SIEMENS

SIMATIC

IO-Link system

Function Manual

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⚠ WARNING
indicates that death or severe personal injury **may** result if proper precautions are not taken.

⚠ CAUTION
indicates that minor personal injury can result if proper precautions are not taken.

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We have reviewed the contents of this publication to ensure consistency with the hardware and software described. Since variance cannot be precluded entirely, we cannot guarantee full consistency. However, the information in this publication is reviewed regularly and any necessary corrections are included in subsequent editions.

Introduction

Purpose of the documentation

This function manual provides a general overview of the IO-Link communication system. It shows the interaction of the various components of an IO-Link system and will help you improve your general understanding of IO-Link.

Basic knowledge required

The following knowledge is required in order to understand the documentation:
- General knowledge of automation technology
- Knowledge of the industrial automation system SIMATIC
- Proficiency with STEP 7

Scope of the documentation

This documentation is the basic documentation for IO-Link systems at Siemens. The product documentation is based on this documentation.

Conventions

In this documentation, "STEP 7" is used as a synonym for all versions of the configuration and programming software "STEP 7 (TIA Portal)".

Please also observe notes marked as follows:

NOTE

A note contains important information on the product described in the documentation, on the handling of the product or on the section of the documentation to which particular attention should be paid.

Additional support

- Information about Technical Support is available in section Siemens Industry Online Support (Page 5).
- The range of technical documentation for the individual SIMATIC products and systems can be found on the Internet (https://support.automation.siemens.com/WW/view/en/58649293).
- Information about the online catalog and online order system is available in section SiePortal (Page 5).

Guide

Documentation

Various IO-Link products are available from Siemens. Each of these products has a separate documentation. The IO-Link products are embedded in systems, e.g. ET 200SP. The documentation for the system consists of the respective system manual, function manuals and manuals. In addition, the STEP 7 online help and the Port Configuration Tool S7-PCT online help assist you in configuring and programming your automation system with IO-Link.

IO-Link components from Siemens

Siemens offers a wide range of products and support for IO-Link:

- Master
- Device, I/O modules
- Device, industrial switchgear
- Device, RFID systems (RFID = radio-frequency identification)
- Device, process instrumentation
- Device, signaling columns
- Device, power supplies
- Port Configuration Tool - S7-PCT (https://support.industry.siemens.com/cs/ww/en/view/32469496)
- IO-Link library (https://support.industry.siemens.com/cs/ww/en/view/82981502) with the blocks "LIOLink_Master" and "LIOLink_Device"
- Overview of the topic IO-Link (http://www.siemens.com/io-link)
- IT connection of IO-Link devices via OPC UA with the Field Data Enabler PN

Additional information on the products can be found on the Internet (https://support.industry.siemens.com/cs/ww/en/view/109737170).

Additional documentation for IO-Link

You can find a free download of the latest documentation on the IO-Link products on the Internet (https://support.industry.siemens.com/cs/CN/en/ps/15818/man).

Siemens Industry Online Support

You can find current information on the following topics quickly and easily here:

- **Product support**

  All the information and extensive know-how on your product, technical specifications, FAQs, certificates, downloads, and manuals.

- **Application examples**

  Tools and examples to solve your automation tasks – as well as function blocks, performance information and videos.

- **Services**

  Information about Industry Services, Field Services, Technical Support, spare parts and training offers.

- **Forums**

  For answers and solutions concerning automation technology.

- **mySupport**

  Your personal working area in Industry Online Support for messages, support queries, and configurable documents.

This information is provided by the Siemens Industry Online Support in the Internet (http://www.siemens.com/automation/service&support).

SiePortal

SiePortal is the catalog and ordering system of Siemens AG for automation and drive solutions on the basis of Totally Integrated Automation (TIA) and Totally Integrated Power (TIP).
You can find catalogs for all automation and drive products on the Internet (https://mall.industry.siemens.com).

Open-source software

Open-source software is used in the firmware of the SIMATIC Drive Controller. The open-source software is provided free of charge. We are liable for the product described, including the open-source software contained in it, pursuant to the conditions applicable to the product. Siemens accepts no liability for the use of the open-source software over and above the program sequence intended for our product, or for any faults caused by modifications to the software.
For legal reasons, we are obliged to publish the original text of the license conditions and copyright notices.
You will find these on the Internet with the firmware downloads

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System overview

<div style="text-align: right;">**1**</div>

Introduction

A continuous communication down to the lowest field level ensures enhanced use of the functions and performance capability of sensors and actuators. Enhanced use of sensors and actuators allows you to operate your machines and plants more productively.

No data other than the actual process value can be exchanged via the standard interfaces (digital, analog) used at the sensor/actuator level. Sensors and actuators with integrated intelligence are now used for increasingly complex functions and require a communication interface tailored to these requirements.

Definition

IO-Link is an innovative, point-to-point communication interface for the sensor/actuator area that is specified in IEC 61131-9.

IO-Link consists of the following system components:

- IO-Link master
- IO-Link device and device-specific description files (IODD)
- Unshielded 3-wire or 5-wire standard cable
- Engineering tool for configuring and assigning parameters of IO-Link

1.1 Advantages of IO-Link

The IO-Link system offers significant advantages as digital interface when connecting sensors/actuators:

- Open standard in accordance with IEC 61131-9
  - Devices can be integrated in the same way in all conventional fieldbus systems and automation systems
- Tool supported parameter setting and central data management
  - Fast configuration and commissioning
  - Simple creation of current plant documentation even for sensors/actuators
- Single, uniform wiring and far fewer different interfaces at the sensors/actors
  - Standardized, uniform interface for sensors and actuators independent of their complexity (switching, measuring, multi-channel, binary, mixed signals, etc.)
  - Reduction in the variety of types and inventory
  - Fast commissioning
  - Any combination of IO-Link devices and sensors/actuators without IO-Link at IO-Link master
- Continuous communication between sensors/actuators and the CPU
  - Access to all process data, diagnostic data and device information
  - Access to device-specific data, such as energy data
  - Remote diagnostics can be performed

- Continuous diagnostic information down to sensor/actuator level
  - Reduction in troubleshooting effort
  - Minimizing risk of failure
  - Preventive maintenance and optimization of service and maintenance planning
- Dynamic change of sensor/actuators parameters by the controller or the operator at the HMI
  - Reduction in downtimes during product change
  - Increased variability of the machine
- Automatic reassignment of parameters when devices are replaced during operation
  - Minimization of downtimes
  - Device replacement by untrained personnel without additional aids
  - Avoidance of incorrect settings
- Integrated device identification
  - Identification of the installed devices
  - Ensure quality of result in production and manufacturing when replacing the device

1.2 Overview of IO-Link system

Components

A Siemens IO-Link system consists of the following components:

- IO-Link master
- IO-Link device, for example:
  - Sensors/actuators
  - RFID readers
  - I/O modules
  - Signaling columns
  - ...
- Unshielded 3-wire or 5-wire standard cables
- Engineering tool for configuring and assigning parameters of IO-Link
- IT connection via OPC UA

Example plant with IO-Link

The figure below shows an example of plant architecture with IO-Link.
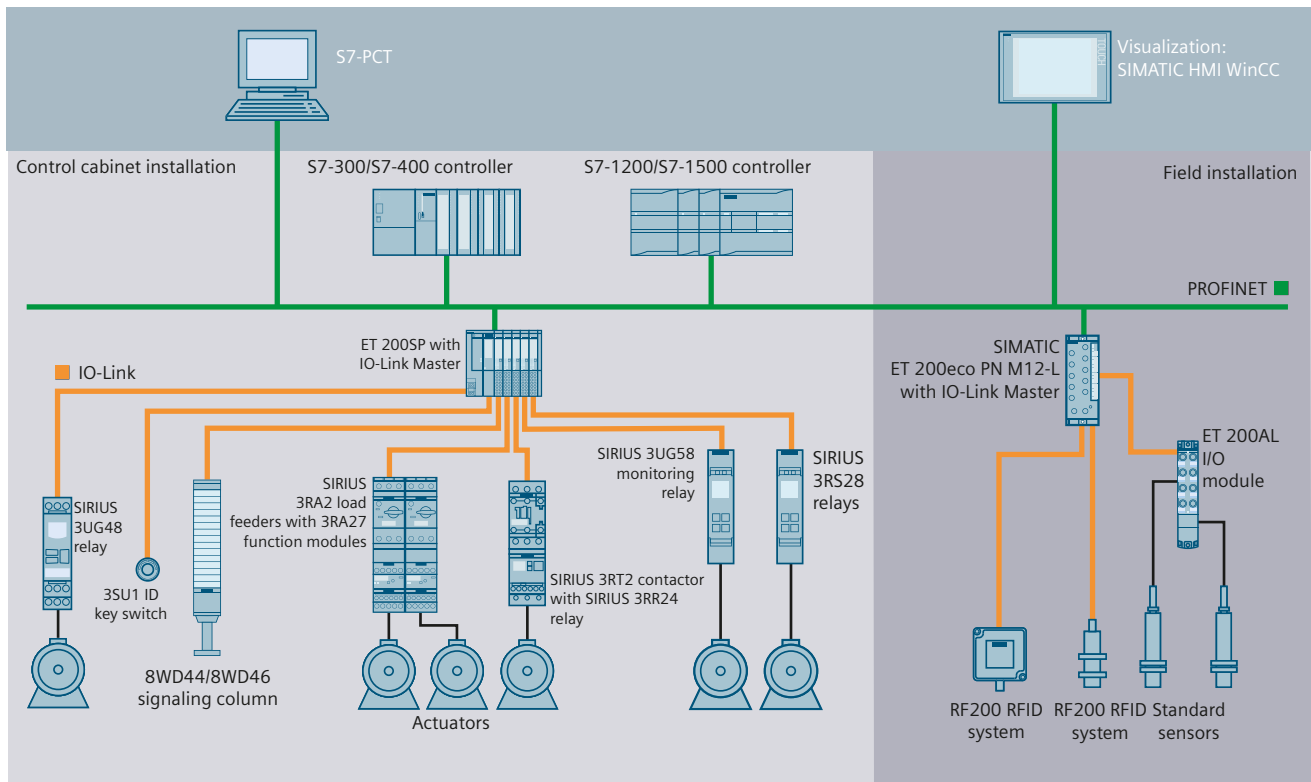

Figure 1-1 Plant architecture with IO-Link

The IO-Link master establishes the connection between the IO-Link devices and the automation system. If the IO-Link master is a component of the I/O system, it is installed either in the control cabinet or directly in the field as remote I/O in degree of protection IP65/67/69K. The IO-Link master communicates by means of various fieldbuses or product-specific backplane buses. An IO-Link master can have multiple IO-Link ports (channels). An IO-Link device can be connected (point-to-point communication) to each port.

Engineering

The IO-Link system is engineered parallel to the overall automation system and can be embedded in it and intermeshed with it.

1.3   IO-Link interface

Introduction

The IO-Link is a serial, bidirectional point-to-point connection for signal transmission and power distribution under any network, fieldbus or backplane bus.

Connection system in IP65/67/69K

M12 connectors and other connectors are defined for the connection system in IP65/67/69K; sensors have a 4-pin connector, actuators a 5-pin connector. IO-Link masters are always equipped with a 5-pin M12 socket.

The pin assignment according to IEC 60974-5-2 is specified as follows:

- Pin 1: 24 V
- Pin 3: 0 V
- Pin 4: Switching and communication cable (C/Q)

In addition to IO Link communication, these three pins also implement the power supply of the device.

Detailed information about the power supply can be found in the documentation of the utilized IO-Link master.
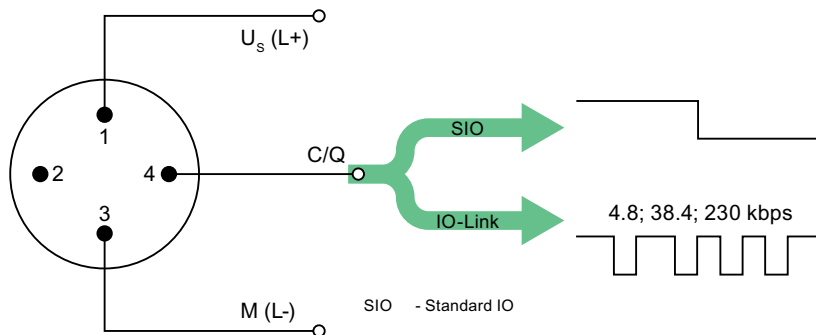
Pin	Signal	Definition	Standard
1	U_s (L+)	24 V	IEC 61131-2
2	-	not defined	-
3	M (L-)	0 V	IEC 61131-2
4	Q	Switching signal DI, DQ (SIO)	IEC 61131-2
4	C	"coded switching signal" (IO-Link)	IEC 61131-9

Figure 1-2 Pin assignment IO-Link device

Port types in IP65/67/69K

Two types of ports are distinguished in the specifications for IO-Link masters:

- Port Class A (Type A)
  With this type, the functions of pins 2 and 5 are not assigned. The manufacturer defines this function. Generally, an additional digital channel is assigned to pin 2.
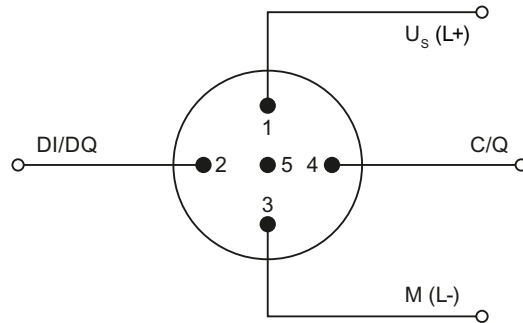

Figure 1-3 Pin assignment Port Class A

- Port Class B (Type B)
  This type offers an additional supply voltage and is suitable for the connection of devices that have an increased power requirement. In this case an additional (galvanically isolated) supply voltage is made available by pins 2 and 5. A 5-wire standard cable is required to use this additional supply voltage.
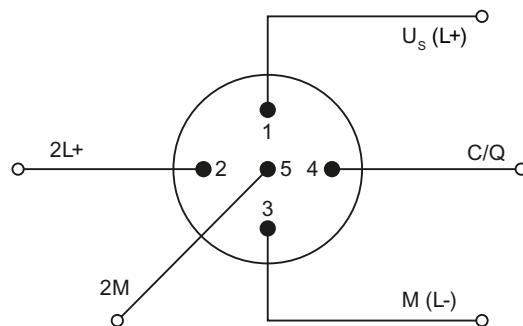

Figure 1-4 Pin assignment Port Class B

Connecting cables

The devices are connected to the master with unshielded 3-wire or 5-wire standard cables with a maximum length of 20 m. Standard cables can be used to wire the sensors. No shielding or compliance with specific regulations is necessary for the installation of the cables.

1.4 IO-Link protocol

Operating modes

The IO-Link port of the master can be operated in the following modes:

- IO-Link:
  The port is located in the IO-Link communication.
- DI:
  The port behaves like a digital input.
- DQ:
  The port behaves like a digital output.
- Disabled:
  The port is disabled.

Transmission rate

In the IO-Link specification V1.1, three data transmission rates (baud rates) are specified for the IO-Link operating mode:

- COM 1 = 4.8 kBaud
- COM 2 = 38.4 kBaud
- COM 3 = 230.4 kBaud (optional according to Specification V1.0)

The IO-Link device only supports one of the defined data transmission rates. The IO-Link master to Specification V1.1 supports all data transmission rates and adjusts automatically to the data transmission rated supported by the device.

Response time of the IO-Link system

The response time of the IO-Link system provides information about the frequency and speed of the data transmission between device and master. The response time depends on various factors.

A value for the minimum cycle time of the device is stored in the device description file IODD of the device (Page 15). This value indicates in which time intervals the master may address the device. The value has a big influence on the response time. The master also has an internal processing time that is factored into the calculation of the response time.

Devices with different minimum cycle time can be configured on a master. The response time for these devices differs accordingly. In other words, the response time for various devices connected to a master can vary greatly.

When you configure the master you can specify a fixed cycle time in addition to the device-specific minimum cycle time stored in the IODD. The master then addresses the device according to this specification.

The typical response time for a device thus results from the effective cycle time of the device and the typical internal processing time of the master.

Transmission performance

IO-Link is a very robust communication system. This communication system operates with a 24V level. If transmissions fail, the frame is repeated two more times. The IO-Link master only detects a break in communication after the failure of the second repeat attempt and reports this to the higher-level CPU.

Data types

Four data types are available:
- Process data → Cyclic data
- PQI → Cyclic data
- Device data → Acyclic data
- Events → Acyclic data

Process data

The process data of the devices is transferred cyclically in a data frame with the process data size being determined by the device. Process data from 0 to 32 bytes is possible per device (input and output, respectively).

Port Qualifier Information (PQI)

Each port has a Port Qualifier Information (PQI). This PQI provides information on the device status of the port and IO-Link (value status). The PQI is transmitted cyclically with the process data.

Device data

Device data can be parameters, identification data or diagnostic information. The data is exchanged cyclically and at the request of the IO-Link master. Device data can be written to the device and also read from the device.

Events

When an event occurs, the device signals to the master that an event is present. The master then reads the event. Events can be error messages (for example, short-circuit) and warning/maintenance data (for example, dirt, overheating).

Error messages are transferred from the device to the CPU or the HMI by the IO-Link master.

The IO-Link master can also transfer events and states. Such events are, for example, wire break, break in communication or overload.

Device parameters or events are transmitted independently of the cyclic transmission of process data. The transmissions do not influence or impair each other.

Startup of the IO system

If the port of the master is set to IO-Link mode, the IO-Link master attempts to communicate with the connected IO-Link device. For this purpose the IO-Link master sends a defined signal and waits for the reply of the IO-Link device.

The IO-Link master first attempts a communication with the highest defined data transmission rate. If this transmission attempt fails the IO-Link master attempts a communication with the lowest data transmission rate. The device always supports only one defined data transmission rate.

If the master receives a reply, communication starts. First they exchange communication parameters. If necessary the parameters stored in the system are transferred to the device.

Then the cyclic data exchange of process data and value status starts.

1.5 Device profiles

Introduction

Device profiles are defined for IO-Link to standardize access of the CPU user program to the devices.

Data structure, data contents and basic functionality are defined in the device profiles. A standard user view and an identical program access is thus achieved for a number of different devices that have the same device profile.

IO-Link profiles

The device profile "Smart Sensor Profile" is currently defined for IO-Link. This profile is especially suited for measurement sensors. In other words, measured values are transmitted in addition to switching points.

For the Smart Sensor Profile, the TIA Portal library for IO-Link ("LIOLink") contains function blocks (FBs) for "Adjustable Switching Sensors" (FB LIOLink_AdjSwitchingSensor), for "Multiple Adjusting Switching Sensors" (type 2, FB LIOLink_MultAdjSwitchingSensor), "Digital Measuring Sensors" (type 3) and "Digital Measuring Switching Sensors" (type 4) (both in LIOLink_MeasuredDataChannel FB).

The "Common Profile" profile is used for the manufacturer-independent reading of identification and diagnostics data from the devices and enables the writing of application-specific tags - it is supported by the FB LIOLink_IdentAndDiag.

In addition, the switchgear (for example, contactors) support the LVSG (Low Voltage Switchgear) profile defined in IEC 61915-2.

1.6 IODD and Port Configuration Tool - S7-PCT

Device description IODD

An electronic device description, the IODD file (IO Device Description) is available for each device. The IODD provides a wealth of information for system integration:

- Communication properties
- Device parameters with value range and default value
- Identification, process and diagnostic data
- Device data
- Text description
- Image of the device
- Manufacturer logo

The structure of the IODD is identical for all devices from all manufacturers. The structure of the IODD is always represented in the identical manner by the IO-Link Configuration Tool of the master manufacturer (for Siemens, S7-PCT). This ensures that the handling is the same for all IO-Link devices regardless of the manufacturer.

Two different IODD versions are available for devices that support both V1.0 and V1.1 functionality.

IODDfinder

The IODDfinder is a cross-vendor, central IO-Link database.
This database provides you with the latest IODDs of the device manufacturers and offers an information and download platform.
The IODDfinder is available on the Internet (https://ioddfinder.io-link.com).

As of version V3.5 SP3 update 2, S7-PCT can automatically access the IODD database and download missing IODDs, see SIOS (https://support.industry.siemens.com/cs/ww/en/view/32469496) under "What's New in PCT Version V3.5 SP3 update 2".

IO-Link configuration tool

Configuration tools are required to configure the entire IO-Link system. The IO-Link configuration tools of the master manufacturers are able to read IODDs.
The main tasks of the IO-Link configuration tool include:

- Assigning the devices to the ports of the master
- Address assignment of ports within the address area of the master
- Assigning parameters for the IO-Link device

Diagnostics can also be carried out on the connected devices.

This means the IO-Link configuration tool supports the transparent representation of the IO-Link system down to field level.

Siemens provides S7-PCT for engineering of the IO-Link system.

S7-PCT with IODD of a device

The following figure shows a section from S7-PCT with IODD of a device and the device information contained therein.

Figure 1-5 S7-PCT with IODD of a device and the device information contained therein

1.7 Differences between IO-Link specifications V1.0 and V1.1

Specification

The technical definition of the IO-Link system is described in a specification of the IO-Link consortium. The first step was the creation of specification version 1.0. The further development and added functions of the IO-Link system led to version 1.1.

The main enhancements of version 1.1 are:

- Data backup for device replacement during operation (Backup&Restore)
- Data transmission rate 230.4 kBaud is mandatory for the IO-Link master

Combination of IO-Link devices

Note the following when combining IO-Link devices:

- Only IO-Link devices that comply with V1.0 can be operated on the IO-Link master to V1.0.
- IO-Link devices that comply with V1.0 and V1.1 can be operated on the IO-Link master to V1.1.
- Data backup and a data transmission rate of 230.4 kBaud of the IO-Link master after V1.1 can only be used when these functions are also supported by the IO-Link device and the IO-Link master (optionally as of V1.0).
- IO-Link master after V1.0 only optionally supports 230.4 kBaud. If IO-Link master V1.0 does not support 230.4 kBaud, then communication with an IO-Link device with 230.4 kBaud is not possible.

Integration into the automation system

2

2.1 Configuration of the IO-Link system

Introduction

An IO-Link system is configured in several steps. In the first step, the master is integrated in the automation system and configured. In the second step, the IO-Link devices are configured.

Integration in the automation system

When using a SIMATIC S7 CPU, use the engineering tool STEP 7, V5.x or STEP 7 (TIA Portal) for configuration.

The IO-Link system is represented by the IO-Link master in the configuration of the automation system or the fieldbus and integrated with STEP 7 or a GSD file.

The IO-Link master itself can be a field bus node (e.g. ET 200eco PN IO-Link master) or a part of the modular IO system that is connected to the field bus (e.g. ET 200SP IO-Link master). In both cases, the number of ports, the address range and the module properties are described in STEP 7 or in the GSD file.

Example configuration in STEP 7 (TIA Portal)

The figure below shows a PROFINET configuration with integrated PROFINET devices ET 200SP and ET 200eco PN with IO-Link masters.
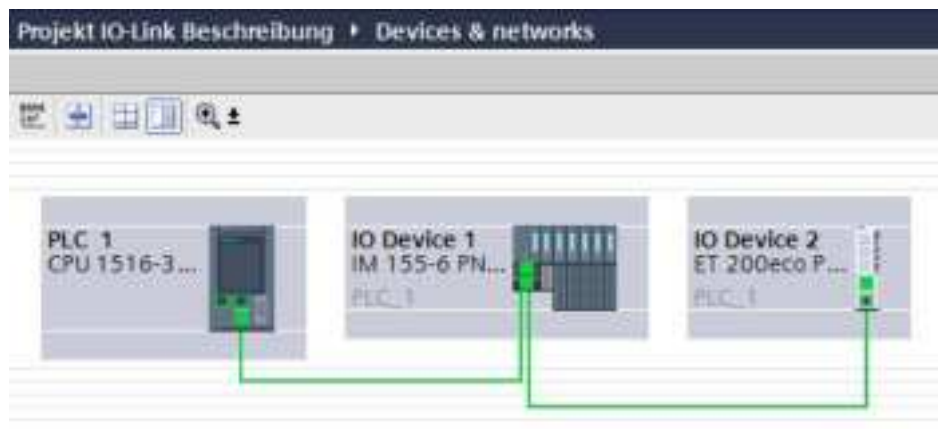
Figure 2-1 Configuration of a PROFINET network with lower-level IO-Link masters

In the device view of the PROFINET device, you can:

- Parameterize the ports
- Specify the input and output address ranges of IO-Link for exchange of cyclic data (process values).
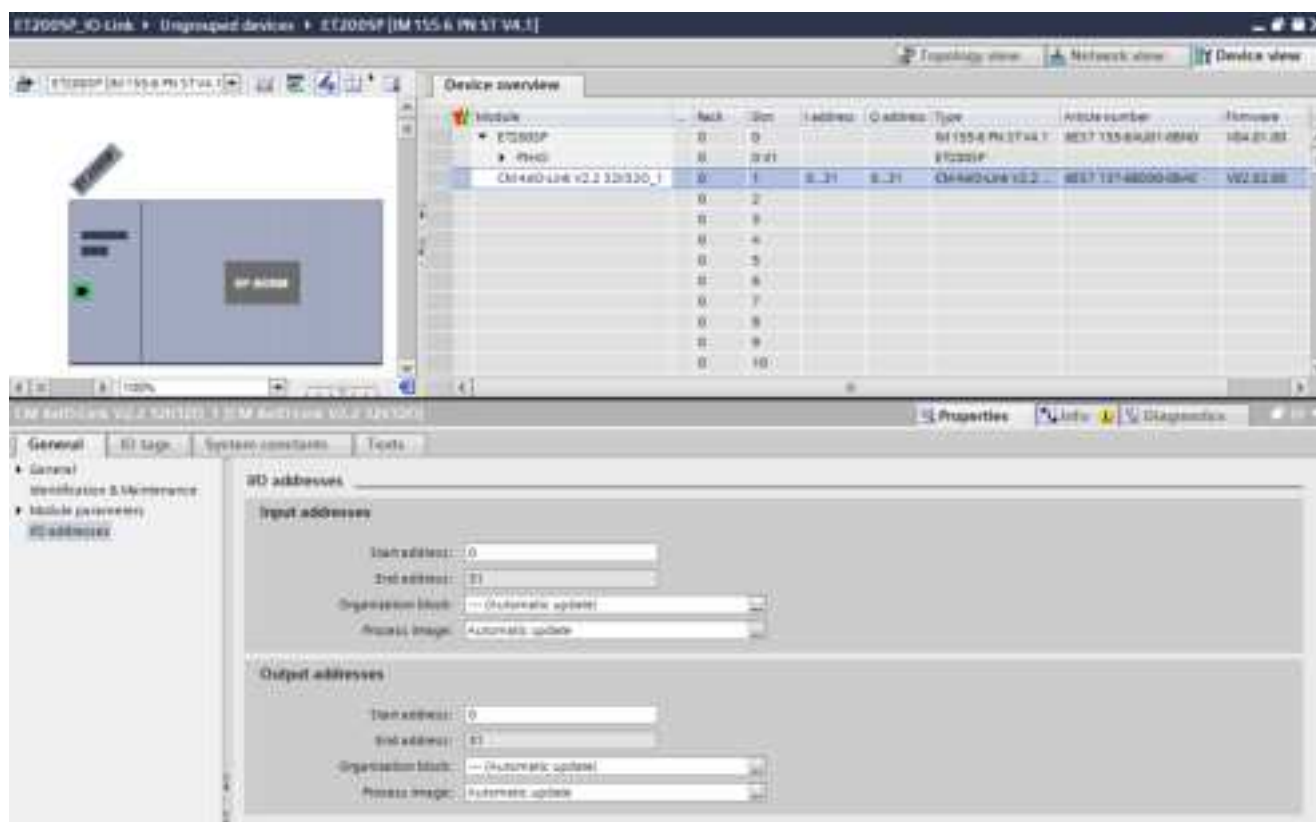
Figure 2-2 Device view with setting of the IO-Link address range

In addition, you can set in the module properties of the IO-Link master how the IO-Link system is to be configured and parameterized.
In doing so, you can select whether or not you also want to work with the S7-PCT configuration tool.

NOTE

IO data length

To ensure smooth operation, select an IO data length during configuration of the IO-Link master that corresponds at least to the IO data length of all connected IO-Link devices. If necessary, the IO-Link master offers the option of configuring the IO data length for each individual port. In this case, the IO data length must at least correspond to the IO data length of the connected IO-Link device.

2.1.1 Configuration with S7-PCT

Introduction

The following sections describe how you configure your IO-Link master with the S7-Port Configuration Tool (S7-PCT).

You need S7-PCT to display the system architecture completely and transparently all the way to the IO-Link device and to configure and parameterize the IO-Link system in detail.

With S7-PCT you can easily configure the IO-Link devices with the help of the IODD (IO-Link Device Description) supplied by the device manufacturer.

In the S7-PCT online view you can display the diagnostics states and process values of the IO-Link devices in detail.

Configuration with S7-PCT

When you have selected the option "Configuration with S7-PCT", you are also making the settings of the IO-Link master ports with S7-PCT. See Figure 3-5 (Page 23).

These settings include:

- Specification of the address range for each port
- Behavior when replacing an IO-Link device
- Setting the identification data for checking the connected IO-Link device type

Start S7-PCT from HW Config in STEP 7.

S7-PCT shows you all Siemens IO-Link masters you have configured in your automation system.

After selecting an IO-Link master, you can assign its IO-Link ports to the desired IO-Link devices.

To do so, select the corresponding IO-Link devices (or their IODDs) from the device catalog and drag them to the port of the IO-Link master.

Example configuration in S7-PCT

The following figure shows the configuration of an IO-Link master in S7-PCT.
This S7-PCT view shows you a wide variety of information:
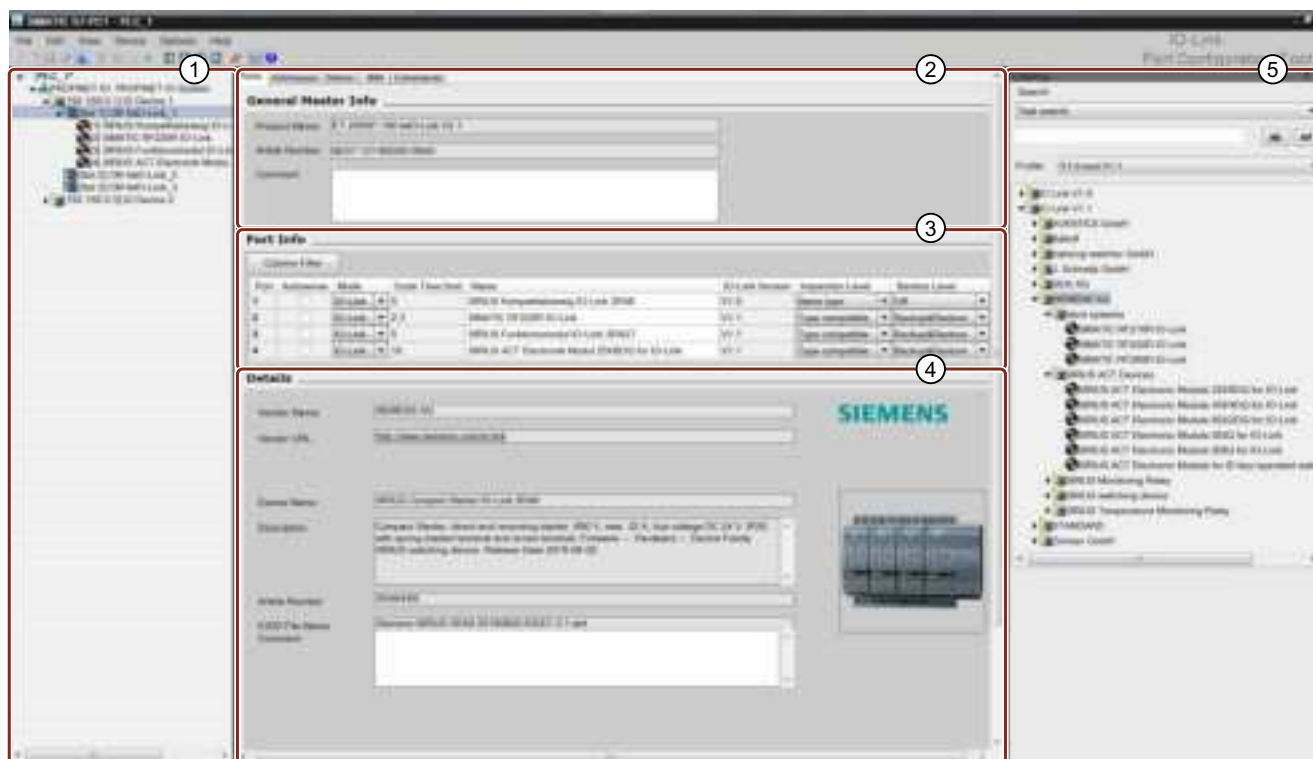
①	Higher-level field bus and overview or structure of the lower-level IO-Link master
②	Detailed information on the selected IO-Link master
③	Current configuration of the IO-Link ports of the selected IO-Link master
④	Detailed information on the selected IO-Link device
⑤	Device catalog with the IODDS of the IO-Link devices from different manufacturers

Figure 2-3 Configuration of an IO-Link master in S7-PCT

Address range of the ports

In addition to the assignment of the IO-Link devices to the IO-Link master ports, the default address ranges of the ports can be changed. The IO-Link master transfers the process values that it receives from the IO-Link device in these address ranges and makes the process values available to the higher-level automation system.
To set the address range, select the "Addresses" tab.

Setting device parameters

Specific parameter settings are required to adjust the device to the respective application task. The possible parameters and set values are contained in the IODD of each device. You set the device parameters directly in S7-PCT.

After selecting the corresponding device in the project tree (left tree), set the device parameters in the "Parameters" tab.

The figure below shows you an example of the parameter assignment of an IO-Link device:

Figure 2-4 Setting the parameter values of the IO-Link device

Starting from the displayed defaults, you can edit and save the values in the defined value range.

The configuration of the IO-Link system and the parameters of the devices are available to the IO-Link system and the entire automation project. You have the option of saving and printing the configuration and the parameters.

It is not possible to change parameters in online mode.

2.1.2   Configuration without S7-PCT

Introduction

The following sections describe how you configure your IO-Link master without the S7-Port Configuration Tool (S7-PCT).

Your options for configuration of the IO-Link system without S7-PCT are limited.

You can configure the port of the IO-Link master using STEP 7 or the GSD file, but you cannot set any parameters of the lower-level IO-Link devices.

Configuration without S7-PCT

You can activate the following parameters in STEP 7 or the GSD file during port configuration:

- Port Qualifier Information (PQI):
  provides information on the status, such as process data of the IO-Link port; is transmitted with the input data of the IO-Link device.
- Operating mode
  - IO-Link Autostart:
    The IO-Link master accepts each connected IO-Link device and starts it automatically.
  - IO-Link Manual:
    The IO-Link master only accepts IO-Link devices that match the Vendor ID and Device ID set below.
    The connected IO-Link device is started automatically after a successful Vendor ID and Device ID check.
  - DI:
    The port is operating as a standard digital input.
  - DQ:
    The port is operating as a standard digital output.
  - Disabled:
    The port is disabled.
- Input Data Length:
  Process data length of the input data
- Output Data Length:
  Process data length of the output data
- Vendor ID
  ID number of the device manufacturer. You can find the Vendor ID on the Internet (https://support.industry.siemens.com/cs/ww/en/view/109748852).
- Device ID
  ID number of the device. You can find the Device ID on the Internet (https://support.industry.siemens.com/cs/ww/en/view/109748852).
- The IODD - and thus Device and Vendor ID - can be loaded into the TIA project as a .zip file (as of TIAP V17)
- Inspection level for data backup:
  - Identical type (V1.0) without Backup&Restore
  - Type-compatible (V1.1) without Backup&Restore
  - Type-compatible (V1.1) with Backup&Restore
  - Type-compatible (V1.1) with Restore

The figure below shows you an example of the settings of a port configuration in STEP 7 or with GSD file:
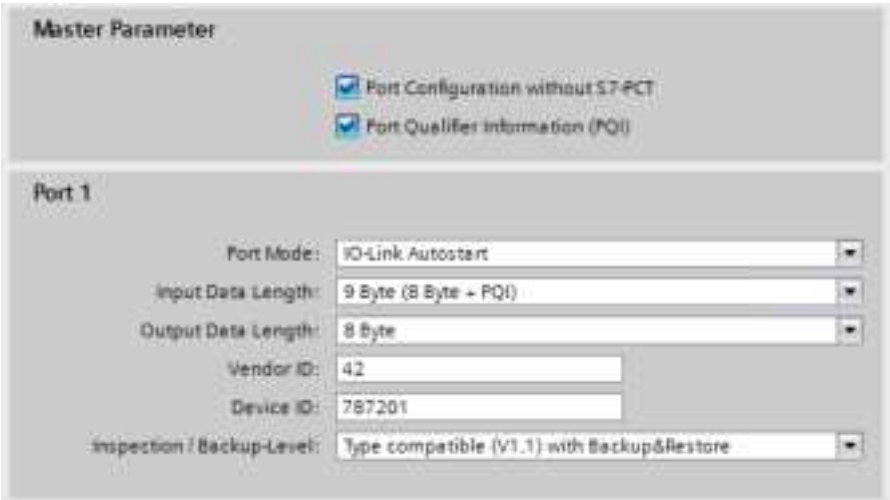

Figure 2-5 Settings of the port configuration in STEP 7 or with GSD file

2.1.3 Comparison of the configuration options

The following table provides an overview of the available options for configuration with and without S7-PCT:

Requirement	Configuration with S7-PCT	Configuration without S7-PCT	
		IO-Link Autostart	**IO-Link Manual**
Use of the IO-Link device description IODD	Yes	No	No
Setting the length of input and output data (per port)	Automatic	Manual	Manual
Assignment of the Vendor ID and Device ID	Automatic	-	Manual (see FAQ (https://support.industry.siemens.com/cs/ww/en/view/1097488-52))
Behavior during IO-Link device replacement	Programmable	-	Programmable
Adjustable IO-Link cycle time	Yes	No	No
Adjustable IO-Link device para-meters	Yes	No	No
Display of the IO-Link process data structure	Yes	No	No
Monitoring of IO-Link process data	Yes	No	No
Display of IO-Link device dia-gnostics messages	Yes	No	No

2.2 Data access of the automation system and the HMI device

Cyclic data exchange

To exchange cyclic process data between an IO-Link device and a CPU, the IO-Link data is assigned by the IO-Link master to the previously set address ranges. The user program of the CPU accesses and processes the process values by using these addresses. The cyclic data from the CPU to the IO-Link device (for example, IO-Link actuator) takes place in reverse order.

Acyclic data exchange

Acyclic data, such as device parameters or events, is exchanged by means of a fixed index and subindex area. The CPU accesses the data using system mechanisms (for example, for online functions such as reading the status). You can use the index and subindex area to access specific device information (for example, to re-assign parameters of the device or master during operation).

Function blocks "LIOLink_Master" and "LIOLink_Device"

The programming of the CPU user program is another task in addition to the configuration and parameterization of the IO-Link system and its integration into the overall automation system.

For acyclic data exchange, you can use the function blocks "LIOLink_Master" and "LIOLink_Device" for controllers of the S7-300, S7-400, S7-1200 and S7-1500 product lines.

The function block "LIOLink_Master" reads all relevant functions and access to the IO-Link master, the function block "LIOLink_Device" reads all access to the IO-Link devices.

With the "LIOLink_Master" function block, you can save (Backup) and retrieve (Restore) the device parameters and settings of an IO-Link master via the S7 program (master replacement without engineering tool). A typical application is the replacement of the IO-Link master.

NOTE

Function blocks "LIOLink_Master" and "LIOLink_Device"

The function blocks "LIOLink_Master" and "LIOLink_Device" replace the functions of the previously available block "IOL_CALL".

Reference

The IO-Link block library with a description of the integration is available on the Internet (https://support.industry.siemens.com/cs/ww/en/view/82981502).

You can find an application example of using the block library with HMI devices on the Internet (https://support.industry.siemens.com/cs/ww/en/view/90529409).

2.3   Changing and saving device parameters during plant operation

Changing device parameters

You can adjust the device parameters during operation.
The changed parameters will become effective on the device in the process and are
retentively saved in the device.
The parameters can be adapted during operation with:

*   the engineering tool used (e.g. during plant commissioning)
*   the CPU user program (program-controlled)
*   HMI (through plant operator during batch change, process optimization)
*   Locally through operation on the device (local operating unit on the device)

Saving device parameters (backup)

You can also automatically save the parameters set in the device during commissioning or
changed during operation of the plant in the IO-Link master.
This data backup takes place depending on the set behavior of the IO-Link master ports.
You can set the following data backup levels:

*   None
    No data backup in the IO-Link master.
*   Backup&Restore
    Every time the device parameters are changed, the changed data is automatically saved in
    the IO-Link master (see section "Triggering a backup").
*   Restore
    No automatic data backup in the IO-Link master.

IO-Link Version	Inspection Level		Backup Level	
V1.0	No check	▼	Off	▼
V1.1	Type compatible	▼	Backup&Restore	▼
V1.1	Type compatible	▼	Backup&Restore	▼
V1.1	Type compatible	▼	Backup&Restore	▼

Figure 2-6 Overview of data backup level in S7-PCT

NOTE

IO-Link Specification V1.0

IO-Link master and devices to IO-Link specification V1.0 do not offer this function; a data
backup cannot be set (Data backup: None).

Note that the behavior of the IO-Link master and the IO-Link devices during device replacement depends directly on the set data backup level.
You can find additional information on this dependency in the section Replacing a master or device during operation (Page 28).

NOTE

We strongly recommend resetting an IO-Link device to the factory settings before performing a restore by the IO-Link master. This prevents a permanently stored backup prompt of the device from accidentally overwriting the restore parameters.

Triggering a backup

Requirements

- You have set the correct data backup level.
- The IO-Link master and the IO-Link devices you are using support this function (IO-Link Specification V1.1).

Procedure

There are several ways to trigger a backup:

- In the engineering tool:
  After you have downloaded the engineering settings to the device, the IO-Link device immediately triggers a backup.

- In the CPU user program:
  IO-Link device parameters can be changed successively by the user program.
  A backup is only triggered by a system command. The system command must be triggered by the user program after the parameter changes.
  You can implement the parameter changes and the system command for triggering the backup with function blocks of the CPU.

- Using the HMI:
  You proceed as with triggering by the user program.
  The plant operator then triggers the necessary system command on the HMI device.

- Locally by operating the IO-Link device:
  After confirming the input on the IO-Link device, the IO-Link device initiates the backup.

2.4 Replacing a master or device during operation

Replacing a device

Replacing a device during operation is a scenario that occurs again and again and has to be completed without longer plant downtimes. Replace a device quickly and avoid incorrect settings. Devices can also be replaced by operators without special knowledge and aids.

When you use the backup function of the master, the master automatically supplies the saved parameters to the new device during device replacement.

You have the following setting options for device replacement:

- Backup&Restore
  You have set the master port to Backup&Restore. The new device behaves as the replaced device because the master has saved the last parameter change with the backup function.

- Restore
  You have set the master port to Restore. The new device applies the parameter settings that were saved in the master at the time of the last backup.
  If you have made parameter changes since the last backup, these are not saved in the master and are not available to the new device.
  The behavior of the new device can deviate from the behavior of the replaced device. This may be useful if you want to make short-term plant optimizations but do not want to save them in the plant backup.

NOTE

Field calibration of sensors

When you are using sensors that must be adapted to specific rated conditions on site (field calibration), you must repeat this calibration after replacing the device.
The backup does not include the data of the field calibration. After repeating the field calibration, the new device works just like the replaced device.

Replacing a master

Replacing a master during operation is a rather rare scenario. Here, too, longer plant downtimes are to be avoided. Replace a device quickly and avoid incorrect settings. Devices can also be replaced by operators without special knowledge and aids.

The "Toolchanger" function enables the deliberate replacement of devices without error messages (e.g. when replacing tools with IO-Link functionality).

You can save the configuration and parameter data of the master and the devices connected to the master in the CPU and download this information to the new master after the replacement.

When using an S7-CPU, you can use function blocks for this purpose.

You can find additional information on function blocks in the section Data access of the automation system and the HMI device (Page 25).