

Saitel DR

M588AB000y / HUe

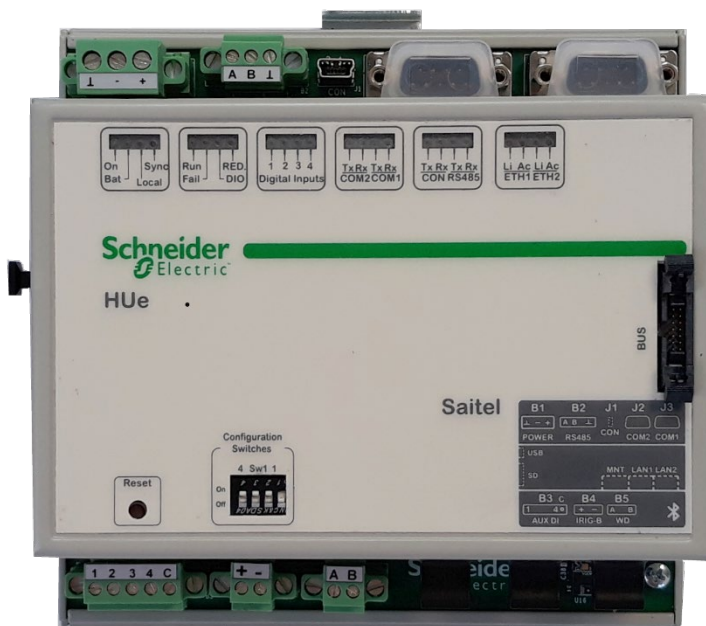
User Manual

This manual provides information for the assembly, wiring, configuration and maintenance of the HUe module.

SE-USR-M588

Publication Date (09/2020)

Read carefully the information contained in this manual before assembly, installation and use of the equipment.



Change Control

Rev	Date	Description
01	14-01-2019	Initial edition
02	08-08-2019	<ul style="list-style-type: none"> The supervision point TEMP is not available for HUe. Information about safety is included according the standard 60950-1.
03	02-03-2020	<ul style="list-style-type: none"> Included information about Bluetooth connection. Included information about PTP, PRP and HSR. New certification according to the RED European Directive.
04	23-06-2020	<ul style="list-style-type: none"> Included some safety boxes. Correct the 'Serial communication ports' figure. Structure updated. Add wiring recommendations.
05	25-09-2020	<ul style="list-style-type: none"> Included RSTP and BOND1 protocols information. Updated Easergy Builder version.

General Information

The Saitel platform and all its components have been developed in accordance to the requirements for a quality management system, complying with the ISO 9001:2015 Norm.

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Reference Documents

User Manual	Document Code
Easergy Builder User Manual	FTE-MSS-S856
webApp User Manual	FTE-WPP-S856
IEC101 User Manual	FTE-I1D-S854
IEC104 User Manual	FTE-I4D-S854
IEC103 Master User Manual	FTE-I3D-S854
Modbus User Manual	FTE-MBD-S854
ISaGRAF® User Manual	FTE-ISD-S854
DNP User Manual	FTE-DNP-S854
SOE User Manual	FTE-SOE-S854
IEC61850 User Manual - Ed1	FTE-IEC61-1-S854
IEC61850 User Manual - Ed2	FTE-IEC61-2-S854
EOL Instructions	FTE-EOLI-M588

Software Version in this Manual

The information in this manual is valid for the software versions listed below. This information is also valid for later versions, although some parameters may change slightly:

Module	Version
Baseline	11.06.08
Easergy Builder Tool	1.6.4

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1 Safety & Health

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1.1 Introduction

1.1.1 Information of Safety

Important information

Read these instructions carefully and look at the equipment to become familiar with the equipment before trying to install, operate, service or maintain it. In this manual you can find different types of messages associated with situations that have different level of risk for people and / or for the equipment.



This symbol indicates "DANGER" or "WARNING". This symbol informs of an electrical risk that will cause personal injuries if the instructions are not followed.



This symbol is associated to a safety alert. It is used to warn of possible personal injury hazards. The user must follow all instructions or messages associated to this symbol to avoid possible injuries.



DANGER

DANGER indicates a hazardous situation which, if not avoided, **will result** in death or serious injury.



WARNING

WARNING indicates a hazardous situation which, if not avoided, **could result** in death or serious injury.

NOTICE

NOTICE is used to address practices not related to physical injury. The safety alert symbol shall not be used with this signal word.

To Keep in Mind

Electrical equipment should be installed, operated, serviced, and maintained only by qualified personnel. No responsibility is assumed by Schneider Electric for any consequences arising out of the use of this material.

A qualified person is who fulfill the requirements in section 1.2 .

1.1.2 Presentation

This manual provides information for an appropriate handling, commissioning and testing. This chapter about Safety also includes descriptions of the labels on the equipment.

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

The technical data in this safety guide is typical only, see the technical data section of the user manual for specific details of a particular equipment.



Before carrying out any work on the equipment the user should be familiar with the contents of this Safety guide, the ratings on the equipment's rating label and the user manual.

THE SAFETY SECTION MUST BE READ BEFORE STARTING ANY WORK ON THE EQUIPMENT.

1.2 Introduction to Safety

The information in this chapter is provided in order to the equipment is properly installed and handled maintaining it in a safety condition. It is assumed that everyone who will be associated with the equipment will be familiar with the contents of that Safety section.

When electrical equipment is in operation, high voltages will be present in certain parts of the equipment. Failure to observe warning notices, an incorrect or not appropriate use may endanger personnel and equipment and also cause personal injury or physical damage.

WARNING

Before working with the terminal of connection, the equipment must be switched off and disconnected of the power supply.

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:

- Have read and understood the information on the device and its user manual.
- 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).










It is necessary to consider that the documentation of the equipment collects the instructions for its installation, set up and operation. However, the manuals could not cover all the possible circumstances neither include specific information on all the details.

In case of questions or specific problems, contact with his sales office of Schneider Electric or with the customer care center and request the necessary information.

1.3 Symbols and Labels on the Equipment

Before the equipment is installed or commissioned, the user must understand the following symbols, which may be used on the equipment or referred to in the user documentation:

Table 1 – Symbols

Symbol	Associated Text	Description
	Possibility of electric shock	International Electrotechnical Commission (IEC) symbol associated to a DANGER or WARNING message indicating that there is an electrical risk. Failure to follow these instructions could cause damage to people or death.
	Caution, read the manual.	Symbol associated with a risk alert. The user must read the manual before handling the equipment.
	Possibility of electric shock	American National Standards Institute (ANSI) symbol associated to a DANGER or WARNING message indicating that there is an electrical risk. Failure to follow these instructions could cause damage to people or death.
	Protective earth connection	Associated symbol to the protective ground connection.
	CE Mark	This symbol indicates that the equipment has been developed in compliance with all applicable European Directives.
	Electronic equipment. Special instructions must be followed for disposed.	This symbol indicates that, at the end of its life, this module must be disposed according to the WEEE Directive (Waste Electrical and Electronic Equipment).
	Compliant with RoHS.	The equipment has been designed and manufactured according to RoHS Directive (Restriction of Hazardous Substances).
	Direct Voltage	Symbol of direct voltage (V_{DC}).
	Alternate Voltage	Symbol of alternate voltage (V_{AC}).

1.4 Installation, Setup and Operation

There are several acquisition blocks in Saitel DR that use high voltages (> 50 V). The user is responsible to check that the characteristics of each equipment are adapted and convenient for his installation. The user should read the instructions of installation before proceeding to the use or maintenance of the equipment.

Not following these instructions can be dangerous for the people and the equipment.

⚠ ⚡ DANGER

Devices that handle dangerous tensions are marked with a sticker on the front label (size: 12,5 mm). This label must be visible all the time while the module is installed on the DIN rail.

The following products handle high voltages:

- **HU_AF**: Advanced head unit with acquisition (P/N M503xx3x0x and P/N M503xx4x0x). For other part numbers, depending on the voltage handled by the equipment connected to the digital outputs (voltage > 50 V), this module must be marked with an electric risk label. It will not be marked on factory.
- **AB_DI**: Digital inputs module (P/N: M55520000x, M55530000x and M55540000x).
- **AB_DIDO**: Input and output digital module (P/N M5722x000x, M5723x000x and M5724x000x). For other part numbers, depending on the voltage handled by the equipment connected to the digital outputs (voltage > 50 V), this module must be marked with an electric risk label. It will not be marked on factory.
- **AB_AC**: Direct measurements module (P/N M562x0000x).
- **AB_DO**: This module does not handle high voltages, it will not be marked at the factory. This module must be marked with an electric risk label when some equipment that manage voltage higher than 50 V are connected to digital outputs.

It is recommended to install the RTU inside a cabinet with a key. This cabinet only should be opened by a qualified person.

⚠ WARNING

If this type of cabinet isn't available, a barrier must be installed in order to avoid an accidental contact with these dangerous elements. This barrier only should can be removed using a special tool.

If the barrier has to be removed in order to access to equipment, personnel responsible for the task must be sure that the barrier is installed again when the task is finished.

While the RTU is accessible for a user, all people must follow all instructions to prevent electrical risk or discharges.

Not following these instructions can give like result that the equipment do not work properly or even can damage to the people or equipment.



An electrical risk symbol with enough size must be included on the cabinet's door or on the barrier.

The following image shows an example:

Figure 1 - Barrier of protection for elements with high voltages.



NOTICE

Terminals will not be accessible to the user directly once it has made the installation of the equipment. The cabinet will have to remain closed with key or the screen of installed protection.

The cabinet or installation must have a general switch placed just in the cable entry of the installation (see paragraph 1.7.1).

For the cleaning of the equipment, it is recommended to remove the power and to use only a dry cloth by the surface when it detects excessive presence of dust or any element deposited on the surface.

**WARNING**

Don't use liquid products of cleanliness due to the presence of active parts.

Because of the variety of uses of the product, the managers of the application and use of this controller device will have to take the measures to the fulfillment of all the safety requirements and provision of each application. These requirements are according to the applicable laws, regulations, codes and standard.

1.5 Earthing

**WARNING**

Before energizing the equipment, it has to be earthed properly such as it indicates in the sections 1.5.1 and 1.5.2 .

When installing the equipment, ground is the first thing that should be connected and the last one that should be disconnected.

Saitel can be earthed for two distinct needs:

- For purposes of electrical safety (Protective Earth, PE).
- Improve the behavior in Electromagnetic Compatibility (EMC) and derive perturbations to earth (functional Earth).

1.5.1 Electrical Safety

Only qualified personnel, with knowledge about hazards associated with electrical equipment is allowed to install Saitel DR. In general, the installation will be following IEC 61010-1 recommendations in order to be compliant with this norm.



The modules must be installed on a metallic DIN Rail which is fixed on a metallic surface. This metallic surface must have an M4 screw marked with this symbol. According to the norm IEC 61010-1, the ground of the cabinet or installation must be connected to this screw.

Saitel DR modules have a metallic enclosure offering protection for isolation faults.

**WARNING**

All electronic equipment with high voltage must be disconnected before dismounting a module from the DIN rail.

A dedicated connection with green/yellow wire should be used to have electric continuity to the installation protective earth. Use a wire with adequate section according to IEC 61010.

Figure 2 – Yellow and Green cable for earthing.



The design and installation of the cabinet is responsible for compliance with all the existing international and national electrical codes concerning protective grounding of any equipment.

WARNING

According to Electrical Safety:

- The screw for ground must be exclusive for this use.
- The power voltage must be supplied by a power supply that offers double or reinforced insulation against high voltages (higher than 50 V).

1.5.2 Functional Earth (EMC)

In this case the main rule is that the connection has to be done with wires of the lower possible length to the shield or earth connection nearest. In this case the section of the driver is less notable, moreover, it is advised of the use of flat wires or flexible conductive bands for a good behavior EMC.

NOTICE

The DIN rail must have terminals of earthing (of yellow and green colour) necessary to connect the terminals of PE (if it is present).

Figure 3 –Terminal for functional earth (EMC).



All Saitel DR modules with power or polarization connector have an exclusive terminal for earthing EMC. These modules are HUe, HU_B, HU_A, HU_AF, XU, AB_DO, AB_DIDO and AB_SER with external polarization.


It must be connected as follows:

Figure 4 – Example of earthing for EMC.



1.6 Handling Electronic Components

Like any electronic equipment, Saitel is susceptible to receive electrostatic discharges during the handling. It is necessary to take the usual measures to minimize this risk, since serious damage to the equipment can be caused, which may not be detected immediately but which may affect the reliability of the product.

 WARNING
<p>The enclosure should ONLY be removed by authorized use and ONLY when is strictly necessary, because this action has a risk for the equipment. The following precautions will be taken:</p> <ul style="list-style-type: none"> • Before removing the enclosure, you must be equipotential with the equipment. You must have a grounding bracelet and the device must be connected to ground as well • Avoid touching the electronic. The board must be always manipulated for the edges. • If the equipment has to be passed between two persons, both must be equipotential. • Put the module always on an antistatic surface or on a surface equipotential with you. • During the storage and transport, the module will remain in the packaging. <p>Not following these instructions can give like result that the equipment do not work properly or even can damage the people or equipment.</p>


1.7 Technical Specifications for Safety

1.7.1 Protective Elements

The cabinet's engineering and installation must include a general automatic switch next to the cables' input in the cabinet; once the door is opened, high voltages must be interrupted inside. This switch must be located at a place which is not accessible by a third person while the operator is using the boards in the cabinet.

Moreover, the installation will incorporate a circuit breaker of 5A next to the cabinet protecting it from possible overcurrent in the power supply.

Both switches will be labeled with the symbol O as "Off" and I as "On".

 WARNING
<p>The connection / disconnection switch must be installed in a fixed element (for example the wall of the cabinet) and it mustn't break any earthing wire.</p>

1.7.2 Environmental Conditions

The protection degree of the equipment is IP20.



 WARNING
<p>This equipment has been designed ONLY for indoor use.</p>

If it is necessary for his use in some external surroundings, it has to mount in a cabinet or specific accommodation that contributes at least a degree of protection IP54, protected against the dust and water.

The electronic cards of the modules will be able to be tropicalized or no according to the manufacturing option. The tropicalized used is the AVR80, of the company ABchimie. It can consult all the technical information of this type of finishing in <http://www.abchimie.com/>.

Other data to take into account about the environmental are:

- Altitude until 2000 m.
- Operation temperature range: Between -40 °C and 70 °C. (IEC 60068-2-1 and IEC 60068-2-2).

 WARNING	
	According to the standard 60950-1, all electrical safety tests have been done in an environmental temperature range of -40 °C to 60 °C. For higher temperature (> 60 °C), the module must be handled with care, since the metal surface could reach a dangerous temperature for the user.

- Maximum relative humidity of 95%. (IEC 60068-2-30)
- Degree of pollution II. (IEC 60255-5)
- Overvoltage transitory until levels of Category III. (IEC 60255-5)

1.7.3 Storage Conditions

The continuous exhibition to some high levels of humidity during the storage can cause damages to the electronic components and reduce the useful life of the equipment.

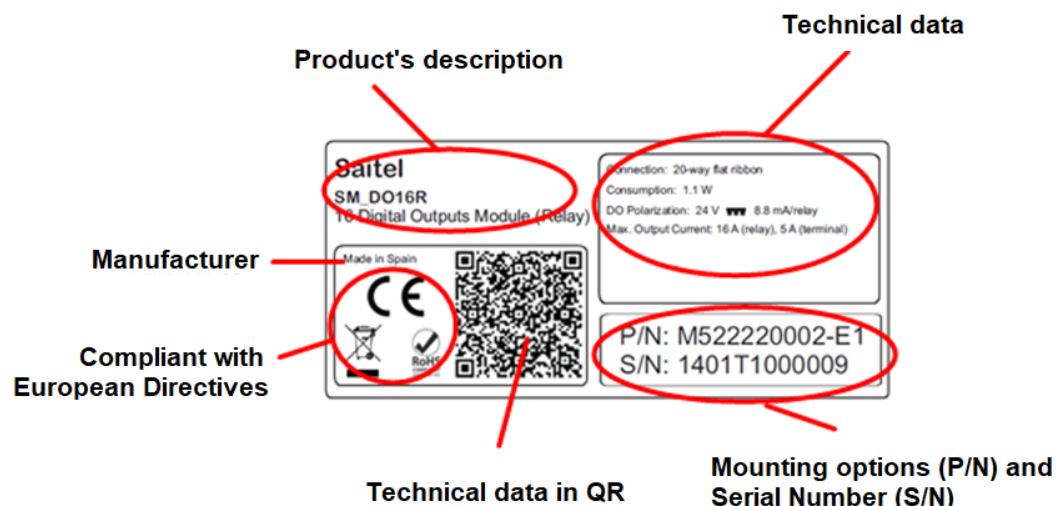
We recommend that, in the enclosure of storage, the relative humidity do not exceed 50%.

Before the installation of an electrical equipment, it is recommended to leave the necessary time for the acclimatization of the environmental temperature.

1.8 Technical Label

Each Saitel product includes a technical label with the following information:

Figure 5 – Technical label.



NOTICE

On the "Technical data" zone, you can see relevant information about the input and output voltage in the module. Any voltage greater than 50 V must be considered as a high voltage.

1.9 Packing and Unpacking

All Saitel modules are packaged separately in their own carton box and shipped inside outer packaging. Use special care when unpacking the equipment. Don't use force.

NOTICE
Our products leave our factory in closed, sealed original packaging. If at receipt of the delivery the transport packaging is open or the seal is broken, the confidentiality and authenticity of the information contained in the products cannot be ensured.

The design revision and manufacturing options can be determined using the P/N included in the packaging label on packaging.

After unpacking the equipment, inspect it visually to be sure it is in proper mechanical condition.

If the product needs to be shipped, the original packaging must be used, including foams and the carton box. If the original packaging is no longer available, make sure that the packaging used is according to ISO 2248 specifications for a drop height of 1 m.

1.10 Decommissioning and Disposal



When the product is marked with this symbol, it means that, at the end of its life cycle, you mustn't dispose the product together with habitual residues. To avoid the possible damage to the environment or to the human health that represents the uncontrolled elimination of residues, please, separate the battery (if there is one) of the other elements, and each one must be recycled according to the local regulation.

2 General Description of HUe

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2.1 Saitel DR Platform

Saitel DR is a hardware platform by Schneider Electric. It consists of a set of equipment which have been specifically designed for real-time control and automation applications. Saitel DR is a high-technology platform which serves Schneider Electric's business areas.

On this hardware platform, the Baseline Software Platform is installed. This software is used in Saitel families (Saitel DP and Saitel DR) and other Schneider Electric products.

Other features identifying Saitel DR are:

- A DIN rail is used for the mechanical installation.
- The communication between the controls units integrated in a distributed system is mainly established by Ethernet.
- The terminal blocks for field-connection are completely built into acquisition blocks.

Figure 6 – Saitel DR.



Saitel DR's design has been optimized to meet the most demanding requirements of multiple sectors:

- Safety and reliability requirements for power, gas and water supply, as well as sewage treatment plants, etc.
- Compliance with electric safety, electromagnetic compatibility, and environmental standards.
- Centralized monitoring and control of geographically-distributed systems which support hierarchical data acquisition and sharing networks.
- Local monitoring and control with data sharing capabilities of plant-distributed equipments.
- Quick troubleshooting, including the possibility of using programmable automation execution.

NOTICE

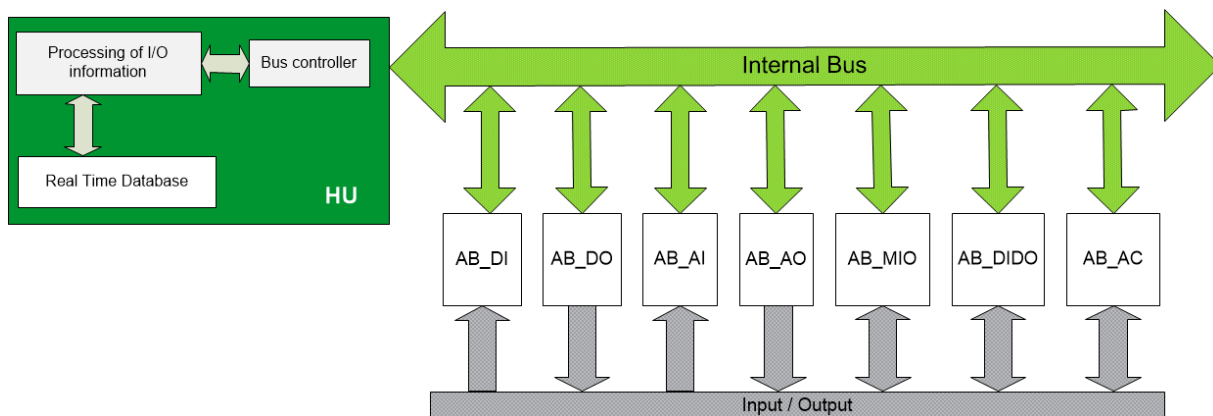
Please note Saitel DR **does not** support hot-swapping, that is, module replacements during operation.

2.2 HUE Functions in the ITB

HUE is a high-performance CPU developed by Schneider Electric within the Saitel DR family. HUE performs the control functions for the complete system, centralizes the information acquired by other modules, and executes the programmable logic control, communication protocols and user-specific applications.

The communication with the acquisition modules in the ITB is established by an internal high-speed bus that makes the system highly reliable even in noisy environments.

Figure 7 – Communication between HUE and ABs.



HUE controls and manages the following functions:

ITB Controller

This block controls the operation of both the HU and the ABs connected to the HU through the bus. These functions include:

- Operation mode monitoring. It performs functions as hardware and software Watchdog control, the states control of the ABs and the HU and the provision of diagnostic information about the ITB status through the LED indicators and several log files. These files can be consulted by a user with sufficient privileges through SFTP or webApp.
- Interface with the operator through the console, webApp (for supervision and maintenance) and Easergy Builder (for configuration).
- Firmware upgrade by SFTP or webApp (using MNT port) or USB 2.0 port.

ITB Configuration

HUE maintains and manages the information that supports the real-time database, coreDb. In this database, the I/O signals are related to the communication protocols signals. The configuration is based on XML files that are generated with the Easergy Builder tool. These files are generated on a PC and sent to the CPU via an SFTP connection through the MNT port.

ITB Synchronization

Up to two different synchronization sources can be configured. In this configuration is included the priority level for each source, so there will be a primary and a secondary source. If both sources are active, only the primary source will synchronize the system.

NOTICE

The primary source is used to synchronize the ITB, if available. Otherwise, the secondary source is used.

The available synchronization sources are:

- A **GPS** connected to the COM1 port. The time received from the GPS is used to set the system's clock and the RTC.
- An **SNTP** source through Ethernet. HUE can be used as SNTP server and client.
- **Protocol**: Most telecontrol protocols allow synchronizing to slave devices.
- **Console**: The user can set the system's time manually from the console terminal.
- **IRIG-B**: HUE can be used as a server and/or a client. The communication always will be made with IRIG-B compliant devices.

NOTICE

If the HUE is configured as IRIG-B server you have to include an AB_SER module in the ITB. The IRIG-B signal will be sent to client devices through the COM ports of this module. More information in the AB_SER user manual.

If the synchronization source is not configured, the console device will always be created by default. The console operates as the lowest priority when other source is configured.

ITB Communications

The HUE configuration includes information about definition and parameterization of communications. For HUE you have:

- IEC101 master and slave.
- IEC104 master and slave.
- DNP 3.0 master and slave.
- IEC103 master.
- Modbus master and slave.
- IEC61850 client, Edition 1 and 2.
- IEC61850 server, Edition 2.

I/O Acquisition

HUE manages the information exchange with the ABs. Its main functions include:

- Processing I/O information, which offers an added value to the information exchanged with the ABs.
- Accessing the internal bus to exchange information with the ABs.
- The HUE module has 4 digital inputs that can be used as 4 general-purpose digital inputs or as 2 specific-purpose digital inputs and 2 general-purpose digital inputs (more details below in this manual).

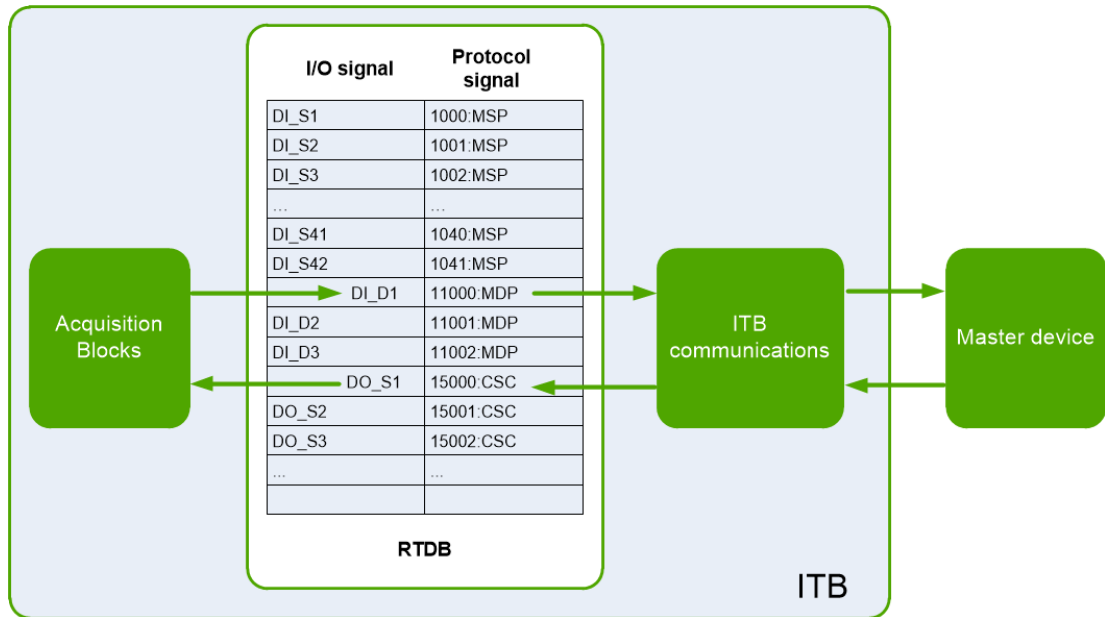
Real-Time DataBase (RTDB)

The core of the Baseline Software Platform is the real-time database or coreDb. It is a real-time database which stores not only the information acquired from field devices, but also the information about the status of HUE and ABs included in the ITB.

coreDb also relates the acquisition signals to the communication protocol signals. This database is generated in the CPU by using the configuration information.

The information which is received from field in real time is processed, stored in the RTDB and then related to the communication protocols signals of the ITB, which function is to transfer that information to the master device.

Figure 8 – coreDb operation example.



coreDb can also have as a source of information the result of a logic, which can be implemented by a third-party software such as ISaGRAF® or within the database itself with an internal device of the type "Formula".

Consult more information about this functionality in the Easergy Builder user manual.

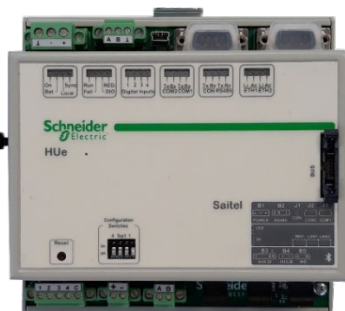
Cybersecurity

The HUE module is supplied with a standard security policy, complemented with the definition of an RBAC model (Role-Based Access Control). This model is defined and managed through a special tool, CAE (EcoStruxure™ Cybersecurity Admin Expert).

2.3 Interfaces

The HUE module is a high-performance CPU, which offers superior performance to other Saitel DR CPUs. It includes the Baseline Software Platform based on Linux operating system and with an integrated cybersecurity brick.

Figure 9 – HUE front view.



The main features of this module are:

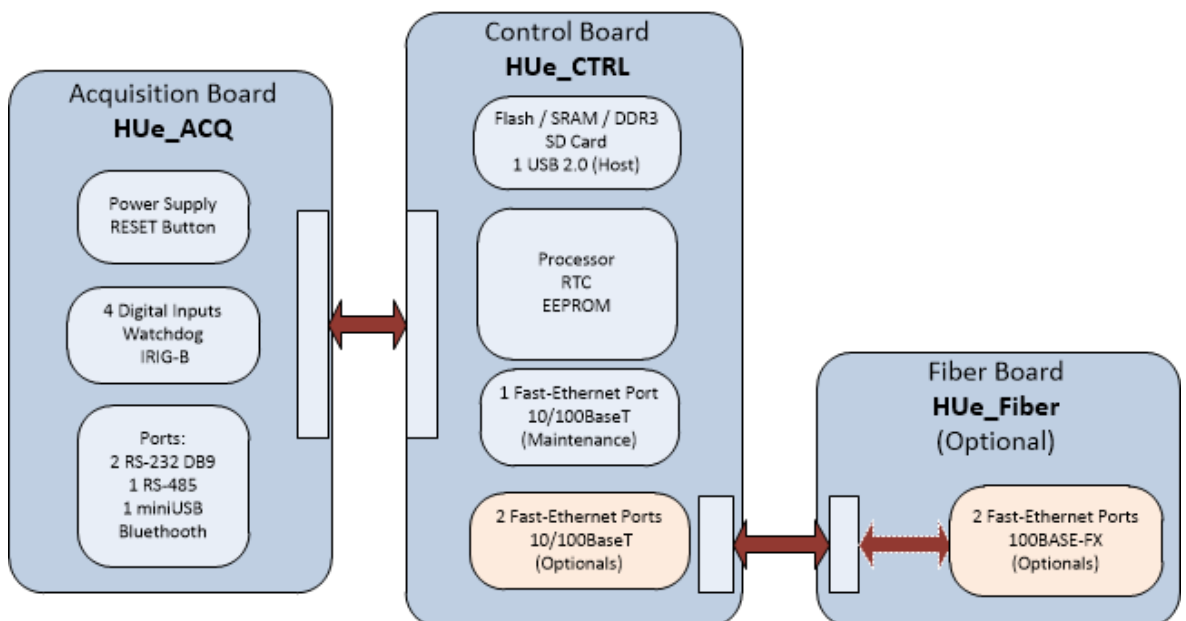
- Power input between 24 and 48 V_{DC}, with tolerance of 20%.
- A reset button integrated allowing the user to reset the module mechanically.
- It implements a security mechanism for data in memory (NVRAM) allowing to keep the information for some time if the power is temporarily down.

- 4 general-purpose digital inputs.
- Synchronization using: IRIG-B input, PPS signal (through a GPS), console or SNTP.
- A watchdog isolated output is available and can be used according to the requirements of the system.
- A copper Fast-Ethernet port for configuration and maintenance (10/100BaseT).
- Two additional Fast-Ethernet ports, which can be copper (10/100BaseT) or fiber optic (100BASE-FX) depending on the mounting options.
- Two RS-232 non-isolated communication ports. COM1 allows modem control but COM2 does not.
- One RS-485 isolated communication port.
- One console port using a miniUSB connector or bluetooth.
- One USB 2.0 connector for software upgrading.
- SD slot.

2.4 Hardware Architecture

The HUe module is composed by two or three electronic boards, depending on the manufacturing options.

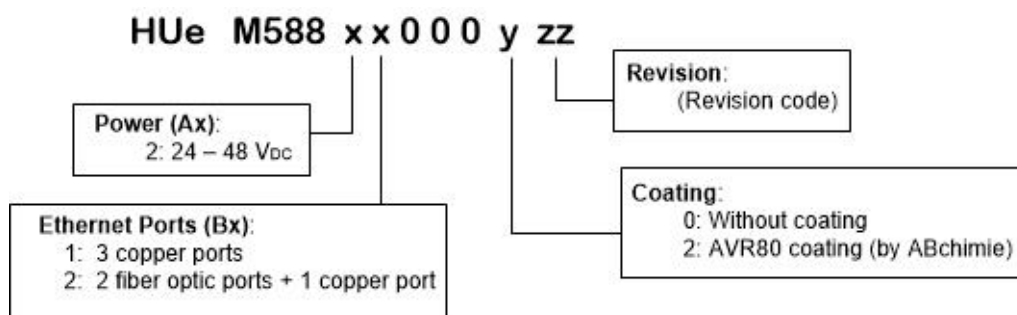
Figure 10 – Electronic boards in HUe.



These electronic boards and the metallic enclosure make up the HUe module.

This information is shown in the technical label on the module with the Part Number (P/N):

Figure 11 – Part Number description.



If the module is manufactured without optic fiber, only two boards will be mounted.

Ordering options:

- (Ax) Version of the microprocessor: Lite / Pro.
- (Bx) Power supply. The module can be powered with 24 V_{DC} or 48 V_{DC}, both $\pm 20\%$.

3 Physical Mounting & Installing

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3.1 ITB Installation

3.1.1 Handling Modules

Please note the following precautions to avoid electrostatic damages:

- You should never touch the pins of the bus connector.
- You should keep the module in its packaging box when unused.

 WARNING
Electrostatic discharges may damage semi-conductive devices within the module.

3.1.2 HUe Location in the ITB

The HUe module must always be the first module in the ITB, that is, it must be mounted in the first position of the first DIN rail, being the bus initiator in the ITB.

The HU can only be found in the second position of the DIN rail, if the ITB requires processing redundancy. In this configuration, there is a main DIN rail in which two redundant HU modules are installed and connected to the acquisition ITB by means of an Ethernet network; the system's bus is not used in this case.

NOTICE
In order to minimize the adverse effects of noise and heat, it is recommended to install the ITB's head unit as far as possible from other modules handling alternating current and high voltages.


3.1.3 Power Supply Requirements

To calculate the ITB's power supply requirements, you will need to consider the power consumption of each module. The modules' power consumptions must be added plus a safety margin (min. 20%). Each row in the ITB is powered independently through the HUe (first row) or XU (second and following rows) module.

In order to avoid ITB overload, the power supply performance should also be considered (typically, 70-90%).

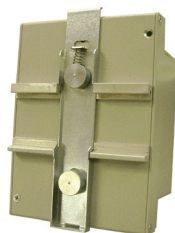
The power consumption data is detailed in the technical specifications table of each module's user manual and in the technical label on the equipment.

3.1.4 Mount and Dismount Procedures

 WARNING
It is important to assure that handling is always done while the ITB elements are unpowered.

Saitel DR modules have a DIN-rail bracket at the rear side that allows mounting on a DIN rail.

Figure 12 – Mount bracket on DIN rail.



The mounting procedure is described below:

- Switch off the power supply.
- Attach the module's rear bracket on the upper DIN rail.

- Press the lower front panel gently until a click confirms that the bracket is fit on the rail.
- Verify the module is anchored firmly to the rail, although lateral movement is possible.

Figure 13 – Saitel DR module on a DIN rail.



The module is dismounted from the DIN rail as follows:

- Switch off the power supply.
- If necessary, disconnect the bridge(s) connecting the module to the system bus.
- Holding the module by the front panel, push the upper metal tab downward. The user can also pull the tab down using for example a screwdriver as shown:






- Pressing the tab, remove the module from the lower DIN rail.
- Once detached, the module can be removed easily.

3.2 Wiring HUe

3.2.1 Wiring Recommendations

The following table shows several wiring recommendations for signals, communications and power:

				Type
Power	7 mm	1.5-2.5 mm ² 15-13 AWG	0.5 Nm	Copper
Digital Inputs	7 mm	1.5 mm ² 15 AWG	0.5 Nm	Copper
RS-485	7 mm	1.5 mm ² 15 AWG	0.5 Nm	Copper, shielded
IRIG-B	7 mm	1.5 mm ² 15 AWG	0.5 Nm	Copper
Watchdog	7 mm	1.5 mm ² 15 AWG	0.5 Nm	Copper

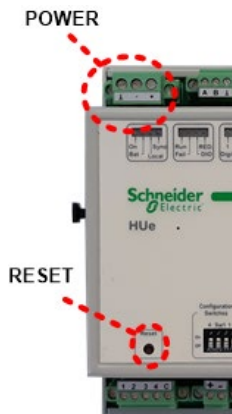
The following section describes each HUe interface, including functionality and wiring when it is required.

NOTICE

Follow all wiring recommendation for EMC included in Saitel DR Platform user manual.

3.2.2 Power and Reset

Figure 14 – Power and Reset.



In the upper left area you can observe the power supply input terminal for the first row in the ITB. There is a DC/DC converter, next to the filtering electronic components, which is used to power both the HUe module itself and all the AB modules assembled on the same row.

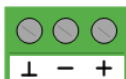
NOTICE

The maximum power to be supplied to the rest of modules in the same row by the HUe module is 10 W. If the modules to be assembled on the ITB require a higher power, then, you will need to split the ITB into several rows, always observing the above-mentioned maximum power allowed for each row.

A Reset button is included in this block allowing the user to reset all the ITB.

Power Wiring

The **POWER** connector must be used as power input. The input voltage range is 24 to 48 V_{DC}, with a tolerance of $\pm 20\%$.



⚠ WARNING

For safety reasons, the use of ferrules on power input cables is recommended to avoid possible short-circuits.

From left to right, the connecting order must be: functional Earth, negative and positive terminal.

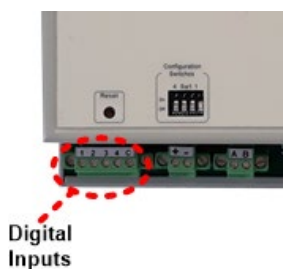
⚠ WARNING

For safety reasons, before connecting the aerial terminal to the module, it is recommended:

- To check that the voltage between the positive and negative poles does not exceed the maximum operating voltage (see the technical table in chapter 6).
- To check that the polarity has not been inverted according to the label on the terminal.

3.2.3 Digital Inputs

Figure 15 – General-purpose digital inputs.



HUE has 4 digital inputs located in the lower left, only configurable as single inputs. These signals are useful to inform the operator about some malfunction in the system.

The digital input 1 and 2 can be used for the following purposes:

- **Digital input 1:** This signal provides the HUE module with information about the digital inputs' polarization status of the ABs installed in the ITB. When the signal is active, the polarization of all digital signals is correct. If the signal is disabled, the HU will understand that there is a polarization fault.
- **Digital input 2:** If this signal is enabled, the HUE module will interpret that the ITB is working in LOCAL mode, whereas if it is disabled, the ITB is operating in REMOTE mode. When the ITB is in LOCAL mode the commands are disabled.

To use these two signals with the purpose described above, they must be defined in the database following the instructions included in paragraph 4.5.1 of this manual.

WARNING

Before doing any local operation, for safety reasons, the operator **MUST**:

- To be sure that the "Local" LED on HUE is lit.
- To be sure that the secondary relays are de-energized.

Digital Inputs Wiring

Use AUX DI terminal in order to use the general-purpose digital inputs. These signals are self-polarized, that is, they do not need an external polarization source.

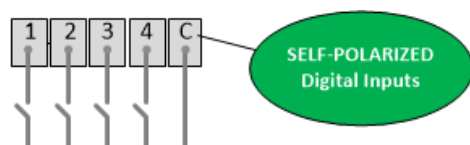


These digital inputs are designed for internal use within the cabinet where the HUE module is installed.

WARNING

These signals must not be connected to equipment that are outside the cabinet. Failing this instruction could modify EMC behavior of the equipment.

The following figure illustrates how each input receives the polarization through the common:

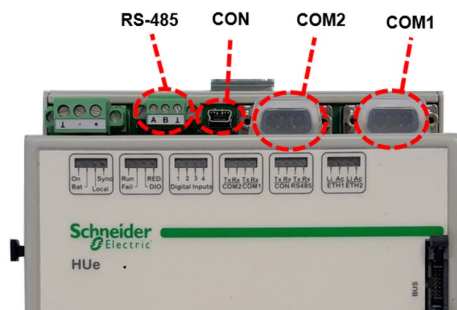


⚠ WARNING

These digital inputs are internally polarized. Please, **DON'T CONNECT** to other power supply. Failure to observe this instruction can result in equipment damage.

3.2.4 Serial Communications

Figure 16 – Serial communication ports.



- **COM1** and **COM2**: non-isolated RS-232 communication ports for general-purpose. Both ports use male DB-9 connector.
- **CON**: Console port with miniUSB connector.
- **RS-485**: Isolated TS-485 communication port.
- **Bluetooth**: Wireless connection. Currently it can only be used for the console.

RS-232 Communications Wiring (COM1 and COM2)

All modem signals are available in COM1 port. COM2 only uses RTS and CTS signals. The maximum speed in both ports is 115200 bps.

Following tables show the pinout for both connectors:

Table 2 – Pinout of COM1

Pin	Description	I/O
1	DCD – Data Carrier Detect	I
2	Rx – Data Reception	I
3	Tx – Data Transmission	O
4	DTR – Data Terminal Ready	O
5	GND – Ground	-
6	DSR - Data Set Ready	I
7	RTS – Request to Send	O
8	CTS – Clear to Send	I
9	RI – Call indicator	I

Table 3 – Pinout of COM2

Pin	Description	I/O
1	Not connected	-
2	Rx – Data Reception	I
3	Tx – Data transmission	O
4	Not connected	-
5	GND – Ground	-
6	Not connected	-
7	RTS – Request to Send	O
8	CTS – Clear to Send	I
9	Not connected	-

NOTICE

COM1 can receive a pulse per second signal (PPS) through pin 8, so it must be used as the GPS input, if required. The input PPS signal must be valid for RS-232 levels.

The validated GPS devices to be connected to the COM1 port are GPS35 (Garmin) and GPS16 (Garmin).

Some GPS devices don't allow to use PPS signal. This operation mode implies that the synchronization accuracy will be lower. It can produce a deviation of up to 10 ms in the generation of the signal.

NOTICE

When using a GPS synchronization device, it is always advisable to wire the PPS signal to achieve the highest accuracy in the synchronization.

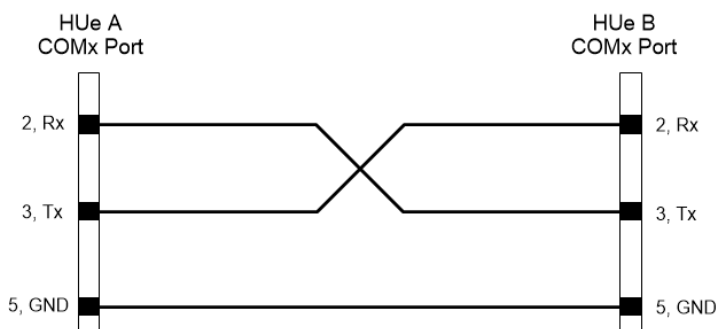
⚠ WARNING

The installer should check that the cable connected to each COMx port is correct. It is also recommended to use identification tags on the cables to avoid errors.

Redundancy Wiring (COM1 and COM2)

For redundant system, both HUe can be connected using COM1 and COM2 ports. The following pinout must be considered (other pins should not be connected):

Figure 17 –Pinout of the cable for redundancy.



Console Port Wiring (CON)

The following table shows the pinout of the miniUSB port for the console:

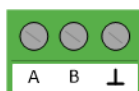


Table 4 – Pinout of the console port.

Pin	Name	Wire color	I/O
1	-		Not connected
2	Data -	White	O
3	Data +	Green	I
4	Mode detection	-	Not connected
5	Ground	Black	Ground

RS-485 Wiring (RS-485)

This terminal block is used to communicate with other equipment through a 2-wire RS-485 communication (Half-Duplex). The figure below shows the pinout of this terminal:



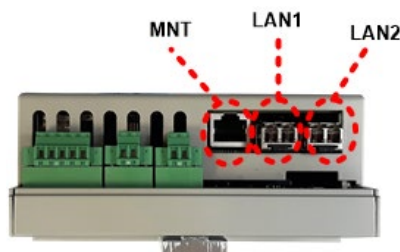
The relationship between this 3-poles terminal and the SM_SER's DB9 connector is the following:

Table 5 – 2-wire RS-485 to DB9

HUe connector	DB9 connector
A	Pin 9 (Y)
B	Pin 8 (Z)
Ground	Pin 5

3.2.5 Ethernet Communications

Figure 18 –Ethernet communication ports.



- **MNT:** Fast-Ethernet port (10/100BaseT) for maintenance purpose. It uses a RJ-45 connector.
- **LAN1** and **LAN2:** Fast-Ethernet communication ports using copper or fiber optic depending on the manufacturing options.
 - Copper ports allow 10/100 BaseT IEEE 1588, with a RJ-45 connector.
 - Fiber optic ports allow 100Base-FX with SFP connectors.

⚠ WARNING

The installer should check that the cable connected to each Ethernet port is correct. It is also recommended to use identification tags on the cables to avoid errors.

Ethernet Wiring – Copper ports

The pinout for RJ-45 connector is the following:



Table 6 – Pinout of the copper ports.

Pin	Name	Description	TIA/EIA 568A		TIA/EIA 568B	
1	BI_DA+	Bi-directional pair A+ (TX)		White/Green		White/Orange
2	BI_DA-	Bi-directional pair A- (TX)		Green		Orange
3	BI_DB+	Bi-directional pair B+ (RX)		White/Orange		White/Green
4	BI_DC+	Bi-directional pair C+		Blue		Blue
5	BI_DC-	Bi-directional pair C-		White/Blue		White/Blue
6	BI_DB-	Bi-directional pair B- (RX)		Orange		Green
7	BI_DD+	Bi-directional pair D+		White/Brown		White/Brown
8	BI_DD-	Bi-directional pair D-		Brown		Brown

TIA/EIA 568A and TIA/EIA 568B are two color codes used for wiring eight-position RJ45 modular plugs. Both are allowed under the ANSI/TIA/EIA wiring standards. The only difference between both codes is that the orange and green pairs are interchanged.

⚠ WARNING

Each network segment cable length may be up to 100 m.

Ethernet Wiring – Fiber Optic Ports

If fiber optic is selected in manufacturing options for LAN1 and LAN2, they have to mount a SFP transceiver with LC connector. These transceivers aren't included with HUE.

The following figure shows two connectors which could be used in LAN1 and LAN2:

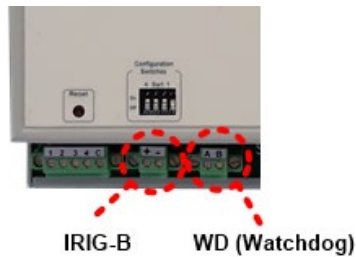


The following models are recommended:

- Models: **HFBR-57E0PZ** and **HFBR-57E0APZ**
 - Full compliance with the optical performance requirements of 100Base-FX version of IEEE802.3u.
 - Operates with 62.5/125 µm and 50/125 µm multimode fiber, with a LED light source of 1300 nm.
 - Maximum link length: 2 km.
 - Operating temperature: From -40 °C to +85 °C (only HFBR-57E0APZ)

3.2.6 IRIG-B and Watchdog Output

Figure 19 –IRIG-B and WD output connectors.



IRIG-B Wiring

This terminal block is used to receive an IRIG-B claqsignal (non modulated TTL - 5V) which can be used by the CPU to synchronize the ITB. The input impedance is 600 Ohm.

The connector for IRIG-B has the following pinout:



HUe can be set as an IRIG-B client and/or server, according the standards IRIG-B002, 003, 006 and 007.

Watchdog Wiring (WD)

A watchdog output (identified as WD and labeled as B5) is available in HUe for system monitoring. It is implemented as follows:

- solid-state relay (normally open)
- supporting a maximum voltage of 250 V.
- current of 200 mA.

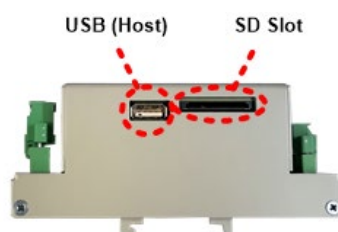
The relay status depends on the FAIL_RTU supervision signal. A normal value of this signal is 0, and value 1 is associated to the detection of a malfunction in the system.

⚠ WARNING

The watchdog output is not designed to be wired as a field output. This output was designed to be connected to a local device inside the same cabinet. The connection wire must be shorter than 3 meters.

3.3 Compact-Flash Card

Figure 20 – Slot for SD card and USB connector.



The slot for the SD card is located on the left side of the module. This card can be used for mass storage of data, for example, the event log or configuration files.

The slot for the Compact-Flash card is located on the left side of the module. This card can be used for mass storage of data, for example, the event log.

The following Compact Flash card have been validated (both with capacity of 512 MB):

- Swissbit manufacturer, model SFCF0512H1BK1MT-I-MS-553-SMA.
- Apacer manufacturer, model AP-CF512ME3NR-ETNRQ.

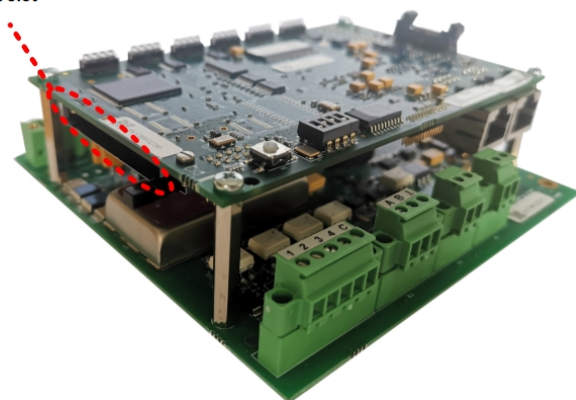
If necessary, to extract the compact flash card, use the ejector located at right of the slot.

NOTICE

For P/N E7 and later, this ejector is not mounted. To extract the compact flash card, use an appropriate tool, for example a tweezers for electronic.

If the CF ejector is not available for the module and there is some problem to access the card, you can remove the enclosure and access to the card as follow:

CF card slot



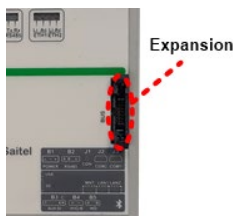
⚠ WARNING

Turn off all power supplying this equipment before working on or inside it. Consider all sources of power, including the possibility of back feeding.

3.4 Expansion

Through a flat ribbon connector, the CPU starts the data and power bus, expanding it to the other modules.

Figure 21 – Expansion bus connector.



NOTICE

Before disconnecting the slave modules from the bus (disconnecting the flat ribbon) the ITB must be unpowered.

3.5 Configuration Switches

There are 4 configuration switches on the front of the module. They are numbered 1 to 4 from the left to the right.

Figure 22 – Configuration Switches.



Configuration

This group of switches allows:

- Restoring the manufacturing default configuration.
- Enabling the automatic execution of the addressing procedure (AAP).
- Executing the AAP automatically when the ITB starts.

As is indicated on the label, the switch is in position ON if is up and OFF when is down.

These switches can be used as follow:

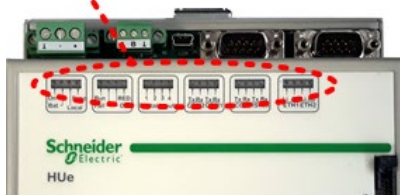
- **Switch 4:** It restores the factory IP configuration. If switch 4 is ON when HUe starts, the network configuration will be restored for all Ethernet ports. If the network configuration file (netConfig.xml) exists, it will be renamed to old_netConfig.xml. The default IP addresses are indicated in paragraph 4.1 .
- **Switch 3:** It enables or not the automatic execution of the AAP:
 - **On:** Enabled. When the ITB starts, the AAP procedure is automatically executed.
 - **Off:** Disabled. The AAP procedure has to be executed with a command if it is required. This command may be executed depending on the position of switch 2.
- **Switch 2:** It allows or not the execution of AAP:
 - **On:** Allowed. The AAP can be executed.
 - **Off:** Not allowed. The AAP cannot be executed either automatically or manually.
- **Switch 1:** Reserved. It must be in **OFF** position.

3.6 LED Indicators

There are 24 light indicators (LED) on the front of the module:

Figure 23 – LED indicators

LED Indicators



The information by the LED indicators includes:

- General status of the module (**On**, **Bat**, **Local** and **Sync**)
- Configuration and acquisition status (**Run**, **Fail**, **DIO** and **RED**)
- Status of the 4 general-purpose digital inputs (**Digital Input x**).
- Transmission/Reception in COM1, COM2, CON and RS-485 ports (**Tx** and **Rx**).
- Communications in the Ethernet ports LAN1 (**ETH1**) and LAN2 (**ETH2**).

NOTICE

There is not a LED associated to the MNT port.

HUE's LED provide the following information to the operator:



→ Blink
















→ On



→ Off

Table 7 – LED indicators.

LED	Status	Description	Recommended action
On		Powered.	-
		Unpowered.	Connect the module to a power supply according to the input voltage of the module.
Bat		The supercapacitor is discharged. While this led is on, the system cannot keep the data in memory if a power down occurs.	Switch 1 must be turned OFF. The led will turn off when the supercapacitor is loaded.
		Normal state. If the supercapacitor is fully charged, data in memory can be kept for 8 hours (at 25 °C) if a power down occurs.	
Local		RTU in LOCAL mode. Digital outputs are disabled in the ITB.	
		RTU in REMOTE mode.	
Sync		The system uses an external synchronization source.	
		Any external synchronization source is being used.	
Run		RTU operative, with configuration or not.	
		RTU not operative.	Use the console tool in order to check if the message "CONF OK" is shown. The supervision signal DOING_WELL must be defined in coreDb and set to 1.
Fail		RTU not configured or with errors.	Use Easergy Builder and load a configuration without errors in the CPU.
		A correct configuration is loaded in the CPU.	
DIO		There is at least one module in Fail status in the ITB.	Identify the module with problems and perform the recommended actions. More information in the user manual of the module in fail status.
		All modules in the ITB are OK.	

LED	Status	Description	Recommended action
RED.		Redundant system and this is the HUE HOT.	
		Redundant system and this is the HUE STANDBY.	
		Non redundant system or configuration.	
Digital Inputs x		The digital input x is activated.	
		The digital input x is deactivated or not defined in coreDb.	
Tx		The port COMx/CON/RS485 is transferring.	
		The port COMx/CON/RS485 is not transferring.	
Rx		The port COMx/CON/RS485 is receiving.	
		The port COMx/CON/RS485 is not receiving.	
Li		The port ETHx has a physical connection.	
		The port ETHx has not a physical connection.	
Ac		There is a channel activity through the ETHx port.	
		There is not a channel activity through the ETHx port.	

4 Configuration & Maintenance

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4.1 Getting Started

HUe is supplied with a basic configuration, which will help us have a first contact with the system. To get started, you need to know the following data:

Default IP Addresses

Table 8 – Default IP Addresses.

Port	Description	IP	Subnet Mask
LAN1	Operating system's eth0 port.	10.1.1.1	255.0.0.0
LAN2	Operating system's eth1 port.	192.168.1.1	255.255.255.0
MNT	Operating system's eth2 port. This is the maintenance dedicated port.	192.168.2.1	255.255.255.0

User

In accordance to the policy provided with the CAE tool, the default users which can log into the system are:

Table 9 – Default users.

User Level	User	Password	Description
Operator	Operator	Operator1!	This user can view most of the system's information (data, syslog, events, settings...) It can write to coreDb, but it does NOT have access to security parameters.
Engineer	Engineer	Engineer1!	This user can view and modify all the system information, except for the security parameters. It can also access the operating system's console, although it cannot execute Saitel commands.
Installer	Installer	Installer1!	This user can view and modify all the system information, except for the security parameters. In the console, it can only access the BLMon application and Saitel commands.
Viewer	Viewer	Viewer1!	This user level can read coreDb settings and data and can connect to webApp. It cannot make changes to settings or to the coreDb data.
Administrator	SecurityAdmin	Security1!	This user level is only used to define and modify the security parameters and user permissions.

NOTICE

We recommend using the **Engineer** user to perform configuration tasks with Easergy Builder and the **Installer** user to use the console.

It is possible to execute console commands with the **Engineer** user as follow:

Activate the command terminal with: **tty > /tmp/BLCMD**

Execute the command: **echo "claqVersion" > /tmp/BLCMD**

This command provides the software version installed on the ITB modules.

When working with the HUE module, the user will need to prepare the working environment, in terms of installing the adequate tools, making the software files available, in case the CPU needs to be upgraded, and so on.

There are certain tasks that the user must be familiar with before using Saitel DR, such as:

- Installing and using Easergy Builder: This manual describes specific operations to be performed with this tool (see Chapter 5 in this manual). For detailed information about the use of Easergy Builder, please refer to "Easergy Builder User Manual".
- Using webApp: For detailed information about the use of the web server, please refer to "webApp User Manual".
- Operating Saitel DR modules: For further information about the wiring, configuration, and use of the modules which be included in an ITB, please refer to their respective user manual.

4.1.1 Using the Console

The material below is required to use the console:

- A HUE M588 Module.
- A console cable if a USB cable is used. For connecting to the HUE, the cable must have a miniUSB connector (for further information about the CON port and its pinout, please refer to section 3.2.4 in this manual).
- Software for serial channel connection. In the examples of this user manual, we have used PuTTY, which is a free-license software that can be used in most PC's running on Microsoft® Windows® and several UNIX® platforms.

Bluetooth Connection

The name of the Bluetooth device has been changed. It will now follow the format below:

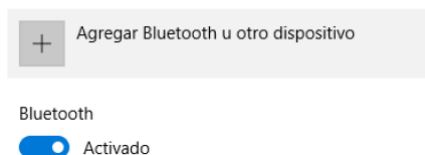
- X(A):
 1. X is the name of the CPU, in this case HUE.
 2. A is the MAC of the eth0 port.

Therefore, each bluetooth device will have a different name and no confusion will be created

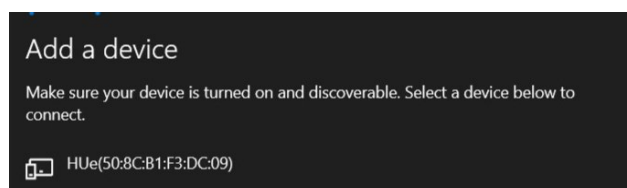
The following describes how to connect to the console using Windows 10 on the PC.

Select "Settings Menu" -> "Bluetooth and other devices". Make sure the bluetooth interface is active (On).

Bluetooth y otros dispositivos

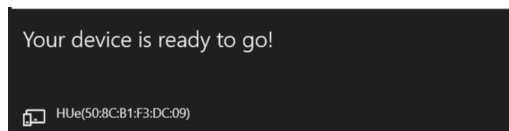


Click on the "Add Bluetooth or other device" button and select "Bluetooth" and Windows will show you all the Bluetooth devices available.



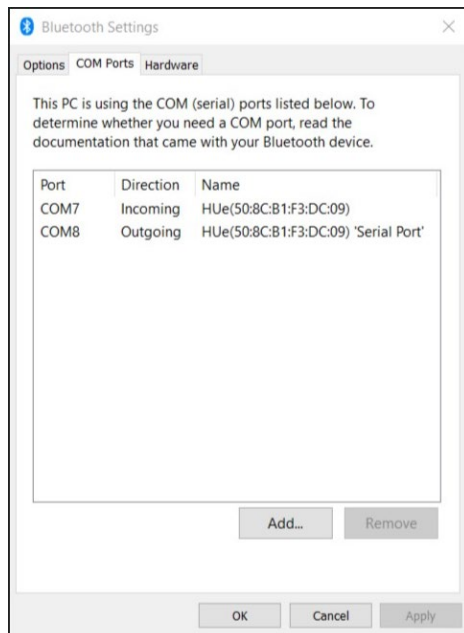
One with the name "HUE" should appear in the list of detected devices.

Click on the HUE device and Windows will perform the connection and pairing process, until finally the following message appears:



Then we click on the "Done" button, and in the next screen we select "More Bluetooth Options" -> "COM Ports". In the screen that appears, we write down the COM port that appears as Outgoing:

Figure 24 - Bluetooth Settings



This is the serial port that, from Windows, we will use to connect to the HUE's bluetooth console. In our case we have used the program "PuTTY".

Connection

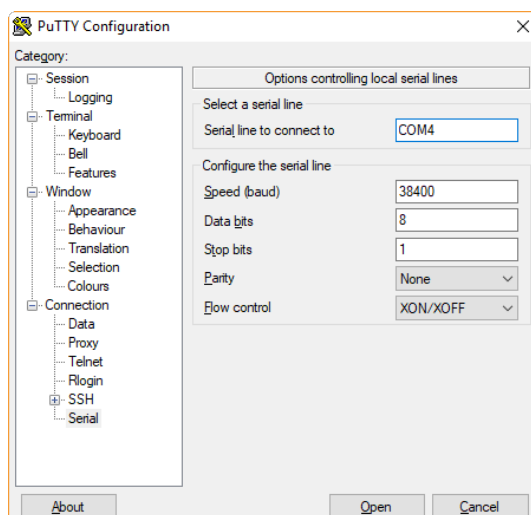
Connect the cable between the CON port (miniUSB connector) in the HUE to a PC serial port (one of the USB ports can be used).

Switch on the HUE module and execute PuTTY (or another commercial software).

Working with the Console

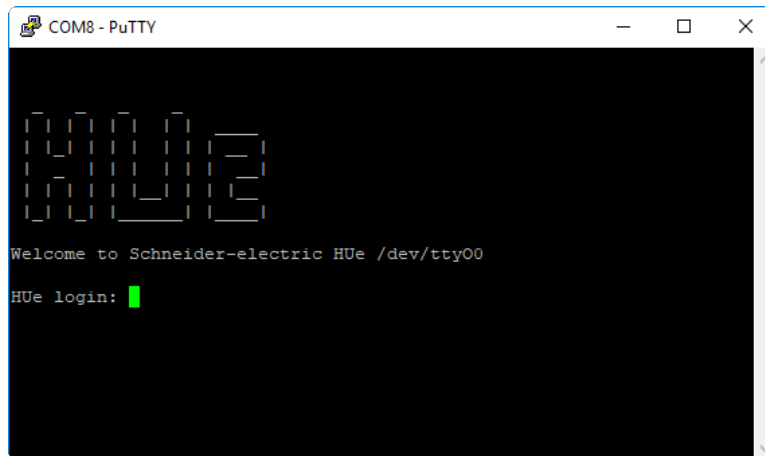
Once you know which COMx port you need to connect in the PC. Open a console session with the following parameters:

Figure 25 - Putty Configuration



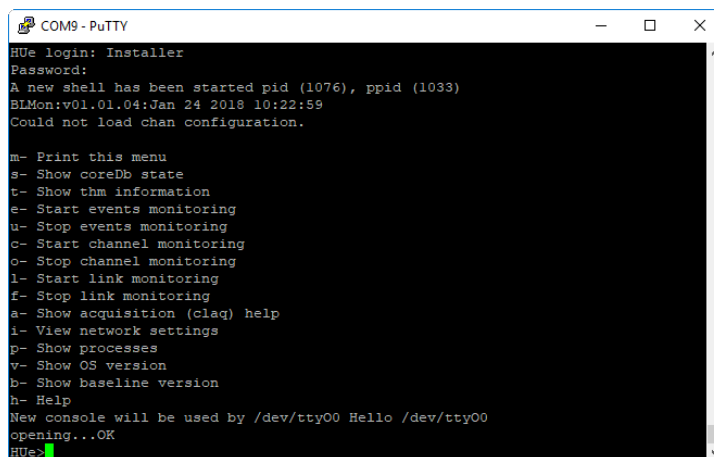
When the connection is established, you will be prompted to enter a valid user by the operating system's console:

Figure 26 - HUE Login



The commands that can be executed in the console will depend on the logged-in user permissions. In order to execute the usual actions with this tool, we recommend using the **Installer** user and **Installer1!** password.

Figure 27 - Login Session



For a complete list of all BLMon commands and its actions, please refer to section 5.9.1 in this manual.

4.1.2 File System

You can access the file system in the HUE module by using a secure connection, such as SFTP (SSH – File Transfer Protocol). In the following examples, Filezilla software was used.

You can also browse several directories using the Linux commands available in the console.

The files constituting the Baseline Software Platform are installed in a non-volatile memory which is accessible by the user. The file system is structured as follows:

- **/mnt/bf**: Flash memory. This is a general-purpose memory. It stores ISaGRAF®, web server, and other application's files.
- **/mnt/flash**: Main memory. It stores user applications of Baseline Platform, for example, the software for the Device Drivers and their configuration files.
- **/mnt/nflash**: Auxiliary memory assembled on a NAND flash memory.
- **/nvRam**: Non-volatile SRAM memory. Memory used for data storage (i.e. Event log). This memory has a power fail protection by means of a supercapacitor, which is capable of retaining data for 8 hours.

- **/mnt/sd1**: Memory for mass data storage in a SD memory card. The board needs to be inserted in the slot on the module's side panel. The /mnt/sd1 folder is listed in the file system when the card is inserted in this slot. If the card is not inserted, then the folder will not be displayed in the file system.
- **/mnt/usb1**: Memory for mass data storage in a pen drive. When the device is connected to a USB port, the /mnt/usb1 folder is listed in the file system, and we can access its contents. If there is no pen drive connected to this port, the folder is not displayed in the file system.

NOTICE

The host USB port can be used to update Baseline. You need to connect a pen drive containing new Baseline file to be installed (for example, "Baseline_11.06.02.tar.gz") and, then, click Reset on the equipment.

IMPORTANT: For the update to be successful, there should only be one file Baseline_XX.XX.XX.tar.gz on the pendrive.

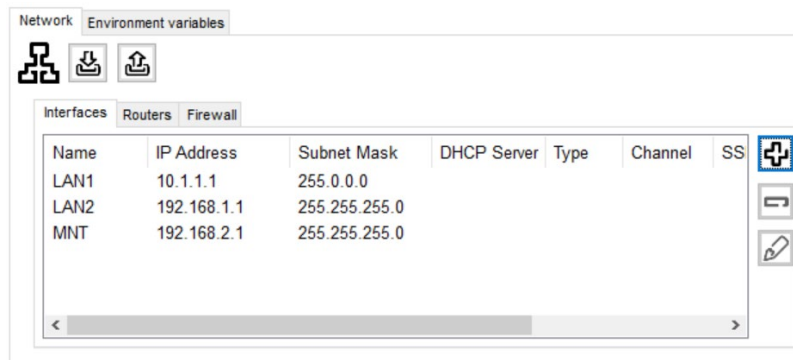
4.1.3 Network Configuration (IP / Router / Firewalls)



The configuration windows will depend on whether you are configuring a redundant RTU or not; two or more tabs will be displayed in the network settings and environment variables screen.




If the RTU is not redundant, you can only see the following tabs: "**Network**" and "**Environment Variables A**". If the RTU is redundant, you will see the corresponding configuration tabs for each CPU, that is "**Network – CPU A**", "**Network - CPU B**", "**Environment Variables A**", and "**Environment Variables B**", where A is the main CPU and B is the secondary CPU.

Network Interfaces

Figure 28 – Network Interface Settings.



You can view the existing network settings in the CPU (by clicking ) or modify the interfaces and, then, applying the changes (by clicking ) so that they are effective in the next initialization.

If you need to add new network interfaces, remove one of the existing interfaces or change their respective parameters, use the , , and  buttons respectively.

All the network interfaces integrated in the HUE can be set as DHCP client, so "**IP Address**" and "**Subnet Mask**" fields are ignored. These data are automatically assigned by a DHCP server through the network.

NOTICE

HUE cannot be set as a DHCP server.

Nevertheless, it is possible to configure a Parallel Redundancy Protocol (PRP) logical interface. This interface allows two physical ports to be used as a single port, that is, both ports will have the same MAC address and the same IP address.

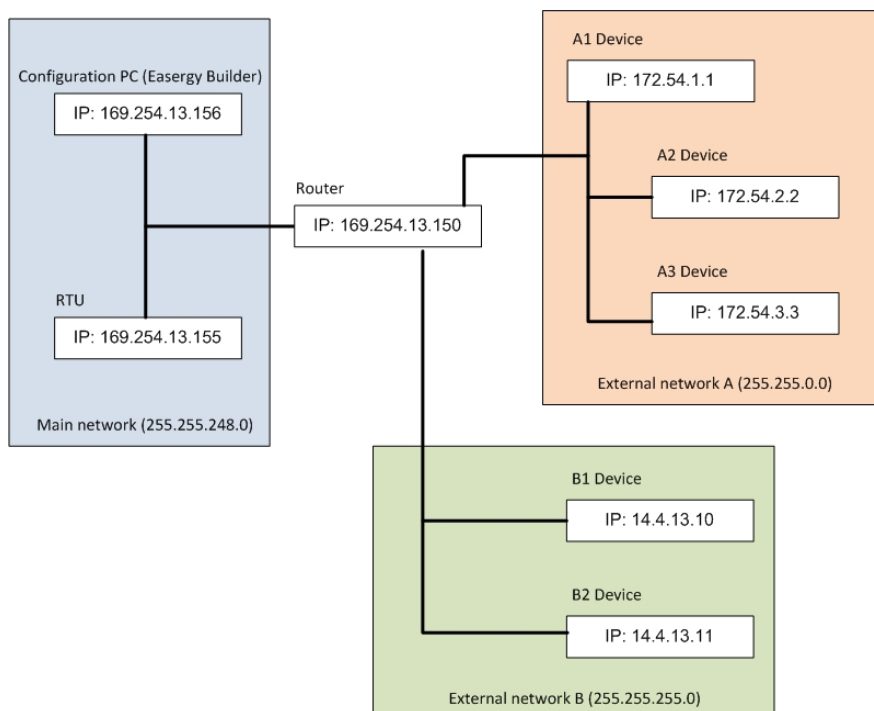
NOTICE

If configuring the PRP interface, you CANNOT define the LAN ports.

Routers

If you need to define interfaces in different networks, then you need to configure the device that gives us access to different networks. Each device is configured in the “**Routers**” tab, in which we specify their respective IP address. The figure below illustrates an example with two external subnets.

Figure 29 – Using routers to configure subnets.



Define the following settings in Easergy Builder:

Figure 30 - Router Settings

Interfaces Routers Firewall		
Subnet IP	Subnet Mask	Router IP
172.54.0.0	255.255.0.0	169.254.13.190
14.4.13.0	255.255.0.0	169.254.13.190

The Destination IP and Destination Mask fields are related to the IP addresses to be reached from the router. The Router IP is the device's IP address in the main network.

You can register the default IP address and mask once (i.e., 0.0.0.0 and 0.0.0.0) in order to access external networks. With these settings you can reach any device connected to the router from the CPU.

Interfaces Routers Firewall		
Subnet IP	Subnet Mask	Router IP
0.0.0.0	0.0.0.0	169.254.13.190

As with network interfaces, you can use the buttons on the right to add, remove or edit a router.

Firewalls

The network ports (MNT, LAN1, and LAN2) have the Firewalls tab in which you can define the following:

- **Defining a white list:** A pool of IP addresses which will access the CPU through this port.
- **Defining a black list:** A pool of IP addresses which CANNOT access the CPU through this port.
- **Blocking a TCP or UDP port in the interface.** In this case, no device can connect to this network interface using the specified port.


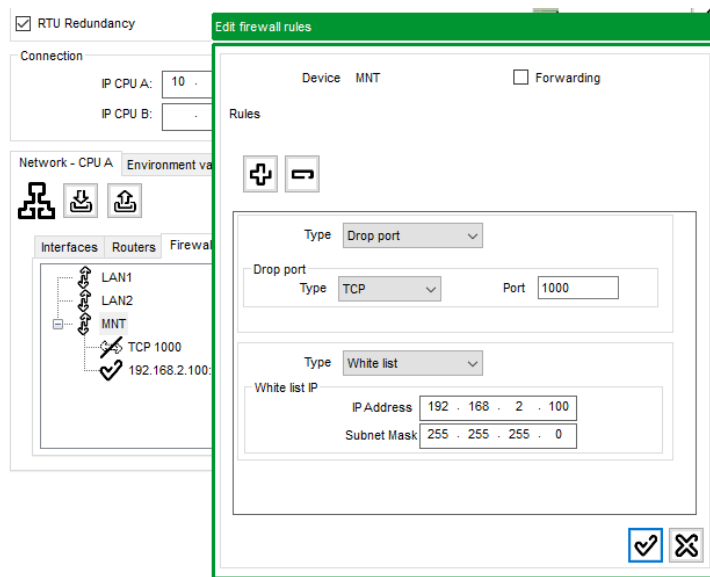
To manage the firewall rules for each port, you need to select it from the list and click .

Figure 31 - Edit Firewall Rules



The configuration of the Firewalls in the system is not required. If the network interface does not have Firewall settings, then no restrictions or capabilities are associated to use this feature.

To define a “White list.” or “Black List”, you need to select the **Type** and indicate the pool of addresses to be included (**IP Address / Subnet Mask**).

To block a port, you need to select “Blocked port” in Type field and then indicate the port number and type (TCP or UDP).

The firewall rules are defined in the order below:

- Firstly, indicate the Forwarding state.
- Secondly, close the ports
- Thirdly, block the “Black list” addresses
- Fourthly, allow the “White list” addresses

With this configuration, make sure that the information received from one port or one address will be accepted or rejected in accordance to this rule ordering. When a rule matches, the information is accepted or rejected. If no rule matches, then communication is enabled

It is also possible to forward a packet received through an Ethernet port with the IP Address belonging to another port's subnet. This is known as Packet Forwarding between Ethernet ports. To use this feature, you need to check the “**Forwarding**” box.

This feature is disabled by default for all ports.

4.1.4 Environment Variables



There are multiple environment variables defined in Baseline Software Platform which should be known in order to configure our system according to our requirements. These variables are defined in the “main_cfg.xml” en /mnt/flash file, which is managed and edited by means of Easergy Builder tool, as shown below.

The environment variables that must be defined with default values are:

- **CONFIG_DIR**:(Default value:/mnt/flash/cfgFiles/).This is the folder in which configuration files are stored. The CPU may have several projects stored in different associated configuration folders. The system will load the project whose configuration folder is associated with the value of this variable. If necessary, you can use an external storage device for these configuration folders (SD card o USB pen drive).
- **BIN_DIR**:(Default value:/mnt/bf/).Alternative path for application or binary files. The default directory in which application files are stored is /mnt/flash.If these files are not in this folder, the system will search in an alternative file path, as indicated in BIN_DIR.
- **SLOT**: In a redundant system, it is necessary to define the type of CPU you are configuring. It will have the value **A** in the main CPU, the one that is initialized HOT by default, and **B** for the secondary CPU.
- **WEB_IS_REMOTE**:(It doesn't apply with HUe).

If a redundant HUe is configured, then you will have two tabs; the first is associated to the CPU A and the second is associated to CPU B. The figure below illustrates the variable definition in a redundant CPU:

Figure 32 - Variable definition in a redundant CPU

You can change the values in these tabs and send the changes to the CPU by clicking ; new values will be applied in the next CPU initialization. If button  is used, you can read the current value for these variables.

4.2 Cybersecurity

The HUe module implements a standard security policy and a default RBAC model (Role-based access control). This model is defined and managed by a special tool, i.e. CAE (EcoStruxure™ Cybersecurity Admin Expert). Based on this model, authorized users can create and manage other system's users. Moreover, the CPU includes a firewall.

The RBAC model implemented in the HUe module complies with the IEC 62351-8 standard.

4.2.1 CAE and RBAC

CAE is the tool designed to administer the security policy and define access restrictions for the system and/or communication interfaces.

A key aspect of this RBAC model is that every access is controlled by means of roles; each role is defined as a set of permissions and privileges. Permissions are assigned to users by means of roles; they can also inherit roles through a hierarchy.

The RBAC model provides the HUe module with:

- Secure connections for local and remote maintenance: HTTPS and SSH.
- Secure file transfer protocol: SFTP.
- Firewall capability.

Default RBAC model is detailed in further sections in this manual, including:

- List of objects.
- List of roles (users)
- Allocation of each role to each object's permission.

It is not necessary to modify the RBAC module supplied with the equipment, if it fulfils the system's requirements.

Otherwise, use the CAE tool for:

- Creating a user database
- Defining the roles
- Managing the RBAC model in each device centrally.

4.2.2 Users

During the engineering phase, CAE must be used to redefine or change the access restrictions for the system, including the access rights and responsibilities.

In the basic model supplied with HUe, the **SecurityAdmin** user is the only user with sufficient privileges to administer Saitel cybersecurity (please, see table below). It means that it is the only user which is able to administer and/or modify the passwords and roles being assigned to the users.

Table 10 – Default users

User	Password	Role
Viewer	Viewer1!	VIEWER
Operator	Operator1!	OPERATOR
Engineer	Engineer1!	ENGINEER
Installer	Installer1!	INSTALLER
SecurityAdmin	Security1!	SECADM
SecAud	Secaud1!	SECAUD
RbacMnt	Rbacmnt1!	RBACMNT

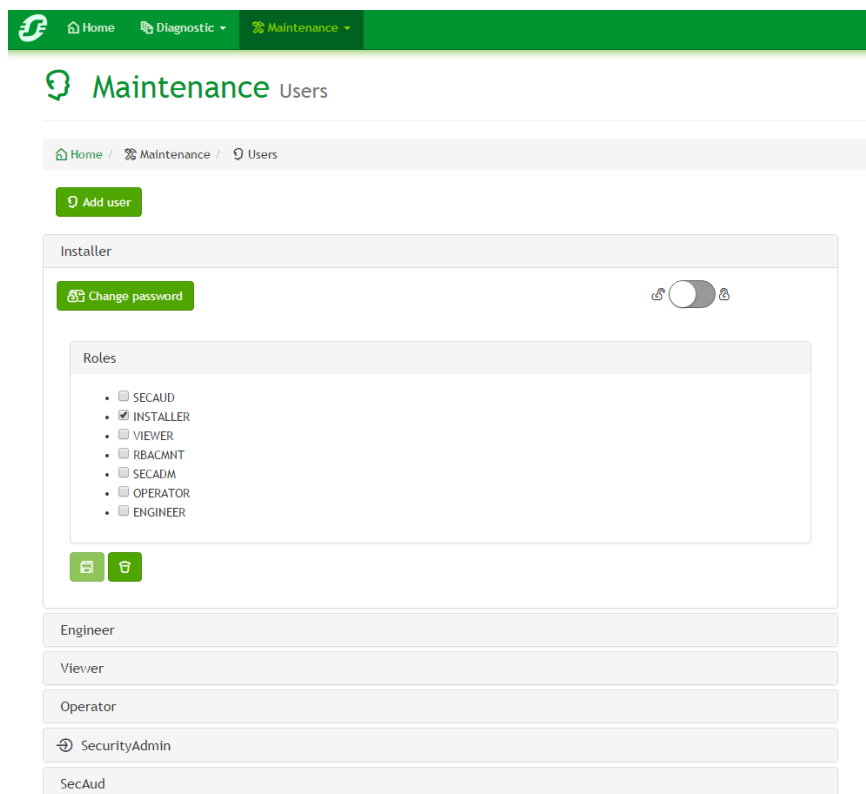
Once access levels are defined in the RBAC model, you can use HUe's web server (webApp) in order to add or remove users, modify passwords and assign one or several predefined functions to the users or modify them.

⚠ WARNING

When users are modified, if new RBAC configuration is uploaded from CAE, all changes here will be overwritten.

In webApp, use Maintenance tab in order to manage the users:

Figure 33 – Managing users in HUe.



For further information, please refer to webApp User Manual.

NOTICE

For security reasons, these users' password must be changed when the system is initialized.

4.2.3 Roles

Role-based-access-control (RBAC) is a control mechanism that defines the roles and privileges assigned to each role. These privileges are defined in accordance to some objects and actions that the user can act upon:

The table below illustrates the actions allowed for each object. Depending on the roles assigned to the logged-in user in the system, a specific action is allowed or not for an object:

Table 11 – Default roles

Object	Description	Actions	Privilege
CONF_DB	Configuration files in coreDb.	Reading	CONFDB_READ
		Writing	CONFDB_WRITE
CONF_SYS	Configuration files in the system.	Reading	CONFSYS_READ
		Writing	CONFSYS_WRITE
FIRMWARE		Reading	FIRMWARE_READ

Object	Description	Actions	Privilege
	Directory in which Baseline executables and libraries are contained (excluding the smAutoLoad file).	Writing	FIRMWARE_WRITE
		Viewing	FIRMWARE_VIEW
WEBSERVICE	Web server.	Access	WEBSERVICES_ACCESS
SSH	SSH and SFTP connection to the operating system.	Access	SSH_ACCESS
OSSHELL	Operating system's console.	Access	OSSHELL_ACCESS
BLMON	Baseline Console.	Access	BLSHELL_ACCESS
SYSLOG	System's Log File (Baseline).It includes the log file both for the system and SOE (sequence of events), but it does not include the cybersecurity log.	Reading	SYSLOG_READ
		Writing	SYSLOG_WRITE
RBAC	Configuration of the model associated to cybersecurity brick.	Reading	RBAC_READ
		Writing	RBAC_WRITE
RBAC_LOG	Log file for the cybersecurity brick.	Reading	RBACLOG_READ
RESET	System reset.	Access	RESET_ACCESS
DATA	Access to the information about coreDb points.	Reading	DATA_READ
		Writing	DATA_WRITE

The table below illustrates the privileges associated each role defined in the RBAC model for the HUe module. In order to administer users and roles, you will need to log into webApp with SecurityAdmin user.

Table 12 – User's privileges.

Privilege	Roles						
	VIEWER	OPERATOR	ENGINEER	INSTALLER	SECADM	SECAUD	RBACMNT
CONF_DB	✓	✓	✓	✓			
CONFDB_WRITE			✓	✓			
CONFSYS_READ		✓	✓	✓			
CONFSYS_WRITE			✓	✓			
FIRMWARE_VIEW		✓	✓	✓			
FIRMWARE_READ			✓	✓			
FIRMWARE_WRITE			✓	✓			
WEBSERVICES_ACCESS	✓	✓	✓	✓	✓		
SSH_ACCESS			✓	✓			
OSSHELL_ACCESS			✓				
BLSHELL_ACCESS				✓			
SYSLOG_READ		✓	✓	✓			

Privilege	Roles						
	VIEWER	OPERATOR	ENGINEER	INSTALLER	SECADM	SECAUD	RBACMNT
SYSLOG_WRITE			✓	✓	✓		✓
RBAC_READ					✓		✓
RBAC_WRITE					✓		✓
RBACLOG_READ					✓	✓	✓
RESET_ACCESS	✓	✓	✓	✓			
DATA_READ		✓	✓	✓			
DATA_WRITE			✓	✓			

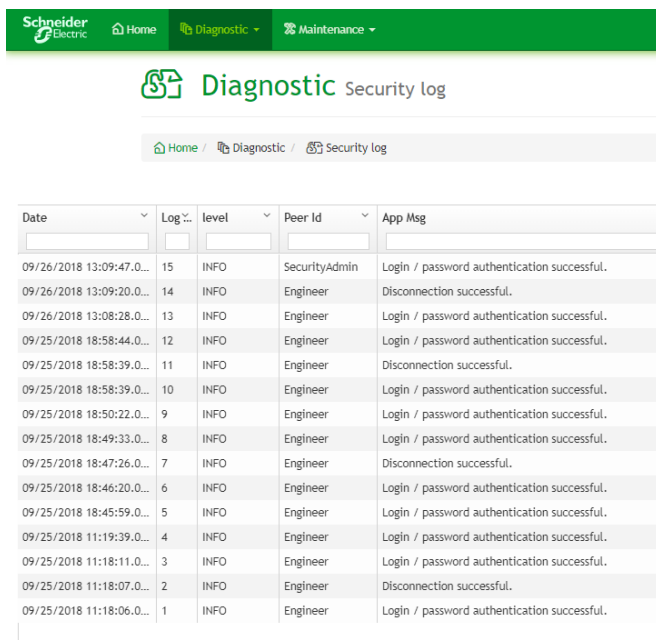
4.2.4 Security Event Log

The HUe module contains an event log which is exclusively used for cybersecurity. This file registers the following data:

- Events associated with the connections to the CPU.
- Modifications made to the cybersecurity policy.

This file is only accessible by a user with the adequate rights to cybersecurity options. It can be viewed and downloaded from webApp, by clicking Diagnostics → Cybersecurity menu.

Figure 34 – Cybersecurity Log.



Date	Log	level	Peer Id	App Msg
09/26/2018 13:09:47.0...	15	INFO	SecurityAdmin	Login / password authentication successful.
09/26/2018 13:09:20.0...	14	INFO	Engineer	Disconnection successful.
09/26/2018 13:08:28.0...	13	INFO	Engineer	Login / password authentication successful.
09/25/2018 18:58:44.0...	12	INFO	Engineer	Login / password authentication successful.
09/25/2018 18:58:39.0...	11	INFO	Engineer	Disconnection successful.
09/25/2018 18:58:39.0...	10	INFO	Engineer	Login / password authentication successful.
09/25/2018 18:50:22.0...	9	INFO	Engineer	Login / password authentication successful.
09/25/2018 18:49:33.0...	8	INFO	Engineer	Login / password authentication successful.
09/25/2018 18:47:26.0...	7	INFO	Engineer	Disconnection successful.
09/25/2018 18:46:20.0...	6	INFO	Engineer	Login / password authentication successful.
09/25/2018 18:45:59.0...	5	INFO	Engineer	Login / password authentication successful.
09/25/2018 11:19:39.0...	4	INFO	Engineer	Login / password authentication successful.
09/25/2018 11:18:11.0...	3	INFO	Engineer	Login / password authentication successful.
09/25/2018 11:18:07.0...	2	INFO	Engineer	Disconnection successful.
09/25/2018 11:18:06.0...	1	INFO	Engineer	Login / password authentication successful.

4.3 ITB Addressing (AAP)

Inside the ITB, each acquisition block or communication block must be identified with a number. This number is assigned with Easergy Builder when configuring the local acquisition (please see section 5.1).

Once the local acquisition is defined with the configuration tool and it is transferred to the RTU, it is necessary to define these modules' runtime addressing. To do so, execute a so-called Automatic Addressing Procedure (AAP) that creates a table in the memory in which the acquisition blocks assembled physically on the ITB are associated to an address and a type. The physical components on the system must match the configuration in Easergy Builder.

NOTICE

For AAP execution, at least one configuration needs to be loaded in the RTU; it must match the configuration loaded in the modules that are physically installed on the ITB. For further information about how to define and load a configuration to the RTU by using Easergy Builder, please refer to section 5.1 .

The Automatic Addressing Procedure (AAP) must be performed every time the ITB morphology changes, that is, every time a module is added, deleted or replaced.

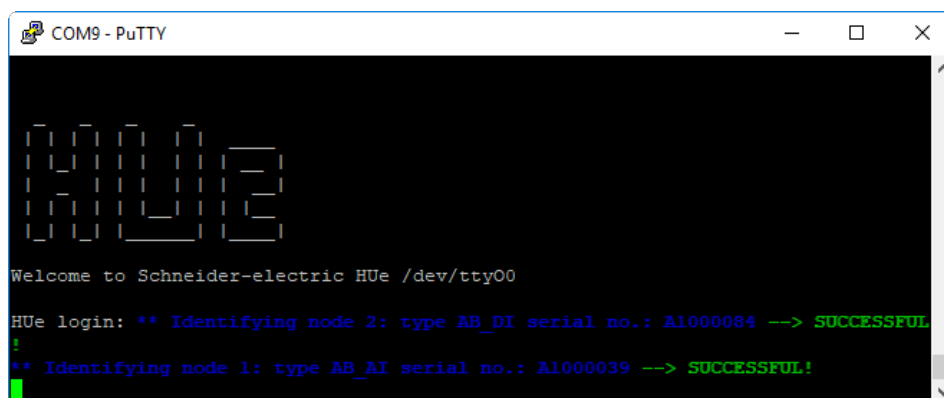
The AAP procedure can be executed both automatically and manually.

Automatic Execution

For a forced execution of the AAP when the ITB is reset, switches 2 and 3 in the HUE must be set to ON (please, see section 0). After resetting the HUE module, an AAP procedure is executed, displaying the information about the modules that are installed and configured.

The figure shown below illustrates an example of the messages generated by the console when AAP procedure is completed:

Figure 35 - Welcome view



In this case, there is an AB_AI module with the address 1 and an AB_DI module with the address 2.

If any of these acquisition blocks which was configured previously with Easergy Builder is not properly addressed (the "SUCCESSFUL!" message is not shown in the console), the module's RUN led DOES NOT flash and the DIO led on HUE module remains lit.

Manual Execution

The user can force the module addressing at any time.

Log into the console with the **Installer** user and in BLMon prompt, execute the "**claqStartAAP**" command to route the acquisition AB and the "**MUX_startAAP**" command for the communication AB.

NOTICE

To execute the AAP procedure, the switch 2 must be set to ON.

If switch 3 is also set to ON, the entire procedure is performed automatically. Otherwise, follow these steps:

- When executing the **claqStartAAP** or **MUX_startAAP** command, the following message appears. Upon the execution, the screen will display each module's information (type, assigned address, and serial number).
- The user will need to verify that all necessary modules are displayed with the text **"SUCCESSFUL!"** next to them.
- To complete the procedure, the user will need to execute the **claqTableAck** command to confirm that the information is correct. In this case, the addressing information is stored permanently. If the information is not correct, then you need to execute the **claqTableNack** command in order to indicate that there was an addressing problem and that the information being displayed must be ignored

NOTICE

Only after executing the claqTableAck command, the information will be recorded permanently.

4.4 Local Acquisition

We consider local acquisition as how the system treats the HUE information received from field devices through acquisition blocks (AB).

This manual describes the configuration of the local acquisition signals in general terms, with no comprehensive information about the configuration of each AB. This chapter explains how information is processed by the CPU once it is received from each module.

For more detailed information about each AB, please refer to the corresponding user manual.

With respect to the ITB architecture, there are two types:

- **Centralized Local Acquisition:** All modules are installed in the same ITB, in which you only have a HUE module (or two if the configuration is redundant). The ITB may have more than one row of modules, but only the first row may have a CPU.
- **Distributed Local Acquisition:** There are several acquisition ITB's reporting information to a single ITB. In this case, the system is configured as if all AB modules are installed in the same physical ITB.

More information in the Saitel DR Platform user manual.

4.5 Treatment of Local Acquisition Signals

The claq Device is responsible for the treatment and configuration of the local acquisition signals in Easergy Builder. This Device is created by default in any configuration of Saitel DR.

For further information about how configuring ITB and how signals are added automatically in coreDb, please refer to Easergy Builder User Manual.

Moreover, you will see how the HUE module processes the information based on the particular signal type.

4.5.1 General-Purpose Digital Inputs

The HUE module integrates 4 digital inputs in the lower part, which are configurable only as simple signals. These signals are useful to inform the operator about the general faults occurred.

The digital inputs 1 and 2 can be used for the following purpose:

- **Digital 1:** It informs the HUE module about the polarization of the digital signals of the AB's installed in the ITB. When the signal is active, the polarization of all digital input is correct. If there are inactive, the HUE module will understand that a problem with the polarization has occurred. To use this signal for this purpose, in coreDb you must configure the Supervision Device's **POL_OK_ABDI** signal.
- **Digital 2:** Depending on its on/off state, the HUE module will understand that the ITB is operating in LOCAL or REMOTE respectively. In LOCAL mode, the command execution will be disabled. To use this signal, in coreDb you must configure the Supervision Device's **LOCALREMOTE** signal.

If you click the graph on the HUE figure, you see that it lights up in green and the 4 general-purpose digital Inputs available in the module are displayed.

For each signal you need to define:

- **Type:** Type of digital input. You can only select DI_ISIM (simple digital input) for these digital signals in the HUE module.
- **Inverse:** It indicates if the signal is inverted (**Y**) or not (**N**).
- **TF (ms):** Filtering time to be used for the digital filtering. Expressed in milliseconds, it can range between 0 and 255.
- **TM (ms*10):** Memory time to be considered for change memory. The indicated value is expressed with 10-ms intervals, and it can range between 0 and 255.
- **NChat and TChat:** They have no effect on these signals and cannot be configured.

For this type of signals, you need to configure "Digital Filtering" and "Change Memory". Both concepts are explained in Saitel DR Platform user manual.

4.5.2 Field Signals

HUE doesn't have field signals but it is in charge of to do the treatment of the information received from AB modules.

HUE execute the following function depending on the type of signal:

- Digital inputs
 - Digital filtering
 - Change memory
 - Settling Time
 - Anti-Chattering
 - Inversion
 - Edge Configuration for Counters
- Digital outputs
 - Pulse time
 - SBO Command Lock

- Analog Inputs
 - Input Range
 - Out-of-Range Detection
 - Digital Filtering
 - Scaling to Engineering Units
 - Cancellation of Values Close to Zero
 - Range Checking
 - Change Threshold
- Analog Outputs
 - Reset Value
 - Maintenance
 - Scaling to Field Values
 - Output range Configuration

Consult Saitel DR user manual for all information about how HUE executes these functions.

4.6 Working with HUE in Easergy Builder

NOTICE

To perform the operations described in this chapter, the user must be familiar with the Easergy Builder tool. Otherwise, please, refer to the tool's user manual.

4.6.1 Creating a RTU Based on HUE


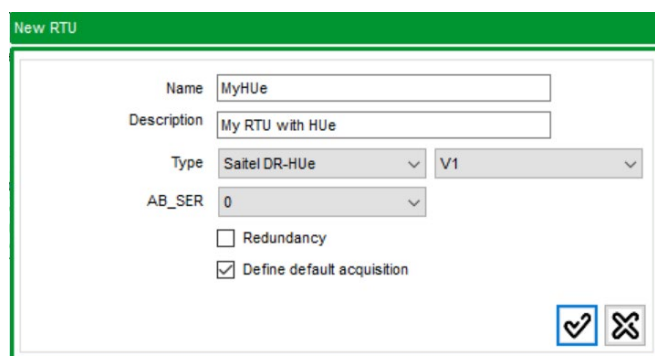
Press button  or right-click on the RTU tree to add a new RTU by entering the required information in following fields:

Figure 36 – New RTU.



- **Name:** RTU's name. The name cannot be longer than 64 characters and it cannot contain the following symbols: \, /, :, *, ?, ", <, > o |. The tree hierarchy will display a RTU identified with that name.
- **Description:** RTU's description. This field is optional and can be 128 characters long.
- **AB_SER:** Number of the communication modules installed in the RTU. These modules are not shown in Easergy Builder, even though its communication channels are available for use.


- **Redundancy:** This field must be checked when the RTU is controlled by two redundant CPU's.
- **Define default acquisition:** If this box is checked, every time a configuration is created for this RTU, you will add a series of default acquisition modules. These selectable modules are specified below.

The previous parameters are assigned as default values in each Configuration created for this RTU.

For example, if you check the “Define default acquisition” box, all the acquisition modules included in this RTU will also be included in its corresponding Configurations. Moreover, the ITB configuration window is displayed where you include the RTU's acquisition block:



Figure 37 – Configuring the ITB



You can also access and change this default configuration by clicking the  button next to the ITB figure.

Build the ITB using the buttons on the upper part of the screen.

You must take the following factors into account:

- The **Addr** field is the number associated to an acquisition block inside the ITB. This number must be unique for each AB and will be used to identify both the AB and its points. The user can change the associated address by selecting the module and using the   buttons. If you select the “**Auto Address**” box, when reordering the modules physically or when modifying the ITB, all addresses are reassigned automatically. The address 1 is assigned to the closest AB to the HUe module. If the “**Automatic Address**” is unchecked, the modules retain the assigned address ignoring the changes made to the ITB.
- The Automatic Addressing Procedure (**AAP**) must be performed every time the ITB structure changes, that is, every time a module is added, deleted or replaced from the ITB. These procedure can be launched both manually, using the Console or Easergy Builder, or automatically by using the switch 3 in the HUe module (more information in section 0 in this manual).

The RTU is ready for creating the different configurations with which you will work later on.

For more information about SOE, please, consult the SOE user manual.

4.6.2 Configuring a Redundant RTU

For a redundant ITB, the following consideration must be considered:


- Field Redundancy must be marked.
- IP CPU A and IP CPU B must be indicated. These IP addresses are used for communications with Easergy Builder.
- In tab Network – CPU A and Network – CPU B, IP addresses for ETH1 and ETH2 for CPU A and CPU B should be indicated.
- In tab Environment Variables A and Environment Variables B, the environment variables to be created in each CPU should be indicated. The environment variable SLOT is mandatory and must be different for each CPU. In CPU A, SLOT must be A and in CPU B, SLOT must be B.

More information about redundant configuration in the Easergy Builder User Manual.


4.6.3 Reading the Configuration from the HU

If the HU module was not built-in from the factory, you might want to read the loaded configuration. Once this configuration is read and loaded in Easergy Builder, you can edit it to make the necessary modifications which will be resent to the CPU with the modifications.

NOTICE

We recommend backing up the original configuration in the RTU in order to restore the CPU to its original state at any time. To back up the security configuration, select the RTU from the tree and generate an EBR file by clicking the  button. This file will include all the settings for that RTU. If you only want to save a copy of the configuration, select the specific configuration from the tree and click the same button. In this case, an EBC file is generated, which only includes the selected configuration.

To load the existing configuration in the HU, it's necessary to follow next steps from the Easergy Builder Workspace.

- In the RTU tree, the RTU to which the new configuration will be associated has to be selected. If there is no configuration, a new one has to be loaded. The HU needs to have configured an IP address so it's possible to communicate with it.
- Once the “Read Configuration” button () is pressed, the user would need to introduce a user and password.
- It's necessary to choose the information to be loaded: “Network”, “Environment Variables” and/or “Configuration”.

In case that “Configuration” has been chosen, it will be necessary to choose a name for it. After that, the configuration would appear available in the RTU tree. If “Environment Variables” and “Network” were selected, the RTU will take the values defined in the HU that is being read.

4.6.4 Create a New Configuration


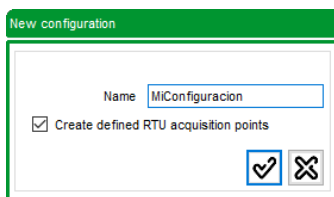
To create a new configuration for the HUe, select the RTU from the tree and right-click it, or click the  button.

Figure 38 – New configuration.



Type the new configuration's name.

If “**Create defined RTU acquisition points**” box is checked, all local acquisition points will be included in coreDb for each acquisition blocks included in the default configuration associated to the RTU.

For example, if a HUe has an associated ITB that includes an AB_DI module, an AB_AI module, and another AB_DO module, after selecting the “Create acquisition points defined in the RTU” field when creating a new configuration, the following points will be created in coreDb:

- 16 digital inputs in Status table.
- 8 analog inputs in Analog table.
- 8 digital outputs in Command table.
- The supervision points of each acquisition block.

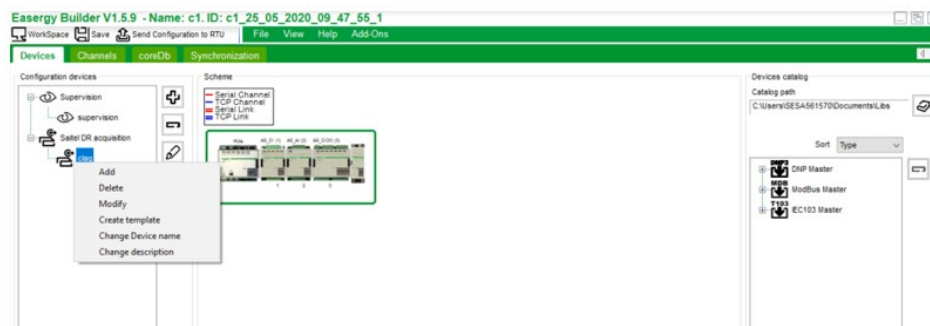
When the operation completes, the new configuration will be listed in the RTU trees. Double-click on it and the Easergy Builder tool enters Configuration mode. Now the new configuration can be edited.

Figure 39 - Configuration mode.



By right-clicking on the configuration name, a contextual menu is displayed:

Figure 40 – Contextual menu for Configuration.



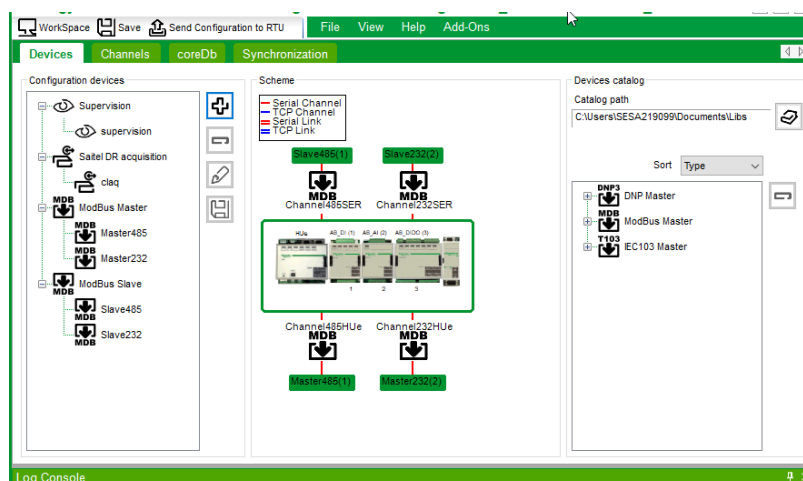
This menu allows:

- Add, remove or modify a configuration.
- Create a template with the information associated to this configuration.
- Change the name or description of the Device (description field allows 128 characters maximum).

4.6.5 Editing the Configuration

The figure below illustrates the Easergy Builder environment when editing for a HUE CPU:

Figure 41 – Editing a configuration.



The user needs to be familiar with the use of Easergy Builder, since this user manual only refers to certain aspects affecting directly the configuration of the HUE module.

4.6.6 Communications

The default configuration does not include any communication Device, since this functionality depends on how the RTU will be used in the system. Communication Devices available for the HUE module are:

- Master and slave IEC101
- Master and slave IEC104
- Master and slave DNP 3.0.
- Master IEC103.
- Master and slave Modbus.
- IEC61850. Client (Editions 1 and 2) and server (Edition 2)

Each Device has a dedicated user manual which detail all configuration parameters.

4.6.7 Configuring HUE Communication Channels

In the Easergy Builder Manual you can find the general operations that are necessary to know to create and edit the communication channels available in the CPU and communications modules.

In Configuration mode, select Channels tab in order to access channel management window.

Figure 42 - Module management window.

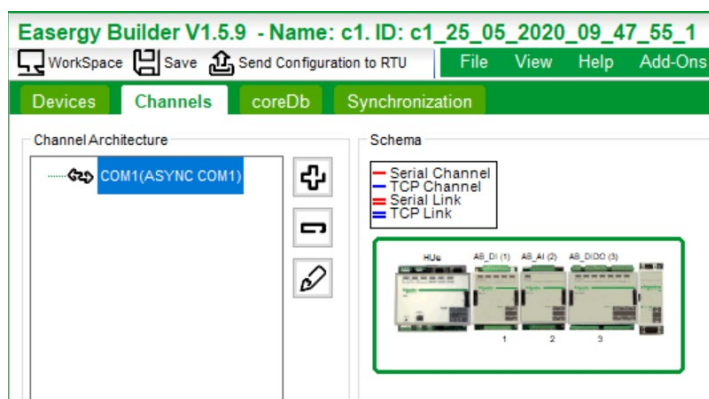
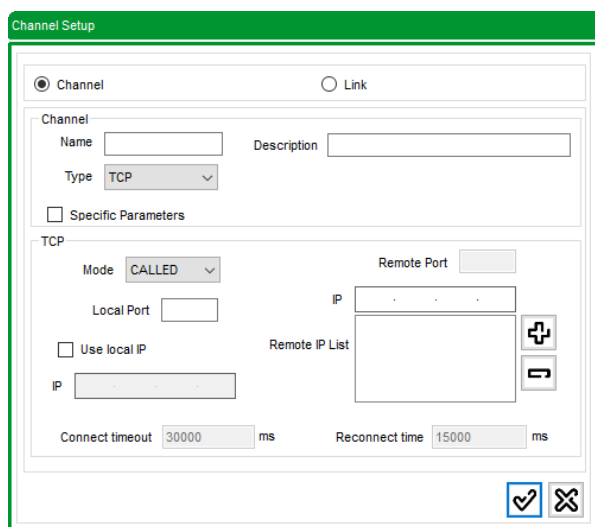


Figure 43 – Channel configuration window.



You can show all configuration channels in tab “Channels” of Easergy Builder.

Once created and loaded in the CPU, you can view and even modify these channels' parameters through webApp.

NOTICE

The CON port cannot be used for communications, and that is why it is not necessary to include it in the channel list.

The communication ports available in HUE are:

- **Ethernet Ports.** You will need to define as channels all the ports you will use for communications. These ports can have channels associated as TCP or UDP.
- Serial ports (ASYNC):
 - COM1 (GPS input).
 - COM2
 - RS-485

Apart from those, depending if you have an AB_SER module, the serial channels for these modules are also listed: AB_SERx-COM1..AB_SERx-COM4, being x the AB_SER module number.

NOTICE

It you set the RTS control to AUTO for a specific channel:

- In COM1 and COM2, the hardware will control RTS and CTS signals. **CAUTION!** If the CTS signal is not received, then there is no transmission.
- For RS-485, the control for the RTS signal and the changes between the transmission and reception modes would be controlled by the hardware **IT IS HIGHLY RECOMMENDED!!**

Please refer to the Easergy Builder manual to obtain further details about how to create and define parameters for communication channels.

4.6.8 Configuring HUE Link Configuration

Some Devices support double channel management. This functionality can be different depending on the protocol in use. A link is the association of two channels; you can also understand it as a double channel.

To configure a channel, in the window displayed above, select "Link" and indicate the two channels that will be associated to create the link; you will also define the operation mode and the link test time:

Figure 44 – Link configuration window.

The screenshot shows the 'Channel Setup' window with the 'Link' tab selected. The window contains the following fields and controls:

- Channel Selection:** Two dropdown menus labeled 'Channel 1' and 'Channel 2'.
- Mode:** A dropdown menu currently set to 'AutoSwitch'.
- Force Switch Time:** A text input field with '0' and a unit 's'.
- Buttons:** A green checkmark button and a red X button at the bottom right.

4.6.9 Synchronization

The factory configuration does not include a defined Synchronization Device. The configuration source is defined in Easergy Builder. webApp only allows changing the configuration once it has been previously defined with Easergy Builder.

For HUE, you can define two synchronization channels: a primary channel and a secondary channel, which will be used when the primary channel is not available.

Figure 45 - Synchronization configuration.

The synchronization sources to be used with HUE are:

- **PROTOCOL:** Time is received through a user-specific protocol. Most telecontrol protocols enable slave devices to be synchronized.
- **SNTP:** The remote unit will operate as a SNTP client; therefore, you will need to indicate the SNTP server's IP address and the synchronization period through that server.
- **IRIG:** The time received from the IRIG device is used to set the system's clock and RTC. The configurable formats are: IRIG-B002, IRIG-B003, IRIG-B006, and IRIG-B007.

NOTICE

If the HUE is configured as IRIG-B server, an AB_SER module with external polarization (M56720000yZZ) must be included in the first row of the ITB. The IRIG-B signal is sent to the client devices through COM ports of this AB_SER.

- **GPS:** GPS35 and GPS16 of Garmin have been validated.
- **PTP:** As indicated in the IEEE-1588 standard, a PTP master will synchronize the accessible slave PTP devices through one or multiple Ethernet interfaces. This functionality for Hue is available in version 11.06.08 and later.
- **Console**, using the commands:
 - **thmShow:** It displays the states of the synchronization devices and the information about current time and date.
 - **thmConsoleSetTime "YY:MM:DD:HH:NN:SS":** It configures the date and time manually.

Moreover, the HUE module can be configured as a Simple Network Time Protocol (SNTP) server, as a master PTP or as an IRIG-B server.

The synchronization module allows the time zone and summer/winter (day light saving) calendars to be configured.

Figure 46 - Time configuration.

The screenshot shows the 'Time Configuration' tab. At the top, there are three tabs: 'Synchronization', 'Synchronization server', and 'Time Configuration'. Below the tabs, there are two dropdowns for 'Local time Zone' with values '+1' and '0'. A checkbox for 'Summer Time' is checked. Below it, 'Start Day/End Day type' has four radio buttons: 'Day/Day', 'Day/Relative Day', 'Relative Day/Day', and 'Relative Day/Relative Day' (which is selected). There is also a 'Custom' option. Below these are two date pickers: 'Relative Start Date' and 'Relative End Date'. Each picker has four dropdowns: 'Month', 'Week Day', 'Hour', and 'Week'. For 'Relative Start Date', the values are '03', 'Sunday', '02', and 'Last'. For 'Relative End Date', the values are '10', 'Sunday', '03', and 'Last'.

For further details about synchronization configuration, please refer to the Easergy Builder user manual.

4.6.9.1 Configuring PTP in HUE

PTP is only available with BOND interfaces.

NOTICE

To configure PTP the RTU must be a Saitel DR-HUE V1.
If PTP is configured then, UDP port type can not be selected.

PTP Client (Precise Time Protocol)

According to IEEE-1588 terminology, when the RTU is synchronized by an external PTP device, the RTU works in "Ordinary Clock" mode (OC). If the RTU is a PTP server, then it works in "Boundary clock" mode (BC).

NOTICE

The RTU can be configured a PTP client or a PTP server, but not both at the same time.

The following information is required:

Figure 47 – Configuring synchronization with a PTP device.

The screenshot shows the 'Primary Device' configuration window. At the top, there is a dropdown for 'Primary Device' set to 'PTP' and a 'Timeout' field set to '30' with a unit 's'. Below this is a 'Port' dropdown set to 'LAN2'. There are several numeric input fields: 'Domain number' (0), 'Announce messages period' (1), 'Max Announce messages lost' (3), 'Delay req period' (1), 'Sync period' (0), and 'Pdelay req period' (0). Each of these fields has a unit '2^n s'. Below these is a 'Delay mode' dropdown set to 'P2P' and a 'Net transport' dropdown set to 'IEEE_802_3'. There is a checkbox for 'Vlan tagging' which is unchecked. At the bottom, there are two numeric input fields: 'ID' (1024) and 'Priority' (1).

- **Port:** Select the physical port for synchronization with the PTP device.
- **domainNumber:** Value of the "domain" attribute of the local clock. The default value is 0.
- **Announce messages period:** Average time interval between "Announce messages". Value in seconds, as a base two logarithm. The default value is 1, that is, 2 seconds.
- **Max. Announce messages lost:** Maximum number of lost messages before considering a time-out in the reception. The default value is 3.

- **Delay req period:** Minimum allowed time interval between "Delay_Req" messages. It is specified, in seconds, as a base two logarithm. The default value is 0, that is, 1 second.
- **Sync period:** Average time interval between synchronization messages. A shorter interval can improve the accuracy of the local clock. It is specified, in seconds, as a base two logarithm. The default value is 0, that is, 1 second.
- **Pdelay req period:** Minimum allowed time interval between "Pdelay_Req" messages. It is specified, in seconds, as a base two logarithm. The default value is 0, that is, 1 second.
- **delay mode:** Delay determination mechanism. The possible values are:
 - P2P. Peer-to-Peer.
- **net transport:** network transport mechanism. Possible values are:
 - IEEE_802_3. IEEE 802.3 network transport
- **vlan tagging:** It selects whether the PTP frames should include their VLAN tagging (IEEE 802.1Q). Only can be select when "Net transport" is IEEE 802.3.
- **ID:** ID of the vlan. From 0 to 4095. It is only available if vlan_tagging is selected.
- **Priority:** Priority of the vlan. From 0 to 7.

PTP Server

Select tabs Synchronization server - PTP and configure the following parameters:

Figure 48 – Configuring the RTU as PTP server.

The screenshot shows the PTP Server configuration window. At the top, there are tabs for Sntp, Irig, and Ptp, with Ptp selected. Below the tabs, there is a checkbox for 'PTP Server' which is checked. The configuration fields include: Port (LAN1), Domain number (0), Clock class (127), Priority 1 (128), Priority 2 (128), Announce messages period (1), Max Announce messages lost (3), Sync period (0), Delay req period (1), Pdelay req period (0), Delay mode (P2P), Net transport (IEEE_802_3), and Vlan tagging (unchecked). At the bottom, there are fields for ID (1024) and Priority (1).

The information for each field is detailed in the previous paragraph but in PTP Server it add:

- **Clock Class:** Denotes the traceability of the time or frequency distributed by the grandmaster clock. Default value is 127.
- **Priority 1:** A configurable designation that a clock belongs to an ordered set of clocks from which a master is selected, through the "Best Master Clock algorithm". Values can range from 0 to 255 (lower values take preference). Default value is 128.
- **Priority 2:** A user configurable designation that provides finer grained ordering among otherwise equivalent clocks. Values can range from 0 to 255 (lower values take preference). Default value is 128.

NOTICE

An RTU cannot be OC (Ordinary clock) and BC at the same time. If it is synchronized by a PTP device, it can't be configured as PTP server.

4.6.10 Using Formulas

coreDb signals can be associated to a series of functions such as: mathematic operations, logical operations or event triggering. All these functions are implemented and controlled by the Formula Device available in Easergy Builder.

In Easergy Builder user manual, you can find all the details about the use of this Device, as well as available functions.

4.6.11 PLC Configuration

The HUE module integrates the use of ISaGRAF®, that is, a logic programming tool working under the IEC 61131-3 environment to develop PLC programs.

ISaGRAF® is a third party tool consisting of two parts:

- **Runtime:** Control and execution environment for logic programs. The licence is included as part of the Baseline Software Platform installed in the HUE module.
- **Workbench:** Development environment. It is installed in a PC, and needs to be purchased for the project, since it requires an additional license that is not included as part of our software platform.

The logic programming languages include:

- **SFC:** Sequential Function Chart
- **FBD:** Function Block Diagram
- **LD:** Ladder Diagram
- **ST:** Structured Text
- **IL:** Instruction List

To let ISaGRAF® interact with coreDb, you need to define a Device of this type in Easergy Builder.

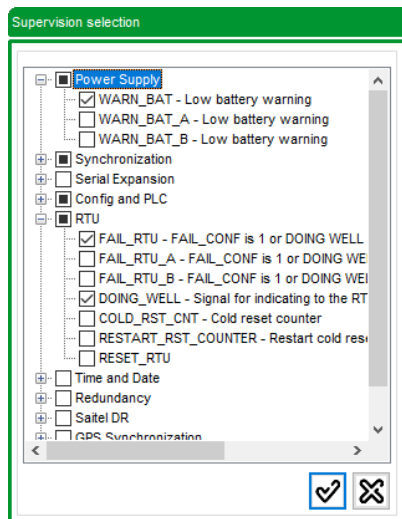
For detailed information about the use of ISaGRAF® inside Saitel, please refer to the Device user manual.

4.6.12 Supervision

The **Supervision** Device is a default Device in Easergy Builder. The Device is used to monitor the status of CPU's components and generates information about other components in the RTU.

You can double click the “Supervision” Device in the tree to see a complete list of all the concepts you can monitor in this type of CPU:

Figure 49 – Supervision signals.



In this window you can check or uncheck the available supervision points to be used for that RTU.

NOTICE

We highly recommend configuring the Supervision; besides, it is essential in redundant configurations. The CPU itself cannot be arbitrated autonomously with the other CPU in redundant systems, so there must be some supervision in charge of this Device.

For redundant configurations, most of the supervision points are also available with “_A” and “_B” suffixes in order to provide CPU-related information. For example, the points PS1_V, PS1_V_A, and PS1_V_B are available for power supply voltage. Regardless which CPU is in online mode, you can know the information about both CPU's.

If points are not available with _A and _B suffixes in a redundant configuration, it means that you only have information about the its value in the online CPU, for example, DOING_WELL.

The information generated by the supervision is complemented with control and diagnostic information that is generated by each Device.

The table below shows the supervision points available for HUE:

Table 13 – Supervision points

Point	Table	Type	Description
COLD_RST_CNT	Status	Source	Cold start-up counter.
COM_CTS			Reserved use. Do not configure.
DAY	Analog	Source	Current day.
DB_UPDATE	Status	Source	1 → The system is redundant and it is configured as “Hot data”. The data has been correctly updated.
DOING_WELL	Status	Destination	1 → The source to which the point is associated is operating properly. If you need do not need to define a source for this point, you must assign the value “1” as the initial value. This signal is generally set with an ISaGRAF® point in order to control that PLC is operating properly.
FAIL_CONF	Status	Source	The value “1” indicates a problem in the configuration.
FAIL_PLC	Status	Source	It is used with ISaGRAF®. 1 → There is no a program in the PLC or the program has been stoped.
FAIL_RTU	Status	Source	1 → The CPU state is anomalous. 0 → There are no configuration errors (FAIL_CONF = 0); the value of DOING_WELL = 1 and all the tasks controlled by the watchdog are working properly. When the value for FAIL_RTU is “0”, pulses for RTS and DTR are generated. If a task doesn't reply to the watchdog, the value for FAIL_RTU will change to 1.
FAIL_SER1 ...FAIL_SER4	Status	Source	1 → There is a problem in the corresponding module (FAIL_SER1 indicates a problem in module 1, and so on). The number of points you can configure will depend on the number of communication modules included in the configuration.

Point	Table	Type	Description
FAIL_SYNC1	Status	Source	1 → Synchronization problem in the main synchronization source.
FAIL_SYNC2	Status	Source	1 → Synchronization problem in the secondary synchronization source.
FAIL_SYNCDESV	Status	Source	1 → There is a delay of at least 3 seconds.
FAIL_SYNCHW	Status	Source	1 → Hardware problem in the synchronization source.
HOURL	Analog	Source	Current hour.
LAQ_FAIL	Status	Source	1 → Problem detected in the local acquisition. At least one acquisition module is out of service or with error.
LINK:LAN1	Status	Source	Link status in LAN1 port.
LINK:LAN2	Status	Source	Link status in LAN2 port.
LINK:MNT	Status	Source	Link status in MNT port.
LOCALREMOTE	Status	Source	Value of Digital signal 2 in HUe. 1 → The system is in local mode (no commands can be executed on the digital signals). 0 → The system is operating in remote mode. This is the usual state of the RTU. (*) See note at the end of the table.
LOCALREMOTE:I	Status	Source	INVERTED value of Digital signal 2 in HUe. 0 → The system is in local mode (no commands can be executed on the digital signals). 1 → The system is operating in remote mode. This is the usual state of the RTU. (*) See note at the end of the table.
MEM_USAGE	Analog	Source	Use of RAM in %.
MINUTE	Analog	Source	Current minute.
MONTH	Analog	Source	Current month.
NODE_A	Status	Source	1 → CPU configured as A (Main).
NODE_B	Status	Source	1 → CPU configured as B (Secondary).
ONLINE	Status	Source	In a redundant system, 1 → CPU is HOT.
PLC_WARNING	Status	Source	It is used with ISaGRAF®. 1 → There are ISaGRAF® points that are not mapped in coreDb.
POL_OK_ABDI	Status	Source	1 → The polarization for digital inputs is correct. 0 → The polarization is not correct or the point has not been defined in coreDb. If the point is not defined in coreDb, then the polarization of digital inputs is not supervised.

Point	Table	Type	Description
RED_I_STATE	Status	Source	LOCAL state of RTU redundancy, that is, the CPU on which the Supervision controller is operating. 1 → The local CPU status is HOT or STANDBY. 0 → The local CPU status is in FAIL status.
RED_IT_FAIL	Status	Source	GENERAL status of the redundancy in the RTU. 1 → The redundant CPU status is in FAIL status. 0 → The redundant CPU status is HOT or STANDBY.
RED_VIA1_FAIL	Status	Source	1 → The main line of the RCAP protocol does not work properly.
RED_VIA2_FAIL	Status	Source	1 → The secondary line of the RCAP protocol does not work properly.
RESET_RTU	Command	Destination	A value higher than 0 launches a command to reset the RTU.
RESTART_RST_COUNTER	Command	Destination	Command that restarts the system reset counter.
SECOND	Analog	Source	Current second.
WARN_BAT	Status	Source	1 → The backup supercapacitor is disconnected.
WDAY	Analog	Source	Day of the week, considering; 0-Sunday, 1-Monday, ..., 6-Saturday)
YEAR	Analog	Source	Current year.

WARNING

(*) Please do not define **LOCALREMOTE** and **LOCALREMOTE:I** simultaneously in coreDb. Otherwise, the behavior would be unpredictable.

4.6.13 Redundancy

You have seen that when you have two redundant CPU's, there are certain differences in the configuration of, for example, environment variables and supervision points. Moreover, you have to define how redundancy will be implemented both in physical terms (control mechanism) and functional terms (data redundancy mode).

The environment variables A and environment variables B table must be correctly configured to indicate which CPU will act as primary and which as redundancy

To do so, you need access the dbRED tab in CoreDb.

NOTICE

The dbRED section is only available in Easergy Builder if you have defined the CPU as redundant.

Control Mechanism

For HUE there is redundancy only through the RCAP protocol (Redundancy Control Asynchronous Protocol). It consists of a redundant channel between the two HUE modules that is switched when required by means of a Schneider Electric proprietary protocol.

To implement this control mechanism, you can configure up to two different channels which are used redundantly to obtain a fault-tolerant redundancy control:

- Through network ports. You need to define the IP addresses for CPU A and CPU B.
- Through a serial channel. You need to indicate the serial port you will use in both CPU's.

Mode

There are two different modes to implement redundancy:

- **Cold redundancy:** The databases in both CPU's are NOT synchronized. When switching, the other CPU will initialize with its own database using default values.
- **Hot redundancy:** You must define a high-speed communication channel (Ethernet) between the two CPU's to keep the database updated in the backup CPU. When switching, the redundant CPU will initialize with updated values.

NOTICE

When using the "Hot redundancy" mode, the names of the points in both databases must be identical, that is, it is very important to use the **SAME** Easergy Builder configuration in both CPU's.

The backup CPU's database is updated when exceptions are thrown (i.e. only the modified points are updated), except for the initialization after which the entire database is updated. The **DB_UPDATE** supervision point allows us to monitor the process.

Additional IP's

You can define a list of IP addresses related to the HOT CPU. These addresses are dynamically associated, so that in redundant systems they can always communicate with the online CPU at the time.

NOTICE

If you define a static IP address and a virtual address for the same device in the same subnet, a warning console message will be displayed to inform about an anomalous situation (sup_redAddIPs: dev xxx ip x.x.x.x subnetMask xxxxxxxx).

The message is an operating system warning, even though it will not cause a malfunction.

PRP (Parallel Redundancy Protocol), **HSR** (Highly-available Seamless Redundancy) and **RSTP** (Rapid Spanning Tree Protocol) protocols allow using two physical ports as a unique logical port, with a same MAC address and IP.

NOTICE

If you define a PRP, HSR or RSTP interface, the associated LAN ports couldn't be defined.

We can configure HUE with PRP, HSR and RSTP protocols:

4.6.13.1 Configuring PRP

This protocol is based on the use of two independent networks at all levels, LAN A and LAN B, and sending the same message at the same time on both networks.

The device must send through each of its two network interfaces, a frame with the same MAC and the same IP through a different port in both networks.

In this case we need to have two switches, one for network A and one for network B. In HUE the network A (LAN(A)) for PRP is always the interfaces labelled LAN2.

Click on “add new interfaces” and select PRP.

Figure 50 – Configuring PRP:

4.6.13.2 Configuring HSR

HSR is a redundancy protocol, like PRP. It is based on a redundancy in the device, a Layer 3 network frame, is converted into 2 identical HSR frames and sent by the 2 ports of the device to a ring topology network, in opposite directions. The devices linked in this ring network are called DANH (Double Attached Node implementing HSR).

One difference from PRP is that there is only one LAN with a mandatory ring topology in the HSR protocol.

Click on “add new interfaces” and select HSR.

Figure 51 – Configuring HSR:

4.6.13.3 Configuring RSTP

This is a second OSI layer network protocol that ensures a loop-free topology for Ethernet networks. RSTP (IEEE 802.1w) is an evolution of STP (Spanning Tree Protocol; IEEE 802.1D).

This protocol monitoring each link state. If an active link goes down, RSTP active the redundant links and reconfigure the network topology.

Click on “add new interfaces” and select RSTP.

Figure 52 - Configuring RSTP:

4.6.13.4 Configuring BOND1

This is a method of combining (joining) two or more network interfaces together into a single interface. It will increase the network throughput, bandwidth and will give redundancy.

If one interface is down or unplugged, the other one will keep the network traffic up and alive.

Click on “add new interfaces” and select BOND1.

Figure 53 – Configuring BOND1:

4.6.14 Local Acquisition Configuration

As mentioned before, the local acquisition Device for Saitel DR is named “**claq**” and it is created by default for each Saitel DR configuration.

Figure 54 - Configuring local acquisition for Saitel DR

For HUE the following types of modules can be configured:

Figure 55 - Available Saitel DR modules in Easergy Builder.

New slave

Name	DI	DO	AI	AO	PT100	FCNT	Paran
AB_DI	16	0	0	0	0	0	0
AB_DO	0	8	0	0	0	0	0
AB_AI	0	0	8	0	0	0	0
AB_AC2							
AB_AC							
AB_MIO	0	0	8	2	2	2	0
AB_AO	0	0	0	4	0	0	0
AB_DIDO	16	8	0	0	0	0	0

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



>

Number

✓

✗

Back in the local acquisition configuration, several options are possible:

-  button, to add a new module.
-  button, to remove a module.
-   buttons, to change the address of the modules.
-  button, to create in coreDb acquisition and diagnostics points for all included modules.

For more information, you can look at the claq in the manual of the different acquisition modules.

4.6.15 General Purpose Digital Inputs

HUE has 4 digital inputs located in the lower left, only configurable as single inputs. These signals are useful to inform the operator about a general problem in the system. All signals can be configured for a general-purpose, but Digital 1 and 2 can be used with the following purpose too:

- **Digital 1:** This signal provides the HU module with information about the digital inputs' polarization status of the ABs installed in the ITB. When the signal is active (1), the polarization of all digital signals is correct. If the signal is disabled (0), the HU will understand that there is a problem with polarization.

In order for the CPU to interpret the value of Digital 1 in this way, the supervision signal **POL OK ABDI** must be included in coreDb.

- Digital 2:** Depending on this signal is active or not, the CPU will understand that the ITB is in LOCAL mode (signal is 1) or in REMOTE mode (signal is 0). In order for the CPU to interpret the value of Digital 2 in this way, the supervision signal **LOCALREMOTE** or **LOCALREMOTE:I** must be included in coreDb.

⚠ WARNING

(*) Please do not define **LOCALREMOTE** and **LOCALREMOTE:I** simultaneously in coreDb. Otherwise, the behavior would be unpredictable.

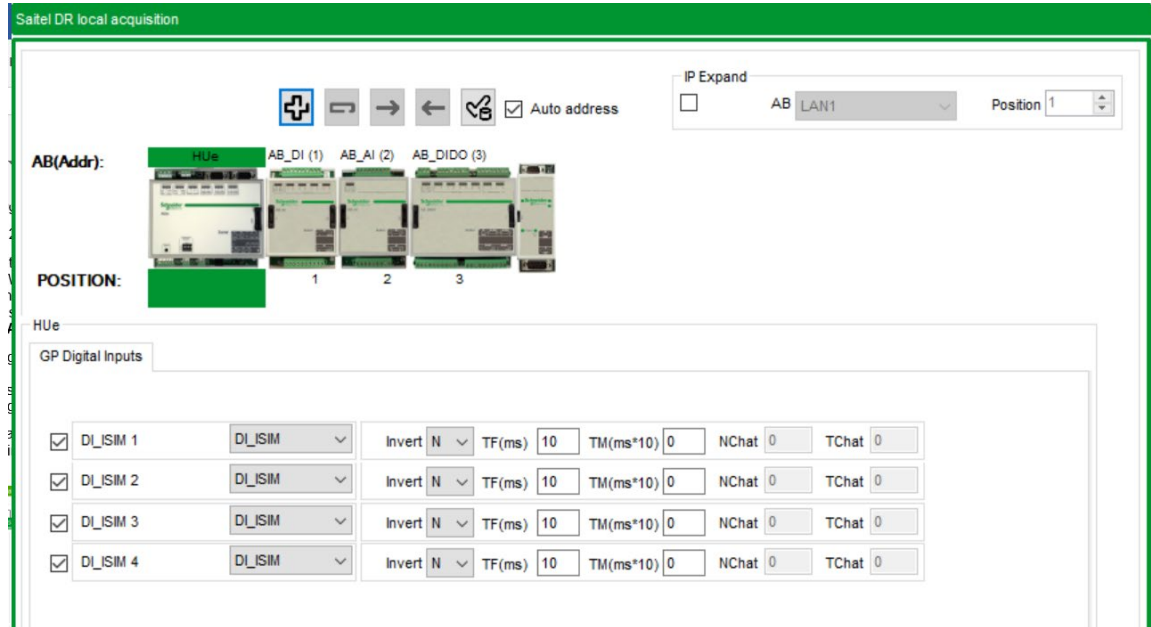
If you define LOCALREMOTE, when Digital 2 is 1 → LOCALREMOTE is 1, the ITB is in LOCAL mode, so the commands are not enabled in the digital output modules. If the Digital 2 signal is 0 → LOCALREMOTE is 0, the ITB is in REMOTE mode, which will be the normal operating state.

If, instead, you create the LOCALREMOTE:i point in CoreDb, this signal inverts the value of Digital 2.

The REMOTE mode is the default mode when neither LOCALREMOTE nor LOCALREMOTE:I are included in coreDb.

To configure these signals, click on claq Device, and select the module HUE on the ITB. The HUE module lights up in green and the 4 general-purpose digital Inputs available in the module are displayed.

Figure 56 - Configure signals Easergy Builder





For each signal you need to define:

- **Type:** Type of digital input. You can only select DI_ISIM (simple digital input) for these digital signals in the HUE module.
- **Invert:** It indicates if the signal is inverted (**Y**) or not (**N**).
- **TF (ms):** Filtering time to be used for the digital filtering. Expressed in milliseconds, it can range between 0 and 255.
- **TM (ms*10):** Memory time to be considered for change memory. The indicated value is expressed with 10-ms intervals, and it can range between 0 and 255.
- **NChat and TChat:** They have no effect on these signals and cannot be configured.

For this type of signals, you need to configure “Digital Filtering” and “Change Memory”. Both concepts are explained in further details below.

4.6.16 Transferring the Configuration to the RTU

To transfer the configuration from Easergy Builder (in the PC) to the CPU, if configuration mode is active, select button  Send Configuration to RTU. If Workspace mode is active select button . Then, you are prompted to confirm the project save operation. Press “Yes” and the log window will display the information about the operation progress.

Finally, reset the RTU and, if no problem occurs, the console will display the information about the initialization progress of operating system and then the application. If everything is correct, the message “CONF OK” should be shown in the console.

5 Advanced Operations

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5.1 Getting Started with HUE

5.1.1 Connection with the Console

You have several options to connect with the HUE console: using a SFTP client (for example, Filezilla), using webApp (HUE web-based tool), or using a USB pen drive connected to the USB Host port.

You need the following:

- An Ethernet cable connected to the CPU's MNT port and PC's Ethernet port. Both need to be connected in the same network. This wired connection is only necessary when transferring the update file through SFTP or webApp. If using a pen drive, it would not be necessary.
- A file with the new Baseline to be installed. It will be a compressed file with a name like "Baseline_11.06.02.tar.gz".

The file's name containing the image must have a specific syntax:

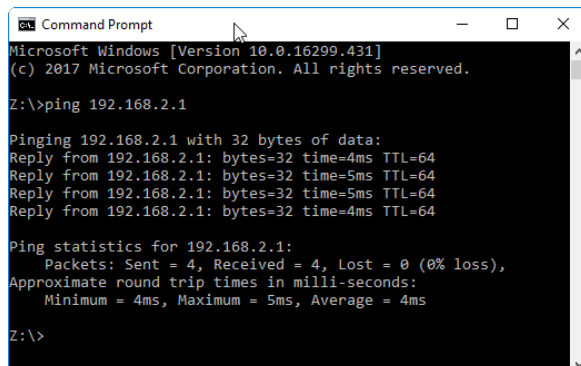
- It must start with "Baseline_", (no case sensitivity).
- It must finish with the ".tar.gz" extension

The following names are valid, for example: BaseLine_11.04.00.tar.gz, Baseline_10.tar.gz, and BASELINE_9.3.0.tar.gz.

5.2 Baseline Update through SFTP

You must install the client SFTP software in our PC to connect to the CPU. This Ethernet cable must be connected to the MNT port. Both the CPU and our PC must be in the same subnet.

You check the connection by using the ping command in a command prompt:



```

Microsoft Windows [Version 10.0.16299.431]
(c) 2017 Microsoft Corporation. All rights reserved.

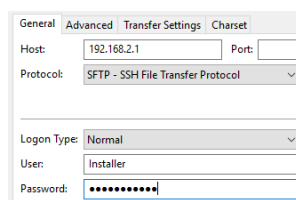
Z:\>ping 192.168.2.1

Pinging 192.168.2.1 with 32 bytes of data:
Reply from 192.168.2.1: bytes=32 time=4ms TTL=64
Reply from 192.168.2.1: bytes=32 time=5ms TTL=64
Reply from 192.168.2.1: bytes=32 time=5ms TTL=64
Reply from 192.168.2.1: bytes=32 time=4ms TTL=64

Ping statistics for 192.168.2.1:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 4ms, Maximum = 5ms, Average = 4ms

Z:\>
  
```

Once the connection is verified, you open the FTP client software and establish connection with the CPU using the **SFTP** protocol and **Installer** (user) and **Installer1!** (password).



General Advanced Transfer Settings Charset

Host: 192.168.2.1 Port:

Protocol: SFTP - SSH File Transfer Protocol

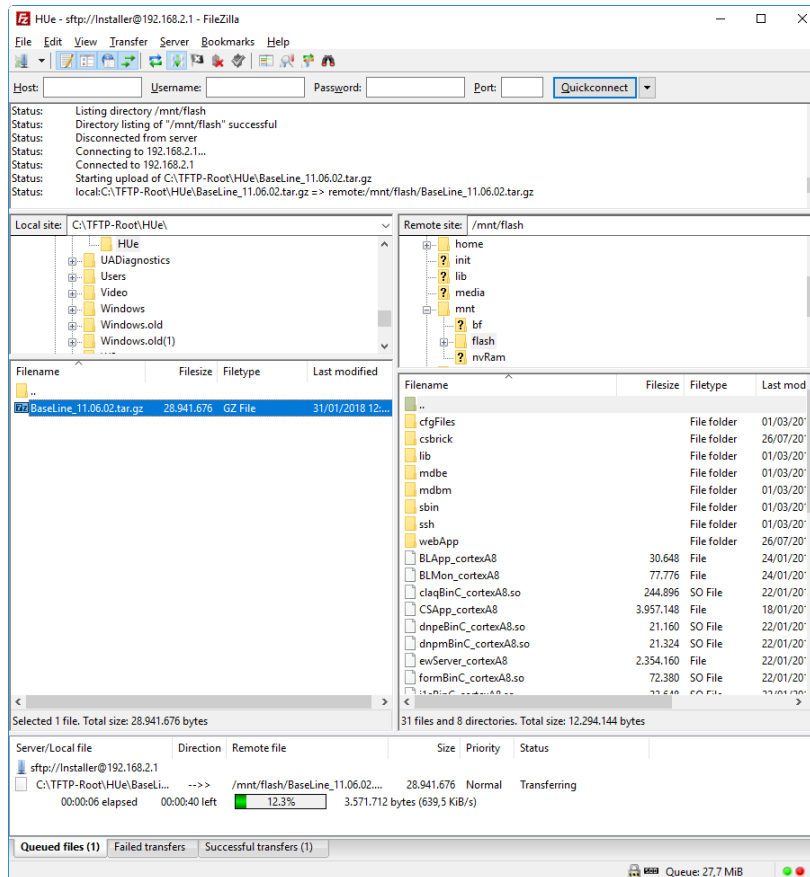
Logon Type: Normal

User: Installer

Password:

When connection is established, you can see the /home folder. You need to change to /mnt/bf or /mnt/flash folder and transfer the Baseline file from our PC.

Figure 57 – SFTP connection.



When loading is completed, press the Reset button on the CPU. If the console is available you can see that when browsing to the Baseline file, the installation is executed directly.

Once installed, the compressed file including the Baseline image is deleted.

Finally, reboot the system and Baseline is updated.

5.3 Baseline Update through USB

If you want to use the USB to upgrade the system, you only need to copy the file to the USB pen drive's root folder, connect the drive to the port and reboot the HUE.

During Linux initialization, the USB drive is installed in /mnt/usb1 and, if the file with a Baseline image is detected, the implementation is executed automatically.

There is a slight difference after the installation with respect to the previous section:

- The target image is not deleted from the /mnt/usb1 device. Therefore, you could use the pen drive to restore the same image in different CPU's.
- Since the /mnt/usb1 image is not deleted, the system does not reboot. Thus, any "auto-installation" of the same image is prevented. We recommend that, after the file's automatic installation from the /mnt/usb1 device, you remove the pen drive and reboot the system manually.

The priority order for the update procedure is:

- File in USB drive
- File in /mnt/bf
- File in /mnt/flash

5.4 Baseline Update through WebApp

If you use a web browser, such as Chrome, you can connect to the web server using the MNT port and indicating its IP address.

NOTICE

Considering that the connection must be secure, you will type “https://192.168.2.1” in the address bar (or the IP address associated to the MNT port).

Figure 58 – webApp.

Log in with the “Installer” user and the webApp main screen appears:

Figure 59 -Web App main screen

Field	Value
Id	RTU1
Description	My RTU
Owner	Schneider Electric
Primary operator	
Secondary operator	

Field	Value
Manufacturer	Schneider Electric
Model	Saitel
Software revision	11.06.04

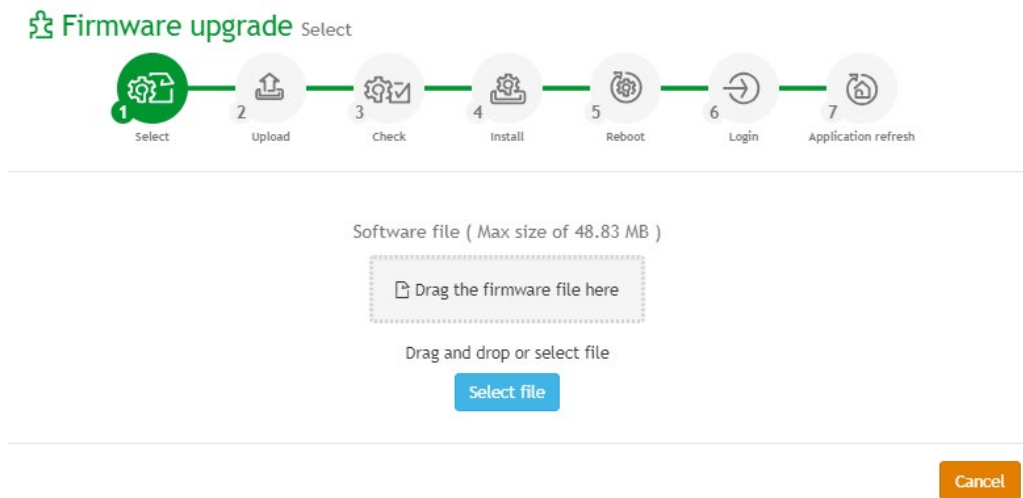
In the lower area, identified with factory information, there is information about the Baseline version you have installed.

To install the update from the main menu, click: **Maintenance → Software**.

You can see the information about the versions of the modules integrated in the Software Platform and “**Install new software**” button.

After clicking, you will see the following screen:

Figure 60 – Firmware upgrade using webApp.



- You can drag and drop the file in the designated area or you can search for it using the “**Select file**” button (Step 1).
- Click the “**Load**” button (Step 2).
- Next, you need to confirm that the software file is correct (Step 3).
- Click the “**Install new firmware**”, and the software file will be sent to the CPU to install the new firmware (Step 4).
- Then, reboot the CPU (Step 5).
- Finally, the user will need to log in again and the CPU will be ready with the new software version.

5.5 AB Software Update

Apart from the software installed in the HUe, both the acquisition blocks and the communication blocks have a software to be updated.

To update the ITB modules’ software you need:

- To have a console connection with HUe.
- To have a correct addressing in all ITB modules (please, see section 4.3).
- Update file for each type of module.

Once Baseline is installed in the HUe module, the /mnt/flash directory will include all the files required to update any of the modules in the ITB. If you have a file with a more recent update for any of the modules, you need to copy the file using the SFTP software in this directory.

NOTICE

To be able to execute the update commands for the ITB modules, you need to use the **Installer** user to log into the console. No other user has permissions to execute these commands.

The table below shows the file you use to update each type of module and the command to be executed by the operator in the console.

Table 14 – Software Update File for ITB Modules.

Module	File	Command	Description
All	*.bin	claqUpgrade all	It updates all the acquisition AB addressed in the ITB. You need to use the adequate file for each block.
Position	<Module type>.bin	claqUpgrade <position>	It updates the acquisition AB with the <position> address, using the adequate file for its type.
AB_DI	AB_DI.bin	claqUpgrade all AB_DI	It updates all the AB_DI modules installed in the ITB.
AB_AI	AB_AI.bin	claqUpgrade all AB_AI	It updates all the AB_AI modules installed in the ITB.
AB_AC	abaca.t00	claqDSPUpgrade all	It updates the DSP in all the AB_AC modules installed in the ITB.
	AB_AC_A.bin	claqUpgrade all AB_AC_A	It updates the firmware in all the AB_AC modules installed in the ITB.
AB_AC/LPVT	abaca2.t00	claqDSPUpgrade all	It updates the DSP in all the AB_AC/LPVT modules installed in the ITB.
	AB_AC2.bin	claqUpgrade all AB_AC2	It updates the firmware in all the AB_AC/LPVT modules installed in the ITB.
AB_DO	AB_DO.bin	claqUpgrade all AB_DO	It updates all the AB_DO modules installed in the ITB.
AB_AO	AB_AO.bin	claqUpgrade all AB_AO	It updates all the AB_AO modules installed in the ITB.
AB_MIO	AB_MIO.bin	claqUpgrade all AB_MIO	It updates all the AB_MIO modules installed in the ITB.
AB_DIDO	AB_DIDO.bin	claqUpgrade all AB_DIDO	It updates all the AB_DIDO modules installed in the ITB.
AB_SER	AB_SER.bin	MUX_upgrade “all”	It updates the firmware in all the AB_SER modules installed in the ITB.
AB_SER	AB_SER.bin	MUX_upgrade “<position>”	It updates the AB_SER module with the <position> address in the ITB.

5.6 Operating System Update (Linux)

NOTICE

Only users with advanced knowledge about the equipment should perform the tasks described in this section.

The operating system update is executed, if required, during Baseline installation, but only if the currently installed version is older than the version to be uploaded.

Finally, reboot the system and the baseline is updated.

NOTICE

You can force the update for the operating system even though their version is older than the version currently installed in the system (downgrade). You need to have a file with the file named “_KFD.tar.gz”.

5.7 Create a bootable SD

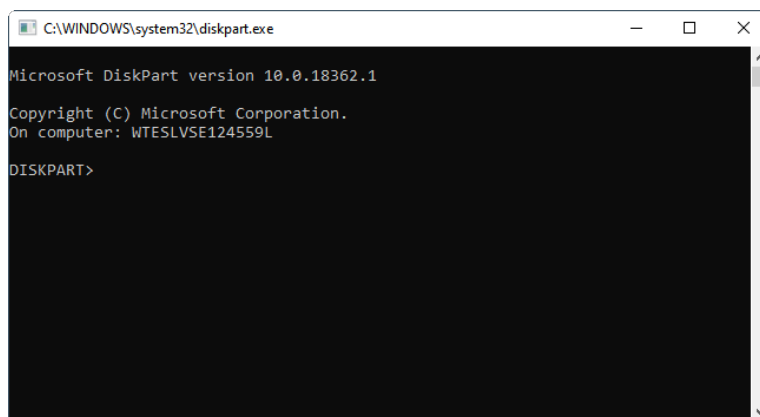
Insert the SD card inside the PC slot, then open a MS-DOS command window.

Figure 61 - MS-DOS command window.



Execute “diskpart” command and a window will be opened asking for application permissions, then write “Yes” to accept them:

Figure 62 - Diskpart application.



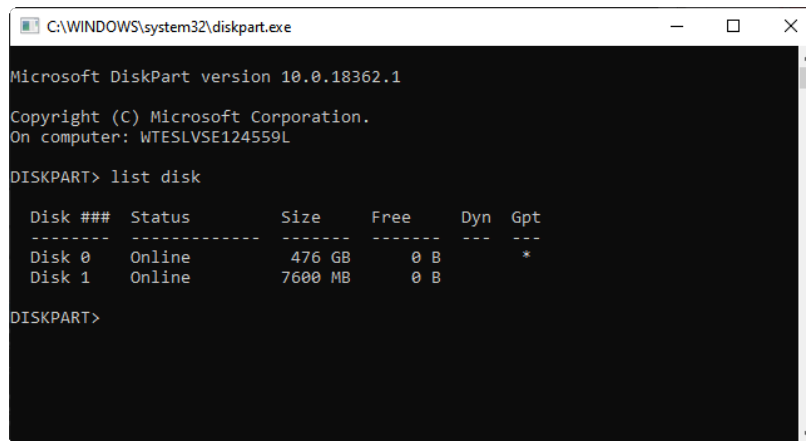
Consulting the disk installed list on the PC, a disk list (internals and externals), a pendrive, if there is any connected, and the SD card will appear.

NOTICE

Please, make sure the SD card is correctly identified as it will be formatted.

To view the list, execute the “list disk” command:

Figure 63 - Disk list.



```

C:\WINDOWS\system32\diskpart.exe

Microsoft DiskPart version 10.0.18362.1

Copyright (C) Microsoft Corporation.
On computer: WTESLVSE124559L

DISKPART> list disk

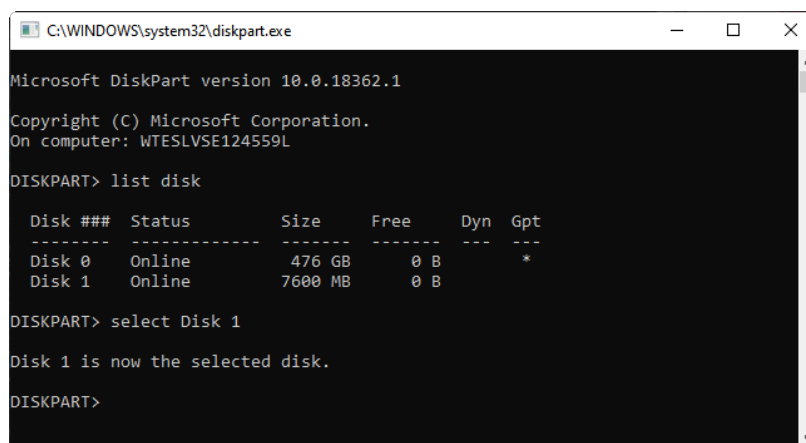
   Disk ###  Status       Size       Free       Dyn  Gpt
   -----  -
   Disk 0    Online        476 GB     0 B           *
   Disk 1    Online       7600 MB     0 B

```

In this case, the SD card is the Disk 1.

Select the SD related disk executing “select Disk x” where “x” is the related disk.

Figure 64 - select the disk to clean.



```

C:\WINDOWS\system32\diskpart.exe

Microsoft DiskPart version 10.0.18362.1

Copyright (C) Microsoft Corporation.
On computer: WTESLVSE124559L

DISKPART> list disk

   Disk ###  Status       Size       Free       Dyn  Gpt
   -----  -
   Disk 0    Online        476 GB     0 B           *
   Disk 1    Online       7600 MB     0 B

DISKPART> select Disk 1

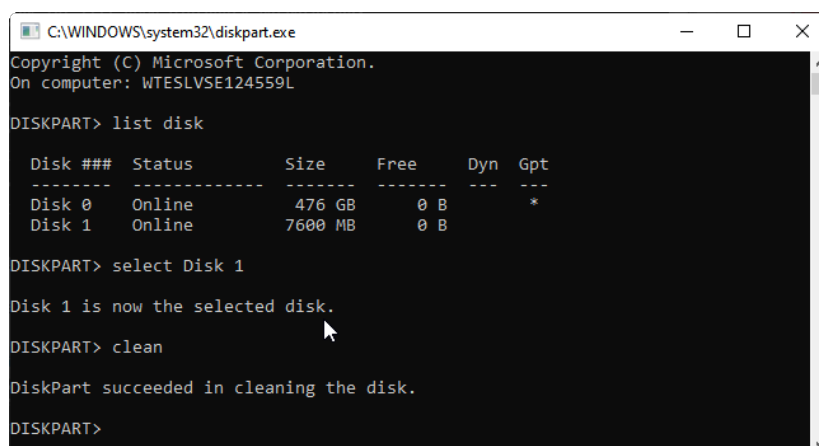
Disk 1 is now the selected disk.

DISKPART>

```

Clean the disk with the command “clean”:

Figure 65 - clean the disk.



```

C:\WINDOWS\system32\diskpart.exe

Copyright (C) Microsoft Corporation.
On computer: WTESLVSE124559L

DISKPART> list disk

   Disk ###  Status       Size       Free       Dyn  Gpt
   -----  -
   Disk 0    Online        476 GB     0 B           *
   Disk 1    Online       7600 MB     0 B

DISKPART> select Disk 1

Disk 1 is now the selected disk.

DISKPART> clean

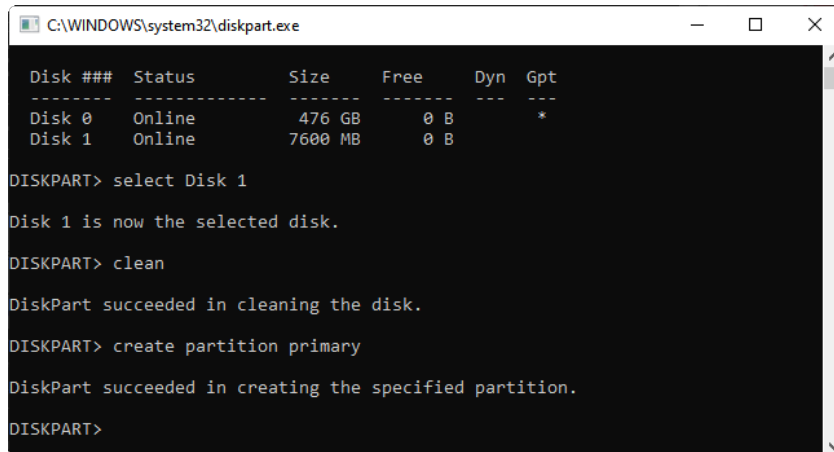
DiskPart succeeded in cleaning the disk.

DISKPART>

```

Then, create a primary partition, this one it is necessary for the startup. To do this, execute the “create partition primary” command:

Figure 66 - Create partition primary.



```
C:\WINDOWS\system32\diskpart.exe

Disk ###  Status       Size       Free       Dyn  Gpt
-----  -
Disk 0    Online      476 GB     0 B
Disk 1    Online      7600 MB    0 B

DISKPART> select Disk 1

Disk 1 is now the selected disk.

DISKPART> clean

DiskPart succeeded in cleaning the disk.

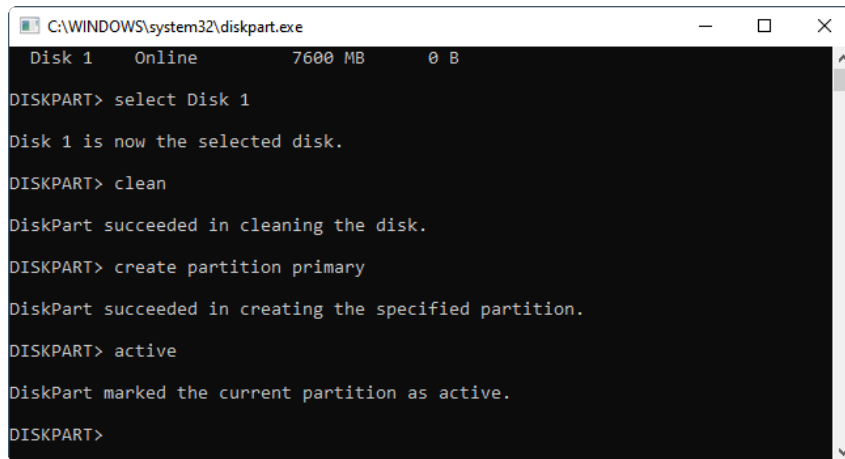
DISKPART> create partition primary

DiskPart succeeded in creating the specified partition.

DISKPART>
```

Activate this new partition with “active” command:

Figure 67 - Activate the partition.



```
C:\WINDOWS\system32\diskpart.exe

Disk 1    Online      7600 MB    0 B

DISKPART> select Disk 1

Disk 1 is now the selected disk.

DISKPART> clean

DiskPart succeeded in cleaning the disk.

DISKPART> create partition primary

DiskPart succeeded in creating the specified partition.

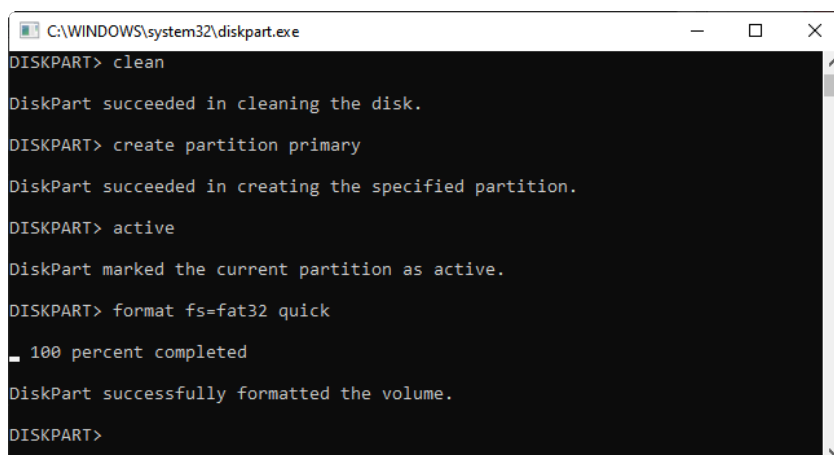
DISKPART> active

DiskPart marked the current partition as active.

DISKPART>
```

Format the unit executing “format fs=fat32 quick” command and wait until finishes:

Figure 68 - Formatting the unit.



```
C:\WINDOWS\system32\diskpart.exe

DISKPART> clean

DiskPart succeeded in cleaning the disk.

DISKPART> create partition primary

DiskPart succeeded in creating the specified partition.

DISKPART> active

DiskPart marked the current partition as active.

DISKPART> format fs=fat32 quick

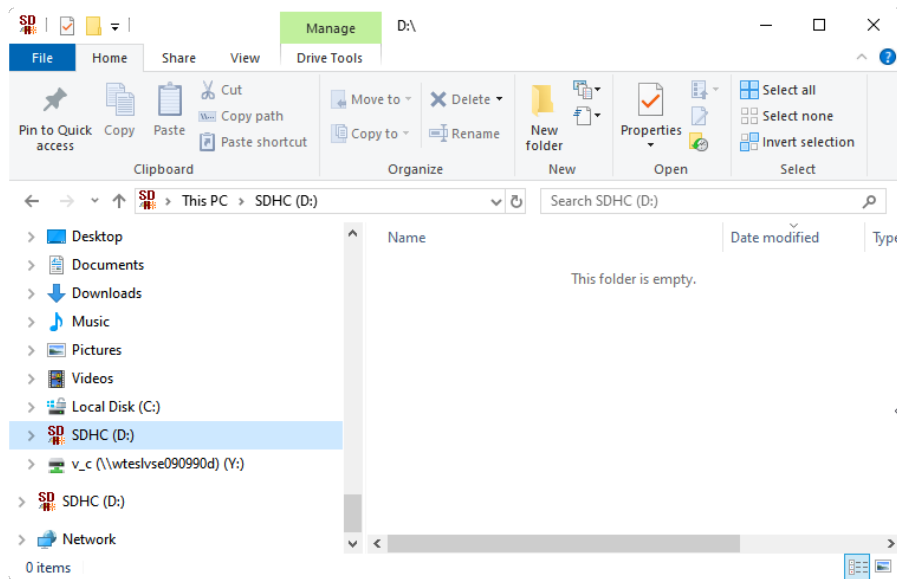
_ 100 percent completed

DiskPart successfully formatted the volume.

DISKPART>
```

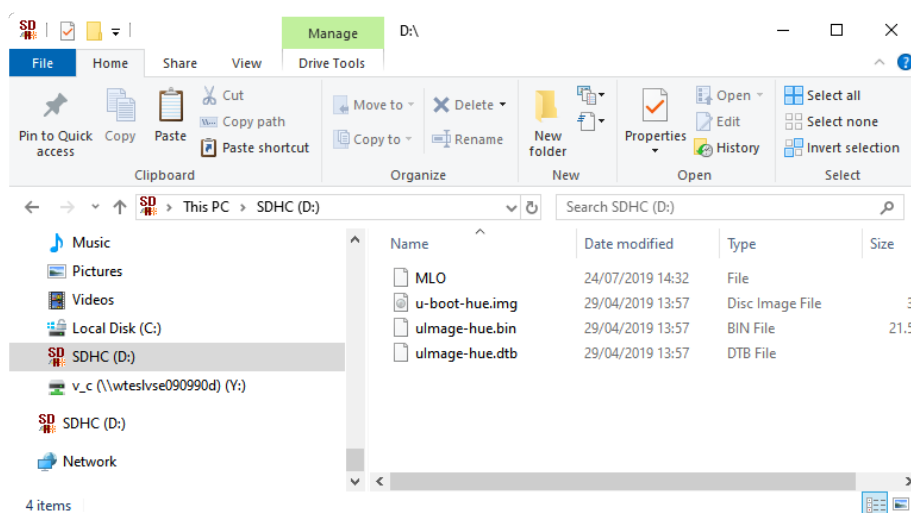
Execute “assign” command to assign a letter to the unit. A window will be opened where you can see the card content:

Figure 69 - Card content.



Now, it is possible to copy the necessary operating system folders. In this case the FOF content folder, sent to factory:

Figure 70 - Files to copy.



These four files, plus the factory baseline and user ones can be find in the following folder:



Ficheros HUe E4.zip

5.8 Booting from bootable SD

To running HUe from SD, it is necessary to follow the steps:

- Insert the SD card.
- Open HUe console command.
- Press, without releasing them, both reset buttons (The big one and the little one).
- Release only the big one.

- Release now the little one and press a key in the command window to view the boot prompt.
- Execute the following commands in order, waiting for them to finish:
 - run flash_MLO
 - run flash_uboot
 - run flash_dtb
 - run flash_kernel

Now it is possible to remove the card and reset the module.

At this moment only the Operating system is installed.

For installing the baseline, use a pendrive following the normal procedure.

NOTICE

It is important to use the factory baseline (file name contains “_F_”), which contains the default IP definition.

5.9 Console Commands

The HUE operating system offers a high-priority command console to help with certain monitoring and diagnostic tasks.

The connection to this console from the PC is established through the CON port. The section 4.1.1 in this manual describes how you can access the command console.

You need to take the following factors into account:

- The use of the command console must be restricted only to **expert operators** in the system.
- The command execution in the console must return a “0” character when outputted. If it returns other values, then there has been a problem in the execution. It is usually caused by parameters with the wrong format.
- When executing a command for any controller, it must be saved into the memory to solve this problem, that is, the controller must be included in the configuration loaded in the CPU from Easergy Builder.

NOTICE

Only the Device controllers included in the current configuration will be loaded into the memory.

Then, the commands available in the console for the Installer user are displayed below. To find out the arguments that a command requires, you have used the following convention:

- **(No parameters)**:The command must be executed directly, with no additional parameter.
- **<XX>**:Required parameter. It must be replaced with the XX value. The symbols <>**MUST NOT** be included.
- **[YY]**:Optional argument. If using the argument, it must be replaced with the YY value. The characters [] **MUST NOT** be included.

5.9.1 BLMon

When accessing the console with the **Installer** user (recommended), the BLMon menu is directly shown. The commands in this menu are executed on the operating system's prompt. Most commands shown below are NOT available for the rest of the users.

```

COM9 - PuTTY

HUE login: Installer
Password:
A new shell has been started pid (3011), ppid (1085)
BLMon:v01.01.04:Jun 21 2018 10:23:14

m- Print this menu
s- Show coreDb state
t- Show thm information
e- Start events monitoring
u- Stop events monitoring
c- Start channel monitoring
o- Stop channel monitoring
l- Start link monitoring
f- Stop link monitoring
a- Show acquisition (claq) help
i- View network settings
p- Show processes
v- Show OS version
b- Show baseline version
h- Help
New console will be used by /dev/tty00 Hello /dev/tty00
opening...OK
HUE>

```

The BLMon menu includes the following commands:

Table 15 - List of BLMon commands

Command	Use
a	<p>It displays the list of the commands available to obtain information about the local acquisition. This chapter includes more information about these commands.</p> <pre> HUE>a ITB Local Acquisition commands: claqSniffOn - Enable bus sniffer. Usage: claqSniffOn <layer>,<filter> claqSniffOff - Disable bus sniffer claqStartAAP - Starts an autoaddressing process claqShow - Show static table claqBusInfo - Show info about incidences in bus claqResetBusInfo - Reset number of incidences in bus claqTableShow - Show the node state list claqShowMod - Show node signals. Usage: claqShowMod <nodeId> claqShowEvents - Show events enabled claqUnShowEvents - Show events disabled claqForceOut - Force digital output. Usage: claqForceOut <entId> <value> claqForceOutNTimes - Force digital output. Usage: claqForceOutNTimes <entId> <times> <interval> claqReboot - Reboot AB module. Usage: claqReboot <nodeId> claqVersion - Show info version from module claqGetMIT - Show MIT info from module claqFileVersion - Show version and compiling date from a file .bin claqUpgrade - Upgrade AB firmware claqDSPUpgrade - Update the DSP firmware version of the AB_AC module claqCheckUpgrade - Check if version firmware AB module to install is older or newer than installed now 10 HUE> </pre>
b	<p>It displays the version of the Baseline software being executed.</p> <pre> HUE>b claqBinC:v10.00.13:Jun 21 2018 10:29:45 coreDb:v10.01.06:Jun 21 2018 10:18:46 chan:v03.00.19:Jun 21 2018 10:18:54 idUtlLib:v10.01.01:Jun 21 2018 10:19:21 libcan:v01.01.01:Jun 21 2018 10:21:02 libsys:v01.02.15:Dec 14 2017 09:50:17 libXML:v01.03.01:Dec 14 2017 11:39:19 mdbeBinC:v10.00.15:Jun 21 2018 10:22:35 mdbe_STD:v10.00.10:Jun 21 2018 10:22:44 mdbmBinC:v10.00.16:Jun 21 2018 10:22:20 mdbm_STD:v10.00.11:Jun 21 2018 10:22:28 supBinC:v10.01.13:Jun 21 2018 10:30:28 libthm:v05.03.18:Jun 21 2018 10:19:09 webServer:v03.03.01:Jun 21 2018 10:30:54 0 </pre> <p>This command is similar to “baselineShowVer”.</p>

Command	Use
e	It starts the monitoring of the system events. All the events occurred will be shown in the console.
c	<p>It starts the monitoring of a communication channel.</p> <pre>HUe>c 1- Canal1 2- Canal2 3- Canal485HUe 4- Canal485SER Select channel number. Hit enter key to go back. SELECT: █</pre> <p>It displays the channels configured selectable by the user. If you press “Enter” instead of a channel number, the command is aborted. This command is similar to “chanSniffOn”.</p>
f	It finishes the monitoring of the communication links. This command is similar to “ chlnSniffOff ”.
h	Using this command, you access detailed information about the system's commands. Apart from BLMon commands, the user has other commands to be executed in the prompt. Type the desired “ FUNCTION_HELP: ” command to view the following information. If you type “ a ”, you will see a list of the commands available.
m	It displays the BLMon menu.
l	It starts the monitoring of a communication link. It is similar to the “c” command but it is for a link (association between two communication channels). This command is similar to “ chlnSniffOn ”.
o	It finishes the supervision of all the channels being monitored. This command is similar to “ chanSniffOff ”.
s	<p>It displays the coreDb and configuration status.</p> <pre>HUe>s (miConfiguracion_11/07/2018 12:29:20_4)CONF OK NO REDUNDANCY, SHARED BUS, REMOTE STATE 0 HUe>█</pre>
t	<p>It displays the information about the configuration and the current synchronization status.</p> <pre>Current date: Fri Mar 16 18:11:13 2018 Active device: CONSOLE Devices configured: ----- Primary device: IRIG-B003 Device is enabled and inactive ----- Default device: CONSOLE Device is enabled and active ----- HUe//mnt/flash>█</pre> <p>This command is similar to “thmShow”.</p>
u	It finishes the monitoring of the system events.
v	<p>It displays the current version of the operating system.</p> <pre>HUe>v Linux HUe 4.9.41-rt23-gc038d21a22 #4 SMP PREEMPT RT Wed Jan 31 07:03:32 CET 2018 armv7l GNU/Linux HUe>█</pre> <p>This command is similar to “version”.</p>

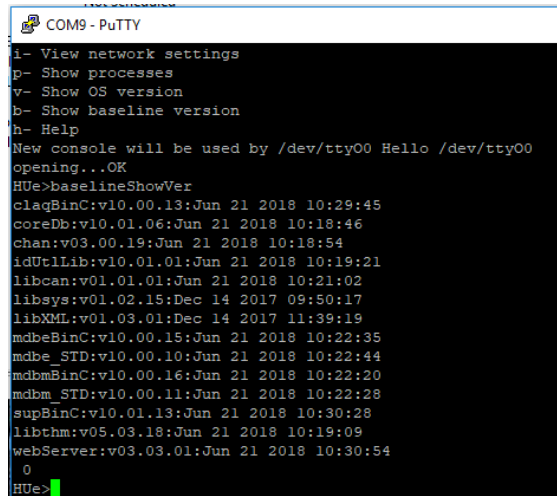
Command	Use
p	<p>It displays the processes being executed.</p> <pre> HUE>p F S UID PID SPID PPID CLS PRI ADDR SZ WCHAN TTY TIME CMD 4 S 0 1 1 0 TS 19 - 341 - ? 00:00:05 init 1 S 0 2 2 0 TS 19 - 0 - ? 00:00:00 kthreadd 1 S 0 3 3 2 TS 19 - 0 - ? 00:00:00 ksoftirqd/0 5 S 0 4 4 2 FF 41 - 0 - ? 00:00:07 ktimersoftd 1 S 0 5 5 2 TS 19 - 0 - ? 00:00:00 kworker/0:0 1 S 0 6 6 2 TS 39 - 0 - ? 00:00:00 kworker/0:0 1 S 0 8 8 2 FF 41 - 0 - ? 00:00:00 rcu_preempt 1 S 0 9 9 2 FF 41 - 0 - ? 00:00:00 rcu_sched 1 S 0 10 10 2 FF 41 - 0 - ? 00:00:00 rcub/0 1 S 0 11 11 2 FF 41 - 0 - ? 00:00:01 rcuc/0 1 S 0 12 12 2 TS 19 - 0 - ? 00:00:00 kswork 1 S 0 13 13 2 FF 139 - 0 - ? 00:00:00 posixcpu_tm 1 S 0 14 14 2 FF 139 - 0 - ? 00:00:00 migration/0 1 S 0 15 15 2 TS 19 - 0 - ? 00:00:00 cpuhp/0 5 S 0 16 16 2 TS 19 - 0 - ? 00:00:00 kdevtmpfs 1 S 0 17 17 2 TS 39 - 0 - ? 00:00:00 netns 1 S 0 18 18 2 FF 90 - 0 - ? 00:00:00 irq/26-44e0 1 S 0 20 20 2 FF 90 - 0 - ? 00:00:00 irq/59-4804 1 S 0 21 21 2 FF 90 - 0 - ? 00:00:00 irq/92-481a 1 S 0 22 22 2 FF 90 - 0 - ? 00:00:00 irq/125-481 1 S 0 23 23 2 TS 19 - 0 - ? 00:00:00 oom_reaper 1 S 0 24 24 2 TS 39 - 0 - ? 00:00:00 writeback 1 S 0 25 25 2 TS 19 - 0 - ? 00:00:00 kcompactd0 1 S 0 26 26 2 TS 39 - 0 - ? 00:00:00 crypto 1 S 0 27 27 2 TS 39 - 0 - ? 00:00:00 bioset 1 S 0 28 28 2 TS 39 - 0 - ? 00:00:00 kblockd 1 S 0 29 29 2 FF 90 - 0 - ? 00:00:00 irq/20-4900 1 S 0 30 30 2 FF 90 - 0 - ? 00:00:00 irq/22-4900 1 S 0 31 31 2 TS 39 - 0 - ? 00:00:00 edac-poller </pre> <p>This command is similar to the operating system's command, "ps -eTcl".</p>

Command	Use								
i	<p>It displays the configuration of all network interfaces.</p> <p>NOTICE!! Please note that the physical name shown for each interface has the following relationship with the Ethernet ports' names:</p> <table> <tr> <th>Port's name (Front label)</th><th>Physical name (Linux)</th></tr> <tr> <td>MNT</td><td>eth2</td></tr> <tr> <td>LAN1</td><td>eth0</td></tr> <tr> <td>LAN2</td><td>eth1</td></tr> </table> <pre> HUE>i eth0 Link encap:Ethernet HWaddr D4:36:39:0C:52:5E inet addr:10.1.1.1 Bcast:10.255.255.255 Mask:255.0.0.0 inet6 addr: fe80::d636:39ff:fe0c:525e%772060/64 Scope:Link UP BROADCAST RUNNING MULTICAST MTU:1500 Metric:1 RX packets:1007 errors:0 dropped:2 overruns:0 frame:0 TX packets:19 errors:0 dropped:0 overruns:0 carrier:0 collisions:0 txqueuelen:1000 RX bytes:86221 (84.2 KiB) TX bytes:3666 (3.5 KiB) eth1 Link encap:Ethernet HWaddr D4:36:39:0C:52:5C inet addr:192.168.1.1 Bcast:192.168.1.255 Mask:255.255.255.0 UP BROADCAST MULTICAST MTU:1500 Metric:1 RX packets:0 errors:0 dropped:0 overruns:0 frame:0 TX packets:0 errors:0 dropped:0 overruns:0 carrier:0 collisions:0 txqueuelen:1000 RX bytes:0 (0.0 B) TX bytes:0 (0.0 B) eth2 Link encap:Ethernet HWaddr 00:10:A1:86:95:11 inet addr:192.168.2.1 Bcast:192.168.2.255 Mask:255.255.255.0 UP BROADCAST MULTICAST MTU:1500 Metric:1 RX packets:0 errors:0 dropped:0 overruns:0 frame:0 TX packets:0 errors:0 dropped:0 overruns:0 carrier:0 collisions:0 txqueuelen:1000 RX bytes:0 (0.0 B) TX bytes:0 (0.0 B) Interrupt:106 lo Link encap:Local Loopback inet addr:127.0.0.1 Mask:255.0.0.0 inet6 addr: ::1%772060/128 Scope:Host UP LOOPBACK RUNNING MTU:65536 Metric:1 RX packets:18 errors:0 dropped:0 overruns:0 frame:0 TX packets:18 errors:0 dropped:0 overruns:0 carrier:0 collisions:0 txqueuelen:1 RX bytes:654 (654.0 B) TX bytes:654 (654.0 B) Kernel IP routing table Destination Gateway Genmask Flags Metric Ref Use Iface 10.0.0.0 * 255.0.0.0 U 0 0 0 eth0 192.168.1.0 * 255.255.255.0 U 0 0 0 eth1 192.168.2.0 * 255.255.255.0 U 0 0 0 eth2 239.255.255.250 * 255.255.255.255 UH 0 0 0 eth0 HUE> </pre> <p>This command is similar to “ifconfig” and “route”.</p>	Port's name (Front label)	Physical name (Linux)	MNT	eth2	LAN1	eth0	LAN2	eth1
Port's name (Front label)	Physical name (Linux)								
MNT	eth2								
LAN1	eth0								
LAN2	eth1								

5.9.2 General Commands

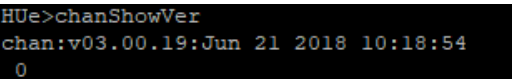
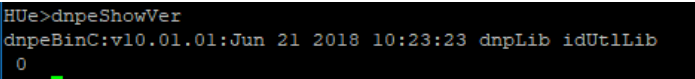
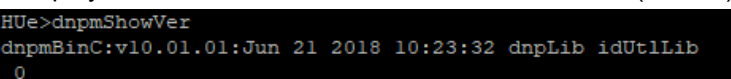
Table 16 - List of general commands

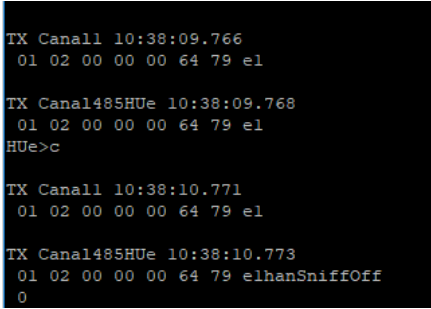
Command	Parameters / Description
coreDbShowEvents	(No parameters) It starts the monitoring of the system events. It is similar to the e of BLMon.
coreDbShowVer	(No parameters) It shows the version of coreDb for the Baseline in the CPU.
coreDbShowState	(No parameters) It displays the coreDb and configuration status. It is similar to the s of BLMon.
coreDbUnShowEvents	(No parameters)

Command	Parameters / Description
	It finishes the monitoring of the system events. It is similar to the u of BLMon.
baselineShowVer	<p>(No parameters)</p> <p>It displays the version of the controllers loaded into the application. Please note that if a controller is not used in the current configuration, it will not be loaded into the memory.</p>  <pre> COM9 - PuTTY i- View network settings p- Show processes v- Show OS version b- Show baseline version h- Help New console will be used by /dev/tty00 Hello /dev/tty00 opening...OK HUe>baselineShowVer claqBinC:v10.00.13:Jun 21 2018 10:29:45 coreDb:v10.01.06:Jun 21 2018 10:18:46 chan:v03.00.19:Jun 21 2018 10:18:54 idUtlLib:v10.01.01:Jun 21 2018 10:19:21 libcan:v01.01.01:Jun 21 2018 10:21:02 libsys:v01.02.15:Dec 14 2017 09:50:17 libXML:v01.03.01:Dec 14 2017 11:39:19 mdbcBinC:v10.00.15:Jun 21 2018 10:22:35 mdbc_STD:v10.00.10:Jun 21 2018 10:22:44 mdbmBinC:v10.00.16:Jun 21 2018 10:22:20 mdbm_STD:v10.00.11:Jun 21 2018 10:22:28 supBinC:v10.01.13:Jun 21 2018 10:30:28 libthm:v05.03.18:Jun 21 2018 10:19:09 webServer:v03.03.01:Jun 21 2018 10:30:54 0 HUe> </pre>

5.9.3 Communications

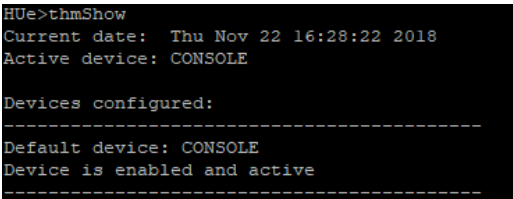
Table 17 - List of communication commands

Command	Parameters / Description
chanShowVer	<p>(No parameters)</p> <p>It displays information about the channel controller.</p>  <pre> HUe>chanShowVer chan:v03.00.19:Jun 21 2018 10:18:54 0 </pre>
chanSniffOff	<p>(No parameters)</p> <p>It deactivates the transparent mode for ALL channels.</p>
dnpeShowVer	<p>(No parameters)</p> <p>It displays information about the controller of the DNP (slave) protocol.</p>  <pre> HUe>dnpeShowVer dnpeBinC:v10.01.01:Jun 21 2018 10:23:23 dnpLib idUtlLib 0 </pre>
dnpmShowVer	<p>(No parameters)</p> <p>It displays information about the controller of the DNP (master) protocol.</p>  <pre> HUe>dnpmShowVer dnpmBinC:v10.01.01:Jun 21 2018 10:23:32 dnpLib idUtlLib 0 </pre>
chInSniffOff	<p>(No parameters)</p> <p>It deactivates the transparent mode for ALL links</p>
chInSniffOn	<p><Link_Name></p> <p>It activates the transparent mode for the specified link. You can use the I command of BLMon to execute this command more easily. Example → chInSniffOn Link1</p> <p>The operation is the same as for chanSniffOn, but for a link instead of a channel.</p>

Command	Parameters / Description
chanSniffOn	<p><Channel_Name></p> <p>It activates the transparent mode for the specified channel. You can use the c command of BLMon to execute this command more easily.</p> <p>Example → chanSniffOn Channel1</p> <p>You can activate this transparent mode for more than one channel at the same time. Each message will indicate the related channel.</p>  <p>For this example, you see messages from channel1 and Channel485HUe.</p>

5.9.4 Monitoring and Synchronization Commands

Table 18 - List of Monitoring and Synchronization Commands

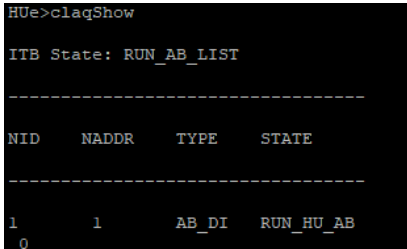
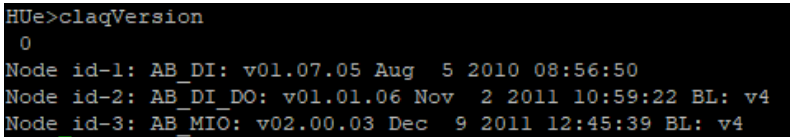
Command	Parameters / Description
supCpuUsage	<p>(No parameters)</p> <p>It shows the instantaneous usage of the CPU.</p>
supShowVer	<p>(No parameters)</p> <p>It displays the software version of the supervision controller (sup) included in the Baseline.</p>
thmConsoleSetTime	<p><AA>:<MM>:<DD>:<HH><mm>:<SS></p> <p>It sets the system date and time.</p> <p><AA>: Year</p> <p><MM>: Month</p> <p><DD>: Day</p> <p><HH>: Hour</p> <p><mm>: Minute</p> <p><SS>: Second</p>
thmShow	<p>(No parameters)</p> <p>It displays the information about the configuration and the current synchronization status. It is similar to the t of BLMon.</p> 
thmShowVer	<p>(No parameters)</p> <p>It displays the software version of the synchronization controller (thm) included in the Baseline.</p>

5.9.5 Local Acquisition Commands

Table 19 - List of Local Acquisition Commands

Command	Parameters / Description
claqSniffOn	<p>[0 1] <Node Address></p> <p>0:Link layer 1:Application Layer</p> <p><Node Address> AB you request information from</p> <p>It displays the communications of the link or application layer in the local acquisition data bus. Only the messages associated to the specified node in the second parameters are displayed.</p> <p>Example of the link message:</p> <pre>HUE>claqSniffOn 0 1 0 HUE> (113.202) RX PLL ADDR=1 TP=1 04 (116.203) RX PLL ADDR=1 TP=1 04 (119.204) RX PLL ADDR=1 TP=1 04 (122.205) RX PLL ADDR=1 TP=1 04</pre>
claqHelp	<p>(No parameters)</p> <p>It displays a brief explanation of the list of commands available to interact with the Local Acquisition Device and how they can be used.</p> <pre>ITB Local Acquisition commands: claqSniffOn - Enable bus sniffer. Usage: claqSniffOn <layer>,<filter> claqSniffOff - Disable bus sniffer claqStartAAP - Starts an autoaddressing process claqShow - Show static table claqBusInfo - Show info about incidences in bus claqResetBusInfo - Reset number of incidences in bus claqTableShow - Show the node state list claqShowMod - Show node signals. Usage: claqShowMod <nodeId> claqShowEvents - Show events enabled claqUnShowEvents - Show events disabled claqForceOut - Force digital output. Usage: claqForceOut <entId> <value> claqForceOutNTimes - Force digital output. Usage: claqForceOutNTimes <entId> <times> <interval> claqReboot - Reboot AB module. Usage: claqReboot <nodeId> claqVersion - Show info version from module claqGetMIT - Show MIT info from module claqFileVersion - Show version and compiling date from a file .bin claqUpgrade - Upgrade AB firmware claqDSPUpgrade - Update the DSP firmware version of the AB_AC module claqCheckUpgrade - Check if version firmware AB module to install is older or newer than installed now</pre>
claqSniffOff	<p>(No parameters)</p> <p>It finishes the local acquisition data bus.</p>
claqStartAAP	<p>(No parameters)</p> <p>It starts the ITB addressing. All module addresses are recalculated.</p> <p>To execute this addressing procedure, the configuration switch 2 must be set to ON.</p> <p>For further information, please refer to section 4.3</p>
claqTableAck	<p>(No parameters)</p> <p>It confirms the information displayed by the claqStartAAP command so that it is stored permanently in the ITB addressing table.</p> <p>For further information, please refer to section 4.3</p>

Command	Parameters / Description								
claqTableNack	(No parameters) It rejects the information displayed by the claqStartAAP command. The ITB addressing table is not updated. For further information, please refer to section 4.3								
claqShowMod	<AB address> It displays the value of all input and diagnostic signals of the module. It does NOT show the value of the output signals. <div>HUE>claqShowMod 1 Module 1 Points: ENTID 1001000000: Val=0x1 ENTID 1001000001: Val=0x0 ENTID 1001000002: Val=0x0 ENTID 1001020000: Val=0 Lq=0x4 ENTID 1001020001: Val=0 Lq=0x4 ENTID 1001020002: Val=0 Lq=0x4 ENTID 1001020003: Val=0 Lq=0x4 ENTID 1001020004: Val=0 Lq=0x4 ENTID 1001020005: Val=0 Lq=0x4 ENTID 1001020006: Val=0 Lq=0x4 ENTID 1001020007: Val=0 Lq=0x4 ENTID 1001020008: Val=0 Lq=0x4 ENTID 1001020009: Val=0 Lq=0x4 ENTID 1001020010: Val=0 Lq=0x4 ENTID 1001020011: Val=0 Lq=0x4 ENTID 1001020012: Val=0 Lq=0x4 ENTID 1001020013: Val=0 Lq=0x4 ENTID 1001020014: Val=0 Lq=0x4 ENTID 1001020015: Val=0 Lq=0x4</div>								
claqTableShow	(No parameters) It shows the ITB addressing table. <div>HUE>claqTableShow AAP Table: <table><thead><tr><th>POSITION</th><th>NADDRESS</th><th>TYPE</th><th>SERIAL NO.</th></tr></thead><tbody><tr><td>1</td><td>1</td><td>AB_DI</td><td>A1000084</td></tr></tbody></table></div>	POSITION	NADDRESS	TYPE	SERIAL NO.	1	1	AB_DI	A1000084
POSITION	NADDRESS	TYPE	SERIAL NO.						
1	1	AB_DI	A1000084						
claqShowEvents	(No parameters) It activates the event monitoring.								
claqUnShowEvents	(No parameters) It deactivates the event monitoring.								
claqForceOut	<Signal's coordinate> <Value> It forces a digital output to a value. Where: <Signal's coordinate>: Local acquisition coordinate of the signal. <Value>: Value to which you want to force the signal.								
claqForceOutNTimes	<Signal's coordinate> <Number> <Time> It forces a digital output a number of times. Where: <Signal's coordinate>: Local acquisition coordinate of the signal. <Number>: Number of times the signal will be forced. <Tiempo>: How often (in ms) the signal will be forced. Maximum: 999 ms.								
claqReboot	<AB address> Reboot an AB. If the command doesn't work, the message " fun_Reboot: Unable to reboot AB module 3 " is shown. It is recommended to wait a few seconds and retry.								
claqResetBusInfo	(No parameters) Set to zero the counter of bus errors.								
claqShowInfoEmerOn	(No parameters) It allows that emergency information is shown.								

Command	Parameters / Description
claqShowInfoEmerOff	(No parameters) It hides that emergency information is shown.
claqShowVer	(No parameters) It displays the software version of the local acquisition controller (claq) included in the Baseline.
claqShow	<p>(No parameters) It shows the status of the ITB and the status of each addressed module.</p>  <pre> HUe>claqShow ITB State: RUN_AB_LIST ----- NID NADDR TYPE STATE ----- 1 1 AB_DI RUN_HU_AB 0 </pre> <p>The ITB can be in any of the following status:</p> <ul style="list-style-type: none"> • BOOT_HU: Initial status after a boot of the ITB. • CHECK_LAQ: Local acquisition wasn't configured. • READY_HU: The information in the addressing table is compatible with the loaded configuration. • RUN_AB_LIST: HUe is asking for information of the status of each AB module. • WAIT_HU_AAP: Error detected in the addressing procedure. Information in the addressing table is not compatible with the loaded configuration. An AAP procedure must be executed. • WAIT_END_AAP: The CPU is waiting for a validation of the addressing table (claqTableAck command). <p>Each AB can be in the following status:</p> <ul style="list-style-type: none"> • START_HU_IDP: The AB needs to be identified by the. An AAP must be executed. • STOP_HU_AB: Problem in the addressing procedure. The AB module didn't answer the request for information from the HU. • VERIFIED_HU_IDP: The AB was addressed correctly and it is waiting for the configuration. • START_HU_AB: The AB was configured correctly and it is waiting for go to the normal work status (RUN_HU_AB). • RUN_HU_AB: Normal work status. It is sharing data with the CPU.
claqVersion	<p>(No parameters) Information about the firmware version installed in each of the AB.</p>  <pre> HUe>claqVersion 0 Node id-1: AB_DI: v01.07.05 Aug 5 2010 08:56:50 Node id-2: AB_DI_DO: v01.01.06 Nov 2 2011 10:59:22 BL: v4 Node id-3: AB_MIO: v02.00.03 Dec 9 2011 12:45:39 BL: v4 </pre>
claqGetMIT	<p><AB address> Information about the tests carried out in the factory. This information includes: Type of module, S/N of the module and boards, P/N of the module and boards, date on which the firmware were downloaded and its version.</p>

Command	Parameters / Description
claqFileVersion	<p><File></p> <p>It shows information about the software version of a file (.bin). The name of the file must include the full path. For example:</p> <pre>HUe>claqFileVersion /mnt/flash/AB_F.bin HUe>VERSION: v01.00.04:Jan 24 2014 10:28:14</pre>
claqDSPUpgrade	<p>[all AB_AC all AB_AC2 <Address>]</p> <p>This command updates the DSP firmware included in the AB_AC and AB_AC_LPVT (AB_AC2) modules. The file ".t00" with the necessary software must be available in folder "/mnt/flash" of the CPU.</p> <p>It can be used as follows: all AB_AC: Update the DSP in all AB_AC modules. all AB_AC2: Update the DSP in all AB_AC_LPVT modules. <Address>: Update the module AB_AC or AB_AC_LPVT with this address. If the module with this address is not an AB_AC or AB_AC_LPVT modules, the following message is shown "Node to flash should be an AB_AC or AB_AC2".</p>
claqUpgrade	<p>[all all <Type of module> <Address>]</p> <p>This command is used to update the software of the AB modules installed in the ITB. The ".bin" file(s) with the necessary software must be available in folder "/mnt/flash". It can be used as follows: all: Update all modules in the ITB (included in the addressing table). all <Type of module>: Update all the ITB modules that are of the indicated type. For example: claqUpgrade all AB_DI. <Address>: Update only the module with this address. For example: claqUpgrade 1.</p> <pre>HUe>claqUpgrade 1 0 Node 1 will be flashed Going into programming mode... HUe> ***** Ready to flash: AB_DI: v01.07.08:Nov 2 2011 10:38:49 Installed now: AB_DI: v01.07.05 Aug 5 2010 08:56:50 INFO: AB module will be upgraded Flashing /mnt/flash/AB_DI.bin in node 1 (23004 bytes) -----0-----25-----50-----75-----100--- --- Flashing --- ----- ---- Transferred! --- Reading --- ----- ---- Verified! ----- Successfully loaded ----- /mnt/flash/AB_DI.bin has been transferred to node 1 23004 bytes in 3.549 seconds ***** AB module with id 1 has been rebooted! Unable to connect to node id 2. Rebooting is not possible. AB module with id 3 has been rebooted! Switching to normal mode ***** ***** UPGRADING MODULES SUMMARY ***** Node 1 has been flashed SUCCESSFULLY ! /mnt/flash/AB_DI.bin, v01.07.08:Nov 2 2011 10:38:49 ***** ** Identifying node 1: type AB_DI serial no.: A1000084 --> SUCCESSFUL! ** Identifying node 3: type AB_MIO serial no.: R1500466 --> SUCCESSFUL!</pre>

Command	Parameters / Description
claqCheckUpgrade	<p>(No parameters)</p> <p>It makes a comparison between the software files in folder "/mnt/flash" (version to install) and the software installed in each module (currently installed). For example:</p> <pre>HUe>claqCheckUpgrade Retrieving module version informationHUe>. Version to install: v01.07.08:Nov 2 2011 10:38:49 Currently installed: AB_DI: v01.07.08 Nov 2 2011 10:38:49. Module not available. Version to install: v02.00.03:Dec 9 2011 12:45:39 Currently installed: AB_MIO: v02.00.03 Dec 9 2011 12:45:39 BL: v4 .</pre> <p>If a module is included in the addressing table, but it is not installed in the ITB, the following message will be displayed: "Module not available".</p>
claqJtag	<p><File></p> <p>Be careful using this command, it can block the AB modules in the ITB!! On this situation, each blocked AB need to be sent to the repair service!!</p> <p>It restores the software of a module when it can not be addressed in the ITB. This command must be used when the claqUpdate command doesn't work and only for users with great knowledge of the system.</p> <p><File>: File's name, including the path. For example:</p> <p style="text-align: center;">claqJtag /mnt/flash/AB_MIO.bin.</p> <p>When this command is executed, the user must BE SURE of:</p> <ul style="list-style-type: none"> • The module has a bootLoader. • Only the AB module to be restored shall must be connected in the ITB. • The File must be the same time of the AB to to be restored. For example, for an AB_MIO module, the file must be AB_MIO.bin

6 Technical Specifications Table

Hardware Specifications

Processing unit	Sitara™ AM3356BZCZD60
	Technology: ARM® Cortex™-A8
	Data bus: 32-bits
	Clock frequency: Up to 720 MHz
External RTC	DS3232 controlled by I2C
RTC accuracy	±2 ppm (0°C to +40°C)
	±3.5 ppm (-40°C to +85°C)
FLASH memory (NOR)	32 MB
FLASH memory (NAND)	256 MB
Static RAM memory	2 MB
Dynamic RAM memory (DDR3)	256 MB
Assurance for static RAM	Integrated supercapacitor
Autonomy in power down	Up to 8 hours (+25 °C)
Consumption	5 W Maximum
Weight	600 g
Dimensions	134 mm x 129 mm x 60 mm
Coating	AVR80 (Depending on P/N)
Protection degree	IP20
Range of temperature	Operation: From -40° C to +70° C (See warning note below)
	Storage: From -40° C to +125° C

⚠ WARNING



According to the standard 60950-1, all electrical safety tests have been done in an environmental temperature range of -40 °C to 60 °C. For higher temperature (> 60 °C), the module must be handled with care, since the metal surface could reach a dangerous temperature for the user.

Interfaces

Power supply (POWER)	Voltage range 24 – 48 VDC (±20%)
	3-pole terminal block
	Wire: 2.5 mm² (13 AWG)
Console port (CON)	Bluetooth connection
	Mini-USB connector
Serial port (RS-485)	RS-485 communications
	3-pole connector, with isolation
	Wire: 1.5 mm² (15 AWG)
Serial port (COM1)	RS-232 communications
	Male DB9 connector, without isolation
	Modem control (full)
	GPS port
Serial port (COM2)	RS-232 communications
	Male DB9 connector, without isolation
	Modem control (only RTS and CTS)
USB port	2.0 (Host)
SD card	Up to 32 GB

Interfaces	
Auxiliary digital inputs (AUX DI)	5-pole terminal block with isolation 4 digital inputs for general purpose
IRIG-B	2-pole terminal block with isolation 1.5 mm ² (15 AWG) Non-modulated TTL 5V Input impedance 600 Ohm
External watchdog (WD)	Maximum capacity of current: 20 mA 2-pole terminal block with isolation 1.5 mm ² (15 AWG)
Ethernet port (MNT)	Fast-Ethernet 10/100BaseT RJ-45 connector
Ethernet ports (LAN1 and LAN2) (Copper)	Fast-Ethernet 10/100BaseT RJ-45 connector
Ethernet ports (LAN1 and LAN2) (Fiber Optic)	Fast-Ethernet 100Base-FX Recommended transceivers for FO: <ul style="list-style-type: none"> • HFBR-57E0PZ (From 0° C to +70° C) • HFBR-57E0APZ (From -40° C to +85° C)
Communication with other modules	Internal bus (power, data, synchronization, ...)
Bluetooth	HCI communication

Software	
Operating System	RTLinux
External synchronization	GPS IRIG-B Protocol Console PTP
IRIG-B	TTL input signal Protocols: IRIG-B002, IRIG-B003, IRIG-B006 and IRIG-B007
Discrimination time for events	1 ms
Watchdog software	Internal
Security control	Cybersecurity brick included Embedded firewall Secured interfaces User management based on a RBAC model

Ordering Options
<div style="text-align: center; margin-bottom: 20px;"> HUe M588 x x 0 0 0 y zz </div> <div style="display: flex; justify-content: space-around; align-items: flex-start;"> <div style="border: 1px solid black; padding: 5px; width: 30%;"> Power (Ax): 2: 24 – 48 V_{DC} </div> <div style="border: 1px solid black; padding: 5px; width: 30%;"> Ethernet Ports (Bx): 1: 3 copper ports 2: 2 fiber optic ports + 1 copper port </div> <div style="border: 1px solid black; padding: 5px; width: 30%;"> Revision: (Revision code) </div> <div style="border: 1px solid black; padding: 5px; width: 30%;"> Coating: 0: Without coating 2: AVR80 coating (by ABchimie) </div> </div>

Cybersecurity	
Based on	IEC62351
	IEC62443
Security Engine	SEC 3.3.2 (XOR acceleration)
Supported cryptographic algorithms	3DES, AES, MD5/SHA, RSA/ECC, & FIPS (determinist generator)
Processing	Single pass encryption and authentication
Security protocols	SSL 3.0, SSL 3.1 / TLS 1.0

CE Mark		
Standards, Directives and harmonized norms.	LVD – Low Voltage Directive	Directive 2014/35/UE
	EMC – Electromagnetic Compatibility	Directive 2014/30/UE
	RoHS 2	Directive 2011/65/EU, according to RD 219/2013
	RED - Radio Equipment	Directive 2014/53/UE according to RD 188/2016
	WEEE – Waste Electrical and Electronic Equipment	Directive 2012/19/UE according to RD 110/2015
Electric Safety	General requirements IEC 60950-1:2005 + CORR:2006 + A1:2009 + A2:2013 EN 60950-1:2006 + A11:2009 + A1:2010 + AC:2011 + A12:2011+ A2:2013 UNE EN 60950-1:2007 + A11:2009 + CORR:2007 + A1:2011 + A12:2011 + AC:2012 + A2:2014	
RoHS	Directive 2011/65/UE	Verification of Lead, Cadmium, Mercury, Chrome and Bromine
Environmental tests	Cold - EN 60068-2-1:2007	-20°C during 16h (100h)
	Dry heat - EN 60068-2-2:2007	+80°C during 16h (100h)
	Damp heat - EN 60068-2-30:2005	25-60°C with 95%RH during 24h

EMC Directive		
Tests according to	EN 60870-2-1 (1996)	
	IEC/TS 61000-6-5 (2015)	
Emission	Radiated emissions EN 55022:2006 + A1:2007	From 30 to 1000 MHz (Class A)
	Conducted emissions EN 55022:2006 + A1:2007	From 0.15 to 30 MHz (Class A)
Immunity	Electrostatic discharges (ESD) EN 61000-4-2:2009	By air ±8 kV and by contact ±6 kV (Level 3)
	Radiated, radio-frequency, electromagnetic field EN 61000-4-3:2006 + A2:2010	From 80 to 2700 MHz (Level 3).
	Fast transients common mode EN 61000-4-4:2012	Power port: ±4 kV, 5kHz. Communications ports: ±4 kV 5kHz and 2.5kHz. I/O ports: ±4 kV 5kHz (Level 4).
	Surges, line to line and line to ground EN 61000-4-5:2006	Power: ±4 kV symmetric and asymmetric (Level 4) Power: ±4 kV, 5kHz. Communications: ±4 kV CM, ±2 kV DM (Level 4). I/O: ±4 kV CM, ±2 kV DM
	RF common mode EN 61000-4-6:1996 + A1:2001	10 V _{RMS} 0.15-80MHz 80% AM (Level 3).
	Power frequency magnetic field EN 61000-4-8:2010.	100 A/m, 1000 A/m 3s (Level 4).
	Power frequency common mode disturbances EN 61000-4-16:1998	30V 50Hz, 300V 50Hz 1s (Level 4).
	Damped Oscillatory wave EN 61000-4-18:2007 + A1:2010	Power, Communications and I/O: 1kV DM, 2.5kV CM (Level 4), (f=1MHz)

RED Directive (EMC)		
Tests according to	Common Requirements Draft ETSI EN 301 489-1 V2.2.0 (2017-03)	
	General conditions for broadband systems Draft ETSI EN 301 489-17 V3.2.0 (2017-03)	
Emission	Radiated Emission. EN 55032 (2015) / AC (2016-07)	From 30 to 6000 MHz (Class A)
	Conducted Emission on power leads EN 55032 (2015) / AC (2016)	From 0.15 to 30 MHz (Class A)
Immunity	Radiated RF electromagnetic field EN 61000-4-3 (2006) / A1 (2008) / A2 (2010)	From 80 to 6000 MHz (Level 3).
	Conducted disturbances, induced by RF fields EN 61000-4-6 (2014)	0.15-80MHz 80% AM (Level 3).
	Electrical fast transients / Burst EN 61000-4-4 (2012)	Power port: ± 0.5 kV, 5kHz. Communications ports: ± 0.5 kV 5kHz
	Surge EN 61000-4-5 (2014)	Communication: ± 0.5 kV, ± 1 kV (symmetrical) Communication: ± 0.5 kV, ± 1 kV, ± 2 kV (asymmetrical)
External device	Electrostatic discharge EN 61000-4-2 (2009)	By air ± 8 kV and by contact ± 4 kV
	RF Tests according to EN 300 328 V2.1.1	Texas Instruments' CC2564 Bluetooth module (model CC2564MODA) has been used. Based on its Declaration of Conformity, this module has been designed to the required standard.

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Glossary

A

A: Ampere.

AAP: Automatic Addressing Procedure.

AB: Saitel DR Acquisition Block.

AB_AC: Direct measurements Acquisition Block.

AB_AI: Analog Inputs Acquisition Block.

AB_AO: Analog Outputs Acquisition Block.

AB_DI: Digital Inputs Acquisition Block.

AB_DIDO: Digital Inputs and Outputs Acquisition Blocks.

AB_DO: Digital Outputs Acquisition Blocks.

AB_MIO: Multiple Inputs and Outputs Acquisition Block.

AB_SER: Communication module for expansion.

AC: Alternate Current.

AI: Analog Input.

AO: Analog Output.

AWG: American Wire Gauge.

B

Bps: Bits per second.

C

°C: Celsius degree.

COM: Communication port.

CPU: Central Processing Unit.

CTS: Clear to Send.

D

DC: Direct Current.

DI: Digital Input.

DIN: Deutsches Institut für Normung.

DO: Digital Output.

DRAM: Dynamic Random Access Memory.

E

EMC: ElectroMagnetic Compatibility.

EPROM: Erasable Programmable Read Only Memory

F

FTP: File Transfer Protocol.

G

g: Gram.

GPS: Global Positioning System.

H

HU: Head Unit. Saitel DR CPU.

HU_A: Saitel DR Advanced Head Unit.

HU_AF: Saitel DR Advanced Head Unit with acquisition.

HU_B: Saitel DR Basic Head Unit.

HUe: Saitel DR High-Performance Head Unit.

Hz: Hertz.

I

IED: Intelligent Electronic Device.

I/O: Input / Output.

IRIG: Inter Range Instrumentation Group.

IRIG-B: Mode B of the standard IRIG.

ISO 9001: International standard for Quality Systems.

ITB: Intelligent Terminal Block.

K

KB: Kilobyte.

kHz: Kilohertz.

L

LAN: Local Area Network.

LED: Light Emitting Diode.

M

mA: Milliampere.

MHz: Megahertz.

MB: Megabyte.

Mbps: Megabits per second.

m: Meter.

mm: Millimeter.

ms: Millisecond.

N

N/A: Non-Application.

P

PC: Personal Computer.

PPS: Pulses per Second.

PS: Power Supply.

PWR: Power.

R

RAM: Random Access Memory.

RS-232: Communication standard.

RS-485: Multipoint differential Bus.

RTDB: Real Time DataBase.

RTS: Request To Send.

RTU: Remote Terminal Unit.

Rx: Reception

S

s: Second.

SCADA: Supervisory Control And Data Acquisition.

SFTP: Secure File Transfer Protocol.

SNTP: Simple Network Time Protocol.

SRAM: Static Random Access Memory.

SSH: Secure SHell.

T

TCP/IP: Transmission Control Protocol/Internet Protocol.

TU: Terminal Unit.

Tx: Transmission.

V

VAC: Volt of Alternate Current.

VDC: Volt of Direct Current.

W

W: Watt.

X

XU: Expansion Unit.



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