

The following table is taken from the relay menu and shows the available settings and commands associated with circuit breaker control.

A manual trip will be permitted provided that the circuit breaker is initially closed. Likewise, a close command can only be issued if the CB is initially open. To confirm these states it will be necessary to use the breaker 52A and/or 52B contacts via PSL. If no CB auxiliary contacts are available no CB control (manual or auto) will be possible.

Once a CB Close command is initiated the output contact can be set to operate following a user defined time delay (‘Man Close Delay’). This would give personnel time to move away from the circuit breaker following the close command. This time delay will apply to all manual CB Close commands.

The length of the trip or close control pulse can be set via the ‘Man Trip Pulse’ and ‘Man Close Pulse’ settings respectively. These should be set long enough to ensure the breaker has completed its open or close cycle before the pulse has elapsed.

Note	*The manual close commands for each user interface are found in the System Data column of the menu.*

If an attempt to close the breaker is being made, and a protection trip signal is generated, the protection trip command overrides the close command.

If the CB fails to respond to the control command (indicated by no change in the state of CB Status inputs) a ‘CB Fail Trip Control’ or ‘CB Fail Close Control’ alarm will be generated after the relevant trip or close pulses have expired. These alarms can be viewed on the relay LCD display or can be assigned to operate output contacts for annunciation using the relays Programmable Scheme Logic (PSL).

4 OPERATION OF NON PROTECTION FUNCTIONS

4.1 Programmable Scheme Logic

4.1.1 Level Settings

Name	Range	Step Size
Time delay t	0-14400000ms	1ms

Table 4 - Time delay settings

4.1.2 Accuracy

Output conditioner timer	Setting ±2% or 50ms whichever is greater
Dwell conditioner timer	Setting ±2% or 50ms whichever is greater
Pulse conditioner timer	Setting ±2% or 50ms whichever is greater

Table 5 - Accuracies

4.2 IRIG-B signal (P741) Only

If a satellite time clock signal conforming to IRIG-B is provided and the P741 relay has the optional IRIG-B port fitted, the satellite clock equipment should be energised.

In the event of the auxiliary supply failing, with a battery fitted in the compartment behind the bottom access cover, the time and date will be maintained. Therefore, when the auxiliary supply is restored, the time and date will be correct and not need to be set again.

The P741 synchronises all peripheral units (P742/P743) every 10s and during the powering on of the scheme.

4.3 Differential Current Display

When the differential currents are low, it is possible to force to 0 the value of these differential currents displayed in the column MEASUREMENT 1 & MEASUREMENT 2 .

When the differential currents of a zone are all lower than the threshold (on the 3 phases), the currents displayed are forced to 0.

5 COMMUNICATIONS BETWEEN PU AND CU

The P740 scheme can be either centralised in one cubicle or distributed in cubicles housing other protection depending on the availability of space. Either way the Peripheral Units still need to communicate with the central unit and vice versa. Each central unit has up to 7 communication boards each accommodating inputs from 4 peripheral units. Thus each central unit can accommodate up to 28 peripheral units.

Note	*From software E1.0, model 50, The CU and all the Pus must have the same model number (digits 12 & 13). When a PU with a not compatible model number and software reference is connected to a Central Unit, the CU will not recognise the PU and will show the Locking Level 2 Error and alarm.*

5.1 Communications Link

The following communication media is used for the communication channel within the P740 scheme. The data rate is 2.5 Mbits/sec.

5.2 Direct Optical Fibre Link, 850nm Multi-Mode Fibre

The units are connected directly using two 850nm multi-mode optical fibres for each signalling channel. Multi-mode fibre type 62.5/125μm is suitable and standard BFOC/2.5 type fibre optic connectors are used. These are commonly known as “ST” connectors (“ST” is a registered trademark of AT&T).

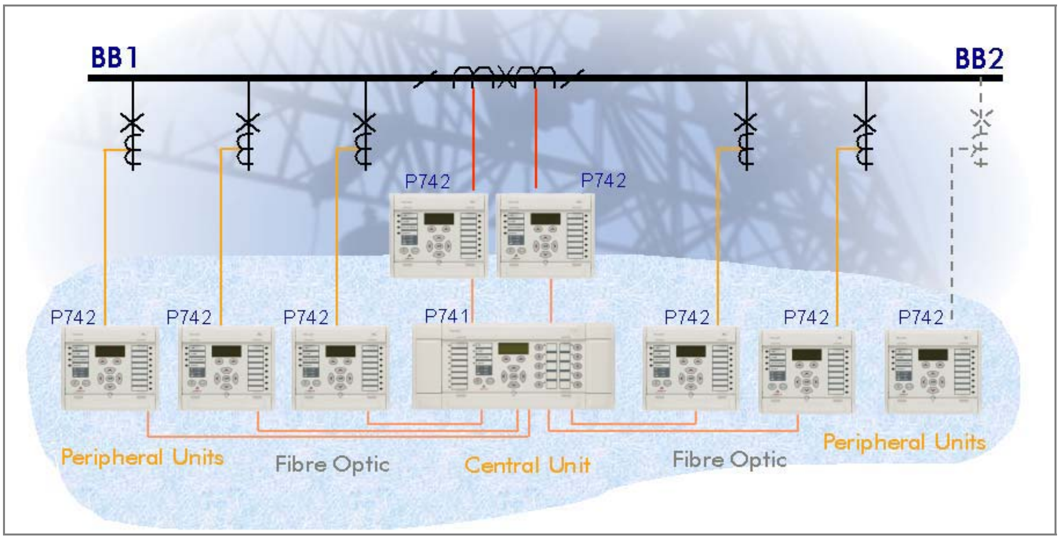

Figure 29 - Module interconnection

This is typically suitable for connection up to 1km.

5.3 Optical Budgets

When using fibre optics as a method of communication the type of fibre used and the distance between devices needs to be considered. The following table shows the optical budgets of the communications interface.

Parameter	850nm Multi mode
Min. transmit output level (average power)	-19.8dBm
Receiver sensitivity (average power)	-25.4dBm
Optical budget	5.6dB
Less safety margin	(3dB) 2.6dB 3dB
Typical cable loss	2.6dB/km

Parameter	850nm Multi mode
Max. transmission distance	1km

Table 6 - Optical budget

The total optical budget is given by transmitter output level minus the receiver sensitivity and will indicate the total allowable losses that can be tolerated between devices. A safety margin of 3dB is also included in the above table. This allows for degradation of the fibre as a result of ageing and any losses in cable joints. The remainder of the losses will come from the fibre itself. The figures given are typical only and should only be used as a guide.

5.3.1 Main Operating Features

5.3.1.1 Operation Modes

5.4 Trip LED Logic

The trip LED can be reset when the flags for the last fault are displayed or via dedicated DDBs. The flags are displayed automatically after a trip occurs, or can be selected in the fault record menu. The reset of trip LED and the fault records is performed by pressing the Ⓒ key once the fault record has been read.

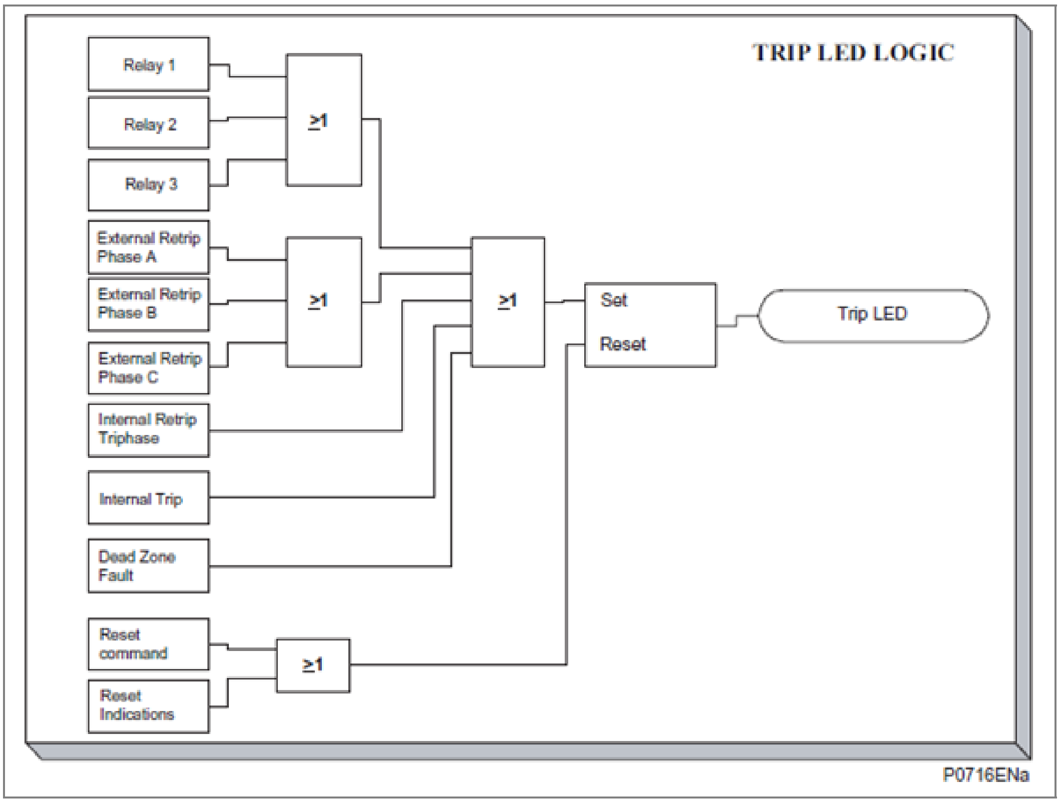

Figure 30 - Trip LED logic diagram

5.5 Function Keys

The P741 and P743 relays offer users 10 function keys for programming any operator control functionality such as auto-reclose ON/OFF, earth fault1 ON/OFF etc. via Programmable Scheme Logic (PSL). Each function key has an associated programmable tri-colour LED that can be programmed to give the desired indication on function key activation.

These function keys can be used to trigger any function that they are connected to as part of the PSL. The function key commands can be found in the 'Function Keys' menu (see Settings section, P740/EN ST). In the 'Fn. Key Status' menu cell there is a 10 bit word which represent the 10 function key commands and their status can be read from this 10 bit word.

In the PSL editor 10 function key signals, which can be set to a logic 1 or On state, as described above, are available to perform control functions defined by the user.

The "Function Keys" column has 'Fn. Key n Mode' cell which allows the user to configure the function key as either 'Toggled' or 'Normal'. In the 'Toggle' mode the function key DDB signal output will remain in the set state until a reset command is given, by activating the function key on the next key press. In the 'Normal' mode, the function key DDB signal will remain energized for as long as the function key is pressed and will then reset automatically.

A minimum pulse duration can be programmed for a function key by adding a minimum pulse timer to the function key DDB output signal.

The "Fn. Key n Status" cell is used to enable/unlock or disable the function key signals in PSL. The 'Lock' setting has been specifically provided to allow the locking of a function key thus preventing further activation of the key on consequent key presses. This allows function keys that are set to 'Toggled' mode and their DDB signal active 'high', to be locked in their active state thus preventing any further key presses from deactivating the associated function. Locking a function key that is set to the "Normal" mode causes the associated DDB signals to be permanently off. This safety feature prevents any inadvertent function key presses from activating or deactivating critical relay functions.

The "Fn. Key Labels" cell makes it possible to change the text associated with each individual function key. This text will be displayed when a function key is accessed in the function key menu, or it can be displayed in the PSL.

The status of the function keys is stored in battery backed memory. In the event that the auxiliary supply is interrupted the status of all the function keys will be recorded. Following the restoration of the auxiliary supply the status of the function keys, prior to supply failure, will be reinstated. If the battery is missing or flat the function key DDB signals will set to logic 0 once the auxiliary supply is restored.

Note	*The relay will only recognize a single function key press at a time and that a minimum key press duration of approximately 200msec. is required before the key press is recognized in PSL. This deglitching feature avoids accidental double presses.*

5.5.1 CB Control Using Hotkeys

In the Peripheral Units, the hotkeys allow direct access to the manual trip and close commands without the need to enter the SYSTEM DATA column. Hotkeys supplement the direct access possible via the function keys described in section 5.5. Red or green colour coding can be applied when used in CB control applications.

If <<TRIP>> or <<CLOSE>> is selected, the user is prompted to confirm the execution of the relevant command. If a trip is executed, a screen with the CB status will be displayed once the command has been completed. If a close is executed, a screen with a timing bar will appear while the command is being executed. This screen has the option to cancel or restart the close procedure. The timer used is taken from the manual close delay timer setting in the CB Control menu. When the command has been executed, a screen confirming the present status of the circuit breaker is displayed. The user is then prompted to select the next appropriate command or exit – this will return to the default relay screen.

If no keys are pressed for a period of 25 seconds while waiting for the command confirmation, the relay will revert to showing the CB Status. If no key presses are made for a period of 25 seconds while displaying the CB status screen, the relay will revert to the default relay screen. Figure 31 shows the hotkey menu associated with CB control functionality

To avoid accidental operation of the trip and close functionality, the hotkey CB control commands will be disabled for 10 seconds after exiting the hotkey menu.

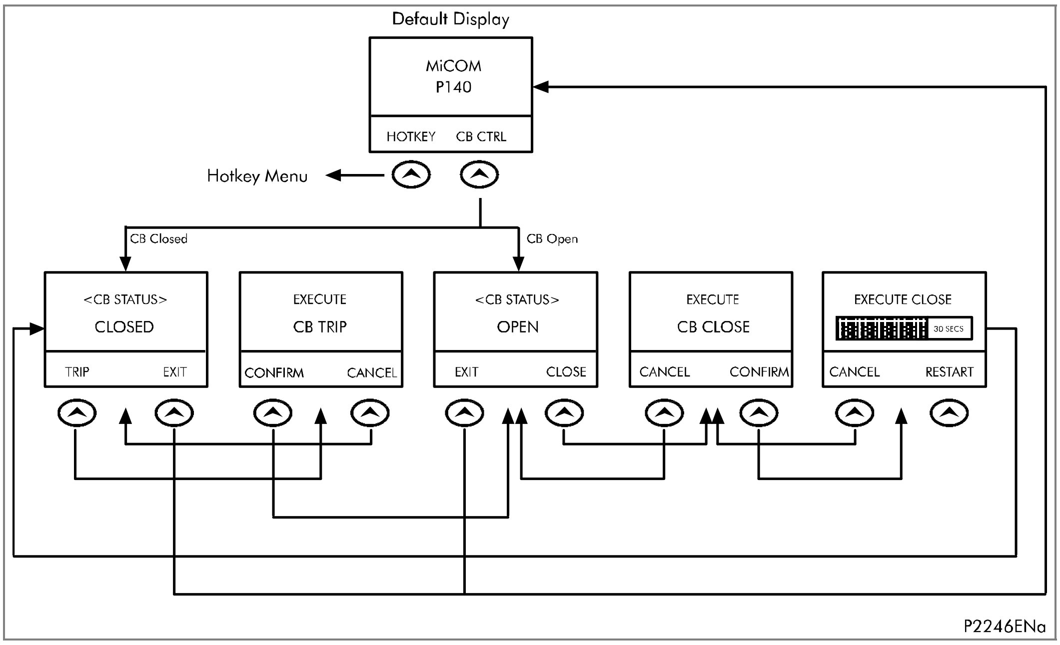

Figure 31 - CB control hotkey menu

5.5.2 CB Control Using Function Keys

In the P743, the function keys allow direct control of the circuit breaker if programmed to do this in PSL. local tripping and closing, via relay opto-isolated inputs must be set in the “CB Control” menu ‘CB control by’ cell to enable this functionality. All CB manual control settings and conditions will apply for manual tripping and closing via function keys.

The following default logic can be programmed to activate this feature:

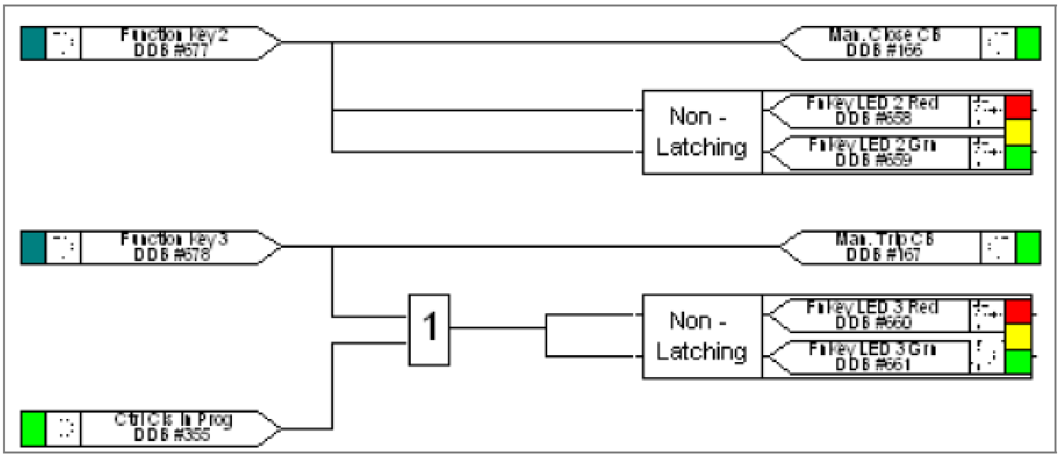

Figure 32 - CB control via function keys default PSL

Function key 2 and function key 3 are both enabled and set to ‘Normal’ Mode and the associated DDB signals ‘DDB 677’ and ‘DDB 678’ will be active high ‘1’ on key press.

The following DDB signal must be mapped to the relevant function key:

- Man. Trip CB – Initiate manual circuit breaker trip
- Man. Close CB – Initiate manual circuit breaker close

The programmable function key LED's have been mapped such that the LED's will indicate yellow whilst the keys are activated.

5.6 Setting Groups Selection

The setting groups can be changed either via opto inputs, via a menu selection, via the hotkey menu or via function keys. In the Configuration column if 'Setting Group - select via optos' is selected then any opto input or function key can be programmed in PSL to select the setting group as shown in the table below. If 'Setting Group - select via menu' is selected then in the Configuration column the 'Active Settings - Group1/2/3/4' can be used to select the setting group.

The setting group can be changed via the hotkey menu providing 'Setting Group select via menu' is chosen.

5.7 Control Inputs

The control inputs function as software switches that can be set or reset either locally or remotely. These inputs can be used to trigger any function that they are connected to as part of the PSL. There are three setting columns associated with the control inputs that are: "CONTROL INPUTS", "CTRL. I/P CONFIG." and "CTRL. I/P LABELS". The function of these columns is described below:

Menu Text	Default Setting	Setting Range	Step Size
CONTROL INPUTS			
Ctrl I/P Status	00000000000000000000000000000000		
Control Input 1	No Operation	No Operation, Set, Reset	
Control Input 2 to 32	No Operation	No Operation, Set, Reset	

Table 7 – Control inputs

The Control Input commands can be found in the 'Control Input' menu. In the 'Ctrl. I/P status' menu cell there is a 32 bit word which represent the 32 control input commands. The status of the 32 control inputs can be read from this 32-bit word. The 32 control inputs can also be set and reset from this cell by setting a 1 to set or 0 to reset a particular control input. Alternatively, each of the 32 Control Inputs can be set and reset using the individual menu setting cells 'Control Input 1, 2, 3' etc. The Control Inputs are available through the relay menu as described above and also via the rear communications.

In the Programmable Scheme Logic (PSL) editor 32 Control Input signals, DDB 800 – 831, which can be set to a logic 1 or On state, as described above, are available to perform control functions defined by the user.

Menu Text	Default Setting	Setting Range	Step Size
CTRL. I/P CONFIG.			
Hotkey Enabled	11111111111111111111111111111111		
Control Input 1	Latched	Latched, Pulsed	
Ctrl Command 1	SET/RESET	SET/RESET, IN/OUT, ENABLED/DISABLED, ON/OFF	
Control Input 2 to 32	Latched	Latched, Pulsed	
Ctrl Command 2 to 32	SET/RESET	SET/RESET, IN/OUT, ENABLED/DISABLED, ON/OFF	
Menu Text	Default Setting	Setting Range	Step Size
CTRL. I/P LABELS			
Control Input 1	Control Input 1	16 character text	
Control Input 2 to 32	Control Input 2 to 32	16 character text	

Table 8 – Control I/P Config

The “CTRL. I/P CONFIG.” column has several functions one of which allows the user to configure the control inputs as either ‘latched’ or ‘pulsed’. A latched control input will remain in the set state until a reset command is given, either by the menu or the serial communications. A pulsed control input, however, will remain energized for 10ms after the set command is given and will then reset automatically (i.e. no reset command required).

In addition to the latched/pulsed option this column also allows the control inputs to be individually assigned to the “Hotkey” menu by setting ‘1’ in the appropriate bit in the “Hotkey Enabled” cell. The hotkey menu allows the control inputs to be set, reset or pulsed without the need to enter the “CONTROL INPUTS” column. The “Ctrl. Command” cell also allows the SET/RESET text, displayed in the hotkey menu, to be changed to something more suitable for the application of an individual control input, such as “ON/OFF”, “IN/OUT” etc.

The “CTRL. I/P LABELS” column makes it possible to change the text associated with each individual control input. This text will be displayed when a control input is accessed by the hotkey menu, or it can be displayed in the PSL.

Note	*With the exception of pulsed operation, the status of the control inputs is stored in battery backed memory.*
Note	*With the firmwares C3.x (model 33) and D2.x (model 40), the Function Keys and Controls Inputs are stored in BBRAM, so they will be restored to 0 if the battery is missing.*
Note	*With the firmwares D3.x (model 41) and D4.x (model 42), the Function Keys and Controls Inputs will be stored in FLASH. So the battery is no more required (except for events and DR), the last status will be restored each time.*

Notes:

APPLICATION NOTES

CHAPTER 6

Date:	02/2017
Products covered by this chapter:	This chapter covers the specific versions of the MiCOM products listed below. This includes ***only*** the following combinations of Software Version and Hardware Suffix.
Hardware Suffix:	L (P742) & M (P741 & P743)
Software Version:	B1 - P74x (P741, P742 & P743)
Connection Diagrams:	10P740xx (xx = 01 to 07)

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1 INTRODUCTION

Warning **Before carrying out any work on the equipment, you should be familiar with the contents of the Safety Information chapter/Safety Guide SFTY/5L M/L11 or later issue, the Technical Data chapter and the ratings on the equipment rating label.**

1.1 Protection of Substation Busbars

The busbars in a substation are possibly one of the most critical elements in a power system. If a fault is not cleared or isolated quickly, not only could substantial damage to the busbars and primary plant result, but also a substantial loss of supply to all consumers who depend upon the substation for their electricity. It is therefore essential that the protection associated with them provide reliable, fast and discriminative operation.

As with any power system the continuity of supply is of the utmost importance, however, faults that occur on substation busbars are rarely transient but more usually of a permanent nature. Circuit breakers should, therefore, be tripped and not subject to any auto-reclosure.

The busbar protection must also remain stable for faults that occur outside of the protected zone as these faults will usually be cleared by external protection devices. In the case of a circuit breaker failure, it may be necessary to open all of the adjacent circuit breakers; this can be achieved by issuing a backtrip to the busbar protection. Security and stability are key requirements of a busbar protection scheme. Should the busbar protection maloperate under such conditions substantial loss of supply could result unnecessarily.

Many different busbar configurations exist. Typical arrangements are single or a double busbar substation. The positioning of the primary plant can also vary and also needs to be considered which in turn introduces variations, all of which have to be able to be accommodated within the busbar protection scheme.

Backup protection is also an important feature of any protection scheme. In the event of equipment failure, such as signalling equipment or switchgear for example it is necessary to provide alternative forms of fault clearance. It is desirable to provide backup protection, which can operate with minimum time delay and yet discriminate with other protection elsewhere on the system.

2 APPLICATION OF INDIVIDUAL PROTECTION FUNCTIONS

The following sections detail the individual protection functions in addition to where and how they may be applied. Worked examples are provided, to show how the settings are applied to the IED.

There are three modules that make up the P740 scheme.

The P741 is the Central Unit (CU), whilst the P742 and P743 are both variants of the Peripheral Unit (PU).

The central unit co-ordinates the scheme, receiving signals from all the peripheral units associated with the protected busbar(s) and acting on these signals, initiating a bus zone protection trip when necessary.

One peripheral unit is associated with each CT location, usually one per incomer/feeder and one or two for each bus coupler/bus section depending on the number of CTs (1 or 2). The peripheral units acquire the analogue signals from the associated CT and the binary signals from the auxiliary contacts of the primary plant (CB and isolator(s)). The peripheral units also incorporate the main circuit breaker failure logic together with backup protection. The difference between the P742 and P743 is the amount of I/O, the number and type of LEDs and the function keys that each can accommodate. The P743 allows for increased I/O (useful in multiple bar applications or where single pole breakers and a transfer bar are employed), tricolour LEDs, function keys and Ethernet board slot. The main features of the P740 scheme are summarised below:

- Current differential busbar protection – Phase segregated biased differential protection (sometimes referred to as low impedance type).
- Provides the main protection element for the scheme. This protection provides high- speed discriminative protection for all fault types.
- Sensitive differential earth fault protection – provided for high impedance earthed systems and incorporates bias current control to guarantee stability under external faults.
- Circuit breaker failure protection – two stage breaker fail logic that can be initiated internally or externally.
- Dead Zone protection – phase and neutral.
- Non-directional phase fault over current protection – provides two stage backup protection.
- Non-directional earth fault protection – provides two stage backup protection.
- Low Burden – Allows the protection to be installed in series with other equipment on a common CT secondary.
- Accommodates different CT classes, ratios and manufacturer.

2.1 Busbar Protection

Busbar Biased Current Differential Protection

2.1.1 Busbar Protection Setting guidelines

2.1.1.1 87BB Phase CU Settings (Solid Earthed Network Schemes)

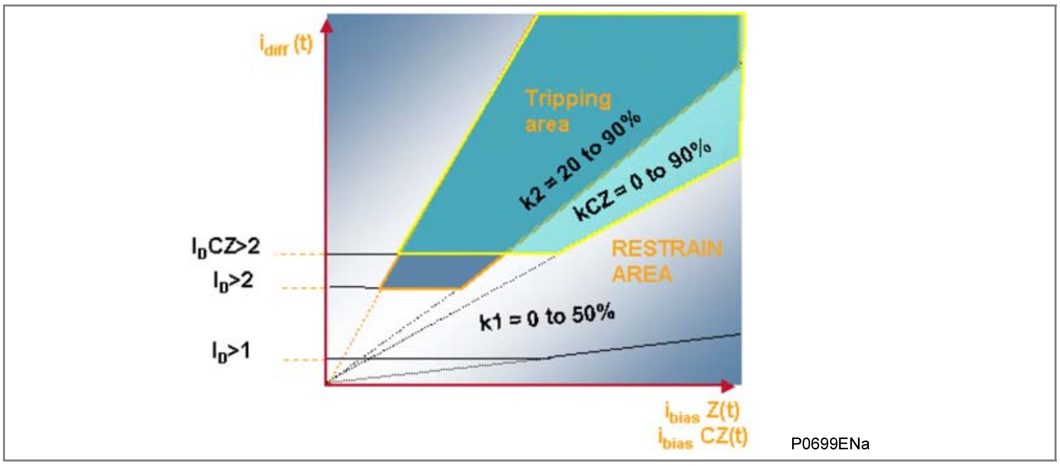


Figure 1 - 87BB Phase CU settings (Solid Earthed Network Schemes)

An Excel spreadsheet tool called “Idiff_Ibias“ is available on request to assure a reliable setting choice:

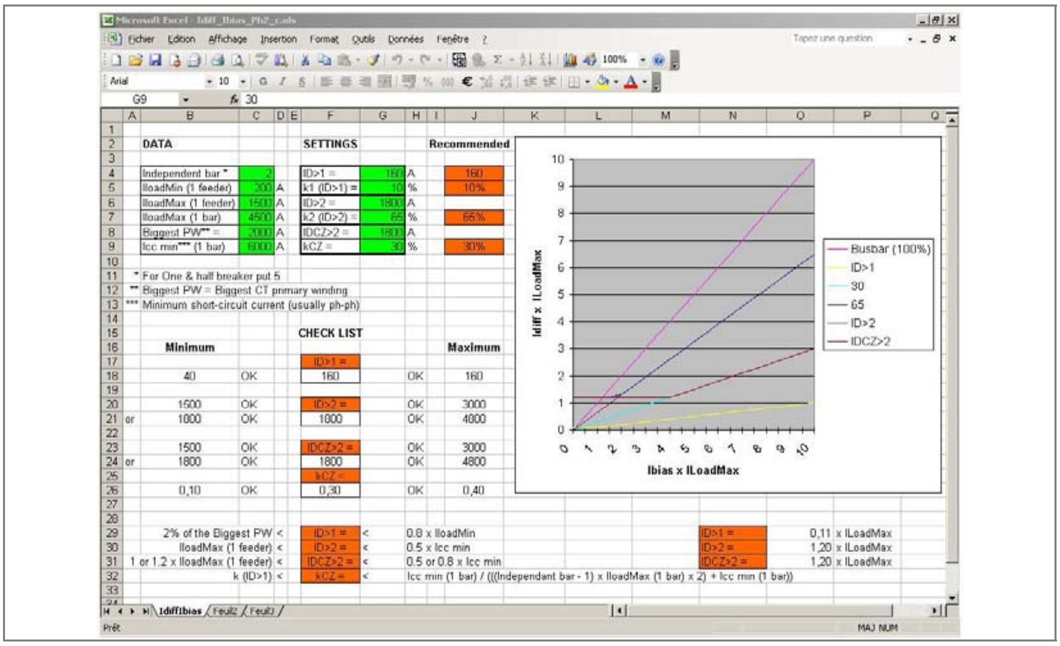


Figure 2 - Excel spreadsheet tool Idiff_Ibias

2.1.1.1.1 <u>Sub-Station Features</u>

Only 6 values have to be known:

1. Minimum load current in a feeder
2. Maximum load current in a feeder
3. Maximum load current in a bus
4. Biggest CT primary winding
5. Minimum short-circuit value (phase to phase) in a bus
6. Number of independent bars

2.1.1.1.2 **"Idiff_Ibias" Setting Calculation Spreadsheet**

Enter in the Idiff_Ibias spreadsheet the 5 values here above listed and you'll be able to choose the 7 values hereafter listed.

2.1.1.1.3 **Differential Busbar Protection**

1. ID>1 (from 5 A to 500 A (primary value)) as high as possible
2. Slope k1 (ID>1) (from 0% to 50%), recommendation is 10%
3. ID>2 (from 50 A to 50000 A (primary value)) as low as possible, whilst ensuring the single CT failure will not cause tripping under maximum load conditions
4. Slope k2 (ID>2) (from 20% to 90%), recommendation is generally 65%
5. IDCZ>2 (from 50 A to 50000 A (primary value)) as low as possible
6. Slope kCZ (IDCZ>2) (from 0% to 90%), recommendation is generally 30%
7. ID>1 Alarm Timer (from 0 to 100 s) shall be greater than the longest protection time (such as line, overcurrent, etc…)

Explanations of the Values:

- ID>1 shall be higher than 2% of the biggest CT to not detect noise coming from it and less than 80% of the minimum load of a feeder to detect the minimum load imbalance in case of a problem in that particular feeder.
- Slope k1 recommendation is 10% to meet 10Pxx current transformers
- ID>2 shall be higher than 100% (and when possible 120% to allow 20% margin) of the biggest load to not maloperate in case of CT short-circuited or open circuit and less than 80% of the minimum fault current to operate sub- cycle for the minimum fault (and 50% when possible to be sure to always operate in 13ms)
- Slope k2 (ID>2)

a) Recommendation is 65%

To be always stable in the worth CT ratio conditions (between the biggest CT and the smallest CT). 60% is OK as long as the CT ratio is less than 5.

b) Recommendation is 50% for China

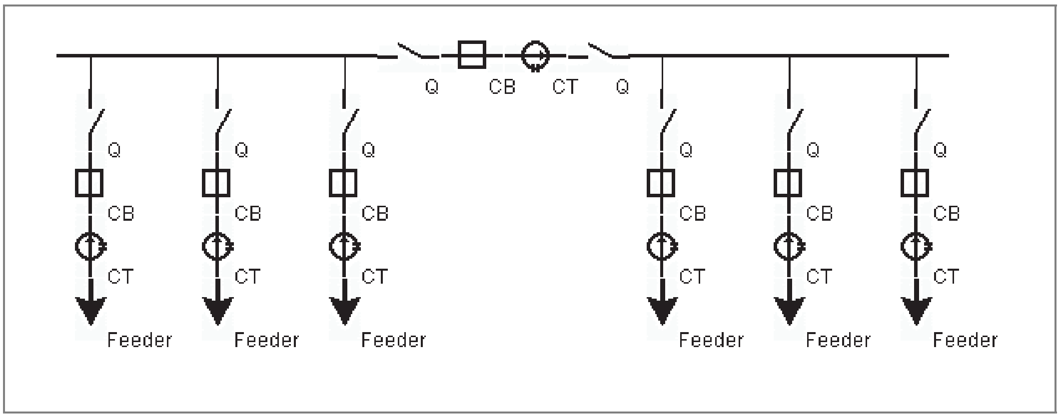
In China, the requirement is to be able to detect a resistive fault equal to 50% of the bias current.

- IDCZ>2 same as ID>2
- Slope kCZ (IDCZ>2)

a) Recommendation is 30%

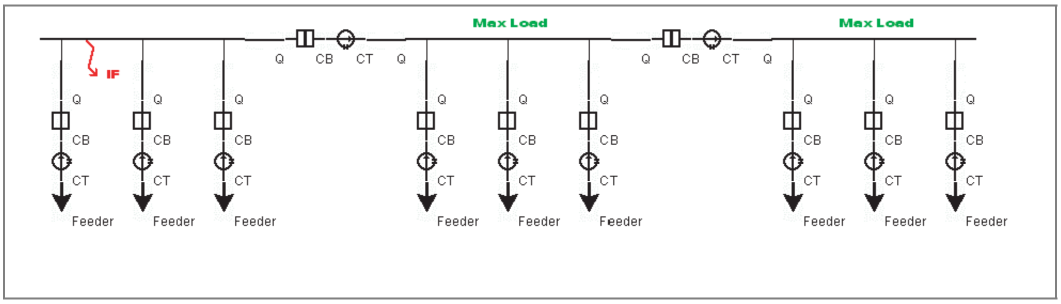
The requirement is to be able to trip for a fault that is counted twice by the Check Zone (for example one and half circuit breaker substation) and depends on the number of bars:

- n bars (Independent bars)
- A minimum internal short-circuit value (Icc min (1 bar))
- A maximum load for a bar (IloadMax (1 bar)).



The worst case is:

- when all these buses are independent (bus sectionalizers open)
- the maximum load is on all the buses (biggest bias current)
- The internal short-circuit value is minimum.



During the internal fault:

- the bias current is: Icc min (1 bar) + (n-1) x IloadMax (1 bar)
- the differential current is: Icc min (1 bar)

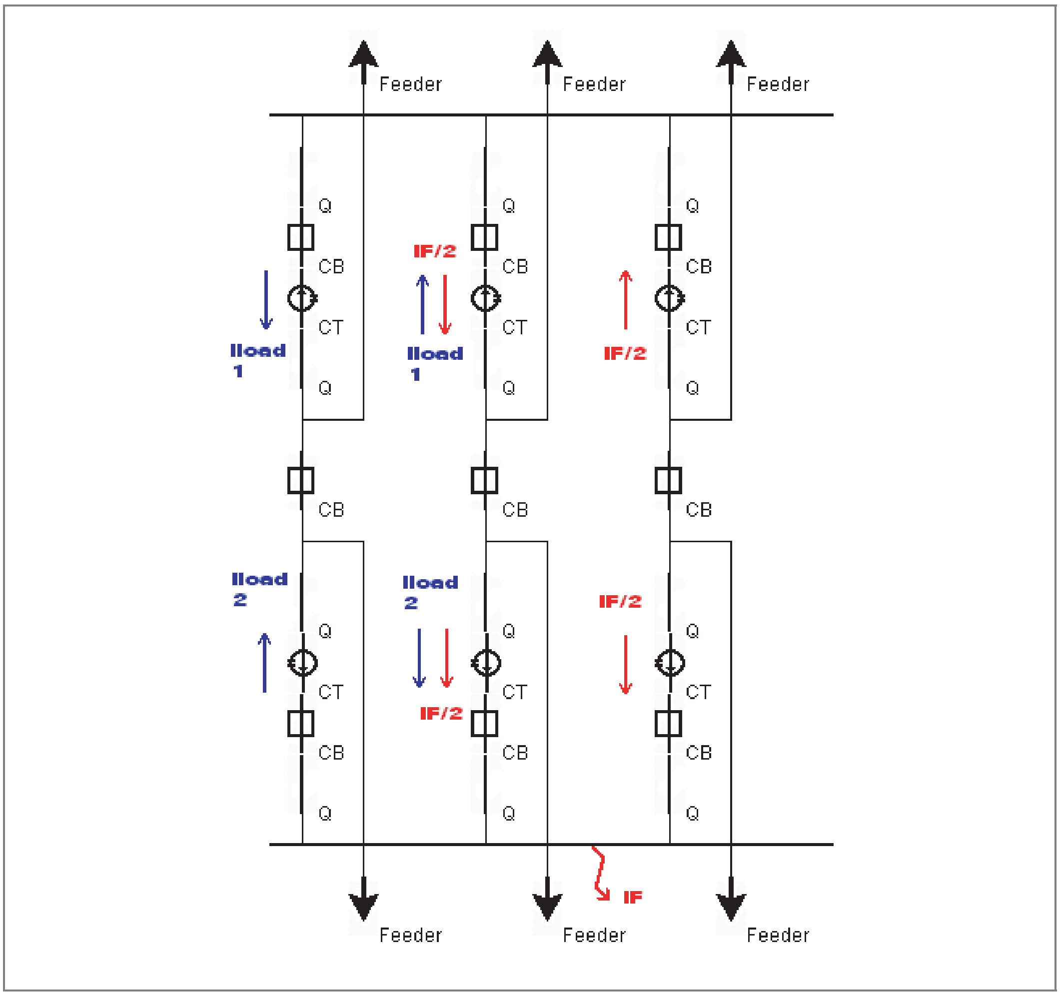
Thus the biggest slope for the Check Zone to detect the fault is:

$$\frac{\text{Icc min (1 bar)}}{\text{((Independent bars - 1) x IloadMax (1 bar)) + Icc min (1 bar)}}$$

If for example:

There are 3 buses and Icc min = IloadMax, the slope must be below 33% For a one and half breaker scheme there are:

- 2 bars (Independent bars)
- A minimum internal short-circuit value (Icc min (1 bar))
- A maximum load for a bar (IloadMax (1 bar)).



The worst case is:

- when the is split in 2 and goes as well through the opposite bar
- the maximum load is on the 2 buses (biggest bias current)
- The internal short-circuit value is minimum.

During the internal fault:

- the CZ bias current is: Icc min (1 bar) + 4 x IloadMax (1 bar)
- the CZ differential current is: Icc min (1 bar)

Thus the biggest slope for the Check Zone to detect the fault is:

$$\frac{\text{Icc min (1 bar)}}{\text{(4 x IloadMax (1 bar)) + Icc min (1 bar)}}$$

If for example:

Icc min = IloadMax, the slope must be below 20%

b) Recommendation is 25% for China

In China, the requirement is to be able to trip for a resistive fault that is counted twice by the Check Zone (for example one and half circuit breaker substation).

- ID>1 Alarm Timer to not operate for an external fault shall be greater than the longest protection time (such as line, overcurrent, etc…)

2.1.1.2 87BB CU Settings (Compensated Earthed Network Schemes)

2.1.1.2.1 Sub-Station Features

Only 4 values have to be known:

1. Maximum load current in a feeder
2. Minimum phase to phase fault current (Ph-Ph min.) in a bus
3. Maximum single phase steady state faulty current (Ph-N Max.) in a bus
4. Number of independent bars

2.1.1.2.2 Differential Busbar Protection

9 values have to be chosen:

1. ID>1 (from 5 A to 500 A (primary value)), recommendation equal to 1,2 x (Ph-N Max.)
2. Slope k1 (ID>1) (from 0% to 50%), recommendation is 10%.
3. ID>1 Alarm Timer (from 0 to 100 s) shall be greater than the longest Busbar protection time
4. Slope k2 (from 20% to 90%) but recommendation 65%.
5. ID>2 (from 50 A to 50000 A (primary value)), recommendation is:
6. Lower than 0,8 x (Ph-Ph min) and Higher than 1,2 x Iload Max and if possible equal to 6 x (ID>1).
7. Slope kCZ (from 0% to 90%) but recommendation 30%.
8. IDCZ>2 (from 50 A to 50000 A (primary value)), recommendation is:
9. Lower than 0,8 x (Ph-Ph min) and Higher than 1,2 x Iload Max and if possible equal to 6 x (ID>1).

Explanations of the Values:

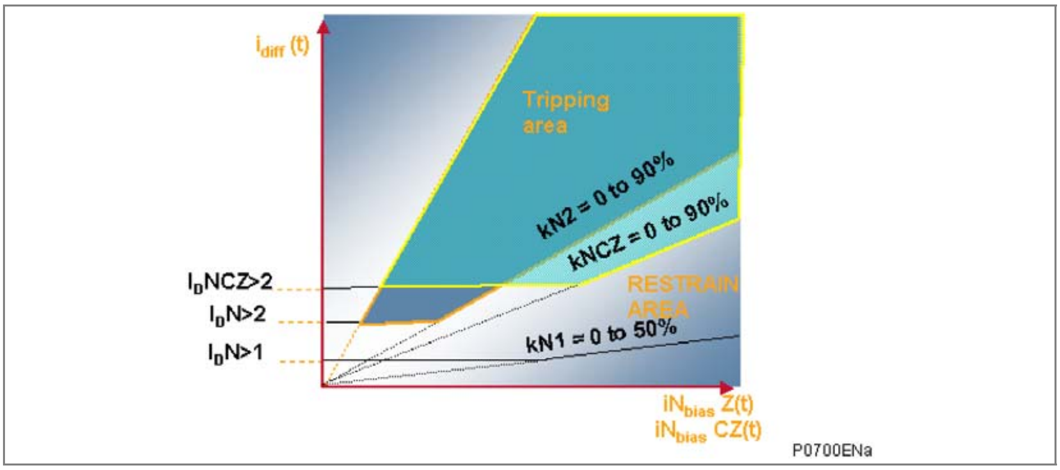
1. ID>1 shall be higher than 120% of the highest phase to neutral fault to not operate in case of phase to neutral fault.
2. Slope k1 recommendation is 10% to meet 10Pxx current transformers
3. ID>1 Alarm Timer to not operate for an external fault shall be greater than the longest protection time (such as line, overcurrent, etc…)
4. Slope k2 (ID>2) recommendation is 65%

To be always stable in the worth CT ratio conditions (between the biggest CT and the smallest CT). 60% is OK as long as the CT ratio is less than 5.

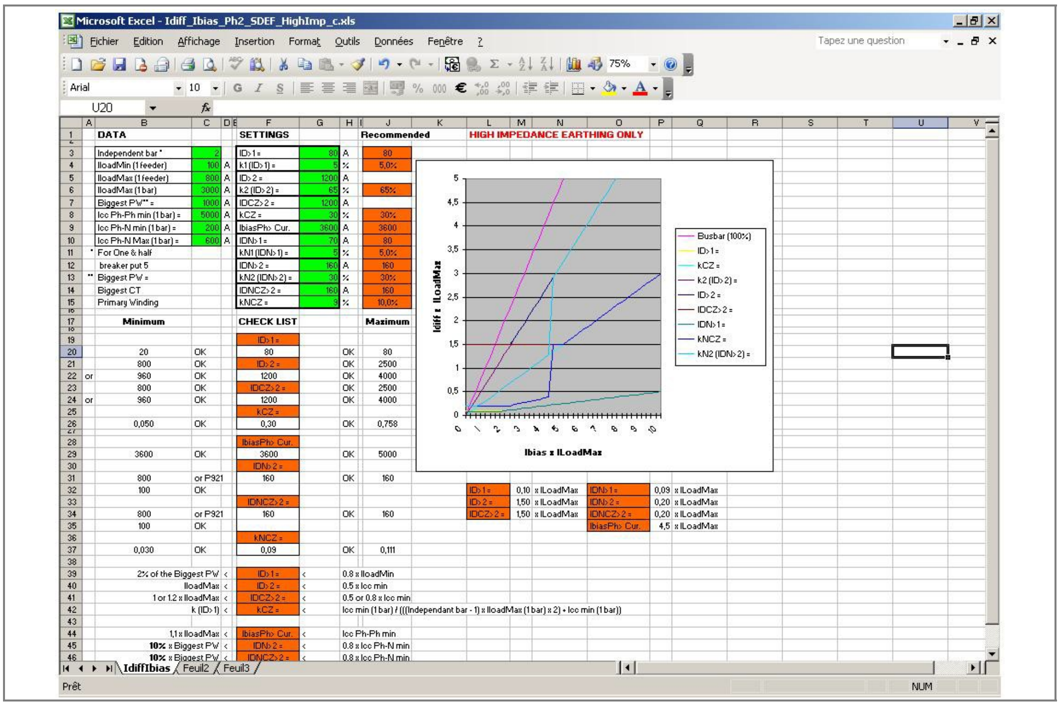
1. ID>2 shall be lower than 80% of the minimum phase to phase fault current to operate sub-cycle for the minimum fault and higher than 120% Iload Max (120% to allow 20% margin) and if possible equal to 6 x (ID>1) to be insensitive to the worth CT saturation.
2. IDCZ>2 same as ID>2
3. Slope kCZ (IDCZ>2) recommendation is 30%

The requirement is to be able to trip for a fault that is counted twice by the Check Zone (for example one and half circuit breaker substation)

2.1.1.3 87BB SDEF CU Settings (High Impedance Earthed Schemes Only)



An Excel spreadsheet tool called "Idiff_Ibias_SDEF_HighImp " is available on request to assure a reliable setting choice:



2.1.1.3.1 <u>Sub-Station Features</u>

8 values have to be known:

1. Number of independent bus
2. Minimum load current in a feeder
3. Maximum load current in a feeder
4. Maximum load current in a bus
5. Biggest CT primary winding
6. Minimum phase to phase short-circuit value in a bus
7. Minimum phase to ground short-circuit value in a bus
8. Maximum phase to ground short-circuit value in a bus

2.1.1.3.2 <u>"Idiff_Ibias_SDEF_HighImp" Setting Calculation Spreadsheet</u>

Enter in the Idiff_Ibias_SDEF spreadsheet the 8 values here above listed and you'll be able to choose the 9 values hereafter listed.

2.1.1.3.3 SDEF Busbar Protection

15 values have to be entered:

1. ID>1 (from 5 A to 500 A (primary value)) as high as possible
2. Slope k1 (ID>1) (from 0% to 50%), recommendation is 5%.
3. ID>2 (from 50 A to 50000 A (primary value))
4. Slope k2 (ID>2) (from 20% to 90%), recommendation is 65%.
5. IDCZ>2 (from 50 A to 50000 A (primary value)) as low as possible
6. Slope kCZ (IDCZ>2) (from 0% to 90%), recommendation is 30%.
7. ID>1 Alarm Timer (from 0 to 100 s) shall be greater than the longest protection time (such as line, overcurrent, etc…)
8. Current IbiasPh> Cur. (from 50 A to 50000 A (primary value)) as low as possible
9. IDN>1 (from 5 A to 500 A (primary value)), recommendation is equal to ID>1
10. Slope kN1 (IDN>1) (from 0% to 50%), recommendation is 5%.
11. IDN>2 (from 50 A to 50000 A (primary value)) as high as possible
12. Slope kN2 (IDN>2) (from 0% to 50%), recommendation is over 30%.
13. IDNCZ>2 (from 50 A to 50000 A (primary value)) as high as possible
14. Slope kNCZ (IDNCZ>2) (from 0% to 50%), recommendation is 10%.
15. IDN>1 Alarm Timer (from 0 to 100 s) recommendation = ID>1 Alarm Timer

2.1.1.4 Protection Options for the Zones

2.1.1.4.1 Options for a Circuitry Fault

When something happens on the primary equipments that creates a small differential current in a Zone such as CT short-circuited or a closed isolator “seen” open etc…, it is detected by the Central Unit.

To avoid maloperation in case of through fault during a circuitry fault, there has been 3 options:

1. Blocking Latched

   An alarm is provided and this alarm can only be reset manually, The zone is blocked and this blocking can only be reset manually.

2. Alarm Latched

   An alarm is provided and this alarm can only be reset manually,

   The zone is blocked and this blocking will be automatically reset once the differential current will disappear and after the set reset timer.

3. Self-Reset

   An alarm is provided and this alarm can only be reset manually,

   The zone is blocked and this blocking will be automatically reset once the differential current will disappear and after the set reset timer.

From software E1.0, model 50, it exists the possibility to allow the operation of one or more zone(s) in case of through fault during a circuitry fault with 2 more options:

1. Alarm and No blocking!!!

   An alarm is provided and this alarm can only be reset manually, The zone is not blocked!!!

2. Alarm Self-Reset and No blocking!!!

   An alarm is provided.

   The zone is not blocked!!!

2.1.1.4.2 Options for a PU error mode

When something happens that creates a loss of communication for a Zone such as loss of power supply on a Peripheral Unit or fibre optic cut etc…, it is detected by the Central Unit.

To avoid maloperation in case of switch on to a through fault during maintenance for example, there are 3 options:

1. Blocking Latched

    An alarm is provided and this alarm can only be reset manually, The zone is blocked and this blocking can only be reset manually.

2. Alarm Latched

    An alarm is provided and this alarm can only be reset manually,

    The zone is blocked and this blocking will be automatically reset once the communication will be reinstated and after the set reset timer.

3. Self-Reset

    An alarm is provided and the zone is blocked.

    The alarm and the blocking will be automatically reset once the communication will be reinstated and after the set reset timer.

2.1.1.5 Protection Options for the Check Zone

2.1.1.5.1 Options for a Circuitry Fault

To block the operation of the other zones in case of internal fault during a circuitry fault in the Check Zone, there are 5 options:

1. Blocking Latched

    An alarm is provided and this alarm can only be reset manually,

    The Check Zone is blocked and this blocking can only be reset manually.

2. Alarm Latched

    An alarm is provided and this alarm can only be reset manually,

    The Check Zone is blocked and this blocking will be automatically reset once the differential current will disappear and after the set reset timer.

3. Self-Reset

    An alarm is provided and this alarm can only be reset manually,

    The Check Zone is blocked and this blocking will be automatically reset once the differential current will disappear and after the set reset timer.

To allow operation of the other zones in case of internal fault during a circuitry fault in the Check Zone, there are 2 options:

1. Alarm and No blocking

    An alarm is provided and this alarm can only be reset manually, The Check Zone is not blocked

2. Alarm Self-Reset and No blocking

    An alarm is provided.

    The Check Zone is not blocked

2.1.1.5.2 Options for a PU Error Mode

To block the operation of the other zones in case of internal fault during a loss of Check Zone, there are 3 options:

1. Blocking Latched

    An alarm is provided and this alarm can only be reset manually, The zone is blocked and this blocking can only be reset manually.

2. Alarm Latched

    An alarm is provided and this alarm can only be reset manually,

    The Check Zone is blocked and this blocking will be automatically reset once the communication will be reinstated and after the set reset timer.

3. Self-Reset

    An alarm is provided and the Check Zone is blocked.

    The alarm and the blocking will be automatically reset once the communication will be reinstated and after the set reset timer.

To allow the operation of the other zones in case of internal fault during a loss of Check Zone, there are 2 more options:

1. Alarm and No blocking

   An alarm is provided and this alarm can only be reset manually, The Check Zone is not blocked

2. Alarm Self-Reset and No blocking

   An alarm is provided.

   The Check Zone is not blocked

2.1.1.6 Voltage Criteria for Busbar Protection

Where there is a need to use voltage criteria such as undervoltage, zero sequence overvoltage, direct overvoltage or inverse undervoltage, an external device such as a MiCOM P923 must be connected to the VT(s).

2.1.1.6.1 VT(s) Connected to the Bar(s) and the Central Unit,

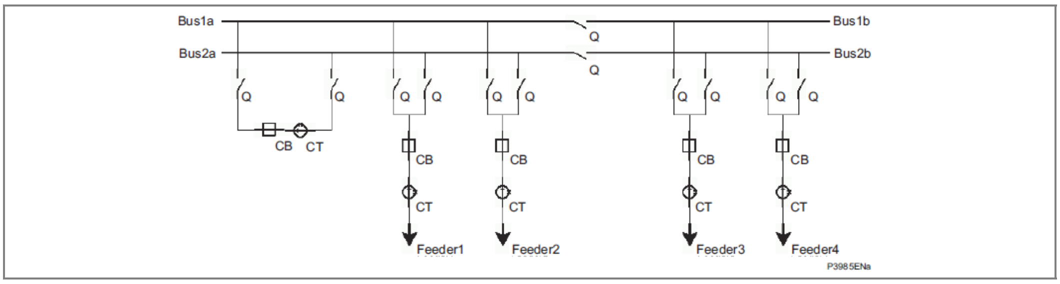
This device calculates the required voltage information and sends the release information to the Central Unit via an output contact to opto input communication link. The required logic is made in the P741 PSL.

The 87BB trip order can be blocked in the CU using 2 logic input sets, one to block the phase element, the second to block the SEF element and that per zone:

- INP Block 3Ph Z1 to Z8
- INP Block SEF Z1 to Z8

If 2 bus section are included in the same zone (isolator bus section or during double switching), an OR gate between the 2 voltage criteria from the different bus sections is used to confirm the fault detection.

Example:



- When the isolator bus sections are open:
  - The faults in zone 1a are confirmed by the VT connected to the bus section 1a
  - The faults in zone 1b are confirmed by the VT connected to the bus section 1b
- When the isolator bus sections are closed:
  - The section 1a and 1b are in the same zone, the faults are confirmed by the VT connected to the bus section 1a OR the VT connected to the bus section 1b
- When the isolator bus sections are open and during double switching, when both isolators of a feeder are closed:
  - The faults in zone 1a / 2a are confirmed by the OR between VT connected to bus 1a and 2a

2.1.1.6.2 VT(s) Connected to the Line(s) and a Peripheral Unit,

This device calculates the required voltage information and sends the release information to a Peripheral Unit via an output contact to opto input communication link. The required logic is made in the P742 or P743 PSL.

The 87BB trip order can be blocked in the PU using 2 logic inputs, one to block the phase element, the second to block the SEF element:

- INP Block 87BB/P
- INP Block 87BB/N

If some PUs are connected to Voltage device and not the other ones, some PU can trip whereas the other ones are blocked by the voltage criteria coming from the Voltage device.

2.1.1.7 Busbar Protection Tripping Times

2.1.1.7.1 Tripping Times

In the P742 and P743, there are options to use a “high speed, high break” contact board.

As the closing time of a standard relay is around 5ms and the operation of the high speed contact is less than 1ms, this option can be used to speed-up the tripping time by around 4ms.

2.1.1.7.2 Busbar Protection Tripping Time Delay in the CU

In the CU, the 87BB tripping time can be delayed by a settable time, the fault has to be detected by the phase element only.

That allows, for example the clearance of the fault by a fuse on the fault feeder before tripping the whole zone.

2.1.1.7.3 Busbar Protection Tripping Time Delay in a PU

In all the PUs, the 87BB tripping time can be delayed by a settable time.

That allows, for example in Generation, a sequential tripping of all feeders connected to the faulty zone.

2.1.1.8 Busbar Protection Tripping Order PU Logic

In all the PUs, there are options to block the 87BB protection trip order coming from the CU. The logic is based either on the I>2 high set phase overcurrent function or on the IN>2 high set neutral overcurrent function, each with the following options:

- Phase and erth fault element (87BBP&N blocking),
- Only the 87BB phase element (87BB/P blocking),
- Only the 87BB SEF element (87BB/N blocking),
- A combination of the different functions (I>2 & 87BBP&N, I>2 & 87BB/P, I>2 & 87BB/N).

The 87BB blocking function has a settable drop-off timer from 200ms to 600s by step of 100ms.

2.2 Additional Protections

2.2.1 Dead Zone Protection (DZ)

On a feeder, if the isolators or the breaker is open, a dead zone (or end zone) is said to exist between the open element and the CT. The P740 peripheral units can protect this zone with the Dead Zone protection. This is a simple time delayed overcurrent and earth fault element which is only active when a dead zone is identified in the local topology.

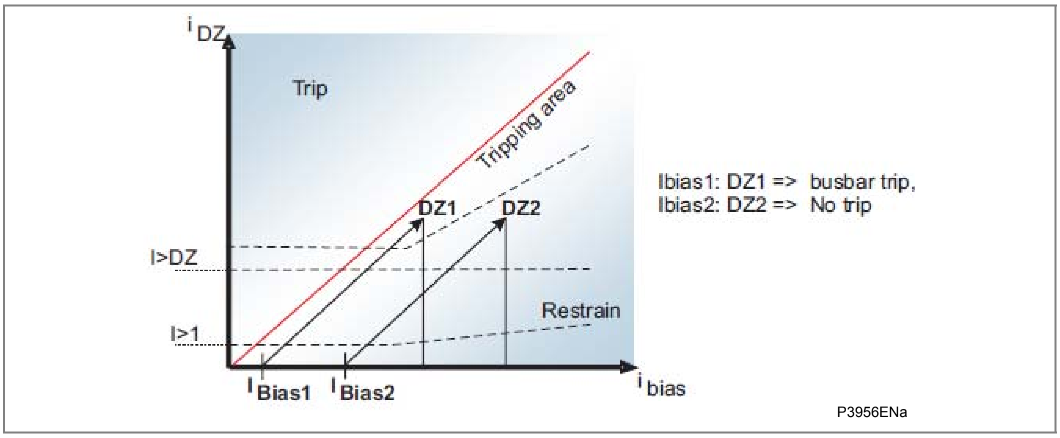
2.2.1.1 Setting Guidelines

The trip order must be mapped in the PSL to an output relay to send an intertrip to the other end of the line if the breaker is on the busbar side.

It is advised to also map it to the breaker relay trip contacts. The busbar diff will trip if the nominal bias current is less than:

$$\text{IDZ fault x } \frac{1 - \text{K2\%}}{\text{K2\%}}$$

i.e. K2% = 65%, IDZfault x 0.538.



For each PU connected to a Feeder Circuit Breaker (not on bus couplers or bus sections)

For the phase:

- I>DZ must be below 80% of the minimum Dead Zone fault level (and if possible bigger than the maximum load).
- I>DZ Time delay must be at least 50ms if the CB status positions are used (any value otherwise).

For the Neutral (if used):

- IN>DZ must be below 80% of the minimum Dead Zone earth fault.
- IN>DZ Time delay must be at least 50ms if the CB status positions are used (any value otherwise).

2.2.2 Over Current Protection (OC)

Two stages overcurrent protection is available in each Peripheral Unit. The first stage I>1 is either DT or IDMT, the second I>2 stage is DT only. Both can be individually blocked using ddb signal in the PSL:

- Block phase overcurrent stage 1 time delay (I>1 Timer Block)
- Block phase overcurrent stage 2 time delay (I>2 Timer Block)

2.2.3 Earth Fault Protection (EF)

Two stages neutral overcurrent i.e. Earth Fault protection is available in each Peripheral Unit.

The first stage IN>1 is either DT or IDMT, the second stage IN>2 is DT only. Both can be individually blocked using ddb signal in the PSL:

- Block earth fault stage 1 time delay (IN>1 Timer Block)
- Block earth fault stage 2 time delay (IN>2 Timer Block)

2.2.4 Stub Protection

When a one and half breaker scheme is protected by a MiCOM P740, the stub protection can be done using a simple time delayed overcurrent element in each PU.

The activation of this protection has to be set in the PSL and activated when all the associated isolators are open.

In the main setting group (usually 1), there is no overcurrent protection, in the next setting group (usually 2) this overcurrent is enabled (on top of the same setting as in the main setting group).

The setting group will be changed from “main” to “next” in the PSL.

2.2.4.1 Setting Guidelines

For each PU:

- I>1 must be below 80% of the minimum Stub fault level (and if possible bigger than the maximum load).

- The time delay can be any value.

2.2.5 Circuit Breaker Fail (CBF)

2.2.5.1 Setting Guidelines

Typical timer settings to use are as follows:

CB fail reset mechanism	tBF time delay	Typical delay for 2 cycle circuit breaker
CB open	CB auxiliary contacts opening/ closing time (max.) + error in tBF timer + safety margin	50 + 10 + 50 = 110 ms
Undercurrent elements	CB interrupting time + undercurrent element (max.) + safety margin operating time	50 + 15 + 20 = 85 ms

The examples above consider direct tripping of a 2-cycle circuit breaker. Note that where auxiliary tripping relays are used, an additional 10-15ms must be added to allow for trip relay operation.

The phase undercurrent settings (I<) must be set less than load current, to ensure that I< operation indicates that the circuit breaker pole is open. A typical setting for overhead line or cable circuits is 20% In, with 5% In common for generator circuit breaker CBF.

2.2.6 External Fault Detection by High-Set Overcurrent or Earth Fault Element

There are feeders where, the short-circuit power is sufficiently low in relation to that of the busbar or external faults that the CT would saturate for an external fault within 2ms. These feeders are mainly transformer feeders where the short circuit reactance poses significant limitations, or weak outfeeders. Thus, knowing the feeder's maximum possible contribution to the busbar fault current, it is easy to infer that exceeding this value will indicate an external fault. In these cases it is just the presence of a high current that will indicate an external fault.

In this case, CT saturation could occur very quickly. The P740 scheme may detect a fault, but a saturation condition is immediately detected and inhibits tripping.

An ultra high-speed detection is carried out by each of the peripheral units (P742 and P743) and can generate a blocking signal from the moment of the first sample at 0.42 ms.

In this scenario de-saturation may not occur until after the scheme has eliminated the saturation condition for the external fault.

This function can be activated independently for phase faults (I>2) and for earth faults (I_N>2).

2.2.6.1 Application Example

Example of use of high speed detectors I>2 and/or IN>2 to block the 87BB element before CT saturation

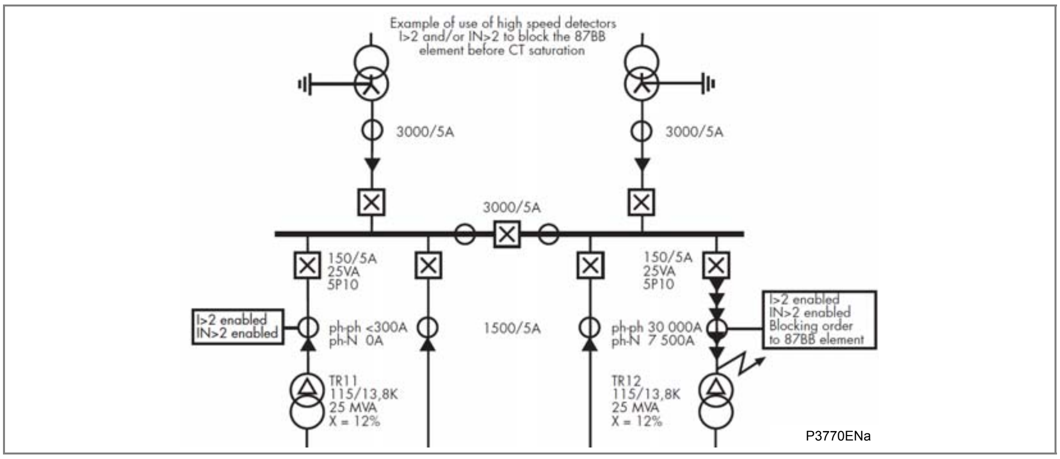


Figure 3 - Transformer feeder example

An example where this facility is required and where there is a high risk of CT saturation, is shown in the above example.

The problem lies in the transformer feeder circuits TR11 and TR12 both 25 MVA 115/13.8kV rated and with a reactance of 12%. Both feeders are equipped with 150/5 A CTs. (If rating is 25 MVA I=125A @115 kV). Maximum busbar short circuit current is 30kA phase to phase and 7.5kA phase to earth.

The contribution of each transformer feeder under internal fault conditions is as follows:

1. Maximum of 1045A i.e. full load current x 1/X%, assuming infinite 13.8kV bar (which is unrealistic).
2. 0 A for phase to earth faults.

When an external fault occurs on one of these transformer feeders, the fault MVA will be the same as that for an internal fault but the feeder will be subjected to an excessively high overcurrent condition as compared to normal load conditions at rated current.

In the example shown, under the external fault condition, the short-circuit phase to phase current is 200 times the primary rated current. Taking into account the CT and initial flux estimated at 80% of that at full load, saturation will be detected at 10 times In, where In is the CT nominal current – in this case in primary values (150 A x 10 = 1500 A).

With $I_{saturation}$ = 1500 A and $I_{short\text{-}circuit}$ = 30000 A = 20 x $I_{saturation}$.

If the assumption is taken that there is no remnant flux, saturation will be detected 1.4 ms after the appearance of the fault at which time the current will have reached 0.4 times the maximum value i.e. 1200 A.

Conclusion: An ultra fast Overcurrent detector in the P742 and P743 when used on HV/MV transformer feeders makes it possible to pre-empt CT saturation and establish an external fault condition. The setting used for this detection is I>2 for phase faults and IN>2 for earth faults.

In this example a setting of 1305 A can be used for both phase and earth faults.

2.2.7 Setting Guidelines

A spreadsheet tool called “FastExtThreshold” is available on request.

This feature has to be used when secondary maximum current is over 50A (IN = 1A) or 250A (IN=5A) or the CT does not meet the CT requirements and if the maximum feeder contribution is far less than the maximum external fault.

For each PU connected to a Circuit Breaker

2.2.7.1 CT Features:

Only 5 values have to be known and entered:

1. Phase CT Primary current given by the manufacturer.
2. Phase CT secondary current (1 or 5 A) given by the manufacturer.
3. CT secondary resistance given by the manufacturer.

4. Secondary burdens to be measured.
5. Knee point Voltage (or Rated Burden and KSCC) given by the manufacturer.

2.2.7.2 Sub-Station Features

1. Maximum feeder load
2. Feeder contribution to internal fault

2.2.7.3 Please use FastExtThreshold Setting Calculation Spreadsheet

Put for I>2 the recommended value.

The settings necessary for the implementation of InterMiCOM are contained within two columns of the relay menu structure. The first column entitled “INTERMICOM COMMS” contains all the information to configure the communication channel and also contains the channel statistics and diagnostic facilities. The second column entitled “INTERMICOM CONF” selects the format of each signal and its fallback operation mode.

The settings required for the InterMiCOM signaling are largely dependant upon whether a direct or indirect (modem/multiplexed) connection between the scheme ends is used.

Direct connections will either be short metallic or dedicated fiber optic based and hence can be set to have the highest signaling speed of 19200b/s. Due to this high signaling rate, the difference in operating speed between the direct, permissive and blocking type signals is so small that the most secure signaling (direct intertrip) can be selected without any significant loss of speed. In turn, since the direct intertrip signaling requires the full checking of the message frame structure and CRC checks, it would seem prudent that the “IM# Fallback Mode” be set to “Default” with a minimal intentional delay by setting “IM# FrameSyncTim” to 10msecs. In other words, whenever two consecutive messages have an invalid structure, the relay will immediately revert to the default value until a new valid message is received.

For indirect connections, the settings that should be applied will become more application and communication media dependent. As for the direct connections, it may be appealing to consider only the fastest baud rate but this will usually increase the cost of the necessary modem/multiplexer. In addition, devices operating at these high baud rates may suffer from “data jams” during periods of interference and in the event of communication interruptions, may require longer re-synchronization periods. Both of these factors will reduce the effective communication speed thereby leading to a recommended baud rate setting of 9.6 kbit/s. It should be noted that as the baud rate decreases, the communications become more robust with fewer interruptions, but that overall signaling times will increase.

Since it is likely that slower baud rates will be selected, the choice of signaling mode becomes significant. However, once the signaling mode has been chosen it is necessary to consider what should happen during periods of noise when message structure and content can be lost. If “**Blocking**” mode is selected, only a small amount of the total message is actually used to provide the signal, which means that in a noisy environment there is still a good likelihood of receiving a valid message. In this case, it is recommended that the “IM# Fallback Mode” is set to “Default” with a reasonably long “IM# FrameSyncTim”. A typical default selection of Default = 1 (blocking received substitute) would generally apply as the failsafe assignment for blocking schemes.

If “**Direct Intertrip**” mode is selected, the whole message structure must be valid and checked to provide the signal, which means that in a very noisy environment the chances of receiving a valid message are quite small. In this case, it is recommended that the “IM# Fallback Mode” is set to “Default” with a minimum “IM# FrameSyncTim” setting i.e. whenever a non-valid message is received, InterMiCOM will use the set default value. A typical default selection of Default = 0 (intertrip NOT received substitute) would generally apply as the failsafe assignment for intertripping schemes.

If “**Permissive**” mode is selected, the chances of receiving a valid message is between that of the “Blocking” and “Direct Intertrip” modes. In this case, it is possible that the “IM# Fallback Mode” is set to “Latched”. The table below highlights the recommended “IM# FrameSyncTim” settings for the different signaling modes and baud rates:

	Minimum Recommended			
Baud Rate	**Direct Intertrip Mode**	**Blocking Mode**	**Minimum Setting (ms)**	**Maximum Setting (ms)**
600	100	250	100	1500
1200	50	130	50	1500
2400	30	70	30	1500
4800	20	40	20	1500
9600	10	20	10	1500
19200	10	10	10	1500

Table 1 – Recommended “IM# FrameSyncTim” settings

Note *No recommended setting is given for the Permissive mode since it is anticipated that “Latched” operation will be selected. However, if “Default mode” is selected, the “IM# FrameSyncTim” setting should be set greater than the minimum settings listed above. If the “IM# FrameSyncTim” setting is set lower than the minimum setting listed above, there is a danger that the relay will monitor a correct change in message as a corrupted message.*

A setting of 25% is recommended for the communications failure alarm.

3 CURRENT TRANSFORMERS

It is important that the CT settings are entered in full as these are required to calculate additional parameters for use in the saturation detection algorithms that run within the peripheral units .

A P740 scheme can accommodate different CT ratios throughout the protected zone, the maximum difference being 40. In other words, the maximum ratio between the smallest primary CT winding and the biggest primary CT winding is 40. This mix must, therefore, be accounted for by the scheme and this is achieved by using the primary currents sent by the Peripheral Units to the central unit that undertakes scheme calculations.

In the P741, a common virtual current transformer of 1000/1 A is used to convert to secondary values.

3.1 Current Transformers Supervision

3.1.1 Low voltage” Current Transformers Supervision

The “Low voltage” CTs in the PU are supervised by the 3I0 supervision algorithm.

If the difference between 3I0 and the measured In is higher than set, after a set timer, the “PU CT Fail IN” alarm appears in the PU.

This supervision does impact the 87BB protection.

3.1.2 “High Voltage” Current Transformers Supervision

The “High voltage” CTs are supervised by the CT supervision algorithm:

If there is at least 10% of In current in the CT, the difference between the magnitude of the current measured by 2 phases should not exceed 50%.

If that happens, after a set timer, the “CT Fail” alarm appears in the PU and in the dynamic synoptic (if connected).

This supervision does not impact directly the 87BB protection, there is no blocking request sent to the CU.

4 CIRCUIT BREAKER FUNCTION

4.1 Circuit Breaker State Monitoring

An operator at a remote location requires a reliable indication of the state of the switchgear. Without an indication that each circuit breaker is either open or closed, the operator has insufficient information to decide on switching operations. The relay incorporates circuit breaker state monitoring, giving an indication of the position of the circuit breaker, or, if the state is unknown, an alarm is raised.

4.2 Trip Relays and Trip Circuit Supervision

Relays contacts 1, 2, and 3 of every PU are used for tripping signals from busbar protection, overcurrent protection and back-trip breaker failure. Even if these relay contacts 1, 2, and 3 are not used in the PSL, they are closed if there is a trip command from these functions listed above. However these relays can be affected in PSL for additional functions (breaker- failure retrip for example).

The dwell time of these three contacts is controlled by the [CB CONTROL, Prot Trip Pulse] setting and ensures that a minimum tripping duration is always applied.

The trip circuit, in most protective schemes, extends beyond the relay enclosure and passes through components such as fuses, links, relay contacts, auxiliary switches and other terminal boards. This complex arrangement, coupled with the importance of the trip circuit, has led to dedicated schemes for its supervision.

Several trip circuit supervision schemes with various features can be produced with the P740 range. Although there are no dedicated settings for TCS, in the P740, the following schemes can be produced using the programmable scheme logic (PSL). A user alarm is used in the PSL to issue an alarm message on the relay front display. If necessary, the user alarm can be re-named using the menu text editor to indicate that there is a fault with the trip circuit.

4.2.1 TCS Scheme 1

4.2.1.1 Scheme Description

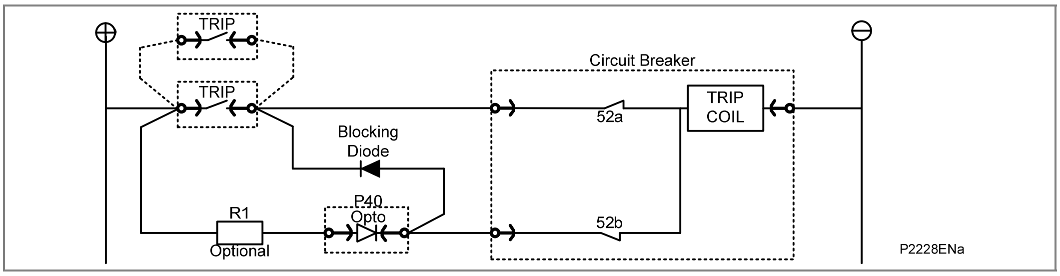


Figure 4 - TCS Scheme 1

This scheme provides supervision of the trip coil with the breaker open or closed, however, pre-closing supervision is not provided. This scheme is also incompatible with latched trip contacts, as a latched contact will short out the opto for greater than the recommended DDO timer setting of 400ms. If breaker status monitoring is required a further 1 or 2 opto inputs must be used.

Note	*A 52a CB auxiliary contact follows the CB position and a 52b contact is the opposite.*

When the breaker is closed, supervision current passes through the opto input, blocking diode and trip coil. When the breaker is open current still flows through the opto input and into the trip coil via the 52b auxiliary contact. Hence, no supervision of the trip path is provided whilst the breaker is open. Any fault in the trip path will only be detected on CB closing, after a 400ms delay.

Resistor R1 is an optional resistor that can be fitted to prevent maloperation of the circuit breaker if the opto input is inadvertently shorted, by limiting the current to <60mA. The resistor should not be fitted for auxiliary voltage ranges of 30/34 volts or less, as satisfactory operation can no longer be guaranteed. The table below shows the appropriate resistor value and voltage setting (**Opto Config.** menu) for this scheme.

This TCS scheme will function correctly even without resistor R1, since the opto input automatically limits the supervision current to less that 10mA. However, if the opto is accidentally shorted the circuit breaker may trip.

Auxiliary Voltage (Vx)	Resistor R1 (ohms)	Opto Voltage Setting with R1 Fitted
24/27	-	-
30/34	-	-
48/54	1.2k	24/27
110/250	2.5k	48/54
220/250	5.0k	110/125

Note	*When R1 is not fitted the opto voltage setting must be set equal to supply voltage of the supervision circuit.*

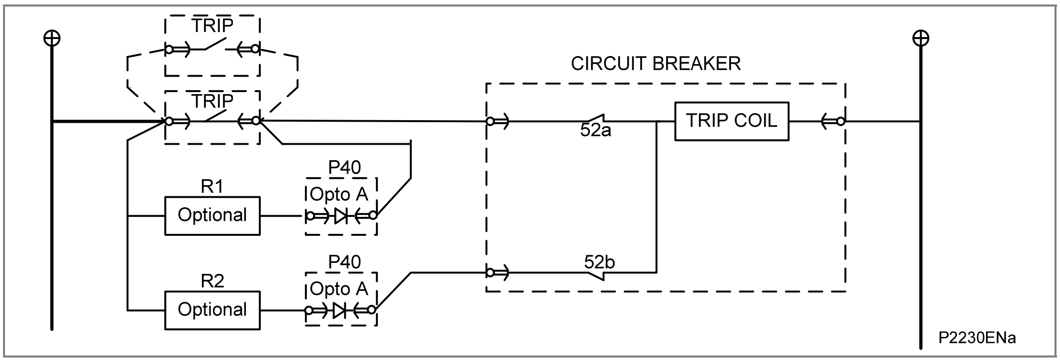
4.2.2 Scheme 1 PSL

The next figure shows the scheme logic diagram for the TCS scheme 1. Any of the available opto inputs can be used to show whether or not the trip circuit is healthy. The delay on drop off timer operates as soon as the opto is energized, but will take 400ms to drop off/reset in the event of a trip circuit failure. The 400ms delay prevents a false alarm due to voltage dips caused by faults in other circuits or during normal tripping operation when the opto input is shorted by a self-reset trip contact. When the timer is operated the NC (normally closed) output relay opens and the LED and user alarms are reset.

The 50ms delay on pick-up timer prevents false LED and user alarm indications during the relay power up time, following an auxiliary supply interruption.

4.2.3 TCS Scheme 2

4.2.3.1 Scheme Description



Much like scheme 1, this scheme provides supervision of the trip coil with the breaker open or closed and also does not provide pre-closing supervision. However, using two opto inputs allows the relay to correctly monitor the circuit breaker status since they are connected in series with the CB auxiliary contacts. This is achieved by assigning Opto A to the 52a contact and Opto B to the 52b contact. Provided the “CB Fail / Control by” is set to “52a and <” (CB Fail column) the relay will correctly monitor the status of the breaker. This scheme is also fully compatible with latched contacts as the supervision current will be maintained through the 52b contact when the trip contact is closed.

When the breaker is closed, supervision current passes through opto input A and the trip coil. When the breaker is open current flows through opto input B and the trip coil. As with scheme 1, no supervision of the trip path is provided whilst the breaker is open. Any fault in the trip path will only be detected on CB closing, after a 400ms delay.

As with scheme 1, optional resistors R1 and R2 can be added to prevent tripping of the CB if either opto is shorted. The resistor values of R1 and R2 are equal and can be set the same as R1 in scheme 1.

4.2.4 Scheme 2 PSL

The PSL for this scheme is practically the same as that of scheme 1. The main difference being that both opto inputs must be off before a trip circuit fail alarm is given.

4.2.5 TCS Scheme 3

4.2.5.1 Scheme Description

Scheme 3 is designed to provide supervision of the trip coil with the breaker open or closed, but unlike schemes 1 and 2, it also provides pre-closing supervision. Since only one opto input is used, this scheme is not compatible with latched trip contacts. If circuit breaker status monitoring is required a further 1 or 2 opto inputs must be used.

When the breaker is closed, supervision current passes through the opto input, resistor R2 and the trip coil. When the breaker is open current flows through the opto input, resistors R1 and R2 (in parallel), resistor R3 and the trip coil. Unlike schemes 1 and 2, supervision current is maintained through the trip path with the breaker in either state, thus giving pre-closing supervision.

As with schemes 1 and 2, resistors R1 and R2 are used to prevent false tripping, if the opto-input is accidentally shorted. However, unlike the other two schemes, this scheme is dependent upon the position and value of these resistors. Removing them would result in incomplete trip circuit monitoring. The table below shows the resistor values and voltage settings required for satisfactory operation.

Auxiliary Voltage (Vx)	Resistor R1 & R2 (ohms)	Resistor R3 (ohms)	Opto Voltage Setting
24/27	-	-	-
30/34	-	-	-
48/54	1.2k	0.6k	24/27
110/250	2.5k	1.2k	48/54
220/250	5.0k	2.5k	110/125

Note *Scheme 3 is not compatible with auxiliary supply voltages of 30/34 volts and below.*

4.2.6 Scheme 3 PSL

The PSL for scheme 3 is identical to that of scheme 1.

5 ISOLATION AND REDUCED FUNCTION MODE

The scheme permits maintenance on the busbar and, or busbar protection whilst maintaining some form of protection if possible. Two maintenance mode levels in the Central Unit and two maintenance mode levels in the Peripheral Units allow this to be possible. A command to one or more of the affected units will then force the scheme to a selected (reduced) operating mode. The levels are as follow.

5.1 Normal Mode

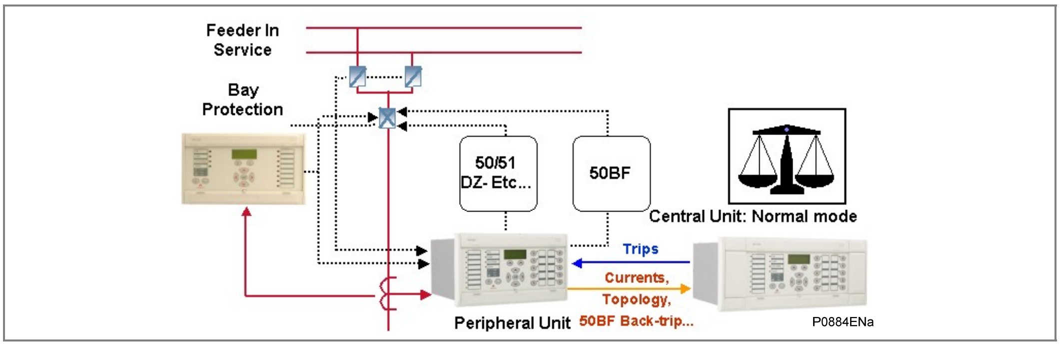


Figure 5 – Normal mode

5.2 Peripheral Units (P742 and P743)

Two levels of command can be applied selectively to each peripheral unit.

5.2.1 CB Failure Protection (50BF) Disabled

In this mode, all tripping information from external relay are not taken into account. The topology algorithm forwards the feeder positions to the central unit as normal. As the peripheral unit continues to monitor the analogue values the central unit will maintain a balanced condition with the remainder of the system still in normal operation. However, the CB failure backtrip information will not be sent to the Central Unit. The local protections (Dead Zone, Overcurrent, Earth Fault) are still enabled and the PU is able to retrip the breaker. However, the Peripheral Unit is able to react to a fault condition by creating a CB fail condition and back tripping the zone(s) if the CU sends a trip order (87BB or 50BF backtrip), to clear a genuine fault).

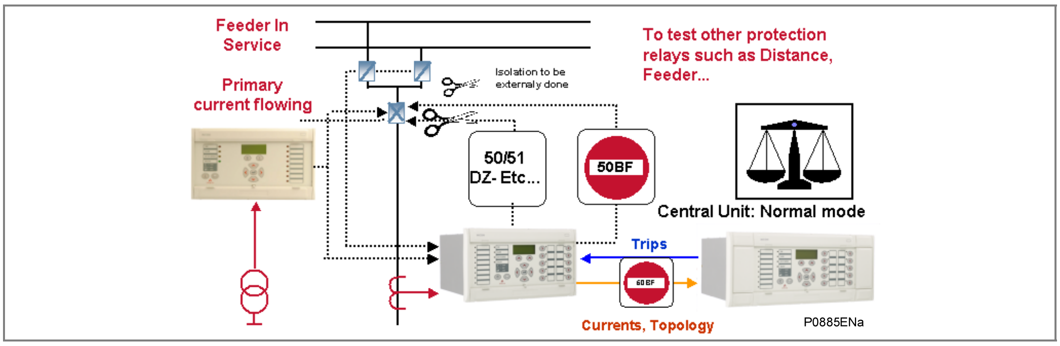


Figure 6 - PU – 50BF disabled

5.2.2 Overhaul

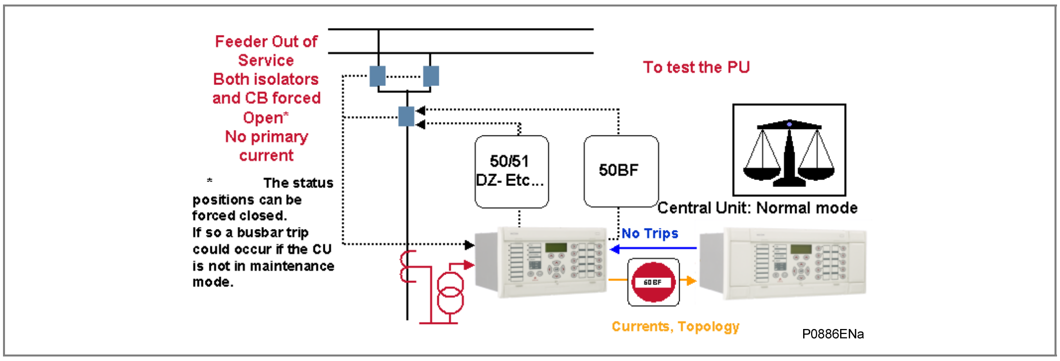


Figure 7 - PU – overhaul

In this mode the feeder is totally disconnected from the system because all the isolators are open but all information is passed back to the central unit for inclusion in zone calculations and hence the protection scheme. Hence the central unit can keep the zone elements in service as the contribution of this feeder will be zero. (The CT is still used by the Check Zone element)

Whilst in this mode the peripheral unit can be tested locally for example secondary injections tests can be carried out.(The system is stable because during the current injection there is a differential current in the CZ but not in the Zone)

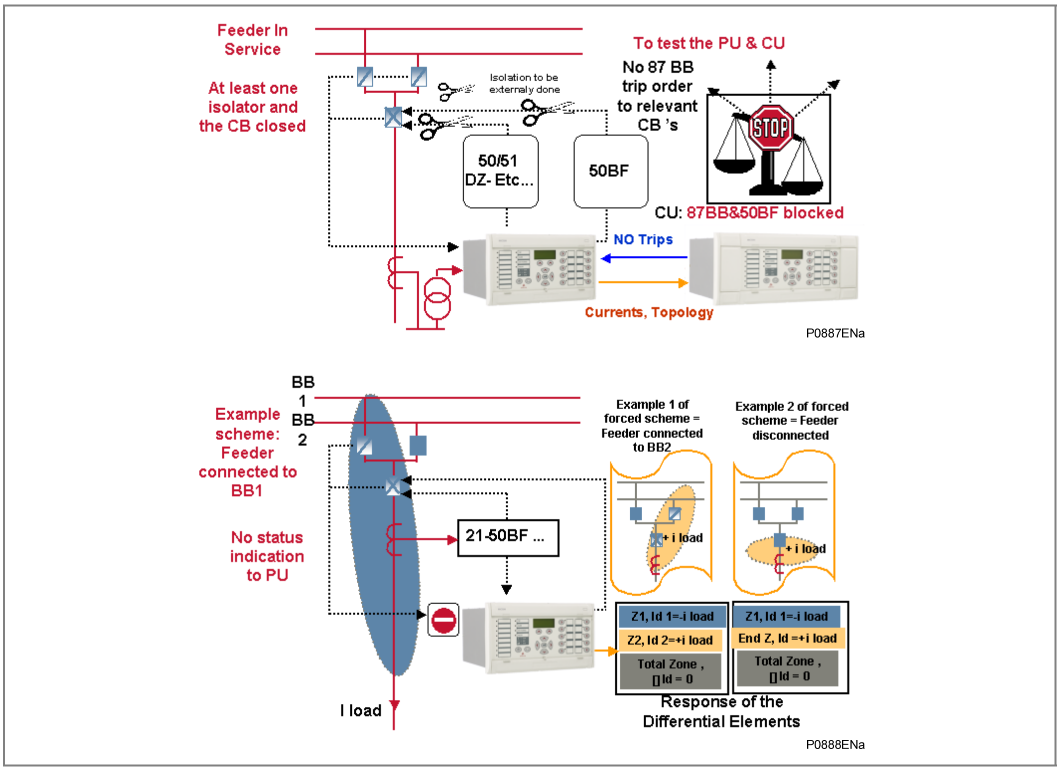


Figure 8 - Forcing Plant Position State

Under certain conditions it may be desirable to force the positions of the primary plant to enable scheme testing to be carried out, for example during commissioning.

In the first example the forced scheme theoretically connects the feeder to busbar 2, whilst in practice it is connected to busbar 1. Zone 1 will see a differential current equal to $-i_{load}$ whilst zone 2 will see a differential current equal to $+i_{load}$ this will give a check zone equal to zero.

In the second example the forced scheme theoretically totally disconnects the feeder. An end zone or extra node, is created by the topology in order to fully replicate the scheme. This lies between the feeder CT and the circuit breaker.

However, it must be remembered that in practice the feeder is still connected to busbar 1. Zone 1 will see a differential current equal to $-i_{load}$. This extra node will see a differential current equal to $+i_{load}$ and which when included in the check zone will give a result equal to zero.

If done, to avoid any maloperation, the Central Unit must be in 87BB blocking mode while performing these forcings.

5.3 Central Processing Unit (P741)

A central instruction for a reduced operation mode of the busbar protection on two levels can be applied selectively zone by zone.

5.3.1 Busbar Protection (87BB) Blocked

The busbar protection is monitored only (not protected by 87BB) (i.e. all BB protection trips are inhibited and measurements are enabled). All other protection remains in service and trips can still be issued for genuine CBF conditions.

5.3.2 87BB Blocked & 50BF Disabled

In this mode, both the busbar and circuit breaker fail conditions are monitored but all trips are inhibited.

Additionally, all protection functions are disabled when the system is awaiting configuration downloads (topology is missing).

5.4 System Operation under Failed Communications Situation

With each start or reboot of the CU, all the zones are set to 87BB and 50BF disabled mode as described above. They will remain in this mode until all peripheral units are recognised as being in service and synchronised. (PU CONF & STATUS/PU in service).

If a PU that was considered to be out of service but suddenly communicates with the CU, the CU automatically places all zones to a waiting system configuration mode while waiting for an input from the user to either assign the PU in service or disconnect additional PUs.

During operation, if the communication with a PU is broken during a very short time, the zone connected to the CT of the non-communicating PU is temporarily suspended. If the communication is restored, the differential protection is restored for the zone. On the other hand, if the break in communications persists longer than permitted as given by the PU Error Timer, the zone protection is suspended.

If the PU error self-reset mode is disabled, for the reinstatement of the zone the user must intervene:

- If communication is restored the user must reset the alarm by the same command to reset PU Error (PU CONF & STATUS -> Reset PU Error)

If the PU error self-reset mode is enabled, the reinstatement of the zone will be automatically done after the set timer delay

On the PU, an alarm will indicate loss of communication with the CU.

On the CU, an alarm will indicate that one or more PUs are no longer synchronised.

In the PU CONF & STATUS column, it is possible to view the list of synchronised PU (PU connected) after having altered the list of PU in service (PU in service).

If at the time of the initial start-up, the topology of the substation was implemented including futures (for example 15 PU including 6 extensions) it is possible to boot the system only activating the existing 9 PUs in the cell PU in service. When the futures 6 PUs are connected, it will be sufficient to connect them and indicate that they are now in service in the CU menu columns.

5.5 Waiting Configuration

Alarm “Config error” occurs when the configuration is incorrect:

- Topology download in relay does not correspond to this relay address
  (be careful to erase topology by sending a default setting file)
- For CU: check the coherency of threshold:

[IDCZ>2] > [ID>1] and [ID>2] > [ID>1] and [IDNCZ>2] > [IDN>1] and [IDN>2] > [IDN>1]

6 TOPOLOGY

The topological analysis of the state of the substation in real time is one of the primary factors of the reliability of numerical differential busbar protection. Thus in the case of a power system fault, this analysis determines the sections of the substation concerned with the fault and only takes those sections out of service. The algorithms available for topological analysis make this level of discrimination possible and it is these algorithms that are used in the scheme.

6.1 Topology Configuration Tool

For the P740 scheme the system topology is determined by replication of the circuit, i.e. the connections between the various pieces of plant on the system, via a graphical interface. This topological replication is carried out from a single line diagram of the system, which is used to recreate the system using the topology configuration software. This is carried out by Schneider Electric personnel at an authorised Schneider Electric competence centre or by the customer for extensions after having successfully completed the dedicated training.

In that case, we'll be very pleased to provide the installation code that is required to install the MiCOM P740 configuration tools (during installation, it will be required to enter this code).

It should be considered that use of the P740 Scheme Editor and Synoptic without appropriate training and careful consideration can be extremely hazardous. To remind you of this, every time the tools are launched the following "pop-up" message will be displayed:

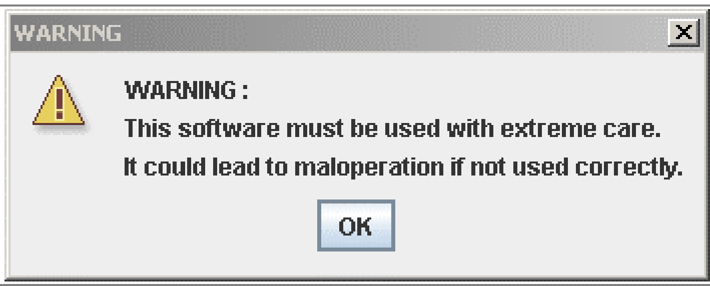


Figure 9 – Warning message

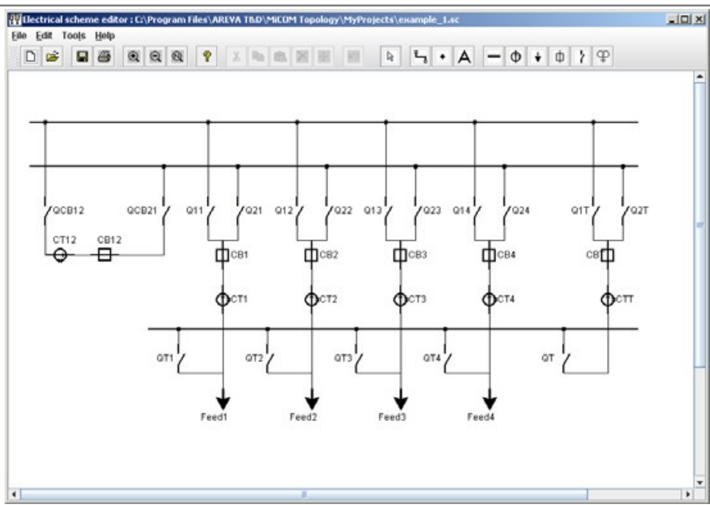


Figure 10 - P740 Scheme Editor

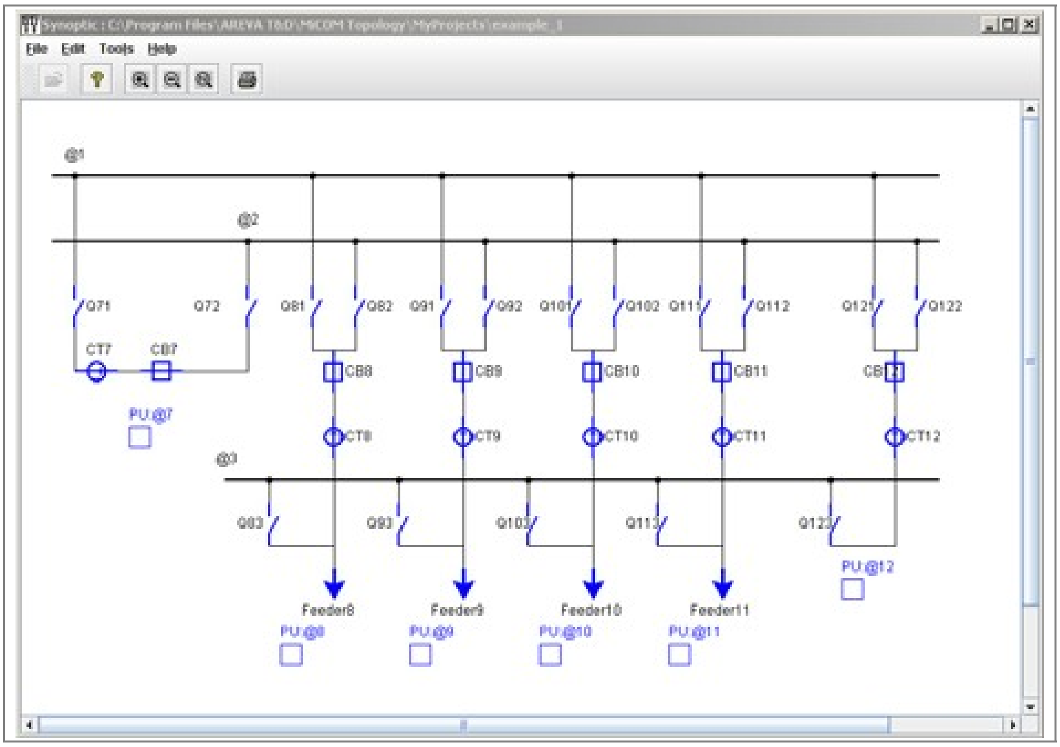


Figure 11 - P740 Synoptic

The topology configuration tool uses standard symbols for creating the system model by simply dragging and dropping in the configuration screen.

	Bar		Link
	Node		
	Current Transformer		Feeder
	Circuit Breaker (CB)		Isolator

Table 2 - Topology configurator objects

The switchgear/busbars are then labelled and assigned to relevant peripheral units.

When the topology has been fully defined it is compiled and then downloaded to each PU and the CU.

6.2 Nodal Assignment

Four files are created from the topological model. The first identifies each piece of primary plant such as circuit breakers, isolators, current transformer (CT), bus section and feeders. The second file identifies the connections between each piece of primary plant and the third calculates the topological nodal assignment thus making it possible to link to each peripheral unit with associated primary plant of the system. The fourth file will be used by the Dynamic Synoptic software to visualise in real time the substation.

Algorithms search to determine the electrical topology. These operate in real time in the P740 scheme. They start with the information obtained regarding the state of the primary plant. A state table is created and associated with each device. According to the algorithm, this state table gathers the data related to the physical states of the primary plant taken by the unit.

The results of these algorithms are then subjects of a further algorithm, developed from operational research. This algorithm identifies commonality between nodes and merges nodes where appropriate. The new node includes all common nodes.

The principal characteristics of this algorithm mean that the scheme has the following benefits:

- Adaptability to various substation configurations

- Permanent identification of current nodes
- Permanent identification of physical links for each zone
- Reference to the neighbouring circuit breakers for each point of the circuit
- These algorithms offer flexibility to the operator not met in non-numeric conventional systems.
- The global substation topology is updated every 16ms.

The above improve the overall function and discrimination of the protection scheme and therefore reliability of the network.

6.3 Topology Communication

The peripheral units relay the information regarding their associated topological model to the central unit. The central unit gathers the information from all attached peripheral units and calculates the topological scheme for these as well as carrying out the calculations for the system topology.

6.4 Topology Data

Topology results are displayed in Central Unit and locally in Peripheral Units and can be visualised in real time using the Dynamic Synoptic software.

For the Central Unit, zones included in each current node are displayed in Topology 1 column and current transformer (or Peripheral Unit) included in each current node are displayed in Topology 2 column.

2 bars with 1 CT coupling example:

Node 1 = Zone 1; Node 2 = Zone 2

If the two zones are shunt by a feeder switches:

Node 1 = Zone 1 and Zone 2; Node 2 is then removed

2 bars with 2 CT coupling example:

Node 1 = Zone 1; Node 2 = Zone 2

A Node 3 is created when the coupling breaker is closed.

For the Peripheral Unit, link between current transformer and zones are displayed in Topology column.

2 bars with 1 CT coupling example:

- The feeder PUs connected to Zone 1 are connected to Node 1
- The feeder PUs connected to Zone 2 are connected to Node 2 (if existing)
- The coupling PU is connected to the both nodes when the breaker is closed and to none when the breaker is open

2 bars with 2 CT coupling example:

- The feeder PUs connected to Zone 1 are connected to Node 1
- The feeder PUs connected to Zone 2 are connected to Node 2 (if existing)
- The coupling PUs are connected to Node 3 and the appropriate node when the breaker is closed and to none when the breaker is open

The bias and differential currents for the connected zone are displayed.

Note	*If the topology scheme is equipped with a transfer bus outside the protection zone, this link is never reported in the Topology column because the current transformer is connected to the feeder.*

6.5 Topology Processing

The following scenarios demonstrate how the dynamic topology processing works and accommodates anomalies and discrepancies in the scheme.

6.5.1 Single Bar or Double Bus with Bus Sectionaliser

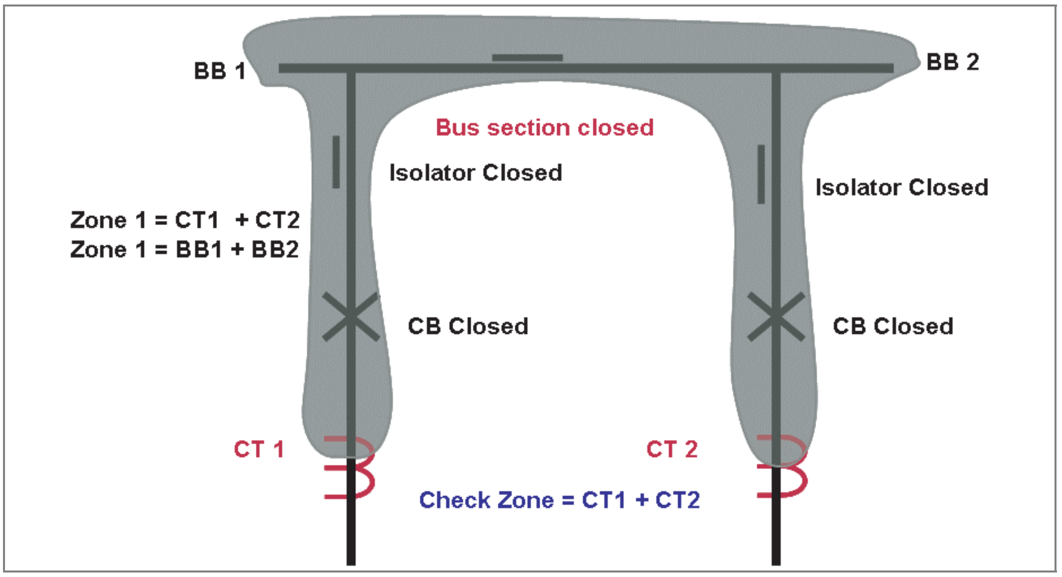


Figure 12 - Bus section closed

A zone is defined from a CT to an other CT or an open electrical element (coupler CB or isolator).

As all the breakers and isolators are closed there is only one zone including BB1 and BB2.

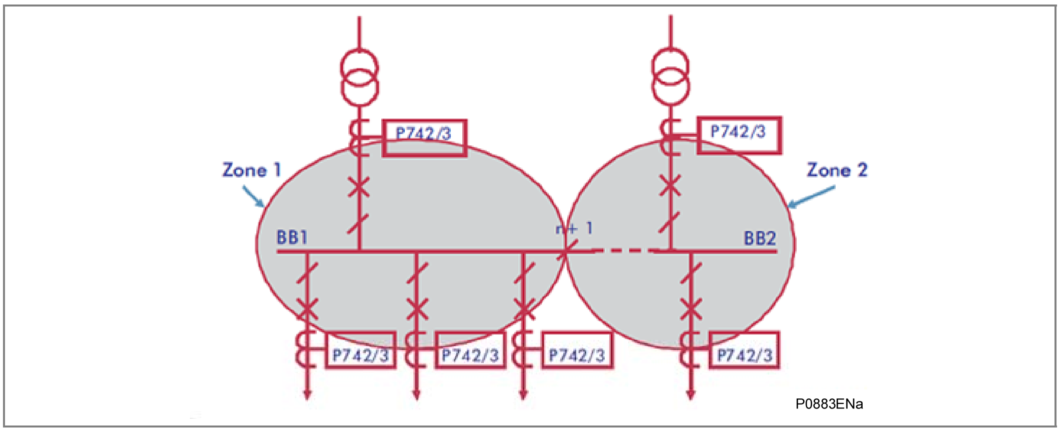


Figure 13 - Bus section open

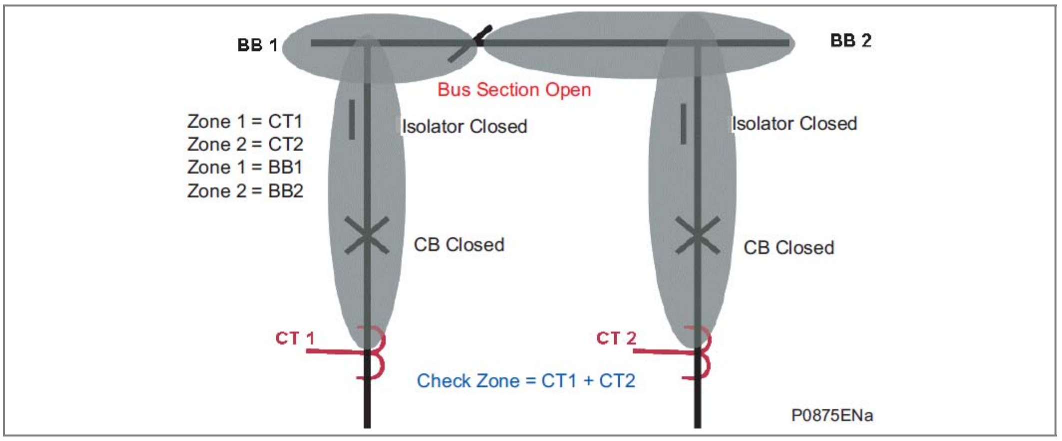


Figure 14 - Bus section open

A zone is defined from a CT to an other CT or an open electrical element (coupler CB or isolator).

When the bus section is open, a zone is created from each bar feeder CT to that open bus section.

There is one zone for BB1 and one zone for BB2

6.5.2 Double Bus with One CT Bus Coupler

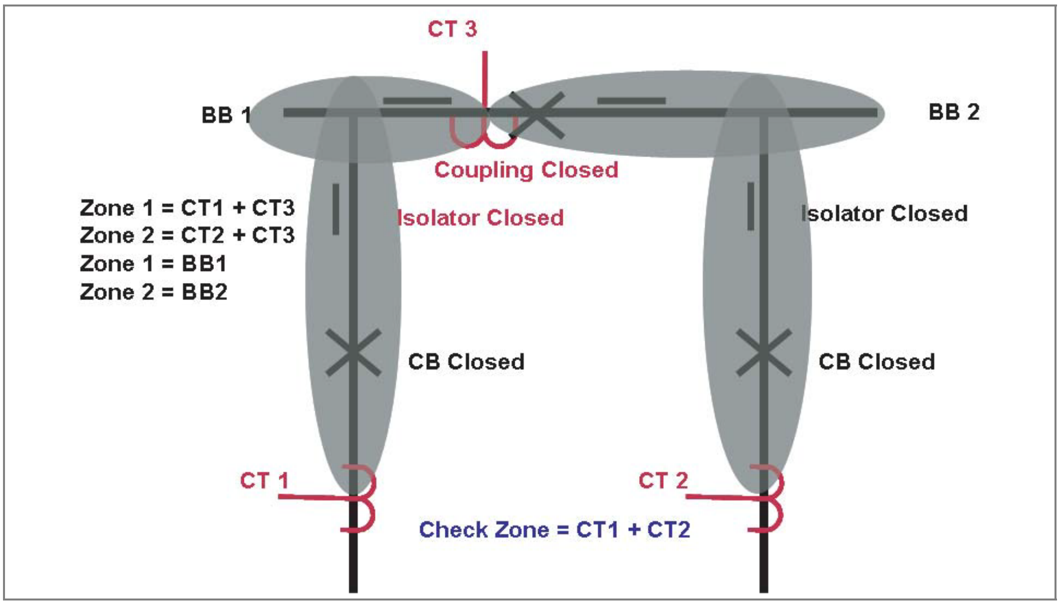


Figure 15 - Bus coupler closed

A zone is defined from a CT to an other CT or an open electrical element (coupler CB or isolator).

When one CT is used in the coupling and the coupler CB is closed, a zone is created from each bar feeder CT to that coupler CT.

There is one zone for BB1 to CT3 and one zone for BB2 to CT3.

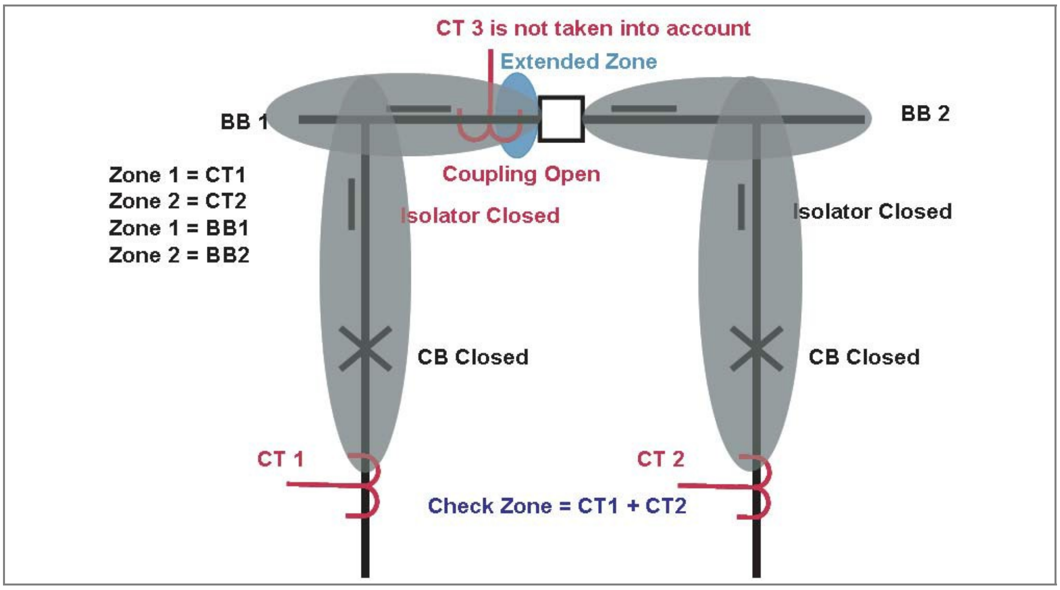


Figure 16 - Bus coupler open

A zone is defined from a CT to an other CT or an open electrical element (coupler CB or isolator).

When one CT is used in the coupling and the coupler CB is open, the coupler CT measurement is not taken into account and a zone is created from each bar feeder CT to that open coupler CB.

There is one zone for BB1 and one zone for BB2

6.5.3 Double Bus with Two CT Bus Coupler

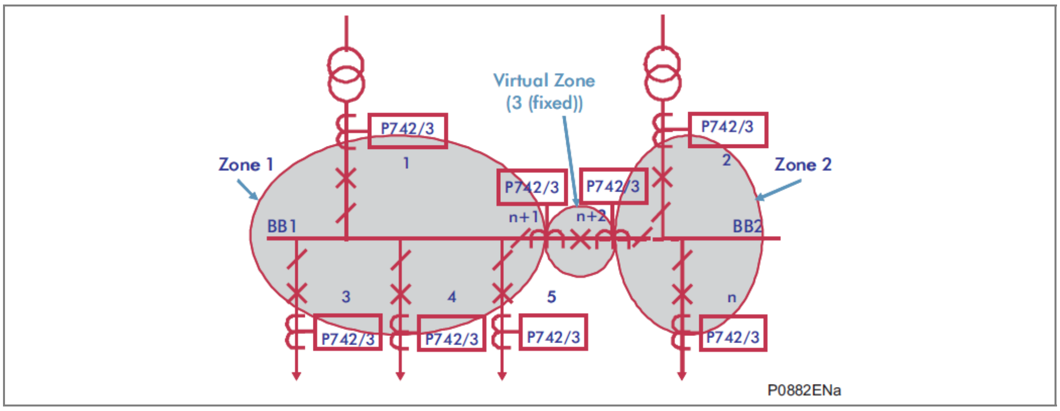


Figure 17 - Bus coupler closed

A zone is defined from a CT to an other CT or an open electrical element (coupler CB or isolator).

When 2 CTs are used in the coupling and the coupler CB is closed, a virtual zone is created from each bar feeder CT to the linked coupler CT.

The zone between the 2 coupler CTs belongs to that virtual zone which is behaving as the overlap of the 2 connected zones.

There is one zone for BB1 to CT3, one zone for BB2 to CT4 and one virtual zone from CT3 to CT4.

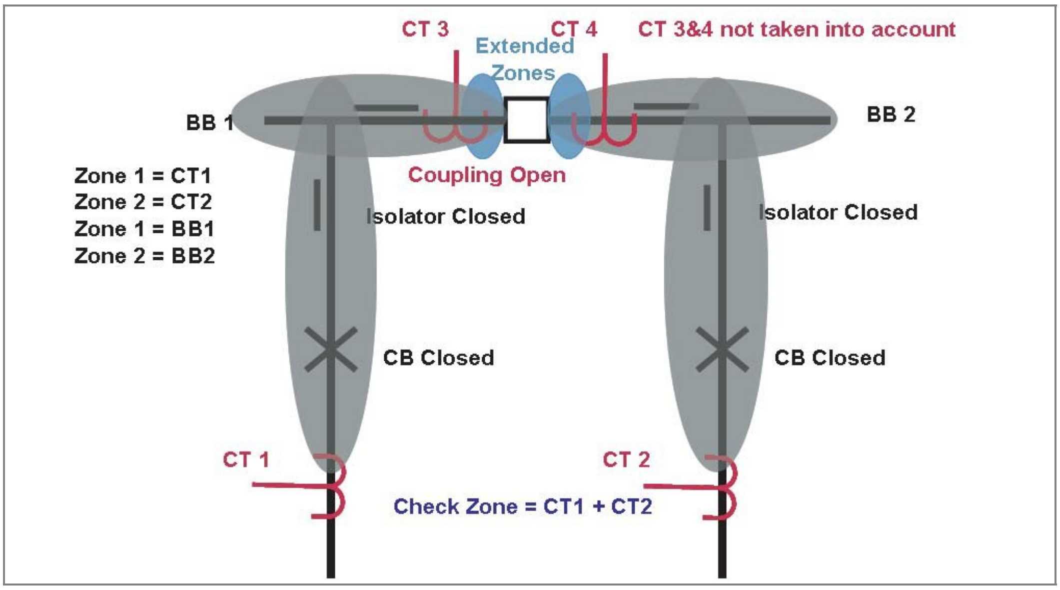


Figure 18 - Bus coupler open

A zone is defined from a CT to an other CT or an open electrical element (coupler CB or isolator).

When 2 CTs are used in the coupling and the coupler CB is open, the coupler CTs measurements are not taken into account and the zones are extended is created from each bar feeder CT to that open coupler CB.

There is one zone for BB1 and one zone for BB2.

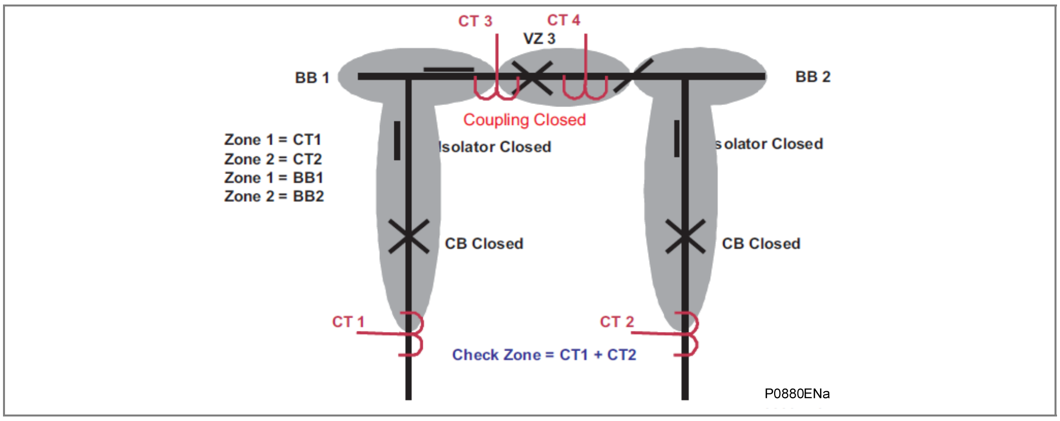


Figure 19 - Bus coupler closed and one isolator open

A zone is defined from a CT to an other CT or an open electrical element (coupler CB or isolator).

When 2 CTs are used in the coupling and the coupler CB is closed but a coupler isolator is open, the coupler CT (linked to that open isolator) measurement is not taken into account and the virtual zone is extended from the coupler CT to that open coupler isolator.

There is one zone for BB1 to the coupler CT, one zone for BB2 to the open isolator and one virtual zone from the coupler CT to the open isolator.

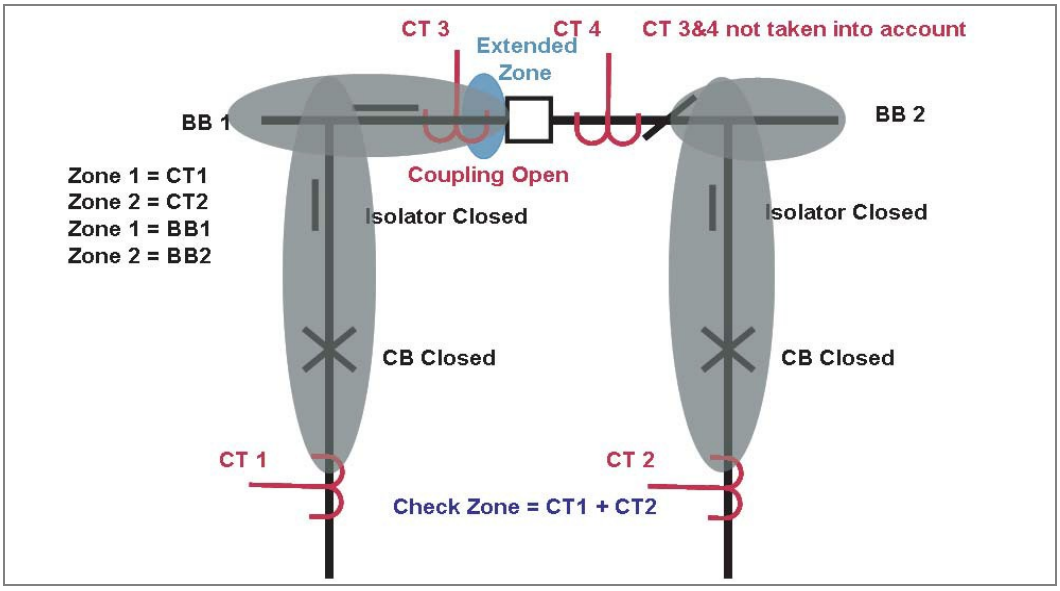


Figure 20 - Bus coupler and one isolator open

A zone is defined from a CT to an other CT or an open electrical element (coupler CB or isolator).

When 2 CTs are used in the coupling and the coupler CB is open and a coupler isolator is open, the coupler CTs measurements are not taken into account and the zone is extended from each bar feeder CT to the open CB coupler and to the open coupler isolator.

There is one zone for BB1 to the open breaker and one zone for BB2 to the open isolator.

6.5.4 CTs on One Side of Bus Coupler, CB Closes Before Status Acquisition.

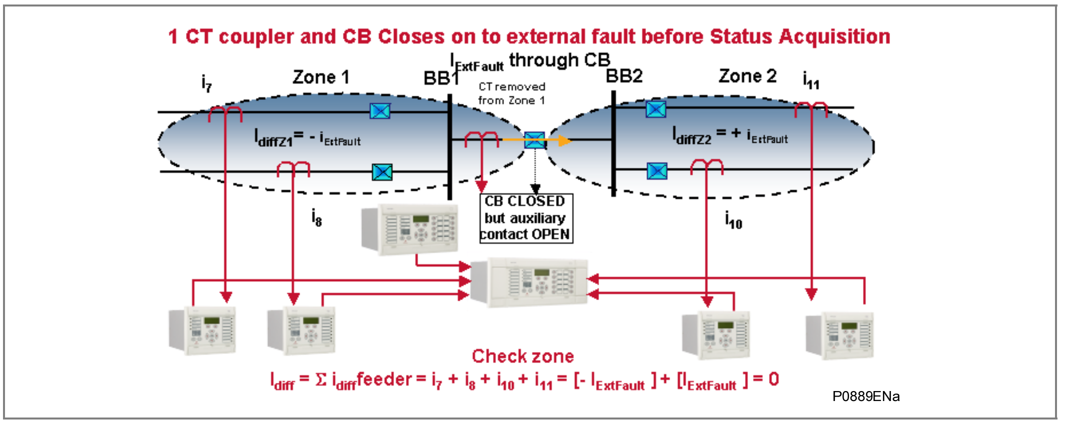


Figure 21 - CTs on one side of bus coupler, CB closes before status acquisition

As the CB has closed but the status has not yet been refreshed the topology still believes the CB to be open.

Treating this as an open bus coupler circuit breaker the topology algorithm will have extended Zone 1(with the area located between the CT and the circuit breaker). This then fully replicates the scheme up to the open bus coupler CB on both sides.

If the circuit breaker was open no load current would flow through the circuit breaker. The differential current in the two main zones would equal zero, as the current flowing into the zones would still equal the current flowing out.

However, if the circuit breaker is actually closed, the external fault current will flow through the circuit breaker. The differential current in main zone 1 and in main zone 2 will be equal in magnitude but opposite in sign. ($\pm_{fault}$)

When the check zone element is calculated, the differential currents seen in zone 1 and 2, which result from the discrepancy in the plant status, can be seen to be cancelled out.

Zone 1 $I_{diff} = I_7 + I_8 = i_{diff}Z1 = -i_{fault} > (I_D>2 + k2 \times I_{Bias})$

Zone 2 $I_{diff} = I_{10} + I_{11} = i_{diff}Z2 = +i_{fault} > (I_D>2 + k2 \times I_{Bias})$

Check zone $I_{diff} = I_7 + I_8 + I_{10} + I_{11} = (-i_{fault}) + (+i_{fault}) = \varnothing$

Again the system retains its stability for discrepancies in plant status (even for switch onto fault).

6.5.5 CTs on Both Sides of Bus Coupler, CB Closes Before Status Acquisition.

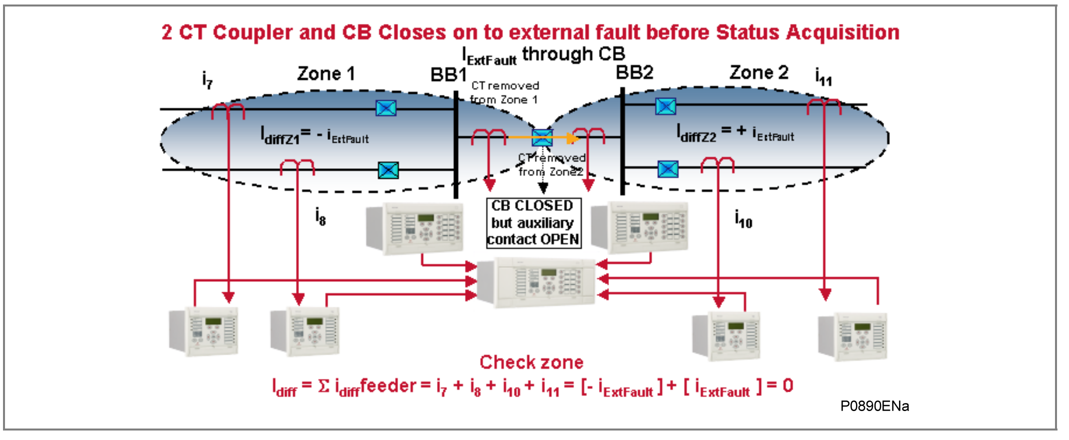


Figure 22 - CTs on both sides of bus coupler, Cb closes before status acquisition

As the CB has closed but the status has not yet been refreshed the topology still believes the CB to be open.

Treating this as an open bus coupler the topology algorithm will have extended the two zones with the areas located between the CTs and the circuit breaker. These then fully replicate the scheme up to the open bus coupler CB on both sides.

If the circuit breaker was open no load current would flow through the circuit breaker. The differential current in the two main zones would equal zero, as the current flowing into the zones would still equal the current flowing out.

However, if the circuit breaker is actually closed, the external fault current will flow through the circuit breaker. The differential current in the two main zones will be equal in magnitude but opposite in sign. ($\pm i_{fault}$)

When the check zone element is calculated, the differential currents seen in the two main zones, which result from the discrepancy in the plant status and which are taken into account for the check zone calculation, can be seen to be cancelled out.

Zone 1 $I_{diff} = I_7 + I_8 = i_{diff}Z1 = -i_{fault} > (I_D>2 + k2 \times I_{Bias})$

Zone 2 $I_{diff} = I_{10} + I_{11} = i_{diff}Z2 = +i_{fault} > (I_D>2 + k2 \times I_{Bias})$

Check zone $I_{diff} = I_7 + I_8 + I_{10} + I_{11} = (-i_{fault}) + (+i_{fault}) = \varnothing$

Hence, the system retains its stability even when there are discrepancies in plant status.

6.5.6 CTs on One Side of Bus Coupler, CB Closed and Fault Evolves Between CT and CB (Even for Switch Onto Fault)

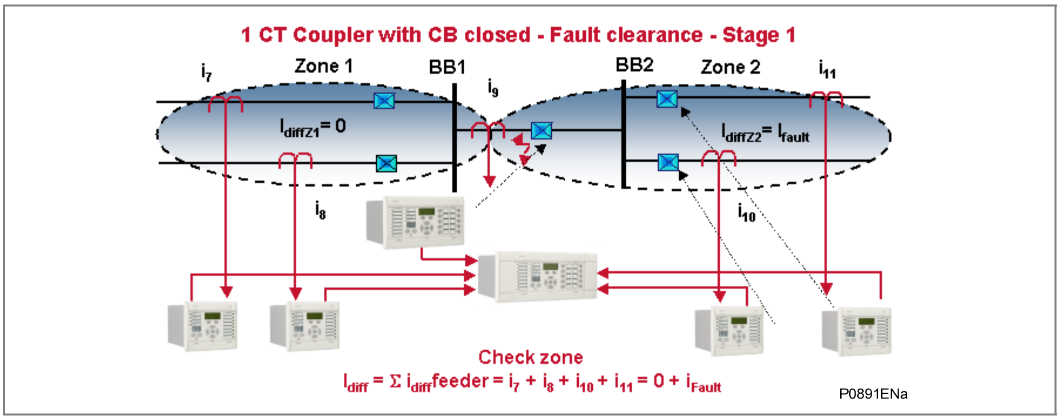


Figure 23 - CTs on one side of bus coupler, CB closed and fault occurs between the CB & the CT

Treating this as a closed bus section circuit breaker the topology algorithm will have extended the limits of the main zones to the bus coupler CT. This then fully replicates the scheme.

Under normal operating conditions when the circuit breaker is closed load current would flow through the circuit breaker and differential current in the two main zones would equal zero, as the current flowing into the zones would still equal the current flowing out.

However, if a fault occurs between the CT and the circuit breaker, the current will flow from zone 1 into zone 2 which feeds the fault. The differential current in main zone 1 will still equal zero, as the current flowing into the zone 1 will still equal the current flowing out, but the differential current measured in zone 2 will be equal to that of the fault current.

In this case zone 2 would operate as will the check zone element.

Zone 1 $I_{diff} = I_7 + I_8 + I_9 = i_{diff}Z1 = 0$

Zone 2 $I_{diff} = I_9 + I_{10} + I_{11} = i_{diff}Z2 = i_{fault} > (I_D>2 + k2 \times I_{Bias})$

Check zone $I_{diff} = I_7 + I_8 + I_{10} + I_{11} = i_{diff}Z2 = i_{fault} > (I_DCZ>2 + kCZ \times I_{Bias})$

However, when zone 2 trips the fault will still be present. The topology then analyses the remainder of the system as follows.

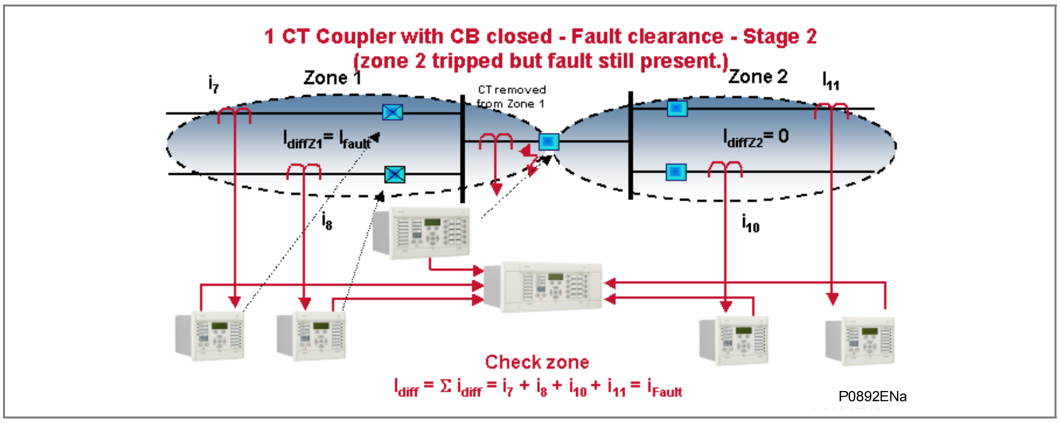


Figure 24 - Zone 2 tripped, fault still present

Treating this as an open bus coupler circuit breaker as before the topology algorithm will have extended zone 1 with the area located between the CT and the circuit breaker. This then fully replicates the scheme up to the open bus coupler CB. Remember that in this example zone 2's limit extended up to the circuit breaker but this zone has been tripped already.

The circuit breaker is now open and the fault current would flow to feed the fault. The differential current in the main zone 2 would equal zero, as the current is flowing into zone 1 whereas the current measured will be equal to the fault current i_{fault}.

Zone 2 $I_{diff} = I_{10} + I_{11} = i_{diff}Z2 = 0$

Zone 1 $I_{diff} = I_7 + I_8 = i_{diff}Z1 = i_{fault} > (I_D{>}2 + k2 \times I_{Bias})$

Check zone $I_{diff} = I_7 + I_8 + I_{10} + I_{11} = i_{diff}Z1 = i_{fault} > (I_DCZ{>}2 + kCZ \times I_{Bias})$

Hence, the system reacts to the continuing presence of the fault and trips the zone 1 as the check zone $I_{diff} > (I_DCZ{>}2 + kCZ \times I_{Bias})$ and the zone $I_{diff} > (I_D{>}2 + k2 \times I_{Bias})$.

In this example it can be seen that the opposite zone is tripped first but the dynamic topology reacts to the changed scheme and subsequently trips the adjacent main zone.

6.5.7 CTs on Both Sides of Coupler, CB Closed and Fault Evolves Between CT and CB.

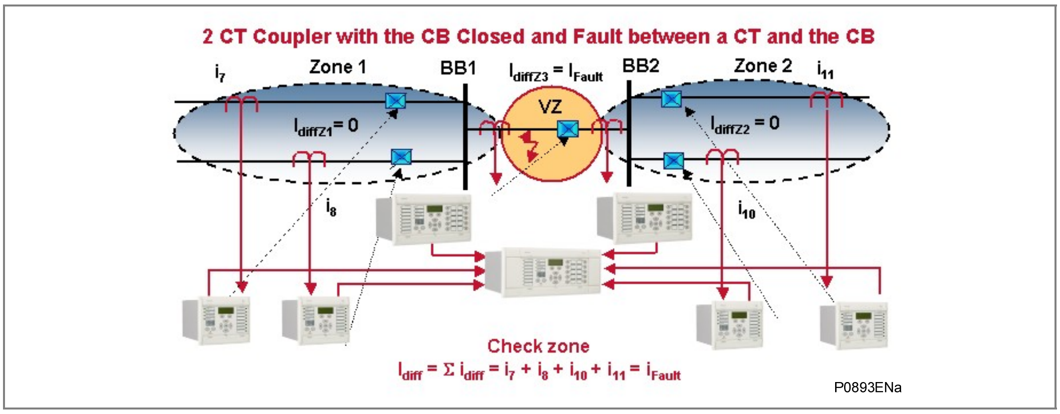


Figure 25 - CTs on both sides of bus coupler, CB closed fault occurs between a CT & the CB

Treating this as a closed bus section circuit breaker the topology algorithm will have created a virtual zone that surrounds the circuit breaker with the bus coupler CTs as its limits called zone 3 in the event report and measurements. This then fully replicates the scheme.

Under normal operating conditions when the circuit breaker is closed load current would flow through the circuit breaker and hence the virtual zone. The differential current in the two main zones would equal zero, as the current flowing into the zones would still equal the current flowing out. This is also the case for the virtual zone around the bus coupler.

However, if a fault was to occur in the virtual zone, current would flow into the virtual zone and feed the fault. The differential current in the two main zones will still equal zero, as the current flowing into the zone(s) will still equal the current flowing out, but the differential current measured in the virtual zone will be equal to that of the fault current.

The main zones would not operate but the virtual zone or zone 3, which surrounds the bus coupler and has limits at the bus coupler CTs would operate. When the check zone element is calculated, the differential current seen in the virtual zone or zone 3, which results from the presence of the fault in the coupler, will confirm the presence of a fault and initiate either (1) a simultaneous trip of both main zones or (2) a step by step trip of, first the coupler then, once the topology has been refreshed, the faulty zone 1 (longer fault clearance: around 60 ms + 2 x opening time of the breakers).

(1) Hence, the system reacts to a fault occurring between the CT and the CB simultaneously tripping both adjacent zones.

Zone 1 $I_{diff} = I_7 + I_8 + I_9 = i_{diff}Z1 = 0$

Zone 2 $I_{diff} = I_{10} + I_{11} + I_{12} = i_{diff}Z2 = 0$

Zone 3 $I_{diff} = I_9 + I_{12} = i_{diff}Z2 = i_{fault} > (I_D{>}2 + k2 \times I_{Bias})$

Check zone $I_{diff} = I_7 + I_8 + I_{10} + I_{11} = i_{diff}Z3 = i_{fault}$

(2) The bus coupler can operate first for a fault in the virtual zone or zone 3 and then the faulty zone 1, zone 2 will remain in service. For such operation a special topology scheme should be used.

First:

Zone 1 $I_{diff} = I_7 + I_8 + I_9 = i_{diff}Z1 = 0$

Zone 2 $I_{diff} = I_{10} + I_{11} + I_{12} = i_{diff}Z2 = 0$

Zone 3 $I_{diff} = I_9 + I_{12} = i_{diff}Z2 = i_{fault} > (I_D{>}2 + k2 \times I_{Bias})$

Check zone $I_{diff} = I_7 + I_8 + I_{10} + I_{11} = i_{diff}Z3 = i_{fault} > (I_DCZ{>}2 + kCZ \times I_{Bias})$

After the coupling breaker has been tripped:

Zone 1 $I_{diff} = I_7 + I_8 = i_{diff}Z1 = i_{fault} > (I_D{>}2 + k2 \times I_{Bias})$

Zone 2 $I_{diff} = I_{10} + I_{11} = i_{diff}Z2 = 0$

Check zone $I_{diff} = I_7 + I_8 + I_{10} + I_{11} = i_{diff}Z1 = i_{fault} > (I_DCZ{>}2 + kCZ \times I_{Bias})$

Note 1	*As the topology algorithm scheme updates every 16ms. The longest time to updates the topology after Isolator auxiliary contacts change state is 33ms.*
Note 2:	*For the Differential Busbar protection, the status positions of the Breakers are not taken into account.*

7 UNDERTAKING A NUMERICAL DIFFERENTIAL BUSBAR PROTECTION PROJECT

This Engineering must be done by a P740 Competency Centre.
The substation construction will influence the protection scheme installed. It is advisable that a scheme evaluation is conducted as soon as possible, preferably at the same time as the definition of the equipment specification.

7.1 Check List

The following steps must be performed: Engineering phase:

1. Check the CT compliance (using VkTest.xls & Rct_Approx.xls)
2. Design the Junction schemes (using AUTOCAD (or equivalent))
3. Create the material definition and the wiring plans (distributed or centralised version)
4. Create the wiring diagram (distributed version)
5. Label the relay Inputs & Outputs (using MiCOM S1 Setting (per Group))
6. Calculate the Central Unit settings (using Idiff_Ibias_xxx.xls & P740 setting guide)
7. Calculate the different Peripheral Units settings (transformer, coupler, line, etc…)
8. Draw the topology line diagram (using Scheme Editor and Topology Tips)
9. Create the topology files (using Synoptic Editor and Topology Tips)
10. Merge the parameter files with the topology files (using P740 File Merger)
11. Merge the testing parameter files with the topology files (using P740 File Merger)
12. Create the CU PSL file (using MiCOM S1 & Tips)
13. Create the PU PSL files (using MiCOM S1 & Tips)
14. Print out the front panel Labels (CU & PUs) (using P74x_Stickers.xls)
15. Write up the test specification
16. Write up the insulation test specification (centralised version)

After Reception of the relays & KITZ(s): Testing phase:

1. Stick the labels on the front of the CU & PUs
2. Mount the relays in the (or a) cubicle
3. Wire them to the Substation Simulation Box(es)
4. Put the right addresses into the relays (CU = 06, PU from 07)
5. Put the right addresses into the KITZs (using comms.xls)
6. Download the complete setting files into the relays (using MiCOM S1)
7. Download the setting files into the KITZs (using comms.xls)
8. Download the PSL files into the relays (using MiCOM S1)
9. Test the PSLs & Analogue inputs (using a Inputs / Outputs and current generator)
10. Put the default Substation Testing Box relay settings (using MiCOM S1)
11. Test the Topology according to the test specification
12. Test the communication links (KITZ) (using Master (courier))
13. Perform the FAT with the customer
14. Put the project relay settings (using MiCOM S1)

Commissioning phase:

1. Check the inputs / outputs
2. Check CT connections (per phase (A, then B, then C))
3. Add Rb & Rbph/Rbn CT parameters in the Pus (using RBurden_b.xls)
4. Check the measurements and the tripping slopes (see documentation)

7.2 General Substation Information

Only a few system parameters are required and it is vital that these are included.

- Number of feeders, bus couplers, bus sections
- Positions of bus sections
- Positions of switchgear plant i.e. circuit breakers, isolators
- Positions of CTs (including the polarity (P1/P2 – S1/S2))
- Planned future extensions with circuit breaker, isolator and Current Transformer (CT)
- Type of electrical network earthing (Solid, High impedance or compensated)

7.3 Short Circuit Levels

Maximum external fault current (phase-to-phase and phase-to-ground faults)

- Solid:
  - Minimum two phase busbar fault current
  - Minimum load current on the smallest feeder
  - Maximum load current on the biggest feeder or coupler
  - Optional: Maximum three phase busbar fault current
- Compensated:
  - Minimum two phase busbar fault current
  - Maximum single-phase steady state busbar fault current
  - Maximum load current on the biggest feeder
  - Optional: Maximum three phase busbar fault current
- With impedance:
  - Minimum two phase busbar fault current
  - Minimum single phase to earth busbar fault current
  - Minimum load current on the smallest feeder
  - Maximum load current on the biggest feeder
  - Optional: Maximum three phase busbar fault current
  - Maximum substation short-circuit withstand time

7.4 Switchgear

- Nominal CT ratio
- Highest nominal primary current (CT In Max)
- Lowest nominal primary current (CT In Min)
- CT Knee point voltage (Vk) for each CT
- CT secondary resistance (RCT) for each CT
- Length and cross section of the conductors between each CT and the peripheral unit. (In the absence of precise information, an estimate taken from the lowest CT ratio will suffice).
- Auxiliary contacts of disconnecting switches and tripping orders for circuit breaker failure (irrespective of the how the CB fail scheme is to be implemented i.e. internally or externally initiated).

7.5 Cubicle Specifications

- Cubicle specification is contract specific.
- However, Schneider Electric propose the following:
- Single cubicle: 800x800x2000
- Double cubicle: 1600x800x2000
- Model: Schroff type Proline

- Colour: RAL 7032

1 P741 and P742:

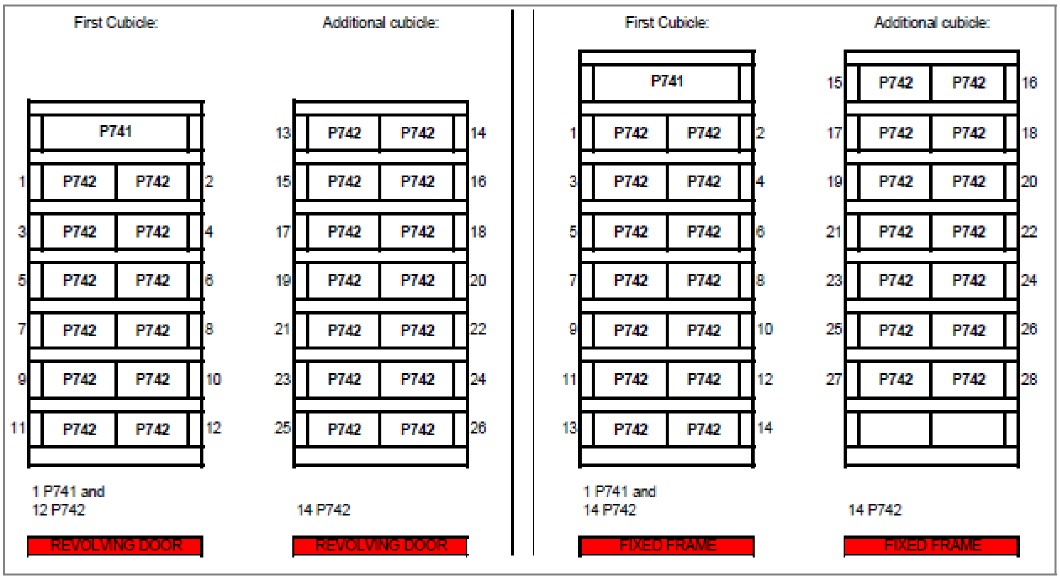


Figure 26 - 1 P741 and P742 with P99X test block

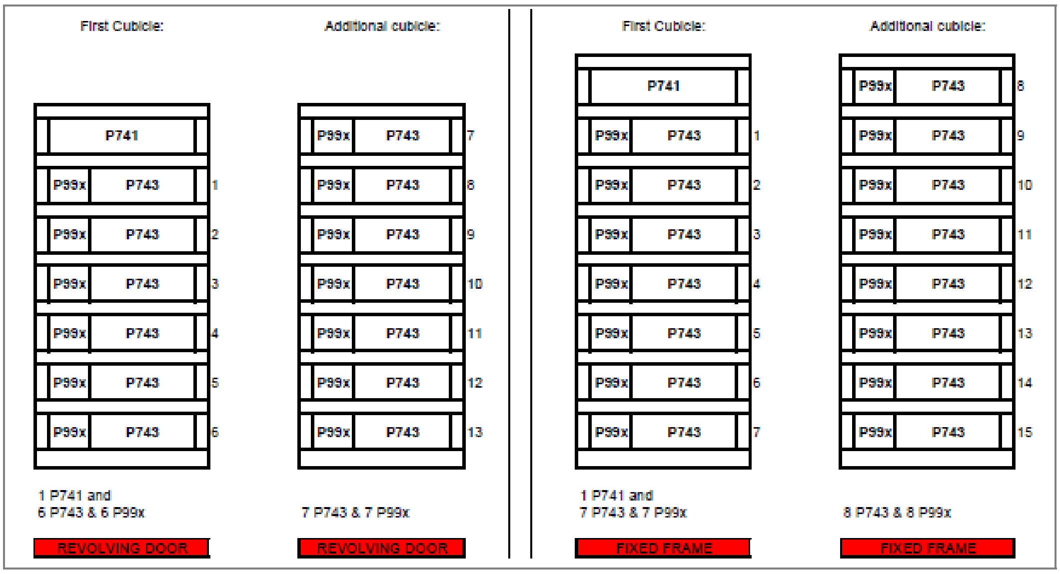


Figure 27 - 1 P741 and P743 with (or without) P99X test block

7.6 Substation Architecture

Due to the flexibility of the differential busbar protection there is an infinite number of busbar configurations that can be accommodated via the topology. Each may have very different architecture and, therefore, vary in complexity.

You will find in the following pages topology examples of layouts most frequently encountered. For each example, the number of central units and peripheral units necessary to protect the busbars is specified.

Generally, the elements of the protection architecture will be identified in a similar manner to the principal parts of the substation e.g. by the letters A and B.

Note	*A cubicle needs to be considered for a centralised solution whereas if the peripheral units are distributed and the scheme is distributed there is no requirement for a dedicated cubicle.*

In both cases, and before any delivery, the topology will be thoroughly tested on appropriate test platforms the scheme is engineered by a Schneider Electric competency centre).

8 STANDARD CONFIGURATIONS

The following information relates only to the more common standard schemes. For further information on the accommodation of other busbar configurations consult your Schneider Electric representative.

The main rule to calculate the minimum number of Peripheral Unit to use is:

1 Peripheral Unit per CT.

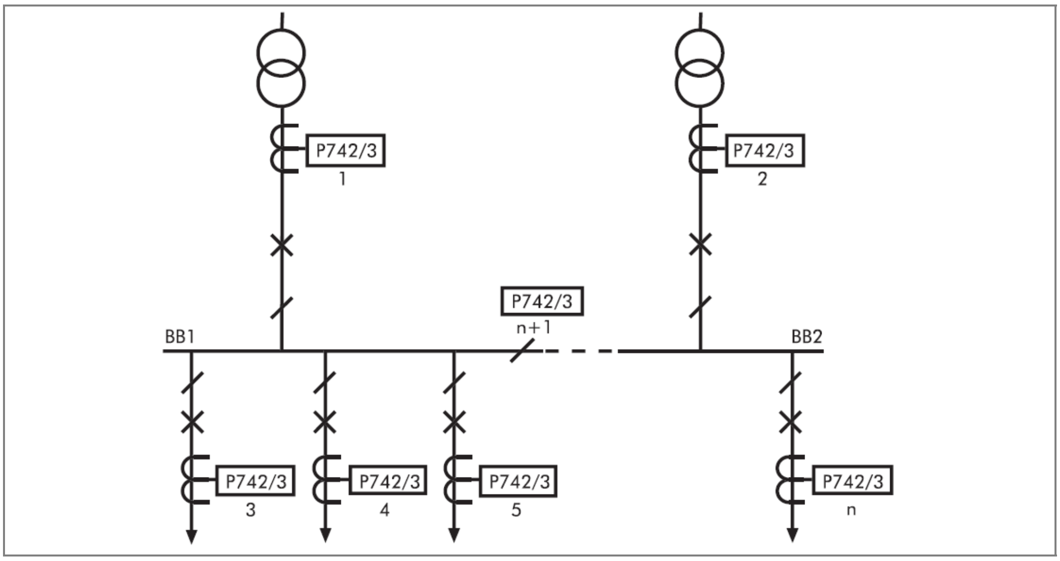


Figure 28 - Single busbar application with bus section isolator

The above example shows a single busbar with a bus section isolator. It is split into two zones. There are n feeders connected to the busbar. This configuration requires 1 central unit and n peripheral units (the additional peripheral unit being for the bus section isolator is optional). The type of peripheral unit used for each bay will depend on the i/o requirements of the bay in question.

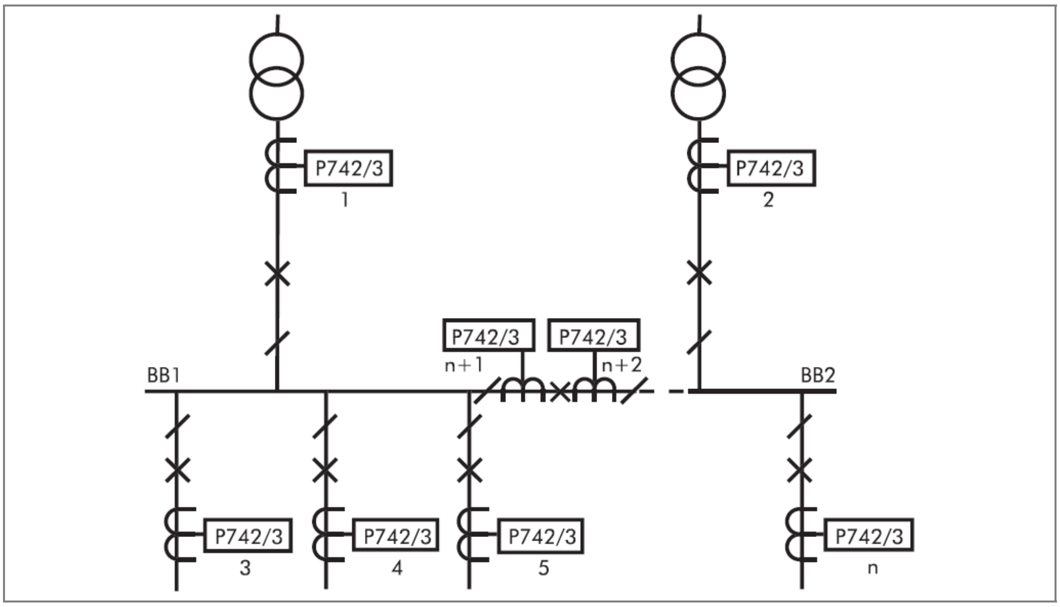


Figure 29 - Single busbar application with bus section circuit breaker

The above example shows a single busbar with a bus section circuit breaker. It is split into two zones. There are n feeders connected to the busbar. The bus section circuit breaker has CTs on either side.

This configuration requires 1 central unit and n + 2 peripheral units (the additional peripheral units being for the bus section CTs). The type of peripheral unit used for each bay will depend on the i/o requirements of the bay in question.

It is recommended that the CTs for feeder protection are sited such as to overlap with the CTs defining the limits of each busbar protection zone.

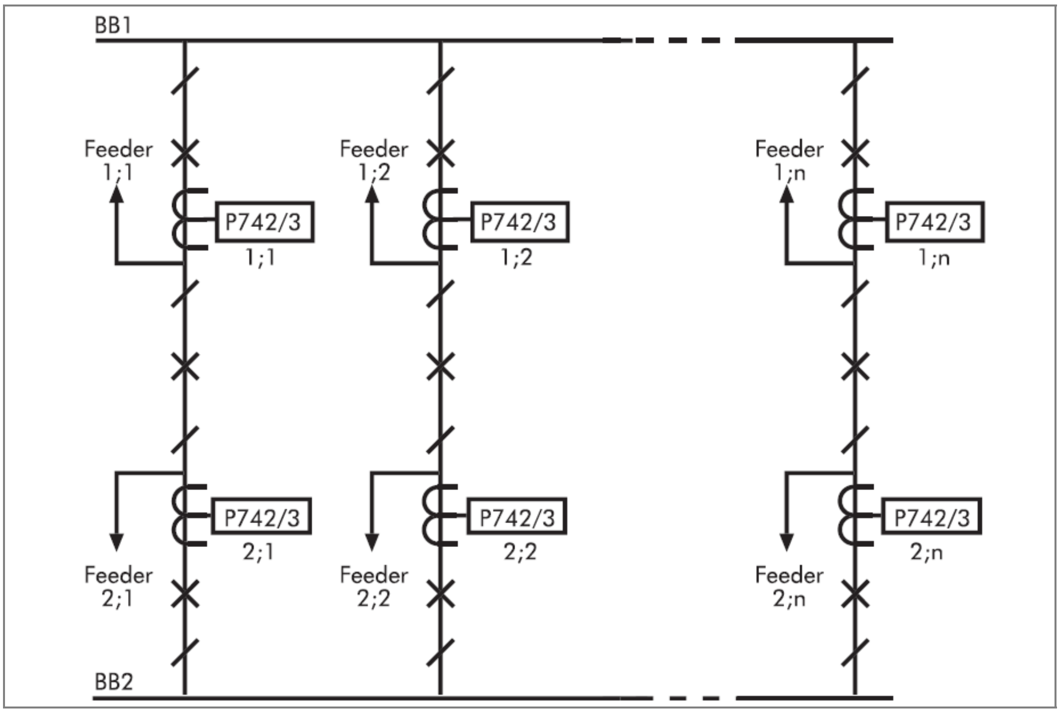


Figure 30 - Breaker and a half scheme

The above example shows a breaker and a half scheme. The recommended solution is to have two separate schemes. There are n feeders connected to each busbar. Each scheme will require 1 central unit and n peripheral units. An other solution is to use only one central unit and 2 x n peripheral units. The type of peripheral unit used for each bay will depend on the i/o requirements of the bay in question.

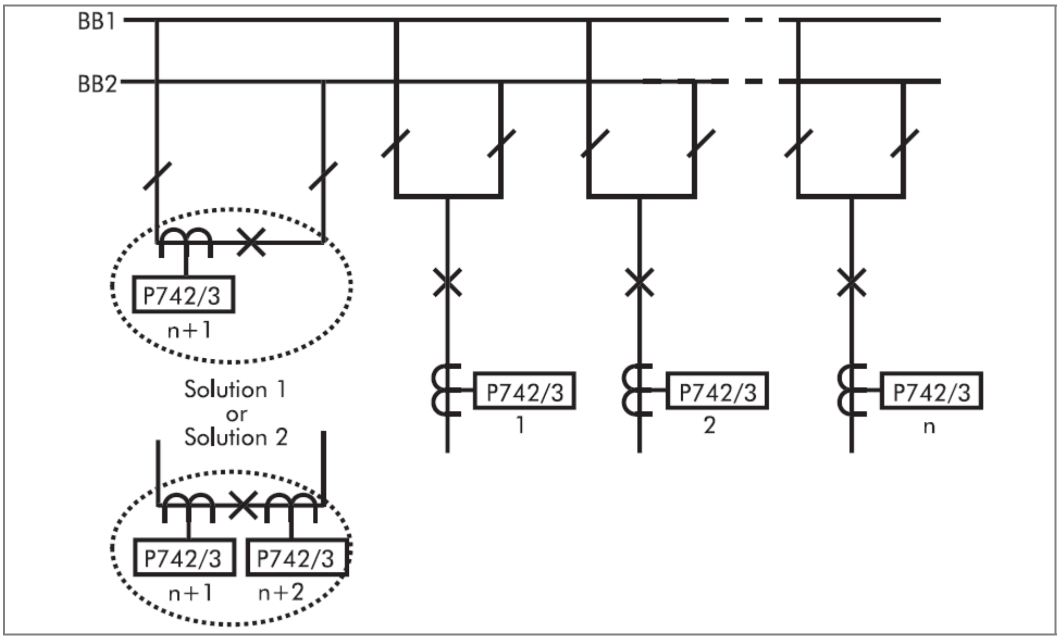


Figure 31 - Double busbar application with bus coupler

The above example shows a double busbar with a bus coupler. It is split into two zones. There are n feeders connected to the busbar. The bus coupler circuit breaker can have either a single CT (solution 1) on one side or CTs on both sides (solution 2).

This configuration requires 1 central unit and n + 1 peripheral units for solution 1 or n + 2 peripheral units for solution 2. (The additional peripheral units being for the bus coupler CTs). The type of peripheral unit used for each bay will depend on the i/o requirements of the bay in question.

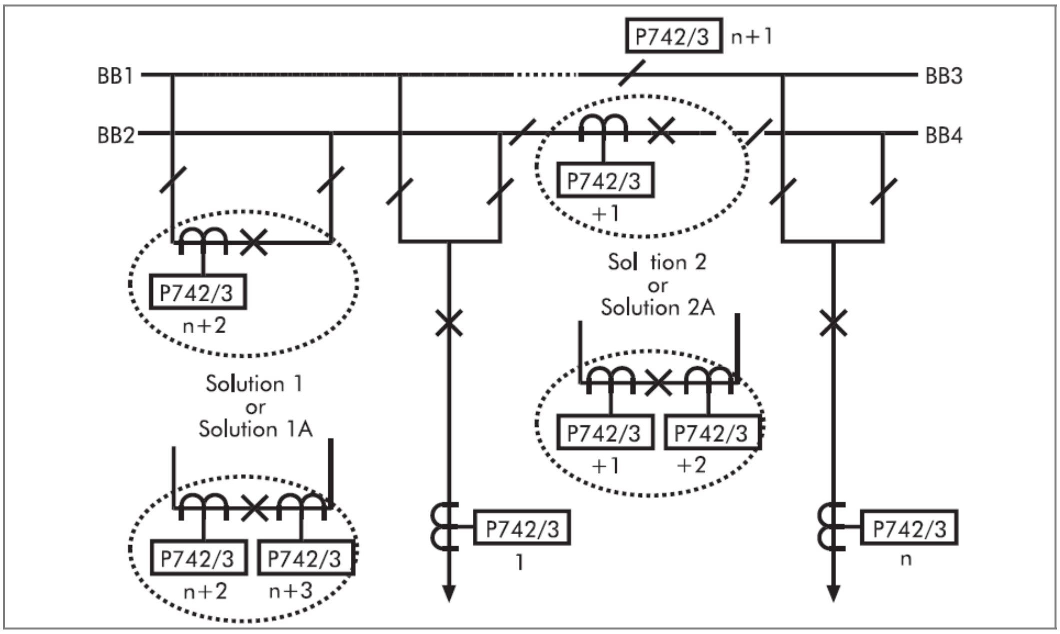


Figure 32 - Traditional double busbar application with bus coupler and bus section

The above example shows a double busbar with both a bus section and a bus coupler. It is split into four zones. There are n feeders connected to the busbar. The bus coupler and bus section circuit breakers can have either a single CT (solution 1 and 2) on one side or CTs on both sides (solution 1a or 2a). This configuration requires 1 central unit and n plus the following number of peripheral units. The total number of peripheral units required allows for a peripheral unit for the bus section isolator on the upper bar.

Solution	Solution A 1 CT on BC & 1 CT on BS	Solution B 2 CT on BC & 2 CT on BS	Solution C 1 CT on BC & 2 CT on BS	Solution D 2 CT on BC & 1 CT on BS
Solution 1	Yes	No	Yes	No
Solution 1a	No	Yes	No	Yes
Solution 2	Yes	No	No	Yes
Solution 2a	No	Yes	Yes	No
Number of peripheral units required	n + 2	n + 4	n + 3	n + 3
If a second bus coupler is added i.e. one bus coupler either side of the bus section				
Using solution 1 for the 2nd coupler	Yes	No	Yes	No
Using solution 1a for the 2nd coupler	No	Yes	No	Yes
Number of peripheral units required	n + 3	n + 6	n + 4	n + 5

Table 3 - Number of required PUs for Figure 32

The additional peripheral unit being for the bus section isolator is optional.

The number of additional peripheral units being dependant on the number of bus section/bus coupler CTs. The type of peripheral unit used for each bay will depend on the i/o requirements of the bay in question.

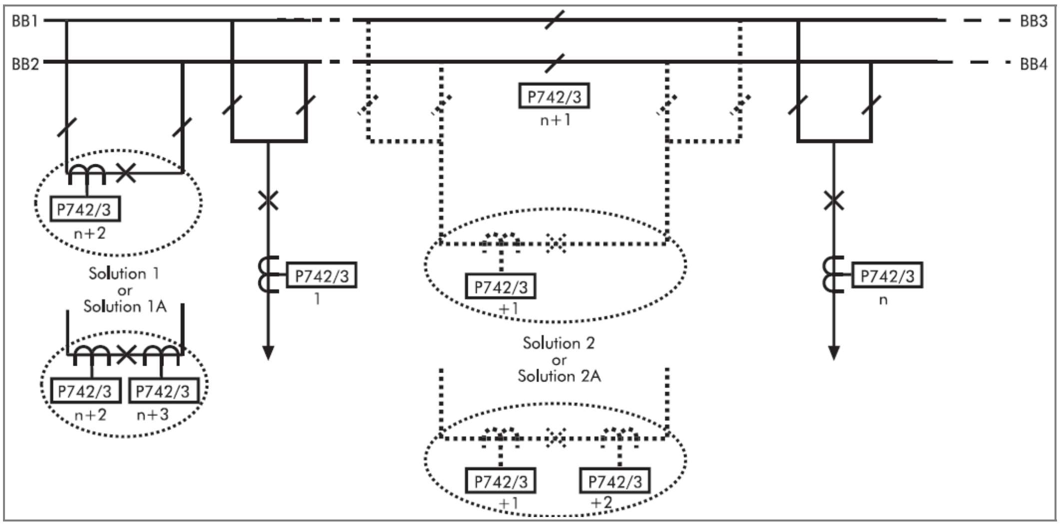


Figure 33 - Double busbar application with bus coupler and bus section with additional bus section isolators

The above example shows a double busbar with both a bus section and a bus coupler. The bus section also has additional bus section isolators and allows for bus section bypass. The scheme is split into four zones. There are n feeders connected to the busbar. The bus coupler and bus section circuit breakers can have either a single CT (solution 1 and 2) on one side or CTs on both sides (solution 1a or 2a). This configuration requires 1 central unit and n plus the following number of peripheral units. The total number of peripheral units required allow for a peripheral unit for the bus section isolators.

Solution	Solution A 1 CT on BC & 1 CT on BS	Solution B 2 CT on BC & 2 CT on BS	Solution C 1 CT on BC & 2 CT on BS	Solution D 2 CT on BC & 1 CT on BS
Solution 1	Yes	No	Yes	No
Solution 1a	No	Yes	No	Yes
Solution 2	Yes	No	No	Yes
Solution 2a	No	Yes	Yes	No
Number of peripheral units required	n + 2	n + 4	n + 3	n + 3
If a second bus coupler is added i.e. one bus coupler either side of the bus section				
Using solution 1 for the 2nd coupler	Yes	No	Yes	No
Using solution 1a for the 2nd coupler	No	Yes	No	Yes
Number of peripheral units required	n + 3	n + 6	n + 4	n + 5

Table 4 - Number of required PUs for Figure 33

The additional peripheral unit being for the bus section isolators is optional.

The number of additional peripheral units being dependant on the number of bus section/bus coupler CTs. The type of peripheral unit used for each bay will depend on the i/o requirements of the bay in question.

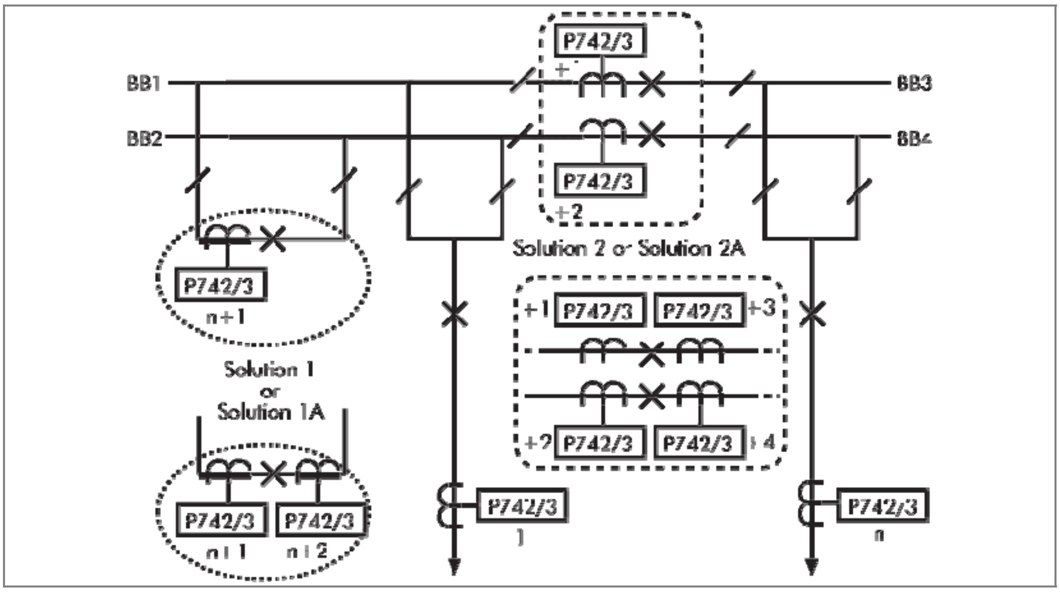


Figure 34 - Double busbar application with bus coupler and double bus section circuit breaker arrangement

The above example shows a double busbar with both a bus section and a bus coupler. There are circuit breakers on both the upper and lower bars. The scheme is split into four zones. There are n feeders connected to the busbar. The bus coupler and bus section circuit breakers can have either a single CT (solution 1 and 2) on one side or CTs on both sides (solution 1a or 2a). This configuration requires 1 central unit and n plus the following number of peripheral units. The total number of peripheral units required allows for a peripheral unit for the bus section isolator on the upper bar.

Solution	Solution A 1 CT on BC & 1 CT on each BS	Solution B 2 CT on BC & 2 CT on each BS	Solution C 1 CT on BC & 2 CT on each BS	Solution D 2 CT on BC & 1 CT on each BS
Solution 1	Yes	No	Yes	No
Solution 1a	No	Yes	No	Yes
Solution 2	Yes	No	No	Yes
Solution 2a	No	Yes	Yes	No
Number of peripheral units required	n + 3	n + 6	n + 5	n + 4
If a second bus coupler is added i.e. one bus coupler either side of the bus section				
Using solution 1 for the 2nd coupler	Yes	No	Yes	No
Using solution 1a for the 2nd coupler	No	Yes	No	Yes
Number of peripheral units required	n + 4	n + 8	n + 6	n + 6

Table 5 - Number of required PUs for Figure 34

The number of additional peripheral units being dependant on the number of bus section/bus coupler CTs. The type of peripheral unit used for each bay will depend on the i/o requirements of the bay in question.

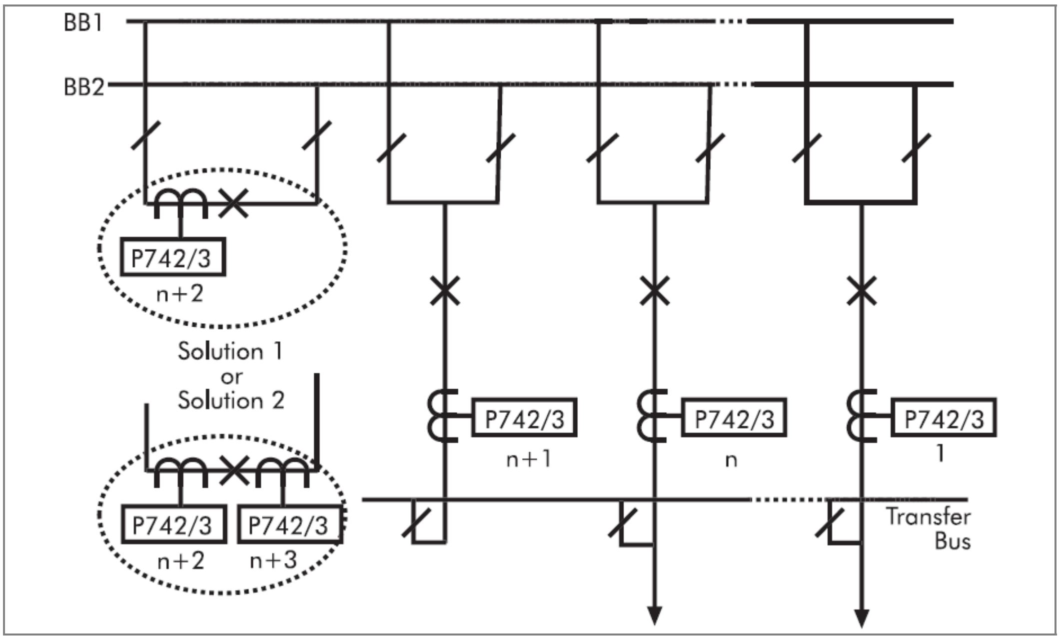


Figure 35 - Double busbar application with a bus coupler. The transfer busbar is not included in the protection zone.

The above example shows a double busbar with a bus coupler and a transfer busbar. As the transfer busbar is on the line side of all the feeder CTs, it is not included in the protected zone it can be considered similarly to Figure 36, an additional peripheral unit must be included for the transfer bay.

It is split into two zones. There are n feeders connected to the busbar. The bus coupler circuit breaker can have either a single CT (solution 1) on one side or CTs on both sides (solution 2). This configuration requires 1 central unit and n + 2 peripheral units for solution 1 or n + 3 peripheral units for solution 2. (The additional peripheral units being for the bus coupler CTs and the transfer bay). The type of peripheral unit used for each bay will depend on the i/o requirements of the bay in question.

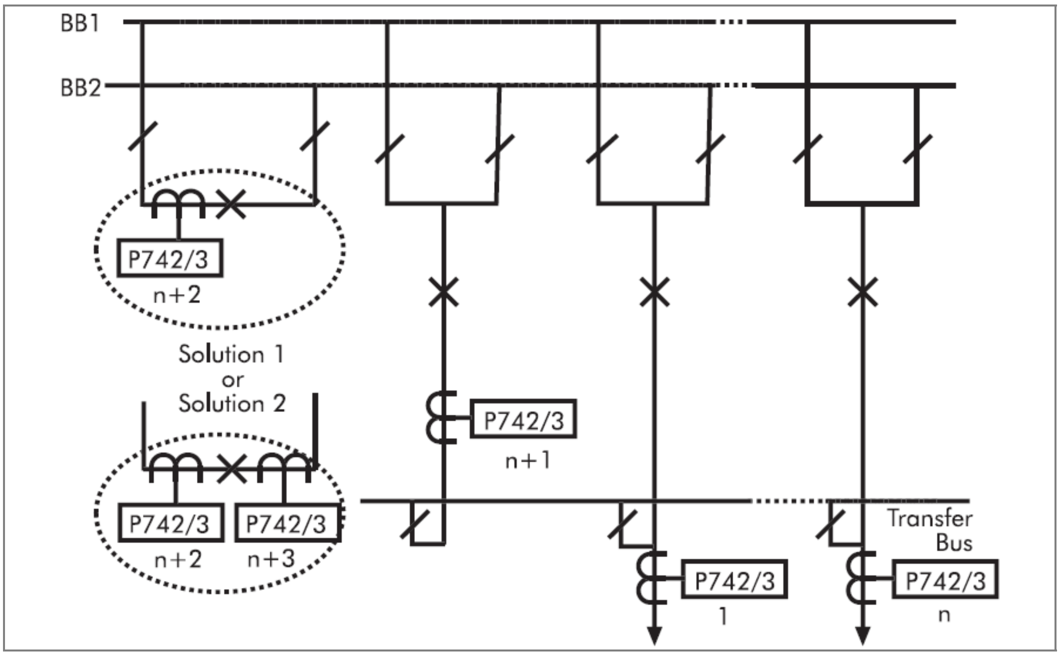


Figure 36 - Double busbar application with a bus coupler. The transfer busbar is included in the protection zone.

The above example shows a double busbar with a bus coupler and a transfer busbar. The transfer busbar is on the bus side of all the feeder CTs, it is included in the protected zone. It can be considered similarly to Figure 37, where an additional peripheral unit has been included for the transfer bay. The only difference being the positioning of the CTs and therefore the protection.

Again it is split into two zones. With an additional zone for the transfer bay, there are n feeders connected to the busbar. The bus coupler circuit breaker can have either a single CT (solution 1) on one side or CTs on both sides (solution 2). This configuration requires 1 central unit and n + 2 peripheral units for solution 1 or n + 3 peripheral units for solution 2. (The additional peripheral units being for the bus coupler CTs and the transfer bay). The type of peripheral unit used for each bay will depend on the i/o requirements of the bay in question.

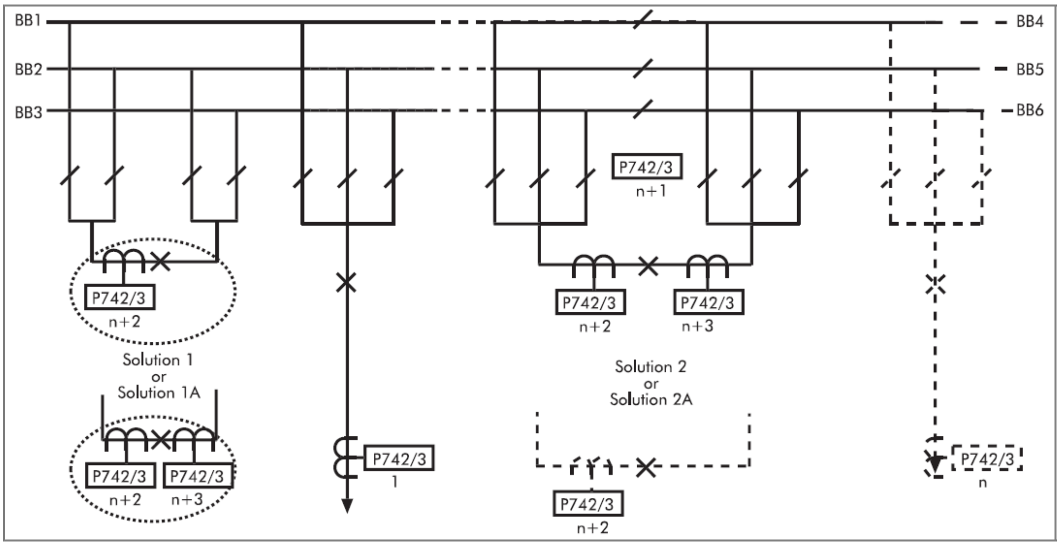


Figure 37 - Triple busbar application with bus coupler and bus section

The above example shows a triple busbar with both a bus section and a bus coupler. The bus section also has additional bus section isolators and allows for bus section bypass. The scheme is split into six zones. There are n feeders connected to the busbar. The bus coupler and bus section circuit breakers can have either a single CT (solution 1 and 2) on one side or CTs on both sides (solution 1a or 2a). This configuration requires 1 central unit and n plus the following number of peripheral units. The total number of peripheral units required allows for a peripheral unit for the bus section isolators.

Solution	Solution A 1 CT on BC & 1 CT on BS	Solution B 2 CT on BC & 2 CT on BS	Solution C 1 CT on BC & 2 CT on BS	Solution D 2 CT on BC & 1 CT on BS
Solution 1	Yes	No	Yes	No
Solution 1a	No	Yes	No	Yes
Solution 2	Yes	No	No	Yes
Solution 2a	No	Yes	Yes	No
Number of peripheral units required	n + 2	n + 4	n + 3	n + 3
If a second bus coupler is added i.e. one bus coupler either side of the bus section				
Using solution 1 for the 2nd coupler	Yes	No	Yes	No
Using solution 1a for the 2nd coupler	No	Yes	No	Yes
Number of peripheral units required	n + 3	n + 6	n + 4	n + 5

Table 6 - Number of required PUs for Figure 37

The additional peripheral unit being for the bus section isolators is optional.

The number of additional peripheral units being dependant on the number of bus section/bus coupler CTs. The type of peripheral unit used for each bay will depend on the i/o requirements of the bay in question.

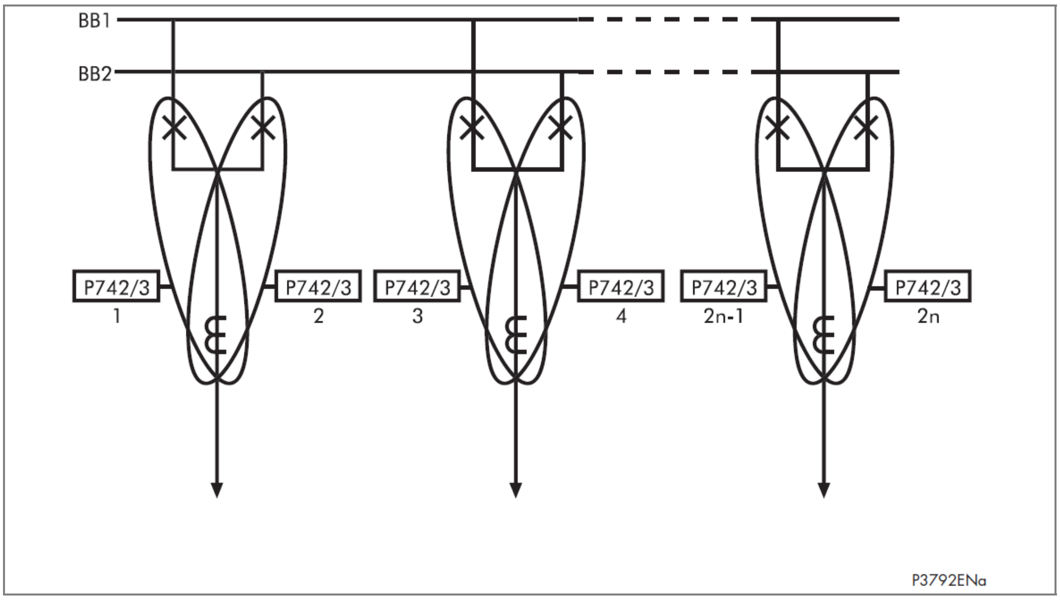


Figure 38 - Double bus bar with two circuit breakers per feeder

The above example shows a double busbar with two circuit breakers on each feeder. The scheme is split into two zones. There are n feeders connected to the busbar. This configuration should require 1 central unit and 2 x n peripheral units but only n Peripheral Units can be used. In each bay the two peripheral units should share the CT, and each circuit breaker should be assigned to a separate peripheral unit but when one Peripheral Unit is used per feeder, the trip order is connected to the two breakers.

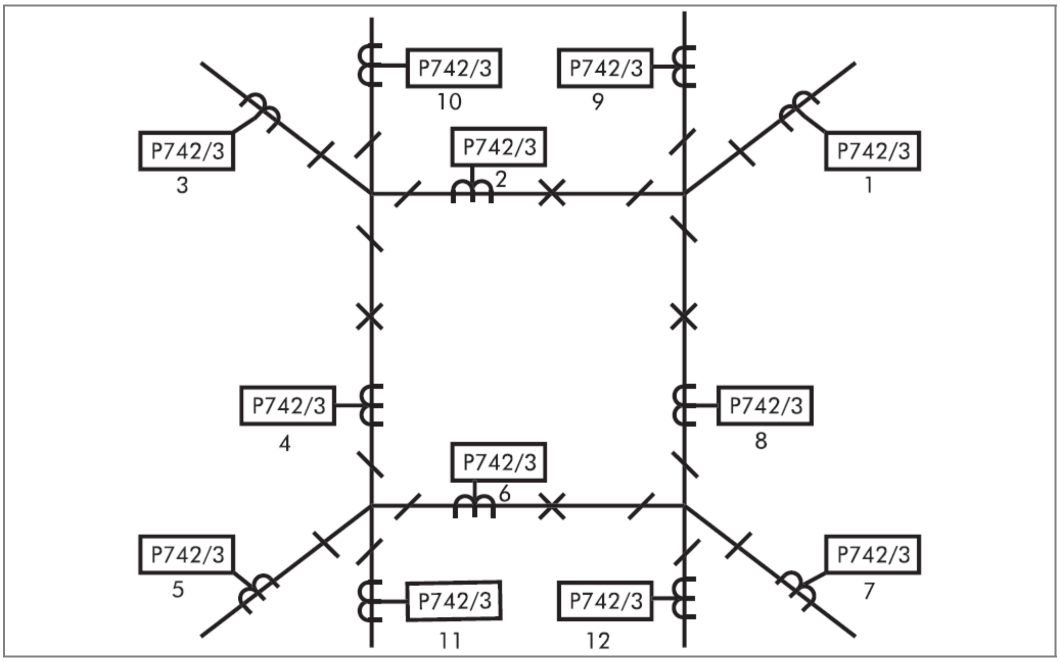


Figure 39 - Mesh corner

The above example shows a mesh corner arrangement. The scheme is split into four zones. This configuration requires 1 central unit and 12 peripheral units.

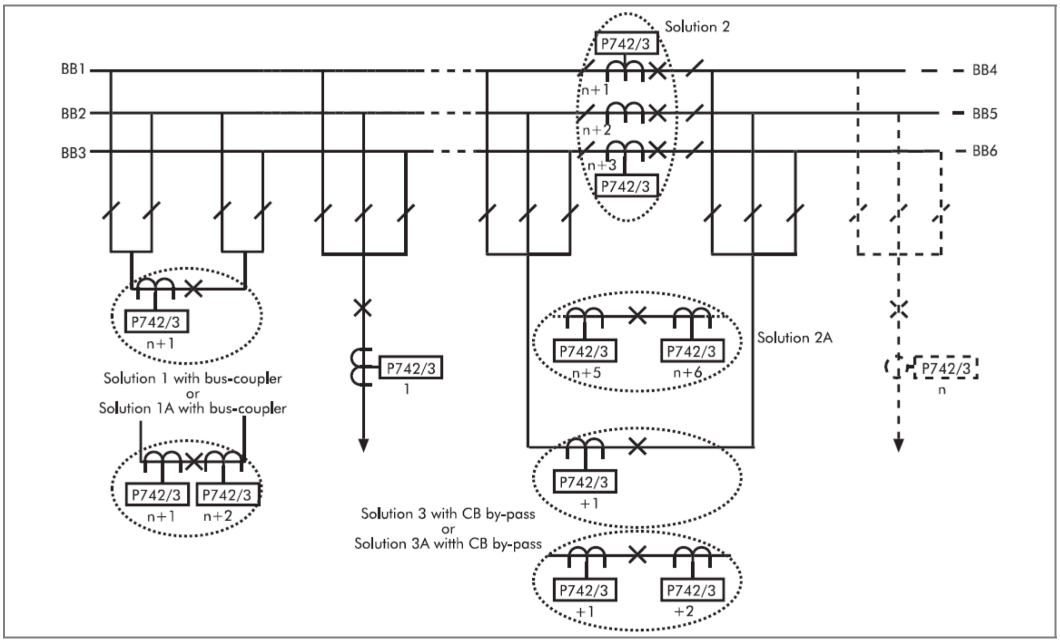


Figure 40 - Six main bus for S/S CB bus-sections and CB by-pass

The above example shows a six busbar arrangement with both a bus section and a bus coupler. It is also possible to include bypass facilities. The scheme is split into six zones. There are n feeders connected to the busbar. The bus coupler, bus section and bypass circuit breakers can have either a single CT (solution 1, 2 and 3) on one side or CTs on both sides (solution 1A, 2A and 3A).

This configuration requires 1 central unit and n plus the following number of peripheral units.

Solution	Solution A 1 CT on BC & 1 CT on each BS	Solution B 2 CT on BC & 2 CT on each BS	Solution C 1 CT on BC & 2 CT on each BS	Solution D 2 CT on BC & 1 CT on each BS
Solution 1	Yes	No	Yes	No
Solution 1a	No	Yes	No	Yes
Solution 2	Yes	No	No	Yes
Solution 2a	No	Yes	Yes	No
Number of peripheral units required	n + 4	n + 8	n + 7	n + 5
If bypass facilities are to be included				
Using solution 3	Yes	No	Yes	No
Using solution 3a	No	Yes	No	Yes
Number of peripheral units required	n + 5	n + 10	n + 8	n + 8
If a second bus coupler is added i.e. one bus coupler either side of the bus section and no bypass facilities				
Using solution 1 for the 2nd coupler	Yes	No	Yes	No
Using solution 1a for the 2nd coupler	No	Yes	No	Yes
Number of peripheral units required	n + 5	n + 10	n + 8	n + 7

Solution	Solution A 1 CT on BC & 1 CT on each BS	Solution B 2 CT on BC & 2 CT on each BS	Solution C 1 CT on BC & 2 CT on each BS	Solution D 2 CT on BC & 1 CT on each BS
If a second bus coupler is added i.e. one bus coupler either side of the bus section and bypass facilities are included				
Using solution 3	Yes	No	Yes	No
Using solution 3a	No	Yes	No	Yes
Number of peripheral units required	n + 6	n + 12	n + 9	n + 10

Table 7 - Number of required PUs for Figure 41

The number of additional peripheral units being dependant on the number of bus section/bus coupler CTs. The type of peripheral unit used for each bay will depend on the i/o requirements of the bay in question.

9 APPLICATION OF NON PROTECTION FUNCTIONS

The non-protection features for the scheme are summarised below:

- Scheme can be centralised/distributed – if space is not available to locate the busbar protection centrally it is possible to decentralise the scheme and locate the units within other protection cubicles.
- Local, zone and scheme measurements – various measurements are available locally via the relay LCD or remotely via the serial communication link
- Event, fault and disturbance recording – Comprehensive post fault analysis available via event lists, disturbance records and fault records which can be accessed locally via the relay LCD or remotely via the serial communication link (PU -> CU)
- Real time clock/time synchronisation – Time synchronisation available via IRIG-B input (option in Central Unit that synchronises the PUs)
- Four settings groups – Independent remotely selectable setting groups to allow for customer specific applications
- CB and isolator state monitoring – indication of the circuit breaker/isolator position via the auxiliary contacts, scheme acts accordingly should discrepancy conditions be detected
- CB control – available locally via the HMI
- Commissioning test facilities
- Continuous self monitoring – extensive self checking routines to ensure maximum reliability
- Communications supervision – detects communication failure between units and enables remedial action to be taken e.g. switch to communication independent backup protection locally and disregard feeder at a zone level
- Graphical programmable scheme logic – allowing user defined protection and control logic to be tailored to the specific application

9.1 Function Keys

The following default PSL logic illustrates the programming of function keys to enable/disable the commissioning mode functionality.

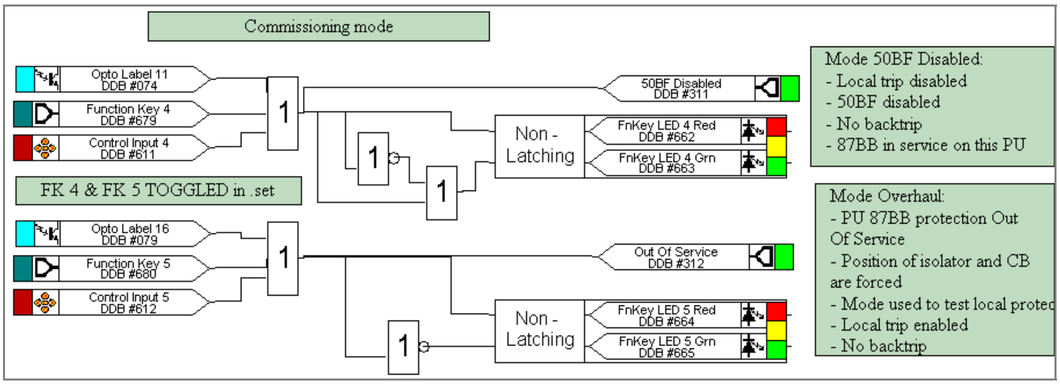


Figure 41 - Commissioning mode default PSL

Note	*Energizing two inputs to an LED conditioner creates a YELLOW illumination.*

Function Keys 4 and 5 are set to 'Toggle' mode and on activation of the key, the commissioning mode will be in service as long as the function has been enabled in the "Configuration" menu. The associated LED will indicate the state of the protection function in service as GREEN and YELLOW for the 50BF disable mode and RED for the Overhaul mode.

9.2 Differential Current Display

When the differential currents are low, it is possible to force to 0 the value of these differential currents displayed in the column MEASUREMENT 1 & MEASUREMENT 2 .

When the differential currents of a zone are all lower than the threshold (on the 3 phases), the currents displayed are forced to 0.

10 CT REQUIREMENTS

10.1 Notation

Abbreviation	Meaning
I_F max fault	maximum fault current (same for all feeders) in A
I_F max int cont	maximum contribution from a feeder to an internal fault (depends on the feeder) in A
I_{np}	CT primary rated current
I_n	nominal secondary current (1A or 5A)
R_{CT}	CT secondary winding Resistance in Ohms
R_B	Total external load resistance in Ohms
V_k	CT knee point voltage in Volts
S_{VA}	Nominal output in VA
K_{SSC}	Short-circuit current coefficient (generally 20)

General recommendations for the specification of protection CTs use common rules of engineering which are not directly related to a particular protection.

10.2 87BB Phase CT Requirements

10.2.1 Feeders Connected to Sources of Significant Power (i.e. Lines and Generators)

The primary rated current is specified above a 1/20th of the maximum contribution of the feeder to internal faults.
i.e. $I_{np} = I_F$ max int/20
e.g. A power line likely to import electricity at 20 kA gives rated primary current Inp as 1000 A.

This recommendation is used for the majority of line or transformer protection applications. The CT must be sized so as not to saturate during internal faults:

For each CT, $I_{FeederMax}$ = maximum contribution of the feeder to an internal fault (could be different for each feeder):
Vk > $I_{FeederMax}$ * (RCT + RB)

Note	*This specification is valid for internal faults.*

10.2.2 Out of Service Feeders or those with Low Power Contribution (Low Infeed)

Because of CT construction, thermal behaviour, and electrodynamics the CT primary rated current cannot be as low as required compared to the maximum fault current. In the case of a CT with primary bushings and not wound there is not a precise limit but a practical one. The primary rated current could not be lower than the 1/200th of the maximum short-circuit current crossing the CT at the time of an external fault

i.e. $I_{np} = I_F$ max /200

This is possible using the fast overcurrent detection I>2 to distinguish between an internal or external fault in case of CT saturation below than 2 ms
e.g. For a substation whose maximum short-circuit current would be 30 kA, the CTs on the least powerful feeders are to be specified for a rated primary current Inp = 150 A, even if the normal consumption of the feeder is much lower than this value (Substation transformer feeder)

10.2.3 CT Specification according to IEC 185, 44-6 and BS 3938 (British Standard)

1. Class X according to British Standard: Minimum knee point voltage for saturation
   V_k min = 0.5 x secondary I_F max x (R_{CT} + R_B)

> *Note* *This specification is valid for external faults.*

The recommended specification makes it possible to guarantee a time to saturation greater than 1.4 ms with a remnant flux of 80 % of maximum flux (class X or TPX). This provides a sufficient margin of security for CT saturation detection, which operates in less than 2 ms.

2. Class 5P to IEC 185. Conversion of class X (BS) with the 5P equivalent (IEC)
3. Class TPX and TPY according to IEC 44-6. IEC defines a composite error as a percentage of a multiple of the rated current (IN) on a definite load SVA.
   e.g. CT 1000/5 A – 50VA 5P 20 [CT I_{np} / I_nA – SVA Accuracy P Kscc]

This definition indicates that the composite error must be lower than 5%, for a primary current of 20Inp when the external load is equal to 2 ohms (50VA to In). If secondary resistance, RCT, is known it is easy to calculate the magnetising EMF developed with the fault current (20In). Actually if the error is 5% (= 5A) with this EMF, the point of operation is beyond the knee point voltage for saturation. By convention one admits that the knee point voltage, Vk, is 80% of this value. For a conversion between a class 5P (IEC) and a class X (BS) CT one uses the relation:

V_k=0.8 X [(SVA x K_{ssc})/I_n + (R_{CT} x K_{ssc} x I_n)]
SVA = (I_n x V_k/0.8 K_{ssc}) – R_{CT} x I_n^2

In particular cases, calculation could reveal values too low to correspond to industrial standards. In this case the minima will be: SVA min = 10 VA 5P 20 which correspond to a knee point voltage of approximately Vkmin = 70 V at 5A or 350V at 1A. Class TPY would permit lower values of power, (demagnetisation air-gap). Taking into account the weak requirements of class X or TPX one can keep specifications common.

For accuracy, class X or class 5P current transformers (CTs) are strongly recommended. The knee point voltage of the CTs should comply with the minimum requirements of the formulae shown below.

V_k ≥ k (R_{CT} + R_B)

Where:
V_k = Required knee point voltage
k = Dimensioning factor
R_{CT} = CT secondary resistance
R_L = Circuit resistance from CT to relay
R_B = Burden resistance

k is a constant depending on:
If = Maximum value of through fault current for stability (multiple of In)
X/R = Primary system X/R ratio (for the P740 system, X/R up to 80)

The following CT requirement can be developed for the P740 scheme

V_k > 0.5 x (secondary If max) x (R_{CT} + R_B)

With R_B = 2 R_L

10.3 87BB Sensitive Differential Earth Fault CT Requirements

The Sensitive Differential Earth Fault (SDEF) shall be enabled only on High Impedance Earthed Networks.

To enable the SDEF the CTs have to comply with the additional following requirement:

V_k min = 1.5 x X/R x I_n x (R_{CT} + R_B)

> *Note* *If the X/R is lower than 20, chose 20 as X/R.*

Where:
V_k = Required knee point voltage
X/R = Primary system X/R ratio (for the P740 system, X/R up to 80)
I_n = nominal secondary current (1A or 5A)
R_{CT} = CT secondary resistance
R_B = Burden resistance (with R_B = 2 R_L)

10.4 Support of IEEE C Class CTs

MiCOM Px40 series protection is compatible with ANSI/IEEE current transformers as specified in the IEEE C57.13 standard. The applicable class for protection is class “C”, which specifies a non air-gapped core. The CT design is identical to IEC class P, or British Standard class X, but the rating is specified differently. The following table allows C57.13 ratings to be translated into an IEC/BS knee point voltage

IEC/BS Knee Point Voltage VK offered BY “C” class CTS						
		IEEE C57.13 – “C” Classification (volts)				
		C50	C100	C200	C400	C800
CT Ratio	RCT (ohm)	V_k	V_k	V_k	V_k	V_k
100/5	0.04	56.5	109	214	424	844
200/5	0.8	60.5	113	218	428	848
400/5	0.16	68.5	121	226	436	856
800/5	0.32	84.5	137	242	452	872
1000/5	0.4	92.5	145	250	460	880
1500/5	0.6	112.5	165	270	480	900
2000/5	0.8	132.5	185	290	500	920
3000/5	1.2	172.5	225	330	540	960

Assumptions:

1. For 5A CTs, the typical resistance is 0.0004 ohm secondary per primary turn (for 1A CTs, the typical resistance is 0.0025 ohm secondary per primary turn)
2. IEC/BS knee is typically 5% higher than ANSI/IEEE knee

Given:

3. IEC/BS knee is specified as an internal EMF, whereas the “C” class voltage is specified at the CT output terminals. To convert from ANSI/IEEE to IEC/BS requires the voltage drop across the CTs secondary winding resistance to be added.
4. IEEE CTs are always rated at 5A secondary
5. The rated dynamic current output of a “C” class CT (Kssc) is always 20 x I_n

V_k = $(C \times 1.05) + (I_n . R_{CT} . K_{ssc})$

Where:
V_k = Equivalent IEC or BS knee point voltage
C = C Rating
I_n = 5A
R_{CT} = CT secondary winding resistance
K_{ssc} = 20 times

11 AUXILIARY SUPPLY FUSE RATING

In the Safety Information part of this manual, the maximum allowable fuse rating of 16A is quoted. To allow time grading with fuses upstream, a lower fuselink current rating is often preferable. Use of standard ratings of between 6A and 16A is recommended. Low voltage fuselinks, rated at 250V minimum and compliant with IEC60269-2 general application type gG are acceptable, with high rupturing capacity. This gives equivalent characteristics to HRC "red spot" fuses type NIT/TIA often specified historically.

The table below recommends advisory limits on relays connected per fused spur. This applies to MiCOM Px40 series devices with hardware suffix C and higher, as these have inrush current limitation on switch-on, to conserve the fuse-link.

Maximum Number of MiCOM Px40 Relays Recommended Per Fuse				
Battery Nominal Voltage	**6A**	**10A Fuse**	**15 or 16A Fuse**	**Fuse Rating > 16A**
24 to 54V	2	4	6	Not permitted
60 to 125V	4	8	12	Not permitted
138 to 250V	6	10	16	Not permitted
Alternatively, Miniature Circuit Breakers (MCBs) may be used to protect the auxiliary supply circuits.				

Notes:

USING THE PSL EDITOR

CHAPTER 7

Date:	07/2016	
Products covered by this chapter:	This chapter covers the specific versions of the MiCOM products listed below. This includes ***only*** the following combinations of Software Version and Hardware Suffix.	
Hardware Suffix:	All MiCOM Px4x products	
Software Version:	All MiCOM Px4x products	
Connection Diagrams:	P14x (P141, P142, P143 & P145): 10P141xx (xx = 01 to 02) 10P142xx (xx = 01 to 05) 10P143xx (xx = 01 to 11) 10P145xx (xx = 01 to 11) P24x (P241, P242 & P243): 10P241xx (xx = 01 to 02) 10P242xx (xx = 01) 10P243xx (xx = 01) P34x (P342, P343, P344, P345 & P391): 10P342xx (xx = 01 to 17) 10P343xx (xx = 01 to 19) 10P344xx (xx = 01 to 12) 10P345xx (xx = 01 to 07) 10P391xx (xx = 01 to 02) P445: 10P445xx (xx = 01 to 04) P44x: 10P44101 (SH 1 & 2) 10P44201 (SH 1 & 2) 10P44202 (SH 1) 10P44203 (SH 1 & 2) 10P44401 (SH 1) 10P44402 (SH 1) 10P44403 (SH 1 & 2) 10P44404 (SH 1) 10P44405 (SH 1) 10P44407 (SH 1 & 2) P44y (P443 & P446): 10P44303 (SH 01 and 03) 10P44304 (SH 01 and 03) 10P44305 (SH 01 and 03) 10P44306 (SH 01 and 03) 10P44600 10P44601 (SH 1 to 2) 10P44602 (SH 1 to 2) 10P44603 (SH 1 to 2)	P54x (P543, P544, P545 & P546): 10P54302 (SH 1 to 2) 10P54303 (SH 1 to 2) 10P54400 10P54404 (SH 1 to 2) 10P54405 (SH 1 to 2) 10P54502 (SH 1 to 2) 10P54503 (SH 1 to 2) 10P54600 10P54604 (SH 1 to 2) 10P54605 (SH 1 to 2) 10P54606 (SH 1 to 2) P547: 10P54702xx (xx = 01 to 02) 10P54703xx (xx = 01 to 02) 10P54704xx (xx = 01 to 02) 10P54705xx (xx = 01 to 02) P64x (P642, P643 & P645): 10P642xx (xx = 1 to 10) 10P643xx (xx = 1 to 6) 10P645xx (xx = 1 to 9) P74x: 10P740xx (xx = 01 to 07) P746: 10P746xx (xx = 00 to 21) P841: 10P84100 10P84101 (SH 1 to 2) 10P84102 (SH 1 to 2) 10P84103 (SH 1 to 2) 10P84104 (SH 1 to 2) 10P84105 (SH 1 to 2) P849: 10P849xx (xx = 01 to 06)

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FIGURES

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Notes:

1 OVERVIEW

The purpose of the Programmable Scheme Logic (PSL) is to allow the relay user to configure an individual protection scheme to suit their own particular application. This is achieved through the use of programmable logic gates and delay timers.

The input to the PSL is any combination of the status of opto inputs. It is also used to assign the mapping of functions to the opto inputs and output contacts, the outputs of the protection elements, e.g. protection starts and trips, and the outputs of the fixed protection scheme logic. The fixed scheme logic provides the relay's standard protection schemes.

The PSL itself consists of software logic gates and timers. The logic gates can be programmed to perform a range of different logic functions and can accept any number of inputs. The timers are used either to create a programmable delay, and/or to condition the logic outputs, e.g. to create a pulse of fixed duration on the output regardless of the length of the pulse on the input. The outputs of the PSL are the LEDs on the front panel of the relay and the output contacts at the rear.

The execution of the PSL logic is event driven; the logic is processed whenever any of its inputs change, for example as a result of a change in one of the digital input signals or a trip output from a protection element. Also, only the part of the PSL logic that is affected by the particular input change that has occurred is processed. This reduces the amount of processing time that is used by the PSL; even with large, complex PSL schemes the relay trip time will not lengthen.

This system provides flexibility for the user to create their own scheme logic design. However, it also means that the PSL can be configured into a very complex system; hence setting of the PSL is implemented through the PC support package MiCOM S1 Studio.

Note	*MiCOM S1 Studio has been renamed as Easergy Studio.*

2 EASERGY STUDIO (MICOM S1 STUDIO) PSL EDITOR

Note	*MiCOM S1 Studio has been renamed as Easergy Studio.*

The PSL Editor can be used inside Easergy Studio (MiCOM S1 Studio) or directly.

This chapter assumes that you are using the PSL Editor from within Easergy Studio (MiCOM S1 Studio).

If you use it from Easergy Studio (MiCOM S1 Studio), the Studio software will be locked whilst you are using the PSL editor software. The Studio software will be unlocked when you close the PSL Editor software.

The Easergy Studio (MiCOM S1 Studio) product is updated periodically. These updates provide support for new features (such as allowing you to manage new MiCOM products, as well as using new software releases and hardware suffixes). The updates may also include fixes. **Accordingly, we strongly advise customers to use the latest Schneider Electric version of Easergy Studio (MiCOM S1 Studio).**

2.1 How to Obtain Easergy Studio (MiCOM S1 Studio) Software

Easergy Studio (MiCOM S1 Studio) is available from the Schneider Electric website:

- www.schneider-electric.com

2.2 To Start Easergy Studio (MiCOM S1 Studio)

To Start the Easergy Studio (MiCOM S1 Studio) software, click the **Start** > **Programs** > **Schneider Electric** > **MiCOM S1 Studio** > **MiCOM S1 Studio** menu option.

2.3 To Open a Pre-Existing System

Within Easergy Studio (MiCOM S1 Studio), click the **File** + **Open System** menu option.

Navigate to where the scheme is stored, then double-click to open the scheme.

2.4 To Start the PSL Editor

The PSL editor lets you connect to any MiCOM device front port, retrieve and edit its PSL files and send the modified file back to a suitable MiCOM device.

Px30 and Px40 products are edited different versions of the PSL Editor. There is one link to the Px30 editor and one link to the Px40 editor.

To start the PSL editor for Px40 products:

Highlight the PSL file you wish to edit, and then either:

Double-click the highlighted PSL file,

Click the open icon or

In the MiCOM S1 Studio main menu, select Tools > PSL PSL editor (Px40) menu.

The PSL Editor will then start, and show you the relevant PSL Diagram(s) for the file you have opened. An example of such a PSL diagram is shown in the *Example of a PSL editor module* diagram.

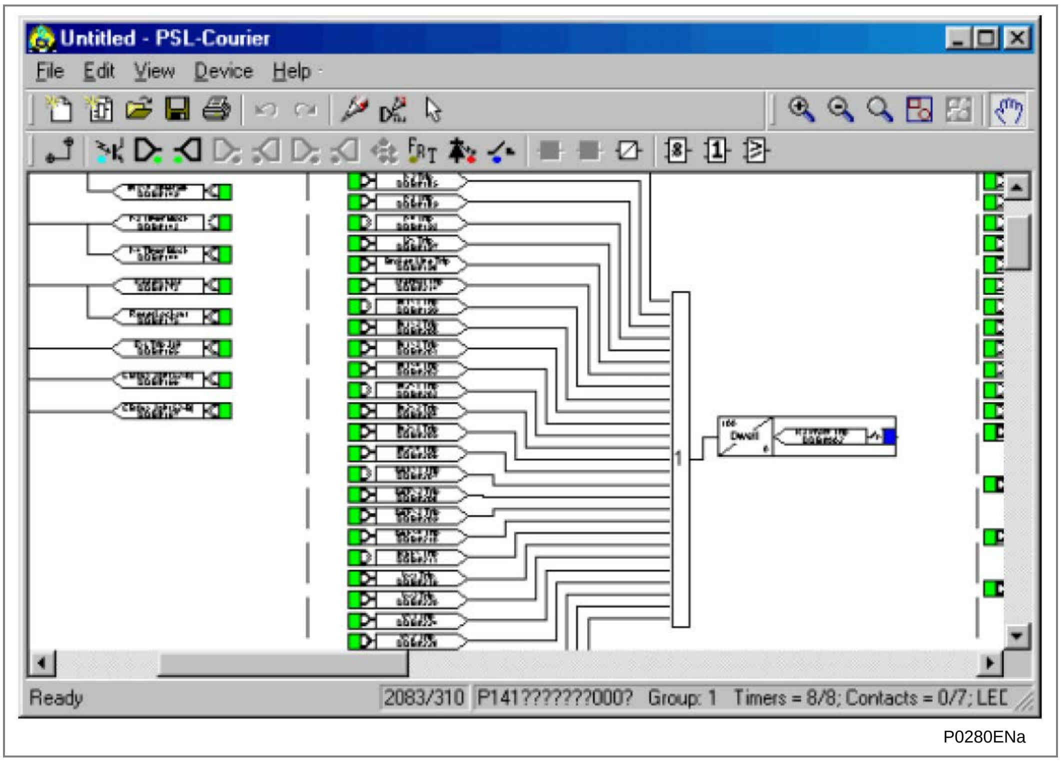


Figure 1 - Example of a PSL editor module

2.5 How to use MiCOM PSL Editor

The MiCOM PSL editor lets you:

- Start a new PSL diagram
- Extract a PSL file from a MiCOM Px40 IED
- Open a diagram from a PSL file
- Add logic components to a PSL file
- Move components in a PSL file
- Edit link of a PSL file
- Add link to a PSL file
- Highlight path in a PSL file
- Use a conditioner output to control logic
- Download PSL file to a MiCOM Px40 IED
- Print PSL files

For a detailed discussion on how to use these functions, please refer to the Easergy Studio (MiCOM S1 Studio) User Manual.

2.6 Warnings

Before the scheme is sent to the relay checks are done. Various warning messages may be displayed as a result of these checks.

The Editor first reads in the model number of the connected relay, then compares it with the stored model number. A "wildcard" comparison is used. If a model mismatch occurs, a warning is generated before sending starts. Both the stored model number and the number read from the relay are displayed with the warning. However, the user must decide if the settings to be sent are compatible with the relay that is connected. Ignoring the warning could lead to undesired behavior of the relay.

If there are any potential problems of an obvious nature then a list will be generated. The types of potential problems that the program attempts to detect are:

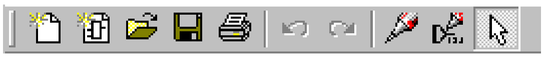
- One or more gates, LED signals, contact signals, and/or timers have their outputs linked directly back to their inputs. An erroneous link of this sort could lock up the relay, or cause other more subtle problems to arise.
- Inputs to Trigger (ITT) exceeds the number of inputs. If a programmable gate has its ITT value set to greater than the number of actual inputs; the gate can never activate. There is no lower ITT value check. A 0-value does not generate a warning.
- Too many gates. There is a theoretical upper limit of 256 gates in a scheme, but the practical limit is determined by the complexity of the logic. In practice the scheme would have to be very complex, and this error is unlikely to occur.
- Too many links. There is no fixed upper limit to the number of links in a scheme. However, as with the maximum number of gates, the practical limit is determined by the complexity of the logic. In practice the scheme would have to be very complex, and this error is unlikely to occur.

3 TOOLBAR AND COMMANDS

There are a number of toolbars available for easy navigation and editing of PSL.

3.1 Standard Tools

For file management and printing.

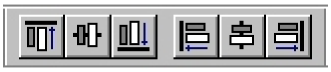


	Blank Scheme	Create a blank scheme based on a relay model.
	Default Configuration	Create a default scheme based on a relay model.
	Open	Open an existing diagram.
	Save	Save the active diagram.
	Print	Display the Windows Print dialog, enabling you to print the current diagram.
	Undo	Undo the last action.
	Redo	Redo the previously undone action.
	Redraw	Redraw the diagram.
	No of DDBs	Display the DDB numbers of the links.
	Calculate CRC	Calculate unique number based on both the function and layout of the logic.
	Compare Files	Compare current file with another stored on disk.
	Select	Enable the select function. While this button is active, the mouse pointer is displayed as an arrow. This is the default mouse pointer. It is sometimes referred to as the selection pointer.

Point to a component and click the left mouse button to select it. Several components may be selected by clicking the left mouse button on the diagram and dragging the pointer to create a rectangular selection area.

3.2 Alignment Tools

To align logic elements horizontally or vertically into groups.



 **Align Top** — Align all selected components so the top of each is level with the others.

 **Align Middle** — Align all selected components so the middle of each is level with the others.

 **Align Bottom** — Align all selected components so the bottom of each is level with the others.

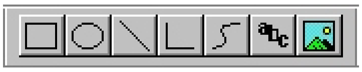
 **Align Left** — Align all selected components so the leftmost point of each is level with the others.

 **Align Centre** — Align all selected components so the centre of each is level with the others.

 **Align Right** — Align all selected components so the rightmost point of each is level with the others.

3.3 Drawing Tools

To add text comments and other annotations, for easier reading of PSL schemes.



 **Rectangle** — When selected, move the mouse pointer to where you want one of the corners to be hold down the left mouse button and move it to where you want the diagonally opposite corner to be. Release the button. To draw a square hold down the SHIFT key to ensure height and width remain the same.

 **Ellipse** — When selected, move the mouse pointer to where you want one of the corners to be hold down the left mouse button and move until the ellipse is the size you want it to be. Release the button. To draw a circle hold down the SHIFT key to ensure height and width remain the same.

 **Line** — When selected, move the mouse pointer to where you want the line to start, hold down left mouse, move to the position of the end of the line and release button. To draw horizontal or vertical lines only hold down the SHIFT key.

 **Polyline** — When selected, move the mouse pointer to where you want the polyline to start and click the left mouse button. Now move to the next point on the line and click the left button. Double click to indicate the final point in the polyline.

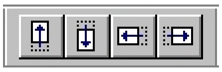
 **Curve** — When selected, move the mouse pointer to where you want the polycurve to start and click the left mouse button. Each time you click the button after this a line will be drawn, each line bisects its associated curve. Double click to end. The straight lines will disappear leaving the polycurve.
Note: whilst drawing the lines associated with the polycurve, a curve will not be displayed until either three lines in succession have been drawn or the polycurve line is complete.

 **Text** — When selected, move the mouse pointer to where you want the text to begin and click the left mouse button. To change the font, size or colour, or text attributes select Properties from the right mouse button menu.

 **Image** — When selected, the Open dialog is displayed, enabling you to select a bitmap or icon file. Click Open, position the mouse pointer where you want the image to be and click the left mouse button.

3.4 Nudge Tools

To move logic elements.



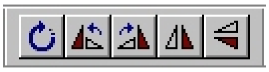
The nudge tool buttons enable you to shift a selected component a single unit in the selected direction, or five pixels if the SHIFT key is held down.

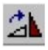
As well as using the tool buttons, single unit nudge actions on the selected components can be achieved using the arrow keys on the keyboard.

	Nudge Up	Shift the selected component(s) upwards by one unit. Holding down the SHIFT key while clicking on this button will shift the component five units upwards.
	Nudge Down	Shift the selected component(s) downwards by one unit. Holding down the SHIFT key while clicking on this button will shift the component five units downwards.
	Nudge Left	Shift the selected component(s) to the left by one unit. Holding down the SHIFT key while clicking on this button will shift the component five units to the left.
	Nudge Right	Shift the selected component(s) to the right by one unit. Holding down the SHIFT key while clicking on this button will shift the component five units to the right.

3.5 Rotation Tools

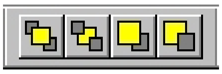
To spin, mirror and flip.

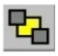


	Free Rotate	Enable the rotation function. While rotation is active components may be rotated as required. Press the ESC key or click on the diagram to disable the function.
	Rotate Left	Rotate the selected component 90 degrees to the left.
	Rotate Right	Rotate the selected component 90 degrees to the right.
	Flip Horizontal	Flip the component horizontally.
	Flip Vertical	Flip the component vertically.

3.6 Structure Tools

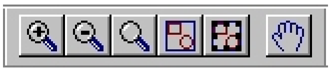
To change the stacking order of logic components.



	Bring to Front	Bring the selected components in front of all other components.
	Send to Back	Bring the selected components behind all other components.
	Bring Forward	Bring the selected component forward one layer.
	Send Backward	Send the selected component backwards one layer.

3.7 Zoom and Pan Tools

For scaling the displayed screen size, viewing the entire PSL, or zooming to a selection.



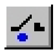
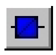
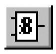
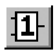
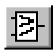
	Zoom In	Increases the Zoom magnification by 25%.
	Zoom Out	Decreases the Zoom magnification by 25%.
	Zoom	Enable the zoom function. While this button is active, the mouse pointer is displayed as a magnifying glass. Right-clicking will zoom out and left-clicking will zoom in. Press the ESC key to return to the selection pointer. Click and drag to zoom in to an area.
	Zoom to Fit	Display at the highest magnification that will show all the diagram's components.
	Zoom to Selection	Display at the highest magnification that will show the selected component(s).
	Pan	Enable the pan function. While this button is active, the mouse pointer is displayed as a hand. Hold down the left mouse button and drag the pointer across the diagram to pan. Press the ESC key to return to the selection pointer.

3.8 Logic Symbols

This toolbar provides icons to place each type of logic element into the scheme diagram. Not all elements are available in all devices. Icons will only be displayed for those elements available in the selected device. Depending on the device, the toolbar may not include Function key or coloured LED conditioner/signal or Contact conditioner or SR Gate icons.

P2718ENa

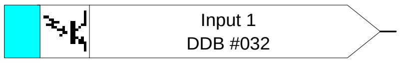
Link Create a link between two logic symbols.	
Opto Signal Create an opto signal.	
Input Signal Create an input signal.	
Output Signal Create an output signal.	
GOOSE In Create an input signal to logic to receive a UCA2.0 or IEC 61850 GOOSE message transmitted from another IED.	
GOOSE Out Create an output signal from logic to transmit a UCA2.0 or IEC 61850 GOOSE message to another IED.	
Control In Create an input signal to logic that can be operated from an external command.	
Integral Intertripping In/InterMiCOM In Create an input signal to logic to receive a MiCOM command transmitted from another IED. InterMiCOM is not available for all products.	

Integral Intertripping Out/InterMiCOM Out transmit a MiCOM command to another IED. InterMiCOM is not available for all products.	
Function Key Create a function key input signal.	
Trigger Signal Create a fault record trigger.	
LED Signal Create an LED input signal that repeats the status of the LED. The icon colour shows whether the product uses mono-colour or tri-color LEDs.	
Contact Signal Create a contact signal.	
LED Conditioner Create a LED conditioner. The icon colour shows whether the product uses mono-colour or tri-color LEDs.	
Contact Conditioner Create a contact conditioner. Contact conditioning is not available for all products.	
Timer Create a timer.	
AND Gate Create an AND Gate.	
OR Gate Create an OR Gate.	
Programmable Gate Create a programmable gate.	
SR gate Create an SR gate.	

4 PSL LOGIC SIGNALS PROPERTIES

The logic signal toolbar is used for the selection of logic signals.

This allows you to link signals together to program the PSL. A number of different properties are associated with each signal. In the following sections, these are characterized by the use of an icon from the toolbar; together with a signal name and a DDB number. The name and DDB number are shown in a pointed rectangular block, which includes a colour code, the icon, the name, DDB No and a directional pointer. One example of such a block (for P54x for Opto Signal 1 DDB No #032) is shown below:



More examples of these are shown in the following properties sections.

Important	**The DDB Numbers vary according to the particular product and the particular name, so that Opto Signal 1 may not be DDB No #032 for all products. The various names and DDB numbers illustrated below are provided as an example.** **You need to look up the DDB numbers for the signal and the specific MiCOM product you are working on in the relevant DDB table for your chosen product.**

4.1 Signal Properties Menu

The logic signal toolbar is used for the selection of logic signals. To use this:

- Use the logic toolbar to select logic signals.
  This is enabled by default but to hide or show it, select **View** > **Logic Toolbar**.
- Zoom in or out of a logic diagram using the toolbar icon or select **View** > **Zoom Percent**.
- Right-click any logic signal and a context-sensitive menu appears.
- Certain logic elements show the **Properties…** option. Select this and a **Component Properties** window appears. The Component Properties window and the signals listed vary depending on the logic symbol selected.

The following subsections describe each of the available logic symbols.

4.2 Link Properties

Links form the logical link between the output of a signal, gate or condition and the input to any element.

Any link that is connected to the input of a gate can be inverted. Right-click the input and select **Properties…**. The **Link Properties** window appears.

Figure 2 - Link properties

4.2.1 Rules for Linking Symbols

An inverted link is shown with a small circle on the input to a gate. A link must be connected to the input of a gate to be inverted.

Links can only be started from the output of a signal, gate, or conditioner, and can only be ended at an input to any element.

Signals can only be an input or an output. To follow the convention for gates and conditioners, input signals are connected from the left and output signals to the right. The Editor automatically enforces this convention.

A link is refused for the following reasons:

- An attempt to connect to a signal that is already driven. The reason for the refusal may not be obvious because the signal symbol may appear elsewhere in the diagram.

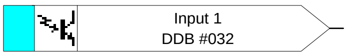
  Right-click the link and select Highlight to find the other signal. Click anywhere on the diagram to disable the highlight.

- An attempt is made to repeat a link between two symbols. The reason for the refusal may not be obvious because the existing link may be represented elsewhere in the diagram.

4.3 Opto Signal Properties

Each opto input can be selected and used for programming in PSL. Activation of the opto input drives an associated DDB signal.

For example, activating opto Input L1 asserts DDB 032 in the PSL for the P14x, P34x, P44y, P445, P54x, P547, P74x, P746, P841, P849 products.

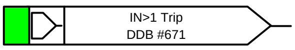


DDB Nos	*“Input 1 DDB #064” applies to: P24x, P64x.* *“Opto Label DDB #064” applies to: P44x.*

4.4 Input Signal Properties

Relay logic functions provide logic output signals that can be used for programming in PSL. Depending on the relay functionality, operation of an active relay function drives an associated DDB signal in PSL.

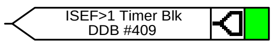
For example, DDB 671 is asserted in the PSL for the P44y, P547 & P841 product if the active earth fault 1, stage 1 protection operate/trip.



4.5 Output Signal Properties

Relay logic functions provide logic input signals that can be used for programming in PSL. Depending on the relay functionality, activation of the output signal will drive an associated DDB signal in PSL and cause an associated response to the relay function.

For example, if DDB 409 is asserted in the PSL for the P44y, P54x, P547 and P841 product, it will block the sensitive earth function stage 1 timer.

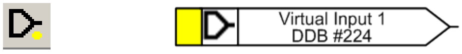


4.6 GOOSE Input Signal Properties

The PSL interfaces with the GOOSE Scheme Logic using virtual inputs. The Virtual Inputs can be used in much the same way as the Opto Input signals.

The logic that drives each of the Virtual Inputs is contained within the relay's GOOSE Scheme Logic file. It is possible to map any number of bit-pairs, from any enrolled device, using logic gates onto a Virtual Input (see Easergy Studio (MiCOM S1 Studio) User Manual for more details). The number of available GOOSE virtual inputs is shown in the *Programmable Logic* chapter.

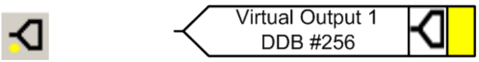
For example DDB 224 will be asserted in PSL for the P44y, P54x, P547 & P841 product should virtual input 1 operate.



4.7 GOOSE Output Signal Properties

The PSL interfaces with the GOOSE Scheme Logic using 32 virtual outputs. Virtual outputs can be mapped to bit-pairs for transmitting to any enrolled devices.

For example if DDB 256 is asserted in PSL for the P44y, P54x, P547 and P841 product, Virtual Output 32 and its associated mappings will operate.



4.8 Control In Signal Properties

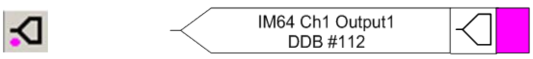
There are 32 control inputs which can be activated via the relay menu, 'hotkeys' or via rear communications. Depending on the programmed setting i.e. latched or pulsed, an associated DDB signal will be activated in PSL when a control input is operated

For example, when operated control input 1 will assert DDB 192 in the PSL for the P44y, P54x, P547 and P841 products.

4.9 InterMiCOM Output Commands Properties

Important	**This does not apply to these products: P24x, P34x, P44x, P64x, P547, P74x, P746, P841 & P849.**

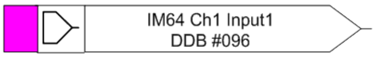
There are 16 InterMiCOM outputs that could be selected and use for teleprotection, remote commands, etc. "InterMiCOM Out" is a send command to a remote end that could be mapped to any logic output or opto input. This will be transmitted to the remote end as corresponding "InterMiCOM In" command for the P14x, P44y, P445 & P54x products.



4.10 InterMiCOM Input Commands Properties

Important	**This does not apply to these products: P24x, P34x, P44x, P64x, P547, P74x, P746, P841 & P849.**

There are 16 InterMiCOM inputs that could be selected and use for teleprotection, remote commands, etc. “InterMiCOM In” is a received signal from remote end that could be mapped to a selected output relay or logic input for the P14x, P44y, P445 & P54x, product.

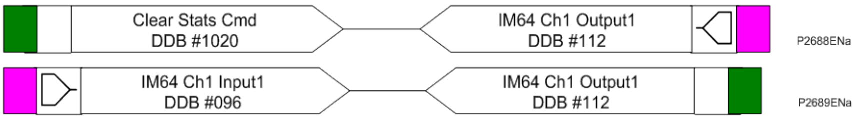


Example:

Relay End A — At end A, InterMiCOM Output 1 is mapped to the command indication “Clear Statistics” (issued at end A).

Relay End B — At end B, InterMiCOM Input 1 is mapped to the command “Clear Statistics”.

Upon receive of IM64 1 from relay at end A, the relay at end B will reset its statistics.



4.11 Function Key Properties

Each function key can be selected and used for programming in PSL. Activation of the function key will drive an associated DDB signal and the DDB signal will remain active depending on the programmed setting i.e. toggled or normal. Toggled mode means the DDB signal will remain latched or unlatched on key press and normal means the DDB will only be active for the duration of the key press.

For example, operate function key 1 to assert DDB 1096 in the PSL for the P44y, P54x, P547 or P841 products.

4.12 Fault Recorder Trigger Properties

The fault recording facility can be activated by driving the fault recorder trigger DDB signal.

For example assert DDB 702 to activate the fault recording in the PSL for the P44y, P54x, P547 or P841 product.

4.13 LED Signal Properties

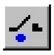
All programmable LEDs will drive associated DDB signal when the LED is activated.

For example DDB 1036 will be asserted when LED 7 is activated for the P44y, P54x, P547 or P841 product.

4.14 Contact Signal Properties

All relay output contacts will drive associated DDB signal when the output contact is activated.

For example, DDB 009 will be asserted when output R10 is activated for all products.



4.15 LED Conditioner Properties

1. Select the **LED name** from the list (only shown when inserting a new symbol).

2. Configure the LED output to be Red, Yellow or Green.

   Configure a Green LED by driving the Green DDB input.
   Configure a RED LED by driving the RED DDB input.
   Configure a Yellow LED by driving the RED and GREEN DDB inputs simultaneously.

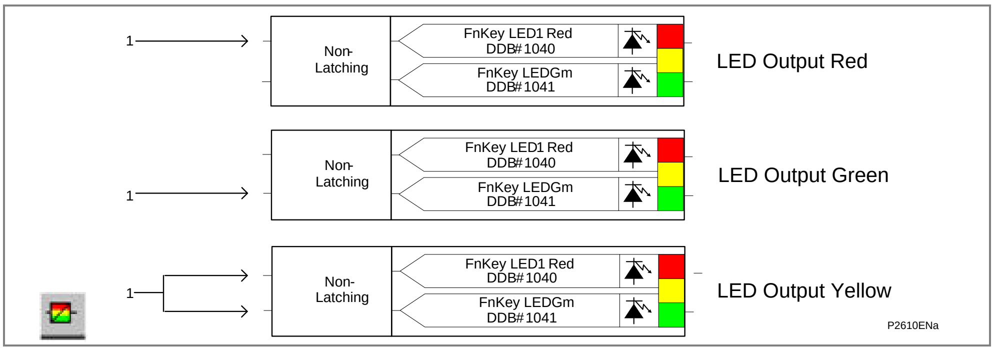


Figure 3 - Red, green and yellow LED outputs

3. Configure the LED output to be latching or non-latching.

DDB #642 and DDB #643 applies to these products: P14x, P44x, P74x, P746 and P849.

DDB #1040 and DDB #1041 applies to these products: P24x, P34x, P44y, P54x, P547, P64x and P841.

4.16 Contact Conditioner Properties

Each contact can be conditioned with an associated timer that can be selected for pick up, drop off, dwell, pulse, pick-up/drop-off, straight-through, or latching operation.

Straight-through means it is not conditioned in any way whereas **Latching** is used to create a sealed-in or lockout type function.

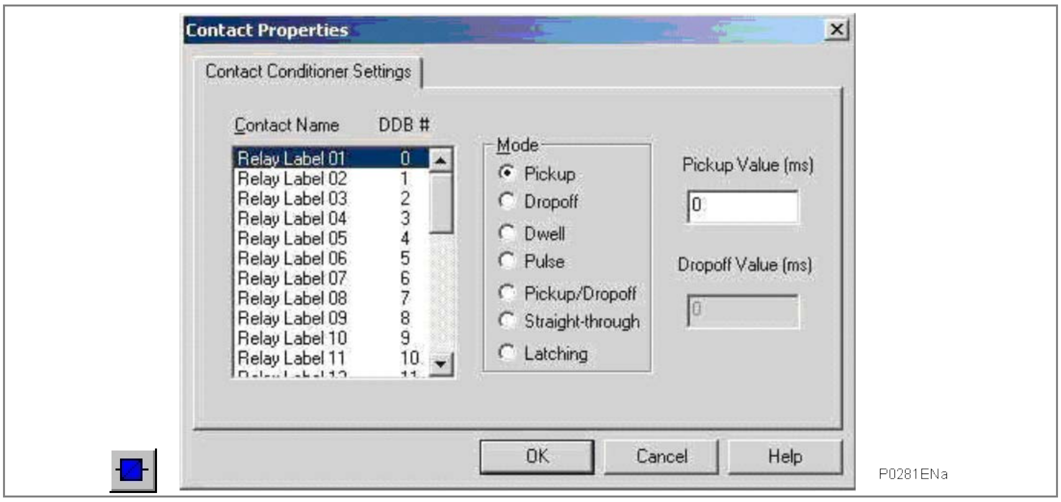


Figure 4 - Contact conditioner settings

1. Select the contact **name** from the **Contact Name** list (only shown when inserting a new symbol).
2. Choose the conditioner type required in the **Mode** tick list.
3. Set the **Pick-up** Time (in milliseconds), if required.
4. Set the **Drop-off** Time (in milliseconds), if required.

4.17 Timer Properties

Each timer can be selected for pick up, drop off, dwell, pulse or pick-up/drop-off operation.

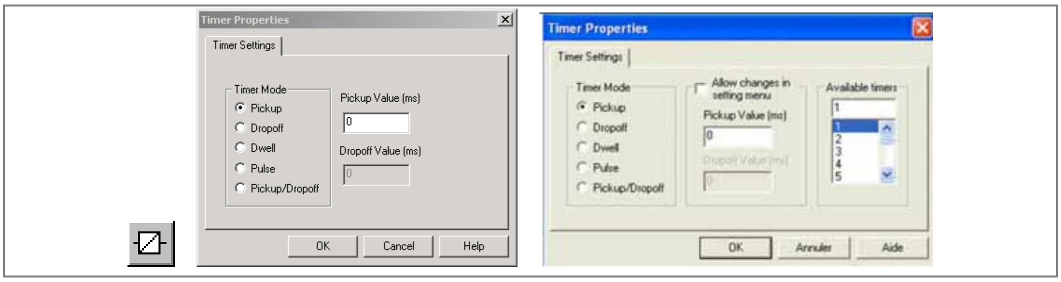


Figure 5 - Timer settings

1. Choose the operation mode from the **Timer Mode** tick list.
2. Set the Pick-up Time (in milliseconds), if required.
3. Set the Drop-off Time (in milliseconds), if required.

4.18 Gate Properties

A Gate may be an AND, OR, or programmable gate.

	An **AND** gate requires that all inputs are TRUE for the output to be TRUE.
	An **OR** gate requires that one or more input is TRUE for the output to be TRUE.
	A **Programmable** gate requires that the number of inputs that are TRUE is equal to or greater than its 'Inputs to Trigger' setting for the output to be TRUE.

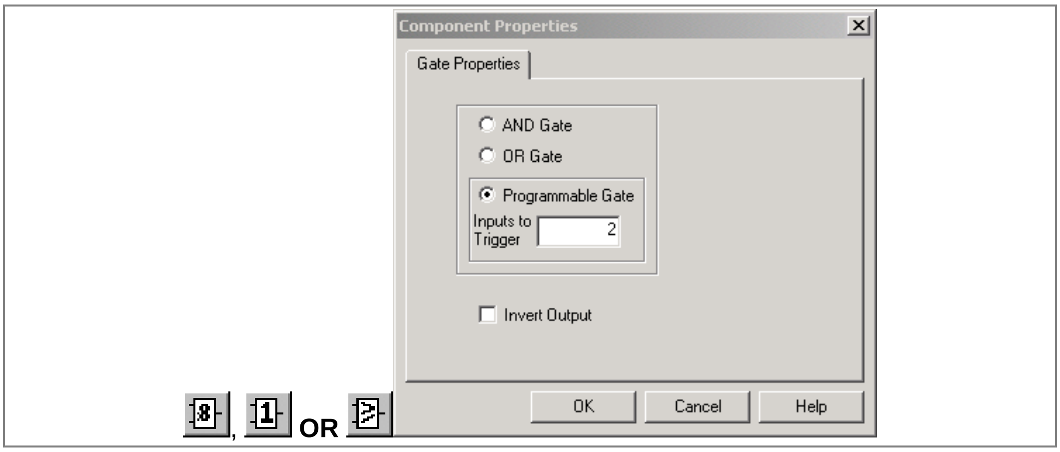


Figure 6 - Gate properties

1. Select the Gate type AND, OR, or Programmable.
2. Set the number of inputs to trigger when Programmable is selected.
3. Select if the output of the gate should be inverted using the Invert Output check box. An inverted output is indicated with a "bubble" on the gate output.

4.19 SR Programmable Gate Properties

For many products a number of programmable SR Latches are added. They are configured by an appropriate version of PSL Editor (S1v2.14 version 5.0.0 or greater) where an SRQ icon features on the toolbar.

Each SR latch has a Q output. The Q output may be inverted in the PSL Editor under the SR Latch component properties window. The SR Latches may be configured as Standard (no input dominant), Set Dominant or Reset Dominant in the PSL Editor under the SR Latch component properties window. The truth table for the SR Latches is given below.

A **Programmable** SR gate can be selected to operate with these latch properties:

S input	R input	O - Standard	O – Set input dominant	O – Rest input dominant
0	0	0	0	0
0	1	0	0	0
1	0	1	1	1
1	1	0	1	1

Table 1 - SR programmable gate properties

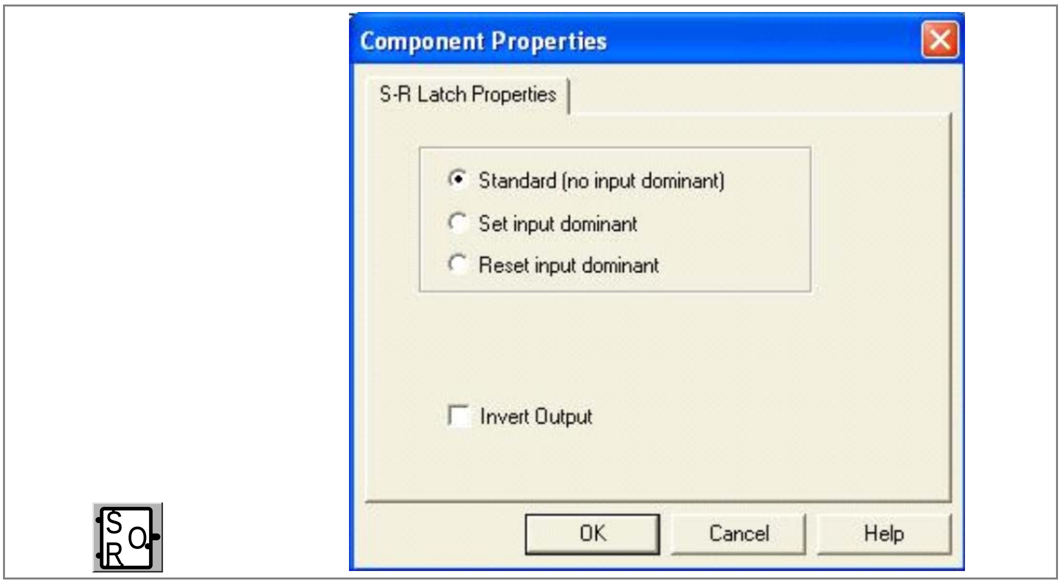


Figure 7 - SR latch component properties

Select if the output of the gate should be inverted using the Invert Output check box. An inverted output is indicated with a "bubble" on the gate output.

5 SPECIFIC TASKS (P44Y, P54X, P445 & P841 ONLY)

Note	MiCOM S1 Studio has been renamed as Easergy Studio.

5.1 PSL Signal Grouping Modes (P44y, P54x, P445 & P841 Software Version D1a and later)

PSL Signal Grouping Nodes

For Software Version D1a and later, these DDB “Group” Nodes can be mapped to individual or multiple DDBs in the PSL:

PSL Group Sig 1
PSL Group Sig 2
PSL Group Sig 3
PSL Group Sig 4

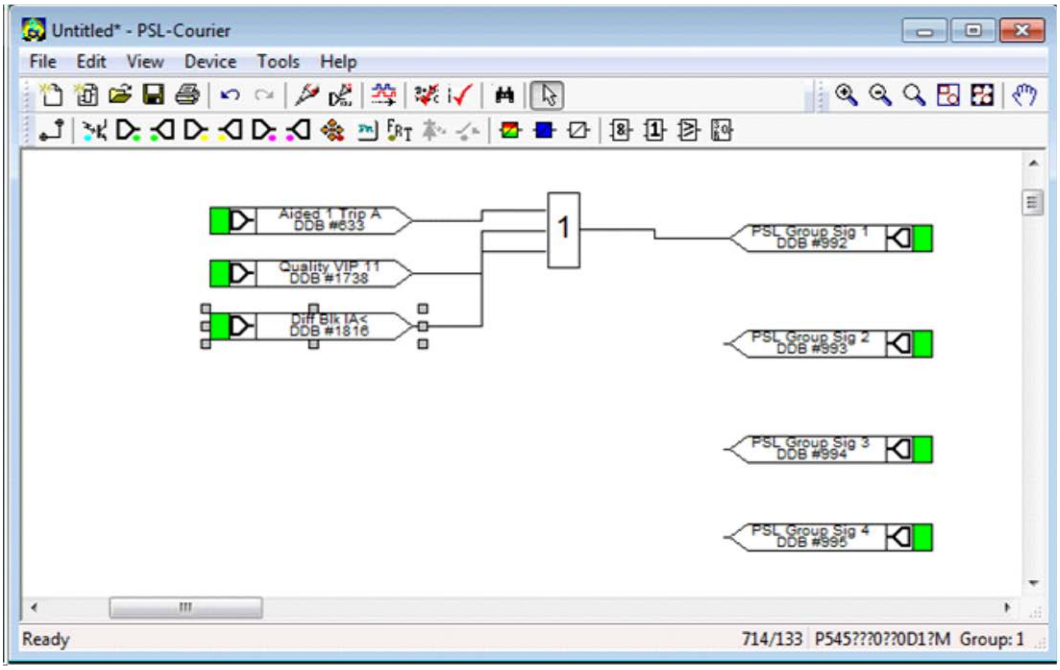
There are now four additional ***DDB Group Sig x*** Nodes that can be mapped to individual or multiple DDBs in the PSL. These can then be set to trigger the DR via the DISTURBANCE RECORD menu.

These "Nodes" are general and can also be used to group signals together in the PSL for any other reason. These four nodes are available in each of the four PSL setting groups.

Number	PSL Group Sig
992	PSL Group Sig 1
993	PSL Group Sig 2
994	PSL Group Sig 3
995	PSL Group Sig 4

1. For a control input, the DR can be triggered directly by triggering directly from the Individual Control Input (e.g. Low to High (L to H) change)
2. For an input that cannot be triggered directly, or where any one of a number of DDBs are required to trigger a DR, map the DDBs to the new PSL Group sig n and then trigger the DR on this.

e.g. in the PSL:



P0638ENa

Figure 8 - PSL diagram

In the DR Settings:

- Digital Input 1 is triggered by the PSL Group Sig 1 (L to H)
- Digital Input 2 is triggered by Control Input 1 (L to H)

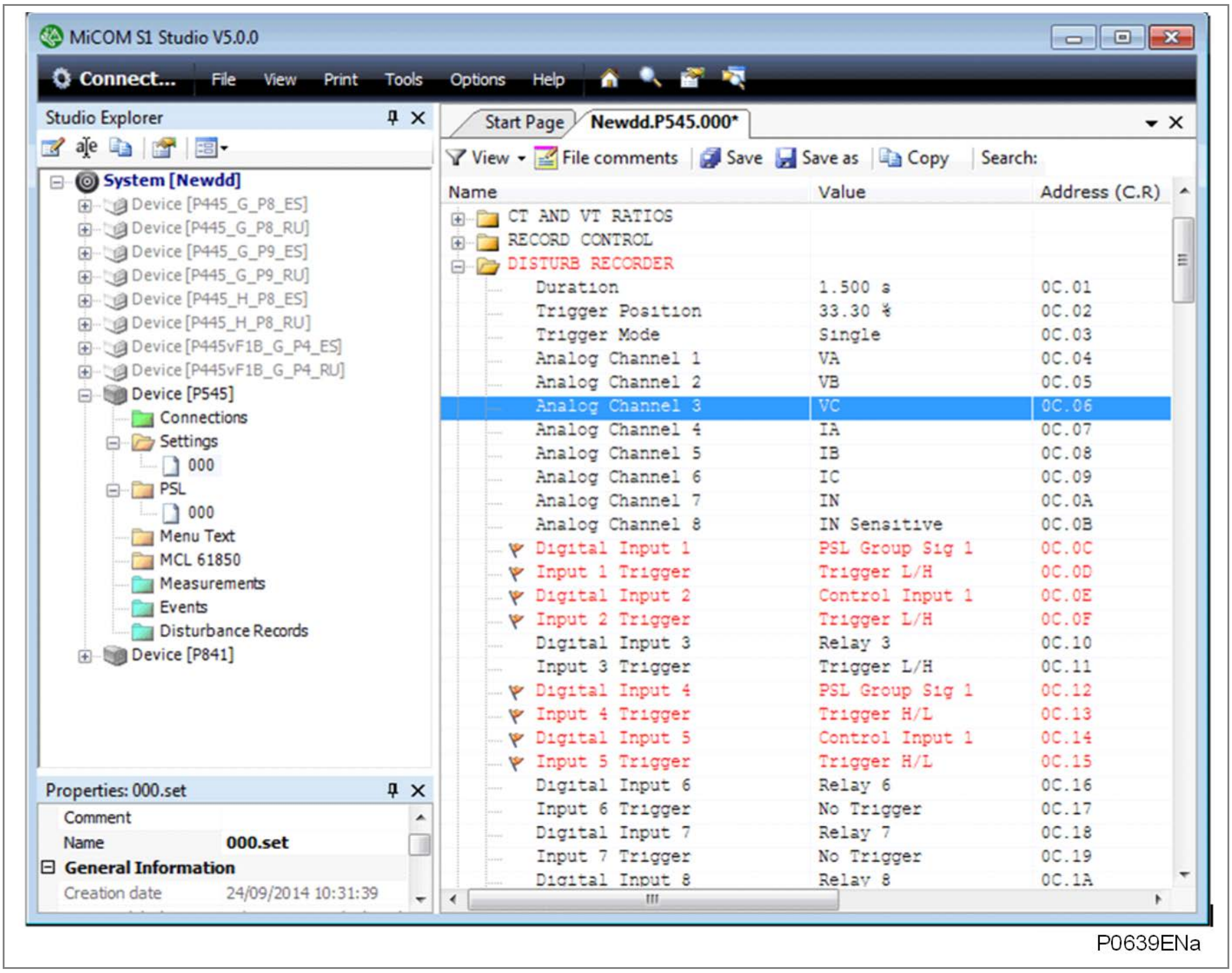


Figure 9 – Easergy Studio (MiCOM S1 Studio) Disturb Recorder table diagram

If triggering on both edges is required map another DR channel to the H/L as well

Digital Input 4 is triggered by the PSL Group Sig 1 (H to L)

Digital Input 5 is triggered by Control Input 1 (H to L)

5.2 Digital Input Label Operation (P44y, P54x, P445 & P841 Software Version D1a and later)

The digital input labels can be modified via the MiCOM P54X User Interface or S1 Studio. The following example is using S1 Studio Version 5.0.0.

The digital input labels are available in the “DR CHAN LABELS” folder in the settings file as shown below:

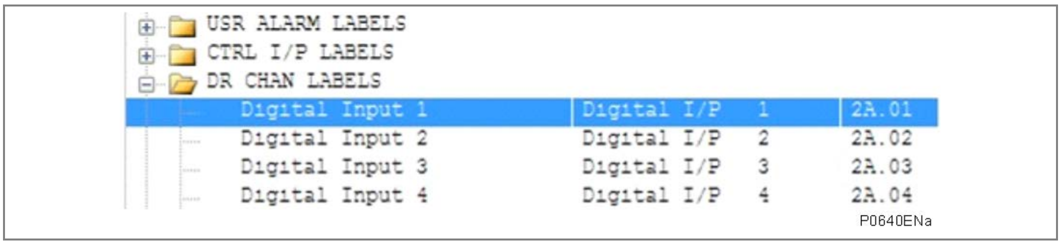


Figure 10 - DR Chan Labels tree

Easergy Studio (MiCOM S1 Studio) removes leading spaces from the value field so making the ‘D’ look as if it’s the 1st character in the label. The default values above in fact have a leading space which is used to switch off the use of the label as show below in the change settings view.

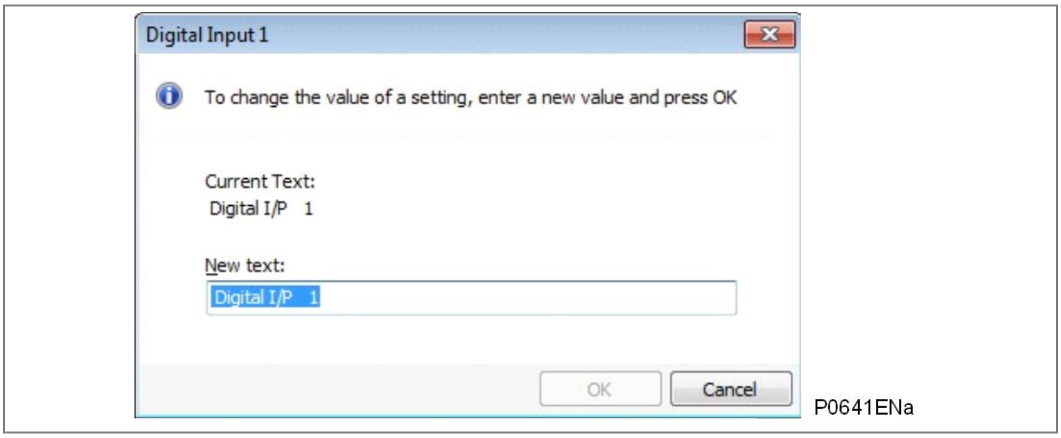


Figure 11 - Digital Input 1 dialog box

Pressing OK will save the setting and return to the settings page as follows:

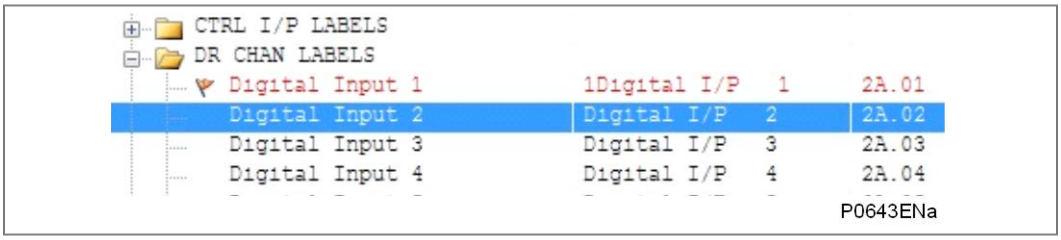


Figure 12 - DR Chan Labels tree

Digital Input 1 label will now be used in the Disturbance Record when the settings file is downloaded to the relay.

5.3 Virtual Input Label Operation (P44y, P54x, P445 & P841 Software Version C1 and later)

The Virtual input labels can be modified via the MiCOM P54X User Interface or S1 Studio. The following example is using MiCOM S1 Studio Version 5.0.0.

The default labels are available in the “VIR I/P LABELS” (or “VIRT I/P LABELS”) folder in the settings file as shown below:

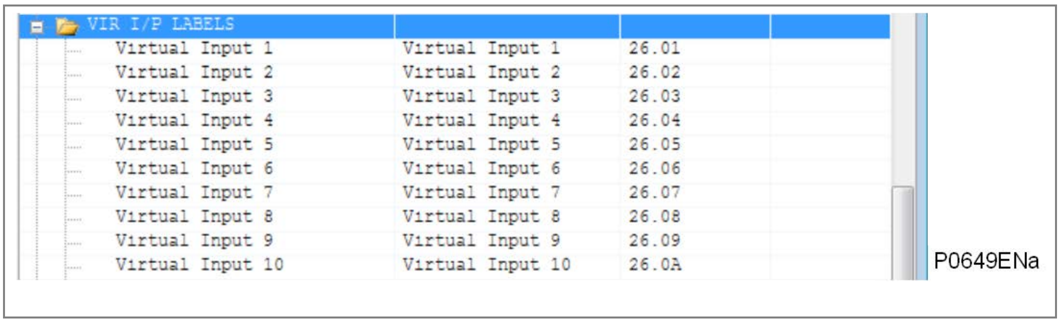


Figure 13 - MiCOM S1 Studio VIR I/P Labels Tree

The default “Virtual Input” labels can be changed to suit the customer requirements. For example, to change default text from “Virtual Input 1” to “Customer Func 1” open the ***Virtual Input 1*** dialog box, and change “Virtual Input 1” in the ***New Text:*** text box to be “Customer Func 1”, as follows:

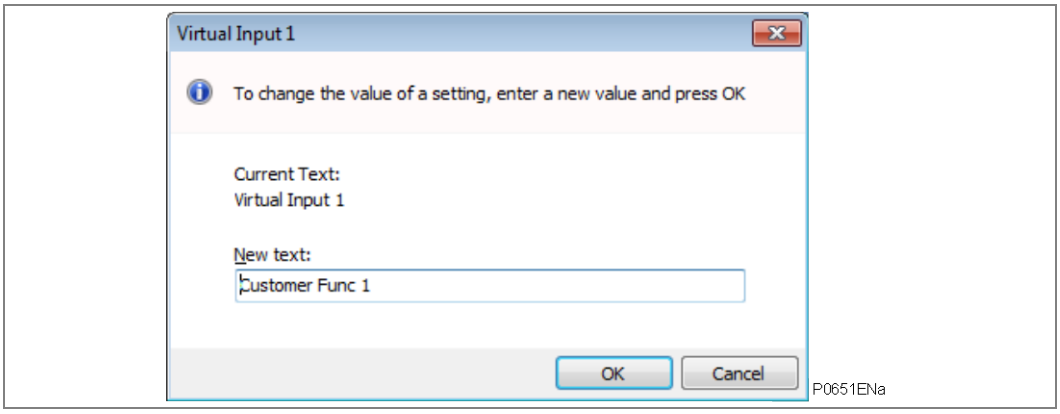


Figure 14 - Virtual Input 1 dialog box

Pressing OK will save the setting and return to the settings page as follows:

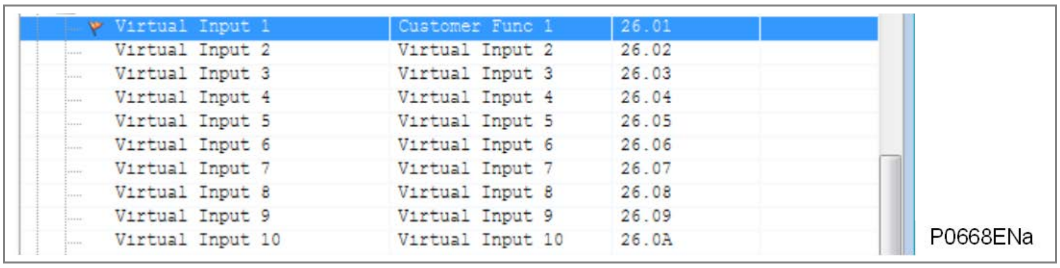


Figure 15 - Easergy Studio (MiCOM S1 Studio) VIR I/P Labels Tree

The above “Customer Func 1” label text will now be used in place of “Virtual Input 1” in the Disturbance / Event Records after the settings file is downloaded to the relay.

5.4 Virtual Output Label Operation (P44y, P54x, P445 & P841 Software Version C1 and later)

The Virtual Output labels can be modified via the MiCOM P54X User Interface or S1 Studio. The following example is using S1 Studio Version 5.0.0.

The virtual Output labels are available in the “VIR O/P LABELS” ” (or “VIRT O/P LABELS”) folder in the settings file as shown below:

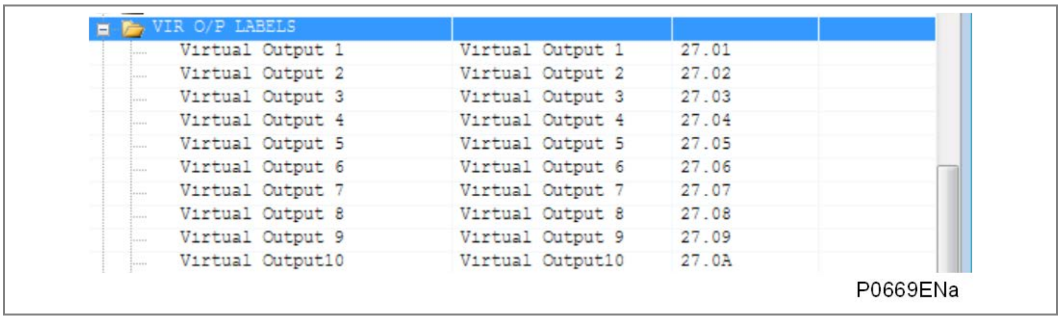


Figure 16 - Easergy Studio (MiCOM S1 Studio) VIR O/P Labels Tree

The default “Virtual Output Labels” can be changed to suit the customer requirements. The process is identical to the previously described procedure for the Virtual Input Labels.

5.5 SR/MR User Alarm Label Operation (P44y, P54x, P445 & P841 Software Version C1 and later)

The SR/MR User Alarm input labels can be modified via the MiCOM P54X User Interface or Easergy Studio (MiCOM S1 Studio). The following example is using S1 Studio Version 5.0.0.

The default labels are available in the "USR ALARM LABELS" folder in the settings file as shown below:

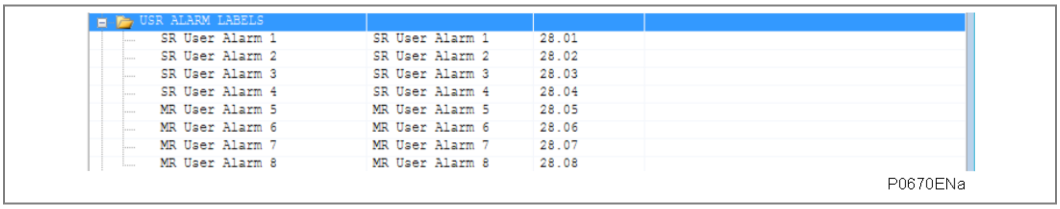


Figure 17 - Easergy Studio (MiCOM S1 Studio) USR Labels Tree

The default "SR User Alarm" and "MR User Alarm" labels can be changed to suit the customer requirements. For example, to change default text from "SR User Alarm 1" to "Customer Alarm 1" open the ***SR User Alarm 1*** dialog box and change "SR User Alarm 1" in the ***New Text:*** Text box to be "Customer Alarm 1".

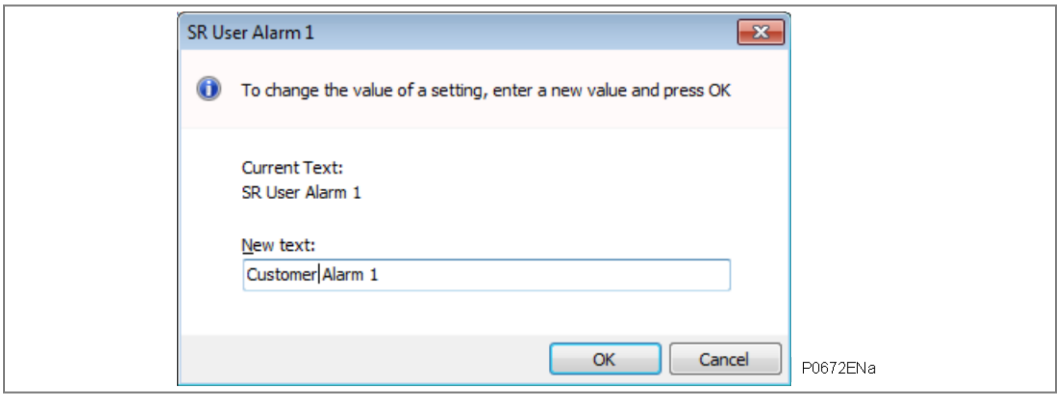


Figure 18 - Virtual Input 1 dialog box

Pressing OK will save the setting and return to the settings page as follows:

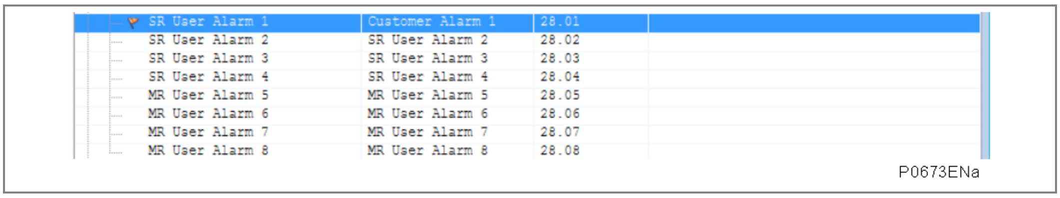


Figure 19 - Virtual Input 1 settings

The above "Customer Alarm 1" label text will now be used in place of "SR User Alarm 1" in the Disturbance / Event Records after the settings file is downloaded to the relay.

5.6 Settable Control Input Operation (P44y, P54x, P445 & P841 Software Version C1 and later)

The settings should be applied to all relays in the current differential protection scheme.

As from Software Versions C1/D1/F1/G4/H4/J4, there are now 32 standard Control Inputs and 16 additional Settable control Inputs available. These are settable via the “CONTROL INPUTS” folder and are located after the standard “Control Input” labels in the relevant settings file.

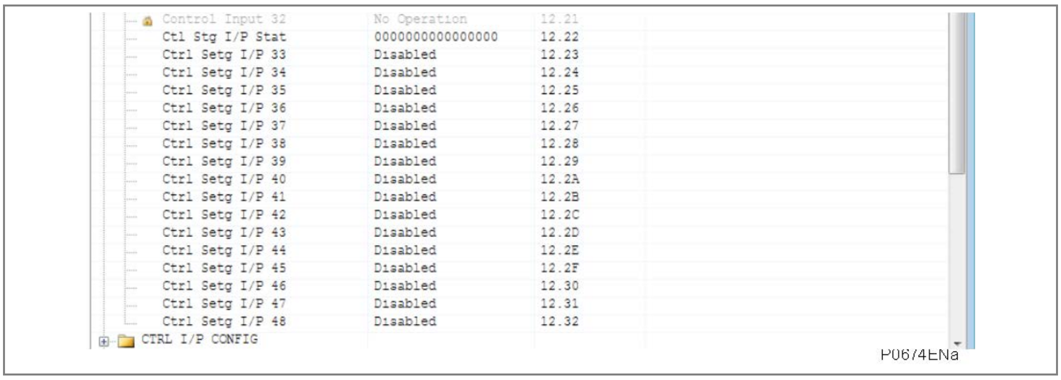


Figure 20 - Easergy Studio (MiCOM S1 Studio) Control Inputs tree

Each Settable control Input “Ctrl Setg I/P xx” can be controlled using Enable / Disable settings. To change from (the default) Disabled to Enabled, open the ***Ctrl Setg I/P xx*** dialog box, then change Disabled to Enabled in the ***New Setting*** drop-down list box:

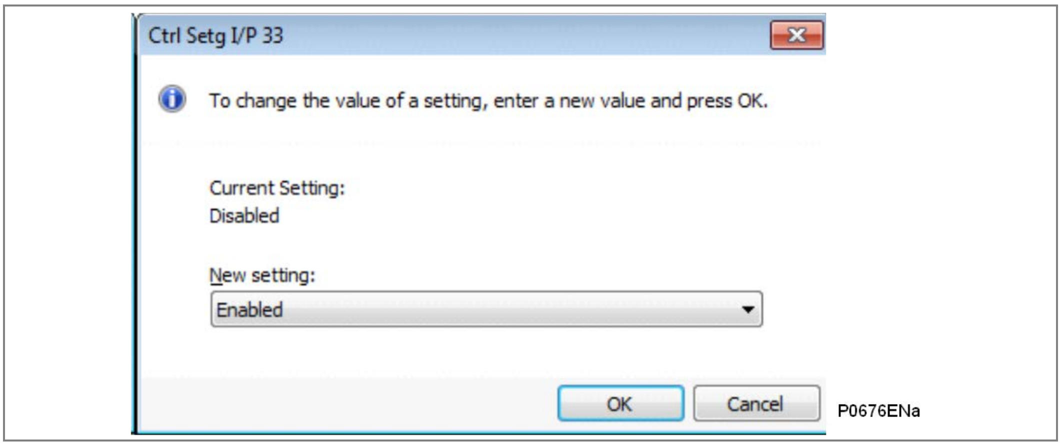


Figure 21 – Ctrl Setg I/P 33 dialog box

Pressing OK will save the setting and return to the settings page as follows:

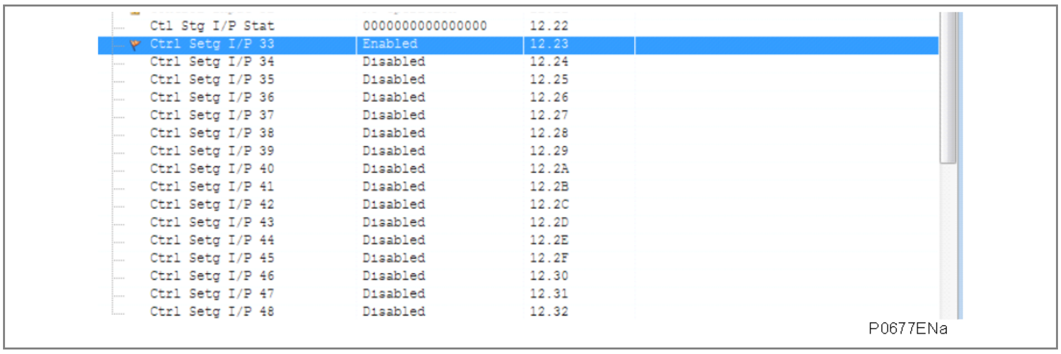


Figure 22 - Easergy Studio (MiCOM S1 Studio) Control Inputs (Ctl Setg I/P 33) tree

The setting “Ctl Stg I/P Stat” can be used to control multiple “Ctrl Setg I/P” at the same time, e.g. clear Ctrl Setg I/P 33 and set Ctrl Setg I/P 34 to 38, but please note that the status will not be reflected in the individual inputs settings or vice versa.

This cell may be hidden in the Easergy Studio (MiCOM S1 Studio) files.

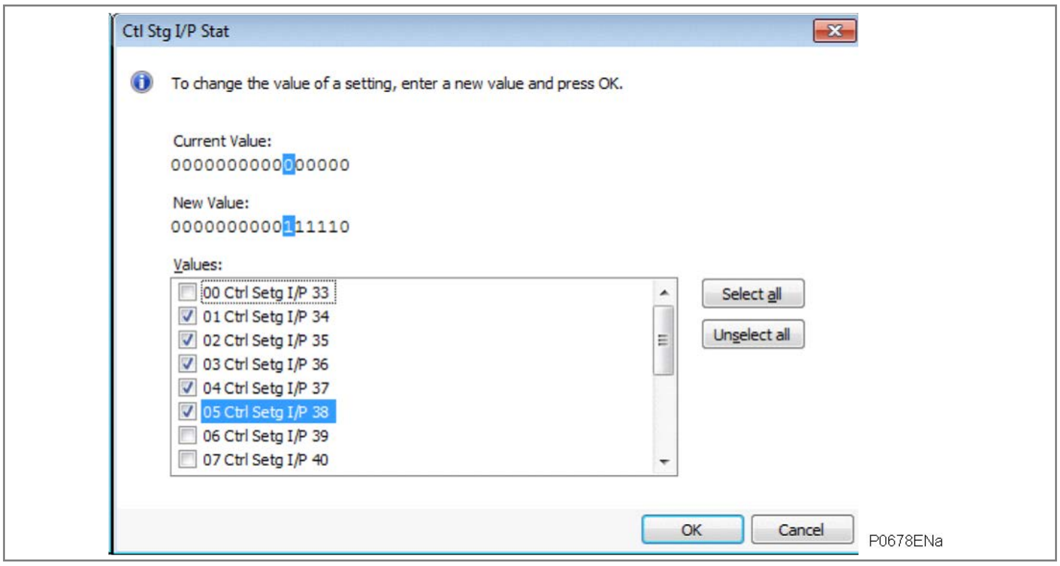


Figure 23 – Ctrl Stg I/P Stat dialog box

5.7 Settable Control Setg I/P Label Operation (P44y, P54x, P445 & P841 Software Version C1 and later)

The default labels are available in the “CTRL I/P LABELS” folder and are located after the standard “Control Input” labels in the settings file as shown below:

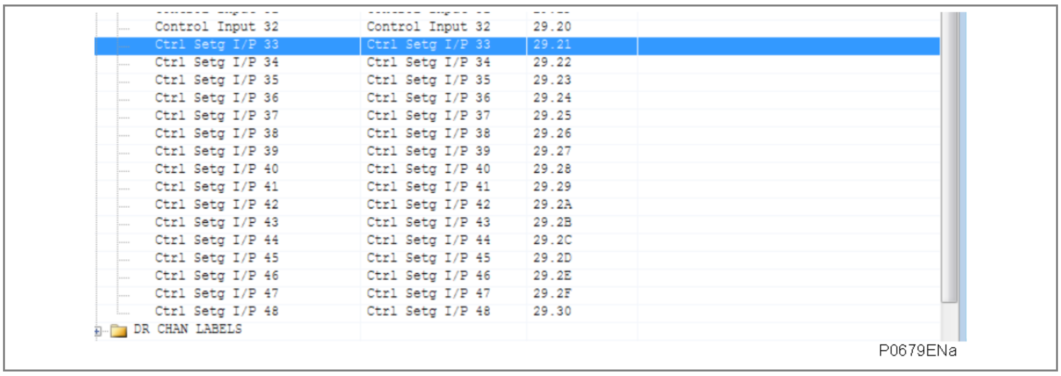


Figure 24 - Easergy Studio (MiCOM S1 Studio) Control I/P Labels (Ctl Setg I/P 33) tree

The default “Ctrl Setg I/P” labels can be changed to suit the customer requirements using the same procedure as for the standard “Control Inputs”. For example to change the default text from “Ctrl Setg I/P 33” to “Custom Ctrl Sg 1” open the ***Ctrl Setg I/P 33*** dialog box, then change “Ctrl Setg I/P 33” in the ***New Text:*** box to be “Custom Ctrl Sg 1”.

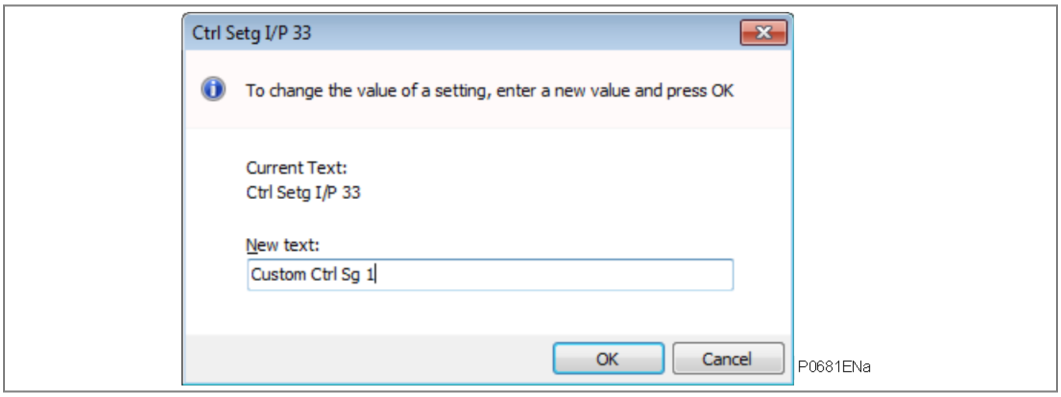


Figure 25 – Ctrl Setg I/P 33 dialog box

Pressing OK will save the setting and return to the settings page as follows:

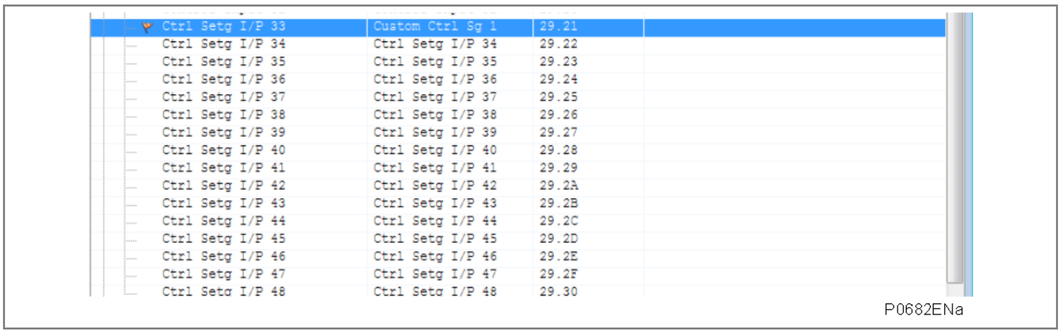


Figure 26 - Easergy Studio (MiCOM S1 Studio) Control I/P Labels (Ctl Setg I/P 33) tree

The above “Custom Ctrl Sg 1” label text will now be used in place of “Ctrl Setg I/P 33” in the Disturbance / Event Records after the settings file is downloaded to the relay.

6 MAKING A RECORD OF MICOM PX40 DEVICE SETTINGS

6.1 Using Easergy Studio (MiCOM S1 Studio) to Manage Device Settings

An engineer often needs to create a record of what settings have been applied to a device. In the past, they could have used paper printouts of all the available settings, and mark up the ones they had used. Keeping such a paper-based Settings Records could be time-consuming and prone to error (e.g. due to being settings written down incorrectly).

The Easergy Studio (MiCOM S1 Studio) software lets you read from or write to MiCOM devices.

- **Extract** lets you download all the settings from a MiCOM Px40 device. A summary is given in the ***Extract Settings from a MiCOM Px40 Device*** section.
- **Send** lets you send the settings you currently have open in Easergy Studio (MiCOM S1 Studio). A summary is given in the ***Send Settings to a MiCOM Px40 Device*** section.

In most cases, it will be quicker and less error prone to extract settings electronically and store them in a settings file on a memory stick. In this way, there will be a digital record which is certain to be accurate. It is also possible to archive these settings files in a repository; so they can be used again or adapted for another use.

Full details of how to do this is provided in the Easergy Studio (MiCOM S1 Studio) help.

A quick summary of the main steps is given here. In each case, you need to make sure that:

- Your computer includes the Easergy Studio (MiCOM S1 Studio) software.
- Your computer and the MiCOM device are powered on.
- You have used a suitable cable to connect your computer to the MiCOM device (Front Port, Rear Port, Ethernet port or Modem as available).

6.2 Extract Settings from a MiCOM Px40 Device

Full details of how to do this is provided in the Easergy Studio (MiCOM S1 Studio) help.

As a quick guide, you need to do the following:

1. In Easergy Studio (MiCOM S1 Studio), click the Quick Connect… button.
2. Select the relevant Device Type in the Quick Connect dialog box.
3. Click the relevant port in the Port Selection dialog box.
4. Enter the relevant connection parameters in the Connection Parameters dialog box and click the Finish button
5. Studio will try to communicate with the Px40 device. It will display a connected message if the connection attempt is successful.
6. The device will appear in the Studio Explorer pane on the top-left hand side of the interface.
7. Click the + button to expand the options for the device, then click on the Settings folder.
8. Right-click on Settings and select the Extract Settings link to read the settings on the device and store them on your computer or a memory stick attached to your computer.
9. After retrieving the settings file, close the dialog box by clicking the Close button.

6.3 Send Settings to a MiCOM Px40 Device

Full details of how to do this is provided in the Easergy Studio (MiCOM S1 Studio) help.

As a quick guide, you need to do the following:

1. In Easergy Studio (MiCOM S1 Studio), click the Quick Connect… button.
2. Select the relevant Device Type in the Quick Connect dialog box.
3. Click the relevant port in the Port Selection dialog box.
4. Enter the relevant connection parameters in the Connection Parameters dialog box and click the Finish button
5. Studio will try to communicate with the Px40 device. It will display a connected message if the connection attempt is successful.
6. The device will appear in the Studio Explorer pane on the top-left hand side of the interface.
7. Click the + button to expand the options for the device, then click on the Settings link.
8. Right-click on the device name and select the Send link.

Note	*When you send settings to a MiCOM Px40 device, the data is stored in a temporary location at first. This temporary data is tested to make sure it is complete. If the temporary data is complete, it will be programmed into the MiCOM Px40 device. This avoids the risk of a device being programmed with incomplete or corrupt settings.*

9. In the Send To dialog box, select the settings file(s) you wish to send, then click the Send button.
10. Close the the Send To dialog box by clicking the Close button.

PROGRAMMABLE LOGIC

CHAPTER 8

Date (month/year):	02/2017
Hardware suffix:	L (P742) & M (P741 & P743)
Software version:	B1
Connection diagrams:	10P740xx (xx = 01 to 07)

CONTENTS

TABLES

FIGURES

1 OVERVIEW

The purpose of the Programmable Scheme Logic (PSL) is to allow the user to configure an individual protection scheme to suit their own particular application. This is achieved through the use of programmable logic gates and delay timers.

The input to the PSL is any combination of the status of opto inputs. It is also used to assign the mapping of functions to the opto inputs and output contacts, the outputs of the protection elements, e.g. protection starts and trips, and the outputs of the fixed protection scheme logic. The fixed scheme logic provides the relay’s standard protection schemes.

The PSL itself consists of software logic gates and timers. The logic gates can be programmed to perform a range of different logic functions and can accept any number of inputs. The timers are used either to create a programmable delay, and/or to condition the logic outputs, e.g. to create a pulse of fixed duration on the output regardless of the length of the pulse on the input. The outputs of the PSL are the LEDs on the front panel of the relay and the output contacts at the rear.

The execution of the PSL logic is event driven; the logic is processed whenever any of its inputs change, for example as a result of a change in one of the digital input signals. Also, only the part of the PSL logic that is affected by the particular input change that has occurred is processed. This reduces the amount of processing time that is used by the PSL. This means that even with large, complex PSL schemes the device trip time will not lengthen.

This system provides flexibility for the user to create their own scheme logic design. It also means that the PSL can be configured into a very complex system, hence setting of the PSL is implemented through the PC support package MiCOM S1 Studio.

How to edit the PSL schemes is described in the “Using the PSL Editor” chapter.

This chapter contains details of the logic nodes which are specific to this product, together with any PSL diagrams which we have published for this product.

2 DESCRIPTION OF P741 LOGIC NODES

The following table shows the available DDB Numbers, a Description of what they are and which products they apply to. Where a range of DDB Numbers apply to a consecutively-numbered range of related items, the DDB Number range is shown. For example, DDB No 0 to 11 to cover Output Relay 1 to Output Relay 11; or 2nd Harmonic A to C to cover 2nd Harmonic A, 2nd Harmonic B and 2nd Harmonic C.
If a DDB Number is not shown, it is not used in this range of products.

P741 Logic Nodes			
DDB No	**Source**	**Description**	**Element Name**
0	SW	Relay 1	DDB_OUTPUT_RELAY_1
1	SW	Relay 2	DDB_OUTPUT_RELAY_2
2	SW	Relay 3	DDB_OUTPUT_RELAY_3
3	SW	Relay 4	DDB_OUTPUT_RELAY_4
4	SW	Relay 5	DDB_OUTPUT_RELAY_5
5	SW	Relay 6	DDB_OUTPUT_RELAY_6
6	SW	Relay 7	DDB_OUTPUT_RELAY_7
7	SW	Relay 8	DDB_OUTPUT_RELAY_8
8	SW	Reserve	DDB_OUTPUT_RELAY_9
9	SW	Reserve	DDB_OUTPUT_RELAY_10
10	SW	Reserve	DDB_OUTPUT_RELAY_11
11	SW	Reserve	DDB_OUTPUT_RELAY_12
12	SW	Reserve	DDB_OUTPUT_RELAY_13
13	SW	Reserve	DDB_OUTPUT_RELAY_14
14	SW	Reserve	DDB_OUTPUT_RELAY_15
15	SW	Reserve	DDB_OUTPUT_RELAY_16
16	SW	Reserve	DDB_OUTPUT_RELAY_17
17	SW	Reserve	DDB_OUTPUT_RELAY_18
18	SW	Reserve	DDB_OUTPUT_RELAY_19
19	SW	Reserve	DDB_OUTPUT_RELAY_20
20	SW	Reserve	DDB_OUTPUT_RELAY_21
21	SW	Reserve	DDB_OUTPUT_RELAY_22
22	SW	Reserve	DDB_OUTPUT_RELAY_23
23	SW	Reserve	DDB_OUTPUT_RELAY_24
24	SW	Reserve	DDB_OUTPUT_RELAY_25
25	SW	Reserve	DDB_OUTPUT_RELAY_26
26	SW	Reserve	DDB_OUTPUT_RELAY_27
27	SW	Reserve	DDB_OUTPUT_RELAY_28
28	SW	Reserve	DDB_OUTPUT_RELAY_29
29	SW	Reserve	DDB_OUTPUT_RELAY_30
30	SW	Reserve	DDB_OUTPUT_RELAY_31
31	SW	Reserve	DDB_OUTPUT_RELAY_32
32	SW	Reserve	DDB_OUTPUT_RELAY_33
33	SW	Reserve	DDB_OUTPUT_RELAY_34
34	SW	Reserve	DDB_OUTPUT_RELAY_35
35	SW	Reserve	DDB_OUTPUT_RELAY_36
36	SW	Reserve	DDB_OUTPUT_RELAY_37
37	SW	Reserve	DDB_OUTPUT_RELAY_38
38	SW	Reserve	DDB_OUTPUT_RELAY_39

P741 Logic Nodes			
DDB No	**Source**	**Description**	**Element Name**
39	SW	Reserve	DDB_OUTPUT_RELAY_40
40	SW	Reserve	DDB_OUTPUT_RELAY_41
41	SW	Reserve	DDB_OUTPUT_RELAY_42
42	SW	Reserve	DDB_OUTPUT_RELAY_43
43	SW	Reserve	DDB_OUTPUT_RELAY_44
44	SW	Reserve	DDB_OUTPUT_RELAY_45
45	SW	Reserve	DDB_OUTPUT_RELAY_46
46	SW	Reserve	DDB_OUTPUT_RELAY_47
47	SW	Reserve	DDB_OUTPUT_RELAY_48
48	SW	Reserve	DDB_OUTPUT_RELAY_49
49	SW	Reserve	DDB_OUTPUT_RELAY_50
50	SW	Reserve	DDB_OUTPUT_RELAY_51
51	SW	Reserve	DDB_OUTPUT_RELAY_52
52	SW	Reserve	DDB_OUTPUT_RELAY_53
53	SW	Reserve	DDB_OUTPUT_RELAY_54
54	SW	Reserve	DDB_OUTPUT_RELAY_55
55	SW	Reserve	DDB_OUTPUT_RELAY_56
56	SW	Reserve	DDB_OUTPUT_RELAY_57
57	SW	Reserve	DDB_OUTPUT_RELAY_58
58	SW	Reserve	DDB_OUTPUT_RELAY_59
59	SW	Reserve	DDB_OUTPUT_RELAY_60
60	SW	Reserve	DDB_OUTPUT_RELAY_61
61	SW	Reserve	DDB_OUTPUT_RELAY_62
62	SW	Reserve	DDB_OUTPUT_RELAY_63
63	SW	Reserve	DDB_OUTPUT_RELAY_64
64	SW	Opto Input 1	DDB_OPTO_ISOLATOR_1
65	SW	Opto Input 2	DDB_OPTO_ISOLATOR_2
66	SW	Opto Input 3	DDB_OPTO_ISOLATOR_3
67	SW	Opto Input 4	DDB_OPTO_ISOLATOR_4
68	SW	Opto Input 5	DDB_OPTO_ISOLATOR_5
69	SW	Opto Input 6	DDB_OPTO_ISOLATOR_6
70	SW	Opto Input 7	DDB_OPTO_ISOLATOR_7
71	SW	Opto Input 8	DDB_OPTO_ISOLATOR_8
72	SW	Reserve	DDB_OPTO_ISOLATOR_9
73	SW	Reserve	DDB_OPTO_ISOLATOR_10
74	SW	Reserve	DDB_OPTO_ISOLATOR_11
75	SW	Reserve	DDB_OPTO_ISOLATOR_12
76	SW	Reserve	DDB_OPTO_ISOLATOR_13
77	SW	Reserve	DDB_OPTO_ISOLATOR_14
78	SW	Reserve	DDB_OPTO_ISOLATOR_15
79	SW	Reserve	DDB_OPTO_ISOLATOR_16
80	SW	Reserve	DDB_OPTO_ISOLATOR_17
81	SW	Reserve	DDB_OPTO_ISOLATOR_18
82	SW	Reserve	DDB_OPTO_ISOLATOR_19
83	SW	Reserve	DDB_OPTO_ISOLATOR_20
84	SW	Reserve	DDB_OPTO_ISOLATOR_21

P741 Logic Nodes			
DDB No	Source	Description	Element Name
85	SW	Reserve	DDB_OPTO_ISOLATOR_22
86	SW	Reserve	DDB_OPTO_ISOLATOR_23
87	SW	Reserve	DDB_OPTO_ISOLATOR_24
88	SW	Reserve	DDB_OPTO_ISOLATOR_25
89	SW	Reserve	DDB_OPTO_ISOLATOR_26
90	SW	Reserve	DDB_OPTO_ISOLATOR_27
91	SW	Reserve	DDB_OPTO_ISOLATOR_28
92	SW	Reserve	DDB_OPTO_ISOLATOR_29
93	SW	Reserve	DDB_OPTO_ISOLATOR_30
94	SW	Reserve	DDB_OPTO_ISOLATOR_31
95	SW	Reserve	DDB_OPTO_ISOLATOR_32
96	PSL	Reserve	UNUSED_96
97	PSL	Reserve	UNUSED_97
98	PSL	Reserve	UNUSED_98
99	PSL	Reserve	UNUSED_99
100	PSL	Reserve	UNUSED_100
101	PSL	Reserve	UNUSED_101
102	PSL	Reserve	UNUSED_102
103	PSL	Reserve	UNUSED_103
104	PSL	TS active group least significant bit	TS_SETTING_GROUP_LSB
105	PSL	TS active group most significant bit	TS_SETTING_GROUP_MSB
106	PSL	Acquisition defect wiring	TS_RESET_CIRCUITRY_FAULT
107	PSL	Starting disturbance	START_DISTURBANCE_RECORDER
108	PSL	Blocking 87BB phase and earth	TS_BLOCK_87BB
109	PSL	TS reset latched led / relay PSL	TS_RESET_LATCHES
110	PSL	PU defect recognition	TS_RESET_PU_ERROR
111	PSL	Block all PU / CU protection	TS_ALL_PROT_DISABLED
112	PSL	Virtual CT 1 CU->PU	VIRTUAL_TC_1
113	PSL	Virtual TC 2 CU->PU	VIRTUAL_TC_2
114	PSL	Virtual TC 3 CU->PU	VIRTUAL_TC_3
115	PSL	Virtual TC 4 CU->PU	VIRTUAL_TC_4
116	PSL	Virtual CT 5 CU->PU	VIRTUAL_TC_5
117	PSL	Virtual TC 6 CU->PU	VIRTUAL_TC_6
118	PSL	Virtual TC 7 CU->PU	VIRTUAL_TC_7
119	PSL	Virtual TC 8 CU->PU	VIRTUAL_TC_8
120	PSL	Virtual CT 9 CU->PU	VIRTUAL_TC_9
121	PSL	Virtual TC 10 CU->PU	VIRTUAL_TC_10
122	PSL	Virtual CT 11 CU->PU	VIRTUAL_TC_11
123	PSL	Virtual CT 12 CU->PU	VIRTUAL_TC_12
124	PSL	Virtual TC 13 CU->PU	VIRTUAL_TC_13
125	PSL	Virtual TC 14 CU->PU	VIRTUAL_TC_14
126	PSL	Virtual CT 15 CU->PU	VIRTUAL_TC_15
127	PSL	Virtual TC 16 CU->PU	VIRTUAL_TC_16
128	PSL	Reserve	UNUSED_128
129	PSL	Reserve	UNUSED_129
130	PSL	Reserve	UNUSED_130

P741 Logic Nodes			
DDB No	Source	Description	Element Name
131	PSL	Reserve	UNUSED_131
132	PSL	Reserve	UNUSED_132
133	PSL	Reserve	UNUSED_133
134	PSL	Reserve	UNUSED_134
135	SW	Communication Error	ALARM_MINOR
136	PSL	Reserve	UNUSED_136
137	PSL	Reserve	UNUSED_137
138	PSL	Reserve	UNUSED_138
139	PSL	Reserve	UNUSED_139
140	PSL	Reserve	UNUSED_140
141	PSL	Reserve	UNUSED_141
142	PSL	Reserve	UNUSED_142
143	PSL	Reserve	UNUSED_143
144	SW	Fault current zone 16	PU_ERR_BLOCK_BAR_8
145	SW	Fault current zone 15	PU_ERR_BLOCK_BAR_7
146	SW	Fault current zone 14	PU_ERR_BLOCK_BAR_6
147	SW	Fault current zone 13	PU_ERR_BLOCK_BAR_5
148	SW	Fault current zone 12	PU_ERR_BLOCK_BAR_4
149	SW	Fault current zone 11	PU_ERR_BLOCK_BAR_3
150	SW	Fault current zone 10	PU_ERR_BLOCK_BAR_2
151	SW	Fault current zone 9	PU_ERR_BLOCK_BAR_1
152	SW	Fault current zone 8	PU_ERR_ALARM_BAR_8
153	SW	Fault current zone 7	PU_ERR_ALARM_BAR_7
154	SW	Fault current zone 6	PU_ERR_ALARM_BAR_6
155	SW	Fault current zone 5	PU_ERR_ALARM_BAR_5
156	SW	Fault current zone 4	PU_ERR_ALARM_BAR_4
157	SW	Fault current zone 3	PU_ERR_ALARM_BAR_3
158	SW	Fault current zone 2	PU_ERR_ALARM_BAR_2
159	SW	Fault current zone 1	PU_ERR_ALARM_BAR_1
160	SW	Wiring fault zone 16	CIRCUITRY_FAULT_BLOCK_BAR_8
161	SW	Wiring fault zone 15	CIRCUITRY_FAULT_BLOCK_BAR_7
162	SW	Wiring fault zone 14	CIRCUITRY_FAULT_BLOCK_BAR_6
163	SW	Wiring fault zone 13	CIRCUITRY_FAULT_BLOCK_BAR_5
164	SW	Wiring Fault Zone 12	CIRCUITRY_FAULT_BLOCK_BAR_4
165	SW	Wiring Fault Zone 11	CIRCUITRY_FAULT_BLOCK_BAR_3
166	SW	Wiring fault area 10	CIRCUITRY_FAULT_BLOCK_BAR_2
167	SW	Wiring Fault Zone 9	CIRCUITRY_FAULT_BLOCK_BAR_1
168	SW	Wiring fault zone 8	CIRCUITRY_FAULT_BAR_8
169	SW	Wiring fault zone 7	CIRCUITRY_FAULT_BAR_7
170	SW	Wiring fault zone 6	CIRCUITRY_FAULT_BAR_6
171	SW	Wiring fault zone 5	CIRCUITRY_FAULT_BAR_5
172	SW	Wiring fault zone 4	CIRCUITRY_FAULT_BAR_4
173	SW	Wiring fault zone 3	CIRCUITRY_FAULT_BAR_3
174	SW	Wiring fault zone 2	CIRCUITRY_FAULT_BAR_2
175	SW	Wiring fault Zone 1	CIRCUITRY_FAULT_BAR_1
176	SW	Trip busbar zone 16	FAULT_CURRENT_BAR_8

P741 Logic Nodes			
DDB No	**Source**	**Description**	**Element Name**
177	SW	Trip busbar zone 15	FAULT_CURRENT_BAR_7
178	SW	Trip busbar zone 14	FAULT_CURRENT_BAR_6
179	SW	Trip busbar zone 13	FAULT_CURRENT_BAR_5
180	SW	Trip busbar zone 12	FAULT_CURRENT_BAR_4
181	SW	Trip busbar zone 11	FAULT_CURRENT_BAR_3
182	SW	Trip busbar zone 10	FAULT_CURRENT_BAR_2
183	SW	Trip busbar zone 9	FAULT_CURRENT_BAR_1
184	SW	Trip busbar zone 8	TRIP_BUSBAR_BAR_8
185	SW	Trip busbar zone 7	TRIP_BUSBAR_BAR_7
186	SW	Trip busbar zone 6	TRIP_BUSBAR_BAR_6
187	SW	Trip busbar zone 5	TRIP_BUSBAR_BAR_5
188	SW	Trip busbar zone 4	TRIP_BUSBAR_BAR_4
189	SW	Trip busbar zone 3	TRIP_BUSBAR_BAR_3
190	SW	Trip busbar zone 2	TRIP_BUSBAR_BAR_2
191	SW	Trip busbar zone 1	TRIP_BUSBAR_BAR_1
192	SW	Manual tripping zone 8	TRIP_MANUAL_BAR_8
193	SW	Manual tripping zone 7	TRIP_MANUAL_BAR_7
194	SW	Manual tripping zone 6	TRIP_MANUAL_BAR_6
195	SW	Manual tripping zone 5	TRIP_MANUAL_BAR_5
196	SW	Manual tripping zone 4	TRIP_MANUAL_BAR_4
197	SW	Manual tripping zone 3	TRIP_MANUAL_BAR_3
198	SW	Manual tripping zone 2	TRIP_MANUAL_BAR_2
199	SW	Manual tripping zone 1	TRIP_MANUAL_BAR_1
200	SW	Circuit Breaker Failure Zone 8	TRIP_BF_BAR_8
201	SW	Circuit Breaker Failure Zone 7	TRIP_BF_BAR_7
202	SW	Circuit Breaker Failure Zone 6	TRIP_BF_BAR_6
203	SW	Failure of circuit breaker zone 5	TRIP_BF_BAR_5
204	SW	Circuit Breaker Failure Zone 4	TRIP_BF_BAR_4
205	SW	Zone 3 Breaker Failure	TRIP_BF_BAR_3
206	SW	Circuit Breaker Failure Zone 2	TRIP_BF_BAR_2
207	SW	Circuit Breaker Failure Zone 1	TRIP_BF_BAR_1
208	PSL	Opto blocking input SEF zone 8	OPTO_SEF_BLOCKING_BAR_8
209	PSL	Opto blocking input SEF zone 7	OPTO_SEF_BLOCKING_BAR_7
210	PSL	Opto Input blocking SEF zone 6	OPTO_SEF_BLOCKING_BAR_6
211	PSL	Opto Input blocking SEF zone 5	OPTO_SEF_BLOCKING_BAR_5
212	PSL	Opto blocking input SEF zone 4	OPTO_SEF_BLOCKING_BAR_4
213	PSL	Opto Input blocking SEF zone 3	OPTO_SEF_BLOCKING_BAR_3
214	PSL	Opto Input blocking SEF zone 2	OPTO_SEF_BLOCKING_BAR_2
215	PSL	Opto Input blocking SEF zone 1	OPTO_SEF_BLOCKING_BAR_1
216	PSL	Input opto 50BF backtrip zone 8	OPTO_TRIP_BF_BAR_8
217	PSL	Input opto 50BF backtrip zone 7	OPTO_TRIP_BF_BAR_7
218	PSL	Input opto 50BF backtrip zone 6	OPTO_TRIP_BF_BAR_6
219	PSL	Input opto 50BF backtrip zone 5	OPTO_TRIP_BF_BAR_5
220	PSL	Input opto 50BF backtrip zone 4	OPTO_TRIP_BF_BAR_4
221	PSL	Input opto 50BF backtrip zone 3	OPTO_TRIP_BF_BAR_3
222	PSL	Input opto 50BF backtrip zone 2	OPTO_TRIP_BF_BAR_2

P741 Logic Nodes			
DDB No	**Source**	**Description**	**Element Name**
223	PSL	Input opto 50BF backtrip zone 1	OPTO_TRIP_BF_BAR_1
224	PSL	Opto input Block level 2 zone 8	OPTO_CONSIGNATION_LEVEL_1_BAR_8
225	PSL	Opto input Block level 2 zone 7	OPTO_CONSIGNATION_LEVEL_1_BAR_7
226	PSL	Opto input Block level 2 zone 6	OPTO_CONSIGNATION_LEVEL_1_BAR_6
227	PSL	Opto input Block level 2 zone 5	OPTO_CONSIGNATION_LEVEL_1_BAR_5
228	PSL	Opto input Block level 2 zone 4	OPTO_CONSIGNATION_LEVEL_1_BAR_4
229	PSL	Opto input Block level 2 zone 3	OPTO_CONSIGNATION_LEVEL_1_BAR_3
230	PSL	Opto input Blocking level 2 zone 2	OPTO_CONSIGNATION_LEVEL_1_BAR_2
231	PSL	Opto input Blocking level 2 zone 1	OPTO_CONSIGNATION_LEVEL_1_BAR_1
232	PSL	Opto input Block level 1 zone 8	OPTO_CONSIGNATION_LEVEL_2_BAR_8
233	PSL	Opto input Block level 1 zone 7	OPTO_CONSIGNATION_LEVEL_2_BAR_7
234	PSL	Opto input Block level 1 zone 6	OPTO_CONSIGNATION_LEVEL_2_BAR_6
235	PSL	Opto input Block level 1 zone 5	OPTO_CONSIGNATION_LEVEL_2_BAR_5
236	PSL	Opto input Block level 1 zone 4	OPTO_CONSIGNATION_LEVEL_2_BAR_4
237	PSL	Opto input Block level 1 zone 3	OPTO_CONSIGNATION_LEVEL_2_BAR_3
238	PSL	Opto input Block level 1 zone 2	OPTO_CONSIGNATION_LEVEL_2_BAR_2
239	PSL	Opto input Blocking level 1 zone 1	OPTO_CONSIGNATION_LEVEL_2_BAR_1
240	SW	Locking Level 1 Zone 8	CONSIGNATION_LEVEL_1_BAR_8
241	SW	Locking Level 1 Zone 7	CONSIGNATION_LEVEL_1_BAR_7
242	SW	Locking Level 1 zone 6	CONSIGNATION_LEVEL_1_BAR_6
243	SW	Locking Level 1 Zone 5	CONSIGNATION_LEVEL_1_BAR_5
244	SW	Locking Level 1 Zone 4	CONSIGNATION_LEVEL_1_BAR_4
245	SW	Locking Level 1 Zone 3	CONSIGNATION_LEVEL_1_BAR_3
246	SW	Locking Level 1 Zone 2	CONSIGNATION_LEVEL_1_BAR_2
247	SW	Locking Level 1 Zone 1	CONSIGNATION_LEVEL_1_BAR_1
248	SW	Locking Level 2 Zone 8	CONSIGNATION_LEVEL_2_BAR_8
249	SW	Locking Level 2 Zone 7	CONSIGNATION_LEVEL_2_BAR_7
250	SW	Locking Level 2 Zone 6	CONSIGNATION_LEVEL_2_BAR_6
251	SW	Locking Level 2 Zone 5	CONSIGNATION_LEVEL_2_BAR_5
252	SW	Locking Level 2 Zone 4	CONSIGNATION_LEVEL_2_BAR_4
253	SW	Locking Level 2 Zone 3	CONSIGNATION_LEVEL_2_BAR_3
254	SW	Locking Level 2 Zone 2	CONSIGNATION_LEVEL_2_BAR_2
255	SW	Locking Level 2 Zone 1	CONSIGNATION_LEVEL_2_BAR_1
256	SW	Busbar tripping order	BUSBAR_TRIP
257	SW	Busbar tripping order blocked	BUSBAR_TRIP_BLOCKED
258	SW	Busbar tripping order blocked but reported	TRIP_MANUAL_ZONE
259	SW	50BF tripping order	ORDER_TRIP_BF
260	SW	50BF tripping order blocked	ORDER_TRIP_BF_NOK
261	SW	Application 50BF backtrip	ALARM_OPTO_TRIP_BF
262	SW	Fault current phase A	FAULT_CURRENT_PHASE_A
263	SW	Fault current phase B	FAULT_CURRENT_PHASE_B
264	SW	Fault current phase C	FAULT_CURRENT_PHASE_C
265	SW	Residual fault current	FAULT_CURRENT_RESIDUAL
266	SW	Wire fault alarm of 1 or + zones	ALARM_CIRCUITRY_FAULT
267	SW	Locking level 1	ALARM_CONSIGNATION_LEVEL_1

P741 Logic Nodes			
DDB No	Source	Description	Element Name
268	SW	Locking level 2	ALARM_CONSIGNATION_LEVEL_2
269	SW	Valid configuration	VALID_CONF
270	SW	Valid topology file	VALID_TOPO
271	SW	Alarm 87BB 3Ph blocked by opto	ALARM_87BB_PHASE_BLOCKED
272	SW	Fibre Error on PU	ALARM_MAJOR
273	SW	Reserve	UNUSED_273
274	SW	Reserve	UNUSED_274
275	SW	Detection of fault on Check Zone	CZ_FAULT
276	SW	Phase A wiring fault	CIRCUITRY_FAULT_PHASE_A
277	SW	Phase B wiring fault	CIRCUITRY_FAULT_PHASE_B
278	SW	Phase C wiring fault	CIRCUITRY_FAULT_PHASE_C
279	SW	Residual wiring fault	CIRCUITRY_FAULT_RESIDUAL
280	SW	Alarm Wiring lock of 1 or + zones	ALARM_CIRC_FAULT_BLOCK
281	SW	Alarm PU error of 1 or + zones	ALARM_PU_ERROR
282	SW	Alarm Locking Err PU of 1 or + zones	ALARM_PU_ERROR_BLOCKING
283	SW	Wire fault alarm of 1 or + zones	ALARM_SEF_BLOCKED
284	SW	Alarm CZ defect wiring	ALARM_CZ_CIRC_FAULT
285	SW	Alarm CZ blocking wiring fault	ALARM_CZ_BLOCKED_CIRC_FAULT
286	SW	Alarm CZ fault PU	ALARM_CZ_PU_ERROR
287	SW	Alarm CZ blocking PU fault	ALARM_CZ_BLOCKED_PU_ERROR
288	SW	Comunication error PU channel A COM 1	PU_A_COM_1_FAULT_MINOR
289	SW	Comunication error PU channel B COM 1	PU_B_COM_1_FAULT_MINOR
290	SW	Comunication error PU channel C COM 1	PU_C_COM_1_FAULT_MINOR
291	SW	Comunication error PU channel D COM 1	PU_D_COM_1_FAULT_MINOR
292	SW	Comunication error PU channel A COM 2	PU_A_COM_2_FAULT_MINOR
293	SW	Comunication error PU channel B COM 2	PU_B_COM_2_FAULT_MINOR
294	SW	Comunication error PU channel C COM 2	PU_C_COM_2_FAULT_MINOR
295	SW	Comunication error PU channel D COM 2	PU_D_COM_2_FAULT_MINOR
296	SW	Comunication error PU channel A COM 3	PU_A_COM_3_FAULT_MINOR
297	SW	Comunication error PU channel B COM 3	PU_B_COM_3_FAULT_MINOR
298	SW	Comunication error PU channel C COM 3	PU_C_COM_3_FAULT_MINOR
299	SW	Comunication error PU channel D COM 3	PU_D_COM_3_FAULT_MINOR
300	SW	Comunication error PU channel A COM 4	PU_A_COM_4_FAULT_MINOR
301	SW	Comunication error PU channel B COM 4	PU_B_COM_4_FAULT_MINOR
302	SW	Comunication error PU channel C COM 4	PU_C_COM_4_FAULT_MINOR
303	SW	Comunication error PU channel D COM 4	PU_D_COM_4_FAULT_MINOR
304	SW	Comunication error PU channel A COM 5	PU_A_COM_5_FAULT_MINOR
305	SW	Comunication error PU channel B COM 5	PU_B_COM_5_FAULT_MINOR
306	SW	Comunication error PU channel C COM 5	PU_C_COM_5_FAULT_MINOR
307	SW	Comunication error PU channel D COM 5	PU_D_COM_5_FAULT_MINOR
308	SW	Comunication error PU channel A COM 6	PU_A_COM_6_FAULT_MINOR
309	SW	Comunication error PU channel B COM 6	PU_B_COM_6_FAULT_MINOR
310	SW	Comunication error PU channel C COM 6	PU_C_COM_6_FAULT_MINOR
311	SW	Comunication error PU channel D COM 6	PU_D_COM_6_FAULT_MINOR
312	SW	Comunication error PU channel A COM 7	PU_A_COM_7_FAULT_MINOR
313	SW	Comunication error PU channel B COM 7	PU_B_COM_7_FAULT_MINOR

P741 Logic Nodes			
DDB No	Source	Description	Element Name
314	SW	Comunication error PU channel C COM 7	PU_C_COM_7_FAULT_MINOR
315	SW	Comunication error PU channel D COM 7	PU_D_COM_7_FAULT_MINOR
316	SW	Reserve	UNUSED_316
317	SW	Reserve	UNUSED_317
318	SW	Reserve	UNUSED_318
319	SW	Reserve	UNUSED_319
320	SW	Reserve	UNUSED_320
321	SW	Reserve	UNUSED_321
322	SW	Reserve	UNUSED_322
323	SW	Reserve	UNUSED_323
324	SW	Error on PU address 34	PU_34_ERROR
325	SW	Error on PU address 33	PU_33_ERROR
326	SW	Error on PU address 32	PU_32_ERROR
327	SW	Error on PU address 31	PU_31_ERROR
328	SW	Error on PU address 30	PU_30_ERROR
329	SW	Error on PU address 29	PU_29_ERROR
330	SW	Error on PU address 28	PU_28_ERROR
331	SW	Error on PU address 27	PU_27_ERROR
332	SW	Error on PU address 26	PU_26_ERROR
333	SW	Error on PU address 25	PU_25_ERROR
334	SW	Error on PU address 24	PU_24_ERROR
335	SW	Error on PU address 23	PU_23_ERROR
336	SW	Error on PU address 22	PU_22_ERROR
337	SW	Error on PU address 21	PU_21_ERROR
338	SW	Error on PU address 20	PU_20_ERROR
339	SW	Error on PU address 19	PU_19_ERROR
340	SW	Error on PU address 18	PU_18_ERROR
341	SW	Error on PU address 17	PU_17_ERROR
342	SW	Error on PU address 16	PU_16_ERROR
343	SW	Error on PU address 15	PU_15_ERROR
344	SW	Error on PU address 14	PU_14_ERROR
345	SW	Error on PU address 13	PU_13_ERROR
346	SW	Error on PU address 12	PU_12_ERROR
347	SW	Error on PU address 11	PU_11_ERROR
348	SW	Error on PU address 10	PU_10_ERROR
349	SW	Error on PU address 9	PU_9_ERROR
350	SW	Error on PU address 8	PU_8_ERROR
351	SW	Error on PU address 7	PU_7_ERROR
352	SW	Reserve	UNUSED_352
353	SW	Reserve	UNUSED_353
354	SW	Reserve	UNUSED_354
355	SW	Minor error on COM 1	COM_1_FAULT_MINOR
356	SW	Minor error on COM 2	COM_2_FAULT_MINOR
357	SW	Minor error on COM 3	COM_3_FAULT_MINOR
358	SW	Minor error on COM 4	COM_4_FAULT_MINOR
359	SW	Minor error on COM 5	COM_5_FAULT_MINOR

P741 Logic Nodes			
DDB No	Source	Description	Element Name
360	SW	Minor Error on COM 6	COM_6_FAULT_MINOR
361	SW	Minor Error on COM 7	COM_7_FAULT_MINOR
362	SW	Minor Error on COM 8	UNUSED_362
363	SW	Reserve	UNUSED_363
364	SW	Configuration valid	OPERATING_MODE_1
365	SW	Configuration error	ALARM_OPERATING_MODE_2
366	SW	Instant 87BB trip	PRE_FAULT
367	SW	Delayed 87BB trip	POST_FAULT
368	SW	Virtual TS 1 PU->CU	VIRTUAL_TS_1
369	SW	Virtual TS 2 PU->CU	VIRTUAL_TS_2
370	SW	Virtual TS 3 PU->CU	VIRTUAL_TS_3
371	SW	Virtual TS 4 PU->CU	VIRTUAL_TS_4
372	SW	Virtual TS 5 PU->CU	VIRTUAL_TS_5
373	SW	Virtual TS 6 PU->CU	VIRTUAL_TS_6
374	SW	Virtual TS 7 PU->CU	VIRTUAL_TS_7
375	SW	Virtual TS 8 PU->CU	VIRTUAL_TS_8
376	SW	Virtual TS 9 PU->CU	VIRTUAL_TS_9
377	SW	Virtual TS 10 PU->CU	VIRTUAL_TS_10
378	SW	Virtual TS 11 PU->CU	VIRTUAL_TS_11
379	SW	Virtual TS 12 PU->CU	VIRTUAL_TS_12
380	SW	Virtual TS 13 PU->CU	VIRTUAL_TS_13
381	SW	Virtual TS 14 PU->CU	VIRTUAL_TS_14
382	SW	Virtual TS 15 PU->CU	VIRTUAL_TS_15
383	SW	Virtual TS 16 PU->CU	VIRTUAL_TS_16
384	SW	Reserve	UNUSED_384
385	SW	Activation Busbar	BUSBAR_ENABLE
386	SW	Activation Busbar Residual	BUSBAR_EARTH_ENABLE
387	SW	Acquiring after a defect	CIRCUITRY_FAULT_RESET
388	SW	Change configuration or topology	CONF_TOPO_CHANGE
389	SW	Start disturbance manually	DISTURB_RECORDER
390	SW	Topo file error of one or more PUs	ALARM_TOPO_PU_NOK
391	SW	Reset PU Error	RESET_PU_ERROR
392	SW	87BB phase and earth blocked by opto	BUSBAR_BLOCKED
393	PSL	Rear port 1 read only	DDB_REMOTEREADONLY_RP1
394	PSL	Rear port 2 read only	DDB_REMOTEREADONLY_RP2
395	PSL	NIC read only	DDB_REMOTEREADONLY_NIC
396	SW	Reserve	UNUSED_396
397	SW	Reserve	UNUSED_397
398	SW	Reserve	UNUSED_398
399	SW	General Alarm	ALARM_GENERAL
400	PSL	Opto input blocking 87BB 3Ph zone 8	INP_BLOCK_3PH_Z8
401	PSL	Opto input blocking 87BB 3Ph zone 7	INP_BLOCK_3PH_Z7
402	PSL	Opto input blocking 87BB 3Ph zone 6	INP_BLOCK_3PH_Z6
403	PSL	Opto input blocking 87BB 3Ph zone 5	INP_BLOCK_3PH_Z5
404	PSL	Opto input blocking 87BB 3Ph zone 4	INP_BLOCK_3PH_Z4
405	PSL	Opto input blocking 87BB 3Ph zone 3	INP_BLOCK_3PH_Z3

P741 Logic Nodes			
DDB No	Source	Description	Element Name
406	PSL	Opto input blocking 87BB 3Ph zone 2	INP_BLOCK_3PH_Z2
407	PSL	Opto input blocking 87BB 3Ph zone 1	INP_BLOCK_3PH_Z1
408	SW	Reserve	UNUSED_408
409	SW	Reserve	UNUSED_409
410	SW	Reserve	UNUSED_410
411	SW	Reserve	UNUSED_411
412	SW	Reserve	UNUSED_412
413	SW	Reserve	UNUSED_413
414	SW	Reserve	UNUSED_414
415	SW	Reserve	UNUSED_415
416	SW	87BB 3Ph defect detected in Z8	DDB_87BB_PHS_DIFF_Z8
417	SW	87BB 3Ph defect detected in Z7	DDB_87BB_PHS_DIFF_Z7
418	SW	87BB 3Ph defect detected in Z6	DDB_87BB_PHS_DIFF_Z6
419	SW	87BB 3Ph defect detected in Z5	DDB_87BB_PHS_DIFF_Z5
420	SW	87BB 3Ph defect detected in Z4	DDB_87BB_PHS_DIFF_Z4
421	SW	87BB 3Ph defect detected in Z3	DDB_87BB_PHS_DIFF_Z3
422	SW	87BB 3Ph defect detected in Z2	DDB_87BB_PHS_DIFF_Z2
423	SW	87BB 3Ph defect detected in Z1	DDB_87BB_PHS_DIFF_Z1
424	SW	87BB 3Ph SEF detected in Z8	DDB_87BB_SEF_DIFF_Z8
425	SW	87BB 3Ph SEF detected in Z7	DDB_87BB_SEF_DIFF_Z7
426	SW	87BB 3Ph SEF detected in Z6	DDB_87BB_SEF_DIFF_Z6
427	SW	87BB 3Ph SEF detected in Z5	DDB_87BB_SEF_DIFF_Z5
428	SW	87BB 3Ph SEF detected in Z4	DDB_87BB_SEF_DIFF_Z4
429	SW	87BB 3Ph SEF detected in Z3	DDB_87BB_SEF_DIFF_Z3
430	SW	87BB 3Ph SEF detected in Z2	DDB_87BB_SEF_DIFF_Z2
431	SW	87BB 3Ph SEF detected in Z1	DDB_87BB_SEF_DIFF_Z1
432	PSL	Reserve	UNUSED_432
433	PSL	Reserve	UNUSED_433
434	PSL	Reserve	UNUSED_434
435	PSL	Reserve	UNUSED_435
436	PSL	Input to auxiliary timer 1	DDB_TIMERIN_1
437	PSL	Input to auxiliary timer 2	DDB_TIMERIN_2
438	PSL	Input to auxiliary timer 3	DDB_TIMERIN_3
439	PSL	Input to auxiliary timer 4	DDB_TIMERIN_4
440	PSL	Input to auxiliary timer 5	DDB_TIMERIN_5
441	PSL	Input to auxiliary timer 6	DDB_TIMERIN_6
442	PSL	Input to auxiliary timer 7	DDB_TIMERIN_7
443	PSL	Input to auxiliary timer 8	DDB_TIMERIN_8
444	PSL	Input to auxiliary timer 9	DDB_TIMERIN_9
445	PSL	Input to auxiliary timer 10	DDB_TIMERIN_10
446	PSL	Input to auxiliary timer 11	DDB_TIMERIN_11
447	PSL	Input to auxiliary timer 12	DDB_TIMERIN_12
448	PSL	Input to auxiliary timer 13	DDB_TIMERIN_13
449	PSL	Input to auxiliary timer 14	DDB_TIMERIN_14
450	PSL	Input to auxiliary timer 15	DDB_TIMERIN_15
451	PSL	Input to auxiliary timer 16	DDB_TIMERIN_16

P741 Logic Nodes			
DDB No	Source	Description	Element Name
452	SW	Output from auxiliary timer 1	DDB_TIMEROUT_1
453	SW	Output from auxiliary timer 2	DDB_TIMEROUT_2
454	SW	Output from auxiliary timer 3	DDB_TIMEROUT_3
455	SW	Output from auxiliary timer 4	DDB_TIMEROUT_4
456	SW	Output from auxiliary timer 5	DDB_TIMEROUT_5
457	SW	Output from auxiliary timer 6	DDB_TIMEROUT_6
458	SW	Output from auxiliary timer 7	DDB_TIMEROUT_7
459	SW	Output from auxiliary timer 8	DDB_TIMEROUT_8
460	SW	Output from auxiliary timer 9	DDB_TIMEROUT_9
461	SW	Output from auxiliary timer 10	DDB_TIMEROUT_10
462	SW	Output from auxiliary timer 11	DDB_TIMEROUT_11
463	SW	Output from auxiliary timer 12	DDB_TIMEROUT_12
464	SW	Output from auxiliary timer 13	DDB_TIMEROUT_13
465	SW	Output from auxiliary timer 14	DDB_TIMEROUT_14
466	SW	Output from auxiliary timer 15	DDB_TIMEROUT_15
467	SW	Output from auxiliary timer 16	DDB_TIMEROUT_16
468	PSL	Indicator to tell relay a fault record needs to be recorded	DDB_FAULT_RECORD_TRIGGER
469	SW	Front panel miniature battery failure - either battery removed from slot, or low voltage	DDB_PLAT_BATTERY_FAIL_ALARM
470	SW	48V field voltage failure	DDB_PLAT_FIELD_VOLT_FAIL_ALARM
471	SW	Comm2 hardware failure - second rear communications board	DDB_REAR_COMMS_FAIL_ALARM_66
472	SW	The IED is not subscribed to a publishing IED in the current scheme	DDB_GOOSE_IED_MISSING_ALARM_67
473	SW	Ethernet board not fitted	DDB_ECARD_NOT_FITTED_ALARM_68
474	SW	Ethernet board not responding	DDB_NIC_NOT_RESPONDING_69
475	SW	Ethernet board unrecoverable error	DDB_NIC_FATAL_ERROR_70
476	SW	Ethernet problem	DDB_NIC_SOFTWARE_RELOAD_71
477	SW	Ethernet problem, invalid IP address	DDB_INVALID_NIC_TCP_IP_CONFIG_72
478	SW	Ethernet problem	DDB_INVALID_NIC_OSI_CONFIG_73
479	SW	Reserve	DDB_ALARM_UNUSED_479
480	SW	Ethernet board software not compatible with main CPU	DDB_SW_MISMATCH_ALARM
481	SW	The IP address of the IED is already used by another IED	DDB_NIC_IP_ADDRESS_CONFLICT_76
482	SW	EIA(RS)232 InterMiCOM indication that Loopback testing is in progress	DDB_INTERMICOM_LOOPBACK_ALARM_77

P741 Logic Nodes			
DDB No	Source	Description	Element Name
483	SW	EIA(RS)232 InterMiCOM Message Failure alarm. Setting that is used to alarm for poor channel quality. If during the fixed 1.6 s rolling window the ratio of invalid messages to the total number of messages that should be received (based upon the 'Baud Rate' setting) exceeds the above threshold, a 'Message Fail' alarm will be issued	DDB_INTERMICOM_MESSAGE_ALARM_78
484	SW	EIA(RS)232 InterMiCOM Data Channel Detect Fail i.e. modem failure	DDB_INTERMICOM_DCD_ALARM_79
485	SW	EIA(RS)232 InterMiCOM Channel Failure alarm. No messages were received during the alarm time setting	DDB_INTERMICOM_CHANNEL_ALARM_80
486	SW	This is an alarm that is ON if any setting fail during the setting changing process. If this happens, the relay will use the last known good setting	DDB_BACKUP_SETTING_ALARM_81
487	PSL	Reserve	DDB_ALARM_UNUSED_487
488	PSL	Reserve	DDB_ALARM_UNUSED_488
489	PSL	Reserve	DDB_ALARM_UNUSED_489
490	PSL	Reserve	DDB_ALARM_UNUSED_490
491	SW	Invalid IEC 61850 Configuration Alarm	DDB_INVALID_CONFIG_ALARM
492	SW	Test Mode Activated Alarm	DDB_TEST_MODE_ALARM
493	SW	Contacts Blocked Alarm	DDB_CONT_BLK_ALARM
494	SW	Main card/Ethernet card hw option mismatch Alarm	DDB_HW_MISMATCH_ALARM
495	SW	Main card/Ethernet card IEC61850 ver mismatch Alarm	DDB_IEC61850_VER_MISMATCH_ALARM
496	SW	IEC 61850 accept simulation GOOSE alarm	DDB_GS_ACEPT_SIMU_ALM
497	PSL	Reserve	DDB_ALARM_UNUSED_497
498	PSL	Reserve	DDB_ALARM_UNUSED_498
499	PSL	Reserve	DDB_ALARM_UNUSED_499
500	PSL	Reserve	DDB_ALARM_UNUSED_500
501	PSL	Reserve	DDB_UNUSED_501
502	PSL	Reserve	DDB_UNUSED_502
503	PSL	Reserve	DDB_UNUSED_503
504	PSL	Reserve	DDB_UNUSED_504
505	PSL	Reserve	DDB_UNUSED_505
506	PSL	Reserve	DDB_UNUSED_506
507	PSL	Reserve	DDB_UNUSED_507
508	PSL	Reserve	DDB_UNUSED_508
509	PSL	Reserve	DDB_UNUSED_509
510	PSL	Reserve	DDB_UNUSED_510
511	PSL	Reserve	DDB_UNUSED_511

P741 Logic Nodes			
DDB No	Source	Description	Element Name
512	PSL	Virtual output 1 - allows user to control a binary signal which can be mapped via SCADA protocol output to other devices	DDB_GOOSEOUT_1
513	PSL	Virtual output 2 - allows user to control a binary signal which can be mapped via SCADA protocol output to other devices	DDB_GOOSEOUT_2
514	PSL	Virtual output 3 - allows user to control a binary signal which can be mapped via SCADA protocol output to other devices	DDB_GOOSEOUT_3
515	PSL	Virtual output 4 - allows user to control a binary signal which can be mapped via SCADA protocol output to other devices	DDB_GOOSEOUT_4
516	PSL	Virtual output 5 - allows user to control a binary signal which can be mapped via SCADA protocol output to other devices	DDB_GOOSEOUT_5
517	PSL	Virtual output 6 - allows user to control a binary signal which can be mapped via SCADA protocol output to other devices	DDB_GOOSEOUT_6
518	PSL	Virtual output 7 - allows user to control a binary signal which can be mapped via SCADA protocol output to other devices	DDB_GOOSEOUT_7
519	PSL	Virtual output 8 - allows user to control a binary signal which can be mapped via SCADA protocol output to other devices	DDB_GOOSEOUT_8
520	PSL	Virtual output 9 - allows user to control a binary signal which can be mapped via SCADA protocol output to other devices	DDB_GOOSEOUT_9
521	PSL	Virtual output 10 - allows user to control a binary signal which can be mapped via SCADA protocol output to other devices	DDB_GOOSEOUT_10
522	PSL	Virtual output 11 - allows user to control a binary signal which can be mapped via SCADA protocol output to other devices	DDB_GOOSEOUT_11
523	PSL	Virtual output 12 - allows user to control a binary signal which can be mapped via SCADA protocol output to other devices	DDB_GOOSEOUT_12
524	PSL	Virtual output 13 - allows user to control a binary signal which can be mapped via SCADA protocol output to other devices	DDB_GOOSEOUT_13
525	PSL	Virtual output 14 - allows user to control a binary signal which can be mapped via SCADA protocol output to other devices	DDB_GOOSEOUT_14
526	PSL	Virtual output 15 - allows user to control a binary signal which can be mapped via SCADA protocol output to other devices	DDB_GOOSEOUT_15

P741 Logic Nodes			
DDB No	Source	Description	Element Name
527	PSL	Virtual output 16 - allows user to control a binary signal which can be mapped via SCADA protocol output to other devices	DDB_GOOSEOUT_16
528	PSL	Virtual output 17 - allows user to control a binary signal which can be mapped via SCADA protocol output to other devices	DDB_GOOSEOUT_17
529	PSL	Virtual output 18 - allows user to control a binary signal which can be mapped via SCADA protocol output to other devices	DDB_GOOSEOUT_18
530	PSL	Virtual output 19 - allows user to control a binary signal which can be mapped via SCADA protocol output to other devices	DDB_GOOSEOUT_19
531	PSL	Virtual output 20 - allows user to control a binary signal which can be mapped via SCADA protocol output to other devices	DDB_GOOSEOUT_20
532	PSL	Virtual output 21 - allows user to control a binary signal which can be mapped via SCADA protocol output to other devices	DDB_GOOSEOUT_21
533	PSL	Virtual output 22 - allows user to control a binary signal which can be mapped via SCADA protocol output to other devices	DDB_GOOSEOUT_22
534	PSL	Virtual output 23 - allows user to control a binary signal which can be mapped via SCADA protocol output to other devices	DDB_GOOSEOUT_23
535	PSL	Virtual output 24 - allows user to control a binary signal which can be mapped via SCADA protocol output to other devices	DDB_GOOSEOUT_24
536	PSL	Virtual output 25 - allows user to control a binary signal which can be mapped via SCADA protocol output to other devices	DDB_GOOSEOUT_25
537	PSL	Virtual output 26 - allows user to control a binary signal which can be mapped via SCADA protocol output to other devices	DDB_GOOSEOUT_26
538	PSL	Virtual output 27 - allows user to control a binary signal which can be mapped via SCADA protocol output to other devices	DDB_GOOSEOUT_27
539	PSL	Virtual output 28 - allows user to control a binary signal which can be mapped via SCADA protocol output to other devices	DDB_GOOSEOUT_28
540	PSL	Virtual output 29 - allows user to control a binary signal which can be mapped via SCADA protocol output to other devices	DDB_GOOSEOUT_29
541	PSL	Virtual output 30 - allows user to control a binary signal which can be mapped via SCADA protocol output to other devices	DDB_GOOSEOUT_30

P741 Logic Nodes			
DDB No	**Source**	**Description**	**Element Name**
542	PSL	Virtual output 31 - allows user to control a binary signal which can be mapped via SCADA protocol output to other devices	DDB_GOOSEOUT_31
543	PSL	Virtual output 32 - allows user to control a binary signal which can be mapped via SCADA protocol output to other devices	DDB_GOOSEOUT_32
544	PSL	Reserve	UNUSED_544
545	PSL	Reserve	UNUSED_545
546	PSL	Reserve	UNUSED_546
547	PSL	Reserve	UNUSED_547
548	PSL	Reserve	UNUSED_548
549	PSL	Reserve	UNUSED_549
550	PSL	Reserve	UNUSED_550
551	PSL	Reserve	UNUSED_551
552	PSL	Reserve	UNUSED_552
553	PSL	Reserve	UNUSED_553
554	PSL	Reserve	UNUSED_554
555	PSL	Reserve	UNUSED_555
556	PSL	Reserve	UNUSED_556
557	PSL	Reserve	UNUSED_557
558	PSL	Reserve	UNUSED_558
559	PSL	Reserve	UNUSED_559
560	PSL	Reserve	UNUSED_560
561	PSL	Reserve	UNUSED_561
562	PSL	Reserve	UNUSED_562
563	PSL	Reserve	UNUSED_563
564	PSL	Reserve	UNUSED_564
565	PSL	Reserve	UNUSED_565
566	PSL	Reserve	UNUSED_566
567	PSL	Reserve	UNUSED_567
568	PSL	Reserve	UNUSED_568
569	PSL	Reserve	UNUSED_569
570	PSL	Reserve	UNUSED_570
571	PSL	Reserve	UNUSED_571
572	PSL	Reserve	UNUSED_572
573	PSL	Reserve	UNUSED_573
574	PSL	Reserve	UNUSED_574
575	PSL	Reserve	UNUSED_575
576	PSL	PSL Internal Node	DDB_PSLINT_576
577	PSL	PSL Internal Node	DDB_PSLINT_577
578	PSL	PSL Internal Node	DDB_PSLINT_578
579	PSL	PSL Internal Node	DDB_PSLINT_579
580	PSL	PSL Internal Node	DDB_PSLINT_580
581	PSL	PSL Internal Node	DDB_PSLINT_581
582	PSL	PSL Internal Node	DDB_PSLINT_582
583	PSL	PSL Internal Node	DDB_PSLINT_583

P741 Logic Nodes			
DDB No	Source	Description	Element Name
584	SW	InterMiCOM Input 1 - is driven by a message from the remote line end	DDB_INTERIN_1
585	SW	InterMiCOM Input 2 - is driven by a message from the remote line end	DDB_INTERIN_2
586	SW	InterMiCOM Input 3 - is driven by a message from the remote line end	DDB_INTERIN_3
587	SW	InterMiCOM Input 4 - is driven by a message from the remote line end	DDB_INTERIN_4
588	SW	InterMiCOM Input 5 - is driven by a message from the remote line end	DDB_INTERIN_5
589	SW	InterMiCOM Input 6 - is driven by a message from the remote line end	DDB_INTERIN_6
590	SW	InterMiCOM Input 7 - is driven by a message from the remote line end	DDB_INTERIN_7
591	SW	InterMiCOM Input 8 - is driven by a message from the remote line end	DDB_INTERIN_8
592	PSL	InterMiCOM Output 1 - is an output to the remote line end	DDB_INTEROUT_1
593	PSL	InterMiCOM Output 2 - is an output to the remote line end	DDB_INTEROUT_2
594	PSL	InterMiCOM Output 3 - is an output to the remote line end	DDB_INTEROUT_3
595	PSL	InterMiCOM Output 4 - is an output to the remote line end	DDB_INTEROUT_4
596	PSL	InterMiCOM Output 5 - is an output to the remote line end	DDB_INTEROUT_5
597	PSL	InterMiCOM Output 6 - is an output to the remote line end	DDB_INTEROUT_6
598	PSL	InterMiCOM Output 7 - is an output to the remote line end	DDB_INTEROUT_7
599	PSL	InterMiCOM Output 8 - is an output to the remote line end	DDB_INTEROUT_8
600	PSL	Reserve	DDB_UNUSED_600
601	PSL	Reserve	DDB_UNUSED_601
602	PSL	Reserve	DDB_UNUSED_602
603	PSL	Reserve	DDB_UNUSED_603
604	PSL	Reserve	DDB_UNUSED_604
605	PSL	Reserve	DDB_UNUSED_605
606	PSL	Reserve	DDB_UNUSED_606
607	PSL	Reserve	DDB_UNUSED_607
608	SW	Control Input 1 energized	DDB_CTRL_IP_1
609	SW	Control Input 2 energized	DDB_CTRL_IP_2
610	SW	Control Input 3 energized	DDB_CTRL_IP_3
611	SW	Control Input 4 energized	DDB_CTRL_IP_4
612	SW	Control Input 5 energized	DDB_CTRL_IP_5
613	SW	Control Input 6 energized	DDB_CTRL_IP_6
614	SW	Control Input 7 energized	DDB_CTRL_IP_7

P741 Logic Nodes			
DDB No	Source	Description	Element Name
615	SW	Control Input 8 energized	DDB_CTRL_IP_8
616	SW	Control Input 9 energized	DDB_CTRL_IP_9
617	SW	Control Input 10 energized	DDB_CTRL_IP_10
618	SW	Control Input 11 energized	DDB_CTRL_IP_11
619	SW	Control Input 12 energized	DDB_CTRL_IP_12
620	SW	Control Input 13 energized	DDB_CTRL_IP_13
621	SW	Control Input 14 energized	DDB_CTRL_IP_14
622	SW	Control Input 15 energized	DDB_CTRL_IP_15
623	SW	Control Input 16 energized	DDB_CTRL_IP_16
624	SW	Control Input 17 energized	DDB_CTRL_IP_17
625	SW	Control Input 18 energized	DDB_CTRL_IP_18
626	SW	Control Input 19 energized	DDB_CTRL_IP_19
627	SW	Control Input 20 energized	DDB_CTRL_IP_20
628	SW	Control Input 21 energized	DDB_CTRL_IP_21
629	SW	Control Input 22 energized	DDB_CTRL_IP_22
630	SW	Control Input 23 energized	DDB_CTRL_IP_23
631	SW	Control Input 24 energized	DDB_CTRL_IP_24
632	SW	Control Input 25 energized	DDB_CTRL_IP_25
633	SW	Control Input 26 energized	DDB_CTRL_IP_26
634	SW	Control Input 27 energized	DDB_CTRL_IP_27
635	SW	Control Input 28 energized	DDB_CTRL_IP_28
636	SW	Control Input 29 energized	DDB_CTRL_IP_29
637	SW	Control Input 30 energized	DDB_CTRL_IP_30
638	SW	Control Input 31 energized	DDB_CTRL_IP_31
639	SW	Control Input 32 energized	DDB_CTRL_IP_32
640	SW	Programmable LED 1 red is energized	DDB_OUTPUT_TRI_LED_1_RED
641	SW	Programmable LED 1 green is energized	DDB_OUTPUT_TRI_LED_1_GRN
642	SW	Programmable LED 2 red is energized	DDB_OUTPUT_TRI_LED_2_RED
643	SW	Programmable LED 2 green is energized	DDB_OUTPUT_TRI_LED_2_GRN
644	SW	Programmable LED 3 red is energized	DDB_OUTPUT_TRI_LED_3_RED
645	SW	Programmable LED 3 green is energized	DDB_OUTPUT_TRI_LED_3_GRN
646	SW	Programmable LED 4 red is energized	DDB_OUTPUT_TRI_LED_4_RED
647	SW	Programmable LED 4 green is energized	DDB_OUTPUT_TRI_LED_4_GRN
648	SW	Programmable LED 5 red is energized	DDB_OUTPUT_TRI_LED_5_RED
649	SW	Programmable LED 5 green is energized	DDB_OUTPUT_TRI_LED_5_GRN
650	SW	Programmable LED 6 red is energized	DDB_OUTPUT_TRI_LED_6_RED
651	SW	Programmable LED 6 green is energized	DDB_OUTPUT_TRI_LED_6_GRN
652	SW	Programmable LED 7 red is energized	DDB_OUTPUT_TRI_LED_7_RED
653	SW	Programmable LED 7 green is energized	DDB_OUTPUT_TRI_LED_7_GRN
654	SW	Programmable LED 8 red is energized	DDB_OUTPUT_TRI_LED_8_RED
655	SW	Programmable LED 8 green is energized	DDB_OUTPUT_TRI_LED_8_GRN
656	SW	Programmable function key LED 1 red is energized	DDB_OUTPUT_TRI_LED_9_RED
657	SW	Programmable function key LED 1 green is energized	DDB_OUTPUT_TRI_LED_9_GRN

P741 Logic Nodes			
DDB No	Source	Description	Element Name
658	SW	Programmable function key LED 2 red is energized	DDB_OUTPUT_TRI_LED_10_RED
659	SW	Programmable function key LED 2 green is energized	DDB_OUTPUT_TRI_LED_10_GRN
660	SW	Programmable function key LED 3 red is energized	DDB_OUTPUT_TRI_LED_11_RED
661	SW	Programmable function key LED 3 green is energized	DDB_OUTPUT_TRI_LED_11_GRN
662	SW	Programmable function key LED 4 red is energized	DDB_OUTPUT_TRI_LED_12_RED
663	SW	Programmable function key LED 4 green is energized	DDB_OUTPUT_TRI_LED_12_GRN
664	SW	Programmable function key LED 5 red is energized	DDB_OUTPUT_TRI_LED_13_RED
665	SW	Programmable function key LED 5 green is energized	DDB_OUTPUT_TRI_LED_13_GRN
666	SW	Programmable function key LED 6 red is energized	DDB_OUTPUT_TRI_LED_14_RED
667	SW	Programmable function key LED 6 green is energized	DDB_OUTPUT_TRI_LED_14_GRN
668	SW	Programmable function key LED 7 red is energized	DDB_OUTPUT_TRI_LED_15_RED
669	SW	Programmable function key LED 7 green is energized	DDB_OUTPUT_TRI_LED_15_GRN
670	SW	Programmable function key LED 8 red is energized	DDB_OUTPUT_TRI_LED_16_RED
671	SW	Programmable function key LED 8 green is energized	DDB_OUTPUT_TRI_LED_16_GRN
672	SW	Programmable function key LED 9 red is energized	DDB_OUTPUT_TRI_LED_17_RED
673	SW	Programmable function key LED 9 green is energized	DDB_OUTPUT_TRI_LED_17_GRN
674	SW	Programmable function key LED 10 red is energized	DDB_OUTPUT_TRI_LED_18_RED
675	SW	Programmable function key LED 10 green is energized	DDB_OUTPUT_TRI_LED_18_GRN
676	SW	Function key 1 is activated. In ‘Normal’ mode it is high on keypress and in ‘Toggle’ mode remains high/low on single keypress	DDB_FN_KEY_1
677	SW	Function key 2 is activated. In ‘Normal’ mode it is high on keypress and in ‘Toggle’ mode remains high/low on single keypress	DDB_FN_KEY_2

P741 Logic Nodes			
DDB No	**Source**	**Description**	**Element Name**
678	SW	Function key 3 is activated. In ‘Normal’ mode it is high on keypress and in ‘Toggle’ mode remains high/low on single keypress	DDB_FN_KEY_3
679	SW	Function key 4 is activated. In ‘Normal’ mode it is high on keypress and in ‘Toggle’ mode remains high/low on single keypress	DDB_FN_KEY_4
680	SW	Function key 5 is activated. In ‘Normal’ mode it is high on keypress and in ‘Toggle’ mode remains high/low on single keypress	DDB_FN_KEY_5
681	SW	Function key 6 is activated. In ‘Normal’ mode it is high on keypress and in ‘Toggle’ mode remains high/low on single keypress	DDB_FN_KEY_6
682	SW	Function key 7 is activated. In ‘Normal’ mode it is high on keypress and in ‘Toggle’ mode remains high/low on single keypress	DDB_FN_KEY_7
683	SW	Function key 8 is activated. In ‘Normal’ mode it is high on keypress and in ‘Toggle’ mode remains high/low on single keypress	DDB_FN_KEY_8
684	SW	Function key 9 is activated. In ‘Normal’ mode it is high on keypress and in ‘Toggle’ mode remains high/low on single keypress	DDB_FN_KEY_9
685	SW	Function key 10 is activated. In ‘Normal’ mode it is high on keypress and in ‘Toggle’ mode remains high/low on single keypress	DDB_FN_KEY_10
686	PSL	Reserve	DDB_UNUSED_686
687	PSL	Reserve	DDB_UNUSED_687
688	PSL	Reserve	DDB_UNUSED_688
689	PSL	Reserve	DDB_UNUSED_689
690	PSL	Reserve	DDB_UNUSED_690
691	PSL	Reserve	DDB_UNUSED_691
692	PSL	Reserve	DDB_UNUSED_692
693	PSL	Reserve	DDB_UNUSED_693
694	PSL	Reserve	DDB_UNUSED_694
695	PSL	Reserve	DDB_UNUSED_695
696	PSL	Reserve	DDB_UNUSED_696
697	PSL	Reserve	DDB_UNUSED_697
698	PSL	Reserve	DDB_UNUSED_698
699	PSL	Reserve	DDB_UNUSED_699
700	PSL	Input to relay 1 output conditioner	DDB_OUTPUT_CON_1

P741 Logic Nodes			
DDB No	**Source**	**Description**	**Element Name**
701	PSL	Input to relay 2 output conditioner	DDB_OUTPUT_CON_2
702	PSL	Input to relay 3 output conditioner	DDB_OUTPUT_CON_3
703	PSL	Input to relay 4 output conditioner	DDB_OUTPUT_CON_4
704	PSL	Input to relay 5 output conditioner	DDB_OUTPUT_CON_5
705	PSL	Input to relay 6 output conditioner	DDB_OUTPUT_CON_6
706	PSL	Input to relay 7 output conditioner	DDB_OUTPUT_CON_7
707	PSL	Input to relay 8 output conditioner	DDB_OUTPUT_CON_8
708	PSL	Input to relay 9 output conditioner	DDB_OUTPUT_CON_9
709	PSL	Input to relay 10 output conditioner	DDB_OUTPUT_CON_10
710	PSL	Input to relay 11 output conditioner	DDB_OUTPUT_CON_11
711	PSL	Input to relay 12 output conditioner	DDB_OUTPUT_CON_12
712	PSL	Input to relay 13 output conditioner	DDB_OUTPUT_CON_13
713	PSL	Input to relay 14 output conditioner	DDB_OUTPUT_CON_14
714	PSL	Input to relay 15 output conditioner	DDB_OUTPUT_CON_15
715	PSL	Input to relay 16 output conditioner	DDB_OUTPUT_CON_16
716	PSL	Input to relay 17 output conditioner	DDB_OUTPUT_CON_17
717	PSL	Input to relay 18 output conditioner	DDB_OUTPUT_CON_18
718	PSL	Input to relay 19 output conditioner	DDB_OUTPUT_CON_19
719	PSL	Input to relay 20 output conditioner	DDB_OUTPUT_CON_20
720	PSL	Input to relay 21 output conditioner	DDB_OUTPUT_CON_21
721	PSL	Input to relay 22 output conditioner	DDB_OUTPUT_CON_22
722	PSL	Input to relay 23 output conditioner	DDB_OUTPUT_CON_23
723	PSL	Input to relay 24 output conditioner	DDB_OUTPUT_CON_24
724	PSL	Input to relay 25 output conditioner	DDB_OUTPUT_CON_25
725	PSL	Input to relay 26 output conditioner	DDB_OUTPUT_CON_26
726	PSL	Input to relay 27 output conditioner	DDB_OUTPUT_CON_27
727	PSL	Input to relay 28 output conditioner	DDB_OUTPUT_CON_28
728	PSL	Input to relay 29 output conditioner	DDB_OUTPUT_CON_29
729	PSL	Input to relay 30 output conditioner	DDB_OUTPUT_CON_30
730	PSL	Input to relay 31 output conditioner	DDB_OUTPUT_CON_31
731	PSL	Input to relay 32 output conditioner	DDB_OUTPUT_CON_32
732	PSL	Input to relay 33 output conditioner	DDB_OUTPUT_CON_33
733	PSL	Input to relay 34 output conditioner	DDB_OUTPUT_CON_34
734	PSL	Input to relay 35 output conditioner	DDB_OUTPUT_CON_35
735	PSL	Input to relay 36 output conditioner	DDB_OUTPUT_CON_36
736	PSL	Input to relay 37 output conditioner	DDB_OUTPUT_CON_37
737	PSL	Input to relay 38 output conditioner	DDB_OUTPUT_CON_38
738	PSL	Input to relay 39 output conditioner	DDB_OUTPUT_CON_39
739	PSL	Input to relay 40 output conditioner	DDB_OUTPUT_CON_40
740	PSL	Input to relay 41 output conditioner	DDB_OUTPUT_CON_41
741	PSL	Input to relay 42 output conditioner	DDB_OUTPUT_CON_42
742	PSL	Input to relay 43 output conditioner	DDB_OUTPUT_CON_43
743	PSL	Input to relay 44 output conditioner	DDB_OUTPUT_CON_44
744	PSL	Input to relay 45 output conditioner	DDB_OUTPUT_CON_45
745	PSL	Input to relay 46 output conditioner	DDB_OUTPUT_CON_46
746	PSL	Input to relay 47 output conditioner	DDB_OUTPUT_CON_47

P741 Logic Nodes			
DDB No	Source	Description	Element Name
747	PSL	Input to relay 48 output conditioner	DDB_OUTPUT_CON_48
748	PSL	Input to relay 49 output conditioner	DDB_OUTPUT_CON_49
749	PSL	Input to relay 50 output conditioner	DDB_OUTPUT_CON_50
750	PSL	Input to relay 51 output conditioner	DDB_OUTPUT_CON_51
751	PSL	Input to relay 52 output conditioner	DDB_OUTPUT_CON_52
752	PSL	Input to relay 53 output conditioner	DDB_OUTPUT_CON_53
753	PSL	Input to relay 54 output conditioner	DDB_OUTPUT_CON_54
754	PSL	Input to relay 55 output conditioner	DDB_OUTPUT_CON_55
755	PSL	Input to relay 56 output conditioner	DDB_OUTPUT_CON_56
756	PSL	Input to relay 57 output conditioner	DDB_OUTPUT_CON_57
757	PSL	Input to relay 58 output conditioner	DDB_OUTPUT_CON_58
758	PSL	Input to relay 59 output conditioner	DDB_OUTPUT_CON_59
759	PSL	Input to relay 60 output conditioner	DDB_OUTPUT_CON_60
760	PSL	Input to relay 61 output conditioner	DDB_OUTPUT_CON_61
761	PSL	Input to relay 62 output conditioner	DDB_OUTPUT_CON_62
762	PSL	Input to relay 63 output conditioner	DDB_OUTPUT_CON_63
763	PSL	Input to relay 64 output conditioner	DDB_OUTPUT_CON_64
764	PSL	Assignment of input signal to drive output LED 1 red	DDB_TRI_LED_RED_CON_1
765	PSL	Assignment of signal to drive output LED 1 green. To drive LED 1 yellow DDB 676 and DDB 677 must be driven at the same time	DDB_TRI_LED_GRN_CON_1
766	PSL	Assignment of input signal to drive output LED 2 red	DDB_TRI_LED_RED_CON_2
767	PSL	Assignment of signal to drive output LED 2 green. To drive LED 2 yellow DDB 678 and DDB 679 must be driven at the same time	DDB_TRI_LED_GRN_CON_2
768	PSL	Assignment of input signal to drive output LED 3 red	DDB_TRI_LED_RED_CON_3
769	PSL	Assignment of signal to drive output LED 3 green. To drive LED 3 yellow DDB 680 and DDB 681 must be driven at the same time	DDB_TRI_LED_GRN_CON_3
770	PSL	Assignment of input signal to drive output LED 4 red	DDB_TRI_LED_RED_CON_4
771	PSL	Assignment of signal to drive output LED 4 green. To drive LED 4 yellow DDB 682 and DDB 683 must be driven at the same time	DDB_TRI_LED_GRN_CON_4
772	PSL	Assignment of input signal to drive output LED 5 red	DDB_TRI_LED_RED_CON_5
773	PSL	Assignment of signal to drive output LED 5 green. To drive LED 5 yellow DDB 684 and DDB 685 must be driven at the same time	DDB_TRI_LED_GRN_CON_5

P741 Logic Nodes			
DDB No	**Source**	**Description**	**Element Name**
774	PSL	Assignment of input signal to drive output LED 6 red	DDB_TRI_LED_RED_CON_6
775	PSL	Assignment of signal to drive output LED 6 green. To drive LED 6 yellow DDB 686 and DDB 687 must be driven at the same time	DDB_TRI_LED_GRN_CON_6
776	PSL	Assignment of input signal to drive output LED 7 red	DDB_TRI_LED_RED_CON_7
777	PSL	Assignment of signal to drive output LED 7 green. To drive LED 7 yellow DDB 688 and DDB 689 must be driven at the same time	DDB_TRI_LED_GRN_CON_7
778	PSL	Assignment of input signal to drive output LED 8 red	DDB_TRI_LED_RED_CON_8
779	PSL	Assignment of signal to drive output LED 8 green. To drive LED 8 yellow DDB 690 and DDB 691 must be driven at the same time	DDB_TRI_LED_GRN_CON_8
780	PSL	Assignment of signal to drive output function key LED 1 red. This LED is associated with function key 1	DDB_TRI_LED_RED_CON_9
781	PSL	Assignment of signal to drive output function key LED 1 green. This LED is associated with function key 1. To drive function key LED, yellow DDB 692 and DDB 693 must be active at the same time	DDB_TRI_LED_GRN_CON_9
782	PSL	Assignment of signal to drive output function key LED 2 red. This LED is associated with function key 2	DDB_TRI_LED_RED_CON_10
783	PSL	Assignment of signal to drive output function key LED 2 green. This LED is associated with function key 2. To drive function key LED, yellow DDB 694 and DDB 695 must be active at the same time	DDB_TRI_LED_GRN_CON_10
784	PSL	Assignment of signal to drive output function key LED 3 red. This LED is associated with function key 3	DDB_TRI_LED_RED_CON_11
785	PSL	Assignment of signal to drive output function key LED 3 green. This LED is associated with function key 3. To drive function key LED, yellow DDB 696 and DDB 697 must be active at the same time	DDB_TRI_LED_GRN_CON_11

P741 Logic Nodes			
DDB No	**Source**	**Description**	**Element Name**
786	PSL	Assignment of signal to drive output function key LED 4 red. This LED is associated with function key 4	DDB_TRI_LED_RED_CON_12
787	PSL	Assignment of signal to drive output function key LED 4 green. This LED is associated with function key 4. To drive function key LED, yellow DDB 698 and DDB 699 must be active at the same time	DDB_TRI_LED_GRN_CON_12
788	PSL	Assignment of signal to drive output function key LED 5 red. This LED is associated with function key 5	DDB_TRI_LED_RED_CON_13
789	PSL	Assignment of signal to drive output function key LED 5 green. This LED is associated with function key 5. To drive function key LED, yellow DDB 700 and DDB 701 must be active at the same time	DDB_TRI_LED_GRN_CON_13
790	PSL	Assignment of signal to drive output function key LED 6 red. This LED is associated with function key 6	DDB_TRI_LED_RED_CON_14
791	PSL	Assignment of signal to drive output function key LED 6 green. This LED is associated with function key 6. To drive function key LED, yellow DDB 702 and DDB 703 must be active at the same time	DDB_TRI_LED_GRN_CON_14
792	PSL	Assignment of signal to drive output function key LED 7 red. This LED is associated with function key 7	DDB_TRI_LED_RED_CON_15
793	PSL	Assignment of signal to drive output function key LED 7 green. This LED is associated with function key 7. To drive function key LED, yellow DDB 704 and DDB 705 must be active at the same time	DDB_TRI_LED_GRN_CON_15
794	PSL	Assignment of signal to drive output function key LED 8 red. This LED is associated with function key 8	DDB_TRI_LED_RED_CON_16
795	PSL	Assignment of signal to drive output function key LED 8 green. This LED is associated with function key 8. To drive function key LED, yellow DDB 706 and DDB 707 must be active at the same time	DDB_TRI_LED_GRN_CON_16
796	PSL	Assignment of signal to drive output function key LED 9 red. This LED is associated with function key 9	DDB_TRI_LED_RED_CON_17

P741 Logic Nodes			
DDB No	Source	Description	Element Name
797	PSL	Assignment of signal to drive output function key LED 9 green. This LED is associated with function key 9. To drive function key LED, yellow DDB 708 and DDB 709 must be active at the same time	DDB_TRI_LED_GRN_CON_17
798	PSL	Assignment of signal to drive output function key LED 10 red. This LED is associated with function key 10	DDB_TRI_LED_RED_CON_18
799	PSL	Assignment of signal to drive output function key LED 10 green. This LED is associated with function key 10. To drive function key LED, yellow DDB 710 and DDB 711 must be active at the same time	DDB_TRI_LED_GRN_CON_18
800	PSL	Reserve	DDB_UNUSED_800
801	PSL	Reserve	DDB_UNUSED_801
802	PSL	Reserve	DDB_UNUSED_802
803	PSL	IEC61850 only - 87BB SEF blocked by the phase protection	IEC61850_87BB_PHASE_BLOCKING_SEF
804	PSL	IEC61850 only - 87BB fault phase x CZ	IEC61850_87BB_FLT_PH_A_CZ
805	PSL	Reserve	IEC61850_87BB_FLT_PH_B_CZ
806	PSL	Reserve	IEC61850_87BB_FLT_PH_C_CZ
807	PSL	Reserve	IEC61850_87BB_FLT_SEF_CZ
808	PSL	IEC61850 only - 87BB circ flt alarm phase x CZ	IEC61850_87BB_CF_PH_A_ALM_CZ
809	PSL	Reserve	IEC61850_87BB_CF_PH_B_ALM_CZ
810	PSL	Reserve	IEC61850_87BB_CF_PH_C_ALM_CZ
811	PSL	Reserve	IEC61850_87BB_CF_SEF_ALM_CZ
812	PSL	IEC61850 only - 87BB circ flt blocking phase x CZ	IEC61850_87BB_CF_PH_A_LCK_CZ
813	PSL	Reserve	IEC61850_87BB_CF_PH_B_LCK_CZ
814	PSL	Reserve	IEC61850_87BB_CF_PH_C_LCK_CZ
815	PSL	Reserve	IEC61850_87BB_CF_SEF_LCK_CZ
816	PSL	IEC61850 only - 87BB circ flt blocking phase A Zx	IEC61850_87BB_CF_PH_A_LCK_Z8
817	PSL	Reserve	IEC61850_87BB_CF_PH_A_LCK_Z7
818	PSL	Reserve	IEC61850_87BB_CF_PH_A_LCK_Z6
819	PSL	Reserve	IEC61850_87BB_CF_PH_A_LCK_Z5
820	PSL	Reserve	IEC61850_87BB_CF_PH_A_LCK_Z4
821	PSL	Reserve	IEC61850_87BB_CF_PH_A_LCK_Z3
822	PSL	Reserve	IEC61850_87BB_CF_PH_A_LCK_Z2
823	PSL	Reserve	IEC61850_87BB_CF_PH_A_LCK_Z1
824	PSL	IEC61850 only - 87BB circ flt blocking phase B Zx	IEC61850_87BB_CF_PH_B_LCK_Z8
825	PSL	Reserve	IEC61850_87BB_CF_PH_B_LCK_Z7
826	PSL	Reserve	IEC61850_87BB_CF_PH_B_LCK_Z6

P741 Logic Nodes			
DDB No	Source	Description	Element Name
827	PSL	Reserve	IEC61850_87BB_CF_PH_B_LCK_Z5
828	PSL	Reserve	IEC61850_87BB_CF_PH_B_LCK_Z4
829	PSL	Reserve	IEC61850_87BB_CF_PH_B_LCK_Z3
830	PSL	Reserve	IEC61850_87BB_CF_PH_B_LCK_Z2
831	PSL	Reserve	IEC61850_87BB_CF_PH_B_LCK_Z1
832	PSL	IEC61850 only - 87BB circ flt blocking phase C Zx	IEC61850_87BB_CF_PH_C_LCK_Z8
833	PSL	Reserve	IEC61850_87BB_CF_PH_C_LCK_Z7
834	PSL	Reserve	IEC61850_87BB_CF_PH_C_LCK_Z6
835	PSL	Reserve	IEC61850_87BB_CF_PH_C_LCK_Z5
836	PSL	Reserve	IEC61850_87BB_CF_PH_C_LCK_Z4
837	PSL	Reserve	IEC61850_87BB_CF_PH_C_LCK_Z3
838	PSL	Reserve	IEC61850_87BB_CF_PH_C_LCK_Z2
839	PSL	Reserve	IEC61850_87BB_CF_PH_C_LCK_Z1
840	PSL	IEC61850 only - 87BB circ flt blocking SEF Zx	IEC61850_87BB_CF_SEF_LCK_Z8
841	PSL	Reserve	IEC61850_87BB_CF_SEF_LCK_Z7
842	PSL	Reserve	IEC61850_87BB_CF_SEF_LCK_Z6
843	PSL	Reserve	IEC61850_87BB_CF_SEF_LCK_Z5
844	PSL	Reserve	IEC61850_87BB_CF_SEF_LCK_Z4
845	PSL	Reserve	IEC61850_87BB_CF_SEF_LCK_Z3
846	PSL	Reserve	IEC61850_87BB_CF_SEF_LCK_Z2
847	PSL	Reserve	IEC61850_87BB_CF_SEF_LCK_Z1
848	PSL	IEC61850 only - 87BB circ flt alarm phase A Zx	IEC61850_87BB_CF_PH_A_ALM_Z8
849	PSL	Reserve	IEC61850_87BB_CF_PH_A_ALM_Z7
850	PSL	Reserve	IEC61850_87BB_CF_PH_A_ALM_Z6
851	PSL	Reserve	IEC61850_87BB_CF_PH_A_ALM_Z5
852	PSL	Reserve	IEC61850_87BB_CF_PH_A_ALM_Z4
853	PSL	Reserve	IEC61850_87BB_CF_PH_A_ALM_Z3
854	PSL	Reserve	IEC61850_87BB_CF_PH_A_ALM_Z2
855	PSL	Reserve	IEC61850_87BB_CF_PH_A_ALM_Z1
856	PSL	IEC61850 only - 87BB circ flt alarm phase B Zx	IEC61850_87BB_CF_PH_B_ALM_Z8
857	PSL	Reserve	IEC61850_87BB_CF_PH_B_ALM_Z7
858	PSL	Reserve	IEC61850_87BB_CF_PH_B_ALM_Z6
859	PSL	Reserve	IEC61850_87BB_CF_PH_B_ALM_Z5
860	PSL	Reserve	IEC61850_87BB_CF_PH_B_ALM_Z4
861	PSL	Reserve	IEC61850_87BB_CF_PH_B_ALM_Z3
862	PSL	Reserve	IEC61850_87BB_CF_PH_B_ALM_Z2
863	PSL	Reserve	IEC61850_87BB_CF_PH_B_ALM_Z1
864	PSL	IEC61850 only - 87BB circ flt alarm phase C Zx	IEC61850_87BB_CF_PH_C_ALM_Z8
865	PSL	Reserve	IEC61850_87BB_CF_PH_C_ALM_Z7
866	PSL	Reserve	IEC61850_87BB_CF_PH_C_ALM_Z6
867	PSL	Reserve	IEC61850_87BB_CF_PH_C_ALM_Z5

P741 Logic Nodes			
DDB No	Source	Description	Element Name
868	PSL	Reserve	IEC61850_87BB_CF_PH_C_ALM_Z4
869	PSL	Reserve	IEC61850_87BB_CF_PH_C_ALM_Z3
870	PSL	Reserve	IEC61850_87BB_CF_PH_C_ALM_Z2
871	PSL	Reserve	IEC61850_87BB_CF_PH_C_ALM_Z1
872	PSL	IEC61850 only - 87BB circ flt alarm SEF Zx	IEC61850_87BB_CF_SEF_ALM_Z8
873	PSL	Reserve	IEC61850_87BB_CF_SEF_ALM_Z7
874	PSL	Reserve	IEC61850_87BB_CF_SEF_ALM_Z6
875	PSL	Reserve	IEC61850_87BB_CF_SEF_ALM_Z5
876	PSL	Reserve	IEC61850_87BB_CF_SEF_ALM_Z4
877	PSL	Reserve	IEC61850_87BB_CF_SEF_ALM_Z3
878	PSL	Reserve	IEC61850_87BB_CF_SEF_ALM_Z2
879	PSL	Reserve	IEC61850_87BB_CF_SEF_ALM_Z1
880	PSL	IEC61850 only - 50BF backtrip from PU Zx	IEC61850_50BF_FROM_PU_Z8
881	PSL	Reserve	IEC61850_50BF_FROM_PU_Z7
882	PSL	Reserve	IEC61850_50BF_FROM_PU_Z6
883	PSL	Reserve	IEC61850_50BF_FROM_PU_Z5
884	PSL	Reserve	IEC61850_50BF_FROM_PU_Z4
885	PSL	Reserve	IEC61850_50BF_FROM_PU_Z3
886	PSL	Reserve	IEC61850_50BF_FROM_PU_Z2
887	PSL	Reserve	IEC61850_50BF_FROM_PU_Z1
888	PSL	IEC61850 only - 87BB fault phase A Zx	IEC61850_87BB_FLT_PH_A_Z8
889	PSL	Reserve	IEC61850_87BB_FLT_PH_A_Z7
890	PSL	Reserve	IEC61850_87BB_FLT_PH_A_Z6
891	PSL	Reserve	IEC61850_87BB_FLT_PH_A_Z5
892	PSL	Reserve	IEC61850_87BB_FLT_PH_A_Z4
893	PSL	Reserve	IEC61850_87BB_FLT_PH_A_Z3
894	PSL	Reserve	IEC61850_87BB_FLT_PH_A_Z2
895	PSL	Reserve	IEC61850_87BB_FLT_PH_A_Z1
896	PSL	IEC61850 only - 87BB fault phase B Zx	IEC61850_87BB_FLT_PH_B_Z8
897	PSL	Reserve	IEC61850_87BB_FLT_PH_B_Z7
898	PSL	Reserve	IEC61850_87BB_FLT_PH_B_Z6
899	PSL	Reserve	IEC61850_87BB_FLT_PH_B_Z5
900	PSL	Reserve	IEC61850_87BB_FLT_PH_B_Z4
901	PSL	Reserve	IEC61850_87BB_FLT_PH_B_Z3
902	PSL	Reserve	IEC61850_87BB_FLT_PH_B_Z2
903	PSL	Reserve	IEC61850_87BB_FLT_PH_B_Z1
904	PSL	IEC61850 only - 87BB fault phase C Zx	IEC61850_87BB_FLT_PH_C_Z8
905	PSL	Reserve	IEC61850_87BB_FLT_PH_C_Z7
906	PSL	Reserve	IEC61850_87BB_FLT_PH_C_Z6
907	PSL	Reserve	IEC61850_87BB_FLT_PH_C_Z5
908	PSL	Reserve	IEC61850_87BB_FLT_PH_C_Z4
909	PSL	Reserve	IEC61850_87BB_FLT_PH_C_Z3
910	PSL	Reserve	IEC61850_87BB_FLT_PH_C_Z2
911	PSL	Reserve	IEC61850_87BB_FLT_PH_C_Z1
912	PSL	IEC61850 only - 87BB fault SEF Zx	IEC61850_87BB_FLT_SEF_Z8

P741 Logic Nodes			
DDB No	**Source**	**Description**	**Element Name**
913	PSL	Reserve	IEC61850_87BB_FLT_SEF_Z7
914	PSL	Reserve	IEC61850_87BB_FLT_SEF_Z6
915	PSL	Reserve	IEC61850_87BB_FLT_SEF_Z5
916	PSL	Reserve	IEC61850_87BB_FLT_SEF_Z4
917	PSL	Reserve	IEC61850_87BB_FLT_SEF_Z3
918	PSL	Reserve	IEC61850_87BB_FLT_SEF_Z2
919	PSL	Reserve	IEC61850_87BB_FLT_SEF_Z1
920	PSL	Reserve	IEC61850_87BB_OP_PHS_Z8
921	PSL	Reserve	IEC61850_87BB_OP_PHS_Z7
922	PSL	Reserve	IEC61850_87BB_OP_PHS_Z6
923	PSL	Reserve	IEC61850_87BB_OP_PHS_Z5
924	PSL	Reserve	IEC61850_87BB_OP_PHS_Z4
925	PSL	Reserve	IEC61850_87BB_OP_PHS_Z3
926	PSL	Reserve	IEC61850_87BB_OP_PHS_Z2
927	PSL	Reserve	IEC61850_87BB_OP_PHS_Z1
928	PSL	Reserve	IEC61850_87BB_OP_SEF_Z8
929	PSL	Reserve	IEC61850_87BB_OP_SEF_Z7
930	PSL	Reserve	IEC61850_87BB_OP_SEF_Z6
931	PSL	Reserve	IEC61850_87BB_OP_SEF_Z5
932	PSL	Reserve	IEC61850_87BB_OP_SEF_Z4
933	PSL	Reserve	IEC61850_87BB_OP_SEF_Z3
934	PSL	Reserve	IEC61850_87BB_OP_SEF_Z2
935	PSL	Reserve	IEC61850_87BB_OP_SEF_Z1
936	PSL	Reserve	DDB_UNUSED_936
937	PSL	Reserve	DDB_UNUSED_937
938	PSL	Reserve	DDB_UNUSED_938
939	PSL	Reserve	DDB_UNUSED_939
940	PSL	Reserve	DDB_UNUSED_940
941	PSL	Reserve	DDB_UNUSED_941
942	PSL	Reserve	DDB_UNUSED_942
943	PSL	Reserve	DDB_UNUSED_943
944	PSL	Reserve	DDB_UNUSED_944
945	PSL	Reserve	DDB_UNUSED_945
946	PSL	Reserve	DDB_UNUSED_946
947	PSL	Reserve	DDB_UNUSED_947
948	PSL	Reserve	DDB_UNUSED_948
949	PSL	Reserve	DDB_UNUSED_949
950	PSL	Reserve	DDB_UNUSED_950
951	PSL	Reserve	DDB_UNUSED_951
952	PSL	Reserve	DDB_UNUSED_952
953	PSL	Reserve	DDB_UNUSED_953
954	PSL	Reserve	DDB_UNUSED_954
955	PSL	Reserve	DDB_UNUSED_955
956	PSL	Reserve	DDB_UNUSED_956
957	PSL	Reserve	DDB_UNUSED_957
958	PSL	Reserve	DDB_UNUSED_958

P741 Logic Nodes			
DDB No	Source	Description	Element Name
959	PSL	Reserve	DDB_UNUSED_959
960	PSL	PSL Internal Node	DDB_PSLINT_38
961	PSL	PSL Internal Node	DDB_PSLINT_39
962	PSL	PSL Internal Node	DDB_PSLINT_40
963	PSL	PSL Internal Node	DDB_PSLINT_41
964	PSL	PSL Internal Node	DDB_PSLINT_42
965	PSL	PSL Internal Node	DDB_PSLINT_43
966	PSL	PSL Internal Node	DDB_PSLINT_44
967	PSL	PSL Internal Node	DDB_PSLINT_45
968	PSL	PSL Internal Node	DDB_PSLINT_46
969	PSL	PSL Internal Node	DDB_PSLINT_47
970	PSL	PSL Internal Node	DDB_PSLINT_48
971	PSL	PSL Internal Node	DDB_PSLINT_49
972	PSL	PSL Internal Node	DDB_PSLINT_50
973	PSL	PSL Internal Node	DDB_PSLINT_51
974	PSL	PSL Internal Node	DDB_PSLINT_52
975	PSL	PSL Internal Node	DDB_PSLINT_53
976	PSL	PSL Internal Node	DDB_PSLINT_54
977	PSL	PSL Internal Node	DDB_PSLINT_55
978	PSL	PSL Internal Node	DDB_PSLINT_56
979	PSL	PSL Internal Node	DDB_PSLINT_57
980	PSL	PSL Internal Node	DDB_PSLINT_58
981	PSL	PSL Internal Node	DDB_PSLINT_59
982	PSL	PSL Internal Node	DDB_PSLINT_60
983	PSL	PSL Internal Node	DDB_PSLINT_61
984	PSL	PSL Internal Node	DDB_PSLINT_62
985	PSL	PSL Internal Node	DDB_PSLINT_63
986	PSL	PSL Internal Node	DDB_PSLINT_64
987	PSL	PSL Internal Node	DDB_PSLINT_65
988	PSL	PSL Internal Node	DDB_PSLINT_66
989	PSL	PSL Internal Node	DDB_PSLINT_67
990	PSL	PSL Internal Node	DDB_PSLINT_68
991	PSL	PSL Internal Node	DDB_PSLINT_69
992	PSL	PSL Internal Node	DDB_PSLINT_70
993	PSL	PSL Internal Node	DDB_PSLINT_71
994	PSL	PSL Internal Node	DDB_PSLINT_72
995	PSL	PSL Internal Node	DDB_PSLINT_73
996	PSL	PSL Internal Node	DDB_PSLINT_74
997	PSL	PSL Internal Node	DDB_PSLINT_75
998	PSL	PSL Internal Node	DDB_PSLINT_76
999	PSL	PSL Internal Node	DDB_PSLINT_77
1000	PSL	PSL Internal Node	DDB_PSLINT_78
1001	PSL	PSL Internal Node	DDB_PSLINT_79
1002	PSL	PSL Internal Node	DDB_PSLINT_80
1003	PSL	PSL Internal Node	DDB_PSLINT_81
1004	PSL	PSL Internal Node	DDB_PSLINT_82

P741 Logic Nodes			
DDB No	**Source**	**Description**	**Element Name**
1005	PSL	PSL Internal Node	DDB_PSLINT_83
1006	PSL	PSL Internal Node	DDB_PSLINT_84
1007	PSL	PSL Internal Node	DDB_PSLINT_85
1008	PSL	PSL Internal Node	DDB_PSLINT_86
1009	PSL	PSL Internal Node	DDB_PSLINT_87
1010	PSL	PSL Internal Node	DDB_PSLINT_88
1011	PSL	PSL Internal Node	DDB_PSLINT_89
1012	PSL	PSL Internal Node	DDB_PSLINT_90
1013	PSL	PSL Internal Node	DDB_PSLINT_91
1014	PSL	PSL Internal Node	DDB_PSLINT_92
1015	PSL	PSL Internal Node	DDB_PSLINT_93
1016	PSL	PSL Internal Node	DDB_PSLINT_94
1017	PSL	PSL Internal Node	DDB_PSLINT_95
1018	PSL	PSL Internal Node	DDB_PSLINT_96
1019	PSL	PSL Internal Node	DDB_PSLINT_97
1020	PSL	PSL Internal Node	DDB_PSLINT_98
1021	PSL	PSL Internal Node	DDB_PSLINT_99
1022	PSL	PSL Internal Node	DDB_PSLINT_100
1023	PSL	PSL Internal Node	DDB_PSLINT_101
1024	SW	Virtual Input 1 - received from GOOSE message	DDB_GOOSEIN_1
1025	SW	Virtual Input 2 - received from GOOSE message	DDB_GOOSEIN_2
1026	SW	Virtual Input 3 - received from GOOSE message	DDB_GOOSEIN_3
1027	SW	Virtual Input 4 - received from GOOSE message	DDB_GOOSEIN_4
1028	SW	Virtual Input 5 - received from GOOSE message	DDB_GOOSEIN_5
1029	SW	Virtual Input 6 - received from GOOSE message	DDB_GOOSEIN_6
1030	SW	Virtual Input 7 - received from GOOSE message	DDB_GOOSEIN_7
1031	SW	Virtual Input 8 - received from GOOSE message	DDB_GOOSEIN_8
1032	SW	Virtual Input 9 - received from GOOSE message	DDB_GOOSEIN_9
1033	SW	Virtual Input 10 - received from GOOSE message	DDB_GOOSEIN_10
1034	SW	Virtual Input 11 - received from GOOSE message	DDB_GOOSEIN_11
1035	SW	Virtual Input 12 - received from GOOSE message	DDB_GOOSEIN_12
1036	SW	Virtual Input 13 - received from GOOSE message	DDB_GOOSEIN_13
1037	SW	Virtual Input 14 - received from GOOSE message	DDB_GOOSEIN_14

P741 Logic Nodes			
DDB No	**Source**	**Description**	**Element Name**
1038	SW	Virtual Input 15 - received from GOOSE message	DDB_GOOSEIN_15
1039	SW	Virtual Input 16 - received from GOOSE message	DDB_GOOSEIN_16
1040	SW	Virtual Input 17 - received from GOOSE message	DDB_GOOSEIN_17
1041	SW	Virtual Input 18 - received from GOOSE message	DDB_GOOSEIN_18
1042	SW	Virtual Input 19 - received from GOOSE message	DDB_GOOSEIN_19
1043	SW	Virtual Input 20 - received from GOOSE message	DDB_GOOSEIN_20
1044	SW	Virtual Input 21 - received from GOOSE message	DDB_GOOSEIN_21
1045	SW	Virtual Input 22 - received from GOOSE message	DDB_GOOSEIN_22
1046	SW	Virtual Input 23 - received from GOOSE message	DDB_GOOSEIN_23
1047	SW	Virtual Input 24 - received from GOOSE message	DDB_GOOSEIN_24
1048	SW	Virtual Input 25 - received from GOOSE message	DDB_GOOSEIN_25
1049	SW	Virtual Input 26 - received from GOOSE message	DDB_GOOSEIN_26
1050	SW	Virtual Input 27 - received from GOOSE message	DDB_GOOSEIN_27
1051	SW	Virtual Input 28 - received from GOOSE message	DDB_GOOSEIN_28
1052	SW	Virtual Input 29 - received from GOOSE message	DDB_GOOSEIN_29
1053	SW	Virtual Input 30 - received from GOOSE message	DDB_GOOSEIN_30
1054	SW	Virtual Input 31 - received from GOOSE message	DDB_GOOSEIN_31
1055	SW	Virtual Input 32 - received from GOOSE message	DDB_GOOSEIN_32
1056	SW	Virtual Input 33 - received from GOOSE message	DDB_GOOSEIN_33
1057	SW	Virtual Input 34 - received from GOOSE message	DDB_GOOSEIN_34
1058	SW	Virtual Input 35 - received from GOOSE message	DDB_GOOSEIN_35
1059	SW	Virtual Input 36 - received from GOOSE message	DDB_GOOSEIN_36
1060	SW	Virtual Input 37 - received from GOOSE message	DDB_GOOSEIN_37

P741 Logic Nodes			
DDB No	Source	Description	Element Name
1061	SW	Virtual Input 38 - received from GOOSE message	DDB_GOOSEIN_38
1062	SW	Virtual Input 39 - received from GOOSE message	DDB_GOOSEIN_39
1063	SW	Virtual Input 40 - received from GOOSE message	DDB_GOOSEIN_40
1064	SW	Virtual Input 41 - received from GOOSE message	DDB_GOOSEIN_41
1065	SW	Virtual Input 42 - received from GOOSE message	DDB_GOOSEIN_42
1066	SW	Virtual Input 43 - received from GOOSE message	DDB_GOOSEIN_43
1067	SW	Virtual Input 44 - received from GOOSE message	DDB_GOOSEIN_44
1068	SW	Virtual Input 45 - received from GOOSE message	DDB_GOOSEIN_45
1069	SW	Virtual Input 46 - received from GOOSE message	DDB_GOOSEIN_46
1070	SW	Virtual Input 47 - received from GOOSE message	DDB_GOOSEIN_47
1071	SW	Virtual Input 48 - received from GOOSE message	DDB_GOOSEIN_48
1072	SW	Virtual Input 49 - received from GOOSE message	DDB_GOOSEIN_49
1073	SW	Virtual Input 40 - received from GOOSE message	DDB_GOOSEIN_50
1074	SW	Virtual Input 41 - received from GOOSE message	DDB_GOOSEIN_51
1075	SW	Virtual Input 52 - received from GOOSE message	DDB_GOOSEIN_52
1076	SW	Virtual Input 53 - received from GOOSE message	DDB_GOOSEIN_53
1077	SW	Virtual Input 54 - received from GOOSE message	DDB_GOOSEIN_54
1078	SW	Virtual Input 55 - received from GOOSE message	DDB_GOOSEIN_55
1079	SW	Virtual Input 56 - received from GOOSE message	DDB_GOOSEIN_56
1080	SW	Virtual Input 57 - received from GOOSE message	DDB_GOOSEIN_57
1081	SW	Virtual Input 58 - received from GOOSE message	DDB_GOOSEIN_58
1082	SW	Virtual Input 59 - received from GOOSE message	DDB_GOOSEIN_59
1083	SW	Virtual Input 60 - received from GOOSE message	DDB_GOOSEIN_60

P741 Logic Nodes			
DDB No	Source	Description	Element Name
1084	SW	Virtual Input 61 - received from GOOSE message	DDB_GOOSEIN_61
1085	SW	Virtual Input 62 - received from GOOSE message	DDB_GOOSEIN_62
1086	SW	Virtual Input 63 - received from GOOSE message	DDB_GOOSEIN_63
1087	SW	Virtual Input 64 - received from GOOSE message	DDB_GOOSEIN_64
1088	PSL	Reserve	UNUSED_1088
1089	PSL	Reserve	UNUSED_1089
1090	PSL	Reserve	UNUSED_1090
1091	PSL	Reserve	UNUSED_1091
1092	PSL	Reserve	UNUSED_1092
1093	PSL	Reserve	UNUSED_1093
1094	PSL	Reserve	UNUSED_1094
1095	PSL	Reserve	UNUSED_1095
1096	PSL	Reserve	UNUSED_1096
1097	PSL	Reserve	UNUSED_1097
1098	PSL	Reserve	UNUSED_1098
1099	PSL	Reserve	UNUSED_1099
1100	PSL	Reserve	UNUSED_1100
1101	PSL	Reserve	UNUSED_1101
1102	PSL	Reserve	UNUSED_1102
1103	PSL	Reserve	UNUSED_1103
1104	PSL	Reserve	UNUSED_1104
1105	PSL	Reserve	UNUSED_1105
1106	PSL	Reserve	UNUSED_1106
1107	PSL	Reserve	UNUSED_1107
1108	PSL	Reserve	UNUSED_1108
1109	PSL	Reserve	UNUSED_1109
1110	PSL	Reserve	UNUSED_1110
1111	PSL	Reserve	UNUSED_1111
1112	PSL	Reserve	UNUSED_1112
1113	PSL	Reserve	UNUSED_1113
1114	PSL	Reserve	UNUSED_1114
1115	PSL	Reserve	UNUSED_1115
1116	PSL	Reserve	UNUSED_1116
1117	PSL	Reserve	UNUSED_1117
1118	PSL	Reserve	UNUSED_1118
1119	PSL	Reserve	UNUSED_1119
1120	PSL	Reserve	UNUSED_1120
1121	PSL	Reserve	UNUSED_1121
1122	PSL	Reserve	UNUSED_1122
1123	PSL	Reserve	UNUSED_1123
1124	PSL	Reserve	UNUSED_1124
1125	PSL	Reserve	UNUSED_1125

P741 Logic Nodes			
DDB No	Source	Description	Element Name
1126	PSL	Reserve	UNUSED_1126
1127	PSL	Reserve	UNUSED_1127
1128	PSL	Reserve	UNUSED_1128
1129	PSL	Reserve	UNUSED_1129
1130	PSL	Reserve	UNUSED_1130
1131	PSL	Reserve	UNUSED_1131
1132	PSL	Reserve	UNUSED_1132
1133	PSL	Reserve	UNUSED_1133
1134	PSL	Reserve	UNUSED_1134
1135	PSL	Reserve	UNUSED_1135
1136	PSL	Reserve	UNUSED_1136
1137	PSL	Reserve	UNUSED_1137
1138	PSL	Reserve	UNUSED_1138
1139	PSL	Reserve	UNUSED_1139
1140	PSL	Reserve	UNUSED_1140
1141	PSL	Reserve	UNUSED_1141
1142	PSL	Reserve	UNUSED_1142
1143	PSL	Reserve	UNUSED_1143
1144	PSL	Reserve	UNUSED_1144
1145	PSL	Reserve	UNUSED_1145
1146	PSL	Reserve	UNUSED_1146
1147	PSL	Reserve	UNUSED_1147
1148	PSL	Reserve	UNUSED_1148
1149	PSL	Reserve	UNUSED_1149
1150	PSL	Reserve	UNUSED_1150
1151	PSL	Reserve	UNUSED_1151
1152	SW	GOOSE virtual input 1 - provides the Quality attributes of any data object in an incoming GOOSE message	DDB_VIP_QUALITY_1
1153	SW	GOOSE virtual input 2 - provides the Quality attributes of any data object in an incoming GOOSE message	DDB_VIP_QUALITY_2
1154	SW	GOOSE virtual input 3 - provides the Quality attributes of any data object in an incoming GOOSE message	DDB_VIP_QUALITY_3
1155	SW	GOOSE virtual input 4 - provides the Quality attributes of any data object in an incoming GOOSE message	DDB_VIP_QUALITY_4
1156	SW	GOOSE virtual input 5 - provides the Quality attributes of any data object in an incoming GOOSE message	DDB_VIP_QUALITY_5
1157	SW	GOOSE virtual input 6 - provides the Quality attributes of any data object in an incoming GOOSE message	DDB_VIP_QUALITY_6
1158	SW	GOOSE virtual input 7 - provides the Quality attributes of any data object in an incoming GOOSE message	DDB_VIP_QUALITY_7

P741 Logic Nodes			
DDB No	**Source**	**Description**	**Element Name**
1159	SW	GOOSE virtual input 8 - provides the Quality attributes of any data object in an incoming GOOSE message	DDB_VIP_QUALITY_8
1160	SW	GOOSE virtual input 9 - provides the Quality attributes of any data object in an incoming GOOSE message	DDB_VIP_QUALITY_9
1161	SW	GOOSE virtual input 10 - provides the Quality attributes of any data object in an incoming GOOSE message	DDB_VIP_QUALITY_10
1162	SW	GOOSE virtual input 11 - provides the Quality attributes of any data object in an incoming GOOSE message	DDB_VIP_QUALITY_11
1163	SW	GOOSE virtual input 12 - provides the Quality attributes of any data object in an incoming GOOSE message	DDB_VIP_QUALITY_12
1164	SW	GOOSE virtual input 13 - provides the Quality attributes of any data object in an incoming GOOSE message	DDB_VIP_QUALITY_13
1165	SW	GOOSE virtual input 14 - provides the Quality attributes of any data object in an incoming GOOSE message	DDB_VIP_QUALITY_14
1166	SW	GOOSE virtual input 15 - provides the Quality attributes of any data object in an incoming GOOSE message	DDB_VIP_QUALITY_15
1167	SW	GOOSE virtual input 16 - provides the Quality attributes of any data object in an incoming GOOSE message	DDB_VIP_QUALITY_16
1168	SW	GOOSE virtual input 17 - provides the Quality attributes of any data object in an incoming GOOSE message	DDB_VIP_QUALITY_17
1169	SW	GOOSE virtual input 18 - provides the Quality attributes of any data object in an incoming GOOSE message	DDB_VIP_QUALITY_18
1170	SW	GOOSE virtual input 19 - provides the Quality attributes of any data object in an incoming GOOSE message	DDB_VIP_QUALITY_19
1171	SW	GOOSE virtual input 20 - provides the Quality attributes of any data object in an incoming GOOSE message	DDB_VIP_QUALITY_20
1172	SW	GOOSE virtual input 21 - provides the Quality attributes of any data object in an incoming GOOSE message	DDB_VIP_QUALITY_21
1173	SW	GOOSE virtual input 22 - provides the Quality attributes of any data object in an incoming GOOSE message	DDB_VIP_QUALITY_22

P741 Logic Nodes			
DDB No	Source	Description	Element Name
1174	SW	GOOSE virtual input 23 - provides the Quality attributes of any data object in an incoming GOOSE message	DDB_VIP_QUALITY_23
1175	SW	GOOSE virtual input 24 - provides the Quality attributes of any data object in an incoming GOOSE message	DDB_VIP_QUALITY_24
1176	SW	GOOSE virtual input 25 - provides the Quality attributes of any data object in an incoming GOOSE message	DDB_VIP_QUALITY_25
1177	SW	GOOSE virtual input 26 - provides the Quality attributes of any data object in an incoming GOOSE message	DDB_VIP_QUALITY_26
1178	SW	GOOSE virtual input 27 - provides the Quality attributes of any data object in an incoming GOOSE message	DDB_VIP_QUALITY_27
1179	SW	GOOSE virtual input 28 - provides the Quality attributes of any data object in an incoming GOOSE message	DDB_VIP_QUALITY_28
1180	SW	GOOSE virtual input 29 - provides the Quality attributes of any data object in an incoming GOOSE message	DDB_VIP_QUALITY_29
1181	SW	GOOSE virtual input 30 - provides the Quality attributes of any data object in an incoming GOOSE message	DDB_VIP_QUALITY_30
1182	SW	GOOSE virtual input 31 - provides the Quality attributes of any data object in an incoming GOOSE message	DDB_VIP_QUALITY_31
1183	SW	GOOSE virtual input 32 - provides the Quality attributes of any data object in an incoming GOOSE message	DDB_VIP_QUALITY_32
1184	SW	GOOSE virtual input 33 - provides the Quality attributes of any data object in an incoming GOOSE message	DDB_VIP_QUALITY_33
1185	SW	GOOSE virtual input 34 - provides the Quality attributes of any data object in an incoming GOOSE message	DDB_VIP_QUALITY_34
1186	SW	GOOSE virtual input 35 - provides the Quality attributes of any data object in an incoming GOOSE message	DDB_VIP_QUALITY_35
1187	SW	GOOSE virtual input 36 - provides the Quality attributes of any data object in an incoming GOOSE message	DDB_VIP_QUALITY_36
1188	SW	GOOSE virtual input 37 - provides the Quality attributes of any data object in an incoming GOOSE message	DDB_VIP_QUALITY_37

P741 Logic Nodes			
DDB No	**Source**	**Description**	**Element Name**
1189	SW	GOOSE virtual input 38 - provides the Quality attributes of any data object in an incoming GOOSE message	DDB_VIP_QUALITY_38
1190	SW	GOOSE virtual input 39 - provides the Quality attributes of any data object in an incoming GOOSE message	DDB_VIP_QUALITY_39
1191	SW	GOOSE virtual input 40 - provides the Quality attributes of any data object in an incoming GOOSE message	DDB_VIP_QUALITY_40
1192	SW	GOOSE virtual input 41 - provides the Quality attributes of any data object in an incoming GOOSE message	DDB_VIP_QUALITY_41
1193	SW	GOOSE virtual input 42 - provides the Quality attributes of any data object in an incoming GOOSE message	DDB_VIP_QUALITY_42
1194	SW	GOOSE virtual input 43 - provides the Quality attributes of any data object in an incoming GOOSE message	DDB_VIP_QUALITY_43
1195	SW	GOOSE virtual input 44 - provides the Quality attributes of any data object in an incoming GOOSE message	DDB_VIP_QUALITY_44
1196	SW	GOOSE virtual input 45 - provides the Quality attributes of any data object in an incoming GOOSE message	DDB_VIP_QUALITY_45
1197	SW	GOOSE virtual input 46 - provides the Quality attributes of any data object in an incoming GOOSE message	DDB_VIP_QUALITY_46
1198	SW	GOOSE virtual input 47 - provides the Quality attributes of any data object in an incoming GOOSE message	DDB_VIP_QUALITY_47
1199	SW	GOOSE virtual input 48 - provides the Quality attributes of any data object in an incoming GOOSE message	DDB_VIP_QUALITY_48
1200	SW	GOOSE virtual input 49 - provides the Quality attributes of any data object in an incoming GOOSE message	DDB_VIP_QUALITY_49
1201	SW	GOOSE virtual input 50 - provides the Quality attributes of any data object in an incoming GOOSE message	DDB_VIP_QUALITY_50
1202	SW	GOOSE virtual input 51 - provides the Quality attributes of any data object in an incoming GOOSE message	DDB_VIP_QUALITY_51
1203	SW	GOOSE virtual input 52 - provides the Quality attributes of any data object in an incoming GOOSE message	DDB_VIP_QUALITY_52

P741 Logic Nodes			
DDB No	**Source**	**Description**	**Element Name**
1204	SW	GOOSE virtual input 53 - provides the Quality attributes of any data object in an incoming GOOSE message	DDB_VIP_QUALITY_53
1205	SW	GOOSE virtual input 54 - provides the Quality attributes of any data object in an incoming GOOSE message	DDB_VIP_QUALITY_54
1206	SW	GOOSE virtual input 55 - provides the Quality attributes of any data object in an incoming GOOSE message	DDB_VIP_QUALITY_55
1207	SW	GOOSE virtual input 56 - provides the Quality attributes of any data object in an incoming GOOSE message	DDB_VIP_QUALITY_56
1208	SW	GOOSE virtual input 57 - provides the Quality attributes of any data object in an incoming GOOSE message	DDB_VIP_QUALITY_57
1209	SW	GOOSE virtual input 58 - provides the Quality attributes of any data object in an incoming GOOSE message	DDB_VIP_QUALITY_58
1210	SW	GOOSE virtual input 59 - provides the Quality attributes of any data object in an incoming GOOSE message	DDB_VIP_QUALITY_59
1211	SW	GOOSE virtual input 60 - provides the Quality attributes of any data object in an incoming GOOSE message	DDB_VIP_QUALITY_60
1212	SW	GOOSE virtual input 61 - provides the Quality attributes of any data object in an incoming GOOSE message	DDB_VIP_QUALITY_61
1213	SW	GOOSE virtual input 62 - provides the Quality attributes of any data object in an incoming GOOSE message	DDB_VIP_QUALITY_62
1214	SW	GOOSE virtual input 63 - provides the Quality attributes of any data object in an incoming GOOSE message	DDB_VIP_QUALITY_63
1215	SW	GOOSE virtual input 64 - provides the Quality attributes of any data object in an incoming GOOSE message	DDB_VIP_QUALITY_64
1216	PSL	Reserve	UNUSED_1216
1217	PSL	Reserve	UNUSED_1217
1218	PSL	Reserve	UNUSED_1218
1219	PSL	Reserve	UNUSED_1219
1220	PSL	Reserve	UNUSED_1220
1221	PSL	Reserve	UNUSED_1221
1222	PSL	Reserve	UNUSED_1222
1223	PSL	Reserve	UNUSED_1223
1224	PSL	Reserve	UNUSED_1224
1225	PSL	Reserve	UNUSED_1225
1226	PSL	Reserve	UNUSED_1226

P741 Logic Nodes			
DDB No	Source	Description	Element Name
1227	PSL	Reserve	UNUSED_1227
1228	PSL	Reserve	UNUSED_1228
1229	PSL	Reserve	UNUSED_1229
1230	PSL	Reserve	UNUSED_1230
1231	PSL	Reserve	UNUSED_1231
1232	PSL	Reserve	UNUSED_1232
1233	PSL	Reserve	UNUSED_1233
1234	PSL	Reserve	UNUSED_1234
1235	PSL	Reserve	UNUSED_1235
1236	PSL	Reserve	UNUSED_1236
1237	PSL	Reserve	UNUSED_1237
1238	PSL	Reserve	UNUSED_1238
1239	PSL	Reserve	UNUSED_1239
1240	PSL	Reserve	UNUSED_1240
1241	PSL	Reserve	UNUSED_1241
1242	PSL	Reserve	UNUSED_1242
1243	PSL	Reserve	UNUSED_1243
1244	PSL	Reserve	UNUSED_1244
1245	PSL	Reserve	UNUSED_1245
1246	PSL	Reserve	UNUSED_1246
1247	PSL	Reserve	UNUSED_1247
1248	PSL	Reserve	UNUSED_1248
1249	PSL	Reserve	UNUSED_1249
1250	PSL	Reserve	UNUSED_1250
1251	PSL	Reserve	UNUSED_1251
1252	PSL	Reserve	UNUSED_1252
1253	PSL	Reserve	UNUSED_1253
1254	PSL	Reserve	UNUSED_1254
1255	PSL	Reserve	UNUSED_1255
1256	PSL	Reserve	UNUSED_1256
1257	PSL	Reserve	UNUSED_1257
1258	PSL	Reserve	UNUSED_1258
1259	PSL	Reserve	UNUSED_1259
1260	PSL	Reserve	UNUSED_1260
1261	PSL	Reserve	UNUSED_1261
1262	PSL	Reserve	UNUSED_1262
1263	PSL	Reserve	UNUSED_1263
1264	PSL	Reserve	UNUSED_1264
1265	PSL	Reserve	UNUSED_1265
1266	PSL	Reserve	UNUSED_1266
1267	PSL	Reserve	UNUSED_1267
1268	PSL	Reserve	UNUSED_1268
1269	PSL	Reserve	UNUSED_1269
1270	PSL	Reserve	UNUSED_1270
1271	PSL	Reserve	UNUSED_1271
1272	PSL	Reserve	UNUSED_1272

P741 Logic Nodes			
DDB No	Source	Description	Element Name
1273	PSL	Reserve	UNUSED_1273
1274	PSL	Reserve	UNUSED_1274
1275	PSL	Reserve	UNUSED_1275
1276	PSL	Reserve	UNUSED_1276
1277	PSL	Reserve	UNUSED_1277
1278	PSL	Reserve	UNUSED_1278
1279	PSL	Reserve	UNUSED_1279
1280	SW	GOOSE virtual input 1- indicates if the GOOSE publisher responsible for publishing the data that derives a virtual input is present.	DDB_VIP_PUB_PRES_1
1281	SW	GOOSE virtual input 2- indicates if the GOOSE publisher responsible for publishing the data that derives a virtual input is present.	DDB_VIP_PUB_PRES_2
1282	SW	GOOSE virtual input 3- indicates if the GOOSE publisher responsible for publishing the data that derives a virtual input is present.	DDB_VIP_PUB_PRES_3
1283	SW	GOOSE virtual input 4- indicates if the GOOSE publisher responsible for publishing the data that derives a virtual input is present.	DDB_VIP_PUB_PRES_4
1284	SW	GOOSE virtual input 5- indicates if the GOOSE publisher responsible for publishing the data that derives a virtual input is present.	DDB_VIP_PUB_PRES_5
1285	SW	GOOSE virtual input 6- indicates if the GOOSE publisher responsible for publishing the data that derives a virtual input is present.	DDB_VIP_PUB_PRES_6
1286	SW	GOOSE virtual input 7- indicates if the GOOSE publisher responsible for publishing the data that derives a virtual input is present.	DDB_VIP_PUB_PRES_7
1287	SW	GOOSE virtual input 8- indicates if the GOOSE publisher responsible for publishing the data that derives a virtual input is present.	DDB_VIP_PUB_PRES_8
1288	SW	GOOSE virtual input 9- indicates if the GOOSE publisher responsible for publishing the data that derives a virtual input is present.	DDB_VIP_PUB_PRES_9
1289	SW	GOOSE virtual input 10- indicates if the GOOSE publisher responsible for publishing the data that derives a virtual input is present.	DDB_VIP_PUB_PRES_10

P741 Logic Nodes			
DDB No	**Source**	**Description**	**Element Name**
1290	SW	GOOSE virtual input 11- indicates if the GOOSE publisher responsible for publishing the data that derives a virtual input is present.	DDB_VIP_PUB_PRES_11
1291	SW	GOOSE virtual input 12- indicates if the GOOSE publisher responsible for publishing the data that derives a virtual input is present.	DDB_VIP_PUB_PRES_12
1292	SW	GOOSE virtual input 13- indicates if the GOOSE publisher responsible for publishing the data that derives a virtual input is present.	DDB_VIP_PUB_PRES_13
1293	SW	GOOSE virtual input 14- indicates if the GOOSE publisher responsible for publishing the data that derives a virtual input is present.	DDB_VIP_PUB_PRES_14
1294	SW	GOOSE virtual input 15- indicates if the GOOSE publisher responsible for publishing the data that derives a virtual input is present.	DDB_VIP_PUB_PRES_15
1295	SW	GOOSE virtual input 16- indicates if the GOOSE publisher responsible for publishing the data that derives a virtual input is present.	DDB_VIP_PUB_PRES_16
1296	SW	GOOSE virtual input 17- indicates if the GOOSE publisher responsible for publishing the data that derives a virtual input is present.	DDB_VIP_PUB_PRES_17
1297	SW	GOOSE virtual input 18- indicates if the GOOSE publisher responsible for publishing the data that derives a virtual input is present.	DDB_VIP_PUB_PRES_18
1298	SW	GOOSE virtual input 19- indicates if the GOOSE publisher responsible for publishing the data that derives a virtual input is present.	DDB_VIP_PUB_PRES_19
1299	SW	GOOSE virtual input 20- indicates if the GOOSE publisher responsible for publishing the data that derives a virtual input is present.	DDB_VIP_PUB_PRES_20
1300	SW	GOOSE virtual input 21- indicates if the GOOSE publisher responsible for publishing the data that derives a virtual input is present.	DDB_VIP_PUB_PRES_21

P741 Logic Nodes			
DDB No	Source	Description	Element Name
1301	SW	GOOSE virtual input 22- indicates if the GOOSE publisher responsible for publishing the data that derives a virtual input is present.	DDB_VIP_PUB_PRES_22
1302	SW	GOOSE virtual input 23- indicates if the GOOSE publisher responsible for publishing the data that derives a virtual input is present.	DDB_VIP_PUB_PRES_23
1303	SW	GOOSE virtual input 24- indicates if the GOOSE publisher responsible for publishing the data that derives a virtual input is present.	DDB_VIP_PUB_PRES_24
1304	SW	GOOSE virtual input 25- indicates if the GOOSE publisher responsible for publishing the data that derives a virtual input is present.	DDB_VIP_PUB_PRES_25
1305	SW	GOOSE virtual input 26- indicates if the GOOSE publisher responsible for publishing the data that derives a virtual input is present.	DDB_VIP_PUB_PRES_26
1306	SW	GOOSE virtual input 27- indicates if the GOOSE publisher responsible for publishing the data that derives a virtual input is present.	DDB_VIP_PUB_PRES_27
1307	SW	GOOSE virtual input 28- indicates if the GOOSE publisher responsible for publishing the data that derives a virtual input is present.	DDB_VIP_PUB_PRES_28
1308	SW	GOOSE virtual input 29- indicates if the GOOSE publisher responsible for publishing the data that derives a virtual input is present.	DDB_VIP_PUB_PRES_29
1309	SW	GOOSE virtual input 30- indicates if the GOOSE publisher responsible for publishing the data that derives a virtual input is present.	DDB_VIP_PUB_PRES_30
1310	SW	GOOSE virtual input 31- indicates if the GOOSE publisher responsible for publishing the data that derives a virtual input is present.	DDB_VIP_PUB_PRES_31
1311	SW	GOOSE virtual input 32- indicates if the GOOSE publisher responsible for publishing the data that derives a virtual input is present.	DDB_VIP_PUB_PRES_32

P741 Logic Nodes			
DDB No	Source	Description	Element Name
1312	SW	GOOSE virtual input 33- indicates if the GOOSE publisher responsible for publishing the data that derives a virtual input is present.	DDB_VIP_PUB_PRES_33
1313	SW	GOOSE virtual input 34- indicates if the GOOSE publisher responsible for publishing the data that derives a virtual input is present.	DDB_VIP_PUB_PRES_34
1314	SW	GOOSE virtual input 35- indicates if the GOOSE publisher responsible for publishing the data that derives a virtual input is present.	DDB_VIP_PUB_PRES_35
1315	SW	GOOSE virtual input 36- indicates if the GOOSE publisher responsible for publishing the data that derives a virtual input is present.	DDB_VIP_PUB_PRES_36
1316	SW	GOOSE virtual input 37- indicates if the GOOSE publisher responsible for publishing the data that derives a virtual input is present.	DDB_VIP_PUB_PRES_37
1317	SW	GOOSE virtual input 38- indicates if the GOOSE publisher responsible for publishing the data that derives a virtual input is present.	DDB_VIP_PUB_PRES_38
1318	SW	GOOSE virtual input 39- indicates if the GOOSE publisher responsible for publishing the data that derives a virtual input is present.	DDB_VIP_PUB_PRES_39
1319	SW	GOOSE virtual input 40- indicates if the GOOSE publisher responsible for publishing the data that derives a virtual input is present.	DDB_VIP_PUB_PRES_40
1320	SW	GOOSE virtual input 41- indicates if the GOOSE publisher responsible for publishing the data that derives a virtual input is present.	DDB_VIP_PUB_PRES_41
1321	SW	GOOSE virtual input 42- indicates if the GOOSE publisher responsible for publishing the data that derives a virtual input is present.	DDB_VIP_PUB_PRES_42
1322	SW	GOOSE virtual input 43- indicates if the GOOSE publisher responsible for publishing the data that derives a virtual input is present.	DDB_VIP_PUB_PRES_43

P741 Logic Nodes			
DDB No	Source	Description	Element Name
1323	SW	GOOSE virtual input 44- indicates if the GOOSE publisher responsible for publishing the data that derives a virtual input is present.	DDB_VIP_PUB_PRES_44
1324	SW	GOOSE virtual input 45- indicates if the GOOSE publisher responsible for publishing the data that derives a virtual input is present.	DDB_VIP_PUB_PRES_45
1325	SW	GOOSE virtual input 46- indicates if the GOOSE publisher responsible for publishing the data that derives a virtual input is present.	DDB_VIP_PUB_PRES_46
1326	SW	GOOSE virtual input 47- indicates if the GOOSE publisher responsible for publishing the data that derives a virtual input is present.	DDB_VIP_PUB_PRES_47
1327	SW	GOOSE virtual input 48- indicates if the GOOSE publisher responsible for publishing the data that derives a virtual input is present.	DDB_VIP_PUB_PRES_48
1328	SW	GOOSE virtual input 49- indicates if the GOOSE publisher responsible for publishing the data that derives a virtual input is present.	DDB_VIP_PUB_PRES_49
1329	SW	GOOSE virtual input 50- indicates if the GOOSE publisher responsible for publishing the data that derives a virtual input is present.	DDB_VIP_PUB_PRES_50
1330	SW	GOOSE virtual input 51- indicates if the GOOSE publisher responsible for publishing the data that derives a virtual input is present.	DDB_VIP_PUB_PRES_51
1331	SW	GOOSE virtual input 52- indicates if the GOOSE publisher responsible for publishing the data that derives a virtual input is present.	DDB_VIP_PUB_PRES_52
1332	SW	GOOSE virtual input 53- indicates if the GOOSE publisher responsible for publishing the data that derives a virtual input is present.	DDB_VIP_PUB_PRES_53
1333	SW	GOOSE virtual input 54- indicates if the GOOSE publisher responsible for publishing the data that derives a virtual input is present.	DDB_VIP_PUB_PRES_54

P741 Logic Nodes			
DDB No	**Source**	**Description**	**Element Name**
1334	SW	GOOSE virtual input 55- indicates if the GOOSE publisher responsible for publishing the data that derives a virtual input is present.	DDB_VIP_PUB_PRES_55
1335	SW	GOOSE virtual input 56- indicates if the GOOSE publisher responsible for publishing the data that derives a virtual input is present.	DDB_VIP_PUB_PRES_56
1336	SW	GOOSE virtual input 57- indicates if the GOOSE publisher responsible for publishing the data that derives a virtual input is present.	DDB_VIP_PUB_PRES_57
1337	SW	GOOSE virtual input 58- indicates if the GOOSE publisher responsible for publishing the data that derives a virtual input is present.	DDB_VIP_PUB_PRES_58
1338	SW	GOOSE virtual input 59- indicates if the GOOSE publisher responsible for publishing the data that derives a virtual input is present.	DDB_VIP_PUB_PRES_59
1339	SW	GOOSE virtual input 60- indicates if the GOOSE publisher responsible for publishing the data that derives a virtual input is present.	DDB_VIP_PUB_PRES_60
1340	SW	GOOSE virtual input 61- indicates if the GOOSE publisher responsible for publishing the data that derives a virtual input is present.	DDB_VIP_PUB_PRES_61
1341	SW	GOOSE virtual input 62- indicates if the GOOSE publisher responsible for publishing the data that derives a virtual input is present.	DDB_VIP_PUB_PRES_62
1342	SW	GOOSE virtual input 63- indicates if the GOOSE publisher responsible for publishing the data that derives a virtual input is present.	DDB_VIP_PUB_PRES_63
1343	SW	GOOSE virtual input 64- indicates if the GOOSE publisher responsible for publishing the data that derives a virtual input is present.	DDB_VIP_PUB_PRES_64
1344	PSL	Reserve	UNUSED_1344
1345	PSL	Reserve	UNUSED_1345
1346	PSL	Reserve	UNUSED_1346
1347	PSL	Reserve	UNUSED_1347
1348	PSL	Reserve	UNUSED_1348
1349	PSL	Reserve	UNUSED_1349
1350	PSL	Reserve	UNUSED_1350

P741 Logic Nodes			
DDB No	Source	Description	Element Name
1351	PSL	Reserve	UNUSED_1351
1352	PSL	Reserve	UNUSED_1352
1353	PSL	Reserve	UNUSED_1353
1354	PSL	Reserve	UNUSED_1354
1355	PSL	Reserve	UNUSED_1355
1356	PSL	Reserve	UNUSED_1356
1357	PSL	Reserve	UNUSED_1357
1358	PSL	Reserve	UNUSED_1358
1359	PSL	Reserve	UNUSED_1359
1360	PSL	Reserve	UNUSED_1360
1361	PSL	Reserve	UNUSED_1361
1362	PSL	Reserve	UNUSED_1362
1363	PSL	Reserve	UNUSED_1363
1364	PSL	Reserve	UNUSED_1364
1365	PSL	Reserve	UNUSED_1365
1366	PSL	Reserve	UNUSED_1366
1367	PSL	Reserve	UNUSED_1367
1368	PSL	Reserve	UNUSED_1368
1369	PSL	Reserve	UNUSED_1369
1370	PSL	Reserve	UNUSED_1370
1371	PSL	Reserve	UNUSED_1371
1372	PSL	Reserve	UNUSED_1372
1373	PSL	Reserve	UNUSED_1373
1374	PSL	Reserve	UNUSED_1374
1375	PSL	Reserve	UNUSED_1375
1376	PSL	Reserve	UNUSED_1376
1377	PSL	Reserve	UNUSED_1377
1378	PSL	Reserve	UNUSED_1378
1379	PSL	Reserve	UNUSED_1379
1380	PSL	Reserve	UNUSED_1380
1381	PSL	Reserve	UNUSED_1381
1382	PSL	Reserve	UNUSED_1382
1383	PSL	Reserve	UNUSED_1383
1384	PSL	Reserve	UNUSED_1384
1385	PSL	Reserve	UNUSED_1385
1386	PSL	Reserve	UNUSED_1386
1387	PSL	Reserve	UNUSED_1387
1388	PSL	Reserve	UNUSED_1388
1389	PSL	Reserve	UNUSED_1389
1390	PSL	Reserve	UNUSED_1390
1391	PSL	Reserve	UNUSED_1391
1392	PSL	Reserve	UNUSED_1392
1393	PSL	Reserve	UNUSED_1393
1394	PSL	Reserve	UNUSED_1394
1395	PSL	Reserve	UNUSED_1395
1396	PSL	Reserve	UNUSED_1396

P741 Logic Nodes			
DDB No	Source	Description	Element Name
1397	PSL	Reserve	UNUSED_1397
1398	PSL	Reserve	UNUSED_1398
1399	PSL	Reserve	UNUSED_1399
1400	PSL	Reserve	UNUSED_1400
1401	PSL	Reserve	UNUSED_1401
1402	PSL	Reserve	UNUSED_1402
1403	PSL	Reserve	UNUSED_1403
1404	PSL	Reserve	UNUSED_1404
1405	PSL	Reserve	UNUSED_1405
1406	PSL	Reserve	UNUSED_1406
1407	PSL	Reserve	UNUSED_1407
1408	PSL	Reserve	UNUSED_1408
1409	PSL	Reserve	UNUSED_1409
1410	PSL	Reserve	UNUSED_1410
1411	PSL	Reserve	UNUSED_1411
1412	PSL	Reserve	UNUSED_1412
1413	PSL	Reserve	UNUSED_1413
1414	PSL	Reserve	UNUSED_1414
1415	PSL	Reserve	UNUSED_1415
1416	PSL	Reserve	UNUSED_1416
1417	PSL	Reserve	UNUSED_1417
1418	PSL	Reserve	UNUSED_1418
1419	PSL	Reserve	UNUSED_1419
1420	PSL	Reserve	UNUSED_1420
1421	PSL	Reserve	UNUSED_1421
1422	PSL	Reserve	UNUSED_1422
1423	PSL	Reserve	UNUSED_1423
1424	PSL	Reserve	UNUSED_1424
1425	PSL	Reserve	UNUSED_1425
1426	PSL	Reserve	UNUSED_1426
1427	PSL	Reserve	UNUSED_1427
1428	PSL	Reserve	UNUSED_1428
1429	PSL	Reserve	UNUSED_1429
1430	PSL	Reserve	UNUSED_1430
1431	PSL	Reserve	UNUSED_1431
1432	PSL	Reserve	UNUSED_1432
1433	PSL	Reserve	UNUSED_1433
1434	PSL	Reserve	UNUSED_1434
1435	PSL	Reserve	UNUSED_1435
1436	PSL	Reserve	UNUSED_1436
1437	PSL	Reserve	UNUSED_1437
1438	PSL	Reserve	UNUSED_1438
1439	PSL	Reserve	UNUSED_1439
1440	PSL	Reserve	UNUSED_1440
1441	PSL	Reserve	UNUSED_1441
1442	PSL	Reserve	UNUSED_1442

P741 Logic Nodes			
DDB No	Source	Description	Element Name
1443	PSL	Reserve	UNUSED_1443
1444	PSL	Reserve	UNUSED_1444
1445	PSL	Reserve	UNUSED_1445
1446	PSL	Reserve	UNUSED_1446
1447	PSL	Reserve	UNUSED_1447
1448	PSL	Reserve	UNUSED_1448
1449	PSL	Reserve	UNUSED_1449
1450	PSL	Reserve	UNUSED_1450
1451	PSL	Reserve	UNUSED_1451
1452	PSL	Reserve	UNUSED_1452
1453	PSL	Reserve	UNUSED_1453
1454	PSL	Reserve	UNUSED_1454
1455	PSL	Reserve	UNUSED_1455
1456	PSL	Reserve	UNUSED_1456
1457	PSL	Reserve	UNUSED_1457
1458	PSL	Reserve	UNUSED_1458
1459	PSL	Reserve	UNUSED_1459
1460	PSL	Reserve	UNUSED_1460
1461	PSL	Reserve	UNUSED_1461
1462	PSL	Reserve	UNUSED_1462
1463	PSL	Reserve	UNUSED_1463
1464	PSL	Reserve	UNUSED_1464
1465	PSL	Reserve	UNUSED_1465
1466	PSL	Reserve	UNUSED_1466
1467	PSL	Reserve	UNUSED_1467
1468	PSL	Reserve	UNUSED_1468
1469	PSL	Reserve	UNUSED_1469
1470	PSL	Reserve	UNUSED_1470
1471	PSL	Reserve	UNUSED_1471
1472	PSL	Reserve	UNUSED_1472
1473	PSL	Reserve	UNUSED_1473
1474	PSL	Reserve	UNUSED_1474
1475	PSL	Reserve	UNUSED_1475
1476	PSL	Reserve	UNUSED_1476
1477	PSL	Reserve	UNUSED_1477
1478	PSL	Reserve	UNUSED_1478
1479	PSL	Reserve	UNUSED_1479
1480	PSL	Reserve	UNUSED_1480
1481	PSL	Reserve	UNUSED_1481
1482	PSL	Reserve	UNUSED_1482
1483	PSL	Reserve	UNUSED_1483
1484	PSL	Reserve	UNUSED_1484
1485	PSL	Reserve	UNUSED_1485
1486	PSL	Reserve	UNUSED_1486
1487	PSL	Reserve	UNUSED_1487
1488	PSL	Reserve	UNUSED_1488

P741 Logic Nodes			
DDB No	Source	Description	Element Name
1489	PSL	Reserve	UNUSED_1489
1490	PSL	Reserve	UNUSED_1490
1491	PSL	Reserve	UNUSED_1491
1492	PSL	Reserve	UNUSED_1492
1493	PSL	Reserve	UNUSED_1493
1494	PSL	Reserve	UNUSED_1494
1495	PSL	Reserve	UNUSED_1495
1496	PSL	Reserve	UNUSED_1496
1497	PSL	Reserve	UNUSED_1497
1498	PSL	Reserve	UNUSED_1498
1499	PSL	Reserve	UNUSED_1499
1500	PSL	Reserve	UNUSED_1500
1501	PSL	Reserve	UNUSED_1501
1502	PSL	Reserve	UNUSED_1502
1503	PSL	Reserve	UNUSED_1503
1504	PSL	Reserve	UNUSED_1504
1505	PSL	Reserve	UNUSED_1505
1506	PSL	Reserve	UNUSED_1506
1507	PSL	Reserve	UNUSED_1507
1508	PSL	Reserve	UNUSED_1508
1509	PSL	Reserve	UNUSED_1509
1510	PSL	Reserve	UNUSED_1510
1511	PSL	Reserve	UNUSED_1511
1512	PSL	Reserve	UNUSED_1512
1513	PSL	Reserve	UNUSED_1513
1514	PSL	Reserve	UNUSED_1514
1515	PSL	Reserve	UNUSED_1515
1516	PSL	Reserve	UNUSED_1516
1517	PSL	Reserve	UNUSED_1517
1518	PSL	Reserve	UNUSED_1518
1519	PSL	Reserve	UNUSED_1519
1520	PSL	Reserve	UNUSED_1520
1521	PSL	Reserve	UNUSED_1521
1522	PSL	Reserve	UNUSED_1522
1523	PSL	Reserve	UNUSED_1523
1524	PSL	Reserve	UNUSED_1524
1525	PSL	Reserve	UNUSED_1525
1526	PSL	Reserve	UNUSED_1526
1527	PSL	Reserve	UNUSED_1527
1528	PSL	Reserve	UNUSED_1528
1529	PSL	Reserve	UNUSED_1529
1530	PSL	Reserve	UNUSED_1530
1531	PSL	Reserve	UNUSED_1531
1532	PSL	Reserve	UNUSED_1532
1533	PSL	Reserve	UNUSED_1533
1534	PSL	Reserve	UNUSED_1534

P741 Logic Nodes			
DDB No	**Source**	**Description**	**Element Name**
1535	PSL	Reserve	UNUSED_1535
1536	PSL	Reserve	UNUSED_1536
1537	PSL	Reserve	UNUSED_1537
1538	PSL	Reserve	UNUSED_1538
1539	PSL	Reserve	UNUSED_1539
1540	PSL	Reserve	UNUSED_1540
1541	PSL	Reserve	UNUSED_1541
1542	PSL	Reserve	UNUSED_1542
1543	PSL	Reserve	UNUSED_1543
1544	PSL	Reserve	UNUSED_1544
1545	PSL	Reserve	UNUSED_1545
1546	PSL	Reserve	UNUSED_1546
1547	PSL	Reserve	UNUSED_1547
1548	PSL	Reserve	UNUSED_1548
1549	PSL	Reserve	UNUSED_1549
1550	PSL	Reserve	UNUSED_1550
1551	PSL	Reserve	UNUSED_1551
1552	PSL	Reserve	UNUSED_1552
1553	PSL	Reserve	UNUSED_1553
1554	PSL	Reserve	UNUSED_1554
1555	PSL	Reserve	UNUSED_1555
1556	PSL	Reserve	UNUSED_1556
1557	PSL	Reserve	UNUSED_1557
1558	PSL	Reserve	UNUSED_1558
1559	PSL	Reserve	UNUSED_1559
1560	PSL	Reserve	UNUSED_1560
1561	PSL	Reserve	UNUSED_1561
1562	PSL	Reserve	UNUSED_1562
1563	PSL	Reserve	UNUSED_1563
1564	PSL	Reserve	UNUSED_1564
1565	PSL	Reserve	UNUSED_1565
1566	PSL	Reserve	UNUSED_1566
1567	PSL	Reserve	UNUSED_1567
1568	PSL	Reserve	UNUSED_1568
1569	PSL	Reserve	UNUSED_1569
1570	PSL	Reserve	UNUSED_1570
1571	PSL	Reserve	UNUSED_1571
1572	PSL	Reserve	UNUSED_1572
1573	PSL	Reserve	UNUSED_1573
1574	PSL	Reserve	UNUSED_1574
1575	PSL	Reserve	UNUSED_1575
1576	PSL	Reserve	UNUSED_1576
1577	PSL	Reserve	UNUSED_1577
1578	PSL	Reserve	UNUSED_1578
1579	PSL	Reserve	UNUSED_1579
1580	PSL	Reserve	UNUSED_1580

P741 Logic Nodes			
DDB No	Source	Description	Element Name
1581	PSL	Reserve	UNUSED_1581
1582	PSL	Reserve	UNUSED_1582
1583	PSL	Reserve	UNUSED_1583
1584	PSL	Reserve	UNUSED_1584
1585	PSL	Reserve	UNUSED_1585
1586	PSL	Reserve	UNUSED_1586
1587	PSL	Reserve	UNUSED_1587
1588	PSL	Reserve	UNUSED_1588
1589	PSL	Reserve	UNUSED_1589
1590	PSL	Reserve	UNUSED_1590
1591	PSL	Reserve	UNUSED_1591
1592	PSL	Reserve	UNUSED_1592
1593	PSL	Reserve	UNUSED_1593
1594	PSL	Reserve	UNUSED_1594
1595	PSL	Reserve	UNUSED_1595
1596	PSL	Reserve	UNUSED_1596
1597	PSL	Reserve	UNUSED_1597
1598	PSL	Reserve	UNUSED_1598
1599	PSL	Reserve	UNUSED_1599
1600	PSL	Reserve	UNUSED_1600
1601	PSL	Reserve	UNUSED_1601
1602	PSL	Reserve	UNUSED_1602
1603	PSL	Reserve	UNUSED_1603
1604	PSL	Reserve	UNUSED_1604
1605	PSL	Reserve	UNUSED_1605
1606	PSL	Reserve	UNUSED_1606
1607	PSL	Reserve	UNUSED_1607
1608	PSL	Reserve	UNUSED_1608
1609	PSL	Reserve	UNUSED_1609
1610	PSL	Reserve	UNUSED_1610
1611	PSL	Reserve	UNUSED_1611
1612	PSL	Reserve	UNUSED_1612
1613	PSL	Reserve	UNUSED_1613
1614	PSL	Reserve	UNUSED_1614
1615	PSL	Reserve	UNUSED_1615
1616	PSL	Reserve	UNUSED_1616
1617	PSL	Reserve	UNUSED_1617
1618	PSL	Reserve	UNUSED_1618
1619	PSL	Reserve	UNUSED_1619
1620	PSL	Reserve	UNUSED_1620
1621	PSL	Reserve	UNUSED_1621
1622	PSL	Reserve	UNUSED_1622
1623	PSL	Reserve	UNUSED_1623
1624	PSL	Reserve	UNUSED_1624
1625	PSL	Reserve	UNUSED_1625
1626	PSL	Reserve	UNUSED_1626

P741 Logic Nodes			
DDB No	Source	Description	Element Name
1627	PSL	Reserve	UNUSED_1627
1628	PSL	Reserve	UNUSED_1628
1629	PSL	Reserve	UNUSED_1629
1630	PSL	Reserve	UNUSED_1630
1631	PSL	Reserve	UNUSED_1631
1632	PSL	Reserve	UNUSED_1632
1633	PSL	Reserve	UNUSED_1633
1634	PSL	Reserve	UNUSED_1634
1635	PSL	Reserve	UNUSED_1635
1636	PSL	Reserve	UNUSED_1636
1637	PSL	Reserve	UNUSED_1637
1638	PSL	Reserve	UNUSED_1638
1639	PSL	Reserve	UNUSED_1639
1640	PSL	Reserve	UNUSED_1640
1641	PSL	Reserve	UNUSED_1641
1642	PSL	Reserve	UNUSED_1642
1643	PSL	Reserve	UNUSED_1643
1644	PSL	Reserve	UNUSED_1644
1645	PSL	Reserve	UNUSED_1645
1646	PSL	Reserve	UNUSED_1646
1647	PSL	Reserve	UNUSED_1647
1648	PSL	Reserve	UNUSED_1648
1649	PSL	Reserve	UNUSED_1649
1650	PSL	Reserve	UNUSED_1650
1651	PSL	Reserve	UNUSED_1651
1652	PSL	Reserve	UNUSED_1652
1653	PSL	Reserve	UNUSED_1653
1654	PSL	Reserve	UNUSED_1654
1655	PSL	Reserve	UNUSED_1655
1656	PSL	Reserve	UNUSED_1656
1657	PSL	Reserve	UNUSED_1657
1658	PSL	Reserve	UNUSED_1658
1659	PSL	Reserve	UNUSED_1659
1660	PSL	Reserve	UNUSED_1660
1661	PSL	Reserve	UNUSED_1661
1662	PSL	Reserve	UNUSED_1662
1663	PSL	Reserve	UNUSED_1663
1664	PSL	Reserve	UNUSED_1664
1665	PSL	Reserve	UNUSED_1665
1666	PSL	Reserve	UNUSED_1666
1667	PSL	Reserve	UNUSED_1667
1668	PSL	Reserve	UNUSED_1668
1669	PSL	Reserve	UNUSED_1669
1670	PSL	Reserve	UNUSED_1670
1671	PSL	Reserve	UNUSED_1671
1672	PSL	Reserve	UNUSED_1672

P741 Logic Nodes			
DDB No	Source	Description	Element Name
1673	PSL	Reserve	UNUSED_1673
1674	PSL	Reserve	UNUSED_1674
1675	PSL	Reserve	UNUSED_1675
1676	PSL	Reserve	UNUSED_1676
1677	PSL	Reserve	UNUSED_1677
1678	PSL	Reserve	UNUSED_1678
1679	PSL	Reserve	UNUSED_1679
1680	PSL	Reserve	UNUSED_1680
1681	PSL	Reserve	UNUSED_1681
1682	PSL	Reserve	UNUSED_1682
1683	PSL	Reserve	UNUSED_1683
1684	PSL	Reserve	UNUSED_1684
1685	PSL	Reserve	UNUSED_1685
1686	PSL	Reserve	UNUSED_1686
1687	PSL	Reserve	UNUSED_1687
1688	PSL	Reserve	UNUSED_1688
1689	PSL	Reserve	UNUSED_1689
1690	PSL	Reserve	UNUSED_1690
1691	PSL	Reserve	UNUSED_1691
1692	PSL	Reserve	UNUSED_1692
1693	PSL	Reserve	UNUSED_1693
1694	PSL	Reserve	UNUSED_1694
1695	PSL	Reserve	UNUSED_1695
1696	PSL	Reserve	UNUSED_1696
1697	PSL	Reserve	UNUSED_1697
1698	PSL	Reserve	UNUSED_1698
1699	PSL	Reserve	UNUSED_1699
1700	PSL	Reserve	UNUSED_1700
1701	PSL	Reserve	UNUSED_1701
1702	PSL	Reserve	UNUSED_1702
1703	PSL	Reserve	UNUSED_1703
1704	PSL	Reserve	UNUSED_1704
1705	PSL	Reserve	UNUSED_1705
1706	PSL	Reserve	UNUSED_1706
1707	PSL	Reserve	UNUSED_1707
1708	PSL	Reserve	UNUSED_1708
1709	PSL	Reserve	UNUSED_1709
1710	PSL	Reserve	UNUSED_1710
1711	PSL	Reserve	UNUSED_1711
1712	PSL	Reserve	UNUSED_1712
1713	PSL	Reserve	UNUSED_1713
1714	PSL	Reserve	UNUSED_1714
1715	PSL	Reserve	UNUSED_1715
1716	PSL	Reserve	UNUSED_1716
1717	PSL	Reserve	UNUSED_1717
1718	PSL	Reserve	UNUSED_1718

P741 Logic Nodes			
DDB No	Source	Description	Element Name
1719	PSL	Reserve	UNUSED_1719
1720	PSL	Reserve	UNUSED_1720
1721	PSL	Reserve	UNUSED_1721
1722	PSL	Reserve	UNUSED_1722
1723	PSL	Reserve	UNUSED_1723
1724	PSL	Reserve	UNUSED_1724
1725	PSL	Reserve	UNUSED_1725
1726	PSL	Reserve	UNUSED_1726
1727	PSL	Reserve	UNUSED_1727
1728	PSL	Reserve	UNUSED_1728
1729	PSL	Reserve	UNUSED_1729
1730	PSL	Reserve	UNUSED_1730
1731	PSL	Reserve	UNUSED_1731
1732	PSL	Reserve	UNUSED_1732
1733	PSL	Reserve	UNUSED_1733
1734	PSL	Reserve	UNUSED_1734
1735	PSL	Reserve	UNUSED_1735
1736	PSL	Reserve	UNUSED_1736
1737	PSL	Reserve	UNUSED_1737
1738	PSL	Reserve	UNUSED_1738
1739	PSL	Reserve	UNUSED_1739
1740	PSL	Reserve	UNUSED_1740
1741	PSL	Reserve	UNUSED_1741
1742	PSL	Reserve	UNUSED_1742
1743	PSL	Reserve	UNUSED_1743
1744	PSL	Reserve	UNUSED_1744
1745	PSL	Reserve	UNUSED_1745
1746	PSL	Reserve	UNUSED_1746
1747	PSL	Reserve	UNUSED_1747
1748	PSL	Reserve	UNUSED_1748
1749	PSL	Reserve	UNUSED_1749
1750	PSL	Reserve	UNUSED_1750
1751	PSL	Reserve	UNUSED_1751
1752	PSL	Reserve	UNUSED_1752
1753	PSL	Reserve	UNUSED_1753
1754	PSL	Reserve	UNUSED_1754
1755	PSL	Reserve	UNUSED_1755
1756	PSL	Reserve	UNUSED_1756
1757	PSL	Reserve	UNUSED_1757
1758	PSL	Reserve	UNUSED_1758
1759	PSL	Reserve	UNUSED_1759
1760	PSL	Reserve	UNUSED_1760
1761	PSL	Reserve	UNUSED_1761
1762	PSL	Reserve	UNUSED_1762
1763	PSL	Reserve	UNUSED_1763
1764	PSL	Reserve	UNUSED_1764

P741 Logic Nodes			
DDB No	Source	Description	Element Name
1765	PSL	Reserve	UNUSED_1765
1766	PSL	Reserve	UNUSED_1766
1767	PSL	Reserve	UNUSED_1767
1768	PSL	Reserve	UNUSED_1768
1769	PSL	Reserve	UNUSED_1769
1770	PSL	Reserve	UNUSED_1770
1771	PSL	Reserve	UNUSED_1771
1772	PSL	Reserve	UNUSED_1772
1773	PSL	Reserve	UNUSED_1773
1774	PSL	Reserve	UNUSED_1774
1775	PSL	Reserve	UNUSED_1775
1776	PSL	Reserve	UNUSED_1776
1777	PSL	Reserve	UNUSED_1777
1778	PSL	Reserve	UNUSED_1778
1779	PSL	Reserve	UNUSED_1779
1780	PSL	Reserve	UNUSED_1780
1781	PSL	Reserve	UNUSED_1781
1782	PSL	Reserve	UNUSED_1782
1783	PSL	Reserve	UNUSED_1783
1784	PSL	Reserve	UNUSED_1784
1785	PSL	Reserve	UNUSED_1785
1786	PSL	Reserve	UNUSED_1786
1787	PSL	Reserve	UNUSED_1787
1788	PSL	Reserve	UNUSED_1788
1789	PSL	Reserve	UNUSED_1789
1790	PSL	Reserve	UNUSED_1790
1791	PSL	Reserve	UNUSED_1791
1792	PSL	Reserve	UNUSED_1792
1793	PSL	Reserve	UNUSED_1793
1794	SW	IRIG-B Status Signal Valid	DDB_IRIGB_SIGNAL_VALID
1795	SW	Logic 0 for use in PSL. This can be used to force a DDB, contact, LED, InterMiCOM or Virtual Output low (or high by using an inversion gate)	DDB_LOGIC_0
1796	SW	If this location DST is in effect now	DDB_DST_STATUS
1797	SW	Network Interface Card link 1 fail indication	DDB_NIC_LINK_1_FAIL
1798	SW	Network Interface Card link 2 fail indication	DDB_NIC_LINK_2_FAIL
1799	SW	Network Interface Card link 3 fail indication	DDB_NIC_LINK_3_FAIL
1800	SW	User logged into UI	DDB_UI_LOGGEDIN
1801	SW	User logged into front port courier	DDB_FCUR_LOGGEDIN
1802	SW	User logged into Rear Port1 courier	DDB_RP1_LOGGEDIN
1803	SW	User logged into Rear Port2 courier	DDB_RP2_LOGGEDIN
1804	SW	User logged into turnneled courier	DDB_TNL_LOGGEDIN

P741 Logic Nodes			
DDB No	**Source**	**Description**	**Element Name**
1805	SW	User logged into co-processor courier	DDB_CPR_LOGGEDIN
1806	PSL	Self-reset user alarm 1	DDB_USER_ALARM_1
1807	PSL	Self-reset user alarm 2	DDB_USER_ALARM_2
1808	PSL	Self-reset user alarm 3	DDB_USER_ALARM_3
1809	PSL	Self-reset user alarm 4	DDB_USER_ALARM_4
1810	PSL	Self-reset user alarm 5	DDB_USER_ALARM_5
1811	PSL	Self-reset user alarm 6	DDB_USER_ALARM_6
1812	PSL	Self-reset user alarm 7	DDB_USER_ALARM_7
1813	PSL	Self-reset user alarm 8	DDB_USER_ALARM_8
1814	PSL	Self-reset user alarm 9	DDB_USER_ALARM_9
1815	PSL	Self-reset user alarm 10	DDB_USER_ALARM_10
1816	PSL	Self-reset user alarm 11	DDB_USER_ALARM_11
1817	PSL	Self-reset user alarm 12	DDB_USER_ALARM_12
1818	PSL	Self-reset user alarm 13	DDB_USER_ALARM_13
1819	PSL	Self-reset user alarm 14	DDB_USER_ALARM_14
1820	PSL	Self-reset user alarm 15	DDB_USER_ALARM_15
1821	PSL	Self-reset user alarm 16	DDB_USER_ALARM_16
1822	PSL	Manual-reset user alarm 17	DDB_USER_ALARM_17
1823	PSL	Manual-reset user alarm 18	DDB_USER_ALARM_18
1824	PSL	Manual-reset user alarm 19	DDB_USER_ALARM_19
1825	PSL	Manual-reset user alarm 20	DDB_USER_ALARM_20
1826	PSL	Manual-reset user alarm 21	DDB_USER_ALARM_21
1827	PSL	Manual-reset user alarm 22	DDB_USER_ALARM_22
1828	PSL	Manual-reset user alarm 23	DDB_USER_ALARM_23
1829	PSL	Manual-reset user alarm 24	DDB_USER_ALARM_24
1830	PSL	Manual-reset user alarm 25	DDB_USER_ALARM_25
1831	PSL	Manual-reset user alarm 26	DDB_USER_ALARM_26
1832	PSL	Manual-reset user alarm 27	DDB_USER_ALARM_27
1833	PSL	Manual-reset user alarm 28	DDB_USER_ALARM_28
1834	PSL	Manual-reset user alarm 29	DDB_USER_ALARM_29
1835	PSL	Manual-reset user alarm 30	DDB_USER_ALARM_30
1836	PSL	Manual-reset user alarm 31	DDB_USER_ALARM_31
1837	PSL	Manual-reset user alarm 32	DDB_USER_ALARM_32
1838	SW	Reserve	DDB_UNUSED_DR
1839	PSL	Reserve	UNUSED_1839
1840	PSL	Reserve	UNUSED_1840
1841	PSL	Reserve	UNUSED_1841
1842	PSL	Reserve	UNUSED_1842
1843	PSL	Reserve	UNUSED_1843
1844	PSL	Reserve	UNUSED_1844
1845	PSL	Reserve	UNUSED_1845
1846	PSL	Reserve	UNUSED_1846
1847	PSL	Reserve	UNUSED_1847
1848	PSL	Reserve	UNUSED_1848
1849	PSL	Reserve	UNUSED_1849
1850	PSL	Reserve	UNUSED_1850

P741 Logic Nodes			
DDB No	Source	Description	Element Name
1851	PSL	Reserve	UNUSED_1851
1852	PSL	Reserve	UNUSED_1852
1853	PSL	Reserve	UNUSED_1853
1854	PSL	Reserve	UNUSED_1854
1855	PSL	Reserve	UNUSED_1855
1856	PSL	Reserve	UNUSED_1856
1857	PSL	Reserve	UNUSED_1857
1858	PSL	Reserve	UNUSED_1858
1859	PSL	Reserve	UNUSED_1859
1860	PSL	Reserve	UNUSED_1860
1861	PSL	Reserve	UNUSED_1861
1862	PSL	Reserve	UNUSED_1862
1863	PSL	Reserve	UNUSED_1863
1864	PSL	Reserve	UNUSED_1864
1865	PSL	Reserve	UNUSED_1865
1866	PSL	Reserve	UNUSED_1866
1867	PSL	Reserve	UNUSED_1867
1868	PSL	Reserve	UNUSED_1868
1869	PSL	Reserve	UNUSED_1869
1870	PSL	Reserve	UNUSED_1870
1871	PSL	Reserve	UNUSED_1871
1872	PSL	Reserve	UNUSED_1872
1873	PSL	Reserve	UNUSED_1873
1874	PSL	Reserve	UNUSED_1874
1875	PSL	Reserve	UNUSED_1875
1876	PSL	Reserve	UNUSED_1876
1877	PSL	Reserve	UNUSED_1877
1878	PSL	Reserve	UNUSED_1878
1879	PSL	Reserve	UNUSED_1879
1880	PSL	Reserve	UNUSED_1880
1881	PSL	Reserve	UNUSED_1881
1882	PSL	Reserve	UNUSED_1882
1883	PSL	Reserve	UNUSED_1883
1884	PSL	Reserve	UNUSED_1884
1885	PSL	Reserve	UNUSED_1885
1886	PSL	Reserve	UNUSED_1886
1887	PSL	Reserve	UNUSED_1887
1888	PSL	Reserve	UNUSED_1888
1889	PSL	Reserve	UNUSED_1889
1890	PSL	Reserve	UNUSED_1890
1891	PSL	Reserve	UNUSED_1891
1892	PSL	Reserve	UNUSED_1892
1893	PSL	Reserve	UNUSED_1893
1894	PSL	Reserve	UNUSED_1894
1895	PSL	Reserve	UNUSED_1895
1896	PSL	Reserve	UNUSED_1896

P741 Logic Nodes			
DDB No	Source	Description	Element Name
1897	PSL	Reserve	UNUSED_1897
1898	PSL	Reserve	UNUSED_1898
1899	PSL	Reserve	UNUSED_1899
1900	PSL	Reserve	UNUSED_1900
1901	PSL	Reserve	UNUSED_1901
1902	PSL	Reserve	UNUSED_1902
1903	PSL	Reserve	UNUSED_1903
1904	PSL	Reserve	UNUSED_1904
1905	PSL	Reserve	UNUSED_1905
1906	PSL	Reserve	UNUSED_1906
1907	PSL	Reserve	UNUSED_1907
1908	PSL	Reserve	UNUSED_1908
1909	PSL	Reserve	UNUSED_1909
1910	PSL	Reserve	UNUSED_1910
1911	PSL	Reserve	UNUSED_1911
1912	PSL	Reserve	UNUSED_1912
1913	PSL	Reserve	UNUSED_1913
1914	PSL	Reserve	UNUSED_1914
1915	PSL	Reserve	UNUSED_1915
1916	PSL	Reserve	UNUSED_1916
1917	PSL	Reserve	UNUSED_1917
1918	PSL	Reserve	UNUSED_1918
1919	PSL	Reserve	UNUSED_1919
1920	PSL	Reserve	UNUSED_1920
1921	PSL	Reserve	UNUSED_1921
1922	PSL	Reserve	UNUSED_1922
1923	PSL	Reserve	UNUSED_1923
1924	PSL	Reserve	UNUSED_1924
1925	PSL	Reserve	UNUSED_1925
1926	PSL	Reserve	UNUSED_1926
1927	PSL	Reserve	UNUSED_1927
1928	PSL	Reserve	UNUSED_1928
1929	PSL	Reserve	UNUSED_1929
1930	PSL	Reserve	UNUSED_1930
1931	PSL	Reserve	UNUSED_1931
1932	PSL	Reserve	UNUSED_1932
1933	PSL	Reserve	UNUSED_1933
1934	PSL	Reserve	UNUSED_1934
1935	PSL	Reserve	UNUSED_1935
1936	PSL	Reserve	UNUSED_1936
1937	PSL	Reserve	UNUSED_1937
1938	PSL	Reserve	UNUSED_1938
1939	PSL	Reserve	UNUSED_1939
1940	PSL	Reserve	UNUSED_1940
1941	PSL	Reserve	UNUSED_1941
1942	PSL	Reserve	UNUSED_1942

P741 Logic Nodes			
DDB No	Source	Description	Element Name
1943	PSL	Reserve	UNUSED_1943
1944	PSL	Reserve	UNUSED_1944
1945	PSL	Reserve	UNUSED_1945
1946	PSL	Reserve	UNUSED_1946
1947	PSL	Reserve	UNUSED_1947
1948	PSL	Reserve	UNUSED_1948
1949	PSL	Reserve	UNUSED_1949
1950	PSL	Reserve	UNUSED_1950
1951	PSL	Reserve	UNUSED_1951
1952	PSL	Reserve	UNUSED_1952
1953	PSL	Reserve	UNUSED_1953
1954	PSL	Reserve	UNUSED_1954
1955	PSL	Reserve	UNUSED_1955
1956	PSL	Reserve	UNUSED_1956
1957	PSL	Reserve	UNUSED_1957
1958	PSL	Reserve	UNUSED_1958
1959	PSL	Reserve	UNUSED_1959
1960	PSL	Reserve	UNUSED_1960
1961	PSL	Reserve	UNUSED_1961
1962	PSL	Reserve	UNUSED_1962
1963	PSL	Reserve	UNUSED_1963
1964	PSL	Reserve	UNUSED_1964
1965	PSL	Reserve	UNUSED_1965
1966	PSL	Reserve	UNUSED_1966
1967	PSL	Reserve	UNUSED_1967
1968	PSL	Reserve	UNUSED_1968
1969	PSL	Reserve	UNUSED_1969
1970	PSL	Reserve	UNUSED_1970
1971	PSL	Reserve	UNUSED_1971
1972	PSL	Reserve	UNUSED_1972
1973	PSL	Reserve	UNUSED_1973
1974	PSL	Reserve	UNUSED_1974
1975	PSL	Reserve	UNUSED_1975
1976	PSL	Reserve	UNUSED_1976
1977	PSL	Reserve	UNUSED_1977
1978	PSL	Reserve	UNUSED_1978
1979	PSL	Reserve	UNUSED_1979
1980	PSL	Reserve	UNUSED_1980
1981	PSL	Reserve	UNUSED_1981
1982	PSL	Reserve	UNUSED_1982
1983	PSL	Reserve	UNUSED_1983
1984	PSL	Reserve	UNUSED_1984
1985	PSL	Reserve	UNUSED_1985
1986	PSL	Reserve	UNUSED_1986
1987	PSL	Reserve	UNUSED_1987
1988	PSL	Reserve	UNUSED_1988

P741 Logic Nodes			
DDB No	Source	Description	Element Name
1989	PSL	Reserve	UNUSED_1989
1990	PSL	Reserve	UNUSED_1990
1991	PSL	Reserve	UNUSED_1991
1992	PSL	Reserve	UNUSED_1992
1993	PSL	Reserve	UNUSED_1993
1994	PSL	Reserve	UNUSED_1994
1995	PSL	Reserve	UNUSED_1995
1996	PSL	Reserve	UNUSED_1996
1997	PSL	Reserve	UNUSED_1997
1998	PSL	Reserve	UNUSED_1998
1999	PSL	Reserve	UNUSED_1999
2000	PSL	Reserve	UNUSED_2000
2001	PSL	Reserve	UNUSED_2001
2002	PSL	Reserve	UNUSED_2002
2003	PSL	Reserve	UNUSED_2003
2004	PSL	Reserve	UNUSED_2004
2005	PSL	Reserve	UNUSED_2005
2006	PSL	Reserve	UNUSED_2006
2007	PSL	Reserve	UNUSED_2007
2008	PSL	Reserve	UNUSED_2008
2009	PSL	Reserve	UNUSED_2009
2010	PSL	Reserve	UNUSED_2010
2011	PSL	Reserve	UNUSED_2011
2012	PSL	Reserve	UNUSED_2012
2013	PSL	Reserve	UNUSED_2013
2014	PSL	Reserve	UNUSED_2014
2015	PSL	Reserve	UNUSED_2015
2016	PSL	Reserve	UNUSED_2016
2017	PSL	Reserve	UNUSED_2017
2018	PSL	Reserve	UNUSED_2018
2019	PSL	Reserve	UNUSED_2019
2020	PSL	Reserve	UNUSED_2020
2021	PSL	Reserve	UNUSED_2021
2022	PSL	Reserve	UNUSED_2022
2023	PSL	Reserve	UNUSED_2023
2024	PSL	Reserve	UNUSED_2024
2025	PSL	Reserve	UNUSED_2025
2026	PSL	Reserve	UNUSED_2026
2027	PSL	Reserve	UNUSED_2027
2028	PSL	Reserve	UNUSED_2028
2029	PSL	Reserve	UNUSED_2029
2030	PSL	Reserve	UNUSED_2030
2031	PSL	Reserve	UNUSED_2031
2032	PSL	Reserve	UNUSED_2032
2033	PSL	Reserve	UNUSED_2033
2034	PSL	Reserve	UNUSED_2034

P741 Logic Nodes			
DDB No	**Source**	**Description**	**Element Name**
2035	PSL	Reserve	UNUSED_2035
2036	PSL	Reserve	UNUSED_2036
2037	PSL	Reserve	UNUSED_2037
2038	PSL	Reserve	UNUSED_2038
2039	PSL	Reserve	UNUSED_2039
2040	PSL	Reserve	UNUSED_2040
2041	PSL	Reserve	UNUSED_2041
2042	PSL	Reserve	UNUSED_2042
2043	PSL	Reserve	UNUSED_2043
2044	PSL	Reserve	UNUSED_2044
2045	PSL	Reserve	UNUSED_2045
2046	PSL	Reserve	UNUSED_2046
2047	PSL	Reserve	UNUSED_2047

Table 1 - Description of available logic nodes for P741 (sorted by DDB No)

3 DESCRIPTION OF P742 LOGIC NODES

The following table shows the available DDB Numbers, a Description of what they are and which products they apply to. Where a range of DDB Numbers apply to a consecutively-numbered range of related items, the DDB Number range is shown. For example, DDB No 0 to 11 to cover Output Relay 1 to Output Relay 11; or 2nd Harmonic A to C to cover 2nd Harmonic A, 2nd Harmonic B and 2nd Harmonic C.
If a DDB Number is not shown, it is not used in this range of products.

P742 Logic Nodes			
DDB No	**Source**	**Description**	**Element Name**
0	SW	Relay 1	DDB_OUTPUT_RELAY_1
1	SW	Relay 2	DDB_OUTPUT_RELAY_2
2	SW	Relay 3	DDB_OUTPUT_RELAY_3
3	SW	Relay 4	DDB_OUTPUT_RELAY_4
4	SW	Relay 5	DDB_OUTPUT_RELAY_5
5	SW	Relay 6	DDB_OUTPUT_RELAY_6
6	SW	Relay 7	DDB_OUTPUT_RELAY_7
7	SW	Relay 8	DDB_OUTPUT_RELAY_8
8	SW	Reserve	DDB_OUTPUT_RELAY_9
9	SW	Reserve	DDB_OUTPUT_RELAY_10
10	SW	Reserve	DDB_OUTPUT_RELAY_11
11	SW	Reserve	DDB_OUTPUT_RELAY_12
12	SW	Reserve	DDB_OUTPUT_RELAY_13
13	SW	Reserve	DDB_OUTPUT_RELAY_14
14	SW	Reserve	DDB_OUTPUT_RELAY_15
15	SW	Reserve	DDB_OUTPUT_RELAY_16
16	SW	Reserve	DDB_OUTPUT_RELAY_17
17	SW	Reserve	DDB_OUTPUT_RELAY_18
18	SW	Reserve	DDB_OUTPUT_RELAY_19
19	SW	Reserve	DDB_OUTPUT_RELAY_20
20	SW	Reserve	DDB_OUTPUT_RELAY_21
21	SW	Reserve	DDB_OUTPUT_RELAY_22
22	SW	Reserve	DDB_OUTPUT_RELAY_23
23	SW	Reserve	DDB_OUTPUT_RELAY_24
24	SW	Reserve	DDB_OUTPUT_RELAY_25
25	SW	Reserve	DDB_OUTPUT_RELAY_26
26	SW	Reserve	DDB_OUTPUT_RELAY_27
27	SW	Reserve	DDB_OUTPUT_RELAY_28
28	SW	Reserve	DDB_OUTPUT_RELAY_29
29	SW	Reserve	DDB_OUTPUT_RELAY_30
30	SW	Reserve	DDB_OUTPUT_RELAY_31
31	SW	Reserve	DDB_OUTPUT_RELAY_32
32	SW	Reserve	DDB_OUTPUT_RELAY_33
33	SW	Reserve	DDB_OUTPUT_RELAY_34
34	SW	Reserve	DDB_OUTPUT_RELAY_35
35	SW	Reserve	DDB_OUTPUT_RELAY_36
36	SW	Reserve	DDB_OUTPUT_RELAY_37
37	SW	Reserve	DDB_OUTPUT_RELAY_38

P742 Logic Nodes			
DDB No	Source	Description	Element Name
38	SW	Reserve	DDB_OUTPUT_RELAY_39
39	SW	Reserve	DDB_OUTPUT_RELAY_40
40	SW	Reserve	DDB_OUTPUT_RELAY_41
41	SW	Reserve	DDB_OUTPUT_RELAY_42
42	SW	Reserve	DDB_OUTPUT_RELAY_43
43	SW	Reserve	DDB_OUTPUT_RELAY_44
44	SW	Reserve	DDB_OUTPUT_RELAY_45
45	SW	Reserve	DDB_OUTPUT_RELAY_46
46	SW	Reserve	DDB_OUTPUT_RELAY_47
47	SW	Reserve	DDB_OUTPUT_RELAY_48
48	SW	Reserve	DDB_OUTPUT_RELAY_49
49	SW	Reserve	DDB_OUTPUT_RELAY_50
50	SW	Reserve	DDB_OUTPUT_RELAY_51
51	SW	Reserve	DDB_OUTPUT_RELAY_52
52	SW	Reserve	DDB_OUTPUT_RELAY_53
53	SW	Reserve	DDB_OUTPUT_RELAY_54
54	SW	Reserve	DDB_OUTPUT_RELAY_55
55	SW	Reserve	DDB_OUTPUT_RELAY_56
56	SW	Reserve	DDB_OUTPUT_RELAY_57
57	SW	Reserve	DDB_OUTPUT_RELAY_58
58	SW	Reserve	DDB_OUTPUT_RELAY_59
59	SW	Reserve	DDB_OUTPUT_RELAY_60
60	SW	Reserve	DDB_OUTPUT_RELAY_61
61	SW	Reserve	DDB_OUTPUT_RELAY_62
62	SW	Reserve	DDB_OUTPUT_RELAY_63
63	SW	Reserve	DDB_OUTPUT_RELAY_64
64	SW	Opto Input 1	DDB_OPTO_ISOLATOR_1
65	SW	Opto Input 2	DDB_OPTO_ISOLATOR_2
66	SW	Opto Input 3	DDB_OPTO_ISOLATOR_3
67	SW	Opto Input 4	DDB_OPTO_ISOLATOR_4
68	SW	Opto Input 5	DDB_OPTO_ISOLATOR_5
69	SW	Opto Input 6	DDB_OPTO_ISOLATOR_6
70	SW	Opto Input 7	DDB_OPTO_ISOLATOR_7
71	SW	Opto Input 8	DDB_OPTO_ISOLATOR_8
72	SW	Opto Input 9	DDB_OPTO_ISOLATOR_9
73	SW	Opto Input 10	DDB_OPTO_ISOLATOR_10
74	SW	Opto Input 11	DDB_OPTO_ISOLATOR_11
75	SW	Opto Input 12	DDB_OPTO_ISOLATOR_12
76	SW	Opto Input 13	DDB_OPTO_ISOLATOR_13
77	SW	Opto Input 14	DDB_OPTO_ISOLATOR_14
78	SW	Opto Input 15	DDB_OPTO_ISOLATOR_15
79	SW	Opto Input 16	DDB_OPTO_ISOLATOR_16
80	SW	Opto Input 17	DDB_OPTO_ISOLATOR_17
81	SW	Opto Input 18	DDB_OPTO_ISOLATOR_18
82	SW	Opto Input 19	DDB_OPTO_ISOLATOR_19
83	SW	Opto Input 20	DDB_OPTO_ISOLATOR_20

P742 Logic Nodes			
DDB No	Source	Description	Element Name
84	SW	Opto Input 21	DDB_OPTO_ISOLATOR_21
85	SW	Opto Input 22	DDB_OPTO_ISOLATOR_22
86	SW	Opto Input 23	DDB_OPTO_ISOLATOR_23
87	SW	Opto Input 24	DDB_OPTO_ISOLATOR_24
88	SW	Reserve	DDB_OPTO_ISOLATOR_25
89	SW	Reserve	DDB_OPTO_ISOLATOR_26
90	SW	Reserve	DDB_OPTO_ISOLATOR_27
91	SW	Reserve	DDB_OPTO_ISOLATOR_28
92	SW	Reserve	DDB_OPTO_ISOLATOR_29
93	SW	Reserve	DDB_OPTO_ISOLATOR_30
94	SW	Reserve	DDB_OPTO_ISOLATOR_31
95	SW	Reserve	DDB_OPTO_ISOLATOR_32
96	SW	Led 1	DDB_OUTPUT_LED_1
97	SW	Led 2	DDB_OUTPUT_LED_2
98	SW	Led 3	DDB_OUTPUT_LED_3
99	SW	Led 4	DDB_OUTPUT_LED_4
100	SW	Led 5	DDB_OUTPUT_LED_5
101	SW	Led 6	DDB_OUTPUT_LED_6
102	SW	Led 7	DDB_OUTPUT_LED_7
103	SW	Led 8	DDB_OUTPUT_LED_8
104	PSL	TS open disconnector 1	IS_1_OPEN
105	PSL	TS closed Disconnect 1	IS_1_CLOSED
106	PSL	TS open disconnector 2	IS_2_OPEN
107	PSL	TS closed disconnector 2	IS_2_CLOSED
108	PSL	TS open disconnector 3	IS_3_OPEN
109	PSL	TS closed disconnector 3	IS_3_CLOSED
110	PSL	TS open disconnector 4	IS_4_OPEN
111	PSL	TS closed disconnector 4	IS_4_CLOSED
112	PSL	TS open disconnector 5	IS_5_OPEN
113	PSL	TS closed disconnector 5	IS_5_CLOSED
114	PSL	TS open disconnector 6	IS_6_OPEN
115	PSL	TS closed disconnector 6	IS_6_CLOSED
116	PSL	External trip on 3 phases	TS_CB_TRIP_3PH
117	PSL	External trip on phase A	TS_CB_TRIP_A
118	PSL	External trip on phase B	TS_CB_TRIP_B
119	PSL	External trip on phase C	TS_CB_TRIP_C
120	PSL	TS closing order Circuit breaker	TS_CB_CLOSING_ORDER
121	PSL	TS Circuit breaker not available	TS_CB_HS
122	PSL	External circuit breaker failure - request backtrip	TS_CB_EXTERNAL_CBF
123	PSL	TS 3-phase closed circuit breaker	TS_CB_52A_3PH
124	PSL	TS 3-phase open circuit breaker	TS_CB_52B_3PH
125	PSL	TS Circuit breaker closed phase A	TS_CB_52A_PHASE_A
126	PSL	TS Phase A open circuit breaker	TS_CB_52B_PHASE_A
127	PSL	TS Circuit breaker closed phase B	TS_CB_52A_PHASE_B
128	PSL	TS Open circuit breaker phase B	TS_CB_52B_PHASE_B

P742 Logic Nodes			
DDB No	**Source**	**Description**	**Element Name**
129	PSL	TS Circuit breaker closed phase C	TS_CB_52A_PHASE_C
130	PSL	TS Phase C open circuit breaker	TS_CB_52B_PHASE_C
131	PSL	TS unlocking relays dec latchés	TS_RESET_LOCKOUT
132	PSL	TS active group low weight	TS_SETTING_GROUP_LSB
133	PSL	TS active group	TS_SETTING_GROUP_MSB
134	PSL	TS reset all values => CB monitoring (not used)	TS_RESET_ALL_VALUES
135	PSL	TS reset latched led / relay PSL	TS_RESET_LATCHES
136	PSL	Reserve	UNUSED_136
137	PSL	Reserve	UNUSED_137
138	PSL	Reserve	UNUSED_138
139	PSL	Reserve	UNUSED_139
140	PSL	Reserve	UNUSED_140
141	PSL	Reserve	UNUSED_141
142	PSL	Reserve	UNUSED_142
143	PSL	Auxiliary contact power supply	AUX_VOLTAGE
144	PSL	Virtual TC 1 PU->CU	VIRTUAL_TC_1
145	PSL	Virtual TC 2 PU->CU	VIRTUAL_TC_2
146	PSL	Virtual TC 3 PU->CU	VIRTUAL_TC_3
147	PSL	Virtual TC 4 PU->CU	VIRTUAL_TC_4
148	PSL	Virtual TC 5 PU->CU	VIRTUAL_TC_5
149	PSL	Virtual TC 6 PU->CU	VIRTUAL_TC_6
150	PSL	Virtual TC 7 PU->CU	VIRTUAL_TC_7
151	PSL	Virtual TC 8 PU->CU	VIRTUAL_TC_8
152	PSL	Virtual TC 9 PU->CU	VIRTUAL_TC_9
153	PSL	Virtual TC 10 PU->CU	VIRTUAL_TC_10
154	PSL	Virtual TC 11 PU->CU	VIRTUAL_TC_11
155	PSL	Virtual TC 12 PU->CU	VIRTUAL_TC_12
156	PSL	Virtual TC 13 PU->CU	VIRTUAL_TC_13
157	PSL	Virtual TC 14 PU->CU	VIRTUAL_TC_14
158	PSL	Virtual TC 15 PU->CU	VIRTUAL_TC_15
159	PSL	Virtual TC 16 PU->CU	VIRTUAL_TC_16
160	PSL	Disconnector 1: closing order	IS_1_CLOSING_ORDER
161	PSL	Disconnector 2: closing order	IS_2_CLOSING_ORDER
162	PSL	Disconnector 3: closing order	IS_3_CLOSING_ORDER
163	PSL	Disconnector 4: closing order	IS_4_CLOSING_ORDER
164	PSL	Disconnector 5: closing order	IS_5_CLOSING_ORDER
165	PSL	Disconnector 6: closing order	IS_6_CLOSING_ORDER
166	PSL	CB Control: Close command	CB_CONTROL_CLOSE
167	PSL	CB Control: opening command	CB_CONTROL_OPEN
168	SW	External retrip phase A	CBF_RETRIP_A_EXTERNAL
169	SW	External retrip phase B	CBF_RETRIP_B_EXTERNAL
170	SW	External retrip phase C	CBF_RETRIP_C_EXTERNAL
171	SW	External retrip 3 phases	CBF_RETRIP_TRI_INTERNAL
172	SW	CBF backtrip - internal	CBF_FAILURE_INTERNAL
173	SW	CBF backtrip - external	CBF_FAILURE_EXTERNAL

P742 Logic Nodes			
DDB No	Source	Description	Element Name
174	SW	CBF abnormal breaker	ALARM_CBF
175	SW	Reserve	UNUSED_175
176	SW	Overcurrent I>1 Start phase A	OC_1_A_START
177	SW	Overcurrent I>1 Start phase B	OC_1_B_START
178	SW	Overcurrent I>1 Start phase C	OC_1_C_START
179	SW	Overcurrent I>1 Start neutral phase	OC_1_N_START
180	SW	Overcurrent I>1 Trip 3 phases	OC_1_PHASE_TRIP_TRI
181	SW	Overcurrent IN>1 Trip 3 phases	OC_1_EARTH_TRIP_TRI
182	SW	Overcurrent I>2 Start phase A	OC_2_A_START
183	SW	Overcurrent I>2 Start phase B	OC_2_B_START
184	SW	Overcurrent I>2 Start phase C	OC_2_C_START
185	SW	Overcurrent I>2 Start neutral phase	OC_2_N_START
186	SW	Overcurrent I>2 Trip 3 phases	OC_2_PHASE_TRIP_TRI
187	SW	Overcurrent IN>2 Trip 3 phases	OC_2_EARTH_TRIP_TRI
188	PSL	Blocks Timer Overcurrent I>1	OC_1_PHASE_TIMER_BLOCK
189	PSL	Blocks Timer Overcurrent IN>1	OC_1_EARTH_TIMER_BLOCK
190	PSL	Blocks Timer Overcurrent I>2	OC_2_PHASE_TIMER_BLOCK
191	PSL	Blocks Timer Overcurrent IN>2	OC_2_EARTH_TIMER_BLOCK
192	SW	Virtual opto/relay CU to PU	VIRTUAL_OPTO_1
193	SW	Virtual opto/relay CU to PU	VIRTUAL_OPTO_2
194	SW	Virtual opto/relay CU to PU	VIRTUAL_OPTO_3
195	SW	Virtual opto/relay CU to PU	VIRTUAL_OPTO_4
196	SW	Virtual opto/relay CU to PU	VIRTUAL_OPTO_5
197	SW	Virtual opto/relay CU to PU	VIRTUAL_OPTO_6
198	SW	Virtual opto/relay CU to PU	VIRTUAL_OPTO_7
199	SW	Virtual opto/relay CU to PU	VIRTUAL_OPTO_8
200	SW	Virtual opto/relay CU to PU	VIRTUAL_OPTO_9
201	SW	Virtual opto/relay CU to PU	VIRTUAL_OPTO_10
202	SW	Virtual opto/relay CU to PU	VIRTUAL_OPTO_11
203	SW	Virtual opto/relay CU to PU	VIRTUAL_OPTO_12
204	SW	Virtual opto/relay CU to PU	VIRTUAL_OPTO_13
205	SW	Virtual opto/relay CU to PU	VIRTUAL_OPTO_14
206	SW	Virtual opto/relay CU to PU	VIRTUAL_OPTO_15
207	SW	Virtual opto/relay CU to PU	VIRTUAL_OPTO_16
208	SW	Zone 8 closed off	BAR_8_OFF
209	SW	Zone 7 closed off	BAR_7_OFF
210	SW	Zone 6 closed off	BAR_6_OFF
211	SW	Zone 5 closed off	BAR_5_OFF
212	SW	Zone 4 closed off	BAR_4_OFF
213	SW	Zone 3 closed off	BAR_3_OFF
214	SW	Zone 2 closed off	BAR_2_OFF
215	SW	Zone 1 closed off	BAR_1_OFF
216	SW	Tripping Zone 8	TRIP_BAR_8
217	SW	Tripping Zone 7	TRIP_BAR_7

P742 Logic Nodes			
DDB No	Source	Description	Element Name
218	SW	Tripping Zone 6	TRIP_BAR_6
219	SW	Tripping Zone 5	TRIP_BAR_5
220	SW	Tripping Zone 4	TRIP_BAR_4
221	SW	Tripping Zone 3	TRIP_BAR_3
222	SW	Tripping Zone 2	TRIP_BAR_2
223	SW	Tripping Zone 1	TRIP_BAR_1
224	SW	Overcurrent Ia>BB - Confirmation Busbar	OC_BB_A_START
225	SW	Overcurrent Ib>BB - Confirmation Busbar	OC_BB_B_START
226	SW	Overcurrent Ic>BB - Confirmation Busbar	OC_BB_C_START
227	SW	Overcurrent In>BB - Confirmation Busbar	OC_BB_N_START
228	SW	Overcurrent Ia>BB - Blocking Busbar	OC_BB_A_BLOCKING
229	SW	Overcurrent Ib>BB - Blocking Busbar	OC_BB_B_BLOCKING
230	SW	Overcurrent Ic>BB - Blocking Busbar	OC_BB_C_BLOCKING
231	SW	Overcurrent In>BB - Blocking Busbar	OC_BB_N_BLOCKING
232	SW	Saturation phase a	SATURATION_PHASE_A
233	SW	Saturation phase b	SATURATION_PHASE_B
234	SW	Saturation phase c	SATURATION_PHASE_C
235	SW	Fiber Optic Format> Max	ALARM_CURRENT_OVERFLOW
236	SW	Max current reached phase A	FLUX_MAX_REACHED_PHASE_A
237	SW	Max current reached phase B	FLUX_MAX_REACHED_PHASE_B
238	SW	Max current reached phase C	FLUX_MAX_REACHED_PHASE_C
239	SW	Offse analog card phase A, B, C or N	ALARM_OFFSET_ABCN
240	SW	Prediction error on phase A	PREDICT_ERROR_PHASE_A
241	SW	Prediction error on phase B	PREDICT_ERROR_PHASE_B
242	SW	Prediction error on phase C	PREDICT_ERROR_PHASE_C
243	SW	Reserve	IEC61850_OP_TRIP_CU
244	SW	Saturation CAN phase A	SATURATION_CAN_PHASE_A
245	SW	Saturation CAN phase B	SATURATION_CAN_PHASE_B
246	SW	Saturation CAN phase C	SATURATION_CAN_PHASE_C
247	SW	Saturation CAN phase N	SATURATION_CAN_PHASE_N
248	SW	Variation phase A	VARIATION_PHASE_A
249	SW	Variation phase B	VARIATION_PHASE_B
250	SW	Variation phase C	VARIATION_PHASE_C
251	SW	Variation phase N	VARIATION_PHASE_N
252	SW	PU/CU communication error	ALARM_PU_FAULT_MINOR
253	SW	Fibre error on the PU	ALARM_PU_FAULT_MAJOR
254	SW	Sample acquisition error 3*Io=In	ACQ_ERROR_3I0
255	SW	Error 3 * Io = In with tempo Tce	ALARM_CT_FAULT

P742 Logic Nodes			
DDB No	**Source**	**Description**	**Element Name**
256	SW	Internal tripping	INTERNAL_TRIPPING
257	SW	Busbar	BUSBAR_TRIPPING
258	SW	Busbar blocked with signaling	BUSBAR_TRIPPING_BLOCK
259	SW	50BF	BF_TRIPPING
260	SW	Zone manual deactivation from the CU	ZONE_CB_TRIPPING
261	SW	Phase or earth dead zone fault	ALARM_DEAD_ZONE
262	SW	Dead-zone phase failure	DEAD_ZONE_PHASE
263	SW	Dead zone dead earth	DEAD_ZONE_EARTH
264	SW	Operating mode 1	OPERATING_MODE_1
265	SW	Operating mode 2	OPERATING_MODE_2
266	SW	Configuration error	ALARM_OPERATING_MODE_3
267	SW	Valid configuration	VALID_CONF
268	SW	Valid topology	VALID_TOPO
269	SW	Valid configuration & topology	VALID_CONF_TOPO
270	SW	Block all PU/CU protection	ALARM_ALL_PROT_DISABLED
271	SW	Reserve	ENABLE_TS_ALL_PROT_DISABLED
272	SW	Reserve	UNUSED_272
273	SW	Reserve	UNUSED_273
274	SW	Reserve	UNUSED_274
275	SW	Reserve	UNUSED_275
276	SW	Reserve	UNUSED_276
277	SW	Reserve	UNUSED_277
278	SW	Reserve	UNUSED_278
279	SW	Reserve	UNUSED_279
280	SW	Reserve	UNUSED_280
281	SW	Reserve	UNUSED_281
282	SW	Reserve	UNUSED_282
283	SW	Reserve	UNUSED_283
284	SW	Reserve	UNUSED_284
285	SW	Reserve	UNUSED_285
286	SW	Reserve	UNUSED_286
287	SW	Reserve	UNUSED_287
288	SW	Overcurrent tripping	OC_TRIPPING
289	SW	Circuit breaker is available for tripping	CB_AVAILABLE_TO_TRIP
290	SW	50BF internal or external	BF_TRIP_REQUEST
291	SW	Reserve	ALL_PROT_DISABLED_BBRAM
292	SW	Reserve	IEC61850_CB_CONNECT_3PH
293	SW	Reserve	IEC61850_CBA_STATUS_ALARM_PSL
294	PSL	Blocking 87BB/P by opto	INP_BLOCK_87BB_P
295	PSL	Blocking 87BB/N by opto	INP_BLOCK_87BB_N
296	SW	Overcurrent tripping - supplement	OC_TRIPPING_COMP
297	SW	Circuit breaker is not available for tripping	CB_AVAILABLE_TO_TRIP_COMP

P742 Logic Nodes			
DDB No	**Source**	**Description**	**Element Name**
298	SW	50BF internal or external - supplement	BF_TRIP_REQUEST_COMP
299	SW	Reserve	IEC61850_INTERLOCKING_ENACLS
300	SW	Reserve	UNUSED_300
301	SW	Reserve	UNUSED_301
302	SW	Reserve	UNUSED_302
303	SW	Reserve	UNUSED_303
304	SW	Reserve	UNUSED_304
305	SW	Manual release of the local circuit breaker	LOCAL_CB_TRIPPING
306	SW	Closing the local circuit breaker manually	LOCAL_CB_CLOSING
307	SW	PU in test mode	ALARM_MAINTENANCE_CONSIGNATION
308	SW	50BF is disabled	ALARM_FEEDER_CONSIGNATION
309	SW	Reserve	UNUSED_309
310	SW	Reserve	UNUSED_310
311	PSL	PU input in test mode in the slice	OPTO_CONSIGNATION_BAY_TEST
312	PSL	PU input in test mode	OPTO_CONSIGNATION_PU_TEST
313	SW	Reserve	DEAD_ZONE_ENABLED
314	SW	Activation OC Busbar Confirmation	OC_BLOCKING_BB_1_ENABLE
315	SW	Activation Latched Trip Relay	TRIP_RELAY_HOLD
316	SW	Activation OC Busbar Blocking Phase	OC_BB2_PH_ENABLE
317	SW	Activation OC Busbar Blocking Residual	OC_BB2_N_ENABLE
318	SW	Acquisition Latched trigger relay	TRIP_RELAY_RESET
319	SW	Change configuration or topology	CONF_TOPO_CHANGE
320	SW	Disconnector 1 closed	IS_1_POSITION
321	PSL	Alarm on disconnector 1	ALARM_IS_1_POSITION
322	SW	Disconnector 1 closed	IS_2_POSITION
323	PSL	Alarm on disconnector 2	ALARM_IS_2_POSITION
324	SW	Disconnector 1 closed	IS_3_POSITION
325	PSL	Alarm on disconnector 3	ALARM_IS_3_POSITION
326	SW	Disconnector 1 closed	IS_4_POSITION
327	PSL	Alarm on disconnector 4	ALARM_IS_4_POSITION
328	SW	Disconnector 1 closed	IS_5_POSITION
329	PSL	Alarm on disconnector 5	ALARM_IS_5_POSITION
330	SW	Disconnector 1 closed	IS_6_POSITION
331	PSL	Alarm on disconnector 6	ALARM_IS_6_POSITION
332	SW	Circuit breaker closed	CB_1_POSITION
333	SW	Availability of circuit breaker	CB_1_AVAILABLE
334	SW	Reserve	UNUSED_334
335	SW	Reserve	UNUSED_335
336	SW	Forced position disconnector 1	IS_1_FORCED_POSITION
337	SW	Forced position disconnector 2	IS_2_FORCED_POSITION

P742 Logic Nodes			
DDB No	Source	Description	Element Name
338	SW	Forced position disconnector 3	IS_3_FORCED_POSITION
339	SW	Forced position disconnector 4	IS_4_FORCED_POSITION
340	SW	Forced position disconnector 5	IS_5_FORCED_POSITION
341	SW	Forced position disconnector 6	IS_6_FORCED_POSITION
342	SW	Forced position of circuit breaker	CB_1_FORCED_POSITION
343	SW	Activation of forced positions	FORCED_POSITION_ENABLE
344	SW	Circuit breaker open position	CB_POSITION_52A
345	SW	Circuit breaker closed position	CB_POSITION_52B
346	SW	Circuit breaker three-phase trip	CB_TRIP_3PH
347	SW	Circuit breaker trip phase A	CB_TRIP_A
348	SW	Circuit breaker trip phase B	CB_TRIP_B
349	SW	Circuit breaker trip phase C	CB_TRIP_C
350	SW	Reserve	UNUSED_350
351	SW	General Alarm	ALARM_GENERAL
352	SW	CB Control Alarm - Circuit breaker status error	ALARM_CB_STATUS
353	SW	CB Control Alarm - Close error	ALARM_CB_FAIL_CLOSE
354	SW	CB Control Alarm - Trigger error	ALARM_CB_FAIL_TRIP
355	SW	CB Control request closure in progress	PRT_CONTROL_CLOSE_IN_PROG
356	SW	CB Control DJ Closure Control	PRT_CONTROL_CLOSE
357	SW	CB Control request to open in progress	PRT_CONTROL_TRIP
358	SW	OR between 136, 137, 138, 139, 224	ANY_TRIP
359	SW	Reserve	UNUSED_359
360	SW	Reserve	UNUSED_360
361	SW	Reserve	UNUSED_361
362	PSL	Rear port 1 read only	DDB_REMOTEREADONLY_RP1
363	PSL	Rear port 2 read only	DDB_REMOTEREADONLY_RP2
364	PSL	NIC read only	DDB_REMOTEREADONLY_NIC
365	SW	Reserve	UNUSED_365
366	SW	Reserve	UNUSED_366
367	SW	Reserve	UNUSED_367
368	SW	Reserve	UNUSED_368
369	SW	Reserve	UNUSED_369
370	SW	Reserve	UNUSED_370
371	SW	Reserve	UNUSED_371
372	SW	Reserve	UNUSED_372
373	SW	Reserve	UNUSED_373
374	SW	Reserve	IEC61850_87BB_FAULT_OP
375	SW	Error detected by the CT supervision	ALARM_CT_SUPERVISION
376	SW	87BB fault phase A	DDB_87BB_FAULT_A
377	SW	87BB fault phase B	DDB_87BB_FAULT_B
378	SW	87BB fault phase C	DDB_87BB_FAULT_C

P742 Logic Nodes			
DDB No	Source	Description	Element Name
379	SW	87BB earth fault	DDB_87BB_FAULT_N
380	SW	Reserve	IEC61850_DZP_A_START
381	SW	Reserve	IEC61850_DZP_B_START
382	SW	Reserve	IEC61850_DZP_C_START
383	SW	Reserve	IEC61850_DZP_N_START
384	SW	Reserve	UNUSED_384
385	SW	Reserve	UNUSED_385
386	SW	Reserve	UNUSED_386
387	SW	Reserve	UNUSED_387
388	SW	Reserve	UNUSED_388
389	SW	Reserve	UNUSED_389
390	SW	Reserve	UNUSED_390
391	SW	Reserve	UNUSED_391
392	SW	Reserve	UNUSED_392
393	SW	Reserve	UNUSED_393
394	SW	Reserve	UNUSED_394
395	SW	Reserve	UNUSED_395
396	SW	Reserve	UNUSED_396
397	SW	Reserve	UNUSED_397
398	SW	Reserve	UNUSED_398
399	SW	Reserve	UNUSED_399
400	SW	Reserve	UNUSED_400
401	SW	Reserve	UNUSED_401
402	SW	Reserve	UNUSED_402
403	SW	Reserve	UNUSED_403
404	SW	Reserve	UNUSED_404
405	SW	Reserve	UNUSED_405
406	SW	Reserve	UNUSED_406
407	SW	Reserve	UNUSED_407
408	SW	Reserve	UNUSED_408
409	SW	Reserve	UNUSED_409
410	SW	Reserve	UNUSED_410
411	SW	Reserve	UNUSED_411
412	SW	Reserve	UNUSED_412
413	SW	Reserve	UNUSED_413
414	SW	Reserve	UNUSED_414
415	SW	Reserve	UNUSED_415
416	SW	Reserve	UNUSED_416
417	SW	Reserve	UNUSED_417
418	SW	Reserve	UNUSED_418
419	SW	Reserve	UNUSED_419
420	SW	Reserve	UNUSED_420
421	SW	Reserve	UNUSED_421
422	SW	Reserve	UNUSED_422
423	SW	Reserve	UNUSED_423
424	SW	Reserve	UNUSED_424

P742 Logic Nodes			
DDB No	**Source**	**Description**	**Element Name**
425	SW	Reserve	UNUSED_425
426	SW	Reserve	UNUSED_426
427	SW	Reserve	UNUSED_427
428	PSL	Assignment of input signal to drive output LED 1	DDB_LED_CON_1
429	PSL	Assignment of input signal to drive output LED 2	DDB_LED_CON_2
430	PSL	Assignment of input signal to drive output LED 3	DDB_LED_CON_3
431	PSL	Assignment of input signal to drive output LED 4	DDB_LED_CON_4
432	PSL	Assignment of input signal to drive output LED 5	DDB_LED_CON_5
433	PSL	Assignment of input signal to drive output LED 6	DDB_LED_CON_6
434	PSL	Assignment of input signal to drive output LED 7	DDB_LED_CON_7
435	PSL	Assignment of input signal to drive output LED 8	DDB_LED_CON_8
436	PSL	Input to auxiliary timer 1	DDB_TIMERIN_1
437	PSL	Input to auxiliary timer 2	DDB_TIMERIN_2
438	PSL	Input to auxiliary timer 3	DDB_TIMERIN_3
439	PSL	Input to auxiliary timer 4	DDB_TIMERIN_4
440	PSL	Input to auxiliary timer 5	DDB_TIMERIN_5
441	PSL	Input to auxiliary timer 6	DDB_TIMERIN_6
442	PSL	Input to auxiliary timer 7	DDB_TIMERIN_7
443	PSL	Input to auxiliary timer 8	DDB_TIMERIN_8
444	PSL	Input to auxiliary timer 9	DDB_TIMERIN_9
445	PSL	Input to auxiliary timer 10	DDB_TIMERIN_10
446	PSL	Input to auxiliary timer 11	DDB_TIMERIN_11
447	PSL	Input to auxiliary timer 12	DDB_TIMERIN_12
448	PSL	Input to auxiliary timer 13	DDB_TIMERIN_13
449	PSL	Input to auxiliary timer 14	DDB_TIMERIN_14
450	PSL	Input to auxiliary timer 15	DDB_TIMERIN_15
451	PSL	Input to auxiliary timer 16	DDB_TIMERIN_16
452	SW	Output from auxiliary timer 1	DDB_TIMEROUT_1
453	SW	Output from auxiliary timer 2	DDB_TIMEROUT_2
454	SW	Output from auxiliary timer 3	DDB_TIMEROUT_3
455	SW	Output from auxiliary timer 4	DDB_TIMEROUT_4
456	SW	Output from auxiliary timer 5	DDB_TIMEROUT_5
457	SW	Output from auxiliary timer 6	DDB_TIMEROUT_6
458	SW	Output from auxiliary timer 7	DDB_TIMEROUT_7
459	SW	Output from auxiliary timer 8	DDB_TIMEROUT_8
460	SW	Output from auxiliary timer 9	DDB_TIMEROUT_9
461	SW	Output from auxiliary timer 10	DDB_TIMEROUT_10
462	SW	Output from auxiliary timer 11	DDB_TIMEROUT_11

P742 Logic Nodes			
DDB No	**Source**	**Description**	**Element Name**
463	SW	Output from auxiliary timer 12	DDB_TIMEROUT_12
464	SW	Output from auxiliary timer 13	DDB_TIMEROUT_13
465	SW	Output from auxiliary timer 14	DDB_TIMEROUT_14
466	SW	Output from auxiliary timer 15	DDB_TIMEROUT_15
467	SW	Output from auxiliary timer 16	DDB_TIMEROUT_16
468	PSL	Indicator to tell relay a fault record needs to be recorded	DDB_FAULT_RECORD_TRIGGER
469	SW	Front panel miniature battery failure - either battery removed from slot, or low voltage	DDB_PLAT_BATTERY_FAIL_ALARM
470	SW	48V field voltage failure	DDB_PLAT_FIELD_VOLT_FAIL_ALARM
471	SW	Comm2 hardware failure - second rear communications board	DDB_REAR_COMMS_FAIL_ALARM_66
472	SW	The IED is not subscribed to a publishing IED in the current scheme	DDB_GOOSE_IED_MISSING_ALARM_67
473	SW	Ethernet board not fitted	DDB_ECARD_NOT_FITTED_ALARM_68
474	SW	Ethernet board not responding	DDB_NIC_NOT_RESPONDING_69
475	SW	Ethernet board unrecoverable error	DDB_NIC_FATAL_ERROR_70
476	SW	Ethernet problem	DDB_NIC_SOFTWARE_RELOAD_71
477	SW	Ethernet problem, invalid IP address	DDB_INVALID_NIC_TCP_IP_CONFIG_72
478	SW	Ethernet problem	DDB_INVALID_NIC_OSI_CONFIG_73
479	SW	Reserve	DDB_ALARM_UNUSED_479
480	SW	Ethernet board software not compatible with main CPU	DDB_SW_MISMATCH_ALARM
481	SW	The IP address of the IED is already used by another IED	DDB_NIC_IP_ADDRESS_CONFLICT_76
482	SW	EIA(RS)232 InterMiCOM indication that Loopback testing is in progress	DDB_INTERMICOM_LOOPBACK_ALARM_77
483	SW	EIA(RS)232 InterMiCOM Message Failure alarm. Setting that is used to alarm for poor channel quality. If during the fixed 1.6 s rolling window the ratio of invalid messages to the total number of messages that should be received (based upon the 'Baud Rate' setting) exceeds the above threshold, a 'Message Fail' alarm will be issued	DDB_INTERMICOM_MESSAGE_ALARM_78
484	SW	EIA(RS)232 InterMiCOM Data Channel Detect Fail i.e. modem failure	DDB_INTERMICOM_DCD_ALARM_79

P742 Logic Nodes			
DDB No	Source	Description	Element Name
485	SW	EIA(RS)232 InterMiCOM Channel Failure alarm. No messages were received during the alarm time setting	DDB_INTERMICOM_CHANNEL_ALARM_80
486	SW	This is an alarm that is ON if any setting fail during the setting changing process. If this happens, the relay will use the last known good setting	DDB_BACKUP_SETTING_ALARM_81
487	PSL	Reserve	DDB_ALARM_UNUSED_487
488	PSL	Reserve	DDB_ALARM_UNUSED_488
489	PSL	Reserve	DDB_ALARM_UNUSED_489
490	PSL	Reserve	DDB_ALARM_UNUSED_490
491	SW	Invalid IEC 61850 Configuration Alarm	DDB_INVALID_CONFIG_ALARM
492	SW	Test Mode Activated Alarm	DDB_TEST_MODE_ALARM
493	SW	Contacts Blocked Alarm	DDB_CONT_BLK_ALARM
494	SW	Main card/Ethernet card hw option mismatch Alarm	DDB_HW_MISMATCH_ALARM
495	SW	Main card/Ethernet card IEC61850 ver mismatch Alarm	DDB_IEC61850_VER_MISMATCH_ALARM
496	SW	IEC 61850 accept simulation GOOSE alarm	DDB_GS_ACEPT_SIMU_ALM
497	PSL	Reserve	DDB_ALARM_UNUSED_497
498	PSL	Reserve	DDB_ALARM_UNUSED_498
499	PSL	Reserve	DDB_ALARM_UNUSED_499
500	PSL	Reserve	DDB_ALARM_UNUSED_500
501	PSL	Reserve	DDB_UNUSED_501
502	PSL	Reserve	DDB_UNUSED_502
503	PSL	Reserve	DDB_UNUSED_503
504	PSL	Reserve	DDB_UNUSED_504
505	PSL	Reserve	DDB_UNUSED_505
506	PSL	Reserve	DDB_UNUSED_506
507	PSL	Reserve	DDB_UNUSED_507
508	PSL	Reserve	DDB_UNUSED_508
509	PSL	Reserve	DDB_UNUSED_509
510	PSL	Reserve	DDB_UNUSED_510
511	PSL	Reserve	DDB_UNUSED_511
512	PSL	Virtual output 1 - allows user to control a binary signal which can be mapped via SCADA protocol output to other devices	DDB_GOOSEOUT_1
513	PSL	Virtual output 2 - allows user to control a binary signal which can be mapped via SCADA protocol output to other devices	DDB_GOOSEOUT_2

P742 Logic Nodes			
DDB No	Source	Description	Element Name
514	PSL	Virtual output 3 - allows user to control a binary signal which can be mapped via SCADA protocol output to other devices	DDB_GOOSEOUT_3
515	PSL	Virtual output 4 - allows user to control a binary signal which can be mapped via SCADA protocol output to other devices	DDB_GOOSEOUT_4
516	PSL	Virtual output 5 - allows user to control a binary signal which can be mapped via SCADA protocol output to other devices	DDB_GOOSEOUT_5
517	PSL	Virtual output 6 - allows user to control a binary signal which can be mapped via SCADA protocol output to other devices	DDB_GOOSEOUT_6
518	PSL	Virtual output 7 - allows user to control a binary signal which can be mapped via SCADA protocol output to other devices	DDB_GOOSEOUT_7
519	PSL	Virtual output 8 - allows user to control a binary signal which can be mapped via SCADA protocol output to other devices	DDB_GOOSEOUT_8
520	PSL	Virtual output 9 - allows user to control a binary signal which can be mapped via SCADA protocol output to other devices	DDB_GOOSEOUT_9
521	PSL	Virtual output 10 - allows user to control a binary signal which can be mapped via SCADA protocol output to other devices	DDB_GOOSEOUT_10
522	PSL	Virtual output 11 - allows user to control a binary signal which can be mapped via SCADA protocol output to other devices	DDB_GOOSEOUT_11
523	PSL	Virtual output 12 - allows user to control a binary signal which can be mapped via SCADA protocol output to other devices	DDB_GOOSEOUT_12
524	PSL	Virtual output 13 - allows user to control a binary signal which can be mapped via SCADA protocol output to other devices	DDB_GOOSEOUT_13

P742 Logic Nodes			
DDB No	Source	Description	Element Name
525	PSL	Virtual output 14 - allows user to control a binary signal which can be mapped via SCADA protocol output to other devices	DDB_GOOSEOUT_14
526	PSL	Virtual output 15 - allows user to control a binary signal which can be mapped via SCADA protocol output to other devices	DDB_GOOSEOUT_15
527	PSL	Virtual output 16 - allows user to control a binary signal which can be mapped via SCADA protocol output to other devices	DDB_GOOSEOUT_16
528	PSL	Virtual output 17 - allows user to control a binary signal which can be mapped via SCADA protocol output to other devices	DDB_GOOSEOUT_17
529	PSL	Virtual output 18 - allows user to control a binary signal which can be mapped via SCADA protocol output to other devices	DDB_GOOSEOUT_18
530	PSL	Virtual output 19 - allows user to control a binary signal which can be mapped via SCADA protocol output to other devices	DDB_GOOSEOUT_19
531	PSL	Virtual output 20 - allows user to control a binary signal which can be mapped via SCADA protocol output to other devices	DDB_GOOSEOUT_20
532	PSL	Virtual output 21 - allows user to control a binary signal which can be mapped via SCADA protocol output to other devices	DDB_GOOSEOUT_21
533	PSL	Virtual output 22 - allows user to control a binary signal which can be mapped via SCADA protocol output to other devices	DDB_GOOSEOUT_22
534	PSL	Virtual output 23 - allows user to control a binary signal which can be mapped via SCADA protocol output to other devices	DDB_GOOSEOUT_23
535	PSL	Virtual output 24 - allows user to control a binary signal which can be mapped via SCADA protocol output to other devices	DDB_GOOSEOUT_24

P742 Logic Nodes			
DDB No	Source	Description	Element Name
536	PSL	Virtual output 25 - allows user to control a binary signal which can be mapped via SCADA protocol output to other devices	DDB_GOOSEOUT_25
537	PSL	Virtual output 26 - allows user to control a binary signal which can be mapped via SCADA protocol output to other devices	DDB_GOOSEOUT_26
538	PSL	Virtual output 27 - allows user to control a binary signal which can be mapped via SCADA protocol output to other devices	DDB_GOOSEOUT_27
539	PSL	Virtual output 28 - allows user to control a binary signal which can be mapped via SCADA protocol output to other devices	DDB_GOOSEOUT_28
540	PSL	Virtual output 29 - allows user to control a binary signal which can be mapped via SCADA protocol output to other devices	DDB_GOOSEOUT_29
541	PSL	Virtual output 30 - allows user to control a binary signal which can be mapped via SCADA protocol output to other devices	DDB_GOOSEOUT_30
542	PSL	Virtual output 31 - allows user to control a binary signal which can be mapped via SCADA protocol output to other devices	DDB_GOOSEOUT_31
543	PSL	Virtual output 32 - allows user to control a binary signal which can be mapped via SCADA protocol output to other devices	DDB_GOOSEOUT_32
544	PSL	Reserve	UNUSED_544
545	PSL	Reserve	UNUSED_545
546	PSL	Reserve	UNUSED_546
547	PSL	Reserve	UNUSED_547
548	PSL	Reserve	UNUSED_548
549	PSL	Reserve	UNUSED_549
550	PSL	Reserve	UNUSED_550
551	PSL	Reserve	UNUSED_551
552	PSL	Reserve	UNUSED_552
553	PSL	Reserve	UNUSED_553
554	PSL	Reserve	UNUSED_554
555	PSL	Reserve	UNUSED_555
556	PSL	Reserve	UNUSED_556
557	PSL	Reserve	UNUSED_557
558	PSL	Reserve	UNUSED_558

P742 Logic Nodes			
DDB No	Source	Description	Element Name
559	PSL	Reserve	UNUSED_559
560	PSL	Reserve	UNUSED_560
561	PSL	Reserve	UNUSED_561
562	PSL	Reserve	UNUSED_562
563	PSL	Reserve	UNUSED_563
564	PSL	Reserve	UNUSED_564
565	PSL	Reserve	UNUSED_565
566	PSL	Reserve	UNUSED_566
567	PSL	Reserve	UNUSED_567
568	PSL	Reserve	UNUSED_568
569	PSL	Reserve	UNUSED_569
570	PSL	Reserve	UNUSED_570
571	PSL	Reserve	UNUSED_571
572	PSL	Reserve	UNUSED_572
573	PSL	Reserve	UNUSED_573
574	PSL	Reserve	UNUSED_574
575	PSL	Reserve	UNUSED_575
576	PSL	PSL Internal Node	DDB_PSLINT_576
577	PSL	PSL Internal Node	DDB_PSLINT_577
578	PSL	PSL Internal Node	DDB_PSLINT_578
579	PSL	PSL Internal Node	DDB_PSLINT_579
580	PSL	PSL Internal Node	DDB_PSLINT_580
581	PSL	PSL Internal Node	DDB_PSLINT_581
582	PSL	PSL Internal Node	DDB_PSLINT_582
583	PSL	PSL Internal Node	DDB_PSLINT_583
584	SW	InterMiCOM Input 1 - is driven by a message from the remote line end	DDB_INTERIN_1
585	SW	InterMiCOM Input 2 - is driven by a message from the remote line end	DDB_INTERIN_2
586	SW	InterMiCOM Input 3 - is driven by a message from the remote line end	DDB_INTERIN_3
587	SW	InterMiCOM Input 4 - is driven by a message from the remote line end	DDB_INTERIN_4
588	SW	InterMiCOM Input 5 - is driven by a message from the remote line end	DDB_INTERIN_5
589	SW	InterMiCOM Input 6 - is driven by a message from the remote line end	DDB_INTERIN_6
590	SW	InterMiCOM Input 7 - is driven by a message from the remote line end	DDB_INTERIN_7

P742 Logic Nodes			
DDB No	Source	Description	Element Name
591	SW	InterMiCOM Input 8 - is driven by a message from the remote line end	DDB_INTERIN_8
592	PSL	InterMiCOM Output 1 - is an output to the remote line end	DDB_INTEROUT_1
593	PSL	InterMiCOM Output 2 - is an output to the remote line end	DDB_INTEROUT_2
594	PSL	InterMiCOM Output 3 - is an output to the remote line end	DDB_INTEROUT_3
595	PSL	InterMiCOM Output 4 - is an output to the remote line end	DDB_INTEROUT_4
596	PSL	InterMiCOM Output 5 - is an output to the remote line end	DDB_INTEROUT_5
597	PSL	InterMiCOM Output 6 - is an output to the remote line end	DDB_INTEROUT_6
598	PSL	InterMiCOM Output 7 - is an output to the remote line end	DDB_INTEROUT_7
599	PSL	InterMiCOM Output 8 - is an output to the remote line end	DDB_INTEROUT_8
600	SW	Circuit breaker failure I< Start Phase A	CBF_DEAD_POLE_START_A
601	SW	Circuit breaker failure I< Start Phase B	CBF_DEAD_POLE_START_B
602	SW	Circuit breaker failure I< Start Phase C	CBF_DEAD_POLE_START_C
603	SW	Circuit breaker failure I> Start Phase A	CBF_CONFIRM_START_A
604	SW	Circuit breaker failure I> Start Phase B	CBF_CONFIRM_START_B
605	SW	Circuit breaker failure I> Start Phase C	CBF_CONFIRM_START_C
606	SW	Circuit breaker failure I> Start Neutral Phase	CBF_CONFIRM_START_N
607	PSL	Reserve	DDB_UNUSED_607
608	SW	Control Input 1 energized	DDB_CTRL_IP_1
609	SW	Control Input 2 energized	DDB_CTRL_IP_2
610	SW	Control Input 3 energized	DDB_CTRL_IP_3
611	SW	Control Input 4 energized	DDB_CTRL_IP_4
612	SW	Control Input 5 energized	DDB_CTRL_IP_5
613	SW	Control Input 6 energized	DDB_CTRL_IP_6
614	SW	Control Input 7 energized	DDB_CTRL_IP_7
615	SW	Control Input 8 energized	DDB_CTRL_IP_8
616	SW	Control Input 9 energized	DDB_CTRL_IP_9
617	SW	Control Input 10 energized	DDB_CTRL_IP_10
618	SW	Control Input 11 energized	DDB_CTRL_IP_11
619	SW	Control Input 12 energized	DDB_CTRL_IP_12
620	SW	Control Input 13 energized	DDB_CTRL_IP_13

P742 Logic Nodes			
DDB No	Source	Description	Element Name
621	SW	Control Input 14 energized	DDB_CTRL_IP_14
622	SW	Control Input 15 energized	DDB_CTRL_IP_15
623	SW	Control Input 16 energized	DDB_CTRL_IP_16
624	SW	Control Input 17 energized	DDB_CTRL_IP_17
625	SW	Control Input 18 energized	DDB_CTRL_IP_18
626	SW	Control Input 19 energized	DDB_CTRL_IP_19
627	SW	Control Input 20 energized	DDB_CTRL_IP_20
628	SW	Control Input 21 energized	DDB_CTRL_IP_21
629	SW	Control Input 22 energized	DDB_CTRL_IP_22
630	SW	Control Input 23 energized	DDB_CTRL_IP_23
631	SW	Control Input 24 energized	DDB_CTRL_IP_24
632	SW	Control Input 25 energized	DDB_CTRL_IP_25
633	SW	Control Input 26 energized	DDB_CTRL_IP_26
634	SW	Control Input 27 energized	DDB_CTRL_IP_27
635	SW	Control Input 28 energized	DDB_CTRL_IP_28
636	SW	Control Input 29 energized	DDB_CTRL_IP_29
637	SW	Control Input 30 energized	DDB_CTRL_IP_30
638	SW	Control Input 31 energized	DDB_CTRL_IP_31
639	SW	Control Input 32 energized	DDB_CTRL_IP_32
640	PSL	Reserve	DDB_UNUSED_640
641	PSL	Reserve	DDB_UNUSED_641
642	PSL	Reserve	DDB_UNUSED_642
643	PSL	Reserve	DDB_UNUSED_643
644	PSL	Reserve	DDB_UNUSED_644
645	PSL	Reserve	DDB_UNUSED_645
646	PSL	Reserve	DDB_UNUSED_646
647	PSL	Reserve	DDB_UNUSED_647
648	PSL	Reserve	DDB_UNUSED_648
649	PSL	Reserve	DDB_UNUSED_649
650	PSL	Reserve	DDB_UNUSED_650
651	PSL	Reserve	DDB_UNUSED_651
652	PSL	Reserve	DDB_UNUSED_652
653	PSL	Reserve	DDB_UNUSED_653
654	PSL	Reserve	DDB_UNUSED_654
655	PSL	Reserve	DDB_UNUSED_655
656	PSL	Reserve	DDB_UNUSED_656
657	PSL	Reserve	DDB_UNUSED_657
658	PSL	Reserve	DDB_UNUSED_658
659	PSL	Reserve	DDB_UNUSED_659
660	PSL	Reserve	DDB_UNUSED_660
661	PSL	Reserve	DDB_UNUSED_661
662	PSL	Reserve	DDB_UNUSED_662
663	PSL	Reserve	DDB_UNUSED_663
664	PSL	Reserve	DDB_UNUSED_664
665	PSL	Reserve	DDB_UNUSED_665
666	PSL	Reserve	DDB_UNUSED_666

P742 Logic Nodes			
DDB No	Source	Description	Element Name
667	PSL	Reserve	DDB_UNUSED_667
668	PSL	Reserve	DDB_UNUSED_668
669	PSL	Reserve	DDB_UNUSED_669
670	PSL	Reserve	DDB_UNUSED_670
671	PSL	Reserve	DDB_UNUSED_671
672	PSL	Reserve	DDB_UNUSED_672
673	PSL	Reserve	DDB_UNUSED_673
674	PSL	Reserve	DDB_UNUSED_674
675	PSL	Reserve	DDB_UNUSED_675
676	PSL	Reserve	DDB_UNUSED_676
677	PSL	Reserve	DDB_UNUSED_677
678	PSL	Reserve	DDB_UNUSED_678
679	PSL	Reserve	DDB_UNUSED_679
680	PSL	Reserve	DDB_UNUSED_680
681	PSL	Reserve	DDB_UNUSED_681
682	PSL	Reserve	DDB_UNUSED_682
683	PSL	Reserve	DDB_UNUSED_683
684	PSL	Reserve	DDB_UNUSED_684
685	PSL	Reserve	DDB_UNUSED_685
686	PSL	Reserve	DDB_UNUSED_686
687	PSL	Reserve	DDB_UNUSED_687
688	PSL	Reserve	DDB_UNUSED_688
689	PSL	Reserve	DDB_UNUSED_689
690	PSL	Reserve	DDB_UNUSED_690
691	PSL	Reserve	DDB_UNUSED_691
692	PSL	Reserve	DDB_UNUSED_692
693	PSL	Reserve	DDB_UNUSED_693
694	PSL	Reserve	DDB_UNUSED_694
695	PSL	Reserve	DDB_UNUSED_695
696	PSL	Reserve	DDB_UNUSED_696
697	PSL	Reserve	DDB_UNUSED_697
698	PSL	Reserve	DDB_UNUSED_698
699	PSL	Reserve	DDB_UNUSED_699
700	PSL	Input to relay 1 output conditioner	DDB_OUTPUT_CON_1
701	PSL	Input to relay 2 output conditioner	DDB_OUTPUT_CON_2
702	PSL	Input to relay 3 output conditioner	DDB_OUTPUT_CON_3
703	PSL	Input to relay 4 output conditioner	DDB_OUTPUT_CON_4
704	PSL	Input to relay 5 output conditioner	DDB_OUTPUT_CON_5
705	PSL	Input to relay 6 output conditioner	DDB_OUTPUT_CON_6

P742 Logic Nodes			
DDB No	Source	Description	Element Name
706	PSL	Input to relay 7 output conditioner	DDB_OUTPUT_CON_7
707	PSL	Input to relay 8 output conditioner	DDB_OUTPUT_CON_8
708	PSL	Input to relay 9 output conditioner	DDB_OUTPUT_CON_9
709	PSL	Input to relay 10 output conditioner	DDB_OUTPUT_CON_10
710	PSL	Input to relay 11 output conditioner	DDB_OUTPUT_CON_11
711	PSL	Input to relay 12 output conditioner	DDB_OUTPUT_CON_12
712	PSL	Input to relay 13 output conditioner	DDB_OUTPUT_CON_13
713	PSL	Input to relay 14 output conditioner	DDB_OUTPUT_CON_14
714	PSL	Input to relay 15 output conditioner	DDB_OUTPUT_CON_15
715	PSL	Input to relay 16 output conditioner	DDB_OUTPUT_CON_16
716	PSL	Input to relay 17 output conditioner	DDB_OUTPUT_CON_17
717	PSL	Input to relay 18 output conditioner	DDB_OUTPUT_CON_18
718	PSL	Input to relay 19 output conditioner	DDB_OUTPUT_CON_19
719	PSL	Input to relay 20 output conditioner	DDB_OUTPUT_CON_20
720	PSL	Input to relay 21 output conditioner	DDB_OUTPUT_CON_21
721	PSL	Input to relay 22 output conditioner	DDB_OUTPUT_CON_22
722	PSL	Input to relay 23 output conditioner	DDB_OUTPUT_CON_23
723	PSL	Input to relay 24 output conditioner	DDB_OUTPUT_CON_24
724	PSL	Input to relay 25 output conditioner	DDB_OUTPUT_CON_25
725	PSL	Input to relay 26 output conditioner	DDB_OUTPUT_CON_26
726	PSL	Input to relay 27 output conditioner	DDB_OUTPUT_CON_27
727	PSL	Input to relay 28 output conditioner	DDB_OUTPUT_CON_28
728	PSL	Input to relay 29 output conditioner	DDB_OUTPUT_CON_29

P742 Logic Nodes			
DDB No	**Source**	**Description**	**Element Name**
729	PSL	Input to relay 30 output conditioner	DDB_OUTPUT_CON_30
730	PSL	Input to relay 31 output conditioner	DDB_OUTPUT_CON_31
731	PSL	Input to relay 32 output conditioner	DDB_OUTPUT_CON_32
732	PSL	Input to relay 33 output conditioner	DDB_OUTPUT_CON_33
733	PSL	Input to relay 34 output conditioner	DDB_OUTPUT_CON_34
734	PSL	Input to relay 35 output conditioner	DDB_OUTPUT_CON_35
735	PSL	Input to relay 36 output conditioner	DDB_OUTPUT_CON_36
736	PSL	Input to relay 37 output conditioner	DDB_OUTPUT_CON_37
737	PSL	Input to relay 38 output conditioner	DDB_OUTPUT_CON_38
738	PSL	Input to relay 39 output conditioner	DDB_OUTPUT_CON_39
739	PSL	Input to relay 40 output conditioner	DDB_OUTPUT_CON_40
740	PSL	Input to relay 41 output conditioner	DDB_OUTPUT_CON_41
741	PSL	Input to relay 42 output conditioner	DDB_OUTPUT_CON_42
742	PSL	Input to relay 43 output conditioner	DDB_OUTPUT_CON_43
743	PSL	Input to relay 44 output conditioner	DDB_OUTPUT_CON_44
744	PSL	Input to relay 45 output conditioner	DDB_OUTPUT_CON_45
745	PSL	Input to relay 46 output conditioner	DDB_OUTPUT_CON_46
746	PSL	Input to relay 47 output conditioner	DDB_OUTPUT_CON_47
747	PSL	Input to relay 48 output conditioner	DDB_OUTPUT_CON_48
748	PSL	Input to relay 49 output conditioner	DDB_OUTPUT_CON_49
749	PSL	Input to relay 50 output conditioner	DDB_OUTPUT_CON_50
750	PSL	Input to relay 51 output conditioner	DDB_OUTPUT_CON_51
751	PSL	Input to relay 52 output conditioner	DDB_OUTPUT_CON_52

P742 Logic Nodes			
DDB No	Source	Description	Element Name
752	PSL	Input to relay 53 output conditioner	DDB_OUTPUT_CON_53
753	PSL	Input to relay 54 output conditioner	DDB_OUTPUT_CON_54
754	PSL	Input to relay 55 output conditioner	DDB_OUTPUT_CON_55
755	PSL	Input to relay 56 output conditioner	DDB_OUTPUT_CON_56
756	PSL	Input to relay 57 output conditioner	DDB_OUTPUT_CON_57
757	PSL	Input to relay 58 output conditioner	DDB_OUTPUT_CON_58
758	PSL	Input to relay 59 output conditioner	DDB_OUTPUT_CON_59
759	PSL	Input to relay 60 output conditioner	DDB_OUTPUT_CON_60
760	PSL	Input to relay 61 output conditioner	DDB_OUTPUT_CON_61
761	PSL	Input to relay 62 output conditioner	DDB_OUTPUT_CON_62
762	PSL	Input to relay 63 output conditioner	DDB_OUTPUT_CON_63
763	PSL	Input to relay 64 output conditioner	DDB_OUTPUT_CON_64
764	PSL	Reserve	DDB_UNUSED_764
765	PSL	Reserve	DDB_UNUSED_765
766	PSL	Reserve	DDB_UNUSED_766
767	PSL	Reserve	DDB_UNUSED_767
768	PSL	Reserve	DDB_UNUSED_768
769	PSL	Reserve	DDB_UNUSED_769
770	PSL	Reserve	DDB_UNUSED_770
771	PSL	Reserve	DDB_UNUSED_771
772	PSL	Reserve	DDB_UNUSED_772
773	PSL	Reserve	DDB_UNUSED_773
774	PSL	Reserve	DDB_UNUSED_774
775	PSL	Reserve	DDB_UNUSED_775
776	PSL	Reserve	DDB_UNUSED_776
777	PSL	Reserve	DDB_UNUSED_777
778	PSL	Reserve	DDB_UNUSED_778
779	PSL	Reserve	DDB_UNUSED_779
780	PSL	Reserve	DDB_UNUSED_780
781	PSL	Reserve	DDB_UNUSED_781
782	PSL	Reserve	DDB_UNUSED_782
783	PSL	Reserve	DDB_UNUSED_783
784	PSL	Reserve	DDB_UNUSED_784
785	PSL	Reserve	DDB_UNUSED_785
786	PSL	Reserve	DDB_UNUSED_786

P742 Logic Nodes			
DDB No	Source	Description	Element Name
787	PSL	Reserve	DDB_UNUSED_787
788	PSL	Reserve	DDB_UNUSED_788
789	PSL	Reserve	DDB_UNUSED_789
790	PSL	Reserve	DDB_UNUSED_790
791	PSL	Reserve	DDB_UNUSED_791
792	PSL	Reserve	DDB_UNUSED_792
793	PSL	Reserve	DDB_UNUSED_793
794	PSL	Reserve	DDB_UNUSED_794
795	PSL	Reserve	DDB_UNUSED_795
796	PSL	Reserve	DDB_UNUSED_796
797	PSL	Reserve	DDB_UNUSED_797
798	PSL	Reserve	DDB_UNUSED_798
799	PSL	Reserve	DDB_UNUSED_799
800	PSL	Reserve	DDB_UNUSED_800
801	PSL	Reserve	DDB_UNUSED_801
802	PSL	Reserve	DDB_UNUSED_802
803	PSL	Reserve	DDB_UNUSED_803
804	PSL	Reserve	DDB_UNUSED_804
805	PSL	Reserve	DDB_UNUSED_805
806	PSL	Reserve	DDB_UNUSED_806
807	PSL	Reserve	DDB_UNUSED_807
808	PSL	Reserve	DDB_UNUSED_808
809	PSL	Reserve	DDB_UNUSED_809
810	PSL	Reserve	DDB_UNUSED_810
811	PSL	Reserve	DDB_UNUSED_811
812	PSL	Reserve	DDB_UNUSED_812
813	PSL	Reserve	DDB_UNUSED_813
814	PSL	Reserve	DDB_UNUSED_814
815	PSL	Reserve	DDB_UNUSED_815
816	PSL	Reserve	DDB_UNUSED_816
817	PSL	Reserve	DDB_UNUSED_817
818	PSL	Reserve	DDB_UNUSED_818
819	PSL	Reserve	DDB_UNUSED_819
820	PSL	Reserve	DDB_UNUSED_820
821	PSL	Reserve	DDB_UNUSED_821
822	PSL	Reserve	DDB_UNUSED_822
823	PSL	Reserve	DDB_UNUSED_823
824	PSL	Reserve	DDB_UNUSED_824
825	PSL	Reserve	DDB_UNUSED_825
826	PSL	Reserve	DDB_UNUSED_826
827	PSL	Reserve	DDB_UNUSED_827
828	PSL	Reserve	DDB_UNUSED_828
829	PSL	Reserve	DDB_UNUSED_829
830	PSL	Reserve	DDB_UNUSED_830
831	PSL	Reserve	DDB_UNUSED_831
832	PSL	Reserve	DDB_UNUSED_832

P742 Logic Nodes			
DDB No	Source	Description	Element Name
833	PSL	Reserve	DDB_UNUSED_833
834	PSL	Reserve	DDB_UNUSED_834
835	PSL	Reserve	DDB_UNUSED_835
836	PSL	Reserve	DDB_UNUSED_836
837	PSL	Reserve	DDB_UNUSED_837
838	PSL	Reserve	DDB_UNUSED_838
839	PSL	Reserve	DDB_UNUSED_839
840	PSL	Reserve	DDB_UNUSED_840
841	PSL	Reserve	DDB_UNUSED_841
842	PSL	Reserve	DDB_UNUSED_842
843	PSL	Reserve	DDB_UNUSED_843
844	PSL	Reserve	DDB_UNUSED_844
845	PSL	Reserve	DDB_UNUSED_845
846	PSL	Reserve	DDB_UNUSED_846
847	PSL	Reserve	DDB_UNUSED_847
848	PSL	Reserve	DDB_UNUSED_848
849	PSL	Reserve	DDB_UNUSED_849
850	PSL	Reserve	DDB_UNUSED_850
851	PSL	Reserve	DDB_UNUSED_851
852	PSL	Reserve	DDB_UNUSED_852
853	PSL	Reserve	DDB_UNUSED_853
854	PSL	Reserve	DDB_UNUSED_854
855	PSL	Reserve	DDB_UNUSED_855
856	PSL	Reserve	DDB_UNUSED_856
857	PSL	Reserve	DDB_UNUSED_857
858	PSL	Reserve	DDB_UNUSED_858
859	PSL	Reserve	DDB_UNUSED_859
860	PSL	Reserve	DDB_UNUSED_860
861	PSL	Reserve	DDB_UNUSED_861
862	PSL	Reserve	DDB_UNUSED_862
863	PSL	Reserve	DDB_UNUSED_863
864	PSL	Reserve	DDB_UNUSED_864
865	PSL	Reserve	DDB_UNUSED_865
866	PSL	Reserve	DDB_UNUSED_866
867	PSL	Reserve	DDB_UNUSED_867
868	PSL	Reserve	DDB_UNUSED_868
869	PSL	Reserve	DDB_UNUSED_869
870	PSL	Reserve	DDB_UNUSED_870
871	PSL	Reserve	DDB_UNUSED_871
872	PSL	Reserve	DDB_UNUSED_872
873	PSL	Reserve	DDB_UNUSED_873
874	PSL	Reserve	DDB_UNUSED_874
875	PSL	Reserve	DDB_UNUSED_875
876	PSL	Reserve	DDB_UNUSED_876
877	PSL	Reserve	DDB_UNUSED_877
878	PSL	Reserve	DDB_UNUSED_878

P742 Logic Nodes			
DDB No	Source	Description	Element Name
879	PSL	Reserve	DDB_UNUSED_879
880	PSL	Reserve	DDB_UNUSED_880
881	PSL	Reserve	DDB_UNUSED_881
882	PSL	Reserve	DDB_UNUSED_882
883	PSL	Reserve	DDB_UNUSED_883
884	PSL	Reserve	DDB_UNUSED_884
885	PSL	Reserve	DDB_UNUSED_885
886	PSL	Reserve	DDB_UNUSED_886
887	PSL	Reserve	DDB_UNUSED_887
888	PSL	Reserve	DDB_UNUSED_888
889	PSL	Reserve	DDB_UNUSED_889
890	PSL	Reserve	DDB_UNUSED_890
891	PSL	Reserve	DDB_UNUSED_891
892	PSL	Reserve	DDB_UNUSED_892
893	PSL	Reserve	DDB_UNUSED_893
894	PSL	Reserve	DDB_UNUSED_894
895	PSL	Reserve	DDB_UNUSED_895
896	PSL	Reserve	DDB_UNUSED_896
897	PSL	Reserve	DDB_UNUSED_897
898	PSL	Reserve	DDB_UNUSED_898
899	PSL	Reserve	DDB_UNUSED_899
900	PSL	Reserve	DDB_UNUSED_900
901	PSL	Reserve	DDB_UNUSED_901
902	PSL	Reserve	DDB_UNUSED_902
903	PSL	Reserve	DDB_UNUSED_903
904	PSL	Reserve	DDB_UNUSED_904
905	PSL	Reserve	DDB_UNUSED_905
906	PSL	Reserve	DDB_UNUSED_906
907	PSL	Reserve	DDB_UNUSED_907
908	PSL	Reserve	DDB_UNUSED_908
909	PSL	Reserve	DDB_UNUSED_909
910	PSL	Reserve	DDB_UNUSED_910
911	PSL	Reserve	DDB_UNUSED_911
912	PSL	Reserve	DDB_UNUSED_912
913	PSL	Reserve	DDB_UNUSED_913
914	PSL	Reserve	DDB_UNUSED_914
915	PSL	Reserve	DDB_UNUSED_915
916	PSL	Reserve	DDB_UNUSED_916
917	PSL	Reserve	DDB_UNUSED_917
918	PSL	Reserve	DDB_UNUSED_918
919	PSL	Reserve	DDB_UNUSED_919
920	PSL	Reserve	DDB_UNUSED_920
921	PSL	Reserve	DDB_UNUSED_921
922	PSL	Reserve	DDB_UNUSED_922
923	PSL	PSL Internal Node	DDB_PSLINT_1
924	PSL	PSL Internal Node	DDB_PSLINT_2

P742 Logic Nodes			
DDB No	Source	Description	Element Name
925	PSL	PSL Internal Node	DDB_PSLINT_3
926	PSL	PSL Internal Node	DDB_PSLINT_4
927	PSL	PSL Internal Node	DDB_PSLINT_5
928	PSL	PSL Internal Node	DDB_PSLINT_6
929	PSL	PSL Internal Node	DDB_PSLINT_7
930	PSL	PSL Internal Node	DDB_PSLINT_8
931	PSL	PSL Internal Node	DDB_PSLINT_9
932	PSL	PSL Internal Node	DDB_PSLINT_10
933	PSL	PSL Internal Node	DDB_PSLINT_11
934	PSL	PSL Internal Node	DDB_PSLINT_12
935	PSL	PSL Internal Node	DDB_PSLINT_13
936	PSL	PSL Internal Node	DDB_PSLINT_14
937	PSL	PSL Internal Node	DDB_PSLINT_15
938	PSL	PSL Internal Node	DDB_PSLINT_16
939	PSL	PSL Internal Node	DDB_PSLINT_17
940	PSL	PSL Internal Node	DDB_PSLINT_18
941	PSL	PSL Internal Node	DDB_PSLINT_19
942	PSL	PSL Internal Node	DDB_PSLINT_20
943	PSL	PSL Internal Node	DDB_PSLINT_21
944	PSL	PSL Internal Node	DDB_PSLINT_22
945	PSL	PSL Internal Node	DDB_PSLINT_23
946	PSL	PSL Internal Node	DDB_PSLINT_24
947	PSL	PSL Internal Node	DDB_PSLINT_25
948	PSL	PSL Internal Node	DDB_PSLINT_26
949	PSL	PSL Internal Node	DDB_PSLINT_27
950	PSL	PSL Internal Node	DDB_PSLINT_28
951	PSL	PSL Internal Node	DDB_PSLINT_29
952	PSL	PSL Internal Node	DDB_PSLINT_30
953	PSL	PSL Internal Node	DDB_PSLINT_31
954	PSL	PSL Internal Node	DDB_PSLINT_32
955	PSL	PSL Internal Node	DDB_PSLINT_33
956	PSL	PSL Internal Node	DDB_PSLINT_34
957	PSL	PSL Internal Node	DDB_PSLINT_35
958	PSL	PSL Internal Node	DDB_PSLINT_36
959	PSL	PSL Internal Node	DDB_PSLINT_37
960	PSL	PSL Internal Node	DDB_PSLINT_38
961	PSL	PSL Internal Node	DDB_PSLINT_39
962	PSL	PSL Internal Node	DDB_PSLINT_40
963	PSL	PSL Internal Node	DDB_PSLINT_41
964	PSL	PSL Internal Node	DDB_PSLINT_42
965	PSL	PSL Internal Node	DDB_PSLINT_43
966	PSL	PSL Internal Node	DDB_PSLINT_44
967	PSL	PSL Internal Node	DDB_PSLINT_45
968	PSL	PSL Internal Node	DDB_PSLINT_46
969	PSL	PSL Internal Node	DDB_PSLINT_47
970	PSL	PSL Internal Node	DDB_PSLINT_48

P742 Logic Nodes			
DDB No	Source	Description	Element Name
971	PSL	PSL Internal Node	DDB_PSLINT_49
972	PSL	PSL Internal Node	DDB_PSLINT_50
973	PSL	PSL Internal Node	DDB_PSLINT_51
974	PSL	PSL Internal Node	DDB_PSLINT_52
975	PSL	PSL Internal Node	DDB_PSLINT_53
976	PSL	PSL Internal Node	DDB_PSLINT_54
977	PSL	PSL Internal Node	DDB_PSLINT_55
978	PSL	PSL Internal Node	DDB_PSLINT_56
979	PSL	PSL Internal Node	DDB_PSLINT_57
980	PSL	PSL Internal Node	DDB_PSLINT_58
981	PSL	PSL Internal Node	DDB_PSLINT_59
982	PSL	PSL Internal Node	DDB_PSLINT_60
983	PSL	PSL Internal Node	DDB_PSLINT_61
984	PSL	PSL Internal Node	DDB_PSLINT_62
985	PSL	PSL Internal Node	DDB_PSLINT_63
986	PSL	PSL Internal Node	DDB_PSLINT_64
987	PSL	PSL Internal Node	DDB_PSLINT_65
988	PSL	PSL Internal Node	DDB_PSLINT_66
989	PSL	PSL Internal Node	DDB_PSLINT_67
990	PSL	PSL Internal Node	DDB_PSLINT_68
991	PSL	PSL Internal Node	DDB_PSLINT_69
992	PSL	PSL Internal Node	DDB_PSLINT_70
993	PSL	PSL Internal Node	DDB_PSLINT_71
994	PSL	PSL Internal Node	DDB_PSLINT_72
995	PSL	PSL Internal Node	DDB_PSLINT_73
996	PSL	PSL Internal Node	DDB_PSLINT_74
997	PSL	PSL Internal Node	DDB_PSLINT_75
998	PSL	PSL Internal Node	DDB_PSLINT_76
999	PSL	PSL Internal Node	DDB_PSLINT_77
1000	PSL	PSL Internal Node	DDB_PSLINT_78
1001	PSL	PSL Internal Node	DDB_PSLINT_79
1002	PSL	PSL Internal Node	DDB_PSLINT_80
1003	PSL	PSL Internal Node	DDB_PSLINT_81
1004	PSL	PSL Internal Node	DDB_PSLINT_82
1005	PSL	PSL Internal Node	DDB_PSLINT_83
1006	PSL	PSL Internal Node	DDB_PSLINT_84
1007	PSL	PSL Internal Node	DDB_PSLINT_85
1008	PSL	PSL Internal Node	DDB_PSLINT_86
1009	PSL	PSL Internal Node	DDB_PSLINT_87
1010	PSL	PSL Internal Node	DDB_PSLINT_88
1011	PSL	PSL Internal Node	DDB_PSLINT_89
1012	PSL	PSL Internal Node	DDB_PSLINT_90
1013	PSL	PSL Internal Node	DDB_PSLINT_91
1014	PSL	PSL Internal Node	DDB_PSLINT_92
1015	PSL	PSL Internal Node	DDB_PSLINT_93
1016	PSL	PSL Internal Node	DDB_PSLINT_94

P742 Logic Nodes			
DDB No	**Source**	**Description**	**Element Name**
1017	PSL	PSL Internal Node	DDB_PSLINT_95
1018	PSL	PSL Internal Node	DDB_PSLINT_96
1019	PSL	PSL Internal Node	DDB_PSLINT_97
1020	PSL	PSL Internal Node	DDB_PSLINT_98
1021	PSL	PSL Internal Node	DDB_PSLINT_99
1022	PSL	PSL Internal Node	DDB_PSLINT_100
1023	PSL	PSL Internal Node	DDB_PSLINT_101
1024	SW	Virtual Input 1 - received from GOOSE message	DDB_GOOSEIN_1
1025	SW	Virtual Input 2 - received from GOOSE message	DDB_GOOSEIN_2
1026	SW	Virtual Input 3 - received from GOOSE message	DDB_GOOSEIN_3
1027	SW	Virtual Input 4 - received from GOOSE message	DDB_GOOSEIN_4
1028	SW	Virtual Input 5 - received from GOOSE message	DDB_GOOSEIN_5
1029	SW	Virtual Input 6 - received from GOOSE message	DDB_GOOSEIN_6
1030	SW	Virtual Input 7 - received from GOOSE message	DDB_GOOSEIN_7
1031	SW	Virtual Input 8 - received from GOOSE message	DDB_GOOSEIN_8
1032	SW	Virtual Input 9 - received from GOOSE message	DDB_GOOSEIN_9
1033	SW	Virtual Input 10 - received from GOOSE message	DDB_GOOSEIN_10
1034	SW	Virtual Input 11 - received from GOOSE message	DDB_GOOSEIN_11
1035	SW	Virtual Input 12 - received from GOOSE message	DDB_GOOSEIN_12
1036	SW	Virtual Input 13 - received from GOOSE message	DDB_GOOSEIN_13
1037	SW	Virtual Input 14 - received from GOOSE message	DDB_GOOSEIN_14
1038	SW	Virtual Input 15 - received from GOOSE message	DDB_GOOSEIN_15
1039	SW	Virtual Input 16 - received from GOOSE message	DDB_GOOSEIN_16
1040	SW	Virtual Input 17 - received from GOOSE message	DDB_GOOSEIN_17
1041	SW	Virtual Input 18 - received from GOOSE message	DDB_GOOSEIN_18
1042	SW	Virtual Input 19 - received from GOOSE message	DDB_GOOSEIN_19
1043	SW	Virtual Input 20 - received from GOOSE message	DDB_GOOSEIN_20

P742 Logic Nodes			
DDB No	Source	Description	Element Name
1044	SW	Virtual Input 21 - received from GOOSE message	DDB_GOOSEIN_21
1045	SW	Virtual Input 22 - received from GOOSE message	DDB_GOOSEIN_22
1046	SW	Virtual Input 23 - received from GOOSE message	DDB_GOOSEIN_23
1047	SW	Virtual Input 24 - received from GOOSE message	DDB_GOOSEIN_24
1048	SW	Virtual Input 25 - received from GOOSE message	DDB_GOOSEIN_25
1049	SW	Virtual Input 26 - received from GOOSE message	DDB_GOOSEIN_26
1050	SW	Virtual Input 27 - received from GOOSE message	DDB_GOOSEIN_27
1051	SW	Virtual Input 28 - received from GOOSE message	DDB_GOOSEIN_28
1052	SW	Virtual Input 29 - received from GOOSE message	DDB_GOOSEIN_29
1053	SW	Virtual Input 30 - received from GOOSE message	DDB_GOOSEIN_30
1054	SW	Virtual Input 31 - received from GOOSE message	DDB_GOOSEIN_31
1055	SW	Virtual Input 32 - received from GOOSE message	DDB_GOOSEIN_32
1056	SW	Virtual Input 33 - received from GOOSE message	DDB_GOOSEIN_33
1057	SW	Virtual Input 34 - received from GOOSE message	DDB_GOOSEIN_34
1058	SW	Virtual Input 35 - received from GOOSE message	DDB_GOOSEIN_35
1059	SW	Virtual Input 36 - received from GOOSE message	DDB_GOOSEIN_36
1060	SW	Virtual Input 37 - received from GOOSE message	DDB_GOOSEIN_37
1061	SW	Virtual Input 38 - received from GOOSE message	DDB_GOOSEIN_38
1062	SW	Virtual Input 39 - received from GOOSE message	DDB_GOOSEIN_39
1063	SW	Virtual Input 40 - received from GOOSE message	DDB_GOOSEIN_40
1064	SW	Virtual Input 41 - received from GOOSE message	DDB_GOOSEIN_41
1065	SW	Virtual Input 42 - received from GOOSE message	DDB_GOOSEIN_42
1066	SW	Virtual Input 43 - received from GOOSE message	DDB_GOOSEIN_43

P742 Logic Nodes			
DDB No	Source	Description	Element Name
1067	SW	Virtual Input 44 - received from GOOSE message	DDB_GOOSEIN_44
1068	SW	Virtual Input 45 - received from GOOSE message	DDB_GOOSEIN_45
1069	SW	Virtual Input 46 - received from GOOSE message	DDB_GOOSEIN_46
1070	SW	Virtual Input 47 - received from GOOSE message	DDB_GOOSEIN_47
1071	SW	Virtual Input 48 - received from GOOSE message	DDB_GOOSEIN_48
1072	SW	Virtual Input 49 - received from GOOSE message	DDB_GOOSEIN_49
1073	SW	Virtual Input 40 - received from GOOSE message	DDB_GOOSEIN_50
1074	SW	Virtual Input 41 - received from GOOSE message	DDB_GOOSEIN_51
1075	SW	Virtual Input 52 - received from GOOSE message	DDB_GOOSEIN_52
1076	SW	Virtual Input 53 - received from GOOSE message	DDB_GOOSEIN_53
1077	SW	Virtual Input 54 - received from GOOSE message	DDB_GOOSEIN_54
1078	SW	Virtual Input 55 - received from GOOSE message	DDB_GOOSEIN_55
1079	SW	Virtual Input 56 - received from GOOSE message	DDB_GOOSEIN_56
1080	SW	Virtual Input 57 - received from GOOSE message	DDB_GOOSEIN_57
1081	SW	Virtual Input 58 - received from GOOSE message	DDB_GOOSEIN_58
1082	SW	Virtual Input 59 - received from GOOSE message	DDB_GOOSEIN_59
1083	SW	Virtual Input 60 - received from GOOSE message	DDB_GOOSEIN_60
1084	SW	Virtual Input 61 - received from GOOSE message	DDB_GOOSEIN_61
1085	SW	Virtual Input 62 - received from GOOSE message	DDB_GOOSEIN_62
1086	SW	Virtual Input 63 - received from GOOSE message	DDB_GOOSEIN_63
1087	SW	Virtual Input 64 - received from GOOSE message	DDB_GOOSEIN_64
1088	PSL	Reserve	UNUSED_1088
1089	PSL	Reserve	UNUSED_1089
1090	PSL	Reserve	UNUSED_1090
1091	PSL	Reserve	UNUSED_1091
1092	PSL	Reserve	UNUSED_1092

P742 Logic Nodes			
DDB No	Source	Description	Element Name
1093	PSL	Reserve	UNUSED_1093
1094	PSL	Reserve	UNUSED_1094
1095	PSL	Reserve	UNUSED_1095
1096	PSL	Reserve	UNUSED_1096
1097	PSL	Reserve	UNUSED_1097
1098	PSL	Reserve	UNUSED_1098
1099	PSL	Reserve	UNUSED_1099
1100	PSL	Reserve	UNUSED_1100
1101	PSL	Reserve	UNUSED_1101
1102	PSL	Reserve	UNUSED_1102
1103	PSL	Reserve	UNUSED_1103
1104	PSL	Reserve	UNUSED_1104
1105	PSL	Reserve	UNUSED_1105
1106	PSL	Reserve	UNUSED_1106
1107	PSL	Reserve	UNUSED_1107
1108	PSL	Reserve	UNUSED_1108
1109	PSL	Reserve	UNUSED_1109
1110	PSL	Reserve	UNUSED_1110
1111	PSL	Reserve	UNUSED_1111
1112	PSL	Reserve	UNUSED_1112
1113	PSL	Reserve	UNUSED_1113
1114	PSL	Reserve	UNUSED_1114
1115	PSL	Reserve	UNUSED_1115
1116	PSL	Reserve	UNUSED_1116
1117	PSL	Reserve	UNUSED_1117
1118	PSL	Reserve	UNUSED_1118
1119	PSL	Reserve	UNUSED_1119
1120	PSL	Reserve	UNUSED_1120
1121	PSL	Reserve	UNUSED_1121
1122	PSL	Reserve	UNUSED_1122
1123	PSL	Reserve	UNUSED_1123
1124	PSL	Reserve	UNUSED_1124
1125	PSL	Reserve	UNUSED_1125
1126	PSL	Reserve	UNUSED_1126
1127	PSL	Reserve	UNUSED_1127
1128	PSL	Reserve	UNUSED_1128
1129	PSL	Reserve	UNUSED_1129
1130	PSL	Reserve	UNUSED_1130
1131	PSL	Reserve	UNUSED_1131
1132	PSL	Reserve	UNUSED_1132
1133	PSL	Reserve	UNUSED_1133
1134	PSL	Reserve	UNUSED_1134
1135	PSL	Reserve	UNUSED_1135
1136	PSL	Reserve	UNUSED_1136
1137	PSL	Reserve	UNUSED_1137
1138	PSL	Reserve	UNUSED_1138

P742 Logic Nodes			
DDB No	Source	Description	Element Name
1139	PSL	Reserve	UNUSED_1139
1140	PSL	Reserve	UNUSED_1140
1141	PSL	Reserve	UNUSED_1141
1142	PSL	Reserve	UNUSED_1142
1143	PSL	Reserve	UNUSED_1143
1144	PSL	Reserve	UNUSED_1144
1145	PSL	Reserve	UNUSED_1145
1146	PSL	Reserve	UNUSED_1146
1147	PSL	Reserve	UNUSED_1147
1148	PSL	Reserve	UNUSED_1148
1149	PSL	Reserve	UNUSED_1149
1150	PSL	Reserve	UNUSED_1150
1151	PSL	Reserve	UNUSED_1151
1152	SW	GOOSE virtual input 1 - provides the Quality attributes of any data object in an incoming GOOSE message	DDB_VIP_QUALITY_1
1153	SW	GOOSE virtual input 2 - provides the Quality attributes of any data object in an incoming GOOSE message	DDB_VIP_QUALITY_2
1154	SW	GOOSE virtual input 3 - provides the Quality attributes of any data object in an incoming GOOSE message	DDB_VIP_QUALITY_3
1155	SW	GOOSE virtual input 4 - provides the Quality attributes of any data object in an incoming GOOSE message	DDB_VIP_QUALITY_4
1156	SW	GOOSE virtual input 5 - provides the Quality attributes of any data object in an incoming GOOSE message	DDB_VIP_QUALITY_5
1157	SW	GOOSE virtual input 6 - provides the Quality attributes of any data object in an incoming GOOSE message	DDB_VIP_QUALITY_6
1158	SW	GOOSE virtual input 7 - provides the Quality attributes of any data object in an incoming GOOSE message	DDB_VIP_QUALITY_7
1159	SW	GOOSE virtual input 8 - provides the Quality attributes of any data object in an incoming GOOSE message	DDB_VIP_QUALITY_8

P742 Logic Nodes			
DDB No	**Source**	**Description**	**Element Name**
1160	SW	GOOSE virtual input 9 - provides the Quality attributes of any data object in an incoming GOOSE message	DDB_VIP_QUALITY_9
1161	SW	GOOSE virtual input 10 - provides the Quality attributes of any data object in an incoming GOOSE message	DDB_VIP_QUALITY_10
1162	SW	GOOSE virtual input 11 - provides the Quality attributes of any data object in an incoming GOOSE message	DDB_VIP_QUALITY_11
1163	SW	GOOSE virtual input 12 - provides the Quality attributes of any data object in an incoming GOOSE message	DDB_VIP_QUALITY_12
1164	SW	GOOSE virtual input 13 - provides the Quality attributes of any data object in an incoming GOOSE message	DDB_VIP_QUALITY_13
1165	SW	GOOSE virtual input 14 - provides the Quality attributes of any data object in an incoming GOOSE message	DDB_VIP_QUALITY_14
1166	SW	GOOSE virtual input 15 - provides the Quality attributes of any data object in an incoming GOOSE message	DDB_VIP_QUALITY_15
1167	SW	GOOSE virtual input 16 - provides the Quality attributes of any data object in an incoming GOOSE message	DDB_VIP_QUALITY_16
1168	SW	GOOSE virtual input 17 - provides the Quality attributes of any data object in an incoming GOOSE message	DDB_VIP_QUALITY_17
1169	SW	GOOSE virtual input 18 - provides the Quality attributes of any data object in an incoming GOOSE message	DDB_VIP_QUALITY_18
1170	SW	GOOSE virtual input 19 - provides the Quality attributes of any data object in an incoming GOOSE message	DDB_VIP_QUALITY_19

P742 Logic Nodes			
DDB No	**Source**	**Description**	**Element Name**
1171	SW	GOOSE virtual input 20 - provides the Quality attributes of any data object in an incoming GOOSE message	DDB_VIP_QUALITY_20
1172	SW	GOOSE virtual input 21 - provides the Quality attributes of any data object in an incoming GOOSE message	DDB_VIP_QUALITY_21
1173	SW	GOOSE virtual input 22 - provides the Quality attributes of any data object in an incoming GOOSE message	DDB_VIP_QUALITY_22
1174	SW	GOOSE virtual input 23 - provides the Quality attributes of any data object in an incoming GOOSE message	DDB_VIP_QUALITY_23
1175	SW	GOOSE virtual input 24 - provides the Quality attributes of any data object in an incoming GOOSE message	DDB_VIP_QUALITY_24
1176	SW	GOOSE virtual input 25 - provides the Quality attributes of any data object in an incoming GOOSE message	DDB_VIP_QUALITY_25
1177	SW	GOOSE virtual input 26 - provides the Quality attributes of any data object in an incoming GOOSE message	DDB_VIP_QUALITY_26
1178	SW	GOOSE virtual input 27 - provides the Quality attributes of any data object in an incoming GOOSE message	DDB_VIP_QUALITY_27
1179	SW	GOOSE virtual input 28 - provides the Quality attributes of any data object in an incoming GOOSE message	DDB_VIP_QUALITY_28
1180	SW	GOOSE virtual input 29 - provides the Quality attributes of any data object in an incoming GOOSE message	DDB_VIP_QUALITY_29
1181	SW	GOOSE virtual input 30 - provides the Quality attributes of any data object in an incoming GOOSE message	DDB_VIP_QUALITY_30

P742 Logic Nodes			
DDB No	**Source**	**Description**	**Element Name**
1182	SW	GOOSE virtual input 31 - provides the Quality attributes of any data object in an incoming GOOSE message	DDB_VIP_QUALITY_31
1183	SW	GOOSE virtual input 32 - provides the Quality attributes of any data object in an incoming GOOSE message	DDB_VIP_QUALITY_32
1184	SW	GOOSE virtual input 33 - provides the Quality attributes of any data object in an incoming GOOSE message	DDB_VIP_QUALITY_33
1185	SW	GOOSE virtual input 34 - provides the Quality attributes of any data object in an incoming GOOSE message	DDB_VIP_QUALITY_34
1186	SW	GOOSE virtual input 35 - provides the Quality attributes of any data object in an incoming GOOSE message	DDB_VIP_QUALITY_35
1187	SW	GOOSE virtual input 36 - provides the Quality attributes of any data object in an incoming GOOSE message	DDB_VIP_QUALITY_36
1188	SW	GOOSE virtual input 37 - provides the Quality attributes of any data object in an incoming GOOSE message	DDB_VIP_QUALITY_37
1189	SW	GOOSE virtual input 38 - provides the Quality attributes of any data object in an incoming GOOSE message	DDB_VIP_QUALITY_38
1190	SW	GOOSE virtual input 39 - provides the Quality attributes of any data object in an incoming GOOSE message	DDB_VIP_QUALITY_39
1191	SW	GOOSE virtual input 40 - provides the Quality attributes of any data object in an incoming GOOSE message	DDB_VIP_QUALITY_40
1192	SW	GOOSE virtual input 41 - provides the Quality attributes of any data object in an incoming GOOSE message	DDB_VIP_QUALITY_41

P742 Logic Nodes			
DDB No	**Source**	**Description**	**Element Name**
1193	SW	GOOSE virtual input 42 - provides the Quality attributes of any data object in an incoming GOOSE message	DDB_VIP_QUALITY_42
1194	SW	GOOSE virtual input 43 - provides the Quality attributes of any data object in an incoming GOOSE message	DDB_VIP_QUALITY_43
1195	SW	GOOSE virtual input 44 - provides the Quality attributes of any data object in an incoming GOOSE message	DDB_VIP_QUALITY_44
1196	SW	GOOSE virtual input 45 - provides the Quality attributes of any data object in an incoming GOOSE message	DDB_VIP_QUALITY_45
1197	SW	GOOSE virtual input 46 - provides the Quality attributes of any data object in an incoming GOOSE message	DDB_VIP_QUALITY_46
1198	SW	GOOSE virtual input 47 - provides the Quality attributes of any data object in an incoming GOOSE message	DDB_VIP_QUALITY_47
1199	SW	GOOSE virtual input 48 - provides the Quality attributes of any data object in an incoming GOOSE message	DDB_VIP_QUALITY_48
1200	SW	GOOSE virtual input 49 - provides the Quality attributes of any data object in an incoming GOOSE message	DDB_VIP_QUALITY_49
1201	SW	GOOSE virtual input 50 - provides the Quality attributes of any data object in an incoming GOOSE message	DDB_VIP_QUALITY_50
1202	SW	GOOSE virtual input 51 - provides the Quality attributes of any data object in an incoming GOOSE message	DDB_VIP_QUALITY_51
1203	SW	GOOSE virtual input 52 - provides the Quality attributes of any data object in an incoming GOOSE message	DDB_VIP_QUALITY_52

P742 Logic Nodes			
DDB No	**Source**	**Description**	**Element Name**
1204	SW	GOOSE virtual input 53 - provides the Quality attributes of any data object in an incoming GOOSE message	DDB_VIP_QUALITY_53
1205	SW	GOOSE virtual input 54 - provides the Quality attributes of any data object in an incoming GOOSE message	DDB_VIP_QUALITY_54
1206	SW	GOOSE virtual input 55 - provides the Quality attributes of any data object in an incoming GOOSE message	DDB_VIP_QUALITY_55
1207	SW	GOOSE virtual input 56 - provides the Quality attributes of any data object in an incoming GOOSE message	DDB_VIP_QUALITY_56
1208	SW	GOOSE virtual input 57 - provides the Quality attributes of any data object in an incoming GOOSE message	DDB_VIP_QUALITY_57
1209	SW	GOOSE virtual input 58 - provides the Quality attributes of any data object in an incoming GOOSE message	DDB_VIP_QUALITY_58
1210	SW	GOOSE virtual input 59 - provides the Quality attributes of any data object in an incoming GOOSE message	DDB_VIP_QUALITY_59
1211	SW	GOOSE virtual input 60 - provides the Quality attributes of any data object in an incoming GOOSE message	DDB_VIP_QUALITY_60
1212	SW	GOOSE virtual input 61 - provides the Quality attributes of any data object in an incoming GOOSE message	DDB_VIP_QUALITY_61
1213	SW	GOOSE virtual input 62 - provides the Quality attributes of any data object in an incoming GOOSE message	DDB_VIP_QUALITY_62
1214	SW	GOOSE virtual input 63 - provides the Quality attributes of any data object in an incoming GOOSE message	DDB_VIP_QUALITY_63

P742 Logic Nodes			
DDB No	Source	Description	Element Name
1215	SW	GOOSE virtual input 64 - provides the Quality attributes of any data object in an incoming GOOSE message	DDB_VIP_QUALITY_64
1216	PSL	Reserve	UNUSED_1216
1217	PSL	Reserve	UNUSED_1217
1218	PSL	Reserve	UNUSED_1218
1219	PSL	Reserve	UNUSED_1219
1220	PSL	Reserve	UNUSED_1220
1221	PSL	Reserve	UNUSED_1221
1222	PSL	Reserve	UNUSED_1222
1223	PSL	Reserve	UNUSED_1223
1224	PSL	Reserve	UNUSED_1224
1225	PSL	Reserve	UNUSED_1225
1226	PSL	Reserve	UNUSED_1226
1227	PSL	Reserve	UNUSED_1227
1228	PSL	Reserve	UNUSED_1228
1229	PSL	Reserve	UNUSED_1229
1230	PSL	Reserve	UNUSED_1230
1231	PSL	Reserve	UNUSED_1231
1232	PSL	Reserve	UNUSED_1232
1233	PSL	Reserve	UNUSED_1233
1234	PSL	Reserve	UNUSED_1234
1235	PSL	Reserve	UNUSED_1235
1236	PSL	Reserve	UNUSED_1236
1237	PSL	Reserve	UNUSED_1237
1238	PSL	Reserve	UNUSED_1238
1239	PSL	Reserve	UNUSED_1239
1240	PSL	Reserve	UNUSED_1240
1241	PSL	Reserve	UNUSED_1241
1242	PSL	Reserve	UNUSED_1242
1243	PSL	Reserve	UNUSED_1243
1244	PSL	Reserve	UNUSED_1244
1245	PSL	Reserve	UNUSED_1245
1246	PSL	Reserve	UNUSED_1246
1247	PSL	Reserve	UNUSED_1247
1248	PSL	Reserve	UNUSED_1248
1249	PSL	Reserve	UNUSED_1249
1250	PSL	Reserve	UNUSED_1250
1251	PSL	Reserve	UNUSED_1251
1252	PSL	Reserve	UNUSED_1252
1253	PSL	Reserve	UNUSED_1253
1254	PSL	Reserve	UNUSED_1254
1255	PSL	Reserve	UNUSED_1255
1256	PSL	Reserve	UNUSED_1256
1257	PSL	Reserve	UNUSED_1257

P742 Logic Nodes			
DDB No	Source	Description	Element Name
1258	PSL	Reserve	UNUSED_1258
1259	PSL	Reserve	UNUSED_1259
1260	PSL	Reserve	UNUSED_1260
1261	PSL	Reserve	UNUSED_1261
1262	PSL	Reserve	UNUSED_1262
1263	PSL	Reserve	UNUSED_1263
1264	PSL	Reserve	UNUSED_1264
1265	PSL	Reserve	UNUSED_1265
1266	PSL	Reserve	UNUSED_1266
1267	PSL	Reserve	UNUSED_1267
1268	PSL	Reserve	UNUSED_1268
1269	PSL	Reserve	UNUSED_1269
1270	PSL	Reserve	UNUSED_1270
1271	PSL	Reserve	UNUSED_1271
1272	PSL	Reserve	UNUSED_1272
1273	PSL	Reserve	UNUSED_1273
1274	PSL	Reserve	UNUSED_1274
1275	PSL	Reserve	UNUSED_1275
1276	PSL	Reserve	UNUSED_1276
1277	PSL	Reserve	UNUSED_1277
1278	PSL	Reserve	UNUSED_1278
1279	PSL	Reserve	UNUSED_1279
1280	SW	GOOSE virtual input 1- indicates if the GOOSE publisher responsible for publishing the data that derives a virtual input is present.	DDB_VIP_PUB_PRES_1
1281	SW	GOOSE virtual input 2- indicates if the GOOSE publisher responsible for publishing the data that derives a virtual input is present.	DDB_VIP_PUB_PRES_2
1282	SW	GOOSE virtual input 3- indicates if the GOOSE publisher responsible for publishing the data that derives a virtual input is present.	DDB_VIP_PUB_PRES_3
1283	SW	GOOSE virtual input 4- indicates if the GOOSE publisher responsible for publishing the data that derives a virtual input is present.	DDB_VIP_PUB_PRES_4
1284	SW	GOOSE virtual input 5- indicates if the GOOSE publisher responsible for publishing the data that derives a virtual input is present.	DDB_VIP_PUB_PRES_5
1285	SW	GOOSE virtual input 6- indicates if the GOOSE publisher responsible for publishing the data that derives a virtual input is present.	DDB_VIP_PUB_PRES_6

P742 Logic Nodes			
DDB No	Source	Description	Element Name
1286	SW	GOOSE virtual input 7- indicates if the GOOSE publisher responsible for publishing the data that derives a virtual input is present.	DDB_VIP_PUB_PRES_7
1287	SW	GOOSE virtual input 8- indicates if the GOOSE publisher responsible for publishing the data that derives a virtual input is present.	DDB_VIP_PUB_PRES_8
1288	SW	GOOSE virtual input 9- indicates if the GOOSE publisher responsible for publishing the data that derives a virtual input is present.	DDB_VIP_PUB_PRES_9
1289	SW	GOOSE virtual input 10- indicates if the GOOSE publisher responsible for publishing the data that derives a virtual input is present.	DDB_VIP_PUB_PRES_10
1290	SW	GOOSE virtual input 11- indicates if the GOOSE publisher responsible for publishing the data that derives a virtual input is present.	DDB_VIP_PUB_PRES_11
1291	SW	GOOSE virtual input 12- indicates if the GOOSE publisher responsible for publishing the data that derives a virtual input is present.	DDB_VIP_PUB_PRES_12
1292	SW	GOOSE virtual input 13- indicates if the GOOSE publisher responsible for publishing the data that derives a virtual input is present.	DDB_VIP_PUB_PRES_13
1293	SW	GOOSE virtual input 14- indicates if the GOOSE publisher responsible for publishing the data that derives a virtual input is present.	DDB_VIP_PUB_PRES_14
1294	SW	GOOSE virtual input 15- indicates if the GOOSE publisher responsible for publishing the data that derives a virtual input is present.	DDB_VIP_PUB_PRES_15
1295	SW	GOOSE virtual input 16- indicates if the GOOSE publisher responsible for publishing the data that derives a virtual input is present.	DDB_VIP_PUB_PRES_16

P742 Logic Nodes			
DDB No	Source	Description	Element Name
1296	SW	GOOSE virtual input 17- indicates if the GOOSE publisher responsible for publishing the data that derives a virtual input is present.	DDB_VIP_PUB_PRES_17
1297	SW	GOOSE virtual input 18- indicates if the GOOSE publisher responsible for publishing the data that derives a virtual input is present.	DDB_VIP_PUB_PRES_18
1298	SW	GOOSE virtual input 19- indicates if the GOOSE publisher responsible for publishing the data that derives a virtual input is present.	DDB_VIP_PUB_PRES_19
1299	SW	GOOSE virtual input 20- indicates if the GOOSE publisher responsible for publishing the data that derives a virtual input is present.	DDB_VIP_PUB_PRES_20
1300	SW	GOOSE virtual input 21- indicates if the GOOSE publisher responsible for publishing the data that derives a virtual input is present.	DDB_VIP_PUB_PRES_21
1301	SW	GOOSE virtual input 22- indicates if the GOOSE publisher responsible for publishing the data that derives a virtual input is present.	DDB_VIP_PUB_PRES_22
1302	SW	GOOSE virtual input 23- indicates if the GOOSE publisher responsible for publishing the data that derives a virtual input is present.	DDB_VIP_PUB_PRES_23
1303	SW	GOOSE virtual input 24- indicates if the GOOSE publisher responsible for publishing the data that derives a virtual input is present.	DDB_VIP_PUB_PRES_24
1304	SW	GOOSE virtual input 25- indicates if the GOOSE publisher responsible for publishing the data that derives a virtual input is present.	DDB_VIP_PUB_PRES_25

P742 Logic Nodes			
DDB No	Source	Description	Element Name
1305	SW	GOOSE virtual input 26- indicates if the GOOSE publisher responsible for publishing the data that derives a virtual input is present.	DDB_VIP_PUB_PRES_26
1306	SW	GOOSE virtual input 27- indicates if the GOOSE publisher responsible for publishing the data that derives a virtual input is present.	DDB_VIP_PUB_PRES_27
1307	SW	GOOSE virtual input 28- indicates if the GOOSE publisher responsible for publishing the data that derives a virtual input is present.	DDB_VIP_PUB_PRES_28
1308	SW	GOOSE virtual input 29- indicates if the GOOSE publisher responsible for publishing the data that derives a virtual input is present.	DDB_VIP_PUB_PRES_29
1309	SW	GOOSE virtual input 30- indicates if the GOOSE publisher responsible for publishing the data that derives a virtual input is present.	DDB_VIP_PUB_PRES_30
1310	SW	GOOSE virtual input 31- indicates if the GOOSE publisher responsible for publishing the data that derives a virtual input is present.	DDB_VIP_PUB_PRES_31
1311	SW	GOOSE virtual input 32- indicates if the GOOSE publisher responsible for publishing the data that derives a virtual input is present.	DDB_VIP_PUB_PRES_32
1312	SW	GOOSE virtual input 33- indicates if the GOOSE publisher responsible for publishing the data that derives a virtual input is present.	DDB_VIP_PUB_PRES_33
1313	SW	GOOSE virtual input 34- indicates if the GOOSE publisher responsible for publishing the data that derives a virtual input is present.	DDB_VIP_PUB_PRES_34

P742 Logic Nodes			
DDB No	Source	Description	Element Name
1314	SW	GOOSE virtual input 35- indicates if the GOOSE publisher responsible for publishing the data that derives a virtual input is present.	DDB_VIP_PUB_PRES_35
1315	SW	GOOSE virtual input 36- indicates if the GOOSE publisher responsible for publishing the data that derives a virtual input is present.	DDB_VIP_PUB_PRES_36
1316	SW	GOOSE virtual input 37- indicates if the GOOSE publisher responsible for publishing the data that derives a virtual input is present.	DDB_VIP_PUB_PRES_37
1317	SW	GOOSE virtual input 38- indicates if the GOOSE publisher responsible for publishing the data that derives a virtual input is present.	DDB_VIP_PUB_PRES_38
1318	SW	GOOSE virtual input 39- indicates if the GOOSE publisher responsible for publishing the data that derives a virtual input is present.	DDB_VIP_PUB_PRES_39
1319	SW	GOOSE virtual input 40- indicates if the GOOSE publisher responsible for publishing the data that derives a virtual input is present.	DDB_VIP_PUB_PRES_40
1320	SW	GOOSE virtual input 41- indicates if the GOOSE publisher responsible for publishing the data that derives a virtual input is present.	DDB_VIP_PUB_PRES_41
1321	SW	GOOSE virtual input 42- indicates if the GOOSE publisher responsible for publishing the data that derives a virtual input is present.	DDB_VIP_PUB_PRES_42
1322	SW	GOOSE virtual input 43- indicates if the GOOSE publisher responsible for publishing the data that derives a virtual input is present.	DDB_VIP_PUB_PRES_43

P742 Logic Nodes			
DDB No	**Source**	**Description**	**Element Name**
1323	SW	GOOSE virtual input 44- indicates if the GOOSE publisher responsible for publishing the data that derives a virtual input is present.	DDB_VIP_PUB_PRES_44
1324	SW	GOOSE virtual input 45- indicates if the GOOSE publisher responsible for publishing the data that derives a virtual input is present.	DDB_VIP_PUB_PRES_45
1325	SW	GOOSE virtual input 46- indicates if the GOOSE publisher responsible for publishing the data that derives a virtual input is present.	DDB_VIP_PUB_PRES_46
1326	SW	GOOSE virtual input 47- indicates if the GOOSE publisher responsible for publishing the data that derives a virtual input is present.	DDB_VIP_PUB_PRES_47
1327	SW	GOOSE virtual input 48- indicates if the GOOSE publisher responsible for publishing the data that derives a virtual input is present.	DDB_VIP_PUB_PRES_48
1328	SW	GOOSE virtual input 49- indicates if the GOOSE publisher responsible for publishing the data that derives a virtual input is present.	DDB_VIP_PUB_PRES_49
1329	SW	GOOSE virtual input 50- indicates if the GOOSE publisher responsible for publishing the data that derives a virtual input is present.	DDB_VIP_PUB_PRES_50
1330	SW	GOOSE virtual input 51- indicates if the GOOSE publisher responsible for publishing the data that derives a virtual input is present.	DDB_VIP_PUB_PRES_51
1331	SW	GOOSE virtual input 52- indicates if the GOOSE publisher responsible for publishing the data that derives a virtual input is present.	DDB_VIP_PUB_PRES_52

P742 Logic Nodes			
DDB No	Source	Description	Element Name
1332	SW	GOOSE virtual input 53- indicates if the GOOSE publisher responsible for publishing the data that derives a virtual input is present.	DDB_VIP_PUB_PRES_53
1333	SW	GOOSE virtual input 54- indicates if the GOOSE publisher responsible for publishing the data that derives a virtual input is present.	DDB_VIP_PUB_PRES_54
1334	SW	GOOSE virtual input 55- indicates if the GOOSE publisher responsible for publishing the data that derives a virtual input is present.	DDB_VIP_PUB_PRES_55
1335	SW	GOOSE virtual input 56- indicates if the GOOSE publisher responsible for publishing the data that derives a virtual input is present.	DDB_VIP_PUB_PRES_56
1336	SW	GOOSE virtual input 57- indicates if the GOOSE publisher responsible for publishing the data that derives a virtual input is present.	DDB_VIP_PUB_PRES_57
1337	SW	GOOSE virtual input 58- indicates if the GOOSE publisher responsible for publishing the data that derives a virtual input is present.	DDB_VIP_PUB_PRES_58
1338	SW	GOOSE virtual input 59- indicates if the GOOSE publisher responsible for publishing the data that derives a virtual input is present.	DDB_VIP_PUB_PRES_59
1339	SW	GOOSE virtual input 60- indicates if the GOOSE publisher responsible for publishing the data that derives a virtual input is present.	DDB_VIP_PUB_PRES_60
1340	SW	GOOSE virtual input 61- indicates if the GOOSE publisher responsible for publishing the data that derives a virtual input is present.	DDB_VIP_PUB_PRES_61

P742 Logic Nodes			
DDB No	Source	Description	Element Name
1341	SW	GOOSE virtual input 62- indicates if the GOOSE publisher responsible for publishing the data that derives a virtual input is present.	DDB_VIP_PUB_PRES_62
1342	SW	GOOSE virtual input 63- indicates if the GOOSE publisher responsible for publishing the data that derives a virtual input is present.	DDB_VIP_PUB_PRES_63
1343	SW	GOOSE virtual input 64- indicates if the GOOSE publisher responsible for publishing the data that derives a virtual input is present.	DDB_VIP_PUB_PRES_64
1344	PSL	Reserve	UNUSED_1344
1345	PSL	Reserve	UNUSED_1345
1346	PSL	Reserve	UNUSED_1346
1347	PSL	Reserve	UNUSED_1347
1348	PSL	Reserve	UNUSED_1348
1349	PSL	Reserve	UNUSED_1349
1350	PSL	Reserve	UNUSED_1350
1351	PSL	Reserve	UNUSED_1351
1352	PSL	Reserve	UNUSED_1352
1353	PSL	Reserve	UNUSED_1353
1354	PSL	Reserve	UNUSED_1354
1355	PSL	Reserve	UNUSED_1355
1356	PSL	Reserve	UNUSED_1356
1357	PSL	Reserve	UNUSED_1357
1358	PSL	Reserve	UNUSED_1358
1359	PSL	Reserve	UNUSED_1359
1360	PSL	Reserve	UNUSED_1360
1361	PSL	Reserve	UNUSED_1361
1362	PSL	Reserve	UNUSED_1362
1363	PSL	Reserve	UNUSED_1363
1364	PSL	Reserve	UNUSED_1364
1365	PSL	Reserve	UNUSED_1365
1366	PSL	Reserve	UNUSED_1366
1367	PSL	Reserve	UNUSED_1367
1368	PSL	Reserve	UNUSED_1368
1369	PSL	Reserve	UNUSED_1369
1370	PSL	Reserve	UNUSED_1370
1371	PSL	Reserve	UNUSED_1371
1372	PSL	Reserve	UNUSED_1372
1373	PSL	Reserve	UNUSED_1373
1374	PSL	Reserve	UNUSED_1374
1375	PSL	Reserve	UNUSED_1375

P742 Logic Nodes			
DDB No	Source	Description	Element Name
1376	PSL	Reserve	UNUSED_1376
1377	PSL	Reserve	UNUSED_1377
1378	PSL	Reserve	UNUSED_1378
1379	PSL	Reserve	UNUSED_1379
1380	PSL	Reserve	UNUSED_1380
1381	PSL	Reserve	UNUSED_1381
1382	PSL	Reserve	UNUSED_1382
1383	PSL	Reserve	UNUSED_1383
1384	PSL	Reserve	UNUSED_1384
1385	PSL	Reserve	UNUSED_1385
1386	PSL	Reserve	UNUSED_1386
1387	PSL	Reserve	UNUSED_1387
1388	PSL	Reserve	UNUSED_1388
1389	PSL	Reserve	UNUSED_1389
1390	PSL	Reserve	UNUSED_1390
1391	PSL	Reserve	UNUSED_1391
1392	PSL	Reserve	UNUSED_1392
1393	PSL	Reserve	UNUSED_1393
1394	PSL	Reserve	UNUSED_1394
1395	PSL	Reserve	UNUSED_1395
1396	PSL	Reserve	UNUSED_1396
1397	PSL	Reserve	UNUSED_1397
1398	PSL	Reserve	UNUSED_1398
1399	PSL	Reserve	UNUSED_1399
1400	PSL	Reserve	UNUSED_1400
1401	PSL	Reserve	UNUSED_1401
1402	PSL	Reserve	UNUSED_1402
1403	PSL	Reserve	UNUSED_1403
1404	PSL	Reserve	UNUSED_1404
1405	PSL	Reserve	UNUSED_1405
1406	PSL	Reserve	UNUSED_1406
1407	PSL	Reserve	UNUSED_1407
1408	PSL	Reserve	UNUSED_1408
1409	PSL	Reserve	UNUSED_1409
1410	PSL	Reserve	UNUSED_1410
1411	PSL	Reserve	UNUSED_1411
1412	PSL	Reserve	UNUSED_1412
1413	PSL	Reserve	UNUSED_1413
1414	PSL	Reserve	UNUSED_1414
1415	PSL	Reserve	UNUSED_1415
1416	PSL	Reserve	UNUSED_1416
1417	PSL	Reserve	UNUSED_1417
1418	PSL	Reserve	UNUSED_1418
1419	PSL	Reserve	UNUSED_1419
1420	PSL	Reserve	UNUSED_1420
1421	PSL	Reserve	UNUSED_1421

P742 Logic Nodes			
DDB No	Source	Description	Element Name
1422	PSL	Reserve	UNUSED_1422
1423	PSL	Reserve	UNUSED_1423
1424	PSL	Reserve	UNUSED_1424
1425	PSL	Reserve	UNUSED_1425
1426	PSL	Reserve	UNUSED_1426
1427	PSL	Reserve	UNUSED_1427
1428	PSL	Reserve	UNUSED_1428
1429	PSL	Reserve	UNUSED_1429
1430	PSL	Reserve	UNUSED_1430
1431	PSL	Reserve	UNUSED_1431
1432	PSL	Reserve	UNUSED_1432
1433	PSL	Reserve	UNUSED_1433
1434	PSL	Reserve	UNUSED_1434
1435	PSL	Reserve	UNUSED_1435
1436	PSL	Reserve	UNUSED_1436
1437	PSL	Reserve	UNUSED_1437
1438	PSL	Reserve	UNUSED_1438
1439	PSL	Reserve	UNUSED_1439
1440	PSL	Reserve	UNUSED_1440
1441	PSL	Reserve	UNUSED_1441
1442	PSL	Reserve	UNUSED_1442
1443	PSL	Reserve	UNUSED_1443
1444	PSL	Reserve	UNUSED_1444
1445	PSL	Reserve	UNUSED_1445
1446	PSL	Reserve	UNUSED_1446
1447	PSL	Reserve	UNUSED_1447
1448	PSL	Reserve	UNUSED_1448
1449	PSL	Reserve	UNUSED_1449
1450	PSL	Reserve	UNUSED_1450
1451	PSL	Reserve	UNUSED_1451
1452	PSL	Reserve	UNUSED_1452
1453	PSL	Reserve	UNUSED_1453
1454	PSL	Reserve	UNUSED_1454
1455	PSL	Reserve	UNUSED_1455
1456	PSL	Reserve	UNUSED_1456
1457	PSL	Reserve	UNUSED_1457
1458	PSL	Reserve	UNUSED_1458
1459	PSL	Reserve	UNUSED_1459
1460	PSL	Reserve	UNUSED_1460
1461	PSL	Reserve	UNUSED_1461
1462	PSL	Reserve	UNUSED_1462
1463	PSL	Reserve	UNUSED_1463
1464	PSL	Reserve	UNUSED_1464
1465	PSL	Reserve	UNUSED_1465
1466	PSL	Reserve	UNUSED_1466
1467	PSL	Reserve	UNUSED_1467

P742 Logic Nodes			
DDB No	Source	Description	Element Name
1468	PSL	Reserve	UNUSED_1468
1469	PSL	Reserve	UNUSED_1469
1470	PSL	Reserve	UNUSED_1470
1471	PSL	Reserve	UNUSED_1471
1472	PSL	Reserve	UNUSED_1472
1473	PSL	Reserve	UNUSED_1473
1474	PSL	Reserve	UNUSED_1474
1475	PSL	Reserve	UNUSED_1475
1476	PSL	Reserve	UNUSED_1476
1477	PSL	Reserve	UNUSED_1477
1478	PSL	Reserve	UNUSED_1478
1479	PSL	Reserve	UNUSED_1479
1480	PSL	Reserve	UNUSED_1480
1481	PSL	Reserve	UNUSED_1481
1482	PSL	Reserve	UNUSED_1482
1483	PSL	Reserve	UNUSED_1483
1484	PSL	Reserve	UNUSED_1484
1485	PSL	Reserve	UNUSED_1485
1486	PSL	Reserve	UNUSED_1486
1487	PSL	Reserve	UNUSED_1487
1488	PSL	Reserve	UNUSED_1488
1489	PSL	Reserve	UNUSED_1489
1490	PSL	Reserve	UNUSED_1490
1491	PSL	Reserve	UNUSED_1491
1492	PSL	Reserve	UNUSED_1492
1493	PSL	Reserve	UNUSED_1493
1494	PSL	Reserve	UNUSED_1494
1495	PSL	Reserve	UNUSED_1495
1496	PSL	Reserve	UNUSED_1496
1497	PSL	Reserve	UNUSED_1497
1498	PSL	Reserve	UNUSED_1498
1499	PSL	Reserve	UNUSED_1499
1500	PSL	Reserve	UNUSED_1500
1501	PSL	Reserve	UNUSED_1501
1502	PSL	Reserve	UNUSED_1502
1503	PSL	Reserve	UNUSED_1503
1504	PSL	Reserve	UNUSED_1504
1505	PSL	Reserve	UNUSED_1505
1506	PSL	Reserve	UNUSED_1506
1507	PSL	Reserve	UNUSED_1507
1508	PSL	Reserve	UNUSED_1508
1509	PSL	Reserve	UNUSED_1509
1510	PSL	Reserve	UNUSED_1510
1511	PSL	Reserve	UNUSED_1511
1512	PSL	Reserve	UNUSED_1512
1513	PSL	Reserve	UNUSED_1513

P742 Logic Nodes			
DDB No	Source	Description	Element Name
1514	PSL	Reserve	UNUSED_1514
1515	PSL	Reserve	UNUSED_1515
1516	PSL	Reserve	UNUSED_1516
1517	PSL	Reserve	UNUSED_1517
1518	PSL	Reserve	UNUSED_1518
1519	PSL	Reserve	UNUSED_1519
1520	PSL	Reserve	UNUSED_1520
1521	PSL	Reserve	UNUSED_1521
1522	PSL	Reserve	UNUSED_1522
1523	PSL	Reserve	UNUSED_1523
1524	PSL	Reserve	UNUSED_1524
1525	PSL	Reserve	UNUSED_1525
1526	PSL	Reserve	UNUSED_1526
1527	PSL	Reserve	UNUSED_1527
1528	PSL	Reserve	UNUSED_1528
1529	PSL	Reserve	UNUSED_1529
1530	PSL	Reserve	UNUSED_1530
1531	PSL	Reserve	UNUSED_1531
1532	PSL	Reserve	UNUSED_1532
1533	PSL	Reserve	UNUSED_1533
1534	PSL	Reserve	UNUSED_1534
1535	PSL	Reserve	UNUSED_1535
1536	PSL	Reserve	UNUSED_1536
1537	PSL	Reserve	UNUSED_1537
1538	PSL	Reserve	UNUSED_1538
1539	PSL	Reserve	UNUSED_1539
1540	PSL	Reserve	UNUSED_1540
1541	PSL	Reserve	UNUSED_1541
1542	PSL	Reserve	UNUSED_1542
1543	PSL	Reserve	UNUSED_1543
1544	PSL	Reserve	UNUSED_1544
1545	PSL	Reserve	UNUSED_1545
1546	PSL	Reserve	UNUSED_1546
1547	PSL	Reserve	UNUSED_1547
1548	PSL	Reserve	UNUSED_1548
1549	PSL	Reserve	UNUSED_1549
1550	PSL	Reserve	UNUSED_1550
1551	PSL	Reserve	UNUSED_1551
1552	PSL	Reserve	UNUSED_1552
1553	PSL	Reserve	UNUSED_1553
1554	PSL	Reserve	UNUSED_1554
1555	PSL	Reserve	UNUSED_1555
1556	PSL	Reserve	UNUSED_1556
1557	PSL	Reserve	UNUSED_1557
1558	PSL	Reserve	UNUSED_1558
1559	PSL	Reserve	UNUSED_1559

P742 Logic Nodes			
DDB No	Source	Description	Element Name
1560	PSL	Reserve	UNUSED_1560
1561	PSL	Reserve	UNUSED_1561
1562	PSL	Reserve	UNUSED_1562
1563	PSL	Reserve	UNUSED_1563
1564	PSL	Reserve	UNUSED_1564
1565	PSL	Reserve	UNUSED_1565
1566	PSL	Reserve	UNUSED_1566
1567	PSL	Reserve	UNUSED_1567
1568	PSL	Reserve	UNUSED_1568
1569	PSL	Reserve	UNUSED_1569
1570	PSL	Reserve	UNUSED_1570
1571	PSL	Reserve	UNUSED_1571
1572	PSL	Reserve	UNUSED_1572
1573	PSL	Reserve	UNUSED_1573
1574	PSL	Reserve	UNUSED_1574
1575	PSL	Reserve	UNUSED_1575
1576	PSL	Reserve	UNUSED_1576
1577	PSL	Reserve	UNUSED_1577
1578	PSL	Reserve	UNUSED_1578
1579	PSL	Reserve	UNUSED_1579
1580	PSL	Reserve	UNUSED_1580
1581	PSL	Reserve	UNUSED_1581
1582	PSL	Reserve	UNUSED_1582
1583	PSL	Reserve	UNUSED_1583
1584	PSL	Reserve	UNUSED_1584
1585	PSL	Reserve	UNUSED_1585
1586	PSL	Reserve	UNUSED_1586
1587	PSL	Reserve	UNUSED_1587
1588	PSL	Reserve	UNUSED_1588
1589	PSL	Reserve	UNUSED_1589
1590	PSL	Reserve	UNUSED_1590
1591	PSL	Reserve	UNUSED_1591
1592	PSL	Reserve	UNUSED_1592
1593	PSL	Reserve	UNUSED_1593
1594	PSL	Reserve	UNUSED_1594
1595	PSL	Reserve	UNUSED_1595
1596	PSL	Reserve	UNUSED_1596
1597	PSL	Reserve	UNUSED_1597
1598	PSL	Reserve	UNUSED_1598
1599	PSL	Reserve	UNUSED_1599
1600	PSL	Reserve	UNUSED_1600
1601	PSL	Reserve	UNUSED_1601
1602	PSL	Reserve	UNUSED_1602
1603	PSL	Reserve	UNUSED_1603
1604	PSL	Reserve	UNUSED_1604
1605	PSL	Reserve	UNUSED_1605

P742 Logic Nodes			
DDB No	Source	Description	Element Name
1606	PSL	Reserve	UNUSED_1606
1607	PSL	Reserve	UNUSED_1607
1608	PSL	Reserve	UNUSED_1608
1609	PSL	Reserve	UNUSED_1609
1610	PSL	Reserve	UNUSED_1610
1611	PSL	Reserve	UNUSED_1611
1612	PSL	Reserve	UNUSED_1612
1613	PSL	Reserve	UNUSED_1613
1614	PSL	Reserve	UNUSED_1614
1615	PSL	Reserve	UNUSED_1615
1616	PSL	Reserve	UNUSED_1616
1617	PSL	Reserve	UNUSED_1617
1618	PSL	Reserve	UNUSED_1618
1619	PSL	Reserve	UNUSED_1619
1620	PSL	Reserve	UNUSED_1620
1621	PSL	Reserve	UNUSED_1621
1622	PSL	Reserve	UNUSED_1622
1623	PSL	Reserve	UNUSED_1623
1624	PSL	Reserve	UNUSED_1624
1625	PSL	Reserve	UNUSED_1625
1626	PSL	Reserve	UNUSED_1626
1627	PSL	Reserve	UNUSED_1627
1628	PSL	Reserve	UNUSED_1628
1629	PSL	Reserve	UNUSED_1629
1630	PSL	Reserve	UNUSED_1630
1631	PSL	Reserve	UNUSED_1631
1632	PSL	Reserve	UNUSED_1632
1633	PSL	Reserve	UNUSED_1633
1634	PSL	Reserve	UNUSED_1634
1635	PSL	Reserve	UNUSED_1635
1636	PSL	Reserve	UNUSED_1636
1637	PSL	Reserve	UNUSED_1637
1638	PSL	Reserve	UNUSED_1638
1639	PSL	Reserve	UNUSED_1639
1640	PSL	Reserve	UNUSED_1640
1641	PSL	Reserve	UNUSED_1641
1642	PSL	Reserve	UNUSED_1642
1643	PSL	Reserve	UNUSED_1643
1644	PSL	Reserve	UNUSED_1644
1645	PSL	Reserve	UNUSED_1645
1646	PSL	Reserve	UNUSED_1646
1647	PSL	Reserve	UNUSED_1647
1648	PSL	Reserve	UNUSED_1648
1649	PSL	Reserve	UNUSED_1649
1650	PSL	Reserve	UNUSED_1650
1651	PSL	Reserve	UNUSED_1651

P742 Logic Nodes			
DDB No	Source	Description	Element Name
1652	PSL	Reserve	UNUSED_1652
1653	PSL	Reserve	UNUSED_1653
1654	PSL	Reserve	UNUSED_1654
1655	PSL	Reserve	UNUSED_1655
1656	PSL	Reserve	UNUSED_1656
1657	PSL	Reserve	UNUSED_1657
1658	PSL	Reserve	UNUSED_1658
1659	PSL	Reserve	UNUSED_1659
1660	PSL	Reserve	UNUSED_1660
1661	PSL	Reserve	UNUSED_1661
1662	PSL	Reserve	UNUSED_1662
1663	PSL	Reserve	UNUSED_1663
1664	PSL	Reserve	UNUSED_1664
1665	PSL	Reserve	UNUSED_1665
1666	PSL	Reserve	UNUSED_1666
1667	PSL	Reserve	UNUSED_1667
1668	PSL	Reserve	UNUSED_1668
1669	PSL	Reserve	UNUSED_1669
1670	PSL	Reserve	UNUSED_1670
1671	PSL	Reserve	UNUSED_1671
1672	PSL	Reserve	UNUSED_1672
1673	PSL	Reserve	UNUSED_1673
1674	PSL	Reserve	UNUSED_1674
1675	PSL	Reserve	UNUSED_1675
1676	PSL	Reserve	UNUSED_1676
1677	PSL	Reserve	UNUSED_1677
1678	PSL	Reserve	UNUSED_1678
1679	PSL	Reserve	UNUSED_1679
1680	PSL	Reserve	UNUSED_1680
1681	PSL	Reserve	UNUSED_1681
1682	PSL	Reserve	UNUSED_1682
1683	PSL	Reserve	UNUSED_1683
1684	PSL	Reserve	UNUSED_1684
1685	PSL	Reserve	UNUSED_1685
1686	PSL	Reserve	UNUSED_1686
1687	PSL	Reserve	UNUSED_1687
1688	PSL	Reserve	UNUSED_1688
1689	PSL	Reserve	UNUSED_1689
1690	PSL	Reserve	UNUSED_1690
1691	PSL	Reserve	UNUSED_1691
1692	PSL	Reserve	UNUSED_1692
1693	PSL	Reserve	UNUSED_1693
1694	PSL	Reserve	UNUSED_1694
1695	PSL	Reserve	UNUSED_1695
1696	PSL	Reserve	UNUSED_1696
1697	PSL	Reserve	UNUSED_1697

P742 Logic Nodes			
DDB No	**Source**	**Description**	**Element Name**
1698	PSL	Reserve	UNUSED_1698
1699	PSL	Reserve	UNUSED_1699
1700	PSL	Reserve	UNUSED_1700
1701	PSL	Reserve	UNUSED_1701
1702	PSL	Reserve	UNUSED_1702
1703	PSL	Reserve	UNUSED_1703
1704	PSL	Reserve	UNUSED_1704
1705	PSL	Reserve	UNUSED_1705
1706	PSL	Reserve	UNUSED_1706
1707	PSL	Reserve	UNUSED_1707
1708	PSL	Reserve	UNUSED_1708
1709	PSL	Reserve	UNUSED_1709
1710	PSL	Reserve	UNUSED_1710
1711	PSL	Reserve	UNUSED_1711
1712	PSL	Reserve	UNUSED_1712
1713	PSL	Reserve	UNUSED_1713
1714	PSL	Reserve	UNUSED_1714
1715	PSL	Reserve	UNUSED_1715
1716	PSL	Reserve	UNUSED_1716
1717	PSL	Reserve	UNUSED_1717
1718	PSL	Reserve	UNUSED_1718
1719	PSL	Reserve	UNUSED_1719
1720	PSL	Reserve	UNUSED_1720
1721	PSL	Reserve	UNUSED_1721
1722	PSL	Reserve	UNUSED_1722
1723	PSL	Reserve	UNUSED_1723
1724	PSL	Reserve	UNUSED_1724
1725	PSL	Reserve	UNUSED_1725
1726	PSL	Reserve	UNUSED_1726
1727	PSL	Reserve	UNUSED_1727
1728	PSL	Reserve	UNUSED_1728
1729	PSL	Reserve	UNUSED_1729
1730	PSL	Reserve	UNUSED_1730
1731	PSL	Reserve	UNUSED_1731
1732	PSL	Reserve	UNUSED_1732
1733	PSL	Reserve	UNUSED_1733
1734	PSL	Reserve	UNUSED_1734
1735	PSL	Reserve	UNUSED_1735
1736	PSL	Reserve	UNUSED_1736
1737	PSL	Reserve	UNUSED_1737
1738	PSL	Reserve	UNUSED_1738
1739	PSL	Reserve	UNUSED_1739
1740	PSL	Reserve	UNUSED_1740
1741	PSL	Reserve	UNUSED_1741
1742	PSL	Reserve	UNUSED_1742
1743	PSL	Reserve	UNUSED_1743

P742 Logic Nodes			
DDB No	Source	Description	Element Name
1744	PSL	Reserve	UNUSED_1744
1745	PSL	Reserve	UNUSED_1745
1746	PSL	Reserve	UNUSED_1746
1747	PSL	Reserve	UNUSED_1747
1748	PSL	Reserve	UNUSED_1748
1749	PSL	Reserve	UNUSED_1749
1750	PSL	Reserve	UNUSED_1750
1751	PSL	Reserve	UNUSED_1751
1752	PSL	Reserve	UNUSED_1752
1753	PSL	Reserve	UNUSED_1753
1754	PSL	Reserve	UNUSED_1754
1755	PSL	Reserve	UNUSED_1755
1756	PSL	Reserve	UNUSED_1756
1757	PSL	Reserve	UNUSED_1757
1758	PSL	Reserve	UNUSED_1758
1759	PSL	Reserve	UNUSED_1759
1760	PSL	Reserve	UNUSED_1760
1761	PSL	Reserve	UNUSED_1761
1762	PSL	Reserve	UNUSED_1762
1763	PSL	Reserve	UNUSED_1763
1764	PSL	Reserve	UNUSED_1764
1765	PSL	Reserve	UNUSED_1765
1766	PSL	Reserve	UNUSED_1766
1767	PSL	Reserve	UNUSED_1767
1768	PSL	Reserve	UNUSED_1768
1769	PSL	Reserve	UNUSED_1769
1770	PSL	Reserve	UNUSED_1770
1771	PSL	Reserve	UNUSED_1771
1772	PSL	Reserve	UNUSED_1772
1773	PSL	Reserve	UNUSED_1773
1774	PSL	Reserve	UNUSED_1774
1775	PSL	Reserve	UNUSED_1775
1776	PSL	Reserve	UNUSED_1776
1777	PSL	Reserve	UNUSED_1777
1778	PSL	Reserve	UNUSED_1778
1779	PSL	Reserve	UNUSED_1779
1780	PSL	Reserve	UNUSED_1780
1781	PSL	Reserve	UNUSED_1781
1782	PSL	Reserve	UNUSED_1782
1783	PSL	Reserve	UNUSED_1783
1784	PSL	Reserve	UNUSED_1784
1785	PSL	Reserve	UNUSED_1785
1786	PSL	Reserve	UNUSED_1786
1787	PSL	Reserve	UNUSED_1787
1788	PSL	Reserve	UNUSED_1788
1789	PSL	Reserve	UNUSED_1789

P742 Logic Nodes			
DDB No	Source	Description	Element Name
1790	PSL	Reserve	UNUSED_1790
1791	PSL	Reserve	UNUSED_1791
1792	PSL	Reserve	UNUSED_1792
1793	PSL	Reserve	UNUSED_1793
1794	SW	IRIG-B Status Signal Valid	DDB_IRIGB_SIGNAL_VALID
1795	SW	Logic 0 for use in PSL. This can be used to force a DDB, contact, LED, InterMiCOM or Virtual Output low (or high by using an inversion gate)	DDB_LOGIC_0
1796	SW	If this location DST is in effect now	DDB_DST_STATUS
1797	SW	Network Interface Card link 1 fail indication	DDB_NIC_LINK_1_FAIL
1798	SW	Network Interface Card link 2 fail indication	DDB_NIC_LINK_2_FAIL
1799	SW	Network Interface Card link 3 fail indication	DDB_NIC_LINK_3_FAIL
1800	SW	User logged into UI	DDB_UI_LOGGEDIN
1801	SW	User logged into front port courier	DDB_FCUR_LOGGEDIN
1802	SW	User logged into Rear Port1 courier	DDB_RP1_LOGGEDIN
1803	SW	User logged into Rear Port2 courier	DDB_RP2_LOGGEDIN
1804	SW	User logged into turnneled courier	DDB_TNL_LOGGEDIN
1805	SW	User logged into co-processor courier	DDB_CPR_LOGGEDIN
1806	PSL	Self-reset user alarm 1	DDB_USER_ALARM_1
1807	PSL	Self-reset user alarm 2	DDB_USER_ALARM_2
1808	PSL	Self-reset user alarm 3	DDB_USER_ALARM_3
1809	PSL	Self-reset user alarm 4	DDB_USER_ALARM_4
1810	PSL	Self-reset user alarm 5	DDB_USER_ALARM_5
1811	PSL	Self-reset user alarm 6	DDB_USER_ALARM_6
1812	PSL	Self-reset user alarm 7	DDB_USER_ALARM_7
1813	PSL	Self-reset user alarm 8	DDB_USER_ALARM_8
1814	PSL	Self-reset user alarm 9	DDB_USER_ALARM_9
1815	PSL	Self-reset user alarm 10	DDB_USER_ALARM_10
1816	PSL	Self-reset user alarm 11	DDB_USER_ALARM_11
1817	PSL	Self-reset user alarm 12	DDB_USER_ALARM_12
1818	PSL	Self-reset user alarm 13	DDB_USER_ALARM_13
1819	PSL	Self-reset user alarm 14	DDB_USER_ALARM_14
1820	PSL	Self-reset user alarm 15	DDB_USER_ALARM_15
1821	PSL	Self-reset user alarm 16	DDB_USER_ALARM_16
1822	PSL	Manual-reset user alarm 17	DDB_USER_ALARM_17
1823	PSL	Manual-reset user alarm 18	DDB_USER_ALARM_18
1824	PSL	Manual-reset user alarm 19	DDB_USER_ALARM_19
1825	PSL	Manual-reset user alarm 20	DDB_USER_ALARM_20
1826	PSL	Manual-reset user alarm 21	DDB_USER_ALARM_21

P742 Logic Nodes			
DDB No	Source	Description	Element Name
1827	PSL	Manual-reset user alarm 22	DDB_USER_ALARM_22
1828	PSL	Manual-reset user alarm 23	DDB_USER_ALARM_23
1829	PSL	Manual-reset user alarm 24	DDB_USER_ALARM_24
1830	PSL	Manual-reset user alarm 25	DDB_USER_ALARM_25
1831	PSL	Manual-reset user alarm 26	DDB_USER_ALARM_26
1832	PSL	Manual-reset user alarm 27	DDB_USER_ALARM_27
1833	PSL	Manual-reset user alarm 28	DDB_USER_ALARM_28
1834	PSL	Manual-reset user alarm 29	DDB_USER_ALARM_29
1835	PSL	Manual-reset user alarm 30	DDB_USER_ALARM_30
1836	PSL	Manual-reset user alarm 31	DDB_USER_ALARM_31
1837	PSL	Manual-reset user alarm 32	DDB_USER_ALARM_32
1838	SW	Reserve	DDB_UNUSED_DR
1839	PSL	Reserve	UNUSED_1839
1840	PSL	Reserve	UNUSED_1840
1841	PSL	Reserve	UNUSED_1841
1842	PSL	Reserve	UNUSED_1842
1843	PSL	Reserve	UNUSED_1843
1844	PSL	Reserve	UNUSED_1844
1845	PSL	Reserve	UNUSED_1845
1846	PSL	Reserve	UNUSED_1846
1847	PSL	Reserve	UNUSED_1847
1848	PSL	Reserve	UNUSED_1848
1849	PSL	Reserve	UNUSED_1849
1850	PSL	Reserve	UNUSED_1850
1851	PSL	Reserve	UNUSED_1851
1852	PSL	Reserve	UNUSED_1852
1853	PSL	Reserve	UNUSED_1853
1854	PSL	Reserve	UNUSED_1854
1855	PSL	Reserve	UNUSED_1855
1856	PSL	Reserve	UNUSED_1856
1857	PSL	Reserve	UNUSED_1857
1858	PSL	Reserve	UNUSED_1858
1859	PSL	Reserve	UNUSED_1859
1860	PSL	Reserve	UNUSED_1860
1861	PSL	Reserve	UNUSED_1861
1862	PSL	Reserve	UNUSED_1862
1863	PSL	Reserve	UNUSED_1863
1864	PSL	Reserve	UNUSED_1864
1865	PSL	Reserve	UNUSED_1865
1866	PSL	Reserve	UNUSED_1866
1867	PSL	Reserve	UNUSED_1867
1868	PSL	Reserve	UNUSED_1868
1869	PSL	Reserve	UNUSED_1869
1870	PSL	Reserve	UNUSED_1870
1871	PSL	Reserve	UNUSED_1871
1872	PSL	Reserve	UNUSED_1872

P742 Logic Nodes			
DDB No	Source	Description	Element Name
1873	PSL	Reserve	UNUSED_1873
1874	PSL	Reserve	UNUSED_1874
1875	PSL	Reserve	UNUSED_1875
1876	PSL	Reserve	UNUSED_1876
1877	PSL	Reserve	UNUSED_1877
1878	PSL	Reserve	UNUSED_1878
1879	PSL	Reserve	UNUSED_1879
1880	PSL	Reserve	UNUSED_1880
1881	PSL	Reserve	UNUSED_1881
1882	PSL	Reserve	UNUSED_1882
1883	PSL	Reserve	UNUSED_1883
1884	PSL	Reserve	UNUSED_1884
1885	PSL	Reserve	UNUSED_1885
1886	PSL	Reserve	UNUSED_1886
1887	PSL	Reserve	UNUSED_1887
1888	PSL	Reserve	UNUSED_1888
1889	PSL	Reserve	UNUSED_1889
1890	PSL	Reserve	UNUSED_1890
1891	PSL	Reserve	UNUSED_1891
1892	PSL	Reserve	UNUSED_1892
1893	PSL	Reserve	UNUSED_1893
1894	PSL	Reserve	UNUSED_1894
1895	PSL	Reserve	UNUSED_1895
1896	PSL	Reserve	UNUSED_1896
1897	PSL	Reserve	UNUSED_1897
1898	PSL	Reserve	UNUSED_1898
1899	PSL	Reserve	UNUSED_1899
1900	PSL	Reserve	UNUSED_1900
1901	PSL	Reserve	UNUSED_1901
1902	PSL	Reserve	UNUSED_1902
1903	PSL	Reserve	UNUSED_1903
1904	PSL	Reserve	UNUSED_1904
1905	PSL	Reserve	UNUSED_1905
1906	PSL	Reserve	UNUSED_1906
1907	PSL	Reserve	UNUSED_1907
1908	PSL	Reserve	UNUSED_1908
1909	PSL	Reserve	UNUSED_1909
1910	PSL	Reserve	UNUSED_1910
1911	PSL	Reserve	UNUSED_1911
1912	PSL	Reserve	UNUSED_1912
1913	PSL	Reserve	UNUSED_1913
1914	PSL	Reserve	UNUSED_1914
1915	PSL	Reserve	UNUSED_1915
1916	PSL	Reserve	UNUSED_1916
1917	PSL	Reserve	UNUSED_1917
1918	PSL	Reserve	UNUSED_1918

P742 Logic Nodes			
DDB No	Source	Description	Element Name
1919	PSL	Reserve	UNUSED_1919
1920	PSL	Reserve	UNUSED_1920
1921	PSL	Reserve	UNUSED_1921
1922	PSL	Reserve	UNUSED_1922
1923	PSL	Reserve	UNUSED_1923
1924	PSL	Reserve	UNUSED_1924
1925	PSL	Reserve	UNUSED_1925
1926	PSL	Reserve	UNUSED_1926
1927	PSL	Reserve	UNUSED_1927
1928	PSL	Reserve	UNUSED_1928
1929	PSL	Reserve	UNUSED_1929
1930	PSL	Reserve	UNUSED_1930
1931	PSL	Reserve	UNUSED_1931
1932	PSL	Reserve	UNUSED_1932
1933	PSL	Reserve	UNUSED_1933
1934	PSL	Reserve	UNUSED_1934
1935	PSL	Reserve	UNUSED_1935
1936	PSL	Reserve	UNUSED_1936
1937	PSL	Reserve	UNUSED_1937
1938	PSL	Reserve	UNUSED_1938
1939	PSL	Reserve	UNUSED_1939
1940	PSL	Reserve	UNUSED_1940
1941	PSL	Reserve	UNUSED_1941
1942	PSL	Reserve	UNUSED_1942
1943	PSL	Reserve	UNUSED_1943
1944	PSL	Reserve	UNUSED_1944
1945	PSL	Reserve	UNUSED_1945
1946	PSL	Reserve	UNUSED_1946
1947	PSL	Reserve	UNUSED_1947
1948	PSL	Reserve	UNUSED_1948
1949	PSL	Reserve	UNUSED_1949
1950	PSL	Reserve	UNUSED_1950
1951	PSL	Reserve	UNUSED_1951
1952	PSL	Reserve	UNUSED_1952
1953	PSL	Reserve	UNUSED_1953
1954	PSL	Reserve	UNUSED_1954
1955	PSL	Reserve	UNUSED_1955
1956	PSL	Reserve	UNUSED_1956
1957	PSL	Reserve	UNUSED_1957
1958	PSL	Reserve	UNUSED_1958
1959	PSL	Reserve	UNUSED_1959
1960	PSL	Reserve	UNUSED_1960
1961	PSL	Reserve	UNUSED_1961
1962	PSL	Reserve	UNUSED_1962
1963	PSL	Reserve	UNUSED_1963
1964	PSL	Reserve	UNUSED_1964

P742 Logic Nodes			
DDB No	Source	Description	Element Name
1965	PSL	Reserve	UNUSED_1965
1966	PSL	Reserve	UNUSED_1966
1967	PSL	Reserve	UNUSED_1967
1968	PSL	Reserve	UNUSED_1968
1969	PSL	Reserve	UNUSED_1969
1970	PSL	Reserve	UNUSED_1970
1971	PSL	Reserve	UNUSED_1971
1972	PSL	Reserve	UNUSED_1972
1973	PSL	Reserve	UNUSED_1973
1974	PSL	Reserve	UNUSED_1974
1975	PSL	Reserve	UNUSED_1975
1976	PSL	Reserve	UNUSED_1976
1977	PSL	Reserve	UNUSED_1977
1978	PSL	Reserve	UNUSED_1978
1979	PSL	Reserve	UNUSED_1979
1980	PSL	Reserve	UNUSED_1980
1981	PSL	Reserve	UNUSED_1981
1982	PSL	Reserve	UNUSED_1982
1983	PSL	Reserve	UNUSED_1983
1984	PSL	Reserve	UNUSED_1984
1985	PSL	Reserve	UNUSED_1985
1986	PSL	Reserve	UNUSED_1986
1987	PSL	Reserve	UNUSED_1987
1988	PSL	Reserve	UNUSED_1988
1989	PSL	Reserve	UNUSED_1989
1990	PSL	Reserve	UNUSED_1990
1991	PSL	Reserve	UNUSED_1991
1992	PSL	Reserve	UNUSED_1992
1993	PSL	Reserve	UNUSED_1993
1994	PSL	Reserve	UNUSED_1994
1995	PSL	Reserve	UNUSED_1995
1996	PSL	Reserve	UNUSED_1996
1997	PSL	Reserve	UNUSED_1997
1998	PSL	Reserve	UNUSED_1998
1999	PSL	Reserve	UNUSED_1999
2000	PSL	Reserve	UNUSED_2000
2001	PSL	Reserve	UNUSED_2001
2002	PSL	Reserve	UNUSED_2002
2003	PSL	Reserve	UNUSED_2003
2004	PSL	Reserve	UNUSED_2004
2005	PSL	Reserve	UNUSED_2005
2006	PSL	Reserve	UNUSED_2006
2007	PSL	Reserve	UNUSED_2007
2008	PSL	Reserve	UNUSED_2008
2009	PSL	Reserve	UNUSED_2009
2010	PSL	Reserve	UNUSED_2010

P742 Logic Nodes			
DDB No	Source	Description	Element Name
2011	PSL	Reserve	UNUSED_2011
2012	PSL	Reserve	UNUSED_2012
2013	PSL	Reserve	UNUSED_2013
2014	PSL	Reserve	UNUSED_2014
2015	PSL	Reserve	UNUSED_2015
2016	PSL	Reserve	UNUSED_2016
2017	PSL	Reserve	UNUSED_2017
2018	PSL	Reserve	UNUSED_2018
2019	PSL	Reserve	UNUSED_2019
2020	PSL	Reserve	UNUSED_2020
2021	PSL	Reserve	UNUSED_2021
2022	PSL	Reserve	UNUSED_2022
2023	PSL	Reserve	UNUSED_2023
2024	PSL	Reserve	UNUSED_2024
2025	PSL	Reserve	UNUSED_2025
2026	PSL	Reserve	UNUSED_2026
2027	PSL	Reserve	UNUSED_2027
2028	PSL	Reserve	UNUSED_2028
2029	PSL	Reserve	UNUSED_2029
2030	PSL	Reserve	UNUSED_2030
2031	PSL	Reserve	UNUSED_2031
2032	PSL	Reserve	UNUSED_2032
2033	PSL	Reserve	UNUSED_2033
2034	PSL	Reserve	UNUSED_2034
2035	PSL	Reserve	UNUSED_2035
2036	PSL	Reserve	UNUSED_2036
2037	PSL	Reserve	UNUSED_2037
2038	PSL	Reserve	UNUSED_2038
2039	PSL	Reserve	UNUSED_2039
2040	PSL	Reserve	UNUSED_2040
2041	PSL	Reserve	UNUSED_2041
2042	PSL	Reserve	UNUSED_2042
2043	PSL	Reserve	UNUSED_2043
2044	PSL	Reserve	UNUSED_2044
2045	PSL	Reserve	UNUSED_2045
2046	PSL	Reserve	UNUSED_2046
2047	PSL	Reserve	UNUSED_2047

Table 2 - Description of available logic nodes for P742 (sorted by DDB No)

4 DESCRIPTION OF P743 LOGIC NODES

The following table shows the available DDB Numbers, a Description of what they are and which products they apply to. Where a range of DDB Numbers apply to a consecutively-numbered range of related items, the DDB Number range is shown. For example, DDB No 0 to 11 to cover Output Relay 1 to Output Relay 11; or 2nd Harmonic A to C to cover 2nd Harmonic A, 2nd Harmonic B and 2nd Harmonic C.
If a DDB Number is not shown, it is not used in this range of products.

P743 Logic Nodes			
DDB No	**Source**	**Description**	**Element Name**
0	SW	Relay 1	DDB_OUTPUT_RELAY_1
1	SW	Relay 2	DDB_OUTPUT_RELAY_2
2	SW	Relay 3	DDB_OUTPUT_RELAY_3
3	SW	Relay 4	DDB_OUTPUT_RELAY_4
4	SW	Relay 5	DDB_OUTPUT_RELAY_5
5	SW	Relay 6	DDB_OUTPUT_RELAY_6
6	SW	Relay 7	DDB_OUTPUT_RELAY_7
7	SW	Relay 8	DDB_OUTPUT_RELAY_8
8	SW	Relay 9	DDB_OUTPUT_RELAY_9
9	SW	Relay 10	DDB_OUTPUT_RELAY_10
10	SW	Relay 11	DDB_OUTPUT_RELAY_11
11	SW	Relay 12	DDB_OUTPUT_RELAY_12
12	SW	Relay 13	DDB_OUTPUT_RELAY_13
13	SW	Relay 14	DDB_OUTPUT_RELAY_14
14	SW	Relay 15	DDB_OUTPUT_RELAY_15
15	SW	Relay 16	DDB_OUTPUT_RELAY_16
16	SW	Reserve	DDB_OUTPUT_RELAY_17
17	SW	Reserve	DDB_OUTPUT_RELAY_18
18	SW	Reserve	DDB_OUTPUT_RELAY_19
19	SW	Reserve	DDB_OUTPUT_RELAY_20
20	SW	Reserve	DDB_OUTPUT_RELAY_21
21	SW	Reserve	DDB_OUTPUT_RELAY_22
22	SW	Reserve	DDB_OUTPUT_RELAY_23
23	SW	Reserve	DDB_OUTPUT_RELAY_24
24	SW	Reserve	DDB_OUTPUT_RELAY_25
25	SW	Reserve	DDB_OUTPUT_RELAY_26
26	SW	Reserve	DDB_OUTPUT_RELAY_27
27	SW	Reserve	DDB_OUTPUT_RELAY_28
28	SW	Reserve	DDB_OUTPUT_RELAY_29
29	SW	Reserve	DDB_OUTPUT_RELAY_30
30	SW	Reserve	DDB_OUTPUT_RELAY_31
31	SW	Reserve	DDB_OUTPUT_RELAY_32
32	SW	Reserve	DDB_OUTPUT_RELAY_33
33	SW	Reserve	DDB_OUTPUT_RELAY_34
34	SW	Reserve	DDB_OUTPUT_RELAY_35
35	SW	Reserve	DDB_OUTPUT_RELAY_36
36	SW	Reserve	DDB_OUTPUT_RELAY_37
37	SW	Reserve	DDB_OUTPUT_RELAY_38
38	SW	Reserve	DDB_OUTPUT_RELAY_39

P743 Logic Nodes			
DDB No	Source	Description	Element Name
39	SW	Reserve	DDB_OUTPUT_RELAY_40
40	SW	Reserve	DDB_OUTPUT_RELAY_41
41	SW	Reserve	DDB_OUTPUT_RELAY_42
42	SW	Reserve	DDB_OUTPUT_RELAY_43
43	SW	Reserve	DDB_OUTPUT_RELAY_44
44	SW	Reserve	DDB_OUTPUT_RELAY_45
45	SW	Reserve	DDB_OUTPUT_RELAY_46
46	SW	Reserve	DDB_OUTPUT_RELAY_47
47	SW	Reserve	DDB_OUTPUT_RELAY_48
48	SW	Reserve	DDB_OUTPUT_RELAY_49
49	SW	Reserve	DDB_OUTPUT_RELAY_50
50	SW	Reserve	DDB_OUTPUT_RELAY_51
51	SW	Reserve	DDB_OUTPUT_RELAY_52
52	SW	Reserve	DDB_OUTPUT_RELAY_53
53	SW	Reserve	DDB_OUTPUT_RELAY_54
54	SW	Reserve	DDB_OUTPUT_RELAY_55
55	SW	Reserve	DDB_OUTPUT_RELAY_56
56	SW	Reserve	DDB_OUTPUT_RELAY_57
57	SW	Reserve	DDB_OUTPUT_RELAY_58
58	SW	Reserve	DDB_OUTPUT_RELAY_59
59	SW	Reserve	DDB_OUTPUT_RELAY_60
60	SW	Reserve	DDB_OUTPUT_RELAY_61
61	SW	Reserve	DDB_OUTPUT_RELAY_62
62	SW	Reserve	DDB_OUTPUT_RELAY_63
63	SW	Reserve	DDB_OUTPUT_RELAY_64
64	SW	Opto Input 1	DDB_OPTO_ISOLATOR_1
65	SW	Opto Input 2	DDB_OPTO_ISOLATOR_2
66	SW	Opto Input 3	DDB_OPTO_ISOLATOR_3
67	SW	Opto Input 4	DDB_OPTO_ISOLATOR_4
68	SW	Opto Input 5	DDB_OPTO_ISOLATOR_5
69	SW	Opto Input 6	DDB_OPTO_ISOLATOR_6
70	SW	Opto Input 7	DDB_OPTO_ISOLATOR_7
71	SW	Opto Input 8	DDB_OPTO_ISOLATOR_8
72	SW	Opto Input 9	DDB_OPTO_ISOLATOR_9
73	SW	Opto Input 10	DDB_OPTO_ISOLATOR_10
74	SW	Opto Input 11	DDB_OPTO_ISOLATOR_11
75	SW	Opto Input 12	DDB_OPTO_ISOLATOR_12
76	SW	Opto Input 13	DDB_OPTO_ISOLATOR_13
77	SW	Opto Input 14	DDB_OPTO_ISOLATOR_14
78	SW	Opto Input 15	DDB_OPTO_ISOLATOR_15
79	SW	Opto Input 16 - Config P742	DDB_OPTO_ISOLATOR_16
80	SW	Opto Input 17	DDB_OPTO_ISOLATOR_17
81	SW	Opto Input 18	DDB_OPTO_ISOLATOR_18
82	SW	Opto Input 19	DDB_OPTO_ISOLATOR_19
83	SW	Opto Input 20	DDB_OPTO_ISOLATOR_20
84	SW	Opto Input 21	DDB_OPTO_ISOLATOR_21

P743 Logic Nodes			
DDB No	Source	Description	Element Name
85	SW	Opto Input 22	DDB_OPTO_ISOLATOR_22
86	SW	Opto Input 23	DDB_OPTO_ISOLATOR_23
87	SW	Opto Input 24 - Config P743	DDB_OPTO_ISOLATOR_24
88	SW	Reserve	DDB_OPTO_ISOLATOR_25
89	SW	Reserve	DDB_OPTO_ISOLATOR_26
90	SW	Reserve	DDB_OPTO_ISOLATOR_27
91	SW	Reserve	DDB_OPTO_ISOLATOR_28
92	SW	Reserve	DDB_OPTO_ISOLATOR_29
93	SW	Reserve	DDB_OPTO_ISOLATOR_30
94	SW	Reserve	DDB_OPTO_ISOLATOR_31
95	SW	Reserve	DDB_OPTO_ISOLATOR_32
96	SW	Reserve	UNUSED_96
97	SW	Reserve	UNUSED_97
98	SW	Reserve	UNUSED_98
99	SW	Reserve	UNUSED_99
100	SW	Reserve	UNUSED_100
101	SW	Reserve	UNUSED_101
102	SW	Reserve	UNUSED_102
103	SW	Reserve	UNUSED_103
104	PSL	TS open disconnector 1	IS_1_OPEN
105	PSL	TS closed Disconnect 1	IS_1_CLOSED
106	PSL	TS open disconnector 2	IS_2_OPEN
107	PSL	TS closed disconnector 2	IS_2_CLOSED
108	PSL	TS open disconnector 3	IS_3_OPEN
109	PSL	TS closed disconnector 3	IS_3_CLOSED
110	PSL	TS open disconnector 4	IS_4_OPEN
111	PSL	TS closed disconnector 4	IS_4_CLOSED
112	PSL	TS open disconnector 5	IS_5_OPEN
113	PSL	TS closed disconnector 5	IS_5_CLOSED
114	PSL	TS open disconnector 6	IS_6_OPEN
115	PSL	TS closed disconnector 6	IS_6_CLOSED
116	PSL	External trip on 3 phases	TS_CB_TRIP_3PH
117	PSL	External trip on phase A	TS_CB_TRIP_A
118	PSL	External trip on phase B	TS_CB_TRIP_B
119	PSL	External trip on phase C	TS_CB_TRIP_C
120	PSL	TS closing order Circuit breaker	TS_CB_CLOSING_ORDER
121	PSL	TS Circuit breaker not available	TS_CB_HS
122	PSL	External circuit breaker failure - request backtrip	TS_CB_EXTERNAL_CBF
123	PSL	TS 3-phase closed circuit breaker	TS_CB_52A_3PH
124	PSL	TS 3-phase open circuit breaker	TS_CB_52B_3PH
125	PSL	TS Circuit breaker closed phase A	TS_CB_52A_PHASE_A
126	PSL	TS Phase A open circuit breaker	TS_CB_52B_PHASE_A
127	PSL	TS Circuit breaker closed phase B	TS_CB_52A_PHASE_B
128	PSL	TS Open circuit breaker phase B	TS_CB_52B_PHASE_B
129	PSL	TS Circuit breaker closed phase C	TS_CB_52A_PHASE_C

P743 Logic Nodes			
DDB No	Source	Description	Element Name
130	PSL	TS Phase C open circuit breaker	TS_CB_52B_PHASE_C
131	PSL	TS unlocking relays dec latchés	TS_RESET_LOCKOUT
132	PSL	TS active group low weight	TS_SETTING_GROUP_LSB
133	PSL	TS active group	TS_SETTING_GROUP_MSB
134	PSL	TS reset all values => CB monitoring (not used)	TS_RESET_ALL_VALUES
135	PSL	TS reset latched led / relay PSL	TS_RESET_LATCHES
136	PSL	Reserve	UNUSED_136
137	PSL	Reserve	UNUSED_137
138	PSL	Reserve	UNUSED_138
139	PSL	Reserve	UNUSED_139
140	PSL	Reserve	UNUSED_140
141	PSL	Reserve	UNUSED_141
142	PSL	Reserve	UNUSED_142
143	PSL	Auxiliary contact power supply	AUX_VOLTAGE
144	PSL	Virtual TC 1 PU->CU	VIRTUAL_TC_1
145	PSL	Virtual TC 2 PU->CU	VIRTUAL_TC_2
146	PSL	Virtual TC 3 PU->CU	VIRTUAL_TC_3
147	PSL	Virtual TC 4 PU->CU	VIRTUAL_TC_4
148	PSL	Virtual TC 5 PU->CU	VIRTUAL_TC_5
149	PSL	Virtual TC 6 PU->CU	VIRTUAL_TC_6
150	PSL	Virtual TC 7 PU->CU	VIRTUAL_TC_7
151	PSL	Virtual TC 8 PU->CU	VIRTUAL_TC_8
152	PSL	Virtual TC 9 PU->CU	VIRTUAL_TC_9
153	PSL	Virtual TC 10 PU->CU	VIRTUAL_TC_10
154	PSL	Virtual TC 11 PU->CU	VIRTUAL_TC_11
155	PSL	Virtual TC 12 PU->CU	VIRTUAL_TC_12
156	PSL	Virtual TC 13 PU->CU	VIRTUAL_TC_13
157	PSL	Virtual TC 14 PU->CU	VIRTUAL_TC_14
158	PSL	Virtual TC 15 PU->CU	VIRTUAL_TC_15
159	PSL	Virtual TC 16 PU->CU	VIRTUAL_TC_16
160	PSL	Disconnector 1: closing order	IS_1_CLOSING_ORDER
161	PSL	Disconnector 2: closing order	IS_2_CLOSING_ORDER
162	PSL	Disconnector 3: closing order	IS_3_CLOSING_ORDER
163	PSL	Disconnector 4: closing order	IS_4_CLOSING_ORDER
164	PSL	Disconnector 5: closing order	IS_5_CLOSING_ORDER
165	PSL	Disconnector 6: closing order	IS_6_CLOSING_ORDER
166	PSL	CB Control: Close command	CB_CONTROL_CLOSE
167	PSL	CB Control: opening command	CB_CONTROL_OPEN
168	SW	External retrip phase A	CBF_RETRIP_A_EXTERNAL
169	SW	External retrip phase B	CBF_RETRIP_B_EXTERNAL
170	SW	External retrip phase C	CBF_RETRIP_C_EXTERNAL
171	SW	External retrip 3 phases	CBF_RETRIP_TRI_INTERNAL
172	SW	CBF backtrip - internal	CBF_FAILURE_INTERNAL
173	SW	CBF backtrip - external	CBF_FAILURE_EXTERNAL
174	SW	CBF abnormal breaker	ALARM_CBF

P743 Logic Nodes			
DDB No	Source	Description	Element Name
175	SW	Reserve	UNUSED_175
176	SW	Overcurrent I>1 Start phase A	OC_1_A_START
177	SW	Overcurrent I>1 Start phase B	OC_1_B_START
178	SW	Overcurrent I>1 Start phase C	OC_1_C_START
179	SW	Overcurrent I>1 Start neutral phase	OC_1_N_START
180	SW	Overcurrent I>1 Trip 3 phases	OC_1_PHASE_TRIP_TRI
181	SW	Overcurrent IN>1 Trip 3 phases	OC_1_EARTH_TRIP_TRI
182	SW	Overcurrent I>2 Start phase A	OC_2_A_START
183	SW	Overcurrent I>2 Start phase B	OC_2_B_START
184	SW	Overcurrent I>2 Start phase C	OC_2_C_START
185	SW	Overcurrent I>2 Start neutral phase	OC_2_N_START
186	SW	Overcurrent I>2 Trip 3 phases	OC_2_PHASE_TRIP_TRI
187	SW	Overcurrent IN>2 Trip 3 phases	OC_2_EARTH_TRIP_TRI
188	PSL	Blocks Timer Overcurrent I>1	OC_1_PHASE_TIMER_BLOCK
189	PSL	Blocks Timer Overcurrent IN>1	OC_1_EARTH_TIMER_BLOCK
190	PSL	Blocks Timer Overcurrent I>2	OC_2_PHASE_TIMER_BLOCK
191	PSL	Blocks Timer Overcurrent IN>2	OC_2_EARTH_TIMER_BLOCK
192	SW	Virtual opto/relay CU to PU	VIRTUAL_OPTO_1
193	SW	Virtual opto/relay CU to PU	VIRTUAL_OPTO_2
194	SW	Virtual opto/relay CU to PU	VIRTUAL_OPTO_3
195	SW	Virtual opto/relay CU to PU	VIRTUAL_OPTO_4
196	SW	Virtual opto/relay CU to PU	VIRTUAL_OPTO_5
197	SW	Virtual opto/relay CU to PU	VIRTUAL_OPTO_6
198	SW	Virtual opto/relay CU to PU	VIRTUAL_OPTO_7
199	SW	Virtual opto/relay CU to PU	VIRTUAL_OPTO_8
200	SW	Virtual opto/relay CU to PU	VIRTUAL_OPTO_9
201	SW	Virtual opto/relay CU to PU	VIRTUAL_OPTO_10
202	SW	Virtual opto/relay CU to PU	VIRTUAL_OPTO_11
203	SW	Virtual opto/relay CU to PU	VIRTUAL_OPTO_12
204	SW	Virtual opto/relay CU to PU	VIRTUAL_OPTO_13
205	SW	Virtual opto/relay CU to PU	VIRTUAL_OPTO_14
206	SW	Virtual opto/relay CU to PU	VIRTUAL_OPTO_15
207	SW	Virtual opto/relay CU to PU	VIRTUAL_OPTO_16
208	SW	Zone 8 closed off	BAR_8_OFF
209	SW	Zone 7 closed off	BAR_7_OFF
210	SW	Zone 6 closed off	BAR_6_OFF
211	SW	Zone 5 closed off	BAR_5_OFF
212	SW	Zone 4 closed off	BAR_4_OFF
213	SW	Zone 3 closed off	BAR_3_OFF
214	SW	Zone 2 closed off	BAR_2_OFF
215	SW	Zone 1 closed off	BAR_1_OFF
216	SW	Tripping Zone 8	TRIP_BAR_8
217	SW	Tripping Zone 7	TRIP_BAR_7
218	SW	Tripping Zone 6	TRIP_BAR_6

P743 Logic Nodes			
DDB No	**Source**	**Description**	**Element Name**
219	SW	Tripping Zone 5	TRIP_BAR_5
220	SW	Tripping Zone 4	TRIP_BAR_4
221	SW	Tripping Zone 3	TRIP_BAR_3
222	SW	Tripping Zone 2	TRIP_BAR_2
223	SW	Tripping Zone 1	TRIP_BAR_1
224	SW	Overcurrent Ia>BB - Confirmation Busbar	OC_BB_A_START
225	SW	Overcurrent Ib>BB - Confirmation Busbar	OC_BB_B_START
226	SW	Overcurrent Ic>BB - Confirmation Busbar	OC_BB_C_START
227	SW	Overcurrent In>BB - Confirmation Busbar	OC_BB_N_START
228	SW	Overcurrent Ia>BB - Blocking Busbar	OC_BB_A_BLOCKING
229	SW	Overcurrent Ib>BB - Blocking Busbar	OC_BB_B_BLOCKING
230	SW	Overcurrent Ic>BB - Blocking Busbar	OC_BB_C_BLOCKING
231	SW	Overcurrent In>BB - Blocking Busbar	OC_BB_N_BLOCKING
232	SW	Saturation phase a	SATURATION_PHASE_A
233	SW	Saturation phase b	SATURATION_PHASE_B
234	SW	Saturation phase c	SATURATION_PHASE_C
235	SW	Fiber Optic Format> Max	ALARM_CURRENT_OVERFLOW
236	SW	Max current reached phase A	FLUX_MAX_REACHED_PHASE_A
237	SW	Max current reached phase B	FLUX_MAX_REACHED_PHASE_B
238	SW	Max current reached phase C	FLUX_MAX_REACHED_PHASE_C
239	SW	Offse analog card phase A, B, C or N	ALARM_OFFSET_ABCN
240	SW	Prediction error on phase A	PREDICT_ERROR_PHASE_A
241	SW	Prediction error on phase B	PREDICT_ERROR_PHASE_B
242	SW	Prediction error on phase C	PREDICT_ERROR_PHASE_C
243	SW	Reserve	IEC61850_OP_TRIP_CU
244	SW	Saturation CAN phase A	SATURATION_CAN_PHASE_A
245	SW	Saturation CAN phase B	SATURATION_CAN_PHASE_B
246	SW	Saturation CAN phase C	SATURATION_CAN_PHASE_C
247	SW	Saturation CAN phase N	SATURATION_CAN_PHASE_N
248	SW	Variation phase A	VARIATION_PHASE_A
249	SW	Variation phase B	VARIATION_PHASE_B
250	SW	Variation phase C	VARIATION_PHASE_C
251	SW	Variation phase N	VARIATION_PHASE_N
252	SW	PU/CU communication error	ALARM_PU_FAULT_MINOR
253	SW	Fibre error on the PU	ALARM_PU_FAULT_MAJOR
254	SW	Sample acquisition error 3*Io=In	ACQ_ERROR_3I0
255	SW	Error 3 * Io = In with tempo Tce	ALARM_CT_FAULT
256	SW	Internal tripping	INTERNAL_TRIPPING

P743 Logic Nodes			
DDB No	Source	Description	Element Name
257	SW	Busbar	BUSBAR_TRIPPING
258	SW	Busbar blocked with signaling	BUSBAR_TRIPPING_BLOCK
259	SW	50BF	BF_TRIPPING
260	SW	Zone manual deactivation from the CU	ZONE_CB_TRIPPING
261	SW	Phase or earth dead zone fault	ALARM_DEAD_ZONE
262	SW	Dead-zone phase failure	DEAD_ZONE_PHASE
263	SW	Dead zone dead earth	DEAD_ZONE_EARTH
264	SW	Operating mode 1	OPERATING_MODE_1
265	SW	Operating mode 2	OPERATING_MODE_2
266	SW	Configuration error	ALARM_OPERATING_MODE_3
267	SW	Valid configuration	VALID_CONF
268	SW	Valid topology	VALID_TOPO
269	SW	Valid configuration & topology	VALID_CONF_TOPO
270	SW	Block all PU/CU protection	ALARM_ALL_PROT_DISABLED
271	SW	Reserve	ENABLE_TS_ALL_PROT_DISABLED
272	SW	Reserve	UNUSED_272
273	SW	Reserve	UNUSED_273
274	SW	Reserve	UNUSED_274
275	SW	Reserve	UNUSED_275
276	SW	Reserve	UNUSED_276
277	SW	Reserve	UNUSED_277
278	SW	Reserve	UNUSED_278
279	SW	Reserve	UNUSED_279
280	SW	Reserve	UNUSED_280
281	SW	Reserve	UNUSED_281
282	SW	Reserve	UNUSED_282
283	SW	Reserve	UNUSED_283
284	SW	Reserve	UNUSED_284
285	SW	Reserve	UNUSED_285
286	SW	Reserve	UNUSED_286
287	SW	Reserve	UNUSED_287
288	SW	Overcurrent tripping	OC_TRIPPING
289	SW	Circuit breaker is available for tripping	CB_AVAILABLE_TO_TRIP
290	SW	50BF internal or external	BF_TRIP_REQUEST
291	SW	Reserve	ALL_PROT_DISABLED_BBRAM
292	SW	Reserve	IEC61850_CB_CONNECT_3PH
293	SW	Reserve	IEC61850_CBA_STATUS_ALARM_PSL
294	PSL	Blocking 87BB/P by opto	INP_BLOCK_87BB_P
295	PSL	Blocking 87BB/N by opto	INP_BLOCK_87BB_N
296	SW	Overcurrent tripping - supplement	OC_TRIPPING_COMP
297	SW	Circuit breaker is not available for tripping	CB_AVAILABLE_TO_TRIP_COMP
298	SW	50BF internal or external - supplement	BF_TRIP_REQUEST_COMP

P743 Logic Nodes			
DDB No	Source	Description	Element Name
299	SW	Reserve	IEC61850_INTERLOCKING_ENACLS
300	SW	Reserve	UNUSED_300
301	SW	Reserve	UNUSED_301
302	SW	Reserve	UNUSED_302
303	SW	Reserve	UNUSED_303
304	SW	Reserve	UNUSED_304
305	SW	Manual release of the local circuit breaker	LOCAL_CB_TRIPPING
306	SW	Closing the local circuit breaker manually	LOCAL_CB_CLOSING
307	SW	PU in test mode	ALARM_MAINTENANCE_CONSIGNATION
308	SW	50BF is disabled	ALARM_FEEDER_CONSIGNATION
309	SW	Reserve	UNUSED_309
310	SW	Reserve	UNUSED_310
311	PSL	PU input in test mode in the slice	OPTO_CONSIGNATION_BAY_TEST
312	PSL	PU input in test mode	OPTO_CONSIGNATION_PU_TEST
313	SW	Reserve	DEAD_ZONE_ENABLED
314	SW	Activation OC Busbar Confirmation	OC_BLOCKING_BB_1_ENABLE
315	SW	Activation Latched Trip Relay	TRIP_RELAY_HOLD
316	SW	Activation OC Busbar Blocking Phase	OC_BB2_PH_ENABLE
317	SW	Activation OC Busbar Blocking Residual	OC_BB2_N_ENABLE
318	SW	Acquisition Latched trigger relay	TRIP_RELAY_RESET
319	SW	Change configuration or topology	CONF_TOPO_CHANGE
320	SW	Disconnector 1 closed	IS_1_POSITION
321	PSL	Alarm on disconnector 1	ALARM_IS_1_POSITION
322	SW	Disconnector 1 closed	IS_2_POSITION
323	PSL	Alarm on disconnector 2	ALARM_IS_2_POSITION
324	SW	Disconnector 1 closed	IS_3_POSITION
325	PSL	Alarm on disconnector 3	ALARM_IS_3_POSITION
326	SW	Disconnector 1 closed	IS_4_POSITION
327	PSL	Alarm on disconnector 4	ALARM_IS_4_POSITION
328	SW	Disconnector 1 closed	IS_5_POSITION
329	PSL	Alarm on disconnector 5	ALARM_IS_5_POSITION
330	SW	Disconnector 1 closed	IS_6_POSITION
331	PSL	Alarm on disconnector 6	ALARM_IS_6_POSITION
332	SW	Circuit breaker closed	CB_1_POSITION
333	SW	Availability of circuit breaker	CB_1_AVAILABLE
334	SW	Reserve	UNUSED_334
335	SW	Reserve	UNUSED_335
336	SW	Forced position disconnector 1	IS_1_FORCED_POSITION
337	SW	Forced position disconnector 2	IS_2_FORCED_POSITION
338	SW	Forced position disconnector 3	IS_3_FORCED_POSITION
339	SW	Forced position disconnector 4	IS_4_FORCED_POSITION

P743 Logic Nodes			
DDB No	Source	Description	Element Name
340	SW	Forced position disconnector 5	IS_5_FORCED_POSITION
341	SW	Forced position disconnector 6	IS_6_FORCED_POSITION
342	SW	Forced position of circuit breaker	CB_1_FORCED_POSITION
343	SW	Activation of forced positions	FORCED_POSITION_ENABLE
344	SW	Circuit breaker open position	CB_POSITION_52A
345	SW	Circuit breaker closed position	CB_POSITION_52B
346	SW	Circuit breaker three-phase trip	CB_TRIP_3PH
347	SW	Circuit breaker trip phase A	CB_TRIP_A
348	SW	Circuit breaker trip phase B	CB_TRIP_B
349	SW	Circuit breaker trip phase C	CB_TRIP_C
350	SW	Reserve	UNUSED_350
351	SW	General Alarm	ALARM_GENERAL
352	SW	CB Control Alarm - Circuit breaker status error	ALARM_CB_STATUS
353	SW	CB Control Alarm - Close error	ALARM_CB_FAIL_CLOSE
354	SW	CB Control Alarm - Trigger error	ALARM_CB_FAIL_TRIP
355	SW	CB Control request closure in progress	PRT_CONTROL_CLOSE_IN_PROG
356	SW	CB Control DJ Closure Control	PRT_CONTROL_CLOSE
357	SW	CB Control request to open in progress	PRT_CONTROL_TRIP
358	SW	OR between 136, 137, 138, 139, 224	ANY_TRIP
359	SW	Reserve	UNUSED_359
360	SW	Reserve	UNUSED_360
361	SW	Reserve	UNUSED_361
362	PSL	Rear port 1 read only	DDB_REMOTEREADONLY_RP1
363	PSL	Rear port 2 read only	DDB_REMOTEREADONLY_RP2
364	PSL	NIC read only	DDB_REMOTEREADONLY_NIC
365	SW	Reserve	UNUSED_365
366	SW	Reserve	UNUSED_366
367	SW	Reserve	UNUSED_367
368	SW	Reserve	UNUSED_368
369	SW	Reserve	UNUSED_369
370	SW	Reserve	UNUSED_370
371	SW	Reserve	UNUSED_371
372	SW	Reserve	UNUSED_372
373	SW	Reserve	UNUSED_373
374	SW	Reserve	IEC61850_87BB_FAULT_OP
375	SW	Error detected by the CT supervision	ALARM_CT_SUPERVISION
376	SW	87BB fault phase A	DDB_87BB_FAULT_A
377	SW	87BB fault phase B	DDB_87BB_FAULT_B
378	SW	87BB fault phase C	DDB_87BB_FAULT_C
379	SW	87BB earth fault	DDB_87BB_FAULT_N
380	SW	Reserve	IEC61850_DZP_A_START

P743 Logic Nodes			
DDB No	Source	Description	Element Name
381	SW	Reserve	IEC61850_DZP_B_START
382	SW	Reserve	IEC61850_DZP_C_START
383	SW	Reserve	IEC61850_DZP_N_START
384	SW	Reserve	UNUSED_384
385	SW	Reserve	UNUSED_385
386	SW	Reserve	UNUSED_386
387	SW	Reserve	UNUSED_387
388	SW	Reserve	UNUSED_388
389	SW	Reserve	UNUSED_389
390	SW	Reserve	UNUSED_390
391	SW	Reserve	UNUSED_391
392	SW	Reserve	UNUSED_392
393	SW	Reserve	UNUSED_393
394	SW	Reserve	UNUSED_394
395	SW	Reserve	UNUSED_395
396	SW	Reserve	UNUSED_396
397	SW	Reserve	UNUSED_397
398	SW	Reserve	UNUSED_398
399	SW	Reserve	UNUSED_399
400	SW	Reserve	UNUSED_400
401	SW	Reserve	UNUSED_401
402	SW	Reserve	UNUSED_402
403	SW	Reserve	UNUSED_403
404	SW	Reserve	UNUSED_404
405	SW	Reserve	UNUSED_405
406	SW	Reserve	UNUSED_406
407	SW	Reserve	UNUSED_407
408	SW	Reserve	UNUSED_408
409	SW	Reserve	UNUSED_409
410	SW	Reserve	UNUSED_410
411	SW	Reserve	UNUSED_411
412	SW	Reserve	UNUSED_412
413	SW	Reserve	UNUSED_413
414	SW	Reserve	UNUSED_414
415	SW	Reserve	UNUSED_415
416	SW	Reserve	UNUSED_416
417	SW	Reserve	UNUSED_417
418	SW	Reserve	UNUSED_418
419	SW	Reserve	UNUSED_419
420	SW	Reserve	UNUSED_420
421	SW	Reserve	UNUSED_421
422	SW	Reserve	UNUSED_422
423	SW	Reserve	UNUSED_423
424	SW	Reserve	UNUSED_424
425	SW	Reserve	UNUSED_425
426	SW	Reserve	UNUSED_426

P743 Logic Nodes			
DDB No	Source	Description	Element Name
427	SW	Reserve	UNUSED_427
428	PSL	Reserve	UNUSED_428
429	PSL	Reserve	UNUSED_429
430	PSL	Reserve	UNUSED_430
431	PSL	Reserve	UNUSED_431
432	PSL	Reserve	UNUSED_432
433	PSL	Reserve	UNUSED_433
434	PSL	Reserve	UNUSED_434
435	PSL	Reserve	UNUSED_435
436	PSL	Input to auxiliary timer 1	DDB_TIMERIN_1
437	PSL	Input to auxiliary timer 2	DDB_TIMERIN_2
438	PSL	Input to auxiliary timer 3	DDB_TIMERIN_3
439	PSL	Input to auxiliary timer 4	DDB_TIMERIN_4
440	PSL	Input to auxiliary timer 5	DDB_TIMERIN_5
441	PSL	Input to auxiliary timer 6	DDB_TIMERIN_6
442	PSL	Input to auxiliary timer 7	DDB_TIMERIN_7
443	PSL	Input to auxiliary timer 8	DDB_TIMERIN_8
444	PSL	Input to auxiliary timer 9	DDB_TIMERIN_9
445	PSL	Input to auxiliary timer 10	DDB_TIMERIN_10
446	PSL	Input to auxiliary timer 11	DDB_TIMERIN_11
447	PSL	Input to auxiliary timer 12	DDB_TIMERIN_12
448	PSL	Input to auxiliary timer 13	DDB_TIMERIN_13
449	PSL	Input to auxiliary timer 14	DDB_TIMERIN_14
450	PSL	Input to auxiliary timer 15	DDB_TIMERIN_15
451	PSL	Input to auxiliary timer 16	DDB_TIMERIN_16
452	SW	Output from auxiliary timer 1	DDB_TIMEROUT_1
453	SW	Output from auxiliary timer 2	DDB_TIMEROUT_2
454	SW	Output from auxiliary timer 3	DDB_TIMEROUT_3
455	SW	Output from auxiliary timer 4	DDB_TIMEROUT_4
456	SW	Output from auxiliary timer 5	DDB_TIMEROUT_5
457	SW	Output from auxiliary timer 6	DDB_TIMEROUT_6
458	SW	Output from auxiliary timer 7	DDB_TIMEROUT_7
459	SW	Output from auxiliary timer 8	DDB_TIMEROUT_8
460	SW	Output from auxiliary timer 9	DDB_TIMEROUT_9
461	SW	Output from auxiliary timer 10	DDB_TIMEROUT_10
462	SW	Output from auxiliary timer 11	DDB_TIMEROUT_11
463	SW	Output from auxiliary timer 12	DDB_TIMEROUT_12
464	SW	Output from auxiliary timer 13	DDB_TIMEROUT_13
465	SW	Output from auxiliary timer 14	DDB_TIMEROUT_14
466	SW	Output from auxiliary timer 15	DDB_TIMEROUT_15
467	SW	Output from auxiliary timer 16	DDB_TIMEROUT_16
468	PSL	Indicator to tell relay a fault record needs to be recorded	DDB_FAULT_RECORD_TRIGGER
469	SW	Front panel miniature battery failure - either battery removed from slot, or low voltage	DDB_PLAT_BATTERY_FAIL_ALARM

P743 Logic Nodes			
DDB No	Source	Description	Element Name
470	SW	48V field voltage failure	DDB_PLAT_FIELD_VOLT_FAIL_ALARM
471	SW	Comm2 hardware failure - second rear communications board	DDB_REAR_COMMS_FAIL_ALARM_66
472	SW	The IED is not subscribed to a publishing IED in the current scheme	DDB_GOOSE_IED_MISSING_ALARM_67
473	SW	Ethernet board not fitted	DDB_ECARD_NOT_FITTED_ALARM_68
474	SW	Ethernet board not responding	DDB_NIC_NOT_RESPONDING_69
475	SW	Ethernet board unrecoverable error	DDB_NIC_FATAL_ERROR_70
476	SW	Ethernet problem	DDB_NIC_SOFTWARE_RELOAD_71
477	SW	Ethernet problem, invalid IP address	DDB_INVALID_NIC_TCP_IP_CONFIG_72
478	SW	Ethernet problem	DDB_INVALID_NIC_OSI_CONFIG_73
479	SW	Reserve	DDB_ALARM_UNUSED_479
480	SW	Ethernet board software not compatible with main CPU	DDB_SW_MISMATCH_ALARM
481	SW	The IP address of the IED is already used by another IED	DDB_NIC_IP_ADDRESS_CONFLICT_76
482	SW	EIA(RS)232 InterMiCOM indication that Loopback testing is in progress	DDB_INTERMICOM_LOOPBACK_ALARM_77
483	SW	EIA(RS)232 InterMiCOM Message Failure alarm. Setting that is used to alarm for poor channel quality. If during the fixed 1.6 s rolling window the ratio of invalid messages to the total number of messages that should be received (based upon the 'Baud Rate' setting) exceeds the above threshold, a 'Message Fail' alarm will be issued	DDB_INTERMICOM_MESSAGE_ALARM_78
484	SW	EIA(RS)232 InterMiCOM Data Channel Detect Fail i.e. modem failure	DDB_INTERMICOM_DCD_ALARM_79
485	SW	EIA(RS)232 InterMiCOM Channel Failure alarm. No messages were received during the alarm time setting	DDB_INTERMICOM_CHANNEL_ALARM_80
486	SW	This is an alarm that is ON if any setting fail during the setting changing process. If this happens, the relay will use the last known good setting	DDB_BACKUP_SETTING_ALARM_81
487	PSL	Reserve	DDB_ALARM_UNUSED_487
488	PSL	Reserve	DDB_ALARM_UNUSED_488

P743 Logic Nodes			
DDB No	Source	Description	Element Name
489	PSL	Reserve	DDB_ALARM_UNUSED_489
490	PSL	Reserve	DDB_ALARM_UNUSED_490
491	SW	Reserve	DDB_INVALID_CONFIG_ALARM
492	SW	Reserve	DDB_TEST_MODE_ALARM
493	SW	Reserve	DDB_CONT_BLK_ALARM
494	SW	Reserve	DDB_HW_MISMATCH_ALARM
495	SW	Reserve	DDB_IEC61850_VER_MISMATCH_ALARM
496	SW	Reserve	DDB_GS_ACEPT_SIMU_ALM
497	PSL	Reserve	DDB_ALARM_UNUSED_497
498	PSL	Reserve	DDB_ALARM_UNUSED_498
499	PSL	Reserve	DDB_ALARM_UNUSED_499
500	PSL	Reserve	DDB_ALARM_UNUSED_500
501	PSL	Reserve	DDB_UNUSED_501
502	PSL	Reserve	DDB_UNUSED_502
503	PSL	Reserve	DDB_UNUSED_503
504	PSL	Reserve	DDB_UNUSED_504
505	PSL	Reserve	DDB_UNUSED_505
506	PSL	Reserve	DDB_UNUSED_506
507	PSL	Reserve	DDB_UNUSED_507
508	PSL	Reserve	DDB_UNUSED_508
509	PSL	Reserve	DDB_UNUSED_509
510	PSL	Reserve	DDB_UNUSED_510
511	PSL	Reserve	DDB_UNUSED_511
512	PSL	Virtual output 1 - allows user to control a binary signal which can be mapped via SCADA protocol output to other devices	DDB_GOOSEOUT_1
513	PSL	Virtual output 2 - allows user to control a binary signal which can be mapped via SCADA protocol output to other devices	DDB_GOOSEOUT_2
514	PSL	Virtual output 3 - allows user to control a binary signal which can be mapped via SCADA protocol output to other devices	DDB_GOOSEOUT_3
515	PSL	Virtual output 4 - allows user to control a binary signal which can be mapped via SCADA protocol output to other devices	DDB_GOOSEOUT_4
516	PSL	Virtual output 5 - allows user to control a binary signal which can be mapped via SCADA protocol output to other devices	DDB_GOOSEOUT_5
517	PSL	Virtual output 6 - allows user to control a binary signal which can be mapped via SCADA protocol output to other devices	DDB_GOOSEOUT_6

P743 Logic Nodes			
DDB No	Source	Description	Element Name
518	PSL	Virtual output 7 - allows user to control a binary signal which can be mapped via SCADA protocol output to other devices	DDB_GOOSEOUT_7
519	PSL	Virtual output 8 - allows user to control a binary signal which can be mapped via SCADA protocol output to other devices	DDB_GOOSEOUT_8
520	PSL	Virtual output 9 - allows user to control a binary signal which can be mapped via SCADA protocol output to other devices	DDB_GOOSEOUT_9
521	PSL	Virtual output 10 - allows user to control a binary signal which can be mapped via SCADA protocol output to other devices	DDB_GOOSEOUT_10
522	PSL	Virtual output 11 - allows user to control a binary signal which can be mapped via SCADA protocol output to other devices	DDB_GOOSEOUT_11
523	PSL	Virtual output 12 - allows user to control a binary signal which can be mapped via SCADA protocol output to other devices	DDB_GOOSEOUT_12
524	PSL	Virtual output 13 - allows user to control a binary signal which can be mapped via SCADA protocol output to other devices	DDB_GOOSEOUT_13
525	PSL	Virtual output 14 - allows user to control a binary signal which can be mapped via SCADA protocol output to other devices	DDB_GOOSEOUT_14
526	PSL	Virtual output 15 - allows user to control a binary signal which can be mapped via SCADA protocol output to other devices	DDB_GOOSEOUT_15
527	PSL	Virtual output 16 - allows user to control a binary signal which can be mapped via SCADA protocol output to other devices	DDB_GOOSEOUT_16
528	PSL	Virtual output 17 - allows user to control a binary signal which can be mapped via SCADA protocol output to other devices	DDB_GOOSEOUT_17

P743 Logic Nodes			
DDB No	**Source**	**Description**	**Element Name**
529	PSL	Virtual output 18 - allows user to control a binary signal which can be mapped via SCADA protocol output to other devices	DDB_GOOSEOUT_18
530	PSL	Virtual output 19 - allows user to control a binary signal which can be mapped via SCADA protocol output to other devices	DDB_GOOSEOUT_19
531	PSL	Virtual output 20 - allows user to control a binary signal which can be mapped via SCADA protocol output to other devices	DDB_GOOSEOUT_20
532	PSL	Virtual output 21 - allows user to control a binary signal which can be mapped via SCADA protocol output to other devices	DDB_GOOSEOUT_21
533	PSL	Virtual output 22 - allows user to control a binary signal which can be mapped via SCADA protocol output to other devices	DDB_GOOSEOUT_22
534	PSL	Virtual output 23 - allows user to control a binary signal which can be mapped via SCADA protocol output to other devices	DDB_GOOSEOUT_23
535	PSL	Virtual output 24 - allows user to control a binary signal which can be mapped via SCADA protocol output to other devices	DDB_GOOSEOUT_24
536	PSL	Virtual output 25 - allows user to control a binary signal which can be mapped via SCADA protocol output to other devices	DDB_GOOSEOUT_25
537	PSL	Virtual output 26 - allows user to control a binary signal which can be mapped via SCADA protocol output to other devices	DDB_GOOSEOUT_26
538	PSL	Virtual output 27 - allows user to control a binary signal which can be mapped via SCADA protocol output to other devices	DDB_GOOSEOUT_27
539	PSL	Virtual output 28 - allows user to control a binary signal which can be mapped via SCADA protocol output to other devices	DDB_GOOSEOUT_28

P743 Logic Nodes			
DDB No	Source	Description	Element Name
540	PSL	Virtual output 29 - allows user to control a binary signal which can be mapped via SCADA protocol output to other devices	DDB_GOOSEOUT_29
541	PSL	Virtual output 30 - allows user to control a binary signal which can be mapped via SCADA protocol output to other devices	DDB_GOOSEOUT_30
542	PSL	Virtual output 31 - allows user to control a binary signal which can be mapped via SCADA protocol output to other devices	DDB_GOOSEOUT_31
543	PSL	Virtual output 32 - allows user to control a binary signal which can be mapped via SCADA protocol output to other devices	DDB_GOOSEOUT_32
544	PSL	Reserve	UNUSED_544
545	PSL	Reserve	UNUSED_545
546	PSL	Reserve	UNUSED_546
547	PSL	Reserve	UNUSED_547
548	PSL	Reserve	UNUSED_548
549	PSL	Reserve	UNUSED_549
550	PSL	Reserve	UNUSED_550
551	PSL	Reserve	UNUSED_551
552	PSL	Reserve	UNUSED_552
553	PSL	Reserve	UNUSED_553
554	PSL	Reserve	UNUSED_554
555	PSL	Reserve	UNUSED_555
556	PSL	Reserve	UNUSED_556
557	PSL	Reserve	UNUSED_557
558	PSL	Reserve	UNUSED_558
559	PSL	Reserve	UNUSED_559
560	PSL	Reserve	UNUSED_560
561	PSL	Reserve	UNUSED_561
562	PSL	Reserve	UNUSED_562
563	PSL	Reserve	UNUSED_563
564	PSL	Reserve	UNUSED_564
565	PSL	Reserve	UNUSED_565
566	PSL	Reserve	UNUSED_566
567	PSL	Reserve	UNUSED_567
568	PSL	Reserve	UNUSED_568
569	PSL	Reserve	UNUSED_569
570	PSL	Reserve	UNUSED_570
571	PSL	Reserve	UNUSED_571
572	PSL	Reserve	UNUSED_572
573	PSL	Reserve	UNUSED_573
574	PSL	Reserve	UNUSED_574

P743 Logic Nodes			
DDB No	**Source**	**Description**	**Element Name**
575	PSL	Reserve	UNUSED_575
576	PSL	PSL Internal Node	DDB_PSLINT_576
577	PSL	PSL Internal Node	DDB_PSLINT_577
578	PSL	PSL Internal Node	DDB_PSLINT_578
579	PSL	PSL Internal Node	DDB_PSLINT_579
580	PSL	PSL Internal Node	DDB_PSLINT_580
581	PSL	PSL Internal Node	DDB_PSLINT_581
582	PSL	PSL Internal Node	DDB_PSLINT_582
583	PSL	PSL Internal Node	DDB_PSLINT_583
584	SW	InterMiCOM Input 1 - is driven by a message from the remote line end	DDB_INTERIN_1
585	SW	InterMiCOM Input 2 - is driven by a message from the remote line end	DDB_INTERIN_2
586	SW	InterMiCOM Input 3 - is driven by a message from the remote line end	DDB_INTERIN_3
587	SW	InterMiCOM Input 4 - is driven by a message from the remote line end	DDB_INTERIN_4
588	SW	InterMiCOM Input 5 - is driven by a message from the remote line end	DDB_INTERIN_5
589	SW	InterMiCOM Input 6 - is driven by a message from the remote line end	DDB_INTERIN_6
590	SW	InterMiCOM Input 7 - is driven by a message from the remote line end	DDB_INTERIN_7
591	SW	InterMiCOM Input 8 - is driven by a message from the remote line end	DDB_INTERIN_8
592	PSL	InterMiCOM Output 1 - is an output to the remote line end	DDB_INTEROUT_1
593	PSL	InterMiCOM Output 2 - is an output to the remote line end	DDB_INTEROUT_2
594	PSL	InterMiCOM Output 3 - is an output to the remote line end	DDB_INTEROUT_3
595	PSL	InterMiCOM Output 4 - is an output to the remote line end	DDB_INTEROUT_4
596	PSL	InterMiCOM Output 5 - is an output to the remote line end	DDB_INTEROUT_5
597	PSL	InterMiCOM Output 6 - is an output to the remote line end	DDB_INTEROUT_6
598	PSL	InterMiCOM Output 7 - is an output to the remote line end	DDB_INTEROUT_7

P743 Logic Nodes			
DDB No	**Source**	**Description**	**Element Name**
599	PSL	InterMiCOM Output 8 - is an output to the remote line end	DDB_INTEROUT_8
600	SW	Circuit breaker failure I< Start Phase A	CBF_DEAD_POLE_START_A
601	SW	Circuit breaker failure I< Start Phase B	CBF_DEAD_POLE_START_B
602	SW	Circuit breaker failure I< Start Phase C	CBF_DEAD_POLE_START_C
603	SW	Circuit breaker failure I> Start Phase A	CBF_CONFIRM_START_A
604	SW	Circuit breaker failure I> Start Phase B	CBF_CONFIRM_START_B
605	SW	Circuit breaker failure I> Start Phase C	CBF_CONFIRM_START_C
606	SW	Circuit breaker failure I> Start Neutral Phase	CBF_CONFIRM_START_N
607	PSL	Reserve	DDB_UNUSED_607
608	SW	Control Input 1 energized	DDB_CTRL_IP_1
609	SW	Control Input 2 energized	DDB_CTRL_IP_2
610	SW	Control Input 3 energized	DDB_CTRL_IP_3
611	SW	Control Input 4 energized	DDB_CTRL_IP_4
612	SW	Control Input 5 energized	DDB_CTRL_IP_5
613	SW	Control Input 6 energized	DDB_CTRL_IP_6
614	SW	Control Input 7 energized	DDB_CTRL_IP_7
615	SW	Control Input 8 energized	DDB_CTRL_IP_8
616	SW	Control Input 9 energized	DDB_CTRL_IP_9
617	SW	Control Input 10 energized	DDB_CTRL_IP_10
618	SW	Control Input 11 energized	DDB_CTRL_IP_11
619	SW	Control Input 12 energized	DDB_CTRL_IP_12
620	SW	Control Input 13 energized	DDB_CTRL_IP_13
621	SW	Control Input 14 energized	DDB_CTRL_IP_14
622	SW	Control Input 15 energized	DDB_CTRL_IP_15
623	SW	Control Input 16 energized	DDB_CTRL_IP_16
624	SW	Control Input 17 energized	DDB_CTRL_IP_17
625	SW	Control Input 18 energized	DDB_CTRL_IP_18
626	SW	Control Input 19 energized	DDB_CTRL_IP_19
627	SW	Control Input 20 energized	DDB_CTRL_IP_20
628	SW	Control Input 21 energized	DDB_CTRL_IP_21
629	SW	Control Input 22 energized	DDB_CTRL_IP_22
630	SW	Control Input 23 energized	DDB_CTRL_IP_23
631	SW	Control Input 24 energized	DDB_CTRL_IP_24
632	SW	Control Input 25 energized	DDB_CTRL_IP_25
633	SW	Control Input 26 energized	DDB_CTRL_IP_26
634	SW	Control Input 27 energized	DDB_CTRL_IP_27
635	SW	Control Input 28 energized	DDB_CTRL_IP_28
636	SW	Control Input 29 energized	DDB_CTRL_IP_29

P743 Logic Nodes			
DDB No	Source	Description	Element Name
637	SW	Control Input 30 energized	DDB_CTRL_IP_30
638	SW	Control Input 31 energized	DDB_CTRL_IP_31
639	SW	Control Input 32 energized	DDB_CTRL_IP_32
640	SW	Programmable LED 1 red is energized	DDB_OUTPUT_TRI_LED_1_RED
641	SW	Programmable LED 1 green is energized	DDB_OUTPUT_TRI_LED_1_GRN
642	SW	Programmable LED 2 red is energized	DDB_OUTPUT_TRI_LED_2_RED
643	SW	Programmable LED 2 green is energized	DDB_OUTPUT_TRI_LED_2_GRN
644	SW	Programmable LED 3 red is energized	DDB_OUTPUT_TRI_LED_3_RED
645	SW	Programmable LED 3 green is energized	DDB_OUTPUT_TRI_LED_3_GRN
646	SW	Programmable LED 4 red is energized	DDB_OUTPUT_TRI_LED_4_RED
647	SW	Programmable LED 4 green is energized	DDB_OUTPUT_TRI_LED_4_GRN
648	SW	Programmable LED 5 red is energized	DDB_OUTPUT_TRI_LED_5_RED
649	SW	Programmable LED 5 green is energized	DDB_OUTPUT_TRI_LED_5_GRN
650	SW	Programmable LED 6 red is energized	DDB_OUTPUT_TRI_LED_6_RED
651	SW	Programmable LED 6 green is energized	DDB_OUTPUT_TRI_LED_6_GRN
652	SW	Programmable LED 7 red is energized	DDB_OUTPUT_TRI_LED_7_RED
653	SW	Programmable LED 7 green is energized	DDB_OUTPUT_TRI_LED_7_GRN
654	SW	Programmable LED 8 red is energized	DDB_OUTPUT_TRI_LED_8_RED
655	SW	Programmable LED 8 green is energized	DDB_OUTPUT_TRI_LED_8_GRN
656	SW	Programmable function key LED 1 red is energized	DDB_OUTPUT_TRI_LED_9_RED
657	SW	Programmable function key LED 1 green is energized	DDB_OUTPUT_TRI_LED_9_GRN
658	SW	Programmable function key LED 2 red is energized	DDB_OUTPUT_TRI_LED_10_RED
659	SW	Programmable function key LED 2 green is energized	DDB_OUTPUT_TRI_LED_10_GRN
660	SW	Programmable function key LED 3 red is energized	DDB_OUTPUT_TRI_LED_11_RED
661	SW	Programmable function key LED 3 green is energized	DDB_OUTPUT_TRI_LED_11_GRN

P743 Logic Nodes			
DDB No	Source	Description	Element Name
662	SW	Programmable function key LED 4 red is energized	DDB_OUTPUT_TRI_LED_12_RED
663	SW	Programmable function key LED 4 green is energized	DDB_OUTPUT_TRI_LED_12_GRN
664	SW	Programmable function key LED 5 red is energized	DDB_OUTPUT_TRI_LED_13_RED
665	SW	Programmable function key LED 5 green is energized	DDB_OUTPUT_TRI_LED_13_GRN
666	SW	Programmable function key LED 6 red is energized	DDB_OUTPUT_TRI_LED_14_RED
667	SW	Programmable function key LED 6 green is energized	DDB_OUTPUT_TRI_LED_14_GRN
668	SW	Programmable function key LED 7 red is energized	DDB_OUTPUT_TRI_LED_15_RED
669	SW	Programmable function key LED 7 green is energized	DDB_OUTPUT_TRI_LED_15_GRN
670	SW	Programmable function key LED 8 red is energized	DDB_OUTPUT_TRI_LED_16_RED
671	SW	Programmable function key LED 8 green is energized	DDB_OUTPUT_TRI_LED_16_GRN
672	SW	Programmable function key LED 9 red is energized	DDB_OUTPUT_TRI_LED_17_RED
673	SW	Programmable function key LED 9 green is energized	DDB_OUTPUT_TRI_LED_17_GRN
674	SW	Programmable function key LED 10 red is energized	DDB_OUTPUT_TRI_LED_18_RED
675	SW	Programmable function key LED 10 green is energized	DDB_OUTPUT_TRI_LED_18_GRN
676	SW	Function key 1 is activated. In ‘Normal’ mode it is high on keypress and in ‘Toggle’ mode remains high/low on single keypress	DDB_FN_KEY_1
677	SW	Function key 2 is activated. In ‘Normal’ mode it is high on keypress and in ‘Toggle’ mode remains high/low on single keypress	DDB_FN_KEY_2
678	SW	Function key 3 is activated. In ‘Normal’ mode it is high on keypress and in ‘Toggle’ mode remains high/low on single keypress	DDB_FN_KEY_3

P743 Logic Nodes			
DDB No	Source	Description	Element Name
679	SW	Function key 4 is activated. In 'Normal' mode it is high on keypress and in 'Toggle' mode remains high/low on single keypress	DDB_FN_KEY_4
680	SW	Function key 5 is activated. In 'Normal' mode it is high on keypress and in 'Toggle' mode remains high/low on single keypress	DDB_FN_KEY_5
681	SW	Function key 6 is activated. In 'Normal' mode it is high on keypress and in 'Toggle' mode remains high/low on single keypress	DDB_FN_KEY_6
682	SW	Function key 7 is activated. In 'Normal' mode it is high on keypress and in 'Toggle' mode remains high/low on single keypress	DDB_FN_KEY_7
683	SW	Function key 8 is activated. In 'Normal' mode it is high on keypress and in 'Toggle' mode remains high/low on single keypress	DDB_FN_KEY_8
684	SW	Function key 9 is activated. In 'Normal' mode it is high on keypress and in 'Toggle' mode remains high/low on single keypress	DDB_FN_KEY_9
685	SW	Function key 10 is activated. In 'Normal' mode it is high on keypress and in 'Toggle' mode remains high/low on single keypress	DDB_FN_KEY_10
686	PSL	Reserve	DDB_UNUSED_686
687	PSL	Reserve	DDB_UNUSED_687
688	PSL	Reserve	DDB_UNUSED_688
689	PSL	Reserve	DDB_UNUSED_689
690	PSL	Reserve	DDB_UNUSED_690
691	PSL	Reserve	DDB_UNUSED_691
692	PSL	Reserve	DDB_UNUSED_692
693	PSL	Reserve	DDB_UNUSED_693
694	PSL	Reserve	DDB_UNUSED_694
695	PSL	Reserve	DDB_UNUSED_695
696	PSL	Reserve	DDB_UNUSED_696
697	PSL	Reserve	DDB_UNUSED_697

P743 Logic Nodes			
DDB No	Source	Description	Element Name
698	PSL	Reserve	DDB_UNUSED_698
699	PSL	Reserve	DDB_UNUSED_699
700	PSL	Input to relay 1 output conditioner	DDB_OUTPUT_CON_1
701	PSL	Input to relay 2 output conditioner	DDB_OUTPUT_CON_2
702	PSL	Input to relay 3 output conditioner	DDB_OUTPUT_CON_3
703	PSL	Input to relay 4 output conditioner	DDB_OUTPUT_CON_4
704	PSL	Input to relay 5 output conditioner	DDB_OUTPUT_CON_5
705	PSL	Input to relay 6 output conditioner	DDB_OUTPUT_CON_6
706	PSL	Input to relay 7 output conditioner	DDB_OUTPUT_CON_7
707	PSL	Input to relay 8 output conditioner	DDB_OUTPUT_CON_8
708	PSL	Input to relay 9 output conditioner	DDB_OUTPUT_CON_9
709	PSL	Input to relay 10 output conditioner	DDB_OUTPUT_CON_10
710	PSL	Input to relay 11 output conditioner	DDB_OUTPUT_CON_11
711	PSL	Input to relay 12 output conditioner	DDB_OUTPUT_CON_12
712	PSL	Input to relay 13 output conditioner	DDB_OUTPUT_CON_13
713	PSL	Input to relay 14 output conditioner	DDB_OUTPUT_CON_14
714	PSL	Input to relay 15 output conditioner	DDB_OUTPUT_CON_15
715	PSL	Input to relay 16 output conditioner	DDB_OUTPUT_CON_16
716	PSL	Input to relay 17 output conditioner	DDB_OUTPUT_CON_17
717	PSL	Input to relay 18 output conditioner	DDB_OUTPUT_CON_18
718	PSL	Input to relay 19 output conditioner	DDB_OUTPUT_CON_19
719	PSL	Input to relay 20 output conditioner	DDB_OUTPUT_CON_20
720	PSL	Input to relay 21 output conditioner	DDB_OUTPUT_CON_21
721	PSL	Input to relay 22 output conditioner	DDB_OUTPUT_CON_22

P743 Logic Nodes			
DDB No	Source	Description	Element Name
722	PSL	Input to relay 23 output conditioner	DDB_OUTPUT_CON_23
723	PSL	Input to relay 24 output conditioner	DDB_OUTPUT_CON_24
724	PSL	Input to relay 25 output conditioner	DDB_OUTPUT_CON_25
725	PSL	Input to relay 26 output conditioner	DDB_OUTPUT_CON_26
726	PSL	Input to relay 27 output conditioner	DDB_OUTPUT_CON_27
727	PSL	Input to relay 28 output conditioner	DDB_OUTPUT_CON_28
728	PSL	Input to relay 29 output conditioner	DDB_OUTPUT_CON_29
729	PSL	Input to relay 30 output conditioner	DDB_OUTPUT_CON_30
730	PSL	Input to relay 31 output conditioner	DDB_OUTPUT_CON_31
731	PSL	Input to relay 32 output conditioner	DDB_OUTPUT_CON_32
732	PSL	Input to relay 33 output conditioner	DDB_OUTPUT_CON_33
733	PSL	Input to relay 34 output conditioner	DDB_OUTPUT_CON_34
734	PSL	Input to relay 35 output conditioner	DDB_OUTPUT_CON_35
735	PSL	Input to relay 36 output conditioner	DDB_OUTPUT_CON_36
736	PSL	Input to relay 37 output conditioner	DDB_OUTPUT_CON_37
737	PSL	Input to relay 38 output conditioner	DDB_OUTPUT_CON_38
738	PSL	Input to relay 39 output conditioner	DDB_OUTPUT_CON_39
739	PSL	Input to relay 40 output conditioner	DDB_OUTPUT_CON_40
740	PSL	Input to relay 41 output conditioner	DDB_OUTPUT_CON_41
741	PSL	Input to relay 42 output conditioner	DDB_OUTPUT_CON_42
742	PSL	Input to relay 43 output conditioner	DDB_OUTPUT_CON_43
743	PSL	Input to relay 44 output conditioner	DDB_OUTPUT_CON_44
744	PSL	Input to relay 45 output conditioner	DDB_OUTPUT_CON_45

P743 Logic Nodes			
DDB No	**Source**	**Description**	**Element Name**
745	PSL	Input to relay 46 output conditioner	DDB_OUTPUT_CON_46
746	PSL	Input to relay 47 output conditioner	DDB_OUTPUT_CON_47
747	PSL	Input to relay 48 output conditioner	DDB_OUTPUT_CON_48
748	PSL	Input to relay 49 output conditioner	DDB_OUTPUT_CON_49
749	PSL	Input to relay 50 output conditioner	DDB_OUTPUT_CON_50
750	PSL	Input to relay 51 output conditioner	DDB_OUTPUT_CON_51
751	PSL	Input to relay 52 output conditioner	DDB_OUTPUT_CON_52
752	PSL	Input to relay 53 output conditioner	DDB_OUTPUT_CON_53
753	PSL	Input to relay 54 output conditioner	DDB_OUTPUT_CON_54
754	PSL	Input to relay 55 output conditioner	DDB_OUTPUT_CON_55
755	PSL	Input to relay 56 output conditioner	DDB_OUTPUT_CON_56
756	PSL	Input to relay 57 output conditioner	DDB_OUTPUT_CON_57
757	PSL	Input to relay 58 output conditioner	DDB_OUTPUT_CON_58
758	PSL	Input to relay 59 output conditioner	DDB_OUTPUT_CON_59
759	PSL	Input to relay 60 output conditioner	DDB_OUTPUT_CON_60
760	PSL	Input to relay 61 output conditioner	DDB_OUTPUT_CON_61
761	PSL	Input to relay 62 output conditioner	DDB_OUTPUT_CON_62
762	PSL	Input to relay 63 output conditioner	DDB_OUTPUT_CON_63
763	PSL	Input to relay 64 output conditioner	DDB_OUTPUT_CON_64
764	PSL	Assignment of input signal to drive output LED 1 red	DDB_TRI_LED_RED_CON_1
765	PSL	Assignment of signal to drive output LED 1 green. To drive LED 1 yellow DDB 676 and DDB 677 must be driven at the same time	DDB_TRI_LED_GRN_CON_1
766	PSL	Assignment of input signal to drive output LED 2 red	DDB_TRI_LED_RED_CON_2

P743 Logic Nodes			
DDB No	**Source**	**Description**	**Element Name**
767	PSL	Assignment of signal to drive output LED 2 green. To drive LED 2 yellow DDB 678 and DDB 679 must be driven at the same time	DDB_TRI_LED_GRN_CON_2
768	PSL	Assignment of input signal to drive output LED 3 red	DDB_TRI_LED_RED_CON_3
769	PSL	Assignment of signal to drive output LED 3 green. To drive LED 3 yellow DDB 680 and DDB 681 must be driven at the same time	DDB_TRI_LED_GRN_CON_3
770	PSL	Assignment of input signal to drive output LED 4 red	DDB_TRI_LED_RED_CON_4
771	PSL	Assignment of signal to drive output LED 4 green. To drive LED 4 yellow DDB 682 and DDB 683 must be driven at the same time	DDB_TRI_LED_GRN_CON_4
772	PSL	Assignment of input signal to drive output LED 5 red	DDB_TRI_LED_RED_CON_5
773	PSL	Assignment of signal to drive output LED 5 green. To drive LED 5 yellow DDB 684 and DDB 685 must be driven at the same time	DDB_TRI_LED_GRN_CON_5
774	PSL	Assignment of input signal to drive output LED 6 red	DDB_TRI_LED_RED_CON_6
775	PSL	Assignment of signal to drive output LED 6 green. To drive LED 6 yellow DDB 686 and DDB 687 must be driven at the same time	DDB_TRI_LED_GRN_CON_6
776	PSL	Assignment of input signal to drive output LED 7 red	DDB_TRI_LED_RED_CON_7
777	PSL	Assignment of signal to drive output LED 7 green. To drive LED 7 yellow DDB 688 and DDB 689 must be driven at the same time	DDB_TRI_LED_GRN_CON_7
778	PSL	Assignment of input signal to drive output LED 8 red	DDB_TRI_LED_RED_CON_8
779	PSL	Assignment of signal to drive output LED 8 green. To drive LED 8 yellow DDB 690 and DDB 691 must be driven at the same time	DDB_TRI_LED_GRN_CON_8
780	PSL	Assignment of signal to drive output function key LED 1 red. This LED is associated with function key 1	DDB_TRI_LED_RED_CON_9

P743 Logic Nodes			
DDB No	Source	Description	Element Name
781	PSL	Assignment of signal to drive output function key LED 1 green. This LED is associated with function key 1. To drive function key LED, yellow DDB 692 and DDB 693 must be active at the same time	DDB_TRI_LED_GRN_CON_9
782	PSL	Assignment of signal to drive output function key LED 2 red. This LED is associated with function key 2	DDB_TRI_LED_RED_CON_10
783	PSL	Assignment of signal to drive output function key LED 2 green. This LED is associated with function key 2. To drive function key LED, yellow DDB 694 and DDB 695 must be active at the same time	DDB_TRI_LED_GRN_CON_10
784	PSL	Assignment of signal to drive output function key LED 3 red. This LED is associated with function key 3	DDB_TRI_LED_RED_CON_11
785	PSL	Assignment of signal to drive output function key LED 3 green. This LED is associated with function key 3. To drive function key LED, yellow DDB 696 and DDB 697 must be active at the same time	DDB_TRI_LED_GRN_CON_11
786	PSL	Assignment of signal to drive output function key LED 4 red. This LED is associated with function key 4	DDB_TRI_LED_RED_CON_12
787	PSL	Assignment of signal to drive output function key LED 4 green. This LED is associated with function key 4. To drive function key LED, yellow DDB 698 and DDB 699 must be active at the same time	DDB_TRI_LED_GRN_CON_12
788	PSL	Assignment of signal to drive output function key LED 5 red. This LED is associated with function key 5	DDB_TRI_LED_RED_CON_13

P743 Logic Nodes			
DDB No	**Source**	**Description**	**Element Name**
789	PSL	Assignment of signal to drive output function key LED 5 green. This LED is associated with function key 5. To drive function key LED, yellow DDB 700 and DDB 701 must be active at the same time	DDB_TRI_LED_GRN_CON_13
790	PSL	Assignment of signal to drive output function key LED 6 red. This LED is associated with function key 6	DDB_TRI_LED_RED_CON_14
791	PSL	Assignment of signal to drive output function key LED 6 green. This LED is associated with function key 6. To drive function key LED, yellow DDB 702 and DDB 703 must be active at the same time	DDB_TRI_LED_GRN_CON_14
792	PSL	Assignment of signal to drive output function key LED 7 red. This LED is associated with function key 7	DDB_TRI_LED_RED_CON_15
793	PSL	Assignment of signal to drive output function key LED 7 green. This LED is associated with function key 7. To drive function key LED, yellow DDB 704 and DDB 705 must be active at the same time	DDB_TRI_LED_GRN_CON_15
794	PSL	Assignment of signal to drive output function key LED 8 red. This LED is associated with function key 8	DDB_TRI_LED_RED_CON_16
795	PSL	Assignment of signal to drive output function key LED 8 green. This LED is associated with function key 8. To drive function key LED, yellow DDB 706 and DDB 707 must be active at the same time	DDB_TRI_LED_GRN_CON_16
796	PSL	Assignment of signal to drive output function key LED 9 red. This LED is associated with function key 9	DDB_TRI_LED_RED_CON_17

P743 Logic Nodes			
DDB No	**Source**	**Description**	**Element Name**
797	PSL	Assignment of signal to drive output function key LED 9 green. This LED is associated with function key 9. To drive function key LED, yellow DDB 708 and DDB 709 must be active at the same time	DDB_TRI_LED_GRN_CON_17
798	PSL	Assignment of signal to drive output function key LED 10 red. This LED is associated with function key 10	DDB_TRI_LED_RED_CON_18
799	PSL	Assignment of signal to drive output function key LED 10 green. This LED is associated with function key 10. To drive function key LED, yellow DDB 710 and DDB 711 must be active at the same time	DDB_TRI_LED_GRN_CON_18
800	PSL	Reserve	DDB_UNUSED_800
801	PSL	Reserve	DDB_UNUSED_801
802	PSL	Reserve	DDB_UNUSED_802
803	PSL	Reserve	DDB_UNUSED_803
804	PSL	Reserve	DDB_UNUSED_804
805	PSL	Reserve	DDB_UNUSED_805
806	PSL	Reserve	DDB_UNUSED_806
807	PSL	Reserve	DDB_UNUSED_807
808	PSL	Reserve	DDB_UNUSED_808
809	PSL	Reserve	DDB_UNUSED_809
810	PSL	Reserve	DDB_UNUSED_810
811	PSL	Reserve	DDB_UNUSED_811
812	PSL	Reserve	DDB_UNUSED_812
813	PSL	Reserve	DDB_UNUSED_813
814	PSL	Reserve	DDB_UNUSED_814
815	PSL	Reserve	DDB_UNUSED_815
816	PSL	Reserve	DDB_UNUSED_816
817	PSL	Reserve	DDB_UNUSED_817
818	PSL	Reserve	DDB_UNUSED_818
819	PSL	Reserve	DDB_UNUSED_819
820	PSL	Reserve	DDB_UNUSED_820
821	PSL	Reserve	DDB_UNUSED_821
822	PSL	Reserve	DDB_UNUSED_822
823	PSL	Reserve	DDB_UNUSED_823
824	PSL	Reserve	DDB_UNUSED_824
825	PSL	Reserve	DDB_UNUSED_825
826	PSL	Reserve	DDB_UNUSED_826
827	PSL	Reserve	DDB_UNUSED_827
828	PSL	Reserve	DDB_UNUSED_828

P743 Logic Nodes			
DDB No	Source	Description	Element Name
829	PSL	Reserve	DDB_UNUSED_829
830	PSL	Reserve	DDB_UNUSED_830
831	PSL	Reserve	DDB_UNUSED_831
832	PSL	Reserve	DDB_UNUSED_832
833	PSL	Reserve	DDB_UNUSED_833
834	PSL	Reserve	DDB_UNUSED_834
835	PSL	Reserve	DDB_UNUSED_835
836	PSL	Reserve	DDB_UNUSED_836
837	PSL	Reserve	DDB_UNUSED_837
838	PSL	Reserve	DDB_UNUSED_838
839	PSL	Reserve	DDB_UNUSED_839
840	PSL	Reserve	DDB_UNUSED_840
841	PSL	Reserve	DDB_UNUSED_841
842	PSL	Reserve	DDB_UNUSED_842
843	PSL	Reserve	DDB_UNUSED_843
844	PSL	Reserve	DDB_UNUSED_844
845	PSL	Reserve	DDB_UNUSED_845
846	PSL	Reserve	DDB_UNUSED_846
847	PSL	Reserve	DDB_UNUSED_847
848	PSL	Reserve	DDB_UNUSED_848
849	PSL	Reserve	DDB_UNUSED_849
850	PSL	Reserve	DDB_UNUSED_850
851	PSL	Reserve	DDB_UNUSED_851
852	PSL	Reserve	DDB_UNUSED_852
853	PSL	Reserve	DDB_UNUSED_853
854	PSL	Reserve	DDB_UNUSED_854
855	PSL	Reserve	DDB_UNUSED_855
856	PSL	Reserve	DDB_UNUSED_856
857	PSL	Reserve	DDB_UNUSED_857
858	PSL	Reserve	DDB_UNUSED_858
859	PSL	Reserve	DDB_UNUSED_859
860	PSL	Reserve	DDB_UNUSED_860
861	PSL	Reserve	DDB_UNUSED_861
862	PSL	Reserve	DDB_UNUSED_862
863	PSL	Reserve	DDB_UNUSED_863
864	PSL	Reserve	DDB_UNUSED_864
865	PSL	Reserve	DDB_UNUSED_865
866	PSL	Reserve	DDB_UNUSED_866
867	PSL	Reserve	DDB_UNUSED_867
868	PSL	Reserve	DDB_UNUSED_868
869	PSL	Reserve	DDB_UNUSED_869
870	PSL	Reserve	DDB_UNUSED_870
871	PSL	Reserve	DDB_UNUSED_871
872	PSL	Reserve	DDB_UNUSED_872
873	PSL	Reserve	DDB_UNUSED_873
874	PSL	Reserve	DDB_UNUSED_874

P743 Logic Nodes			
DDB No	Source	Description	Element Name
875	PSL	Reserve	DDB_UNUSED_875
876	PSL	Reserve	DDB_UNUSED_876
877	PSL	Reserve	DDB_UNUSED_877
878	PSL	Reserve	DDB_UNUSED_878
879	PSL	Reserve	DDB_UNUSED_879
880	PSL	Reserve	DDB_UNUSED_880
881	PSL	Reserve	DDB_UNUSED_881
882	PSL	Reserve	DDB_UNUSED_882
883	PSL	Reserve	DDB_UNUSED_883
884	PSL	Reserve	DDB_UNUSED_884
885	PSL	Reserve	DDB_UNUSED_885
886	PSL	Reserve	DDB_UNUSED_886
887	PSL	Reserve	DDB_UNUSED_887
888	PSL	Reserve	DDB_UNUSED_888
889	PSL	Reserve	DDB_UNUSED_889
890	PSL	Reserve	DDB_UNUSED_890
891	PSL	Reserve	DDB_UNUSED_891
892	PSL	Reserve	DDB_UNUSED_892
893	PSL	Reserve	DDB_UNUSED_893
894	PSL	Reserve	DDB_UNUSED_894
895	PSL	Reserve	DDB_UNUSED_895
896	PSL	Reserve	DDB_UNUSED_896
897	PSL	Reserve	DDB_UNUSED_897
898	PSL	Reserve	DDB_UNUSED_898
899	PSL	Reserve	DDB_UNUSED_899
900	PSL	Reserve	DDB_UNUSED_900
901	PSL	Reserve	DDB_UNUSED_901
902	PSL	Reserve	DDB_UNUSED_902
903	PSL	Reserve	DDB_UNUSED_903
904	PSL	Reserve	DDB_UNUSED_904
905	PSL	Reserve	DDB_UNUSED_905
906	PSL	Reserve	DDB_UNUSED_906
907	PSL	Reserve	DDB_UNUSED_907
908	PSL	Reserve	DDB_UNUSED_908
909	PSL	Reserve	DDB_UNUSED_909
910	PSL	Reserve	DDB_UNUSED_910
911	PSL	Reserve	DDB_UNUSED_911
912	PSL	Reserve	DDB_UNUSED_912
913	PSL	Reserve	DDB_UNUSED_913
914	PSL	Reserve	DDB_UNUSED_914
915	PSL	Reserve	DDB_UNUSED_915
916	PSL	Reserve	DDB_UNUSED_916
917	PSL	Reserve	DDB_UNUSED_917
918	PSL	Reserve	DDB_UNUSED_918
919	PSL	Reserve	DDB_UNUSED_919
920	PSL	Reserve	DDB_UNUSED_920

P743 Logic Nodes			
DDB No	Source	Description	Element Name
921	PSL	Reserve	DDB_UNUSED_921
922	PSL	Reserve	DDB_UNUSED_922
923	PSL	PSL Internal Node	DDB_PSLINT_1
924	PSL	PSL Internal Node	DDB_PSLINT_2
925	PSL	PSL Internal Node	DDB_PSLINT_3
926	PSL	PSL Internal Node	DDB_PSLINT_4
927	PSL	PSL Internal Node	DDB_PSLINT_5
928	PSL	PSL Internal Node	DDB_PSLINT_6
929	PSL	PSL Internal Node	DDB_PSLINT_7
930	PSL	PSL Internal Node	DDB_PSLINT_8
931	PSL	PSL Internal Node	DDB_PSLINT_9
932	PSL	PSL Internal Node	DDB_PSLINT_10
933	PSL	PSL Internal Node	DDB_PSLINT_11
934	PSL	PSL Internal Node	DDB_PSLINT_12
935	PSL	PSL Internal Node	DDB_PSLINT_13
936	PSL	PSL Internal Node	DDB_PSLINT_14
937	PSL	PSL Internal Node	DDB_PSLINT_15
938	PSL	PSL Internal Node	DDB_PSLINT_16
939	PSL	PSL Internal Node	DDB_PSLINT_17
940	PSL	PSL Internal Node	DDB_PSLINT_18
941	PSL	PSL Internal Node	DDB_PSLINT_19
942	PSL	PSL Internal Node	DDB_PSLINT_20
943	PSL	PSL Internal Node	DDB_PSLINT_21
944	PSL	PSL Internal Node	DDB_PSLINT_22
945	PSL	PSL Internal Node	DDB_PSLINT_23
946	PSL	PSL Internal Node	DDB_PSLINT_24
947	PSL	PSL Internal Node	DDB_PSLINT_25
948	PSL	PSL Internal Node	DDB_PSLINT_26
949	PSL	PSL Internal Node	DDB_PSLINT_27
950	PSL	PSL Internal Node	DDB_PSLINT_28
951	PSL	PSL Internal Node	DDB_PSLINT_29
952	PSL	PSL Internal Node	DDB_PSLINT_30
953	PSL	PSL Internal Node	DDB_PSLINT_31
954	PSL	PSL Internal Node	DDB_PSLINT_32
955	PSL	PSL Internal Node	DDB_PSLINT_33
956	PSL	PSL Internal Node	DDB_PSLINT_34
957	PSL	PSL Internal Node	DDB_PSLINT_35
958	PSL	PSL Internal Node	DDB_PSLINT_36
959	PSL	PSL Internal Node	DDB_PSLINT_37
960	PSL	PSL Internal Node	DDB_PSLINT_38
961	PSL	PSL Internal Node	DDB_PSLINT_39
962	PSL	PSL Internal Node	DDB_PSLINT_40
963	PSL	PSL Internal Node	DDB_PSLINT_41
964	PSL	PSL Internal Node	DDB_PSLINT_42
965	PSL	PSL Internal Node	DDB_PSLINT_43
966	PSL	PSL Internal Node	DDB_PSLINT_44

P743 Logic Nodes			
DDB No	Source	Description	Element Name
967	PSL	PSL Internal Node	DDB_PSLINT_45
968	PSL	PSL Internal Node	DDB_PSLINT_46
969	PSL	PSL Internal Node	DDB_PSLINT_47
970	PSL	PSL Internal Node	DDB_PSLINT_48
971	PSL	PSL Internal Node	DDB_PSLINT_49
972	PSL	PSL Internal Node	DDB_PSLINT_50
973	PSL	PSL Internal Node	DDB_PSLINT_51
974	PSL	PSL Internal Node	DDB_PSLINT_52
975	PSL	PSL Internal Node	DDB_PSLINT_53
976	PSL	PSL Internal Node	DDB_PSLINT_54
977	PSL	PSL Internal Node	DDB_PSLINT_55
978	PSL	PSL Internal Node	DDB_PSLINT_56
979	PSL	PSL Internal Node	DDB_PSLINT_57
980	PSL	PSL Internal Node	DDB_PSLINT_58
981	PSL	PSL Internal Node	DDB_PSLINT_59
982	PSL	PSL Internal Node	DDB_PSLINT_60
983	PSL	PSL Internal Node	DDB_PSLINT_61
984	PSL	PSL Internal Node	DDB_PSLINT_62
985	PSL	PSL Internal Node	DDB_PSLINT_63
986	PSL	PSL Internal Node	DDB_PSLINT_64
987	PSL	PSL Internal Node	DDB_PSLINT_65
988	PSL	PSL Internal Node	DDB_PSLINT_66
989	PSL	PSL Internal Node	DDB_PSLINT_67
990	PSL	PSL Internal Node	DDB_PSLINT_68
991	PSL	PSL Internal Node	DDB_PSLINT_69
992	PSL	PSL Internal Node	DDB_PSLINT_70
993	PSL	PSL Internal Node	DDB_PSLINT_71
994	PSL	PSL Internal Node	DDB_PSLINT_72
995	PSL	PSL Internal Node	DDB_PSLINT_73
996	PSL	PSL Internal Node	DDB_PSLINT_74
997	PSL	PSL Internal Node	DDB_PSLINT_75
998	PSL	PSL Internal Node	DDB_PSLINT_76
999	PSL	PSL Internal Node	DDB_PSLINT_77
1000	PSL	PSL Internal Node	DDB_PSLINT_78
1001	PSL	PSL Internal Node	DDB_PSLINT_79
1002	PSL	PSL Internal Node	DDB_PSLINT_80
1003	PSL	PSL Internal Node	DDB_PSLINT_81
1004	PSL	PSL Internal Node	DDB_PSLINT_82
1005	PSL	PSL Internal Node	DDB_PSLINT_83
1006	PSL	PSL Internal Node	DDB_PSLINT_84
1007	PSL	PSL Internal Node	DDB_PSLINT_85
1008	PSL	PSL Internal Node	DDB_PSLINT_86
1009	PSL	PSL Internal Node	DDB_PSLINT_87
1010	PSL	PSL Internal Node	DDB_PSLINT_88
1011	PSL	PSL Internal Node	DDB_PSLINT_89
1012	PSL	PSL Internal Node	DDB_PSLINT_90

P743 Logic Nodes			
DDB No	**Source**	**Description**	**Element Name**
1013	PSL	PSL Internal Node	DDB_PSLINT_91
1014	PSL	PSL Internal Node	DDB_PSLINT_92
1015	PSL	PSL Internal Node	DDB_PSLINT_93
1016	PSL	PSL Internal Node	DDB_PSLINT_94
1017	PSL	PSL Internal Node	DDB_PSLINT_95
1018	PSL	PSL Internal Node	DDB_PSLINT_96
1019	PSL	PSL Internal Node	DDB_PSLINT_97
1020	PSL	PSL Internal Node	DDB_PSLINT_98
1021	PSL	PSL Internal Node	DDB_PSLINT_99
1022	PSL	PSL Internal Node	DDB_PSLINT_100
1023	PSL	PSL Internal Node	DDB_PSLINT_101
1024	SW	Virtual Input 1 - received from GOOSE message	DDB_GOOSEIN_1
1025	SW	Virtual Input 2 - received from GOOSE message	DDB_GOOSEIN_2
1026	SW	Virtual Input 3 - received from GOOSE message	DDB_GOOSEIN_3
1027	SW	Virtual Input 4 - received from GOOSE message	DDB_GOOSEIN_4
1028	SW	Virtual Input 5 - received from GOOSE message	DDB_GOOSEIN_5
1029	SW	Virtual Input 6 - received from GOOSE message	DDB_GOOSEIN_6
1030	SW	Virtual Input 7 - received from GOOSE message	DDB_GOOSEIN_7
1031	SW	Virtual Input 8 - received from GOOSE message	DDB_GOOSEIN_8
1032	SW	Virtual Input 9 - received from GOOSE message	DDB_GOOSEIN_9
1033	SW	Virtual Input 10 - received from GOOSE message	DDB_GOOSEIN_10
1034	SW	Virtual Input 11 - received from GOOSE message	DDB_GOOSEIN_11
1035	SW	Virtual Input 12 - received from GOOSE message	DDB_GOOSEIN_12
1036	SW	Virtual Input 13 - received from GOOSE message	DDB_GOOSEIN_13
1037	SW	Virtual Input 14 - received from GOOSE message	DDB_GOOSEIN_14
1038	SW	Virtual Input 15 - received from GOOSE message	DDB_GOOSEIN_15
1039	SW	Virtual Input 16 - received from GOOSE message	DDB_GOOSEIN_16
1040	SW	Virtual Input 17 - received from GOOSE message	DDB_GOOSEIN_17
1041	SW	Virtual Input 18 - received from GOOSE message	DDB_GOOSEIN_18

P743 Logic Nodes			
DDB No	**Source**	**Description**	**Element Name**
1042	SW	Virtual Input 19 - received from GOOSE message	DDB_GOOSEIN_19
1043	SW	Virtual Input 20 - received from GOOSE message	DDB_GOOSEIN_20
1044	SW	Virtual Input 21 - received from GOOSE message	DDB_GOOSEIN_21
1045	SW	Virtual Input 22 - received from GOOSE message	DDB_GOOSEIN_22
1046	SW	Virtual Input 23 - received from GOOSE message	DDB_GOOSEIN_23
1047	SW	Virtual Input 24 - received from GOOSE message	DDB_GOOSEIN_24
1048	SW	Virtual Input 25 - received from GOOSE message	DDB_GOOSEIN_25
1049	SW	Virtual Input 26 - received from GOOSE message	DDB_GOOSEIN_26
1050	SW	Virtual Input 27 - received from GOOSE message	DDB_GOOSEIN_27
1051	SW	Virtual Input 28 - received from GOOSE message	DDB_GOOSEIN_28
1052	SW	Virtual Input 29 - received from GOOSE message	DDB_GOOSEIN_29
1053	SW	Virtual Input 30 - received from GOOSE message	DDB_GOOSEIN_30
1054	SW	Virtual Input 31 - received from GOOSE message	DDB_GOOSEIN_31
1055	SW	Virtual Input 32 - received from GOOSE message	DDB_GOOSEIN_32
1056	SW	Virtual Input 33 - received from GOOSE message	DDB_GOOSEIN_33
1057	SW	Virtual Input 34 - received from GOOSE message	DDB_GOOSEIN_34
1058	SW	Virtual Input 35 - received from GOOSE message	DDB_GOOSEIN_35
1059	SW	Virtual Input 36 - received from GOOSE message	DDB_GOOSEIN_36
1060	SW	Virtual Input 37 - received from GOOSE message	DDB_GOOSEIN_37
1061	SW	Virtual Input 38 - received from GOOSE message	DDB_GOOSEIN_38
1062	SW	Virtual Input 39 - received from GOOSE message	DDB_GOOSEIN_39
1063	SW	Virtual Input 40 - received from GOOSE message	DDB_GOOSEIN_40
1064	SW	Virtual Input 41 - received from GOOSE message	DDB_GOOSEIN_41

P743 Logic Nodes			
DDB No	**Source**	**Description**	**Element Name**
1065	SW	Virtual Input 42 - received from GOOSE message	DDB_GOOSEIN_42
1066	SW	Virtual Input 43 - received from GOOSE message	DDB_GOOSEIN_43
1067	SW	Virtual Input 44 - received from GOOSE message	DDB_GOOSEIN_44
1068	SW	Virtual Input 45 - received from GOOSE message	DDB_GOOSEIN_45
1069	SW	Virtual Input 46 - received from GOOSE message	DDB_GOOSEIN_46
1070	SW	Virtual Input 47 - received from GOOSE message	DDB_GOOSEIN_47
1071	SW	Virtual Input 48 - received from GOOSE message	DDB_GOOSEIN_48
1072	SW	Virtual Input 49 - received from GOOSE message	DDB_GOOSEIN_49
1073	SW	Virtual Input 40 - received from GOOSE message	DDB_GOOSEIN_50
1074	SW	Virtual Input 41 - received from GOOSE message	DDB_GOOSEIN_51
1075	SW	Virtual Input 52 - received from GOOSE message	DDB_GOOSEIN_52
1076	SW	Virtual Input 53 - received from GOOSE message	DDB_GOOSEIN_53
1077	SW	Virtual Input 54 - received from GOOSE message	DDB_GOOSEIN_54
1078	SW	Virtual Input 55 - received from GOOSE message	DDB_GOOSEIN_55
1079	SW	Virtual Input 56 - received from GOOSE message	DDB_GOOSEIN_56
1080	SW	Virtual Input 57 - received from GOOSE message	DDB_GOOSEIN_57
1081	SW	Virtual Input 58 - received from GOOSE message	DDB_GOOSEIN_58
1082	SW	Virtual Input 59 - received from GOOSE message	DDB_GOOSEIN_59
1083	SW	Virtual Input 60 - received from GOOSE message	DDB_GOOSEIN_60
1084	SW	Virtual Input 61 - received from GOOSE message	DDB_GOOSEIN_61
1085	SW	Virtual Input 62 - received from GOOSE message	DDB_GOOSEIN_62
1086	SW	Virtual Input 63 - received from GOOSE message	DDB_GOOSEIN_63
1087	SW	Virtual Input 64 - received from GOOSE message	DDB_GOOSEIN_64
1088	PSL	Reserve	UNUSED_1088

P743 Logic Nodes			
DDB No	Source	Description	Element Name
1089	PSL	Reserve	UNUSED_1089
1090	PSL	Reserve	UNUSED_1090
1091	PSL	Reserve	UNUSED_1091
1092	PSL	Reserve	UNUSED_1092
1093	PSL	Reserve	UNUSED_1093
1094	PSL	Reserve	UNUSED_1094
1095	PSL	Reserve	UNUSED_1095
1096	PSL	Reserve	UNUSED_1096
1097	PSL	Reserve	UNUSED_1097
1098	PSL	Reserve	UNUSED_1098
1099	PSL	Reserve	UNUSED_1099
1100	PSL	Reserve	UNUSED_1100
1101	PSL	Reserve	UNUSED_1101
1102	PSL	Reserve	UNUSED_1102
1103	PSL	Reserve	UNUSED_1103
1104	PSL	Reserve	UNUSED_1104
1105	PSL	Reserve	UNUSED_1105
1106	PSL	Reserve	UNUSED_1106
1107	PSL	Reserve	UNUSED_1107
1108	PSL	Reserve	UNUSED_1108
1109	PSL	Reserve	UNUSED_1109
1110	PSL	Reserve	UNUSED_1110
1111	PSL	Reserve	UNUSED_1111
1112	PSL	Reserve	UNUSED_1112
1113	PSL	Reserve	UNUSED_1113
1114	PSL	Reserve	UNUSED_1114
1115	PSL	Reserve	UNUSED_1115
1116	PSL	Reserve	UNUSED_1116
1117	PSL	Reserve	UNUSED_1117
1118	PSL	Reserve	UNUSED_1118
1119	PSL	Reserve	UNUSED_1119
1120	PSL	Reserve	UNUSED_1120
1121	PSL	Reserve	UNUSED_1121
1122	PSL	Reserve	UNUSED_1122
1123	PSL	Reserve	UNUSED_1123
1124	PSL	Reserve	UNUSED_1124
1125	PSL	Reserve	UNUSED_1125
1126	PSL	Reserve	UNUSED_1126
1127	PSL	Reserve	UNUSED_1127
1128	PSL	Reserve	UNUSED_1128
1129	PSL	Reserve	UNUSED_1129
1130	PSL	Reserve	UNUSED_1130
1131	PSL	Reserve	UNUSED_1131
1132	PSL	Reserve	UNUSED_1132
1133	PSL	Reserve	UNUSED_1133
1134	PSL	Reserve	UNUSED_1134

P743 Logic Nodes			
DDB No	**Source**	**Description**	**Element Name**
1135	PSL	Reserve	UNUSED_1135
1136	PSL	Reserve	UNUSED_1136
1137	PSL	Reserve	UNUSED_1137
1138	PSL	Reserve	UNUSED_1138
1139	PSL	Reserve	UNUSED_1139
1140	PSL	Reserve	UNUSED_1140
1141	PSL	Reserve	UNUSED_1141
1142	PSL	Reserve	UNUSED_1142
1143	PSL	Reserve	UNUSED_1143
1144	PSL	Reserve	UNUSED_1144
1145	PSL	Reserve	UNUSED_1145
1146	PSL	Reserve	UNUSED_1146
1147	PSL	Reserve	UNUSED_1147
1148	PSL	Reserve	UNUSED_1148
1149	PSL	Reserve	UNUSED_1149
1150	PSL	Reserve	UNUSED_1150
1151	PSL	Reserve	UNUSED_1151
1152	SW	GOOSE virtual input 1 - provides the Quality attributes of any data object in an incoming GOOSE message	DDB_VIP_QUALITY_1
1153	SW	GOOSE virtual input 2 - provides the Quality attributes of any data object in an incoming GOOSE message	DDB_VIP_QUALITY_2
1154	SW	GOOSE virtual input 3 - provides the Quality attributes of any data object in an incoming GOOSE message	DDB_VIP_QUALITY_3
1155	SW	GOOSE virtual input 4 - provides the Quality attributes of any data object in an incoming GOOSE message	DDB_VIP_QUALITY_4
1156	SW	GOOSE virtual input 5 - provides the Quality attributes of any data object in an incoming GOOSE message	DDB_VIP_QUALITY_5
1157	SW	GOOSE virtual input 6 - provides the Quality attributes of any data object in an incoming GOOSE message	DDB_VIP_QUALITY_6
1158	SW	GOOSE virtual input 7 - provides the Quality attributes of any data object in an incoming GOOSE message	DDB_VIP_QUALITY_7

P743 Logic Nodes			
DDB No	**Source**	**Description**	**Element Name**
1159	SW	GOOSE virtual input 8 - provides the Quality attributes of any data object in an incoming GOOSE message	DDB_VIP_QUALITY_8
1160	SW	GOOSE virtual input 9 - provides the Quality attributes of any data object in an incoming GOOSE message	DDB_VIP_QUALITY_9
1161	SW	GOOSE virtual input 10 - provides the Quality attributes of any data object in an incoming GOOSE message	DDB_VIP_QUALITY_10
1162	SW	GOOSE virtual input 11 - provides the Quality attributes of any data object in an incoming GOOSE message	DDB_VIP_QUALITY_11
1163	SW	GOOSE virtual input 12 - provides the Quality attributes of any data object in an incoming GOOSE message	DDB_VIP_QUALITY_12
1164	SW	GOOSE virtual input 13 - provides the Quality attributes of any data object in an incoming GOOSE message	DDB_VIP_QUALITY_13
1165	SW	GOOSE virtual input 14 - provides the Quality attributes of any data object in an incoming GOOSE message	DDB_VIP_QUALITY_14
1166	SW	GOOSE virtual input 15 - provides the Quality attributes of any data object in an incoming GOOSE message	DDB_VIP_QUALITY_15
1167	SW	GOOSE virtual input 16 - provides the Quality attributes of any data object in an incoming GOOSE message	DDB_VIP_QUALITY_16
1168	SW	GOOSE virtual input 17 - provides the Quality attributes of any data object in an incoming GOOSE message	DDB_VIP_QUALITY_17
1169	SW	GOOSE virtual input 18 - provides the Quality attributes of any data object in an incoming GOOSE message	DDB_VIP_QUALITY_18

P743 Logic Nodes			
DDB No	Source	Description	Element Name
1170	SW	GOOSE virtual input 19 - provides the Quality attributes of any data object in an incoming GOOSE message	DDB_VIP_QUALITY_19
1171	SW	GOOSE virtual input 20 - provides the Quality attributes of any data object in an incoming GOOSE message	DDB_VIP_QUALITY_20
1172	SW	GOOSE virtual input 21 - provides the Quality attributes of any data object in an incoming GOOSE message	DDB_VIP_QUALITY_21
1173	SW	GOOSE virtual input 22 - provides the Quality attributes of any data object in an incoming GOOSE message	DDB_VIP_QUALITY_22
1174	SW	GOOSE virtual input 23 - provides the Quality attributes of any data object in an incoming GOOSE message	DDB_VIP_QUALITY_23
1175	SW	GOOSE virtual input 24 - provides the Quality attributes of any data object in an incoming GOOSE message	DDB_VIP_QUALITY_24
1176	SW	GOOSE virtual input 25 - provides the Quality attributes of any data object in an incoming GOOSE message	DDB_VIP_QUALITY_25
1177	SW	GOOSE virtual input 26 - provides the Quality attributes of any data object in an incoming GOOSE message	DDB_VIP_QUALITY_26
1178	SW	GOOSE virtual input 27 - provides the Quality attributes of any data object in an incoming GOOSE message	DDB_VIP_QUALITY_27
1179	SW	GOOSE virtual input 28 - provides the Quality attributes of any data object in an incoming GOOSE message	DDB_VIP_QUALITY_28
1180	SW	GOOSE virtual input 29 - provides the Quality attributes of any data object in an incoming GOOSE message	DDB_VIP_QUALITY_29

P743 Logic Nodes			
DDB No	Source	Description	Element Name
1181	SW	GOOSE virtual input 30 - provides the Quality attributes of any data object in an incoming GOOSE message	DDB_VIP_QUALITY_30
1182	SW	GOOSE virtual input 31 - provides the Quality attributes of any data object in an incoming GOOSE message	DDB_VIP_QUALITY_31
1183	SW	GOOSE virtual input 32 - provides the Quality attributes of any data object in an incoming GOOSE message	DDB_VIP_QUALITY_32
1184	SW	GOOSE virtual input 33 - provides the Quality attributes of any data object in an incoming GOOSE message	DDB_VIP_QUALITY_33
1185	SW	GOOSE virtual input 34 - provides the Quality attributes of any data object in an incoming GOOSE message	DDB_VIP_QUALITY_34
1186	SW	GOOSE virtual input 35 - provides the Quality attributes of any data object in an incoming GOOSE message	DDB_VIP_QUALITY_35
1187	SW	GOOSE virtual input 36 - provides the Quality attributes of any data object in an incoming GOOSE message	DDB_VIP_QUALITY_36
1188	SW	GOOSE virtual input 37 - provides the Quality attributes of any data object in an incoming GOOSE message	DDB_VIP_QUALITY_37
1189	SW	GOOSE virtual input 38 - provides the Quality attributes of any data object in an incoming GOOSE message	DDB_VIP_QUALITY_38
1190	SW	GOOSE virtual input 39 - provides the Quality attributes of any data object in an incoming GOOSE message	DDB_VIP_QUALITY_39
1191	SW	GOOSE virtual input 40 - provides the Quality attributes of any data object in an incoming GOOSE message	DDB_VIP_QUALITY_40

P743 Logic Nodes			
DDB No	**Source**	**Description**	**Element Name**
1192	SW	GOOSE virtual input 41 - provides the Quality attributes of any data object in an incoming GOOSE message	DDB_VIP_QUALITY_41
1193	SW	GOOSE virtual input 42 - provides the Quality attributes of any data object in an incoming GOOSE message	DDB_VIP_QUALITY_42
1194	SW	GOOSE virtual input 43 - provides the Quality attributes of any data object in an incoming GOOSE message	DDB_VIP_QUALITY_43
1195	SW	GOOSE virtual input 44 - provides the Quality attributes of any data object in an incoming GOOSE message	DDB_VIP_QUALITY_44
1196	SW	GOOSE virtual input 45 - provides the Quality attributes of any data object in an incoming GOOSE message	DDB_VIP_QUALITY_45
1197	SW	GOOSE virtual input 46 - provides the Quality attributes of any data object in an incoming GOOSE message	DDB_VIP_QUALITY_46
1198	SW	GOOSE virtual input 47 - provides the Quality attributes of any data object in an incoming GOOSE message	DDB_VIP_QUALITY_47
1199	SW	GOOSE virtual input 48 - provides the Quality attributes of any data object in an incoming GOOSE message	DDB_VIP_QUALITY_48
1200	SW	GOOSE virtual input 49 - provides the Quality attributes of any data object in an incoming GOOSE message	DDB_VIP_QUALITY_49
1201	SW	GOOSE virtual input 50 - provides the Quality attributes of any data object in an incoming GOOSE message	DDB_VIP_QUALITY_50
1202	SW	GOOSE virtual input 51 - provides the Quality attributes of any data object in an incoming GOOSE message	DDB_VIP_QUALITY_51

P743 Logic Nodes			
DDB No	Source	Description	Element Name
1203	SW	GOOSE virtual input 52 - provides the Quality attributes of any data object in an incoming GOOSE message	DDB_VIP_QUALITY_52
1204	SW	GOOSE virtual input 53 - provides the Quality attributes of any data object in an incoming GOOSE message	DDB_VIP_QUALITY_53
1205	SW	GOOSE virtual input 54 - provides the Quality attributes of any data object in an incoming GOOSE message	DDB_VIP_QUALITY_54
1206	SW	GOOSE virtual input 55 - provides the Quality attributes of any data object in an incoming GOOSE message	DDB_VIP_QUALITY_55
1207	SW	GOOSE virtual input 56 - provides the Quality attributes of any data object in an incoming GOOSE message	DDB_VIP_QUALITY_56
1208	SW	GOOSE virtual input 57 - provides the Quality attributes of any data object in an incoming GOOSE message	DDB_VIP_QUALITY_57
1209	SW	GOOSE virtual input 58 - provides the Quality attributes of any data object in an incoming GOOSE message	DDB_VIP_QUALITY_58
1210	SW	GOOSE virtual input 59 - provides the Quality attributes of any data object in an incoming GOOSE message	DDB_VIP_QUALITY_59
1211	SW	GOOSE virtual input 60 - provides the Quality attributes of any data object in an incoming GOOSE message	DDB_VIP_QUALITY_60
1212	SW	GOOSE virtual input 61 - provides the Quality attributes of any data object in an incoming GOOSE message	DDB_VIP_QUALITY_61
1213	SW	GOOSE virtual input 62 - provides the Quality attributes of any data object in an incoming GOOSE message	DDB_VIP_QUALITY_62

P743 Logic Nodes			
DDB No	Source	Description	Element Name
1214	SW	GOOSE virtual input 63 - provides the Quality attributes of any data object in an incoming GOOSE message	DDB_VIP_QUALITY_63
1215	SW	GOOSE virtual input 64 - provides the Quality attributes of any data object in an incoming GOOSE message	DDB_VIP_QUALITY_64
1216	PSL	Reserve	UNUSED_1216
1217	PSL	Reserve	UNUSED_1217
1218	PSL	Reserve	UNUSED_1218
1219	PSL	Reserve	UNUSED_1219
1220	PSL	Reserve	UNUSED_1220
1221	PSL	Reserve	UNUSED_1221
1222	PSL	Reserve	UNUSED_1222
1223	PSL	Reserve	UNUSED_1223
1224	PSL	Reserve	UNUSED_1224
1225	PSL	Reserve	UNUSED_1225
1226	PSL	Reserve	UNUSED_1226
1227	PSL	Reserve	UNUSED_1227
1228	PSL	Reserve	UNUSED_1228
1229	PSL	Reserve	UNUSED_1229
1230	PSL	Reserve	UNUSED_1230
1231	PSL	Reserve	UNUSED_1231
1232	PSL	Reserve	UNUSED_1232
1233	PSL	Reserve	UNUSED_1233
1234	PSL	Reserve	UNUSED_1234
1235	PSL	Reserve	UNUSED_1235
1236	PSL	Reserve	UNUSED_1236
1237	PSL	Reserve	UNUSED_1237
1238	PSL	Reserve	UNUSED_1238
1239	PSL	Reserve	UNUSED_1239
1240	PSL	Reserve	UNUSED_1240
1241	PSL	Reserve	UNUSED_1241
1242	PSL	Reserve	UNUSED_1242
1243	PSL	Reserve	UNUSED_1243
1244	PSL	Reserve	UNUSED_1244
1245	PSL	Reserve	UNUSED_1245
1246	PSL	Reserve	UNUSED_1246
1247	PSL	Reserve	UNUSED_1247
1248	PSL	Reserve	UNUSED_1248
1249	PSL	Reserve	UNUSED_1249
1250	PSL	Reserve	UNUSED_1250
1251	PSL	Reserve	UNUSED_1251
1252	PSL	Reserve	UNUSED_1252
1253	PSL	Reserve	UNUSED_1253

P743 Logic Nodes			
DDB No	Source	Description	Element Name
1254	PSL	Reserve	UNUSED_1254
1255	PSL	Reserve	UNUSED_1255
1256	PSL	Reserve	UNUSED_1256
1257	PSL	Reserve	UNUSED_1257
1258	PSL	Reserve	UNUSED_1258
1259	PSL	Reserve	UNUSED_1259
1260	PSL	Reserve	UNUSED_1260
1261	PSL	Reserve	UNUSED_1261
1262	PSL	Reserve	UNUSED_1262
1263	PSL	Reserve	UNUSED_1263
1264	PSL	Reserve	UNUSED_1264
1265	PSL	Reserve	UNUSED_1265
1266	PSL	Reserve	UNUSED_1266
1267	PSL	Reserve	UNUSED_1267
1268	PSL	Reserve	UNUSED_1268
1269	PSL	Reserve	UNUSED_1269
1270	PSL	Reserve	UNUSED_1270
1271	PSL	Reserve	UNUSED_1271
1272	PSL	Reserve	UNUSED_1272
1273	PSL	Reserve	UNUSED_1273
1274	PSL	Reserve	UNUSED_1274
1275	PSL	Reserve	UNUSED_1275
1276	PSL	Reserve	UNUSED_1276
1277	PSL	Reserve	UNUSED_1277
1278	PSL	Reserve	UNUSED_1278
1279	PSL	Reserve	UNUSED_1279
1280	SW	GOOSE virtual input 1- indicates if the GOOSE publisher responsible for publishing the data that derives a virtual input is present.	DDB_VIP_PUB_PRES_1
1281	SW	GOOSE virtual input 2- indicates if the GOOSE publisher responsible for publishing the data that derives a virtual input is present.	DDB_VIP_PUB_PRES_2
1282	SW	GOOSE virtual input 3- indicates if the GOOSE publisher responsible for publishing the data that derives a virtual input is present.	DDB_VIP_PUB_PRES_3
1283	SW	GOOSE virtual input 4- indicates if the GOOSE publisher responsible for publishing the data that derives a virtual input is present.	DDB_VIP_PUB_PRES_4
1284	SW	GOOSE virtual input 5- indicates if the GOOSE publisher responsible for publishing the data that derives a virtual input is present.	DDB_VIP_PUB_PRES_5

P743 Logic Nodes			
DDB No	**Source**	**Description**	**Element Name**
1285	SW	GOOSE virtual input 6- indicates if the GOOSE publisher responsible for publishing the data that derives a virtual input is present.	DDB_VIP_PUB_PRES_6
1286	SW	GOOSE virtual input 7- indicates if the GOOSE publisher responsible for publishing the data that derives a virtual input is present.	DDB_VIP_PUB_PRES_7
1287	SW	GOOSE virtual input 8- indicates if the GOOSE publisher responsible for publishing the data that derives a virtual input is present.	DDB_VIP_PUB_PRES_8
1288	SW	GOOSE virtual input 9- indicates if the GOOSE publisher responsible for publishing the data that derives a virtual input is present.	DDB_VIP_PUB_PRES_9
1289	SW	GOOSE virtual input 10- indicates if the GOOSE publisher responsible for publishing the data that derives a virtual input is present.	DDB_VIP_PUB_PRES_10
1290	SW	GOOSE virtual input 11- indicates if the GOOSE publisher responsible for publishing the data that derives a virtual input is present.	DDB_VIP_PUB_PRES_11
1291	SW	GOOSE virtual input 12- indicates if the GOOSE publisher responsible for publishing the data that derives a virtual input is present.	DDB_VIP_PUB_PRES_12
1292	SW	GOOSE virtual input 13- indicates if the GOOSE publisher responsible for publishing the data that derives a virtual input is present.	DDB_VIP_PUB_PRES_13
1293	SW	GOOSE virtual input 14- indicates if the GOOSE publisher responsible for publishing the data that derives a virtual input is present.	DDB_VIP_PUB_PRES_14
1294	SW	GOOSE virtual input 15- indicates if the GOOSE publisher responsible for publishing the data that derives a virtual input is present.	DDB_VIP_PUB_PRES_15

P743 Logic Nodes			
DDB No	Source	Description	Element Name
1295	SW	GOOSE virtual input 16- indicates if the GOOSE publisher responsible for publishing the data that derives a virtual input is present.	DDB_VIP_PUB_PRES_16
1296	SW	GOOSE virtual input 17- indicates if the GOOSE publisher responsible for publishing the data that derives a virtual input is present.	DDB_VIP_PUB_PRES_17
1297	SW	GOOSE virtual input 18- indicates if the GOOSE publisher responsible for publishing the data that derives a virtual input is present.	DDB_VIP_PUB_PRES_18
1298	SW	GOOSE virtual input 19- indicates if the GOOSE publisher responsible for publishing the data that derives a virtual input is present.	DDB_VIP_PUB_PRES_19
1299	SW	GOOSE virtual input 20- indicates if the GOOSE publisher responsible for publishing the data that derives a virtual input is present.	DDB_VIP_PUB_PRES_20
1300	SW	GOOSE virtual input 21- indicates if the GOOSE publisher responsible for publishing the data that derives a virtual input is present.	DDB_VIP_PUB_PRES_21
1301	SW	GOOSE virtual input 22- indicates if the GOOSE publisher responsible for publishing the data that derives a virtual input is present.	DDB_VIP_PUB_PRES_22
1302	SW	GOOSE virtual input 23- indicates if the GOOSE publisher responsible for publishing the data that derives a virtual input is present.	DDB_VIP_PUB_PRES_23
1303	SW	GOOSE virtual input 24- indicates if the GOOSE publisher responsible for publishing the data that derives a virtual input is present.	DDB_VIP_PUB_PRES_24

P743 Logic Nodes			
DDB No	Source	Description	Element Name
1304	SW	GOOSE virtual input 25- indicates if the GOOSE publisher responsible for publishing the data that derives a virtual input is present.	DDB_VIP_PUB_PRES_25
1305	SW	GOOSE virtual input 26- indicates if the GOOSE publisher responsible for publishing the data that derives a virtual input is present.	DDB_VIP_PUB_PRES_26
1306	SW	GOOSE virtual input 27- indicates if the GOOSE publisher responsible for publishing the data that derives a virtual input is present.	DDB_VIP_PUB_PRES_27
1307	SW	GOOSE virtual input 28- indicates if the GOOSE publisher responsible for publishing the data that derives a virtual input is present.	DDB_VIP_PUB_PRES_28
1308	SW	GOOSE virtual input 29- indicates if the GOOSE publisher responsible for publishing the data that derives a virtual input is present.	DDB_VIP_PUB_PRES_29
1309	SW	GOOSE virtual input 30- indicates if the GOOSE publisher responsible for publishing the data that derives a virtual input is present.	DDB_VIP_PUB_PRES_30
1310	SW	GOOSE virtual input 31- indicates if the GOOSE publisher responsible for publishing the data that derives a virtual input is present.	DDB_VIP_PUB_PRES_31
1311	SW	GOOSE virtual input 32- indicates if the GOOSE publisher responsible for publishing the data that derives a virtual input is present.	DDB_VIP_PUB_PRES_32
1312	SW	GOOSE virtual input 33- indicates if the GOOSE publisher responsible for publishing the data that derives a virtual input is present.	DDB_VIP_PUB_PRES_33

P743 Logic Nodes			
DDB No	Source	Description	Element Name
1313	SW	GOOSE virtual input 34- indicates if the GOOSE publisher responsible for publishing the data that derives a virtual input is present.	DDB_VIP_PUB_PRES_34
1314	SW	GOOSE virtual input 35- indicates if the GOOSE publisher responsible for publishing the data that derives a virtual input is present.	DDB_VIP_PUB_PRES_35
1315	SW	GOOSE virtual input 36- indicates if the GOOSE publisher responsible for publishing the data that derives a virtual input is present.	DDB_VIP_PUB_PRES_36
1316	SW	GOOSE virtual input 37- indicates if the GOOSE publisher responsible for publishing the data that derives a virtual input is present.	DDB_VIP_PUB_PRES_37
1317	SW	GOOSE virtual input 38- indicates if the GOOSE publisher responsible for publishing the data that derives a virtual input is present.	DDB_VIP_PUB_PRES_38
1318	SW	GOOSE virtual input 39- indicates if the GOOSE publisher responsible for publishing the data that derives a virtual input is present.	DDB_VIP_PUB_PRES_39
1319	SW	GOOSE virtual input 40- indicates if the GOOSE publisher responsible for publishing the data that derives a virtual input is present.	DDB_VIP_PUB_PRES_40
1320	SW	GOOSE virtual input 41- indicates if the GOOSE publisher responsible for publishing the data that derives a virtual input is present.	DDB_VIP_PUB_PRES_41
1321	SW	GOOSE virtual input 42- indicates if the GOOSE publisher responsible for publishing the data that derives a virtual input is present.	DDB_VIP_PUB_PRES_42

P743 Logic Nodes			
DDB No	**Source**	**Description**	**Element Name**
1322	SW	GOOSE virtual input 43- indicates if the GOOSE publisher responsible for publishing the data that derives a virtual input is present.	DDB_VIP_PUB_PRES_43
1323	SW	GOOSE virtual input 44- indicates if the GOOSE publisher responsible for publishing the data that derives a virtual input is present.	DDB_VIP_PUB_PRES_44
1324	SW	GOOSE virtual input 45- indicates if the GOOSE publisher responsible for publishing the data that derives a virtual input is present.	DDB_VIP_PUB_PRES_45
1325	SW	GOOSE virtual input 46- indicates if the GOOSE publisher responsible for publishing the data that derives a virtual input is present.	DDB_VIP_PUB_PRES_46
1326	SW	GOOSE virtual input 47- indicates if the GOOSE publisher responsible for publishing the data that derives a virtual input is present.	DDB_VIP_PUB_PRES_47
1327	SW	GOOSE virtual input 48- indicates if the GOOSE publisher responsible for publishing the data that derives a virtual input is present.	DDB_VIP_PUB_PRES_48
1328	SW	GOOSE virtual input 49- indicates if the GOOSE publisher responsible for publishing the data that derives a virtual input is present.	DDB_VIP_PUB_PRES_49
1329	SW	GOOSE virtual input 50- indicates if the GOOSE publisher responsible for publishing the data that derives a virtual input is present.	DDB_VIP_PUB_PRES_50
1330	SW	GOOSE virtual input 51- indicates if the GOOSE publisher responsible for publishing the data that derives a virtual input is present.	DDB_VIP_PUB_PRES_51

P743 Logic Nodes			
DDB No	**Source**	**Description**	**Element Name**
1331	SW	GOOSE virtual input 52- indicates if the GOOSE publisher responsible for publishing the data that derives a virtual input is present.	DDB_VIP_PUB_PRES_52
1332	SW	GOOSE virtual input 53- indicates if the GOOSE publisher responsible for publishing the data that derives a virtual input is present.	DDB_VIP_PUB_PRES_53
1333	SW	GOOSE virtual input 54- indicates if the GOOSE publisher responsible for publishing the data that derives a virtual input is present.	DDB_VIP_PUB_PRES_54
1334	SW	GOOSE virtual input 55- indicates if the GOOSE publisher responsible for publishing the data that derives a virtual input is present.	DDB_VIP_PUB_PRES_55
1335	SW	GOOSE virtual input 56- indicates if the GOOSE publisher responsible for publishing the data that derives a virtual input is present.	DDB_VIP_PUB_PRES_56
1336	SW	GOOSE virtual input 57- indicates if the GOOSE publisher responsible for publishing the data that derives a virtual input is present.	DDB_VIP_PUB_PRES_57
1337	SW	GOOSE virtual input 58- indicates if the GOOSE publisher responsible for publishing the data that derives a virtual input is present.	DDB_VIP_PUB_PRES_58
1338	SW	GOOSE virtual input 59- indicates if the GOOSE publisher responsible for publishing the data that derives a virtual input is present.	DDB_VIP_PUB_PRES_59
1339	SW	GOOSE virtual input 60- indicates if the GOOSE publisher responsible for publishing the data that derives a virtual input is present.	DDB_VIP_PUB_PRES_60

P743 Logic Nodes			
DDB No	Source	Description	Element Name
1340	SW	GOOSE virtual input 61- indicates if the GOOSE publisher responsible for publishing the data that derives a virtual input is present.	DDB_VIP_PUB_PRES_61
1341	SW	GOOSE virtual input 62- indicates if the GOOSE publisher responsible for publishing the data that derives a virtual input is present.	DDB_VIP_PUB_PRES_62
1342	SW	GOOSE virtual input 63- indicates if the GOOSE publisher responsible for publishing the data that derives a virtual input is present.	DDB_VIP_PUB_PRES_63
1343	SW	GOOSE virtual input 64- indicates if the GOOSE publisher responsible for publishing the data that derives a virtual input is present.	DDB_VIP_PUB_PRES_64
1344	PSL	Reserve	UNUSED_1344
1345	PSL	Reserve	UNUSED_1345
1346	PSL	Reserve	UNUSED_1346
1347	PSL	Reserve	UNUSED_1347
1348	PSL	Reserve	UNUSED_1348
1349	PSL	Reserve	UNUSED_1349
1350	PSL	Reserve	UNUSED_1350
1351	PSL	Reserve	UNUSED_1351
1352	PSL	Reserve	UNUSED_1352
1353	PSL	Reserve	UNUSED_1353
1354	PSL	Reserve	UNUSED_1354
1355	PSL	Reserve	UNUSED_1355
1356	PSL	Reserve	UNUSED_1356
1357	PSL	Reserve	UNUSED_1357
1358	PSL	Reserve	UNUSED_1358
1359	PSL	Reserve	UNUSED_1359
1360	PSL	Reserve	UNUSED_1360
1361	PSL	Reserve	UNUSED_1361
1362	PSL	Reserve	UNUSED_1362
1363	PSL	Reserve	UNUSED_1363
1364	PSL	Reserve	UNUSED_1364
1365	PSL	Reserve	UNUSED_1365
1366	PSL	Reserve	UNUSED_1366
1367	PSL	Reserve	UNUSED_1367
1368	PSL	Reserve	UNUSED_1368
1369	PSL	Reserve	UNUSED_1369
1370	PSL	Reserve	UNUSED_1370

P743 Logic Nodes			
DDB No	Source	Description	Element Name
1371	PSL	Reserve	UNUSED_1371
1372	PSL	Reserve	UNUSED_1372
1373	PSL	Reserve	UNUSED_1373
1374	PSL	Reserve	UNUSED_1374
1375	PSL	Reserve	UNUSED_1375
1376	PSL	Reserve	UNUSED_1376
1377	PSL	Reserve	UNUSED_1377
1378	PSL	Reserve	UNUSED_1378
1379	PSL	Reserve	UNUSED_1379
1380	PSL	Reserve	UNUSED_1380
1381	PSL	Reserve	UNUSED_1381
1382	PSL	Reserve	UNUSED_1382
1383	PSL	Reserve	UNUSED_1383
1384	PSL	Reserve	UNUSED_1384
1385	PSL	Reserve	UNUSED_1385
1386	PSL	Reserve	UNUSED_1386
1387	PSL	Reserve	UNUSED_1387
1388	PSL	Reserve	UNUSED_1388
1389	PSL	Reserve	UNUSED_1389
1390	PSL	Reserve	UNUSED_1390
1391	PSL	Reserve	UNUSED_1391
1392	PSL	Reserve	UNUSED_1392
1393	PSL	Reserve	UNUSED_1393
1394	PSL	Reserve	UNUSED_1394
1395	PSL	Reserve	UNUSED_1395
1396	PSL	Reserve	UNUSED_1396
1397	PSL	Reserve	UNUSED_1397
1398	PSL	Reserve	UNUSED_1398
1399	PSL	Reserve	UNUSED_1399
1400	PSL	Reserve	UNUSED_1400
1401	PSL	Reserve	UNUSED_1401
1402	PSL	Reserve	UNUSED_1402
1403	PSL	Reserve	UNUSED_1403
1404	PSL	Reserve	UNUSED_1404
1405	PSL	Reserve	UNUSED_1405
1406	PSL	Reserve	UNUSED_1406
1407	PSL	Reserve	UNUSED_1407
1408	PSL	Reserve	UNUSED_1408
1409	PSL	Reserve	UNUSED_1409
1410	PSL	Reserve	UNUSED_1410
1411	PSL	Reserve	UNUSED_1411
1412	PSL	Reserve	UNUSED_1412
1413	PSL	Reserve	UNUSED_1413
1414	PSL	Reserve	UNUSED_1414
1415	PSL	Reserve	UNUSED_1415
1416	PSL	Reserve	UNUSED_1416

P743 Logic Nodes			
DDB No	Source	Description	Element Name
1417	PSL	Reserve	UNUSED_1417
1418	PSL	Reserve	UNUSED_1418
1419	PSL	Reserve	UNUSED_1419
1420	PSL	Reserve	UNUSED_1420
1421	PSL	Reserve	UNUSED_1421
1422	PSL	Reserve	UNUSED_1422
1423	PSL	Reserve	UNUSED_1423
1424	PSL	Reserve	UNUSED_1424
1425	PSL	Reserve	UNUSED_1425
1426	PSL	Reserve	UNUSED_1426
1427	PSL	Reserve	UNUSED_1427
1428	PSL	Reserve	UNUSED_1428
1429	PSL	Reserve	UNUSED_1429
1430	PSL	Reserve	UNUSED_1430
1431	PSL	Reserve	UNUSED_1431
1432	PSL	Reserve	UNUSED_1432
1433	PSL	Reserve	UNUSED_1433
1434	PSL	Reserve	UNUSED_1434
1435	PSL	Reserve	UNUSED_1435
1436	PSL	Reserve	UNUSED_1436
1437	PSL	Reserve	UNUSED_1437
1438	PSL	Reserve	UNUSED_1438
1439	PSL	Reserve	UNUSED_1439
1440	PSL	Reserve	UNUSED_1440
1441	PSL	Reserve	UNUSED_1441
1442	PSL	Reserve	UNUSED_1442
1443	PSL	Reserve	UNUSED_1443
1444	PSL	Reserve	UNUSED_1444
1445	PSL	Reserve	UNUSED_1445
1446	PSL	Reserve	UNUSED_1446
1447	PSL	Reserve	UNUSED_1447
1448	PSL	Reserve	UNUSED_1448
1449	PSL	Reserve	UNUSED_1449
1450	PSL	Reserve	UNUSED_1450
1451	PSL	Reserve	UNUSED_1451
1452	PSL	Reserve	UNUSED_1452
1453	PSL	Reserve	UNUSED_1453
1454	PSL	Reserve	UNUSED_1454
1455	PSL	Reserve	UNUSED_1455
1456	PSL	Reserve	UNUSED_1456
1457	PSL	Reserve	UNUSED_1457
1458	PSL	Reserve	UNUSED_1458
1459	PSL	Reserve	UNUSED_1459
1460	PSL	Reserve	UNUSED_1460
1461	PSL	Reserve	UNUSED_1461
1462	PSL	Reserve	UNUSED_1462

P743 Logic Nodes			
DDB No	Source	Description	Element Name
1463	PSL	Reserve	UNUSED_1463
1464	PSL	Reserve	UNUSED_1464
1465	PSL	Reserve	UNUSED_1465
1466	PSL	Reserve	UNUSED_1466
1467	PSL	Reserve	UNUSED_1467
1468	PSL	Reserve	UNUSED_1468
1469	PSL	Reserve	UNUSED_1469
1470	PSL	Reserve	UNUSED_1470
1471	PSL	Reserve	UNUSED_1471
1472	PSL	Reserve	UNUSED_1472
1473	PSL	Reserve	UNUSED_1473
1474	PSL	Reserve	UNUSED_1474
1475	PSL	Reserve	UNUSED_1475
1476	PSL	Reserve	UNUSED_1476
1477	PSL	Reserve	UNUSED_1477
1478	PSL	Reserve	UNUSED_1478
1479	PSL	Reserve	UNUSED_1479
1480	PSL	Reserve	UNUSED_1480
1481	PSL	Reserve	UNUSED_1481
1482	PSL	Reserve	UNUSED_1482
1483	PSL	Reserve	UNUSED_1483
1484	PSL	Reserve	UNUSED_1484
1485	PSL	Reserve	UNUSED_1485
1486	PSL	Reserve	UNUSED_1486
1487	PSL	Reserve	UNUSED_1487
1488	PSL	Reserve	UNUSED_1488
1489	PSL	Reserve	UNUSED_1489
1490	PSL	Reserve	UNUSED_1490
1491	PSL	Reserve	UNUSED_1491
1492	PSL	Reserve	UNUSED_1492
1493	PSL	Reserve	UNUSED_1493
1494	PSL	Reserve	UNUSED_1494
1495	PSL	Reserve	UNUSED_1495
1496	PSL	Reserve	UNUSED_1496
1497	PSL	Reserve	UNUSED_1497
1498	PSL	Reserve	UNUSED_1498
1499	PSL	Reserve	UNUSED_1499
1500	PSL	Reserve	UNUSED_1500
1501	PSL	Reserve	UNUSED_1501
1502	PSL	Reserve	UNUSED_1502
1503	PSL	Reserve	UNUSED_1503
1504	PSL	Reserve	UNUSED_1504
1505	PSL	Reserve	UNUSED_1505
1506	PSL	Reserve	UNUSED_1506
1507	PSL	Reserve	UNUSED_1507
1508	PSL	Reserve	UNUSED_1508

P743 Logic Nodes			
DDB No	Source	Description	Element Name
1509	PSL	Reserve	UNUSED_1509
1510	PSL	Reserve	UNUSED_1510
1511	PSL	Reserve	UNUSED_1511
1512	PSL	Reserve	UNUSED_1512
1513	PSL	Reserve	UNUSED_1513
1514	PSL	Reserve	UNUSED_1514
1515	PSL	Reserve	UNUSED_1515
1516	PSL	Reserve	UNUSED_1516
1517	PSL	Reserve	UNUSED_1517
1518	PSL	Reserve	UNUSED_1518
1519	PSL	Reserve	UNUSED_1519
1520	PSL	Reserve	UNUSED_1520
1521	PSL	Reserve	UNUSED_1521
1522	PSL	Reserve	UNUSED_1522
1523	PSL	Reserve	UNUSED_1523
1524	PSL	Reserve	UNUSED_1524
1525	PSL	Reserve	UNUSED_1525
1526	PSL	Reserve	UNUSED_1526
1527	PSL	Reserve	UNUSED_1527
1528	PSL	Reserve	UNUSED_1528
1529	PSL	Reserve	UNUSED_1529
1530	PSL	Reserve	UNUSED_1530
1531	PSL	Reserve	UNUSED_1531
1532	PSL	Reserve	UNUSED_1532
1533	PSL	Reserve	UNUSED_1533
1534	PSL	Reserve	UNUSED_1534
1535	PSL	Reserve	UNUSED_1535
1536	PSL	Reserve	UNUSED_1536
1537	PSL	Reserve	UNUSED_1537
1538	PSL	Reserve	UNUSED_1538
1539	PSL	Reserve	UNUSED_1539
1540	PSL	Reserve	UNUSED_1540
1541	PSL	Reserve	UNUSED_1541
1542	PSL	Reserve	UNUSED_1542
1543	PSL	Reserve	UNUSED_1543
1544	PSL	Reserve	UNUSED_1544
1545	PSL	Reserve	UNUSED_1545
1546	PSL	Reserve	UNUSED_1546
1547	PSL	Reserve	UNUSED_1547
1548	PSL	Reserve	UNUSED_1548
1549	PSL	Reserve	UNUSED_1549
1550	PSL	Reserve	UNUSED_1550
1551	PSL	Reserve	UNUSED_1551
1552	PSL	Reserve	UNUSED_1552
1553	PSL	Reserve	UNUSED_1553
1554	PSL	Reserve	UNUSED_1554

P743 Logic Nodes			
DDB No	Source	Description	Element Name
1555	PSL	Reserve	UNUSED_1555
1556	PSL	Reserve	UNUSED_1556
1557	PSL	Reserve	UNUSED_1557
1558	PSL	Reserve	UNUSED_1558
1559	PSL	Reserve	UNUSED_1559
1560	PSL	Reserve	UNUSED_1560
1561	PSL	Reserve	UNUSED_1561
1562	PSL	Reserve	UNUSED_1562
1563	PSL	Reserve	UNUSED_1563
1564	PSL	Reserve	UNUSED_1564
1565	PSL	Reserve	UNUSED_1565
1566	PSL	Reserve	UNUSED_1566
1567	PSL	Reserve	UNUSED_1567
1568	PSL	Reserve	UNUSED_1568
1569	PSL	Reserve	UNUSED_1569
1570	PSL	Reserve	UNUSED_1570
1571	PSL	Reserve	UNUSED_1571
1572	PSL	Reserve	UNUSED_1572
1573	PSL	Reserve	UNUSED_1573
1574	PSL	Reserve	UNUSED_1574
1575	PSL	Reserve	UNUSED_1575
1576	PSL	Reserve	UNUSED_1576
1577	PSL	Reserve	UNUSED_1577
1578	PSL	Reserve	UNUSED_1578
1579	PSL	Reserve	UNUSED_1579
1580	PSL	Reserve	UNUSED_1580
1581	PSL	Reserve	UNUSED_1581
1582	PSL	Reserve	UNUSED_1582
1583	PSL	Reserve	UNUSED_1583
1584	PSL	Reserve	UNUSED_1584
1585	PSL	Reserve	UNUSED_1585
1586	PSL	Reserve	UNUSED_1586
1587	PSL	Reserve	UNUSED_1587
1588	PSL	Reserve	UNUSED_1588
1589	PSL	Reserve	UNUSED_1589
1590	PSL	Reserve	UNUSED_1590
1591	PSL	Reserve	UNUSED_1591
1592	PSL	Reserve	UNUSED_1592
1593	PSL	Reserve	UNUSED_1593
1594	PSL	Reserve	UNUSED_1594
1595	PSL	Reserve	UNUSED_1595
1596	PSL	Reserve	UNUSED_1596
1597	PSL	Reserve	UNUSED_1597
1598	PSL	Reserve	UNUSED_1598
1599	PSL	Reserve	UNUSED_1599
1600	PSL	Reserve	UNUSED_1600

P743 Logic Nodes			
DDB No	Source	Description	Element Name
1601	PSL	Reserve	UNUSED_1601
1602	PSL	Reserve	UNUSED_1602
1603	PSL	Reserve	UNUSED_1603
1604	PSL	Reserve	UNUSED_1604
1605	PSL	Reserve	UNUSED_1605
1606	PSL	Reserve	UNUSED_1606
1607	PSL	Reserve	UNUSED_1607
1608	PSL	Reserve	UNUSED_1608
1609	PSL	Reserve	UNUSED_1609
1610	PSL	Reserve	UNUSED_1610
1611	PSL	Reserve	UNUSED_1611
1612	PSL	Reserve	UNUSED_1612
1613	PSL	Reserve	UNUSED_1613
1614	PSL	Reserve	UNUSED_1614
1615	PSL	Reserve	UNUSED_1615
1616	PSL	Reserve	UNUSED_1616
1617	PSL	Reserve	UNUSED_1617
1618	PSL	Reserve	UNUSED_1618
1619	PSL	Reserve	UNUSED_1619
1620	PSL	Reserve	UNUSED_1620
1621	PSL	Reserve	UNUSED_1621
1622	PSL	Reserve	UNUSED_1622
1623	PSL	Reserve	UNUSED_1623
1624	PSL	Reserve	UNUSED_1624
1625	PSL	Reserve	UNUSED_1625
1626	PSL	Reserve	UNUSED_1626
1627	PSL	Reserve	UNUSED_1627
1628	PSL	Reserve	UNUSED_1628
1629	PSL	Reserve	UNUSED_1629
1630	PSL	Reserve	UNUSED_1630
1631	PSL	Reserve	UNUSED_1631
1632	PSL	Reserve	UNUSED_1632
1633	PSL	Reserve	UNUSED_1633
1634	PSL	Reserve	UNUSED_1634
1635	PSL	Reserve	UNUSED_1635
1636	PSL	Reserve	UNUSED_1636
1637	PSL	Reserve	UNUSED_1637
1638	PSL	Reserve	UNUSED_1638
1639	PSL	Reserve	UNUSED_1639
1640	PSL	Reserve	UNUSED_1640
1641	PSL	Reserve	UNUSED_1641
1642	PSL	Reserve	UNUSED_1642
1643	PSL	Reserve	UNUSED_1643
1644	PSL	Reserve	UNUSED_1644
1645	PSL	Reserve	UNUSED_1645
1646	PSL	Reserve	UNUSED_1646

P743 Logic Nodes			
DDB No	Source	Description	Element Name
1647	PSL	Reserve	UNUSED_1647
1648	PSL	Reserve	UNUSED_1648
1649	PSL	Reserve	UNUSED_1649
1650	PSL	Reserve	UNUSED_1650
1651	PSL	Reserve	UNUSED_1651
1652	PSL	Reserve	UNUSED_1652
1653	PSL	Reserve	UNUSED_1653
1654	PSL	Reserve	UNUSED_1654
1655	PSL	Reserve	UNUSED_1655
1656	PSL	Reserve	UNUSED_1656
1657	PSL	Reserve	UNUSED_1657
1658	PSL	Reserve	UNUSED_1658
1659	PSL	Reserve	UNUSED_1659
1660	PSL	Reserve	UNUSED_1660
1661	PSL	Reserve	UNUSED_1661
1662	PSL	Reserve	UNUSED_1662
1663	PSL	Reserve	UNUSED_1663
1664	PSL	Reserve	UNUSED_1664
1665	PSL	Reserve	UNUSED_1665
1666	PSL	Reserve	UNUSED_1666
1667	PSL	Reserve	UNUSED_1667
1668	PSL	Reserve	UNUSED_1668
1669	PSL	Reserve	UNUSED_1669
1670	PSL	Reserve	UNUSED_1670
1671	PSL	Reserve	UNUSED_1671
1672	PSL	Reserve	UNUSED_1672
1673	PSL	Reserve	UNUSED_1673
1674	PSL	Reserve	UNUSED_1674
1675	PSL	Reserve	UNUSED_1675
1676	PSL	Reserve	UNUSED_1676
1677	PSL	Reserve	UNUSED_1677
1678	PSL	Reserve	UNUSED_1678
1679	PSL	Reserve	UNUSED_1679
1680	PSL	Reserve	UNUSED_1680
1681	PSL	Reserve	UNUSED_1681
1682	PSL	Reserve	UNUSED_1682
1683	PSL	Reserve	UNUSED_1683
1684	PSL	Reserve	UNUSED_1684
1685	PSL	Reserve	UNUSED_1685
1686	PSL	Reserve	UNUSED_1686
1687	PSL	Reserve	UNUSED_1687
1688	PSL	Reserve	UNUSED_1688
1689	PSL	Reserve	UNUSED_1689
1690	PSL	Reserve	UNUSED_1690
1691	PSL	Reserve	UNUSED_1691
1692	PSL	Reserve	UNUSED_1692

P743 Logic Nodes			
DDB No	Source	Description	Element Name
1693	PSL	Reserve	UNUSED_1693
1694	PSL	Reserve	UNUSED_1694
1695	PSL	Reserve	UNUSED_1695
1696	PSL	Reserve	UNUSED_1696
1697	PSL	Reserve	UNUSED_1697
1698	PSL	Reserve	UNUSED_1698
1699	PSL	Reserve	UNUSED_1699
1700	PSL	Reserve	UNUSED_1700
1701	PSL	Reserve	UNUSED_1701
1702	PSL	Reserve	UNUSED_1702
1703	PSL	Reserve	UNUSED_1703
1704	PSL	Reserve	UNUSED_1704
1705	PSL	Reserve	UNUSED_1705
1706	PSL	Reserve	UNUSED_1706
1707	PSL	Reserve	UNUSED_1707
1708	PSL	Reserve	UNUSED_1708
1709	PSL	Reserve	UNUSED_1709
1710	PSL	Reserve	UNUSED_1710
1711	PSL	Reserve	UNUSED_1711
1712	PSL	Reserve	UNUSED_1712
1713	PSL	Reserve	UNUSED_1713
1714	PSL	Reserve	UNUSED_1714
1715	PSL	Reserve	UNUSED_1715
1716	PSL	Reserve	UNUSED_1716
1717	PSL	Reserve	UNUSED_1717
1718	PSL	Reserve	UNUSED_1718
1719	PSL	Reserve	UNUSED_1719
1720	PSL	Reserve	UNUSED_1720
1721	PSL	Reserve	UNUSED_1721
1722	PSL	Reserve	UNUSED_1722
1723	PSL	Reserve	UNUSED_1723
1724	PSL	Reserve	UNUSED_1724
1725	PSL	Reserve	UNUSED_1725
1726	PSL	Reserve	UNUSED_1726
1727	PSL	Reserve	UNUSED_1727
1728	PSL	Reserve	UNUSED_1728
1729	PSL	Reserve	UNUSED_1729
1730	PSL	Reserve	UNUSED_1730
1731	PSL	Reserve	UNUSED_1731
1732	PSL	Reserve	UNUSED_1732
1733	PSL	Reserve	UNUSED_1733
1734	PSL	Reserve	UNUSED_1734
1735	PSL	Reserve	UNUSED_1735
1736	PSL	Reserve	UNUSED_1736
1737	PSL	Reserve	UNUSED_1737
1738	PSL	Reserve	UNUSED_1738

P743 Logic Nodes			
DDB No	Source	Description	Element Name
1739	PSL	Reserve	UNUSED_1739
1740	PSL	Reserve	UNUSED_1740
1741	PSL	Reserve	UNUSED_1741
1742	PSL	Reserve	UNUSED_1742
1743	PSL	Reserve	UNUSED_1743
1744	PSL	Reserve	UNUSED_1744
1745	PSL	Reserve	UNUSED_1745
1746	PSL	Reserve	UNUSED_1746
1747	PSL	Reserve	UNUSED_1747
1748	PSL	Reserve	UNUSED_1748
1749	PSL	Reserve	UNUSED_1749
1750	PSL	Reserve	UNUSED_1750
1751	PSL	Reserve	UNUSED_1751
1752	PSL	Reserve	UNUSED_1752
1753	PSL	Reserve	UNUSED_1753
1754	PSL	Reserve	UNUSED_1754
1755	PSL	Reserve	UNUSED_1755
1756	PSL	Reserve	UNUSED_1756
1757	PSL	Reserve	UNUSED_1757
1758	PSL	Reserve	UNUSED_1758
1759	PSL	Reserve	UNUSED_1759
1760	PSL	Reserve	UNUSED_1760
1761	PSL	Reserve	UNUSED_1761
1762	PSL	Reserve	UNUSED_1762
1763	PSL	Reserve	UNUSED_1763
1764	PSL	Reserve	UNUSED_1764
1765	PSL	Reserve	UNUSED_1765
1766	PSL	Reserve	UNUSED_1766
1767	PSL	Reserve	UNUSED_1767
1768	PSL	Reserve	UNUSED_1768
1769	PSL	Reserve	UNUSED_1769
1770	PSL	Reserve	UNUSED_1770
1771	PSL	Reserve	UNUSED_1771
1772	PSL	Reserve	UNUSED_1772
1773	PSL	Reserve	UNUSED_1773
1774	PSL	Reserve	UNUSED_1774
1775	PSL	Reserve	UNUSED_1775
1776	PSL	Reserve	UNUSED_1776
1777	PSL	Reserve	UNUSED_1777
1778	PSL	Reserve	UNUSED_1778
1779	PSL	Reserve	UNUSED_1779
1780	PSL	Reserve	UNUSED_1780
1781	PSL	Reserve	UNUSED_1781
1782	PSL	Reserve	UNUSED_1782
1783	PSL	Reserve	UNUSED_1783
1784	PSL	Reserve	UNUSED_1784

P743 Logic Nodes			
DDB No	Source	Description	Element Name
1785	PSL	Reserve	UNUSED_1785
1786	PSL	Reserve	UNUSED_1786
1787	PSL	Reserve	UNUSED_1787
1788	PSL	Reserve	UNUSED_1788
1789	PSL	Reserve	UNUSED_1789
1790	PSL	Reserve	UNUSED_1790
1791	PSL	Reserve	UNUSED_1791
1792	PSL	Reserve	UNUSED_1792
1793	PSL	Reserve	UNUSED_1793
1794	SW	IRIG-B Status Signal Valid	DDB_IRIGB_SIGNAL_VALID
1795	SW	Logic 0 for use in PSL. This can be used to force a DDB, contact, LED, InterMiCOM or Virtual Output low (or high by using an inversion gate)	DDB_LOGIC_0
1796	SW	If this location DST is in effect now	DDB_DST_STATUS
1797	SW	Network Interface Card link 1 fail indication	DDB_NIC_LINK_1_FAIL
1798	SW	Network Interface Card link 2 fail indication	DDB_NIC_LINK_2_FAIL
1799	SW	Network Interface Card link 3 fail indication	DDB_NIC_LINK_3_FAIL
1800	SW	User logged into UI	DDB_UI_LOGGEDIN
1801	SW	User logged into front port courier	DDB_FCUR_LOGGEDIN
1802	SW	User logged into Rear Port1 courier	DDB_RP1_LOGGEDIN
1803	SW	User logged into Rear Port2 courier	DDB_RP2_LOGGEDIN
1804	SW	User logged into turnneled courier	DDB_TNL_LOGGEDIN
1805	SW	User logged into co-processor courier	DDB_CPR_LOGGEDIN
1806	PSL	Self-reset user alarm 1	DDB_USER_ALARM_1
1807	PSL	Self-reset user alarm 2	DDB_USER_ALARM_2
1808	PSL	Self-reset user alarm 3	DDB_USER_ALARM_3
1809	PSL	Self-reset user alarm 4	DDB_USER_ALARM_4
1810	PSL	Self-reset user alarm 5	DDB_USER_ALARM_5
1811	PSL	Self-reset user alarm 6	DDB_USER_ALARM_6
1812	PSL	Self-reset user alarm 7	DDB_USER_ALARM_7
1813	PSL	Self-reset user alarm 8	DDB_USER_ALARM_8
1814	PSL	Self-reset user alarm 9	DDB_USER_ALARM_9
1815	PSL	Self-reset user alarm 10	DDB_USER_ALARM_10
1816	PSL	Self-reset user alarm 11	DDB_USER_ALARM_11
1817	PSL	Self-reset user alarm 12	DDB_USER_ALARM_12
1818	PSL	Self-reset user alarm 13	DDB_USER_ALARM_13
1819	PSL	Self-reset user alarm 14	DDB_USER_ALARM_14
1820	PSL	Self-reset user alarm 15	DDB_USER_ALARM_15
1821	PSL	Self-reset user alarm 16	DDB_USER_ALARM_16

P743 Logic Nodes			
DDB No	Source	Description	Element Name
1822	PSL	Manual-reset user alarm 17	DDB_USER_ALARM_17
1823	PSL	Manual-reset user alarm 18	DDB_USER_ALARM_18
1824	PSL	Manual-reset user alarm 19	DDB_USER_ALARM_19
1825	PSL	Manual-reset user alarm 20	DDB_USER_ALARM_20
1826	PSL	Manual-reset user alarm 21	DDB_USER_ALARM_21
1827	PSL	Manual-reset user alarm 22	DDB_USER_ALARM_22
1828	PSL	Manual-reset user alarm 23	DDB_USER_ALARM_23
1829	PSL	Manual-reset user alarm 24	DDB_USER_ALARM_24
1830	PSL	Manual-reset user alarm 25	DDB_USER_ALARM_25
1831	PSL	Manual-reset user alarm 26	DDB_USER_ALARM_26
1832	PSL	Manual-reset user alarm 27	DDB_USER_ALARM_27
1833	PSL	Manual-reset user alarm 28	DDB_USER_ALARM_28
1834	PSL	Manual-reset user alarm 29	DDB_USER_ALARM_29
1835	PSL	Manual-reset user alarm 30	DDB_USER_ALARM_30
1836	PSL	Manual-reset user alarm 31	DDB_USER_ALARM_31
1837	PSL	Manual-reset user alarm 32	DDB_USER_ALARM_32
1838	SW	Reserve	DDB_UNUSED_DR
1839	PSL	Reserve	UNUSED_1839
1840	PSL	Reserve	UNUSED_1840
1841	PSL	Reserve	UNUSED_1841
1842	PSL	Reserve	UNUSED_1842
1843	PSL	Reserve	UNUSED_1843
1844	PSL	Reserve	UNUSED_1844
1845	PSL	Reserve	UNUSED_1845
1846	PSL	Reserve	UNUSED_1846
1847	PSL	Reserve	UNUSED_1847
1848	PSL	Reserve	UNUSED_1848
1849	PSL	Reserve	UNUSED_1849
1850	PSL	Reserve	UNUSED_1850
1851	PSL	Reserve	UNUSED_1851
1852	PSL	Reserve	UNUSED_1852
1853	PSL	Reserve	UNUSED_1853
1854	PSL	Reserve	UNUSED_1854
1855	PSL	Reserve	UNUSED_1855
1856	PSL	Reserve	UNUSED_1856
1857	PSL	Reserve	UNUSED_1857
1858	PSL	Reserve	UNUSED_1858
1859	PSL	Reserve	UNUSED_1859
1860	PSL	Reserve	UNUSED_1860
1861	PSL	Reserve	UNUSED_1861
1862	PSL	Reserve	UNUSED_1862
1863	PSL	Reserve	UNUSED_1863
1864	PSL	Reserve	UNUSED_1864
1865	PSL	Reserve	UNUSED_1865
1866	PSL	Reserve	UNUSED_1866
1867	PSL	Reserve	UNUSED_1867

P743 Logic Nodes			
DDB No	Source	Description	Element Name
1868	PSL	Reserve	UNUSED_1868
1869	PSL	Reserve	UNUSED_1869
1870	PSL	Reserve	UNUSED_1870
1871	PSL	Reserve	UNUSED_1871
1872	PSL	Reserve	UNUSED_1872
1873	PSL	Reserve	UNUSED_1873
1874	PSL	Reserve	UNUSED_1874
1875	PSL	Reserve	UNUSED_1875
1876	PSL	Reserve	UNUSED_1876
1877	PSL	Reserve	UNUSED_1877
1878	PSL	Reserve	UNUSED_1878
1879	PSL	Reserve	UNUSED_1879
1880	PSL	Reserve	UNUSED_1880
1881	PSL	Reserve	UNUSED_1881
1882	PSL	Reserve	UNUSED_1882
1883	PSL	Reserve	UNUSED_1883
1884	PSL	Reserve	UNUSED_1884
1885	PSL	Reserve	UNUSED_1885
1886	PSL	Reserve	UNUSED_1886
1887	PSL	Reserve	UNUSED_1887
1888	PSL	Reserve	UNUSED_1888
1889	PSL	Reserve	UNUSED_1889
1890	PSL	Reserve	UNUSED_1890
1891	PSL	Reserve	UNUSED_1891
1892	PSL	Reserve	UNUSED_1892
1893	PSL	Reserve	UNUSED_1893
1894	PSL	Reserve	UNUSED_1894
1895	PSL	Reserve	UNUSED_1895
1896	PSL	Reserve	UNUSED_1896
1897	PSL	Reserve	UNUSED_1897
1898	PSL	Reserve	UNUSED_1898
1899	PSL	Reserve	UNUSED_1899
1900	PSL	Reserve	UNUSED_1900
1901	PSL	Reserve	UNUSED_1901
1902	PSL	Reserve	UNUSED_1902
1903	PSL	Reserve	UNUSED_1903
1904	PSL	Reserve	UNUSED_1904
1905	PSL	Reserve	UNUSED_1905
1906	PSL	Reserve	UNUSED_1906
1907	PSL	Reserve	UNUSED_1907
1908	PSL	Reserve	UNUSED_1908
1909	PSL	Reserve	UNUSED_1909
1910	PSL	Reserve	UNUSED_1910
1911	PSL	Reserve	UNUSED_1911
1912	PSL	Reserve	UNUSED_1912
1913	PSL	Reserve	UNUSED_1913

P743 Logic Nodes			
DDB No	Source	Description	Element Name
1914	PSL	Reserve	UNUSED_1914
1915	PSL	Reserve	UNUSED_1915
1916	PSL	Reserve	UNUSED_1916
1917	PSL	Reserve	UNUSED_1917
1918	PSL	Reserve	UNUSED_1918
1919	PSL	Reserve	UNUSED_1919
1920	PSL	Reserve	UNUSED_1920
1921	PSL	Reserve	UNUSED_1921
1922	PSL	Reserve	UNUSED_1922
1923	PSL	Reserve	UNUSED_1923
1924	PSL	Reserve	UNUSED_1924
1925	PSL	Reserve	UNUSED_1925
1926	PSL	Reserve	UNUSED_1926
1927	PSL	Reserve	UNUSED_1927
1928	PSL	Reserve	UNUSED_1928
1929	PSL	Reserve	UNUSED_1929
1930	PSL	Reserve	UNUSED_1930
1931	PSL	Reserve	UNUSED_1931
1932	PSL	Reserve	UNUSED_1932
1933	PSL	Reserve	UNUSED_1933
1934	PSL	Reserve	UNUSED_1934
1935	PSL	Reserve	UNUSED_1935
1936	PSL	Reserve	UNUSED_1936
1937	PSL	Reserve	UNUSED_1937
1938	PSL	Reserve	UNUSED_1938
1939	PSL	Reserve	UNUSED_1939
1940	PSL	Reserve	UNUSED_1940
1941	PSL	Reserve	UNUSED_1941
1942	PSL	Reserve	UNUSED_1942
1943	PSL	Reserve	UNUSED_1943
1944	PSL	Reserve	UNUSED_1944
1945	PSL	Reserve	UNUSED_1945
1946	PSL	Reserve	UNUSED_1946
1947	PSL	Reserve	UNUSED_1947
1948	PSL	Reserve	UNUSED_1948
1949	PSL	Reserve	UNUSED_1949
1950	PSL	Reserve	UNUSED_1950
1951	PSL	Reserve	UNUSED_1951
1952	PSL	Reserve	UNUSED_1952
1953	PSL	Reserve	UNUSED_1953
1954	PSL	Reserve	UNUSED_1954
1955	PSL	Reserve	UNUSED_1955
1956	PSL	Reserve	UNUSED_1956
1957	PSL	Reserve	UNUSED_1957
1958	PSL	Reserve	UNUSED_1958
1959	PSL	Reserve	UNUSED_1959

P743 Logic Nodes			
DDB No	Source	Description	Element Name
1960	PSL	Reserve	UNUSED_1960
1961	PSL	Reserve	UNUSED_1961
1962	PSL	Reserve	UNUSED_1962
1963	PSL	Reserve	UNUSED_1963
1964	PSL	Reserve	UNUSED_1964
1965	PSL	Reserve	UNUSED_1965
1966	PSL	Reserve	UNUSED_1966
1967	PSL	Reserve	UNUSED_1967
1968	PSL	Reserve	UNUSED_1968
1969	PSL	Reserve	UNUSED_1969
1970	PSL	Reserve	UNUSED_1970
1971	PSL	Reserve	UNUSED_1971
1972	PSL	Reserve	UNUSED_1972
1973	PSL	Reserve	UNUSED_1973
1974	PSL	Reserve	UNUSED_1974
1975	PSL	Reserve	UNUSED_1975
1976	PSL	Reserve	UNUSED_1976
1977	PSL	Reserve	UNUSED_1977
1978	PSL	Reserve	UNUSED_1978
1979	PSL	Reserve	UNUSED_1979
1980	PSL	Reserve	UNUSED_1980
1981	PSL	Reserve	UNUSED_1981
1982	PSL	Reserve	UNUSED_1982
1983	PSL	Reserve	UNUSED_1983
1984	PSL	Reserve	UNUSED_1984
1985	PSL	Reserve	UNUSED_1985
1986	PSL	Reserve	UNUSED_1986
1987	PSL	Reserve	UNUSED_1987
1988	PSL	Reserve	UNUSED_1988
1989	PSL	Reserve	UNUSED_1989
1990	PSL	Reserve	UNUSED_1990
1991	PSL	Reserve	UNUSED_1991
1992	PSL	Reserve	UNUSED_1992
1993	PSL	Reserve	UNUSED_1993
1994	PSL	Reserve	UNUSED_1994
1995	PSL	Reserve	UNUSED_1995
1996	PSL	Reserve	UNUSED_1996
1997	PSL	Reserve	UNUSED_1997
1998	PSL	Reserve	UNUSED_1998
1999	PSL	Reserve	UNUSED_1999
2000	PSL	Reserve	UNUSED_2000
2001	PSL	Reserve	UNUSED_2001
2002	PSL	Reserve	UNUSED_2002
2003	PSL	Reserve	UNUSED_2003
2004	PSL	Reserve	UNUSED_2004
2005	PSL	Reserve	UNUSED_2005

P743 Logic Nodes			
DDB No	Source	Description	Element Name
2006	PSL	Reserve	UNUSED_2006
2007	PSL	Reserve	UNUSED_2007
2008	PSL	Reserve	UNUSED_2008
2009	PSL	Reserve	UNUSED_2009
2010	PSL	Reserve	UNUSED_2010
2011	PSL	Reserve	UNUSED_2011
2012	PSL	Reserve	UNUSED_2012
2013	PSL	Reserve	UNUSED_2013
2014	PSL	Reserve	UNUSED_2014
2015	PSL	Reserve	UNUSED_2015
2016	PSL	Reserve	UNUSED_2016
2017	PSL	Reserve	UNUSED_2017
2018	PSL	Reserve	UNUSED_2018
2019	PSL	Reserve	UNUSED_2019
2020	PSL	Reserve	UNUSED_2020
2021	PSL	Reserve	UNUSED_2021
2022	PSL	Reserve	UNUSED_2022
2023	PSL	Reserve	UNUSED_2023
2024	PSL	Reserve	UNUSED_2024
2025	PSL	Reserve	UNUSED_2025
2026	PSL	Reserve	UNUSED_2026
2027	PSL	Reserve	UNUSED_2027
2028	PSL	Reserve	UNUSED_2028
2029	PSL	Reserve	UNUSED_2029
2030	PSL	Reserve	UNUSED_2030
2031	PSL	Reserve	UNUSED_2031
2032	PSL	Reserve	UNUSED_2032
2033	PSL	Reserve	UNUSED_2033
2034	PSL	Reserve	UNUSED_2034
2035	PSL	Reserve	UNUSED_2035
2036	PSL	Reserve	UNUSED_2036
2037	PSL	Reserve	UNUSED_2037
2038	PSL	Reserve	UNUSED_2038
2039	PSL	Reserve	UNUSED_2039
2040	PSL	Reserve	UNUSED_2040
2041	PSL	Reserve	UNUSED_2041
2042	PSL	Reserve	UNUSED_2042
2043	PSL	Reserve	UNUSED_2043
2044	PSL	Reserve	UNUSED_2044
2045	PSL	Reserve	UNUSED_2045
2046	PSL	Reserve	UNUSED_2046
2047	PSL	Reserve	UNUSED_2047

Table 3 - Description of available logic nodes for P743 (sorted by DDB No)

5 FACTORY DEFAULT PROGRAMMABLE SCHEME LOGIC

The following section details the default settings of the PSL. The P740 models are as follows:

Model	Logic Inputs	Relay Outputs
P741xxxAxxxxxxM	8	8
P742xxxAxxxxxxL P742xxxBxxxxxxL	16 8	8 8 + 4 high break relays
P743xxxAxxxxxxM P743xxxBxxxxxxM P743xxxCxxxxxxM P743xxxDxxxxxxM	24 16 24 16	16 16 + 4 high break relays 8 + 4 high break relays 8 + 8 high break relays

Table 4 – Products, inputs and outputs

6 LOGIC INPUT MAPPING

The default mappings for each of the opto-isolated inputs are as shown in the following table:

6.1 Central Unit P741:

Opto-Input Number	P740 Relay Text	Function
1	Input Label 01	Disable 87BB on zone 1 & zone 2
2	Input Label 02	Disable 87BB & 50BF on zone 1 & zone 2
3	Input Label 03	Disable 87BB & 50BF on zone 1
4	Input Label 04	Disable 87BB & 50BF on zone 2
5	Input Label 05	Maintenance mode authorization
6	Input Label 06	Not Mapped
7	Input Label 07	Not Mapped
8	Input Label 08	Block all protections (CU & PU)

Table 5 – Logic input mappings for P741

6.2 Peripheral Unit P742:

Opto-Input Number	P740 Relay Text	Function
1	Input Label 01	Reset Indication
2	Input Label 02	Reset Trip Latch
3	Input Label 03	Isolator 1 closed auxiliary contact (89a)
4	Input Label 04	Isolator 1 open auxiliary contact (89b)
5	Input Label 05	Isolator 2 closed auxiliary contact (89a)
6	Input Label 06	Isolator 2 open auxiliary contact (89b)
7	Input Label 07	Circuit Breaker closed auxiliary contact (52a)
8	Input Label 08	Circuit Breaker open auxiliary contact (52b)
9	Input Label 09	Isolator 3 closed auxiliary contact (89a)
10	Input Label 10	Isolator 3 open auxiliary contact (89b)
11	Input Label 11	Mode 50BF disabled
12	Input Label 12	Can be linked to External 3 phase trip initiation
13	Input Label 13	CB not available
14	Input Label 14	Can be linked to External circuit breaker failure
15	Input Label 15	Manual CB close command
16	Input Label 16	Mode Overhaul

Table 6 – Logic input mappings for P742

6.3 Peripheral Unit P743:

Opto-Input Number	P740 Relay Text	Function
1	Input Label 01	Reset Indication
2	Input Label 02	Reset Trip Latch
3	Input Label 03	Isolator 1 closed auxiliary contact (89a)
4	Input Label 04	Isolator 1 open auxiliary contact (89b)
5	Input Label 05	Isolator 2 closed auxiliary contact (89a)

Opto-Input Number	P740 Relay Text	Function
6	Input Label 06	Isolator 2 open auxiliary contact (89b)
7	Input Label 07	Circuit Breaker closed auxiliary contact (52a)
8	Input Label 08	Circuit Breaker open auxiliary contact (52b)
9	Input Label 09	Isolator 3 closed auxiliary contact (89a)
10	Input Label 10	Isolator 3 open auxiliary contact (89b)
11	Input Label 11	Mode 50BF disabled
12	Input Label 12	Can be linked to External 3 phase trip initiation
13	Input Label 13	CB not available
14	Input Label 14	Can be linked to External circuit breaker failure
15	Input Label 15	Manual CB close command
16	Input Label 16	Mode Overhaul
17	Input Label 17	Can be linked to External single phase A trip initiation
18	Input Label 18	Can be linked to External single phase B trip initiation
19	Input Label 19	Can be linked to External single phase C trip initiation
20	Input Label 20	Not Mapped
21	Input Label 21	Not Mapped
22	Input Label 22	Not Mapped
23	Input Label 23	Not Mapped
24	Input Label 24	Not Mapped

Table 7 – Logic input mappings for P743

7 RELAY OUTPUT CONTACT MAPPING

The default mappings for each of the relay output contacts are as shown in the following table:

7.1 Central Unit P741:

Relay Contact Number	P740 Relay Text	P740 Relay Conditioner	Function
1	Relay Label 01	Pick-up 0/0	Trip 87BB or 50BF backtrip or overcurrent / earth fault trip (fixed)
2	Relay Label 02	Pick-up 0/0	Trip 87BB or 50BF backtrip or overcurrent / earth fault trip (fixed)
3	Relay Label 03	Pick-up 0/0	Trip 87BB or 50BF backtrip or overcurrent / earth fault trip (fixed)
4	Relay Label 04	Pick-up 0/0	Trip zone 1
5	Relay Label 05	Pick-up 0/0	Trip zone 2
6	Relay Label 06	Pick-up 0/0	Circuit fault or PU error
7	Relay Label 07	Pick-up 0/0	Zone 1 or zone 2 blocked
8	Relay Label 08	Pick-up 0/0	Check Zone fault

Table 8 – Relay output mappings for P741

7.2 Peripheral Unit P742:

Relay Contact Number	P740 Relay Text	P740 Relay Conditioner	Function
1	Relay Label 01	Pick-up 0/0	Trip 87BB or 50BF backtrip or overcurrent / earth fault trip (fixed)
2	Relay Label 02	Pick-up 0/0	Trip 87BB or 50BF backtrip or overcurrent / earth fault trip (fixed)
3	Relay Label 03	Pick-up 0/0	Trip 87BB or 50BF backtrip or overcurrent / earth fault trip (fixed)
4	Relay Label 04	Pick-up 0/0	Circuit Breaker failure
5	Relay Label 05	Pick-up 0/0	Circuit Breaker failure or out of service
6	Relay Label 06	Pick-up 0/0	Circuit Breaker failure retrip
7	Relay Label 07	Pick-up 0/0	Trip or Dead Zone Fault
8	Relay Label 08	Pick-up 0/0	Circuit Breaker or Isolator status alarm
9	Relay Label 09	Pick-up 0/0	Circuit Breaker failure retrip phase A
10	Relay Label 10	Pick-up 0/0	Circuit Breaker failure retrip phase B
11	Relay Label 11	Pick-up 0/0	Circuit Breaker failure retrip phase C
12	Relay Label 12	Pick-up 0/0	Not Mapped

Table 9 – Relay output mappings for P742

7.3 Peripheral Unit P743:

Relay Contact Number	P740 Relay Text	P740 Relay Conditioner	Function
1	Relay Label 01	Pick-up 0/0	Trip 87BB or 50BF backtrip (fixed)
2	Relay Label 02	Pick-up 0/0	Trip 87BB or 50BF backtrip (fixed)

Relay Contact Number	P740 Relay Text	P740 Relay Conditioner	Function
3	Relay Label 03	Pick-up 0/0	Trip 87BB or 50BF backtrip (fixed)
4	Relay Label 04	Pick-up 0/0	Circuit Breaker failure
5	Relay Label 05	Pick-up 0/0	Circuit Breaker failure or out of service
6	Relay Label 06	Pick-up 0/0	Circuit Breaker failure retrip
7	Relay Label 07	Pick-up 0/0	Trip or Dead Zone Fault
8	Relay Label 08	Pick-up 0/0	Circuit Breaker or Isolator status alarm
9	Relay Label 09	Pick-up 0/0	Circuit Breaker failure retrip phase A
10	Relay Label 10	Pick-up 0/0	Circuit Breaker failure retrip phase B
11	Relay Label 11	Pick-up 0/0	Circuit Breaker failure retrip phase C
12	Relay Label 12	Pick-up 0/0	Not Mapped
13	Relay Label 13	Pick-up 0/0	Not Mapped
14	Relay Label 14	Pick-up 0/0	Not Mapped
15	Relay Label 15	Pick-up 0/0	Not Mapped
16	Relay Label 16	Pick-up 0/0	Not Mapped

Table 10 – Relay output mappings for P743

Note *It is essential that Relay 1, 2 and 3 are used for tripping purposes as this output is directly driven in the fixed logic to obtain the typical 13ms tripping time.*

A fault record can be generated by connecting one or a number of contacts to the "Fault Record Trigger" in PSL. It is recommended that the triggering contact be 'self reset' and not a latching. If a latching contact were chosen the fault record would not be generated until the contact had fully reset.

8 FUNCTION KEY INPUT MAPPING

The default mappings for each of the function key inputs are as shown in the following table:

8.1 Central Unit P741:

LED Number	Text	Setting	Function
1	FnKey 1	Normal	To reset Zone or CZ circuitry fault
2	FnKey 2	Normal	To reset Zone or CZ PU error fault
3	FnKey 3	Normal	To Disable All protections (CU & PU)
4	FnKey 4	Toggled	To block in Zone 1: 87BB & 50BF
5	FnKey 5	Toggled	To block in Zone 2: 87BB & 50BF
6	FnKey 6	Normal	To reset CU Indications
7	FnKey 7	Normal	To reset CU & PU Indications
8	FnKey 8	Normal	To reset PU Trip Latch
9	FnKey 9	Normal	To trigger the Manual DR
10	FnKey 10	Not Used	Not used

Table 11 – Function key input mappings for P741

8.2 Peripheral Unit P743:

LED Number	Text	Setting	Function
1	FnKey 1	Normal	To reset the Latches
2	FnKey 2	Normal	To reset the Trip Latch
3	FnKey 3	Not Used	Not used
4	FnKey 4	Toggled	To select the 50BF Disable mode
5	FnKey 5	Toggled	To select the Overhaul mode
6	FnKey 6	Not Used	Not used
7	FnKey 7	Not Used	Not used
8	FnKey 8	Not Used	Not used
9	FnKey 9	Not Used	Not used
10	FnKey 10	Not Used	Not used

Table 12 – Function key input mappings for P743

9 PROGRAMMABLE LED OUTPUT MAPPING

The default mappings for each of the programmable LEDs are as shown in the following table:

9.1 Central Unit P741

LED Number	LED Input Connection/Text	Latched	P740 LED Function Indication
1	LED1 Red LED1 Yellow LED1 Green	Yes	87BB fault on phase A Not used Not used
2	LED2 Red LED2 Yellow LED2 Green	Yes	87BB fault on phase B Not used Not used
3	LED3 Red LED3 Yellow LED3 Green	Yes	87BB fault on phase C Not used Not used
4	LED4 Red LED4 Yellow LED4 Green	Yes	50BF Trip Zone 1 87BB & 50BF Trip Zone 1 87BB Trip Zone 1
5	LED5 Red LED5 Yellow LED5 Green	Yes	50BF Trip Zone 2 87BB & 50BF Trip Zone 2 87BB Trip Zone 2
6	LED6 Red LED6 Yellow LED6 Green	No	Zone 1 blocked by itself Zone 1 blocked by Check Zone Zone 1 protected
7	LED7 Red LED7 Yellow LED7 Green	No	Zone 2 blocked by itself Zone 2 blocked by Check Zone Zone 2 protected
8	LED8 Red LED8 Yellow LED8 Green	No	Fiber communication Error Fiber communication to change Fiber communication healthy
9	FnKey LED1 Red FnKey LED1 Yellow FnKey LED1 Green	No	Zone or CZ circuitry fault block. Zone or CZ circuitry fault alarm No Zone or CZ circuitry fault
10	FnKey LED2 Red FnKey LED2 Yellow FnKey LED2 Green	No	Zone or CZ PU error fault block. Zone or CZ PU error fault alarm No Zone or CZ PU error fault
11	FnKey LED3 Red FnKey LED3 Yellow FnKey LED3 Green	No	All protections Disabled Not used All protections Not Disabled
12	FnKey LED4 Red FnKey LED4 Yellow FnKey LED4 Green	No	Zone 1: 87BB & 50BF blocked Zone 1: 50BF blocked Zone 1: protected
13	FnKey LED5 Red FnKey LED5 Yellow FnKey LED5 Green	No	Zone 2: 87BB & 50BF blocked Zone 2: 50BF blocked Zone 2: protected
14	FnKey LED6 Red FnKey LED6 Yellow FnKey LED6 Green	No	Not used Not used Reset CU Indications
15	FnKey LED7 Red FnKey LED7 Yellow FnKey LED7 Green	No	Not used Not used Reset CU & PU Indications
16	FnKey LED8 Red FnKey LED8 Yellow FnKey LED8 Green	No	Not used Not used Reset PU Trip Latch

LED Number	LED Input Connection/Text	Latched	P740 LED Function Indication
17	FnKey LED9 Red FnKey LED9 Yellow FnKey LED9 Green	No	Not used Not used Manual DR trigger
18	FnKey LED10 Red FnKey LED10 Yellow FnKey LED10 Green	No	Not used Dead Zone fault Not used

Table 13 – Programmable LED output mappings for P741

9.2 Peripheral Unit P742

LED Number	LED Input Connection/Text	Latched	P740 LED Function Indication
1	LED 1 Red	No	Isolator 1 Closed
2	LED 2 Red	No	Isolator 2 Closed
3	LED 3 Red	No	Isolator 3 Closed
4	LED 4 Red	Yes	Trip on CU 50BF backtrip order
5	LED 5 Red	Yes	Trip on CU 87BB trip order
6	LED 6 Red	Yes	Dead Zone fault
7	LED 7 Red	No	Circuit Breaker out of service
8	LED 8 Red	No	Fiber communication Error

Table 14 – Programmable LED output mappings for P742

9.3 Peripheral Unit P743

LED Number	LED Input Connection/Text	Latched	P740 LED Function Indication
1	LED1 Red LED1 Yellow LED1 Green	No	Isolator 1 Closed Isolator 1 Status Alarm Isolator 1 Open
2	LED2 Red LED2 Yellow LED2 Green	No	Isolator 2 Closed Isolator 2 Status Alarm Isolator 2 Open
3	LED3 Red LED3 Yellow LED3 Green	No	Isolator 3 Closed Isolator 3 Status Alarm Isolator 3 Open
4	LED4 Red LED4 Yellow LED4 Green	Yes	Trip on CU 50BF backtrip order Not used Not used
5	LED5 Red LED5 Yellow LED5 Green	Yes	Trip on CU 87BB trip order Not used Not used
6	LED6 Red LED6 Yellow LED6 Green	Yes	Dead Zone fault Not used Not used
7	LED7 Red LED7 Yellow LED7 Green	No	Circuit Breaker out of service Not used Circuit Breaker healthy
8	LED8 Red LED8 Yellow LED8 Green	No	Fiber communication Error Fiber communication to change Fiber communication healthy
9	FnKey LED1 Red FnKey LED1 Yellow FnKey LED1 Green	No	Not used Not used Reset PU Indications

LED Number	LED Input Connection/Text	Latched	P740 LED Function Indication
10	FnKey LED2 Red FnKey LED2 Yellow FnKey LED2 Green	No	Not used Not used Reset PU Trip Latch
11	FnKey LED3 Red FnKey LED3 Yellow FnKey LED3 Green	No	Not used
12	FnKey LED4 Red FnKey LED4 Yellow FnKey LED4 Green	No	Not used Mode 50BF disabled Mode normal
13	FnKey LED5 Red FnKey LED5 Yellow FnKey LED5 Green	No	Mode overhaul Not used Mode normal
14	FnKey LED6 Red FnKey LED6 Yellow FnKey LED6 Green	No	Not used
15	FnKey LED7 Red FnKey LED7 Yellow FnKey LED7 Green	No	Not used
16	FnKey LED8 Red FnKey LED8 Yellow FnKey LED8 Green	No	Not used
17	FnKey LED9 Red FnKey LED9 Yellow FnKey LED9 Green	No	Not used
18	FnKey LED10 Red FnKey LED10 Yellow FnKey LED10 Green	No	Not used

Table 15 – Programmable LED output mappings for P743

10 FAULT RECORDER START MAPPING

The default mapping for the signal which initiates a fault record is as shown in the following table:

10.1.1 Central Unit (P741)

Initiating Signal	Fault Trigger
Trip 87BB	Initiate fault recording from main protection trip
Trip 50BF	Initiate fault recording from main protection trip

Table 16 – Fault recorder start mappings for P741

10.1.2 Peripheral Unit (P742 and P743)

Initiating Signal	Fault Trigger
Any Trip	Initiate fault recording from main protection trip
Dead zone fault	Initiate fault recording from main protection trip

Table 17 – Fault recorder start mappings for P742 & P743

10.2 PSL DATA column

The relay contains a PSL DATA column that can be used to track PSL modifications. A total of 12 cells are contained in the PSL DATA column, 3 for each setting group. The function for each cell is shown below:

Grp PSL Ref	When downloading a PSL to the relay, the user will be prompted to enter which groups the PSL is for and a reference ID. The first 32 characters of the reference ID will be displayed in this cell. The ◄ and ► keys can be used to scroll through 32 characters as only 16 can be displayed at any one time.
18 Nov 2002 08:59:32.047	This cell displays the date and time when the PSL was down loaded to the relay.
Grp 1 PSL ID - 2062813232	This is a unique number for the PSL that has been entered. Any change in the PSL will result in a different number being displayed.

Note *The above cells are repeated for each setting group.*

11 VIEWING AND PRINTING DEFAULT PSL DIAGRAMS

11.1 Typical Mappings

It is possible to view and print the default PSL diagrams for the device. Typically, these diagrams allow you to see these mappings:

- Opto Input Mappings
- Output Relay Mappings
- LED Mappings
- Start Indications
- Phase Trip Mappings
- System Check Mapping

Important	***The following PSL diagrams show the DDB numbers for a specific MiCOM product, with a specific software version to run on a specific hardware platform. Descriptions, DDB Numbers, Inputs and Outputs may vary for different products, software or hardware.***

11.2 Download and Print PSL Diagrams

To download and print the default PSL diagrams for the device:

1. Close MiCOM S1 Studio.
2. Select **Programs** > then navigate through to > **MiCOM S1 Studio** > **Data Model Manager**.
3. Click **Add** then **Next**.
4. Click **Internet** then **Next**.
5. Select your language then click **Next**.
6. From the tree view, select the model and software version.
7. Click **Install**. When complete click **OK**.
8. Close the Data Model Manager and start MiCOM S1 Studio.
9. Select Tools > PSL Editor (Px40).
10. In the PSL Editor select **File** > **Open**. The downloaded PSL files are in C:\Program Files\ directory located in the \MiCOM S1\Courier\PSL\Defaults sub-directory.
11. Highlight the required PSL diagram and select **File** > **Print**.

12 PROGRAMMABLE SCHEME LOGIC

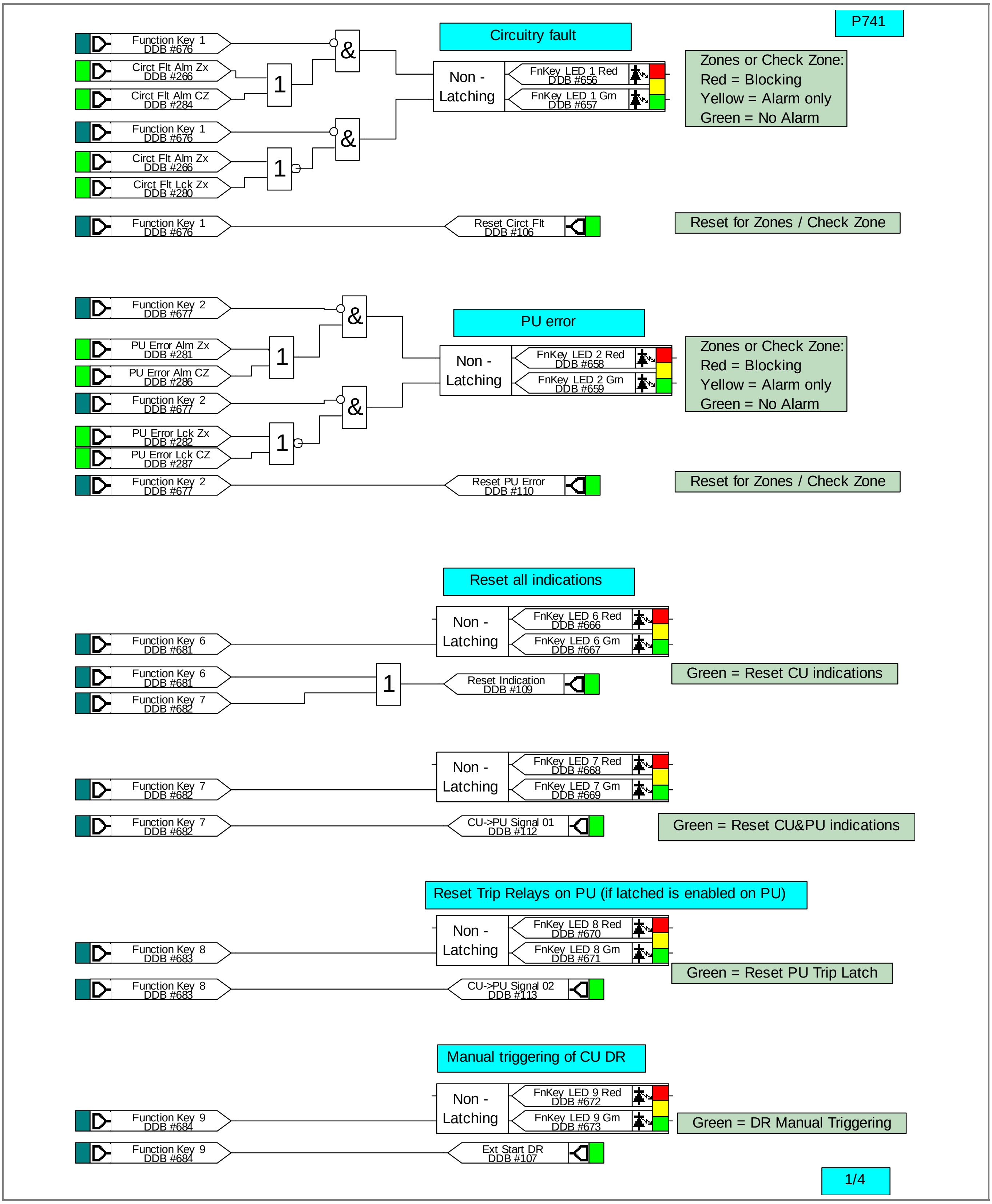


Figure 1 - P741 PSL Diagram 1 of 4

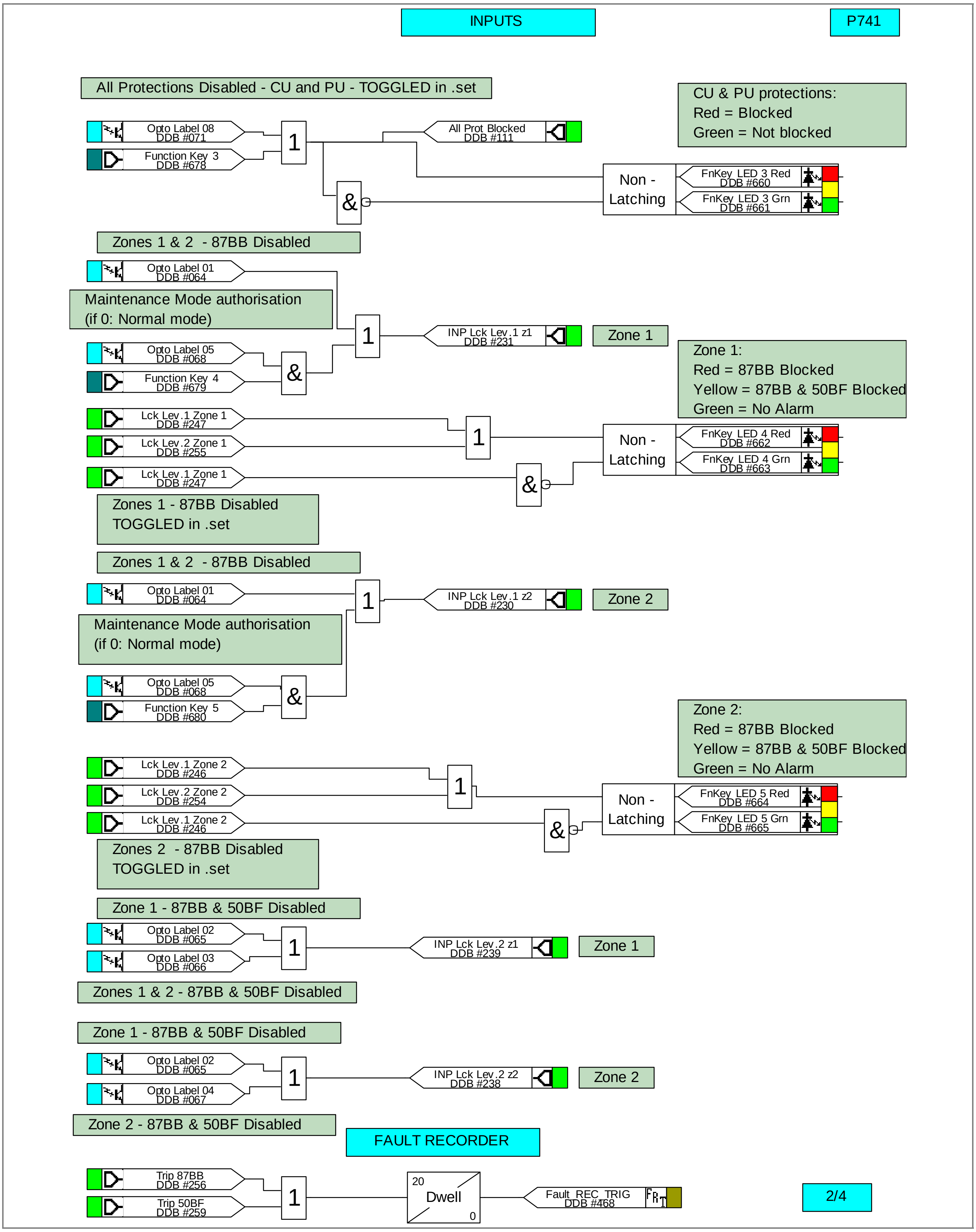


Figure 2 - P741 PSL Diagram 2 of 4

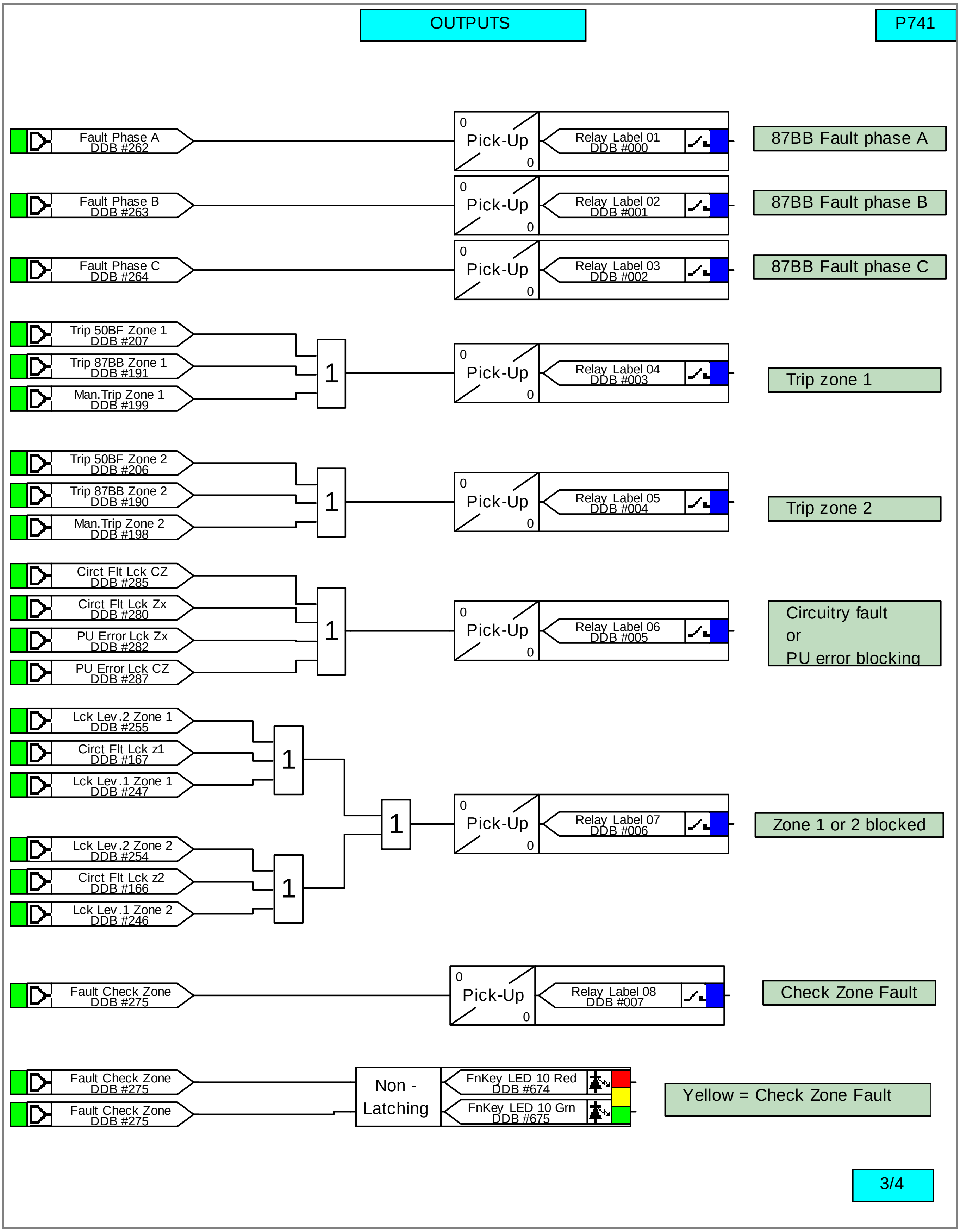


Figure 3 - P741 PSL Diagram 3 of 4

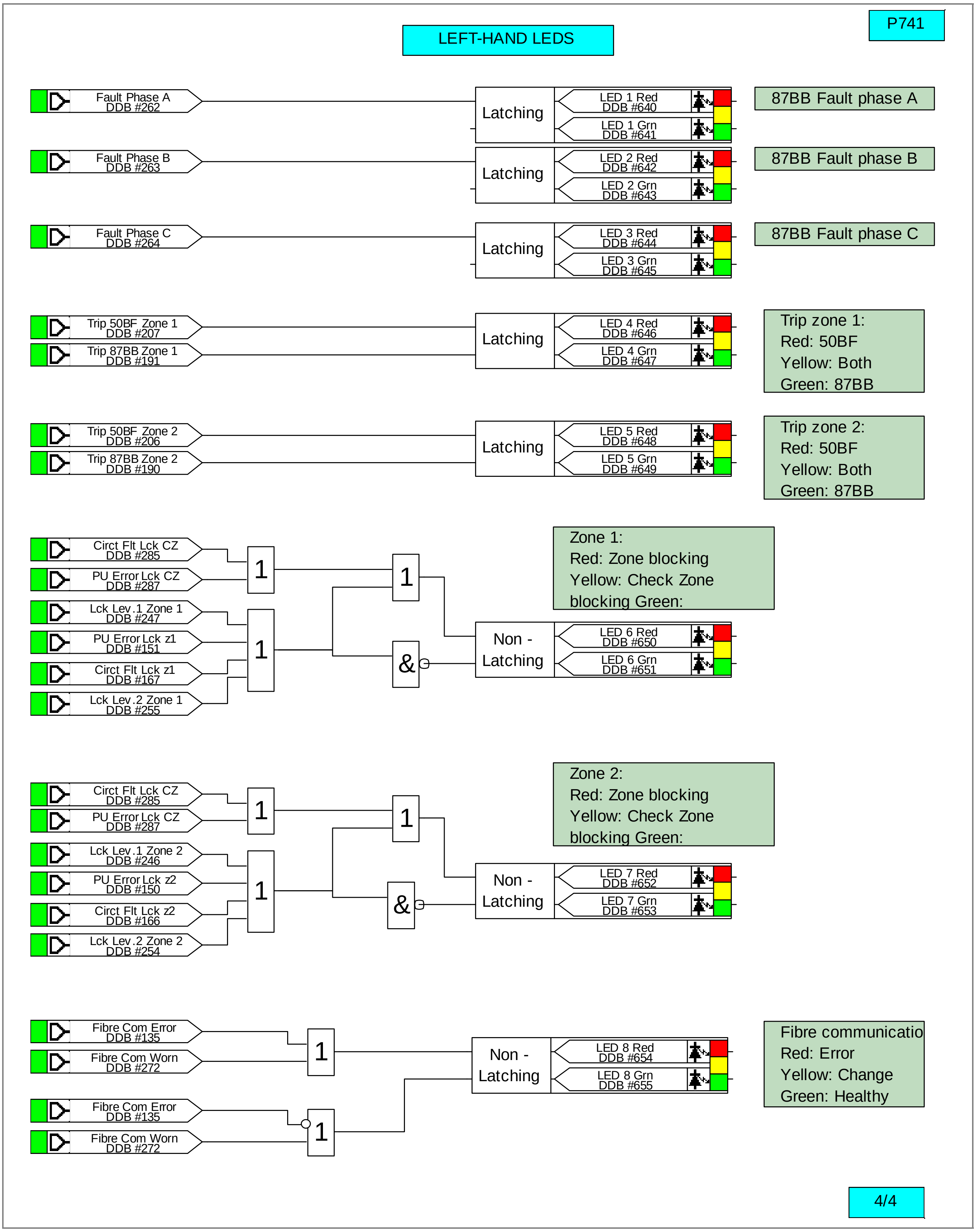


Figure 4 - P741 PSL Diagram 4 of 4

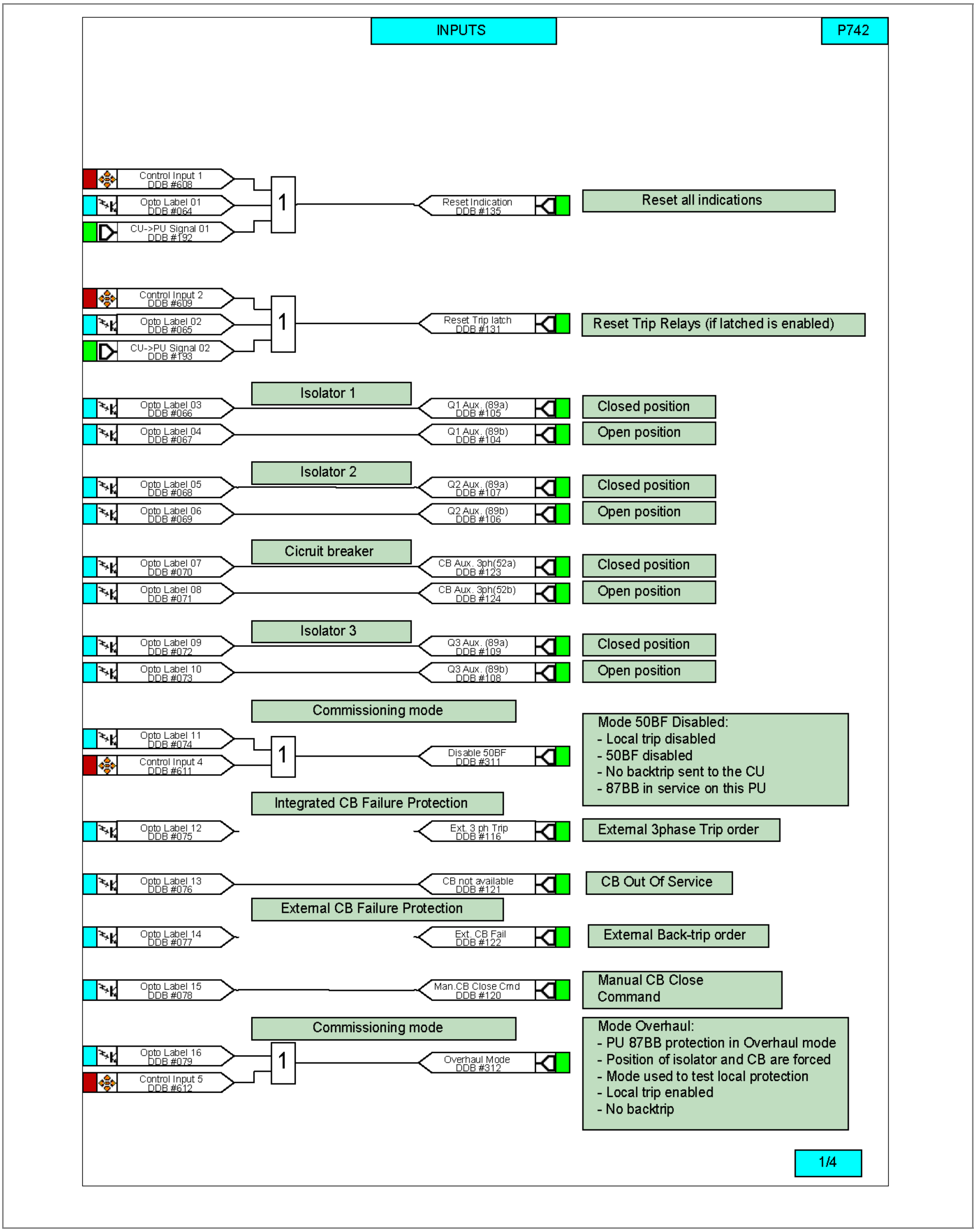


Figure 5 - P742 PSL Diagram 1 of 4

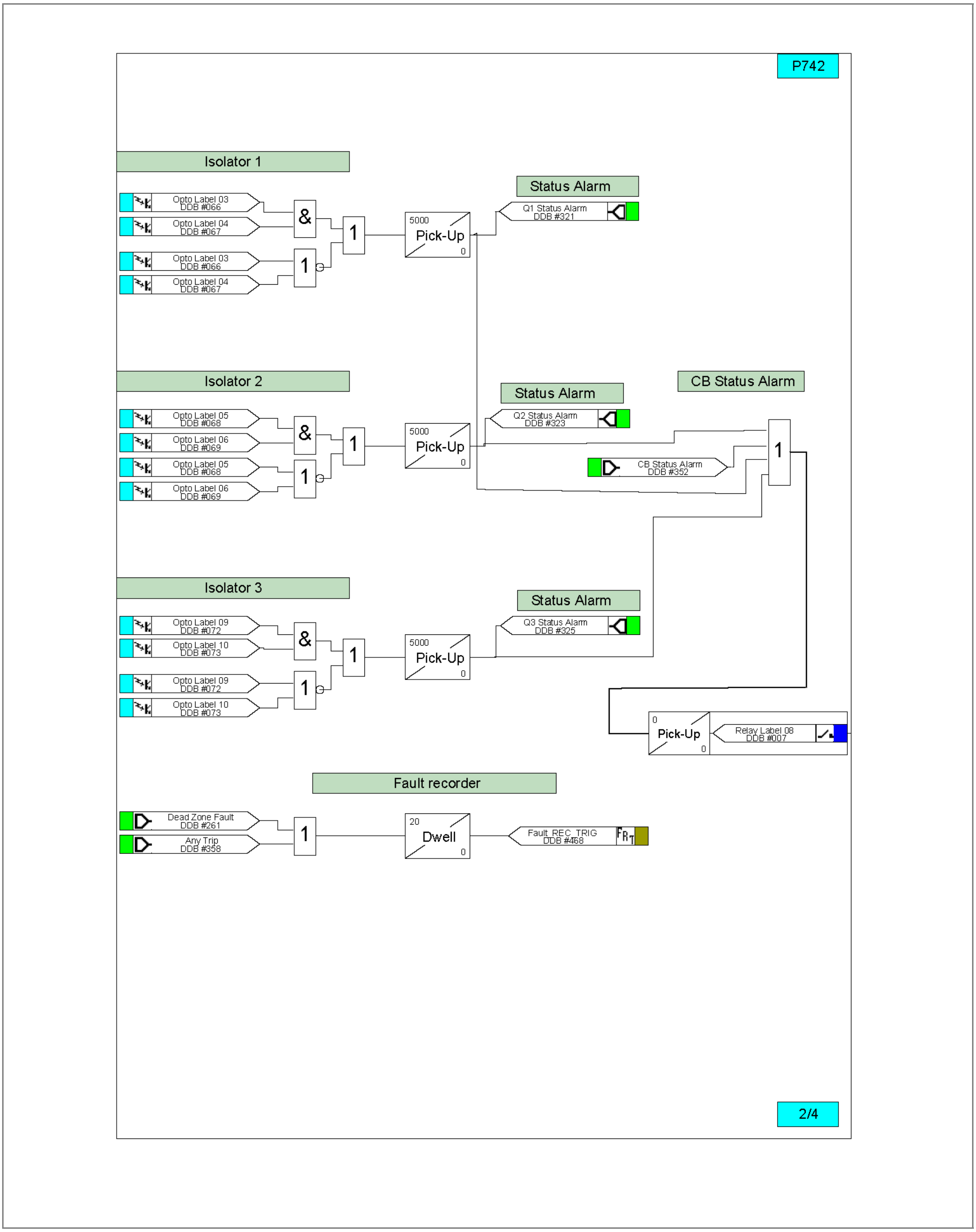


Figure 6 - P742 PSL Diagram 2 of 4

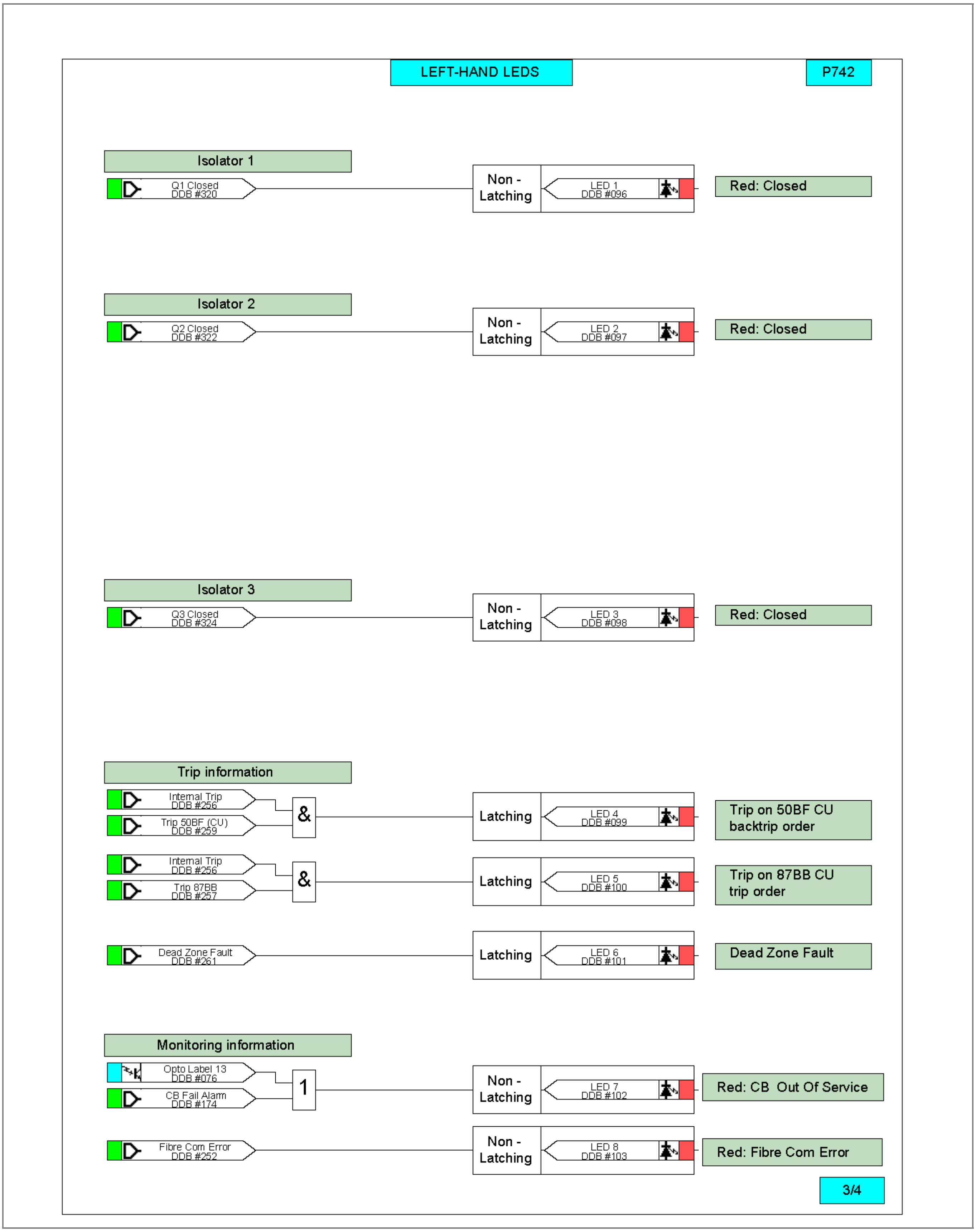


Figure 7 - P742 PSL Diagram 3 of 4

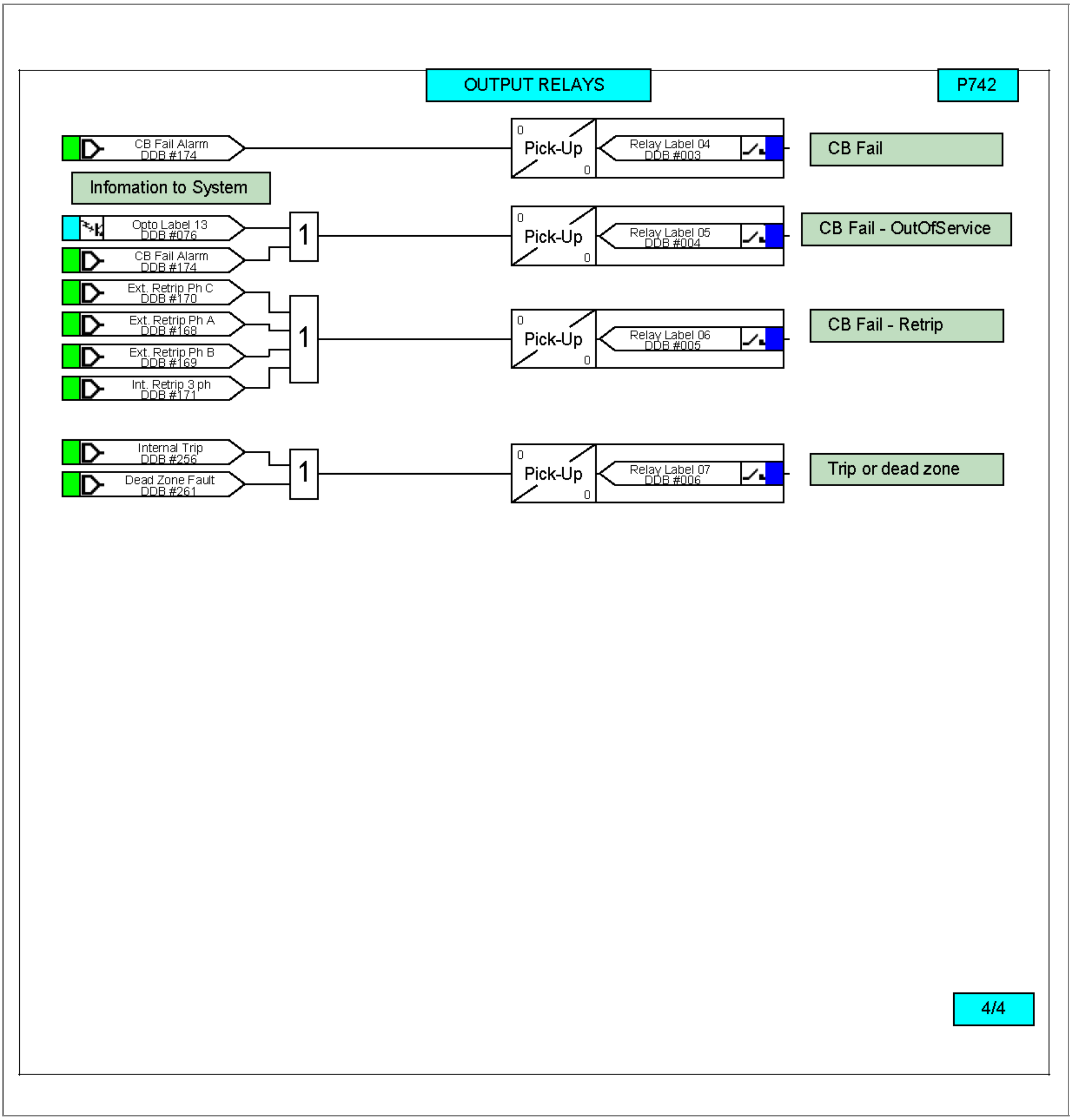


Figure 8 - P742 PSL Diagram 4 of 4

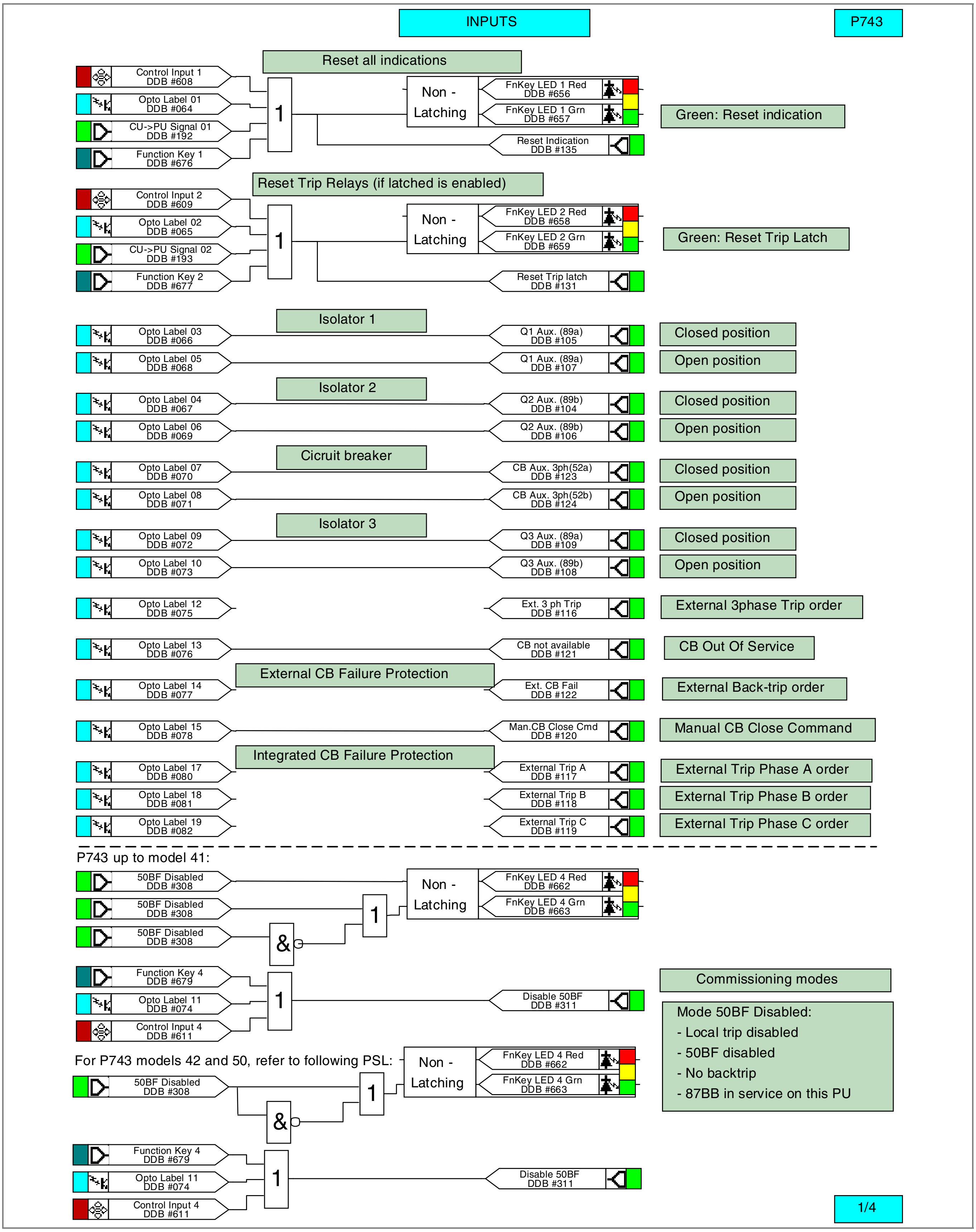


Figure 9 - P743 PSL Diagram 1 of 4

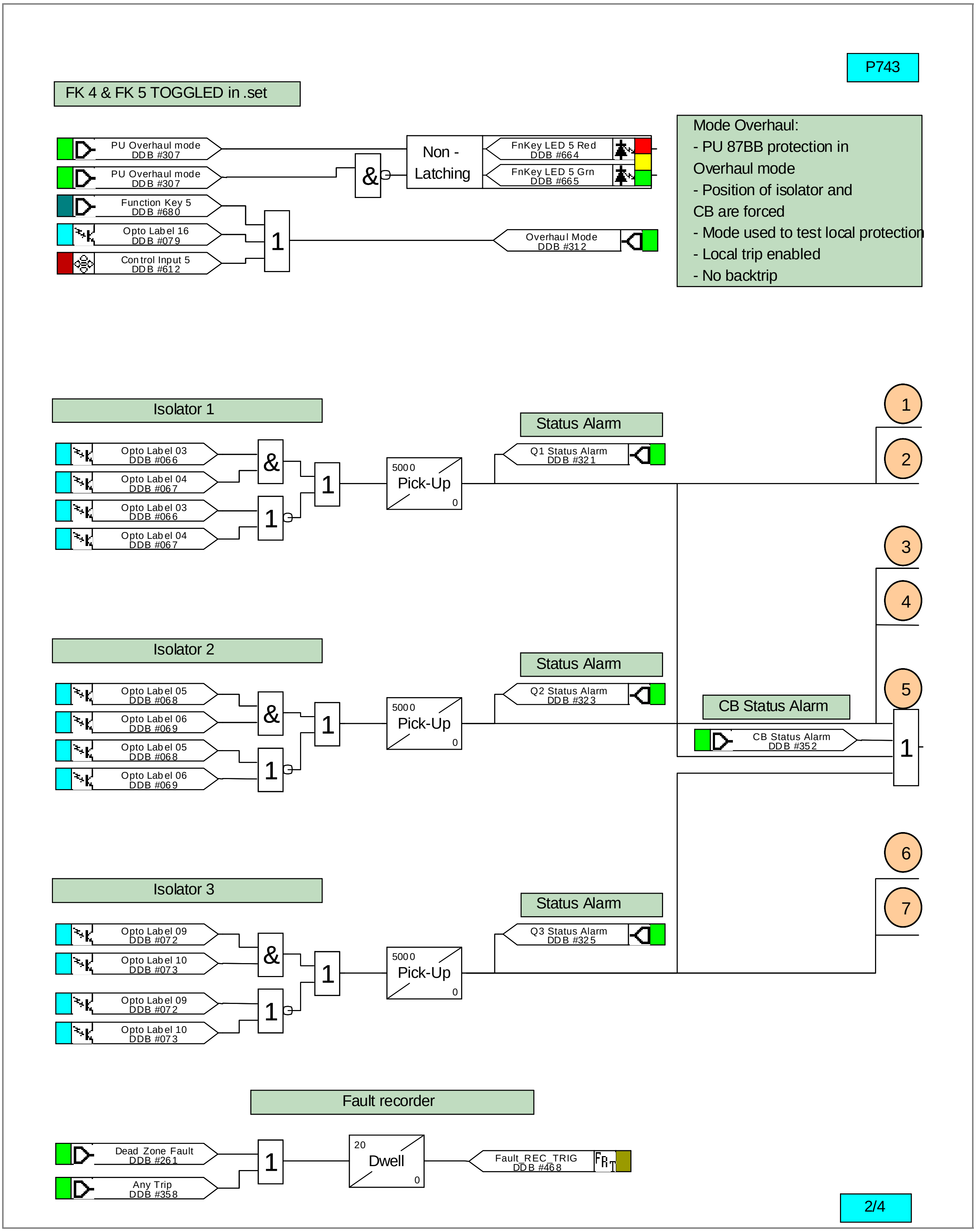


Figure 10 - P743 PSL Diagram 2 of 4

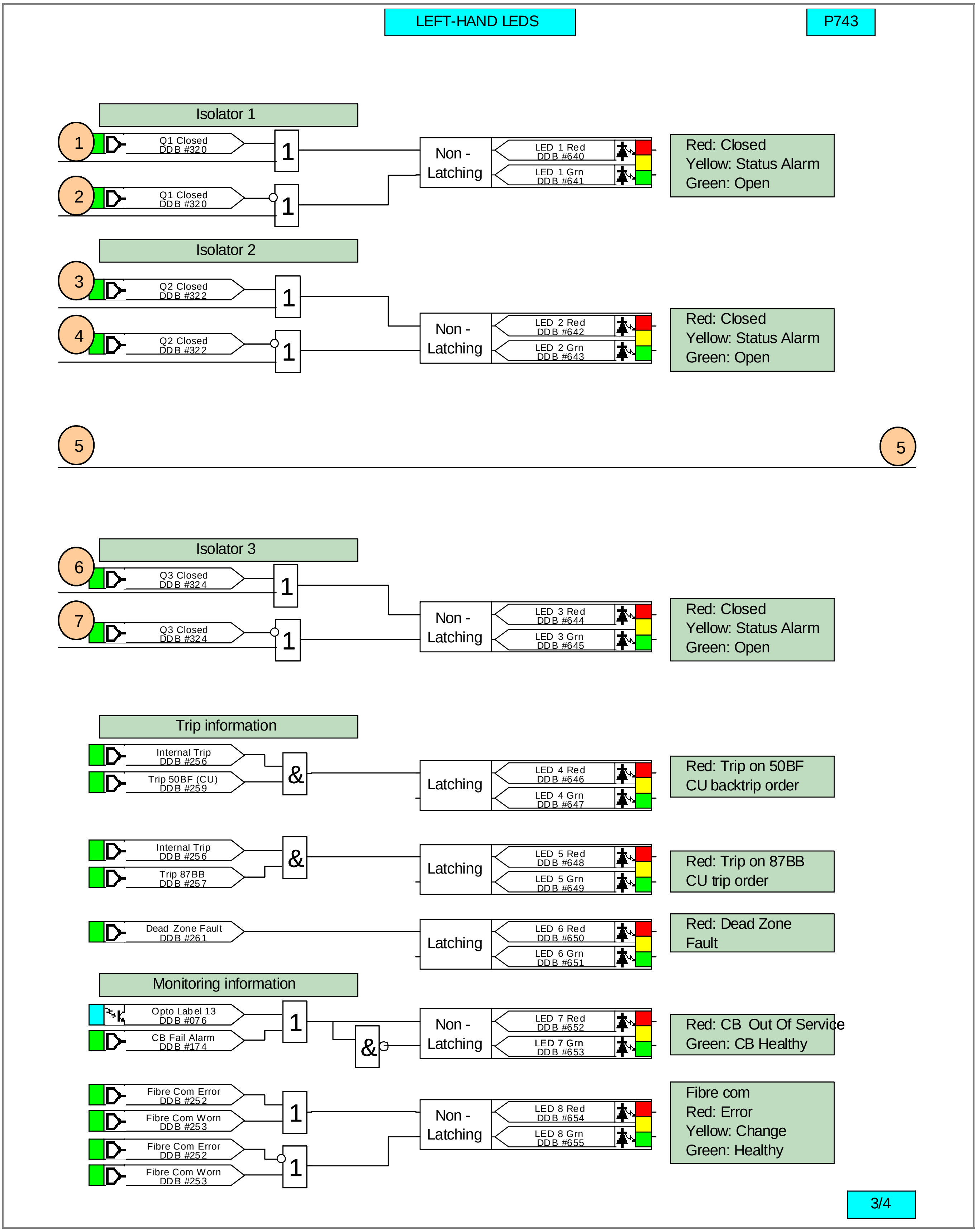


Figure 11 - P743 PSL Diagram 3 of 4

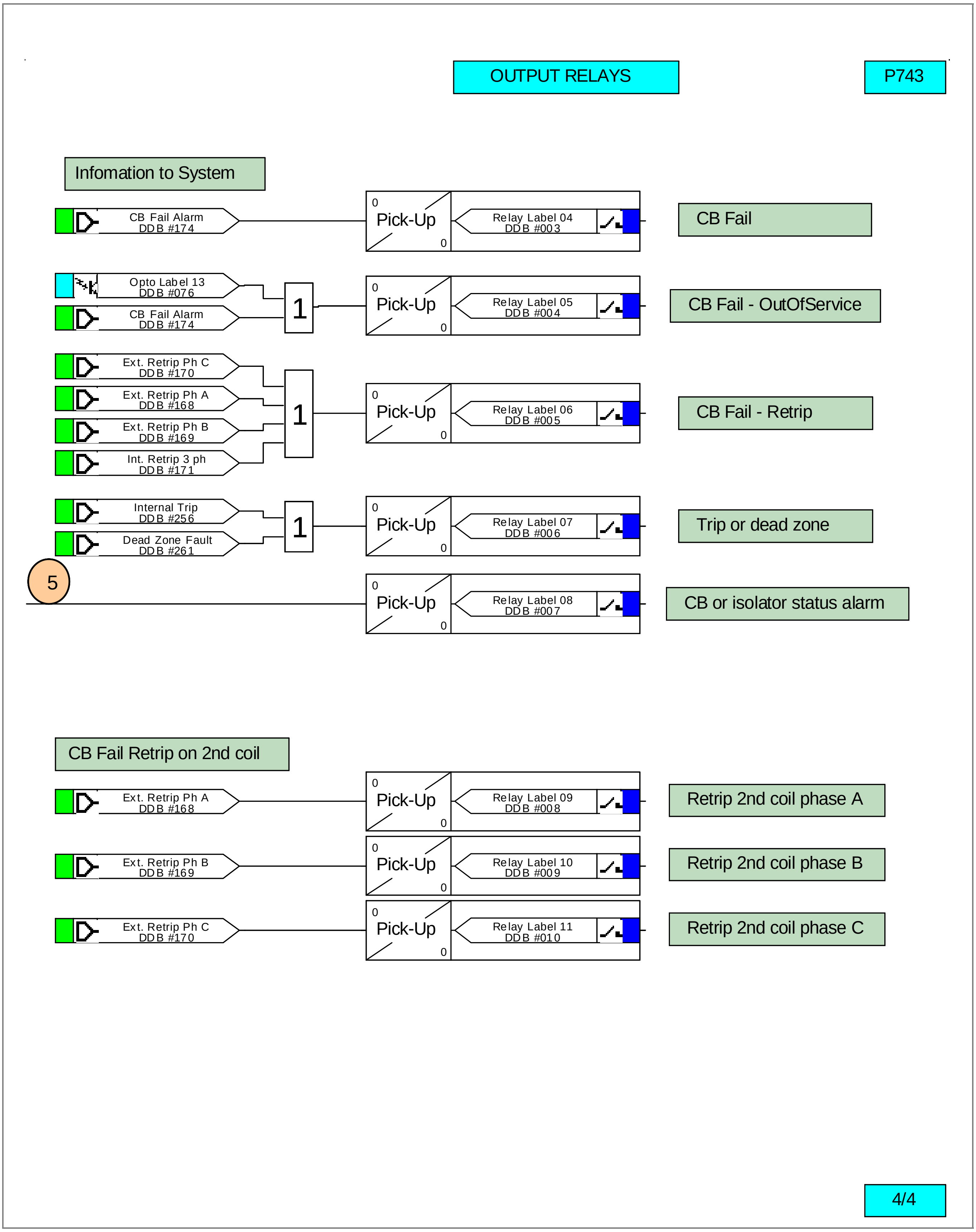


Figure 12 - P743 PSL Diagram 4 of 4

MEASUREMENTS AND RECORDING

CHAPTER 9

Date:	02/2017
Products covered by this chapter:	This chapter covers the specific versions of the MiCOM products listed below. This includes ***only*** the following combinations of Software Version and Hardware Suffix.
Hardware Suffix:	L (P742) & M (P741 & P743)
Software Version:	B1 - P74x (P741, P742 & P743)
Connection Diagrams:	10P740xx (xx = 01 to 07)

CONTENTS

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FIGURES

1 INTRODUCTION

The relay is equipped with integral measurements, event, fault and disturbance recording facilities suitable for analysis of complex system disturbances.

The relay is flexible enough to allow for the programming of these facilities to specific user application requirements. These requirements are discussed in the sections which follow.

2 EVENT AND FAULT RECORDS

The relay records and time tags up to 250 or 512 events (only up to 250 events in the P24x and P44x) and stores them in non-volatile (battery-backed up) memory. This lets the system operator establish the sequence of events that occurred in the relay following a particular power system condition or switching sequence. When the available space is used up, the oldest event is automatically overwritten by the new one (i.e. first in, first out).

The relay's real-time clock provides the time tag to each event, to a resolution of 1 ms.

The event records can be viewed either from the front plate LCD or remotely using the communications ports (using any available protocols, such as Courier or MODBUS).

For local viewing on the LCD of event, fault and maintenance records, select the **VIEW RECORDS** menu column.

For extraction from a remote source using communications, see the *SCADA Communications* chapter or the MiCOM S1 Studio instructions.

For a full list of all the event types and the meaning of their values, see the Menu Database document.

Important	**Throughout this manual, you may see references to products as follows: P741 = Central Unit or CU P742/P743 = Peripheral Unit or PU**

2.1 View Records

The menu settings vary slightly between products. The options are:

- View Records Column (P741)
- View Records Column (P742 / P743)

2.1.1 View Records Column (P741)

Col	Row	Menu Text	Default Setting	Available Setting
Description				
01	00	VIEW RECORDS		
This column contains event, fault and maintenance records				
01	01	Select Event [0...n]	0	From 0 to 511 step 1
This selects the required event record from all the possible ones that may be stored. A value of 0 corresponds to the latest event, with the maximum value the oldest.				
01	02	Menu Cell Ref		Not Settable
Indicates type of event				
01	03	Time & Date		Not Settable
Time & Date Stamp for the event given by the internal Real Time Clock.				
01	04	Event Text		Not Settable
Up to 16 Character description of the Event (refer to following sections).				
01	05	Event Value		Not Settable
Up to 32 Bit Binary Flag or integer representative of the Event (refer to following sections).				
01	06	Select Fault [0...n]	0	From 0 to 4 step 1
This selects the required fault record from the possible 5 that may be stored. A value of 0 corresponds to the latest fault and so on.				

Col	Row	Menu Text	Default Setting	Available Setting
Description				
01	07	Active Group		Not Settable
Displays the active setting group when fault occurred.				
01	08	Faulted Phase		Not Settable
Indicates whether measurements and fault location are valid				
01	0A	Trip Elements		Not Settable
Displays the status of the first 32 trip signals.				
01	0C	Time Stamp		Not Settable
Displays fault time and date.				
01	0D	Fault Alarms		Not Settable
Displays the status of the fault alarm signals.				
01	0E	System Frequency		Not Settable
Displays the system frequency				
01	0F	Fault Duration		Not Settable
Displays time from the start or trip until the undercurrent elements indicate the CB is open				
01	19	IA CZ diff		Not Settable
Measured parameter				
01	1A	IB CZ diff		Not Settable
Measured parameter				
01	1B	IC CZ diff		Not Settable
Measured parameter				
01	1C	IN CZ diff		Not Settable
Measured parameter				
01	1D	IA CZ bias		Not Settable
Measured parameter				
01	1E	IB CZ bias		Not Settable
Measured parameter				
01	1F	IC CZ bias		Not Settable
Measured parameter				
01	20	IN CZ bias		Not Settable
Measured parameter				
01	21	Faulted Zone		Not Settable
Measured parameter				
01	22	Tripped Zone		Not Settable
Measured parameter				
01	23	Zone / Cur.Node1		Not Settable
Measured parameter				
01	24	Zone / Cur.Node2		Not Settable
Measured parameter				
01	25	Zone / Cur.Node3		Not Settable
Measured parameter				
01	26	Zone / Cur.Node4		Not Settable
Measured parameter				
01	27	Zone / Cur.Node5		Not Settable

Col	Row	Menu Text	Default Setting	Available Setting
Description				
Measured parameter				
01	28	Zone / Cur.Node6		Not Settable
Measured parameter				
01	29	Zone / Cur.Node7		Not Settable
Measured parameter				
01	2A	Zone / Cur.Node8		Not Settable
Measured parameter				
01	2B	CT / Cur. Node 1		Not Settable
Measured parameter				
01	2C	CT / Cur. Node 2		Not Settable
Measured parameter				
01	2D	CT / Cur. Node 3		Not Settable
Measured parameter				
01	2E	CT / Cur. Node 4		Not Settable
Measured parameter				
01	2F	CT / Cur. Node 5		Not Settable
Measured parameter				
01	30	CT / Cur. Node 6		Not Settable
Measured parameter				
01	31	CT / Cur. Node 7		Not Settable
Measured parameter				
01	32	CT / Cur. Node 8		Not Settable
Measured parameter				
01	F0	Select Maint[0…n]	0	From 0 to 9 step 1
This selects the required maintenance report from those stored. A value of 0 corresponds to the latest report and so on.				
01	F1	Maint Text		Not Settable
Up to 16 Character description of the occurrence (refer to following sections).				
01	F2	Maint Type		Not Settable
These cells are numbers representative of the occurrence. They form a specific error code which should be quoted in any related correspondence to Report Data.				
01	F3	Maint Data		Not Settable
These cells are numbers representative of the occurrence. They form a specific error code which should be quoted in any related correspondence to Report Data.				
01	FA	Evt Iface Source		Not Settable
Interface on which the event was logged				
01	FB	Evt Access Level		Not Settable
Any security event that indicates that it came from an interface action, such as disabling a port, will also record the access level of the interface that initiated the event. This will be recorded in the ‘Event State’ field of the event.				
01	FC	Evt Extra Info		Not Settable
This cell provides supporting information for the event and can vary between the different event types.				
01	FE	Evt Unique Id		Not Settable
Each event will have a unique event id. The event id is a 32 bit unsigned integer that is incremented for each new event record and is stored in the record in battery-backed memory (BBRAM). The current event id must be non-volatile so as to preserve it du				
01	FF	Reset Indication	No	0=No 1=Yes

Col	Row	Menu Text	Default Setting	Available Setting
Description				
This serves to reset the trip LED indications provided that the relevant protection element has reset, to reset all LED and relays latched in the PSL, and to reset the latched alarms.				

2.1.2 View Records Column (P742 / P743)

Col	Row	Courier Text	Default Setting	Available Setting	P742	P743
Description						
01	00	VIEW RECORDS			*	*
This column contains event, fault and maintenance records						
01	01	Select Event	0	From 0 to 511 step 1		*
This selects the required event record from all the possible ones that may be stored. A value of 0 corresponds to the latest event, with the maximum value the oldest.						
01	02	Menu Cell Ref		Not Settable		*
Indicates type of event						
01	03	Time & Date		Not Settable		*
Time & Date Stamp for the event given by the internal Real Time Clock.						
01	04	Event Text		Not Settable		*
Up to 16 Character description of the Event (refer to following sections).						
01	05	Event Value		Not Settable		*
Up to 32 Bit Binary Flag or integer representative of the Event (refer to following sections).						
01	06	Select Fault	0	From 0 to 4 step 1		*
This selects the required fault record from the possible 5 that may be stored. A value of 0 corresponds to the latest fault and so on.						
01	07	Active Group		Not Settable		*
Displays the active setting group when fault occurred.						
01	08	Faulted Phase		Not Settable	*	*
Indicates whether measurements and fault location are valid						
01	09	Start Elements		Not Settable	*	*
Displays the status of the first 32 start signals.						
01	0A	Trip Elements		Not Settable	*	*
Displays the status of the first 32 trip signals.						
01	0C	Time Stamp		Not Settable	*	*
Displays fault time and date.						
01	0D	Fault Alarms		Not Settable	*	*
Displays the status of the fault alarm signals.						
01	0E	System Frequency		Not Settable	*	*
Displays the system frequency						
01	10	Relay Trip Time		Not Settable	*	*
Displays time from protection start to protection trip						
01	11	IA		Not Settable	*	*
Measured parameter						
01	12	IB		Not Settable	*	*
Measured parameter						
01	13	IC		Not Settable	*	*
Measured parameter						

Col	Row	Courier Text	Default Setting	Available Setting	P742	P743
Description						
01	14	IN		Not Settable	*	*
Measured parameter						
01	15	VA		Not Settable	*	*
Measured parameter						
01	16	VB		Not Settable	*	*
Measured parameter						
01	17	VC		Not Settable	*	*
Measured parameter						
01	18	VN		Not Settable	*	*
Measured parameter						
01	22	Tripped Zone		Not Settable	*	*
Measured parameter						
01	F0	Select Maint [0…n]	0	From 0 to 9 step 1	*	*
This selects the required maintenance report from those stored. A value of 0 corresponds to the latest report and so on.						
01	F1	Maint Text		Not Settable	*	*
Up to 16 Character description of the occurrence (refer to following sections).						
01	F2	Maint Type		Not Settable	*	*
These cells are numbers representative of the occurrence. They form a specific error code which should be quoted in any related correspondence to Report Data.						
01	F3	Maint Data		Not Settable	*	*
These cells are numbers representative of the occurrence. They form a specific error code which should be quoted in any related correspondence to Report Data.						
01	FA	Evt Iface Source		Not Settable	*	*
Interface on which the event was logged						
01	FB	Evt Access Level		Not Settable	*	*
Any security event that indicates that it came from an interface action, such as disabling a port, will also record the access level of the interface that initiated the event. This will be recorded in the 'Event State' field of the event.						
01	FC	Evt Extra Info		Not Settable	*	*
This cell provides supporting information for the event and can vary between the different event types.						
01	FE	Evt Unique Id		Not Settable	*	*
Each event will have a unique event id. The event id is a 32 bit unsigned integer that is incremented for each new event record and is stored in the record in battery-backed memory (BBRAM). The current event id must be non-volatile so as to preserve it du						
01	FF	Reset Indication	No	0=No 1=Yes	*	*

2.2 Types of Event

An event may be a change of state of a control input or output relay, an alarm condition, or a setting change. The following sections show the various items that constitute an event:

2.2.1 Change of State of Opto-Isolated Inputs

If one or more of the opto (logic) inputs has changed state since the last time the protection algorithm ran, the new status is logged as an event. When this event is selected to be viewed on the LCD, three cells appear, as in shown here:

```
Time & date of event
“LOGIC INPUTS1”
“Event Value 0101010101010101”
```

The Event Value is a multi-bit word (see note) showing the status of the opto inputs, where the least significant bit (extreme right) corresponds to opto input 1. The same information is present if the event is extracted and viewed using a PC.

Note	*For P24x or P44x the Event Value is an 8 or 16 bit word.* *For P34x or P64x it is an 8, 12, 16, 24 or 32-bit word.* *For P445 it is an 8, 12 or 16-bit word.* *For P44y, P54x, P547 or P841, it is an 8, 12, 16 or 24-bit word.* *For P74x it is a 12, 16, 24 or 32-bit word.* *For P746 or P849 it is a 32-bit word.*

2.2.2 Change of State of One or More Output Relay Contacts

If one or more of the output relay contacts have changed state since the last time the protection algorithm ran, the new status is logged as an event. When this event is selected to be viewed on the LCD, three cells appear, as shown here:

```
Time and Date of Event
Output Contacts
Event Value 010101010101010101010
```

The Event Value is a multi-bit word (see Note) showing the status of the output contacts, where the least significant bit (extreme right) corresponds to output contact 1, etc. The same information is present if the event is extracted and viewed using a PC.

Note	*For P24x the Event Value is is a 7 or 16-bit word.* *For P34x or P64x it is an 7, 11, 14, 15, 16, 22, 24 or 32-bit word.* *For P445 it is an 8, 12 or 16-bit word.* *For P44x it is a 7, 14 or 21 bit word.* *For P44y, P54x, P547 or P841, it is an 8, 12, 16, 24 or 32 bit word.* *For P74x it is a 12, 16, 24 or 32 bit word.* *For P746 or P849 it is a 24-bit word.*

2.2.3 Relay Alarm Conditions

Any alarm conditions generated by the relays are logged as individual events. The following table shows examples of some of the alarm conditions and how they appear in the event list:

Alarm Condition	Event Text	Event Value
Battery Fail	Battery Fail ON/OFF	Bit position 0 in 32 bit field
Field Voltage Fail	Field Volt Fail ON/OFF	Bit position 1 in 32 bit field

The previous table shows the abbreviated description given to the various alarm conditions and a corresponding value between 0 and 31. This value is appended to each alarm event in a similar way to the input and output events described previously. It is used by the event extraction software, such as MiCOM S1 Studio, to identify the alarm and is therefore invisible if the event is viewed on the LCD. ON or OFF is shown after the description to signify whether the particular condition has become operated or has reset.

2.2.4 Alarm List

Alarm	P741	P742	P743
Bit	Alarm Status 1		
0	Unused	Unused	Unused
1	Unused	Unused	Unused
2	Ext Trip 50BF	Breaker Failure	Breaker Failure
3	Fibre Com Worn	Offset Chan ABCN	Offset Chan ABCN
4	All Prot Blocked	Fibre Com Error	Fibre Com Error
5	Fibre Com Error	Fibre Com Worn	Fibre Com Worn
6	Circt Flt Alm Zx	PU CT Fail IN	PU CT Fail IN
7	Locking Level 1	CB Status Alarm	CB Status Alarm
8	Locking Level 2	Man CB Trip Fail	Man CB Trip Fail
9	Circt Flt Lck Zx	Man CB Cls Fail	Man CB Cls Fail
10	PU Error Alm Zx	Current Overflow	Current Overflow
11	PU Error Lck Zx	Dead Zone Fault	Dead Zone Fault
12	SEF Blocked	Config Error	Config Error
13	Circt Flt Alm CZ	All Prot Blocked	All Prot Blocked
14	Circt Flt Lck CZ	PU Overhaul mode	PU Overhaul mode
15	PU Error Alm CZ	50BF Disabled	50BF Disabled
16	PU Error Lck CZ	Q1 Status Alarm	Q1 Status Alarm
17	Config Error	Q2 Status Alarm	Q2 Status Alarm
18	Alarm 19 Active	Q3 Status Alarm	Q3 Status Alarm
19	Alarm 20 Active	Q4 Status Alarm	Q4 Status Alarm
20	Alarm 21 Active	Q5 Status Alarm	Q5 Status Alarm
21	Alarm 22 Active	Q6 Status Alarm	Q6 Status Alarm
22	Alarm 23 Active	General Alarm	General Alarm
23	Alarm 24 Active	CT Fail	CT Fail
24	Alarm 25 Active	Alarm 25 Active	Alarm 25 Active
25	Alarm 26 Active	Alarm 26 Active	Alarm 26 Active
26	General Alarm	Alarm 27 Active	Alarm 27 Active
27	87BB 3Ph Blocked	Alarm 28 Active	Alarm 28 Active
28	Alarm 29 Active	Alarm 29 Active	Alarm 29 Active
29	Alarm 30 Active	Alarm 30 Active	Alarm 30 Active
30	Alarm 31 Active	Alarm 31 Active	Alarm 31 Active
31	Alarm 32 Active	Alarm 32 Active	Alarm 32 Active
Bit	Alarm Status 2		
0	Alarm 33 Active	Alarm 33 Active	Alarm 33 Active
1	Alarm 34 Active	Alarm 34 Active	Alarm 34 Active
2	Alarm 35 Active	Alarm 35 Active	Alarm 35 Active

Alarm	P741	P742	P743
3	Alarm 36 Active	Alarm 36 Active	Alarm 36 Active
4	Alarm 37 Active	Alarm 37 Active	Alarm 37 Active
5	Alarm 38 Active	Alarm 38 Active	Alarm 38 Active
6	Alarm 39 Active	Alarm 39 Active	Alarm 39 Active
7	Alarm 40 Active	Alarm 40 Active	Alarm 40 Active
8	Alarm 41 Active	Alarm 41 Active	Alarm 41 Active
9	Alarm 42 Active	Alarm 42 Active	Alarm 42 Active
10	Alarm 43 Active	Alarm 43 Active	Alarm 43 Active
11	Alarm 44 Active	Alarm 44 Active	Alarm 44 Active
12	Alarm 45 Active	Alarm 45 Active	Alarm 45 Active
13	Alarm 46 Active	Alarm 46 Active	Alarm 46 Active
14	Alarm 47 Active	Alarm 47 Active	Alarm 47 Active
15	Alarm 48 Active	Alarm 48 Active	Alarm 48 Active
16	Alarm 49 Active	Alarm 49 Active	Alarm 49 Active
17	Alarm 50 Active	Alarm 50 Active	Alarm 50 Active
18	Alarm 51 Active	Alarm 51 Active	Alarm 51 Active
19	Alarm 52 Active	Alarm 52 Active	Alarm 52 Active
20	Alarm 53 Active	Alarm 53 Active	Alarm 53 Active
21	Alarm 54 Active	Alarm 54 Active	Alarm 54 Active
22	Alarm 55 Active	Alarm 55 Active	Alarm 55 Active
23	Alarm 56 Active	Alarm 56 Active	Alarm 56 Active
24	Alarm 57 Active	Alarm 57 Active	Alarm 57 Active
25	Alarm 58 Active	Alarm 58 Active	Alarm 58 Active
26	Alarm 59 Active	Alarm 59 Active	Alarm 59 Active
27	Alarm 60 Active	Alarm 60 Active	Alarm 60 Active
28	Alarm 61 Active	Alarm 61 Active	Alarm 61 Active
29	Alarm 62 Active	Alarm 62 Active	Alarm 62 Active
30	Alarm 63 Active	Alarm 63 Active	Alarm 63 Active
31	Alarm 64 Active	Alarm 64 Active	Alarm 64 Active
Bit	Alarm Status 3		
0	Battery Fail	Battery Fail	Battery Fail
1	Field Volt Fail	Field Volt Fail	Field Volt Fail
2	Comm2 H/W FAIL	Comm2 H/W FAIL	Comm2 H/W FAIL
3	GOOSE IED Absent	GOOSE IED Absent	GOOSE IED Absent
4	NIC Not Fitted	NIC Not Fitted	NIC Not Fitted
5	NIC No Response	NIC No Response	NIC No Response
6	NIC Fatal Error	NIC Fatal Error	NIC Fatal Error
7	Unused	Unused	Unused
8	Unused	Unused	Unused
9	Unused	Unused	Unused
10	Unused	Unused	Unused
11	NIC SW Mis-Match	NIC SW Mis-Match	NIC SW Mis-Match
12	IP Addr Conflict	IP Addr Conflict	IP Addr Conflict
13	IM Loopback	IM Loopback	IM Loopback

Alarm	P741	P742	P743
14	IM Message Fail	IM Message Fail	IM Message Fail
15	IM Data CD Fail	IM Data CD Fail	IM Data CD Fail
16	IM Channel Fail	IM Channel Fail	IM Channel Fail
17	Backup Setting	Backup Setting	Backup Setting
18	Unused	Unused	Unused
19	Unused	Unused	Unused
20	Unused	Unused	Unused
21	Unused	Unused	Unused
22	Invalid Config.	Invalid Config.	Invalid Config.
23	Test Mode Alm	Test Mode Alm	Test Mode Alm
24	Contacts Blk Alm	Contacts Blk Alm	Contacts Blk Alm
25	NIC HW Mismatch	NIC HW Mismatch	NIC HW Mismatch
26	NIC APP Mismatch	NIC APP Mismatch	NIC APP Mismatch
27	Simul.GOOSE Alm	Simul.GOOSE Alm	Simul.GOOSE Alm
28-31	Reserved for other platform alarms	Reserved for other platform alarms	Reserved for other platform alarms
Bit	User Alarm Status		
0	SR User Alarm 1	SR User Alarm 1	SR User Alarm 1
1	SR User Alarm 2	SR User Alarm 2	SR User Alarm 2
2	SR User Alarm 3	SR User Alarm 3	SR User Alarm 3
3	SR User Alarm 4	SR User Alarm 4	SR User Alarm 4
4	SR User Alarm 5	SR User Alarm 5	SR User Alarm 5
5	SR User Alarm 6	SR User Alarm 6	SR User Alarm 6
6	SR User Alarm 7	SR User Alarm 7	SR User Alarm 7
7	SR User Alarm 8	SR User Alarm 8	SR User Alarm 8
8	SR User Alarm 9	SR User Alarm 9	SR User Alarm 9
9	SR User Alarm 10	SR User Alarm 10	SR User Alarm 10
10	SR User Alarm 11	SR User Alarm 11	SR User Alarm 11
11	SR User Alarm 12	SR User Alarm 12	SR User Alarm 12
12	SR User Alarm 13	SR User Alarm 13	SR User Alarm 13
13	SR User Alarm 14	SR User Alarm 14	SR User Alarm 14
14	SR User Alarm 15	SR User Alarm 15	SR User Alarm 15
15	SR User Alarm 16	SR User Alarm 16	SR User Alarm 16
16	MR User Alarm 17	MR User Alarm 17	MR User Alarm 17
17	MR User Alarm 18	MR User Alarm 18	MR User Alarm 18
18	MR User Alarm 19	MR User Alarm 19	MR User Alarm 19
19	MR User Alarm 20	MR User Alarm 20	MR User Alarm 20
20	MR User Alarm 21	MR User Alarm 21	MR User Alarm 21
21	MR User Alarm 22	MR User Alarm 22	MR User Alarm 22
22	MR User Alarm 23	MR User Alarm 23	MR User Alarm 23
23	MR User Alarm 24	MR User Alarm 24	MR User Alarm 24
24	MR User Alarm 25	MR User Alarm 25	MR User Alarm 25
25	MR User Alarm 26	MR User Alarm 26	MR User Alarm 26
26	MR User Alarm 27	MR User Alarm 27	MR User Alarm 27
27	MR User Alarm 28	MR User Alarm 28	MR User Alarm 28

Alarm	P741	P742	P743
28	MR User Alarm 29	MR User Alarm 29	MR User Alarm 29
29	MR User Alarm 30	MR User Alarm 30	MR User Alarm 30
30	MR User Alarm 31	MR User Alarm 31	MR User Alarm 31
31	MR User Alarm 32	MR User Alarm 32	MR User Alarm 32

2.2.5 Protection Element Starts and Trips

Any operation of protection elements, (either a start or a trip condition) is logged as an event record, consisting of a text string indicating the operated element and an event value. This value is intended for use by the event extraction software, such as MiCOM S1 Studio, rather than for the user, and is invisible when the event is viewed on the LCD.

2.2.6 General Events

Several events come under the heading of **General Events**. An example appears here.

Nature of event	Displayed text in event record	Displayed value
Password modified, either from the front or the rear port.	PW modified F, R or R2	0 F=11, R=16, R2=38. For P44x, the value displayed is 0.

A complete list of the General Events is in the Relay Menu Database document. This is a separate document, for each MiCOM Px4x product or product range. They are normally available for download from www.schneider-electric.com

2.2.7 Fault Records

Each time a fault record is generated, an event is also created. The event states that a fault record was generated, with a corresponding time stamp.

Further down the **VIEW RECORDS** column, select the **Select Fault** cell to view the actual fault record, which is selectable from up to 5, 15 or 20 records (see Note). These records consist of fault flags, fault location, fault measurements, etc. The time stamp given in the fault record is more accurate than the corresponding stamp given in the event record as the event is logged some time after the actual fault record is generated.

> *Note* *Up to 5 records for the P14x, P24x, P34x, P44x and P74x.*
> *Up to 15 records for the P445, P44y, P54x, P547 and P841.*
> *Up to 20 records for the P746.*

The fault record is triggered from the **Fault REC. TRIG.** signal assigned in the default programmable scheme logic. Normally this is assigned to relay 3, protection trip, but in the P746 it is assigned to Any Start or Any Trip. The fault measurements in the fault record are given at the time of the protection start.

The fault recorder does not stop recording until the reset of the ‘Fault REC. TRIG.’ signal in order to record all the protection flags during the fault.

It is recommended that the triggering contact be ‘self reset’ and not latching. If a latching contact were chosen the fault record would not be generated until the contact had fully reset.

2.2.8 Maintenance Reports

Internal failures detected by the self-monitoring circuitry, such as watchdog failure, field voltage failure etc. are logged into a maintenance report. The maintenance report holds up to 10 such '**events**' (only 5 events for the P24x/P54x/P547) and is accessed from the "**Select Report**" cell at the bottom of the "**VIEW RECORDS**" column.

Each entry consists of a self explanatory text string and a '**Type**' and '**Data**' cell, which are explained in the menu extract at the beginning of this section.

Each time a Maintenance Report is generated, an event is also created. The event simply states that a report was generated, with a corresponding time stamp.

2.2.9 Setting Changes

Changes to any setting in the relay are logged as an event. For example:

Type of setting change	Displayed text in event record	Displayed value
Control/Support Setting	C & S Changed	22
Group # Change	Group # Changed	#
Where # = 1 to 4		

Note *Control/Support settings are communications, measurement, CT/VT ratio settings etc, which are not duplicated in the setting groups. When any of these settings are changed, the event record is created simultaneously. Changes to protection or disturbance recorder settings only generate an event once the settings have been confirmed at the 'setting trap'.*

2.3 Resetting of Event/Fault Records

To delete the event, fault or maintenance reports, use the **RECORD CONTROL** column.

2.4 Viewing Event Records via MiCOM S1 Support Software

When the event records are extracted and viewed on a PC they look slightly different than when viewed on the LCD. The following shows an example of how various events appear when displayed using MiCOM S1 Studio:

```
+ Thursday 22 December 2005 17:03:19.731 GMT PW Unlocked F
+ Thursday 22 December 2005 17:02:49.855 GMT PW Unlocked F
+ Thursday 22 December 2005 17:01:40.135 GMT Fault Recorded
+ Thursday 22 December 2005 17:01:39.897 GMT Trip 87BB Zone 1 OFF
+ Thursday 22 December 2005 17:01:39.897 GMT Trip 87BB OFF
+ Thursday 22 December 2005 17:01:39.699 GMT Fault Check Zone OFF
+ Thursday 22 December 2005 17:01:39.694 GMT Flt 87BB Zone 1 OFF
+ Thursday 22 December 2005 17:01:39.694 GMT Fault phase A OFF
+ Thursday 22 December 2005 17:01:39.669 GMT Output Contacts1
+ Thursday 22 December 2005 17:01:39.669 GMT Output Contacts1
+ Thursday 22 December 2005 17:01:39.669 GMT Trip 87BB Zone 1 ON
+ Thursday 22 December 2005 17:01:39.669 GMT Trip 87BB ON
+ Thursday 22 December 2005 17:01:39.667 GMT Flt 87BB Zone 1 ON
+ Thursday 22 December 2005 17:01:39.667 GMT Fault phase A ON
+ Thursday 22 December 2005 17:01:39.666 GMT Fault Check Zone ON
+ Thursday 22 December 2005 17:01:15.134 GMT Manual Start DR OFF
+ Thursday 22 December 2005 17:01:11.158 GMT Ext Start DR OFF
+ Thursday 22 December 2005 17:01:11.158 GMT Function Key 9 OFF
+ Thursday 22 December 2005 17:01:10.903 GMT Manual Start DR ON
+ Thursday 22 December 2005 17:01:10.903 GMT Ext Start DR ON
+ Thursday 22 December 2005 17:01:10.903 GMT Function Key 9 ON
+ Thursday 22 December 2005 17:01:07.703 GMT CU->PU Virt.RL02 OFF
+ Thursday 22 December 2005 17:01:07.703 GMT Function Key 8 OFF
+ Thursday 22 December 2005 17:01:07.449 GMT CU->PU Virt.RL02 ON
+ Thursday 22 December 2005 17:01:07.449 GMT Function Key 8 ON
+ Thursday 22 December 2005 17:01:06.912 GMT To Reset CircFlt OFF
+ Thursday 22 December 2005 17:01:06.912 GMT Reset Latches OFF
+ Thursday 22 December 2005 17:01:06.912 GMT To Reset PU err OFF
+ Thursday 22 December 2005 17:01:06.912 GMT PU->CU Virt.RL04 OFF
+ Thursday 22 December 2005 17:01:06.900 GMT CU->PU Virt.RL01 OFF
+ Thursday 22 December 2005 17:01:06.900 GMT Function Key 7 OFF
+ Thursday 22 December 2005 17:01:06.672 GMT PU Error Reset OFF
+ Thursday 22 December 2005 17:01:06.672 GMT Circ Flt Reset OFF
+ Thursday 22 December 2005 17:01:06.659 GMT PU Error Reset ON
+ Thursday 22 December 2005 17:01:06.659 GMT Circ Flt Reset ON
+ Thursday 22 December 2005 17:01:06.657 GMT To Reset CircFlt ON
+ Thursday 22 December 2005 17:01:06.657 GMT To Reset PU err ON
```

The following shows a P742 example of how various events appear when displayed using MiCOM S1:

```
+ Thursday 22 December 2005 17:09:05.751 GMT PW Unlocked F0
+ Thursday 22 December 2005 17:08:56.541 GMT PW Unlocked F0
+ Thursday 22 December 2005 17:01:39.900 GMT Trip Zone 1 OFF
+ Thursday 22 December 2005 17:01:39.898 GMT Output Contacts1
+ Thursday 22 December 2005 17:01:40.197 GMT Fault Recorded
+ Thursday 22 December 2005 17:01:39.898 GMT Any Trip OFF
+ Thursday 22 December 2005 17:01:39.898 GMT CB Trip 3 ph OFF
+ Thursday 22 December 2005 17:01:39.898 GMT Trip 87BB OFF
+ Thursday 22 December 2005 17:01:39.898 GMT Output Contacts1
+ Thursday 22 December 2005 17:01:39.898 GMT Internal Trip OFF
+ Thursday 22 December 2005 17:01:39.739 GMT Delta IN OFF
+ Thursday 22 December 2005 17:01:39.739 GMT Delta IA OFF
+ Thursday 22 December 2005 17:01:39.694 GMT CB Closed OFF
+ Thursday 22 December 2005 17:01:39.694 GMT CB Aux. 52b ON
+ Thursday 22 December 2005 17:01:39.694 GMT CB Aux. 3ph(52b) ON
+ Thursday 22 December 2005 17:01:39.694 GMT Logic Inputs 1
+ Thursday 22 December 2005 17:01:39.692 GMT CB Aux. 52a OFF
+ Thursday 22 December 2005 17:01:39.692 GMT CB Aux. 3ph(52a) OFF
+ Thursday 22 December 2005 17:01:39.692 GMT Logic Inputs 1
+ Thursday 22 December 2005 17:01:39.672 GMT Trip Zone 1 ON
+ Thursday 22 December 2005 17:01:39.671 GMT Output Contacts1
+ Thursday 22 December 2005 17:01:39.671 GMT Any Trip ON
+ Thursday 22 December 2005 17:01:39.671 GMT CB Trip 3 ph ON
+ Thursday 22 December 2005 17:01:39.671 GMT Trip 87BB ON
+ Thursday 22 December 2005 17:01:39.671 GMT Output Contacts1
+ Thursday 22 December 2005 17:01:39.671 GMT Internal Trip ON
+ Thursday 22 December 2005 17:01:39.664 GMT Delta IN ON
+ Thursday 22 December 2005 17:01:39.664 GMT Delta IA ON
+ Thursday 22 December 2005 17:01:37.100 GMT Man.CB Close Cmd OFF
+ Thursday 22 December 2005 17:01:37.100 GMT Logic Inputs 1
+ Thursday 22 December 2005 17:01:37.075 GMT Delta IN OFF
+ Thursday 22 December 2005 17:01:37.075 GMT Delta IA OFF
+ Thursday 22 December 2005 17:01:37.031 GMT CB Aux. 52a ON
+ Thursday 22 December 2005 17:01:37.031 GMT CB Aux. 3ph(52a) ON
+ Thursday 22 December 2005 17:01:37.031 GMT Logic Inputs 1
+ Thursday 22 December 2005 17:01:37.030 GMT CB Aux. 52b OFF
+ Thursday 22 December 2005 17:01:37.030 GMT CB Aux. 3ph(52b) OFF
```

The first line gives the description and time stamp for the event, while the additional information displayed below may be collapsed using the +/– symbol.

For further information regarding events and their specific meaning, refer to the *Relay Menu Database* document. This standalone document not included in this manual.

2.5 Event Filtering

Event reporting can be disabled from all interfaces that support setting changes. The settings that control the various types of events are in the RECORD CONTROL column. The effect of setting each to disabled is in shown in the following table:

Note	*Some occurrences can result in more than one type of event, e.g. a battery failure will produce an alarm event and a maintenance record event.*

If the Protection Event setting is Enabled, a further set of settings is revealed which allow the event generation by individual DDB signals to be enabled or disabled.

For further information on events and their specific meaning, see the *Relay Menu Database* document.

The “record control” setting is used to:

- clear events logs, fault records and alarm events,
- enable or disable event generation for any change in relay output, logic input, general and protection events or fault and maintenance record.
- display DDB signals.

3 DISTURBANCE RECORDER

The integral enhanced disturbance recorder has an area of memory specifically set aside for record storage. The number of records that may be stored by the relay is dependent on the selected recording duration and the installed software release.

The relay can typically store a pre-set minimum number of records, each of a pre-set duration. These may vary between different MiCOM products.

Disturbance records continue to be recorded until the available memory is exhausted, at which time the oldest record(s) are overwritten to make space for the newest one.

The recorder stores actual samples that are taken at a rate of pre-defined number of samples per cycle. Again, this may vary between different MiCOM products.

Each disturbance record consists of a number of analog data channels and digital data channels.

The relevant CT and VT ratios for the analog channels are also extracted to enable scaling to primary quantities. If a CT ratio is set less than unity, the relay will choose a scaling factor of zero for the appropriate channel.

This relay can typically store a minimum of 50 records, each of 1.2 seconds duration in the Central Unit (CU) and up to 10.5 seconds in a Peripheral Unit (PU).

The recorder stores actual samples that are taken at a rate of 12 samples per cycle in the CU and in the PUs.

The minimum delay between 2 disturbance records (in the CU) is 5s.

Each disturbance record consists of 8 analogue data channels in the CU and 4 analogue data channels in the PUs and 32 digital data channels.

The following tables give default setting configuration for central and peripheral units.

The disturbance recorder settings include the record duration and trigger position, selection of analog and digital signals to record, and the signal sources that trigger the recording.

The precise event recorder column (“Disturb. Recorder” menu) is visible when the “Disturb recorder” setting (“Configuration” column) = “visible”.

The "DISTURBANCE RECORDER" menu columns are different for the Central Unit and the Peripheral Units as shown in the configuration columns below:

- **Error! Reference source not found.**
- **Error! Reference source not found.**

The pre and post fault recording times are set by a combination of the **Duration** and **Trigger Position** cells. **Duration** sets the overall recording time and the **Trigger Position** sets the trigger point as a percentage of the duration.

- For example, the default settings show that the overall recording time is set to 1.2s with the trigger point being at 33.3% of this, giving 0.4s pre-fault and 0.8s post fault recording times.

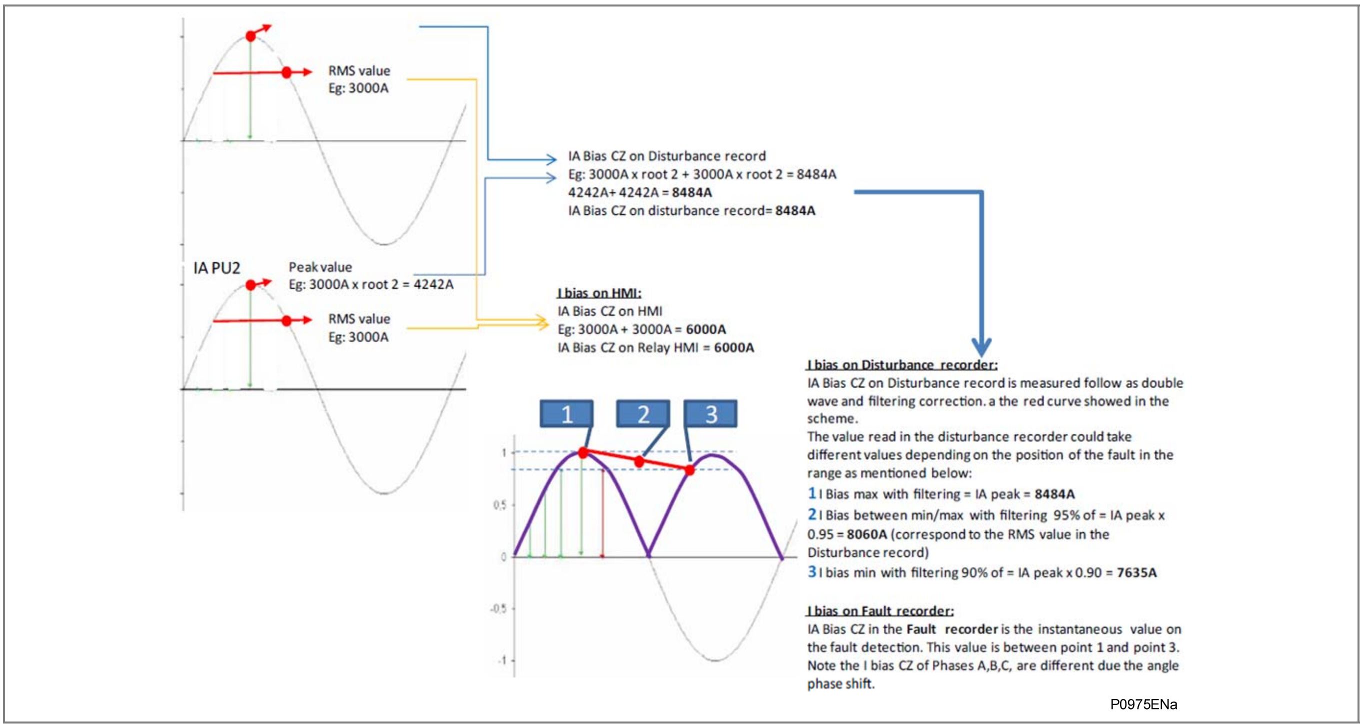
If a further trigger occurs while a recording is taking place, the recorder ignores the trigger if the **Trigger Mode** is set to **Single**. However, if this is set to **Extended**, the post-trigger timer is reset to zero, extending the recording time.

As can be seen from the menu, each of the analog channels is selectable from the available analog inputs to the relay. The digital channels may be mapped to any of the opto isolated inputs or output contacts, in addition to several internal relay digital signals, such as protection starts and LEDs. The complete list of these signals may be found by viewing the available settings in the relay menu or using a setting file in MiCOM S1 Studio. Any of the digital channels may be selected to trigger the disturbance recorder on either a low-to-high or a high-to-low transition, using the **Input Trigger** cell. The default trigger settings are that any dedicated trip output contacts, such as relay 3, trigger the recorder.

It is not possible to view the disturbance records locally using the LCD; they must be extracted using suitable software such as MiCOM S1 Studio. This process is fully explained in the *SCADA Communications* chapter.

Disturbance Record Notes

Note	*The IA, IB,IC, IN bias CZ read in the Disturbance record is the Maximum value of the sample with the summation of the current measured on each PUs including filtering and calculation process.* *This value is the real bias current value read on sample used for the trip calculation.*



RMS value

Eg: 3000A

The Differential Measurement values read on the HMI, Fault Record, Disturbance Record are all instantaneous values (signal non-filtered) i.e. value of samples.

As example if the current is 3000A on Ph A PU1, and 3000A on Ph A PU2, the current read by the disturbance recorder is:

IA Bias CZ= 3000Axroot2+3000A xroot2= 8484A

This value is different of the IA Bias CZ displayed by the relay HMI due to the filtering process (see detail in measurement chapter).

3.1 Disturbance Recorder Settings (P741)

Col	Row	Menu Text	Default Setting	Available Setting
Description				
0C	00	DISTURB RECORDER		
This column contains settings for the Disturbance Recorder				
0C	01	Duration	1.2s	From 100 ms to 10.5 s step 10 ms
This sets the overall recording time.				
0C	02	Trigger Position	33.34%	From 0% to 50.01% step 16.67%
This sets the trigger point as a percentage of the duration. For example, the default settings show that the overall recording time is set to 1.5 s with the trigger point being at 33.3% of this, giving 0.5 s pre-fault and 1s post fault recording times.				
0C	03	Trigger Mode	Single	0 = Single or 1 = Extended
If set to single mode, if a further trigger occurs whilst a recording is taking place, the recorder will ignore the trigger. However, if this has been set to Extended, the post trigger timer will be reset to zero, thereby extending the recording time.				
0C	04	Analog Channel 1	IA diff	0 - VA, 1 - VB, 2 - VC, 3 - VN, 4 - IA, 5 - IB, 6 - IC, 7 - IN, 8 - IM, 9 - V Checksync1, 10 - unassigned, 11 - V Checksync 2
Selects any available analogue input to be assigned to this channel.				
0C	05	Analog Channel 2	IB diff	0 - VA, 1 - VB, 2 - VC, 3 - VN, 4 - IA, 5 - IB, 6 - IC, 7 - IN, 8 - IM, 9 - V Checksync1, 10 - unassigned, 11 - V Checksync 2
Selects any available analogue input to be assigned to this channel.				
0C	06	Analog Channel 3	IC diff	0 - VA, 1 - VB, 2 - VC, 3 - VN, 4 - IA, 5 - IB, 6 - IC, 7 - IN, 8 - IM, 9 - V Checksync1, 10 - unassigned, 11 - V Checksync 2
Selects any available analogue input to be assigned to this channel.				
0C	07	Analog Channel 4	IN diff	0 - VA, 1 - VB, 2 - VC, 3 - VN, 4 - IA, 5 - IB, 6 - IC, 7 - IN, 8 - IM, 9 - V Checksync1, 10 - unassigned, 11 - V Checksync 2
Selects any available analogue input to be assigned to this channel.				
0C	08	Analog Channel 5	IA bias	0 - VA, 1 - VB, 2 - VC, 3 - VN, 4 - IA, 5 - IB, 6 - IC, 7 - IN, 8 - IM, 9 - V Checksync1, 10 - unassigned, 11 - V Checksync 2
Selects any available analogue input to be assigned to this channel.				
0C	09	Analog Channel 6	IB bias	0 - VA, 1 - VB, 2 - VC, 3 - VN, 4 - IA, 5 - IB, 6 - IC, 7 - IN, 8 - IM, 9 - V Checksync1, 10 - unassigned, 11 - V Checksync 2
Selects any available analogue input to be assigned to this channel.				
0C	0A	Analog Channel 7	IC bias	0 - VA, 1 - VB, 2 - VC, 3 - VN, 4 - IA, 5 - IB, 6 - IC, 7 - IN, 8 - IM, 9 - V Checksync1, 10 - unassigned, 11 - V Checksync 2
Selects any available analogue input to be assigned to this channel.				
0C	0B	Analog Channel 8	IN bias	0 - VA, 1 - VB, 2 - VC, 3 - VN, 4 - IA, 5 - IB, 6 - IC, 7 - IN, 8 - IM, 9 - V Checksync1, 10 - unassigned, 11 - V Checksync 2
Selects any available analogue input to be assigned to this channel.				
0C	0C	Digital Input 1	Circt Flt Alm z1	See Data Types - G32
The digital channels may monitor any of the opto isolated inputs or output contacts, in addition to a number of internal IED digital signals, such as protection starts, LEDs etc.				
0C	0D	Digital Input 2	Circt Flt Alm z2	See Data Types - G32
The digital channels may monitor any of the opto isolated inputs or output contacts, in addition to a number of internal IED digital signals, such as protection starts, LEDs etc.				
0C	0E	Digital Input 3	INP Block 3Ph z5	See Data Types - G32
The digital channels may monitor any of the opto isolated inputs or output contacts, in addition to a number of internal IED digital signals, such as protection starts, LEDs etc.				
0C	0F	Digital Input 4	Ext Start DR	See Data Types - G32

Col	Row	Menu Text	Default Setting	Available Setting
Description				
The digital channels may monitor any of the opto isolated inputs or output contacts, in addition to a number of internal IED digital signals, such as protection starts, LEDs etc.				
0C	10	Digital Input 5	Fault Check Zone	See Data Types - G32
The digital channels may monitor any of the opto isolated inputs or output contacts, in addition to a number of internal IED digital signals, such as protection starts, LEDs etc.				
0C	11	Digital Input 6	SEF Blocked	See Data Types - G32
The digital channels may monitor any of the opto isolated inputs or output contacts, in addition to a number of internal IED digital signals, such as protection starts, LEDs etc.				
0C	12	Digital Input 7	Topology valid	See Data Types - G32
The digital channels may monitor any of the opto isolated inputs or output contacts, in addition to a number of internal IED digital signals, such as protection starts, LEDs etc.				
0C	13	Digital Input 8	87BB 3Ph Blocked	See Data Types - G32
The digital channels may monitor any of the opto isolated inputs or output contacts, in addition to a number of internal IED digital signals, such as protection starts, LEDs etc.				
0C	14	Digital Input 9	Fibre Com Worn	See Data Types - G32
The digital channels may monitor any of the opto isolated inputs or output contacts, in addition to a number of internal IED digital signals, such as protection starts, LEDs etc.				
0C	15	Digital Input 10	Trip 87BB Zone 1	See Data Types - G32
The digital channels may monitor any of the opto isolated inputs or output contacts, in addition to a number of internal IED digital signals, such as protection starts, LEDs etc.				
0C	16	Digital Input 11	Trip 87BB Zone 2	See Data Types - G32
The digital channels may monitor any of the opto isolated inputs or output contacts, in addition to a number of internal IED digital signals, such as protection starts, LEDs etc.				
0C	17	Digital Input 12	INP Block 3Ph z8	See Data Types - G32
The digital channels may monitor any of the opto isolated inputs or output contacts, in addition to a number of internal IED digital signals, such as protection starts, LEDs etc.				
0C	18	Digital Input 13	General Alarm	See Data Types - G32
The digital channels may monitor any of the opto isolated inputs or output contacts, in addition to a number of internal IED digital signals, such as protection starts, LEDs etc.				
0C	19	Digital Input 14	Circt Flt Alm Zx	See Data Types - G32
The digital channels may monitor any of the opto isolated inputs or output contacts, in addition to a number of internal IED digital signals, such as protection starts, LEDs etc.				
0C	1A	Digital Input 15	INP Block SEF z1	See Data Types - G32
The digital channels may monitor any of the opto isolated inputs or output contacts, in addition to a number of internal IED digital signals, such as protection starts, LEDs etc.				
0C	1B	Digital Input 16	INP Block SEF z2	See Data Types - G32
The digital channels may monitor any of the opto isolated inputs or output contacts, in addition to a number of internal IED digital signals, such as protection starts, LEDs etc.				
0C	1C	Digital Input 17	Man.Trip Zone 1	See Data Types - G32
The digital channels may monitor any of the opto isolated inputs or output contacts, in addition to a number of internal IED digital signals, such as protection starts, LEDs etc.				
0C	1D	Digital Input 18	Man.Trip Zone 2	See Data Types - G32
The digital channels may monitor any of the opto isolated inputs or output contacts, in addition to a number of internal IED digital signals, such as protection starts, LEDs etc.				
0C	1E	Digital Input 19	PU Error Alm z1	See Data Types - G32
The digital channels may monitor any of the opto isolated inputs or output contacts, in addition to a number of internal IED digital signals, such as protection starts, LEDs etc.				
0C	1F	Digital Input 20	PU Error Alm z2	See Data Types - G32

Col	Row	Menu Text	Default Setting	Available Setting
Description				
The digital channels may monitor any of the opto isolated inputs or output contacts, in addition to a number of internal IED digital signals, such as protection starts, LEDs etc.				
0C	20	Digital Input 21	unused	See Data Types - G32
The digital channels may monitor any of the opto isolated inputs or output contacts, in addition to a number of internal IED digital signals, such as protection starts, LEDs etc.				
0C	21	Digital Input 22	unused	See Data Types - G32
The digital channels may monitor any of the opto isolated inputs or output contacts, in addition to a number of internal IED digital signals, such as protection starts, LEDs etc.				
0C	22	Digital Input 23	unused	See Data Types - G32
The digital channels may monitor any of the opto isolated inputs or output contacts, in addition to a number of internal IED digital signals, such as protection starts, LEDs etc.				
0C	23	Digital Input 24	unused	See Data Types - G32
The digital channels may monitor any of the opto isolated inputs or output contacts, in addition to a number of internal IED digital signals, such as protection starts, LEDs etc.				
0C	24	Digital Input 25	unused	See Data Types - G32
The digital channels may monitor any of the opto isolated inputs or output contacts, in addition to a number of internal IED digital signals, such as protection starts, LEDs etc.				
0C	25	Digital Input 26	unused	See Data Types - G32
The digital channels may monitor any of the opto isolated inputs or output contacts, in addition to a number of internal IED digital signals, such as protection starts, LEDs etc.				
0C	26	Digital Input 27	unused	See Data Types - G32
The digital channels may monitor any of the opto isolated inputs or output contacts, in addition to a number of internal IED digital signals, such as protection starts, LEDs etc.				
0C	27	Digital Input 28	unused	See Data Types - G32
The digital channels may monitor any of the opto isolated inputs or output contacts, in addition to a number of internal IED digital signals, such as protection starts, LEDs etc.				
0C	28	Digital Input 29	unused	See Data Types - G32
The digital channels may monitor any of the opto isolated inputs or output contacts, in addition to a number of internal IED digital signals, such as protection starts, LEDs etc.				
0C	29	Digital Input 30	unused	See Data Types - G32
The digital channels may monitor any of the opto isolated inputs or output contacts, in addition to a number of internal IED digital signals, such as protection starts, LEDs etc.				
0C	2A	Digital Input 31	unused	See Data Types - G32
The digital channels may monitor any of the opto isolated inputs or output contacts, in addition to a number of internal IED digital signals, such as protection starts, LEDs etc.				
0C	2B	Digital Input 32	unused	See Data Types - G32
The digital channels may monitor any of the opto isolated inputs or output contacts, in addition to a number of internal IED digital signals, such as protection starts, LEDs etc.				
0C	2C	Manual Trigger	No	0 = No Trigger, 1 = Trigger L/H, 2 = Trigger H/L
Any of the digital channels may be selected to trigger the disturbance recorder on either a low to high or a high to low transition.				
0C	2D	Zone To Record	10000000(bin)	Bit 00=Zone 8 to Bit FF=Zone 1
Select the protection zone needs to record the disturbance				

3.2 Disturbance Recorder Settings (P742 or P743))

Col	Row	Menu Text	Default Setting	Available Setting	74	74
Description						
0C	00	DISTURB RECORDER			*	*
This column contains settings for the Disturbance Recorder						
0C	01	Duration	1.2s	From 100ms to 10.5s step 10ms	*	*
This sets the overall recording time.						
0C	02	Trigger Position	33.3%	From 0 % to 100% step 33.3%	*	*
This sets the trigger point as a percentage of the duration. For example, the default settings show that the overall recording time is set to 1.5 s with the trigger point being at 33.3% of this, giving 0.5 s pre-fault and 1s post fault recording times.						
0C	03	Trigger Mode	Extended	0 = Single or 1 = Extended	*	*
If set to single mode, if a further trigger occurs whilst a recording is taking place, the recorder will ignore the trigger. However, if this has been set to Extended, the post trigger timer will be reset to zero, thereby extending the recording time.						
0C	04	Analog Channel 1	IA	0-VA, 1-VB, 2-VC, 3-VN, 4-IA, 5-IB, 6-IC, 7-IN, 8-IM, 9-V Checksync, 10-Unasigned	*	*
Selects any available analogue input to be assigned to this channel.						
0C	05	Analog Channel 2	IB	0-VA, 1-VB, 2-VC, 3-VN, 4-IA, 5-IB, 6-IC, 7-IN, 8-IM, 9-V Checksync, 10-Unasigned	*	*
Selects any available analogue input to be assigned to this channel.						
0C	06	Analog Channel 3	IC	0-VA, 1-VB, 2-VC, 3-VN, 4-IA, 5-IB, 6-IC, 7-IN, 8-IM, 9-V Checksync, 10-Unasigned	*	*
Selects any available analogue input to be assigned to this channel.						
0C	07	Analog Channel 4	IN	0-VA, 1-VB, 2-VC, 3-VN, 4-IA, 5-IB, 6-IC, 7-IN, 8-IM, 9-V Checksync, 10-Unasigned	*	*
Selects any available analogue input to be assigned to this channel.						
0C	08	Analog Channel 5	Unassigned	0-VA, 1-VB, 2-VC, 3-VN, 4-IA, 5-IB, 6-IC, 7-IN, 8-IM, 9-V Checksync, 10-Unasigned	*	*
Selects any available analogue input to be assigned to this channel.						
0C	09	Analog Channel 6	Unassigned	0-VA, 1-VB, 2-VC, 3-VN, 4-IA, 5-IB, 6-IC, 7-IN, 8-IM, 9-V Checksync, 10-Unasigned	*	*
Selects any available analogue input to be assigned to this channel.						
0C	0A	Analog Channel 7	Unassigned	0-VA, 1-VB, 2-VC, 3-VN, 4-IA, 5-IB, 6-IC, 7-IN, 8-IM, 9-V Checksync, 10-Unasigned	*	*
Selects any available analogue input to be assigned to this channel.						
0C	0B	Analog Channel 8	Unassigned	0-VA, 1-VB, 2-VC, 3-VN, 4-IA, 5-IB, 6-IC, 7-IN, 8-IM, 9-V Checksync, 10-Unasigned	*	*
Selects any available analogue input to be assigned to this channel.						
0C	0C	Digital Input 1	Bad TCP/IP Cfg.	See Data Types - G32	*	*
The digital channels may monitor any of the opto isolated inputs or output contacts, in addition to a number of internal IED digital signals, such as protection starts, LEDs etc.						
0C	0D	Input 1 Trigger	No Trigger	0 = No Trigger, 1 = Trigger L/H, 2 = Trigger H/L	*	*
Any of the digital channels may be selected to trigger the disturbance recorder on either a low to high or a high to low transition.						
0C	0E	Digital Input 2	87BB Fault Ph C	See Data Types - G32	*	*
The digital channels may monitor any of the opto isolated inputs or output contacts, in addition to a number of internal IED digital signals, such as protection starts, LEDs etc.						
0C	0F	Input 2 Trigger	Trigger L/H	0 = No Trigger, 1 = Trigger L/H, 2 = Trigger H/L	*	*
Any of the digital channels may be selected to trigger the disturbance recorder on either a low to high or a high to low transition.						
0C	10	Digital Input 3	Q6 Status Forced	See Data Types - G32	*	*

Col	Row	Menu Text	Default Setting	Available Setting	7 4	7 4
Description						
The digital channels may monitor any of the opto isolated inputs or output contacts, in addition to a number of internal IED digital signals, such as protection starts, LEDs etc.						
0C	11	Input 3 Trigger	No Trigger	0 = No Trigger, 1 = Trigger L/H, 2 = Trigger H/L	*	*
Any of the digital channels may be selected to trigger the disturbance recorder on either a low to high or a high to low transition.						
0C	12	Digital Input 4	I>2 Start A	See Data Types - G32	*	*
The digital channels may monitor any of the opto isolated inputs or output contacts, in addition to a number of internal IED digital signals, such as protection starts, LEDs etc.						
0C	13	Input 4 Trigger	No Trigger	0 = No Trigger, 1 = Trigger L/H, 2 = Trigger H/L	*	*
Any of the digital channels may be selected to trigger the disturbance recorder on either a low to high or a high to low transition.						
0C	14	Digital Input 5	CB not available	See Data Types - G32	*	*
The digital channels may monitor any of the opto isolated inputs or output contacts, in addition to a number of internal IED digital signals, such as protection starts, LEDs etc.						
0C	15	Input 5 Trigger	No Trigger	0 = No Trigger, 1 = Trigger L/H, 2 = Trigger H/L	*	*
Any of the digital channels may be selected to trigger the disturbance recorder on either a low to high or a high to low transition.						
0C	16	Digital Input 6	I>1 Trip	See Data Types - G32	*	*
The digital channels may monitor any of the opto isolated inputs or output contacts, in addition to a number of internal IED digital signals, such as protection starts, LEDs etc.						
0C	17	Input 6 Trigger	Trigger L/H	0 = No Trigger, 1 = Trigger L/H, 2 = Trigger H/L	*	*
Any of the digital channels may be selected to trigger the disturbance recorder on either a low to high or a high to low transition.						
0C	18	Digital Input 7	IN>1 Trip	See Data Types - G32	*	*
The digital channels may monitor any of the opto isolated inputs or output contacts, in addition to a number of internal IED digital signals, such as protection starts, LEDs etc.						
0C	19	Input 7 Trigger	Trigger L/H	0 = No Trigger, 1 = Trigger L/H, 2 = Trigger H/L	*	*
Any of the digital channels may be selected to trigger the disturbance recorder on either a low to high or a high to low transition.						
0C	1A	Digital Input 8	Topology valid	See Data Types - G32	*	*
The digital channels may monitor any of the opto isolated inputs or output contacts, in addition to a number of internal IED digital signals, such as protection starts, LEDs etc.						
0C	1B	Input 8 Trigger	Trigger L/H	0 = No Trigger, 1 = Trigger L/H, 2 = Trigger H/L	*	*
Any of the digital channels may be selected to trigger the disturbance recorder on either a low to high or a high to low transition.						
0C	1C	Digital Input 9	Ext. CB Fail	See Data Types - G32	*	*
The digital channels may monitor any of the opto isolated inputs or output contacts, in addition to a number of internal IED digital signals, such as protection starts, LEDs etc.						
0C	1D	Input 9 Trigger	Trigger L/H	0 = No Trigger, 1 = Trigger L/H, 2 = Trigger H/L	*	*
Any of the digital channels may be selected to trigger the disturbance recorder on either a low to high or a high to low transition.						
0C	1E	Digital Input 10	Ext. 3 ph Trip	See Data Types - G32	*	*
The digital channels may monitor any of the opto isolated inputs or output contacts, in addition to a number of internal IED digital signals, such as protection starts, LEDs etc.						
0C	1F	Input 10 Trigger	Trigger L/H	0 = No Trigger, 1 = Trigger L/H, 2 = Trigger H/L	*	*
Any of the digital channels may be selected to trigger the disturbance recorder on either a low to high or a high to low transition.						
0C	20	Digital Input 11	Dead Zone Earth	See Data Types - G32	*	*
The digital channels may monitor any of the opto isolated inputs or output contacts, in addition to a number of internal IED digital signals, such as protection starts, LEDs etc.						
0C	21	Input 11 Trigger	Trigger L/H	0 = No Trigger, 1 = Trigger L/H, 2 = Trigger H/L	*	*
Any of the digital channels may be selected to trigger the disturbance recorder on either a low to high or a high to low transition.						
0C	22	Digital Input 12	Q4 Status Alarm	See Data Types - G32	*	*

Col	Row	Menu Text	Default Setting	Available Setting	7 4	7 4
Description						
The digital channels may monitor any of the opto isolated inputs or output contacts, in addition to a number of internal IED digital signals, such as protection starts, LEDs etc.						
0C	23	Input 12 Trigger	No Trigger	0 = No Trigger, 1 = Trigger L/H, 2 = Trigger H/L	*	*
Any of the digital channels may be selected to trigger the disturbance recorder on either a low to high or a high to low transition.						
0C	24	Digital Input 13	Q5 Status Alarm	See Data Types - G32	*	*
The digital channels may monitor any of the opto isolated inputs or output contacts, in addition to a number of internal IED digital signals, such as protection starts, LEDs etc.						
0C	25	Input 13 Trigger	No Trigger	0 = No Trigger, 1 = Trigger L/H, 2 = Trigger H/L	*	*
Any of the digital channels may be selected to trigger the disturbance recorder on either a low to high or a high to low transition.						
0C	26	Digital Input 14	Q6 Status Alarm	See Data Types - G32	*	*
The digital channels may monitor any of the opto isolated inputs or output contacts, in addition to a number of internal IED digital signals, such as protection starts, LEDs etc.						
0C	27	Input 14 Trigger	No Trigger	0 = No Trigger, 1 = Trigger L/H, 2 = Trigger H/L	*	*
Any of the digital channels may be selected to trigger the disturbance recorder on either a low to high or a high to low transition.						
0C	28	Digital Input 15	Config. Valid	See Data Types - G32	*	*
The digital channels may monitor any of the opto isolated inputs or output contacts, in addition to a number of internal IED digital signals, such as protection starts, LEDs etc.						
0C	29	Input 15 Trigger	Trigger L/H	0 = No Trigger, 1 = Trigger L/H, 2 = Trigger H/L	*	*
Any of the digital channels may be selected to trigger the disturbance recorder on either a low to high or a high to low transition.						
0C	2A	Digital Input 16	Relay Label 01	See Data Types - G32	*	*
The digital channels may monitor any of the opto isolated inputs or output contacts, in addition to a number of internal IED digital signals, such as protection starts, LEDs etc.						
0C	2B	Input 16 Trigger	No Trigger	0 = No Trigger, 1 = Trigger L/H, 2 = Trigger H/L	*	*
Any of the digital channels may be selected to trigger the disturbance recorder on either a low to high or a high to low transition.						
0C	2C	Digital Input 17	Relay Label 02	See Data Types - G32	*	*
The digital channels may monitor any of the opto isolated inputs or output contacts, in addition to a number of internal IED digital signals, such as protection starts, LEDs etc.						
0C	2D	Input 17 Trigger	No Trigger	0 = No Trigger, 1 = Trigger L/H, 2 = Trigger H/L	*	*
Any of the digital channels may be selected to trigger the disturbance recorder on either a low to high or a high to low transition.						
0C	2E	Digital Input 18	Relay Label 03	See Data Types - G32	*	*
The digital channels may monitor any of the opto isolated inputs or output contacts, in addition to a number of internal IED digital signals, such as protection starts, LEDs etc.						
0C	2F	Input 18 Trigger	No Trigger	0 = No Trigger, 1 = Trigger L/H, 2 = Trigger H/L	*	*
Any of the digital channels may be selected to trigger the disturbance recorder on either a low to high or a high to low transition.						
0C	30	Digital Input 19	Offset Chan ABCN	See Data Types - G32	*	*
The digital channels may monitor any of the opto isolated inputs or output contacts, in addition to a number of internal IED digital signals, such as protection starts, LEDs etc.						
0C	31	Input 19 Trigger	No Trigger	0 = No Trigger, 1 = Trigger L/H, 2 = Trigger H/L	*	*
Any of the digital channels may be selected to trigger the disturbance recorder on either a low to high or a high to low transition.						
0C	32	Digital Input 20	Predict err ph A	See Data Types - G32	*	*
The digital channels may monitor any of the opto isolated inputs or output contacts, in addition to a number of internal IED digital signals, such as protection starts, LEDs etc.						
0C	33	Input 20 Trigger	No Trigger	0 = No Trigger, 1 = Trigger L/H, 2 = Trigger H/L	*	*
Any of the digital channels may be selected to trigger the disturbance recorder on either a low to high or a high to low transition.						
0C	34	Digital Input 21	Predict err ph B	See Data Types - G32	*	*

Col	Row	Menu Text	Default Setting	Available Setting	7 4	7 4
Description						
The digital channels may monitor any of the opto isolated inputs or output contacts, in addition to a number of internal IED digital signals, such as protection starts, LEDs etc.						
0C	35	Input 21 Trigger	No Trigger	0 = No Trigger, 1 = Trigger L/H, 2 = Trigger H/L	*	*
Any of the digital channels may be selected to trigger the disturbance recorder on either a low to high or a high to low transition.						
0C	36	Digital Input 22	Config Error	See Data Types - G32	*	*
The digital channels may monitor any of the opto isolated inputs or output contacts, in addition to a number of internal IED digital signals, such as protection starts, LEDs etc.						
0C	37	Input 22 Trigger	Trigger L/H	0 = No Trigger, 1 = Trigger L/H, 2 = Trigger H/L	*	*
Any of the digital channels may be selected to trigger the disturbance recorder on either a low to high or a high to low transition.						
0C	38	Digital Input 23	Operating mode 1	See Data Types - G32	*	*
The digital channels may monitor any of the opto isolated inputs or output contacts, in addition to a number of internal IED digital signals, such as protection starts, LEDs etc.						
0C	39	Input 23 Trigger	Trigger L/H	0 = No Trigger, 1 = Trigger L/H, 2 = Trigger H/L	*	*
Any of the digital channels may be selected to trigger the disturbance recorder on either a low to high or a high to low transition.						
0C	3A	Digital Input 24	Unused	See Data Types - G32	*	*
The digital channels may monitor any of the opto isolated inputs or output contacts, in addition to a number of internal IED digital signals, such as protection starts, LEDs etc.						
0C	3B	Input 24 Trigger	No Trigger	0 = No Trigger, 1 = Trigger L/H, 2 = Trigger H/L	*	*
Any of the digital channels may be selected to trigger the disturbance recorder on either a low to high or a high to low transition.						
0C	3C	Digital Input 25	Unused	See Data Types - G32	*	*
The digital channels may monitor any of the opto isolated inputs or output contacts, in addition to a number of internal IED digital signals, such as protection starts, LEDs etc.						
0C	3D	Input 25 Trigger	No Trigger	0 = No Trigger, 1 = Trigger L/H, 2 = Trigger H/L	*	*
Any of the digital channels may be selected to trigger the disturbance recorder on either a low to high or a high to low transition.						
0C	3E	Digital Input 26	Unused	See Data Types - G32	*	*
The digital channels may monitor any of the opto isolated inputs or output contacts, in addition to a number of internal IED digital signals, such as protection starts, LEDs etc.						
0C	3F	Input 26 Trigger	No Trigger	0 = No Trigger, 1 = Trigger L/H, 2 = Trigger H/L	*	*
Any of the digital channels may be selected to trigger the disturbance recorder on either a low to high or a high to low transition.						
0C	40	Digital Input 27	Unused	See Data Types - G32	*	*
The digital channels may monitor any of the opto isolated inputs or output contacts, in addition to a number of internal IED digital signals, such as protection starts, LEDs etc.						
0C	41	Input 27 Trigger	No Trigger	0 = No Trigger, 1 = Trigger L/H, 2 = Trigger H/L	*	*
Any of the digital channels may be selected to trigger the disturbance recorder on either a low to high or a high to low transition.						
0C	42	Digital Input 28	Unused	See Data Types - G32	*	*
The digital channels may monitor any of the opto isolated inputs or output contacts, in addition to a number of internal IED digital signals, such as protection starts, LEDs etc.						
0C	43	Input 28 Trigger	No Trigger	0 = No Trigger, 1 = Trigger L/H, 2 = Trigger H/L	*	*
Any of the digital channels may be selected to trigger the disturbance recorder on either a low to high or a high to low transition.						
0C	44	Digital Input 29	Unused	See Data Types - G32	*	*
The digital channels may monitor any of the opto isolated inputs or output contacts, in addition to a number of internal IED digital signals, such as protection starts, LEDs etc.						
0C	45	Input 29 Trigger	No Trigger	0 = No Trigger, 1 = Trigger L/H, 2 = Trigger H/L	*	*
Any of the digital channels may be selected to trigger the disturbance recorder on either a low to high or a high to low transition.						
0C	46	Digital Input 30	Unused	See Data Types - G32	*	*

Col	Row	Menu Text	Default Setting	Available Setting	7 4	7 4
Description						
The digital channels may monitor any of the opto isolated inputs or output contacts, in addition to a number of internal IED digital signals, such as protection starts, LEDs etc.						
0C	47	Input 30 Trigger	No Trigger	0 = No Trigger, 1 = Trigger L/H, 2 = Trigger H/L	*	*
Any of the digital channels may be selected to trigger the disturbance recorder on either a low to high or a high to low transition.						
0C	48	Digital Input 31	Unused	See Data Types - G32	*	*
The digital channels may monitor any of the opto isolated inputs or output contacts, in addition to a number of internal IED digital signals, such as protection starts, LEDs etc.						
0C	49	Input 31 Trigger	No Trigger	0 = No Trigger, 1 = Trigger L/H, 2 = Trigger H/L	*	*
Any of the digital channels may be selected to trigger the disturbance recorder on either a low to high or a high to low transition.						
0C	4A	Digital Input 32	Unused	See Data Types - G32	*	*
The digital channels may monitor any of the opto isolated inputs or output contacts, in addition to a number of internal IED digital signals, such as protection starts, LEDs etc.						
0C	4B	Input 32 Trigger	No Trigger	0 = No Trigger, 1 = Trigger L/H, 2 = Trigger H/L	*	*
Any of the digital channels may be selected to trigger the disturbance recorder on either a low to high or a high to low transition.						

4 MEASUREMENTS

The relay produces a variety of both directly measured and calculated power system quantities. These measurement values are updated every second and can be viewed in the **Measurements** columns (up to three) of the relay or using the MiCOM S1 Studio Measurement viewer.

The relay can measure and display these quantities:

4.1 Check Zone Phase Currents

There are also measured values from the protection functions, which are also displayed under the measurement columns of the menu; these are described in the section on the relevant protection function.

The P742 and P743 relays are able to measure and display the following quantities as summarized.

- Phase Currents

4.2 Measured Currents

Important	***The P742 and P743 relays produce current values (the P741 does not).***

The relay produces current values. They are produced directly from the DFT (Discrete Fourier Transform) used by the relay protection functions and present both magnitude and phase angle measurement.

4.3 Sequence Voltages and Currents

Important	***Sequence quantities are produced by the P742 and P743 relays, but not for the P741.***

Sequence quantities are produced by the relay from the measured Fourier values; these are displayed as magnitude and phase angle values.

4.4 Settings

The settings shown under the heading **MEASURE'T SETUP** can be used to configure the relay measurement function. See the following Measurements table for more details:

4.5 Measurement Display Quantities

The relay has Measurement columns for viewing measurement quantities. These can also be viewed with MiCOM S1 Studio and are shown below.

4.5.1 Central Unit (P741):

MEASUREMENTS 1	MEASUREMENTS 2	TOPOLOGY 1	TOPOLOGY 2
IA Diff CZ	Z01 : IA diff	Current Node 1	Current Node 1
IB Diff CZ	Z01 : IB diff	If existing:	If existing:
IC Diff CZ	Z01 : IC diff	Current Node 2	Current Node 2
IN Diff CZ	Z01 : IN diff	Current Node 3	Current Node 3
IA Bias CZ	Z01 : IA bias	Current Node 4	Current Node 4

MEASUREMENTS 1	MEASUREMENTS 2	TOPOLOGY 1	TOPOLOGY 2
IB Bias CZ	Z01 : IB bias	Current Node 5	Current Node 5
IC Bias CZ	Z01 : IC bias	Current Node 6	Current Node 6
IN Bias CZ	Z01 : IN bias	Current Node 7	Current Node 7
	If existing:	Current Node 8	Current Node 8
	Z02 : IA diff		
	Z02 : IB diff		
	Z02 : IC diff		
	Z02 : IN diff		
	Z02 : IA bias		
	Z02 : IB bias		
	Z02 : IC bias		
	Z02 : IN bias		
	…		
	Z08 : IA diff		
	Z08 : IB diff		
	Z08 : IC diff		
	Z08 : IN diff		
	Z08 : IA bias		
	Z08 : IB bias		
	Z08 : IC bias		
	Z08 : IN bias		

4.5.2 Peripheral Unit (P742 or P743):

MEASUREMENTS 1	TOPOLOGY 1
IA Magnitude	Link CT / zone
IA Phase Angle	Zx1: IA Diff
IB Magnitude	Zx1: IB Diff
IB Phase Angle	Zx1: IC Diff
IC Magnitude	Zx1: IN Diff
IC Phase Angle	Zx1: IA Bias
IN Magnitude	Zx1: IB Bias
IN Phase Angle	Zx1: IC Bias
IN Derived Magn	Zx1: IN Bias
IN Derived Angle	Zx2: IA Diff
Frequency	Zx2: IB Diff
	Zx2: IC Diff
	Zx2: IN Diff
	Zx2: IA Bias
	Zx2: IB Bias

MEASUREMENTS 1	TOPOLOGY 1
	Zx2: IC Bias
	Zx2: IN Bias

5 MONITORING TOOLS

5.1 MiCOM S1

The embedded standard MiCOM S1 Software monitoring is designed for 8 zones substation. Consequently, if you open connection with P741 which protects 4 zones substation, there are error messages to inform you that cells corresponding to topology and measurements of zone 5 to 8 can not be displayed.

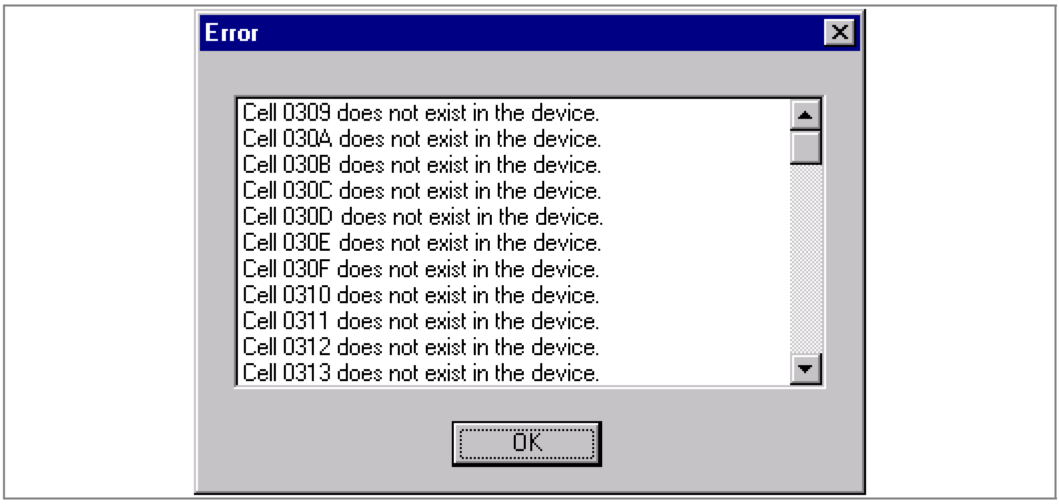


Figure 1 – Error dialog box

You can use the monitor tool even if this error message appears.

To remove an error message, you have to remove cells in the default file:

Open file celllist.txt with text editor (for example notepad). This file is located in directory

Monitor in the path of MiCOM S1 install (default is c:\Programmes Files\ Schneider Electric\MiCOM S1\Monitor)

Go to line [P741], referring to documentation “Menu Database - P74X/EN GC”

Remove addresses of cell that you don’t want to display after the line /Measurement. For example, to remove cell [Topology 1, Current node 5], delete line 0405

Save file:

Later, if you want to display a new zone, perform the reverse operation.

5.2 Dynamic Synoptic

A dedicated software monitoring tool has been developed which allows the user to display on a PC (desktop or laptop) the substation busbar scheme and monitor the status of the isolators, breakers and CTs as well as analogue measurements and digital values.

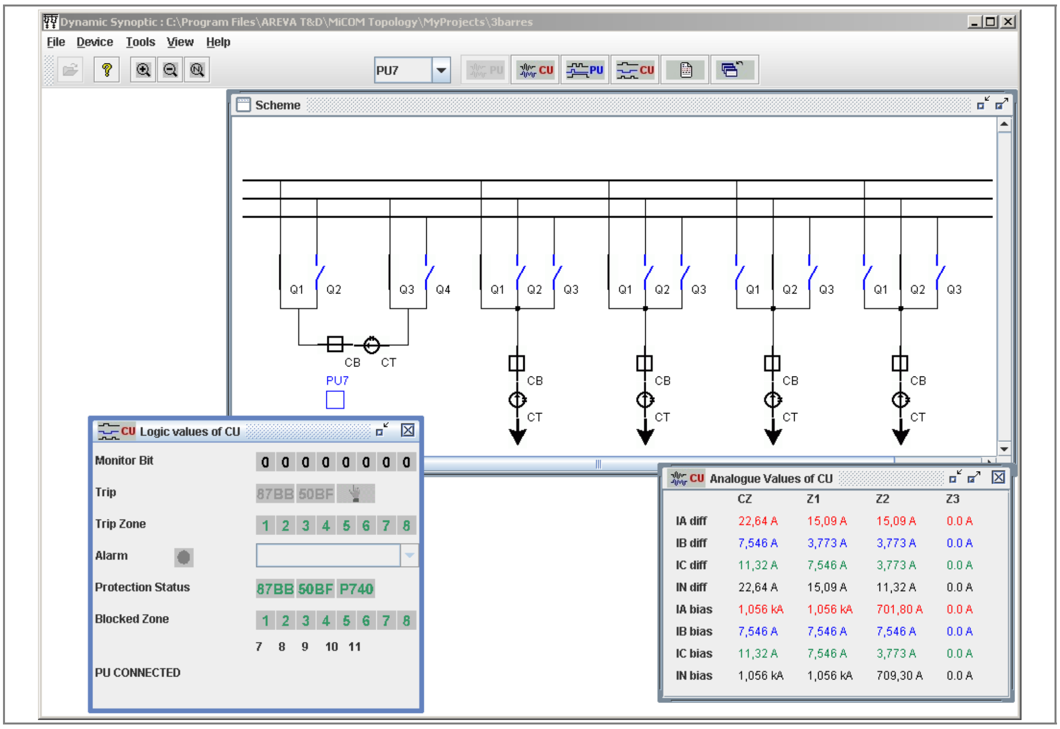


Figure 2 - Connected to the central unit

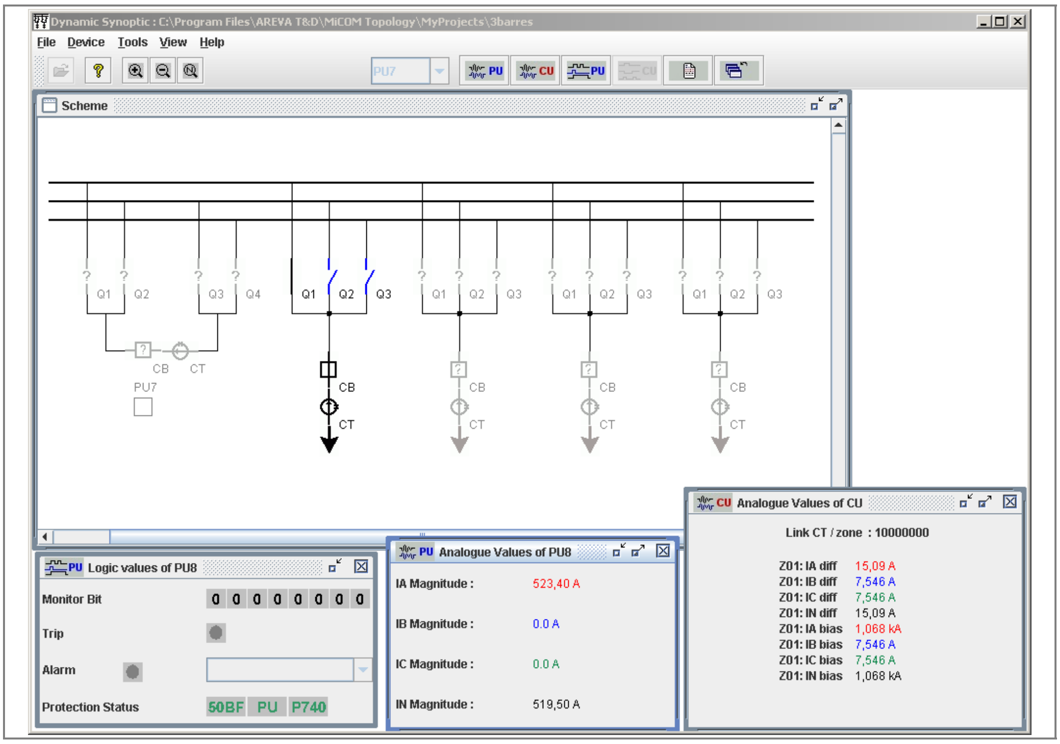


Figure 3 - Connected to a peripheral unit

PRODUCT DESIGN

CHAPTER 10

Date:	02/2017
Products covered by this chapter:	This chapter covers the specific versions of the MiCOM products listed below. This includes ***only*** the following combinations of Software Version and Hardware Suffix.
Hardware Suffix:	L (P742) & M (P741 & P743)
Software Version:	B1
Connection Diagrams:	10P740xx (xx = 01 to 07)

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FIGURES

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1 RELAY SYSTEM OVERVIEW

1.1 Hardware Overview

The relay is based on a modular hardware design where each module performs a separate function. This section describes the functional operation of the various hardware modules. Some modules are essential while others are optional depending on the user's requirements (see *Product Specific Options* and *Hardware Communications Options*).

All modules are connected by a parallel data and address bus which allows the processor board to send and receive information to and from the other modules as required.

There is also a separate serial data bus for transferring sample data from the input module to the processor. See the *Relay modules* diagram.

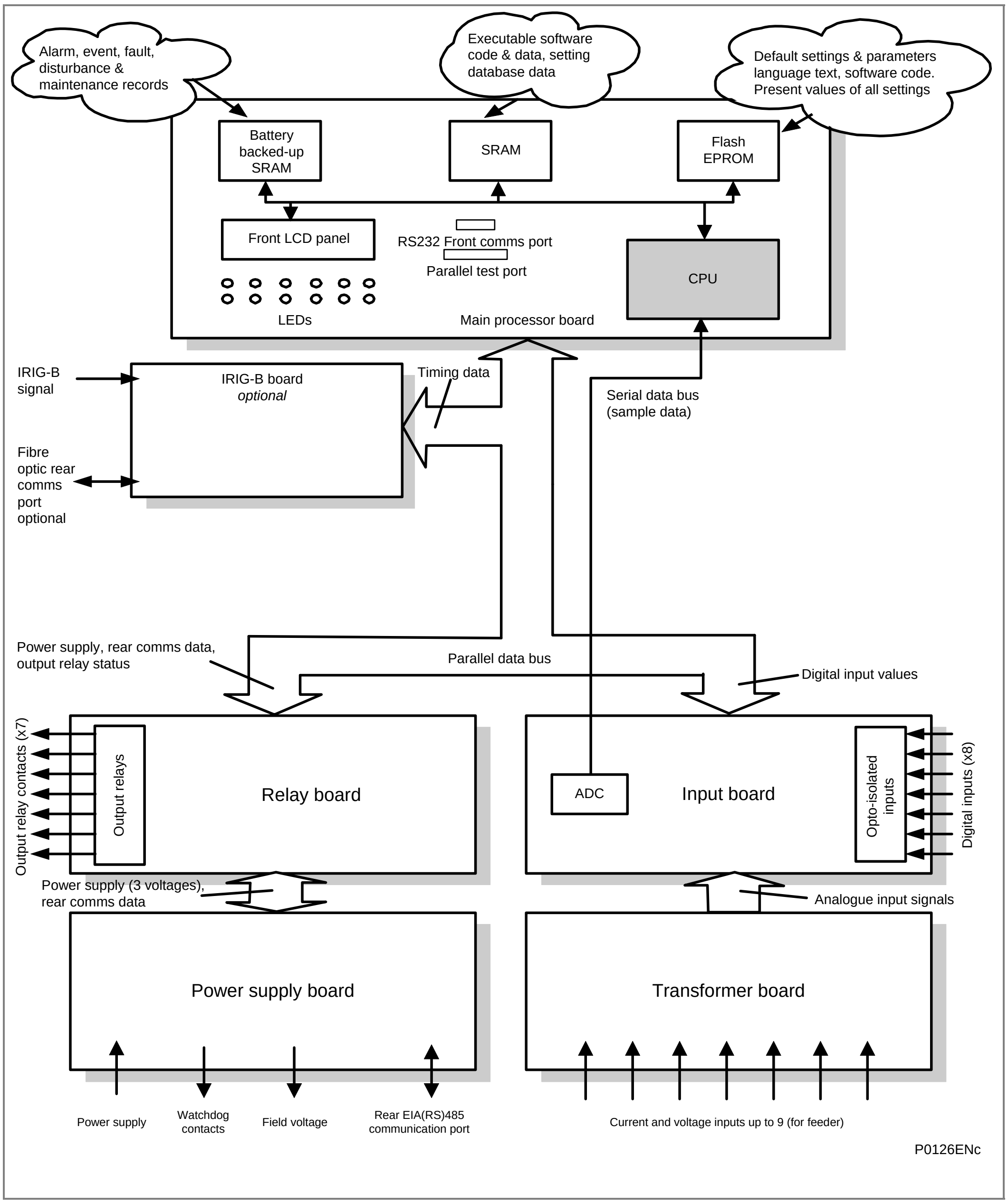

Figure 1 - Relay modules and information flow

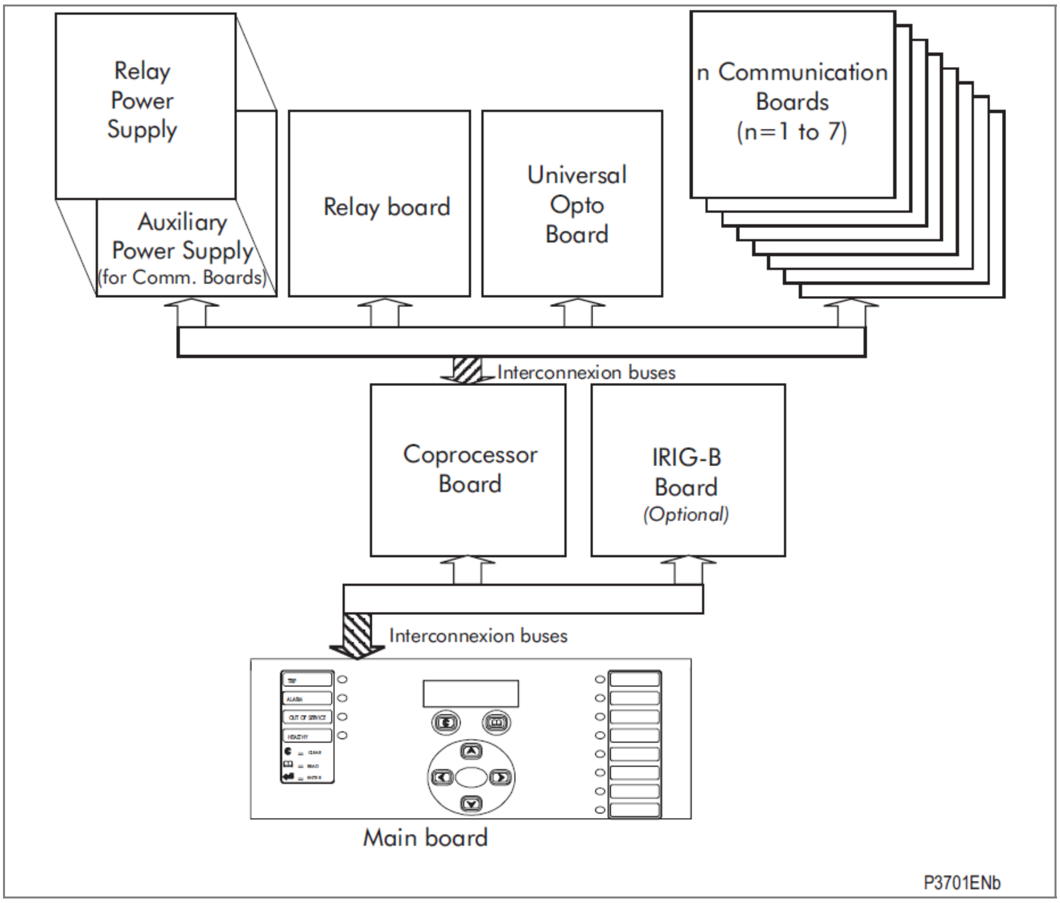

Figure 2 - P741 architecture

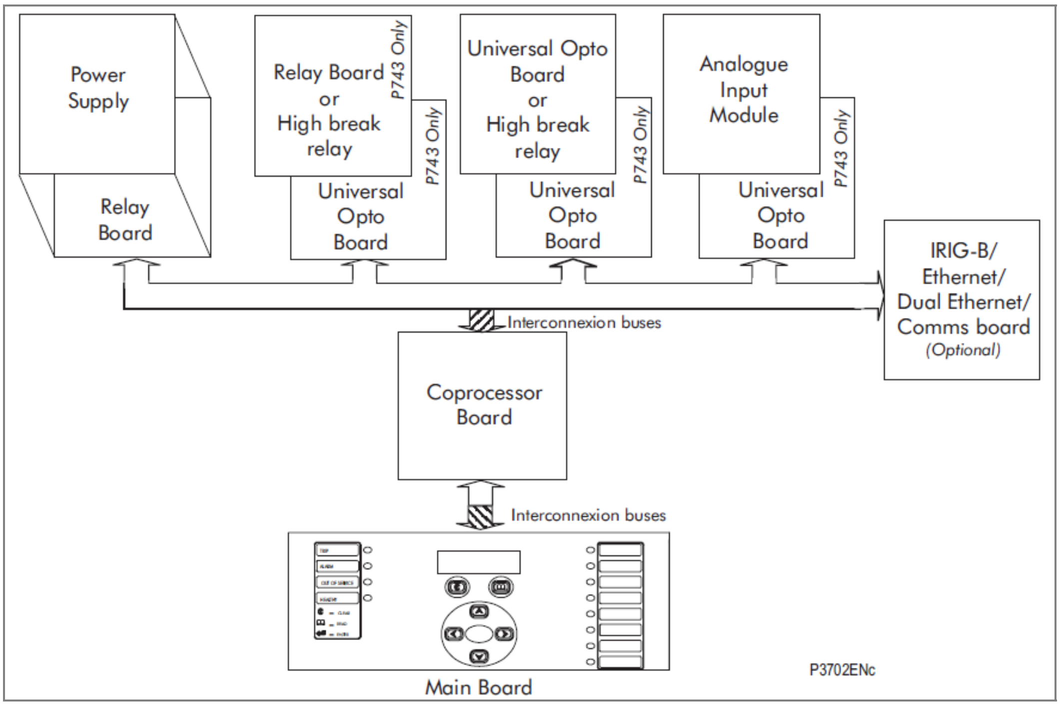

Figure 3 - P742 & P743 architecture

1.2 Mechanical Layout

The relay case is pre-finished steel with a conductive covering of aluminum and zinc. This provides good earthing at all joints with a low impedance path to earth that is essential for shielding from external noise. The boards and modules use multi-point grounding (earthing) to improve immunity to external noise and minimize the effect of circuit noise. Ground planes are used on boards to reduce impedance paths and spring clips are used to ground the module metalwork.

Heavy duty terminal blocks are used at the rear of the relay for the current and voltage signal connections. Medium duty terminal blocks are used for the digital logic input signals, output relay contacts, power supply and rear communication port. A BNC connector is used for the optional IRIG-B signal. 9-pin and 25-pin female D-connectors are used at the front of the relay for data communication.

Inside the relay the boards plug into the connector blocks at the rear, and can be removed from the front of the relay only. The connector blocks to the relay's CT inputs have internal shorting links inside the relay. These automatically short the current transformer circuits before they are broken when the board is removed.

The front panel consists of a membrane keypad with tactile dome keys, an LCD and 12 or 22 LEDs (depending on the model) mounted on an aluminum backing plate.

1.3 Processor Board

The processor board performs all calculations for the relay and controls the operation of all other modules in the relay. The processor board also contains and controls the user interfaces (LCD, LEDs, keypad and communication interfaces).

The relay is based around a TMS320VC33-150MHz (peak speed), floating-point, 32-bit Digital Signal Processor (DSP) operating at a clock frequency of half this speed. This processor performs all of the calculations for the relay, including the protection functions, control of the data communication and user interfaces including the operation of the LCD, keypad and LEDs.

The processor board is directly behind the relay's front panel. This allows the LCD and LEDs and front panel communication ports to be mounted on the processor board. These ports are:

- The 9-pin D-connector for EIA(RS)232 serial communications used for MiCOM S1 Studio and Courier communications.
- The 25-pin D-connector relay test port for parallel communication.

All serial communication is handled using a Field Programmable Gate Array (FPGA).

The main processor board has:

- 2 MB SRAM for the working area. This is fast access (zero wait state) volatile memory used to temporarily store and execute the processor software.
- 4 MB flash ROM to store the software code, text, configuration data, default settings, and present settings.
- 4 MB battery-backed SRAM to store disturbance, event, fault and maintenance records.

Note	*With hardware revisions L and M, the SRAM size has changed from 2MB to 8MB; and the Flash size has changed from 4MB to 8MB.*

1.3.1 Co-Processor Board

In P742 and P743, the co-processor board controls the operation of I/O modules within the relay and manages the communication with the P741 relay.

In the P741 relay, the co-processor board controls the communication boards and manages the communication with others P741 of the system (if present).

In the P741 relay, coprocessor board controls 1 opto board, 1 relay board and up to 7 communication boards via its own interconnection bus.

In the P742 and P743 relays, coprocessor board controls opto boards and relay boards via its own interconnection bus. Coprocessor board provides the sample synchronisation to input module and receives the samples from input module.

The co-processor board is based around a TMS320VC5402, 16-bit digital signal processor (DSP) operating at a clock frequency of 100MHz.

The features of the co-processor board are:

- 128 K * 16 bits high speed memory for external code execution.
- 128 K * 16 bits high speed memory for data storage.
- Interface with first interconnection bus from main board.
- 4 K * 16 bits double access memory for communication with main board.
- Interface with second interconnection bus towards peripheral boards.
- Serial communication interface on optical fibre with 4 full duplex channels. The communication uses a synchronous protocol with a date rate of 2.5 Mbit/s. On the co-processor board only 2 of the 4 optical channels are provided.
- On board DC-DC converter which gives 3.3V chip power supply from the interconnection bus 22V rail.
- After power on, the main board loads the software in coprocessor board via double access memory. When software starts, the microprocessor configures the board. After this, optical communication can begin.

1.3.2 Analogue Input Module

The Analogue input module is only present in P742 and P743 relays. The input module converts the information contained in the analogue or digital input signals into a format suitable for the co-processor board. The standard input module consists of two boards:

- a Current transformer board to provide electrical isolation
- a main input board which provides analogue to digital conversion and the isolated digital inputs.

1.4 Internal Communication Buses

The relay has two internal buses for the communication of data between different modules. The main bus is a parallel link that is part of a 64-way ribbon cable. The ribbon cable carries the data and address bus signals in addition to control signals and all power supply lines. Operation of the bus is driven by the main processor board that operates as a master while all other modules in the relay are slaves.

The second bus is a serial link that is used exclusively for communicating the digital sample values from the input module to the main processor board. The DSP has a built-in serial port that is used to read the sample data from the serial bus. The serial bus is also carried on the 64-way ribbon cable.

1.4.1 Internal Communication Board (only used in the P741)

The internal communication board is only used within P741 relay. It performs the communication with the P742 and P743 relays.

Up to seven communication boards can be interfaced within P741 relay. This means that up to 28 P742 or P743 relays can be interfaced from a P741 relay.

The communication board resembles the coprocessor board, but with these differences:

- Four duplex optical channels are provided.
- The second interconnection bus is not provided. The communication board does not control any boards.

1.5 Input Module

The input module provides the interface between the relay processor board(s) and the analog and digital signals coming into the relay. The input module varies depending on the MiCOM model number. The variations include:

Model	Input Boards	Transformer Boards	Voltage Inputs	Current Inputs	Notes
P741	0	0	0	0	
P742	1	1	0	4	
P743	1	1	3	4	

1.5.1 Transformer Board (P742 and P743 only)

The transformer board holds up to four Voltage Transformers (VTs) and up to five Current Transformers (CTs).

The current inputs will accept either 1A or 5A nominal current (menu and wiring options) and the voltage inputs can be specified for either 110V or 440V nominal voltage (order option). The transformers are used both to step-down the currents and voltages to levels appropriate to the relay’s electronic circuitry and to provide effective isolation between the relay and the power system. The connection arrangements of both the current and voltage transformer secondary’s provide differential input signals to the main input board to reduce noise.

1.5.2 Input Board

The main input board is shown as a block diagram in the *Main input board* diagram. It provides the circuitry for the digital input signals and the analogue-to-digital conversion for the analogue signals. Hence it takes the differential analogue signals from the CTs and VTs on the transformer board(s), converts these to digital samples and transmits the samples to the processor board via the serial data bus. On the input board the analogue signals are passed through an anti-alias filter before being multiplexed into a single analogue to digital converter chip. The A - D converter provides 16-bit resolution and a serial data stream output. The digital input signals are opto isolated on this board to prevent excessive voltages on these inputs causing damage to the relay's internal circuitry.

The signal multiplexing arrangement provides for 16 analogue channels to be sampled. The P74x relay provides four current inputs and four voltage inputs. Three spare channels are used to sample three different reference voltages for the purpose of continually checking the operation of the multiplexer and the accuracy of the A - D converter.

The sample frequency is maintained at 2.4kHz. This equates to 48 samples per cycle at 50Hz and at 40 samples per cycle at 60Hz. The calibration E2PROM holds the calibration coefficients that are used by the processor board to correct for any amplitude or phase errors introduced by the transformers and analogue circuitry.

The other function of the input board is to read the state of the signals present on the digital inputs and present this to the parallel data bus for processing. The input board holds eight optical isolators for the connection of up to eight digital input signals. The opto-isolators are used with the digital signals for the same reason as the transformers with the analogue signals; to isolate the relay's electronics from the power system environment. The input board provides some hardware filtering of the digital signals to remove unwanted noise before buffering the signals for reading on the parallel data bus.

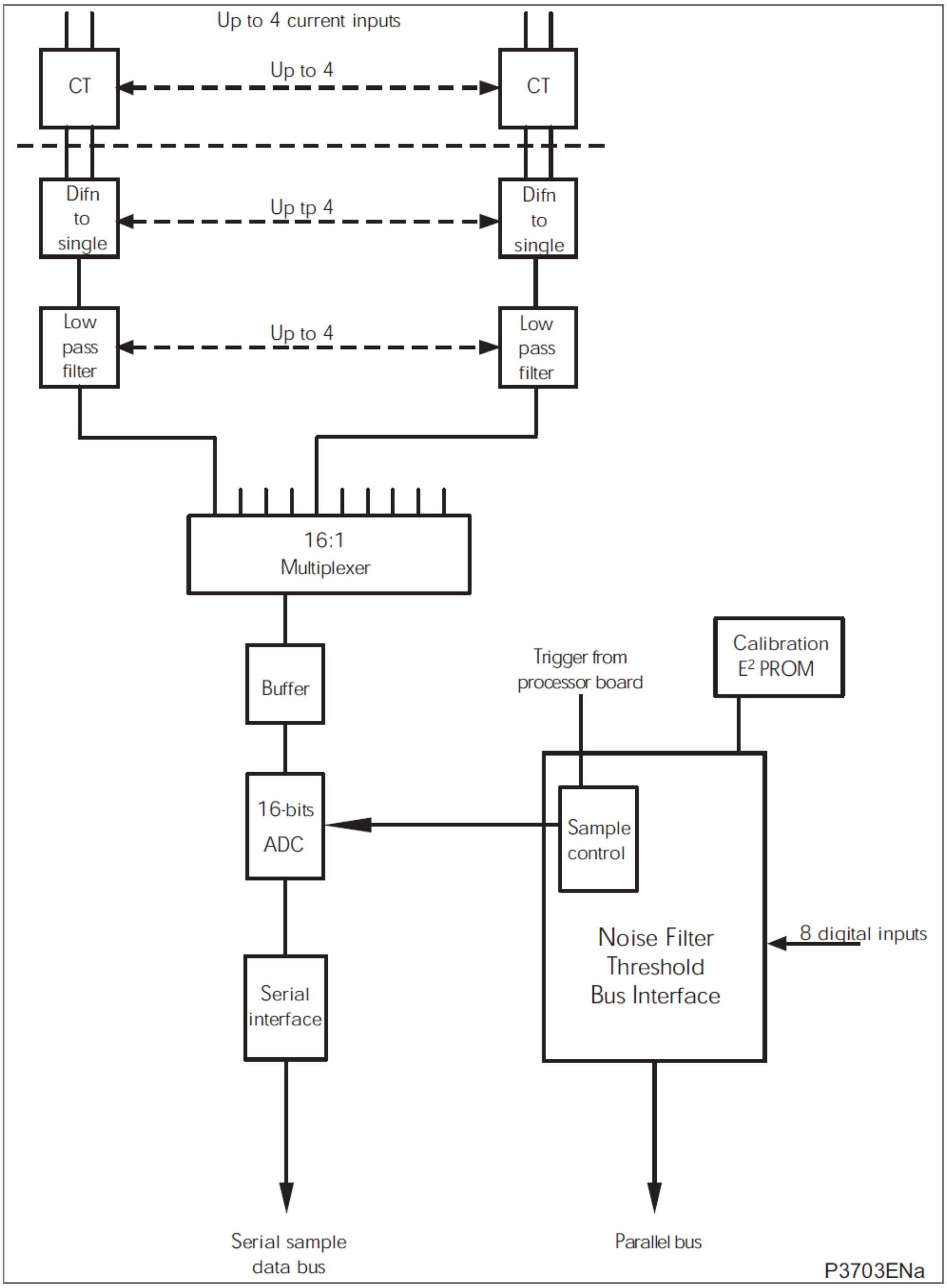

Figure 4 - Main input board

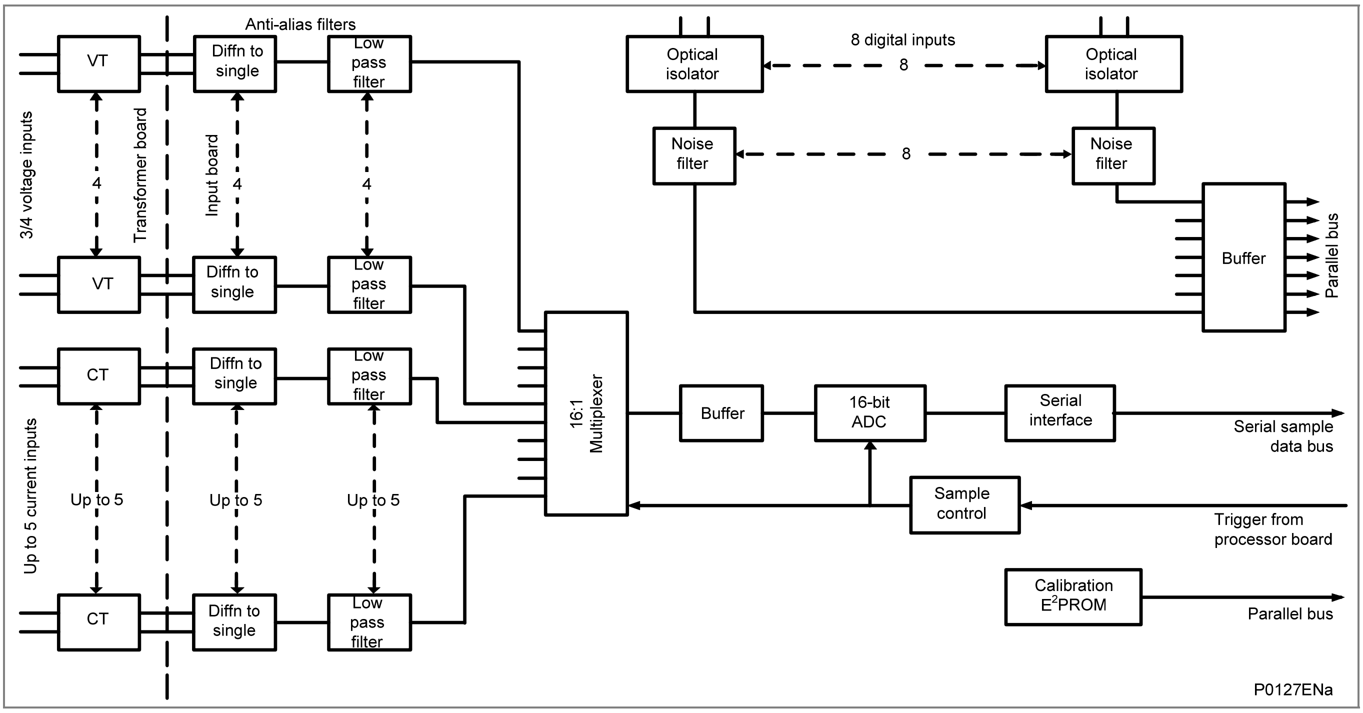

Figure 5 - Main input board

1.5.3 Universal Opto Isolated Logic Inputs

This series of relays have universal opto-isolated logic inputs that can be programmed for the nominal battery voltage of the circuit of which they are a part. This allows different voltages for different circuits such as signaling and tripping. They can also be programmed as Standard 60% - 80% or 50% - 70% to satisfy different operating constraints.
Threshold levels are shown in this table:

Nominal battery voltage (Vdc)	Standard 60% - 80%		50% - 70%	
	No operation (Logic 0) Vdc	Operation (Logic 1) Vdc	No operation (Logic 0) Vdc	Operation (Logic 1) Vdc
24/27	<16.2	>19.2	<12.0	>16.8
30/34	<20.4	>24.0	<15.0	>21.0
48/54	<32.4	>38.4	<24.0	>33.6
110/125	<75.0	>88.0	<55.0	>77.0
220/250	<150.0	>176.0	<110	>154

Table 1 - Setting ranges (24-27V = P741) and (48-54V = P742/P743)

This lower value eliminates fleeting pickups that may occur during a battery earth fault, when stray capacitance may present up to 50% of battery voltage across an input. Each input has filtering of 7ms. This renders the input immune to induced noise on the wiring: although this method is secure it can be slow.

In the Opto Config. menu the nominal battery voltage can be selected for all opto inputs by selecting one of the five standard ratings in the Global Nominal V settings. If Custom is selected then each opto input can individually be set to a nominal voltage value.

1.6 Power Supply Module (including Output Relays)

The power supply module contains two boards, one for the power supply unit and the other for the output relays. It provides power to all of the other modules in the relay, as well as the EIA(RS)485 electrical connection for the rear communication port. The second board of the power supply module contains the relays that provide the output contacts.

1.6.1 Power Supply Board (Including EIA(RS)485 Communication Interface)

The power supply module also provides a 48V external field supply output to drive the opto isolated digital inputs (or the substation battery may be used to drive the optos).

One of three different configurations of the power supply board can be fitted to the relay. This will be specified at the time of order and depends on the nature of the supply voltage that will be connected to the relay. The options are shown in the following table:

Nominal dc range	Nominal ac range
24 - 32 V dc	dc only
48 - 110 V dc	dc only
110 - 250 V dc	100 - 240 V ac rms

Table 2 - Power supply options

The output from all versions of the power supply module are used to provide isolated power supply rails to all of the other modules in the relay. Three voltage levels are used in the relay: 5.1 V for all of the digital circuits, ±16 V for the analog electronics such as on the input board, and 22 V for driving the output relay coils. All power supply voltages including the 0 V earth line are distributed around the relay through the 64-way ribbon cable. The power supply board also provides the 48 V field voltage. This is brought out to terminals on the back of the relay so that it can be used to drive the optically-isolated digital inputs.

The two other functions provided by the power supply board are the EIA(RS)485 communications interface and the watchdog contacts for the relay. The EIA(RS)485 interface is used with the relay’s rear communication port to provide communication using one of either Courier, MODBUS, IEC60870-5-103, or DNP3.0 protocols. The EIA(RS)485 hardware supports half-duplex communication and provides optical isolation of the serial data that is transmitted and received. All internal communication of data from the power supply board is through the output relay board connected to the parallel bus.

The watchdog facility has two output relay contacts, one Normally Open (N/O)and one Normally Closed (N/C). These are driven by the main processor board and indicate that the relay is in a healthy state.

The power supply board incorporates inrush current limiting. This limits the peak inrush current, during energization, to approximately 10 A.

1.6.2 Auxiliary Power Supply

In the relay the power supply module contains a main power supply and an auxiliary power supply. The auxiliary power supply adds power on the 22 V rail for up to seven communication boards within the relay.

The three input voltage options are the same as for main supply. The relay board is provided as a standalone board.

1.6.3 Output Relay Board

The output relay board has eight relays, six normally open contacts and two changeover contacts.

The relays are driven from the 22 V power supply line. The relays' state is written to or read from using the parallel data bus.

1.6.4 High Break Relay Board

The output relay board holds four relays, all normally open. The relays are driven from the 22V power supply line. The relays' state is written to or read from using the parallel data bus.

This board uses a hybrid of MOSFET Solid State Devices (SSD) in parallel with high capacity relay output contacts. The MOSFET has a varistor across it to provide protection which is required when switching off inductive loads because the stored energy in the inductor causes a reverse high voltage which could damage the MOSFET.

When there is a control input command to operate an output contact, the miniature relay is operated at the same time as the SSD. The miniature relay contact closes in nominally 3.5 ms and is used to carry the continuous load current; the SSD operates in <0.2 ms and is switched off after 7.5 ms. When the control input resets to open the contacts, the SSD is again turned on for 7.5 ms. The miniature relay resets in nominally 3.5 ms before the SSD so the SSD is used to break the load. The SSD absorbs the energy when breaking inductive loads and so limits the resulting voltage surge. This contact arrangement is for switching dc circuits only. As the SSD comes on very fast (<0.2 ms) these high break output contacts have the added advantage of being very fast operating. See the *High break contact operation* diagram below:

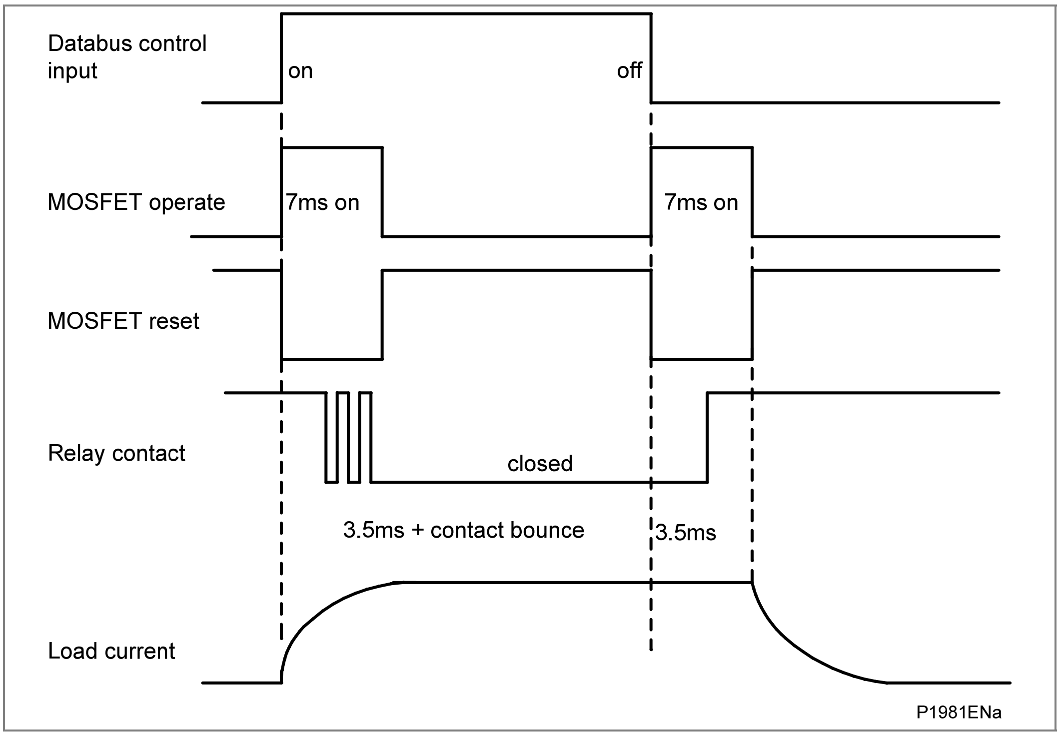

Figure 6 - High break contact operation

1.6.4.1 High Break Contact Applications

1. Efficient Scheme Engineering

   In traditional hardwired scheme designs, high break capability could only be achieved using external electromechanical trip relays. External tripping relays can be used or the high break contacts inside MiCOM relays can be used, reducing panel space.

2. Accessibility of CB Auxiliary Contacts

   Common practice is to use circuit breaker 52a (CB Closed) auxiliary contacts to break the trip coil current on breaker opening, easing the duty on the protection contacts. In cases such as operation of disconnectors, or retrofitting, 52a contacts may be unavailable or unreliable. High break contacts can be used to break the trip coil current in these applications.

3. Breaker Fail

   The technique to use 52a contacts in trip circuits was described above. However, in the event of failure of the local circuit breaker (stuck breaker), or defective auxiliary contacts (stuck contacts), the 52a contact action is incorrect. The interrupting duty at the local breaker then falls on the relay output contacts which may not be rated to perform this duty. MiCOM high break contacts will avoid the risk of burnt relay contacts.

4. Initiation of Teleprotection

   The MiCOM high break contacts also offer fast making, which can provide faster tripping. Also fast keying of teleprotection is a benefit. Fast keying bypasses the usual contact operation time so that permissive, blocking and intertrip commands can be routed faster.

1.7 Product Specific Options

Product Specific Options may mean that an additional board may be present if it was specified when the relay was ordered. The product specific options commonly allow a choice of IRIG-B, different numbers of Optos, Relays (including High Break relays). These options are shown in the *Ordering Options* section in *Chapter 1 – Introduction*.

1.8 IRIG-B Board (Optional) (P741 only)

The optional IRIG-B board can be used where an IRIG-B signal is available to provide an accurate time reference for the relays (P741, P742 and P743). The IRIG-B board can only be used in P741 relay and is controlled by the main board.

The optional IRIG-B board is an order option that can be fitted to provide an accurate timing reference for the relay. This can be used wherever an IRIG-B signal is available. The IRIG-B signal is connected to the board with a BNC connector on the back of the relay. The timing information is used to synchronize the relay's internal real-time clock to an accuracy of 1 ms. The internal clock is then used for the time tagging of the event, fault maintenance and disturbance records. The IRIG-B board can also be specified with a fiber optic or Ethernet rear communication port.

1.9 Second Rear Communications & InterMiCOM Teleprotection Board (in P741 & P743)

On ordering this board within a relay, both 2nd rear communications and InterMiCOM will become connection and setting options. The user may then enable either one, or both, as demanded by the installation.

For relays with the Courier protocol on the first rear communications port there is the hardware option of a second rear communications port (which also runs the Courier language). This can be used over one of three physical links: twisted pair K-BUS (non-polarity sensitive), twisted pair EIA(RS)485 (connection polarity sensitive) or EIA(RS)232.

The second rear comms. board, Ethernet and IRIG-B boards are mutually exclusive since they use the same hardware slot. For this reason two versions of second rear comms. and Ethernet boards are available; one with an IRIG-B input and one without. The second rear comms. board is shown in the following diagram.

SK5: The InterMiCOM board is used to connect to an EIA(RS)232 link, allowing up to eight programmable signaling bits to be transferred from/to the remote line end relay. A suitable EIA(RS)232 link must exist between the two line ends, for example a MODEM, or via a compatible multiplexer (check compatibility before ordering the relay).

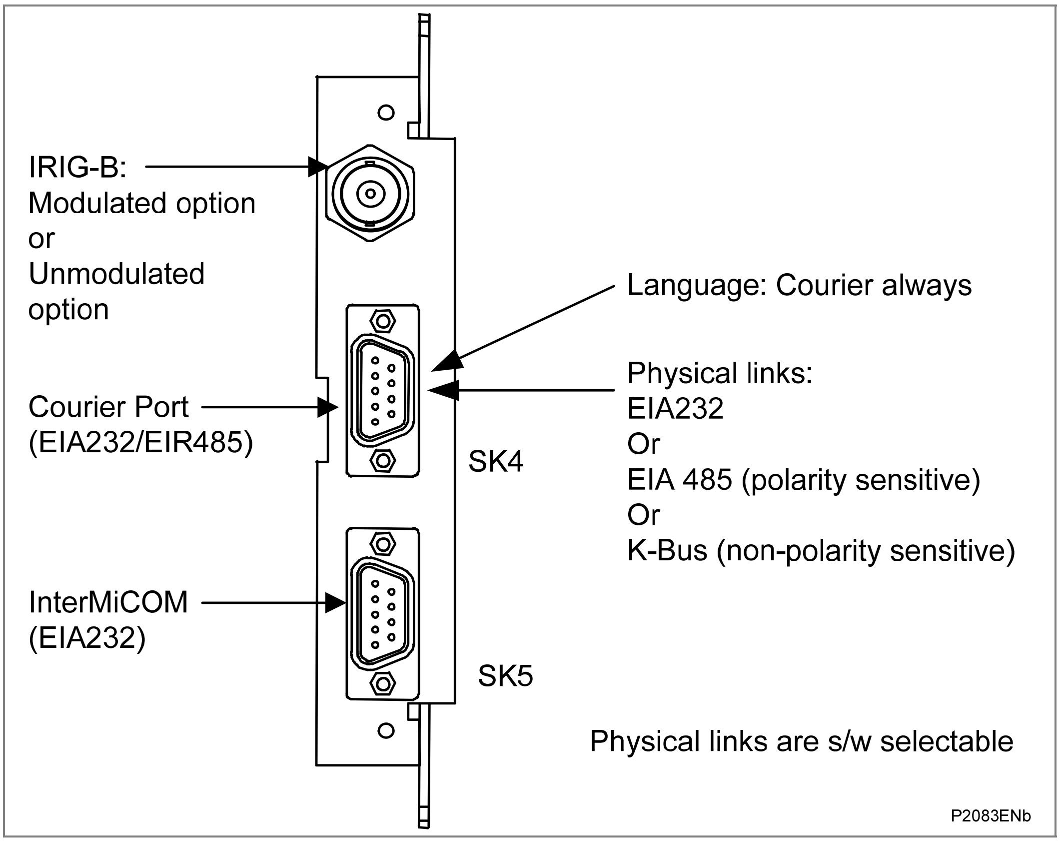

Figure 7 - Rear comms. port

1.10 Ethernet Board (Options) (P741 and P743)

This is a mandatory board for IEC 61850 enabled relays. It provides network connectivity through either copper or fiber media at rates of 10Mb/s (copper only) or 100Mb/s. There is also an option on this board to specify IRIG-B board port (modulated and/or un-modulated). This board, the IRIG-B board mentioned in the Hardware Communications Options section and second rear comms. board mentioned in the IRIG-B Board section are mutually exclusive as they all use slot A within the relay case.

All modules are connected by a parallel data and address bus that allows the processor board to send and receive information to and from the other modules as required. There is also a separate serial data bus for conveying sample data from the input module to the processor. The relay modules and information flow diagram shows the modules of the relay and the flow of information between them.

This optional board is required for providing network connectivity using IEC 61850. There are a variety of different boards which provide Ethernet connectivity.

Important	**The choice of communication board options varies according to the Hardware Suffix and the Software Version of the MiCOM product. These are shown in the *Ordering Options* section in *Chapter 1 – Introduction*.**

By way of example, the board options may include:

- single-port Ethernet boards (which use 10/100 Mbits/s Copper and modulated/unmodulated IRIG-B connectivity)
- single-port Ethernet boards (which use 100MBits/s optical fibre connectivity)
- Redundant Ethernet Self-Healing Ring with one or more multi-mode fibre optic ports and modulated/unmodulated IRIG-B connectivity
- Redundant Ethernet RSTP with one or more multi-mode fibre optic ports and modulated/unmodulated IRIG-B connectivity
- Redundant Ethernet Dual Homing Star with one or more multi-mode fibre optic ports and modulated/unmodulated IRIG-B connectivity
- Redundant Ethernet Parallel Redundancy Protocol (PRP) with one or more multi-mode fibre optic ports and modulated/unmodulated IRIG-B connectivity
- Redundant Ethernet with PRP/HSR/Dual IP and a mixture of LC/RJ45 ports and modulated/unmodulated IRIG-B connectivity

These options are mutually exclusive as they all use slot A in the relay case.

Note	*Each Ethernet board has a unique MAC address used for each Ethernet communication interface. The MAC address is printed on the rear of the board, next to the Ethernet sockets.*

Note	*The 100 Mbits/s Fiber Optic ports use ST/LC type connectors and are suitable for 1310 nm multi-mode fiber type.*

Copper ports use RJ45 type connectors. When using copper Ethernet, it is important to use Shielded Twisted Pair (STP) or Foil Twisted Pair (FTP) cables, to shield the IEC 61850 communications against electromagnetic interference. The RJ45 connector at each end of the cable must be shielded, and the cable shield must be connected to this RJ45 connector shield, so that the shield is grounded to the relay case. Both the cable and the RJ45 connector at each end of the cable must be Category 5 minimum, as specified by the IEC 61850 standard.

It is recommended that each copper Ethernet cable is limited to a maximum length of 3 m and confined to one bay or cubicle.

When using IEC 61850 communications through the Ethernet board, the rear EIA(RS)485 and front EIA(RS)232 ports are also available for simultaneous use, both using the Courier protocol.

One example of an Ethernet board is shown in this *Ethernet board connectors* diagram:

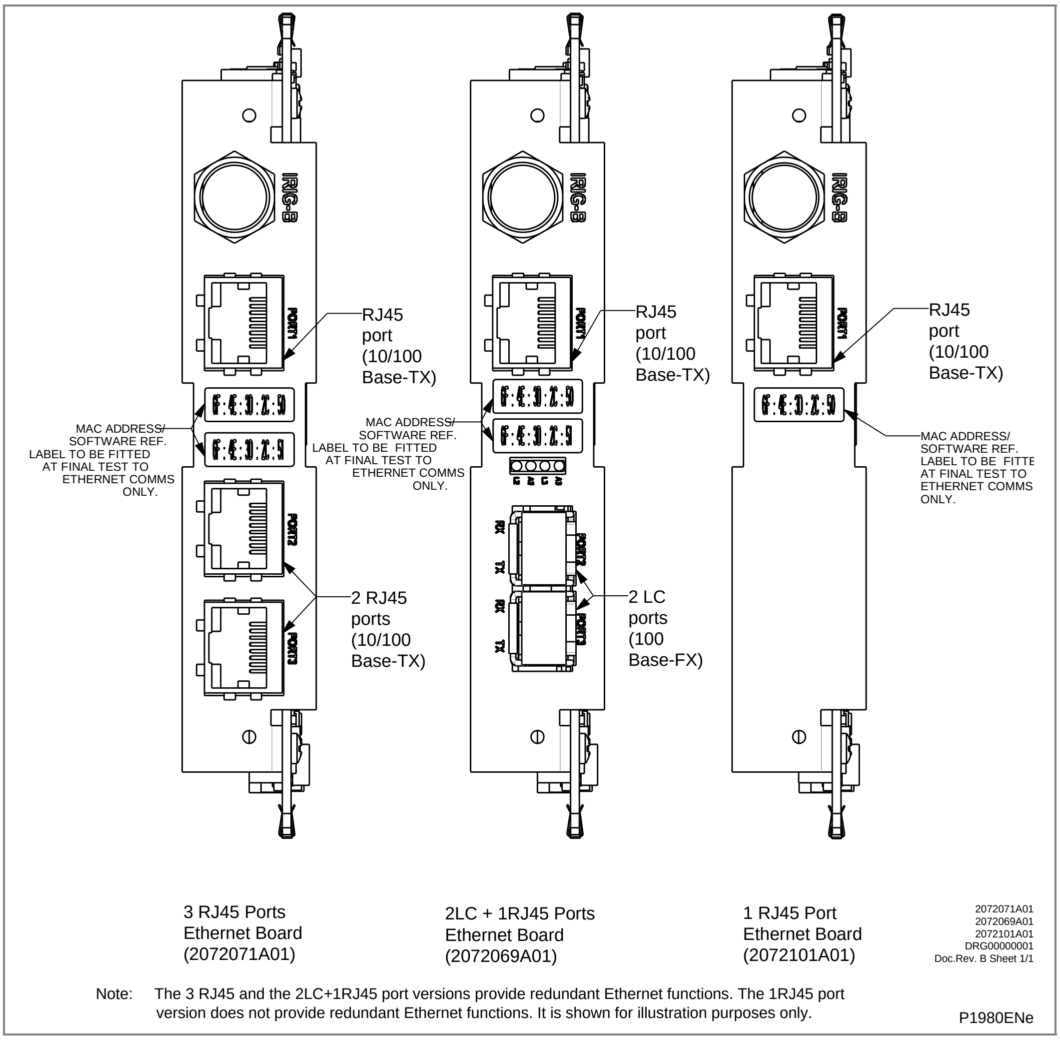

Figure 8 - Ethernet board connectors (3 RJ45 or 2 LC + RJ45 or 1 RJ45)

1.10.1 Input and Output Boards

Model	Opto-inputs	Relay outputs		
		normally open	change over	High Break
P741	8 x UNI (1)	6	2	--
P742xxxA	16 x UNI (1)	6	2	--
P742xxxB	8 x UNI (1)	6	2	4
P743xxxA	24 x UNI (1)	14	2	--
P743xxxB	16 x UNI (1)	12	4	4
P743xxxC	24 x UNI (1)	6	2	4
P743xxxD	16 x UNI (1)	6	2	8
(1) Universal voltage range opto inputs n/o – normally open c/o – change over				

Table 3 - Relay outputs

1.10.2 Power Supply Module

The power supply module provides a power supply to all of the other modules in the relay, at three different voltage levels.

The power supply board also provides the EIA(RS)485 electrical connection for the rear communication port.

On a second board, the power supply module contains:

- relays which provide the output contacts (P742 and P743),
- an auxiliary power supply (P741).

The power supply module also provides a 48V external field supply output to drive the opto isolated digital inputs (or the substation battery may be used to drive the optos).

1.10.3 Second Rear Comms and EIA(RS)232 InterMiCOM Board (Optional) (P741 and P743)

The optional second rear port is designed typically for dial-up modem access by protection engineers/operators, when the main port is reserved for SCADA traffic. Communication is via one of three physical links; K-Bus, EIA(RS)485 or EIA(RS)232. The port supports full local or remote protection and control access by MiCOM S1 software. The second rear port is also available with an on board IRIG-B input (P741).

The optional board also houses port “SK5”, the EIA232 InterMiCOM teleprotection port. InterMiCOM permits end-to-end signaling with a remote InterMiCOM relay, for example in a distance protection channel aided scheme. Port SK5 has an EIA(RS)232 connection, allowing connection to a MODEM, or compatible multiplexers.

All modules are connected by a parallel data and address bus that allows the processor board to send and receive information to and from the other modules as required. There is also a separate serial data bus for conveying sample data from the input module to the processor.

2 RELAY SOFTWARE

The busbar protection is a distributed system composed of two different software: the first one is used in central unit (P741) and the second one in peripheral units (P742 & P743).

The relay software was introduced in the overview of the relay at the start of this chapter. The software can be considered to be made up of these sections:

- The real-time operating system
- The system services software
- The platform software
- The protection and control software

These four elements are all processed by the same processor board.This section describes in detail the ***platform software*** and the ***protection and control software***, which between them control the functional behavior of the relay. The following *Relay software structure* diagram shows the structure of the relay software.

In addition to these four sections, you can also consider that there is a communications software section within the P741 relay.

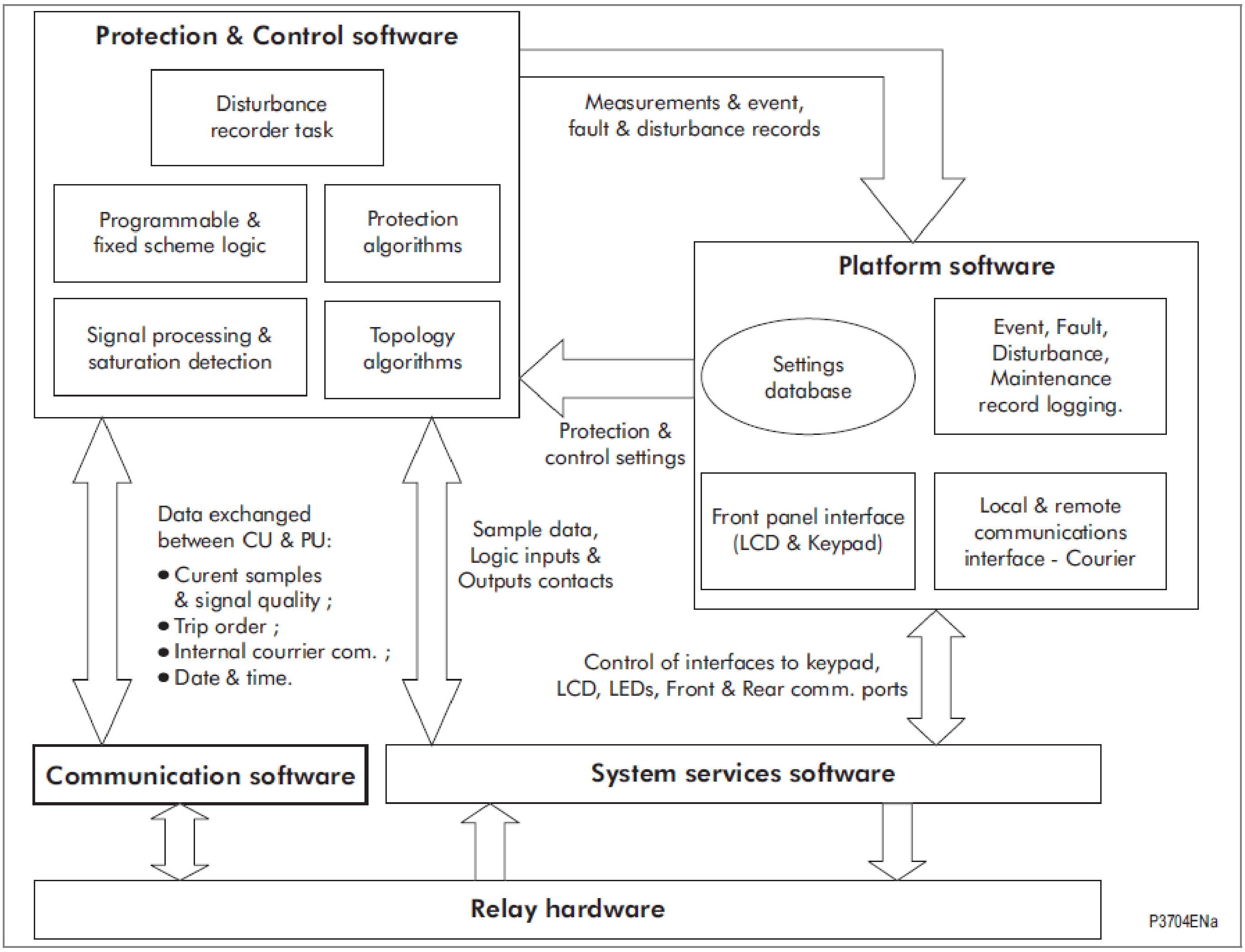

Figure 9 – Relay software structure

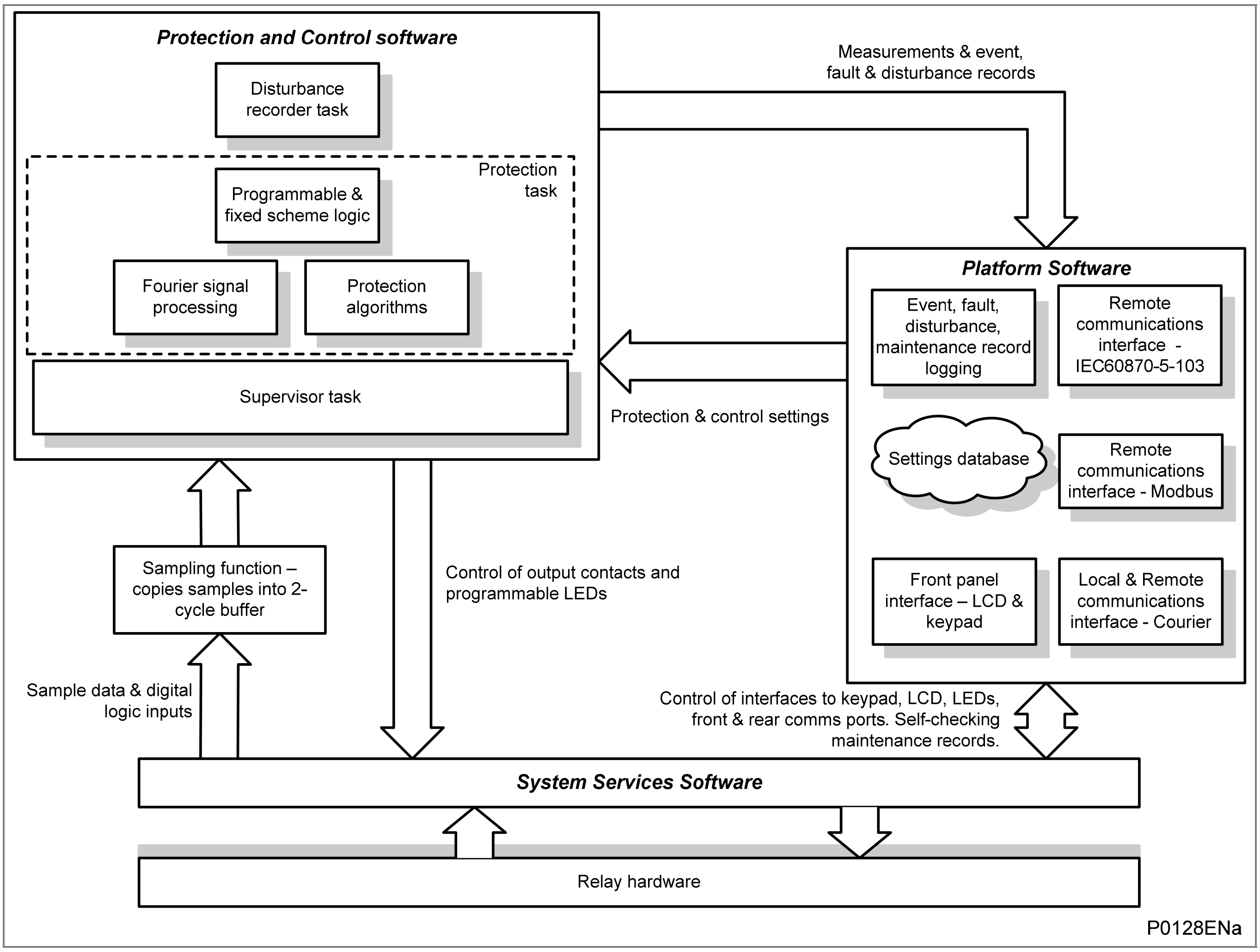

Figure 10 - Relay software structure

2.1 Real-Time Operating System

The real-time operating system provides a framework for the different parts of the relay's software to operate in.

The software is split into tasks; the real-time operating system is used to schedule the processing of the tasks to ensure that they are processed in the time available and in the desired order of priority. The operating system is also responsible in part for controlling the communication between the software tasks through the use of operating system messages.

As explained in the hardware overview, each relay contains one main board and one coprocessor board. These two boards use two different operating systems:

- For main board software: a real time operating system provides a framework for the different parts of the relay's software to operate within. To this end, the software is split into tasks. The real-time operating system is responsible for scheduling the processing of these tasks such that they are carried out in the time available and in the desired order of priority.
- For coprocessor board software: a sequencer manages all the functions implemented on the coprocessor board. Each function is executed at a fixed frequency. Consequently the CPU load of the coprocessor is fixed and independent of the network's frequency.

The real-time operating system is responsible for scheduling the processing of these tasks such that they are carried out in the time available and in the desired order of priority. The operating system is also responsible for the exchange of information between tasks, in the form of messages.

2.2 System Services Software

As shown in the above *Relay software structure* diagram, the system services software provides the low-level control of the relay hardware. It also provides the interface between the relay's hardware and the higher-level functionality of the platform software and the protection and control software.

For example, the system services software provides drivers for items such as the LCD display, the keypad and the remote communication ports. It also controls the boot of the processor and downloading of the processor code into SRAM from non-volatile flash EPROM at power up.

2.3 Platform Software

The platform software has these main functions:

- To deal with the management of the relay settings.
- To control the logging of all records that are generated by the protection software, including alarms and event, fault, disturbance and maintenance records.
- To store and maintain a database of all of the relay's settings in non-volatile memory.
- To provide the internal interface between the settings database and each of the relay's user interfaces. These interfaces are the front panel interface and the front and rear communication ports, using whichever communication protocol has been specified (Courier, MODBUS, IEC60870-5-103 and DNP3.0). The platform software converts the information from the database into the format required.

The platform software notifies the protection and control software of all settings changes and logs data as specified by the protection and control software.

2.3.1 Record Logging

The logging function is provided to store all alarms, events, faults and maintenance records. The records for all of these incidents are logged in battery backed-up SRAM in order to provide a non-volatile log of what has happened. The relay maintains four logs: one each for up to 32 alarms, 512 event records, 5 fault records and 5 maintenance records. The logs are maintained such that the oldest record is overwritten with the newest record.

The logging function can be initiated from the protection software or the platform software, and is responsible for logging of a maintenance record in the event of a relay failure. This includes errors that have been detected by the platform software itself or error that are detected by either the system services or the protection software functions. See also the section on *Self-Testing and Diagnostics* later in this section.

2.3.2 Settings Database

The settings database contains all of the settings and data for the relay, including the protection, disturbance recorder and control and support settings. The settings are maintained in non-volatile memory. The platform software's management of the settings database make sure that only one user interface modifies the database settings at any one time. This feature is used to avoid confusion between different parts of the software during a setting change. For changes to protection settings and disturbance recorder settings, the platform software operates a 'scratchpad' in SRAM memory. This allows a number of setting changes to be made in any order but applied to the protection elements, disturbance recorder and saved in the database in non-volatile memory, at the same time. If a setting change affects the protection and control task, the database advises it of the new values.

The database is directly compatible with Courier communications.

2.3.3 Database Interface

The other function of the platform software is to implement the relay's internal interface between the database and each of the relay's user interfaces. The database of settings and measurements must be accessible from all of the relay's user interfaces to allow read and modify operations. The platform software presents the data in the appropriate format for each user interface.

2.4 Protection and Control Software

The protection and control software interfaces with the platform software for settings changes and logging of records, and with the system services software for acquisition of sample data and access to output relays and digital opto-isolated inputs. It also performs the calculations for all of the protection algorithms of the relay. This includes digital signal processing such as Fourier filtering and ancillary tasks such as the disturbance recorder.

The protection and control software task processes all of the protection elements and measurement functions of the relay. It has to communicate with both the system services software and the platform software, and organize its own operations. The protection software has the highest priority of any of the software tasks in the relay, to provide the fastest possible protection response. It also has a supervisor task that controls the start-up of the task and deals with the exchange of messages between the task and the platform software.

2.4.1 Overview - Protection and Control Scheduling

The *P741 Architecture* and the *P742 & P743 Architecture* diagrams show the parts of Schneider Electric software and their allocation on the different boards of the peripheral and central units.

The P74x relays contained two global protections, busbar protection and circuit breaker failure, and one local function, overcurrent protection. Overcurrent protection is implemented on peripheral unit and is totally independent of the central unit. On the contrary, busbar protection and circuit breaker failure are distributed between central unit and peripheral units. Local functions such as saturation detection algorithm, logic of circuit breaker failure and local confirmation threshold are performed on each peripheral unit. Sum of current, logic of differential protection and circuit breaker failure are processed on central unit.

2.4.2 Topology Software

Topology algorithm determines dynamically the electric scheme of the substation from the auxiliary contact of circuit breaker and isolators. The results of local topology performed on peripheral unit are sending to central unit which determines global topology of the substation. At the end of process, central unit know the node of current and zone to trip according to the fault location.

2.4.3 Signal Processing

The sampling function filters the digital input signals from the opto-isolators and tracks the frequency of the analog signals. The digital inputs are checked against their previous value over a period of half a cycle. Therefore a change in the state of one of the inputs must be maintained over at least half a cycle before it is registered with the protection and control software.

The frequency tracking of the analog input signals is achieved by a recursive Fourier algorithm which is applied to one of the input signals, and works by detecting a change in the measured signal’s phase angle. The calculated value of the frequency is used to modify the sample rate being used by the input module to achieve a constant sample rate of 24 samples per cycle of the power waveform. The value of the frequency is also stored for use by the protection and control task.

When the protection and control task is re-started by the sampling function, it calculates the Fourier components for the analog signals. The Fourier components are calculated using a one-cycle, 24-sample Discrete Fourier Transform (DFT). The DFT is always calculated using the last cycle of samples from the 2-cycle buffer, which is the most recent data. Used in this way, the DFT extracts the power frequency fundamental component from the signal and produces the magnitude and phase angle of the fundamental in rectangular component format. The DFT provides an accurate measurement of the fundamental frequency component, and effective filtering of harmonic frequencies and noise. This performance is achieved with the relay input module which provides hardware anti-alias filtering to attenuate frequencies above the half sample rate, and frequency tracking to maintain a sample rate of 24 samples per cycle. The Fourier components of the input current and voltage signals are stored in memory so they can be accessed by all of the protection elements’ algorithms. The samples from the input module are also used in an unprocessed form by the disturbance recorder for waveform recording and to calculate true RMS values of current, voltage and power for metering purposes.

The sampling frequency of analogue signal is fixed to 2400Hz apart from the electric network frequency.

To ensure that the frequency is identical on each PU, analogue acquisition is based on interruption signal from communication software. The central unit sends frames on the optical fibres in diffusion towards all peripheral units. So they received data at the same instant, this reception signal starts the acquisition of analogue signal.

The main signal processing algorithms are:

- Flux calculation and prediction algorithm to detect CT saturation
- Zero sequence supervision
- Detection of signal variation
- Local threshold to block busbar protection on external fault

All this information are transmitted to central unit with the sample of current, they represent signal quality. The sum of current is processed in central unit each 1200Hz but the signal processing is executed at 2400Hz on peripheral unit.

2.4.4 Programmable Scheme Logic (PSL)

The Programmable Scheme Logic (PSL) allows the relay user to configure an individual protection scheme to suit their own particular application. This is done with programmable logic gates and delay timers.

The input to the PSL is any combination of the status of the digital input signals from the opto-isolators on the input board, the outputs of the protection elements such as protection starts and trips, and the outputs of the fixed PSL. The fixed PSL provides the relay's standard protection schemes. The PSL consists of software logic gates and timers. The logic gates can be programmed to perform a range of different logic functions and can accept any number of inputs. The timers are used either to create a programmable delay or to condition the logic outputs, such as to create a pulse of fixed duration on the output, regardless of the length of the pulse on the input. The outputs of the PSL are the LEDs on the front panel of the relay and the output contacts at the rear.

The execution of the PSL logic is event driven: the logic is processed whenever any of its inputs change, for example as a result of a change in one of the digital input signals or a trip output from a protection element. Also, only the part of the PSL logic that is affected by the particular input change that has occurred is processed. This reduces the amount of processing time that is used by the PSL. The protection and control software updates the logic delay timers and checks for a change in the PSL input signals every time it runs.

This system provides flexibility for the user to create their own scheme logic design. However, it also means that the PSL can be configured into a very complex system, and because of this setting of the PSL is implemented through the PC support package Easergy Studio/MiCOM S1 Studio.

2.4.5 Function Key Interface (P741 and P743)

The ten function keys interface directly into the PSL as digital input signals and are processed based on the PSLs event-driven execution. However, a change of state is only recognized when a key press is executed, on average for longer than 200 ms. The time to register a change of state depends on whether the function key press is executed at the start or the end of a protection task cycle, with the additional hardware and software scan time included. A function key press can provide a latched (toggled mode) or output on key press only (normal mode) depending on how it is programmed and can be configured to individual protection scheme requirements. The latched state signal for each function key is written to non-volatile memory and read from non-volatile memory during relay power up, allowing the function key state to be reinstated after power-up if the relay power is lost.

2.4.6 Event and Fault Recording

A change in any digital input signal or protection element output signal is used to indicate that an event has taken place. When this happens, the protection and control task sends a message to the supervisor task to show that an event is available to be processed. The protection and control task writes the event data to a fast buffer in SRAM that is controlled by the supervisor task. When the supervisor task receives either an event or fault record message, it instructs the platform software to create the appropriate log in battery backed-up SRAM. The supervisor's buffer is faster than battery backed-up SRAM, therefore the protection software is not delayed waiting for the records to be logged by the platform software. However, if a large number of records to be logged are created in a short time, some may be lost if the supervisor's buffer is full before the platform software is able to create a new log in battery backed-up SRAM. If this occurs, an event is logged to indicate this loss of information.

2.4.7 Disturbance Recorder

The analog values and logic signals are routed from the protection and control software to the disturbance recorder software. The platform software interfaces with the disturbance recorder to allow the stored records to be extracted.

The disturbance recorder operates as a separate task from the protection and control task. It can record the waveforms for up to 8 analogue channels and the values of up to 32 digital signals. For peripheral unit the recording time is user selectable up to a maximum of 10 seconds and for central unit the record duration is fixed to 600ms. The disturbance recorder is supplied with data by the protection and control task once per cycle. The disturbance recorder collates the data that it receives into the required length disturbance record. It attempts to limit the demands it places on memory space by saving the analogue data in compressed format whenever possible. This is done by detecting changes in the analogue input signals and compressing the recording of the waveform when it is in a steady-state condition. The disturbance records can be extracted by MiCOM S1 that can also store the data in COMTRADE format, thus allowing the use of other packages to view the recorded data.

2.5 Communication Software

The communication software manages optical fibre communication between the central unit and the peripheral units. This includes the control of data exchanged transmitted and the synchronisation of peripheral units. With this object, the communication software interfaces with the sequencer used in co-processors boards.

In accordance with sequencer used in coprocessor board, the communication software sends frames at fixed frequency equal to 2400Hz. Likewise the contents of the frames is independent of the frequency and of the status of the protections. The frames are split in fixed parts according to the priority of each application. For example trip order and current sample are respectively transmitted at 2400Hz and 1200Hz whereas the internal courier communication or date & time are exchange at low frequency.

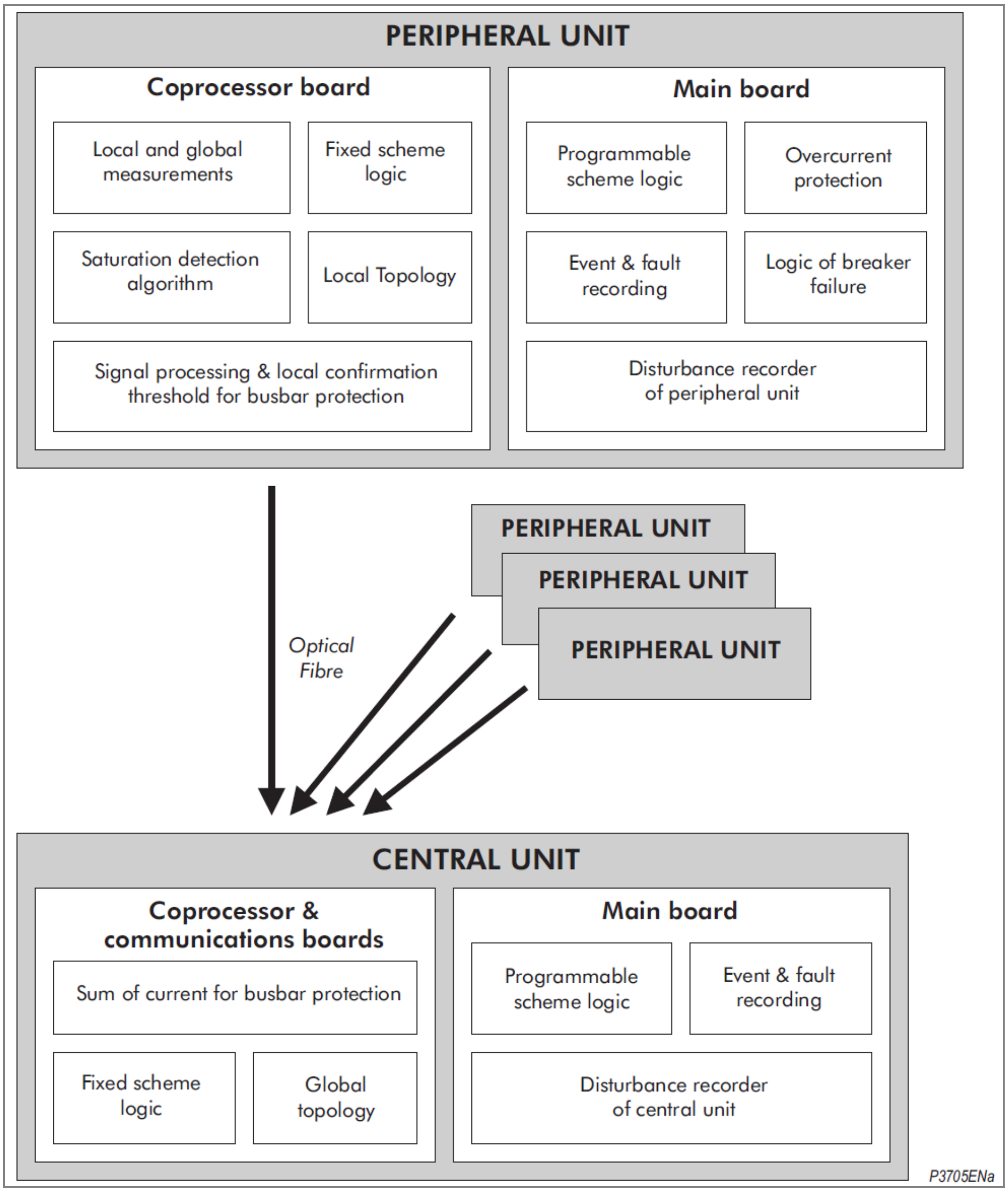

Figure 11 - System overview

3 SELF-TESTING AND DIAGNOSTICS

The relay includes several self-monitoring functions to check the operation of its hardware and software when it is in service. These are included so that if an error or fault occurs in the relay's hardware or software, the relay is able to detect and report the problem and attempt to resolve it by performing a reboot. The relay must therefore be out of service for a short time, during which the **Healthy** LED on the front of the relay is OFF and, the watchdog contact at the rear is ON. If the reboot fails to resolve the problem, the relay takes itself permanently out of service; the **Healthy** LED stays OFF and watchdog contact stays ON.

If a problem is detected by the self-monitoring functions, the relay stores a maintenance record in battery backed-up SRAM.

The self-monitoring is implemented in two stages:

- firstly a thorough diagnostic check that is performed when the relay is booted-up
- secondly a continuous self-checking operation that checks the operation of the relay's critical functions while it is in service.

3.1 Start-Up Self-Testing

The self-testing that is carried out when the relay is started takes a few seconds to complete, during which time the relay's protection is unavailable. This is shown by the **Healthy** LED on the front of the relay which is ON when the relay has passed all tests and entered operation. If the tests detect a problem, the relay remains out of service until it is manually restored to working order.

The operations that are performed at start-up are:

- System Boot
- Initialization Software
- Platform Software Initialization & Monitoring

3.1.1 System Boot

The integrity of the flash memory is verified using a checksum before the program code and data are copied into SRAM and executed by the processor. When the copy is complete the data then held in SRAM is checked against that in flash memory to ensure they are the same and that no errors have occurred in the transfer of data from flash memory to SRAM. The entry point of the software code in SRAM is then called which is the relay initialization code.

3.1.2 Initialization Software

In the initialization process the relay checks the following.

- The status of the battery
- The integrity of the battery backed-up SRAM that stores event, fault and disturbance records
- The voltage level of the field voltage supply that drives the opto-isolated inputs
- The operation of the LCD controller
- The watchdog operation

When the initialization software routine is complete, the supervisor task starts the platform software.

3.1.3 Platform Software Initialization & Monitoring

In starting the platform software, the relay checks the integrity of the data held in non-volatile memory with a checksum, the operation of the real-time clock, and the IRIG-B board if fitted. The final test that is made concerns the input and output of data; the presence and healthy condition of the input board is checked and the analog data acquisition system is checked through sampling the reference voltage.

At the successful conclusion of all of these tests the relay is entered into service and the protection started-up.

3.2 Continuous Self-Testing

When the relay is in service, it continually checks the operation of the critical parts of its hardware and software. The checking is carried out by the system services software (see section on relay software earlier in this section) and the results reported to the platform software.

The functions that are checked are as follows:

- The flash EPROM containing all program code and language text is verified by a checksum
- The code and constant data held in SRAM is checked against the corresponding data in flash EPROM to check for data corruption
- The SRAM containing all data other than the code and constant data is verified with a checksum
- The non-volatile memory containing setting values is verified by a checksum, whenever its data is accessed
- The battery status
- The level of the field voltage
- The integrity of the digital signal I/O data from the opto-isolated inputs and the relay contacts, is checked by the data acquisition function every time it is executed. The operation of the analog data acquisition system is checked by the acquisition function every time it is executed. This is done by sampling the reference voltage on a spare multiplexed channel
- The operation of the IRIG-B board is checked, where it is fitted, by the software that reads the time and date from the board

If the Ethernet board is fitted, it is checked by the software on the main processor board. If the Ethernet board fails to respond, an alarm is raised and the board is reset in an attempt to resolve the problem

In the unlikely event that one of the checks detects an error in the relay's subsystems, the platform software is notified and it will attempt to log a maintenance record in battery backed-up SRAM. If the problem is with the battery status or the IRIG-B board, the relay continues in operation. However, for problems detected in any other area the relay shuts down and reboots. This result in a period of up to 5 seconds when protection is unavailable, but the complete restart of the relay including all initializations should clear most problems that could occur. An integral part of the start-up procedure is a thorough diagnostic self-check. If this detects the same problem that caused the relay to restart, the restart has not cleared the problem and the relay takes itself permanently out of service. This is indicated by the **Healthy** LED on the front of the relay which goes OFF, and the watchdog contact that goes ON.

Notes:

COMMISSIONING

CHAPTER 11

Date:	02/2017
Products covered by this chapter:	This chapter covers the specific versions of the MiCOM products listed below. This includes ***only*** the following combinations of Software Version and Hardware Suffix.
Hardware Suffix:	L (P742) & M (P741 & P743)
Software Version:	B1 - P74x (P741, P742 & P743)
Connection Diagrams:	10P740xx (xx = 01 to 07)

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TABLES

FIGURES

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1 INTRODUCTION

About MiCOM Range

MiCOM is a comprehensive solution capable of meeting all electricity supply requirements. It comprises a range of components, systems and services from Schneider Electric.

Central to the MiCOM concept is flexibility. MiCOM provides the ability to define an application solution and, through extensive communication capabilities, integrate it with your power supply control system.

The components within MiCOM are:

- P range protection relays
- C range control products
- M range measurement products for accurate metering and monitoring
- S range versatile PC support and substation control packages

MiCOM products include extensive facilities for recording information on the state and behaviour of the power system using disturbance and fault records. They can also provide measurements of the system at regular intervals to a control centre enabling remote monitoring and control to take place.

For up-to-date information, please see:

www.schneider-electric.com

Note	*During 2011, the International Electrotechnical Commission classified the voltages into different levels (IEC 60038). The IEC defined LV, MV, HV and EHV as follows: LV is up to 1000V. MV is from 1000V up to 35 kV. HV is from 110 kV or 230 kV. EHV is above 230 KV.* *There is still ambiguity about where each band starts and ends. A voltage level defined as LV in one country or sector, may be described as MV in a different country or sector. Accordingly, LV, MV, HV and EHV suggests a possible range, rather than a fixed band. Please refer to your local Schneider Electric office for more guidance.*

The MiCOM P40 range of products includes various devices which have different functions. This chapter includes information related to the Commissioning of one or more of these devices. Many, although not all, of the commissioning tasks are common to these products.

This chapter applies to the MiCOM P40 products shown on the second page of this chapter. Where a particular section or paragraph relates only to one of more of the products, this is stated in the heading or at the beginning of the paragraph or section. If this states “Applicability: All”, this means the following information relates to all the products in shown on the second page of this chapter. Otherwise the Applicability statement will list the MiCOM P40 products which the information covers.

When using this chapter, you (i.e. in your role as the Commissioning Engineer), need to be aware of:

- The MiCOM product number you are commissioning
- The features associated with that MiCOM product number
- The subset of features which have been enabled for the specific piece of equipment you are commissioning
- Any work instructions which determine how the equipment should be installed and which of its functions have been enabled and how they should relate to other equipment
- You will then be able to select which of the following sections/subsections you need to follow. Some of these sections will not be relevant for the particular commissioning tasks you are performing. By way of example, if the MiCOM device you are commissioning has an Auto-Reclose function you need to refer to the sections which cover Auto-Reclose, otherwise you can ignore them.
- You should start using this chapter at the beginning and work your way through to the end. At key points in the chapter, you will have to know what technical functions have been enabled, as you will be asked to omit certains sections of this chapter if they are not relevant for your current commissioning task.

MiCOM P40 relays are fully numerical in their design, implementing all protection and non-protection functions in software. The relays use a high degree of self-checking and give an alarm in the unlikely event of a failure. Therefore, the commissioning tests do not need to be as extensive as with non-numeric electronic or electro-mechanical relays.

To commission numeric relays, it is only necessary to verify that the hardware is functioning correctly and the application-specific software settings have been applied to the relay. It is considered unnecessary to test every function of the relay if the settings have been verified by one of the following methods:

- Extracting the settings applied to the relay using appropriate setting software (preferred method)
- Using the operator interface

To confirm that the product is operating correctly once the application-specific settings have been applied, perform a test on a single protection element.

Unless previously agreed to the contrary, the customer is responsible for determining the application-specific settings to be applied to the relay and for testing any scheme logic applied by external wiring or configuration of the relay’s internal programmable scheme logic.

Blank commissioning test and setting records are provided within this manual for completion as required.

As the relay’s menu language is user-selectable, the Commissioning Engineer can change it to allow accurate testing as long as the menu is restored to the customer’s preferred language on completion.

To simplify the specifying of menu cell locations in these Commissioning Instructions, they are given in the form [courier reference: COLUMN HEADING, Cell Text]. For example, the cell for selecting the menu language (first cell under the column heading) is in the System Data column (column 00) so it is given as [0001: SYSTEM DATA, Language].

Warning	**Before carrying out any work on the equipment, you should be familiar with the contents of the Safety Information chapter/Safety Guide SFTY/5L M/L11 or later issue, the Technical Data chapter and the ratings on the equipment rating label.**

Caution	**The relay must not be disassembled in any way during commissioning.**

2 SETTING FAMILIARISATION

When first commissioning a relay, allow sufficient time to become familiar with how to apply the settings.

The *Relay Menu Database document* and the *Introduction* or *Settings* chapters contain a detailed description of the menu structure of Schneider Electric relays. The relay menu database is a separate document which can be downloaded from our website:

www.schneider-electric.com

With the secondary front cover in place, all keys except the ⏎ key are accessible. All menu cells can be read. LEDs and alarms can be reset. However, no protection or configuration settings can be changed, or fault and event records cleared.

Removing the secondary front cover allows access to all keys so that settings can be changed, LEDs and alarms reset, and fault and event records cleared. However, to make changes to menu cells, the appropriate user role and password is needed.

Alternatively, if a portable PC with suitable setting software is available (such as MiCOM S1 Studio), the menu can be viewed one page at a time, to display a full column of data and text. This PC software also allows settings to be entered more easily, saved to a file for future reference, or printed to produce a settings record. Refer to the PC software user manual for details. If the software is being used for the first time, allow sufficient time to become familiar with its operation.

3 EQUIPMENT REQUIRED FOR COMMISSIONING

3.1 Minimum Equipment Required

The minimum equipment needed varies slightly, depending on the features provided by each type of MiCOM product. The list of minimum equipment is given below:

- Multifunctional dynamic current and voltage injection test set.
- Multimeter with suitable ac current range, and ac and dc voltage ranges of 0 - 440V and 0 - 250V respectively.
- Continuity tester (if not included in multimeter).
- Phase angle meter.
- Phase rotation meter.

Note *Modern test equipment may contain many of the above features in one unit.*

- Fiber optic power meter.
- Fiber optic test leads (type and number according to application).
- P594 Commissioning Instructions. If the scheme features P594 time synchronizing devices, these will need commissioning. Separate documentation containing commissioning instructions is available for the P594.
- Overcurrent test set with interval timer
- 110 V ac voltage supply (if stage 1 of the overcurrent function is set directional)
- 100 Ω precision wire wound or metal film resistor, 0.1% tolerance (0°C ±2°C)

3.2 Optional Equipment

- Multi-finger test plug type Easergy test plug (if Easergy test block type is installed)
- An electronic or brushless insulation tester with a dc output not exceeding 500 V (for insulation resistance testing when required)
- A portable PC, with an RS232 port as well as appropriate software. This allows the rear communications port to be tested. If this is used, and it can save considerable time during commissioning.
- K-Bus to EIA(RS)232 protocol converter (if the first rear EIA(RS)485 K-Bus port or second rear port configured for K-Bus is being tested and one is not already installed)
- EIA(RS)485 to EIA(RS)232 converter (if first rear EIA(RS)485 port or second rear port configured for EIA(RS)485 is being tested)
- A printer, for printing a setting record from the portable PC

4 PRODUCT CHECKS

These product checks cover all aspects of the relay that need to be checked to ensure:

- that it has not been physically damaged before commissioning
- that it is functioning correctly and
- that all input quantity measurements are within the stated tolerances

If the application-specific settings have been applied to the relay before commissioning, it is advisable to make a copy of the settings to allow their restoration later.

If Programmable Scheme Logic (PSL) (other than the default settings with which the relay was supplied) has been applied, the default settings should be restored before commissioning. This can be done by:

- Obtaining a setting file from the customer. This requires a portable PC with appropriate setting software for transferring the settings from the PC to the relay.
- Extracting the settings from the relay itself. This requires a portable PC with appropriate setting software.
- Manually creating a setting record. This could be done by stepping through the front panel menu using the front panel user interface.

If password protection is enabled, and the customer has changed password 2 that prevents unauthorized changes to some of the settings, either the revised password 2 should be provided, or the customer should restore the original password before testing is started.

Note	*If the password has been lost, a recovery password can be obtained from Schneider Electric by quoting the serial number of the relay. The recovery password is unique to that relay and will not work on any other relay.*

Warning	**Before carrying out any work on the equipment, you should be familiar with the contents of the Safety Information chapter/Safety Guide SFTY/5L M/L11 or later issue, the Technical Data chapter and the ratings on the equipment rating label.**

4.1 With the Relay De-Energised

The following group of tests should be carried out without the auxiliary supply applied to the relay and with the trip circuit isolated.

Before inserting the test plug, refer to the scheme diagram to ensure this will not cause damage or a safety hazard. For example, the test block may be associated with protection current transformer circuits. Before the test plug is inserted into the test block, make sure the sockets in the test plug which correspond to the current transformer secondary windings are linked.

Warning	**The current and voltage transformer connections must be isolated from the relay for these checks. If a MiCOM P991 or an Easergy test block is provided, insert the Easergy or MiCOM P992 test plug, which open-circuits all wiring routed through the test block.**

Danger	**Never open-circuit the secondary circuit of a current transformer because the high voltage produced may be lethal. It could also damage insulation.**

If a test block is not provided, isolate the voltage transformer supply to the relay using the panel links or connecting blocks. Short-circuit and disconnect the line current transformers from the relay terminals. Where means of isolating the auxiliary supply and trip circuit (such as isolation links, fuses and MCB) are provided, these should be used. If this is impossible, the wiring to these circuits must be disconnected and the exposed ends suitably terminated to prevent them from being a safety hazard.

4.1.1 Visual Inspection

Caution	**Check the rating information under the top access cover on the front of the relay. Check that the relay being tested is correct for the protected line or circuit. Ensure that the circuit reference and system details are entered onto the setting record sheet. Double-check the CT secondary current rating, and be sure to record the actual CT tap which is in use.**

Carefully examine the relay to see that no physical damage has occurred since installation.

Ensure that the case earthing connections, at the bottom left-hand corner at the rear of the relay case, are used to connect the relay to a local earth bar using an adequate conductor.

4.1.2 Current Transformer Shorting Contacts

If required, the current transformer shorting contacts can be checked to ensure that they close when the heavy duty terminal block shown in the following figure(s) is disconnected from the current input PCB. The heavy duty terminal block location depends on the relay model.

- For P742 relays, block reference B is a heavy duty terminal block.
- For P743 relays, block reference A is a heavy duty terminal block.

See Figure 1 and Figure 2 for more details.

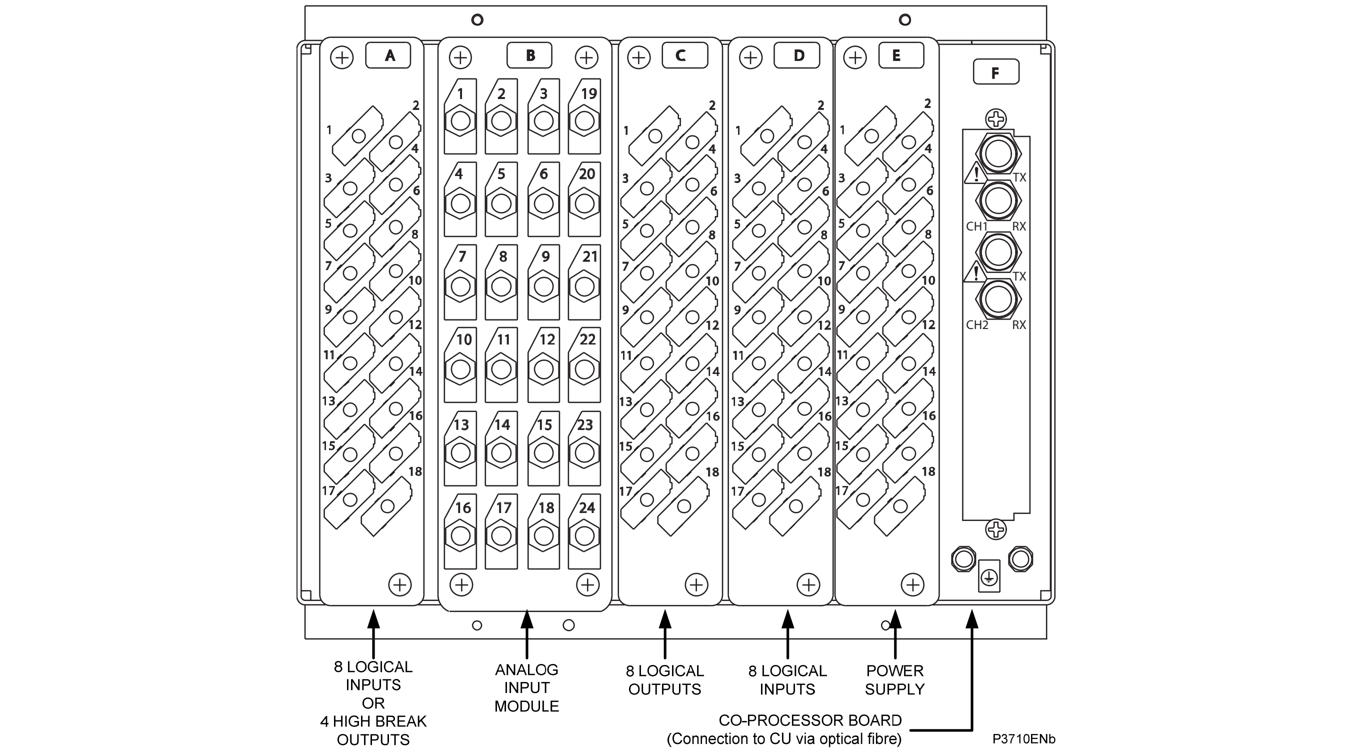


Figure 1 – Rear Terminal Blocks on P742

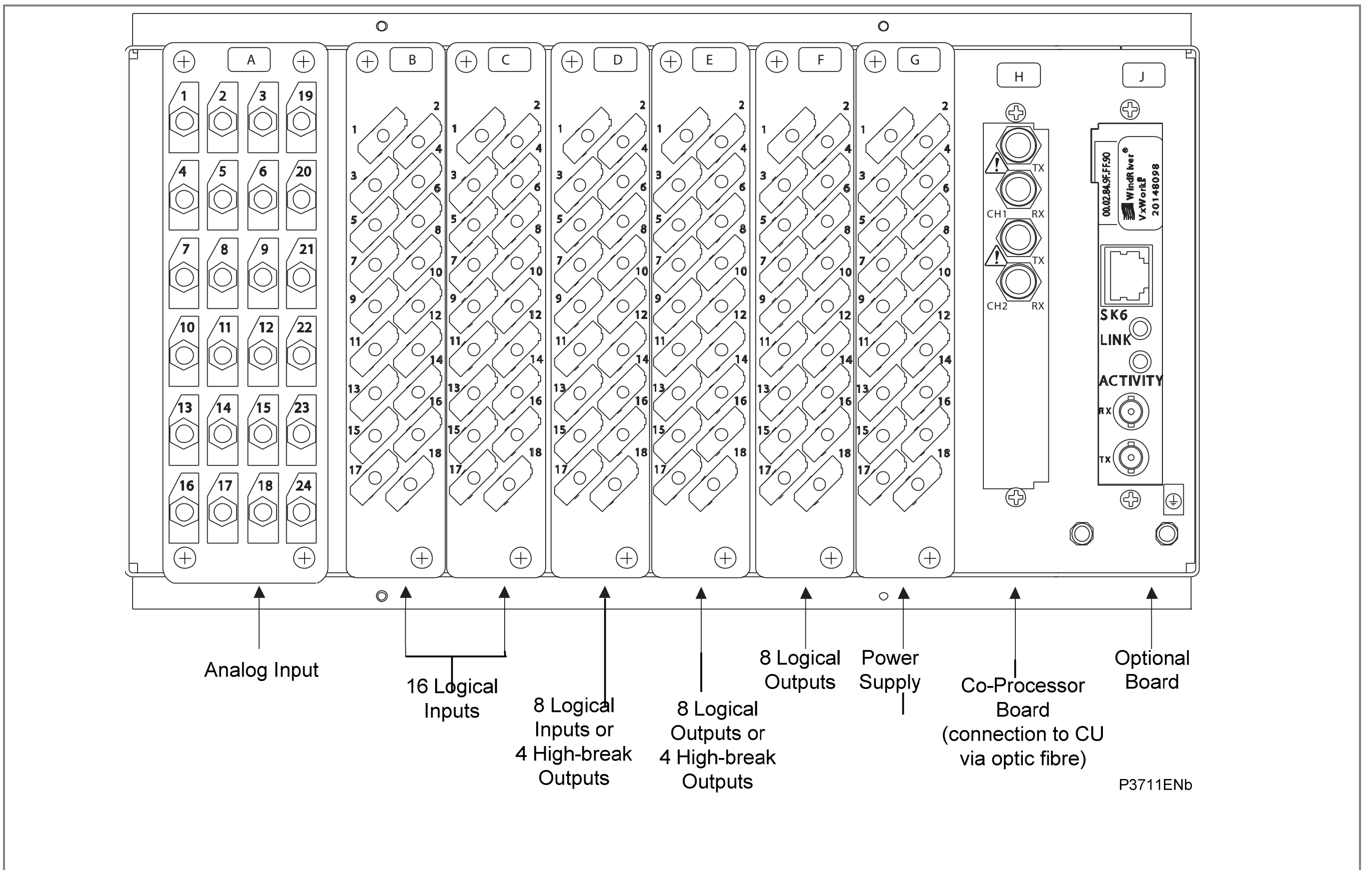


Figure 2 – Rear Terminal Blocks on P743

Heavy duty terminal blocks are fastened to the rear panel using four Pozidriv or PZ1 screws. These are at the top and bottom between the first and second, and third and fourth, columns of terminals (see the *Location of Securing Screws for Terminal Blocks* diagram below).

Note	*Use a magnetic-bladed screwdriver to avoid losing screws or leaving them in the terminal block.*

Pull the terminal block away from the rear of the case and check with a continuity tester that all the shorting switches being used are closed. The following table(s) shows the terminals between which shorting contacts are fitted.

	Shorting contact between terminals	
Current input	**P742**	**P743**
	1A – common – 5A	1A – common – 5A
IA	B3 – B2 – B1	A3 – A2 – A1
IB	B6 – B5 – B4	A6 – A5 – A4
IC	B9 – B8 – B7	A9 – A8 – A7
IN	B12 – B11 – B10	A12 – A11 – A10

Table 1 - P74x Current transformer shorting contact locations

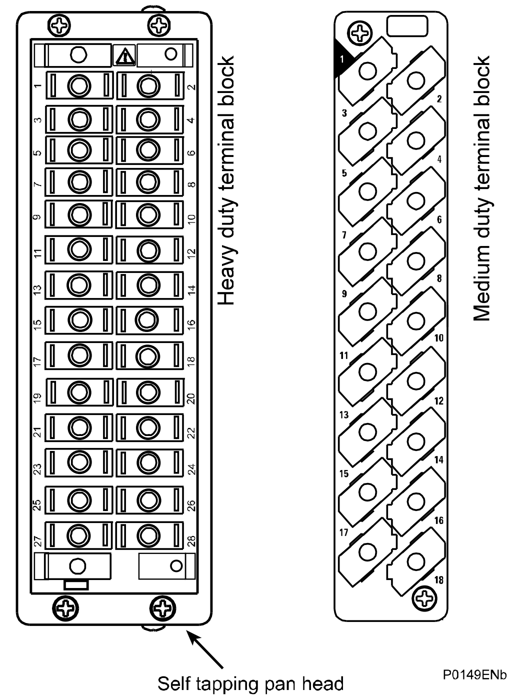


Figure 3 – Location of securing screws for heavy duty terminal blocks

4.1.3 Insulation

Insulation resistance tests are only necessary during commissioning if it is required for them to be done and they have not been performed during installation.

Isolate all wiring from the earth and test the insulation with an electronic or brushless insulation tester at a dc voltage not exceeding 500V. Terminals of the same circuits should be temporarily connected together.

The main groups of relay terminals are:

a. Current transformer circuits
b. Auxiliary voltage supply.
c. Field voltage output and opto-isolated control inputs.
d. Relay contacts.
e. Case earth.

The insulation resistance should be greater than 100MΩ at 500V.

On completion of the insulation resistance tests, ensure all external wiring is correctly reconnected to the relay.

4.1.4 External Wiring

Caution	**Check that the external wiring is correct to the relevant relay diagram and scheme diagram. Ensure as far as practical that phasing/phase rotation appears to be as expected. The relay diagram number appears on the rating label under the top access cover on the front of the relay.** **Schneider Electric supply the corresponding connection diagram with the order acknowledgement for the relay.**

If a MiCOM P991 or an Easergy test block is provided, check the connections against the wiring diagram. It is recommended that the supply connections are to the live side of the test block (colored orange with the odd numbered terminals 1, 3, 5, 7, and so on). The auxiliary supply is normally routed through terminals 13 (supply positive) and 15 (supply negative), with terminals 14 and 16 connected to the relay's positive and negative auxiliary supply terminals respectively. However, check the wiring against the schematic diagram for the installation to ensure compliance with the customer's normal practice.

4.1.5 Watchdog Contacts

Using a continuity tester, check that the watchdog contacts are in the states shown in the *Watchdog contact statu*s table for a de-energized relay.

Terminals		Contact state	
		Relay de-energised	Relay energised
L11 – L12 E11 – E12 G11 – G12	P741 P742 P743	Closed	Open
L13 – L14 E13 – E14 G13 – G14	P741 P742 P743	Open	Closed

Table 2 – Watchdog contact status

4.1.6 Auxiliary Supply

Caution **The relay can be operated from either a dc only or an ac/dc auxiliary supply depending on the relay's nominal supply rating. The incoming voltage must be within the operating range specified in the following table.**

Without energizing the relay, measure the auxiliary supply to ensure it is within the operating range.

Note *The relay can withstand an ac ripple of up to 12% of the upper rated voltage on the dc auxiliary supply.*

Nominal Supply Rating		Operating Ranges	
dc	ac	dc	ac
24 - 32V dc	-	19 - 38V dc	-
48 - 110V dc	-	37 - 150V dc	-
110 - 250V dc	100 - 240V ac rms	87 - 300V dc	80 - 265V ac

Table 3 – Operational range of auxiliary supply VX.

Caution **Do not energize the relay using the battery charger with the battery disconnected as this can irreparably damage the relay's power supply circuitry.**

Caution **Energize the relay only if the auxiliary supply is within the operating range. If a test block is provided, it may be necessary to link across the front of the test plug to connect the auxiliary supply to the relay.**

4.2 With the Relay Energised

The following group of tests verify that the relay hardware and software is functioning correctly and should be carried out with the auxiliary supply applied to the relay.

Caution **The current and voltage transformer connections must remain isolated from the relay for these checks. The trip circuit should also remain isolated to prevent accidental operation of the associated circuit breaker.**

4.2.1 Watchdog Contacts

Using a continuity tester, check that the watchdog contacts are in the states shown in the *Watchdog contact statu*s table for a de-energized relay.

4.2.2 Date and Time

Before setting the date and time, ensure that the factory-fitted battery isolation strip that prevents battery drain during transportation and storage has been removed. With the lower access cover open, the presence of the battery isolation strip can be checked by a red tab protruding from the positive side of the battery compartment. Lightly pressing the battery to prevent it falling out of the battery compartment, pull the red tab to remove the isolation strip.

The data and time should now be set to the correct values. The method of setting depends on whether accuracy is being maintained through the optional Inter-Range Instrumentation Group standard B (IRIG-B) port on the rear of the relay or by using SNTP via Ethernet.

4.2.2.1 With an IRIG-B Signal for Central Unit (P741) Only

Note	*For P741 the IRIG-B signal may apply to the Central Unit only.*

If a satellite time clock signal conforming to IRIG-B is provided and the relay has the optional IRIG-B port fitted, the satellite clock equipment should be energized.

To allow the relay's time and date to be maintained from an external IRIG-B source cell [DATE and TIME, IRIG-B Sync.] must be set to **Enabled**.

Ensure the relay is receiving the IRIG-B signal by checking that cell [DATE and TIME, IRIG-B Status] reads **Active**.

Once the IRIG-B signal is active, adjust the time offset of the universal coordinated time (satellite clock time) on the satellite clock equipment so that local time is displayed.

Check the time, date and month are correct in cell [0801: DATE and TIME, Date/Time]. The IRIG-B signal does not contain the current year so needs to be set manually in this cell.

If the auxiliary supply fails, with a battery fitted in the compartment behind the bottom access cover, the time and date is maintained. Therefore, when the auxiliary supply is restored, the time and date are correct and need not be set again.

To test this, remove the IRIG-B signal, then remove the auxiliary supply from the relay. Leave the relay de-energized for approximately 30 seconds. On re-energization, the time in cell [DATE and TIME, Date/Time] should be correct. Then reconnect the IRIG-B signal.

4.2.2.2 Without an IRIG-B Signal for Central Unit (P741) or Peripheral Unit (P742/P743)

Note	*For P741 the IRIG-B signal may not apply to the Central Unit only. For the P742/P743 it may apply to the Peripheral Unit only.*

If the time and date is not being maintained by an IRIG-B signal, ensure that cell [0804: DATE and TIME, IRIG-B Sync.] is set to **Disabled**.

Set the date and time to the correct local time and date using cell [0801: DATE and TIME, Date/Time].

If the auxiliary supply fails, with a battery fitted in the compartment behind the bottom access cover, the time and date are maintained. Therefore when the auxiliary supply is restored, the time and date are correct and need not be set again.

To test this, remove the auxiliary supply from the relay for approximately 30 seconds. On re-energization, the time in cell [0801: DATE and TIME, Date/Time] should be correct.

4.2.3 Light Emitting Diodes (LEDs)

On power-up, the green LED should switch on and stay on, indicating that the relay is healthy. The relay has non-volatile memory which stores the state (on or off) of the alarm, trip and, if configured to latch, user-programmable LED indicators when the relay was last energized from an auxiliary supply. Therefore, these indicators may also switch on when the auxiliary supply is applied.

If any of these LEDs are on, reset them before proceeding with further testing. If the LED successfully resets (the LED switches off), there is no testing required for that LED because it is known to be operational.

Note	*It is likely that alarms related to the communications channels will not reset at this stage.*

4.2.3.1 Testing the Alarm and Out of Service LEDs

The alarm and out of service LEDs can be tested using the **COMMISSIONING TESTS** menu column. Set cell [0F0D: COMMISSIONING TESTS, Test Mode] to **Contacts Blocked**. Check that the out of service LED is on continuously and the alarm LED flashes.

It is not necessary to return cell [0F0D: COMMISSIONING TESTS, Test Mode] to **Disabled** at this stage because the test mode will be required for later tests.

Out of service LED behaviour for P741xxxxxxxxx5K:

- If the logic input “All Prot Blocked” is ON, then the ‘Out of Service’ LED is NOT illuminated because this is an elected operation by the user and can be indicated on the programmable LEDs if indication is required.
- If individual zones of protection, or multiple zones, or all zones are switched out of service via external switches (i.e. using the DDB signals within the PSL), the ‘Out of Service’ LED remains OFF because this is an operator manual selection. It just switches for "abnormal" operating conditions rather than for commissioning purposes.
- When selection of zones in/out of service is achieved via the Commission Test column of the menu structure in the CU, as soon as the user has the potential to switch zones in/out of service, then the ‘Out of Service’ LED comes ON but no zone is out of service until, in the Commission Test column, a zone is selected to be out of service and the patent is applied.
- The ‘Out of Service’ LED ON only turns off when the commissioning mode has been set to “Disabled” AND all zones are selected in service in the Commission Test column (note: if the user wants to select a zone out of service for operational reasons, this must be done by the switches and not the setting selection in the commissioning mode).

Out of Service LED behaviour for P742xxxxxxxxx5J or for P743xxxxxxxxx5K:

- The Commission Test menu structure in the PU also allows for an 'Overhaul' mode where secondary injection of the PU is permitted. In this mode, the isolators must be open for testing but all information is passed back to the CU for inclusion in the zone calculations. Whilst in this mode the Peripheral Unit can be tested locally, secondary injections tests, for example, can be carried out (the system is stable because during the current injection there is a differential current in the CZ but not in the Zone). In this case, since the system must have primary action (i.e open isolators), the 'Out of Service' LED is ON.
- The Commission Test menu structure in a Peripheral Unit allows for a '50BF Disabled' mode where the PU does not initiate the breaker fail protection, but can respond to commands to trip from the CU (in the event of a busbar protection trip or CB failure backtrip). In this case, since the busbar protection is not out of service, the 'Out of Service' LED remains OFF in the CU.

4.2.3.2 Testing the Trip LED

The trip LED can be tested by initiating a manual circuit breaker trip from the relay. However, the trip LED will operate during the setting checks performed later. Therefore, no further testing of the trip LED is required at this stage.

Note	*The CB control function does not exist in the Central Unit (P741) as only the Peripheral Unit (P742/P743) may trip/close the local circuit breakers.*

4.2.3.3 Testing the User-Programmable LEDs

To test the user-programmable LEDs set cell [0F10: COMMISSIONING TESTS, Test LEDs] to **Apply Test**. Check that all the programmable LEDs on the relay switch on.

In the MiCOM P741, P743, P746 & P849:

- The 'Red LED Status' cell is an 18-bit binary string that indicates which of the user-programmable LEDs on the device are illuminated when accessing the device from a remote location, a '1' indicating a particular Red LED is lit.
- The 'Green LED Status' cell is an 18-bit binary string that indicates which of the user-programmable LEDs on the device are illuminated when accessing the device from a remote location, a '1' indicating a particular Green LED is lit.
- If a 'Red LED Status' cell AND the same 'Green LED Status' cell are at '1' the particular LED is lit Orange
- If a 'Red LED Status' cell AND the same 'Green LED Status' cell are at '0' the particular LED is not lit.

In the P742:

- The 'LED Status' cell is an eight bit binary string that indicates which of the user-programmable LEDs on the relay are illuminated when accessing the relay from a remote location, a '1' indicating a particular LED is lit and a '0' not lit.

4.2.4 Field Voltage Supply

The relay generates a field voltage of nominally 48 V that can be used to energize the opto-isolated inputs (alternatively the substation battery may be used).

Measure the field voltage across terminals 7 and 9 on the terminal block shown in the following table. Check that the field voltage is in the range 40 V to 60 V when no load is connected and that the polarity is correct.

Repeat for terminals 8 and 10

Supply rail	Terminals		
	P741	P742	P743
+ve	L7 & L8	E7 & E8	G7 & G8
–ve	L9 & L10	E9 & E10	G9 & G10

Table 4 – Field voltage terminals

4.2.5 Input Opto-Isolators

This test checks that all the opto-isolated inputs on the relay are functioning correctly.

Model	Opto-Insulated Inputs
P741	6
P742	16
P743	24

Table 5 - Opto-isolated inputs

The opto-isolated inputs should be energised one at a time, see the *Connection Diagrams* chapter for terminal numbers. Ensuring correct polarity, connect the field supply voltage to the appropriate terminals for the input being tested.

Note	*The opto-isolated inputs may be energised from an external dc auxiliary supply (e.g. the station battery) in some installations. Check that this is not the case before connecting the field voltage otherwise damage to the relay may result.*

The status of each opto-isolated input can be viewed using either cell [SYSTEM DATA, Opto I/P Status] or [COMMISSION TESTS, Opto I/P Status], a ‘1’ indicating an energised input and a ‘0’ indicating a de-energised input. When each opto-isolated input is energised one of the characters on the bottom line of the display will change to indicate the new state of the inputs.

4.2.6 Output Relays

This test checks that all the output relays are functioning correctly.

Model	Outputs
P741 and P742	8
P743	16

Note	*The high break output contacts fitted to I/O options “C” and “D” are polarity sensitive. External wiring should, wherever possible, be verified against polarity requirements described in the external connection diagram to ensure correct high break operation when in service.*

Ensure that the cell [xxxx: COMMISSIONING TESTS, Test Mode] is set to **Contacts Blocked**. (xxxx = 0F0E for P44x/P44y, 0F0D for P14x, P24x, P34x, P54x, P547, P64x or P841).

The output relays should be energized one at a time. To select output relay 1 for testing, set cell [xxxx: COMMISSIONING TESTS, Test Pattern] to 00000000000000000000000000000001. (xxxx = 0F0F for P44x/P44y, 0F0E for P14x, P24x, P34x, P445, P54x, P547, P64x or P841).

Connect a continuity tester across the terminals corresponding to output relay 1 as shown in the relevant external connection diagram in the *Installation* chapter.

To operate the output relay, set cell [xxxx: COMMISSIONING TESTS, Contact Test] to **Apply Test**. Operation is confirmed by the continuity tester operating for a normally open contact and ceasing to operate for a normally closed contact. Measure the resistance of the contacts in the closed state. (xxxx = 0F11 for P44x, 0F0F for P14x, P24x, P34x, P44y, P445, P54x, P547, P64x or P841).

Reset the output relay by setting cell [xxxx: COMMISSIONING TESTS, Contact Test] to **Remove Test**. (xxxx = 0F11 for P44x, 0F0F for P14x, P24x, P34x, P44y, P445, P54x, P547 or P64x).

Note	*Ensure that the thermal ratings of anything connected to the output relays during the contact test procedure are not exceeded by the associated output relay being operated for too long. Keep the time between application and removal of contact test to a minimum.*

Repeat the test for the rest of the relays (the numbers depend on the model).

Return the relay to service by setting cell [0F0D: COMMISSIONING TESTS, Test Mode] to **Disabled**.

4.2.7 Rear Communications Port

This test should only be performed where the relay is to be accessed from a remote location and varies depending on the communications standard adopted.

It is not the intention of the test to verify the operation of the complete system from the relay to the remote location, just the relay's rear communications port and any protocol converter necessary.

A variety of communications protocols may be available. For further details, please see whichever of these sections are relevant for the device you are commissioning:

4.2.7.1 Courier Communications

If a K-Bus to EIA(RS)232 KITZ protocol converter is installed, connect a portable PC running the appropriate software (such as MiCOM S1 Studio or PAS&T) to the incoming (remote from relay) side of the protocol converter.

If a KITZ protocol converter is not installed, it may not be possible to connect the PC to the relay installed. In this case a KITZ protocol converter and portable PC running appropriate software should be temporarily connected to the relay's first rear K-Bus port. The terminal numbers for the relay's first rear K-Bus port are shown in the following table. However, as the installed protocol converter is not being used in the test, only the correct operation of the relay's K-Bus port will be confirmed.

Ensure that the communications baud rate and parity settings in the application software are set the same as those on the protocol converter (usually a KITZ but could be a SCADA RTU). The relays courier address in cell [COMMUNICATIONS, Remote Access] must be set to a value between 6 (P741) and 34. Check that communications can be established with this relay using the portable PC.

Check that, using the Master Station, communications with the relay can be established.

4.2.7.2 IEC60870-5-103 Communication

If the relay has the optional fiber optic communications port fitted, the port to be used should be selected by setting cell [xxxx: COMMUNICATIONS, Physical Link] to **Fiber Optic** or **EIA(RS)485**.

- xxxx = 0E07 for P14x, P24x, P34x, P44y, P445, P54x, P547, P64x or P841
  xxxx = 0E09 for P44x

IEC60870-5-103/VDEW communication systems are designed to have a local Master Station and this should be used to verify that the relay's rear fiber optic or EIA(RS)485 port, as appropriate, is working.

Ensure that the relay address and baud rate settings in the application software are set the same as those in cells [0E02: COMMUNICATIONS, Remote Address] and [0E04: COMMUNICATIONS, Baud Rate] of the relay.

Check, using the Master Station, that communications with the relay can be established.

4.2.7.3 IEC 61850 Communications

Connect a portable PC running the appropriate IEC61850 Master Station Software or MMS browser to the relay's Ethernet port (RJ45 or ST fiber optic connection). The terminal numbers for the relay's Ethernet port are shown in the following *Signals on the Ethernet connector* table.

Configuration of the relay IP parameters (IP Address, Subnet Mask, Gateway) and SNTP time synchronization parameters (SNTP Server 1, SNTP Server 2) is performed by the IED Configurator tool. If these parameters are not available from an SCL file, they must be configured manually.

If the assigned IP address is duplicated elsewhere on the same network, the remote communications operates in an indeterminate way. However, the relay checks for a conflict on every IP configuration change and at power-up. An alarm is raised if an IP conflict is detected. The relay can be configured to accept data from networks other than the local network by using the **Gateway** setting.

Check that communications with this relay can be established.

To communicate with an IEC 61850 IED on Ethernet, it is necessary only to know its IP address. This can then be configured in either of the following:

- An IEC 61850 client (or master), such as a PACiS computer (MiCOM C264) or HMI
- An MMS browser, with which the full data model can be retrieved from the IED without any previous knowledge

Setting changes such as protection settings are not supported in the current IEC 61850 implementation. Such setting changes are done using MiCOM S1 Studio using the front port serial connection of the relay, or over the Ethernet link if preferred. This is known as tunneling. See the *SCADA Communications* chapter for more information on IEC 61850.

The connector for the Ethernet port is a shielded RJ45. The following shows the signals and pins on the connector:

Pin	Signal name	Signal definition
1	TXP	Transmit (positive)
2	TXN	Transmit (negative)
3	RXP	Receive (positive)
4	-	Not used
5	-	Not used
6	RXN	Receive (negative)
7	-	Not used
8	-	Not used

Table 6 – Signals on the Ethernet connector

4.2.8 Second Rear Communications Port

This test should only be performed where the relay is to be accessed from a remote location and varies depending on the communications standard being adopted.

It is not the intention of the test to verify the operation of the complete system from the relay to the remote location, just the relay's rear communications port and any protocol converter necessary.

A variety of communications protocols may be available. For further details, please see whichever of these sections are relevant for the device you are commissioning:

4.2.8.1 K-Bus Configuration

If a K-Bus to EIA(RS)232 KITZ protocol converter is installed, connect a portable PC running the appropriate software (MiCOM S1 Studio or PAS&T) to the incoming (remote from relay) side of the protocol converter.

If a KITZ protocol converter is not installed, it may not be possible to connect the PC to the relay installed. In this case a KITZ protocol converter and portable PC running appropriate software should be temporarily connected to the relay's second rear communications port configured for K-Bus. The terminal numbers for the relay's K-Bus port are shown in the following table. However, as the installed protocol converter is not being used in the test, only the correct operation of the relay's K-Bus port is confirmed.

Pin*	Connection
4	EIA(RS)485 - 1 (+ ve)
7	EIA(RS)485 - 2 (- ve)
* All other pins unconnected.	

Table 7 - Second rear communications port K-Bus terminals

Ensure that the communications baud rate and parity settings in the application software are set the same as those on the protocol converter (usually a KITZ but could be a SCADA RTU). The relay's Courier address in cell [0E90: COMMUNICATIONS, RP2 Address] must be set to a value between 1 and 254. The second rear communication's port configuration [0E88: COMMUNICATIONS RP2 Port Config.] must be set to K-Bus.

Check that communications can be established with this relay using the portable PC.

4.2.8.2 EIA(RS)485 Configuration

If an EIA(RS)485 to EIA(RS)232 converter (Schneider Electric CK222) is installed, connect a portable PC running the appropriate software (Easergy Studio/MiCOM S1 Studio) to the EIA(RS)232 side of the converter and the second rear communications port of the relay to the EIA(RS)485 side of the converter.

The terminal numbers for the relay's EIA(RS)485 port are shown in the *Second rear communications port EIA(RS)232 terminals* table.

Ensure that the communications baud rate and parity settings in the application software are the same as those in the relay. The relay's Courier address in cell [0E90: COMMUNICATIONS, RP2 Address] must be set to a value between 1 and 254. The second rear communications port's configuration [0E88: COMMUNICATIONS RP2 Port Config.] must be set to EIA(RS)485.

Check that communications can be established with this relay using the portable PC.

4.2.8.3 EIA(RS)232 Configuration

Connect a portable PC running the appropriate software (MiCOM S1 Studio) to the rear EIA(RS)232 port of the relay. This port is actually compliant with EIA(RS)574; the 9-pin version of EIA(RS)232, see www.tiaonline.org.

The second rear communications port connects using the 9-way female D-type connector (SK4). The connection is compliant with EIA(RS)574.

Pin	Connection
1	No Connection
2	RxD
3	TxD
4	DTR[#]
5	Ground
6	No Connection
7	RTS[#]
8	CTS[#]
9	No Connection
[#] These pins are control lines for use with a modem.	

Table 8 - Second rear communications port EIA(RS)232 terminals

Connections to the second rear port configured for EIA(RS)232 operation can be made using a screened multi-core communication cable up to 15 m long, or a total capacitance of 2500 pF. Terminate the cable at the relay end with a 9-way, metal-shelled, D-type male plug. The terminal numbers for the relay's EIA(RS)232 port are shown in the previous table.

Ensure that the communications baud rate and parity settings in the application software are set the same as those in the relay. The relay's Courier address in cell [0E90: COMMUNICATIONS, RP2 Address] must be set to a value between 1 and 254. The second rear communication's port configuration [0E88: COMMUNICATIONS RP2 Port Config] must be set to EIA(RS)232.

Check that communications can be established with this relay using the portable PC.

4.2.8.4 EIA(RS)232 InterMiCOM Communications InterMiCOM Loopback Testing & Diagnostics

The “Loopback” test facilities, located within the [15 INTERMICOM COMMS] column of the relay menu, provide a user with the ability to check the software and hardware of the InterMiCOM signaling. If ‘INTERMICOM COMMS’ column is not visible, check that [0490 InterMiCOM] is enabled in the [09 CONFIGURATION] column.

Note that by selecting the [1550 Loopback Mode] to “Internal”, only the internal software of the relay is checked whereas “External” will check both the software and hardware used by InterMiCOM. When relay is switched into either ‘Loopback Mode’ the relay will automatically use generic addresses and will inhibit the InterMiCOM messages to the PSL by setting all eight InterMiCOM message states to zero.

Set ‘External’ and connect the transmit and receive pins together (pins 2 and 3) and ensure the DCD signal is held high (connect pin 1 and pin 4 together) as per the following diagram:

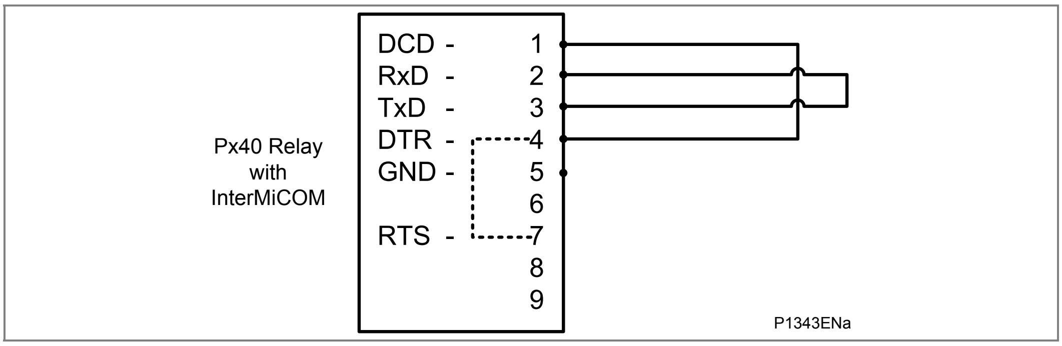


Figure 4 - Connections for external loopback mode

Providing all connections are correct and the software is working correctly, observe that the [1552 Loopback Status] cell that is located within the INTERMICOM COMMS displays “OK”. Set [1540 Ch Diagnostics] within INTERMICOM COMMS to “Visible”.

To test the InterMiCOM enter any test pattern in the [1551 Test Pattern] cell by scrolling and changing selected bits between “1” and “0”. The entered pattern will be transmitted through the software and/or hardware. Check that the [1502 IM Output Status] cell matches with the applied ‘Test Pattern’. Also check that all 8 bits in the [1501 IM Input Status] cell are zero.

Check that the Channel Diagnostics status is displaying:

[1541 Data CD Status]	OK
[1542 FrameSync Status]	OK
[1543 Message Status]	OK
[1544 Channel Status]	OK
[1545 IM H/W Status	OK

To simulate a hardware error, disconnect pin 1. The [1541 Data CD Status] will indicate “FAIL”. Restore pin 1 connection. Observe that status reverts to “OK”. To simulate a channel failure, disconnect the link between pins 2 and 3. The [1542 FrameSync Status], [1543 Message Status] and [1544 Channel Status] will all display “FAIL”.

Note that [1545 IM H/W Status] cell will remain ‘OK’. If displaying “Absent”, it means that the rear communications card that includes EIA(RS)232 InterMiCOM is either not fitted or has failed to initialize.

Alternatively set [0F13 Test Loopback] cell to ‘Internal’ and repeat the ‘Test Pattern’ test as described above. In this mode it is not necessary to make wiring changes.

4.2.8.5 Loopback Removal and Establishing Service Condition

Once the above loopback tests are completed, switch the InterMiCOM channel back in to service by setting the [1550 Loopback Mode] to “Disabled” and restoring the Tx and Rx connections.

The following checks can be made if the remote end is actively communicating, if this is not the case then a comprehensive test cannot be performed until the two ended system is established.

Observe that the amber Alarm LED and a LCD alarm message, “IM Loopback” are not present. Check that the [1502 IM Output Status] cell pattern at the local relay matches with the [1501 IM Input Status] at the remote end and vice versa.

Further checks will be necessary to ensure that the communications between the two relays in the scheme are reliable. To facilitate this, set the [1520 Ch Statistics] cell “Visible” and view a list of channel statistics and diagnostics available in the ‘INTERMiCOM COMMS’ column. The Rx count for Direct, Permissive and Blocking signals (subject to setting) will rise rapidly in proportion to Baud rate setting, whilst the Rx count for “NewData” and “Errored” and the percentage of “Lost Messages” must remain close to zero. Also, all status indications (see above) must display “OK”. That would mean that the comms are of a good quality and that the EIA(RS)232 InterMiCOM has been successfully put back in service. Record all statistics in the Commissioning Test Record provided below.

4.2.9 Current Differential Communications

This test verifies that the P742 or P743 relay’s fibre optic communications ports used for communications to the P741 Central Unit, are operating correctly.

When connecting or disconnecting optical fibres care should be taken not to look directly into the transmit port or end of the optical fibre.

From central unit, the cell [PU CONF & STATUS, PU connected] displayed the list of peripheral units connected to the central unit.

From peripheral unit, it is possible to check the communication with the central unit by disconnecting the optical fibre, an alarm “Fibre Com Error” should appear.

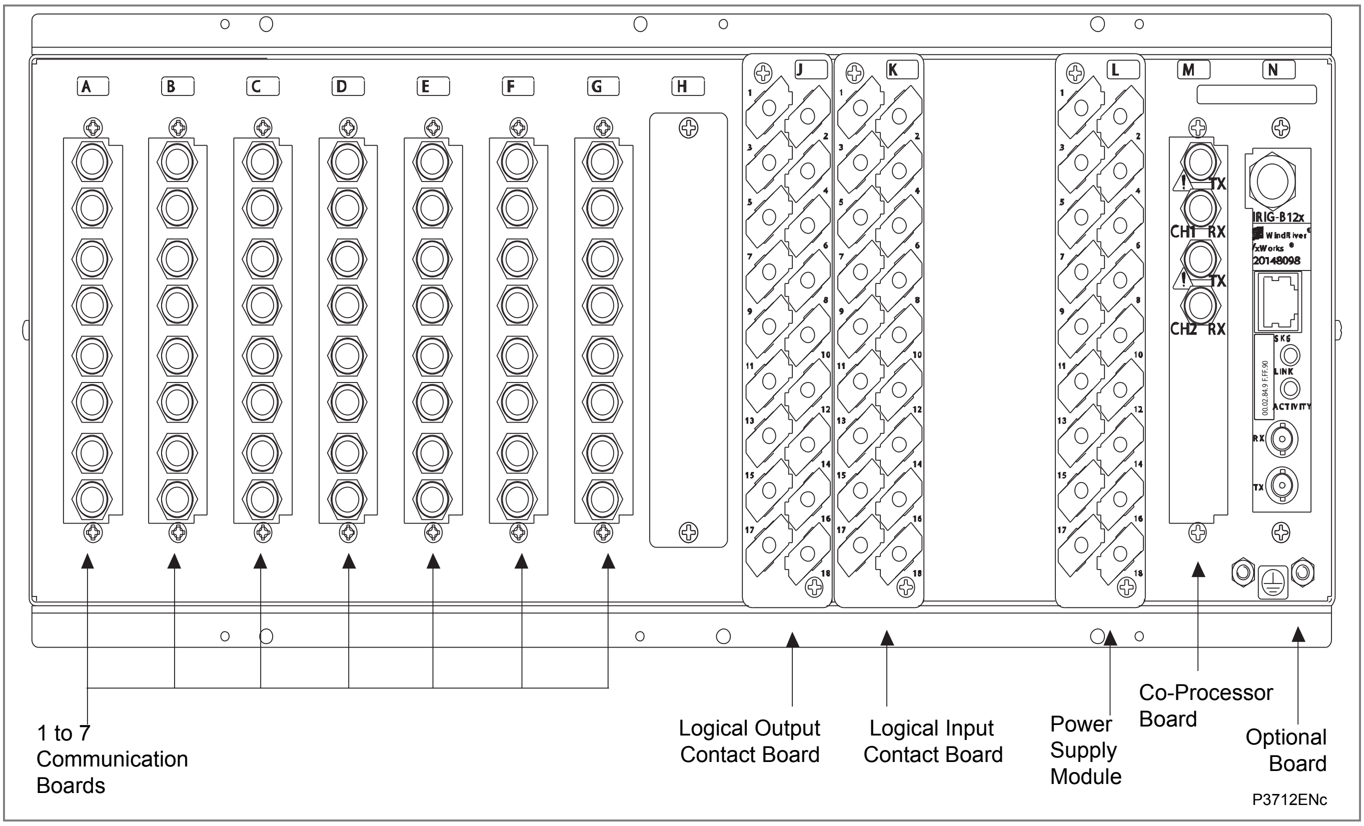


Figure 5 - P741 rear terminal blocks and communication ports

4.2.10 Current Inputs (P742, P743 only)

This test verifies that the accuracy of current measurement is within acceptable tolerances.

All relays leave the factory set for operation at a system frequency of 50 Hz. If operation at 60 Hz is required, this must be set in cell [0009: SYSTEM DATA, Frequency].

Caution	**To avoid spurious operation of protection elements during injection testing, ensure that current operated elements are disabled.**

Apply current equal to the line current transformer secondary winding rating to each current transformer input of the corresponding rating in turn, checking its magnitude using a multimeter. Refer to the *Current input terminals* table for the corresponding reading in the relay's **MEASUREMENTS 1** columns, as appropriate, and record the value displayed.

The measured current values displayed on the relay LCD, or on a portable PC connected to the front communication port, are either in primary or secondary Amperes. If cell [0D02: MEASURE'T SETUP, Local Values] is set to **Primary**, the values displayed should be equal to the applied current multiplied by the corresponding current transformer ratio set in the **CT and VT RATIOS** menu column (see the *CT ratio settings* table). If cell [0D02: MEASURE'T SETUP, Local Values] is set to **Secondary**, the value displayed should be equal to the applied current.

Note	*If a PC connected to the relay's rear communications port is used to display the measured current, the process is similar. However, the setting of cell [0D03: MEASURE'T SETUP, Remote Values] determines whether the displayed values are in primary or secondary Amperes.*

The measurement accuracy of the relay is ±1% (5% for P741/P742/P743/P746). However, an additional allowance must be made for the accuracy of the test equipment being used.

	P74x
Cell in MEASUREMENTS 1 column (02)	**Corresponding CT Ratio (in 'CT and VT RATIOS' column(0A) of menu)**
[IA Magnitude] [IB Magnitude] [IC Magnitude]	$\left[\frac{\text{[Phase CT Primary]}}{\text{[Phase CT Secondary]}}\right]$
[IN Magnitude] (not P746)	$\left[\frac{\text{[Phase CT Primary]}}{\text{[Phase CT Secondary]}}\right]$

Table 9 – CT ratio settings

5 COMMISSIONING TESTS

5.1 Test Mode

5.1.1 Test Mode for PU

This cell is used to allow secondary injection testing to be performed on the relay, without operation of the trip relays, or commissioning of other relays in the same bay as the PU, without mal-operation of the breaker failure protection. It also enables the user to directly test the output contacts and the effect of plant position via the application of controlled tests signals.

Two test modes are available:

- In the 'CB Failure Protection (50BF) disabled' mode, all tripping information from external relay are not taken into account. The topology algorithm forwards the feeder positions to the central unit as normal. As the peripheral unit continues to monitor the analogue values the central unit will maintain a balanced condition with the remainder of the system still in normal operation. However, the CB failure backtrip information will not be sent to the Central Unit. The local protections (Dead Zone, Overcurrent, Earth Fault) are still enabled and the PU is able to retrip the breaker. However, the Peripheral Unit is able to react to a fault condition by creating a CB fail condition and back tripping the zone(s) if the CU sends a trip order (87BB or 50BF backtrip), to clear a genuine fault).
- In the 'Overhaul' mode, the feeder is totally disconnected from the system because all the isolators are open but all information is passed back to the central unit for inclusion in zone calculations and hence the protection scheme. Hence the central unit can keep the zone elements in service as the contribution of this feeder will be zero. (The CT is still used by the Check Zone element)

  Whilst in this mode the peripheral unit can be tested locally for example secondary injections tests can be carried out (The system is stable because during the current injection there is a differential current in the CZ but not in the Zone).

When a test mode is select, the relay is out of service causing an alarm condition to be recorded and the yellow 'Out of Service' LED to illuminate (see the *Testing the Alarm and Out of Service LEDs* section for particular conditions). Once testing is complete the cell must be set back to 'Disabled' to restore the relay back to service.

5.1.2 Test Mode for CU

This cell is used to allow commissioning of busbar and general breaker failure protection. It also enables a facility to directly test the output contacts by applying menu controlled tests signals. During the test mode, opto inputs and outputs contacts remain in last known state before the test mode is selected.

To select test mode this cell should be set to 'Enabled' which takes the relay out of service causing an alarm condition to be recorded and the yellow 'Out of Service' LED to illuminate (see the *Testing the Alarm and Out of Service LEDs* section for particular conditions). Once testing is complete the cell must be set back to 'Disabled' to restore the relay back to service.

Caution	**When the 'Test Mode' cell is set to 'Enabled', the relay scheme logic does not drive the output relays and hence the cu will not trip the associated circuit breaker if a busbar fault occurs (commissioning mode 1 and 2).**

Caution	**However, the communications channels with remote relays remain active, which, if suitable precautions are not taken, could lead to the remote ends tripping when current transformers are isolated or injection tests are performed.**

5.2 Busbar Monitoring (only in CU)

The 'BB monitoring' cell is used to select the status of each zone. This cell has a binary string with one bit per zone which can be set to '1' to disable busbar protection and '0' to keep the zone in operating mode. When a zone is set to '1', the current sum calculation remains active for monitoring but a trip order cannot be generated by the busbar protection, only from the breaker failure protection. Zones can be in busbar monitoring when others zones remain active.

5.3 Busbar (BB) & Circuit Breaker Fail (CBF) Disable (only in CU)

The 'BB & CBF disable' cell is used to select the status of each zone. This cell has a binary string with one bit per zone which can be set to '1' to disable busbar & breaker failure protection and '0' to maintain the zone in operating mode. When a zone is set to '1', the current sum calculation remains active for monitoring but trip orders cannot be sent by either the busbar protection or the breaker failure protection. Zones can be in ' BB & CBF disable ' when others zones remain active.

6 SETTING CHECKS

The setting checks ensure that all of the application-specific relay settings (both the relay's function and Programmable Scheme Logic (PSL) settings) for the particular installation have been correctly applied to the relay.

Caution **The trip circuit should remain isolated during these checks to prevent accidental operation of the associated circuit breaker.**

Note *For busbar protection stability reasons, whatever is the maintenance mode selected, the Check Zone will never be disabled, thus, the time to inject current shall be shorter than the ID>1 set timer to avoid Circuitry Fault alarms.*

6.1 Apply Application-Specific Settings

There are different methods of applying the settings:

- Transferring settings from a pre-prepared setting file to the relay using a laptop PC running the appropriate software (such as Easergy/MiCOM S1 Studio). Use the front EIA(RS)232 port (under the bottom access cover), or the first rear communications port (Courier protocol with a protocol converter connected), or the second rear communications port. This is the preferred method for transferring function settings as it is much faster and there is less margin for error. If PSL other than the default settings with which the relay is supplied is used, this is the only way of changing the settings.

  If a setting file has been created for the particular application and provided on a memory device, the commissioning time is further reduced, especially if application-specific PSL is applied to the relay.
- Enter the settings manually using the relay's operator interface. This method is not suitable for changing the PSL.

Caution **When the installation needs application-specific Programmable Scheme Logic (PSL), it is essential that the appropriate .psl file is downloaded (sent) to the relay, for each setting group that will be used. If the user fails to download the required .psl file to any setting group that may be brought into service, the factory default PSL will still be resident. This may have severe operational and safety consequences.**

6.2 How to Measure the Burden Resistance (RB)

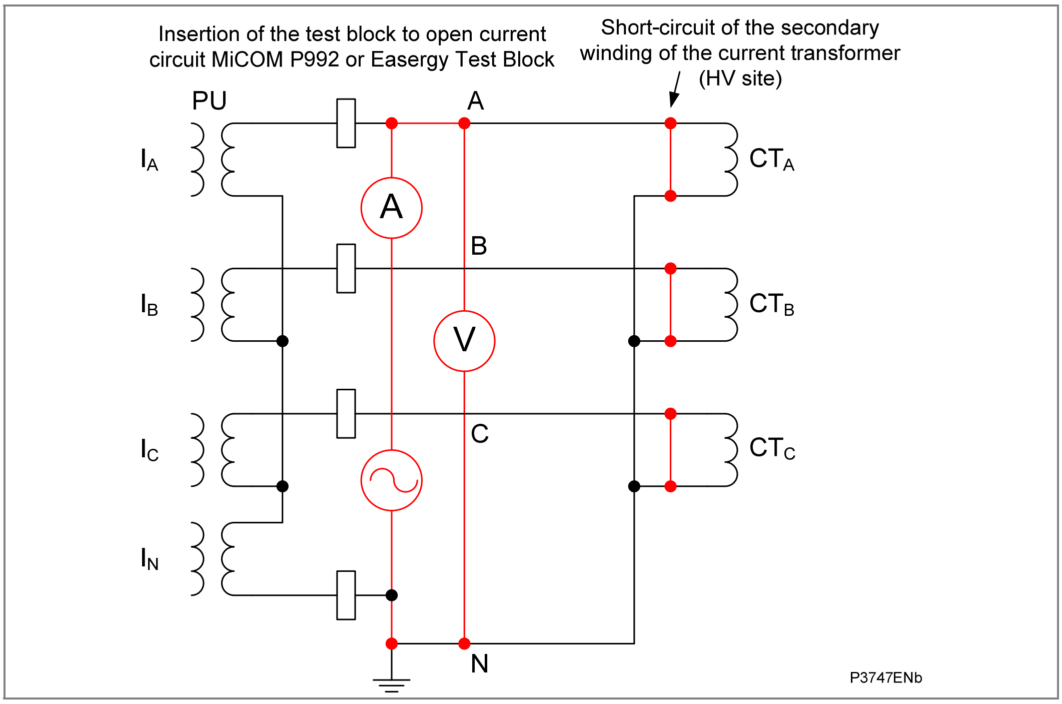


Figure 6 – Wiring

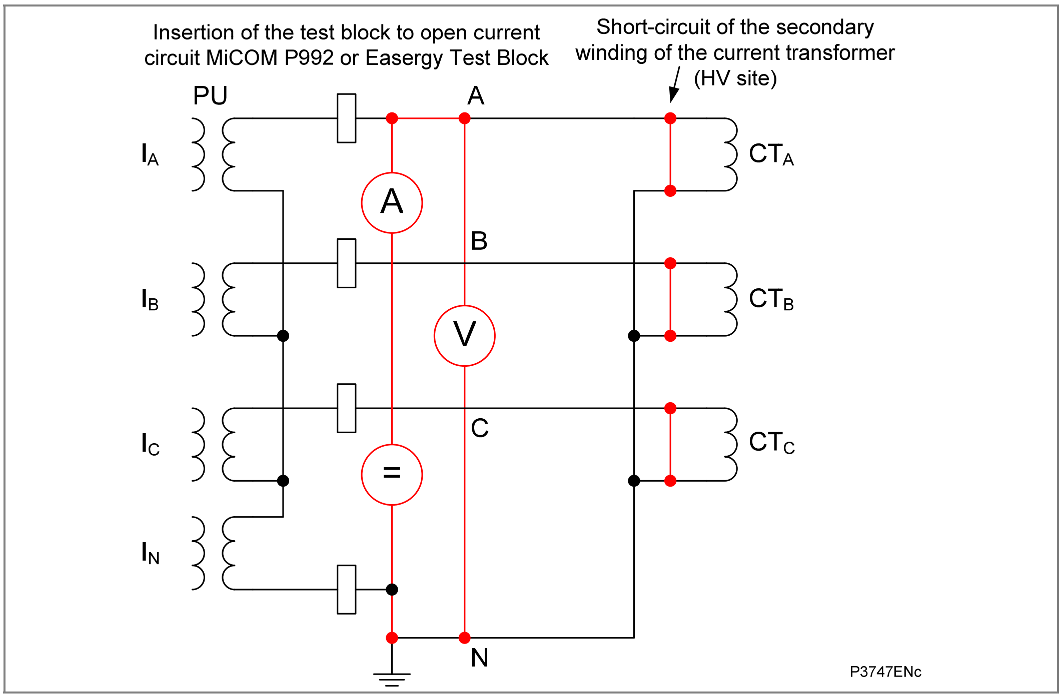
1. Short-circuit the secondary winding of the HV current transformer (see above)
2. Open the wiring by inserting a test block
3. Connect the current testing circuit of the test block (phase + neutral).
4. Inject a current (1A recommended) and measure the voltage at the resistive circuit terminals.
5. An Excel tool is available in order to help calculate the values below accurately.
6. Calculate the load resistance RB per phase using the following equation:

   RB = Umeasured / Iinjected

Repeat the above operation for each resistive circuit:

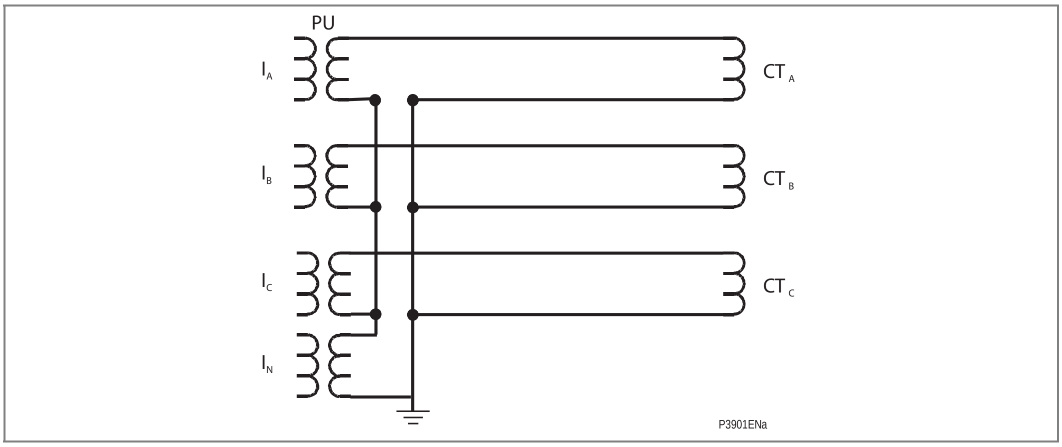
- RAN between loads A and N
- RBN between loads B and N
- RCN between loads C and N
- RAB between loads A et B

6.2.1 RBph / RBN is Close to 1



RBA = (RAB + RAN - RBN) / 2
RBN = RAN - RBA
RBB = RAB - RBA
RBC = RCN – RBN

6.2.2 RBPh / RBN is Close to 3



RBA = RAN / 2
RBB = RBN / 2
RBC = RCN / 2
RBN = (RBA + RBB + RBC) / 9

The highest of the 3 phase values must be multiplied by 1.25 (25% increase at a 75°C temperature) and set in cell [CT/TT Ratios, RB in ohms].

The average of the 3 phase values (RBA, RBB, RBC) should be divided by the neutral resistance, RBN, and set in cell [CT/TT Ratios, RBPh / RBN].

Note	*The use of the Excel spreadsheet tool called “LeadBurdenR” is strongly recommended to calculate these values.*

6.3 Demonstrate Correct Relay Operation

The purpose of these tests is as follows:

- To determine that the primary protection function of the relay, current differential, can trip according to the correct application settings.
- To verify correct setting of any backup phase/phase overcurrent protection.
- To verify correct assignment of the inputs, relays and trip contacts, by monitoring the response to a selection of fault injections.

6.3.1 Current Differential Bias Characteristic

To avoid spurious operation of any Overcurrent, earth fault or breaker fail elements, these should be disabled for the duration of the differential element tests. This is done in the relay’s CONFIGURATION column. Ensure that cells, [Overcurrent Prot], [Earth Fault Prot] and [CB Fail] are all set to “Disabled”. Make a note of which elements need to be re-enabled after testing.

6.3.1.1 Connect the Test Circuit

The following tests require an injection test set, able to feed the relay with one or two currents variable in phase and magnitude.

If only One Current is Available:
As shown in Figure 7, this method will be used for a distributed solution when only one peripheral unit is available.

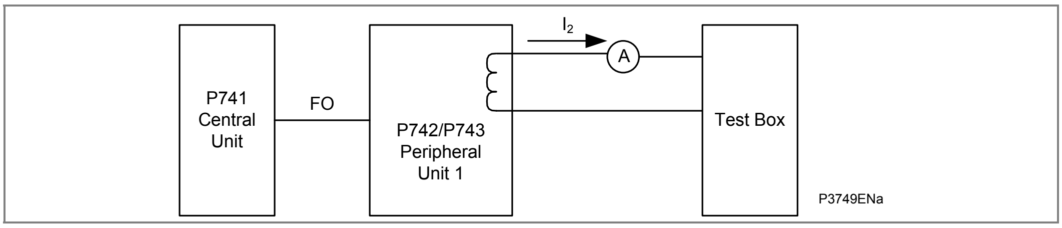
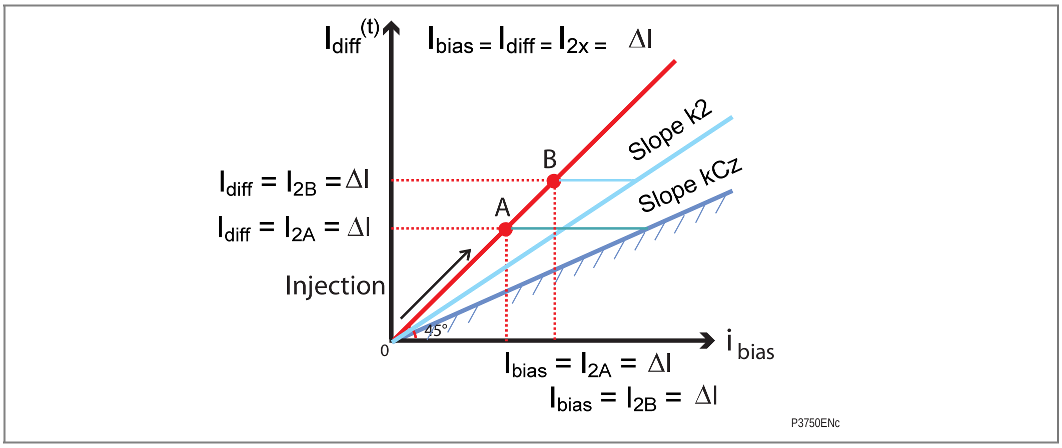


Figure 7 - Connection for bias characteristic testing



An increasing current I_2 is injected into a phase (and neutral) of the PU1 which is used as differential and bias current.

$I_{diff} = I_{bias} = I_2$

K2: Zone percentage bias, Characteristic limit: I_{diff} = ID>2

KCZ: Check Zone percentage bias, Characteristic limit: I_{diff} = IDCZ>2

In this case, we increase I_2 from 0 to A then B point until the differential element operates:

KCZ: Check Zone percentage bias, Characteristic limit: I_{diff} = IDCZ>2, point A

K2: Zone percentage bias, Characteristic limit: I_{diff} = ID>2, point B

When we reach the point A the Central Unit LED 8 and Relay 8 will operate and when we reach the point B the differential element will operate.

Note 1	*I_D>1 alarm timer will be set to 100s during the test.*
Note 2	*This test does not allow checking the slopes but only the thresholds.*

If Two Currents are Available:

This method will be preferred whenever possible.

Note	*The two PUs can have different ratios. This must be taken into account when injecting at the CT secondary side.*

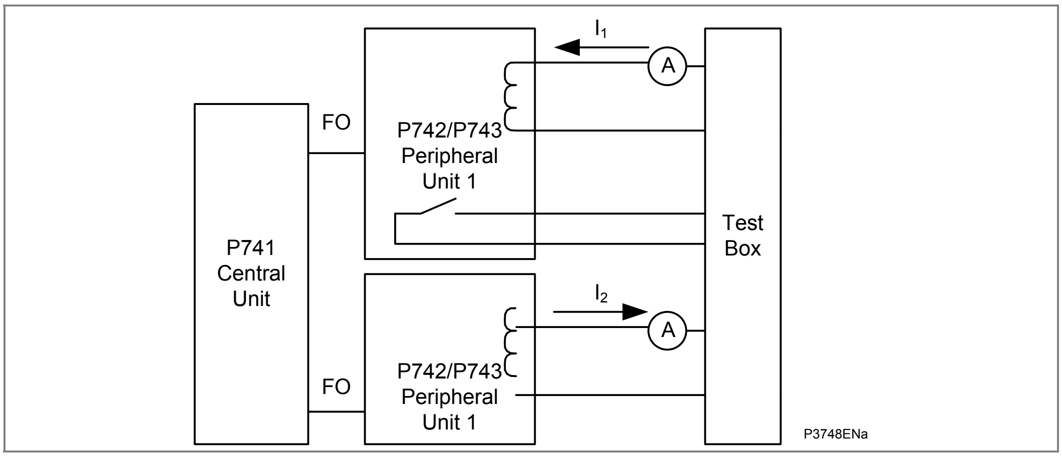
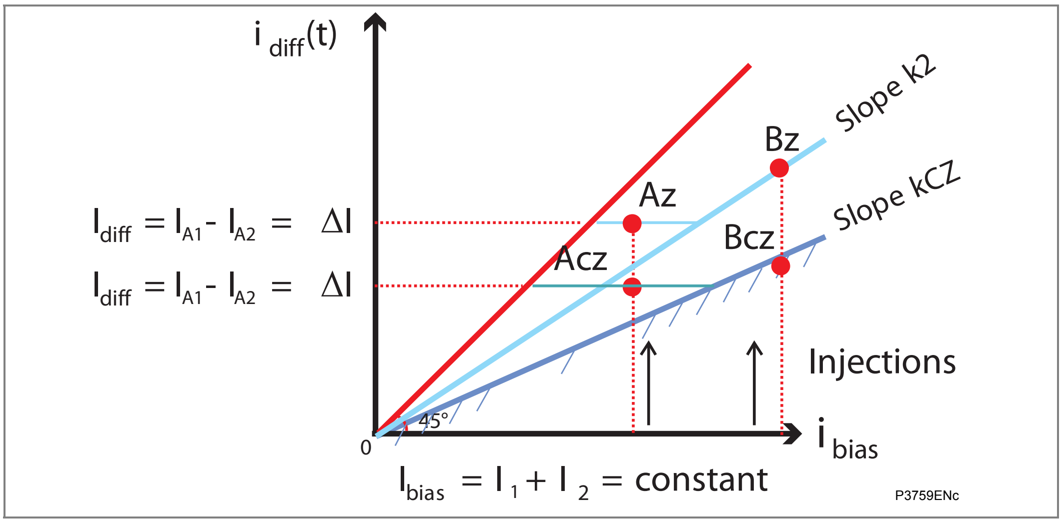


Figure 8 - Connection for bias characteristic testing – centralised solution



Note	*The easiest way to test the thresholds is to inject an increasing slope for I_1 and a decreasing slope for I_2. The $I_{bias} = I_1 + I_2$ is thus constant and $\Delta I = I_{diff} = I_2 - I_1$ is increasing.*

Important	**For the Check zone, the I_{bias} includes all the substation feeder currents.**

To Test the Thresholds:

I_{bias} is fixed to a lowest value of ID>2/k2 and IDCZ>2/kCZ, the Az and Acz points will thus be ID>2 and IDCZ>2. So $I_{bias} = I_1 + I_2$ = fixed value (Points A)

To Test the Slopes:

I_{bias} is fixed to a value greater than ID>2/k2 and IDCZ>2/kCZ the Bz and Bcz points will thus be I_{bias} x k2 and I_{bias} x kCZ. So $I_{bias} = I_1 + I_2$ = fixed value (Points B)

When we reach the point Xcz the Central Unit LED 8 and relay 8 will operate and when we reach the point Xz the differential element will operate.

To calculate the slope k, k = (I1 – I2) / (I1 + I2)

The differential current will increase twice the value ΔI.

Note 1	*ID>1 alarm timer will be set to 100s during the test.*
Note 2	*Whenever possible, inject 2 × ID>2. Alternatively, the minimum current must be higher than 1.7 × ID>2 at 60Hz and l.42 × ID>2 at 50Hz in order to ensure a 15ms tripping time.*

6.3.1.2 Slopes and Thresholds

If a LED has been assigned to display the trip information, these may be used to indicate correct operation. If not, monitor option will need to be used – see below:

- On P741 go Central Unit GROUP1-->BUSBAR PROTECT and set ID>1 Alarm timer to 100s.
- On P742/3 go to COMMISSION TESTS column in the menu, scroll down and change cells [Monitor Bit 1] to [BUSBAR_TRIPPING]. Doing so, cell [Test Port Status] will appropriately set or reset the bits that now represent BUSBAR_TRIPPING (with the rightmost bit representing Busbar Trip. From now on you should monitor the indication of [Test Port Status]. Make a note of which elements need to be re-enabled or re-set after testing.

Test of I_D>2:

I_D>1 Alarm Timer should be set to 100s during testing.

Inject a I_2 current smaller than I_D>2 and slowly increase I_2 until tripping.

Test of the operating time of the differential element:

Inject a I_2 current greater than twice I_D>2 threshold and measure the operating time of the differential element.

Test of I_D>1:

I_D>1 Alarm Timer should be set to 100ms.

Inject a I_2 current smaller than I_D>1 and slowly increase I_2 until circuit fault appears (LED Alarm of LED circuitry fault).

Test of I_D>1 Alarm Timer:

I_D>1 Alarm Timer should be set to 5s.

Inject a I2 current greater than twice the I_D>1 threshold and check that the Circuitry Fault Alarm is coming in 5s.

Note	*Same tests can be applied for the Differential Sensitive Earth Fault Protection.*

Note	*The Sensitive Differential Earth Fault (SDEF) is 20ms delayed and controlled by a settable threshold Ibias ph> to unblock/block the sensitive element depending of the restrain phase currents.*

Important	**Check that if the SDEF is enabled, all the CTs are of the same standard.**

6.3.2 Phase Overcurrent Protection (P742 and P743)

If the overcurrent protection function is being used, both I>1 and I>2 elements should be tested.

To avoid spurious operation of any current differential, earth fault, breaker fail or CT supervision elements, these should be disabled for the duration of the overcurrent tests. This is done in the relay's CONFIGURATION column. Make a note of which elements need to be re-enabled after testing.

6.3.2.1 Connect the Test Circuit

Determine which output relay has been selected to operate when an I>1 trip and an I>2 occur by viewing the relay's programmable scheme logic.

The programmable scheme logic can only be changed using the appropriate software. If this software has not been available then the default output relay allocations will still be applicable.

If the trip outputs are phase-segregated (i.e. a different output relay allocated for each phase), the relay assigned for tripping on 'A' phase faults should be used.

The associated terminal numbers can be found from the external connection diagram (Chapter P746/EN CO).

Connect the output relay so that its operation will trip the test set and stop the timer.

Connect the current output of the test set to the 'A' phase current transformer input of the relay.

Ensure that the timer will start when the current is applied to the relay.

Note	*If stage 1 is not mapped directly to an output relay in the PSL, output relay 1,2 or 3 could be used for the test as it operates for trip condition (phase A, B and C).*

Perform the Test

Ensure that the timer is reset.

Apply a current of twice the setting in cell [GROUP 1 OVERCURRENT, I>1 Current Set] to the relay and note the time displayed when the timer stops.

Check that the red trip LED has illuminated.

Check the Operating Time

Check that the operating time recorded by the timer is within the range shown in the following table.

Note	*Except for the definite time characteristic, the operating times given in the following table are for a time multiplier or time dial setting of 1. Therefore, to obtain the operating time at other time multiplier or time dial settings, the time given in the table must be multiplied by the setting of cell [GROUP 1 OVERCURRENT, I>1 TMS] for IEC and UK characteristics or cell [GROUP 1 OVERCURRENT, Time Dial] for IEEE and US characteristics.*

In addition, for definite time and inverse characteristics there is an additional delay of up to 0.02 second and 0.08 second respectively that may need to be added to the relay's acceptable range of operating times.

For all characteristics, allowance must be made for the accuracy of the test equipment being used.

Characteristic	Operating time at twice current setting and time multiplier/time dial setting of 1.0	
	Nominal (seconds)	**Range (seconds)**
DT	[: I>1 Time Delay] setting	Setting ±2%
IEC S Inverse	10.03	9.53 – 10.53
IEC V Inverse	13.50	12.83 – 14.18
IEC E Inverse	26.67	24.67 – 28.67
UK LT Inverse	120.00	114.00 – 126.00
IEEE M Inverse	0.64	0.61 – 0.67
IEEE V Inverse	1.42	1.35 – 1.50

Characteristic	Operating time at twice current setting and time multiplier/time dial setting of 1.0	
	Nominal (seconds)	Range (seconds)
IEEE E Inverse	1.46	1.39 – 1.54
US Inverse	0.46	0.44 – 0.49
US ST Inverse	0.26	0.25 – 0.28

Table 10 – Characteristic operating times for I>1

Perform the DT tests for the function I>2.
Upon completion of the tests any current differential, overcurrent, earth fault, breaker fail or supervision emements which were disabled for testing purposes must have their original settings restored in the CONFIGURATION column.

6.3.3 Breaker Failure Protection

6.3.3.1 Separate External 50BF Protection to the Busbar Protection

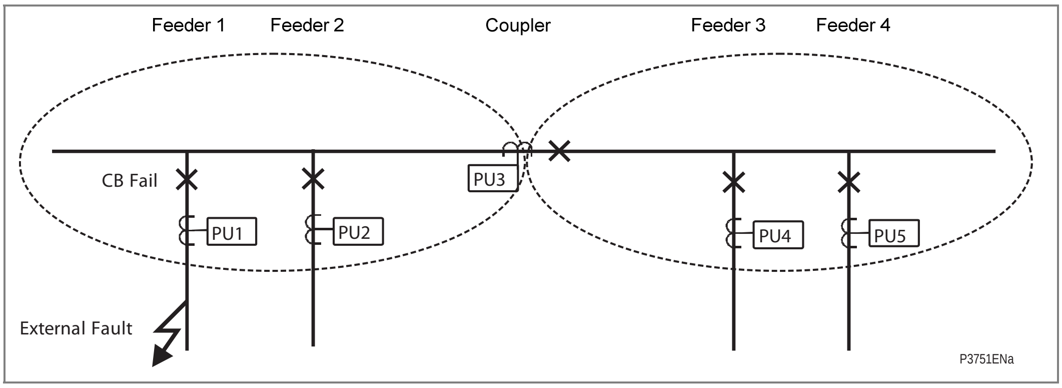


Figure 9 - Separate external 50BF protection to the busbar protection

For example as shown in the above diagram, we simulate a CB fail in feeder 1 (PU1). Therefore, we energise the opto input “External CB Fail” of the PU1 and we check that the central unit issues a tripping order to PU2 and PU3.

Note	*If the I>BB or IN>BB are enabled in menu “Busbar Trip Confirm” in Peripheral Unit, the CB fail trip command issued by the Central Unit will be confirmed by a measured phase currents or neutral currents greater than I>BB (Phase) or IN>BB (Earth).*

For example: PU2 and PU3 will operate only if the phase currents > I>BB else the local trip will be not confirmed.

The trip of the backup phase overcurrent or earth fault overcurrent protection initiates, as described above, the timers tBF3 and tBF4.

6.3.3.2 External Initiation of BF Protection

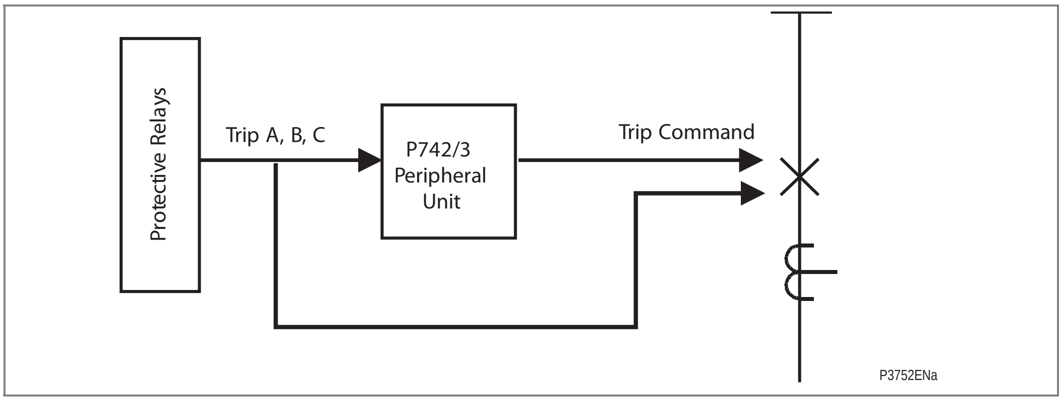


Figure 10 - External initiation of BF protection

To Test the Retrip:

As shown in the above figure, we initiate the opto inputs “External Trip A,B,C” and apply a current twice the I< threshold.

Check that the PU issue a retrip order after the settable time tBF3.

Important	**The time indicated on the PU LCD is the duration of the operation of this PU trip command.**

The fast reset retrip order is equal to the fault clearance time + 13ms – tBF3 pick-up time.

For example if tBF3 = 50ms and the fault is cleared after 60ms, the PU displayed value will be 23ms.

To Test the Backtrip:

Do the same tests as for retrip however apply a faulty current for more than tBF4 and check that the backtrip signal is sent.

Check that feeder 1 and feeder 2 connected to the bus-section 1 are tripped by the CU.

Note	*If the I>BB or IN>BB are enabled in menu “Busbar Trip Confirm” in Peripheral Unit, the CB fail trip command issued by the Central Unit will be confirmed by a measured phase currents or neutral currents greater than I>BB (Phase) or IN>BB (Earth).*

For example: PU2 and PU3 will operate only if the phase currents > I>BB else the local trip will be not confirmed.

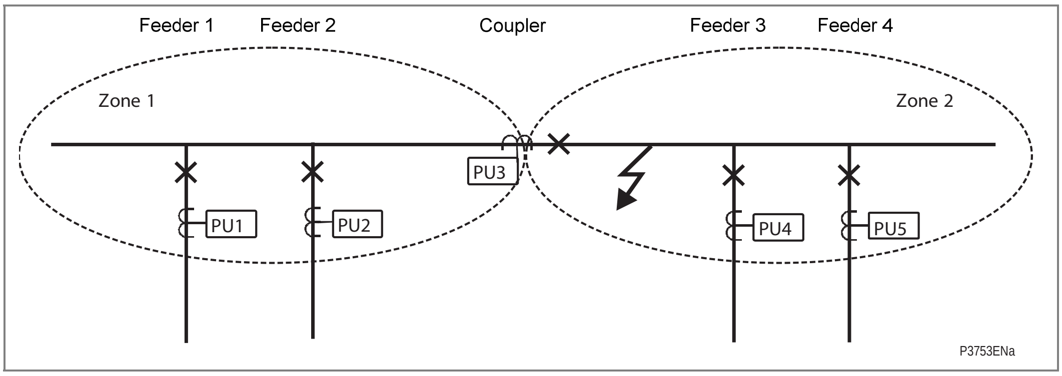


Figure 11 - CB unavailable

Apply an internal fault in zone 2 and energise the opto input of PU3 “CB unavailable” and check that both bus-section 1 tripped simultaneously.

Note	*If the input “CB unavailable” is energised, the CB will be not tripped and is normally used only for bus-coupler.*

Important	**The time indicated on the Cu Lcd is the duration of the operation of the CU trip order + 250ms (time of the PU to CU minimum duration signal information).**

The time indicated on a PU LCD is the duration of the operation of this PU backtrip command with 200ms drop off.

The backtrip order is equal to (the maximum between the fault clearance time and 250 ms) –tBF4 pick-up time.

For example if tBF4 = 200ms and the fault is cleared before 450ms, the CU displayed value will be 450ms and the PU displayed value will be 650ms.

For example if tBF4 = 200ms and the fault is cleared in 500ms, the CU displayed value will be 500ms and the PU displayed value will be 700ms.

6.3.3.3 Internal Initiation Breaker Failure Protection

This Breaker failure Protection can be initiated only by a trip command issued by the Central Unit.

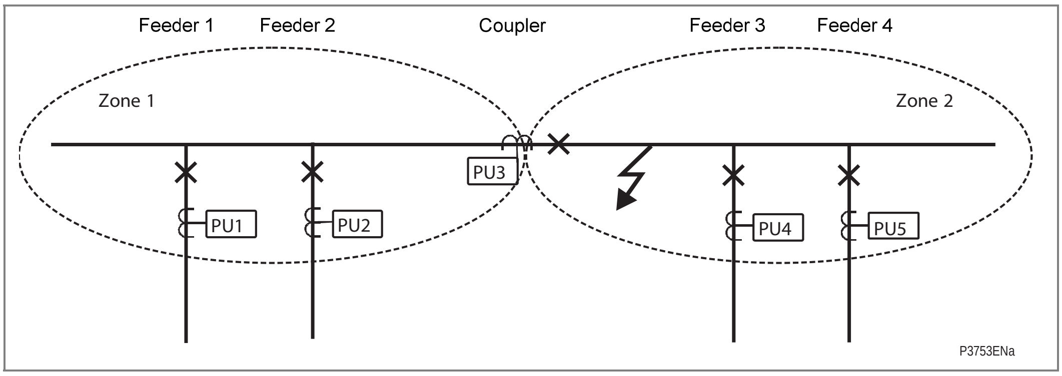


Figure 12 - Internal initiation of BF protection

Simulate a busbar fault on the bus-section 2.

Continue to apply fault current in the bus-coupler until the timer tBF1 elapsed. Check that the retrip signal is given by PU3 and backtrip signal is sent after tBF2.

Check that the CU issued a trip command to both bus-sections (PU1, PU2 PU4 and PU5 should have operated).

Important	**The time indicated on the CU LCD is the duration of the operation of the CU trip order + 250ms (time of the PU to CU minimum duration signal information).**

The time indicated on a PU LCD is the duration of the operation of this PU backtrip command with 200ms drop off.

The backtrip order is equal to (the maximum between the fault clearance time and 250 ms) –tBF2 pick-up time.

For example if tBF2 = 150ms and the fault is cleared before 400ms, the displayed value will be 400ms.

For example if tBF2 = 150ms and the fault is cleared in 500ms, the displayed value will be 500ms.

6.4 Check Application Settings

Carefully check applied settings against the required application-specific settings to ensure they have been entered correctly. However, this is not considered essential if a customer-prepared setting file on a memory device has been transferred to the relay using a portable PC.

There are two methods of checking the settings:

- Extract the settings from the relay using a portable PC running the appropriate software (MiCOM S1 Studio) using the front EIA(RS)232 port, under the bottom access cover, or the first rear communications port (Courier protocol with a KITZ protocol converter connected), or the second rear communications port. Compare the settings transferred from the relay with the original written application-specific setting record (for cases where the customer has only provided a printed copy of the required settings but a portable PC is available).
- Step through the settings using the relay's operator interface and compare them with the original application-specific setting record.

Unless previously agreed to the contrary, the application-specific PSL is not checked as part of the commissioning tests.

Due to the versatility and possible complexity of the PSL, it is beyond the scope of these commissioning instructions to detail suitable test procedures. Therefore, when PSL tests must be performed, written tests that satisfactorily demonstrate the correct operation of the application-specific scheme logic should be devised by the engineer who created it. These tests should be provided to the Commissioning Engineer with the memory device containing the PSL setting file.

7 END-TO-END TESTS

Verify communications between Peripheral units (P742 or P743) and Central Unit (P741) - Advisable for distributed scheme.

The following communication checks confirm that the optical power at the transmit and receive ports of the Peripheral Units and the Central Unit are within the recommended operating limits.

Measure and record the optical signal strength received by the Peripheral Unit (P742 or P743) by disconnecting the optical fibre from the Channel 1 receive port and connecting it to an optical power meter. The mean level should be in the range − 16.8 dBm to −25.4dBm. If the mean level is outside of this range check the size and type of fibre being used.

Caution	**When connecting or disconnecting optical fibres care should be taken not to look directly into the transmit port or end of the optical fibre.**

Measure and record the optical power of the Channel 1 transmit port using the optical power meter and length of optical fibre. The mean value should be in the range -16.8dBm to -22.8dBm.

Ensure that all transmit (Tx) and receive (Rx) optical fibres between Peripheral Unit and Central Unit are reconnected, ensuring correct placement.

Reset any alarm indications and check that no further communications failure alarms are raised.

8 ON-LOAD CHECKS

The objectives of the on-load checks are to:

- Confirm the external wiring to the current inputs is correct.
- Ensure the on-load differential current is well below the relay setting.

However, these checks can only be carried out if there are no restrictions preventing the energisation of the plant being protected and the other P746 relays in the group have been commissioned.

Caution	**Remove all test leads and temporary shorting leads, and replace any external wiring that was removed to allow testing.**

Caution	**If any of the external wiring was disconnected from the relay to run any tests, make sure that all connections are restored according to the external connection or scheme diagram.**

8.1 Current Transformer Connections

Caution	**Measure the current transformer secondary values for each input using a multimeter connected in series with corresponding relay current input.**

Check that the current transformer polarities are correct by measuring the phase angle between the current and voltage, either against a phase meter already installed on site and known to be correct or by determining the direction of power flow by contacting the system control center.

Caution	**Ensure the current flowing in the neutral circuit of the current transformers is negligible.**

Compare the values of the secondary phase currents (and any phase angle) with the relay's measured values, which can be found in the **MEASUREMENTS 1** menu column.

Note	*Under normal load conditions the earth fault function measures little or no current. It is therefore necessary to simulate a phase-to-neutral fault. This can be achieved by temporarily disconnecting one or two of the line current transformer connections to the relay and shorting the terminals of these current transformer secondary windings.*

If cell [0D02: MEASURE'T SETUP, Local Values] is set to **Secondary**, the current displayed on the relay LCD or a portable PC connected to the front EIA(RS)232 communication port should be equal to the applied secondary current. The values should be within 1% (5% for the P741/P742/P743/P746) of the applied secondary currents. However, an additional allowance must be made for the accuracy of the test equipment being used.

If cell [0D02: MEASURE'T SETUP, Local Values] is set to **Primary**, the current displayed should be equal to the applied secondary current multiplied by the corresponding current transformer ratio set in the **CT & VT RATIOS** menu column (see the *Measured Voltages and VT Ratio Settings* table). Again the values should be within 10% (1% for the P34x, 5% for the P741/P742/P743/P746) of the expected value, plus an additional allowance for the accuracy of the test equipment being used.

Note	*If the relay is applied with a single dedicated current transformer for the earth fault function, it may not be possible to check the relay's measured values as the neutral current will be almost zero.*

9 FINAL CHECKS

The tests are now complete.

Caution	**Remove all test or temporary shorting leads. If it has been necessary to disconnect any of the external wiring from the relay to perform the wiring verification tests, make sure all connections are replaced according to the relevant external connection or scheme diagram.**

Ensure that the relay is restored to service by checking that cell [0F0F: COMMISSIONING TESTS, Test Mode] and [0F12: COMMISSION TESTS, Static Test] are set to '**Disabled**' (0F0D (not 0F0F) for P14x/P24x/P34x/P341/P44y/P54x/P841).

If the menu language was changed to allow accurate testing, it must now be restored to the customer's preferred language.

If a MiCOM P991 or Easergy test block is installed, remove the MiCOM P992 or Easergy test plug and replace the test block cover so that the protection is put into service.

Ensure that all event records, fault records, disturbance records, alarms and LEDs have been reset before leaving the relay.

If applicable, replace the secondary front cover on the relay.

Notes:

TEST AND SETTING RECORDS

CHAPTER 12

Date:	02/2017
Products covered by this chapter:	This chapter covers the specific versions of the MiCOM products listed below. This includes ***only*** the following combinations of Software Version and Hardware Suffix.
Hardware Suffix:	L (P742) & M (P741 & P743)
Software Version:	B1 - P74x (P741, P742 & P743)
Connection Diagrams:	10P740xx (xx = 01 to 07)

CONTENTS

Notes:

1 TEST RECORD FOR CENTRAL UNIT P741

1.1 Date

Date:		Engineer:	
Station:		Circuit:	
		System Frequency:	……… Hz
VT Ratio:	……… / ……… V	CT Ratio (tap in use):	……… /A

1.2 Front Plate Information for P741

Relay type	MiCOM P…………
Model number	
Serial number	
Rated current In	
Rated voltage Vn	
Auxiliary voltage Vx	

1.3 Test Equipment Used for P741

This section should be completed to allow future identification of protective devices that have been commissioned using equipment that is later found to be defective or incompatible but may not be detected during the commissioning procedure.

Overcurrent test set	Model: Serial No:	
Injection test set	Model: Serial No:	
Phase angle meter	Model: Serial No:	
Phase rotation meter	Model: Serial No:	
Optical power meter	Model: Serial No:	
Insulation tester	Model: Serial No:	
Setting software:	Type: Version:	

1.4 Checklist for P741

Have all relevant safety instructions been followed?	Yes ☐ No ☐

In the followingComplete or delete as appropriate (na = Not Applicable, nm = Not Measured)

4.1	With the relay de-energised							
4.1.1	Visual inspection							
	Relay damaged?		Yes	☐	No	☐		
	Rating information correct for installation?		Yes	☐	No	☐		
	Case earth installed?		Yes	☐	No	☐		
4.1.2	Current transformer shorting contacts close?		Yes	☐	No	☐	Not checked	☐
4.1.3	Insulation resistance >100MΩ at 500V dc		Yes	☐	No	☐	Not tested	☐
4.1.4	External Wiring (na = not applicable)							
	Wiring checked against diagram?		Yes	☐	No	☐		
	Test block connections checked?		Yes	☐	No	☐	N/A	☐
4.1.5	Watchdog Contacts (auxiliary supply off)							
	Terminals 11 and 12	Contact closed? Contact resistance	Yes	☐ Ω	No Not measured	☐ ☐		
	Terminals 13 and 14	Contact open?	Yes	☐	No	☐		
4.1.6	Measured auxiliary supply		V ac/dc					
4.2	With the relay energised							
4.2.1	Watchdog Contacts (auxiliary supply on)							
	Terminals 11 and 12	Contact open?	Yes	☐	No	☐		
	Terminals 13 and 14	Contact closed?	Yes	☐	No	☐		
	Contact resistance		Yes	☐ Ω	No Not measured	☐ ☐		
4.2.2	Date and time							
	Clock set to local time?		Yes	☐	No	☐		
	Time maintained when auxiliary supply removed?		Yes	☐	No	☐		
4.2.3	Light emitting diodes							
4.2.3.1	Alarm (yellow) LED working?		Yes	☐	No	☐		
	Out of service (yellow) LED working?		Yes	☐	No	☐		
4.2.3.2	Trip (red) LED working?		Yes	☐	No	☐		
4.2.3.3	All 8 programmable LED’s working?		Yes	☐	No	☐		

4.2.4	Field supply voltage	
	Value measured between terminals E7 and E9 (P742) or G7 and G9 (P743)	V dc
	Value measured between terminals E8 and E10 (P742) or G8 and G10 (P743)	V dc

4.2.5	Input opto-isolators:							
	Opto input 2 working?	Yes	☐	No	☐		
	Opto input 3 working?	Yes	☐	No	☐		
	Opto input 4 working?	Yes	☐	No	☐		
	Opto input 5 working?	Yes	☐	No	☐		
	Opto input 6 working?	Yes	☐	No	☐		
	Opto input 7 working?	Yes	☐	No	☐		
	Opto input 8 working?	Yes	☐	No	☐		
For P742	Opto input 9 working?	Yes	☐	No	☐	N/A	☐
	Opto input 10 working?	Yes	☐	No	☐	N/A	☐
	Opto input 11 working?	Yes	☐	No	☐	N/A	☐
	Opto input 12 working?	Yes	☐	No	☐	N/A	☐
	Opto input 13 working?	Yes	☐	No	☐	N/A	☐
	Opto input 14 working?	Yes	☐	No	☐	N/A	☐
	Opto input 15 working?	Yes	☐	No	☐	N/A	☐
	Opto input 16 working?	Yes	☐	No	☐	N/A	☐
For P743	Opto input 17 working?	Yes	☐	No	☐	N/A	☐
	Opto input 18 working?	Yes	☐	No	☐	N/A	☐
	Opto input 19 working?	Yes	☐	No	☐	N/A	☐
	Opto input 20 working?	Yes	☐	No	☐	N/A	☐
	Opto input 21 working?	Yes	☐	No	☐	N/A	☐
	Opto input 22 working?	Yes	☐	No	☐	N/A	☐
	Opto input 23 working?	Yes	☐	No	☐	N/A	☐
	Opto input 24 working?	Yes	☐	No	☐	N/A	☐

4.2.6	Output relays:			
	Relay 1	Working? Contact resistance		Yes ☐ No ☐ Ω Not measured ☐
	Relay 2	Working? Contact resistance		Yes ☐ No ☐ Ω Not measured ☐
	Relay 3	Working? Contact resistance		Yes ☐ No ☐ Ω Not measured ☐
	Relay 4	Working? Contact resistance		Yes ☐ No ☐ Ω Not measured ☐
	Relay 5	Working? Contact resistance		Yes ☐ No ☐ Ω Not measured ☐

	Relay 6	Working? Contact resistance		Yes ☐ No ☐ Ω Not measured ☐
	Relay 7	Working? Contact resistance	 (N/O) (N/C)	Yes ☐ No ☐ Ω ☐ Not measured ☐ Ω ☐ Not measured ☐ Not Available ☐
	Relay 8	Working? Contact resistance	 (N/O) (N/C)	Yes ☐ No ☐ Ω ☐ Not measured ☐ Ω ☐ Not measured ☐ Not Available ☐
	Relay 9	Working? Contact resistance		Yes ☐ No ☐ Ω Not measured ☐
	Relay 10	Working? Contact resistance		Yes ☐ No ☐ Ω Not measured ☐
	Relay 11	Working? Contact resistance	 (N/O) (N/C)	Yes ☐ No ☐ Ω ☐ Not measured ☐ Ω ☐ Not measured ☐ Not Available ☐
	Relay 12	Working? Contact resistance	 (N/O) (N/C)	Yes ☐ No ☐ Ω ☐ Not measured ☐ Ω ☐ Not measured ☐ Not Available ☐
	Relay 13	Working? Contact resistance		Yes ☐ No ☐ Ω Not measured ☐
	Relay 14	Working? Contact resistance		Yes ☐ No ☐ Ω Not measured ☐
	Relay 15	Working? Contact resistance	 (N/O) (N/C)	Yes ☐ No ☐ Ω ☐ Not measured ☐ Ω ☐ Not measured ☐ Not Available ☐
	Relay 16	Working? Contact resistance	 (N/O) (N/C)	Yes ☐ No ☐ Ω ☐ Not measured ☐ Ω ☐ Not measured ☐ Not Available ☐
	Relay 17	Working? Contact resistance		Yes ☐ No ☐ Ω Not measured ☐
	Relay 18	Working? Contact resistance		Yes ☐ No ☐ Ω Not measured ☐
	Relay 19	Working? Contact resistance	 (N/O) (N/C)	Yes ☐ No ☐ Ω ☐ Not measured ☐ Ω ☐ Not measured ☐ Not Available ☐
	Relay 20	Working? Contact resistance	 (N/O) (N/C)	Yes ☐ No ☐ Ω ☐ Not measured ☐ Ω ☐ Not measured ☐ Not Available ☐

4.2.7	Current Inputs		
	Displayed Current Phase CT Ratio (na = not applicable)		Primary/Secondary / na
		Applied value	Displayed value
	IA	A	A
	IB	A	A
	IC	A	A
	IN	A	A

5.	Setting Checks						
5.1	Application-specific function settings applied?	Yes	☐	No	☐		
	Application-specific programmable scheme logic settings applied	Yes	☐	No	☐	n/a	☐
5.2.1.2	Current Differential lower slope pickup	A					
5.2.1.3	Current Differential upper slope pickup	A					
5.2.5	Protection function timing tested?	Yes	☐	No	☐		
	Applied current	A					
	Expected operating time	s					
	Measured operating time	s					
5.4	Application-specific function settings verified?	Yes	☐	No	☐	n/a	☐
	Application-specific programmable scheme logic tested?	Yes	☐	No	☐	n/a	☐
	Signal strength received by P742/3						
	Channel 1	dBm /	☐na				
	Signal strength transmitted by 742/3						
	Channel 1	dBm /	☐na				
	Signal Strength within tolerance	Yes	☐	No	☐	n/a	☐
	Optical fibres reconnected?						
	Channel RX and TX	Yes	☐	No	☐		
	Alarms reset?	Yes	☐	No	☐		

6.	EIA(RS)232 InterMiCOM						
Not for P742	What was loopback mode setting?	Int Ext					
	Amber alarm LED illuminated?	Yes No					
	Did ‘IM loopback’ appear on LCD?	Yes No					
	Did ‘loopback status’ indicate ‘OK’?	Yes No					
	Did any other unexpected alarm appear?	Yes No					
	Enter applied test pattern’						
	Enter observed ‘IM output pattern’						
	‘Data CD status’ change from ‘OK’ to ‘FAIL’ upon pin 1 disconnection?	Yes	☐	No	☐	n/a	☐
	‘FrameSync status’ change from ‘OK’ to ‘FAIL’ upon pin 2-3 disconnection?	Yes	☐	No	☐	n/a	☐
	‘Message status’ change from ‘OK’ to ‘FAIL’ upon pin 2-3 disconnection?	Yes	☐	No	☐	n/a	☐
	‘Channel status’ change from ‘OK’ to ‘FAIL’ upon pin 2-3 disconnection?	Yes	☐	No	☐	n/a	☐
	Did ‘IM H/W status’ remain ‘OK’ throughout the loopback testing?	Yes	☐	No	☐		
	Did amber LED and ‘IM loopback’ LCD alarm and ‘loopback status = OK’ clear on disabling the loopback mode?	Yes	☐	No	☐		

	Enter Rx direct count	n/a ☐
	Enter Rx perm count	n/a ☐
	Enter Rx block count	n/a ☐
	Enter Rx NewData count	
	Enter Rx errored count	
	Enter lost messages reading	(%)
	Was loopback test successful and in accordance to Commissioning section 6.3.3 ?	Yes ☐ No ☐
	Was reverting to service condition successful and in accordance to Commissioning section 6.3.3?	Yes ☐ No ☐

7.	On-load Checks	
	Test wiring removed? Disturbed customer wiring re-checked?	Yes ☐ No ☐ n/a ☐ Yes ☐ No ☐ n/a ☐

7.1	Confirm current transformer wiring	

7.1.2	Current connections		
	CT wiring checked?	Yes ☐ No ☐ n/a ☐	
	CT polarities correct?	Yes ☐ No ☐	
	Displayed current	Primary / Secondary	
	Phase CT ratio	/ na	
	Currents:	Applied value	Displayed value
	IA	A	A
	IB	A	A
	IC	A	A
	IN	A n/a ☐	A n/a ☐

7.3	Differential current	
	Differential current checked?	Yes ☐ No ☐

8.	Final Checks	
	Test wiring removed?	Yes ☐ No ☐ n/a ☐
	Disturbed customer wiring re-checked?	Yes ☐ No ☐ n/a ☐
	Test mode disabled?	Yes ☐ No ☐
	Circuit breaker operations counter reset?	Yes ☐ No ☐ n/a ☐
	Current counters reset?	Yes ☐ No ☐ n/a ☐
	Event records reset?	Yes ☐ No ☐
	Fault records reset?	Yes ☐ No ☐
	Disturbance records reset?	Yes ☐ No ☐
	Alarms reset?	Yes ☐ No ☐
	LED’s reset?	Yes ☐ No ☐
	Secondary front cover replaced?	Yes ☐ No ☐ n/a ☐

1.5 Engineer Details for P741

Commissioning Engineer	Customer Witness
Date:	Date:

2 TEST RECORD FOR PERIPHERAL UNITS: P742/P743

2.1 Date

Date:		Engineer:	
Station:		Circuit:	
		System Frequency:	……… Hz
VT Ratio:	……… / ……… V	CT Ratio (tap in use):	……… /A

2.2 Front Plate Information for P742/P743

Relay type	MiCOM P…………
Model number	
Serial number	
Rated current In	
Rated voltage Vn	
Auxiliary voltage Vx	

2.3 Test Equipment Used for P742/P743

This section should be completed to allow future identification of protective devices that have been commissioned using equipment that is later found to be defective or incompatible but may not be detected during the commissioning procedure.

Overcurrent test set	Model: Serial No:	
Injection test set	Model: Serial No:	
Phase angle meter	Model: Serial No:	
Phase rotation meter	Model: Serial No:	
Optical power meter	Model: Serial No:	
Insulation tester	Model: Serial No:	
Setting software:	Type: Version:	

2.4 Checklist for P742/P743

	Have all relevant safety instructions been followed?	Yes ☐ No ☐

In the following Complete or delete as appropriate (na = Not Applicable, nm = Not Measured)

4.1	With the relay de-energised	
4.1.1	Visual inspection	
	Relay damaged?	Yes ☐ No ☐
	Rating information correct for installation?	Yes ☐ No ☐
	Case earth installed?	Yes ☐ No ☐

4.1.2	Current transformer shorting contacts close?	Yes ☐ No ☐ Not checked ☐

4.1.3	Insulation resistance >100MΩ at 500V dc	Yes ☐ No ☐ Not tested ☐

4.1.4	External Wiring (na = not applicable)	
	Wiring checked against diagram?	Yes ☐ No ☐
	Test block connections checked?	Yes ☐ No ☐ N/A ☐

4.1.5	Watchdog Contacts (auxiliary supply off)		
	Terminals 11 and 12	Contact closed? Contact resistance	Yes ☐ No ☐ Ω Not measured ☐
	Terminals 13 and 14	Contact open?	Yes ☐ No ☐

4.1.6	Measured auxiliary supply	V ac/dc

4.2	With the relay energised	

4.2.1	Watchdog Contacts (auxiliary supply on)		
	Terminals 11 and 12	Contact open?	Yes ☐ No ☐
	Terminals 13 and 14	Contact closed?	Yes ☐ No ☐
	Contact resistance		Yes ☐ No ☐ Ω Not measured ☐

4.2.2	Date and time	
	Clock set to local time?	Yes ☐ No ☐
	Time maintained when auxiliary supply removed?	Yes ☐ No ☐

4.2.3	Light emitting diodes	
4.2.3.1	Alarm (yellow) LED working?	Yes ☐ No ☐
	Out of service (yellow) LED working?	Yes ☐ No ☐
4.2.3.2	Trip (red) LED working?	Yes ☐ No ☐
4.2.3.3	All 8 programmable LED’s working?	Yes ☐ No ☐

4.2.4	Field supply voltage	
	Value measured between terminals E7 and E9 (P742) or G7 and G9 (P743)	V dc
	Value measured between terminals E8 and E10 (P742) or G8 and G10 (P743)	V dc

4.2.5	Input opto-isolators:						
	Opto input 2 working?	Yes	☐	No	☐		
	Opto input 3 working?	Yes	☐	No	☐		
	Opto input 4 working?	Yes	☐	No	☐		
	Opto input 5 working?	Yes	☐	No	☐		
	Opto input 6 working?	Yes	☐	No	☐		
	Opto input 7 working?	Yes	☐	No	☐		
	Opto input 8 working?	Yes	☐	No	☐		
For P742	Opto input 9 working?	Yes	☐	No	☐	N/A	☐
	Opto input 10 working?	Yes	☐	No	☐	N/A	☐
	Opto input 11 working?	Yes	☐	No	☐	N/A	☐
	Opto input 12 working?	Yes	☐	No	☐	N/A	☐
	Opto input 13 working?	Yes	☐	No	☐	N/A	☐
	Opto input 14 working?	Yes	☐	No	☐	N/A	☐
	Opto input 15 working?	Yes	☐	No	☐	N/A	☐
	Opto input 16 working?	Yes	☐	No	☐	N/A	☐
For P743	Opto input 17 working?	Yes	☐	No	☐	N/A	☐
	Opto input 18 working?	Yes	☐	No	☐	N/A	☐
	Opto input 19 working?	Yes	☐	No	☐	N/A	☐
	Opto input 20 working?	Yes	☐	No	☐	N/A	☐
	Opto input 21 working?	Yes	☐	No	☐	N/A	☐
	Opto input 22 working?	Yes	☐	No	☐	N/A	☐
	Opto input 23 working?	Yes	☐	No	☐	N/A	☐
	Opto input 24 working?	Yes	☐	No	☐	N/A	☐

4.2.6	Output relays:			
	Relay 1	Working? Contact resistance		Yes ☐ No ☐ Ω Not measured ☐
	Relay 2	Working? Contact resistance		Yes ☐ No ☐ Ω Not measured ☐
	Relay 3	Working? Contact resistance		Yes ☐ No ☐ Ω Not measured ☐
	Relay 4	Working? Contact resistance		Yes ☐ No ☐ Ω Not measured ☐
	Relay 5	Working? Contact resistance		Yes ☐ No ☐ Ω Not measured ☐
	Relay 6	Working? Contact resistance		Yes ☐ No ☐ Ω Not measured ☐
	Relay 7	Working? Contact resistance	 (N/O) (N/C)	Yes ☐ No ☐ Ω ☐ Not measured ☐ Ω ☐ Not measured ☐ Not Available ☐
	Relay 8	Working? Contact resistance	 (N/O) (N/C)	Yes ☐ No ☐ Ω ☐ Not measured ☐ Ω ☐ Not measured ☐ Not Available ☐
	Relay 9	Working? Contact resistance		Yes ☐ No ☐ Ω Not measured ☐
	Relay 10	Working? Contact resistance		Yes ☐ No ☐ Ω Not measured ☐
	Relay 11	Working? Contact resistance	 (N/O) (N/C)	Yes ☐ No ☐ Ω ☐ Not measured ☐ Ω ☐ Not measured ☐ Not Available ☐
	Relay 12	Working? Contact resistance	 (N/O) (N/C)	Yes ☐ No ☐ Ω ☐ Not measured ☐ Ω ☐ Not measured ☐ Not Available ☐
	Relay 13	Working? Contact resistance		Yes ☐ No ☐ Ω Not measured ☐
	Relay 14	Working? Contact resistance		Yes ☐ No ☐ Ω Not measured ☐
	Relay 15	Working? Contact resistance	 (N/O) (N/C)	Yes ☐ No ☐ Ω ☐ Not measured ☐ Ω ☐ Not measured ☐ Not Available ☐
	Relay 16	Working? Contact resistance	 (N/O) (N/C)	Yes ☐ No ☐ Ω ☐ Not measured ☐ Ω ☐ Not measured ☐ Not Available ☐
	Relay 17	Working? Contact resistance		Yes ☐ No ☐ Ω Not measured ☐
	Relay 18	Working? Contact resistance		Yes ☐ No ☐ Ω Not measured ☐
	Relay 19	Working? Contact resistance	 (N/O) (N/C)	Yes ☐ No ☐ Ω ☐ Not measured ☐ Ω ☐ Not measured ☐ Not Available ☐
	Relay 20	Working? Contact resistance	 (N/O) (N/C)	Yes ☐ No ☐ Ω ☐ Not measured ☐ Ω ☐ Not measured ☐ Not Available ☐

4.2.7	Current Inputs		
	Displayed Current Phase CT Ratio (na = not applicable)		Primary/Secondary / na
		Applied value	Displayed value
	IA	A	A
	IB	A	A
	IC	A	A
	IN	A	A

5.	Setting Checks						
5.1	Application-specific function settings applied?	Yes	☐	No	☐		
	Application-specific programmable scheme logic settings applied	Yes	☐	No	☐	n/a	☐
5.2.1.2	Current Differential lower slope pickup	A					
5.2.1.3	Current Differential upper slope pickup	A					
5.2.5	Protection function timing tested?	Yes	☐	No	☐		
	Applied current	A					
	Expected operating time	s					
	Measured operating time	s					
5.4	Application-specific function settings verified?	Yes	☐	No	☐	n/a	☐
	Application-specific programmable scheme logic tested?	Yes	☐	No	☐	n/a	☐
	Signal strength received by P742/3						
	Channel 1	dBm /	☐na				
	Signal strength transmitted by 742/3						
	Channel 1	dBm /	☐na				
	Signal Strength within tolerance	Yes	☐	No	☐	n/a	☐
	Optical fibres reconnected?						
	Channel RX and TX	Yes	☐	No	☐		
	Alarms reset?	Yes	☐	No	☐		

6.	EIA(RS)232 InterMiCOM						
Not for P742	What was loopback mode setting?	Int Ext					
	Amber alarm LED illuminated?	Yes No					
	Did 'IM loopback' appear on LCD?	Yes No					
	Did 'loopback status' indicate 'OK'?	Yes No					
	Did any other unexpected alarm appear?	Yes No					
	Enter applied test pattern'						
	Enter observed 'IM output pattern'						
	'Data CD status' change from 'OK' to 'FAIL' upon pin 1 disconnection?	Yes	☐	No	☐	n/a	☐
	'FrameSync status' change from 'OK' to 'FAIL' upon pin 2-3 disconnection?	Yes	☐	No	☐	n/a	☐
	'Message status' change from 'OK' to 'FAIL' upon pin 2-3 disconnection?	Yes	☐	No	☐	n/a	☐
	'Channel status' change from 'OK' to 'FAIL' upon pin 2-3 disconnection?	Yes	☐	No	☐	n/a	☐
	Did 'IM H/W status' remain 'OK' throughout the loopback testing?	Yes	☐	No	☐		
	Did amber LED and 'IM loopback' LCD alarm and 'loopback status = OK' clear on disabling the loopback mode?	Yes	☐	No	☐		
	Enter Rx direct count	n/a ☐					
	Enter Rx perm count	n/a ☐					
	Enter Rx block count	n/a ☐					
	Enter Rx NewData count						
	Enter Rx errored count						
	Enter lost messages reading	(%)					
	Was loopback test successful and in accordance to Commissioning section 6.3.3 ?	Yes	☐	No	☐		
	Was reverting to service condition successful and in accordance to Commissioning section 6.3.3?	Yes	☐	No	☐		

7.	On-load Checks						
	Test wiring removed? Disturbed customer wiring re-checked?	Yes Yes	☐ ☐	No No	☐ ☐	n/a n/a	☐ ☐

7.1	Confirm current transformer wiring	

7.1.2	Current connections						
	CT wiring checked?	Yes	☐	No	☐	n/a	☐
	CT polarities correct?	Yes	☐	No	☐		
	Displayed current	Primary / Secondary					
	Phase CT ratio	/ na					
	Currents:	Applied value			Displayed value		
	IA	A			A		
	IB	A			A		
	IC	A			A		
	IN	A	n/a ☐		A	n/a ☐	

7.3	Differential current				
	Differential current checked?	Yes	☐	No	☐

8.	Final Checks						
	Test wiring removed?	Yes	☐	No	☐	n/a	☐
	Disturbed customer wiring re-checked?	Yes	☐	No	☐	n/a	☐
	Test mode disabled?	Yes	☐	No	☐		
	Circuit breaker operations counter reset?	Yes	☐	No	☐	n/a	☐
	Current counters reset?	Yes	☐	No	☐	n/a	☐
	Event records reset?	Yes	☐	No	☐		
	Fault records reset?	Yes	☐	No	☐		
	Disturbance records reset?	Yes	☐	No	☐		
	Alarms reset?	Yes	☐	No	☐		
	LED’s reset?	Yes	☐	No	☐		
	Secondary front cover replaced?	Yes	☐	No	☐	n/a	☐

2.5 Engineer Details for P742/P743

Commissioning Engineer	Customer Witness
Date:	Date:

3 CREATING A SETTING RECORD

You often need to create a record of what settings have been applied to a device. In the past, you could have used paper printouts of all the available settings, and mark up the ones you had used. Keeping such a paper-based Settings Records can be time-consuming and prone to error (e.g. due to being settings written down incorrectly).

The Easergy Studio (MiCOM S1 Studio) software lets you read/write MiCOM devices.

- **Extract** lets you download all the settings from a MiCOM Px40 device. A summary is given in Extract Settings from a MiCOM Px40 Device below.
- **Send** lets you send the settings you currently have open in the Studio software. A summary is given in Send Settings to a MiCOM Px40 Device below.

The Easergy Studio (MiCOM S1 Studio) product is updated periodically. These updates provide support for new features (such as allowing you to manage new MiCOM products, as well as using new software releases and hardware suffixes). The updates may also include fixes. **Accordingly, we strongly advise customers to use the latest Schneider Electric version of Easergy Studio (MiCOM S1 Studio).**

In most cases, it will be quicker and less error prone to extract settings electronically and store them in a settings file on a memory stick. In this way, there will be a digital record which is certain to be accurate. It is also possible to archive these settings files in a repository; so they can be used again or adapted for another use.

Full details of how to do these tasks is provided in the MiCOM S1 Studio help.

A quick summary of the main steps is given below.

In each case you need to make sure that:

- Your computer includes the MiCOM S1 Studio software.
- Your computer and the MiCOM device are powered on.
- You have used a suitable cable to connect your computer to the MiCOM device (Front Port, Rear Port, Ethernet port or Modem as available).

3.1 Extract Settings from a MiCOM Px40 Device

Full details of how to do this is provided in the MiCOM S1 Studio help.

As a quick guide, you need to do the following:

1. In MiCOM S1 Studio, click the Quick Connect… button.
2. Select the relevant Device Type in the Quick Connect dialog box.
3. Click the relevant port in the Port Selection dialog box.
4. Enter the relevant connection parameters in the Connection Parameters dialog box and click the Finish button
5. MiCOM S1 Studio will try to communicate with the Px40 device. It will display a connected message if the connection attempt is successful.
6. The device will appear in the Studio Explorer pane on the top-left of the interface.
7. Click the + button to expand the options for the device, then click on the Settings folder.
8. Right-click on Settings and select the Extract Settings link to read the settings on the device and store them on your computer or a memory stick.
9. After retrieving the settings file, close the dialog box by clicking the Close button.

3.2 Send Settings to a MiCOM Px40 Device

Full details of how to do this is provided in the MiCOM S1 Studio help.

As a quick guide, you need to do the following:

1. In MiCOM S1 Studio, click the Quick Connect… button.
2. Select the relevant Device Type in the Quick Connect dialog box.
3. Click the relevant port in the Port Selection dialog box.
4. Enter the relevant connection parameters in the Connection Parameters dialog box and click the Finish button
5. MiCOM S1 Studio will try to communicate with the Px40 device. It will display a connected message if the connection attempt is successful.
6. The device will appear in the Studio Explorer pane on the top-left of the interface.
7. Click the + button to expand the options for the device, then click on the Settings folder.
8. Right-click on Settings and select the Extract Settings link to read the settings on the device and store them on your computer or a memory stick.
9. After retrieving the settings file, close the dialog box by clicking the Close button.

MAINTENANCE

CHAPTER 13

Date:	07/2016	
Products covered by this chapter:	This chapter covers the specific versions of the MiCOM products listed below. This includes ***only*** the following combinations of Software Version and Hardware Suffix.	
Hardware suffix:	All MiCOM Px4x products	
Software version:	All MiCOM Px4x products	
Connection diagrams:	P14x (P141, P142, P143 & P145): 10P141xx (xx = 01 to 02) 10P142xx (xx = 01 to 05) 10P143xx (xx = 01 to 11) 10P145xx (xx = 01 to 11) P24x (P241, P242 & P243): 10P241xx (xx = 01 to 02) 10P242xx (xx = 01) 10P243xx (xx = 01) P34x (P342, P343, P344, P345 & P391): 10P342xx (xx = 01 to 17) 10P343xx (xx = 01 to 19) 10P344xx (xx = 01 to 12) 10P345xx (xx = 01 to 07) 10P391xx (xx = 01 to 02) P445: 10P445xx (xx = 01 to 04) P44x (P441, P442 & P444): 10P44101 (SH 1 & 2) 10P44201 (SH 1 & 2) 10P44202 (SH 1) 10P44203 (SH 1 & 2) 10P44401 (SH 1) 10P44402 (SH 1) 10P44403 (SH 1 & 2) 10P44404 (SH 1) 10P44405 (SH 1) 10P44407 (SH 1 & 2) P44y (P443 & P446): 10P44303 (SH 01 and 03) 10P44304 (SH 01 and 03) 10P44305 (SH 01 and 03) 10P44306 (SH 01 and 03) 10P44600 10P44601 (SH 1 to 2) 10P44602 (SH 1 to 2) 10P44603 (SH 1 to 2)	P54x (P543, P544, P545 & P546): 10P54302 (SH 1 to 2) 10P54303 (SH 1 to 2) 10P54400 10P54404 (SH 1 to 2) 10P54405 (SH 1 to 2) 10P54502 (SH 1 to 2) 10P54503 (SH 1 to 2) 10P54600 10P54604 (SH 1 to 2) 10P54605 (SH 1 to 2) 10P54606 (SH 1 to 2) P547: 10P54702xx (xx = 01 to 02) 10P54703xx (xx = 01 to 02) 10P54704xx (xx = 01 to 02) 10P54705xx (xx = 01 to 02) P64x (P642, P643 & P645): 10P642xx (xx = 1 to 10) 10P643xx (xx = 1 to 6) 10P645xx (xx = 1 to 9) P74x (P741, P742 & P743): 10P740xx (xx = 01 to 07) P746: 10P746xx (xx = 00 to 21) P841: 10P84100 10P84101 (SH 1 to 2) 10P84102 (SH 1 to 2) 10P84103 (SH 1 to 2) 10P84104 (SH 1 to 2) 10P84105 (SH 1 to 2) P849: 10P849xx (xx = 01 to 06)

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Notes:

1 MAINTENANCE PERIOD

Warning	**Before inspecting any wiring, performing any tests or carrying out any work on the equipment, you should be familiar with the contents of the Safety Information and Technical Data sections and the information on the equipment's rating label.**

It is recommended that products supplied by Schneider Electric receive periodic monitoring after installation. In view of the critical nature of protective and control equipment, and their infrequent operation, it is desirable to confirm that they are operating correctly at regular intervals.

Schneider Electric protection and control equipment is designed for a life in excess of 20 years.

MiCOM relays are self-supervising and so require less maintenance than earlier designs. Most problems will result in an alarm so that remedial action can be taken. However, some periodic tests should be done to ensure that the equipment is functioning correctly and the external wiring is intact.

If the customer's organization has a preventative maintenance policy, the recommended product checks should be included in the regular program. Maintenance periods depend on many factors, such as:

- The operating environment
- The accessibility of the site
- The amount of available manpower
- The importance of the installation in the power system
- The consequences of failure

2 MAINTENANCE CHECKS

Although some functionality checks can be performed from a remote location by using the communications ability of the equipment, these are predominantly restricted to checking that the equipment, is measuring the applied currents and voltages accurately, and checking the circuit breaker maintenance counters. Therefore it is recommended that maintenance checks are performed locally (i.e. at the equipment itself).

Warning	**Before carrying out any work on the equipment, you should be familiar with the contents of the Safety Information chapter/Safety Guide SFTY/5L M/L11 or later issue, the Technical Data chapter and the ratings on the equipment rating label.**

Warning	**If a P391 is used, you should also be familiar with the ratings and warning statements in the P391 technical manual.**

2.1 Alarms

The alarm status LED should first be checked to identify if any alarm conditions exist. If so, press the read key () repeatedly to step through the alarms.

Clear the alarms to extinguish the LED.

2.2 Opto-Isolators

The opto-isolated inputs can be checked to ensure that the equipment responds to energization by repeating the commissioning test detailed in the Commissioning chapter.

2.3 Output Relays

The output relays can be checked to ensure that they operate by repeating the commissioning test detailed in the Commissioning chapter.

2.4 Measurement Accuracy

If the power system is energized, the values measured by the equipment can be compared with known system values to check that they are in the approximate range that is expected. If they are, the analog/digital conversion and calculations are being performed correctly by the relay. Suitable test methods can be found in the Commissioning chapter.

Alternatively, the values measured by the equipment can be checked against known values injected via the test block, if fitted, or injected directly into the equipment terminals. Suitable test methods can be found in the Commissioning chapter. These tests will prove the calibration accuracy is being maintained.

3 METHOD OF REPAIR

If the equipment should develop a fault whilst in service, depending on the nature of the fault, the watchdog contacts will change state and an alarm condition will be flagged. Due to the extensive use of surface-mount components, faulty Printed Circuit Boards (PCBs) should be replaced, as it is not possible to perform repairs on damaged PCBs. Therefore either the complete equipment module or just the faulty PCB (as identified by the in-built diagnostic software), can be replaced. Advice about identifying the faulty PCB can be found in the Troubleshooting chapter.

The preferred method is to replace the complete equipment module as it ensures that the internal circuitry is protected against electrostatic discharge and physical damage at all times and overcomes the possibility of incompatibility between replacement PCBs. However, it may be difficult to remove installed equipment due to limited access in the back of the cubicle and the rigidity of the scheme wiring.

Replacing PCBs can reduce transport costs but requires clean, dry conditions on site and higher skills from the person performing the repair. If the repair is not performed by an approved service center, the warranty will be invalidated.

Warning	**Before carrying out any work on the equipment, you should be familiar with the contents of the Safety Information chapter/Safety Guide SFTY/5L M/L11 or later issue, the Technical Data chapter and the ratings on the equipment rating label.**

This should ensure that no damage is caused by incorrect handling of the electronic components.

3.1 Replacing the Complete Equipment IED/Relay

The case and rear terminal blocks have been designed to facilitate removal of the IED/relay should replacement or repair become necessary without having to disconnect the scheme wiring.

Warning	**Before working at the rear of the equipment, isolate all voltage and current supplies to the equipment.**

Note	*The MiCOM range has integral current transformer shorting switches which will close when the heavy duty terminal block is removed.*

1. Disconnect the equipment's earth, IRIG-B and fiber optic connections, as appropriate, from the rear of the device.

   There are two types of terminal block used on the equipment, medium and heavy duty, which are fastened to the rear panel using Pozidriv or PZ1 screws. The P24x/P43x/P64x ranges also includes an RTD/CLIO terminal block option. These block types are shown in the ***Commissioning*** chapter.

Important	*The use of a magnetic bladed screwdriver is recommended to minimize the risk of the screws being left in the terminal block or lost.*

2. Without exerting excessive force or damaging the scheme wiring, pull the terminal blocks away from their internal connectors.
3. Remove the screws used to fasten the equipment to the panel, rack, etc. These are the screws with the larger diameter heads that are accessible when the access covers are fitted and open.

Warning	**If the top and bottom access covers have been removed, do not remove the screws with the smaller diameter heads which are accessible. These screws secure the front panel to the equipment.**

4. Withdraw the equipment carefully from the panel, rack, etc. because it will be heavy due to the internal transformers.

To reinstall the repaired or replacement equipment, follow the above instructions in reverse, ensuring that each terminal block is relocated in the correct position and the case earth, IRIG-B and fiber optic connections are replaced. To facilitate easy identification of each terminal block, they are labeled alphabetically with 'A' on the left-hand side when viewed from the rear.

Once reinstallation is complete, the equipment should be re-commissioned using the instructions in the Commissioning chapter.

3.2 Replacing a PCB

Replacing PCBs and other internal components must be undertaken only by Service Centers approved by Schneider Electric. Failure to obtain the authorization of Schneider Electric after sales engineers prior to commencing work may invalidate the product warranty.

Warning	**Before removing the front panel to replace a PCB, remove the auxiliary supply and wait at least 30 seconds for the capacitors to discharge.** **We strongly recommend that the voltage and current transformer connections and trip circuit are isolated.**

Schneider Electric support teams are available world-wide. We strongly recommend that any repairs be entrusted to those trained personnel. For this reason, details on product disassembly and re-assembly are not included here.

4 RE-CALIBRATION

Re-calibration is not required when a PCB is replaced **unless it happens to be one of the boards in the input module;** the replacement of either directly affects the calibration.

Warning	**Although it is possible to carry out re-calibration on site, this requires test equipment with suitable accuracy and a special calibration program to run on a PC. It is therefore recommended that the work be carried out by the manufacturer, or entrusted to an approved service center.**

5 CHANGING THE BATTERY

Each relay/IED has a battery to maintain status data and the correct time when the auxiliary supply voltage fails. The data maintained includes event, fault and disturbance records and the thermal state at the time of failure.

This battery will periodically need changing, although an alarm will be given as part of the relay's/IED's continuous self-monitoring in the event of a low battery condition.

If the battery-backed facilities are not required to be maintained during an interruption of the auxiliary supply, the steps below can be followed to remove the battery, but do not replace with a new battery.

Warning	**Before carrying out any work on the equipment, you should be familiar with the contents of the Safety Information chapter/Safety Guide SFTY/5L M/L11 or later issue, the Technical Data chapter and the ratings on the equipment rating label.**

5.1 Instructions for Replacing the Battery

1. Open the bottom access cover on the front of the equipment.
2. Gently extract the battery from its socket. If necessary, use a small, insulated screwdriver to prize the battery free.
3. Ensure that the metal terminals in the battery socket are free from corrosion, grease and dust.
4. The replacement battery should be removed from its packaging and placed into the battery holder, taking care to ensure that the polarity markings on the battery agree with those adjacent to the socket.

Note	*Only use a type ½AA Lithium battery with a nominal voltage of 3.6 V and safety approvals such as UL (Underwriters Laboratory), CSA (Canadian Standards Association) or VDE (Vereinigung Deutscher Elektrizitätswerke).*

5. Ensure that the battery is securely held in its socket and that the battery terminals are making good contact with the metal terminals of the socket.
6. Close the bottom access cover.

5.2 Post Modification Tests

To ensure that the replacement battery will maintain the time and status data if the auxiliary supply fails, check cell [0806: DATE and TIME, Battery Status] reads 'Healthy'. If further confirmation that the replacement battery is installed correctly is required, the commissioning test is described in the Commissioning chapter, 'Date and Time', can be performed.

5.3 Battery Disposal

The battery that has been removed should be disposed of in accordance with the disposal procedure for Lithium batteries in the country in which the equipment is installed.

6 CLEANING

Warning	**Before cleaning the equipment ensure that all ac and dc supplies, current transformer and voltage transformer connections are isolated to prevent any chance of an electric shock whilst cleaning.**

The equipment may be cleaned using a lint-free cloth moistened with clean water. The use of detergents, solvents or abrasive cleaners is not recommended as they may damage the relay's surface and leave a conductive residue.

TROUBLESHOOTING

CHAPTER 14

Date:	07/2016	
Products covered by this chapter:	This chapter covers the specific versions of the MiCOM products listed below. This includes ***only*** the following combinations of Software Version and Hardware Suffix.	
Hardware Suffix:	All MiCOM Px4x products	
Software Version:	All MiCOM Px4x products	
Connection Diagrams:	P14x (P141, P142, P143 & P145): 10P141xx (xx = 01 to 02) 10P142xx (xx = 01 to 05) 10P143xx (xx = 01 to 11) 10P145xx (xx = 01 to 11) P24x (P241, P242 & P243): 10P241xx (xx = 01 to 02) 10P242xx (xx = 01) 10P243xx (xx = 01) P34x (P342, P343, P344, P345 & P391): 10P342xx (xx = 01 to 17) 10P343xx (xx = 01 to 19) 10P344xx (xx = 01 to 12) 10P345xx (xx = 01 to 07) 10P391xx (xx = 01 to 02) P445: 10P445xx (xx = 01 to 04) P44x(P442 & P444): 10P44101 (SH 1 & 2) 10P44201 (SH 1 & 2) 10P44202 (SH 1) 10P44203 (SH 1 & 2) 10P44401 (SH 1) 10P44402 (SH 1) 10P44403 (SH 1 & 2) 10P44404 (SH 1) 10P44405 (SH 1) 10P44407 (SH 1 & 2) P44y (P443 & P446): 10P44303 (SH 01 and 03) 10P44304 (SH 01 and 03) 10P44305 (SH 01 and 03) 10P44306 (SH 01 and 03) 10P44600 10P44601 (SH 1 to 2) 10P44602 (SH 1 to 2) 10P44603 (SH 1 to 2)	P54x (P543, P544, P545 & P546): 10P54302 (SH 1 to 2) 10P54303 (SH 1 to 2) 10P54400 10P54404 (SH 1 to 2) 10P54405 (SH 1 to 2) 10P54502 (SH 1 to 2) 10P54503 (SH 1 to 2) 10P54600 10P54604 (SH 1 to 2) 10P54605 (SH 1 to 2) 10P54606 (SH 1 to 2) P547: 10P54702xx (xx = 01 to 02) 10P54703xx (xx = 01 to 02) 10P54704xx (xx = 01 to 02) 10P54705xx (xx = 01 to 02) P64x (P642, P643 & P645): 10P642xx (xx = 1 to 10) 10P643xx (xx = 1 to 6) 10P645xx (xx = 1 to 9) P74x (P741, P742 & P743): 10P740xx (xx = 01 to 07) P746: 10P746xx (xx = 00 to 21) P841: 10P84100 10P84101 (SH 1 to 2) 10P84102 (SH 1 to 2) 10P84103 (SH 1 to 2) 10P84104 (SH 1 to 2) 10P84105 (SH 1 to 2) P849: 10P849xx (xx = 01 to 06)

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TABLES

Notes:

1 INTRODUCTION

Warning **Before carrying out any work on the equipment, you should be familiar with the contents of the Safety Information chapter/Safety Guide SFTY/5L M/L11 or later issue, the Technical Data chapter and the ratings on the equipment rating label.**

The purpose of this chapter of the service manual is to allow an error condition on the relay to be identified so that appropriate corrective action can be taken.

If the relay has developed a fault, it should be possible in most cases to identify which relay module requires attention. The *Maintenance* chapter advises on the recommended method of repair where faulty modules need replacing. It is not possible to perform an on-site repair to a faulted module.

In cases where a faulty relay/module is being returned to the manufacturer or one of their approved service centers, completed copy of the Repair/Modification Return Authorization Form located at the end of this chapter should be included.

2 INITIAL PROBLEM IDENTIFICATION

Consult the following table to find the description that best matches the problem experienced, then consult the section referenced to perform a more detailed analysis of the problem.

Symptom	Refer To
Relay fails to power up	Power-Up Errors section
Relay powers up - but indicates error and halts during power-up sequence	Error Message/Code On Power-Up section
Relay Powers up but Out of Service LED is illuminated	Out of Service LED illuminated on Power Up section
Error during normal operation	Error Code During Operation section
Mal-operation of the relay during testing	Mal-Operation of the Relay during Testing section

Table 1 - Problem identification

3 POWER UP ERRORS

If the relay does not appear to power up then the following procedure can be used to determine whether the fault is in the external wiring, auxiliary fuse, power supply module of the relay or the relay front panel.

Test	Check	Action
1	Measure auxiliary voltage on terminals 1 and 2; verify voltage level and polarity against rating the label on front. Terminal 1 is –dc, 2 is +dc	If auxiliary voltage is present and correct, then proceed to test 2. Otherwise the wiring/fuses in auxiliary supply should be checked.
2	Do LEDs/and LCD backlight illuminate on power-up, also check the N/O watchdog contact for closing.	If they illuminate or the contact closes and no error code is displayed then error is probably in the main processor board (front panel). If they do not illuminate and the contact does not close then proceed to test 3.
3	Check Field voltage output (nominally 48V DC)	If field voltage is not present then the fault is probably in the relay power supply module.

Table 2 - Failure of relay to power up

4 ERROR MESSAGE/CODE ON POWER-UP

During the power-up sequence of the relay self-testing is performed as indicated by the messages displayed on the LCD. If an error is detected by the relay during these self-tests, an error message will be displayed and the power-up sequence will be halted. If the error occurs when the relay application software is executing, a maintenance record will be created and the relay will reboot.

Test	Check	Action
1	Is an error message or code permanently displayed during power up?	If relay locks up and displays an error code permanently then proceed to Test 2. If the relay prompts for input by the user proceed to Test 4. If the relay re-boots automatically then proceed to Test 5.
2	Record displayed error, then remove and re-apply relay auxiliary supply.	Record whether the same error code is displayed when the relay is rebooted. If no error code is displayed then contact the local service center stating the error code and relay information. If the same code is displayed proceed to Test 3.
3	Error code Identification Following text messages (in English) will be displayed if a fundamental problem is detected preventing the system from booting: Bus Fail address lines SRAM Fail data lines FLASH Fail format error FLASH Fail checksum Code Verify Fail These hex error codes relate to errors detected in specific relay modules: 0c140005/0c0d0000 0c140006/0c0e0000 Last 4 digits provide details on the actual error.	These messages indicate that a problem has been detected on the main processor board of the relay (located in the front panel). Input Module (inc. Opto-isolated inputs) Output Relay Cards Other error codes relate to problems within the main processor board hardware or software. It will be necessary to contact Schneider Electric with details of the problem for a full analysis.
4	Relay displays message for corrupt settings and prompts for restoration of defaults to the affected settings.	The power up tests have detected corrupted relay settings, it is possible to restore defaults to allow the power-up to be completed. It will then be necessary to re-apply the application-specific settings.
5	Relay resets on completion of power up - record error code displayed	Error 0x0E080000, Programmable Scheme Logic (PSL) error due to excessive execution time. Restore default settings by performing a power up with ◁ and ▷ keys depressed, confirm restoration of defaults at prompt using (↵) key. If relay powers up successfully, check PSL for feedback paths. Other error codes will relate to software errors on the main processor board, contact Schneider Electric.

Table 3 - Power-up self-test error

5 OUT OF SERVICE LED ILLUMINATED ON POWER UP

Test	Check	Action	
1	Using the relay menu confirm whether the Commission Test/Test Mode setting is Contact Blocked. Otherwise proceed to test 2.	If the setting is Contact Blocked then disable the test mode and, verify that the Out of Service LED is extinguished.	
2	Select and view the last maintenance record from the menu (in the View Records).	Check for H/W Verify Fail this indicates a discrepancy between the relay model number and the hardware; examine the "**Maint. Data**", this indicates the causes of the failure using bit fields:	
		Bit	**Meaning**
		0	The application type field in the model number does not match the software ID
		1	The application field in the model number does not match the software ID
		2	The variant 1 field in the model number does not match the software ID
		3	The variant 2 field in the model number does not match the software ID
		4	The protocol field in the model number does not match the software ID
		5	The language field in the model number does not match the software ID
		6	The VT type field in the model number is incorrect (110V VTs fitted)
		7	The VT type field in the model number is incorrect (440V VTs fitted)
		8	The VT type field in the model number is incorrect (no VTs fitted)

Table 4 - Out of service LED illuminated

6 ERROR CODE DURING OPERATION

The relay performs continuous self-checking, if an error is detected then an error message will be displayed, a maintenance record will be logged and the relay will reset (after a 1.6 second delay). A permanent problem (for example due to a hardware fault) will generally be detected on the power up sequence, following which the relay will display an error code and halt. If the problem was transient in nature then the relay should reboot correctly and continue in operation. The nature of the detected fault can be determined by examination of the maintenance record logged.

There are also two cases where a maintenance record will be logged due to a detected error where the relay will not reset. These are detection of a failure of either the field voltage or the lithium battery, in these cases the failure is indicated by an alarm message, however the relay will continue to operate.

If the field voltage is detected to have failed (the voltage level has dropped below threshold), then a scheme logic signal is also set. This allows the scheme logic to be adapted in the case of this failure (for example if a blocking scheme is being used).

In the case of a battery failure it is possible to prevent the relay from issuing an alarm using the setting under the Date and Time section of the menu. This setting '**Battery Alarm**' can be set to '**Disabled**' to allow the relay to be used without a battery, without an alarm message being displayed.

In the case of an RTD board failure, an alarm "RTD board fail" message is displayed, the RTD protection is disabled, but the operation of the rest of the relay functionality is unaffected.

7 MAL-OPERATION OF THE RELAY DURING TESTING

7.1 Failure of Output Contacts

An apparent failure of the relay output contacts may be caused by the relay configuration; the following tests should be performed to identify the real cause of the failure.

Note *The relay self-tests verify that the coil of the contact has been energized, an error will be displayed if there is a fault in the output relay board.*

Test	Check	Action
1	Is the Out of Service LED illuminated?	Illumination of this LED may indicate that the relay is Contact Blocked or that the protection has been disabled due to a hardware verify error (see the *Out of service LED illuminated* table..
2	Examine the Contact status in the Commissioning section of the menu.	If the relevant bits of the contact status are operated, proceed to test 4, if not proceed to test 3.
3	Verify by examination of the fault record or by using the test port whether the protection element is operating correctly.	If the protection element does not operate verify whether the test is being correctly applied. If the protection element does operate, it will be necessary to check the PSL to ensure that the mapping of the protection element to the contacts is correct.
4	Using the Commissioning/Test mode function apply a test pattern to the relevant relay output contacts and verify whether they operate (note the correct external connection diagram should be consulted). A continuity tester can be used at the rear of the relay for this purpose.	If the output relay does operate, the problem must be in the external wiring to the relay. If the output relay does not operate this could indicate a failure of the output relay contacts (note that the self-tests verify that the relay coil is being energized). Ensure that the closed resistance is not too high for the continuity tester to detect.

Table 5 - Failure of output contacts

7.2 Failure of Opto-Isolated Inputs

The opto-isolated inputs are mapped onto the relay internal signals using the PSL. If an input does not appear to be recognized by the relay scheme logic the Commission Tests/Opto Status menu option can be used to verify whether the problem is in the opto-isolated input itself or the mapping of its signal to the scheme logic functions. If the opto-isolated input does appear to be read correctly then it will be necessary to examine its mapping within the PSL.

Ensure the voltage rating for the opto inputs has been configured correctly with applied voltage. If the opto-isolated input state is not being correctly read by the relay the applied signal should be tested. Verify the connections to the opto-isolated input using the correct wiring diagram and the correct nominal voltage settings in any standard or custom menu settings. Next, using a voltmeter verify that 80% opto setting voltage is present on the terminals of the opto-isolated input in the energized state. If the signal is being correctly applied to the relay then the failure may be on the input card itself. Depending on which opto-isolated input has failed this may require replacement of either the complete analog input module (the board within this module cannot be individually replaced without re-calibration of the relay) or a separate opto board.

7.3 Incorrect Analog Signals

The measurements may be configured in primary or secondary to assist. If it is suspected that the analog quantities being measured by the relay are not correct then the measurement function of the relay can be used to verify the nature of the problem. The measured values displayed by the relay should be compared with the actual magnitudes at the relay terminals. Verify that the correct terminals are being used (in particular the dual rated CT inputs) and that the CT and VT ratios set on the relay are correct. The correct 120 degree displacement of the phase measurements should be used to confirm that the inputs have been correctly connected.

7.4 PSL Editor Troubleshooting

A failure to open a connection could be because of one or more of the following:

- The relay address is not valid (note: this address is always 1 for the front port).
- Password is not valid
- Communication Set-up - COM port, Baud rate, or Framing - is not correct
- Transaction values are not suitable for the relay and/or the type of connection
- Modem configuration is not valid. Changes may be necessary when using a modem
- The connection cable is not wired correctly or broken. See MiCOM S1 connection configurations
- The option switches on any KITZ101/102 that is in use may be incorrectly set

7.4.1 Diagram Reconstruction after Recover from Relay

Although the extraction of a scheme from a relay is supported, the facility is provided as a way of recovering a scheme in the event that the original file is unobtainable.

The recovered scheme will be logically correct, but much of the original graphical information is lost. Many signals will be drawn in a vertical line down the left side of the canvas. Links are drawn orthogonally using the shortest path from A to B.

Any annotation added to the original diagram (titles, notes, etc.) are lost.

Sometimes a gate type may not be what was expected, e.g. a 1-input AND gate in the original scheme will appear as an OR gate when uploaded. Programmable gates with an inputs-to-trigger value of 1 will also appear as OR gates.

7.4.2 PSL Version Check

The PSL is saved with a version reference, time stamp and CRC check. This gives a visual check whether the default PSL is in place or whether a new application has been downloaded.

8 REPAIR AND MODIFICATION PROCEDURE

Please follow these steps to return an Automation product to us:

1. Get the Repair and Modification Authorization Form (RMA).

   A copy of the RMA form is shown at the end of this section.

2. Fill in the RMA form.

   Fill in only the white part of the form.

   Please ensure that all fields marked **(M)** are completed such as:

   Equipment model

   Model No. and Serial No.

   Description of failure or modification required (please be specific)

   Value for customs (in case the product requires export)

   Delivery and invoice addresses

   Contact details

3. Receive from local service contact, the information required to ship the product.

   Your local service contact will provide you with all the information:

   Pricing details

   RMA No

   Repair center address

   If required, an acceptance of the quote must be delivered before going to next stage.

4. Send the product to the repair center.

   Address the shipment to the repair center specified by your local contact.

   Ensure all items are protected by appropriate packaging: anti-static bag and foam protection.

   Ensure a copy of the import invoice is attached with the unit being returned.

   Ensure a copy of the RMA form is attached with the unit being returned.

   E-mail or fax a copy of the import invoice and airway bill document to your local contact.

Notes:

REPAIR/MODIFICATION RETURN AUTHORIZATION FORM

FIELDS IN GREY TO BE FILLED IN BY SCHNEIDER ELECTRIC PERSONNEL ONLY

Reference **RMA:**		Date:
Repair Center Address (for shipping)	**Service Type** ☐ Retrofit ☐ Warranty ☐ Paid service ☐ Under repair contract ☐ Wrong supply	LSC PO No.:
Schneider Electric - Local Contact Details Name: Telephone No.: Fax No.: E-mail:		

IDENTIFICATION OF UNIT

Fields marked (M) are mandatory, delays in return will occur if not completed.

Model No./Part No.: **(M)**	Site Name/Project:
Manufacturer Reference: **(M)**	Commissioning Date:
Serial No.: **(M)**	Under Warranty: ☐ Yes ☐ No
Software Version:	Additional Information:
Quantity:	Customer P.O (if paid):

FAULT INFORMATION

Type of Failure	**Found Defective**
Hardware fail ☐	During FAT/inspection ☐
Mechanical fail/visible defect ☐	On receipt ☐
Software fail ☐	During installation/commissioning ☐
Other:	During operation ☐
	Other:
Fault Reproducibility	
Fault persists after removing, checking on test bench ☐	
Fault persists after re-energization ☐	
Intermittent fault ☐	

Description of Failure Observed or Modification Required - *Please be specific* **(M)**

FOR REPAIRS ONLY

Would you like us to install an updated firmware version after repair?	☐	Yes	☐	No

CUSTOMS & INVOICING INFORMATION

Required to allow return of repaired items

Value for Customs (M)	
Customer Invoice Address ((M) if paid)	**Customer Return Delivery Address (full street address) (M)** Part shipment accepted ☐ Yes ☐ No **OR** Full shipment required ☐ Yes ☐ No
Contact Name: Telephone No.: Fax No.: E-mail:	Contact Name: Telephone No.: Fax No.: E-mail:

REPAIR TERMS

1. **Please ensure that a copy of the import invoice is attached with the returned unit, together with the airway bill document.** Please fax/e-mail a copy of the appropriate documentation **(M)**.
2. Please ensure the Purchase Order is released, for paid service, to allow the unit to be shipped.
3. Submission of equipment to Schneider Electric is deemed as authorization to repair and acceptance of quote.
4. Please ensure all items returned are marked as Returned for ‘Repair/Modification’ and **protected by appropriate packaging** (anti-static bag for each board and foam protection).

SCADA COMMUNICATIONS

CHAPTER 15

Date:	02/2017
Products covered by this chapter:	This chapter covers the specific versions of the MiCOM products listed below. This includes ***only*** the following combinations of Software Version and Hardware Suffix.
Hardware Suffix:	L (P742) & M (P741 & P743)
Software Version:	B1
Connection Diagrams:	10P740xx (xx = 01 to 07)

CONTENTS

FIGURES

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1 INTRODUCTION

This chapter describes the remote interfaces of the MiCOM relay in enough detail to allow integration in a substation communication network. The relay supports a choice of one of a number of protocols through the rear 2-wire EIA(RS)485 communication interface, selected using the model number when ordering. This is in addition to the front serial interface and second rear communications port, which supports the Courier protocol only. According to the protocol and hardware options selected, the interface may alternatively be presented over an optical fiber interface, or via an Ethernet connection.

The supported protocols include:

- Courier
- IEC-80870-5-103
- IEC 61850 Ethernet Interface

The implementation of both Courier and IEC 60870-5-103 on RP1 can also, optionally, be presented over fiber as well as EIA(RS)485.

The DNP3.0 implementation is available via the EIA(RS)485 port.

The rear EIA(RS)-485 interface is isolated and is suitable for permanent connection whichever protocol is selected. The advantage of this type of connection is that up to 32 relays can be daisy-chained together using a simple twisted-pair electrical connection.

Note	*The second rear Courier port and the fiber optic interface are mutually exclusive as they occupy the same physical slot.*

An outline of the connection details for each of the communications ports is provided here. The ports are configurable using settings - a description of the configuration follows the connections part. Details of the protocol characteristics are also shown.

For each of the protocol options, the supported functions and commands are listed with the database definition. The operation of standard procedures such as extraction of event, fault and disturbance records, or setting changes is also described.

The descriptions in this chapter do not aim to fully describe the protocol in detail. Refer to the relevant documentation protocol for this information. This chapter describes the specific implementation of the protocol in the relay.

1.1 Read Only Mode (Command Blocking)

A Read Only mode is available for the rear communication ports of the Px40 relays. When Read Only mode is enabled for a port, all setting changes and most commands/control actions are blocked (not accepted by the relay). The full functionality is described below. It is similar to the 'Command Blocking' setting of Px30 relays.

Read Only mode can be enabled/disabled for the following rear ports:

- Rear Port 1 – IEC 60870-5-103 and Courier protocols
- Rear Port 2 (if fitted) – Courier protocol
- Ethernet Port (if fitted) – Courier protocol ("tunnelled")

Read Only mode is not currently required for IEC 61850, as there are no settings or controls implemented.

Read Only mode does not apply to the Front Port, that is intended for local connection only.

The following settings enable and disable the Read Only Mode:

- [09FB: CONFIGURATION, RP1 Read Only]
- [09FC: CONFIGURATION, RP2 Read Only]
- [09FD: CONFIGURATION, NIC Read Only]

Read Only mode can only be disabled from either the front panel User Interface or via the Front Port.

Read Only mode can be enabled/disabled in the PSL by using the DDB signals 'RP1 Read Only', 'RP2 Read Only', 'NIC Read Only'.

When Read Only mode is enabled, the commands that are blocked (not accepted by the relay) and the commands that are allowed (accepted by the relay) are as follows.

(1) IEC 60870-5-103 Protocol

Blocked:

INF16 auto-recloser on/off (ASDU20)
INF17 teleprotection on/off (ASDU20)
INF18 protection on/off (ASDU20)
INF19 LED reset (ASDU20)
private INFs e.g CB open/close, Control Inputs (ASDU20)

Allowed:

Poll Class 1 (read spontaneous events)
Poll Class 2 (read measurands)
General Interrogation (GI) sequence
Transmission of Disturbance Records sequence
Time Synchronisation (ASDU6)
INF23 activate characteristic 1 (ASDU20)
INF24 activate characteristic 2 (ASDU20)
INF25 activate characteristic 3 (ASDU20)
INF26 activate characteristic 4 (ASDU20)

(2) Courier Protocol

Blocked:

- All setting changes
- Reset Indication (Trip LED) command
- Operate Control Input commands
- CB operation commands
- Auto-reclose operation commands
- Reset demands / thermal etc... command
- Clear event / fault / maintenance / disturbance record commands
- Test LEDs & contacts commands

Allowed:

- Read settings, statuses, measurands
- Read records (event, fault, disturbance)
- Time Synchronization command
- Change active setting group command

2 CONNECTIONS TO THE COMMUNICATION PORTS

2.1 Front Port

The front communications port is not intended for permanent connection. The front communications port supports the Courier protocol and is implemented on an EIA(RS)232 connection. A 9-pin connector type, as described in the ‘Getting Started’ (GS) chapter of this manual, is used, and the cabling requirements are detailed in the ‘Connection Diagrams’ (CD) chapter of this manual.

2.2 Rear Communication Port EIA(RS)485

The rear EIA(RS)-485 communication port is provided by a 3-terminal screw connector on the back of the relay. See the Connection Diagrams chapter for details of the connection terminals. The rear port provides K-Bus/EIA(RS)-485 serial data communication and is intended for use with a permanently-wired connection to a remote control center. Of the three connections, two are for the signal connection, and the other is for the earth shield of the cable.

When the K-Bus option is selected for the rear port, the two signal connections are not polarity conscious, however for MODBUS, IEC60870-5-103 and DNP3.0 care must be taken to observe the correct polarity.

The protocol provided by the relay is indicated in the relay menu in the **Communications** column. Using the keypad and LCD, first check that the **Comms. settings** cell in the **Configuration** column is set to **Visible**, then move to the **Communications** column. The first cell down the column shows the communication protocol that is being used by the rear port.

Note	*Unless the K-Bus option is chosen for the rear port, correct polarity must be observed for the signal connections. In all other respects (bus wiring, topology, connection, biasing and termination) K-Bus can be considered the same as EIA(RS)485.*

2.3 Second Rear Communication Port (RP2 (Courier)

Relays with Courier, MODBUS, IEC60870-5-103 or DNP3.0 protocol on the first rear communications port have the option of a second rear port, running the Courier language. The second port is intended typically for dial-up modem access by protection engineers or operators, when the main port is reserved for SCADA communication traffic. Communication is through one of three physical links: K-Bus, EIA(RS)-485 or EIA(RS)-232. The port supports full local or remote protection and control access using MiCOM S1 Studio.

When changing the port configuration between K-Bus, EIA(RS)-485 and EIA(RS)-232, reboot the relay to update the hardware configuration of the second rear port.

The EIA(RS)-485 and EIA(RS)-232 protocols can be configured to operate with a modem, using an IEC60870 10-bit frame.

If both rear communications ports are connected to the same bus, make sure their address settings are not the same to avoid message conflicts.

Port Configuration	Valid Communication Protocol
K-Bus	K-Bus
EIA(RS)-232	IEC60870 FT1.2, 11-bit frame IEC60870, 10-bit frame
EIA(RS)-485	IEC60870 FT1.2, 11-bit frame IEC60870, 10-bit frame

Table 1 – Port configurations and communication protocols

2.3.1 Courier Protocol

The second rear communications port is functionally the same as described in the previous section for a Courier rear communications port, with the following exceptions:

2.3.1.1 Event Extraction

Automatic event extraction is not supported when the first rear port protocol is Courier, MODBUS or CS103. It is supported when the first rear port protocol is DNP3.0.

2.3.1.2 Disturbance Record Extraction

Automatic disturbance record extraction is not supported when the first rear port protocol is Courier, MODBUS or CS103. It is supported when the first rear port protocol is DNP3.0.

2.3.2 Connection to the Second Rear Port

The second rear Courier port connects using the 9-way female D-type connector (SK4) in the middle of the card end plate (between the IRIG-B connector and lower D-type). The connection complies with EIA(RS)-574.

For IEC60870-5-2 over EIA(RS)-232		For K-bus or IEC60870-5-2 over EIA(RS)-485	
Pin	Connection	Pin*	Connection
1	No Connection		
2	RxD		
3	TxD		
4	DTR#	4	EIA(RS)-485 - 1 (+ ve)
5	Ground		
6	No Connection		
7	RTS#	7	EIA(RS)-485 - 2 (- ve)
8	CTS#		
9	No Connection		
# - These pins are control lines for use with a modem.		* - All other pins unconnected.	

Notes	*Connector pins 4 and 7 are used by both the EIA(RS)-232and EIA(RS)-485 physical layers, but for different purposes. Therefore, the cables should be removed during configuration switches.* *When using the EIA(RS)-485 protocol, an EIA(RS)-485 to EIA(RS)-232 converter is needed to connect the relay to a modem or PC running MiCOM S1 Studio. A Schneider Electric CK222 is recommended.* *EIA(RS)-485 is polarity sensitive, with pin 4 positive (+) and pin 7 negative (-).* *The K-Bus protocol can be connected to a PC using a KITZ101 or 102.*

Table 2 – Pin connections over EIA(RS)-232 and EIS(RS)-485

2.4 EIA(RS)485 Bus

The EIA(RS)-485 two-wire connection provides a half-duplex fully isolated serial connection to the product. The connection is polarized and while the product's connection diagrams show the polarization of the connection terminals, there is no agreed definition of which terminal is which. If the master is unable to communicate with the product and the communication parameters match, make sure the two-wire connection is not reversed.

EIA(RS)-485 provides the capability to connect multiple devices to the same two-wire bus. MODBUS is a master-slave protocol, so one device is the master, and the remaining devices are slaves. It is not possible to connect two masters to the same bus, unless they negotiate bus access.

2.4.1 EIA(RS)485 Bus Termination

The EIA(RS)-485 bus must have 120 Ω (Ohm) ½ Watt terminating resistors fitted at either end across the signal wires, see the *EIA(RS)-485 bus connection arrangements* diagram below. Some devices may be able to provide the bus terminating resistors by different connection or configuration arrangements, in which case separate external components are not needed. However, this product does not provide such a facility, so if it is located at the bus terminus, an external termination resistor is needed.

2.4.2 EIA(RS)485 Bus Connections & Topologies

The EIA(RS)-485 standard requires each device to be directly connected to the physical cable that is the communications bus. Stubs and tees are expressly forbidden, as are star topologies. Loop bus topologies are not part of the EIA(RS)-485 standard and are forbidden by it.

Two-core screened cable is recommended. The specification of the cable depends on the application, although a multi-strand 0.5 mm^2 per core is normally adequate. Total cable length must not exceed 1000 m. The screen must be continuous and connected at one end, normally at the master connection point. It is important to avoid circulating currents, especially when the cable runs between buildings, for both safety and noise reasons.

This product does not provide a signal ground connection. If the bus cable has a signal ground connection, it must be ignored. However, the signal ground must have continuity for the benefit of other devices connected to the bus. For both safety and noise reasons, the signal ground must never be connected to the cable's screen or to the product's chassis.

2.4.3 EIA(RS)485 Bus Biasing

It may also be necessary to bias the signal wires to prevent jabber. Jabber occurs when the signal level has an indeterminate state because the bus is not being actively driven. This can occur when all the slaves are in receive mode and the master is slow to switch from receive mode to transmit mode. This may be because the master purposefully waits in receive mode, or even in a high impedance state, until it has something to transmit. Jabber causes the receiving device(s) to miss the first bits of the first character in the packet, which results in the slave rejecting the message and consequentially not responding. Symptoms of this are poor response times (due to retries), increasing message error counters, erratic communications, and even a complete failure to communicate.

Biasing requires that the signal lines are weakly pulled to a defined voltage level of about 1 V. There should only be one bias point on the bus, which is best situated at the master connection point. The DC source used for the bias must be clean, otherwise noise is injected. Some devices may (optionally) be able to provide the bus bias, in which case external components are not required.

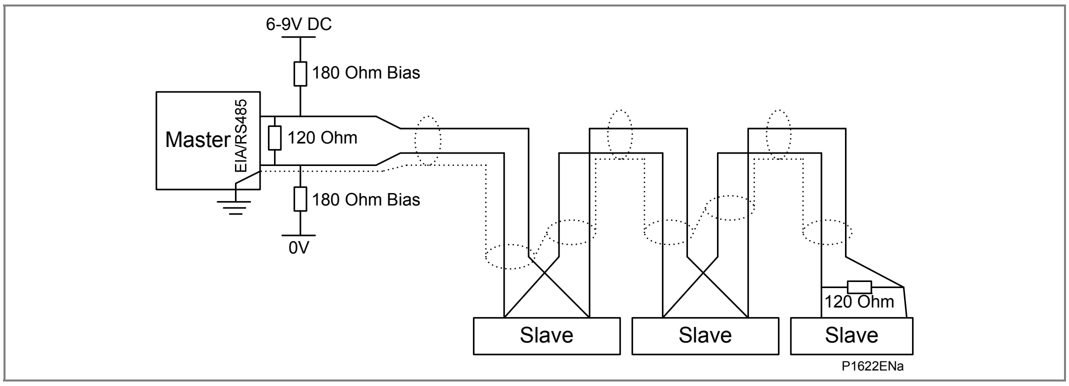

Figure 1 -EIA(RS)485 bus connection arrangements

It is possible to use the product's field voltage output (48 V DC) to bias the bus using values of 2.2 k Ω (½W) as bias resistors instead of the 180 Ω resistors shown in the *EIA(RS)-485 bus connection arrangements* diagram. Note these warnings apply:

Warnings	**It is extremely important that the 120 Ω termination resistors are fitted. Otherwise the bias voltage may be excessive and may damage the devices connected to the bus.** **As the field voltage is much higher than that required, Schneider Electric cannot assume responsibility for any damage that may occur to a device connected to the network as a result of incorrect application of this voltage.** **Ensure the field voltage is not used for other purposes, such as powering logic inputs, because noise may be passed to the communication network.**

2.4.4 Courier Communication

Courier is the communication language developed to allow remote interrogation of its range of protection relays. Courier uses a master and slave. EIA(RS)-232 on the front panel allows only one slave but EIA(RS)-485 on the back panel allows up to 32 daisy-chained slaves. Each slave unit has a database of information and responds with information from its database when requested by the master unit.

The relay is a slave unit that is designed to be used with a Courier master unit such as MiCOM S1 Studio, MiCOM S10, PAS&T or a SCADA system. MiCOM S1 Studio is compatible is specifically designed for setting changes with the relay.

To use the rear port to communicate with a PC-based master station using Courier, a KITZ K-Bus to EIA(RS)-232 protocol converter is needed. This unit (and information on how to use it) is available from Schneider Electric. A typical connection arrangement is shown in the *K-bus remote communication connection arrangements* diagram below. For more detailed information on other possible connection arrangements, refer to the manual for the Courier master station software and the manual for the KITZ protocol converter. Each spur of the K-Bus twisted pair wiring can be up to 1000 m in length and have up to 32 relays connected to it.

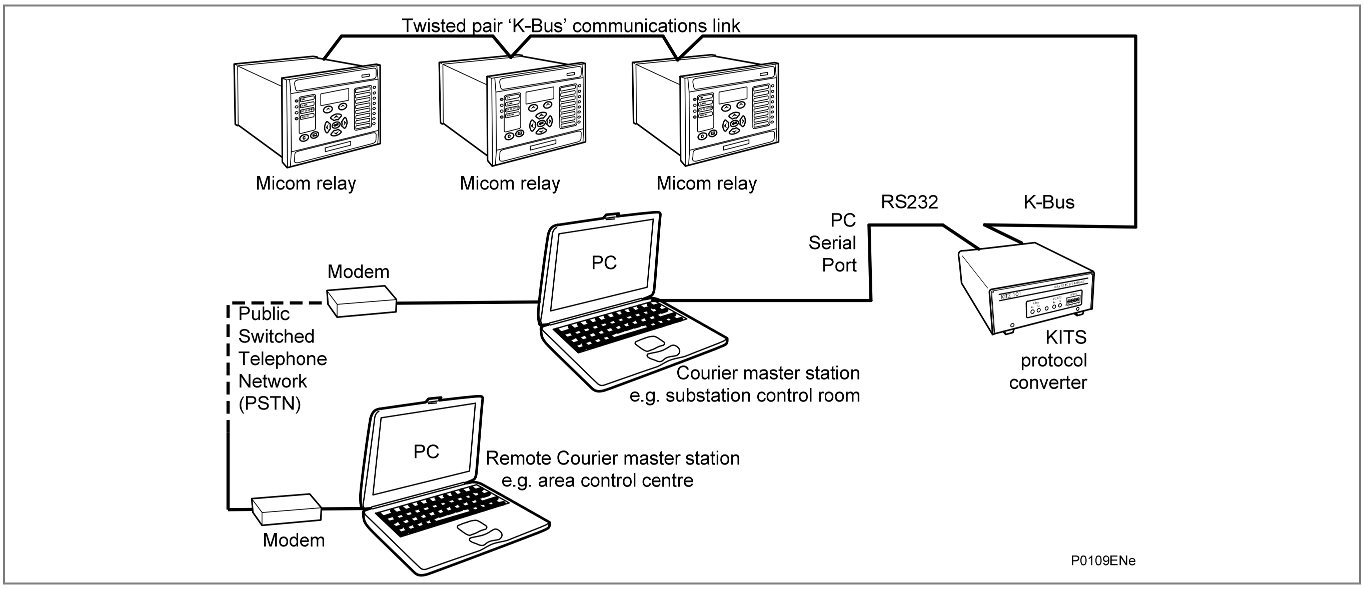

Figure 2 - Remote communication connection arrangements

Once the physical connection is made to the relay, configure the relay's communication settings using the keypad and LCD user interface.

3 CONFIGURING THE COMMUNICATIONS PORTS

3.1 Introduction

Courier works on a master/slave basis where the slave units contain information in the form of a database, and respond with information from the database when it is requested by a master unit.

The relay is a slave unit that is designed to be used with a Courier master unit such as MiCOM S1 Studio, PAS&T or a SCADA system.

3.1.1 Configuring the Front Courier Port

The front EIA(RS)232 9-pin port supports the Courier protocol for one-to-one communication. It is designed for use during installation, commissioning and maintenance and is not suitable for permanent connection. Since this interface is not intended to link the relay to a substation communication system, not all of the features of the Courier interface are supported; the port is not configurable and the following parameters apply:

- Physical presentation EIA(RS)232 via 9-pin connector
- Frame format IEC60870-5 FT1.2 = 11-bit (8 Even 1)
- Address 1
- Baud rate 19200 bps

Note	*As part of the limited implementation of Courier on the front port, neither automatic extraction of event and disturbance records, nor busy response are supported.)*

3.1.2 Configuring the First Rear Courier Port (RP1)

Once the physical connection is made to the relay, configure the relay's communication settings using the keypad and LCD user interface.

1. In the relay menu, select the **Configuration** column, then check that the **Comms. settings** cell is set to **Visible**.
2. Select the **Communications** column. Only two settings apply to the rear port using Courier, the relay's address and the inactivity timer. Synchronous communication uses a fixed baud rate of 64 kbits/s.
3. Move down the **Communications** column from the column heading to the first cell down. This shows the communication protocol.

```
Protocol
Courier
```

4. The next cell down the column controls the address of the relay. As up to 32 relays can be connected to one K-Bus spur, each relay must have a unique address so messages from the master control station are accepted by one relay only. Courier uses an integer (from 0 to 254) for the relay address that is set with this cell. Important: no two relays should have the same Courier address. The master station uses the Courier address to communicate with the relay.

```
Address
1
```

5. The next cell down controls the inactivity timer.

```
Inactiv timer
10.00 mins.
```

The inactivity timer controls how long the relay waits without receiving any messages on the rear port before it reverts to its default state, including revoking any password access that was enabled. For the rear port this can be set between 1 and 30 minutes.

Note	*Protection and disturbance recorder settings that are modified using an on-line editor such as PAS&T must be confirmed with a write to the 'Save changes' cell of the 'Configuration' column. Off-line editors such as MiCOM S1 Studio do not require this action for the setting changes to take effect.*

The next cell down controls the physical media used for the communication.

```
Physical link
Copper
```

The default setting is to select the electrical (copper) connection. If the optional fiber optic interface is fitted to the relay, then this setting can be changed to '**Fiber optic**'. This cell is invisible if a second rear communications port or an Ethernet card is fitted, as they are mutually exclusive and occupy the same physical location.

6. If the Physical link selection is copper, the next cell down becomes visible to further define the configuration:

```
Port Config
KBus
```

The setting choice is between K-Bus and EIA(RS)485. Selecting K-Bus allows connection with K-series devices, but means that a KITZ converter must be used to make a connection. If the EIA(RS)485 selection is made, direct connections can be made to proprietary equipment such as MODEMs. If the EIA(RS)485 selection is made, then two further cells become visible to control the frame format and the communication speed:

7. The frame format is selected in the RP1 Comms mode setting:

```
Comms Mode
IEC60870 FT1.2
```

The standard default is the IEC 60870-FT1.2. This is an 11-bit framing. Alternatively, a 10-bit framing may be selected for use with MODEMs that do not support 11-bit framing.

8. The final RP1 cell controls the communication speed or baud rate:

```
Baud Rate
19200 bits/s
```

Courier communications is asynchronous and three baud rate selections are available to allow the relay communication rate to be matched to that of the connected equipment. Three baud rates are supported by the relay, '9600 bits/s', '19200 bits/s' and '38400 bits/s'.

Important	**If you modify protection and disturbance recorder settings using an on-line editor such as PAS&T, you must confirm them. To do this, from the Configuration column select the Save changes cell. Off-line editors such as MiCOM S1 Studio do not need this action for the setting changes to take effect.**

3.1.3 Configuring the MODBUS Communication (not available)

This protocol is not available for the MiCOM P74x (P741, P742 & P743) relays.

MODBUS is a master/slave communication protocol, which can be used for network control. In a similar fashion to Courier, the system works by the master device initiating all actions and the slave devices, (the relays), responding to the master by supplying the requested data or by taking the requested action. MODBUS communication is achieved via a twisted pair EIA(RS)485 connection to the rear port and can be used over a distance of 1000m with SC up to 32 slave devices.

3.1.4 Configuring the IEC60870-5 CS 103 Rear Port, RP1

The IEC specification IEC 60870-5-103: Telecontrol Equipment and Systems, Part 5: Transmission Protocols Section 103 defines the use of standards IEC 60870-5-1 to IEC 60870-5-5 to perform communication with protection equipment. The standard configuration for the IEC 60870-5-103 protocol is to use a twisted pair connection over distances up to 1000 m. As an option for IEC 60870-5-103, the rear port can be specified to use a fiber optic connection for direct connection to a master station. The relay operates as a slave in the system, responding to commands from a master station. The method of communication uses standardized messages which are based on the VDEW communication protocol.

To use the rear port with IEC 60870-5-103 communication, configure the relay’s communication settings using the keypad and LCD user interface.

A KITZ274 converter can manage up to 8 P740 relays with consecutive addresses.

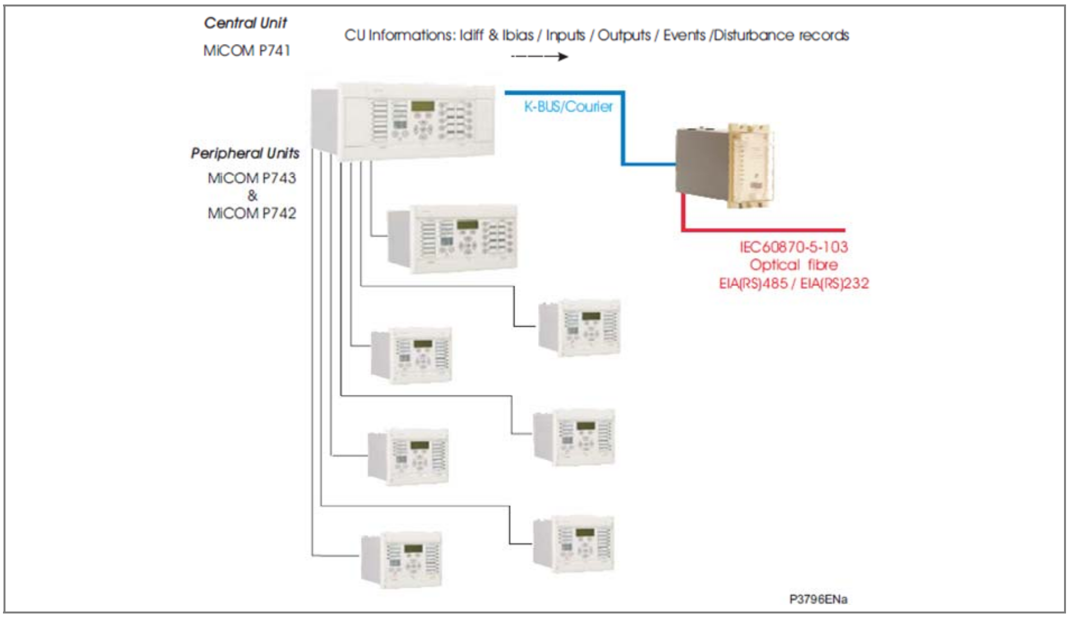

Figure 3 - Up to 8 addresses example

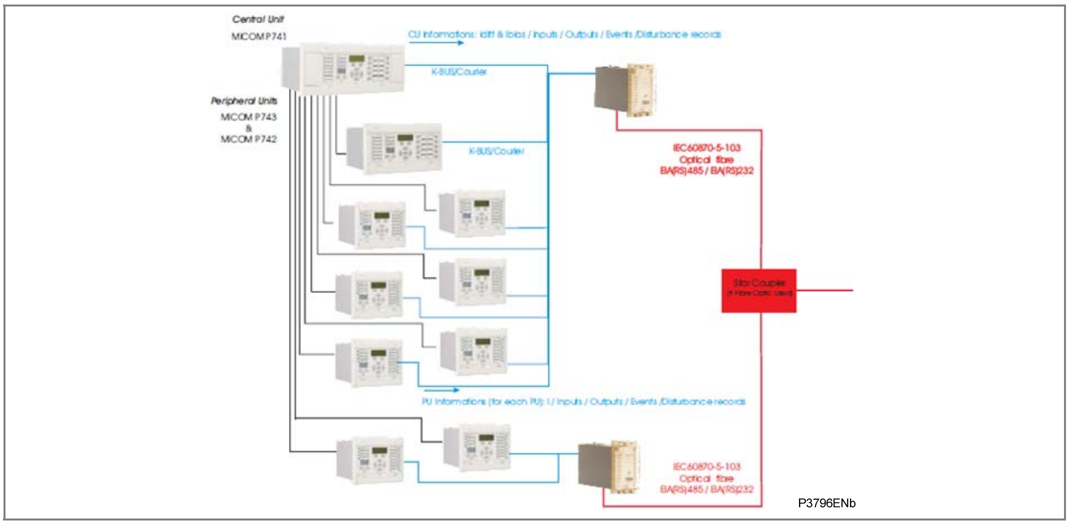

Figure 4 - More than 8 addresses example

The IEC specification IEC 60870-5-103: Telecontrol Equipment and Systems, Part 5: Transmission Protocols Section 103 defines the use of standards IEC 60870-5-1 to IEC 60870-5-5 to perform communication with protection equipment. The standard configuration for the IEC 60870-5-103 protocol is to use a twisted pair connection over distances up to 1000 m. As an option for IEC 60870-5-103, the rear port can be specified to use a fiber optic connection for direct connection to a master station. The relay operates as a slave in the system, responding to commands from a master station. The method of communication uses standardized messages which are based on the VDEW communication protocol.

To use the rear port with IEC 60870-5-103 communication, configure the relay's communication settings using the keypad and LCD user interface.

1. In the relay menu, select the **Configuration** column, then check that the **Comms. settings** cell is set to **Visible**.
2. Select the **Communications** column. Four settings apply to the rear port using IEC 60870-5-103 that are described below.

   Move down the 'COMMUNICATIONS' column from the column heading to the first cell to confirm the communication protocol:

   ```
   Protocol
   IEC60870-5-103
   ```
3. The next cell sets the address of the relay on the IEC 60870-5-103 network:

   ```
   Remote Address
   162
   ```

   Up to 32 relays can be connected to one IEC 60870-5-103 spur, and therefore it is necessary for each relay to have a unique address so that messages from the master control station are accepted by one relay only. IEC 60870-5-103 uses an integer number between 0 and 254 for the relay address. It is important that no two relays have the same address. The address is then used by the master station to communicate with the relay.
4. The next cell down the column controls the baud rate to be used:

   ```
   Baud rate
   9600 bits/s
   ```

   IEC 60870-5-103 communication is asynchronous. Two baud rates are supported by the relay, '9600 bits/s' and '19200 bits/s'. It is important that whatever baud rate is selected on the relay is the same as that set on the IEC 60870-5-103 master station.
5. The next cell down controls the period between IEC 60870-5-103 measurements:

   ```
   Measure't period
   30.00 s
   ```

   The IEC 60870-5-103 protocol allows the relay to supply measurements at regular intervals. The interval between measurements is controlled by this cell, and can be set between 1 and 60 seconds.
6. An optional fiber optic card is available in the relay to allow optical connection to the IEC 60870-5-103 communication to be made over an optical connection. When fitted, it converts between EIA(RS)485 signals and fiber optic signals and the following cell is visible in the menu column:

   ```
   Physical link
   Copper
   ```

The default setting is to select the electrical (copper) connection. If the optional fiber optic interface is fitted to the relay, then this setting can be changed to 'Fiber optic'. This cell is invisible if a second rear communications port or an Ethernet card is fitted, as they are mutually exclusive and occupy the same physical location.

7. The following cell which may be displayed, is not currently used but is available for future expansion.

```
InactivTimer
```

8. The next cell down can be used for monitor or command blocking:

```
CS103 Blocking
```

There are three settings associated with this cell; these are:

- **Disabled**
  No blocking selected.
- **Monitor Blocking**
  When the monitor blocking DDB Signal is active high, either by energizing an opto input or control input, reading of the status information and disturbance records is not permitted. When in this mode the relay returns a "Termination of general interrogation" message to the master station.
- **Command Blocking**
  When the command blocking DDB signal is active high, either by energizing an opto input or control input, all remote commands are ignored, such as CB Trip/Close or change setting group. When in this mode the relay returns a **negative acknowledgement of command** message to the master station.

3.1.5 Configuring the DNP3.0 Communication (Not Available)

This protocol is not available for MiCOM P74x (P741, P742 & P743) relays.

The DNP 3.0 protocol is defined and administered by the DNP User Group. Information about the user group, DNP 3.0 in general and protocol specifications can be found on their website: www.dnp.org

3.2 Configuring the Second Rear Communication Port (SK4) (where fitted)

For relays with Courier, MODBUS, IEC60870-5-103 or DNP3.0 protocol on the first rear communications port there is the hardware option of a second rear communications port, which will run the Courier language. This can be used over one of three physical links: twisted pair K-Bus (non-polarity sensitive), twisted pair EIA(RS)485 (connection polarity sensitive) or EIA(RS)232.
The settings for this port are located immediately below the ones for the first port as described in the *Introduction* chapter.

1. Move down the settings until the following sub heading is displayed.

```
Rear Port 2 (RP2)
```

2. The next cell defines the protocol, which is fixed at Courier for RP2.

```
RP2 protocol
Courier
```

3. The following cell indicates the status of the hardware.

```
RP2 card status
EIA(RS)232 OK
```

4. The following cell allows for selection of the port configuration.

```
RP2 port config.
EIA(RS)232
```

5. The port can be configured for EIA(RS)232, EIA(RS)485 or K-Bus.
   As in the case of the first rear Courier port, if K-Bus is not selected certain other cells to control the communication mode and speed become visible. If either EIA(RS)232 or EIA(RS)485 is selected for the port configuration, the next cell is visible and selects the communication mode.

```
RP2 comms.  Mode
IEC60870 FT1.2
```

6. The standard default is the IEC 60870 FT1.2 for normal operation with 11-bit modems. Alternatively, a 10-bit framing with no parity bit can be selected for special cases.
7. The next cell down sets the communications port address.

```
RP2 address
255
```

   Since up to 32 devices can be connected to one K-bus spur, it is necessary for each device to have a unique address so that messages from the master control station are accepted by one device only. Courier uses an integer number between 0 and 254 for the device address that is set with this cell. It is important that no two devices have the same Courier address. The Courier address is then used by the master station to communicate with the device. The default value is 255 and must be changed to a value in the range 0 to 254 before use.
8. The following cell controls the inactivity timer.

```
RP2 InactivTimer
15 mins.
```

9. The inactivity timer controls how long the relay will wait without receiving any messages on the rear port before it reverts to its default state. This includes revoking any password access that was enabled. The inactivity timer can be set between 1 and 30 minutes.
10. In the case of EIA(RS)232 and EIA(RS)485 the next cell down controls the baud rate. For K-Bus the baud rate is fixed at 64kbit/second between the relay and the KITZ interface at the end of the relay spur.

```
RP2 baud rate
19200
```

Courier communications is asynchronous and three selections are available to allow the relay communication rate to be matched to that of the connected equipment. The three baud rates supported by the relay are: ‘9600 bits/s’, ‘19200 bits/s’ and ‘38400 bits/s’.

If the second rear port is not used, this can also be provided with a KITZ201.

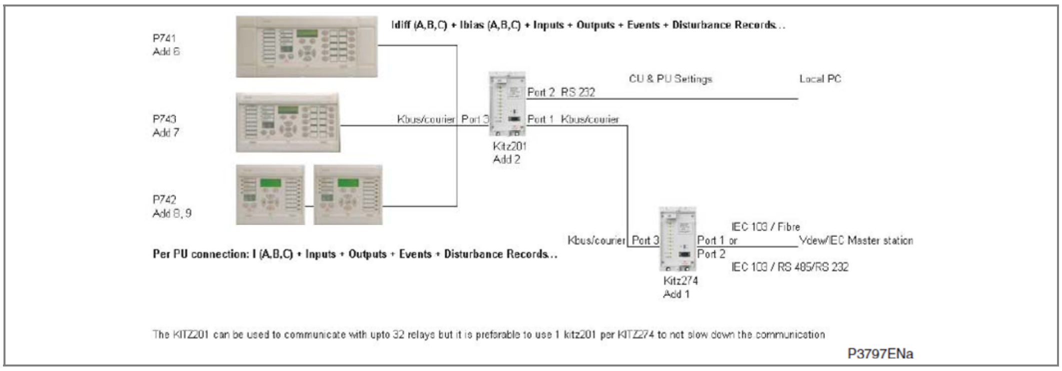

Figure 5 - Second rear port EIA(RS)232 example

Note	*The KITZ201 redates the events.*

3.3 Fiber Optic Converter (option)

An optional fiber optic card is available in this product. This converts the EIA(RS)485 protocols into a fiber optic output. This communication card is available for use on Courier, MODBUS (for products listed in the *Supported Protocols* table), IEC60870-5-103 and DNP3.0 it adds the following setting to the communication column.

This controls the physical media used for the communication:

```
Physical link
Copper
```

The default setting is to select the electrical EIA(RS)485 connection. If the optional fiber optic connectors are fitted to the relay, then this setting can be changed to ‘**Fiber optic**’. This cell is also invisible if a second rear comms. port, or Ethernet card is fitted, as it is mutually exclusive with the fiber optic connectors, and occupies the same physical location.

Where this is used, connection should be made using either 50/125µm or 62.5/125µm multi-mode optical fibers terminated with BFOC/2.5 (ST) connectors.

3.4 SK5 Port Connection

The lower 9-way D-type connector (SK5) is the InterMiCOM port, which is based on the EIA232 standard.

3.5 Ethernet Communication Legacy Protocols

It is possible to communicate through an Ethernet network using an Schneider Electric I4XS4UE (refer to P4x4/EN REB user guide for Redundant Ethernet board connexions).

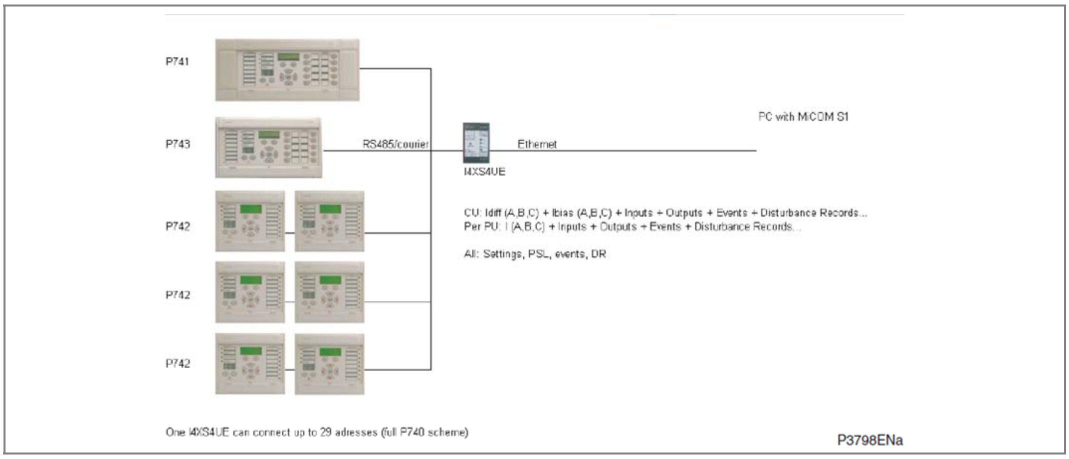

Figure 6 - Ethernet connection example

3.5.1 IEC 61850-8.1 Protocol

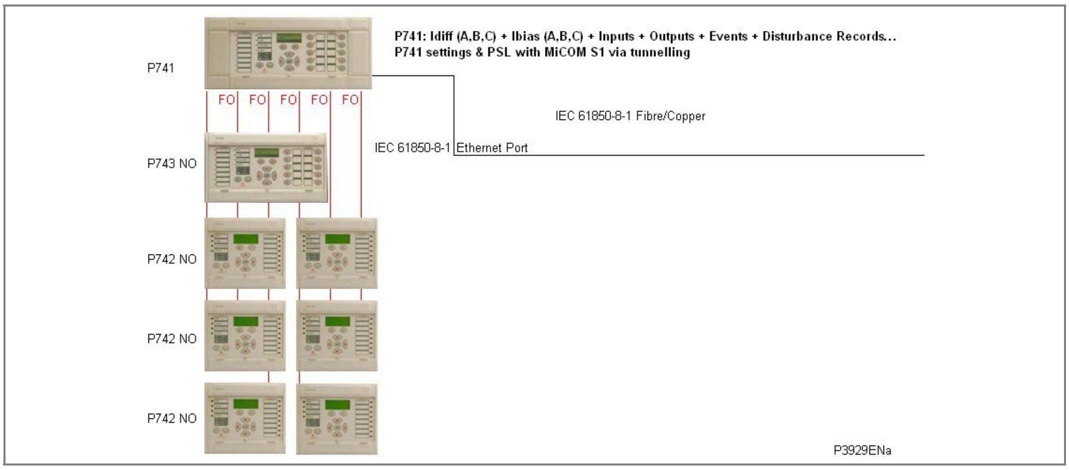

Figure 7 - Ethernet Connection to the P741 only

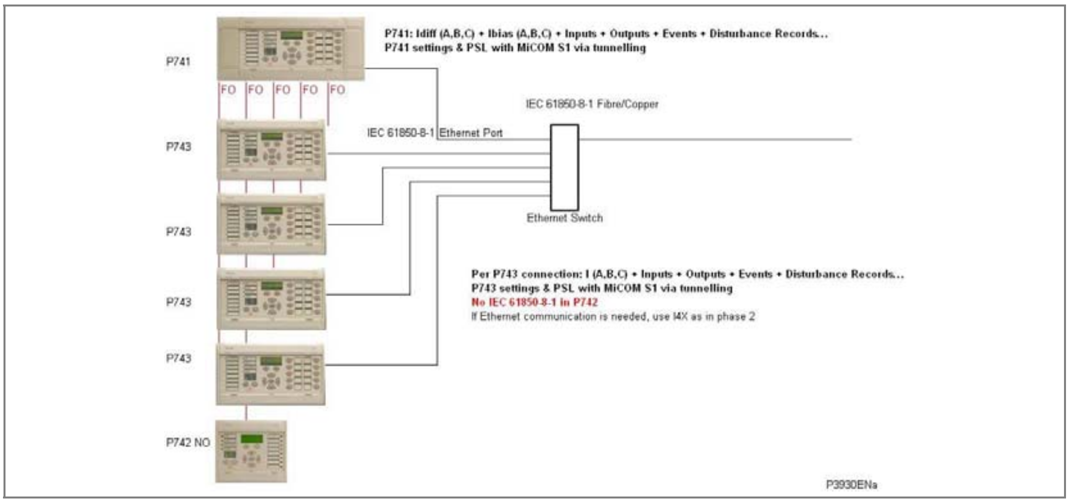

Figure 8 - Ethernet connection to the P741 and P743

4 COURIER INTERFACE

4.1 Courier Protocol

Courier is a Schneider Electric communication protocol. The concept of the protocol is that a standard set of commands is used to access a database of settings and data in the relay. This allows a generic master to be able to communicate with different slave devices. The application-specific aspects are contained in the database rather than the commands used to interrogate it, so the master station does not need to be preconfigured.

The same protocol can be used through two physical links K-Bus or EIA(RS)-232.

K-Bus is based on EIA(RS)-485 voltage levels with HDLC FM0 encoded synchronous signaling and its own frame format. The K-Bus twisted pair connection is unpolarized, whereas the EIA(RS)-485 and EIA(RS)-232 interfaces are polarized.

The EIA(RS)-232 interface uses the IEC60870-5 FT1.2 frame format.

The relay supports an IEC60870-5 FT1.2 connection on the front-port. This is intended for temporary local connection and is not suitable for permanent connection. This interface uses a fixed baud rate, 11-bit frame, and a fixed device address.

The rear interface is used to provide a permanent connection for K-Bus and allows multi-drop connection. Although K-Bus is based on EIA(RS)-485 voltage levels, it is a synchronous HDLC protocol using FM0 encoding. It is not possible to use a standard EIA(RS)-232 to EIA(RS)-485 converter to convert IEC60870-5 FT1.2 frames to K-Bus. Also it is not possible to connect K-Bus to an EIA(RS)-485 computer port. A protocol converter, such as the KITZ101, should be used for this purpose.

For a detailed description of the Courier protocol, command-set and link description, see the following documentation:

R6509	K-Bus Interface Guide
R6510	IEC60870 Interface Guide
R6511	Courier Protocol
R6512	Courier User Guide

Alternatively for direct connections, the fiber optic converter card may be used to convert the rear EIA(RS)485 port into a fiber optic (ST) port. See the *Fiber Optic Converter (option)* section for more information.

4.2 Supported Command Set

The following Courier commands are supported by the relay:

Protocol Layer:

- Reset Remote Link
- Poll Status
- Poll Buffer*

Low Level Commands:

- Send Event*
- Accept Event*
- Send Block
- Store Block Identifier
- Store Block Footer

Menu Browsing:

- Get Column Headings
- Get Column Text
- Get Column Values
- Get Strings
- Get Text
- Get Value
- Get Column Setting Limits

Setting Changes:

- Enter Setting Mode
- Preload Setting
- Abort Setting
- Execute Setting
- Reset Menu Cell
- Set Value

Control Commands:

- Select Setting Group
- Change Device Address*
- Set Real Time

Note	*Commands marked with an asterisk (*) are not supported through the front Courier port.*

4.3 Courier Database

The Courier database is two-dimensional. Each cell in the database is referenced by a row and column address. Both the column and the row can take a range from 0 to 255. Addresses in the database are specified as hexadecimal values, for example, 0A02 is column 0A (10 decimal) row 02. Associated settings or data are part of the same column. Row zero of the column has a text string to identify the contents of the column and to act as a column heading.

The *Relay Menu Database document* contains the complete database definition for the relay. For each cell location the following information is stated:

- Cell Text
- Cell Data type
- Cell value
- Whether the cell is settable, if so
    - Minimum value
    - Maximum value
    - Step size
- Password Level required to allow setting changes
- String information (for Indexed String or Binary flag cells)

4.4 Setting Changes

(See R6512, Courier User Guide - Chapter 9)
Courier provides two mechanisms for making setting changes, both of these are supported by the relay. Either method can be used for editing any of the settings in the relay database.

There are three categories of settings in the relay database:

- Control and support
- Disturbance recorder
- Protection settings group

Setting changes made to the control and support settings are implemented immediately and stored in non-volatile memory. Changes made to either the Disturbance recorder settings or the Protection Settings Groups are stored in a ‘scratchpad’ memory and are not immediately implemented by the relay.

To action setting changes stored in the scratchpad the Save **Changes cell** in the **Configuration** column must be written to. This allows the changes to either be confirmed and stored in non-volatile memory, or the setting changes to be aborted.

4.4.1 Setting Transfer Mode

If it is necessary to transfer all of the relay settings to or from the relay, a cell in the **Communication System Data** column can be used. This cell (location BF03) when set to 1 makes all of the relay settings visible. Any setting changes made with the relay set in this mode are stored in scratchpad memory, including control and support settings. When the value of BF03 is set back to 0, any setting changes are verified and stored in non-volatile memory.

4.5 Event Extraction

Events can be extracted either automatically (rear port only) or manually (either Courier port). For automatic extraction all events are extracted in sequential order using the standard Courier event mechanism, this includes fault/maintenance data if appropriate. The manual approach allows the user to select events, faults, or maintenance data at random from the stored records.

4.5.1 Automatic Event Extraction

(See Chapter 7 Courier User Guide, publication R6512).

This method is intended for continuous extraction of event and fault information as it is produced. It is only supported through the rear Courier port.

When new event information is created, the Event bit is set in the Status byte. This indicates to the Master device that event information is available. The oldest, unextracted event can be extracted from the relay using the Send Event command. The relay responds with the event data, which is either a Courier Type 0 or Type 3 event. The Type 3 event is used for fault records and maintenance records.

Once an event has been extracted from the relay, the Accept Event can be used to confirm that the event has been successfully extracted. If all events have been extracted, the event bit is reset. If there are more events still to be extracted, the next event can be accessed using the **Send Event** command as before.

4.5.2 Event Types

Events are created by the relay under these circumstances:

- Change of state of output contact
- Change of state of opto input
- Protection element operation
- Alarm condition
- Setting change
- Password entered/timed-out
- Fault record (Type 3 Courier Event)
- Maintenance record (Type 3 Courier Event)

4.5.3 Event Format

The Send Event command results in these fields being returned by the relay:

- Cell reference
- Time stamp
- Cell text
- Cell value

The *Relay Menu Database* document for the relevant product, contains a table of the events created by the relay and indicates how the contents of the above fields are interpreted. Fault records and Maintenance records return a Courier Type 3 event, which contains the above fields with two additional fields:

- Event extraction column
- Event number

These events contain additional information that is extracted from the relay using the referenced extraction column. Row 01 of the extraction column contains a setting that allows the fault/maintenance record to be selected. This setting should be set to the event number value returned in the record. The extended data can be extracted from the relay by uploading the text and data from the column.

4.5.4 Manual Event Record Extraction

Column 01 of the database can be used for manual viewing of event, fault, and maintenance records. The contents of this column depend on the nature of the record selected. It is possible to select events by event number and to directly select a fault record or maintenance record by number.

Event Record selection (Row 01)

> This cell can be set to a value between 0 to 511 to select from 512 stored events. 0 selects the most recent record and 511 the oldest stored record. For simple event records, (Type 0) cells 0102 to 0105 contain the event details. A single cell is used to represent each of the event fields. If the event selected is a fault or maintenance record (Type 3), the remainder of the column contains the additional information.

Fault Record Selection (Row 05)

> This cell can be used to select a fault record directly, using a value between 0 and 4 to select one of up to five stored fault records. (0 is the most recent fault and 4 is the oldest). The column then contains the details of the fault record selected.

Maintenance Record Selection (Row F0)

> This cell can be used to select a maintenance record using a value between 0 and 4. This cell operates in a similar way to the fault record selection.

If this column is used to extract event information from the relay, the number associated with a particular record changes when a new event or fault occurs.

4.6 Disturbance Record Extraction

Select Record Number (Row 01)

> This cell can be used to select the record to be extracted. Record 0 is the oldest unextracted record, already extracted older records are assigned positive values, and negative values are used for more recent records. To help automatic extraction through the rear port, the Disturbance bit of the Status byte is set by the relay whenever there are unextracted disturbance records.

Once a record has been selected, using the above cell, the time and date of the record can be read from cell 02. The disturbance record can be extracted using the block transfer mechanism from cell B00B. The file extracted from the relay is in a compressed format. Use MiCOM S1 Studio to decompress this file and save the disturbance record in the COMTRADE format.

As has been stated, the rear Courier port can be used to extract disturbance records automatically as they occur. This operates using the standard Courier mechanism, see *Chapter 8 of the Courier User Guide*. The front Courier port does not support automatic extraction although disturbance record data can be extracted manually from this port.

4.7 Programmable Scheme Logic (PSL Settings

The Programmable Scheme Logic (PSL) settings can be uploaded from and downloaded to the relay using the block transfer mechanism defined in the Courier User Guide.

These cells are used to perform the extraction:

- B204 Domain — Used to select either PSL settings (upload or download) or PSL configuration data (upload only)
- B208 Sub-Domain — Used to select the Protection Setting Group to be uploaded or downloaded.
- B20C Version — Used on a download to check the compatibility of the file to be downloaded with the relay.
- B21C Transfer Mode — Used to set up the transfer process.
- B120 Data Transfer Cell — Used to perform upload or download.

The PSL settings can be uploaded and downloaded to and from the relay using this mechanism. If it is necessary to edit the settings, MiCOM S1 Studio must be used because the data is compressed. MiCOM S1 Studio also performs checks on the validity of the settings before they are downloaded to the relay.

5 IEC 61850 ETHERNET INTERFACE

5.1 Introduction

IEC 61850 is the international standard for Ethernet-based communication in substations. It enables integration of all protection, control, measurement and monitoring functions in a substation, and provides the means for interlocking and inter-tripping. It combines the convenience of Ethernet with the security which is essential in substations today.

The MiCOM protection relays can integrate with the PACiS substation control systems, to complete Schneider Electric's offer of a full IEC 61850 solution for the substation. The majority of MiCOM Px3x and Px4x relay types can be supplied with Ethernet, in addition to traditional serial protocols. Relays which have already been delivered with UCA2.0 on Ethernet can be easily upgraded to IEC 61850.

5.2 What is IEC 61850?

IEC 61850 is a 14-part international standard, which defines a communication architecture for substations. It is more than just a protocol and provides:

- Standardized models for IEDs and other equipment in the substation
- Standardized communication services (the methods used to access and exchange data)
- Standardized formats for configuration files
- Peer-to-peer (for example, relay to relay) communication

The standard includes mapping of data onto Ethernet. Using Ethernet in the substation offers many advantages, most significantly including:

- High-speed data rates (currently 100 Mbits/s, rather than tens of kbits/s or less used by most serial protocols)
- Multiple masters (called “clients”)
- Ethernet is an open standard in every-day use

Schneider Electric has been involved in the Working Groups which formed the standard, building on experience gained with UCA2.0, the predecessor of IEC 61850.

5.2.1 Interoperability

A major benefit of IEC 61850 is interoperability. IEC 61850 standardizes the data model of substation IEDs which simplifies integration of different vendors’ products. Data is accessed in the same way in all IEDs, regardless of the vendor, even though the protection algorithms of different vendors’ relays may be different.

IEC 61850-compliant devices are not interchangeable, you cannot replace one device with another (although they are interoperable). However, the terminology is predefined and anyone with knowledge of IEC 61850 can quickly integrate a new device without mapping all of the new data. IEC 61850 improves substation communications and interoperability at a lower cost to the end user.

5.2.2 Data Model

To ease understanding, the data model of any IEC 61850 IED can be viewed as a hierarchy of information. The categories and naming of this information is standardized in the IEC 61850 specification.

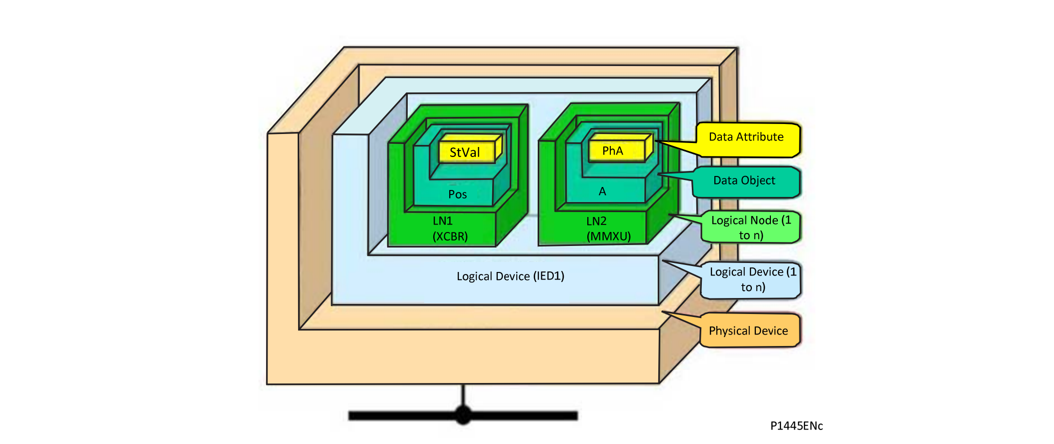

Figure 9 - Data model layers in IEC 61850

The levels of this hierarchy can be described as follows:

- Physical Device — Identifies the actual IED in a system. Typically the device's name or IP address can be used (for example **Feeder_1** or **10.0.0.2**).
- Logical Device — Identifies groups of related Logical Nodes inthe Physical Device. For the MiCOM relays, five Logical Devices exist: **Control, Measurements, Protection, Records, System**.
- Wrapper/Logical Node Instance — Identifies the major functional areas in the IEC 61850 data model. Either 3 or 6 characters are used as a prefix to define the functional group (wrapper) while the actual functionality is identified by a 4 character Logical Node name, suffixed by an instance number. For example, XCBR1 (circuit breaker), MMXU1 (measurements), FrqPTOF2 (overfrequency protection, stage 2).
- Data Object — This next layer is used to identify the type of data presented. For example, **Pos** (position) of Logical Node type **XCBR**.
- Data Attribute — This is the actual data (such as measurement value, status, and description). For example, **stVal** (status value) indicates the actual position of the circuit breaker for Data Object type **Pos** of Logical Node type **XCBR**.

5.3 IEC 61850 in MiCOM relays

IEC 61850 is implemented in MiCOM relays by use of a separate Ethernet card. This card manages the majority of the IEC 61850 implementation and data transfer to avoid any impact on the performance of the protection.

To communicate with an IEC 61850 IED on Ethernet, it is necessary only to know its IP address. This can then be configured into either:

- An IEC 61850 **client** (or **master**), for example a PACiS computer (MiCOM C264) or HMI, or
- An **MMS browser**, with which the full data model can be retrieved from the IED, without any prior knowledge

5.3.1 Capability

The IEC 61850 interface provides these capabilities:

- Read access to measurements

  All measurands are presented using the measurement Logical Nodes, in the **Measurements** Logical Device. Reported measurement values are refreshed by the relay once per second, in line with the relay user interface.

The following fault data have been mapped in LN RFLO1 of LD Records of IEC61850 data model:

- Fault voltages, Fault currents and Fault location
- Operating time of relay and Operating time of breaker
- Fault time, Fault date, etc…

Only the latest fault record can be retrieved over IEC61850.

- Generation of unbuffered reports on change of status/measurement

  Unbuffered reports, when enabled, report any change of state in statuses and measurements (according to deadband settings).
- Support for time synchronization over an Ethernet link

  Time synchronization is supported using SNTP (Simple Network Time Protocol). This protocol is used to synchronize the internal real time clock of the relays.
- GOOSE peer-to-peer communication
  GOOSE communications of statuses are included as part of the IEC 61850 implementation. See *Peer-to-Peer (GSE) Communications* for more details.
- Disturbance record extraction
  Disturbance records can be extracted from MiCOM relays by file transfer, as ASCII format COMTRADE files.
- Controls
  The following control services are available:
  - Direct Control
  - Direct Control with enhanced security
  - Select Before Operate (SBO) with enhanced security
  - Controls are applied to open and close circuit breakers using XCBR.Pos and DDB signals ‘Control Trip’ and ‘Control Close’.
  - System/LLN0. LLN0.LEDRs are used to reset any trip LED indications.
- Reports
  Reports only include data objects that have changed and not the complete dataset. The exceptions to this are a General Interrogation request and integrity reports.
- Buffered Reports
  Eight Buffered Report Control Blocks, (BRCB), are provided in SYSTEM/LLN0 in Logical Device ‘System’.
  Buffered reports are configurable to use any configurable dataset located in the same Logical device as the BRCB (SYSTEM/LLN0).
- Unbuffered Reports
  Sixteen Unbuffered Report Control Blocks (URCB) are provided in SYSTEM/LLN0 in Logical Device ‘System’.
  Unbuffered reports are configurable to use any configurable dataset located in the same Logical device as the URCB (SYSTEM/LLN0).

- Configurable Data Sets
  It is possible to create and configure datasets in any Logical Node using the IED Configurator. The maximum number of datasets will be specified in an IED's ICD file. An IED is capable of handling 100 datasets.
- Published GOOSE message
  Eight GOCBs are provided in SYSTEM/LLN0.
- Uniqueness of control
  The Uniqueness of control mechanism is implemented to be consistent with the PACiS mechanism. This requires the relay to subscribe to the OrdRun signal from all devices in the system and be able to publish such a signal in a GOOSE message.
- Select Active Setting Group
  Functional protection groups can be enabled or disabled using private mod/beh attributes in the Protection/LLN0.OcpMod object. Setting groups are selectable using the Setting Group Control Block class, (SGCB). The Active Setting Group can be selected using the System/LLN0.SP.SGCB.ActSG data attribute in Logical Device 'System'.
- Quality for GOOSE
  It is possible to process the quality attributes of any Data Object in an incoming GOOSE message. Devices that do not support IEC61850 quality flags send quality attributes as all zeros. The supported quality attributes for outgoing GOOSE messages are described in the Protocol Implementation eXtra Information for Testing (PIXIT) document.
- Address List
  An Address List document (to be titled ADL) is produced for each IED which shows the mapping between the IEC61850 data model and the internal data model of the IED. It includes a mapping in the reverse direction, which may be more useful. This document is separate from the PICS/MICS document.
- Originator of Control
  Originator of control mechanism is implemented for operate response message and in the data model on the ST of the related control object, consistent with the PACiS mechanism.
- Metering
  MMTR (metering) logical node is implemented in P14x products. All metered values in the MMTR logical node are of type BCR. The actVal attribute of the BCR class is of type INT128, but this type is not supported by the SISCO MMSLite library. Instead, an INT64 value will be encoded for transmission.
  A SPC data object named MTTRs has been included in the MMTR logical node. This control will reset the demand measurements. A SPC data object named MTTRs is also included in the PTTR logical node. This control will reset the thermal measurements.
- Scaled Measurements
  The Unit definition, as per IEC specifies an SI unit and an optional multiplier for each measurement. This allows a magnitude of measurement to be specified e.g. mA, A, kA, MA.

The multiplier will always be included in the Unit definition and will be configurable in SCL, but not settable at runtime. It will apply to the magnitude, rangeC.min & rangeC.max attributes. rangeC.min & rangeC.max will not be settable at runtime to be more consistent with Px30 and to reduce configuration problems regarding deadbands.

Setting changes, such as changes to protection settings, are done using MiCOM S1 Studio. These changes can also be done using the relay's front port serial connection or the relay's Ethernet link, and is known as "tunneling".

5.3.2 IEC 61850 Configuration

One of the main objectives of IEC 61850 is to allow IEDs to be directly configured from a configuration file generated at system configuration time. At the system configuration level, the capabilities of the IED are determined from an IED capability description file (ICD), which is provided with the product. Using a collection of these ICD files from different products, the entire protection of a substation can be designed, configured and tested (using simulation tools) before the product is even installed into the substation.

To help this process, the MiCOM S1 Studio Support Software provides an IEC61850 IED Configurator tool. Select **Tools > IEC61850 IED Configurator**. This tool allows the preconfigured IEC 61850 configuration file (SCD or CID) to be imported and transferred to the IED. The configuration files for MiCOM relays can also be created manually, based on their original IED Capability Description (ICD) file.

Other features include the extraction of configuration data for viewing and editing, and a sophisticated error-checking sequence. The error checking ensures the configuration data is valid for sending to the IED and ensures the IED functions correctly in the substation.

To help the user, some configuration data is available in the **IED CONFIGURATOR** column of the relay user interface, allowing read-only access to basic configuration data.

5.3.2.1 Configuration Banks

To promote version management and minimize down-time during system upgrades and maintenance, the MiCOM relays have incorporated a mechanism consisting of multiple configuration banks. These configuration banks are categorized as:

- Active Configuration Bank
- Inactive Configuration Bank

Any new configuration sent to the relay is automatically stored in the inactive configuration bank, therefore not immediately affecting the current configuration. Both active and inactive configuration banks can be extracted at any time.

When the upgrade or maintenance stage is complete, the IED Configurator tool can be used to transmit a command to a single IED. This command authorizes the activation of the new configuration contained in the inactive configuration bank, by switching the active and inactive configuration banks. This technique ensures that the system down-time is minimized to the start-up time of the new configuration. The capability to switch the configuration banks is also available using the **IED CONFIGURATOR** column.

For version management, data is available in the **IED CONFIGURATOR** column in the relay user interface, displaying the SCL Name and Revision attributes of both configuration banks.

5.3.2.2 Network connectivity

Note	*This section presumes a prior knowledge of IP addressing and related topics. Further details on this topic may be found on the Internet (search for IP Configuration) and in numerous relevant books.*

Configuration of the relay IP parameters (IP Address, Subnet Mask, Gateway) and SNTP time synchronization parameters (SNTP Server 1, SNTP Server 2) is performed by the IED Configurator tool. If these parameters are not available using an SCL file, they must be configured manually.

If the assigned IP address is duplicated elsewhere on the same network, the remote communications do not operate in a fixed way. However, the relay checks for a conflict at power up and every time the IP configuration is changed. An alarm is raised if an IP conflict is detected.

Use the **Gateway** setting to configure the relay to accept data from networks other than the local network.

5.4 Data Model of MiCOM Relays

The data model naming adopted in the Px30 and Px40 relays has been standardized for consistency. The Logical Nodes are allocated to one of the five Logical Devices, as appropriate, and the wrapper names used to instantiate Logical Nodes are consistent between Px30 and Px40 relays.

The data model is described in the Model Implementation Conformance Statement (MICS) document, which is available separately. The MICS document provides lists of Logical Device definitions, Logical Node definitions, Common Data Class and Attribute definitions, Enumeration definitions, and MMS data type conversions. It generally follows the format used in Parts 7-3 and 7-4 of the IEC 61850 standard.

5.5 Communication Services of MiCOM Relays

The IEC 61850 communication services which are implemented in the Px30 and Px40 relays are described in the Protocol Implementation Conformance Statement (PICS) document, which is available separately. The PICS document provides the Abstract Communication Service Interface (ACSI) conformance statements as defined in Annex A of Part 7-2 of the IEC 61850 standard.

5.6 Peer-to-Peer (GSE) Communications

The implementation of IEC 61850 Generic Object Oriented Substation Event (GOOSE) sets the way for cheaper and faster inter-relay communications. The generic substation event model provides fast and reliable system-wide distribution of input and output data values. The generic substation event model is based on autonomous decentralization This provides an efficient method of allowing simultaneous delivery of the same generic substation event information to more than one physical device, by using multicast services.

The use of multicast messaging means that IEC 61850 GOOSE uses a publisher-subscriber system to transfer information around the network*. When a device detects a change in one of its monitored status points, it publishes (sends) a new message. Any device that is interested in the information subscribes (listens) to the data message.

*Note**	*Multicast messages cannot be routed across networks without specialized equipment.*

Each new message is retransmitted at user-configurable intervals until the maximum interval is reached, to overcome possible corruption due to interference and collisions. In practice, the parameters which control the message transmission cannot be calculated. Time must be allocated to the testing of GOOSE schemes before or during commissioning; in just the same way a hardwired scheme must be tested.

5.6.1 Scope

A maximum of 64 virtual inputs are available in the PSL which can be mapped directly to a published dataset in a GOOSE message (only 1 fixed dataset is supported). All published GOOSE signals are BOOLEAN values.

Each GOOSE signal contained in a subscribed GOOSE message can be mapped to any of the 64 virtual inputs in the PSL. The virtual inputs allow the mapping to internal logic functions for protection control, directly to output contacts or LEDs for monitoring.

The MiCOM relay can subscribe to all GOOSE messages but only the following data types can be decoded and mapped to a virtual input:

- BOOLEAN
- BSTR2
- INT16
- INT32
- INT8
- UINT16
- UINT32
- UINT8

5.6.2 Simulation GOOSE Configuration

From MiCOM S1 Studio select Tools > IEC 61850 IED Configurator (Ed.2). Make sure the configuration is correct as this ensures efficient GOOSE scheme operation.

The relay can be set to publish/subscribe simulation/test GOOSE; it is important that this setting is returned to publish/receive normal GOOSE messages after testing to permit normal operation of the application and GOOSE messaging.

The relay provides a single setting to receive Simulated GOOSE, however it manages each subscribed GOOSE signal independently when the setting is set to simulated GOOSE. Each subscription (virtual input) will continue to respond to GOOSE messages without the simulation flag set; however once the relay receives a GOOSE for a subscription with the simulation flag set, it will respond to this and ignore messages without the simulation flag set. Other subscriptions (virtual inputs) which have not received a GOOSE message with the simulation flag will continue to operate as before. When the setting is reset back to normal GOOSE messaging the relay will ignore all GOOSE messages with the simulation flag set and act on GOOSE messages without the simulation flag.

WARNING **If you set the GOOSE in Simulation Mode, you MUST set it back to normal GOOSE after testing.**
IT IS POTENTIALLY EXTREMELY UNSAFE TO ATTEMPT TO USE ANY RELAY WHICH IS STILL IN GOOSE SIMULATION MODE.

5.6.3 High Performance GOOSE

In addition, the Px40 device is designed to provide maximum performance through an optimized publishing mechanism. This optimized mechanism is enabled so that the published GOOSE message is mapped using only the data attributes rather than mapping a complete data object. If data objects are mapped, the GOOSE messaging will operate correctly; but without the benefit of the optimized mechanism.

A pre-configured dataset named as "HighPerformGOOSE" is available in Ed.2 ICD template, which include all data attributes of all virtual outputs. We recommend using this dataset to get the benefit of better GOOSE performance. The optimized mechanism also applies to Ed.1 but without such a pre-configured dataset.

5.7 Ethernet Functionality

Settings relating to a failed Ethernet link are available in the ‘COMMUNICATIONS’ column of the relay user interface.

5.7.1 Ethernet Disconnection

IEC 61850 ‘Associations’ are unique and made to the relay between the client (master) and server (IEC 61850 device). If the Ethernet is disconnected, such associations are lost and must be re-established by the client. The TCP_KEEPALIVE function is implemented in the relay to monitor each association and terminate any which are no longer active.

5.7.2 Redundant Ethernet Communication Ports

For information regarding the Redundant Ethernet communication ports, refer to the stand alone document *Px4x/EN REB/B11*.

5.7.3 Loss of Power

If the relay's power is removed, the relay allows the client to re-establish associations without a negative impact on the relay’s operation. As the relay acts as a server in this process, the client must request the association. Uncommitted settings are cancelled when power is lost. Reports requested by connected clients are reset and must be re-enabled by the client when the client next creates the new association to the relay.

Notes:

INSTALLATION

CHAPTER 16

Date (month/year):	07/2016			
Products covered by this chapter:	This chapter covers the specific versions of the MiCOM products listed below. This includes ***only*** the following combinations of Software Version and Hardware Suffix.			
Hardware suffix:	P141/P142/P143	J/L	P44y (P443/P446)	K/M
	P145	J/M	P547	K
	P241	J	P54x (P543/P544/P545/P546)	K/M
	P242/P243	K	P642	J/L
	P342	J	P643	K/M
	P343/P344/P345	K	P645	K/M
	P391	A	P74x (P741/P742/P743)	J/K
	P445	J/L	P746	K/M
	P44x (P441/P442/P444)	J/K	P841	K/M
	P44x (P442/P444)	M	P849	K
Software version:	P14x (P141/P142/P143/P145)	43/44/46/ B0/B1/B2	P44y (P443/P446)	55/H4
			P547	57
	P24x (P241/P242/P243):	57	P54x (P543/P544/P545/P546)	45/55/H4
	P342/P343/P344/P345/P391	36	P64x (P642/P643/P645)	04/A0/B1
	P445	35/36/J4	P74x (P741/P742/P743)	51/A0/B1
	P44x (P441/P442/P444)	C7.x/D4.x/ D5.x/D6.x/	P746	A0/B1/B2/C1/C2
			P841	45/55/G4/H4
	P44x (P442/P444)	E0	P849	A0
Connection diagrams:	P14x (P141, P142, P143 & P145): 10P141xx (xx = 01 to 02) 10P142xx (xx = 01 to 05) 10P143xx (xx = 01 to 11) 10P145xx (xx = 01 to 11) P24x (P241, P242 & P243): 10P241xx (xx = 01 to 02) 10P242xx (xx = 01) 10P243xx (xx = 01) P34x (P342, P343, P344, P345 & P391): 10P342xx (xx = 01 to 17) 10P343xx (xx = 01 to 19) 10P344xx (xx = 01 to 12) 10P345xx (xx = 01 to 07) 10P391xx (xx = 01 to 02) P445: 10P445xx (xx = 01 to 04) P44x (P441, P442 & P444): 10P44101 (SH 1 & 2) 10P44201 (SH 1 & 2) 10P44202 (SH 1) 10P44203 (SH 1 & 2) 10P44401 (SH 1) 10P44402 (SH 1) 10P44403 (SH 1 & 2) 10P44404 (SH 1) 10P44405 (SH 1) 10P44407 (SH 1 & 2) P44y (P443 & P446): 10P44303 (SH 01 and 03) 10P44304 (SH 01 and 03) 10P44305 (SH 01 and 03) 10P44306 (SH 01 and 03) 10P44600 10P44601 (SH 1 to 2) 10P44602 (SH 1 to 2) 10P44603 (SH 1 to 2)		P54x (P543, P544, P545 & P546): 10P54302 (SH 1 to 2) 10P54303 (SH 1 to 2) 10P54400 10P54404 (SH 1 to 2) 10P54405 (SH 1 to 2) 10P54502 (SH 1 to 2) 10P54503 (SH 1 to 2) 10P54600 10P54604 (SH 1 to 2) 10P54605 (SH 1 to 2) 10P54606 (SH 1 to 2) P547: 10P54702xx (xx = 01 to 02) 10P54703xx (xx = 01 to 02) 10P54704xx (xx = 01 to 02) 10P54705xx (xx = 01 to 02) P64x (P642, P643 & P645): 10P642xx (xx = 1 to 10) 10P643xx (xx = 1 to 6) 10P645xx (xx = 1 to 9) P74x (P741, P742 & P743): 10P740xx (xx = 01 to 07) P746: 10P746xx (xx = 00 to 21) P841: 10P84100 10P84101 (SH 1 to 2) 10P84102 (SH 1 to 2) 10P84103 (SH 1 to 2) 10P84104 (SH 1 to 2) 10P84105 (SH 1 to 2) P849: 10P849xx (xx = 01 to 06)	

CONTENTS

TABLES

FIGURES

1 INTRODUCTION TO MICOM RANGE

About MiCOM Range

MiCOM is a comprehensive solution capable of meeting all electricity supply requirements. It comprises a range of components, systems and services from Schneider Electric.

Central to the MiCOM concept is flexibility. MiCOM provides the ability to define an application solution and, through extensive communication capabilities, integrate it with your power supply control system.

The components within MiCOM are:

- P range protection relays
- C range control products
- M range measurement products for accurate metering and monitoring
- S range versatile PC support and substation control packages

MiCOM products include extensive facilities for recording information on the state and behaviour of the power system using disturbance and fault records. They can also provide measurements of the system at regular intervals to a control centre enabling remote monitoring and control to take place.

For up-to-date information, please see:

www.schneider-electric.com

MiCOM Px4x Products

The MiCOM Px4x series of protection devices provide a wide range of protection and control functions and meet the requirements of a wide market segment.

Different parts of the Px4x range provide different functions. These include:

- **P14x** **Feeder Management** relay suitable for MV and HV systems
- **P24x** **Motors** and rotating machine management relay for use on a wide range of synchronous and induction machines
- **P34x** **Generator Protection** for small to sophisticated generator systems and interconnection protection
- **P445** Full scheme **Distance Protection** relays for MV, HV and EHV systems
- **P44x** Full scheme **Distance Protection** relays for MV, HV and EHV systems
- **P44y** Full scheme **Distance Protection** relays for MV, HV and EHV systems
- **P54x** **Line Differential** protection relays for HV/EHV systems with multiple communication options and phase comparison protection for use with PLC
- **P547** **Line Differential** protection relays for HV/EHV systems with multiple communication options and phase comparison protection for use with PLC
- **P64x** **Transformer Protection Relays**
- **P74x** **Numerical Busbar Protection** for use on MV, HV and EHV busbars
- **P746** **Numerical Busbar Protection** for use on MV, HV and EHV busbars
- **P84x** **Breaker Failure** protection relays

Note	*During 2011, the International Electrotechnical Commission classified the voltages into different levels (IEC 60038). The IEC defined LV, MV, HV and EHV as follows: LV is up to 1000V. MV is from 1000V up to 35 kV. HV is from 110 kV or 230 kV. EHV is above 230 KV.* *There is still ambiguity about where each band starts and ends. A voltage level defined as LV in one country or sector, may be described as MV in a different country or sector. Accordingly, LV, MV, HV and EHV suggests a possible range, rather than a fixed band. Please refer to your local Schneider Electric office for more guidance.*

2 RECEIPT, HANDLING, STORAGE AND UNPACKING RELAYS

2.1 Receipt of Relays

Protective relays, although generally of robust construction, require careful treatment prior to installation on site.

Upon receipt, relays should be examined immediately to ensure no external damage has been sustained in transit. If damage has been sustained, a claim should be made to the transport contractor and Schneider Electric should be promptly notified.

Relays that are supplied unmounted and not intended for immediate installation should be returned to their protective polythene bags and delivery carton. See the *Storage* section for more information about the storage of relays.

2.2 Handling of Electronic Equipment

Warning **Before carrying out any work on the equipment, you should be familiar with the contents of the Safety Information chapter/Safety Guide SFTY/5L M/L11 or later issue, the Technical Data chapter and the ratings on the equipment rating label.**

A person's normal movements can easily generate electrostatic potentials of several thousand volts. Discharge of these voltages into semiconductor devices when handling electronic circuits can cause serious damage which, although not always immediately apparent, will reduce the reliability of the circuit. This is particularly important to consider where the circuits use Complementary Metal Oxide Semiconductors (CMOS), as is the case with these relays.

The electronic circuits inside the relay are protected from electrostatic discharge when housed in the case. Do not expose them to risk by removing the front panel or Printed Circuit Boards (PCBs) unnecessarily.

Each PCB incorporates the highest practicable protection for its semiconductor devices. However, if it becomes necessary to remove a PCB, the following precautions should be taken to preserve the high reliability and long life for which the relay has been designed and manufactured.

- Before removing a PCB, ensure that you are at the same electrostatic potential as the equipment by touching the case.
- Handle analogue input modules by the front panel, frame or edges of the circuit boards. PCBs should only be handled by their edges. Avoid touching the electronic components, printed circuit tracks or connectors.
- Do not pass the module to another person without first ensuring you are both at the same electrostatic potential. Shaking hands achieves equipotential.
- Place the module on an anti-static surface, or on a conducting surface which is at the same potential as yourself.
- If it is necessary to store or transport printed circuit boards removed from the case, place them individually in electrically conducting anti-static bags.

In the unlikely event that you are making measurements on the internal electronic circuitry of a relay in service, it is preferable that you are earthed to the case with a conductive wrist strap. Wrist straps should have a resistance to ground between 500kΩ to 10MΩ. If a wrist strap is not available you should maintain regular contact with the case to prevent a build-up of electrostatic potential. Instrumentation which may be used for making measurements should also be earthed to the case whenever possible.

More information on safe working procedures for all electronic equipment can be found in IEC 61340-5-1. It is strongly recommended that detailed investigations on electronic circuitry or modification work should be carried out in a special handling area such as described in the aforementioned Standard document.

2.3 Storage

If relays are not to be installed immediately upon receipt, they should be stored in a place free from dust and moisture in their original cartons. Where de-humidifier bags have been included in the packing they should be retained. The action of the de-humidifier crystals will be impaired if the bag is exposed to ambient conditions and may be restored by gently heating the bag for about an hour prior to replacing it in the carton.

To prevent battery drain during transportation and storage a battery isolation strip is fitted during manufacture. With the lower access cover open, presence of the battery isolation strip can be checked by a red tab protruding from the positive side.

Care should be taken on subsequent unpacking that any dust which has collected on the carton does not fall inside. In locations of high humidity the carton and packing may become impregnated with moisture and the de-humidifier crystals will lose their efficiency.

Prior to installation, relays should be stored at a temperature of between -40°C to +70°C (-13°F to +158°F).

2.4 Unpacking

Care must be taken when unpacking and installing the relays so that none of the parts are damaged and additional components are not accidentally left in the packing or lost. Make sure that any user’s CDROM or technical documentation is NOT discarded, and accompanies the relay to its destination substation.

Note	*With the lower access cover open, the red tab of the battery isolation strip will be seen protruding from the positive side of the battery compartment. Do not remove this strip because it prevents battery drain during transportation and storage and will be removed as part of the commissioning tests.*

Relays must only be handled by skilled persons.

The site should be well lit to facilitate inspection, clean, dry and reasonably free from dust and excessive vibration. This particularly applies to installations which are being carried out at the same time as construction work.

3 RELAY MOUNTING

MiCOM relays are dispatched either individually or as part of a panel/rack assembly. Individual relays are normally supplied with an outline diagram showing the dimensions for panel cut-outs and hole centres. This information can also be found in the product publication.

Secondary front covers can also be supplied as an option item to prevent unauthorised changing of settings and alarm status. They are available in sizes 40TE and 60TE. The 60TE cover also fits the 80TE case size of the relay.

Product	Size	Part No
P14x	40TE 60TE / 80TE	GN0037 001 GN0038 001
P24xxxxxxxxxxxA P24xxxxxxxxxxxC	40TE 60TE / 80TE	GN0037 001 GN0038 001
P24xxxxxxxxxxxJ P24xxxxxxxxxxxK	40TE 60TE / 80TE	GN0242 001 GN0243 001
P34xxxxxxxxxxxA P34xxxxxxxxxxxC	40TE 60TE / 80TE	GN0037 001 GN0038 001
P34xxxxxxxxxxxJ P34xxxxxxxxxxxK	40TE 60TE / 80TE	GN0242 001 GN0243 001
P44x	40TE 60TE / 80TE	GN0037 001 GN0038 001
P44y	60TE / 80TE	GN0038 001
P445	40TE 60TE / 80TE	GN0037001 GN0038 001
P54x	60TE / 80TE	GN0038 001
P547	60TE / 80TE	GN0038 001
P64xxxxxxxxxxxA/B/C	40TE 60TE / 80TE	GN0037 001 GN0038 001
P64xxxxxxxxxxxJ/K	40TE 60TE / 80TE	GN0242 001 GN0243 001
P74x P74x	40TE 60TE	GN0037 001 GN0038 001
P746	80TE	GN0038 001
P841	60TE / 80TE	GN0038 001
P849	80TE	GN0038 001

Note *The Part Numbers suitable for rack-mounting have an "N" as the 10th digit. The Part Numbers suitable for panel-mounting have an "M" as the 10th digit.*

Table 1 - Products, sizes and part numbers

The design of the relay is such that the fixing holes in the mounting flanges are only accessible when the access covers are open and hidden from sight when the covers are closed.

If a MiCOM P991 or Easergy test block is to be included with the relays, we recommend you position the test block on the right-hand side of the associated relays (when viewed from the front). This minimises the wiring between the relay and test block, and allows the correct test block to be easily identified during commissioning and maintenance tests.

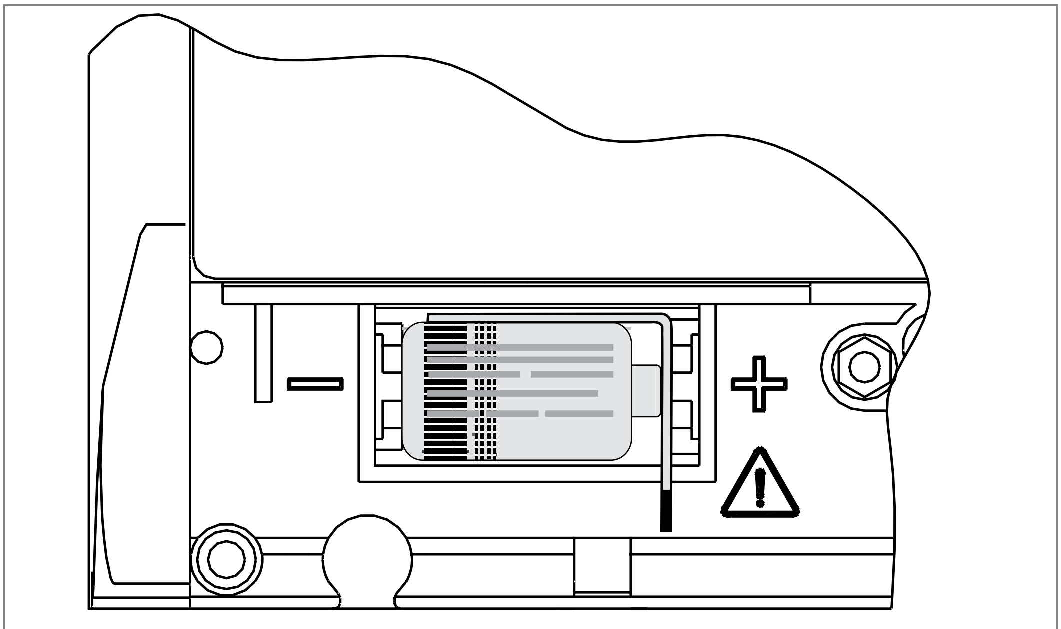

Figure 1 - Location of battery isolation strip

If you need to test correct relay operation during the installation, the battery isolation strip can be removed but should be replaced if commissioning of the scheme is not imminent. This will prevent unnecessary battery drain during transportation to site and installation. The red tab of the isolation strip can be seen protruding from the positive side of the battery compartment when the lower access cover is open. To remove the isolation strip, pull the red tab whilst lightly pressing the battery to prevent it falling out of the compartment. When replacing the battery isolation strip, ensure that the strip is refitted as shown in the *Location of battery isolation strip* diagram, i.e. with the strip behind the battery with the red tab protruding.

3.1 Rack Mounting

Virtually all MiCOM relays can be rack mounted using single tier rack frames (part number FX0021 101), see the ***Rack mounting of relays*** diagram below. These frames have dimensions in accordance with IEC 60297 and are supplied pre-assembled ready to use. On a standard 483 mm rack this enables combinations of case widths up to a total equivalent of size 80TE to be mounted side-by-side.
The two horizontal rails of the rack frame have holes drilled at approximately 26 mm intervals and the relays are attached via their mounting flanges using M4 Taptite self-tapping screws with captive 3 mm thick washers (also known as a SEMS unit). These fastenings are available in packs of 5 (part number ZA0005 104).

Warning	**Risk of damage to the front cover moulding. Do not use conventional self-tapping screws, including those supplied for mounting other relays because they have slightly larger heads.**

Once the tier is complete, the frames are fastened into the racks using mounting angles at each end of the tier.

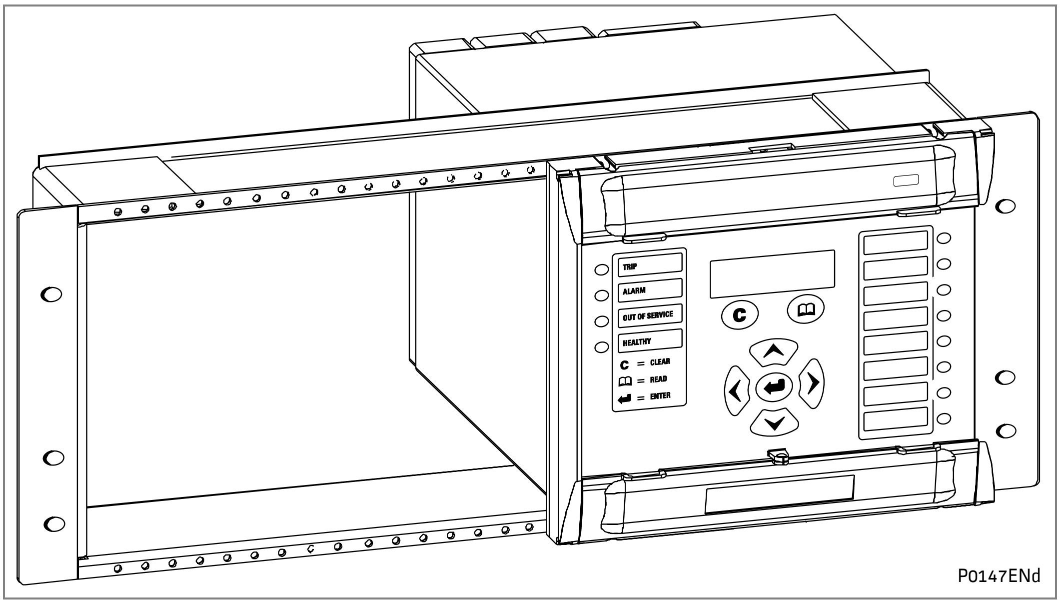

Figure 2 - Rack mounting of relays

Relays can be mechanically grouped into single tier (4U) or multi-tier arrangements by the rack frame. This enables schemes using MiCOM products to be pre-wired together prior to mounting.

Use blanking plates if there are empty spaces. The spaces may be for future installation of relays or because the total size is less than 80TE on any tier. Blanking plates can also be used to mount ancillary components. The following ***Blanking plates*** table shows the sizes that can be ordered.

Note	*Blanking plates are only available in grey.*

Case size summation	Blanking plate part number
5TE	GJ2028 101
10TE	GJ2028 102
15TE	GJ2028 103
20TE	GJ2028 104
25TE	GJ2028 105
30TE	GJ2028 106
35TE	GJ2028 107
40TE	GJ2028 108

Table 2 - Blanking plates

3.2 Panel Mounting

The relays can be flush mounted into panels using M4 SEMS Taptite self-tapping screws with captive 3 mm thick washers (also known as a SEMS unit). These fastenings are available in packs of 5 (part number ZA0005 104).

Warning	**Risk of damage to the front cover moulding. Do not use conventional self-tapping screws, including those supplied for mounting other relays because they have slightly larger heads.**

Alternatively tapped holes can be used if the panel has a minimum thickness of 2.5 mm. If several relays are mounted in a single cut-out in the panel, mechanically group them together horizontally or vertically to form rigid assemblies prior to mounting in the panel.

Note	*Fastening MiCOM relays with pop rivets is not advised because this does not allow easy removal if repair is necessary.*

Rack-mounting panel-mounted versions: it is possible to rack-mount some relay versions which have been designed to be panel-mounted. The relay is mounted on a single-tier rack frame, which occupies the full width of the rack. To make sure a panel-mounted relay assembly complies with BS EN60529 IP52, fit a metallic sealing strip between adjoining relays (Part No GN2044 001) and a sealing ring from the following ***IP52 sealing rings*** table around the complete assembly.

Width	Single tier	Double tier
40TE	GJ9018 008	GJ9018 024
45TE	GJ9018 009	GJ9018 025
50TE	GJ9018 010	GJ9018 026
55TE	GJ9018 011	GJ9018 027
60TE	GJ9018 012	GJ9018 028
65TE	GJ9018 013	GJ9018 029
70TE	GJ9018 014	GJ9018 030
75TE	GJ9018 015	GJ9018 031
80TE	GJ9018 016	GJ9018 032

Table 3 - IP52 sealing rings

4 RELAY WIRING

This section serves as a guide to selecting the appropriate cable and connector type for each terminal on the MiCOM relay.

Warning	**Before carrying out any work on the equipment, you should be familiar with the contents of the Safety Information chapter/Safety Guide SFTY/5L M/L11 or later issue, the Technical Data chapter and the ratings on the equipment rating label.**

4.1 Medium and Heavy Duty Terminal Block Connections

Key:

Heavy duty terminal block: CT and VT circuits, terminals with “C”,“D” or “F” prefix (depending on the relay)

Medium duty: All other terminal blocks (grey color)

Loose relays are supplied with sufficient M4 screws for making connections to the rear mounted terminal blocks using ring terminals, with a recommended maximum of two ring terminals per relay terminal.

If required, Schneider Electric can supply M4 90° crimp ring terminals in three different sizes depending on wire size (see the *M4 90° crimp ring terminals* table). Each type is available in bags of 100.

Part number	Wire size	Insulation colour
ZB9124 901	0.25 – 1.65mm^2 (22 – 16AWG)	Red
ZB9124 900	1.04 – 2.63mm^2 (16 – 14AWG)	Blue
ZB9124 904	2.53 – 6.64mm^2 (12 – 10AWG)	Uninsulated*

Note   ** To maintain the terminal block insulation requirements for safety, fit an insulating sleeve over the ring terminal after crimping.*

Table 4 - M4 90° crimp ring terminals

The following minimum wire sizes are recommended:

- Current Transformers 2.5mm^2
- Auxiliary Supply Vx 1.5mm^2
- RS485 Port See separate section
- Rotor winding to P391 1.0mm^2
- Other circuits 1.0mm^2

Due to the limitations of the ring terminal, the maximum wire size that can be used for any of the medium or heavy duty terminals is 6.0mm^2 using ring terminals that are not pre-insulated. Where it required to only use pre-insulated ring terminals, the maximum wire size that can be used is reduced to 2.63mm^2 per ring terminal. If a larger wire size is required, two wires should be used in parallel, each terminated in a separate ring terminal at the relay.

The wire used for all connections to the medium and heavy duty terminal blocks, except the RS485 port, should have a minimum voltage rating of 300Vrms.

It is recommended that the auxiliary supply wiring should be protected by a 16A maximum High Rupture Capacity (HRC) fuse of type NIT or TIA. For safety reasons, current transformer circuits must never be fused. Other circuits should be appropriately fused to protect the wire used.

Note   *The high-break contacts optional fitted to P44y (P443/P446) and P54x relays are polarity sensitive. External wiring must respect the polarity requirements which are shown on the external connection diagram to ensure correct operation.*

Each opto input has selectable filtering. This allows use of a pre-set filter of ½ cycle which renders the input immune to induced noise on the wiring: although this method is secure it can be slow, particularly for intertripping. This can be improved by switching off the ½ cycle filter in which case one of the following methods to reduce ac noise should be considered. The first method is to use double pole switching on the input, the second is to use screened twisted cable on the input circuit. The recognition time of the opto inputs without the filtering is <2 ms and with the filtering is <12 ms.

4.2 EIA(RS)485 Port

Connections to the first rear EIA(RS)485 port use ring terminals. 2-core screened cable is recommended with a maximum total length of 1000m or 200nF total cable capacitance.
A typical cable specification would be:

Each core:	16/0.2mm copper conductors. PVC insulated
Nominal conductor area:	0.5mm^2 per core
Screen:	Overall braid, PVC sheathed

See the SCADA Communications chapter for details of setting up an EIA(RS)485 bus.

4.3 Current Loop Input Output (CLIO) Connections (if applicable)

Where current loop inputs and outputs are available on a MiCOM relay, the connections are made using screw clamp connectors, as per the RTD inputs, on the rear of the relay which can accept wire sizes between 0.1 mm^2 and 1.5 mm^2. It is recommended that connections between the relay and the current loop inputs and outputs are made using a screened cable. The wire should have a minimum voltage rating of 300 Vrms.

4.4 IRIG-B Connections (if applicable)

The IRIG-B input and BNC connector have a characteristic impedance of 50Ω. It is recommended that connections between the IRIG-B equipment and the relay are made using coaxial cable of type RG59LSF with a halogen free, fire retardant sheath.

4.5 EIA(RS)232 Port

Short term connections to the RS232 port, located behind the bottom access cover, can be made using a screened multi-core communication cable up to 15m long, or a total capacitance of 2500pF. The cable should be terminated at the relay end with a 9-way, metal shelled, D-type male plug. The Getting Started chapter of this manual details the pin allocations.

4.6 Optical Fiber Connectors (when applicable)

Warning **LASER LIGHT RAYS: Where fibre optic communication devices are fitted, never look into the end of a fiber optic due to the risk of causing serious damage to the eye. Optical power meters should be used to determine the operation or signal level of the device. Non-observance of this rule could possibly result in personal injury.**

If electrical to optical converters are used, they must have management of character idle state capability (for when the fibre optic cable interface is "Light off").
Specific care should be taken with the bend radius of the fibres, and the use of optical shunts is not recommended as these can degrade the transmission path over time.
The relay uses 1310nm multi mode 100BaseFx and BFOC 2.5 - (ST/LC according to the MiCOM model) connectors (one Tx – optical emitter, one Rx – optical receiver).

4.7 Ethernet Port for IEC 61850 and/or DNP3.0 (where applicable)

4.7.1 Fiber Optic (FO) Port

The relays can have 100 Mbps Ethernet port. Fibre Optic (FO) connection is recommended for use in permanent connections in a substation environment. The 100 Mbit port uses a type LC connector (according to the MiCOM model), compatible with fiber multimode 50/125 µm or 62.5/125 µm to 1310 nm.

Note	*The new LC fiber optical connector can be used with the Px40 Enhanced Ethernet Board.*

4.7.2 RJ-45 Metallic Port

The user can connect to either a 10Base-T or a 100Base-TX Ethernet hub; the port will automatically sense which type of hub is connected. Due to possibility of noise and interference on this part, it is recommended that this connection type be used for short-term connections and over short distance. Ideally, where the relays and hubs are located in the same cubicle.
The connector for the Ethernet port is a shielded RJ-45. The following ***Signals on the Ethernet connector*** table shows the signals and pins on the connector.

Pin	Signal name	Signal definition
1	TXP	Transmit (positive)
2	TXN	Transmit (negative)
3	RXP	Receive (positive)
4	-	Not used
5	-	Not used
6	RXN	Receive (negative)
7	-	Not used
8	-	Not used

Table 5 - Signals on the Ethernet connector

4.8 RTD Connections (if applicable)

Where RTD inputs are available on a MiCOM relay, the connections are made using screw clamp connectors on the rear of the relay that can accept wire sizes between 0.1 mm^2 and 1.5 mm^2. The connections between the relay and the RTDs must be made using a screened 3-core cable with a total resistance less than 10 Ω. The cable should have a minimum voltage rating of 300 Vrms.
A 3-core cable should be used even for 2-wire RTD applications, as it allows for the cable's resistance to be removed from the overall resistance measurement. In such cases the third wire is connected to the second wire at the point the cable is joined to the RTD.
The screen of each cable must only be earthed at one end, preferably at the relay end and must be continuous. Multiple earthing of the screen can cause circulating current to flow along the screen, which induces noise and is unsafe.
It is recommended to minimize noise pick-up in the RTD cables by keeping them close to earthed metal casings and avoiding areas of high electromagnetic and radio interference. The RTD cables should not be run adjacent to or in the same conduit as other high voltage or current cables.
A typical cable specification would be:

Each core:	7/0.2 mm copper conductors heat resistant PVC insulated
Nominal conductor area:	0.22 mm^2 per core
Screen:	Nickel-plated copper wire braid heat resistant PVC sheathed

The extract below may be useful in defining cable recommendations for the RTDs:
Noise pick-up by cables can be categorized in to three types:

- Resistive
- Capacitive
- Inductive

Resistive coupling	requires there to be an electrical connection to the noise source. So assuming that the wire and cable insulation is sound and that the junctions are clean then this can be dismissed.
Capacitive coupling	requires there to be sufficient capacitance for the impedance path to the noise source to be small enough to allow for significant coupling. This is a function of the dielectric strength between the signal cable on the noise source and the potential (i.e. power) of the noise source.
Inductive coupling	occurs when the signal cable is adjacent to a cable/wire carrying the noise or it is exposed to a radiated EMF.

Standard screened cable is normally used to protect against capacitively coupled noise, but in order for it to be effective the screen must only be bonded to the system ground at one point, otherwise a current could flow and the noise would be coupled in to the signal wires of the cable. There are different types of screening available, but basically there are two types: aluminum foil wrap and tin-copper braid.

Foil screens are good for low to medium frequencies and braid is good for high frequencies. High-fidelity screen cables provide both types.

Protection against magnetic inductive coupling requires very careful cable routing and magnetic shielding. The latter can be achieved with steel-armored cable and the use of steel cable trays. It is important that the armor of the cable is grounded at both ends so that the EMF of the induced current cancels the field of the noise source and hence shields the cables conductors from it. (However, the design of the system ground must be considered and care taken to not bridge two isolated ground systems since this could be hazardous and defeat the objectives of the original ground design). The cable should be laid in the cable trays as close as possible to the metal of the tray and under no circumstance should any power cable be in or near to the tray. (Power cables should only cross the signal cables at 90 degrees and never be adjacent to them).

Both the capacitive and inductive screens must be contiguous from the RTD probes to the relay terminals.

The best types of cable are those provided by the RTD manufactures. These tend to be three conductors (a so-called "triad") which are screened with foil. Such triad cables are available in armored forms as well as multi-triad armored forms.

4.9 Download/Monitor Port

Short term connections to the download/monitor port, located behind the bottom access cover, can be made using a screened 25-core communication cable up to 4m long. The cable should be terminated at the relay end with a 25-way, metal shelled, D-type male plug.

The Getting Started and Commissioning chapters this manual details the pin allocations.

4.10 Second EIA(RS)232/485 Port

Relays with Courier, MODBUS, IEC 60870-5-103 or DNP3 protocol on the first rear communications port have the option of a second rear port, running Courier protocol.

The second rear communications port can be used over one of three physical links:

- twisted pair K-Bus (non-polarity sensitive),
- twisted pair EIA(RS)485 (connection polarity sensitive) or
- EIA(RS)232. This EIA(RS)232 port is actually compliant to EIA(RS)574; the 9-pin version of EIA(RS)232, see www.tiaonline.org.

4.10.1 Connection to the Second Rear Port

The second rear Courier port connects via a 9-way female D-type connector (SK4) in the middle of the card end plate (in between IRIG-B connector and lower D-type). The connection is compliant to EIA(RS)574.

4.10.1.1 For IEC 60870-5-2 over EIA(RS)232/574

Pin	Connection
1	No Connection
2	RxD
3	TxD
4	DTR#
5	Ground
6	No Connection
7	RTS #
8	CTS #
9	No Connection
# - These pins are control lines for use with a modem.	

Table 6 - Pin connections for IEC 60870-5-2 over EIA(RS)232/574

Connections to the second rear port configured for EIA(RS)232 operation can be made using a screened multi-core communication cable up to 15 m long, or a total capacitance of 2500 pF. The cable should be terminated at the relay end with a 9-way, metal shelled, D-type male plug. The table above details the pin allocations.

4.10.1.2 For K-bus or IEC 60870-5-2 over EIA(RS)485

Pin*	Connection
4	EIA(RS)485 - 1 (+ ve)
7	EIA(RS)485 - 2 (- ve)
* - All other pins unconnected.	

Note *Connector pins 4 and 7 are used by both the EIA(RS)232/574 and EIA(RS)485 physical layers, but for different purposes. Therefore, the cables should be removed during configuration switches.*
For the EIA(RS)485 protocol an EIA(RS)485 to EIA(RS)232/574 converter will be required to connect a modem or PC running MiCOM S1 Studio, to the relay. A Schneider Electric CK222 is recommended.
EIA(RS)485 is polarity sensitive, with pin 4 positive (+) and pin 7 negative (-).
The K-Bus protocol can be connected to a PC via a KITZ101 or 102.
It is recommended that a 2-core screened cable be used. To avoid exceeding the second communications port flash clearances it is recommended that the length of cable between the port and the communications equipment should be less than 300 m. This length can be increased to 1000 m or 200nF total cable capacitance if the communications cable is not laid in close proximity to high current carrying conductors. The cable screen should be earthed at one end only.

Table 7 - Pin connections for K-bus or IEC 60870-5-2 over EIA(RS)485

A typical cable specification would be:

Each core:	16/0.2mm copper conductors. PVC insulated
Nominal conductor area:	0.5mm^2 per core
Screen:	Overall braid, PVC sheathed

4.11 Earth Connection (Protective Conductor)

Every relay must be connected to the local earth bar using the M4 earth studs in the bottom left hand corner of the relay case. The minimum recommended wire size is 2.5mm^2 and should have a ring terminal at the relay end.

Due to the limitations of the ring terminal, the maximum wire size that can be used for any of the medium or heavy duty terminals is 6.0mm^2 per wire. If a greater cross-sectional area is required, two parallel connected wires, each terminated in a separate ring terminal at the relay, or a metal earth bar could be used.

Note	*To prevent any possibility of electrolytic action between brass or copper earth conductors and the rear panel of the relay, precautions should be taken to isolate them from one another. This could be achieved in a number of ways, including placing a nickel-plated or insulating washer between the conductor and the relay case, or using tinned ring terminals.*

Warning	**Before carrying out any work on the equipment, you should be familiar with the contents of the Safety Information chapter/Safety Guide SFTY/5L M/L11 or later issue, the Technical Data chapter and the ratings on the equipment rating label.**

4.12 P391 Rotor Earth Fault Unit (REFU) Mounting

Under rotor earth fault conditions, DC currents of up to 29mA can appear in the earth circuit. Accordingly, the P391 must be permanently connected to the local earth via the protective conductor terminal provided.

This section serves as a guide to selecting the appropriate cable and connector type for each terminal on the P391 unit.

Caution	**You must be familiar with all safety statements listed in the Commissioning chapter and the Safety Information section SFTY/4LM/G11 (or later issue) before undertaking any work on the P391.**

Caution	**Under no circumstances should the high voltage DC rotor winding supply be connected via Easergy or P99x test blocks. Both Easergy and P990 test blocks are not rated for continuous working voltages greater than 300 Vrms. These test blocks are not designed to withstand the inductive EMF voltages which will be experienced on disconnection or de-energization of the DC rotor winding supply.**

4.12.1 Medium Duty Terminal Block Connections

Information about the medium duty terminal block connections is described in the ***Medium and Heavy Duty Terminal Block Connections*** section.

Caution	**Wiring between the DC rotor winding and the P391 must be suitably rated to withstand at least twice the rotor winding supply voltage to earth. This is to ensure that the wiring insulation can withstand the inductive Electro Motive Force (EMF) voltage which will be experienced on disconnection or de-energization of the DC rotor winding supply.**

Due to the limitations of the ring terminal, the maximum wire size that can be used for any of the medium terminals is 6.0 mm^2 using ring terminals that are not pre-insulated (protective conductor terminal (PCT) only). All P391 terminals, except PCT shall be pre-insulated ring terminals, the maximum wire size that can be used is reduced to 2.63 mm^2 per ring terminal.

Wiring between the DC rotor winding and the P391 shall be suitably rated to withstand at least twice the rotor winding supply voltage to earth. The wire used for other P391 connections to the medium duty terminal blocks should have a minimum voltage rating of 300 Vrms.

The dielectric withstand of P391 injection resistor connections (A16, B16, A8, B8) to earth is 5.8 kV rms, 1 minute.

It is recommended that the auxiliary supply wiring should be protected by a High Rupture Capacity (HRC) fuse of type NIT or TIA, rated between 2 A and 16 A. Other circuits should be appropriately fused to protect the wire used.

5 CASE DIMENSIONS

The MiCOM range of products are available in a series of different case sizes.
The case sizes available for each product are shown here:

Range	Case Size		
	40TE	**60TE**	**80TE**
P14x	P141, P142	P143, P145	P143
P24x	P241	P242	P243
P34x	P341, P342	P341, P342, P343	P343, P344, P345
P441	P441		
P44x		P442	P444
P44y			P443, P446
P445	P445	P445	
P541	P541		
P542		P542	
P54x		P543, P544	P545, P546
P547			P547
P64x	P642	P643, P645	P645
P74x	P742	P743	P741
P746			P746
P841		P841	P841
P849			P849

Table 8 - Products and case sizes

5.1 40TE Case Dimensions

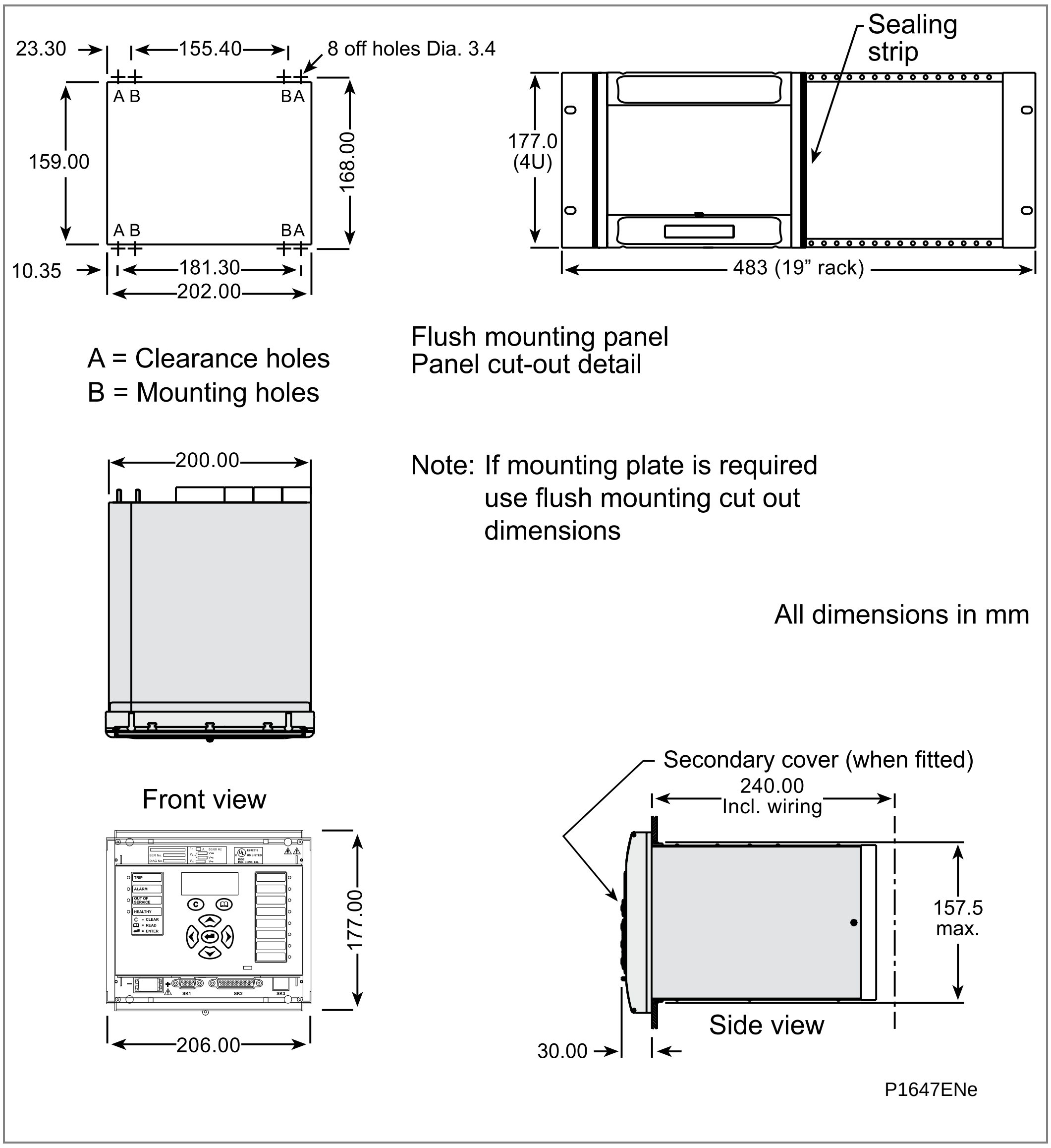

Figure 3 - 40TE Case Dimensions

5.2 60TE Case Dimensions

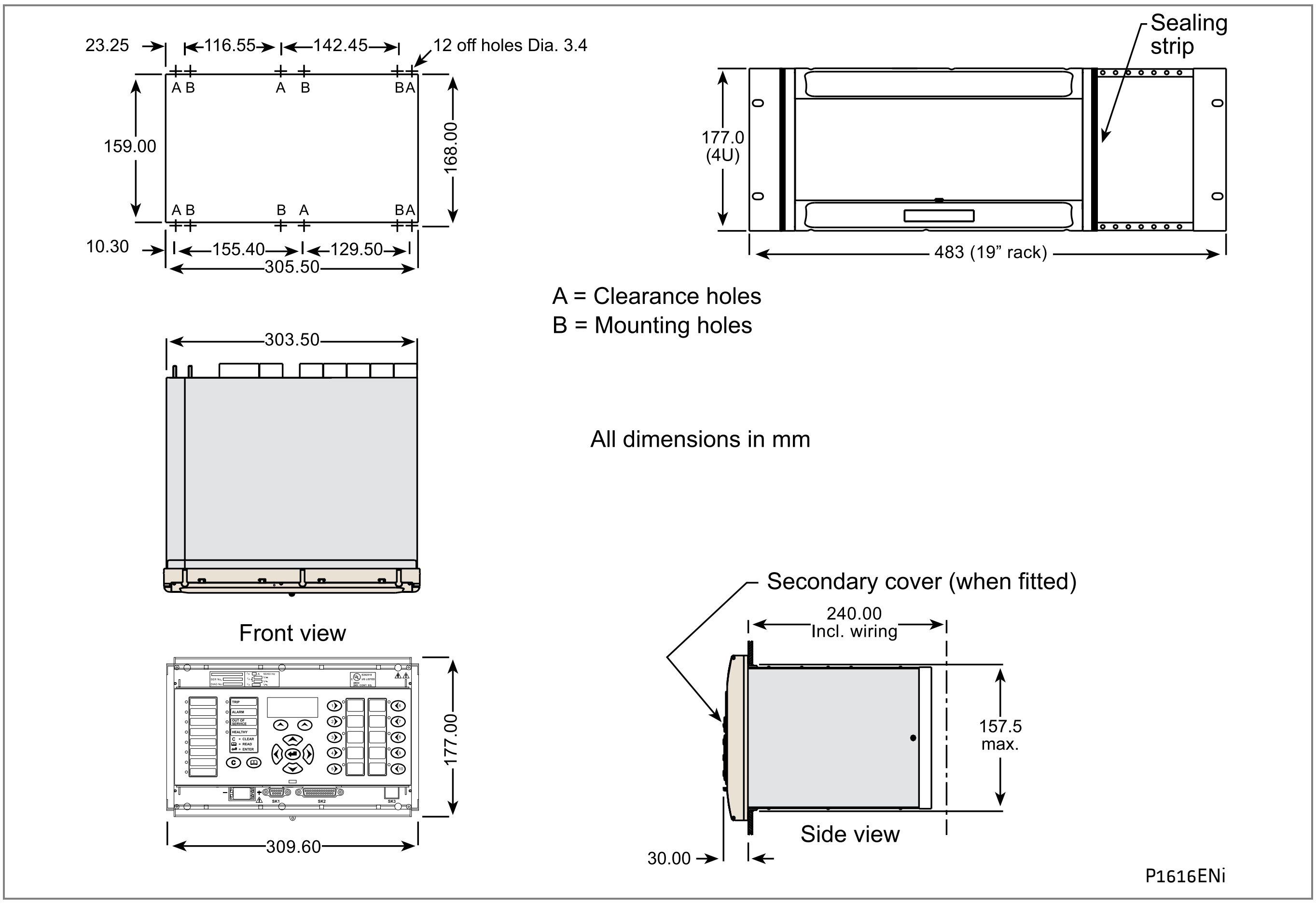

Figure 4 - 60TE Case Dimensions

5.3 80TE Case Dimensions

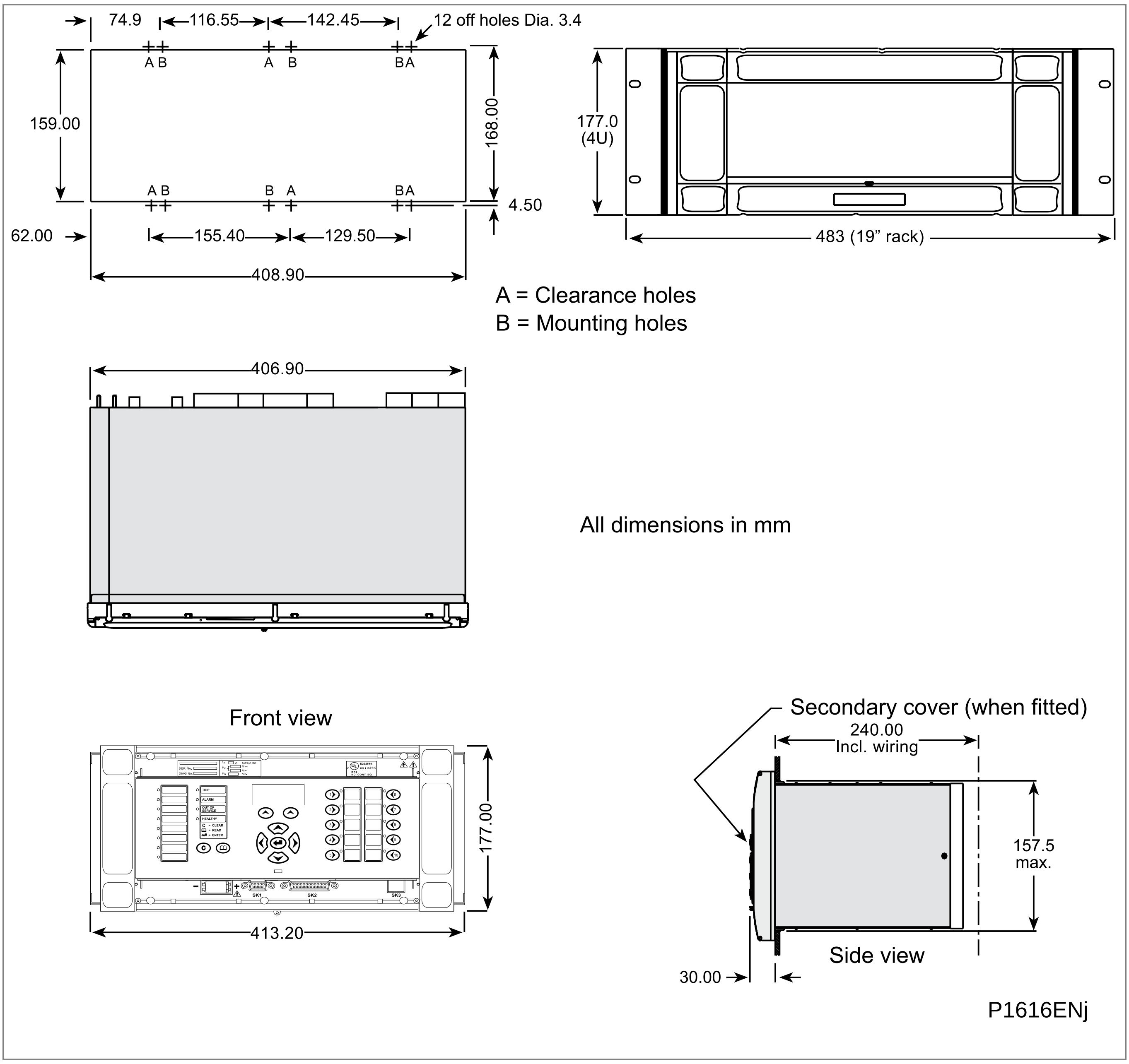

Figure 5 - 80TE Case Dimensions

CONNECTION DIAGRAMS

CHAPTER 17

Date:	02/2017
Products covered by this chapter:	This chapter covers the specific versions of the MiCOM products listed below. This includes ***only*** the following combinations of Software Version and Hardware Suffix.
Hardware Suffix:	L (P742) & M (P741 & P743)
Software Version:	B1
Connection Diagrams:	10P740xx (xx = 01 to 07)

CONTENTS

FIGURES

Notes:

1 COMMUNICATION OPTIONS

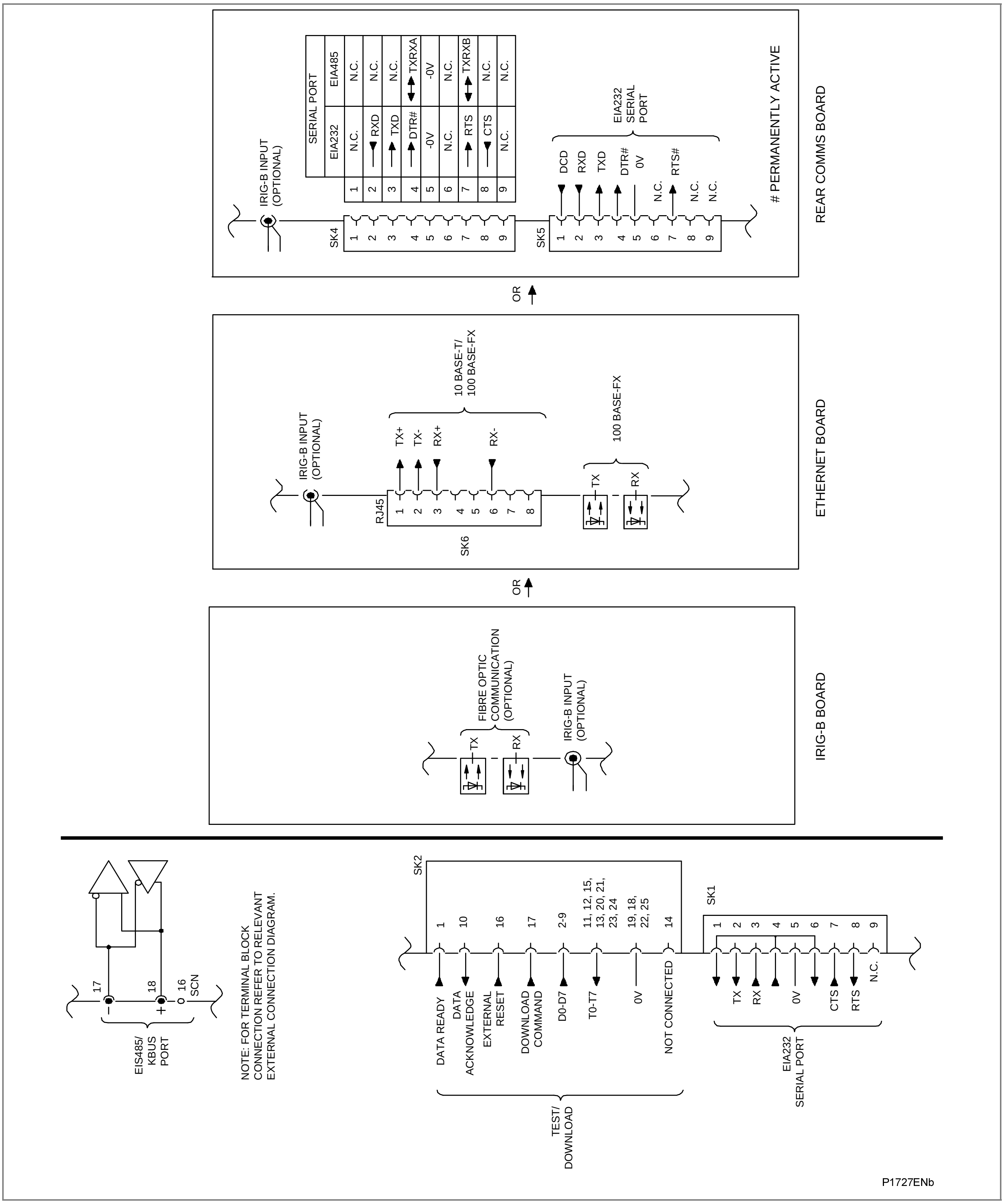

Figure 1 - Comms. Options MiCOM Px40 platform

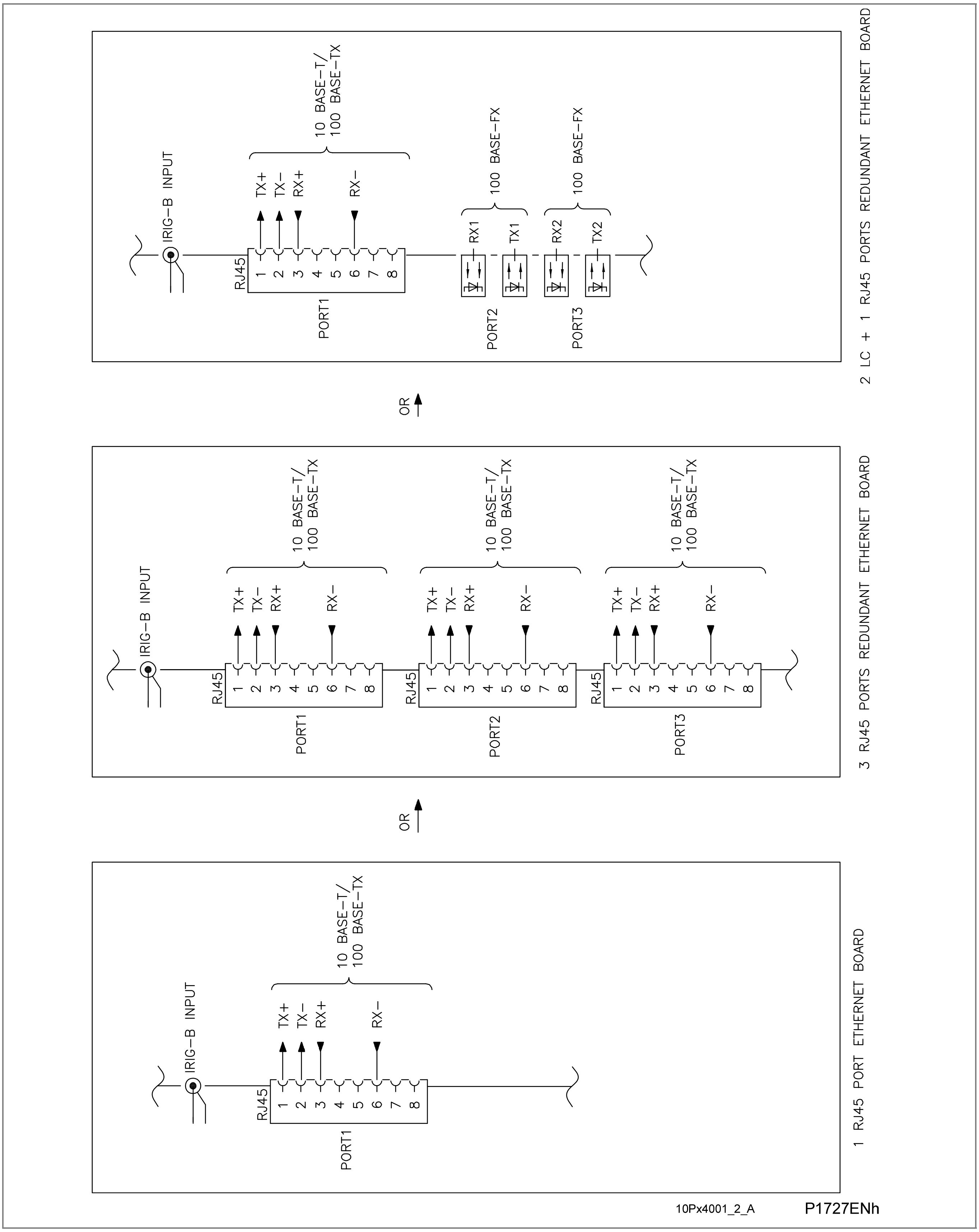

Figure 2 - External Communications Options MiCOM Px40 platform

2 P741 - CENTRAL UNIT

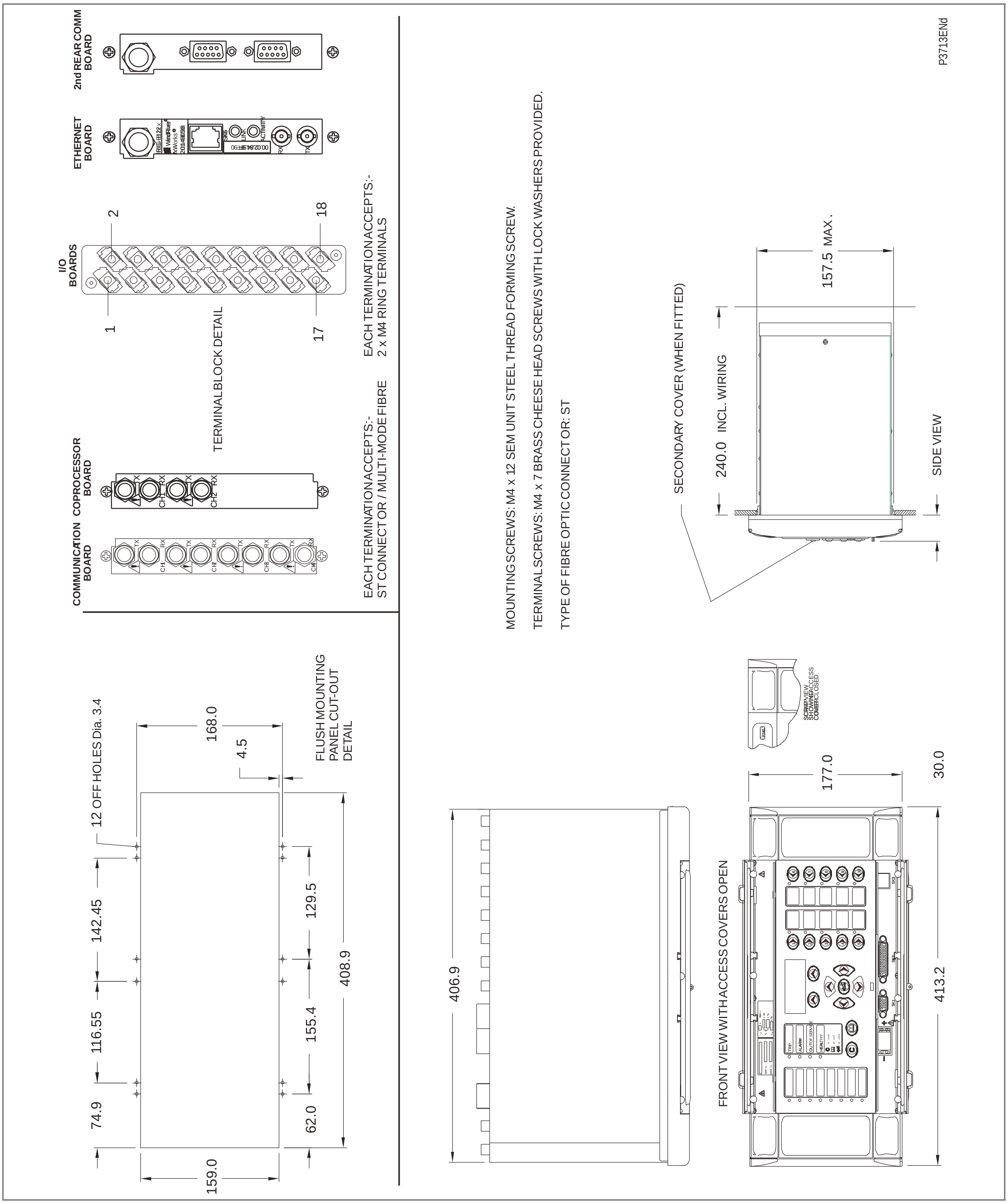

Figure 3 – P741 (80TE) hardware description

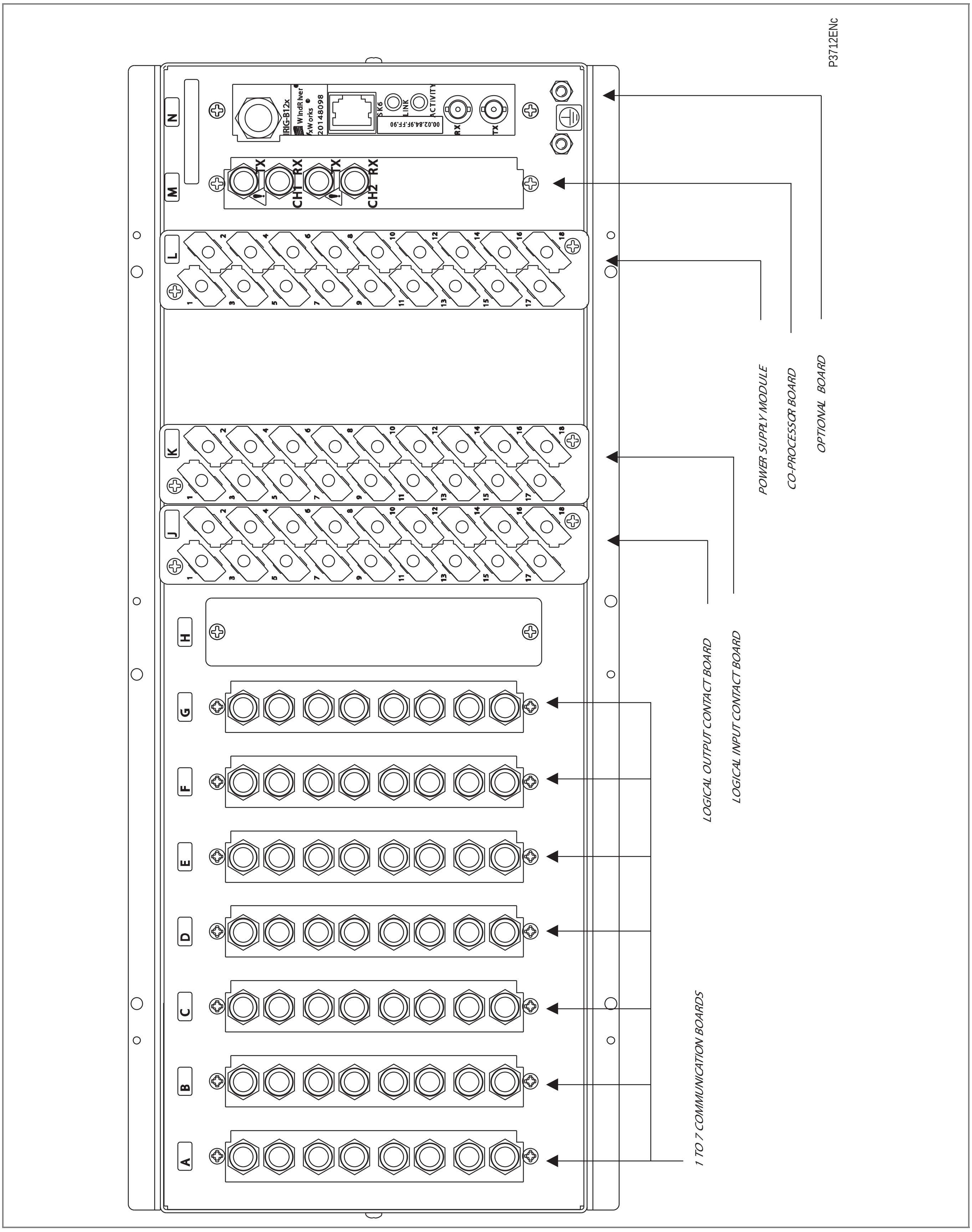

Figure 4 – P741 (80TE) – rear view

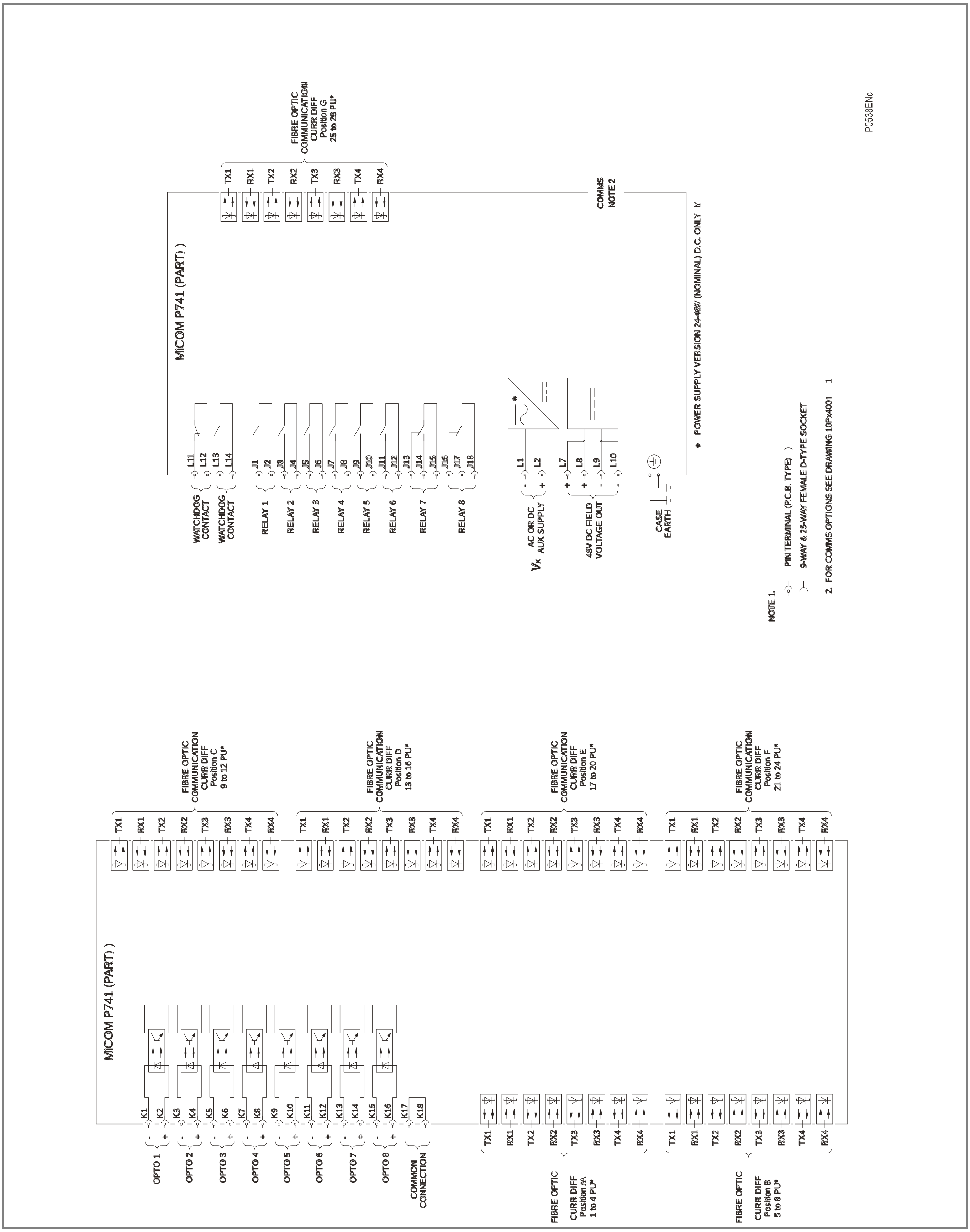

Figure 5 – P741 (80TE) – wiring description

3 P742 – PERIPHERAL UNIT

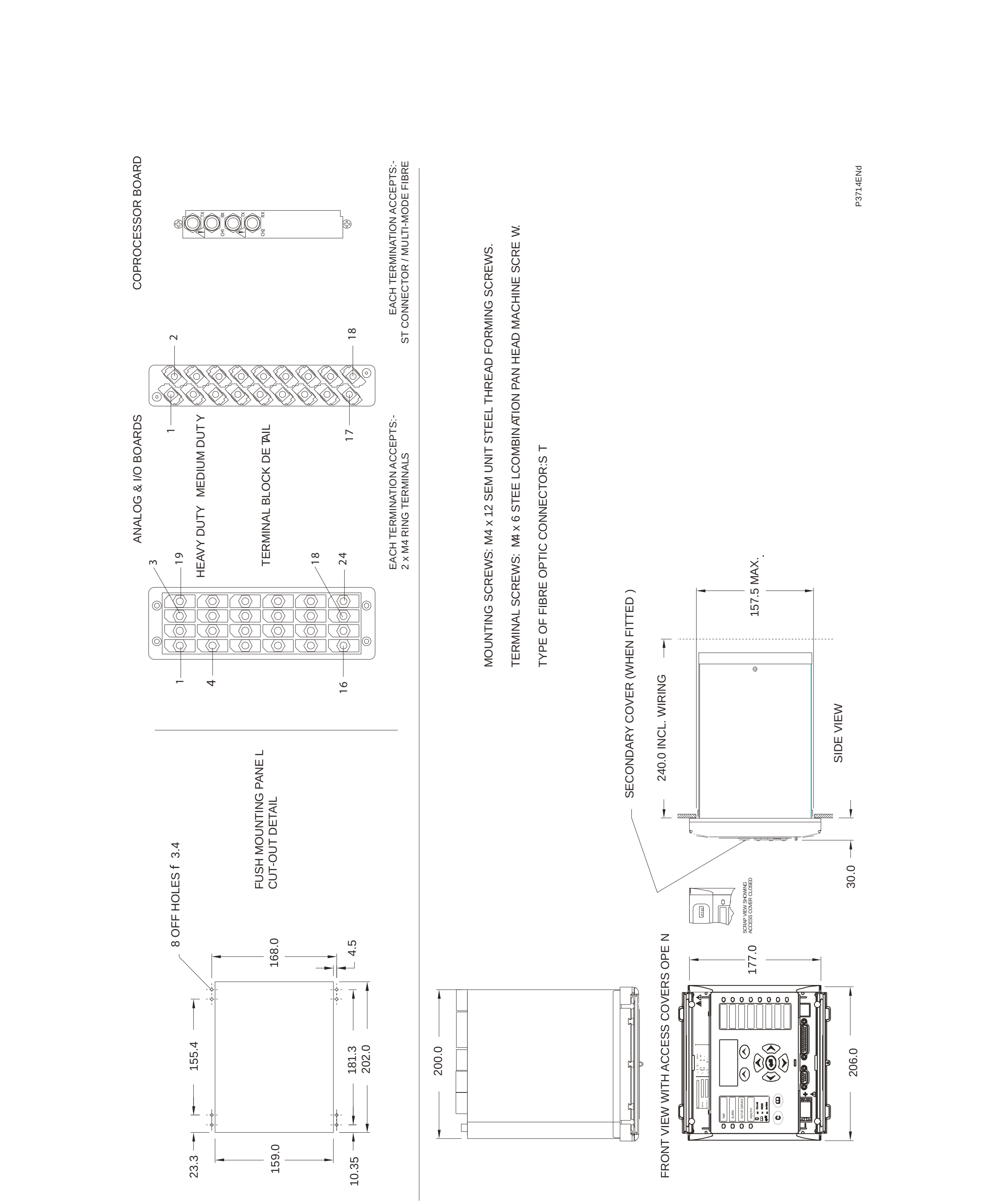

Figure 6 – P742 (40TE) – hardware description

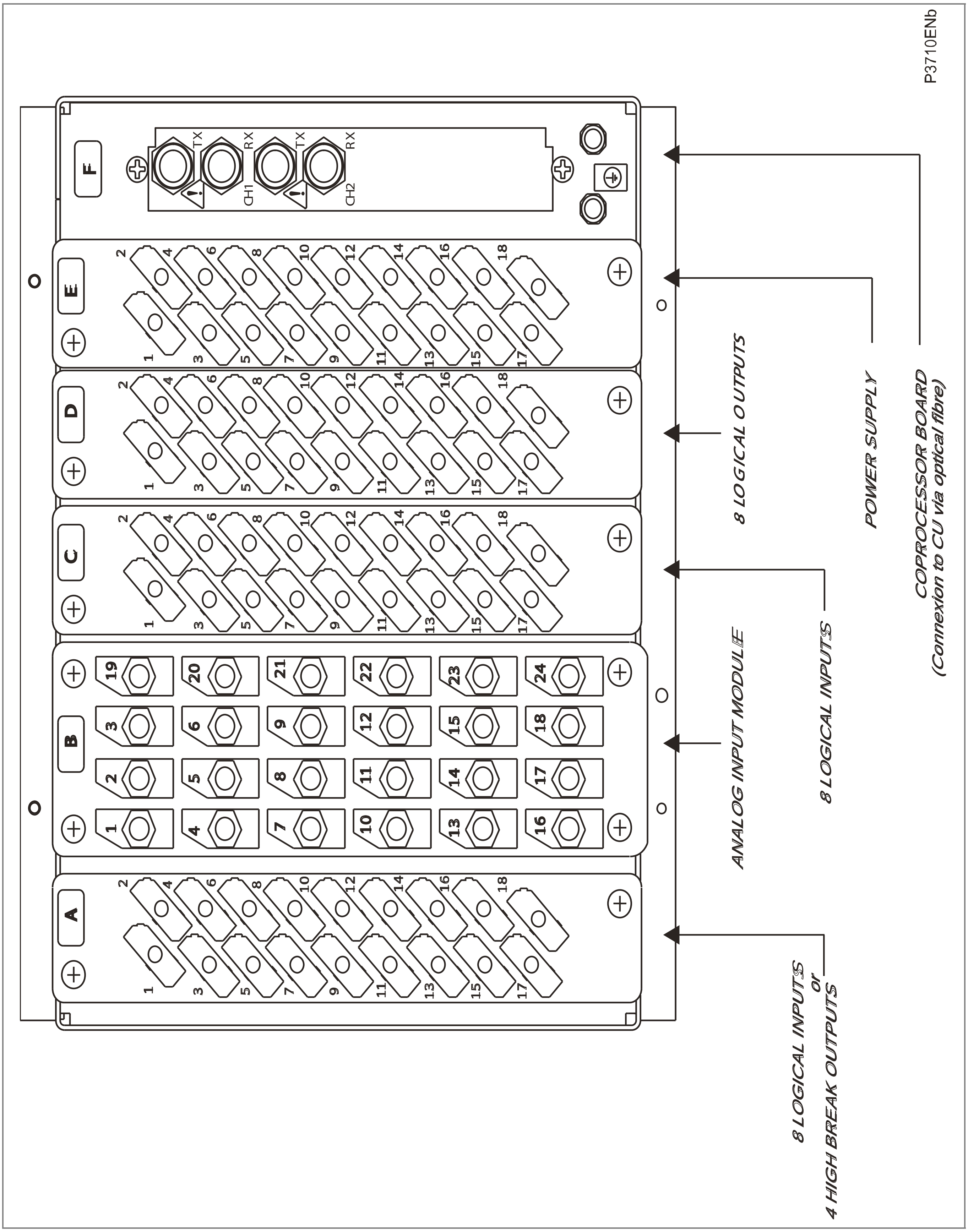

Figure 7 – P742 (40TE) – rear view

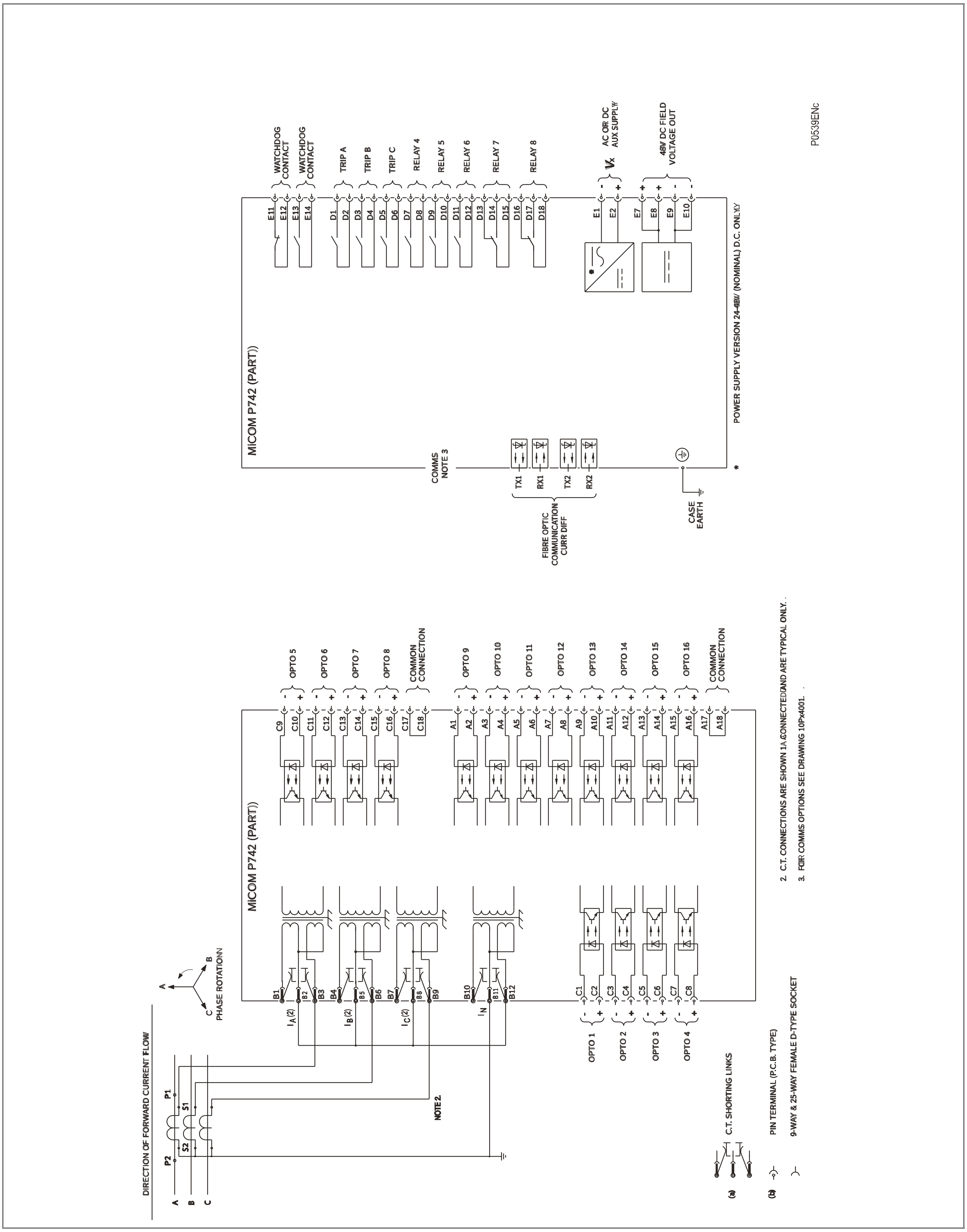

Figure 8 – P742xxxA (40TE) – wiring description

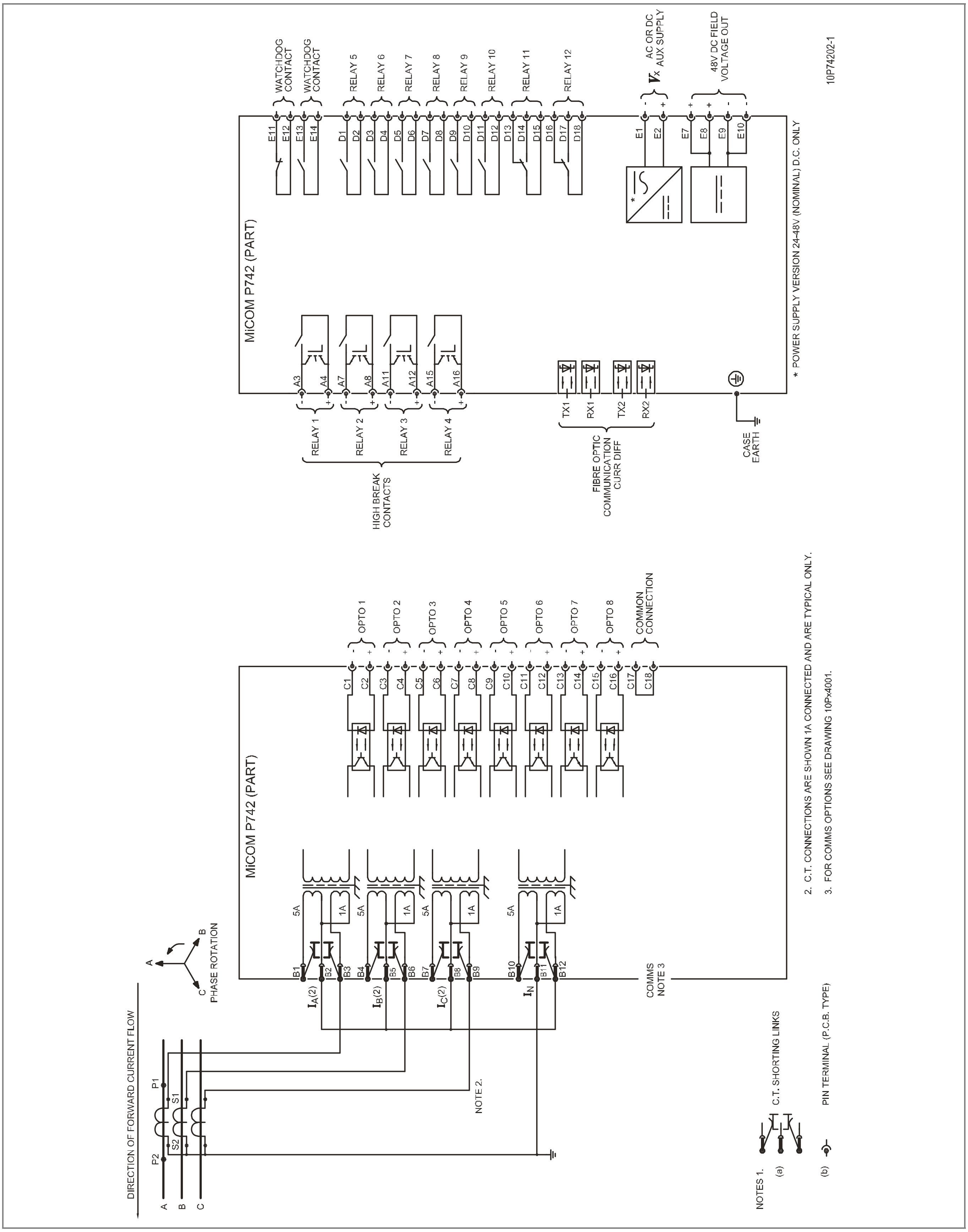

Figure 9 – P742xxxB (40TE) – wiring description

4 P743 – PERIPHERAL UNIT

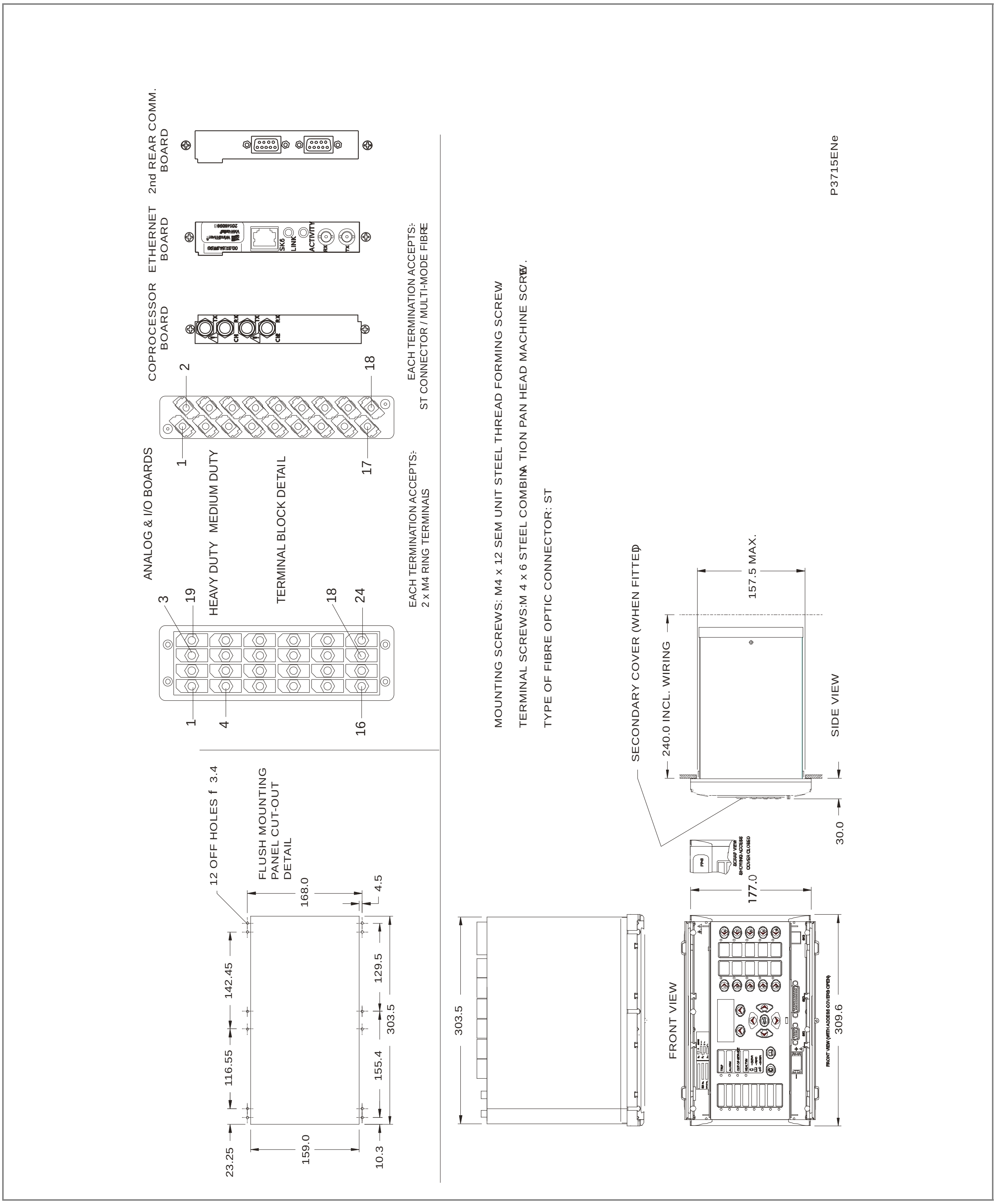

Figure 10 – P743 (60TE) – hardware description

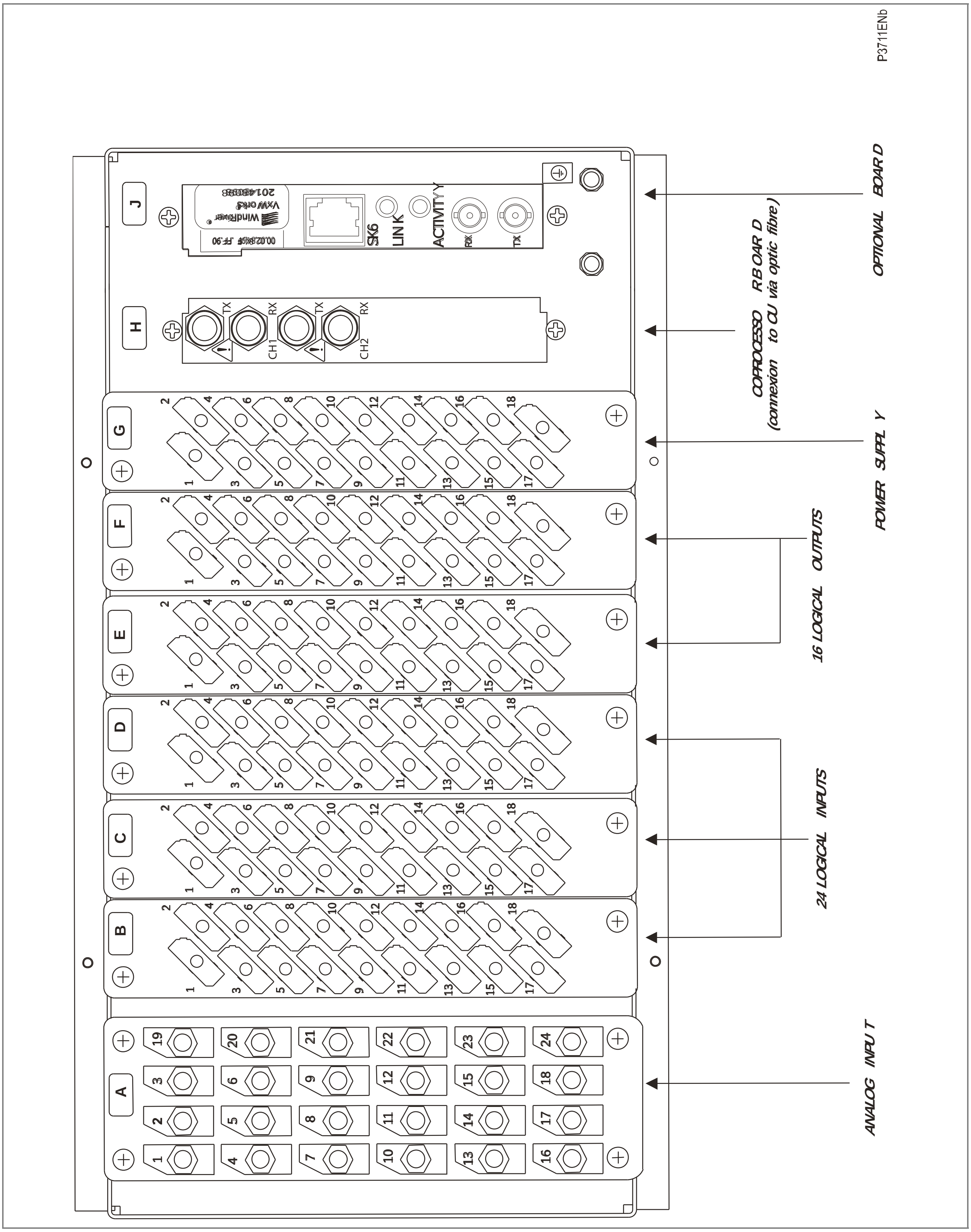

Figure 11 – P743 (60TE) – rear view

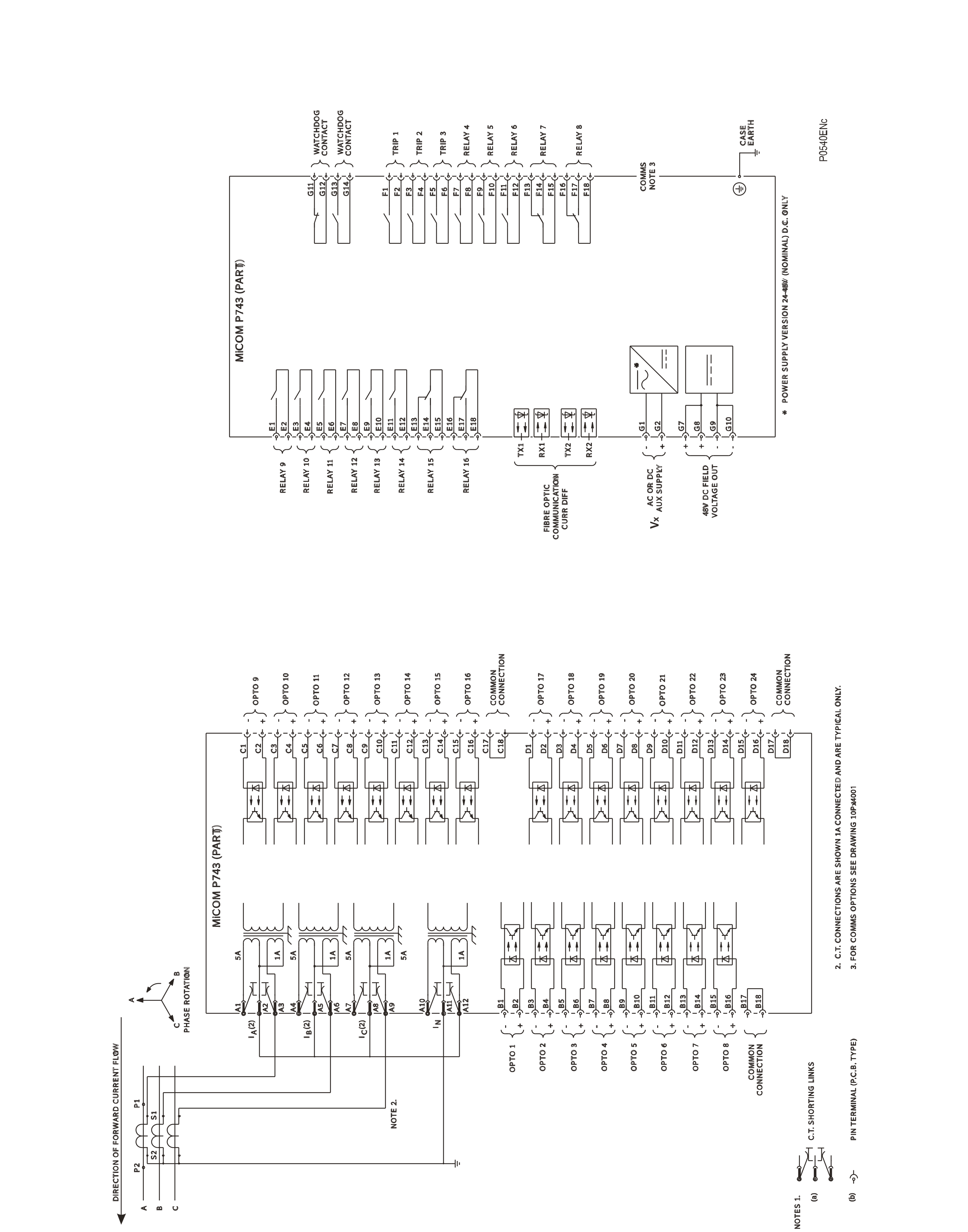

Figure 12 – P743xxxA (60TE) – wiring description

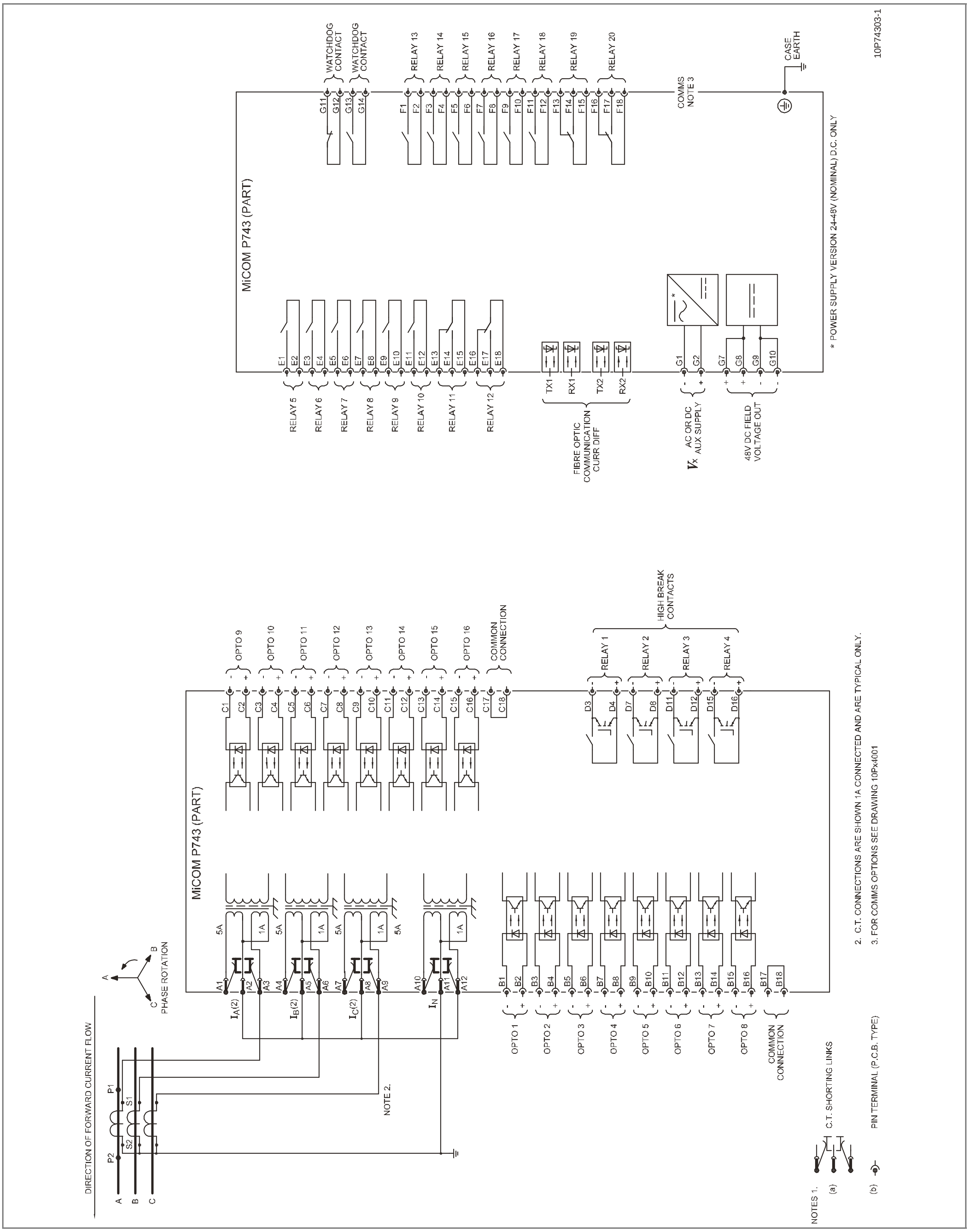

Figure 13 – P743xxxB (60TE) – wiring description

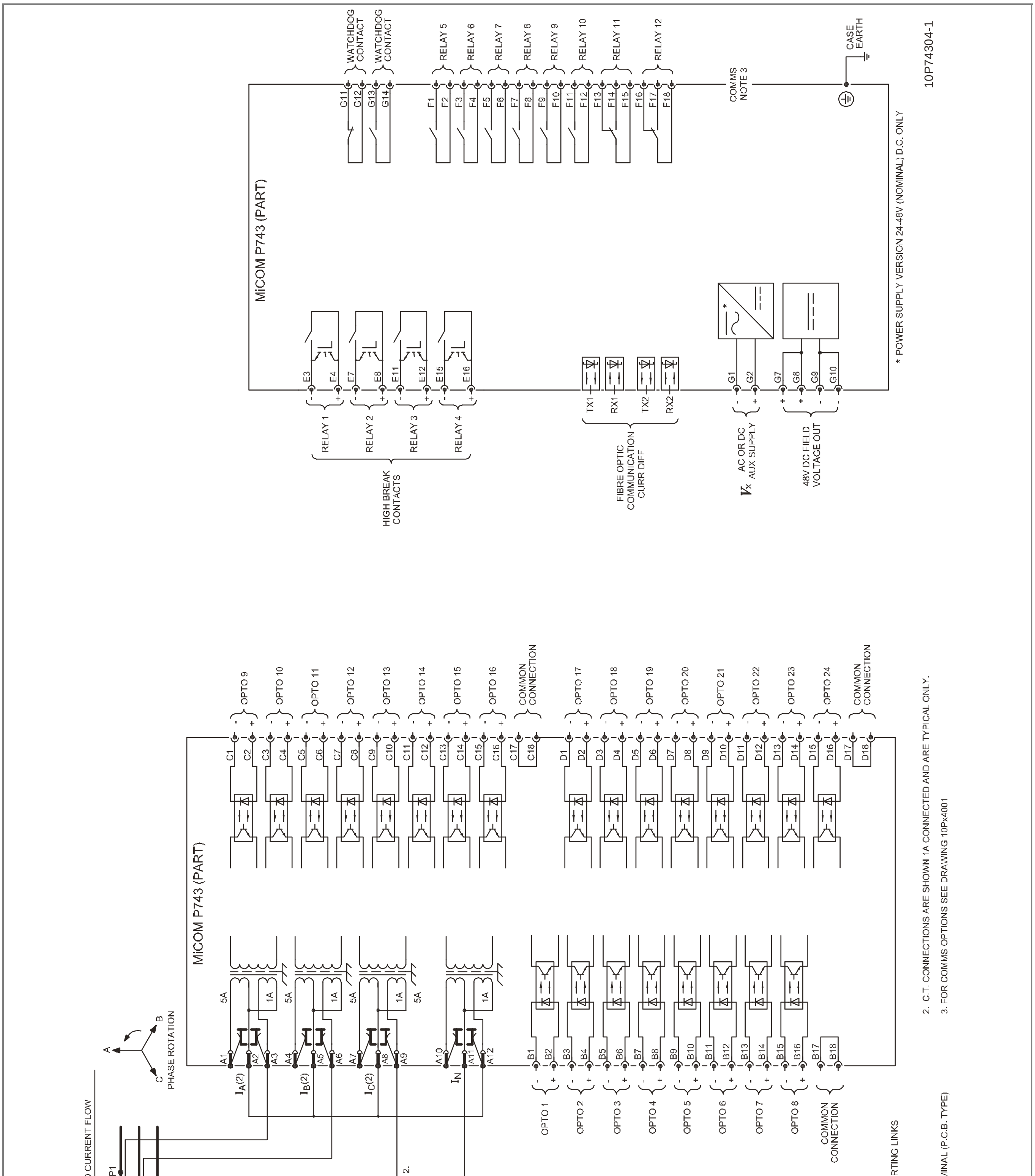

Figure 14 – P743xxxC (60TE) – wiring description

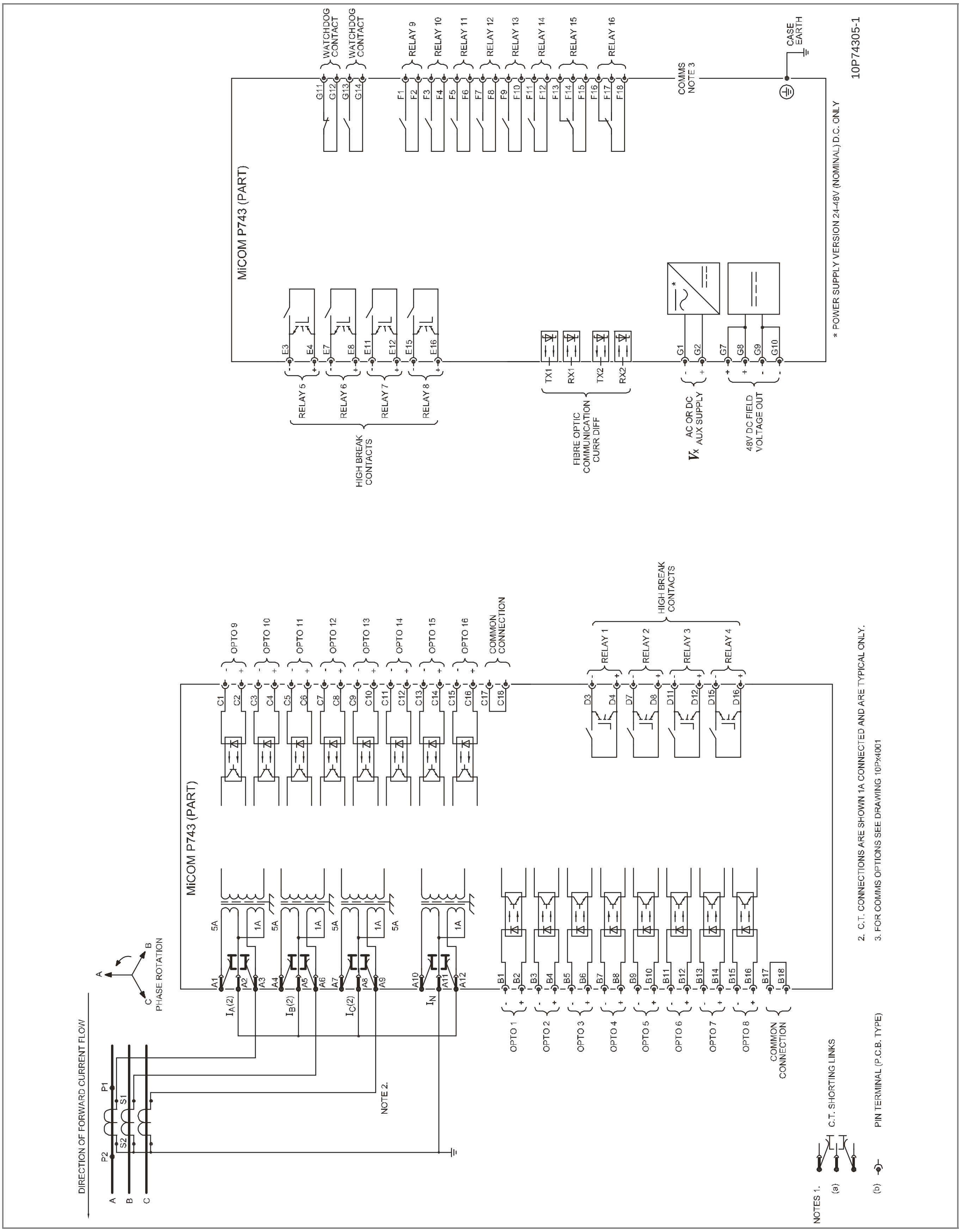

Figure 15 – P743xxxD (60TE) – wiring description

Notes:

CYBER SECURITY

CHAPTER 18

<table>
<tr><td>Date (month/year):</td><td colspan="2">07/2016</td></tr>
<tr><td>Products covered by this chapter:</td><td colspan="2">This chapter covers the specific versions of the MiCOM products listed below. This includes only the following combinations of Software Version and Hardware Suffix.</td></tr>
<tr><td>Software Version:</td><td>P14x (P141, P142, P143 & P145) B2
P445 J4
P44y (P443 & P446) H4</td><td>P54x (P543, P544, P545 & P546) H4
P841A G4
P841B H4</td></tr>
<tr><td>Hardware Suffix:</td><td>P141, P142, P143 L
P145 M
P445 L
P44y (P443 & P446) M</td><td>P54x (P543, P544, P545 & P546) M
P841A (one circuit breaker) M
P841B (two circuit breakers) M</td></tr>
<tr><td>Connection Diagrams:</td><td>P14x (P141, P142, P143 & P145):
10P141xx (xx = 01 to 02)
10P142xx (xx = 01 to 05)
10P143xx (xx = 01 to 11)
10P145xx (xx = 01 to 11)
P24x (P241, P242 & P243):
10P241xx (xx = 01 to 02)
10P242xx (xx = 01)
10P243xx (xx = 01)
P34x (P342, P343, P344, P345 & P391):
10P342xx (xx = 01 to 17)
10P343xx (xx = 01 to 19)
10P344xx (xx = 01 to 12)
10P345xx (xx = 01 to 07)
10P391xx (xx = 01 to 02)
P445:
10P445xx (xx = 01 to 04)
P44x (P442 & P444):
10P44101 (SH 1 & 2)
10P44201 (SH 1 & 2)
10P44202 (SH 1)
10P44203 (SH 1 & 2)
10P44401 (SH 1)
10P44402 (SH 1)
10P44403 (SH 1 & 2)
10P44404 (SH 1)
10P44405 (SH 1)
10P44407 (SH 1 & 2)
P44y (P443 & P446):
10P44303 (SH 01 and 03)
10P44304 (SH 01 and 03)
10P44305 (SH 01 and 03)
10P44306 (SH 01 and 03)
10P44600
10P44601 (SH 1 to 2)
10P44602 (SH 1 to 2)
10P44603 (SH 1 to 2)</td><td>P54x (P543, P544, P545 & P546):
10P54302 (SH 1 to 2)
10P54303 (SH 1 to 2)
10P54400
10P54404 (SH 1 to 2)
10P54405 (SH 1 to 2)
10P54502 (SH 1 to 2)
10P54503 (SH 1 to 2)
10P54600
10P54604 (SH 1 to 2)
10P54605 (SH 1 to 2)
10P54606 (SH 1 to 2)
P547:
10P54702xx (xx = 01 to 02)
10P54703xx (xx = 01 to 02)
10P54704xx (xx = 01 to 02)
10P54705xx (xx = 01 to 02)
P64x (P642, P643 & P645):
10P642xx (xx = 1 to 10)
10P643xx (xx = 1 to 6)
10P645xx (xx = 1 to 9)
P74x (P741, P742 & P743):
10P740xx (xx = 01 to 07)
P746:
10P746xx (xx = 00 to 21)
P841:
10P84100
10P84101 (SH 1 to 2)
10P84102 (SH 1 to 2)
10P84103 (SH 1 to 2)
10P84104 (SH 1 to 2)
10P84105 (SH 1 to 2)
P849:
10P849xx (xx = 01 to 06)</td></tr>
<tr><td></td><td colspan="2">Note This chapter covers the combinations of Products, Software Versions and Hardware Suffixes identified in this table. If you are using earlier software or hardware suffixes, please refer to the Schneider Electric Customer Care Centre (www.schneider-electric.com/ccc) for details of which version of this Cyber Security chapter you need to refer to.</td></tr>
</table>

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TABLES

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1 OVERVIEW

1.1 Definition

Cyber security is a domain that addresses attacks on or by computer systems and through computer networks that can result in accidental or intentional disruptions. Cyber security addresses not only deliberate attacks, such as from disgruntled employees, industrial espionage, and terrorists, but also inadvertent compromises of the information infrastructure due to user errors, equipment failures, and natural disasters.

1.2 Introduction to Cyber Security

The objective of cyber security is to provide increased levels of protection for information and physical assets from theft, corruption, misuse, or accidents while maintaining access for their intended users.

To achieve this objective the owner of the grid must take into account Cyber Security at every level of his organization by the management of an ongoing process that encompasses procedures, policies, technical (software, and hardware asset) and regulatory constraints.

The following diagram outlines some of the associated topics.

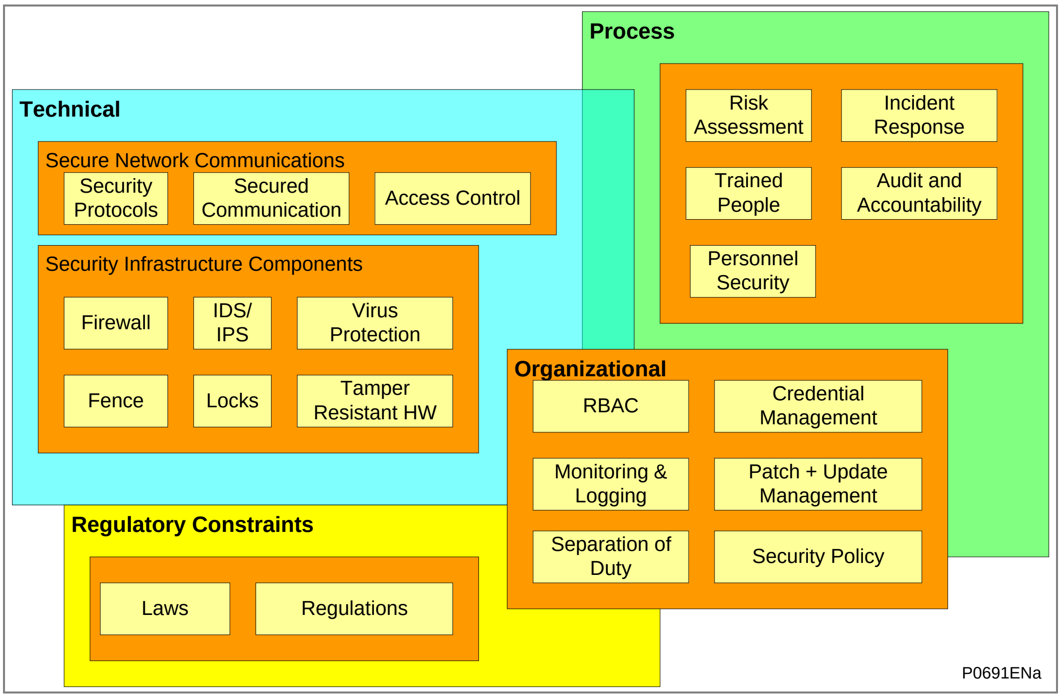

Figure 1 – Associated topics

The asset owner needs to run a continuous improvement process as outlined here:

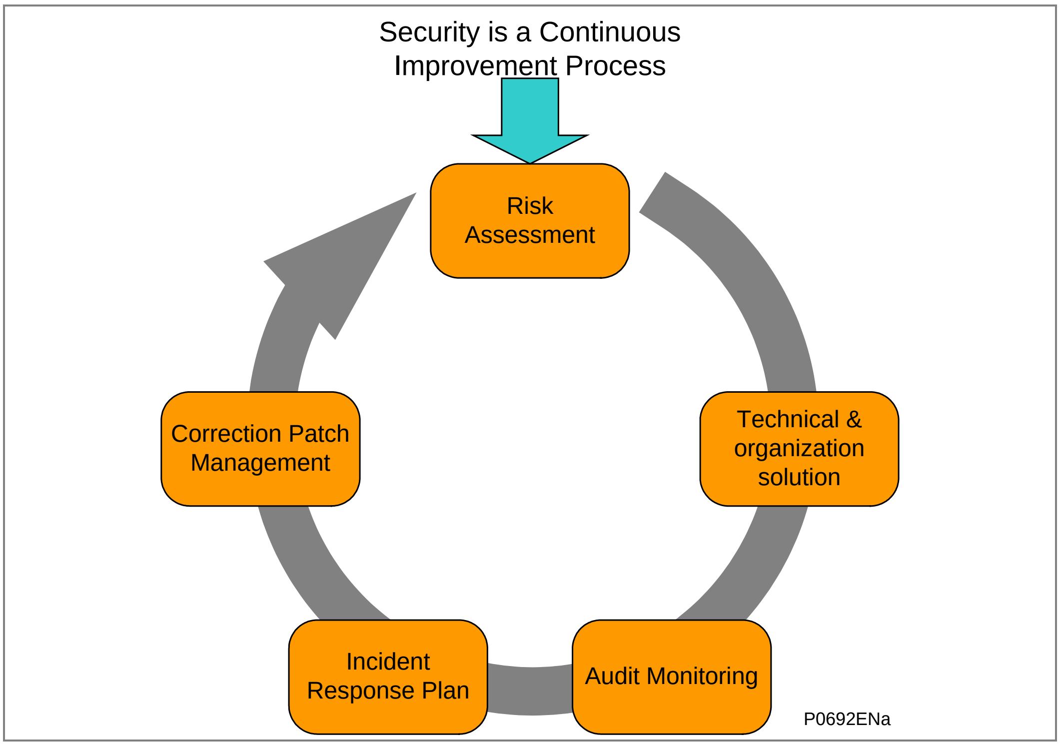

Figure 2 – Continuous improvement process

No single solution can provide adequate protection against all cyber attacks on the control network. Schneider Electric recommends employing a “defense in depth” approach using multiple security techniques to help mitigate risk.

A secured system is to offer:

- Detective controls: Monitor and record specific types of events: Security logs, Intrusion, detection systems, Video Surveillance etc.
- Preventive controls: Help blocking or controlling specific event : Antivirus, White listing, Firewall etc.
- Recovery controls: Help achieve Business continuity and Disaster recovery planning objectives in case of an incident: Backup and Restore solution.

As protective relay vendor, Schneider Electric helps the grid owner to achieve by providing technical features inside the IED, described in the next chapters.

Important	**This product contains a cyber-security function, which manages the encryption of the data exchanged through some of the communication channels. The aim is to protect the data (configuration and process data) from any corruption, malice, attack. Subsequently, this product might be subject to control from customs authorities. It might be necessary to request special authorization from these customs authorities before any export/import operation. For any technical question relating to the characteristics of this encryption please contact your Customer Care Centre - www.schneider-electric.com/ccc.**

1.3 Roles, Rights and relationship between IEC62351 and MiCOM Px4x

1.3.1 Role Based Access Control (RBAC)

The Role Based Access Control (RBAC) is a method to restrict resource access to authorized users. RBAC is an alternative to traditional Mandatory Access Control (MAC) and Discretionary Access Control (DAC).

A key feature of RBAC model is that all access is through roles. A role is essentially a collection of permissions, and all users receive permissions only through the roles to which they are assigned, or through roles they inherit through the role hierarchy.

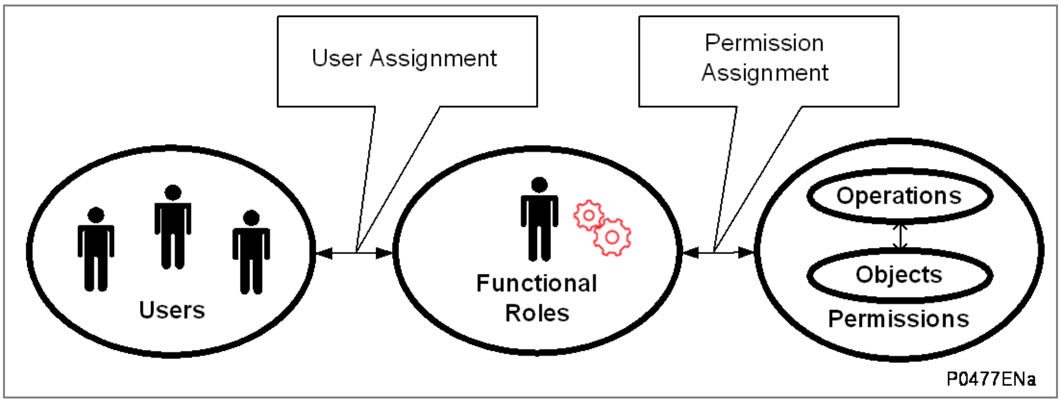

Figure 3 - RBAC Role structure

Roles are created for various job activities. The ***Permissions***, to perform certain operations, are assigned to specific roles. ***Users*** are assigned particular roles, and through those role assignments acquire the computer permissions to perform particular computer-system functions. Since ***users*** are not assigned permissions directly, but only acquire them through their role (or roles), management of individual user rights becomes a matter of simply assigning appropriate roles to the user's account; this simplifies common operations, such as adding a user, or changing user's account.

RBAC defines four different concepts:

RBAC Standard Definition	Description
Object	An ***object*** can represent information containers (e.g. files, directories in an operating system, tables and views in a database management system) or device resources, such as IEDs.
Subject	A ***subject*** is a user of the system. Note that a subject can be a person, or an automated agent / device.
Right	A ***right*** is the ability to access an object in order to perform certain operations (e.g. setting a data or reading a file)
Role	A ***role*** defines a certain authority level in the system. Rights are assigned to roles.

Table 1 – RBAC object, subject, rights and roles definitions

RBAC defines three primary rules:

RBAC Rule	Description
Role assignment	A subject can exercise a permission only if the subject has selected or been assigned a role.
Role authorization	A subject's active role must be authorized for the subject. With rule 1 above, this rule ensures that users can take on only roles for which they are authorized.
Permission authorization	A subject can exercise permission only if the permission is authorized for the subject's active role. With rules 1 and 2, this rule ensures that users can exercise only permissions for which they are authorized.

Table 2 – RBAC permission and authorization rules

1.3.2 User Roles

Different named roles are associated with different access rights. Roles and Rights are setup in a pre-defined arrangement, according to the IEC62351 standard, but customized to the MiCOM Px4x equipment.

When the user tries to access an IED, they need to login using their own username and their own password. The username/password combination is then checked against the records stored on the IED. If they are allowed to login, a message appears which shows them what Role they have been assigned to. It is the role that defines their access to the relevant parts of the system.

The default user roles for MiCOM Px4x are shown here:

Role	Description
VIEWER	Can View what objects are present within a Logical-Device by presenting the type ID of those objects.
OPERATOR	An Operator can view what objects and values are present within a Logical-Device by presenting the type ID of those objects as well as perform control actions.
ENGINEER	An Engineer can view what objects and values are present within a Logical-Device by presenting the type ID of those objects. Moreover, an engineer has full access to Datasets and Files and can configure the server locally or remotely.
SECADM	Security Administrator can change subject-to-role assignments (outside the device) and role-to-right assignment (inside the device) and security policy setting; change security setting such as certificates for subject authentication and access token verification.
SECAUD	Security Auditor can view audit logs

Table 3 – Default user roles summary for MiCOM Px4x

Each authorized user must be placed into at least ONE of these roles that most suits their job description. It is possible to assign a user into a different role; and/or to change the rights associated with a particular role. This means that the administrator can change the access rights for one role; and this will affect ALL the users who are assigned to that role.

It is possible for MiCOM Px4x to create the customized user roles.

1.3.3 Rights

In a similar way in which a set of pre-defined Roles have been created, a pre-defined set of Rights have been created.

These Rights give different permissions to look at what devices may be present, what those devices may contain, manage data within those devices (directly or by using files) and configure rights for other people.

A list of the pre-defined Rights for IEC 62351-8 is given here:

Right	Description
VIEW	Allows the subject/role to discover what objects are present within a Logical-Device by presenting the type ID of those objects. If this right is not granted to a subject/role, the Logical-Device for which the View right has not been granted shall not appear
READ	Allows the subject/role to obtain all or some of the values in addition to the type and ID of objects that are present within a Logical-Device;
DATASET	Allows the subject/role to have full management rights for both permanent and non-permanent Datasets;
REPORTING	Allows a subject/role to use buffered reporting as well as un-buffered reporting;
FILEREAD	Allows the subject/role to have read rights for file objects;
FILEWRITE	Allows the subject/role to have write rights for file objects. This right includes the FILEREAD right
CONTROL	Allows a subject to perform control operations;
CONFIG	Allows a subject to locally or remotely configure certain aspects of the server;
SETTINGGROUP	Allows a subject to remotely configure Settings Groups;
FILEMNGT	Allows the role to transfer files to the Logical-Device, as well as delete existing files on the Logical-Device;
SECURITY	Allows a subject/role to perform security functions at both a Server/Service Access Point and Logical-Device basis. To add Information about the concept of Rights.

Table 4 – Pre-defined rights for IEC 62351-8

The specific Rights for MiCOM Px4x are listed below. These are dependent on the IED data type. Please refer to each product MD file (Menu Database) for the IED data type.

Rights	Authorized Actions to IED	IED_DESC	IED_DATA	DISPLAY	IED_CONFIG	PROT_CONFIG	IEC_COMMAND	AUDIT	IED_FN_KEY	IED_CLEAR
Read Only (SAT default_access_right)	Read	x	x	x	x		x			
	Write	x								
IED Configuration (SAT configuration_right)	Read/write/upload/download				x					
HMI Display Settings (SAT display_action_right)	Read/write/select			x						
Protection Configuration (SAT protection_configuration_right)	Read/write					x				
IED Commands (SAT control_right)	Read/write/clear/reset/select						x			
Reading of Records & Events (SAT audit_read_right)	Read/select/upload							x		
Extraction of Records and Events (SAT audit_write_right)	Send/accept							x		
IED Function Key (SAT fn_key_access_right)	Write								x	
IED Records Clear (SAT clear_right)	Read/write/clear									x

Table 5 – Specific rights for MiCOM Px4x

1.3.4 Roles and their Access Rights

A complete list of the Roles and their access Rights is shown in this table:

Rights \ Roles		VIEWER	OPERATOR	ENGINEER	SECADM	SECAUD
Pre-defined Rights for IEC 62351	VIEW	X	X	X	X	X
	READ		X	X	X	X
	DATASET			X		
	REPORTING	X	X	X		X
	FILEREAD					X
	FILEWRITE			X	X	
	FILEMNGT			X	X	
	CONTROL		X		X	
	CONFIG			X	X	
	SETTINGGROUP				X	
	LOGS				X	X
	SECURITY				X	
Specific Rights for MiCOM Px4x	Read Only	X	X	X		X
	IED Configuration			X		
	HMI Display Settings		X	X		
	Protection Configuration			X		
	IED Commands		X	X		
	Reading of Records and Events	X	X	X		X
	Extraction of Records and Events		X	X		X
	IED Function Key		X	X		
	IED Clear			X		

Table 6 – Pre-defined roles (and rights) for IEC 62351-8 and MiCOM Px4x

Important	**The reason why these are described as Default, is that it is possible to change the definitions of Roles and Rights, using the full version of the SAT software. Depending on the work done by the system administrator, it is possible that your own situation may vary from these initial recommendations.**

1.4 Security Administration Tool (SAT) Software

Important	**This can only be used with Px4x relays with cyber security CSL1 features.**

Important	**For Dual Ethernet cards the SAT functionality is available from communication interface 1. The connection to the SAT would be available from interface 2 only when interface 1 is disconnected from the network.**

The Security Administration Tool (SAT) is the security configuration tool of MiCOM Px4x equipment. It allows the security administrator to define the security policy to the IEDs.

The Security Administrator manages RBAC and security policies data. Security Administrator defines needs to protect devices in accordance with user privileges. Thus, the system security can be configured easily and precisely.

The SAT is used by the Security Administrator to manage the system's security database and deploys security configurations to IED(s).

The SAT allows to Manage User Accounts, Roles, Permission, Elements to Secure (ETS) and Security Server parameters without connection with devices. Information is store on the MS SQL database. This is the Offline mode. SAT allows devices management connected on network. This is the online mode.

The Role Based Access Control (RBAC) is a method to restrict resource access to authorized users. Please refer to this documentation on section "*System RBAC Management*" for more details.

The following table contains the main user main functions of the SAT:

Category	User Function	Note
Offline General Administration	User Accounts Management	User Account Functions: * Creation * Edition * Suppress * Viewing * Sorting * Filtering
	Server Configuration	
	Users Accounts & Roles association Management	Associate a role to the user account
Offline Advanced Administration	Roles Management	Roles Functions: * Creation * Edition * Suppress * Viewing * Sorting
	Element To Secure (ETS) Management	Define ETS which are in fact the PACiS assets present in the project (C264, PACiS Gateway, ECOSUI, IED and SAM). Add, Suppress and Sort permissions associated with the ETS.
	Global Security Management	The Global Security allows scope(s) and associate or disassociate role(s) management for each user account. The security administrator manages the current scope by the Roles: * View Roles List, User Account List and associations User-Roles or Role-Users * Associate / dissociate role(s) for each User Account * Add / Suppress User account(s) for each Role
	Permission access	Define parameters: * Password validity * Inactivity period * Automatic logout period * Maximum attempts of login and lockout period
Communication	Refresh IED list	
	Display IED Logs	
	Display SAM Logs	
	Push RBAC and Security Policies	Send Security Configuration to all Devices integrating Security features.

Table 7 – Main SAT user functions

The details of how to use the SAT are provided in the SAT documentation:

SAT (Security Administration Tool) Documentation - User Guide

This is available from the Schneider Electric website: www.schneider-electric.com.

2 MICOM PX4X CYBER SECURITY IMPLEMENTATION

Schneider Electric MiCOM Px4x IEDs have always been and will continue to be equipped with state-of-the-art security measures. Due to the ever-evolving communication technology and new threats to security, this requirement is not static. Hardware and software security measures are continuously being developed and implemented to mitigate the associated threats and risks.

Considered some users may not want to use the cyber security, Schneider Electric offers MiCOM Px4x relays with CSL0 and CSL1 as below:

CSL0: Simple password management, No SAT required.

CSL1: Advanced cyber security, SAT required.

This depends on the model number, as CSL1 is depend on the Ethernet communication. Hence if the IED if supports only legacy protocol this will be CLS0 default as. The digit position number 9 (protocol options) in the Cortec / model number is used to distinguish it.

Protocol Option Number	Protocol options	Cyber Security options
1	K-Bus/Courier	CSL0
2	Modbus	CSL0
3	IEC 60870 -5 - 103	CSL0
4	DNP3.0	CSL0
6	IEC 61850 Edition 1 / 2 and Courier via rear K-Bus/RS485	CSL0
7	IEC 61850 Edition 1 / 2 and CS103 via rear port RS485	CSL0
B	IEC 61850 Edition 1 / 2 and DNP3oE and DNP Serial	CSL0
G	IEC 61850 Edition 1 / 2 and Courier via rear K-Bus/RS485	CSL1
H	IEC 61850 Edition 1 / 2 and CS103 via rear port RS485	CSL1
L	IEC 61850 Edition 1 / 2 and DNP3oE and DNP3 serial	CSL1

Table 8 – MiCOM Px4x protocol options for cyber security options

2.1 MiCOM Px4x with CSL1 - Advance Cyber Security

For MiCOM Px4x IEDs which support CSL1, this means the IED supports advanced user account right management. Moreover, the IED supports security logs/events and secure administration capability.

If you want to use cyber security, you need to order the IED that supports CSL1. In this case, the Security Administration Tool (SAT) is required for RBAC configuration.

At the IED level, these cyber security features have been implemented:

- Passwords management (via the SAT)
- RBAC Management (via the SAT)
- User Locking
- Inactivity Timer
- RBAC recovery
- Port Disablement (via S1 Studio or the front panel)
- Simple Network Management Protocol (SNMP)
- Security Logs

2.1.1 Password Management

For the IED if CSL1 supported, there are two types of password possible for the IED access: alphanumeric password or Arrow Key password.

The alphanumeric password is only settable via the SAT:

- Passwords may be any length between 1 and 32 characters long
- Passwords may contain any ASCII character in the range ASCII code 33 (21 Hex) to ASCII code 122 (7A Hex) inclusive
- Passwords may or may not be NERC/IEEE 1686 compliant
- The alphanumeric password will used for courier client access

For more details about NERC/IEEE 1686 password compliant, please check the standard.

The Arrow Key password is only settable via the SAT:

- The Arrow Key password is a combination of the four arrow keys on the front panel
- The Arrow Key password may be any length between 1 and 8 of arrow keys long
- The Arrow Key password can only used in the front panel
- The user also can disable the Arrow Key password by not setting it

Important	**If the Arrow Key password is not configured, the alphanumeric password will be used for the front panel access. In this case, alphanumeric passwords longer than 16 characters are not allowed.** **MiCOM S1 Studio and the front panel are not allowed to change the password.**

2.1.2 RBAC Management (via the SAT)

By default, the IED includes a factory RBAC which has three users, and for each user, the Rights depend on the user Role. Please refer to the *Roles and their Access Rights* section for more details.

Username	Role	Default password
SecurityAdmin	SECADM	AAAAAAAA
EngineerLevel	ENGINEER	AAAA
OperatorLevel	OPERATOR	AAAA

Table 9 – Factory RBAC

A Local Default Access function also available for the default RBAC, with the VIEWER role, which allows everyone login the IED in the front panel with VIEWER role. For more details about the Local Default Access function, please refer to the *Local Default Access* section.

For more information about how the SAT management the RBAC and cyber security policies, please see the *Security Administration Tool (SAT)* section.

2.1.3 User Locking

The user is locked out temporarily, after a defined number of failed password entry attempts.

Important	**If a user is locked out, the block is applied to that named user and to the all IED interfaces. The blocking of one user, does not apply blocks to others.** **If the user entry is blocked, recover the RBAC or push a new RBAC will not reset the blocked user entry, but IED reboot will reset the blocking time and attempts count, so the user entry will be unblocked.**

The first invalid password entry sets the attempts count (actual text here) to 1 and initiates an 'attempts timer'. Further invalid passwords during the timed period increments the attempts count. When the maximum number of attempts has been reached, access is blocked. If the attempts timer expires, or the correct password is entered *before* the 'attempt count' reaches the maximum number, then the 'attempts count' is reset to 0.

Once the user entry is blocked, a 'blocking timer' is initiated. Attempts to access the interface whilst the 'blocking timer' is running results in an error message, irrespective of whether the correct password is entered or not. Only after the 'blocking timer' has expired will access to the interface be unblocked, whereupon the attempts counter is reset to zero.

Attempts to write to the password entry whilst it is blocked results in the following message, which is displayed for 2 seconds.

```
LOGIN FAILED
INCORRECT PASSWORD
```

Appropriate responses achieve the same result if the password is written through a communications port.

The attempts count, attempts timer and blocking timer are configurable at the SAT (not by the IED). Attempts remain and blocking time remain information also are visible in IED. Refer to the *Configurable cyber security settings* table for more details about the settings.

2.1.4 Inactivity Timer

The MiCOM device runs an inactivity timer, which means that it records the last time an action was taken by a user who was logged in.

If the user does not perform an action within a pre-defined interval, the user will be logged off. This is to reduce the risk that a device can accidentally be left open to access by unauthorized people.

The inactivity timer is separate for each interface.

The inactivity timer is configurable by using the SAT.

Important	**In case of a connection through an Ethernet interface, the actual inactive time depends on the setting value of both "Minimum inactivity period" & "[0E A7] ETH Tunl Timeout", the smaller value of both timers will be applied.**

Refer to the Table 12 for more details about the settings.

2.1.5 RBAC Recovery

RBAC recovery is the means by which the device can be reset to the factory RBAC settings if required. To obtain the recovery password, the customer must go to www.schneider-electric.com/ccc to raise a recovery password request and supply the IED *Security Code*.

Caution	**The "recovery" password gives you access to the Factory RBAC Configuration. This action deletes all existing users (and their passwords), and restores to Factory RBAC Configuration. Recover the RBAC does not affect relay proper settings and does not provoke reboot of the relay - the protection functions of the relay are always maintained.**

2.1.5.1 Generate Security Code

The security code is a 16-character ASCII string. It is a read-only parameter. The IED generates its own random security code. This is when a new code is generated:

- On power up
- On expiry of validity timer (see below)
- When the recovery password is entered

As soon as the security code is ***first*** displayed on the LCD display, a validity timer is started. This validity timer is set to 120 hours and is not configurable. The validity timer is not reset if you request a subsequent code within the 120 hour period.

To prevent accidental reading of the IED security code the cell will initially display a warning message on the front panel of the IED:

```
PRESS ENTER TO
READ SEC. CODE
```

The security code will be displayed on confirmation, whereupon the validity timer will be started. Note that the security code can only be read from the front panel.

Important	**The recover password will be invalid once the new Security Code is generated, so please make sure the IED is always powered on before you get the reover password, and make sure you input the recover password within 120 hours.**

2.1.5.2 Entry of the Recovery Password

The "recovery" password is intended for recovery only. It is not a replacement password that can be used continually. It can only be used once – for password recovery.

Entry of the recovery password is done at the local front panel and it causes the IED to reset the RBAC back to default.

On this action, the following message is displayed on the front panel of the IED:

```
RBAC reset done
Press any key
```

2.1.6 Port Disabling (Equipment Hardening)

The availability of unused ports could provide a security risk. Hence, unused ports can be disabled (also known as equipment hardening) – either via the front panel or by MiCOM S1 Studio. An Engineer role is needed to perform this action.

These physical ports and logical ports can be enabled/disabled:

Port types	Menu text	Col	Row	Default Setting	Available Value
Physical Ports	Front port	25	05	Enable	Enable/Disable
	Rear Port 1	25	06	Enable	Enable/Disable
	Rear Port 2	25	07	Enable	Enable/Disable
	Ethernet Port 1	25	08	Enable	Enable/Disable
	Ethernet Port 1/2	25	09	Enable	Enable/Disable
	Ethernet Port 2/3	25	0A	Enable	Enable/Disable
	Ethernet Port 3	25	0B	Enable	Enable/Disable
Logical Ports	Courier Tunnel	25	0C	Enable	Enable/Disable
	IEC61850	25	0D	Enable	Enable/Disable
	DNP3oE	25	0E	Enable	Enable/Disable

Table 10 - Port hardening settings

Note	*The port disabling setting cells are not provided in the settings file. In addition, it is not possible to disable simultaneously more than one physical port or Logical port.* *New redundant Ethernet boards have three physical ports but total two interfaces. The actual disabled physical port is depended on the redundant communication mode (PRP, HSR or Dual IP). Refer to the Dual Redundant Ethernet Board (Upgrade) (DREB) chapter (Px4x/EN EB) for more details.*

When the Ethernet board related physical ports or logical ports are disabled or enabled, the Ethernet card will reboot. The status of the ports will be available after reboot of the Ethernet board.

For more details about how to disable/enable the unused ports, please see sections:

- How to Disable a Physical Port
- How to Disable a Logical Port

2.1.7 Simple Network Management Protocol (SNMP)

Simple Network Management Protocol (SNMP) allows security monitoring of events and alarms. Standard third-party SNMP client software can be used to access the log of these events and alarms. Access to the SNMP MIB is given on a read-only basis. For further details of gaining access to the MIB, please contact Schneider Electric.

2.1.8 Security Logs

The Security Logs needs to store logs from each item of equipment. These logs are generated by the system, and cannot be edited by the user. A variety of different items are recorded, including: bad/faulty access attempts, login attempts, authentication errors, changes to roles, users and access control lists, network backup and configuration changes, communication failures and so on.

Security logs emissions depend on the security standards that are configurable by the SAT.

The security logs will push to a Syslog server if the Syslog server IP address and Syslog server IP port are configured and connected.

SAT also can be used to explore the security logs but MiCOM S1 studio is not supported.

The settings for the security log standards and Syslog server IP address and ports are listed in the *Configurable cyber security settings* table. For more detail about the security log configuration, please refer to the SAT documentation.

Note	*The Security logs time stamp may be time shifted by several milliseconds compared with local event log.* *The security logs will not be generated if the Ethernet card is starting up.* *If the Syslog server is unavailable, the new logs will be stored and overwriting the oldest logs.*

This table lists the security logs categories available for each standard.

Log ID	Additional field	Explanation	Level	Standards					
				BDEW	E3	NERC CIP	IEEE 1686	IEC 62351	CS Phase 1
CONNECTION_SUCCESS	The additional field will contain the issuer of the connection: LOCAL or NETWORK	Successful connection	INFO	x	x	x	x		x
CONNECTION_FAILURE		Failed connection (wrong credentials)	WARNING	x	x	x	x		x
CONNECTION_FAILURE_ AND_BLOCK		Failed connection (wrong credentials) triggering the blocking of the account on the IED	DANGER	x	x	x	x		x
CONNECTION_FAILURE_ ALREADY_BLOCKED		Failed connection because of a blocked userID on this IED	DANGER	x	x	x	x		x
DISCONNECTION		Disconnection triggered by the peer /user	INFO	x	x	x	x		x
DISCONNECTION_TIMEOUT		Disconnection triggered by a timeout	INFO	x	x	x	x		x
CONTROL_OPERATION	Type & Data associated to the control	Trace and control / override of real data from a peer	INFO				x		
CONFIGURATION_ DOWNLOAD	Version	Download of the configuration file from the device - Files include PSL, Courier setting, DNP setting, MCL/CID and user curves (crv)	INFO				x		
CONFIGURATION_UPLOAD	Version	Upload of a new configuration file into the device - Files include PSL, Courier setting, DNP setting, MCL and user curves (crv)	INFO				x		
RBAC_UPDATE	Version	Update of the RBAC cache in the IED	INFO				x		x
SEC_LOGS_RETRIEVAL	Version	Retrieval of the security logs of the IED	INFO				x		
TIME_CHANGE	New & Old time	Modification of the time of the IED	INFO				x		
REBOOT_ORDER	None	Reboot order sent to the IED / IED start up	DANGER				x		x
PORT_MANAGEMENT	Port, action (enable / disable)	Any comms port enabled / disabled	INFO						x
AUTHORIZATION_REQ	Action, object	Any authorization request sent to the CS brick	INFO			x		x	x

Table 11 – Security logs recorded

2.1.9 Common Cyber Security Settings

The System Administrator can customize the cyber security settings at the SAT. The following table shows the common cyber security settings. Parts of settings also are visible on the IED with specific Courier cells but not editable in IED or MiCOM S1 Studio. These are shown in the right hand columns of this table:

Setting in SAT	Default Setting	Available Value	Menu in IED	Col	Row
Minimum inactivity period	15	1 to 99 Minutes	-	-	-
If the user does not perform any action within this interval, the user will be logged off.					
Allow user locking	Yes	Yes/No	-	-	-
Option allows user account locking					
Maximum login attempts	5	1 to 99	Attempts Limit	25	02
The maximum failed password entry attempts, the user will lock once the attempts reached.					
Password attempts timer	3	1 to 30 Minutes	Attempts timer	25	03
The time for reset the attempts count to 0. The user got to maximum login attempts.					
Automatic user account unlocking	Yes	Yes/No	-	-	-
Enable/disable the attempts times aromatic reset function.					
Locking period duration	240	1 to 86400 Seconds	Blocking timer	25	04
The Locking period duration (seconds)					
Password Complexity	None	None / IEEE1686/ NERC	-	-	-
Set the password compliant standard.					
Log and monitoring standard	BDEW	BDEW / E3 /NERC-CIP / IEE1686 / IEC62351/ CS_PH1	-	-	-
Setup security log emission standard					
Syslog server IP address	0.0.0.0		-	-	-
Syslog server IP address					
Syslog server IP port	601	1 to 65535	-	-	-
Syslog server IP port					
SNMP client IP address	0.0.0.0		-	-	-
SNMP client IP address					

Table 12 – Configurable cyber security settings

These settings show some common information about cyber security, which are not configurable whether by SAT, or MiCOM S1 Studio or the front panel.

Menu in IED	Col	Row	Description
User Banner	25	01	Show user banner information: ACCESS ONLY FOR AUTHORITY USERS
Attempts remain	25	11	Show the remains attempt times for user login.
Blk time remain	25	12	Show the remains time for blocked user to unlock
User Name	25	21~2F	Configured user name (in SAT)
Security Code	25	FE	The security code used to recovery the password.
RBAC Password	25	FF	Enter 16 characters recover password to recovery password

Table 13 – Un-configurable cyber security settings

2.1.10 Local Default Access

Local Default Access function can be disabled/enabled in the SAT.

The intention for Local Default Access function is to allow the user easy to access the IED from the front panel and without any authorization required. This means if the Local Default Access function is enabled, everyone will be authorized to access the front panel with associated Rights.

By default, the Local Default Access has the VIEWER role, it is also possible to associate the other Roles to the Local Default Access, which is configurable in the SAT.

Local Default Access function is only available in the front panel.

The Local Default Access login/logout process is invisible for the user.

2.2 MiCOM Px4x with CSL0- Simple Password Management

For MiCOM Px4x IED with CSL0, as the Security Administration Tool (SAT) is not supported, all the cyber security features which need SAT support will not be available.

This section describes the different implementations by comparing with CLS1.

The cyber security features that are not mentioned in this section will default to be the same as CSL1.

2.2.1 Password Management

For MiCOM Px4x IED with CSL0, SAT is not supported for the configuration, so only the alphanumeric password can be used.

- The alphanumeric password is settable via MiCOM S1 Studio and the Front panel
- Passwords may be any length between 1 and 16 characters long
- Passwords may contain any ASCII character in the range ASCII code 33 (21 Hex) to ASCII code 122 (7A Hex) inclusive
- No password compliance is required
- The alphanumeric password will used for Courier access and the front panel access

Arrow key password is not available for IED with CLS0.

2.2.2 Fixed Factory RBAC

For MiCOM Px4x IED with CSL0, the user list and its role/right will be fixed as factory RBAC and not configurable. Refer to the *Factory RBAC* table for more details.

2.2.3 Security Logs/SNMP Services

The security logs/SNMP services are not available for MiCOM Px4x IED with CSL0.

2.2.4 Cyber Security Settings

For MiCOM Px4x IED with CSL0, all cyber security settings are fixed as default setting and un-configurable. Refer to the *Configurable cyber security settings* table for the default settings.

2.2.5 Disable/Blank Password

For MiCOM Px4x IED with CSL0, it is possible to remove the user password. In MiCOM S1 Studio, this is achieved by click the BOX “Disable the password”. In the IED, this is achieved by setting the password as blank.

Once the password is disabled/blank, the user can login to the IED directly and there is no need to enter the password.

3 HOW TO USE CYBER SECURITY FEATURES

These sections shows the most common tasks associated with Cyber Security features.

For many of these tasks, the steps you take are the same as you have performed previously; with the main changes being in the steps you use to login and/or logout.

3.1 How to Login

3.1.1 Local Default Access

If the Local Default Access is enabled, the user may login to the front panel with associated roles.

See Table 14 for the applied cases.

3.1.2 Auto Login

Auto login means the user will login the IED automatically and no need to select the user name and enter the password. In this case, the user will be authorized with relevant rights. The auto login will be applied in these cases:

CS Version	Interface	RBAC/PW Cases	Login Process
CSL1	Front panel	Factory RBAC	Auto login with **EngineerLevel**
		Customized RBAC	Local Default Access Enabled: Login with **Local Default Access** Local Default Access Disabled: Login with **Prompt User List**
	Courier Interface	All cases	Login with **Prompt User List**
CSL0	Front panel	Factory RBAC	Auto login with **EngineerLevel**
		Password changed	**EngineerLevel** password is “AAAA” or is disabled/blank: Auto login with **EngineerLevel** **OperatorLevel** password is “AAAA” or is disabled/blank: Auto login with **OperatorLevel** **EngineerLevel** and **OperatorLevel** password changed: Auto login with **ViewerLevel Access**
	Courier Interface	Factory RBAC	Auto login with **EngineerLevel**
		Password changed	**EngineerLevel** password is “AAAA” or is disabled/blank: Auto login with **EngineerLevel** **OperatorLevel** password is “AAAA” or is disabled/blank: Auto login with **OperatorLevel** **EngineerLevel** and **OperatorLevel** password changed: Login with **Prompt User List**

Table 14 – Auto Login process

For more details about the Factory RBAC, please refer to Table 9.

3.1.3 Login with Prompt User List

This login process will happen if:

- The Auto login process is not applied.
- Or high authorization is required for the current operation.

In this case, the IED will prompt the user list, and the user needs to select proper user name and enter the password to login.

3.2 How to Logout

3.2.1 How to Logout at the IED

For security consideration, it would be better to “logout' the IED once the configuration done. You can do this by going up to the default display. When you are at the default display and you press the ‘Cancel’ button, you may be prompted to log out with the following display:

```
ENTER TO LOGOUT
CLEAR TO CANCEL
```

You will be asked this question if you are logged in.

If you confirm, the following message is displayed for 2 seconds:

```
LOGGED OUT
User Name
```

If you decide not to log out (i.e. you cancel), the following message is displayed for 2 seconds.

```
LOGOUT CANCELLED
User Name
```

Note	*The MiCOM IED runs a timer, which logs the user out after a period of inactivity. For more details, refer to the Inactivity Timer section.*

3.2.2 How to Logout at MiCOM S1 Studio

- Right-click on the device name and select Log Off.
- In the Log Off confirmation dialog click Yes.

3.3 How to Disable a Physical Port

Using MiCOM S1 Studio or the front panel it is possible to disable unused physical ports. This can not be done by the SAT. By default, an Engineer-role is needed to perform this action.

To prevent accidental disabling of a port, a warning message is displayed according to whichever port is required to be disabled. For example if rear port 1 is to be disabled, the following message appears:

```
REAR PORT 1 TO BE
DISABLED.CONFIRM
```

There are between two and four ports eligible for disablement:

- Front port
- Rear port 1
- Rear port 2 (available in the specific models)
- Ethernet port (available in the specific models)

Important	**It is not possible to disable a port from which the disabling port command originates.**

3.4 How to Disable a Logical Port

Using MiCOM S1 Studio or the front panel it is possible to disable unused logical ports. This can't be done by the SAT. An Engineer-role is needed to perform this action.

Caution	Disabling the Ethernet port will disable all Ethernet based communications.

If it is not desirable to disable the Ethernet port, it is possible to disable selected protocols on the Ethernet card and leave others functioning.

These protocols can be disabled:

- IEC61850 (available in the specific models)
- Courier Tunnelling (available in the specific models)
- IEC61850 + DNPoE (available in the specific models)

3.5 How to Secure a Function key

In cyber security implementation, this function has been linked to the front panel authorization.

- When the function key pressed, if there is no user login in the front panel or the logged- in user is not authorized, a prompt message will be raised in the front panel to ask the user to login. Once the user is logged-in, they need to press the function key again to execute the command.
- If the user is already logged in and the authorization is OK, the command will be executed immediately.
- By default, the OPERATOR or ENGINEER Roles are able to operate the function keys.
- The function key will be executed immediately if the auto login process is applied and the user is authorized.
- If unauthorized users press the Function Key during the setting change, they need to commit the changes first then login with authorized user to operate the function key.

4 GLOSSARY FOR CYBER SECURITY

Term	Meaning
CIP Standards	Critical Infrastructure Protection standards. NERC CIP standards have been given the force of law by the Federal Energy Regulatory Commission (FERC)
DCS	Distributed Control System
HMI	Human Machine Interface
IED	Intelligent Electronic Device. It is a power industry term to describe microprocessor-based controllers of power system equipments (e.g. Circuit breaker, transformer, etc)
LOGS	All the operations related to the security (connection, configuration…) are automatically caught in events that are logged in order to provide a good visibility of the previous actions to the security administrators.
MIB	Management Information Base
NERC	North American Electric Reliability Corporation
RBAC	Role Based Access Control. Authentication and authorization mechanism based on roles granted to a user. Roles are made of rights, themselves being actions that can be applied on objects. Each user's action is authorized or not based on his roles
Roles	A role is a logical representation of a person activity. This activity authorizes or forbids operations within the tool suite thanks to permissions that are associated to the role. A role needs to be attached to a user account to have a real purpose.
SAM	Security Administration Module. Device in charge of security management on an IP-over-Ethernet network.
SAT	Security Administration Tool TSF based application used to define and create security configuration
Secured IED	Devices embedding security mechanisms defined in the security architecture document
Security Administrator	A user of the system granted to manage its security
SNMP	Simple Network Management Protocol (SNMP) is an "Internet-standard protocol for managing devices on IP networks
TAT	Transfer Administration Tool
Unsecured IED	Relay/IEDs with no security mechanisms.

Table 15 – Glossary for cyber security

Notes:

DUAL REDUNDANT ETHERNET BOARD (UPGRADE) (DREB)

CHAPTER 19

Date (month/year):	07/2016			
Products covered by this chapter:	This chapter covers the specific versions of the MiCOM products listed below. This includes ***only*** the following combinations of Software Version and Hardware Suffix.			
Hardware Suffix:	P141/P142/P143 P145 P241 P242/P243 P342 P343/P344/P345 P391 P445 P44x (P441/P442/P444) P44x (P442/P444) P44y (P443/P446)	L M L M L M A K/L K M M	P54x (P543/P544/P545/P546) P642 P643/P645 P741/P743 P742 P746 P74x (P741, P743) P841A (one circuit breaker) P841B (two circuit breakers) P849	M L M M L M K M M M
Software Version:	P14x (P141/P142/P143/P145) P24x (P241/P242/P243) P34x (P342/P343/P344/P345/P391) P445 P44x (P442/P444) P44y (P443/P446)	B0/B2 D0 B0 J4 E0 H4	P54x (P543/P544/P545/P546) P64x (P642/P643/P645) P746 P74x (P741/P742/P743) P841A P841B P849	H4 B1 B1/B2/ C1/C2 B0 G4 H4 B0
Connection Diagrams:	P14x (P141, P142, P143 & P145): 10P141xx (xx = 01 to 02) 10P142xx (xx = 01 to 05) 10P143xx (xx = 01 to 11) 10P145xx (xx = 01 to 11) P24x (P241, P242 & P243): 10P241xx (xx = 01 to 02) 10P242xx (xx = 01) 10P243xx (xx = 01) P34x (P342, P343, P344, P345 & P391): 10P342xx (xx = 01 to 17) 10P343xx (xx = 01 to 19) 10P344xx (xx = 01 to 12) 10P345xx (xx = 01 to 07) 10P391xx (xx = 01 to 02) P44x (P442 & P444): 10P44101 (SH 1 & 2) 10P44201 (SH 1 & 2) 10P44202 (SH 1) 10P44203 (SH 1 & 2) 10P44401 (SH 1) 10P44402 (SH 1) 10P44403 (SH 1 & 2) 10P44404 (SH 1) 10P44405 (SH 1) 10P44407 (SH 1 & 2) P44y (P443 & P446): 10P44303 (SH 01 and 03) 10P44304 (SH 01 and 03) 10P44305 (SH 01 and 03) 10P44306 (SH 01 and 03) 10P44600 10P44601 (SH 1 to 2) 10P44602 (SH 1 to 2) 10P44603 (SH 1 to 2) P445: 10P445xx (xx = 01 to 04)		P54x (P543, P544, P545 & P546): 10P54302 (SH 1 to 2) 10P54303 (SH 1 to 2) 10P54400 10P54404 (SH 1 to 2) 10P54405 (SH 1 to 2) 10P54502 (SH 1 to 2) 10P54503 (SH 1 to 2) 10P54600 10P54604 (SH 1 to 2) 10P54605 (SH 1 to 2) 10P54606 (SH 1 to 2) P547: 10P54702xx (xx = 01 to 02) 10P54703xx (xx = 01 to 02) 10P54704xx (xx = 01 to 02) 10P54705xx (xx = 01 to 02) P64x (P642, P643 & P645): 10P642xx (xx = 1 to 10) 10P643xx (xx = 1 to 6) 10P645xx (xx = 1 to 9) P74x (P741, P742 & P743): 10P740xx (xx = 01 to 07) P746: 10P746xx (xx = 00 to 21) P841: 10P84100 10P84101 (SH 1 to 2) 10P84102 (SH 1 to 2) 10P84103 (SH 1 to 2) 10P84104 (SH 1 to 2) 10P84105 (SH 1 to 2) P849: 10P849xx (xx = 01 to 06)	

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FIGURES

TABLES

Notes:

1 INTRODUCTION

The redundant Ethernet board assures redundancy at IED level. It is fitted into the following MiCOM IEDs from Schneider Electric.

- P141, P142, P143, P145
- P241, P242, P243
- P341, P342, P343, P344, P345
- P442, P443, P444, P445, P446
- P543, P544, P545, P546, P547
- P642, P643, P645
- P741, P743, P746
- P841, P849

1.1 Standard Safety Statements

For safety information please see the Safety Information chapter of the relevant Px4x Technical Manual.

2 HARDWARE DESCRIPTION

IEC 61850 work over Ethernet. Three boards are available:

- 1RJ45 Port Ethernet Board
- 3RJ45 Ports Redundant Ethernet Board
- 2LC+1RJ45 Ports Redundant Ethernet Board.

All are required for communications but 3RJ45 Ports and 2LC+1RJ45 Ports Redundant Ethernet Board allow an alternative path to be always available, providing bumpless redundancy.

Industrial network failure can be disastrous. Redundancy provides increased security and reliability, but also devices can be added to or removed from the network without network downtime.

The following list shows Schneider Electric’s implementation of Ethernet redundancy, which has two variants with embedded IEC 61850 over Ethernet, plus PRP and HSR redundancy protocols.

- Parallel Redundancy Protocol (PRP)/High-availability Seamless Redundancy (HSR) with 1310 nm multi mode 100BaseFx fiber optic Ethernet ports (LC connector) and modulated/un- modulated IRIG-B input. Part number 2072069A01.

Note	*The board offers compatibility with any PRP/HSR device.*

- Parallel Redundancy Protocol (PRP)/High-availability Seamless Redundancy (HSR) with 100BaseTx Ethernet ports (RJ45) and modulated/un- modulated IRIG-B input. Part number 2072071A01.

Note	*The board offers compatibility with any PRP/HSR device.*

The redundant Ethernet board is fitted into Slot A of the IED, which is the optional communications slot. Each Ethernet board has three MAC addresses for two groups, one group (PORT 1) including one host MAC address, the other group (PORT 2 & 3) used for redundant application, including one host MAC address and one redundant agency device MAC address. Two host MAC addresses of the IED are printed on the rear panel of the IED.

In additional above for HSR/PRP redundant protocols, the redundant Ethernet board also can be operate on Dual IP mode. In this case, each Ethernet board has two host MAC addresses.

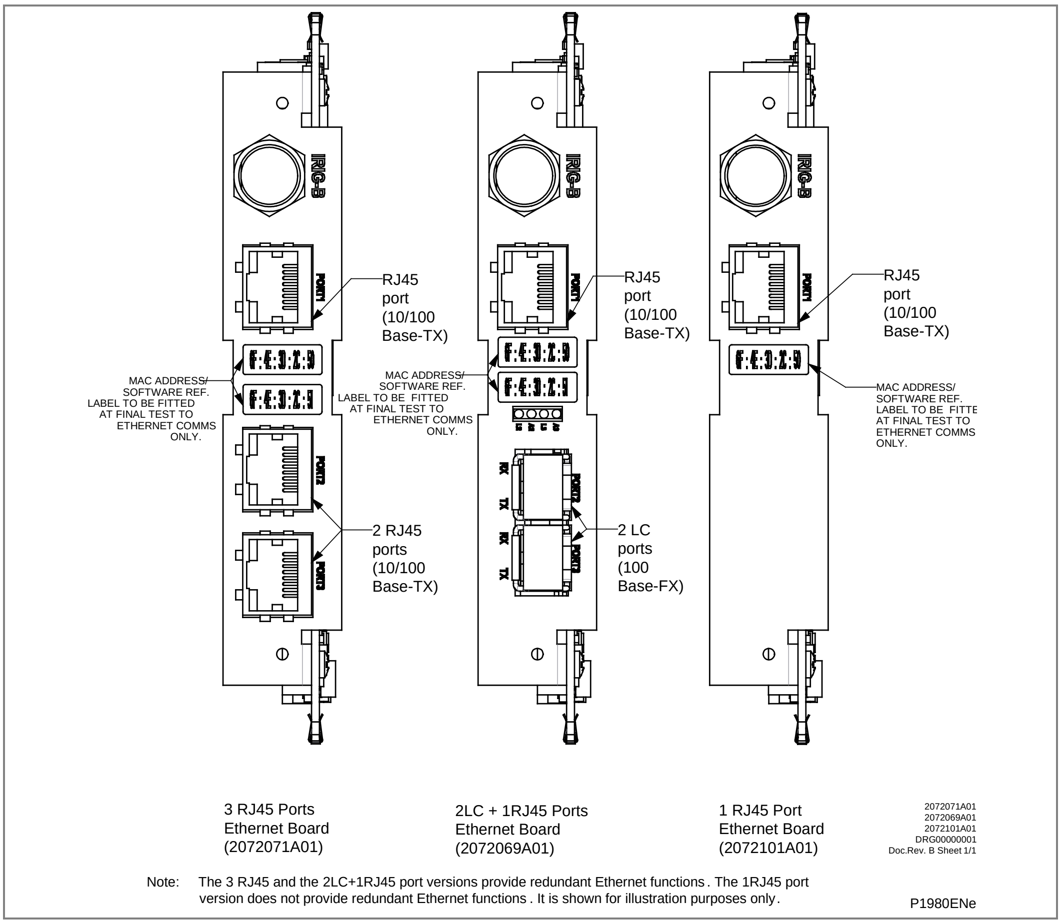


Figure 1 - Ethernet board connectors (3 RJ45 or 2 LC + RJ45 or 1 RJ45)

2.1 IRIG-B Connector

This is available as a modulated/un-modulated input.
See section 6.1.

2.2 LEDs

LED	Function	On	Off	Flashing
Green	Link	Link ok	Link broken	
Yellow	Activity			Traffic activity

Table 1 - LED functionality

2.3 Optical Fiber Connectors

Use 1310 nm multi mode 100BaseFx and LC connectors.

See Figure 1 and section 6.1.

Connector	PRP	HSR
2	R_X	R_X
2	T_X	T_X
3	R_X	R_X
3	T_X	T_X

Table 2 - Optical fiber connector functionality

3 REDUNDANCY PROTOCOLS

There are two redundancy protocols available:

- PRP (Parallel Redundancy Protocol)
- HSR (High-availability Seamless Redundancy)

3.1 Parallel Redundancy Protocol (PRP)

When the upper protocol layers send a data packet, the PRP interface creates a “twin packet” from this. The PRP interface then transmits redundant data packet of the twin pair to each participating LAN simultaneously. As they are transmitted via different LANs, the data packets may have different run times.

The receiving PRP interface forwards the first packet of a pair towards the upper protocol layers and discards the second packet. When viewed from the application, a PRP interface functions like a standard Ethernet interface.

The PRP interface or a Redundancy Box (RedBox) injects a Redundancy Control Trailer (RCT) into each packet. The RCT is a 48-bit identification field and is responsible for the identification of duplicates. This field contains, LAN identification (LAN A or B), information about the length of the payload, and a 16-bit sequence number. The PRP interface increments the sequence number for each packet sent. Using the unique attributes included in each packet, such as Physical MAC source address and sequence number, the receiving RedBox or Double Attached Node (DAN) interface identifies and discards duplicates.

Depending on the packet size, with PRP it attains a throughput of 93 to 99% of the available bandwidth.

3.1.1 PRP Network Structure

PRP uses two independent LANs. The topology of each of these LANs is arbitrary, and ring, star, bus and meshed topologies are possible.

The main advantage of PRP is loss-free data transmission with an active (transit) LAN. When the terminal device receives no packets from one of the LANs, the second (transit) LAN maintains the connection. As long as 1 (transit) LAN is available, repairs and maintenance on the other (transit) LAN have no impact on the data packet transmission.

The elementary devices of a PRP network are known as RedBox (Redundancy Box) and DANP (Double Attached Node implementing PRP).

Both devices have one connection each to the (transit) LANs.

The devices in the (transit) LAN are conventional switches that do not require any PRP support. The devices transmit PRP data packets transparently, without evaluating the RCT information.

Terminal devices that are connected directly to a device in the (transit) LAN are known as SAN (Single Attached Node). If there is an interruption, these terminal devices cannot be reached via the redundant line. To use the uninterruptible redundancy of the PRP network, you integrate your device into the PRP network via a RedBox.

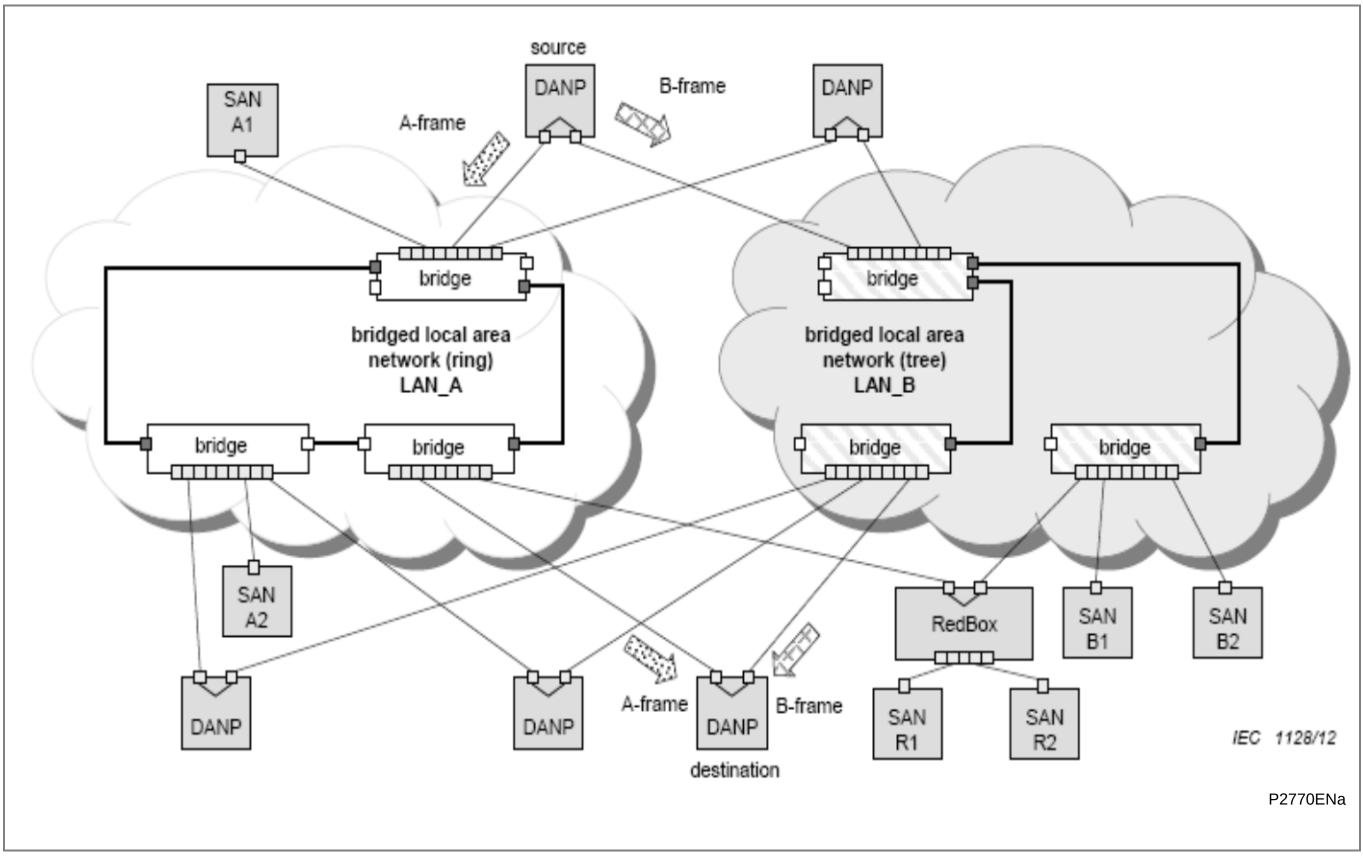


Figure 2 - PRP example of general redundant network

3.1.2 Example Configuration

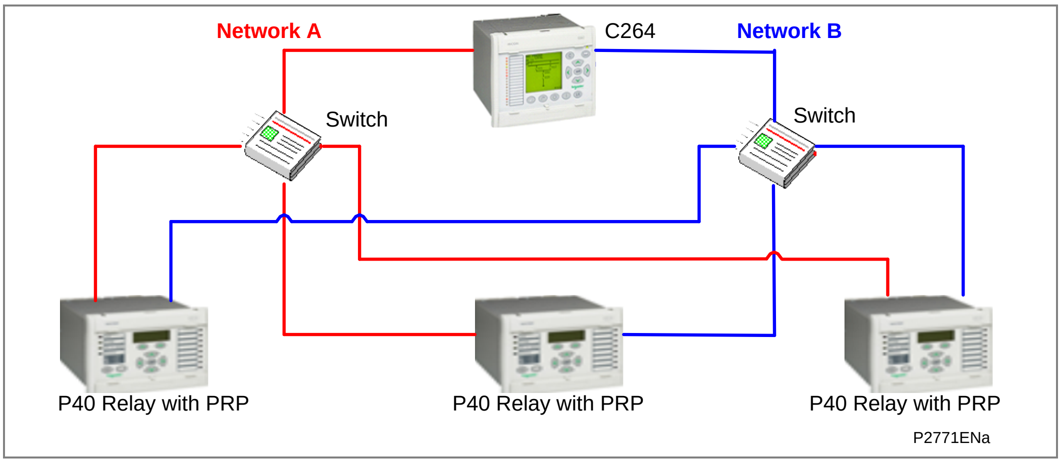


Figure 3 - PRP Relay Configuration

3.2 High-availability Seamless Redundancy (HSR)

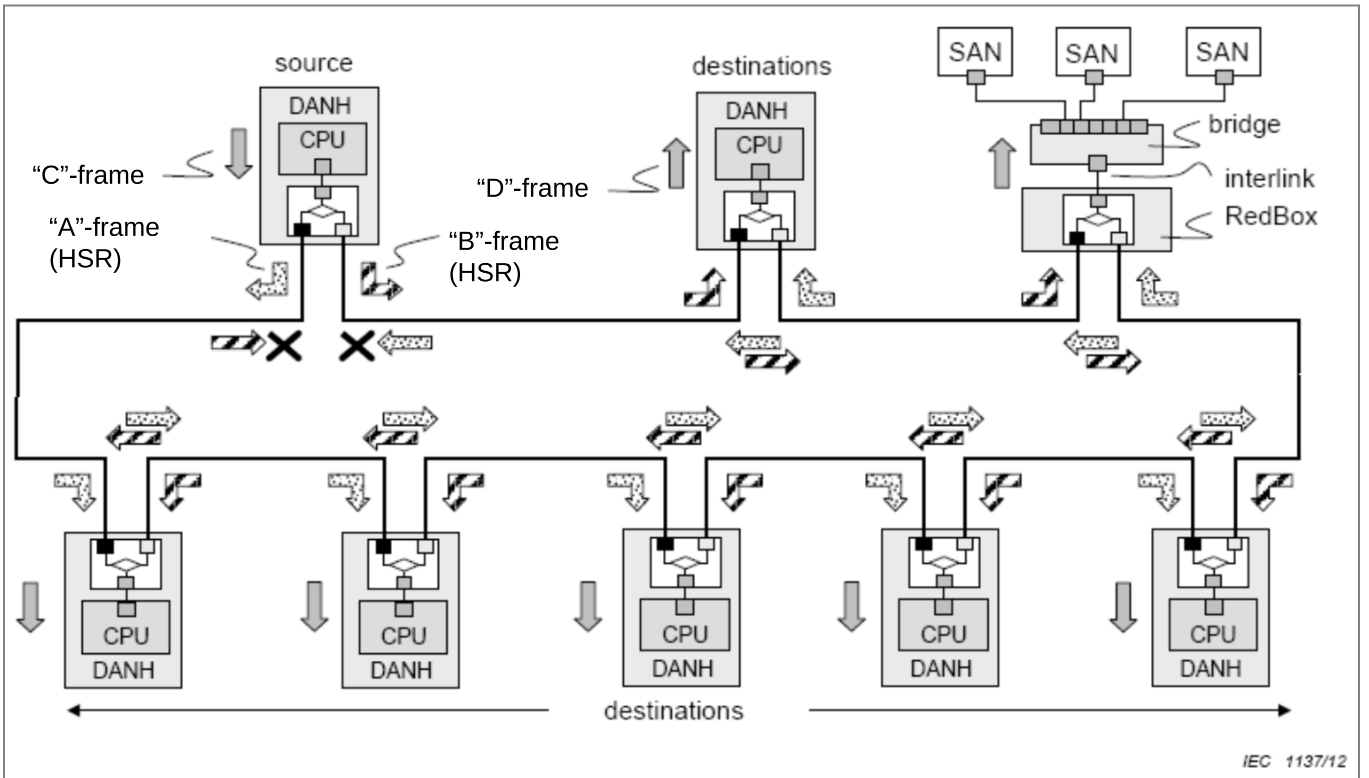
High-availability Seamless Redundancy (HSR) can only be used in a ring topology, This section describes the application of the PRP principles (IEC 62439-3- Clause 4) to implement a High-availability Seamless Redundancy (HSR), retaining the PRP property of zero recovery time, applicable to rings. With respect to PRP, HSR allows you to greatly reduce the network infrastructure. With respect to rings based on IEEE 802.1D (RSTP), IEC 62439-2 (MRP), IEC 62439-6 (DRP) or IEC 62439-7 (RRP), the available network bandwidth for network traffic is somewhat reduced depending on the type of traffic. Nodes within the ring are restricted to be HSR-capable bridging nodes, thus avoiding the use of dedicated bridges. Singly Attached Nodes (SANs) such as laptops or printers cannot be attached directly to the ring, but need attachment through a RedBox (redundancy box).

3.2.1 HSR Network Structure

As in PRP, a node has two ports operated in parallel; it is a DANH (Doubly Attached Node with HSR protocol).

A simple HSR network consists of doubly-attached bridging nodes, each having two ring ports, interconnected by full-duplex links, as shown in these examples for a ring topology:

- Figure 4 (multicast)
- Figure 5 (unicast)



Key

dotted arrows	"A" frames
cross-hatched arrows	"B" frames
grey arrows	non-HSR frames exchanged between ring and host
cross	frame is removed from the ring by the next node

P2772ENa

Figure 4 - HSR example of ring configuration for multicast traffic

A source DANH sends a frame passed from its upper layers ("C" frame), prefixes it by an HSR tag to identify frame duplicates and sends the frame over each port ("A"-frame and "B"-frame). A destination DANH receives, in the fault-free state, two identical frames from each port within a certain interval, removes the HSR tag of the first frame before passing it to its upper layers ("D"-frame) and discards any duplicate.

The nodes support the IEEE 802.1D bridge functionality and forward frames from one port to the other, except if they already sent the same frame in that same direction.

In particular, the node will not forward a frame that it injected into the ring.

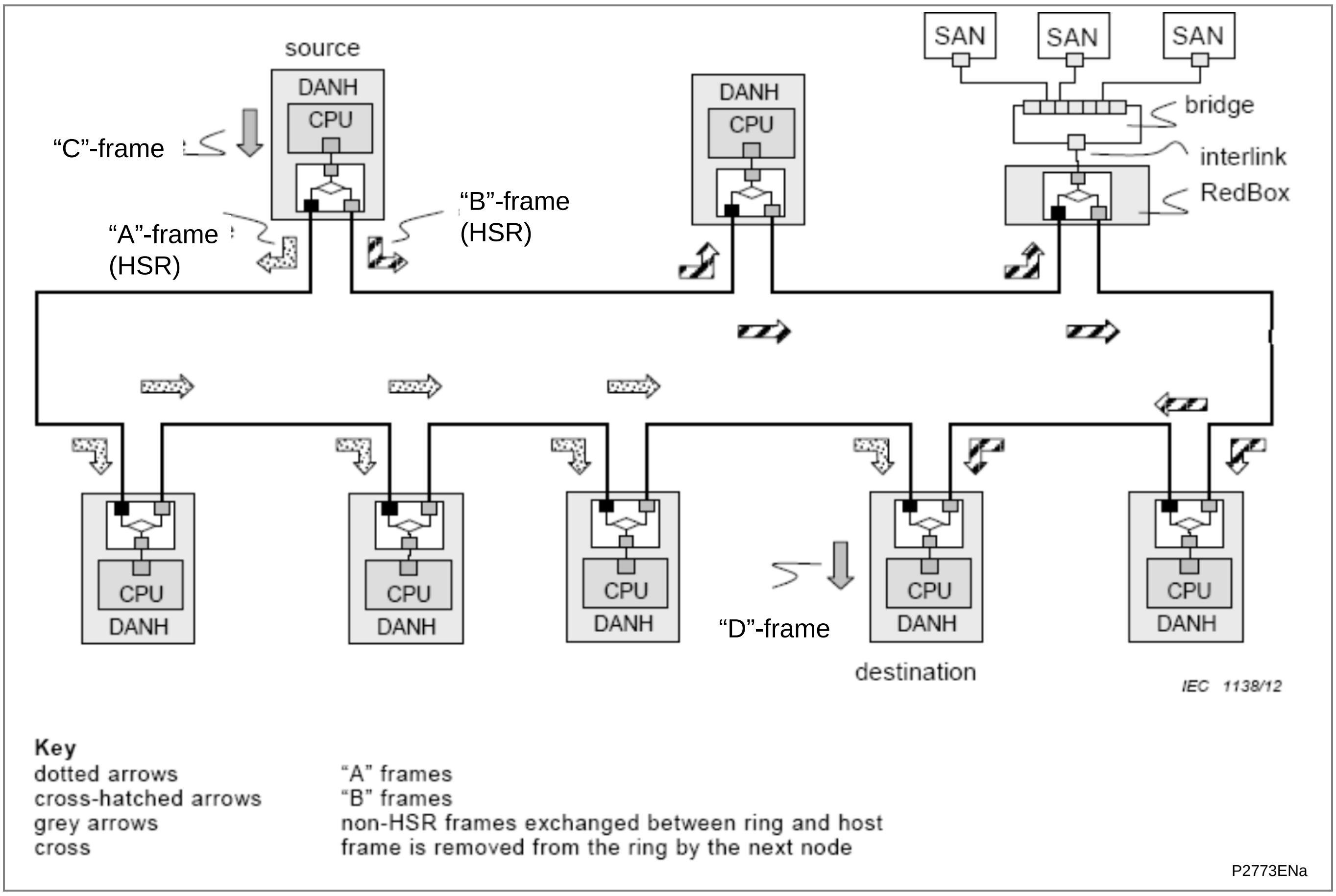


Figure 5 - HSR example of ring configuration for unicast traffic

A destination node of a unicast frame does not forward a frame for which it is the only destination, except for testing.

Frames circulating in the ring carry the HSR tag inserted by the source, which contains a sequence number. The doublet {source MAC address, sequence number} uniquely identifies copies of the same frame.

Singly Attached Nodes (SANs), for instance maintenance laptops or printers cannot be inserted directly into the ring since they have only one port and cannot interpret the HSR tag in the frames. SANs communicate with ring devices through a RedBox (redundancy box) that acts as a proxy for the SANs attached to it, as shown in the diagram. Connecting non-HSR nodes to ring ports, breaking the ring, is allowed to enable configuration. Non-HSR traffic within the closed ring is supported in an optional mode.

3.2.2 Example Configuration

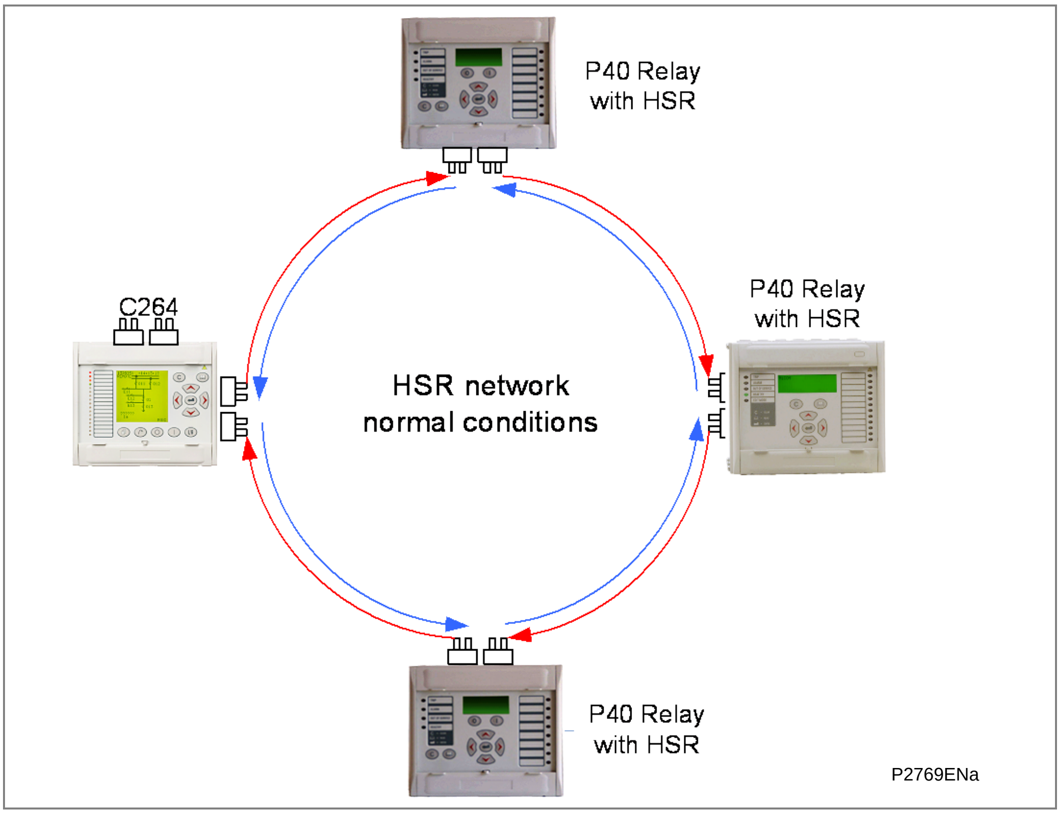


Figure 6 - HSR Relay Configuration

3.3 Generic Functions for all Redundant Ethernet Boards

The following apply to the redundant Ethernet protocols (PRP and HSR).

3.3.1 Priority Tagging

802.1p priority is enabled on all ports.

3.3.2 Simple Network Management Protocol (SNMP)

Simple Network Management Protocol (SNMP) is the network protocol developed to manage devices in an IP network. SNMP relies on a Management Information Base (MIB) that contains information about parameters to supervise. The MIB format is a tree structure, with each node in the tree identified by a numerical Object IDentifier (OID). Each OID identifies a variable that can be read or set using SNMP with the appropriate software. The information in the MIBs is standardized.

3.3.2.1 Redundant Ethernet Board MIB Structure

The IEC 62439-3 MIB provides the following objects available at the OID = .1.0.62439:

SNMP OID	Parameter name	Description
1	iso	
1	std	
1.0.62439	iec62439	
1.0.62439.2	prp	
1.0.62439.2.0	linkRedundancyEntityNotifications	
1.0.62439.2.1	linkRedundancyEntityObjects	
1.0.62439.2.1.0	lreConfiguration	
1.0.62439.2.1.0.0	lreConfigurationGeneralGroup	
1.0.62439.2.1.0.0.1	lreManufacturerName	Specifies the name of the LRE device manufacturer
1.0.62439.2.1.0.0.2	lreInterfaceCount	Total number of LREs present in this system
1.0.62439.2.1.0.1	lreConfigurationInterfaceGroup	
1.0.62439.2.1.0.1.0	lreConfigurationInterfaces	
1.0.62439.2.1.0.1.0.1	lreInterfaceConfigTable	List of PRP/HSR LREs. Each entry corresponds to one PRP/HSR Link Redundancy Entity (LRE), each representing a pair of LAN ports A and B. Basic devices supporting PRP/HSR may have only one LRE and thus one entry in the table, while more complex devices may have several entries for multiple LREs
1.0.62439.2.1.0.1.0.1.1	lreInterfaceConfigEntry	Each entry contains management information
1.0.62439.2.1.0.1.0.1.1.1	lreInterfaceConfigIndex	A unique value for each LRE
1.0.62439.2.1.0.1.0.1.1.2	lreRowStatus	Indicates the status of the LRE table entry
1.0.62439.2.1.0.1.0.1.1.3	lreNodeType	Specifies the operation mode of the LRE: PRP mode 1 (1) HSR mode (2). Note: PRP mode 0 is considered deprecated and is not supported by this revision of the MIB
1.0.62439.2.1.0.1.0.1.1.4	lreNodeName	Specifies this LRE's node name
1.0.62439.2.1.0.1.0.1.1.5	lreVersionName	Specifies the version of this LRE's software
1.0.62439.2.1.0.1.0.1.1.6	lreMacAddress	Specifies the MAC address to be used by this LRE. MAC addresses are identical for all ports of a single LRE
1.0.62439.2.1.0.1.0.1.1.7	lrePortAdminStateA	Specifies whether the port A shall be active or not Active through administrative action (Default: active)
1.0.62439.2.1.0.1.0.1.1.8	lrePortAdminStateB	Specifies whether the port B shall be active or not Active through administrative action (Default: active)

SNMP OID	Parameter name	Description
1.0.62439.2.1.0.1.0.1.1.9	lreLinkStatusA	Shows the actual link status of the LRE's port A
1.0.62439.2.1.0.1.0.1.1.10	lreLinkStatusB	Shows the actual link status of the LRE's port B
1.0.62439.2.1.0.1.0.1.1.11	lreDuplicateDiscard	Specifies whether a duplicate discard algorithm is used at reception (Default: discard)
1.0.62439.2.1.0.1.0.1.1.12	lreTransparentReception	If removeRCT is configured, the RCT is removed when forwarding to the upper layers, only applicable for PRP LRE (Default: removeRCT)
1.0.62439.2.1.0.1.0.1.1.13	lreHsrLREMode	This enumeration is only applicable if the LRE is an HSR bridging node or RedBox. It shows the mode of the HSR LRE: (1) Default mode: The HSR LRE is in mode h and bridges tagged HSR traffic (2) Optional mode: The HSR LRE is in mode n and bridging between its HSR ports is disabled. Traffic is HSR tagged (3) Optional mode: The HSR LRE is in mode t and bridges non-tagged HSR traffic between its HSR ports (4) Optional mode: The HSR LRE is in mode u and behaves like in mode h, except it does not remove unicast messages (5) Optional mode: The HSR LRE is configured in mixed mode. HSR frames are handled according to mode h. Non-HSR frames are handled according to 802.1D bridging rules
1.0.62439.2.1.0.1.0.1.1.14	lreSwitchingEndNode	This enumeration shows which feature is enabled in this particular LRE: (1): an unspecified non-bridging node, e.g. SRP. (2): an unspecified bridging node, e.g. RSTP. (3): a PRP node/RedBox. (4): an HSR RedBox with regular Ethernet traffic on its interlink. (5): an HSR switching node. (6): an HSR RedBox with HSR tagged traffic on its interlink. (7): an HSR RedBox with PRP traffic for LAN A on its interlink. (8): an HSR RedBox with PRP traffic for LAN B on its interlink.
1.0.62439.2.1.0.1.0.1.1.15	lreRedBoxIdentity	Applicable to RedBox HSR-PRP A and RedBox HSR-PRP B. One ID is used by one pair of RedBoxes (one configured to A and one configured to B) coupling an HSR ring to a PRP network. The integer value states the value of the path field a RedBox inserts into each frame it receives from its interlink and injects into the HSR ring. When interpreted as binary values, the LSB denotes the configuration of the RedBox (A or B), and the following 3 bits denote the identifier of a RedBox pair.
1.0.62439.2.1.0.1.0.1.1.16	lreEvaluateSupervision	True if the LRE evaluates received supervision frames. False if it drops the supervision frames without evaluating. Note: LREs are required to send supervision frames, but reception is optional. Default value is dependent on implementation.
1.0.62439.2.1.0.1.0.1.1.17	lreNodesTableClear	Specifies that the Node Table is to be cleared
1.0.62439.2.1.0.1.0.1.1.18	lreProxyNodeTableClear	Specifies that the Proxy Node Table is to be cleared
1.0.62439.2.1.1	lreStatistics	
1.0.62439.2.1.1.1	lreStatisticsInterfaceGroup	
1.0.62439.2.1.1.1.0	lreStatisticsInterfaces	
1.0.62439.2.1.1.1.0.1	lreInterfaceStatsTable	List of PRP/HSR LREs. Each entry corresponds to one PRP/HSR Link Redundancy Entity (LRE), each representing a pair of LAN ports A and B and a port C towards the application/interlink. Basic devices supporting PRP/HSR may have only one LRE and thus one entry in the table, while more complex devices may have several entries for multiple LREs.
1.0.62439.2.1.1.1.0.1.1	lreInterfaceStatsEntry	An entry containing management information applicable to a particular LRE
1.0.62439.2.1.1.1.0.1.1.1	lreInterfaceStatsIndex	A unique value for each LRE
1.0.62439.2.1.1.1.0.1.1.2	lreCntTxA	Number of frames sent over port A that are HSR tagged or fitted with a PRP Redundancy Control Trailer. Only frames that are HSR tagged or do have a PRP RCT are counted. Initial value = 0.
1.0.62439.2.1.1.1.0.1.1.3	lreCntTxB	Number of frames sent over port B that are HSR tagged or fitted with a PRP Redundancy Control Trailer. Only frames that are HSR tagged or do have a PRP RCT are counted. Initial value = 0.

SNMP OID	Parameter name	Description
1.0.62439.2.1.1.1.0.1.1.4	lreCntTxC	Number of frames sent towards the application interface of the DANP or DANH or over the interlink of the RedBox. All frames (with our without PRP RCT or HSR tag) are counted. Initial value = 0
1.0.62439.2.1.1.1.0.1.1.5	lreCntErrWrongLanA	Number of frames with the wrong LAN identifier received on LRE port A. Initial value = 0. Only applicable to PRP ports.
1.0.62439.2.1.1.1.0.1.1.6	lreCntErrWrongLanB	Number of frames with the wrong LAN identifier received on LRE port B. Initial value = 0. Only applicable to PRP ports
1.0.62439.2.1.1.1.0.1.1.7	lreCntErrWrongLanC	Number of frames with the wrong LAN identifier received on the interlink of a RedBox. Only applicable to HSR RedBoxes in HSR-PRP configuration (hsrredboxprpa and hsrredboxprpb).
1.0.62439.2.1.1.1.0.1.1.8	lreCntRxA	Number of frames received on a LRE port A. Only frames that are HSR tagged or fitted with a PRP Redundancy Control Trailer are counted. Initial value = 0.
1.0.62439.2.1.1.1.0.1.1.9	lreCntRxB	Number of frames received on a LRE port B. Only frames that are HSR tagged or fitted with a PRP Redundancy Control Trailer are counted. Initial value = 0
1.0.62439.2.1.1.1.0.1.1.10	lreCntRxC	Number of frames received from the application interface of a DANP or DANH or the number of number of frames received on the interlink of a RedBox. All frames (with our without PRP RCT or HSR tag) are counted. Initial value = 0.
1.0.62439.2.1.1.1.0.1.1.11	lreCntErrorsA	Number of frames with errors received on this LRE port A. Initial value = 0
1.0.62439.2.1.1.1.0.1.1.12	lreCntErrorsB	Number of frames with errors received on this LRE port B. Initial value = 0
1.0.62439.2.1.1.1.0.1.1.13	lreCntErrorsC	Number of frames with errors received on the application interface of a DANP or DANH or on the interlink of a RedBox. Initial value = 0.
1.0.62439.2.1.1.1.0.1.1.14	lreCntNodes	Number of nodes in the Nodes Table
1.0.62439.2.1.1.1.0.1.1.15	lreCntProxyNodes	Number of nodes in the Proxy Node Table. Only applicable to RedBox. Initial value = 0.
1.0.62439.2.1.1.1.0.1.1.16	lreCntUniqueRxA	Number of entries in the duplicate detection mechanism on port A for which no duplicate was received. Initial value = 0
1.0.62439.2.1.1.1.0.1.1.17	lreCntUniqueRxB	Number of entries in the duplicate detection mechanism on port B for which no duplicate was received. Initial value = 0
1.0.62439.2.1.1.1.0.1.1.18	lreCntUniqueRxC	Number of entries in the duplicate detection mechanism on the application interface of the DAN or the interlink of the RedBox for which no duplicate was received. Initial value = 0
1.0.62439.2.1.1.1.0.1.1.19	lreCntDuplicateRxA	Number of entries in the duplicate detection mechanism on port A for which one single duplicate was received. Initial value = 0.
1.0.62439.2.1.1.1.0.1.1.20	lreCntDuplicateRxB	Number of entries in the duplicate detection mechanism on port B for which one single duplicate was received. Initial value = 0.
1.0.62439.2.1.1.1.0.1.1.21	lreCntDuplicateRxC	Number of entries in the duplicate detection mechanism on the application interface of the DAN or the interlink of the RedBox for which one single duplicate was received. Initial value = 0.
1.0.62439.2.1.1.1.0.1.1.22	lreCntMultiRxA	Number of entries in the duplicate detection mechanism on port A for which more than one duplicate was received. Initial value = 0.
1.0.62439.2.1.1.1.0.1.1.23	lreCntMultiRxB	Number of entries in the duplicate detection mechanism on port B for which more than one duplicate was received. Initial value = 0
1.0.62439.2.1.1.1.0.1.1.24	lreCntMultiRxC	Number of entries in the duplicate detection mechanism on the application interface of the DAN or the interlink of the RedBox for which more than one duplicate was received. Initial value = 0
1.0.62439.2.1.1.1.0.1.1.25	lreCntOwnRxA	Number of HSR tagged frames received on Port A that originated from this device. Frames originate from this device if the source MAC matches the MAC of the LRE, or if the source MAC appears in the proxy node table (if implemented). Applicable only to HSR. Initial value = 0.
1.0.62439.2.1.1.1.0.1.1.26	lreCntOwnRxB	Number of HSR tagged frames received on Port B that originated from this device. Frames originate from this device if the source MAC matches the MAC of the LRE, or if the source MAC appears in the proxy node table (if implemented). Applicable only to HSR. Initial value = 0.

SNMP OID	Parameter name	Description
1.0.62439.2.1.1.1.0.2	lreNodesTable	The node table (if it exists on that node) contains information about all remote LRE, which advertised themselves through supervision frames
1.0.62439.2.1.1.1.0.2.1	lreNodesEntry	Each entry in the node table (if it exists) contains information about a particular remote LRE registered in the node table, which advertised itself through supervision frames.
1.0.62439.2.1.1.1.0.2.1.1	lreNodesIndex	Unique value for each node in the LRE's node table
1.0.62439.2.1.1.1.0.2.1.2	lreNodesMacAddress	Each MAC address corresponds to a single Dual Attached Node
1.0.62439.2.1.1.1.0.2.1.3	lreTimeLastSeenA	Time in TimeTicks (1/100s) since the last frame from this remote LRE was received over LAN A. Initialized with a value of 0 upon node registration in the node table
1.0.62439.2.1.1.1.0.2.1.4	lreTimeLastSeenB	Time in TimeTicks (1/100s) since the last frame from this remote LRE was received over LAN B. Initialized with a value of 0 upon node registration in the node table.
1.0.62439.2.1.1.1.0.2.1.5	lreRemNodeType	DAN type, as indicated in the received supervision frame
1.0.62439.2.1.1.1.0.3	lreProxyNodeTable	The proxy node table (if implemented) contains information about all nodes, for which the LRE acts as a connection to the HSR/PRP network.
1.0.62439.2.1.1.1.0.3.1	lreProxyNodeEntry	Each entry in the proxy node table contains information about a particular node for which the LRE acts as a connection to the HSR/PRP network.
1.0.62439.2.1.1.1.0.3.1.1	lreProxyNodeIndex	A unique value for each node in the LRE's proxy node table.
1.0.62439.2.1.1.1.0.3.1.2	lreProxyNodeMacAddress	Each entry contains information about a particular node for which the LRE acts as a proxy for the HSR/PRP network.
1.0.62439.2.2	linkRedundancyEntityConformance	

Table 3 - Redundant Ethernet board MIB Structure

*Port number: 1 to 6 for the RJ45, port 7 management, port 8 ring

Various SNMP client software tools can be used with the MiCOM Px4x, C264 and Hx8x range. Schneider Electric recommends using an SNMP MIB browser which can perform the basic SNMP operations such as GET, GETNEXT, and RESPONSE.

Redundant agency device configuration will be required to access SNMP, refer to section 4.4 for more details.

3.3.3 Simple Network Time Protocol (SNTP)

Simple Network Time Protocol (SNTP) is supported by both the IED and the redundant Ethernet switch. SNTP is used to synchronize the clocks of computer systems over packet-switched, variable-latency data networks. A jitter buffer is used to reduce the effects of variable latency introduced by queuing in packet switched networks, ensuring a continuous data stream over the network.

The IED receives the synchronization from the SNTP server. This is done using the IP address of the SNTP server entered into the IED from the IED Configurator software.

3.3.4 Dual Ethernet Communication (Dual IPs)

3.3.4.1 Dual IP Introduction

Dual IP means the IED provides two independent IEC 61850 interfaces, and both these interfaces support MMS and Goose message.

The IED which supports Dual IP can provide the customer with more flexible network connections: two fully segregated Station BUS networks, or one Station Bus and one Process Bus (for Goose message transmission).

Dual IP is not mutually exclusive with PRP/HSR - Dual IP is automatically supported even if the IED is operate under HSR/PRP mode.

3.3.4.2 Dual IP in MiCOM

Dual IP is only supported for devices with the new Ethernet board assembly. This is shown by the model number, where the 7th digit is either hardware option Q or R. These boards have three Ethernet ports, as shown in Figure 1.

A setting is provided in the HMI to switch the operation mode between PRP/HSR/Dual IP.

Operation mode	Port 1	Port 2	Port3
PRP	Interface 1	Interface 2 (PRP)	Interface 2 (PRP)
HSR	Interface 1	Interface 2 (HSR)	Interface 2 (HSR)
Dual IP	* Interface 1 on Port 1 or Port 2		Interface 2

** Note* *In Dual IP mode, interface 1 can be available on port 1 or port 2. If both of port 1 and port 2 are connected, only port 1 will work.*

Table 4 - Ethernet ports operation mode

For each interface, the fully IEC 61850 functions (GOOSE and MMS services) are supported independently.

For outgoing GOOSE messages, you need to configure whether a message is to be transmitted across one or both Ethernet connections. You also need to configure the destination parameters such as multicast MAC address, AppID, VLAN, etc.

Two communication parameters also need to be configured for each interface (IP address, MAC address, subnet mask). For the CID which is exported from SCD file, the second interface communication parameters are not configured. This needs to be done by manually editing in the IED configurator (this being invisible by the SCD file). This process needs to be completed before the exported CID file is downloaded to the IED. (this being invisible by the SCD file).

3.3.4.3 Typical User Cases

Below for Interface 1 and Interface 2, from a functional point of view it is same. The customer has flexibility to define the functionality according their requirements.

- Both for Station Bus to have duplicated network for DCS.
- One for Station Bus and one for process bus (Goose message)

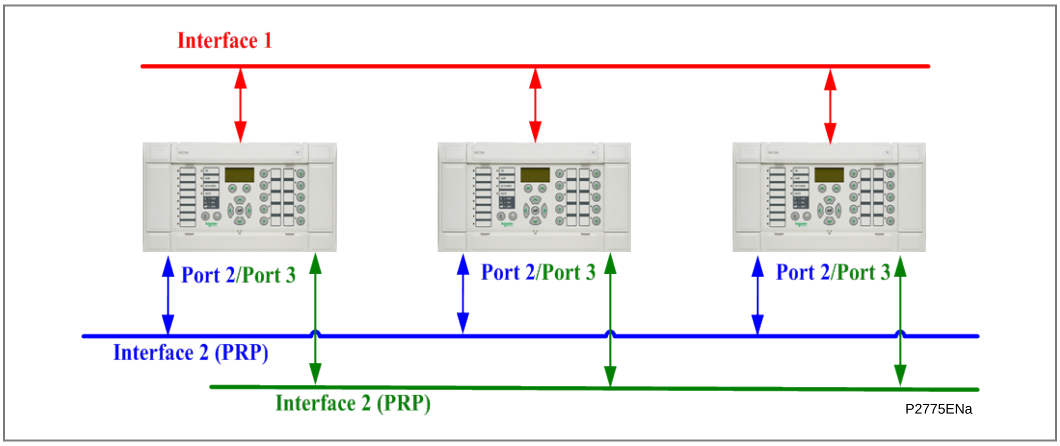


Figure 7 – PRP + Dual IP (Ethernet Mode PRP)

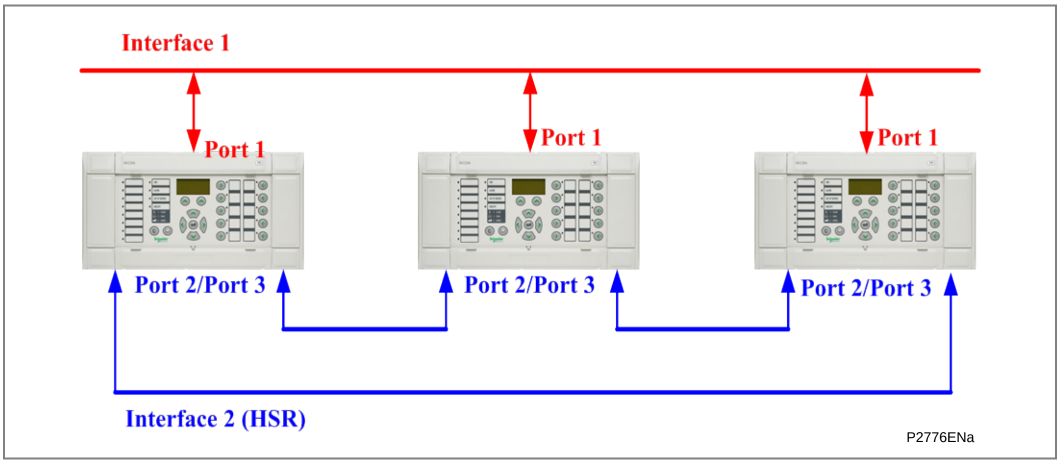


Figure 8 – HSR + Dual IP (Ethernet Mode HSR)

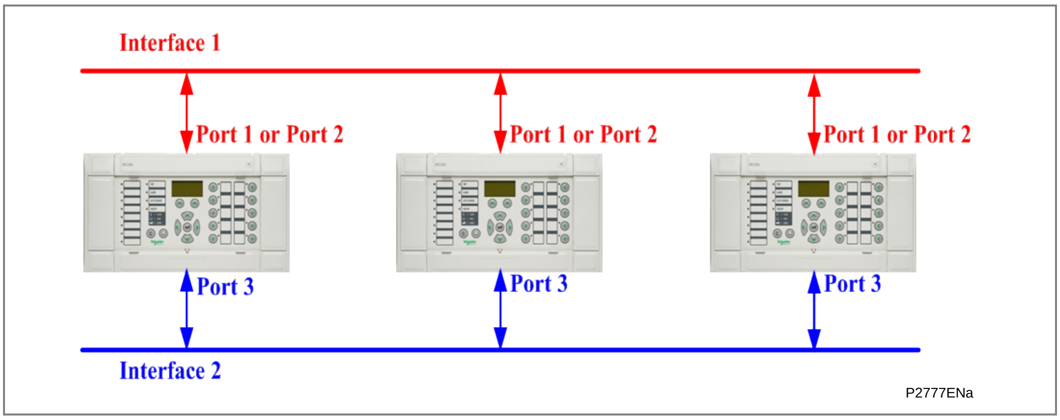


Figure 9 – Dual IP (Ethernet Mode Dual IP)

4 CONFIGURATION

The new redundant Ethernet board supports three communication operation modes. These can be achieved by change the setting in HMI. It is not necessary to flash the firmware.

Also for the two interfaces, the communication parameters need to be configured. These include the IP address, MAC address, and subnet mask, etc.

For redundant protocols, the communication parameters for redundant agency device also need to be configured.

4.1 Configuring Ethernet Communication Mode

Menu Text	Cell Add.	Default Setting	Available Setting
ETH COMM Mode	0016	Dual IP	Dual IP, PRP, HSR
This setting can only be change using the HMI, and the setting change will cause the Ethernet board reboot. Restore default setting does not apply to this setting.			

Table 5 - Ethernet communication mode setting

4.2 Configuring the IED Communication Parameters

The communication parameter for each interface is configured using the IED Configurator software in MiCOM S1 Studio. **Customers can configure these parameters according to their needs, but the IP address for these two interfaces should not be in the same subnet.**

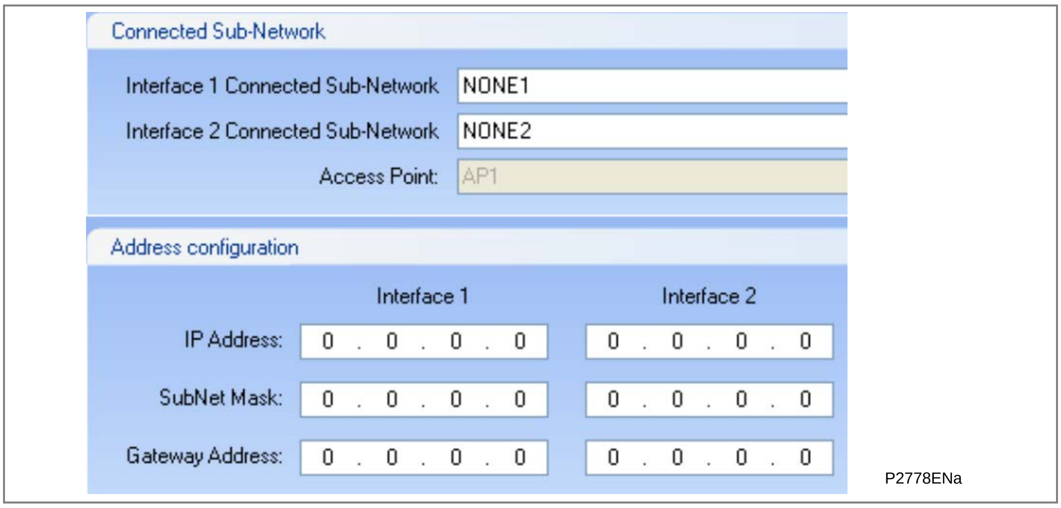


Figure 10 - Communication Parameters for two Interfaces

To use the device configuration with Courier Tunneling, for each interface, a default IP address has been applied. The default IP address for the first three bytes is fixed for each interface as below,

Interface	First three Bytes for IP address
Interface 1	169.254.0.xxx
Interface 2	169.254.1.yyy
Note *xxx = Mod(The last byte MAC1 address, 128) + 1* *yyy = Mod(The last byte MAC2 address, 128) + 1*	

Table 6 - First three bytes for default IP address

The default IP address can be found in the ***IED CONFIGURATOR*** column. Also, you can also calculate it according the MAC address label which is mounted on the rear panel of the Ethernet card.

4.3 Configuring GOOSE Publish Parameters

For outgoing GOOSE messages, you need to configure whether a message is to be transmitted over one or both Ethernet connections. You also need to configure the destination parameters including multicast MAC address, AppID, VLAN, etc.

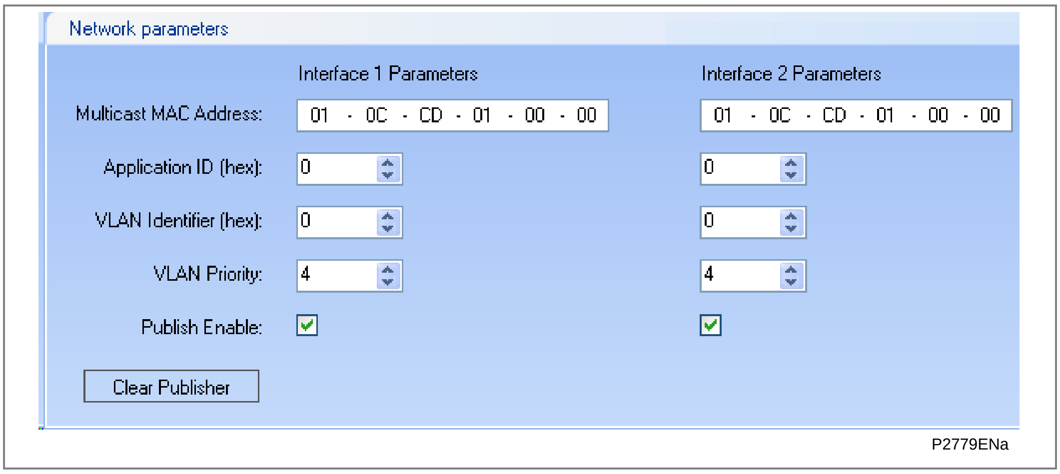


Figure 11 - Goose Publish Parameters for two Interfaces

4.4 Redundant Agency Device Configuration

The redundant agency device configuration is used by the SNMP server and only available for the device which works on PRP/HSR mode. The SNMP server can only be connected with Interface 2 (HSR/PRP port).

The following settings need to be configured in setting files:

- IP address
- Subnet Mask
- Gateway.

The MAC address is set when the device is manufactured. Also, the default IP is applied and linked to the MAC address. This default IP address can be seen in the HMI, in the Communication settings section.

The default IP address is 169.254.2.zzz.

zzz = Mod (The last byte MAC3 address, 128) + 1

5 COMMISSIONING

5.1 PRP Star Connection

The following diagram shows the Px4x IEDs with the PRP variant of Redundant Ethernet boards connected in a STAR topology. The STAR topology can have one or more high-end PRP-enabled Ethernet switches to interface with another network. The Ethernet switch is an HSR-enabled switch with a higher number of ports, which should be configured as the root bridge.

The number of IEDs that can be connected in the STAR can be up to 128.

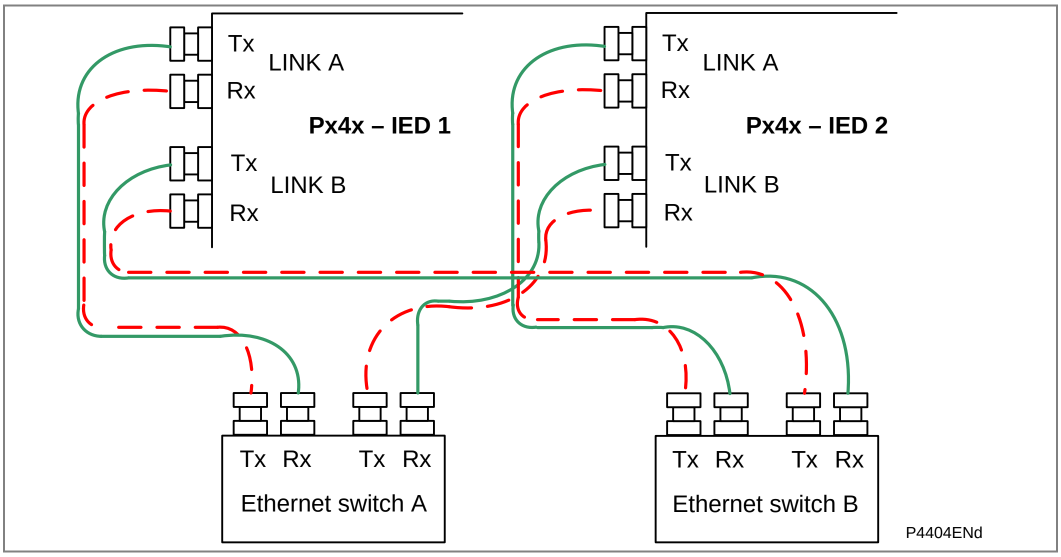


Figure 12 - PRP star connection

5.2 HSR Ring Connection

The following diagram shows the Px4x IEDs (Px4x – IED 1 to IED N) with the HSR variant of redundant Ethernet boards connected in a ring topology. The ring topology can have one or more high-end HSR-enabled Ethernet switches to interface with another network or a control center. The Ethernet switch is an HSR enabled switch with a higher number of ports.

The Ethernet switch, which is connected to the controlling PC, should be configured as the root bridge.

The number of IEDs that can be connected in the ring can be up to 128.

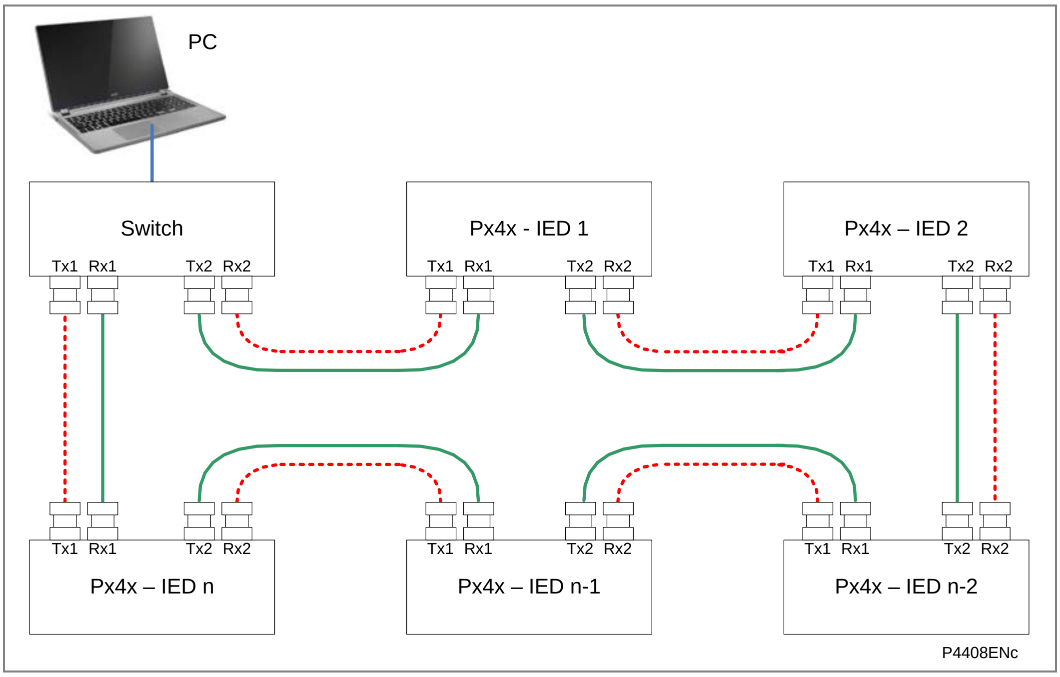


Figure 13 - HSR ring topology

The number of IEDs that can be connected in the ring can be up to 128.

6 TECHNICAL DATA

The technical data applies to a Redundant Ethernet board fitted into these MiCOM products.

- P141, P142, P143, P145
- P241, P242, P243
- P341, P342, P343, P344, P345
- P442, P443, P444, P445, P446
- P543, P544, P545, P546, P547
- P642, P643, P645
- P741, P743, P746
- P841, P849

6.1 Board Hardware

6.1.1 100 Base TX Communications Interface (in accordance with IEEE802.3 and IEC 61850)

Cable type	Screened Twisted Pair (STP)
Connector type	RJ45
Maximum distance	100m
Full Duplex	100 Mbps

Table 7 - 100 Base TX interface

6.1.2 100 Base FX Communications Interface (in accordance with IEEE802.3 and IEC 61850)

Optical fiber cable	Multi-mode 50/125 µm or 62.5/125 µm
Center wavelength	1310 nm
Connector type	LC
Maximum distance	2 km
Full Duplex	100 Mbps

Table 8 - 100 Base FX interface

6.1.3 Transmitter Optical Characteristics

(TA = -40° C to 85° C, Single +3.3 V power supply)

Parameter	Sym	Min.	Typ.	Max.	Unit
Output Optical Power 62.5/125 µm, NA = 0.275 Fiber	PO	-20	-17.0	-14	dBm avg.
Output Optical Power 50/125 µm, NA = 0.20 Fiber	PO	-23.5	-20.0	-14	dBm avg.
Optical Extinction Ratio				10	dB
Output Optical Power at Logic “0” State	PO (“0”)			-45	dBm avg.

Table 9 - Tx optical characteristics

6.1.4 Receiver Optical Characteristics

(TA = -40° C to 85° C, Single +3.3 V power supply)

Parameter	Sym	Min.	Typ.	Max.	Unit
Input Optical Power	PIN	-31		-14	dBm avg.

Table 10 - Rx optical characteristics

6.1.5 IRIG-B and Real-Time Clock

6.1.5.1 Performance

Year 2000: Compliant
Real time accuracy: < ±2 seconds / day
External clock synchronization: Conforms to IRIG standard 200-98, format B

6.1.5.2 Features

Real time 24 hour clock settable in hours, minutes and seconds
Calendar settable from January 1994 to December 2092
Clock and calendar maintained via battery after loss of auxiliary supply
Internal clock synchronization using IRIG-B Interface for IRIG-B signal is BNC

6.1.5.3 Self-adapted Rear IRIG-B interface (Modulated or Unmodulated)

BNC plug
Isolation to SELV level
50 ohm coaxial cable

6.2 Type Tests

6.2.1 Insulation

Per EN / IEC 60255-27:
Insulation resistance > 100 MΩ at 500 Vdc
(Using only electronic/brushless insulation tester).

6.2.2 Creepage Distances and Clearances

Per EN / IEC 60255-27:
Pollution degree 3, Overvoltage category III,

6.2.3 High Voltage (Dielectric) Withstand

(EIA RS-232 ports excepted and normally-open contacts of output relays excepted).

(i) As for EN / IEC 60255-27:

2 kV rms AC, 1 minute:
Between all independent circuits.
Between independent circuits and case earth (ground).
1 kV rms AC for 1 minute, across open watchdog contacts.
1 kV rms AC for 1 minute, across open contacts of changeover output relays.
1 kV rms AC for 1 minute for all D-type EIA(RS)-232 or EIA(RS)-485 ports between the communications port terminals and protective (earth) conductor terminal.
1 kV rms AC for 1 minute between RJ45 ports and the case earth (ground).

(ii) As for ANSI/IEEE C37.90:

1.5 kV rms AC for 1 minute, across open contacts of normally open output relays.
1 kV rms AC for 1 minute, across open watchdog contacts.
1 kV rms AC for 1 minute, across open contacts of changeover output relays.

6.2.4 Impulse Voltage Withstand Test

As for EN / IEC 60255-27:

(i) Front time: 1.2 µs, Time to half-value: 50 µs,
Peak value: 5 kV, 0.5 J
Between all independent circuits.
Between independent circuits and case earth ground.

(ii) Front time: 1.2 µs, Time to half-value: 50 µs,
Peak value: 1.5kV, 0.5 J
Between RJ45 ports and the case earth (ground).
EIA(RS)-232 & EIA(RS)-485 ports and normally open contacts of output relays excepted.

6.3 ElectroMagnetic Compatibility (EMC)

6.3.1 1 MHz Burst High Frequency Disturbance Test

As for EN / IEC 60255-22-1, Class III,

Common-mode test voltage:	2.5 kV,
Differential test voltage:	1.0 kV,
Test duration:	2 s,
Source impedance:	200 Ω

(EIA(RS)-232 ports excepted).

6.3.2 100 kHz and 1MHz Damped Oscillatory Test

EN / IEC 61000-4-18:	Level 3
Common mode test voltage:	2.5 kV
Differential mode test voltage:	1 kV

6.3.3 Immunity to Electrostatic Discharge

As for EN / IEC 60255-22-2, EN / IEC 61000-4-2:

15kV discharge in air to user interface, display, communication ports and exposed metalwork.
6kV contact discharge to the screws on the front of the front communication ports.
8kV point contact discharge to any part of the front of the product.

6.3.4 Electrical Fast Transient or Burst Requirements

As for EN / IEC 60255-22-4, Class B:

- ±4.0 kV, 5kHz and 100kHz applied to all inputs / outputs excluding communication ports
- ±2.0 kV, 5kHz and 100kHz applied to all communication ports

As for EN / IEC 61000-4-4, severity level 4:

- ±2.0 kV, 5kHz and 100kHz applied to all inputs / outputs and communication ports excluding power supply and earth.
- ±4.0 kV, 5kHz and 100kHz applied to all power supply and earth port

Rise time of one pulse:	5 ns
Impulse duration (50% value):	50 ns
Burst duration:	15 ms or 0.75ms
Burst cycle:	300 ms
Source impedance:	50 Ω

6.3.5 Surge Withstand Capability

As for IEEE/ANSI C37.90.1:
4 kV fast transient and 2.5 kV oscillatory
applied directly across each output contact, optically isolated input, and power supply circuit.

6.3.6 Surge Immunity Test

As for EN / IEC 61000-4-5, EN / IEC 60255-26:

Time to half-value:	1.2 to 50 μs,
Amplitude:	4 kV between all groups and case earth (ground),
Amplitude:	2 kV between terminals of each group.
Amplitude:	1kV for LAN ports

6.3.7 Conducted/Radiated Immunity

For RTDs used for tripping applications the conducted and radiated immunity performance is guaranteed only when using totally shielded RTD cables (twisted leads).

6.3.8 Immunity to Radiated Electromagnetic Energy

Per EN / IEC 61000-4-3 and EN / IEC 60255-22-3, Class 3

- Test field strength, frequency band 80 to 1000 MHz and
- 1.4 GHz to 2.7GHz: 10 V/m,
- Test using AM: 1 kHz / 80%, Spot tests at 80, 160, 450, 900, 1850, 2150 MHz

Per IEEE/ANSI C37.90.2:

- 80MHz to 1000MHz, zero and 100% square wave modulated.
- Field strength of 35V/m.

6.3.9 Radiated Immunity from Digital Communications

As for EN / IEC61000-4-3, Level 4:
Test field strength, frequency band 800 to 960 MHz,
and 1.4 to 2.0 GHz: 30 V/m, Test using AM: 1 kHz/80%.

6.3.10 Radiated Immunity from Digital Radio Telephones

As for EN / IEC 61000-4-3: 10 V/m, 900 MHz and 1.89 GHz.

6.3.11 Immunity to Conducted Disturbances Induced by Radio Frequency Fields

As for EN / IEC 61000-4-6, Level 3, Disturbing test voltage: 10 V.

6.3.12 Power Frequency Magnetic Field Immunity

As for EN / IEC 61000-4-8, Level 5,
    100 A/m applied continuously, 1000 A/m applied for 3 s.
As for EN / IEC 61000-4-9, Level 5,
    1000 A/m applied in all planes.
As for EN / IEC 61000-4-10, Level 5,
    100 A/m applied in all planes at 100 kHz and 1 MHz with a burst duration of 2 s.

6.3.13 Conducted Emissions

As for CISPR 22 Class A:
Power supply:
    0.15 - 0.5 MHz, 79 dBµV (quasi peak) 66 dBµV (average)
    0.5 - 30 MHz, 73 dBµV (quasi peak) 60 dBµV (average)
Permanently connected communications ports:
    0.15 - 0.5MHz, 97dBµV (quasi peak) 84dBµV (average)
    0.5 - 30MHz, 87dBµV (quasi peak) 74dBµV (average)

6.3.14 Radiated Emissions

As for CISPR 22 Class A:
    30 to 230 MHz, 40 dBµV/m at 10m measurement distance
    230 to 1 GHz, 47 dBµV/m at 10 m measurement distance.
    1 – 3GHz, 76dBµV/m (peak), 56dBµV/m (average) at 3m measurement distance.
    3 – 5GHz, 80dBµV/m (peak), 60dBµV/m (average) at 3m measurement distance.

6.4 Environmental Conditions

6.4.1 Ambient Temperature Range

Per EN 60068-2-1 & EN / IEC 60068-2-2

Operating temperature range:	-25°C to +55°C (or -13°F to +131°F)
Storage and transit:	-25°C to +70°C (or -13°F to +158°F)

6.4.2 Ambient Humidity Range

Per EN /IEC 60068-2-78:
    56 days at 93% relative humidity and +40 °C
Per EN / IEC 60068-2-14
    5 cycles, -25°C to +55 °C
    1°C / min rate of change
Per EN / IEC 60068-2-30
    Damp heat cyclic, six (12 + 12) hour cycles, +25 to +55°C

6.4.3 Corrosive Environments

Per EN / IEC 60068-2-60, Part 2, Test Ke, Method (class) 3
Industrial corrosive environment/poor environmental control, mixed gas flow test.
21 days at 75% relative humidity and +30°C
Exposure to elevated concentrations of H_2S, (100 ppb), NO_2, (200 ppb) & Cl_2 (20 ppb).
Per EN / IEC 60068-2-52 Salt mist (7 days)
Per EN / IEC 60068-2-43 for H_2S (21 days), 15 ppm
Per EN / IEC 60068-2-42 for SO_2 (21 days), 25 ppm

6.5 EU Directives

6.5.1 EMC Compliance

As for 2004/108/EC:

Compliance to the European Commission Directive on EMC is demonstrated using a Technical File. Product Specific Standards were used to establish conformity:
EN 60255-26

6.5.2 Product Safety

Per 2006/95/EC:

Compliance to the European Commission Low Voltage Directive (LVD) is demonstrated using a Technical File. A product-specific standard was used to establish conformity.

CE EN 60255-27

6.5.3 R&TTE Compliance

Radio and Telecommunications Terminal Equipment (R&TTE) directive 99/5/EC.

Compliance demonstrated by compliance to both the EMC directive and the Low voltage directive, down to zero volts.

Applicable to rear communications ports.

Compliance demonstrated by Notified Body certificates of compliance.

6.5.4 Other Approvals

For ATEX Potentially Explosive Atmospheres directive 94/9/EC compliance, consult Schneider Electric.
For other approvals such as UL / CUL / CSA, consult Schneider Electric.

6.6 Mechanical Robustness

6.6.1 Vibration Test

Per EN / IEC 60255-21-1	Response Class 2 Endurance Class 2

6.6.2 Shock and Bump

Per EN / IEC 60255-21-2	Shock response Class 2 Shock withstand Class 1 Bump Class 1

6.6.3 Seismic Test

Per EN / IEC 60255-21-3:	Class 2

7 CORTEC

This is a generic Cortec to cover all IEDs using the **Redundant Ethernet** boards.
It does not necessarily include all the possible options for all products in the MiCOM Px4x range.

Variants Order Number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
MiCOM Protection	P														
Application/Platform:															
Feeder Management:		1	4	*											
Motor Protection:		2	4	*											
Generator Protection Relay:		3	4	*											
Distance Protection Relay:		4	4	*											
Current Differential:		5	4	*											
Transformer:		6	4	*											
Busbar:		7	4	*											
Breaker Fail:		8	4	*											
Vx Aux Rating:															
24 - 32 Vdc					9										
48 - 110 Vdc					2										
110 - 250 Vdc (100 - 240 Vac)					3										
In/Vn Rating:															
HV-LV (In = 1A/5A), (Vn = 100/120V) (8CT/1VT)						1									
HV-LV (In = 1A/5A), (Vn = 100/120V) (8CT/2VT)						2									
Hardware Options:															
Standard - no options							1								
IRIG-B only (modulated)							2								
Fibre optic converter only							3								
IRIG-B (modulated) & fibre optic converter							4								
Ethernet with 100Mits/s fibre-optic port							6								
Second Rear Comms Port (Courier EIA232/EIA485/k-bus)							7								
Second Rear Comms Port + IRIG-B (modulated) (Courier EIA232/EIA485/k-bus)							8								
InterMiCOM + Courier Rear Port							E								
InterMiCOM + Courier Rear Port + IRIG-B modulated							F								
Redundant Ethernet (100Mbit/s) PRP or HSR and Dual IP, 2 LC ports + 1 RJ45 port + Modulated/Unmodulated IRIG-B							Q								
Redundant Ethernet (100Mbit/s) PRP or HSR and Dual IP, 3 RJ45 ports + Modulated/Unmodulated IRIG-B							R								
Ethernet (100Mbit/s), 1 RJ45 port + Modulated/Unmodulated IRIG-B							S								
Product Specific Options :															
Size 8 (40TE) Case, 8 Optos + 8 Relays								A							
Size 8 (40TE) Case, 8 Optos + 8 Relays + RTD								B							
Size 8 (40TE) Case, 8 Optos + 8 Relays + CLIO (mA I/O)								C							
Size 8 (40TE) Case, 12 Optos + 12 Relays								D							
Size 8 (40TE) Case, 8 Optos + 12 Relays (including 4 High Break)								E							
Protocol Options:															
K-Bus/Courier									1						
Modbus									2						
IEC60870-5-103 (VDEW)									3						
DNP3.0									4						
IEC 61850 over Ethernet and Courier via rear K-Bus/RS485 OR IEC 61850 Edition 1 and Edition 2 and Courier via rear K-Bus/RS485									6						
IEC 61850 over ethernet with CS103 rear port RS485 protocol OR IEC 61850 Edition 1 and Edition 2 and CS103 via rear port RS485									7						
IEC 61850 Edition 1 / 2 and DNPoE and DNP3 Serial with simple password management - (CSL0)									B						
IEC 61850 Edition 1 / 2 and Courier via rear K-Bus/RS485 with advanced Cyber Security - CSL1 - Security Administration Tool (SAT) required									G						

IEC 61850 Edition 1 / 2 and CS103 via rear port RS485 with advanced Cyber Security - CSL1 - Security Administration Tool (SAT) required	H						
IEC 61850 Edition 1 / 2 and DNPoE and DNP3 Serial with advanced Cyber Security - CSL1 - Security Administration Tool (SAT) required	L						
Mounting Options:							
Flush Panel Mounting		M					
Rack Mounting (80TE only)		N					
Language Options:							
English, French, German, Spanish			0				
English, French, German, Russian			5				
Chinese, English or French via HMI, with English or French only via Communications port			C				
Software Version:							
				*	*		
Customisation:							
Default						8	
Customer Settings						9	
Design Suffix:							
							*

Notes:

PRP NOTES

CHAPTER 20

Date (month/year):	07/2016			
Products covered by this chapter:	This chapter covers the specific versions of the MiCOM products listed below. This includes ***only*** the following combinations of Software Version and Hardware Suffix.			
Hardware Suffix:	P141/P142/P143 P145 P241 P242/P243 P342 P343/P344/P345 P391 P445 P44x (P441/P442/P444) P44x (P442/P444) P44y (P443/P446)	L M L M L M A K/L K M M	P54x (P543/P544/P545/P546) P642 P643/P645 P741/P743 P742 P746 P74x (P741, P743) P841A (one circuit breaker) P841B (two circuit breakers) P849	M L M M L M K M M M
Software Version:	P14x (P141/P142/P143/P145) P24x (P241/P242/P243) P34x (P342/P343/P344/P345/P391) P445 P44x (P442/P444) P44y (P443/P446)	B0/B2 D0 B0 J4 E0 H4	P54x (P543/P544/P545/P546) P64x (P642/P643/P645) P746 P74x (P741/P742/P743) P841A P841B P849	H4 B1 B1/B2/ C1/C2 B0 G4 H4 B0
Connection Diagrams:	P14x (P141, P142, P143 & P145): 10P141xx (xx = 01 to 02) 10P142xx (xx = 01 to 05) 10P143xx (xx = 01 to 11) 10P145xx (xx = 01 to 11) P24x (P241, P242 & P243): 10P241xx (xx = 01 to 02) 10P242xx (xx = 01) 10P243xx (xx = 01) P34x (P342, P343, P344, P345 & P391): 10P342xx (xx = 01 to 17) 10P343xx (xx = 01 to 19) 10P344xx (xx = 01 to 12) 10P345xx (xx = 01 to 07) 10P391xx (xx = 01 to 02) P445: 10P445xx (xx = 01 to 04) P44x(P442 & P444): 10P44101 (SH 1 & 2) 10P44201 (SH 1 & 2) 10P44202 (SH 1) 10P44203 (SH 1 & 2) 10P44401 (SH 1) 10P44402 (SH 1) 10P44403 (SH 1 & 2) 10P44404 (SH 1) 10P44405 (SH 1) 10P44407 (SH 1 & 2) P44y (P443 & P446): 10P44303 (SH 01 and 03) 10P44304 (SH 01 and 03) 10P44305 (SH 01 and 03) 10P44306 (SH 01 and 03) 10P44600 10P44601 (SH 1 to 2) 10P44602 (SH 1 to 2) 10P44603 (SH 1 to 2)		P54x (P543, P544, P545 & P546): 10P54302 (SH 1 to 2) 10P54303 (SH 1 to 2) 10P54400 10P54404 (SH 1 to 2) 10P54405 (SH 1 to 2) 10P54502 (SH 1 to 2) 10P54503 (SH 1 to 2) 10P54600 10P54604 (SH 1 to 2) 10P54605 (SH 1 to 2) 10P54606 (SH 1 to 2) P547: 10P54702xx (xx = 01 to 02) 10P54703xx (xx = 01 to 02) 10P54704xx (xx = 01 to 02) 10P54705xx (xx = 01 to 02) P64x (P642, P643 & P645): 10P642xx (xx = 1 to 10) 10P643xx (xx = 1 to 6) 10P645xx (xx = 1 to 9) P74x (P741, P742 & P743): 10P740xx (xx = 01 to 07) P746: 10P746xx (xx = 00 to 21) P841: 10P84100 10P84101 (SH 1 to 2) 10P84102 (SH 1 to 2) 10P84103 (SH 1 to 2) 10P84104 (SH 1 to 2) 10P84105 (SH 1 to 2) P849: 10P849xx (xx = 01 to 06)	

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1 PARALLEL REDUNDANCY PROTOCOL (PRP) NOTES

1.1 Introduction to PRP

This section gives an introduction to the Parallel Redundancy Protocol (PRP); and how it is implemented on MiCOM-based products manufactured by Schneider Electric.

1.2 Protocols

Industrial real-time Ethernets typically need much better levels of availability and uninterrupted operation than normal office-type Ethernet solutions. For power networks, even a short loss of connectivity may result in a significant loss of functionality or impaired safety. To recover from a network failure, various redundancy schemes have been considered, including: Rapid Spanning Tree Protocol (RSTP), Media Redundancy Protocol (MRP) and Parallel Redundancy Protocol (PRP). The key properties of these are as follows:

RSTP this uses mesh-based topologies or ring topology and computes a tree, based on path costs and priorities. In case of network failure, a typical reset time for RSTP-based system is normally a few seconds.

MRP This uses ring-based topologies. In case of network failure, the network is broken into two separate lines, which are reconnected by de-blocking the previously blocked part. The guaranteed reset time for MRP protocol-based systems is typically around 100ms.

PRP this does not change the active topology as it uses two independent networks. Each message is replicated and sent over both networks. The first network node to receive it acts on it, with all later copies of the message being discarded. Importantly, these details are controlled by the low-level PRP layer of the network architecture, with the two networks being hidden from the higher level layers. Consequently, PRP-based networks are continuously available.

Power networks need to be able to respond to problems very quickly (typically in less than 10ms), and PRP is an available protocol which is robust enough to achieve this. The PRP protocol used in the MiCOM relay/IEDs is defined in the IEC62439-3 (2012) standard and is configured using the existing redundant Ethernet card(s).

1.3 PRP Summary (IEC 62439-3 Clause 4)

A summary of the main PRP features is given below:

- Ethernet redundancy method independent of any Ethernet protocol or topology (tree, ring or mesh)
- Seamless switchover and recovery in case of failure, which supports real-time communication
- Supervises redundancy continuously for better management of network devices
- Suitable for hot swap - 24 hour/365 day operation in substations
- Allows the mixing of devices with single and double network attached nodes on the same Local Area Network (LAN)
- Allows laptops and workstations to be connected to the network with standard Ethernet adapters (on double or single attached nodes)
- Particularly suited for substation automation, high-speed drives and transportation

1.4 Example of a PRP Network

Essentially a PRP network is a pair of similar Local Area Networks (LANs) which can be any topology (tree, ring or mesh). An example of a PRP network is shown in Figure 1:

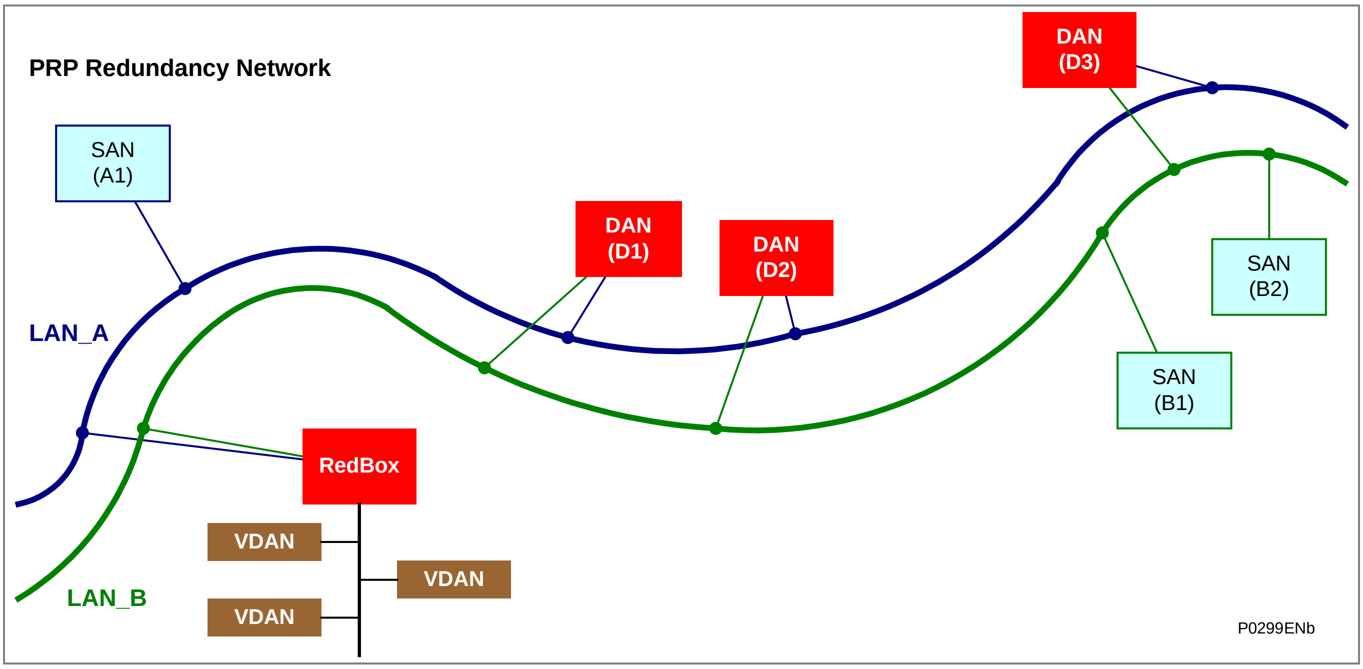

Figure 1 - PRP Redundancy Network

Figure 1 shows two similar Local Area Networks (LANs) which have various Nodes in common. The key features of these networks include:

- With the exception of a RedBox (see below), no direct cable connections can be made between the two LANs.
- Each of these LANs can have one or more Single Attached Nodes (SANs). These are normally non-critical devices that are attached only to a single network. SANs can talk to one another, but only if they are on the same LAN.
- Matched pairs of devices which are critical to the operation of the overall scheme are connected one to each network as Doubly Attached Nodes (DANs).
- To be sure that network messages (also known as frames) are transferred correctly to each DAN, each DAN must have the same Media Access Control (MAC) code and Internet Protocol (IP) address. This will also mean that TCP/IP traffic will automatically communicate with both of the paired devices, so it will be unaware of any two-layer redundancy or frame duplication issues.
- A Redundancy Box (RedBox) is used when a single interface node has to be connected to both networks. The RedBox can talk to all other nodes. So far as other nodes are concerned, the RedBox behaves like a DAN, so a SAN that is connected through a RedBox is also called a Virtual Doubly Attached Node (VDAN). The RedBox must have its own unique IP address.
- Transmission delays can be different between related Nodes of the two LANs.
- Each LAN (i.e. LAN_A and LAN_B) must be powered from a different power source and must be failure independent.

The two LANs can differ in terms of performance and topology. The redundant Ethernet interface can be made using an optical fiber connection with an LC or ST connector type or with RJ45 copper connector type. There is no need for an optical interface away from the relay.

1.5 PRP Network Structure

PRP uses two independent LANs. The topology of each of these LANs is arbitrary, and ring, star, bus and meshed topologies are possible.

The main advantage of PRP is loss-free data transmission with an active (transit) LAN. When the terminal device receives no packets from one of the LANs, the second (transit) LAN maintains the connection. As long as 1 (transit) LAN is available, repairs and maintenance on the other (transit) LAN have no impact on the data packet transmission.

The elementary devices of a PRP network are known as RedBox (Redundancy Box) and DANP (Double Attached Node implementing PRP).

Both devices have one connection each to the (transit) LANs.

The devices in the (transit) LAN are conventional switches that do not require any PRP support. The devices transmit PRP data packets transparently, without evaluating the RCT information.

Terminal devices that are connected directly to a device in the (transit) LAN are known as SAN (Single Attached Node). If there is an interruption, these terminal devices cannot be reached via the redundant line. To use the uninterruptible redundancy of the PRP network, you integrate your device into the PRP network via a RedBox.

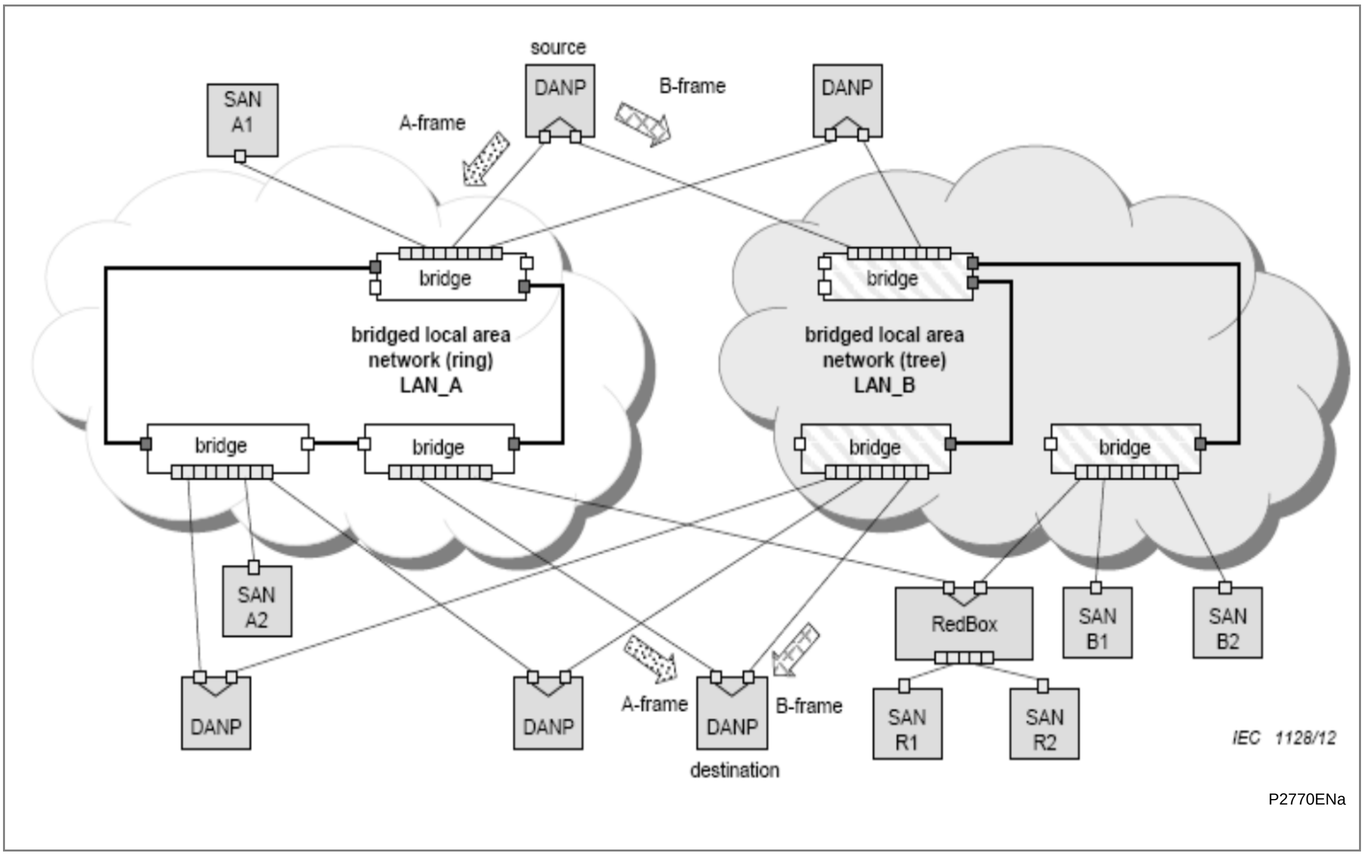

Figure 2 - PRP example of general redundant network

1.6 Structure of a DAN

A MiCOM P40 relay working in PRP Mode works as a DAN within the overall network topology. Each DAN has two ports that operate in parallel. They are attached to the upper layers of the communications stack through the Link Redundancy Entity (LRE) as in Figure 2:

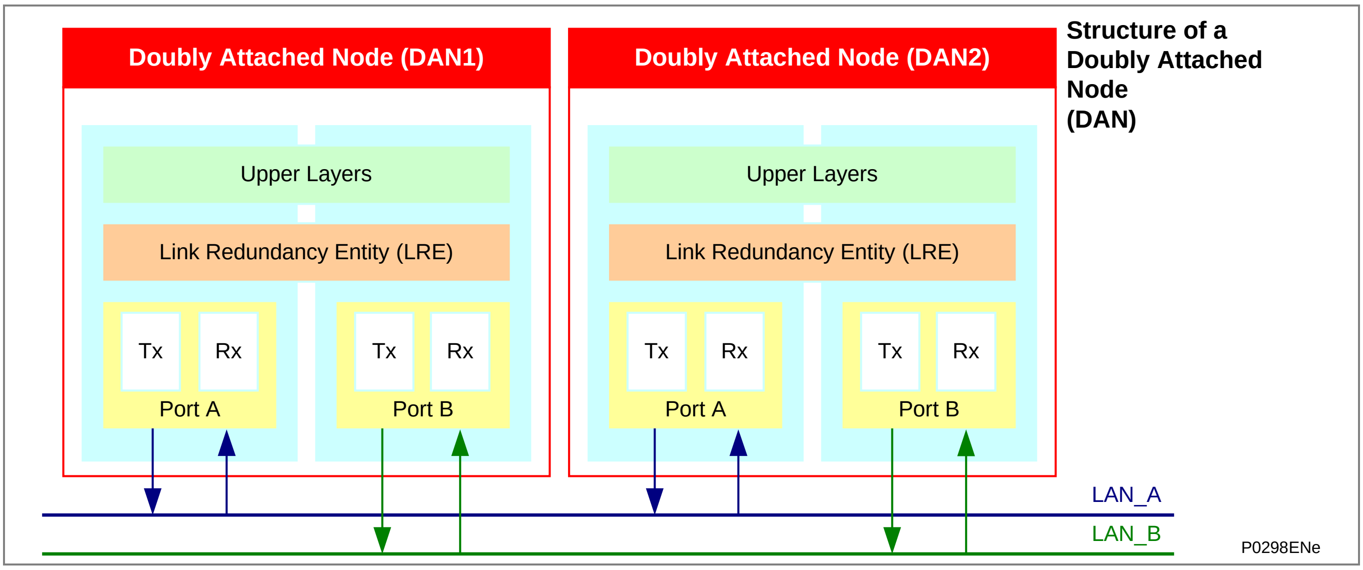

Figure 3 –Communication between two DANs (in PRP)

The LRE has two main tasks:

- handling message frames and
- management of redundancy

When an upper layer sends a frame to the LRE, the LRE replicates the frame and sends it through both its ports at nearly the same time. The two frames move through the two LANs with slightly different delays, ideally arriving at the destination node within a small time window.

When receiving frames, the LRE forwards the first frame it received to its upper layers and then discards the duplicate.

As both DAN nodes have the same MAC and IP addresses, this makes redundancy transparent to the upper layers. This allows the Address Resolution Protocol (ARP) to work in the same way as with a SAN. Accordingly, to the upper layers of a DAN, the LRE layer shows the same interface as the network adapter of a non-redundant adapter.

To manage redundancy, the LRE:

- Adds a 32-bit Redundancy Check Tag (RCT) to each frame it sends and
- Removes the RCT from each frame it receives

1.7 Communication between SANs and DANs

A SAN can be connected to any LAN and can communicate with any other SAN on the same LAN or any DAN. However, a SAN which connected to one LAN can not communicate directly to a SAN which is connected to the other LAN.

A DAN is connected to both LANs and can communicate with any RedBox or any other DANs or any SANs on either network. For communication purposes, a DAN “views” a SAN connected through a RedBox as a VDAN.

When a SAN generates a basic frame, it sends the frame only onto the LAN to which it is connected.

Originating at the SAN, a typical frame contains these parameters:

- dest_addr Destination Address
- src_addr Source Address
- type Type
- data
- fcs Frame Check Sequence (i.e. extra checksum characters added to allow error detection and correction)

The frame from the SAN is then received by the DAN; which sends the frame to its upper layers, which act accordingly.

When a DAN generates a frame, it needs to send the frame onto both of the LANs to which it is connected. When it does this, it extends the frame by adding the 32-bit Redundancy Control Trailer (RCT) into the frame.

The RCT consists of these parameters:

- 16-bit Sequence Number
- 4-bit LAN identifier, 1010 (0xA) for LAN_A and 1011 (0xB) for LAN_B
- 12-bit frame size
- PRP suffix

Note	*The Sequence number is a measure of the number of messages which have been sent since the last system reset. Each time the link layer sends a frame to a particular destination the sender increases the sequence number corresponding to that destination and sends the (nearly) identical frames over both LANs.*

Accordingly, originating at the DAN, a typical frame then contains these parameters:

- dest_addr Destination Address
- src_addr Source Address
- type Type
- lsdu Link Service Data Unit
- Padding if needed
- RCT data:
  - 16-bit sequence number:
    4-bit LAN identifier
    12-bit frame size
  - 16-bit PRP suffix (0X88 0XFB)
- fcs Frame Check Sequence

LSDU	*The Link Service Data Unit (LSDU) data allows PRP frames to be distinguished from none-PRP frames.*

Padding	*After the LSDU data, there may be some data padding. This is added to frames which would otherwise be too short for conventional network traffic (minimum frame size is 64 octets).*
Size	*The frame size will vary depending on the contents of the frame and how it has been tagged by the various SANs and DANs. In VLANs, frame tags may be added or removed during transit through a switch. To make the length field independent of tagging, only the LSDU and the RCT are considered in the size.*

Figure 3 shows the frame types with different types of data.

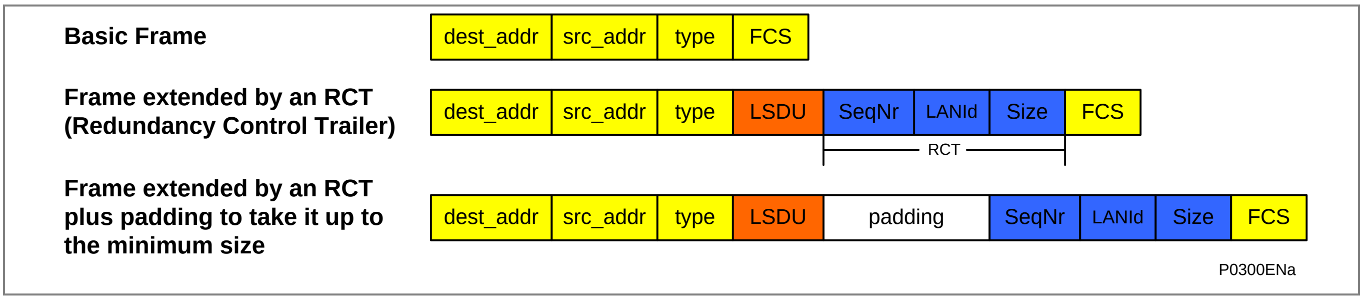

Figure 4 - Frames without and with RCT and padding

The key points about these differing frame structures is that:

- SANs do not implement any redundancy features, so they generate basic frames which SANs and DANs can understand.
- SANs can still understand the frames that come from DANs, as SANs ignore the RCT components in frames which come from DANs (a SAN cannot distinguish the RCT from the IEEE802.3 padding)
- If a DAN receives a frame which does not include the RCT component, it sends a single copy of the frame to its upper layers.
- If a DAN receives a frame which does include the RCT component, it does not send a duplicate copy of the frame to its upper layers.
- If a DANP cannot identify that the remote Node is a DAN, it inserts no RCT.

When using a Single Attached Nodes connected to the IED, a redbox is suggested to handle the case when the TPDU size for the client has been set above than 1024.

1.8 PRP Technical Data

- One VLAN tag supported.
- 128 publishers supported per receiver.
- Up to 100Mbit/s full duplex Ethernet.
- Dynamic frame memory allocation (page manager).
- Configurable duplicate detection.
- Wishbone interface for configuration and status registers.
- CPU port interface - Ethernet or Wishbone.
- Support for link-local protocols - CPU may send to specific ports only - CPU knows receive port.
- Configurable frame memory and queue length.
- Duplicate detection with configurable size and aging time.
- MAC address filtering (8 filter masks for interlink, 6 for CPU).
- Support for interfaces with or without Ethernet preamble.

Maximum Transmission Unit

According to the IEC 8802-3, the MTU (Ethernet maximum packet size) is:

- 1518 bytes without VLAN and without PRP
- 1522 bytes with VLAN and without PRP
- 1524 bytes without VLAN and with PRP
- 1528 bytes with VLAN and with PRP

Note: Check that the LAN switches setting for the MTU is at least 1528 bytes

2 PRP AND MICOM FUNCTIONS

2.1 MiCOM Products and PRP

The PRP functions being introduced as part of the overall MiCOM product range provide additional functionality, which is backwards compatible with existing Schneider Electric MiCOM equipment. This means that existing MiCOM relays/IEDS can be used on networks which use PRP functions, with no changes being made to those relays/IEDs.

The new MiCOM products that use the PRP, will interrogate other equipment to determine the equipment model number, and then use the model number to decide (at runtime), whether that particular item of equipment can support PRP or not.

MiCOM models which include the following Ethernet board assembly provide the possibility of PRP function support. This is denoted by Digit 7 where the Hardware option is N, P, Q or R, as shown in Table 1:

Hardware Option	Type	Model No format
"N" at Digit No 7	2 ST ports redundant Ethernet board (Modulated IRIG-B)	Px4xxxNx6Mxxx8K
"P" at Digit No 7	2 ST ports redundant Ethernet board (Un-modulated IRIG-B)	Px4xxxPx6Mxxx8K
"Q" at Digit No 7	2 LC + 1 RJ45 ports redundant Ethernet board (Modulated/ Un-modulated IRIG-B)	Px4xxxQx6Mxxx8M
"R" at Digit No 7	3 RJ45 ports redundant Ethernet board (Modulated/ Un-modulated IRIG-B)	Px4xxxRx6Mxxx8M

Table 1 - MiCOM model numbers for PRP options

The MiCOM relay/IED firmware has been modified to allow the PRP options to be accepted for the power-up tests in addition to the implementation of the supervision frame transmission.

2.2 MiCOM S1 Studio Software and the PRP Function

The addition of this function has no impact of the MiCOM S1 Studio support files so there is no need to upgrade any MiCOM S1 Studio software.

2.3 MiCOM Relay Configuration and the PRP Function

There is no need to change the configuration of any relay (as relays which include support for this function will be able to recognize other devices which support it).

2.4 Hardware Changes for PRP Protocol

This protocol is implemented using the existing redundant Ethernet and dual redundant Ethernet card as a starting point. The Frame management is achieved by re-programming the Field-Programmable Gate Array (FPGA).

The low-level management of the redundant frames is performed within the FPGA; this being defined as the Link Redundancy Entity (LRE). This will involve the addition of the Redundancy Check Tag (RCT) to a frame to be transmitted; this identifies the LAN and the sequence number of the message over the two networks. The FPGA is also responsible for the stripping of the RCT from received frames and discarding the duplicated messages such that only a single application frame is received by the Ethernet processor.

The LRE functionality of the supervision frame transmission is performed by the Ethernet processor card.

2.5 PRP Parameters

The Redundant Ethernet standard (IEC 62439-3:2012) defines several parameters for the PRP protocol; these being fixed at a default value within this release. The following values are set:

Parameter	Value	Description
Supervision Frame Multicast Address	01-15-4E-00-01-00	Target MAC Address for multicast supervision frame
Life Check Interval	2 seconds	Period between transmission of supervision frames
PRP Mode	Duplicate Discard	This is normal PRP mode, Duplicate address will not be supported.
Node Forget Time	60 s	This is the time after which a node entry is cleared.
Entry Forget Time	400 ms	Duration that the received message Sequence number will be held to discard a duplicate message.
Node Reboot Interval	500ms	Duration following reboot for which no PRP frames should be transmitted.

Table 2 - PRP parameter values (for PRP Protocol Version 1)

2.6 Product Implementation Features

Here is a list of the main Product Requirements for MiCOM products which support PRP:

- The MiCOM relay/IED provides two redundant Ethernet ports using PRP.
- The MiCOM relay/IED must be connected to the redundant Ethernet network as a Double Attached Node (DAN) using PRP (DAN using PRP is known as DANP)
- The redundant Ethernet interface can be made using an RJ45 or an optical fibre connection with an LC or ST connector type (Ethernet card dependent).
- The management of the PRP redundancy is transparent to the application data provided via the Ethernet interface.
- The PRP option is available with any of the existing protocol options via the Ethernet Interface (IEC61850 and/or DNPoE)
- Loss of one of the LAN connections to the device does not cause any loss or degradation to the Application data over the Ethernet interface.
- The MiCOM relay/IED supports the transmission of the PRP Supervision frame at a fixed time period (LifeCheckInterval) of 2s (+/- 100ms)
- Each supervision frame includes a sequence number as defined in the IEC 62439-3:2012 specification. This is incremented for each supervision message and the value starts from zero following a system restart.
- The MiCOM relay/IED does not process received supervision frames to provide supervision of the redundant network.
- The MiCOM relay/IED does not provide for the PRP management to be configured (via either the MiCOM relay/IED HMI or the Ethernet interface). Accordingly, the default values (as defined within this document) are used for all PRP parameters.
- The performance of the Ethernet Interface is not degraded by using the PRP interface.

2.6.1 Abbreviations and Acronyms

Abbreviations / Acronyms	Meaning
CRC	Cyclic Redundancy Check
DAN	Doubly Attached Nodes
DANP	Doubly Attached Node implementing PRP
FPGA	Field-Programmable Gate Array
HMI	Human Machine Interface
IED	Intelligent Electronic Devices
IP	Internet Protocol
LAN	Local Area Network
LRE	Link Redundancy Entity
MAC	Media Access Control
MRP	Media Redundancy Protocol
PRP	Parallel Redundancy Protocol
RCT	Redundancy Check Tag
RedBox	Redundancy Box
RSTP	Rapid Spanning Tree Protocol
SAN	Singly Attached Node
TCP	Transmission Control Protocol
VDAN	Virtual Doubly Attached Node

Notes:

HSR NOTES

CHAPTER 21

Date (month/year):	07/2016			
Products covered by this chapter:	This chapter covers the specific versions of the MiCOM products listed below. This includes ***only*** the following combinations of Software Version and Hardware Suffix.			
Hardware Suffix:	P141/P142/P143	L	P54x (P543/P544/P545/P546)	M
	P145	M	P642	L
	P241	L	P643/P645	M
	P242/P243	M	P741/P743	M
	P342	L	P742	L
	P343/P344/P345	M	P746	M
	P391	A	P74x (P741, P743)	K
	P445	K/L	P841A (one circuit breaker)	M
	P44x (P441/P442/P444)	K	P841B (two circuit breakers)	M
	P44x (P442/P444)	M	P849	M
	P44y (P443/P446)	M		
Software Version:	P14x (P141/P142/P143/P145)	B0/B2	P54x (P543/P544/P545/P546)	H4
	P24x (P241/P242/P243)	D0	P64x (P642/P643/P645)	B1
	P34x (P342/P343/P344/P345/P391)	B0	P746	B1/B2/ C1/C2
	P445	J4	P74x (P741/P742/P743)	B0
	P44x (P442/P444)	E0	P841A	G4
	P44y (P443/P446)	H4	P841B	H4
			P849	B0
Connection Diagrams:	P14x (P141, P142, P143 & P145): 10P141xx (xx = 01 to 02) 10P142xx (xx = 01 to 05) 10P143xx (xx = 01 to 11) 10P145xx (xx = 01 to 11) P24x (P241, P242 & P243): 10P241xx (xx = 01 to 02) 10P242xx (xx = 01) 10P243xx (xx = 01) P34x (P342, P343, P344, P345 & P391): 10P342xx (xx = 01 to 17) 10P343xx (xx = 01 to 19) 10P344xx (xx = 01 to 12) 10P345xx (xx = 01 to 07) 10P391xx (xx = 01 to 02) P445: 10P445xx (xx = 01 to 04) P44x(P442 & P444): 10P44101 (SH 1 & 2) 10P44201 (SH 1 & 2) 10P44202 (SH 1) 10P44203 (SH 1 & 2) 10P44401 (SH 1) 10P44402 (SH 1) 10P44403 (SH 1 & 2) 10P44404 (SH 1) 10P44405 (SH 1) 10P44407 (SH 1 & 2) P44y (P443 & P446): 10P44303 (SH 01 and 03) 10P44304 (SH 01 and 03) 10P44305 (SH 01 and 03) 10P44306 (SH 01 and 03) 10P44600 10P44601 (SH 1 to 2) 10P44602 (SH 1 to 2) 10P44603 (SH 1 to 2)		P54x (P543, P544, P545 & P546): 10P54302 (SH 1 to 2) 10P54303 (SH 1 to 2) 10P54400 10P54404 (SH 1 to 2) 10P54405 (SH 1 to 2) 10P54502 (SH 1 to 2) 10P54503 (SH 1 to 2) 10P54600 10P54604 (SH 1 to 2) 10P54605 (SH 1 to 2) 10P54606 (SH 1 to 2) P547: 10P54702xx (xx = 01 to 02) 10P54703xx (xx = 01 to 02) 10P54704xx (xx = 01 to 02) 10P54705xx (xx = 01 to 02) P64x (P642, P643 & P645): 10P642xx (xx = 1 to 10) 10P643xx (xx = 1 to 6) 10P645xx (xx = 1 to 9) P74x (P741, P742 & P743): 10P740xx (xx = 01 to 07) P746: 10P746xx (xx = 00 to 21) P841: 10P84100 10P84101 (SH 1 to 2) 10P84102 (SH 1 to 2) 10P84103 (SH 1 to 2) 10P84104 (SH 1 to 2) 10P84105 (SH 1 to 2) P849: 10P849xx (xx = 01 to 06)	

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Notes:

1 INTRODUCTION TO HSR

1.1 Introduction to High-availability Seamless Redundancy (HSR)

This section gives an introduction to the High-availability Seamless Redundancy (HSR); and how it is implemented on MiCOM-based products manufactured by Schneider Electric.

1.2 Protocols

Industrial real-time Ethernets typically need much better levels of availability and uninterrupted operation than normal office-type Ethernet solutions. For power networks, even a short loss of connectivity may result in a significant loss of functionality or impaired safety. To recover from a network failure, various redundancy schemes have been considered, including: Rapid Spanning Tree Protocol (RSTP), Media Redundancy Protocol (MRP), High-availability Seamless Redundancy (HSR). The key properties of these are as follows:

RSTP This uses mesh-based topologies or ring topology and computes a tree, based on path costs and priorities. In case of network failure, a typical reset time for RSTP-based system is normally a few seconds.

MRP This uses ring-based topologies. In case of network failure, the network is broken into two separate lines, which are reconnected by de-blocking the previously blocked part. The guaranteed reset time for MRP protocol-based systems is typically around 100ms.

HSR HSR basically uses ring topology, This Clause describes the application of the HSR principles (Clause 5) to implement a High-availability Seamless Redundancy (HSR), retaining the PRP property of zero recovery time, applicable to any topology, in particular rings and rings of rings. With respect to PRP, HSR allows to roughly halve the network infrastructure. With respect to rings based on IEEE 802.1D (RSTP), IEC 62439-2 (MRP), IEC 62439-6 (DRP) or IEC 62439-7 (RRP), the available network bandwidth for network traffic is somewhat reduced depending on the type of traffic. Nodes within the ring are restricted to be HSR-capable bridging nodes, thus avoiding the use of dedicated bridges. Singly Attached Nodes (SANs) such as laptops or printers cannot be attached directly to the ring, but need attachment through a RedBox (redundancy box).

Power networks need to be able to respond to problems very quickly (typically in less than 10ms), and HSR is an available protocol which is robust enough to achieve this. The HSR protocol used in the MiCOM relay/IED is defined in the IEC62439-3 (2012) standard and is configured using the existing redundant Ethernet card(s).

1.3 HSR Summary (IEC 62439-3 Clause 5)

A summary of the main HSR features is given below:

- HSR Ethernet redundancy method independent of any industrial Ethernet protocol and typically used in a ring topology
- Seamless switchover and recovery in case of failure, which supports real-time communication
- Supervises redundancy continuously for better management of network devices
- Suitable for hot swap, 24 hour/365 day operation in substations
- Allows laptops and workstations to be connected to the network with HSR Redbox
- Particularly suited for substation automation, high-speed drives and transportation

1.4 Example of an HSR Network

Essentially a HSR network is a ring topology. An example of a HSR network is shown in Figure 1:

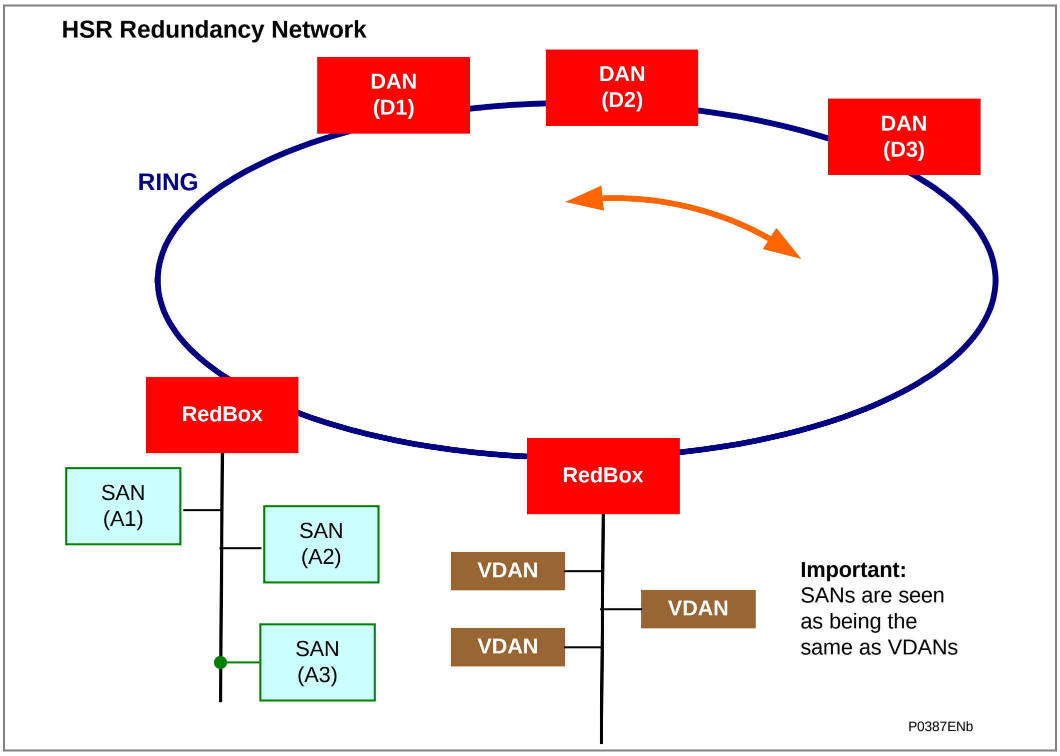

Figure 1 - HSR Redundancy Network

Figure 1 shows typical ring networks that have various Nodes in common.

The key features of the network include:

- Nodes within the ring are restricted to be HSR-capable bridging nodes, thus avoiding the use of dedicated bridges
- Singly Attached Nodes (SANs) such as laptops or printers cannot be attached directly to the ring, but need attachment through a RedBox (redundancy box)
- A simple HSR network consists of doubly attached bridging nodes, each having two ports, interconnected by full-duplex link
- A source DANH sends a frame passed from its upper layers, prefixes it by an HSR tag to identify frame duplicates and sends the frame over each port
- A destination DANH receives, in the fault-free state, two identical frames from each port within a certain interval, if it is a multicast frame, it instantaneously forwards it on the ring (see Note *), removes the HSR tag of the first frame before passing it to its upper layers and discards any duplicate.

*Note **	*In particular, the node will not forward a frame that it injected into the ring.*
*Note **	*A destination node of a unicast frame does not forward a frame for which it is the only destination, except for testing.*

1.5 Structure of a DAN

A MiCOM P40 relay working in HSR Mode works as a DAN within the overall network topology. Each DAN has two ports that operate in parallel. As in Figure 2, The two HSR ports A and B and the device port C are connected by the LRE, which includes a switching matrix allowing to forward frames from one port to the other. The switching matrix allows cut-through bridging. The Link Redundancy Entity (LRE) presents to the higher layers the same interface as a standard Ethernet transceiver would do.

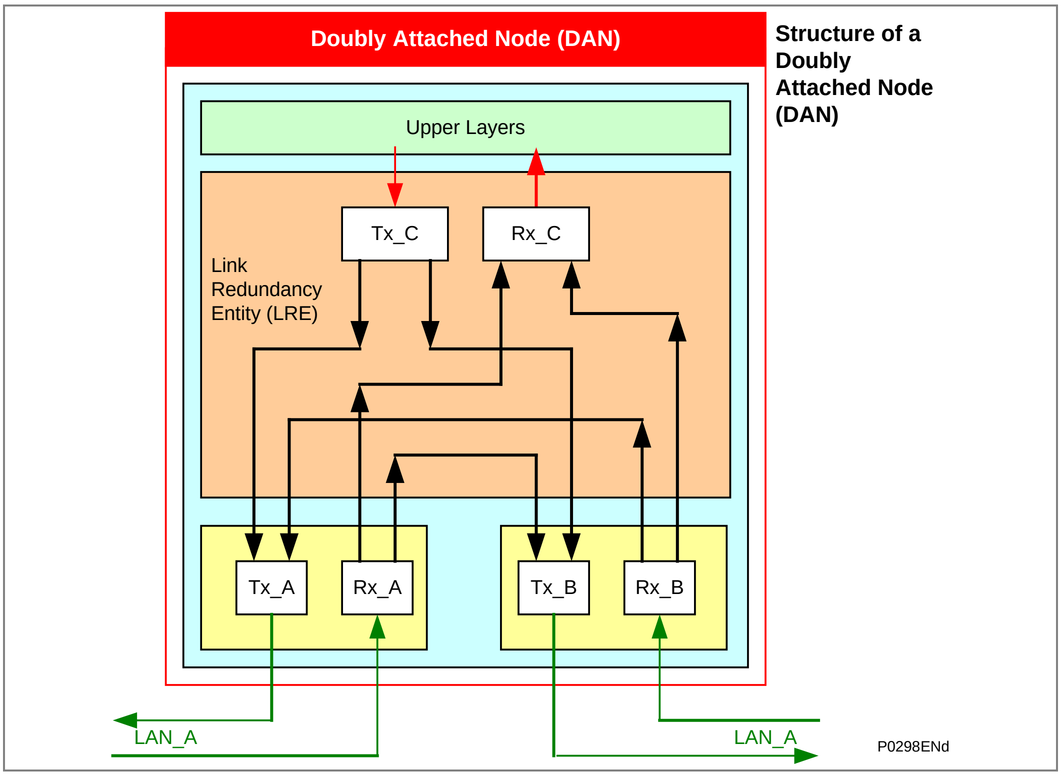

Figure 2 - DAN communication between two paths (in HSR)

DAN node is operable in HSR-tagged forwarding mode, the DAN inserts the HSR tag on behalf of its host and forwards the ring traffic, except for frames sent by the node itself. Duplicate frames and frames where the node is the unicast destination is not forwarded.

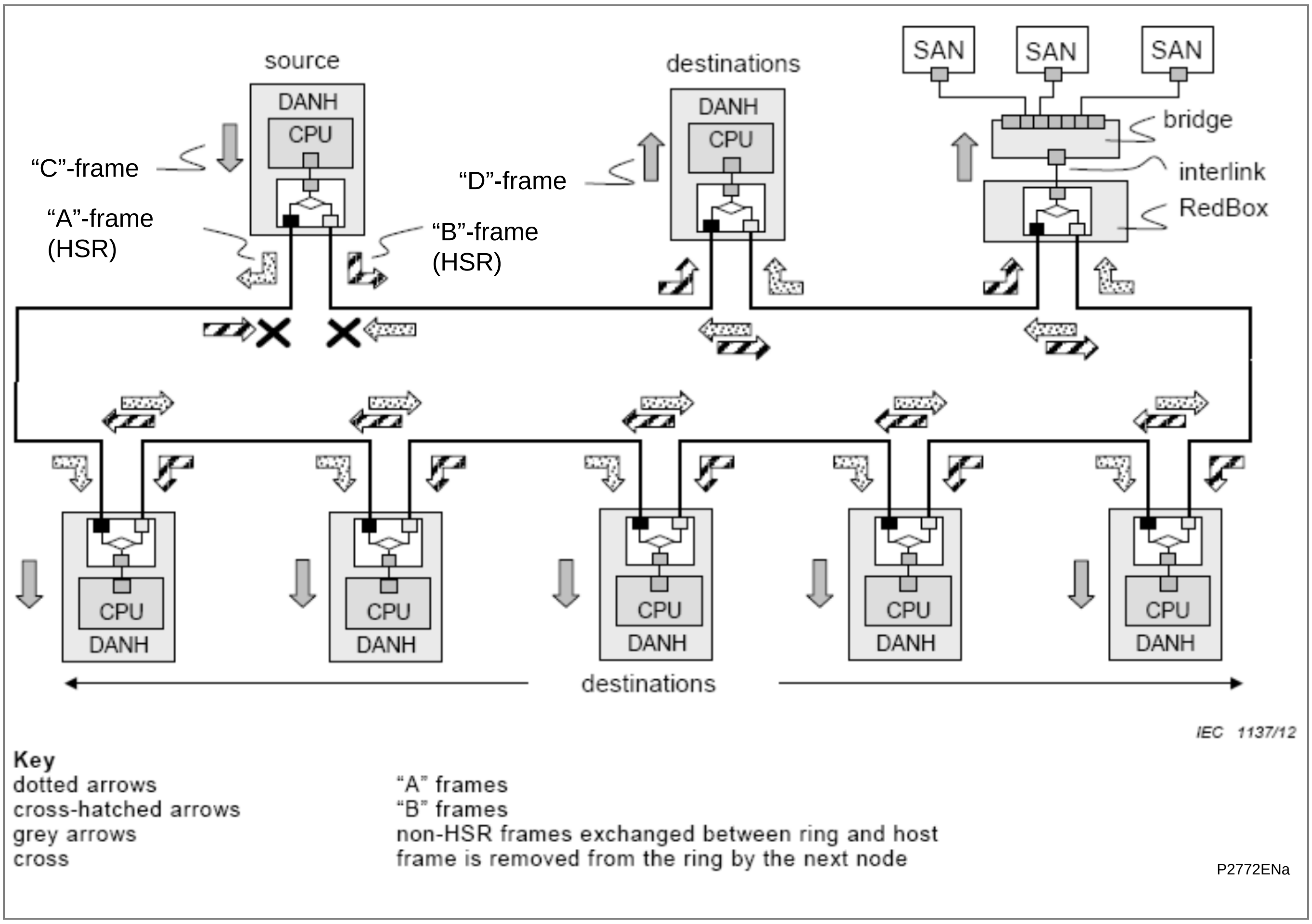

Figure 3 - HSR example of ring configuration for multicast traffic

1.6 Structure of a RedBox

The RedBox has a LRE that performs the duties of the HSR protocol, in particular:

- forwards the frames received from one HSR port to the other HSR port, unless the frame receives frames addressed to its own upper protocols
- prefixes the frames sent by its own upper layers with the corresponding HSR tag before sending two copies over its HSR ports

The switching logic is incorporated into the RedBox, so interlink becomes an internal connection.

A simple RedBox is present in every node, since the LRE makes a transition to a single non-HSR host. In addition, it is usual to have more than one host in a node, since a port for maintenance often exists.

A node does not send over a port a frame that is a duplicate of a frame previously sent over that port in that same direction.

For the purpose of Duplicate Discard, a frame is identified by:

- its source MAC address;
- its sequence number.

The Duplicate Discard method forgets an entry identified by <Source MAC Address><Sequence number> after a time EntryForgetTime.

1.7 Communication between SANs, DANs and RedBoxs

Singly Attached Nodes (SANs), for instance maintenance laptops or printers cannot be inserted directly into the ring since they have only one port and cannot interpret the HSR tag in the frames. SANs communicate with ring devices through a RedBox (Redundancy Box) that acts as a proxy for the SANs attached to it.

A source DANH sends a frame passed from its upper layers, and prefixes it by an HSR tag to identify frame duplicates and sends the frame over both ports.

A destination DANH receives, in the fault-free state, two identical frames from each port within a certain interval, if it is a multicast frame, it instantaneously forwards it on the ring, removes the HSR tag of the first frame before passing it to its upper layers (and discards any duplicate.

A typical frame contains these parameters:

- dest_addr Destination Address
- src_addr Source Address
- type Type
- data
- fcs Frame Check Sequence (i.e. extra checksum characters added to allow error detection and correction)

HSR frames are identified uniquely by their HSR tag.

The HSR tag consists of these parameters:

- 16-bit Ethertype (HSR_EtherType = 0x892F)
- 4-bit path identifier (PathId), 0000 for both HSR nodes A and B, and 0010-1111 for one of 7 PRP networks (A/B).
- 12-bit frame size (LSDUsize)
- 16-bit Sequence Number (SeqNr)

Note	*The 4-bit PathId field prevents reinjection of frames coming from one PRP network to another PRP network.*

Accordingly, a typical HSR frame then contains these parameters:

- dest_addr Destination Address
- src_addr Source Address
- HSR tag data:
  - 16-bit Ethertype (HSR_EtherType = 0x892F)
  - 4-bit path identifier
  - 12-bit frame size
  - 16-bit sequence number:
- type Type
- payload Payload
- Padding if needed
- fcs Frame Check Sequence

Padding	*After the payload data, there may be some data padding. This is added to frames which would otherwise be too short for conventional network traffic (minimum frame size is 70 octets).*
Size	*The frame size will vary depending on the contents of the frame and how it has been tagged by the various SANs and DANs. In VLANs, frame tags may be added or removed during transit through a switch. To make the length field independent of tagging, only the original LPDU and the HSR tag are considered in the size.*

Figure 3 and Figure 4 shows the frame types with different types of data.

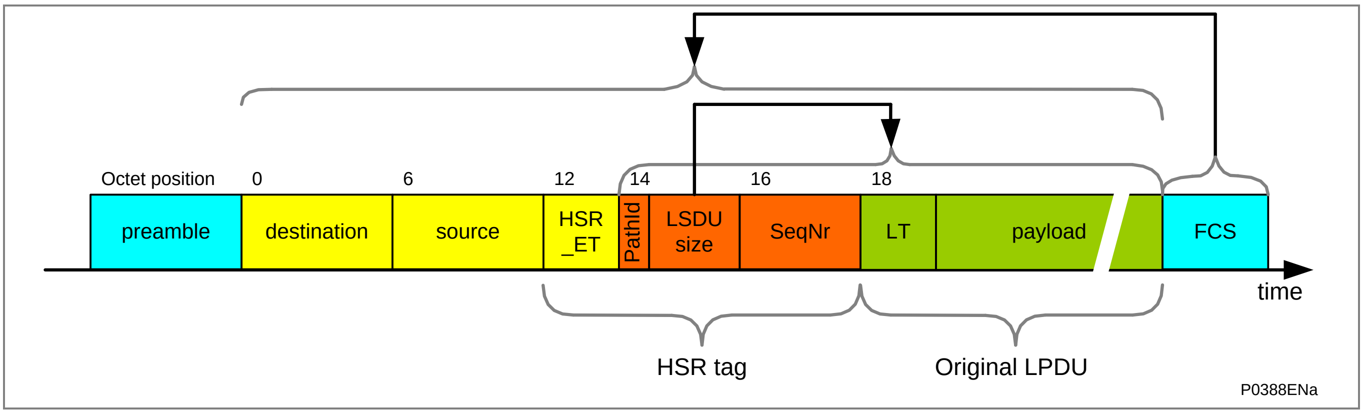

Figure 4 - HSR frame without a VLAN tag

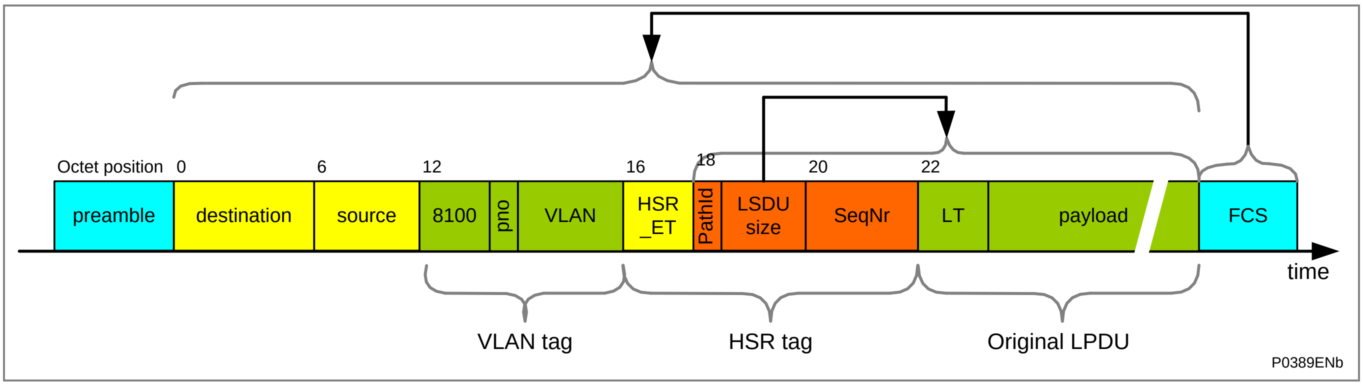

Figure 5 - HSR frame with VLAN tag

The key points about these differing frame structures are that:

- Unlike PRP, SANs cannot be attached directly to such a duplicated network unless they are able to interpret the HSR tag.
- In particular, the node will not forward a frame that it injected into the ring.
- A destination node of a unicast frame does not forward a frame for which it is the only destination, except for testing.
- DANH receiving from an HSR port, if this frame is not HSR-tagged and is a link local traffic, consume the frame and do not forward it.
- DANH receiving from an HSR port, if this frame is HSR-tagged and this node is not a destination, do not pass the frame to the link layer interface.
- A node accepts an HSR tagged frame also if the LanId does not correspond to the PortId and if the LSDUsize does not match the frame size.

1.8 HSR Technical Data

- One VLAN tag supported
- Up to 128 devices supported
- Up to 100Mbit/s full duplex Ethernet
- Dynamic frame memory allocation (page manager)
- Configurable duplicate detection
- Wishbone interface for configuration and status registers
- CPU port interface - Wishbone
- Support for link-local protocols - CPU may send to specific ports only - CPU knows receive port
- Configurable frame memory and queue length
- Duplicate detection with configurable size and aging time

- MAC address filtering (8 filter masks for interlink port, 6 for CPU port)
- Support for interfaces with or without Ethernet preamble

Limitations:

Number of IEDs on a same ring at 100Mbit/s:

Each hop (IED or RedBox) not only carries its own messages but also all the other IED messages thus the bandwidth used is proportional to the number of IEDs.

The maximum number of hops is around 20 when the GOOSE messages are highly used or 40 if the number and importance of GOOSE messages is not high.

When Precision Time Protocol («IEEE1588/IEC 61588») is used:

As the GPS receiver inaccuracy is 200ns and as each hop (IED or RedBox) can add a 50ns inaccuracy, the maximum number of hops is 16 if 1µs accuracy is required (PMU application or Process Bus)

2 HSR AND MICOM FUNCTIONS

2.1 MiCOM Products and HSR

The HSR functions being introduced as part of the overall MiCOM product range provide additional functionality, which is backwards compatible with existing Schneider Electric MiCOM equipment. This means that existing MiCOM relays/IEDS can be used on networks, which use HSR functions, with no changes being made to those relays/IEDs.

The new MiCOM products that use the HSR, will interrogate other equipment to determine the equipment model number, and then use the model number to decide (at runtime), whether that particular item of equipment can support HSR or not.

MiCOM models which include the following Ethernet board assembly provide the possibility of HSR function support. This is denoted by Digit 7 where the Hardware option is Q or R, as shown below:

Hardware Option	Type	Model No format
"Q" at Digit No 7	2 LC + 1 RJ45 ports redundant Ethernet board (Modulated/ Un-modulated IRIG-B)	**Px4xxxQx6Mxxx8M**
"R" at Digit No 7	3 RJ45 ports redundant Ethernet board (Modulated/ Un-modulated IRIG-B)	**Px4xxxRx6Mxxx8M**

Table 1 – Hardware option numbers with HSR functions

The MiCOM relay/IED firmware has been modified to allow the HSR options to be accepted for the power-up tests in addition to the implementation of the supervision frame transmission.

2.2 MiCOM S1 Studio Software and the HSR Function

The addition of this function has no impact of the MiCOM S1 Studio support files so there is no need to upgrade any MiCOM S1 Studio software.

2.3 MiCOM Relay Configuration and the HSR Function

There is no need to change the configuration of any relay (as relays which include support for this function will be able to recognize other devices which support it).

2.4 Hardware Changes for HSR Protocol

This protocol is implemented using the redundant Ethernet card as a starting point. The Frame management is achieved by programming the Field-Programmable Gate Array (FPGA).
The low-level management of the redundant frames is performed within the FPGA; this being defined as the Link Redundancy Entity (LRE). This will add the HSR tag to a frame to be transmitted. The FPGA is also responsible for the stripping of the HSR tag from received frames and discarding the duplicated messages so that only a single application frame is received by the Ethernet processor.
The LRE functionality of the supervision frame transmission is performed by the NIOS II.

The new version of the redundant Ethernet card is based on the 2072069A01 and 2072071A01 (both have modulated and un-modulated IRIG-B).

2.5 HSR Parameters

The Redundant Ethernet standard (IEC 62439-3:2012/FDIS) defines several parameters for the HSR protocol; these being fixed at a default value within this release. The following values are set:

Parameter	Value	Description
Supervision Frame Multicast Address	01-15-4E-00-01-00	Target MAC Address for multicast supervision frame
Life Check Interval	2 seconds	Period between transmission of supervision frames
HSR Mode	Duplicate Discard	This is normal HSR mode, Duplicate address will not be supported.
Node Forget Time	60 s	This is the time after which a node entry is cleared.
Entry Forget Time	400 ms	Duration that the received message Sequence number will be held to discard a duplicate message.
Node Reboot Interval	500ms	Duration following reboot for which no HSR frames should be transmitted.
MulticastFilterSize	16	Number of multicast addresses to be filtered

Table 2 - HSR parameter values

2.6 Product Implementation Features

Here is a list of the main Product Requirements for MiCOM products that support HSR:

- The MiCOM relay/IED provides two redundant Ethernet ports using HSR.
- The MiCOM relay/IED must be connected to the redundant Ethernet network as a Double Attached Node (DAN) using HSR (DAN using HSR is known as DANH)
- The redundant Ethernet interface can be made using an RJ45 or an optical fibre connection with an LC connector type.
- The management of the HSR redundancy is transparent to the application data provided via the Ethernet interface.
- The HSR option is available with any of the existing protocol options via the Ethernet Interface (IEC61850 and/or DNPoE)
- Loss of one of the Node connections to the device does not cause any loss or degradation to the Application data over the Ethernet interface.
- The MiCOM relay/IED supports the transmission of the HSR Supervision frame at a fixed time period (LifeCheckInterval) of 2s (+/- 100ms)
- Each supervision frame includes a sequence number as defined in the IEC 62439-3:2012/FDIS specification. This will be incremented for each supervision message and the value will start from zero following a system restart.
- The MiCOM relay/IED support SNMP.
- The MiCOM relay/IED does not provide for the HSR management to be configured (via either the MiCOM relay/IED HMI or the Ethernet interface). Accordingly, the default values (as defined within this document) are used for all HSR parameters.
- The performance of the Ethernet Interface is not degraded by using the HSR interface.

2.6.1 Abbreviations and Acronyms

Abbreviations / Acronyms	Meaning
CRC	Cyclic Redundancy Check
DAN	Doubly Attached Nodes
DANH	Doubly Attached Node implementing HSR
FPGA	Field-Programmable Gate Array
HMI	Human Machine Interface
HSR	High-availability Seamless Redundancy
IED	Intelligent Electronic Devices
IP	Internet Protocol
LAN	Local Area Network
LRE	Link Redundancy Entity
MAC	Media Access Control
MRP	Media Redundancy Protocol
PRP	Parallel Redundancy Protocol
HSR	High-availability Seamless Redundancy
RedBox	Redundancy Box
RSTP	Rapid Spanning Tree Protocol
SAN	Singly Attached Node
TCP	Transmission Control Protocol
VDAN	Virtual Doubly Attached Node (effectively seen as a DAN)

Notes:

FIRMWARE AND MANUAL VERSION HISTORY

CHAPTER 22

Date:	02/2017
Products covered by this chapter:	This chapter covers the specific versions of the MiCOM products listed below. This includes ***only*** the following combinations of Software Version and Hardware Suffix.
Hardware Suffix:	L (P742) & M (P741 & P743)
Software Version:	B1 - P74x (P741, P742 & P743)
Connection Diagrams:	10P740xx (xx = 01 to 07)

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1 SOFTWARE AND HARDWARE VERSION HISTORY

The Easergy Studio (MiCOM S1 Studio) product is updated periodically. These updates provide support for new features (such as allowing you to manage new MiCOM products, as well as using new software releases and hardware suffixes). The updates may also include fixes. **Accordingly, we strongly advise customers to use the latest Schneider Electric version of Easergy Studio (MiCOM S1 Studio).**

Software Version		Hardware Suffix	Original Date of Issue	Description of Changes	S1 Compatibility	Technical Documentation
Major	Minor					
00		B	Feb 2003	Original Issue First release to production	V2.07	P740/EN xx/D22
31	C3.4	J or K	May 2006	Original Issue P741 and P743 Evolution with extended User Interface (32 Controls Inputs, 10 Function Keys and 18 tricolour LEDs). P742 Evolution with new User Interface (32 Controls Inputs). Control Input status stored in FLASH memory 10 Maintenance Records instead of 5.	V2.12 Patch 31	P740/EN xx/E33
31	C3.5	J or K	Dec 2006	The Delta I criterion did not block the trip: The 87BB protection trips even if only one variation of current is detected. Isolators were considered closed when a status alarm occured even when the auxiliary voltage supervision was used. The last position of the isolator is used. Check zone and circuitry fault with bias characteristic New mode for circuitry fault and PU error Different Commissioning modes	V2.13	P740/EN xx/E33
32	C3.7	J or K	Jan 2007	Spurious error codes does not appear any more during power up of the P741 The Ethernet board and the Coprocessor board are compatible The thresholds ID>2, IDCZ>2 or IBiasph> can be set higher than 6kA Display of MEASUREMENT 2 is MEASUREMENT 2 in Russian language.	V2.13 Patch 32	P740/EN xx/F44
33	C3.8	J or K	Apr 2007	First events following power up are tagged with the right date & time When using default PSL ,there is a DR after a 50BF backtrip through an opto input of the CU The latched Function Key DDB signals are correct on relay power up Uncompressed Disturbance Record Pre-trigger is calculated correctly When using MiCOM S1 to connect to relay and then activate Settings group by right clicking on the group, relay does not reboot If the time delay of the overcurrent protection in PU is set to 0ms, then the overcurrent protection does not mal-trip during its power on.	V2.13 Patch 33	P740/EN xx/F45
33	C3.9	J or K	Jan 2008	The status of the trip relays 1, 2, 3 is stored in BBRAM even if the “Trip Latched” function is disabled in the column “CB Control” The status of the trip relays 1, 2, 3 latched in the PU will not open in case of loss of communication with the CU The CU->PU signals are not received in the PU if there is no CT in the topology of this PU (PU in charge of an isolator bus section) The Control Input values are correct after the reboot of the protection.	V2.14 Patch 33	P740/EN xx/H65
40	D2.2	J or K	Jul 2007	Addition of the Ethernet/IEC61850-8-1 protocol option Addition of the Demodulated Irig-B option	V2.14 Patch 40	P740/EN xx/H65

Software Version		Hardware Suffix	Original Date of Issue	Description of Changes	S1 Compatibility	Technical Documentation
Major	Minor					
40	D2.3	J or K	Feb 2008	The status of the trip relays 1, 2, 3 is stored in BBRAM even if the "Trip Latched" function is disabled in the column "CB Control" The status of the trip relays 1, 2, 3 latched in the PU will not open in case of loss of communication with the CU The CU->PU signals are not received in the PU if there is no CT in the topology of this PU (PU in charge of an isolator bus section) The Control Input values are correct after the reboot of the protection.	V2.14 Patch 40	P740/EN xx/H65
40	D2.5	J or K	Oct 2008	The behaviour of the "Out of Sevice" Led is different between P74xxxxxxxxxx0xx and P74xxxxxxxxxx5xx The Delta I Algorithm has been removed.	V2.14 Patch 40	P740/EN xx/K96
41	D3.1	J or K	Feb 2008	Initial software release with: the second rear port & interrupt driven interMiCOM for the P741 and P743 and PSL Enhancement Positional Data and SR Latch Gates	V2.14 Patch 41	P740/EN xx/I76
42	D4.0	J or K	Mar 2008	Initial software release with the Addition of the Px40 Remote Read Only Mode (allow or block the modification of the settings & the commands via a rear port)	V2.14 Patch 42	P740/EN xx/J86
51	E2.0	K	Jan 2010	Hardware: P742/P743: new options with 4 or 8 high break relays, 8 or 16 outputs and 8, 16 or 24 inputs, P741/P743: Redundant Ethernet board in option Software: No blocking mode" of a zone in case of circuitry fault added. The differential current can be set in order to display 0A when current is not significative. External voltage criteria: – CU logic, VT connected to the bus, with two bus section included in the current node; a voltage criteria will confirm a fault detection, – PU logic, VT connected to the line, with some Pus connected to a MiCOM P923; The voltage criteria can block a PU. The 87BB trip time (CU & PU) can be delayed with a settable time delay. The 200ms drop-off timer in the Central Unit has been replaced by a 200ms dwell timer.	V2.14 V3.1 (studio) Patch 42	P740/EN xx/Lxx
51	E2.0	K	Jan 2010	Software (cont'd): CB supervision time delay is settable. I0 supervision with neutral current measured can block 87BB protection. CT supervision with max(IA, IB, IC) > 10IN and 50% max (IA, IB, IC) > min (IA, IB, IC). 87BB PU fault record: starting phase and faulty zone is indicated. 50BF fault and manual zone tripping: only the zone is available in the PU fault record. I>2 & IN>2 have 87BB/P, 87BB/N, I(N)>2&87BBP, I(N)>2&88BBN blocking options. new DDB to block overcurrent and earth fault protection. IEC 61850 phase 2	V2.14 V3.1 (studio) Patch 42	P740/EN xx/Lxx

Software Version		Hardware Suffix	Original Date of Issue	Description of Changes	S1 Compatibility	Technical Documentation
Major	Minor					
B0	A	L/M	July 2015	Hardware: Update hardware design suffix to L/M. The 24-48 Vdc power supply range has been changed to cover 24-32 Vdc only. Three new Ethernet boards released. Software: IEC 61850 Ed.2 and Ed.1 by configuration. GOOSE number and GOOSE performance enhancement. Disturbance Record LN RDRE Enhancement. Time Synchronization via LTIM/LTMS. Monitor DDB for port physical link status. High-availability Seamless Redundancy (HSR). Parallel Redundancy Protocol (PRP) Dual Ethernet communications (Dual IP). Corrections of these issues: Fixed and enhanced various small issues. Note: DNP Over Ethernet is not included in this release.	V5.0.1 or later	P74x/EN M/Pc9
B1	A	L/M	January 2017	This release integrated the Cyber Security RBAC and provided the option for the user if they want/don't want to use the Cyber Security which depends on the protocol options. CLS0 - Simple password management - No Security Administration Tool (SAT) required. CLS1 - Advanced user account right management, security logs/events and secure administration capability - Security Administration Tool (SAT) required. Courier Tunneling via Secured Communication. Latest Fault Record via IEC61850. User Alarms Labels. Virtual I/O Naming. New DDB: Logic 0 and IRIG-B Valid. Restore Record Clear Functions. Bug Fixes.	V7.0.0 or later	P74x/EN M/Qd9

The Easergy Studio (MiCOM S1 Studio) product is updated periodically. These updates provide support for new features (such as allowing you to manage new MiCOM products, as well as using new software releases and hardware suffixes). The updates may also include fixes. **Accordingly, we strongly advise customers to use the latest Schneider Electric version of Easergy Studio (MiCOM S1 Studio).**

2 RELAY SOFTWARE AND SETTING FILE SOFTWARE VERSIONS

Setting File Software Version	Relay Software Version								
	31	**32**	**33**	**40**	**41**	**42**	**51**	**B0**	**B1**
31	✓	✓	✓	✓	✓	✓	✓		
32	✓	✓	✓	✓	✓	✓	✓		
33	✓	✓	✓	✓	✓	✓	✓		
40				✓	✓	✓	✓		
41					✓	✓	✓		
42						✓	✓		
51							✓		
B0								✓	
B1									✓

3 RELAY SOFTWARE AND PSL FILE SOFTWARE VERSIONS

PSL File Software Version	Relay Software Version								
	31	32	33	40	41	42	51	B0	B1
31	✓	✓	✓	✓					
32	✓	✓	✓	✓					
33	✓	✓	✓	✓					
40				✓					
41					✓	✓			
42						✓			
51							✓		
B0								✓	
B1									✓

4 RELAY SOFTWARE AND MENU TEXT FILE SOFTWARE VERSIONS

Menu Text File Software Version	Relay Software Version								
	31	32	33	40	41	42	51	B0	B1
31	✓	✓	✓	✓	✓	✓	✓		
32	✓	✓	✓	✓	✓	✓	✓		
33	✓	✓	✓	✓	✓	✓	✓		
40	✗	✗	✗	✓	✓	✓	✓		
41	✗	✗	✗	✗	✓	✓	✓		
42	✗	✗	✗	✗	✗	✓	✓		
51	✗	✗	✗	✗	✗	✗	✓		
B0								✓	
B1									✓

SYMBOLS AND GLOSSARY

CHAPTER SG

Date	09/2016	
Products covered by this chapter:	This chapter covers the specific versions of the MiCOM products listed below. This includes ***only*** the following combinations of Software Version and Hardware Suffix.	
Hardware Suffix	All MiCOM Px4x products	
Software Version	All MiCOM Px4x products	
Connection Diagrams:	P14x (P141, P142, P143 & P145): 10P141xx (xx = 01 to 02) 10P142xx (xx = 01 to 05) 10P143xx (xx = 01 to 11) 10P145xx (xx = 01 to 11) P24x (P241, P242 & P243): 10P241xx (xx = 01 to 02) 10P242xx (xx = 01) 10P243xx (xx = 01) P34x (P342, P343, P344, P345 & P391): 10P342xx (xx = 01 to 17) 10P343xx (xx = 01 to 19) 10P344xx (xx = 01 to 12) 10P345xx (xx = 01 to 07) 10P391xx (xx = 01 to 02) P445: 10P445xx (xx = 01 to 04) P44x (P441, P442 & P444): 10P44101 (SH 1 & 2) 10P44201 (SH 1 & 2) 10P44202 (SH 1) 10P44203 (SH 1 & 2) 10P44401 (SH 1) 10P44402 (SH 1) 10P44403 (SH 1 & 2) 10P44404 (SH 1) 10P44405 (SH 1) 10P44407 (SH 1 & 2) P44y (P443 & P446): 10P44303 (SH 01 and 03) 10P44304 (SH 01 and 03) 10P44305 (SH 01 and 03) 10P44306 (SH 01 and 03) 10P44600 10P44601 (SH 1 to 2) 10P44602 (SH 1 to 2) 10P44603 (SH 1 to 2)	P54x (P543, P544, P545 & P546): 10P54302 (SH 1 to 2) 10P54303 (SH 1 to 2) 10P54400 10P54404 (SH 1 to 2) 10P54405 (SH 1 to 2) 10P54502 (SH 1 to 2) 10P54503 (SH 1 to 2) 10P54600 10P54604 (SH 1 to 2) 10P54605 (SH 1 to 2) 10P54606 (SH 1 to 2) P547: 10P54702xx (xx = 01 to 02) 10P54703xx (xx = 01 to 02) 10P54704xx (xx = 01 to 02) 10P54705xx (xx = 01 to 02) P64x (P642, P643 & P645): 10P642xx (xx = 1 to 10) 10P643xx (xx = 1 to 6) 10P645xx (xx = 1 to 9) P74x (P741, P742 & P743): 10P740xx (xx = 01 to 07) P746: 10P746xx (xx = 00 to 21) P841: 10P84100 10P84101 (SH 1 to 2) 10P84102 (SH 1 to 2) 10P84103 (SH 1 to 2) 10P84104 (SH 1 to 2) 10P84105 (SH 1 to 2) P849: 10P849xx (xx = 01 to 06)

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1 ACRONYMS AND ABBREVIATIONS

Term	Description
<	Less than: Used to indicate an “under” threshold, such as undercurrent (current dropout).
>	Greater than: Used to indicate an “over” threshold, such as overcurrent (current overload)
A	Ampere
AA	Application Association
AC / ac	Alternating Current
ACSI	Abstract Communication Service Interface
ACSR	Aluminum Conductor Steel Reinforced
ALF	Accuracy Limit Factor
AM	Amplitude Modulation
ANSI	American National Standards Institute
AR	Auto-Reclose
ARIP	Auto-Reclose In Progress
ASCII	American Standard Code for Information Interchange
ATEX	ATEX is the Potentially Explosive Atmospheres directive 94/9/EC
AUX / Aux	Auxiliary
AV	Anti virus
AWG	American Wire Gauge
BAR	Block Auto-Reclose signal
BCD	Binary Coded Decimal
BCR	Binary Counter Reading
BDEW	Bundesverband der Energie- und Wasserwirtschaft | Startseite (i.e. German Association of Energy and Water Industries)
BMP	BitMaP – a file format for a computer graphic
BN>	Neutral over susceptance in the context of the protection element: Reactive component of admittance calculation from neutral current and residual voltage.
BOP	Blocking Overreach Protection - a blocking aided-channel scheme.
BPDU	Bridge Protocol Data Unit
BRCB	Buffered Report Control Block
BRP	Beacon Redundancy Protocol
BU	Backup: Typically a back-up in the context of the protection element
Business Service Layer	This layer coordinates the application, processes commands, make logical decision and calculation according to the business rules
CA	Certification Authority
CAT	Computer Administration Tool , for replacing CMT
C/O	A ChangeOver contact having normally-closed and normally-open connections: Often called a “form C” contact.
CB	Circuit Breaker
CB Aux.	Circuit Breaker auxiliary contacts: Indication of the breaker open/closed status.
CBF	Circuit Breaker Failure in the context of protection element. Could be labelled 50BF in ANSI terminology.
CDC	Common Data Class
CET	Sepam Configuration tool
CF	Control Function
Ch	Channel: usually a communications or signaling channel

Term	Description
Check Synch	Check Synchronizing function
CID	Configured IED Description
CIFS	Common Internet File System. Microsoft protocol use to share resources on a network.
CIP	Critical Infrastructure Protection
CIP Standards	Critical Infrastructure Protection standards. NERC CIP standards have been given the force of law by the Federal Energy Regulatory Commission (FERC)
CLIO	Current Loop Input Output: 0-1 mA/0-10 mA/0-20 mA/4-20 mA transducer inputs and outputs CLI = current loop input - 0-1 mA/0-10 mA/0-20 mA/4-20 mA transducer input CLO = current loop output - 0-1 mA/0-10 mA/0-20 mA/4-20 mA transducer output
CLK / Clk	Clock
Cls	Close - generally used in the context of close functions in circuit breaker control.
CMC	Certificates Management over CMS. An IETF RFC for distribution and registration of public keys and certificates
CMP	Certificates Management Protocol. An IETF RFC for distribution and registration of public keys and certificates (RFC 4210)
CMV	Complex Measured Value
CNV	Current No Volts
COMFEDE	Common Format for Event Data Exchange
CPNI	Centre for the Protection of National Infrastructure
CRC	Cyclic Redundancy Check
CRL	Certificates Revocation List. A list of revoked certificates. Theoretically still valid, but forbidden by the Security Administrator or the Security Server
CRP	Cross-network Redundancy Protocol
CRV	Curve (file format for curve information)
CRx	Channel Receive: Typically used to indicate a teleprotection signal received.
Crypto Device	A small device embedding cryptographic capabilities and storage memory. It could be a smartcard, USB stick, serial dongle, etc.
CS	Cyber Security or Check Synchronism.
CSMS	Cyber Security Management System
CSV	Comma Separated Values (a file format for database information)
CT	Current Transformer
CTRL	Control - as used for the Control Inputs function
CTS	Current Transformer Supervision: To detect CT input failure.
CTx	Channel Transmit: Typically used to indicate a teleprotection signal send.
CUL	Canadian Underwriters Laboratory
CVT	Capacitor-coupled Voltage Transformer - equivalent to terminology CCVT.
CZ	Abbreviation of “Check Zone”: Zone taking into account only the feeders.
DA	Data Attribute
DAN	Double or Doubly Attached Node
DANH	Double or Doubly Attached Node with HSR protocol
DANP	Double or Doubly Attached Node implementing PRP
Data Layer	Consists of the domain-related objects and their relationships that are manipulated by the user during the interaction with the software
DAU	Data Acquisition Unit
DC	Data Concentrator

Term	Description
DC / dc	Direct Current
DCC	An Omicron compatible format
DCE	Data Communication Equipment
DCS	Distributed Control System
DDB	Digital Data Bus within the programmable scheme logic: A logic point that has a zero or 1 status. DDB signals are mapped in logic to customize the relay's operation.
DDR	Dynamic Disturbance Recorder
DEF	Directional Earth Fault (protection): A directionalized ground fault aided protection scheme. Could be labeled 67N in ANSI terminology.
df/dt	Rate of Change of Frequency (equivalent to ROCOF). Could be labeled 81R in ANSI terminology.
df/dt>1	First stage of df/dt in the context of protection element
DFT	Discrete Fourier Transform
DG	Distributed Generation
DHCP	Dynamic Host Configuration Protocol
DHM	Dual Homing Manager
DHP	Dual Homing Protocol
DHS	Dual Homing Star. Ethernet protocol allowing bumpless redundancy. Used with Redundant Ethernet board with dual homing protocol
Diff	Differential in the context of protection elements . Could be labeled 87 in ANSI terminology.
DIN	Deutsches Institut für Normung (German standards body)
Dist	Distance in the context of protection elements . Could be labeled 21 in ANSI terminology.
DITA	Darwinian Information Typing Architecture
DLDB	Dead-Line Dead-Bus: In system synchronism check, indication that both the line and bus are de-energized.
DLLB	Dead-Line Live-Bus: In system synchronism check, indication that the line is de-energised whilst the bus is energized.
DLR	Dynamic Line Rating
DLY / Dly	Time Delay
DMT	Definite Minimum Time
DNP	Distributed Network Protocol
DO	Data Object
DPWS	Device Profile for Web Services
DR	Disturbance Record
DREB	Dual Redundant Ethernet Board
DSP	Digital Signal Processor
DST	Daylight Saving Time
DT	Definite Time: in the context of protection elements: An element which always responds with the same constant time delay on operation. Or Abbreviation of "Dead Time" in the context of auto-reclose:
DTD	Document Type Definition
DTOC	Definite Time Overcurrent in the context of protection element
DTS	Date and Time Stamp
DVC	Direct Variable Cost
DZ	Dead Zone. Area between a CT and an open breaker or an open isolator.
EF or E/F	Earth Fault (directly equivalent to Ground Fault)
EIA	Electronic Industries Alliance

Term	Description
ELR	Environmental Lapse Rate
EMC	ElectroMagnetic Compatibility
ENA	Energy Networks Association
ER	Engineering Recommendation
ESD	ElectroStatic Discharge
ESP	Electronic Security Perimeter
ESS	Embedded Security Server
ETS	Element To Secure. An ETS is an entity that represents a tool, utility or application function block that can be protected within the tool suite. It gathers a list of corresponding permissions with their set of values. This list is pre-defined and cannot be edited by any business user. A same ETS can be associated to many roles with different set of authorizations.
FAA	Ageing Acceleration Factor: Used by Loss of Life (LOL) element
FCS	Frame Check Sequence
FFail	A field failure (loss of excitation) element: Could be labeled 40 in ANSI terminology.
FFT	Fast Fourier Transform
FIR	Finite Impulse Response
FLC	Full load current: The nominal rated current for the circuit.
FLT / Flt	Fault - typically used to indicate faulted phase selection.
Fn or FN	Function
FPGA	Field Programmable Gate Array
FPS	Frames Per Second
FTP	File Transfer Protocol or Foil Twisted Pair
FTPS	FTP over TLS protocol. The classic file transfer protocol (FTP) secured using TLS tunneling.
FWD, Fwd or Fwd.	Indicates an element responding to a flow in the “Forward” direction
Gen Diff	A generator differential element: Could be labeled 87G in ANSI terminology.
Gen-Xformer Diff	A generator-transformer differential element: Could be labeled 87GT in ANSI terminology.
GI	General Interrogation
GIF	Graphic Interchange Format – a file format for a computer graphic
GN>	Neutral over conductance in the context of protection element: Real component of admittance calculation from neutral current and residual voltage.
GND / Gnd	Ground: used in distance settings to identify settings that relate to ground (earth) faults.
GoCB	GOOSE Control Block
GOOSE	Generic Object Oriented Substation Event
GPS	Global Positioning System
GRP / Grp	Group. Typically an alternative setting group.
GSE	General Substation Event
GSSE	Generic Substation Status Event
GUESS	Generator Unintentional Energization at StandStill.
GUI	Graphical User Interface
HIPS	Host Intrusion Prevention System based on “white list” of accepted executables.
HMI	Human Machine Interface
HSR	High Availability Seamless Redundancy
HTML	Hypertext Markup Language

Term	Description
I	Current
I/O	Input/Output
I/P	Input
IANA	Internet Assigned Numbers Authority
ICAO	International Civil Aviation Organization
ICD	IED Capability Description
ID	Identifier or Identification. Often a label used to track a software version installed.
IDMT	Inverse Definite Minimum Time. A characteristic whose trip time depends on the measured input (e.g. current) according to an inverse-time curve.
IEC	International Electro-technical Commission
IED	Intelligent Electronic Device - a term used to describe microprocessor-based controllers of power system equipment. Common types of IEDs include protective relaying devices, load tap changer controllers, circuit breaker controllers, capacitor bank switches, recloser controllers, voltage regulators, etc.
IEEE	Institute of Electrical and Electronics Engineers
IET	IED Engineering ToolSuite. Similar to SET but dedicated to IED. Or IED Engineering Tool.
IETF	Internet Engineering Task Force
IID	Instantiated/Individual IED Description
IIR	Infinite Impulse Response
Inh	An Inhibit signal
Inst	An element with Instantaneous operation: i.e. having no deliberate time delay.
IP	Internet Protocol
IRIG	InterRange Instrumentation Group
ISA	International Standard Atmosphere or Instrumentation Systems and Automation Society
ISO	International Standards Organization
JPEG	Joint Photographic Experts Group – a file format for a computer graphic
L	Live
LAN	Local Area Network
LCB	Log Control Block
LCD	Liquid Crystal Display: The relay front-panel text display.
LD	Level Detector: An element responding to a current or voltage below its set threshold. Or Logical Device
LDAP	Lightweight Directory Access Protocol
LDOV	Level Detector for OverVoltage
LDUV	Level Detector for UnderVoltage
LED	Light Emitting Diode
LLDB	Live-Line Dead-Bus : In system synchronism check, indication that the line is energized whilst the bus is de-energized.
Ln	Natural logarithm
LN	Logical Node
LOGS	All the operations related to the security (connection, configuration…) are automatically caught in events that are logged in order to provide a good visibility of the previous actions to the security administrators.
LoL	A Loss of Load scheme, providing a fast distance trip without needing a signaling channel.
LPDU	Link Protocol Data Unit
LPHD	Logical Physical Device
LRE	Link Redundancy Entity

Term	Description
MAC	Media Access Control or Mandatory Access Control
MC	MultiCast
MCB	Miniature Circuit Breaker
MIB	Management Information Base
MICS	Model Implementation Conformance Statement
MMF	Magneto-Motive Force
MMS	Manufacturing Message Specification (IEC 61850)
MRP	Media Redundancy Protocol
MU	Merging Unit (function)
MV	Measured Value
N	Neutral
N/A	Not Applicable
N/C	A Normally Closed or “break” contact: Often called a “form B” contact.
N/O	A Normally Open or “make” contact: Often called a “form A” contact.
NERC	North American Reliability Corporation
NERO	NERC Electric Reliability Organization (ERO) certified by the Federal Energy Regulatory Commission to establish and enforce reliability standards for the bulk-power system.
NIC	Network Interface Card: i.e. the Ethernet card of the IED
NIST	National Institute of Standards and Technology
NPS	Negative Phase Sequence
NTP	The Network Time Protocol (NTP) is a protocol for synchronizing the clocks of computer systems.
NVD	Neutral Voltage Displacement: Equivalent to residual overvoltage protection.
NXT	Abbreviation of “Next”: In connection with hotkey menu navigation.
o	A small circle on the input or output of a logic gate: Indicates a NOT (invert) function.
O/C	Overcurrent
O/P	Output
OCB	Oil Circuit Breaker
OCSP	Online Certificate Status Protocol. An IETF RFC for online verification of certificates by servers (RFC 2560).
OID	Object IDentifier
OOS	Out-Of-Step
Opto	An Optically coupled logic input. Alternative terminology: binary input.
OSI	Open Systems Interconnection
PAP	Policy Administration Point. Software entity that manage the security Policy
PCB	Printed Circuit Board
PCT	Protective Conductor Terminal (Ground)
PDC	Phasor Data Concentrator
PDP	Policy Decision Point. Software entity that evaluates the applicable policy and takes an authorization decision
PEP	Policy Enforcement Point. Software entity that performs access control and enforces authorization decision.
Ph	Phase - used in distance settings to identify settings that relate to phase-phase faults.
PICS	Protocol Implementation Conformance Statement
PIP	Policy Information Point. Software entity acting as an information source for the PDP.
PKI	Public Key infrastructure

Term	Description
PMU	Phasor Measurement Unit
PNG	Portable Network Graphics – a file format for a computer graphic
Pol	Polarize - typically the polarizing voltage used in making directional decisions.
POR	A Permissive OverReaching transfer trip scheme (alternative terminology: POTT).
POTT	A Permissive Overreaching Transfer Trip scheme (alternative terminology: POR).
PRP	Parallel Redundancy Protocol
PSB	Power Swing Blocking, to detect power swing/out of step functions, could be labeled 78 in ANSI terminology.
PSL	Programmable Scheme Logic: The part of the relay's logic configuration that can be modified by the user, using the graphical editor within MiCOM S1 Studio software.
PSlip	A Pole slip (out-of-step - OOS) element: could be labeled 78 in ANSI terminology.
PSP	Physical Security Perimeter
PSTN	Public Switched Telephone Network (RTC in French)
PT	Power Transformer
PTP	Precision Time Protocol
PUR	A Permissive UnderReaching transfer trip scheme (alternative terminology: PUTT).
PURR	A Permissive Underreaching Transfer Trip scheme (alternative terminology: PUR).
Q	Quantity defined as per unit value
Qx	Isolator number x
R	Resistance
RA	Registration Authority
R&TTE	Radio and Telecommunications Terminal Equipment
RBAC	Role Based Access Control. Authentication and authorization mechanism based on roles granted to a user. Roles are made of rights, themselves being actions that can be applied on objects. Each user's action is authorized or not based on his roles
RBN	Lead burden for the neutral path.
RBPh	Lead burden for the phasepath.
RCA	Relay Characteristic Angle - The center of the directional characteristic.
RCB	Report Control Block
RCT	Redundancy Control Trailer or Redundancy Check Tag
REB	Redundant Ethernet Board
RedBox	Redundancy Box
REF	Restricted Earth Fault
Rev.	Indicates an element responding to a flow in the "reverse" direction
RMS / rms	Root mean square. The equivalent a.c. current: Taking into account the fundamental, plus the equivalent heating effect of any harmonics.
RoCoF	Rate of Change of Frequency
RP	Rear Port: The communication ports on the rear of the IED
RS232	A common serial communications standard defined by the EIA
RS485	A common serial communications standard defined by the EIA (multi-drop)
RST or Rst	Reset generally used in the context of reset functions in circuit breaker control.
RSTP	Rapid Spanning Tree Protocol.
RTCS	Real Time Certificate Status. Facility. An IETF draft for online certificates validation.
RTD	Resistance Temperature Device
RTU	Remote Terminal Unit

Term	Description
RX	Receive: Typically used to indicate a communication transmit line/pin.
SAM	Security Administration Module. Device in charge of security management on an IP-over-Ethernet network.
SAMU	Stand Alone Merging Unit (device)
SAN	Singly or Single Attached Node
SAS	Substation Automation Solutions / System
SAT	Security Administration Tool TSF based application used to define and create security configuration
SAU	Security Administration Utility
SBS	Straight Binary Second
SC	Synch-Check or system Synchronism Check.
SCADA	Supervisory Control and Data Acquisition
SCD	Substation Configuration Description
SCEP	Simple Certificate Enrollment Protocol. An IETF draft for distribution and registration of public keys and certificates
SCL	Substation Configuration Language. In IEC 61850, the definition of the configuration files.
SCSM	Specific Communication Service Mappings: In IEC 61850, the SCSMs define the actual information exchange mechanisms currently used (e.g. MMS).
SCU	Substation Control Unit
SCVP	Server-based Certificate Validation Protocol. An IETF RFC for online certificates validation.
SDEF	Sensitive Differential Earth Fault in the context of protection element. Could be labeled 87N in ANSI terminology.
SEF	Sensitive Earth Fault in the context of protection element
Sen	Sensitive
SET	System Engineering Tools. New Tools in place of SCE and SMT, to deal with complete life cycle for Systems (design, realization, testing, commissioning, maintenance).
SFTP	A Secured File Transfer Protocol based on SSH.
SGCB	Setting Group Control Block
SHM	Self-Healing Manager
SHP	Self Healing Protocol
SHR	Self Healing Ring: Ethernet protocol allowing bumpless redundancy. Used with Redundant Ethernet board with self-healing protocol.
SIR	Source Impedance Ratio
SLA	Service Level Agreement
SMB	Server Message Block. Microsoft protocol for network resources sharing. Called CIFS on NT
SMT	Substation Management Tool (previously used on PACIS project)
SMTP	Simple Mail Transfer Protocol (SMTP) is an Internet standard for electronic mail (e-mail) transmission across Internet Protocol (IP) networks.
SMV	Sampled Measured Values
SNMP	Simple Network Management Protocol (SNMP) is an "Internet-standard protocol for managing devices on IP networks
SNTP	Simple Network Time Protocol
SOA	Service Oriented Architecture
SOAP	Simple Object Access Protocol
SOC	Second of Century
SOTF	Switch on to Fault
SP	Single pole.
SPAR	Single pole auto-reclose.

Term	Description
SPC	Single Point Controllable
SPDT	Single Pole Dead Time. The dead time used in single pole auto-reclose cycles.
SPS	Single Point Status
SQRT	Square Root
SSD	Solid State Device
SSH	Secured Shell. A secured encrypted network protocol for remote administration of computers
SSL	Secured Socket Layer or Source Impedance Ratio or See TLS (TLS is based on SSLv3).
SSO	Single Sign On
STP	Shielded Twisted Pair or Spanning Tree Protocol
SUI	Substation User Interface
SV	Sampled Values
SVC	Static Var Compensator
SVM	Sampled Value Model
TAF	Turbine Abnormal Frequency
TAT	Transfer Administration Tool
TBD	To Be Defined
TCP	Transmission Control Protocol
TCS	Trip Circuit Supervision
TD	Time Dial. The time dial multiplier setting: Applied to inverse-time curves (ANSI/IEEE).
TE	Unit for case measurements: One inch = 5TE units
THD	Total Harmonic Distortion
TICS	Technical Issues Conformance Statement
TIFF	Tagged Image File Format – a file format for a computer graphic
TLS	Transport Layer Security network protocol successor to SSL. Or Transport Layer Security. Creates encrypted tunnel for TCP connections. Can guarantee authentication when used in a PKI.
TMS	Time Multiplier Setting: Applied to inverse-time curves (IEC)
TOC	Trip On Close (“line check”) (protection). Offers SOTF and TOR functionality.
TOR	Trip On Reclose (protection). Modified protection on autoreclosure of the circuit breaker.
TP	Two-Part
TSF	Tool Suite Foundation. Common framework for SET and IET. Mainly 3 parts Core, Workbench (for standardized HMI), Utilities (applicative components like trace viewer, installer)
TUC	Timed UnderCurrent
TVE	Total Vector Error
Tx	Transmit
UA	User Account. A user account is a logical representation of a person with some configurable parameters. It includes information about the user identity and gives him a login to be recognized within the tool suite. A user account is principally interesting when it is associated to some roles that will grant him authorizations.
UDP	User Datagram Protocol
UL	Underwriters Laboratory
UPCT	User Programmable Curve Tool
UTC	Universal Time Coordinated
V	Voltage

Term	Description
VA	Phase A voltage: Sometimes L1, or red phase
VB	Phase B voltage: Sometimes L2, or yellow phase
VC	Phase C voltage: Sometimes L3, or blue phase
VCO	Voltage Controlled Overcurrent element
VDAN	Virtual Double or Doubly Attached Node
VDEP OC>	A voltage dependent overcurrent element: could be a voltage controlled or voltage restrained overcurrent element and could be labeled 51V in ANSI terminology.
VDR	Voltage Dependent Resistor
VDS	Virtual Device Solution
V/Hz	An overfluxing element, flux is proportional to voltage/frequency: could be labeled 24 in ANSI terminology.
Vk	IEC knee point voltage of a current transformer.
VPN	Virtual Private Network (a secure private connection established on a public network or other unsecured environment).
VT	Voltage Transformer
VTS	Voltage Transformer Supervision: To detect VT failure.
WAN	Wide Area Network
XACML	eXtensible Access Control Markup Language. An OASIS standard defining an XML access control policy implementation.
Xformer	Transformer
XKMS	XML Keys Management Specifications. A 3C standard, XML based, for distribution and registration of public keys and certificates
XML	Extensible Markup Language
XSD	XML Schema Definition

Table 1 - Acronyms and abbreviations

2 COMPANY PROPRIETARY TERMS

Term	Description
Courier	Schneider Electric’s proprietary SCADA communications protocol
Easergy	Schneider Electric’s brand of protection relays and related software products
Metrosil	Brand of non-linear resistor produced by M&I Materials Ltd.
MiCOM	Schneider Electric’s brand of protection relays

Table 2 - Company-proprietary terms

3 ANSI TERMS

ANSI no.	Description
3PAR	Three pole auto-reclose.
3PDT	Three pole dead time. The dead time used in three pole auto-reclose cycles.
52a	A circuit breaker closed auxiliary contact: The contact is in the same state as the breaker primary contacts
52b	A circuit breaker open auxiliary contact: The contact is in the opposite state to the breaker primary contacts
64R	Rotor earth fault protection
64S	100% stator earth (ground) fault protection using a low frequency injection method.
89a	An Isolator closed auxiliary contact: The contact is in the same state as the breaker primary contacts.
89b	An Isolator open auxiliary contact: The contact is in the opposite state to the breaker primary contacts.

Table 3 - ANSI abbreviations

ANSI no.	Function	Description
Current Protection Functions		
50/51	Phase overcurrent	Three-phase protection against overloads and phase-to-phase short-circuits.
50N/51N	Earth fault	Earth fault protection based on measured or calculated residual current values: • 50N/51N: residual current calculated or measured by 3 phase current sensors
50G/51G	Sensitive earth fault	Sensitive earth fault protection based on measured residual current values: • 50G/51G: residual current measured directly by a specific sensor such as a core balance CT
50BF	Breaker failure	If a breaker fails to be triggered by a tripping order, as detected by the non-extinction of the fault current, this backup protection sends a tripping order to the upstream or adjacent breakers.
46	Negative sequence / unbalance	Protection against phase unbalance, detected by the measurement of negative sequence current: • sensitive protection to detect 2-phase faults at the ends of long lines • protection of equipment against temperature build-up, caused by an unbalanced power supply, phase inversion or loss of phase, and against phase current unbalance
46BC	Broken conductor protection	Protection against phase imbalance, detected by measurement of I2/I1.
49RMS	Thermal overload	Protection against thermal damage caused by overloads on machines (transformers, motors or generators). The thermal capacity used is calculated according to a mathematical model which takes into account: • current RMS values • ambient temperature • negative sequence current, a cause of motor rotor temperature rise
Re-Closer		
79	Recloser	Automation device used to limit down time after tripping due to transient or semipermanent faults on overhead lines. The recloser orders automatic reclosing of the breaking device after the time delay required to restore the insulation has elapsed. Recloser operation is easy to adapt for different operating modes by parameter setting.
Directional Current Protection		
67N/67NC type 1 and 67	Directional phase overcurrent	Phase-to-phase short-circuit protection, with selective tripping according to fault current direction. It comprises a phase overcurrent function associated with direction detection, and picks up if the phase overcurrent function in the chosen direction (line or busbar) is activated for at least one of the three phases.

ANSI no.	Function	Description
67N/67NC	Directional earth fault	Earth fault protection, with selective tripping according to fault current direction. Three types of operation: • Type 1: the protection function uses the projection of the I0 vector • Type 2: the protection function uses the I0 vector magnitude with half-plane tripping zone • Type 3: the protection function uses the I0 vector magnitude with angular sector tripping zone
67N/67NC type 1	Directional current protection	Directional earth fault protection for impedant, isolated or compensated neutral systems, based on the projection of measured residual current.
67N/67NC type 2	Directional current protection	Directional overcurrent protection for impedance and solidly earthed systems, based on measured or calculated residual current. It comprises an earth fault function associated with direction detection, and picks up if the earth fault function in the chosen direction (line or busbar) is activated.
67N/67NC type 3	Directional current protection	Directional overcurrent protection for distribution networks in which the neutral earthing system varies according to the operating mode, based on measured residual current. It comprises an earth fault function associated with direction detection (angular sector tripping zone defined by 2 adjustable angles), and picks up if the earth fault function in the chosen direction (line or busbar) is activated.
Directional Power Protection Functions		

32P	Directional active overpower	Two-way protection based on calculated active power, for the following applications:
		• active overpower protection to detect overloads and allow load shedding
		• reverse active power protection:
		  • against generators running like motors when the generators consume active power
		  • against motors running like generators when the motors supply active power

32Q/40	Directional reactive overpower	Two-way protection based on calculated reactive power to detect field loss on synchronous machines: • reactive overpower protection for motors which consume more reactive power with field loss • reverse reactive overpower protection for generators which consume reactive power with field loss.
Machine Protection Functions		
37	Phase undercurrent	Protection of pumps against the consequences of a loss of priming by the detection of motor no-load operation. It is sensitive to a minimum of current in phase 1, remains stable during breaker tripping and may be inhibited by a logic input.

48/51LR/14	Locked rotor / excessive starting time	Protection of motors against overheating caused by:
		• excessive motor starting time due to overloads (e.g. conveyor) or insufficient supply voltage.
		The reacceleration of a motor that is not shut down, indicated by a logic input, may be considered as starting.
		• locked rotor due to motor load (e.g. crusher):
		  • in normal operation, after a normal start
		  • directly upon starting, before the detection of excessive starting time, with detection of locked rotor by a zero speed detector connected to a logic input, or by the underspeed function.

66	Starts per hour	Protection against motor overheating caused by:
		• too frequent starts: motor energizing is inhibited when the maximum allowable number of starts is reached, after counting of:
		  • starts per hour (or adjustable period)
		  • consecutive motor hot or cold starts (reacceleration of a motor that is not shut down, indicated by a logic input, may be counted as a start)
		• starts too close together in time: motor re-energizing after a shutdown is only allowed after an adjustable waiting time.

ANSI no.	Function	Description
50V/51V	Voltage-restrained overcurrent	Phase-to-phase short-circuit protection, for generators. The current tripping set point is voltage-adjusted in order to be sensitive to faults close to the generator which cause voltage drops and lowers the short-circuit current.
26/63	Thermostat/Buchholz	Protection of transformers against temperature rise and internal faults via logic inputs linked to devices integrated in the transformer.
38/49T	Temperature monitoring	Protection that detects abnormal temperature build-up by measuring the temperature inside equipment fitted with sensors: • transformer: protection of primary and secondary windings • motor and generator: protection of stator windings and bearings.
Voltage Protection Functions		
27D	Positive sequence undervoltage	Protection of motors against faulty operation due to insufficient or unbalanced network voltage, and detection of reverse rotation direction.
27R	Remanent undervoltage	Protection used to check that remanent voltage sustained by rotating machines has been cleared before allowing the busbar supplying the machines to be re-energized, to avoid electrical and mechanical transients.
27	Undervoltage	Protection of motors against voltage sags or detection of abnormally low network voltage to trigger automatic load shedding or source transfer. Works with phase-to-phase voltage.
59	Overvoltage	Detection of abnormally high network voltage or checking for sufficient voltage to enable source transfer. Works with phase-to-phase or phase-to-neutral voltage, each voltage being monitored separately.
59N	Neutral voltage displacement	Detection of insulation faults by measuring residual voltage in isolated neutral systems.
47	Negative sequence overvoltage	Protection against phase unbalance resulting from phase inversion, unbalanced supply or distant fault, detected by the measurement of negative sequence voltage.
Frequency Protection Functions		
81O	Overfrequency	Detection of abnormally high frequency compared to the rated frequency, to monitor power supply quality. Other organizations may use 81H instead of 81O.
81U	Underfrequency	Detection of abnormally low frequency compared to the rated frequency, to monitor power supply quality. The protection may be used for overall tripping or load shedding. Protection stability is ensured in the event of the loss of the main source and presence of remanent voltage by a restraint in the event of a continuous decrease of the frequency, which is activated by parameter setting. Other organizations may use 81L instead of 81U.
81R	Rate of change of frequency	Protection function used for fast disconnection of a generator or load shedding control. Based on the calculation of the frequency variation, it is insensitive to transient voltage disturbances and therefore more stable than a phase-shift protection function. **Disconnection** In installations with autonomous production means connected to a utility, the “rate of change of frequency” protection function is used to detect loss of the main system in view of opening the incoming circuit breaker to: • protect the generators from a reconnection without checking synchronization • avoid supplying loads outside the installation. **Load shedding** The “rate of change of frequency” protection function is used for load shedding in combination with the underfrequency protection to: • either accelerate shedding in the event of a large overload • or inhibit shedding following a sudden drop in frequency due to a problem that should not be solved by shedding.
Dynamic Line Rating (DLR) Protection Functions		

ANSI no.	Function	Description
49DLR	Dynamic line rating (DLR)	Protection of overhead lines based on calculation of rating or ampacity to dynamically take into account the effect of prevailing weather conditions as monitored by external sensors for: • Ambient Temperature • Wind Velocity • Wind Direction • Solar Radiation

Table 4 - ANSI descriptions

4 CONCATENATED TERMS

Term
Undercurrent
Overcurrent
Overfrequency
Underfrequency
Undervoltage
Overvoltage

Table 5 - Concatenated terms

5 UNITS FOR DIGITAL COMMUNICATIONS

Unit	Description
b	bit
B	Byte
kb	Kilobit(s)
kbps	Kilobits per second
kB	Kilobyte(s)
Mb	Megabit(s)
Mbps	Megabits per second
MB	Megabyte(s)
Gb	Gigabit(s)
Gbps	Gigabits per second
GB	Gigabyte(s)
Tb	Terabit(s)
Tbps	Terabits per second
TB	Terabyte(s)

Table 6 - Units for digital communications

6 AMERICAN VS BRITISH ENGLISH TERMINOLOGY

British English	American English
…ae…	…e…
…ence	…ense
…ise	…ize
…oe…	…e…
…ogue	…og
…our	…or
…ourite	…orite
…que	…ck
…re	…er
…yse	…yze
Aluminium	Aluminum
Centre	Center
Earth	Ground
Fibre	Fiber
Ground	Earth
Speciality	Specialty

Table 7 - American vs British English terminology

7 LOGIC SYMBOLS AND TERMS

Symbol	Description	Units
&	Logical “AND”: Used in logic diagrams to show an AND-gate function.	
Σ	“Sigma”: Used to indicate a summation, such as cumulative current interrupted.	
τ	“Tau”: Used to indicate a time constant, often associated with thermal characteristics.	
ω	System angular frequency	rad
<	Less than: Used to indicate an “under” threshold, such as undercurrent (current dropout).	
>	Greater than: Used to indicate an “over” threshold, such as overcurrent (current overload)	
o	A small circle on the input or output of a logic gate: Indicates a NOT (invert) function.	
1	Logical “OR”: Used in logic diagrams to show an OR-gate function.	
ABC	Clockwise phase rotation.	
ACB	Anti-Clockwise phase rotation.	
C	Capacitance	A
df/dt	Rate of Change of Frequency protection	Hz/s
df/dt>1	First stage of df/dt protection	Hz/s
F<	Underfrequency protection: Could be labeled 81-U in ANSI terminology.	Hz
F>	Overfrequency protection: Could be labeled 81-O in ANSI terminology.	Hz
F<1	First stage of under frequency protection: Could be labeled 81-U in ANSI terminology.	Hz
F>1	First stage of over frequency protection: Could be labeled 81-O in ANSI terminology.	Hz
f_{max}	Maximum required operating frequency	Hz
f_{min}	Minimum required operating frequency	Hz
f_n	Nominal operating frequency	Hz
I	Current	A
I^	Current raised to a power: Such as when breaker statistics monitor the square of ruptured current squared (∧ power = 2).	An
I’f	Maximum internal secondary fault current (may also be expressed as a multiple of In)	A
I<	An undercurrent element: Responds to current dropout.	A
I>>	Current setting of short circuit element	In
I>	A phase overcurrent protection: Could be labeled 50/51 in ANSI terminology.	A
I>1	First stage of phase overcurrent protection: Could be labeled 51-1 in ANSI terminology.	A
I>2	Second stage of phase overcurrent protection: Could be labeled 51-2 in ANSI terminology.	A
I>3	Third stage of phase overcurrent protection: Could be labeled 51-3 in ANSI terminology.	A
I>4	Fourth stage of phase overcurrent protection: Could be labeled 51-4 in ANSI terminology.	A
I>BB	Minimum pick-up phase threshold for the local trip order confirmation.	A
I>DZ	Minimum pick-up phase threshold for the Dead Zone protection.	A
I_0	Earth fault current setting Zero sequence current: Equals one third of the measured neutral/residual current.	A
I_1	Positive sequence current.	A
I_2	Negative sequence current.	A
I2>	Negative sequence overcurrent protection (NPS element).	A
I2pol	Negative sequence polarizing current.	A
I2therm>	A negative sequence thermal element: Could be labeled 46T in ANSI terminology.	
IA	Phase A current: Might be phase L1, red phase.. or other, in customer terminology.	A
IB	Phase B current: Might be phase L2, yellow phase.. or other, in customer terminology.	A
IbiasPh> Cur.	SDEF blocking bias current threshold.	

Symbol	Description	Units
IC	Phase C current: Might be phase L3, blue phase.. or other, in customer terminology.	A
ID>1	Minimum pick-up phase circuitry fault threshold.	
ID>2	Minimum pick-up differential phase element for all the zones.	
IDCZ>2	Minimum pick-up differential phase element for the Check Zone.	
Idiff	Current setting of biased differential element	A
IDN>1	Minimum pick-up neutral circuitry fault threshold.	
IDN>2	Minimum pick-up differential neutral element for all the zones.	
IDNCZ>2	Minimum pick-up differential neutral element for the Check Zone.	
IDZ	Minimum pick-up differential neutral element for the Check Zone.	
If	Maximum secondary through-fault current	A
If max	Maximum secondary fault current (same for all feeders)	A
If max int	Maximum secondary contribution from a feeder to an internal fault	A
If Z1	Maximum secondary phase fault current at Zone 1 reach point	A
Ife	Maximum secondary through fault earth current	A
IfeZ1	Maximum secondary earth fault current at Zone 1 reach point	A
Ifn	Maximum prospective secondary earth fault current or 31 x I> setting (whichever is lowest)	A
Ifp	Maximum prospective secondary phase fault current or 31 x I> setting (whichever is lowest)	A
I_m	Mutual current	A
IM64	InterMiCOM64.	
IMx	InterMiCOM64 bit (x=1 to 16)	
I_n	Current transformer nominal secondary current. The rated nominal current of the relay: Software selectable as 1 amp or 5 amp to match the line CT input.	A
IN	Neutral current, or residual current: This results from an internal summation of the three measured phase currents.	A
IN>	A neutral (residual) overcurrent element: Detects earth/ground faults.	A
IN>1	First stage of ground overcurrent protection: Could be labeled 51N-1 in ANSI terminology.	A
IN>2	Second stage of ground overcurrent protection: Could be labeled 51N-2 in ANSI terminology.	A
IN>BB	Minimum pick-up neutral threshold for the local trip order confirmation.	
IN>DZ	Minimum pick-up neutral threshold for the Dead Zone protection.	
Inst	An element with “instantaneous” operation: i.e. having no deliberate time delay.	
I/O	Inputs and Outputs - used in connection with the number of optocoupled inputs and output contacts within the relay.	
I/P	Input	
Iref	Reference current of P63x calculated from the reference power and nominal voltage	A
IREF>	A Restricted Earth Fault overcurrent element: Detects earth (ground) faults. Could be labeled 64 in ANSI terminology.	A
IRm2	Second knee-point bias current threshold setting of P63x biased differential element	A
Is	Value of stabilizing current	A
IS1	Differential current pick-up setting of biased differential element	A
IS2	Bias current threshold setting of biased differential element	A
I_{SEF}>	Sensitive Earth Fault overcurrent element.	A
Isn	Rated secondary current (I secondary nominal)	A
Isp	Stage 2 and 3 setting	A
Ist	Motor start up current referred to CT secondary side	A
K	Dimensioning factor	

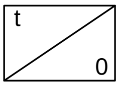
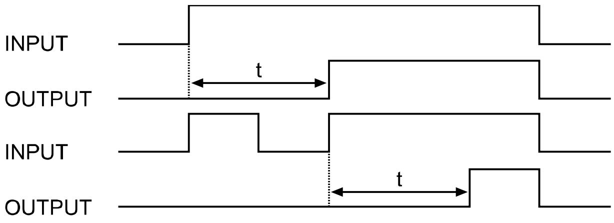
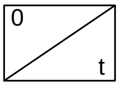
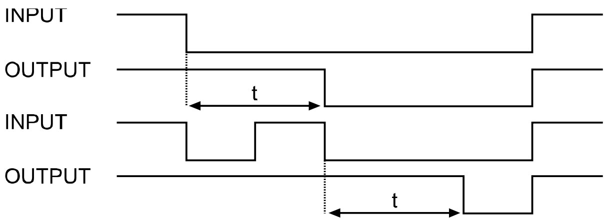
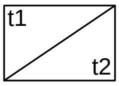
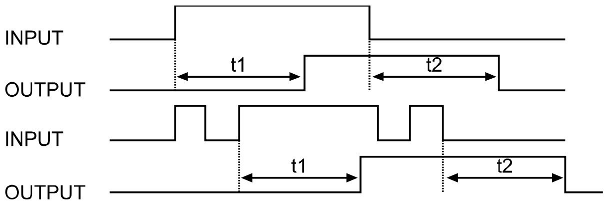
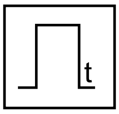
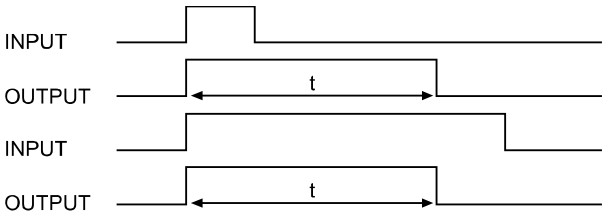
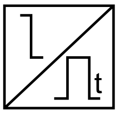
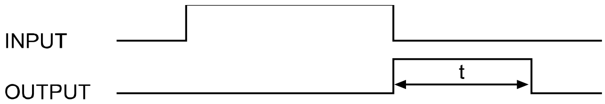
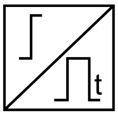
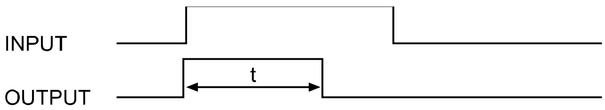
Symbol	Description	Units
K_1	Lower bias slope setting of biased differential element	%
K_2	Higher bias slope setting of biased differential element	%
KCZ	Slope of the differential phase element for the Check Zone.	
K_e	Dimensioning factor for earth fault	
km	Distance in kilometers	
K_{max}	Maximum dimensioning factor	
KNCZ	Slope of the differential neutral element for the Check Zone.	
K_{rpa}	Dimensioning factor for reach point accuracy	
K_s	Dimensioning factor dependent upon through fault current	
K_{ssc}	Short circuit current coefficient or ALF	
K_t	Dimensioning factor dependent upon operating time	
kZm	The mutual compensation factor (mutual compensation of distance elements and fault locator for parallel line coupling effects).	
kZN	The residual compensation factor: Ensuring correct reach for ground distance elements.	
L	Inductance	A
m1	Lower bias slope setting of P63x biased differential element	None
m2	Higher bias slope setting of P63x biased differential element	None
mi	Distance in miles.	
N	Indication of “Neutral” involvement in a fault: i.e. a ground (earth) fault.	
-P>	A reverse power (W) element: could be labeled 32R in ANSI terminology.	
P>	An overpower (W) element: could be labeled 32O in ANSI terminology.	
P<	A low forward power (W) element: could be labeled 32L in ANSI terminology.	
P1	Used in IEC terminology to identify the primary CT terminal polarity: Replace by a dot when using ANSI standards.	
P2	Used in IEC terminology to identify the primary CT terminal polarity: The non-dot terminal.	
P_n	Rotating plant rated single phase power	W
PN>	Wattmetric earth fault protection: Calculated using residual voltage and current quantities.	
Q<	A reactive under power (VAr) element	
R	Resistance (Ω)	Ω
R< or 64S R<	A 100% stator earth (ground) fault via low frequency injection under resistance element: could be labeled 64S in ANSI terminology.	
R Gnd.	A distance zone resistive reach setting: Used for ground (earth) faults.	
R Ph	A distance zone resistive reach setting used for Phase-Phase faults.	
Rct	Secondary winding resistance	Ω
RCT	Current transformer secondary resistance	Ω
Rl	Resistance of single lead from relay to current transformer	Ω
Rr	Resistance of any other protective relays sharing the current transformer	Ω
Rrn	Resistance of relay neutral current input	Ω
Rrp	Resistance of relay phase current input	Ω
Rs	Value of stabilizing resistor	Ω
Rx	Receive: typically used to indicate a communication receive line/pin.	
S<	An apparent under power (VA) element	
S1	Used in IEC terminology to identify the secondary CT terminal polarity: Replace by a dot when using ANSI standards.	

Symbol	Description	Units
S2	Used in IEC terminology to identify the secondary CT terminal polarity: The non-dot terminal. Also used to signify negative sequence apparent power, S2 = V2 x I2.	
S2>	A negative sequence apparent power element, S2 = V2 x I2.	
t	A time delay.	
t'	Duration of first current flow during auto-reclose cycle	s
T1	Primary system time constant	s
TF	Through Fault monitoring	
tfr	Auto-reclose dead time	s
Thermal I>	A stator thermal overload element: could be labeled 49 in ANSI terminology.	
Thru/TF	Through Fault monitoring	
tIdiff	Current differential operating time	s
Ts	Secondary system time constant	s
Tx	Transmit: typically used to indicate a communication transmit line/pin.	
V	Voltage.	V
V<	An undervoltage element: could be labeled 27 in ANSI terminology	V
V<1	First stage of undervoltage protection: Could be labeled 27-1 in ANSI terminology.	V
V<2	Second stage of undervoltage protection: Could be labeled 27-2 in ANSI terminology.	V
V>	An overvoltage element: could be labeled 59 in ANSI terminology	V
V>1	First stage of overvoltage protection: Could be labeled 59-1 in ANSI terminology.	V
V>2	Second stage of overvoltage protection: Could be labeled 59-2 in ANSI terminology.	V
V0	Zero sequence voltage: Equals one third of the measured neutral/residual voltage.	V
V1	Positive sequence voltage.	V
V2	Negative sequence voltage.	V
V2>	A Negative Phase Sequence (NPS) overvoltage element: could be labeled 47 in ANSI terminology.	
$V2_{pol}$	Negative sequence polarizing voltage.	V
V_A	Phase A voltage: Might be phase L1, red phase.. or other, in customer terminology.	V
V_B	Phase B voltage: Might be phase L2, yellow phase.. or other, in customer terminology.	V
V_C	Phase C voltage: Might be phase L3, blue phase.. or other, in customer terminology.	V
Vf	Theoretical maximum voltage produced if CT saturation did not occur	V
Vin	Input voltage e.g. to an opto-input	V
V_k	Required CT knee-point voltage. IEC knee point voltage of a current transformer.	V
VN	Neutral voltage displacement, or residual voltage.	V
VN>	A residual (neutral) overvoltage element: could be labeled 59N in ANSI terminology.	V
V_n	Nominal voltage	V
Vn	The rated nominal voltage of the relay: To match the line VT input.	V
VN>1	First stage of residual (neutral) overvoltage protection.	V
VN>2	Second stage of residual (neutral) overvoltage protection.	V
VN3H>	A 100% stator earth (ground) fault 3rd harmonic residual (neutral) overvoltage element: could be labeled 59TN in ANSI terminology.	
VN3H<	A 100% stator earth (ground) fault 3rd harmonic residual (neutral) undervoltage element: could be labeled 27TN in ANSI terminology.	
Vres.	Neutral voltage displacement, or residual voltage.	V
Vs	Value of stabilizing voltage	V
V_x	An auxiliary supply voltage: Typically the substation battery voltage used to power the relay.	V

Symbol	Description	Units
WI	Weak Infeed logic used in teleprotection schemes.	
X	Reactance	None
X/R	Primary system reactance/resistance ratio	None
Xe/Re	Primary system reactance/resistance ratio for earth loop	None
Xt	Transformer reactance (per unit)	p.u.
Y	Admittance	p.u.
YN>	Neutral overadmittance protection element: Non-directional neutral admittance protection calculated from neutral current and residual voltage.	
Z	Impedance	p.u.
Z<	An under impedance element: could be labeled 21 in ANSI terminology.	
Z0	Zero sequence impedance.	
Z1	Positive sequence impedance.	
Z1	Zone 1 distance protection.	
Z1X	Reach-stepped Zone 1X, for zone extension schemes used with auto-reclosure.	
Z2	Negative sequence impedance.	
Z2	Zone 2 distance protection.	
ZP	Programmable distance zone that can be set forward or reverse looking.	
Zs	Used to signify the source impedance behind the relay location.	
Φal	Accuracy limit flux	Wb
Ψr	Remanent flux	Wb
Ψs	Saturation flux	Wb

Table 8 - Logic Symbols and Terms

8 LOGIC TIMERS

Logic symbols	Explanation	Time chart
	Delay on pick-up timer, t	
	Delay on drop-off timer, t	
	Delay on pick-up/drop-off timer	
	Pulse timer	
	Pulse pick-up falling edge	
	Pulse pick-up raising edge	

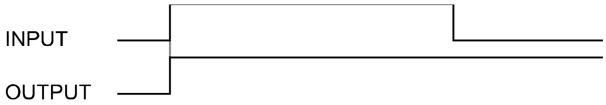
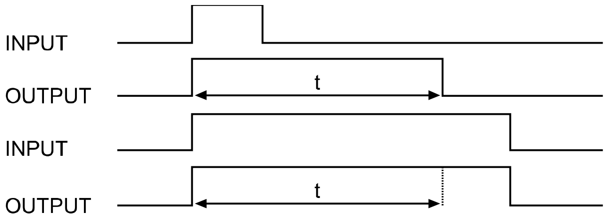
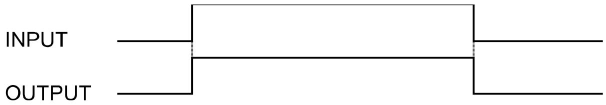
Logic symbols	Explanation	Time chart
Latching	Latch	
Dwell Timer	Dwell timer	
Straight	Straight (non latching): Hold value until input reset signal	

Table 9 - Logic Timers

9 LOGIC GATES

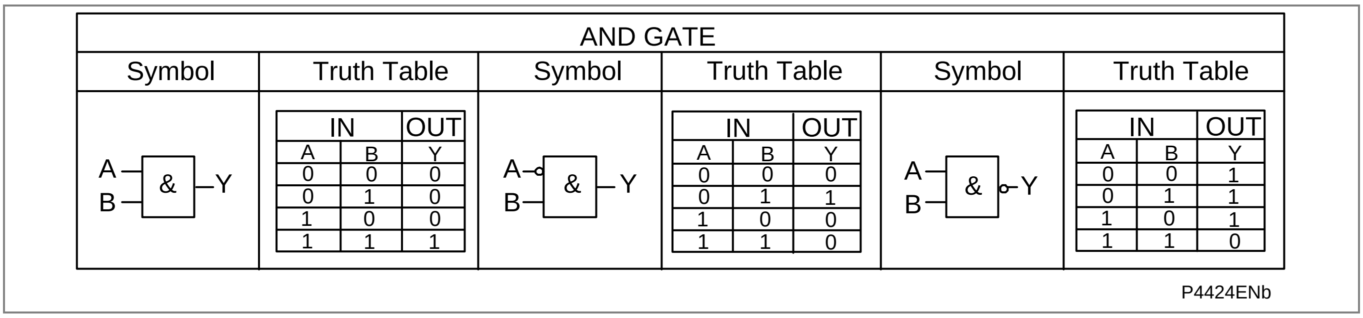


Figure 1 - Logic Gates - AND Gate

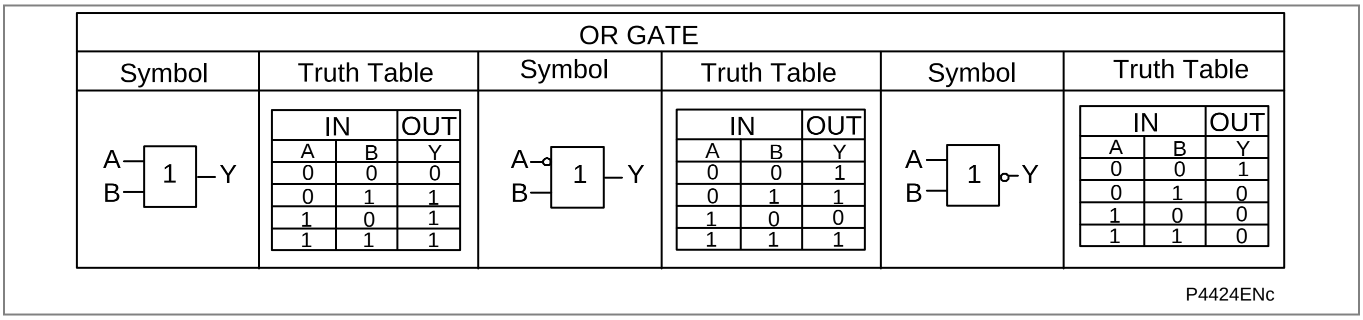


Figure 2 - Logic Gates - OR Gate

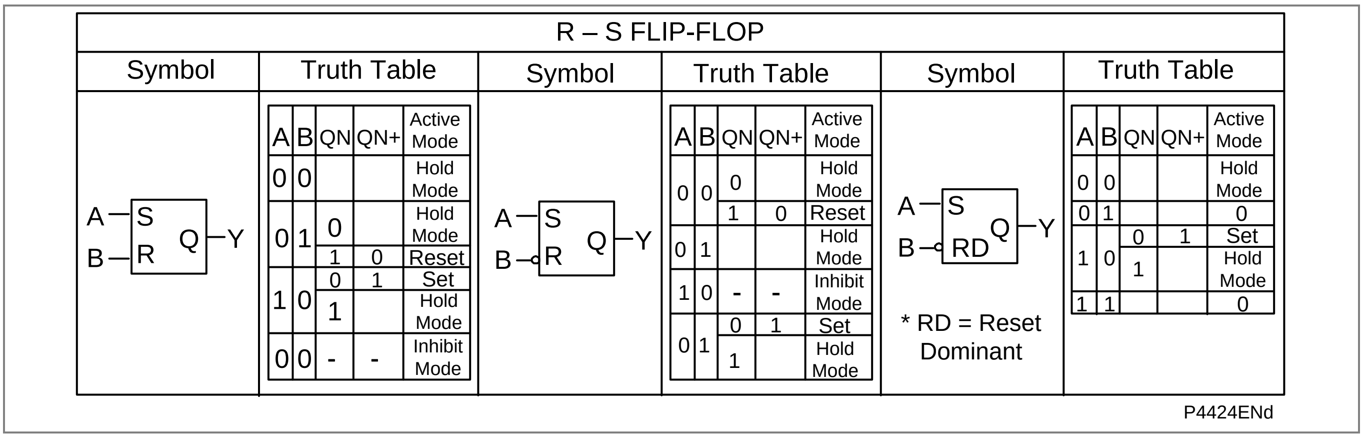


Figure 3 - Logic Gates - R-S Flip-Flop Gate

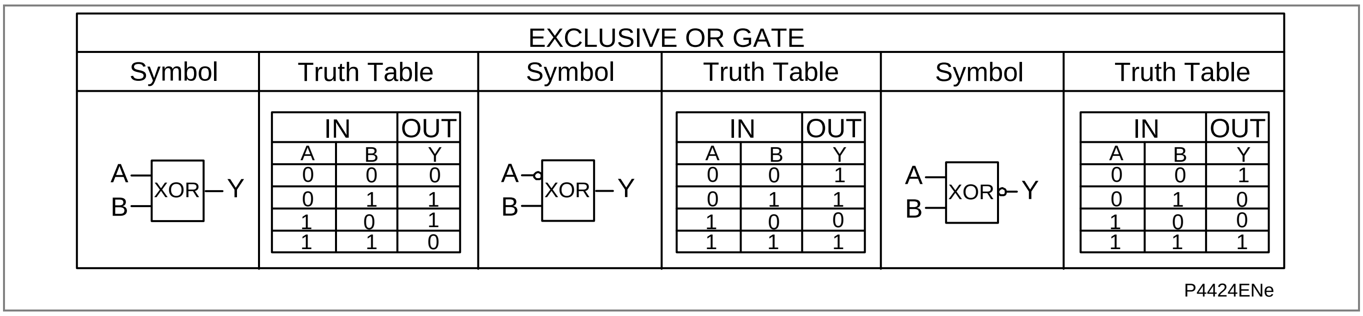
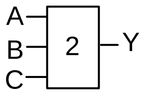


Figure 4 - Logic Gates - Exclusive OR Gate

PROGRAMMABLE GATE

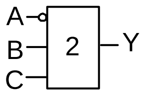
Symbol



Truth Table

IN			OUT
A	B	C	Y
0	0	0	0
0	0	1	0
0	1	0	0
0	1	1	1
1	0	0	0
1	0	1	1
1	1	0	1
1	1	1	1

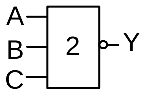
Symbol



Truth Table

IN			OUT
A	B	C	Y
0	0	0	0
0	0	1	1
0	1	0	1
0	1	1	1
1	0	0	0
1	0	1	0
1	1	0	0
1	1	1	1

Symbol



Truth Table

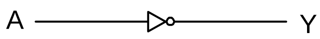
IN			OUT
A	B	C	Y
0	0	0	1
0	0	1	1
0	1	0	1
0	1	1	0
1	0	0	1
1	0	1	0
1	1	0	0
1	1	1	0

P4424ENf

Figure 5 - Logic Gates - Programmable Gate

NOT GATE

Symbol



Inverter (NOT)

Truth Table

IN	OUT
A	Y
0	1
1	0

P4424ENg

Figure 6 - Logic Gates - NOT Gate

Notes:

Customer Care Centre

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Publisher: Schneider Electric

Publication: Easergy MiCOM P74x/EN M/Qd9 Numerical Busbar Protection Relay Software Version: B1 Hardware Suffix: L (P742) & M (P741 & P743)
02/2017