EN

Initial start-up for IO-Link Master in a PROFINET network with TIA V13

Operating Instructions

Original operating instructions
Subject to change without notice
Available as PDF file only
Version: 1.0.0
Dated: 11/23/2017
www.wenglor.com

Table of Contents

1. Notes for the User

These instructions describe an example approach to integrating an IO-Link Master into a PROFINET network. The control software which is used for the instructions in this example is the SIEMENS TIA Portal V13.

2. Safety precautions

- Read the operating instructions carefully before using the products
- Only qualified personnel may install, perform initial start-up and maintain the described products
- The described products are not suitable for safety applications.
- The operating company must comply with local safety regulations.

3. General Note

This document uses an example installation to explain how to incorporate an IO-Link Master with a PROFINET interface into a controller and IO-Link hardware assignment. This description is based on a SIEMENS Simatic S7-1200 controller. wenglor sensoric does not offer any guarantee that the contents of this description are correct and/or complete. The instructions are simply intended to illustrate a normal procedure which can also be applied to other controllers with a PROFINET interface. This version does not describe device-specific use with products by other manufacturers. Please refer to instructions provided by the manufacturer concerned in such cases.

4. Integrating IO-Link Master into the work environment

The following steps comprise an example of an approach to integrating the IO-Link Master into the SIEMENS TIA V13 engineering tool.

- The IO-Link Master requires a power supply and a network connection for the controller to commence initial start-up. If IO-Link components need to be incorporated, they need to be connected via the existing IO-Link ports. Use the connection instructions in the operating instructions for the IO-Link Master (www.wenglor.com → Product World→ Product search (product number) → Download → Operating instructions)

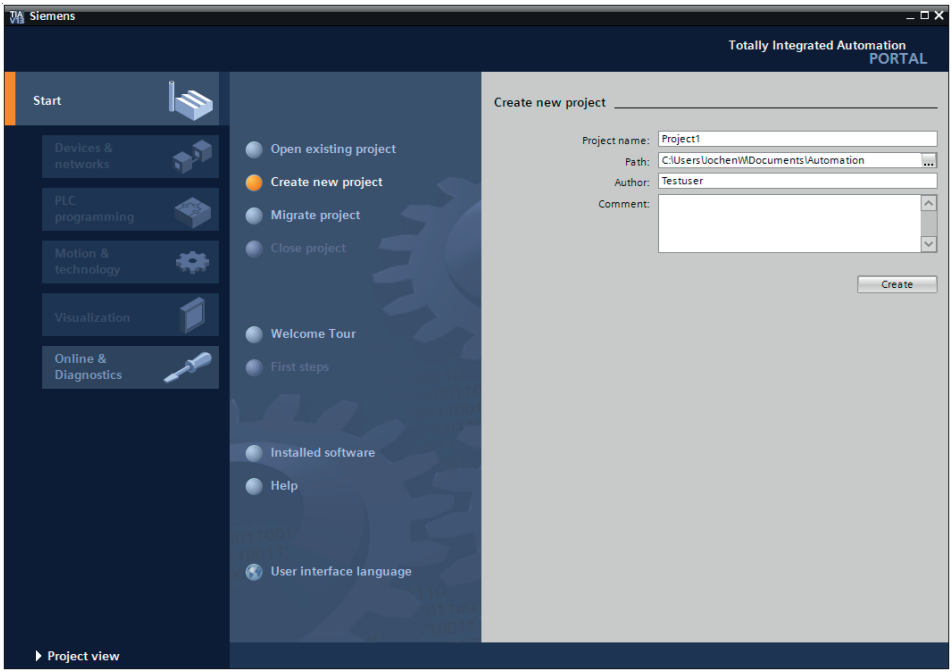
5. Initial start-up

A GSDML file in XML format is required to configure the IO-Link Master. You can download one from our website (www.wenglor.com → Product World → Product search (product number) → Download → (product description file). You can also request the GSDML file from the Support Team.

Save the GSDML file to a location which you can access with the configuration software and unzip it.

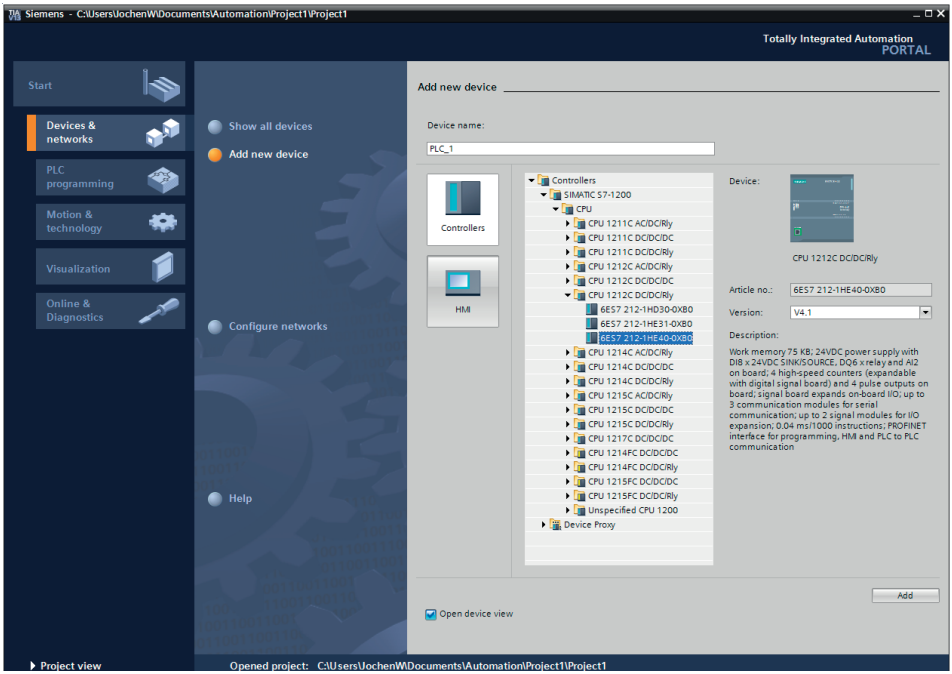
5.1 Creating a new project

Launch the SIEMENS Totally Integrated Automation Portal software and create a new project or open an existing one if IO-Link Master is to be integrated there.



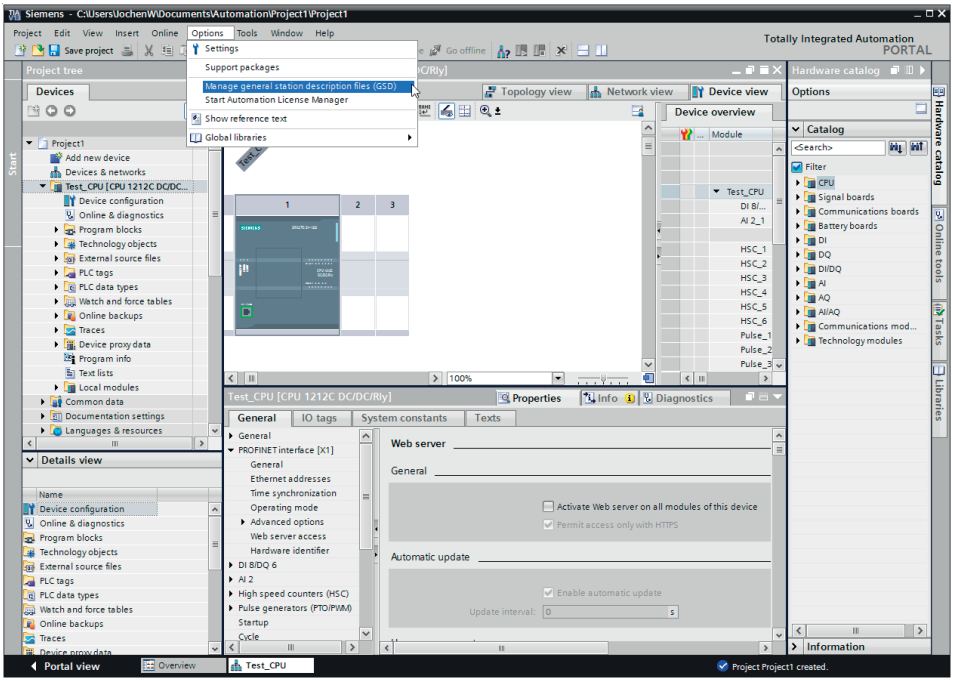
If you create a new project, enter a name for the project and specify the memory location or user name. Press on "Create" to generate the new project.

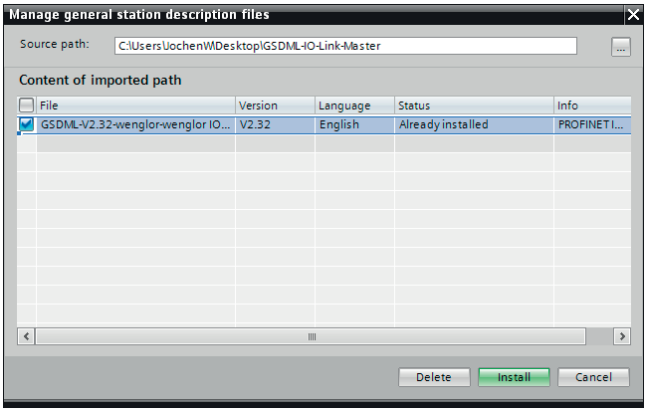
You can then add the connected controller into the PROFINET network. You will find the information on which controller/CPU you should use on the attached nameplate, for example.


Siemens - C:\Users\JochenW\Documents\Automation\Project1\Project1
Totally Integrated Automation
PORTAL
Start
Devices & networks
PLC programming
Motion & technology
Visualization
Online & Diagnostics
Show all devices
Add new device
Configure networks
Help
Add new device
Device name:
PLC_1
Controllers
HMI
Controllers
SIMATIC S7-1200
CPU
CPU 1211C AC/DC/Rly
CPU 1211C DC/DC/DC
CPU 1211C DC/DC/Rly
CPU 1212C AC/DC/Rly
CPU 1212C DC/DC/DC
CPU 1212C DC/DC/Rly
6ES7 212-1HD30-0XB0
6ES7 212-1HE31-0XB0
6ES7 212-1HE40-0XB0
CPU 1214C AC/DC/Rly
CPU 1214C DC/DC/DC
CPU 1214C DC/DC/Rly
CPU 1215C AC/DC/Rly
CPU 1215C DC/DC/DC
CPU 1215C DC/DC/Rly
CPU 1217C DC/DC/DC
CPU 1214FC DC/DC/DC
CPU 1214FC DC/DC/Rly
CPU 1215FC DC/DC/DC
CPU 1215FC DC/DC/Rly
Unspecified CPU 1200
Device Proxy
Device:
CPU 1212C DC/DC/Rly
Article no.:
6ES7 212-1HE40-0XB0
Version:
V4.1
Description:
Work memory 75 KB; 24VDC power supply with DI8 x 24VDC SINK/SOURCE, DQ6 x relay and AI2 on board; 4 high-speed counters (expandable with digital signal board) and 4 pulse outputs on board; signal board expands on-board I/O; up to 3 communication modules for serial communication; up to 2 signal modules for I/O expansion; 0.04 ms/1000 instructions; PROFINET interface for programming, HMI and PLC to PLC communication
Add
Open device view
Project view
Opened project: C:\Users\JochenW\Documents\Automation\Project1\Project1

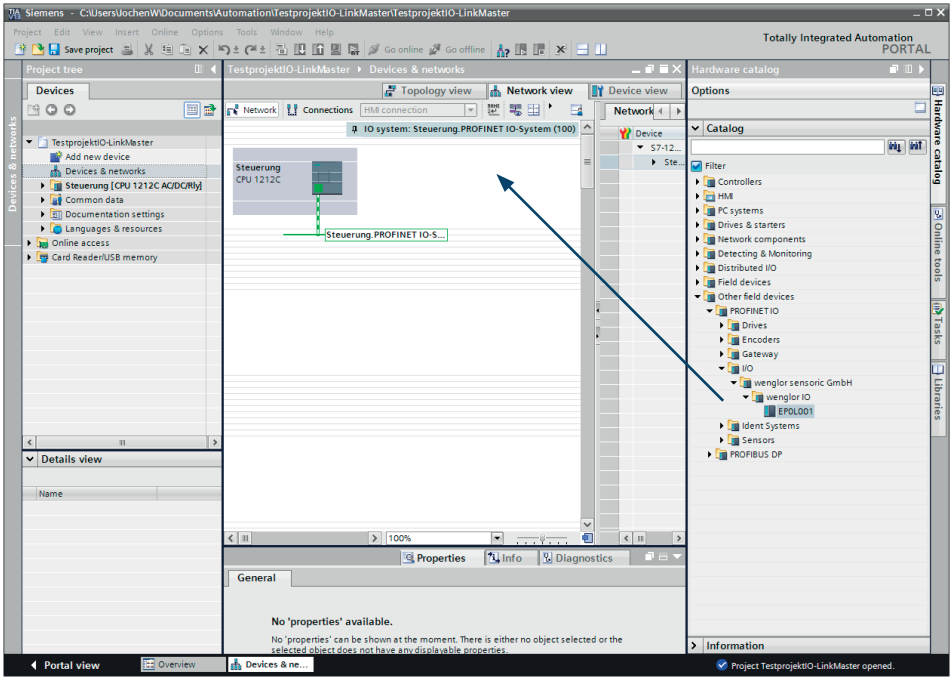
5.2 Installing the GSDML file

You can now use the controller software menu bar to select "Manage device description files" to add the GSDML file for the IO-Link Master. Please open the corresponding file path to select and install the GSDML file.



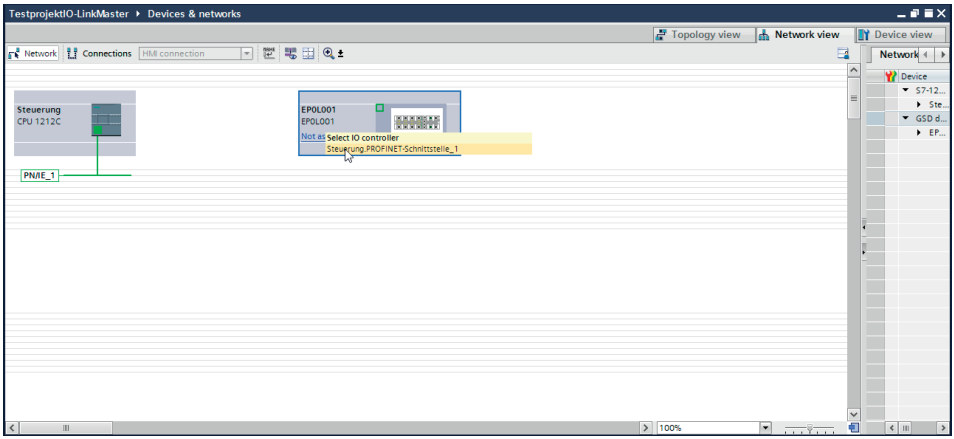


The IO-Link Master can then be selected from the device catalog using the following path and placed in the topology window using drag-and-drop. IO-Link Master path (catalog):
Other field devices → PROFINET IO → I/O → wenglor sensoric GmbH → wenglor IO → Head module

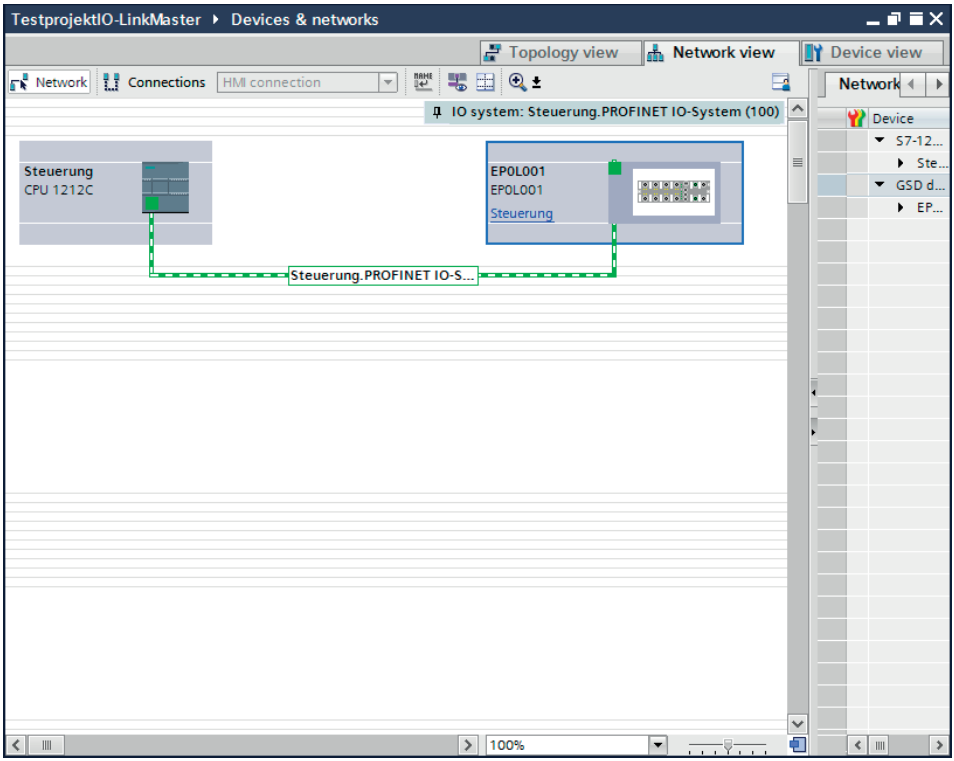


5.3 Establishing network connection

If the IO-Link Master is added to the network overview, the module needs to be assigned to the network. To do so, left-click on "Not assigned" and select the relevant IO controller.



The connection between the controller and the IO-Link Master should then be displayed.

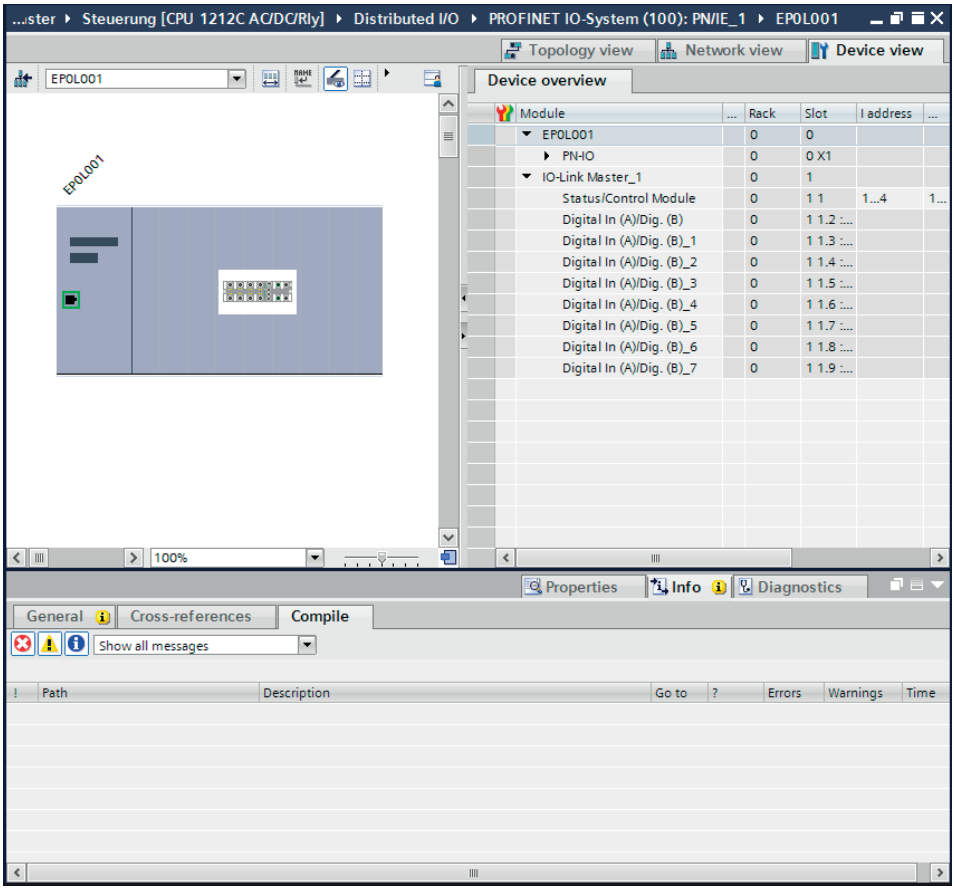


IMPORTANT
Ensure that the device is assigned to the **correct** physical port in the topology view.

5.4 Configuration of the IO-Link channels (receiving process data)

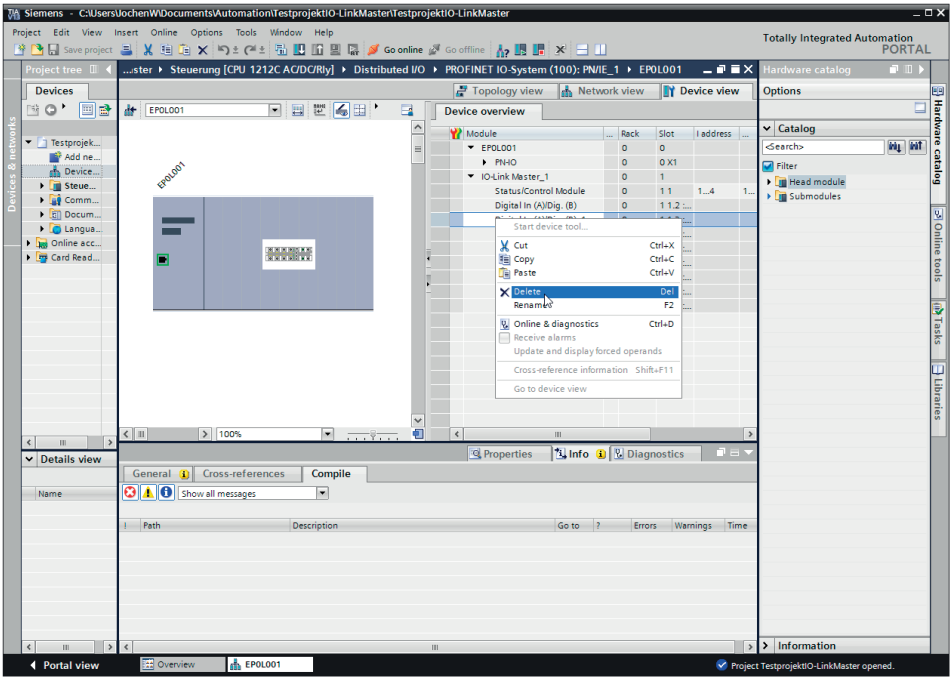
A pre-configuration of the E/A function is automatically used in Slot 1 in the subrack. All channels are pre-configured as a digital input by default as per the IO-Link specifications.
Configuration is flexible for the IO-Link channels (C/Q or Ch. A/Pin 4 in the IO port) in Subslots 2-9 (Port 1 in the device corresponds to Subslot 2, ..., Port 8 in the device corresponds to Subslot 9).
The input and output addresses specified by the hardware manager can be changed.

Double-click on the IO-Link Master to launch the device screen



5.5 Deleting the configuration of an IO-Link channel

If you wish to delete an IO-Link channel, select the corresponding IO-Link channel in the device overview. Right-click and select "Delete" in the menu displayed.



The required configurations can now be found among the submodules in the hardware catalog. You can drag the configuration into a free IO-Link subslot by selecting the required option and holding down the left mouse button.

The following options are available for the IO-Link C/Q channel (Ch. A/Pin 4) :

- **Digital input:**
  The channel acts as a digital input in this mode. The IO-Link master does not try to establish communication to the connected IO-Link device automatically in this mode.
  You can activate the IO-Link COM mode to perform a parametrization by setting the corresponding channel bit using the cyclical output bits in the COM mode byte in the IO-Link Master status/control module.

IMPORTANT
The digital input signal status is not updated during optional COM mode.

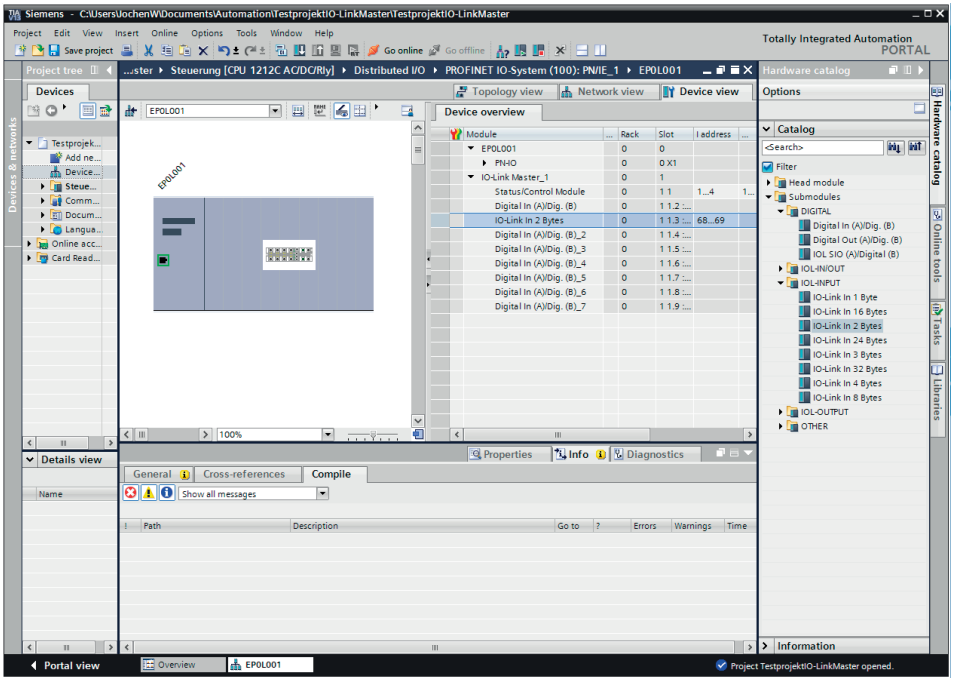
- **Digital output:**
  The channel functions as a digital output in this mode. Communication is not possible to the connected device at any time.

- **Inactive:**
  You should select this mode when the channel is not being used. The port's L+ supply (Pin 1) is disabled in this case.

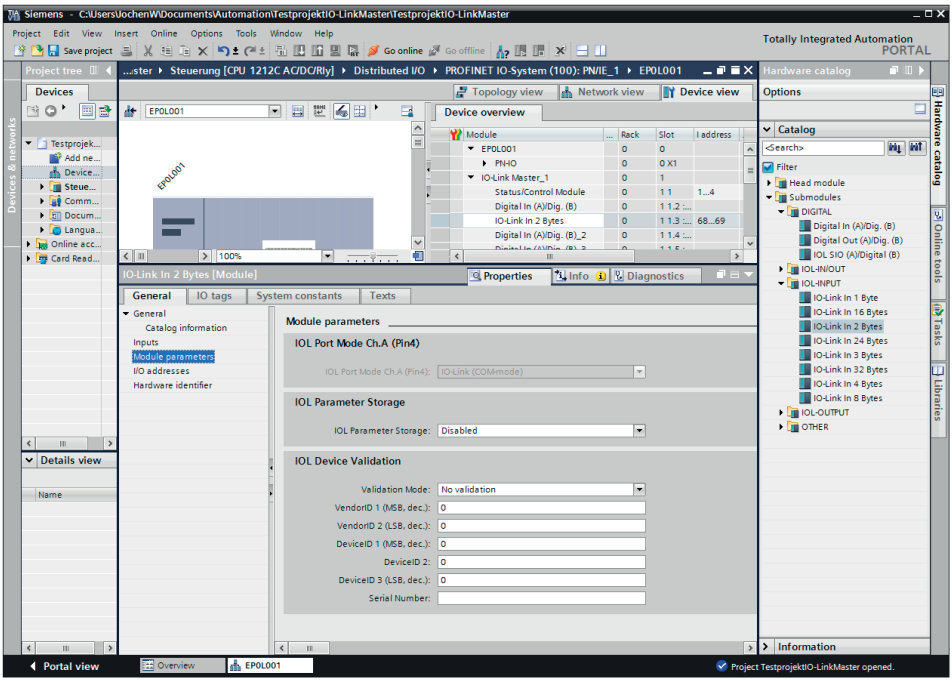
- **IO-Link in SIO mode (DI):**
  This mode is used to parametrize IO-Link devices. It uses the COM Mode fallback mechanism in SIO mode without using the COM mode bits in the IO-Link master status/control module. The IO-Link device is parametrized when the module is launched in this mode. It then uses the fallback mechanism to switch back to digital input mode.

- **IO-Link:**
  In this mode (COM mode), the process data are always exchanged to or from the device via a communications link. The IO-Link Master establishes communication with the connected IO-Link device automatically while taking into account the baud rate. This mode also offers the option to parametrize the IO-Link device. There are configuration modules available with data lengths of 1–32 input and/or output bytes. If there is no configuration module suitable for the device, the next larger data length must be selected.

IMPORTANT
In the example, an IO-Link sensor has been used on Port X2 with 2 byte process data.



The respective channels/ports can be configured under the module parameters (double-click on the required module in the Device overview). This is where the IOL parameter storage can be enabled and configured along with the IOL device validation for correct device identification. The "Parameter storage" function manages the IOL-Device parameters to provide a simple device or master replacement.


Siemens - C:\Users\JochenW\Documents\Automation\TestprojektIO-LinkMaster\TestprojektIO-LinkMaster
Totally Integrated Automation
PORTAL
Project tree
Devices
Hardware catalog
Topology view
Network view
Device view
Device overview
EP0L001
Module
Rack
Slot
I address
PN-IO
IO-Link Master_1
Status/Control Module
Digital In (A)/Dig. (B)
IO-Link In 2 Bytes
Digital In (A)/Dig. (B)_2
Options
Catalog
Filter
Head module
Submodules
DIGITAL
Digital In (A)/Dig. (B)
Digital Out (A)/Dig. (B)
IOL SIO (A)/Digital (B)
IOL-IN/OUT
IOL-INPUT
IO-Link In 1 Byte
IO-Link In 16 Bytes
IO-Link In 2 Bytes
IO-Link In 24 Bytes
IO-Link In 3 Bytes
IO-Link In 32 Bytes
IO-Link In 4 Bytes
IO-Link In 8 Bytes
IOL-OUTPUT
OTHER
IO-Link In 2 Bytes [Module]
Properties
Info
Diagnostics
General
IO tags
System constants
Texts
Catalog information
Inputs
Module parameters
I/O addresses
Hardware identifier
Module parameters
IOL Port Mode Ch.A (Pin4)
IO-Link (COM-mode)
IOL Parameter Storage
Disabled
IOL Device Validation
Validation Mode:
No validation
VendorID 1 (MSB, dec.):
VendorID 2 (LSB, dec.):
DeviceID 1 (MSB, dec.):
DeviceID 2:
DeviceID 3 (LSB, dec.):
Serial Number:
Details view
Name
Information
Portal view
Overview
Project TestprojektIO-LinkMaster opened.

5.6 Parameter memory

The following options can be configured:

- **Disabled:**
  "Disable" mode is the default setting for delivery. The data management function is disabled. If a device's parameter data have been saved previously, these remain unchanged.

- **Download only (master to device):**
  Enables the function to download parameter data to the IO-Link device on the master.
  Parameter data can only be downloaded onto an IO-Link device if they exist on the parameter server and can be used for the device. If an IO-Link device is connected, the master compares the saved parameter data with the device data. If the function is not blocked on the device ("Parameter storage" locked), the master downloads the saved data onto the device in the event of deviations.
  IO-Link Device data can be uploaded using "Upload only" mode. If the master has not saved a device parameter set, the mode is to be compared with "Disable". It is not possible to replace the IO-Link device in this mode.

- **Upload only (device to master):**
  Activates the function to upload parameter data from the master to the IO-Link device.
  An upload is implemented if an IO-Link device is connected and there are no more valid data in the master. This is the case when "Disabled and cleared" mode has been configured previously or in the case of "Disable" in default settings. If parameters data are changed on the device at run time, the device data saved in the master can be overwritten using the ParamDownloadStore command (Index 0x0002, Subindex 0x00, Value 0x05). This command sets the DS_UPLOAD_REQ flag in the device and thus performs an upload.
  It is possible to replace the IO-Link Master in this mode.

- **Download and upload:**
  Enables the function to upload and download IO-Link parameter data.
  An upload is implemented if an IO-Link device is connected and there are no more valid data in the master. This is the case when "Disabled and cleared" mode has been configured previously or in the case of "Disable" in default settings. The parameter data read are permanently stored in the master.
  If parameters data are changed on the device at run time, the device data saved in the master can be overwritten with the ParamDownloadStore command (Index 0x0002, Subindex 0x00, Value 0x05). This command sets the DS_UPLOAD_REQ flag in the device and thus performs an upload.
  Each time a new connection is established to the IO-Link device, the master compares the saved parameter data with the device data.
  If the function is not blocked on the device ("Parameter storage" locked), the master downloads the saved data onto the device in the event of deviations.
  It is possible to replace the IO-Link device in this mode.

Action	IO-Link Master state	IO-Link device state
Upload	Invalid data (cleared before)	Upload flag active (valid data)
Upload	Invalid data (cleared before)	Upload flag not active & valid data
Upload	Valid data	Upload flag active & valid data

Action	IO-Link Master state	IO-Link device state
Download	Invalid data	Upload flag not active (data equal)

5.7 IOL device validation

IO-Link device validation (IO-Link device identification) allows the connected device to be checked regarding the configured values in the control program to identify any incorrectly connected devices and not start them up, for example.

5.8 Fail-safe value (COM mode)

The following values can be selected:

- **Set low:**
  All output data bits with the value 0 are transmitted to the IO-Link device. (default setting)
- **Set high:**
  All output data bits with the value 1 are transmitted to the IO-Link device.
- **Hold last:**
  The last valid output value received by the controller is continuously transmitted to the IO-Link device on a cyclical basis.
- **Replacement value:**
  If this option is selected, the value entered into the "Replacement value" edit box described below is continuously transmitted to the IO-Link device on a cyclical basis.
- **IO-Link Master command:**
  The "IO-Link Master command" option allows IO-Link specific mechanisms to be used for valid/invalid output process data. The device thus determines behavior itself.

Replacement value:

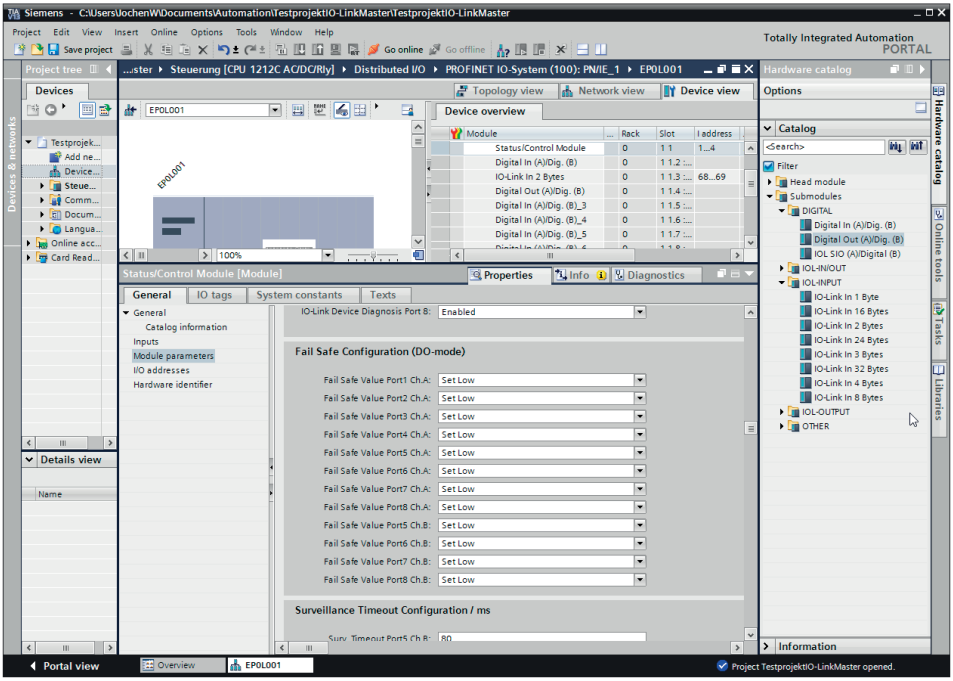
If the "Replacement value" option has been set under the "Fail-safe value" parameter option, the replacement value entered into this edit box/these edit boxes is used.
The value must be entered as a decimal value. Depending on the configured data length, the values are to be entered as a byte (0–255) or decimal value (0-65535) in word form in the order of displayed values.

- MSB = most significant byte
- LSB = least significant byte
- MSW = most significant word
- LSW = least significant word

5.9 Parameterization of status/control modules

If you double-click on status/control modules, you can also use the module parameters to select the behavior of ports in the event of a fault, input logics, diagnosis settings, web server configurations or also the behavior of Class B ports as a digital output, U_{AUX} power supply, or select inactivation.
The status/control module in Slot 1/Subslot 1 is permanently pre-configured for all IO-Link Masters. It contains 4 byte input and 4 byte output data for digital I/O data and the IO-Link Master's status and control bits.

The status/control module can also be used to configure all parameterizations
which are not related to ports in IO-Link COM mode.



5.10 General device settings

The "Digital-IO Bit Mapping Mode" parameter can be used to configure the mapping of the digital input/output bits which are transmitted from the controller to the device or from the device to the controller in the status/control modules' cyclical data.

The "Digital-IO Bit Mapping Mode" parameter can be used to configure the mapping of the digital input/output bits which are transmitted from the controller to the device or from the device to the controller in the status/control modules' cyclical data.

- Default setting:

MM1: Default mapping

- MM1: Default mapping:

In Mapping Mode 1 (MM1), the first channel bit (C/Q, Ch. A/Pin 4) and then the second channel bit (Ch. B/Pin 2) are transmitted for all ports in ascending order on a rotational basis.

- MM2: E2C-compatible mapping:

In Mapping Mode 2 (MM2), the first channel bit (C/Q, Ch. A/Pin 4) and then the second channel bit (Ch. B/Pin 2) are transmitted one after the other for all ports in ascending order.

5.10.1 General diagnosis settings

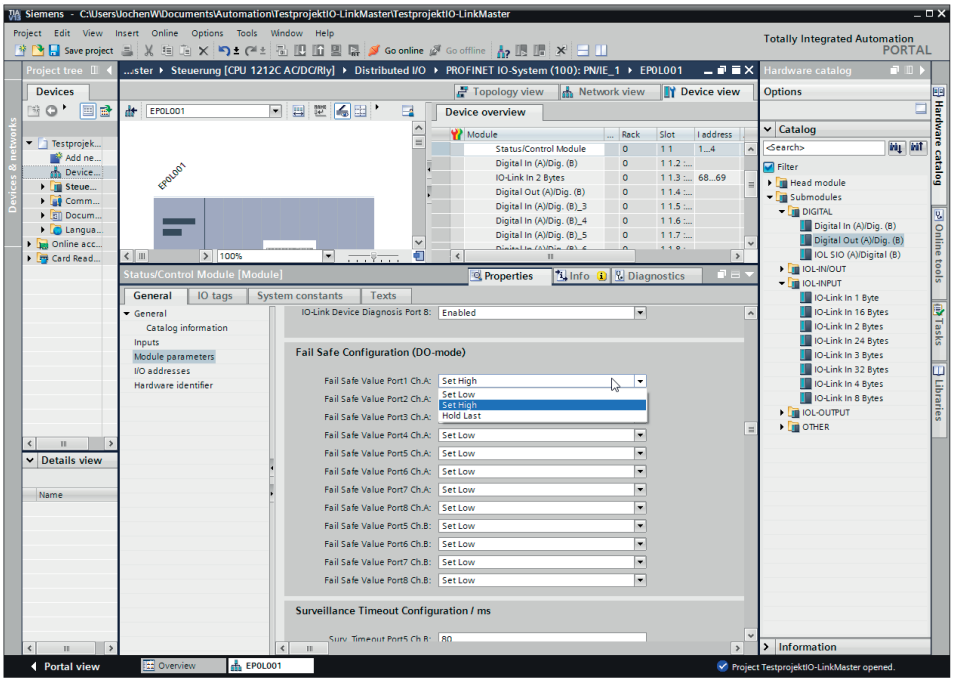
The General diagnosis settings folder can be used to enable or disable diagnoses or a diagnosis level.

IMPORTANT
Report U_{AUX} supply voltage fault is disabled in the default setting to prevent a diagnosis message due to the power supply being switched on or off at a later point in time.

5.10.2 Fail safe configuration (DO mode)

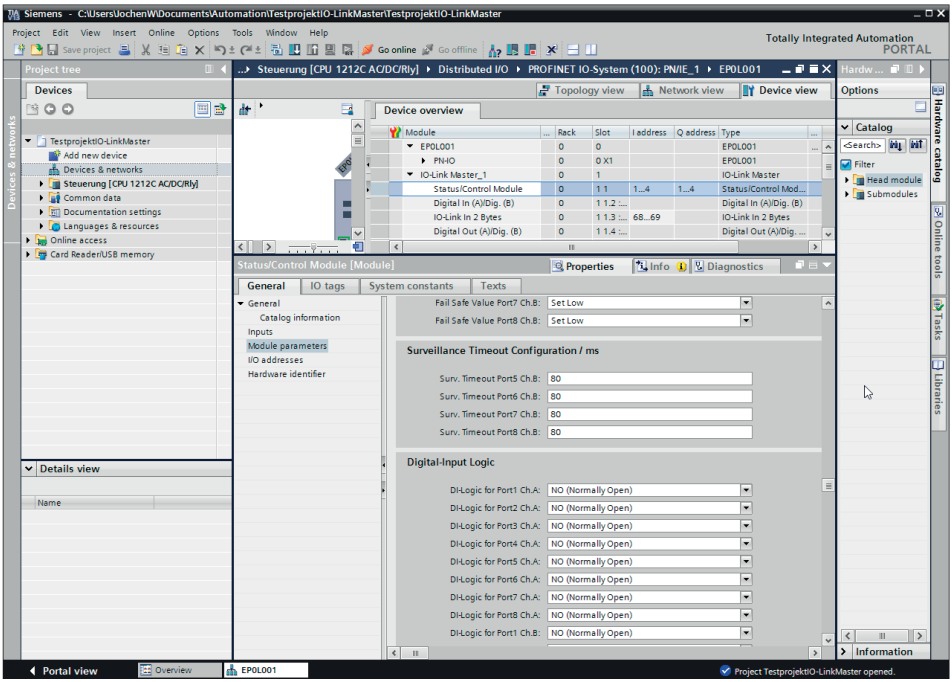
The device supports a fail-safe function for the channels used as a digital output. The status of outputs can be defined during configuration of devices after an interruption or loss in communication in the PROFINET IO network.
The following options can be selected:

- Set low – the output channel is disabled or the output bit is set to 0.
- Set high – the output channel is enabled or the output bit is set to 1.
- Hold last – the last output state is maintained



5.10.3 Surveillance timeout configuration

The separate power supply U_{AUX} in contact with the IO-Link channels Type B (Ch.B/Pin 2), Ports 5–8, can also be configured (tab: "Digital-IO mode for Ch. B (Pin2)". This gives you the option of connecting the power supply as a digital output.
The firmware in the modules allows a delay time to be configured for such a special case before surveillance of output currents is enabled.
This delay time is referred to as a "surveillance timeout" and can be set for each individual output channel.
The delay time
is started after a change in the output channel status, i.e. when the channel is enabled (after a rising edge) or disabled (after a falling edge). When this time interval expires, the output is monitored and error statuses are reported by diagnosis.
The "Surveillance timeout" parameter can be set between 0 and 255 ms. The standard value for this parameter is 80 ms. The value is typically 5 ms when an output channel is in a static status if it is permanently switched on or off.



5.10.4 Digital input logic

These parameters can be used to configure the logic for the channels used as a digital input.

• Default setting:

NO (normally open) for all channels
• NO (normally open)

A non-energized sensor has an open switching output (low refractive index) in this case. The device input detects a low refractive index and sends a 0 to the controller.
• NC (normally closed):

A non-switched sensor has a closed switching output (high refractive index) in this case. The device input detects a high refractive index, inverts the signal and sends a 0 to the controller.

5.10.5 Digital I/O mode for Class B ports on Pin 2

The IO-Link Ports Type B, Ports 5–8, can be parametrized as follows:

• Default setting:

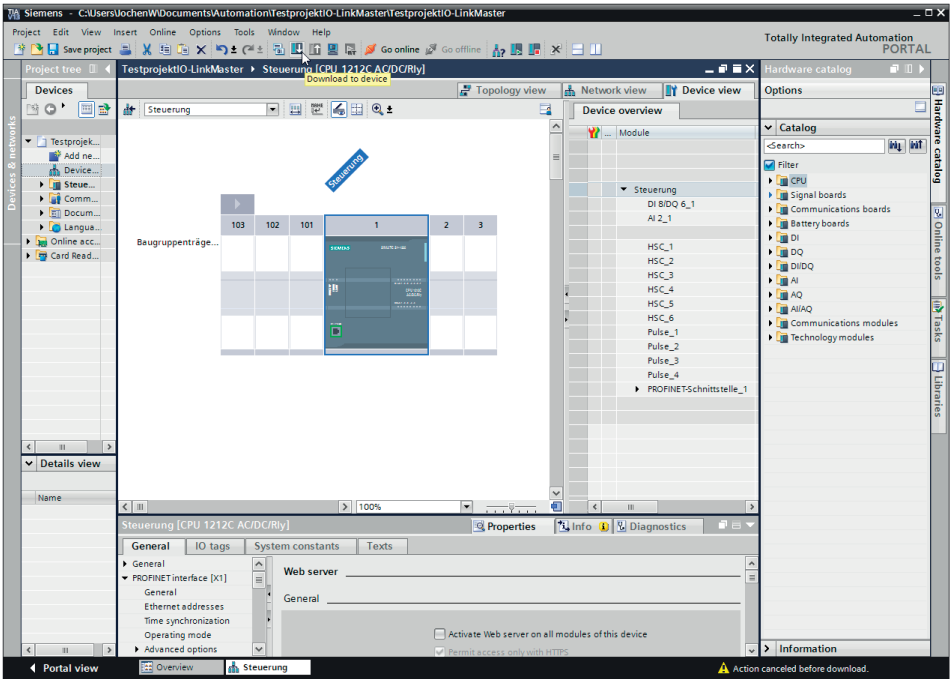
Auxiliary power supply (IO-Link Type B)
• Auxiliary power supply (IO-Link Type B):

In this mode, Pin 2 and Pin 5 in the Type B IO-Link ports, Ports 5–8, act as an auxiliary supply output. The auxiliary supply is fed from the U_{AUX} supply input. The auxiliary power supply output cannot be controlled.
• Digital output (DO):

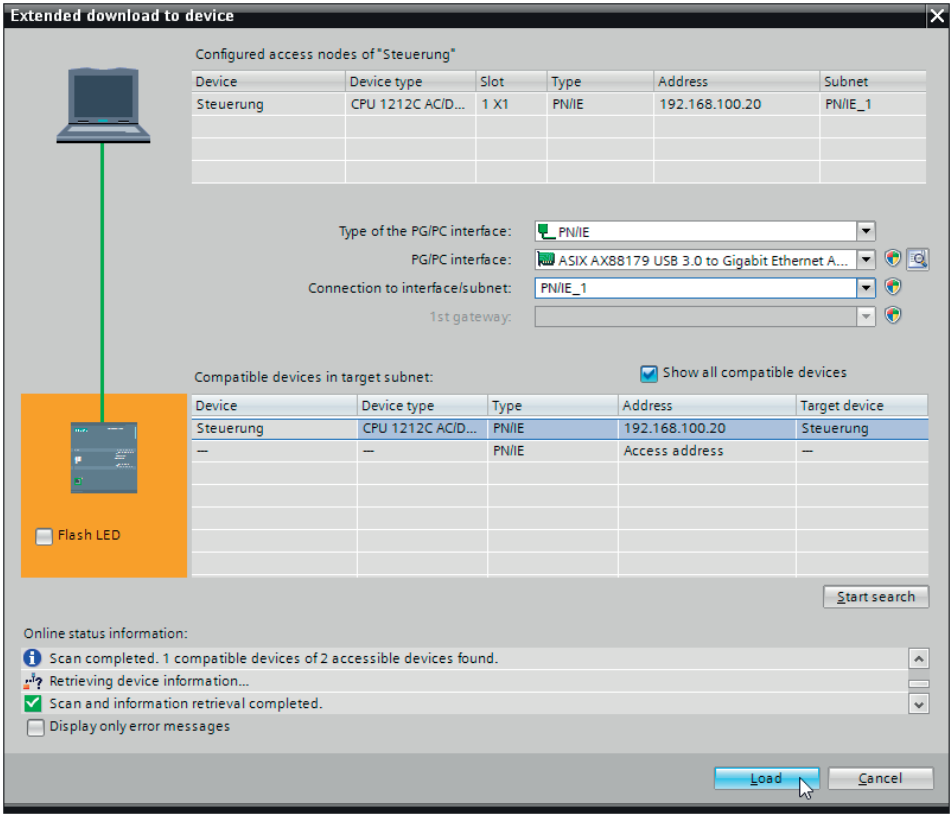
In this mode, Ch. B/Pin 2 in the Type B IO-Link ports, Ports 5–8, act as a digital output. The control bits are transmitted from the controller to the device within the status/control module. A "Surveillance timeout" can be configured for the outputs ("Surveillance timeout configuration" tab).

5.11 Downloading the configuration to the controller

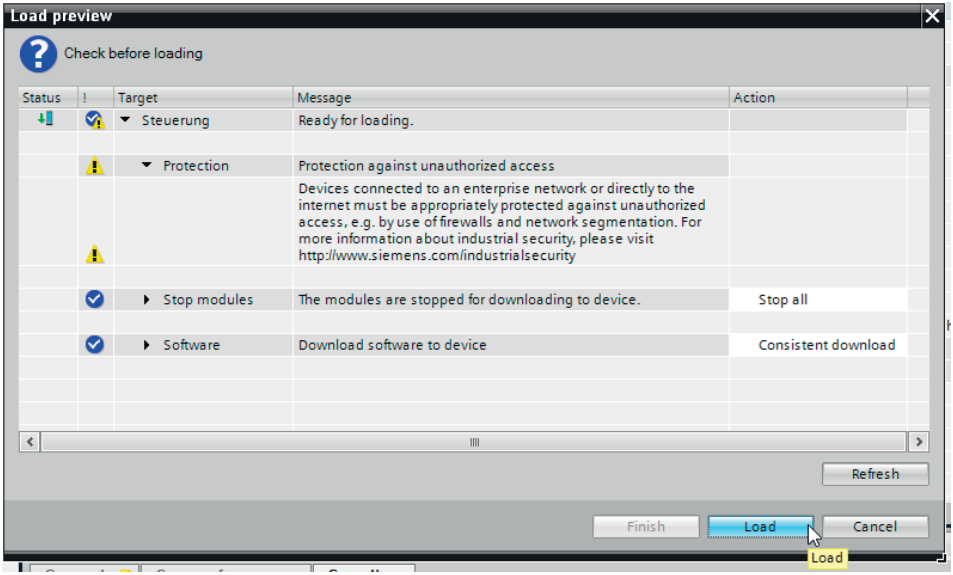
As the module and port settings have now been made, the configuration can be imported into the controller. You will find the "Download to device" function in the toolbar for this purpose – see screenshots.



You then need to select the connection settings and the controller.



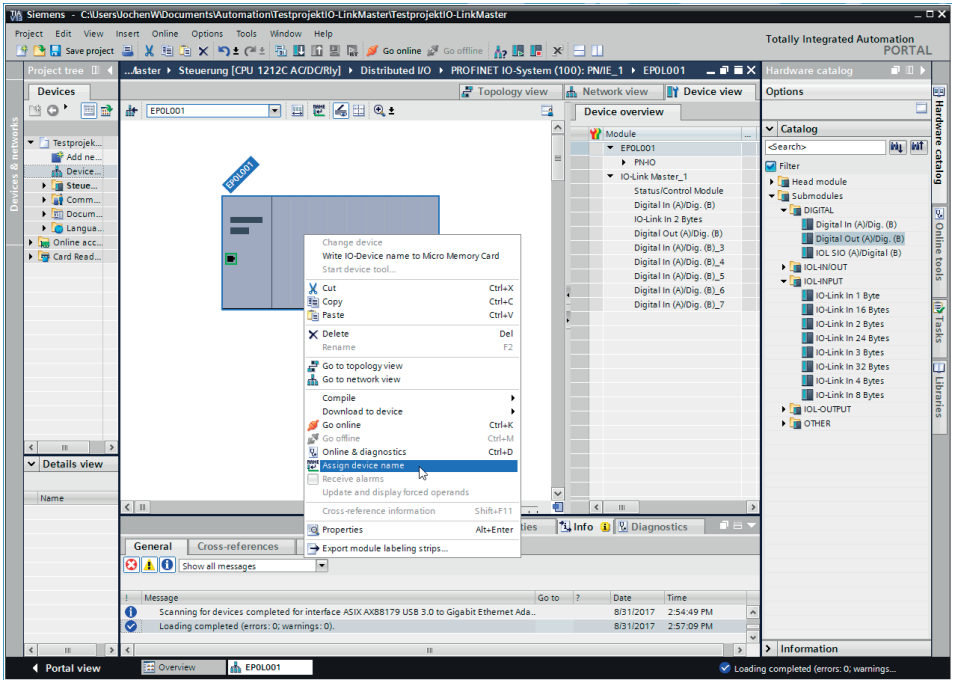
You should observe all notifications in the subsequent Alert window and make any corrections as required.



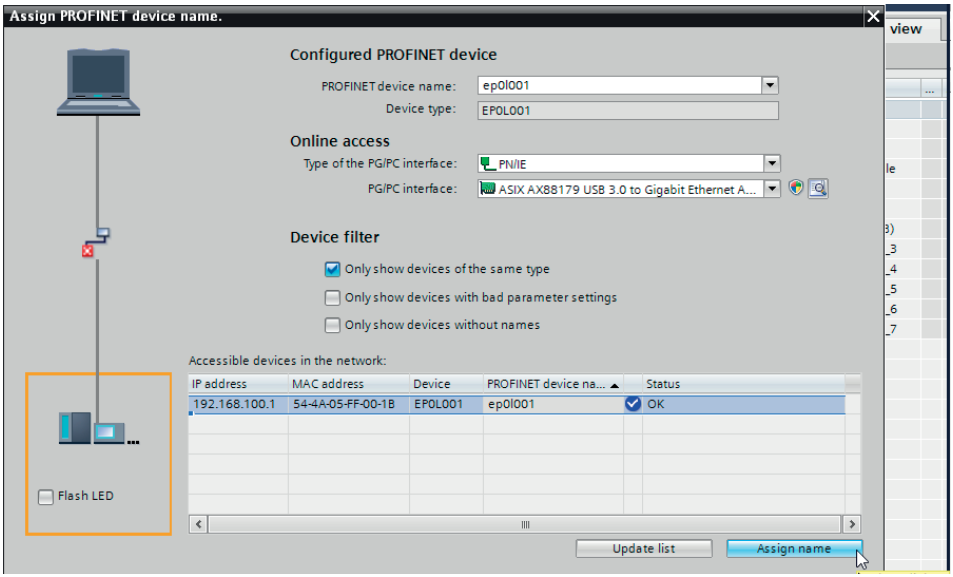
Click on "Finish" to launch the modules.

5.11.1 Allocating the device name

The IO-Link Master needs to be given a unique name, so that it can be suitably assigned in the control environment. To do so, right-click on the controller in the Device view and select "Assign device name".



The IO-Link Master can then be given a name and the name assigned.



IMPORTANT

A basic configuration, including transmission of process data, is now complete. The controller, including the connected IO-Link Master, should thus be in run mode.

5.12 IO-Link device tool configuration (port configuration tool)

This IO-Link Master and the connected IO-link-compatible sensors or actuators can be configured using an IO-Link device tool. The IO-Link Master can be connected to the well-known TMG IO-Link device tool, version 5 or higher, for this purpose. This allows IO-Link devices to be easily configured using IODD (IO-link Device Description files). IODD is recognized worldwide. The IO-Link device tool supports IO-Link V1.0 (IODDs V1.0.1) and IO-Link V1.1 (IODDs V1.1). The corresponding configuration can be saved directly to the connected master using an IO-Link device tool.

Main functions:

- IO-Link device project management
- Port configuration of IO-Link Masters (without connected real-time control)
- IO-Link device operation and configuration by IODD

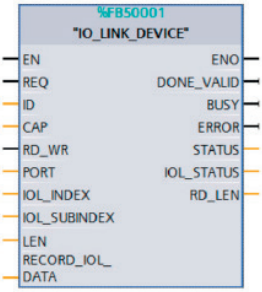
The tool can be used as a standalone program or integrated into the SPS programming software, such as STEP 7 or TIA Portal, via the TCI (Tool Calling Interface).

Please contact the manufacturer directly as an appropriate license is required for the IO-Link device tool.

https://tmg-karlsruhe.de/en/contact

6. IO-Link device parametrization

The Siemens "IO_LINK_DEVICE" TIA function block can be used to write an IO-Link device's parameters and read parameters, measured values and diagnostics data acyclically.



Service data are unambiguously addressed via the index and subindex and can be retrieved using the logic start address for status/control module inputs (ID), the Client Access Point (CAP = 255) and the corresponding IO-Link port (PORT) 1–8 for IO-Link ports).

The function block is always processed over several SPS cycles in such cases. Retrieval, the use of IO-Link port functions and the permanent back up or restoration of device data are to be controlled by the user program. You will find more detailed information in the SIEMENS document "Acyclic read and write with the IO-Link library".

7. SNMP

IO-Link Master devices support the objects required in the PROFINET specifications as per the SNMP v1 protocol standard.
These include objects from RFC 1213 MIB-II (system group and interfaces group) and the LLDP-MIB.
Passwords:

- Read community: public
- Write community: private

8. Media Redundancy Protocol (MRP)

A redundant PROFINET communications can be established with the IO-Link Master via a ring topology without using additional switches. An MRP redundancy manager closes the ring, detects individual faults and sends the data packages via the redundant path in the event of a fault.

The following prerequisites must be met to use MRP:

- All devices must support MRP.
- MRP must be enabled on all devices.
- The devices can only be connected via the ring port.

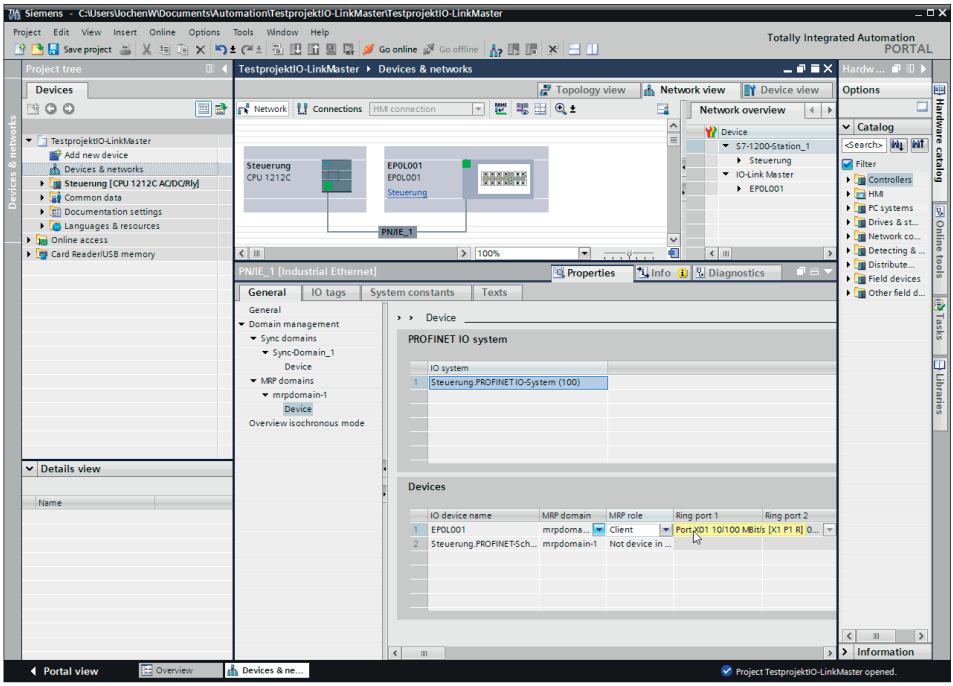
A meshed topology is therefore not permitted.

- Max. 50 devices are permitted in a ring.
- All devices feature the same redundancy domain.
- One device must be configured as a redundancy manager.
- All other devices must be configured as redundancy clients.
- No prioritized ramp-up (FSU) is permitted.
- The addressing surveillance time for all devices must be greater than the

reconfiguration time (typically 200 ms, min. 90 ms).

- It is recommended to use automatic network setting on all devices.

The following screenshot shows the setting option for a possible MRP ring configuration. It is recommended to enable the diagnosis alarm to detect an individual fault.



9. Identification & maintenance functions (I&M)

The PROFINET module is able to clearly identify each individual device built into the system using an electronic nameplate. The user can read such device-specific data on an acyclic basis at any time. Location IDs, installation date and detailed descriptions can also be added to the module during system creation. This range of functions comprise the I&M functions.

9.1 Supported I&M functions

9.1.1 Module-specific I&M functions

The module-specific I&M functions 0 to 4 can be read or written via Slot 0. The data records are assigned using the indicated index.

Data object	Length [byte]	Access	Default value/description
MANUFACTURER_ID	2	Read	0x01D3 (wenglor sensoric GmbH)
ORDER_ID	20	Read	Order number of module in ASCII
SERIAL_NUMBER	16	Read	Defined in production process in ASCII
HARDWARE_REVISION	2	Read	Hardware revision of device
SOFTWARE_REVISION	4	Read	Software revision of device
REVISION_COUNTER	2	Read	Is incremented for each statically saved parameter change in the IO-Link Master (e.g. device name or IP address)
PROFILE_ID	2	Read	0xF600 (Generic device)
PROFILE_SPECIFIC_TYPE	2	Read	0x0003 (IO-Module)
IM_VERSION	2	Read	0x0101 (I&M Version 1.1)
IM_SUPPORTED	2	Read	0x001E (I&M 1...4 is supported)

I&M 0 (Slot 0, Index 0xAFF0)

Data object	Length [byte]	Access	Default value/description
TAG_FUNCTION	32	Read/ write	0x20 ff. (empty)
TAG_LOCATION	22	Read/ write	0x20 ff. (empty)

I&M 1 (Slot 0, Index 0xAFF1)

Data object	Length [byte]	Access	Default value/description
INSTALLATION_DATE	16	Read/ write	0x20 ff. (empty); supported data format is a visible string with a fix length of 16 byte; “YYYY-MM-DD hh:mm” or “YYYY-MM-DD” filled with blank spaces

I&M 2 (Slot 0, Index 0xAFF2)

Data object	Length [byte]	Access	Default value/description
DESCRIPTOR	54	Read/ write	0x20 ff. (empty)

I&M 3 (Slot 0, Index 0xAFF3)

Data object	Length [byte]	Access	Default value/description
SIGNATURE	54	Read/ write	0x20 ff. (empty)

I&M 4 (Slot 0, Index 0xAFF4)

9.1.2 IO-Link Master I&M functions

The IO-Link Master-specific I&M functions 0 to 99 can be read via Slot 1.
The data records are assigned using the indicated index.

Data object	Length [byte]	Access	Default value/description
MANUFACTURER_ID	2	Read	0x01D3 (wenglor sensoric GmbH)
ORDER_ID	20	Read	Order number of module
SERIAL_NUMBER	16	Read	Defined in production process
HARDWARE_REVISION	2	Read	Hardware revision of device
SOFTWARE_REVISION	4	Read	Software revision of device
REVISION_COUNTER	2	Read	Is incremented for each statically saved parameter change in the IO-Link Master (e.g. device name or IP address)
PROFILE_ID	2	Read	0x4E00 (IO-Link Master)
PROFILE_SPECIFIC_TYPE	2	Read	0x0000
IM_VERSION	2	Read	0x0101 (I&M Version 1.1)
IM_SUPPORTED	2	Read	0x0001 (profile-specific)

I&M 0 (Slot 1, Index 0xAFF0)

Data object	Length [byte]	Access	Default value/description
IOL_VERSION	1	Read	0x11 (IO-Link version 1.1)
IOL_PROFILE_VERSION	1	Read	0x10 (IO-Link profile version 1.0)
IOL_FEATURE_SUPPORT	4	Read	0x00000000
NUMBER_OF_PORTS	1	Read	0x08 (number of supported IO-Link ports)
REF_PORT_CONFIG	1	Read	0x00 (no port configuration data supported)
REF_IO_MAPPING	1	Read	0x00 (no I/O mapping data supported)
REF_IPAR_DIRECTORY	1	Read	0x00 (no iPar directory supported)
REF_IOL_M	1	Read	0x00 (no IOL-M parameter supported)
NUMBER_OF_CAPS	1	Read	0x01 (number of Client Access Points)
INDEX_CAP1	1	Read	0xFF (Client Access Point for IOL_CALL)

I&M 99 (Slot 1, Index 0xB063)

9.1.3 IO-Link device ID I&M functions

The IO-Link device specific I&M functions 16 to 23 can be read or written via Slot 1, Subslot 1. The data records are assigned using the indicated index. Only data which is not equal to zero are received if a connection has been established to an IO-Link device.

Data object	Length [byte]	Access	Default value/description
VENDOR_ID	2	Read	0x0000 (IO-Link device – manufacturer ID)
DEVICE_ID	4	Read	0x00000000 (IO-Link device ID)
FUNCTION_ID	2	Read	0x0000 (IO-Link device – function ID)
RESERVED	10	Read	0x00 ff.

I&M 16–23 (Slot 1, Subslot 1, Index 0xB000–0xB007)

9.1.4 Read and write of I&M data

The SIEMENS TIA Portal standard library provides system function blocks which can be used to read and write I&M data. A data record in such blocks contains a block header of 6 bytes and the actual I&M record itself.
The data requested for reading or the data being written thus do not start until after the existing header. The header content also needs to be included when writing. The following table shows the structure of a data record.

Data object	Length [byte]	Data type	Coding	Description
BlockType	2	Word	I&M 0: 0x0020 i&M 1: 0x0021 i&M 2: 0x0022 i&M 3: 0x0023 i&M 4: 0x0024 i&M 16–23: 0x0F00 i&M 99: 0x0F00	BlockHeader
BlockLength	2	Word	I&M 0: 0x0038 i&M 1: 0x0038 i&M 2: 0x0012 i&M 3: 0x0038 i&M 4: 0x0038 i&M 16–23: 0x0014 i&M 99: 0x000F	
BlockVersionHigh	1	Byte	0x01	
BlockVersionLow	1	Byte	0x00	
I&M Data	I&M 0: 54 i&M 1: 54 i&M 2: 16 i&M 3: 54 i&M 4: 54 i&M 16–23: 18 i&M 99: 13	Byte		I&M Record

9.1.5 I&M Read Record

I&M data can be read using the default RDREC (SFB52) function block in TIA. The slot's/subslot's (ID) logic address and the I&MIndex (INDEX) are to be used as the transfer parameters during this process. Return parameters indicate the length of the received I&M data and convey a status or error message.

9.1.6 I&M Write Record

I&M data can be written using the default WRREC (SFB53) function block in TIA. The slot's/subslot's (ID) logic address, the I&MIndex (INDEX) and the data length (LEN) are to be used as the transfer parameters during this process. Return parameters convey a status or error message.

10. Bit assignment

The PROFINET IO-Link Masters use a modular device model.
Slot 1, Subslot 1, contains the IO-Link Master status and control module. This module always features 4 byte input and 4 byte output data and is always permanently pre-configured based on the GSDML file when a IO-Link master is selected.
The IO-Link ports are mapped in the consecutive Subslots 2 to 9 in Slot 1 and may feature a different operating mode and data length depending on the configuration.

10.1 Digital IO mapping mode 1 (default mapping)

Mapping Mode 1 has been selected during the IO-Link master configuration, so the status and control module data are transferred as follows.

10.1.1 Status/control module input data

Byte	Byte 0, digital input status							
Bit	7	6	5	4	3	2	1	0
Port	X4	X4	X3	X3	X2	X2	X1	X1
Pin	2	4	2	4	2	4	2	4
Channel	4	4	3	3	2	2	1	1

Byte 0, digital input status

Byte	Byte 1, digital input status							
Bit	7	6	5	4	3	2	1	0
Port	X8	X8	X7	X7	X6	X6	X5	X5
Pin	2	4	2	4	2	4	2	4
Channel	8	8	7	7	6	6	5	5

Byte 1, digital input status

Byte	Byte 2, IOL-COM state							
Bit	7	6	5	4	3	2	1	0
Port	X8	X7	X6	X5	X4	X3	X2	X1
Pin	4	4	4	4	4	4	4	4
Channel	8	7	6	5	4	3	2	1

Byte 2, IOL-COM state

Byte	Byte 3, IOL PD valid							
Bit	7	6	5	4	3	2	1	0
Port	X8	X8	X7	X7	X6	X6	X5	X5
Pin	4	4	4	4	4	4	4	4
Channel	8	7	6	5	4	3	2	1

Byte 3, IOL PD valid

Key:

- The status of the digital outputs is given in the digital input data.
- The data in the cells highlighted in blue show the status of the outputs.
- Channel: the used PROFINET device model channel number for the diagnosis messages.
- IOL-COM state: the "IOL-COM state" indicates whether the relevant port has established communication with the IO-Link device.
- IOL-PD valid: the "IOL-PD valid" information indicates whether the relevant port's IO-Link process data are valid.

10.1.2 Output data from status/control modules

Byte	Byte 0, IOL PD valid							
Bit	7	6	5	4	3	2	1	0
Port	X4	X4	X3	X3	X2	X2	X1	X1
Pin	—	4	—	4	—	4	—	4
Channel	—	3	—	3	—	2	—	1

Byte 0, digital output state

Byte	Byte 1, digital output state							
Bit	7	6	5	4	3	2	1	0
Port	X8	X8	X7	X7	X6	X6	X5	X5
Pin	2	4	2	4	2	4	2	4
Channel	8	8	7	7	6	6	5	5

Byte 1, digital output state

Byte	Byte 2, digital output state							
Bit	7	6	5	4	3	2	1	0
Port	X8	X7	X6	X5	X4	X3	X2	X1
Pin	4	4	4	4	4	4	4	4
Channel	8	7	6	5	4	3	2	1

Byte 2, COM mode

Byte	Byte 3, reserved							
Bit	7	6	5	4	3	2	1	0
Port	—	—	—	—	—	—	—	—
Pin	—	—	—	—	—	—	—	—
Channel	—	—	—	—	—	—	—	—

Byte 3, reserved

Key:

- Byte 0, (Pin 4, C/Q mode): The process data can be used to control the digital output on the corresponding port. The IO-Link port must be configured as a digital output in the engineering tool.
- Byte 2 (COM mode) allows one or more IO-Link ports which have been previously configured in digital input (DI) operating mode to switch to IO-Link operating mode temporarily (provided that the corresponding COM port has been activated). This ensures that communication can be established to parametrize with the connected IO-Link device. There is no process data exchange during this time.

10.2 Digital IO mapping mode 2 (E2C compatibility)

Has been selected during the Mapping Mode 2 IO-Link Master configuration.

10.2.1 Status/control module input data

Byte	Byte 0, digital input status							
Bit	7	6	5	4	3	2	1	0
Port	X8	X7	X6	X5	X4	X3	X2	X1
Pin	4	4	4	4	4	4	4	4
Channel	8	7	6	5	4	3	2	1

Byte 0, digital input status

Byte	Byte 1, digital input status							
Bit	7	6	5	4	3	2	1	0
Port	X8	X7	X6	X5	X4	X3	X2	X1
Pin	2	2	2	2	2	2	2	2
Channel	8	7	6	5	4	3	2	1

Byte 1, digital input status

Byte	Byte 2, IOL-COM state							
Bit	7	6	5	4	3	2	1	0
Port	X8	X7	X6	X5	X4	X3	X2	X1
Pin	4	4	4	4	4	4	4	4
Channel	8	7	6	5	4	3	2	1

Byte 2, IOL-COM state

Byte	Byte 3, IOL PD valid							
Bit	7	6	5	4	3	2	1	0
Port	X8	X7	X6	X5	X4	X3	X2	X1
Pin	4	4	4	4	4	4	4	4
Channel	8	7	6	5	4	3	2	1

Byte 3, IOL PD valid

Key:

- The status of the digital outputs is given in the digital input data.
- The data in the cells highlighted in dark gray show the status of the outputs.
- Channel: the used PROFINET device model channel number for the diagnosis messages.
- IOL-COM state: the "IOL-COM state" indicates whether the relevant port has established communication with the IO-Link device.
- IOL-PD valid: the "IOL-PD valid" information indicates whether the relevant port's IO-Link process data are valid.

10.2.2 Output data from status/control modules

Byte	Byte 0, digital output state							
Bit	7	6	5	4	3	2	1	0
Port	X8	X7	X6	X5	X4	X3	X2	X1
Pin	4	4	4	4	4	4	4	4
Channel	8	7	6	5	4	3	2	1

Byte 0, digital output state

Byte	Byte 1, digital output state							
Bit	7	6	5	4	3	2	1	0
Port	X8	X7	X6	X5	X4	X3	X2	X1
Pin	2	2	2	2	—	—	—	—
Channel	8	7	6	5	—	—	—	—

Byte 1, digital output state

Byte	Byte 2, COM mode							
Bit	7	6	5	4	3	2	1	0
Port	X8	X7	X6	X5	X4	X3	X2	X1
Pin	4	4	4	4	4	4	4	4
Channel	8	7	6	5	4	3	2	1

Byte 2, COM mode

Byte	Byte 3, reserved							
Bit	7	6	5	4	3	2	1	0
Port	—	—	—	—	—	—	—	—
Pin	—	—	—	—	—	—	—	—
Channel	—	—	—	—	—	—	—	—

Byte 3, reserved

Key:

- Byte 0, (Pin 4, C/Q mode): The process data can be used to control the digital output on the corresponding port. The IO-Link port must be configured as a digital output in the engineering tool.
- Byte 2 (COM mode) allows one or more IO-Link ports which have been previously configured in digital input (DI) operating mode to switch to IO-Link operating mode temporarily (provided that the corresponding COM port has been activated). This ensures that communication can be established to parametrize with the connected IO-Link device. There is no process data exchange during this time.

11. Process data for IO-Link ports, Slot 1/Subslot 2 – Subslot 9

The process data lengths of the IO-Link ports in COM mode depend on the IO-Link port configuration X1 – X8.
Data lengths can be configured between 1 and 32 byte input data and/or 1 and 32 byte output data.
The data contents should be taken from the descriptions of the IO-Link devices. If there is no exact data length for configuration for the IO-Link device, the next highest data length should be selected.
The selected mapping mode for the status/control modules has no impact on the IO-Link ports' process data.

12. Handling of diagnoses

12.1 Errors in the system/sensor power supply

The voltage value reading for the incoming system/sensor power supply is monitored across the board. An error message is generated if the voltage falls below about 18.6 V or exceeds about 30 V.
The green US indicator goes out.
The error message has no impact on the outputs.

ATTENTION!
It must be assured at all times that supply voltage – measured at the most distant user – is no less than 18 V DC from a system power supply standpoint.

The following collective diagnosis message is generated:

Channel number of diagnosis	0x8000 (diagnosis not channel-related)
Channel-related diagnosis code	0x0002
Channel-related diagnosis code message	Undervoltage
Extended description	Voltage fault in auxiliary power supply (U_{AUX}), detected by IO-Link Master.

12.2 Error in the auxiliary/actuator power supply

The voltage value reading for the incoming auxiliary/actuator power supply is monitored across the board. If a U_{AUX} diagnosis message is activated, an error message is generated if the voltage falls below about 18.6 V or exceeds about 30 V.
The U_{AUX} indicator lights up red.
If output channels are activated, other error messages triggered by the voltage error are generated at the I/O ports.
The U_{AUX} diagnosis message is disabled in the default setting and must be activated by parametrization.
The following collective diagnosis is generated:

Channel number of diagnosis	0x8000 (diagnosis not channel-related)
Channel-related diagnosis code	0x0103
Channel-related diagnosis code message	Voltage fault in auxiliary power supply (U_{AUX}), detected by IO-Link Master.

12.3 Overload/short circuit in the I/O port sensor power supply outputs

The following channel-specific diagnosis messages are generated in the event of an overload or short circuit between Pin 1 and Pin 3 in the ports (X1 – X8).

Channel number of diagnosis	0x01 – 0x08
Channel-related diagnosis code	0x01
Channel-related diagnosis code message	Short circuit
Extended description	Short circuit or overload in the sensor power supply at Pin 1 in I/O port detected by the IO-Link Master.

Following error message is generated as an alternative:

Channel number of diagnosis	0x01 – 0x08
Channel-related diagnosis code	0x0113
Channel-related diagnosis code message	IO-Link Port driver's high temperature limit exceeded (short circuit or overload), detected by IO-Link Master.

12.4 Overload/short circuit in the 500 mA digital outputs

The digital outputs on the C/Q pin are short-circuit- and overvoltage-proof. In the event of an error, the output is automatically switched off and automatically switched on again on a cyclical basis.
The device delivers the following PROFINET diagnosis message in the event of a fault:

Channel number of diagnosis	0x01 – 0x08
Channel-related diagnosis code	0x010A
Channel-related diagnosis code message	Short circuit or overload in digital output at Pin 4/Ch. A in IO-Link port in DIO mode, detected by IO-Link Master.

12.5 Overload/short circuit in the 2.0 A digital outputs

There are four 2.0-A outputs are available in the Class B ports in the IO-Link Master module.
A channel error is detected by comparing the target value set by a controller and the actual value in an output channel.

Target value	Actual value	Remark
Active	Active	OK; no diagnosis
Off	Off	OK; no diagnosis
Active	Off	Short circuit Channel indicator is red. Channel error bit in the diagnosis is activated. Channel is blocked after error is eliminated.

Interpretation of channel errors

If an output signal is enabled (rising edge in the channel status)
or disable (falling edge), the channel errors are filtered for the time interval which you have established in the "Surveillance timeout" parameter when configuring the module. The value of this parameter
is between 0 to 255 ms; the factory setting is 80 ms.
The filter is used to prevent premature error messages when switching on a capacitive load, switching off an inductive load or other voltage spikes caused by a change in status.
The filter time is typically 5–10 ms. between error detection and a diagnosis message when the output channel is in a static state, while it is thus permanently switched on or off.

The device delivers the following PROFINET diagnosis message in such a case:

Channel number of diagnosis	0x05 – 0x08
Channel-related diagnosis code	0x0109
Channel-related diagnosis code message	Short circuit or overload in digital output at Pin 2/Ch. B in IO-Link port type, detected by IO-Link Master.

12.6 Overload/short circuit in the auxiliary power supply (U_{AUX}) at Class B port

The following channel-specific diagnosis message is generated in the event of an overload or short circuit between Pin 2 and Pin 5 in these ports (X5 – X8).

Channel number of diagnosis	0x05 – 0x08
Channel-related diagnosis code	0x0108
Channel-related diagnosis code message	Short circuit or overload detected by the IO-Link Master in the sensor power supply at Pin 2 in IO-Link type ports.

12.7 IO-Link C/Q error

The following error message is generated if an IO-Link device is detached in COM mode or an electrical fault occurs at C/Q (Pin 4) due to a short circuit, for example.

Channel number of diagnosis	0x01 – 0x08
Channel-related diagnosis code	0x0006
Channel-related diagnosis code message	Line break
Extended description	Missing/incorrect device, cable break or short circuit/ overload detected by IO-Link Master at Pin 4/Ch. A in IO-Link port.

12.8 IO-Link device diagnoses

Diagnoses from IO-Link devices which send the device to the IO-Link Master are reported using a standard channel diagnoses and an extended channel diagnosis.
Standard channel diagnosis message:

Channel number of diagnosis	0x01 – 0x08
Channel-related diagnosis code	Depends on IO-Link device diagnosis
Channel-related diagnosis code message	Depends on IO-Link device diagnosis

Extended channel diagnosis message:

Channel number of diagnosis	0x01 – 0x08
Channel-related diagnosis code	0x9000
Channel-related diagnosis code message	EventCode << 16 | ChannelNumber << 8 | EventQualifier

- EventCode: diagnosis code reported by the IO-Link device.
  Use the IO-Link device documentation to interpret the error message.
- ChannelNumber: 1–8 in the IO-Link Master port where a connected device reports an error.

- Event qualifier:

	Byte 2, COM mode		Type		Res.	Instance		
Bit	7	6	5	4	3	2	1	0

- Event qualifier instance:

Value	Definition
0	Unknown
1	Phy
2	DL
3	AL
4	Application
5 to 7	Reserved

• Event qualifier res.: this bit is reserved and should be set to 0.

• Event qualifier type:

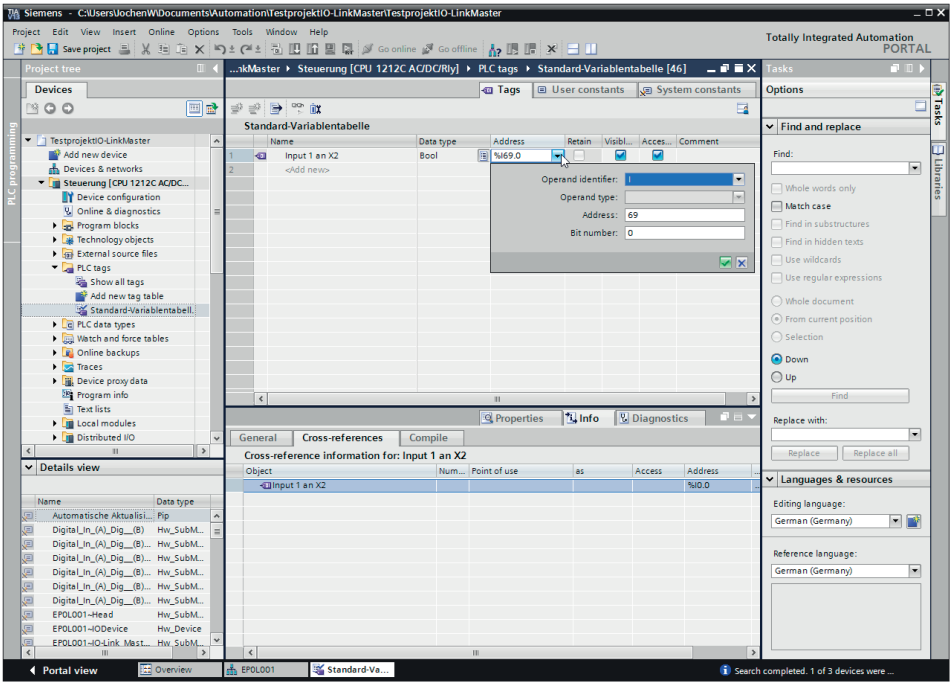
Value	Definition
0	Reserved
1	Information
2	Warning
3	Error

• Event qualifier mode:

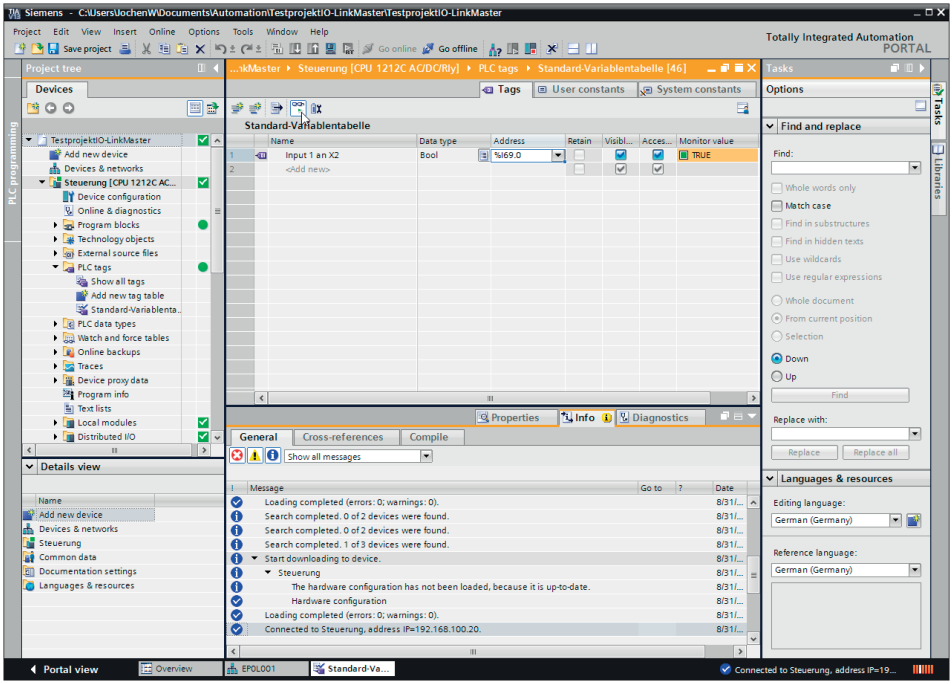
Value	Definition
0	Reserved
1	Event single shot
2	Event disappears
3	Event appears

Writing process data on the controller

The data type and the input address for process data can now be entered in the controller's standard variables table.



The "Monitor all" icon (glasses icon with an arrow in the tags screen in the standard variables table) can then be used to issue the programmed process data value:



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Information included in these operating instructions is subject to change without notice.