SMART
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IO-LINK Master

PROFINET IO and Modbus/TCP

EN 2019/04/15 - 50141762

ORIGINAL OPERATING INSTRUCTIONS

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1 Introduction

This document provides installation, configuration, and embedded web interface information for the Leuze IO-Link Master (IOLM). In addition, it includes detailed information about PROFINET IO and Modbus/TCP.

The web interface provides a platform so that you can easily configure, review diagnostic pages, and access advanced features, such as the ability to:

- Upload the latest IOLM images or applications
- Set up user accounts with different user levels and passwords
- Load IODD files and configure IO-Link device parameters
- Implement manual or automatic data storage (upload or download)
- Implement device and/or data validation

The IOLM installation includes the following procedures.

1. Connect the power and Ethernet cable (see Page 8).

	NOTE
	MD 748i-11-42/L5-2222, MD 748i-11-82/L5-2222, and MD 748iC-11-82/L5-2222 F001: If desired you can use the rotary switch to set the IP address (see Page 8).

2. Download, unzip, and upload the GSD file for the IO-Link Master (IOLM).
3. Insert the IOLM in the PROFINET IO system.
4. Configure the IP address for the IOLM.
5. Assign the PROFINET Device Name.
6. Set the IO Device Update Time.
7. Configure the IO-Link ports.
   a. Configure IO-Link port modules.
   b. Configure port status modules.
   c. If desired, configure data storage, automatic or manual - upload or download.
   d. If desired, configure device validation and data validation.
   e. Use the Diagnostic pages to monitor or troubleshoot your devices.
8. Use Chapter 12 PROFINET IO Reference Information on Page 113 to complete configuration after attaching the IO-Link devices

2 Hardware Installation

Use the appropriate hardware installation for your IOLM model:

- MD 748i-11-42/L5-2222 Hardware Installation
- MD 748i-11-82/L5-2222 and MD 748iC-11-82/L5-2222 F001 Hardware Installation on Page 13
- MD 248i-12-8K/L4-2R2K Hardware Installation on Page 18

NOTE	
	Refer to Chapter 5 Connecting Devices on Page 57 for information about connecting IO-Link or digital devices to the ports after you program the network information using the next chapter.

2.1 MD 748i-11-42/L5-2222 Hardware Installation

Use the following subsections to install the hardware and verify operation.

- Setting the Rotary Switch on Page 8
- Connecting to the Network on Page 10
- Connecting the Power on Page 10
- Mounting the MD 748i-11-42/L5-2222 on Page 12

NOTE	
	Refer to MD 748i-11-42/L5-2222 IO-Link Ports on Page 57 for information about connecting IO- Link or digital devices to the ports after you program the network information using the next chapter.

2.1.1 Setting the Rotary Switch

You can use the rotary switches under the configuration window on the IOLM to set the lower 3-digits (8 bits) of the static IP address.

If the rotary switches are set to a non-default position, the upper 9-digits (24 bits) of the IP address are then taken from the static network address. The switches only take effect during startup, but the current position is always shown on **Help | SUPPORT** page.

Using the rotary switches to set the IP address may be useful in the following situations:

- A permanent method to assign IP addresses while setting machines for a special application where a PC or laptop is not available.
- A temporary method to assign IP addresses to several IOLMs so that they do not have duplicate addresses to make setting the IP addresses using software easier. After using the web page to change the IP address, reset the rotary switches back to 000.
- An emergency method to return the IOLM back to factory defaults, so that software can be used to program the appropriate IP address, and then return the switches back to 000.

NOTE	
	If you set the network address using the rotary switches, the Rotary Switch setting overrides the network settings in the web interface when the IOLM is initially powered on or after cycling the power.

Switch Setting	Node Address
000 (Default setting)	Use the network configuration stored in the flash. The default network configuration values are: • IP address = 192.168.60.101 • Subnet mask = 255.255.255.0 • IP gateway = 0.0.0.0 After completing the hardware installation, see Chapter 3 Configuring the IOLM with STEP 7 on Page 21 to set the network address.
001-254	This is the last three digits in the IP address. This uses the first three numbers from the configured static address, which defaults to 192.168.60.xxx. ***Note!*** *If software is used to change the IP address to another range before setting the rotary switches, the IOLM uses that IP address range. For example, if the IOLM is set to 10.0.0.250 and the first rotary switch is set to 2, the IP address would be 10.0.0.200.*
255-887	Reserved.
888	Reset to factory defaults. If the IOLM is set to 888 and the IP address is changed using other methods, the IP address is returned to the default IP address if the IOLM is rebooted or power cycled.
889-997	Use the network configuration values stored in the flash (reserved).
998	Setting the rotary switches to 998 configures the IOLM to use DHCP addressing.
999	Use the default IP address. If the IOLM is set to 999 and the IP address is changed using other methods, the IP address is returned to the default IP address if the IOLM is rebooted or power cycled.

Use the following steps if you want to change the default rotary switch settings.

1. Remove the two Phillips screws securing the switch window.
2. Gently swing open the switch window from the left to the right, allowing it to pivot on the hinge on the right side.
3. Turn each dial to the appropriate position using a small flathead screwdriver.

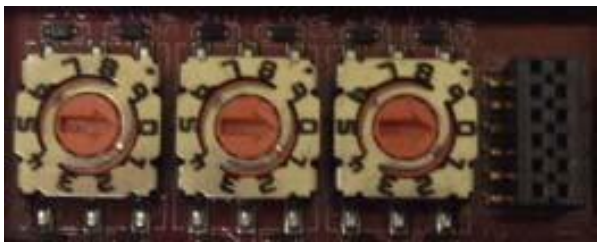


Figure 1: The default setting is 000 as shown above.
The arrow points to the switch location. 0 is located at the 3:00

NOTE	
	If you are using the rotary switch to assign a temporary IP address, you may want to leave the door open until you use software to set a permanent IP address. After doing so, you can close and seal the window.

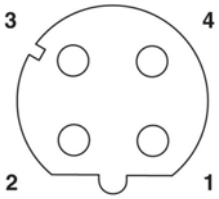
4. Carefully close the window making sure that it is properly aligned.
5. Reinsert and hand-tighten the two screws making sure that the window is securely sealed.

NOTE
Failure to reassemble the configuration window properly may compromise IP67 integrity.

2.1.2 Connecting to the Network

The IOLM provides two Fast Ethernet (10/100BASE-TX) M12, 4-pin female D-coded connectors.

Pin	Signal
1	Tx+
2	Rx+
3	Tx-
4	Rx-



You can use this procedure to connect the IOLM to the network.

1. Securely connect one end of a shielded twisted-pair (Cat 5 or higher) M12 Ethernet cable to either Ethernet port.
2. Connect the other end of the cable to the network.
3. Optionally, use the other Ethernet port to daisy-chain to another Ethernet device.
4. If you did not connect both Ethernet ports, make sure that the unused port is covered with a connector cap to keep dust and liquids from getting in the connector.

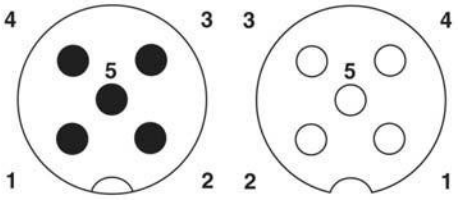
NOTE
Ethernet ports must have an approved cable or protective cover attached to the connector to guarantee IP67 integrity.

2.1.3 Connecting the Power

The MD 748i-11-42/L5-2222 provides M12 (5-poles) A-coded power input and output connectors. Use a 24VDC power supply that is capable of the total output current required.

NOTE
Power connectors must have an approved cable or protective cover attached to the port guarantee to IP67 compliance.

Pin	Power Input (Male)	Power Output (Female)
1	L+	L+
2	L2+	L2+
3	L-	L-
4	L2-	L2-
5	Not connected	Not connected



The MD 748i-11-42/L5-2222 requires a UL listed power supply with an output rating of 24VDC.

Power Supply	Values
Power Supply In - Maximum (U_S)	4A
IO-Link Connectors (Ports 1 - 4) C/Q (Pin 4) L+/L- (Pins 1 and 3)	 200 mA (Maximum) 500 mA (Maximum)
IOLM Power	100mA @ 24VDC (V_S)
Power Supply Out (US)	4A * (Maximum)
* V_S output available is determined by subtracting the following from the available input current. • IO-Link Master module electronics current. • Actual VS current for each IO-Link port. • Total L+/L- current for all IO-Link ports. • Total C/Q current for all IO-Link ports.	

You can use this procedure to connect the MD 748i-11-42/L5-2222 to a power supply.

NOTE	
	Power should be disconnected from the power supply before connecting it to the MD 748I-11-42/L5- 2222. Otherwise, your screwdriver blade can inadvertently short your power supply terminal connections to the grounded enclosure.

1. Securely attach the power cable between the male power connector (**PWR In**) and the power supply.
2. Either attach a power cable between the female power connector and another device to which you want to provide power or securely attach a connector cap to prevent dust or liquids from getting into the connector.
3. Apply the power and verify that the following LEDs are lit indicating that you are ready to attach your IO-Link or digital I/O devices. For more information about the LEDs, see MD 748i-11-42/L5-2222 LEDs on Page 149.

LED Activity During Power On Sequence - MD 748i-11-42/L5-2222	
uBoot Bootloader v1.00 through v1.23	**uBoot Bootloader v1.24 or higher**
1. The PWR LED lights. 2. The ETH LED lights on the connected port. 3. The IO-Link LEDs flash (if no IO-Link device attached) or are lit if an IO-Link device is attached. If a PLC is connected: NET LED is lit and green.	1. The PWR LED lights. 2. The ETH LED lights on the connected port. 3. The MOD and NET LEDs light red/amber. 4. The IO-Link LEDs flash (if no IO-Link device attached) or are lit if an IO-Link device is attached. If a PLC is connected: NET LED is lit and green.

If the LEDs indicate that you are ready to go to the next installation step:

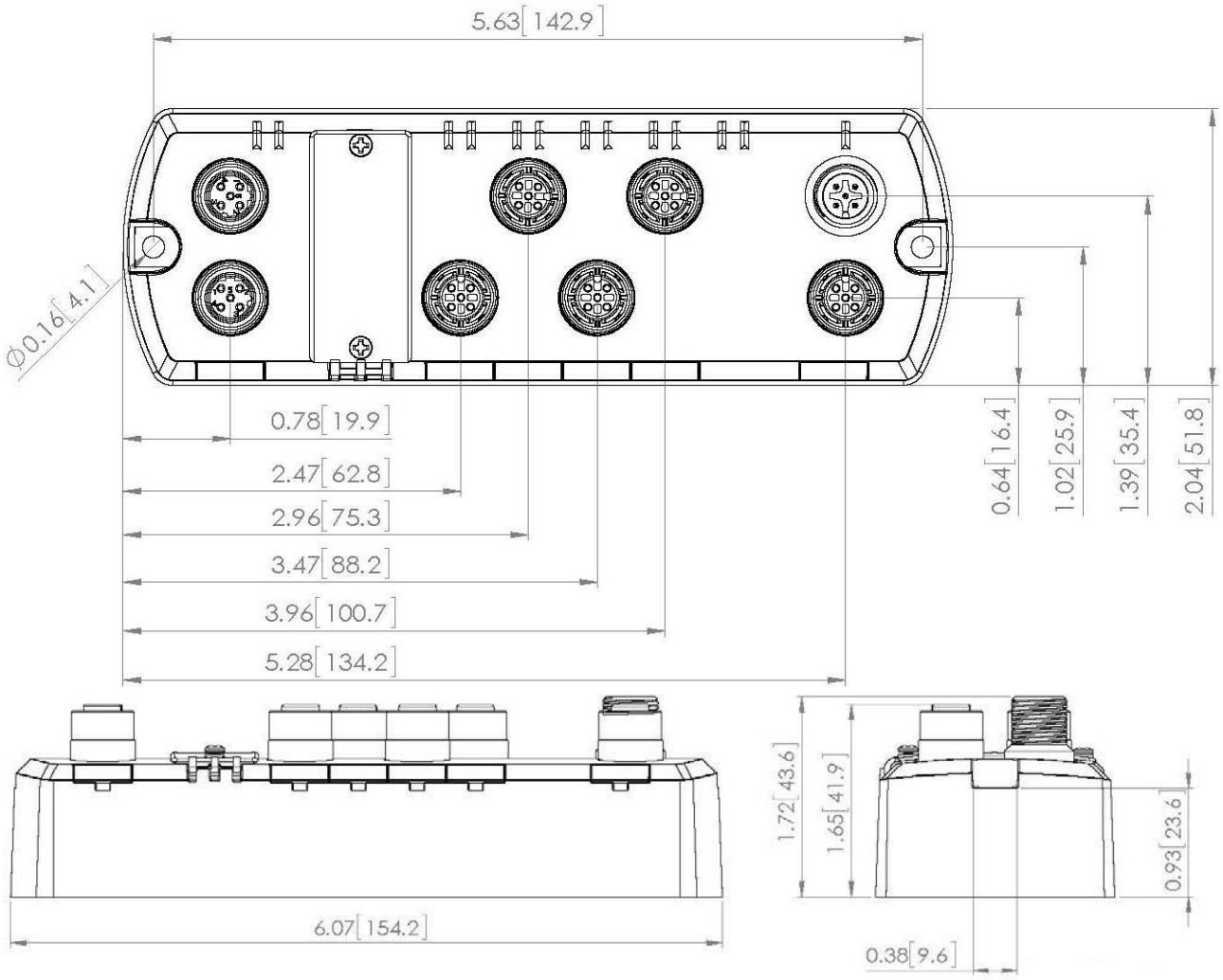
- Program the IP address using the web interface. Refer to Chapter 3 Configuring the IOLM with STEP 7 on Page 21 for configuring the network information.
- If using the rotary switches to set the IP address, then you are ready to attach devices using Chapter 5 Connecting Devices on Page 57.

If the LEDs do not meet the above conditions, you can refer to MD 748i-11-42/L5-2222 LEDs on Page 149 in the Troubleshooting and Technical Support chapter for more information.

2.1.4 Mounting the MD 748i-11-42/L5-2222

Use the following procedure to mount the IOLM. You can mount the IOLM on a mounting panel or a machine.

1. Verify that the mounting surface is level (flat) to prevent mechanical stress to the IOLM.
2. Attach the IOLM to the surface with two 6mm screws and washers, torque down to 8 Nm.



2.2 MD 748i-11-82/L5-2222 and MD 748iC-11-82/L5-2222 F001 Hardware Installation

Use the following subsections to install the hardware and verify operation.

- Setting the Rotary SwitchMD 748i-11-82/L5-2222 and MD 748iC-11-82/L5-2222 F001 Hardware Installation on Page 13
- Connecting the Power on Page 15
- Mounting the MD 748i-11-82/L5-2222 and MD 748iC-11-82/L5-2222 F001 on Page 18

NOTE	
	Refer to 5.2 MD 748i-11-82/L5-2222 and MD 748iC-11-82/L5-2222 F001 IO-Link Ports on Page 58 for information about connecting IO-Link or digital devices to the ports after you program the network information using the next chapter.

2.2.1 Setting the Rotary Switch

You can use the rotary switches under the configuration window on the IOLM to set the lower 3-digits (8 bits) of the static IP address.

If the rotary switches are set to a non-default position, the upper 9-digits (24 bits) of the IP address are then taken from the static network address. The switches only take effect during startup, but the current position is always shown on **Help | SUPPORT** page.

Using the rotary switches to set the IP address may be useful in the following situations:

- A permanent method to assign IP addresses while setting machines for a special application where a PC or laptop is not available.
- A temporary method to assign IP addresses to several IOLMs so that they do not have duplicate addresses to make setting the IP addresses using software easier. After using the web page to change the IP address, reset the rotary switches back to 000.
- An emergency method to return the IOLM back to factory defaults, so that software can be used to program the appropriate IP address, and then return the switches back to 000.

NOTE	
	If you set the network address using the rotary switches, the Rotary Switch setting overrides the network settings in the web interface when the IOLM is initially powered on or after cycling the power.

Switch Setting	Node Address
000 (Default setting)	Use the network configuration stored in the flash. The default network configuration values are: • IP address = 192.168.60.101 • Subnet mask = 255.255.255.0 • IP gateway = 0.0.0.0 After completing the hardware installation, see Chapter 3 Configuring the IOLM with STEP 7 on Page 21 to set the network address using the web interface.
001-254	This is the last three digits in the IP address. This uses the first three numbers from the configured static address, which defaults to 192.168.60.xxx.  ***Note!*** *If software is used to change the IP address to another range before setting the rotary switches, the IOLM uses that IP address range. For example, if the IOLM is set to 10.0.0.250 and the first rotary switch is set to 2, the IP address would be 10.0.0.200.*
255-887	Reserved.
888	Reset to factory defaults. If the IOLM is set to 888 and the IP address is changed using other methods, the IP address is returned to the default IP address if the IOLM is rebooted or power cycled.
889-997	Use the network configuration values stored in the flash (reserved).
998	Setting the rotary switches to 998 configures the IOLM to use DHCP addressing.
999	Use the default IP address. If the IOLM is set to 999 and the IP address is changed using other methods, the IP address is returned to the default IP address if the IOLM is rebooted or power cycled.

Use the following steps if you want to change the default rotary switch settings.

1. Gently pop open the window using a small flathead screwdriver.
2. Gently swing open the switch window from the top to the bottom, allowing it to pivot on the hinge on the bottom of the window.
3. Turn each dial to the appropriate position using a small flathead screwdriver.

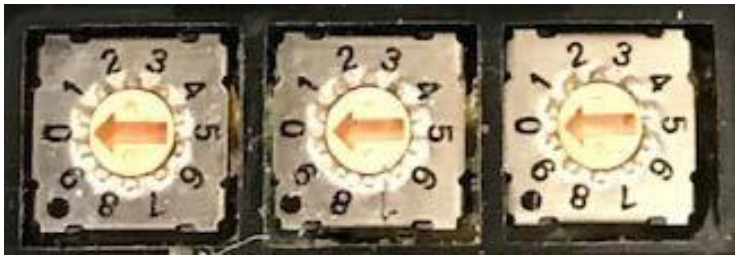


Figure 2: The default setting is 000 as shown above.
The arrow points to the switch location. 0 is located at the 9:00 position. Turn the dial clockwise to the appropriate setting.

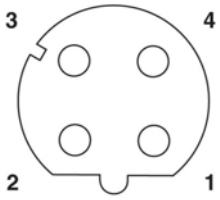
4. Close the window and make sure that it snaps shut tightly.

	NOTE
	Failure to close the configuration window properly may compromise IP67 integrity.

2.2.2 Connecting to the Network

The IOLM provides two Fast Ethernet (10/100BASE-TX) M12, 4-pin female D-coded connectors.

Pin	Signal
1	Tx+
2	Rx+
3	Tx-
4	Rx-



You can use this procedure to connect the IOLM to the network.

1. Securely connect one end of a shielded twisted-pair (Cat 5 or higher) M12 Ethernet cable to either Ethernet port.
2. Connect the other end of the cable to the network.
3. Optionally, use the other Ethernet port to daisy-chain to another Ethernet device.
4. If you did not connect both Ethernet ports, make sure that the unused port is covered with a connector cap to keep dust and liquids from getting in the connector.

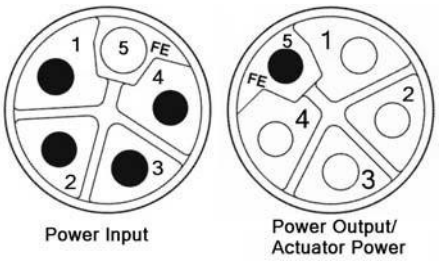
	NOTE
	Ethernet ports must have an approved cable or protective cover attached to the connector to guarantee IP67 integrity.

2.2.3 Connecting the Power

The MD 748i-11-82/L5-2222 and MD 748iC-11-82/L5-2222 F001 provides M12 (5-poles) L-coded input and output power connectors. Use a 24VDC power supply capable of the total output current required.

NOTE
Power connectors must have an approved cable or protective cover attached to the port guarantee to IP67 compliance. If you require cables or protective covers, see the Leuze web site.

Pin	Power Input (Male)	Power Output or Actuator Power (Female)	Description
1	US+	US+ or +V	IO-Link Master's system electronics and IO-Link devices
2	UA-	UA- or 0V	Actuator supply
3	US-	US- or 0V	IO-Link Master's system electronics and IO-Link devices
4	UA+	UA+ or +V	Actuator supply
5	FE		



NOTE
The IOLM requires a UL listed power supply with an output rating of 24VDC.

Power Supply	Values
Power Supply In - Maximum V_S and V_A	16A (Maximum)
IO-Link Connector **Port 1** C/Q (Pin 4) L+/L- Sensor Supply (Pins 1 and 3)	200 mA (Maximum) 1.6A (Maximum)
IO-Link Connector **Port 3** C/Q (Pin 4) L+/L- Sensor Supply (Pins 1 and 3)	200 mA (Maximum) 1.A (Maximum)
IO-Link Connectors **Ports 2 and 4 - 8** C/Q (Pin 4) L+/L- Sensor Supply (Pins 1 and 3)	200 mA (Maximum) 500 mA (Maximum)/up to 1A Output Budget ***Note!*** *See MD 748i-11-82/L5-2222 and MD 748iC-11-82/L5-2222 F001 IO-Link Ports on Page 58 for information about how to divide up the power output between ports.*

Power Supply	Values
IOLM Power	100mA @ 24VDC (V_S)
Power Supply Out V_S V_A	 16A * (Maximum) 16A ** (Maximum)
* V_S output available is determined by subtracting the following from the available input current. • IO-Link Master module electronics current. • Total L+/L- current for all IO-Link ports. • Total C/Q current for all IO-Link ports. ** VA output available is the same as the available VA input current.	

You can use the following procedure to connect the IOLM to a power supply.

NOTE
Power should be disconnected from the power supply before connecting it to the IOLM. Otherwise, your screwdriver blade can inadvertently short your power supply terminal connections to the grounded enclosure.

1. Securely attach the power cable between the male power connector (**PWR In**) and the power supply.
2. Either attach a power cable between the female power connector and another device to which you want to provide power or securely attach a connector cap to prevent dust or liquids from getting into the connector. Contact your Customer Sales Representative if you need to order connector caps for the MD 748i-11-82/L5-2222 and MD 748iC-11-82/L5-2222 F001.
3. Apply the power and verify that the following LEDs are lit indicating that you are ready to attach your IO-Link or digital I/O devices.
   a. The **US** LED lights.
   b. The **XF1/XF2** LED lights on the connected port.
   c. The **MS** and **NS** LEDs light orange.
   d. The IO-Link LEDs flash (if no IO-Link device attached) or are lit if an IO-Link device is attached.

NOTE
It takes approximately 25 seconds after power up for the IO-Link Master to be ready for operation.

   e. If a PLC is connected, the NS LED is lit and green.

If the LEDs indicate that you are ready to go to the next installation step:

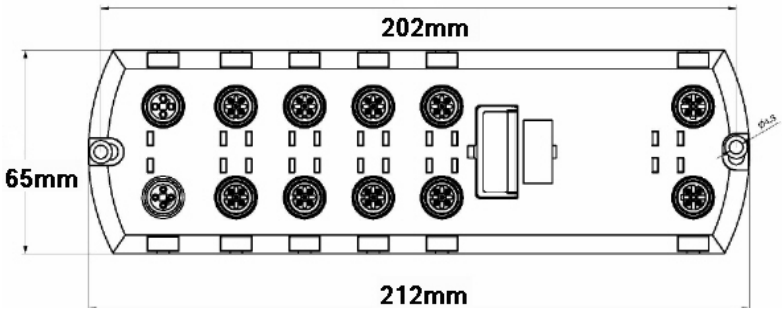
- Program the IP address using the web interface. Refer to Chapter 3 Configuring the IOLM with STEP 7 on Page 21 for configuring the network information.
- If using the rotary switches to set the IP address, then you are ready to attach devices using Chapter 5 Connecting Devices on Page 57.

If the LEDs do not meet the above conditions, you can refer to MD 748i-11-82/L5-2222 and MD 748iC-11-82/L5-2222 F001 LEDs on Page 150 in the Troubleshooting and Technical Support chapter for more information.

2.2.4 Mounting the MD 748i-11-82/L5-2222 and MD 748iC-11-82/L5-2222 F001

Use the following procedure to mount the IOLM. You can mount the IOLM on a mounting panel or a machine.

1. Verify that the mounting surface is level (flat) to prevent mechanical stress to the IOLM.
2. Attach the IOLM to the surface with two 6mm screws and washers, torque down to 8 Nm.



2.3 MD 248i-12-8K/L4-2R2K Hardware Installation

Use the following information to install the hardware for the MD 248i-12-8K/L4-2R2K.

- Connecting to the Network
- Connecting the Power on Page 19
- Mounting on Page 20

	NOTE
	The MD 248i-12-8K/L4-2R2K must be installed in a suitable fire, electrical, mechanical enclosure.

Refer to 5.3 MD 248i-12-8K/L4-2R2K IO-Link and DIO Ports on Page 60 for information about connecting IO-Link or digital devices to the ports after you program the network information using the next chapter.

2.3.1 Connecting to the Network

The IOLM provides two Fast Ethernet (10/100BASE-TX) standard RJ45 connectors.

Pin	Signal
1	Tx+
2	Tx-
3	Rx+
4	Rx-

You can use this procedure to connect the IOLM to the network or IO controller.

1. Securely connect one end of the RJ45 Ethernet cable to either Ethernet port.
2. Connect the other end to the network or an IO controller.
3. Optionally, use the other Ethernet port to daisy-chain to another Ethernet device.

NOTE
If you do not connect the IOLM to an IO controller, an IO controller needs to be connected to the network for PROFINET IO configuration.

2.3.2 Connecting the Power

The MD 248i-12-8K/L4-2R2K provides two redundant power inputs with screw terminals on the top and bottom of the unit. The

NOTE
Use either power terminal (top or bottom) but DO NOT use both to supply power to the IOLM.

Signal	Pin	Description
V-	1	24VDC Power Supply Return
V-	2	24VDC Power Supply Return
V+	3	Primary +24VDC Supply
V+	4	Secondary +24VDC Supply

NOTE
The MD 248i-12-8K/L4-2R2K must be installed in a suitable fire, electrical, mechanical enclosure.

Power Supply	Values
Power Supply In V+	4A (Maximum) *
IO-Link Connectors Ports 1 - 8 C/Q L+	 200 mA (Maximum) 200 mA (Maximum)
Digital IO (D1 and D2 | D3 and D4) D2, D4 L+	 200 mA (Maximum) 200 mA (Maximum)
IO-Link Master Power	100mA @ 24VDC (VS)

* The sum of the following must not exceed V+ maximum input current:

- IO-Link Mode module power
- Actual C/Q current for each IO-Link port and for D2 and D4 output
- Actual US current for each IO-Link port

You can use this procedure to connect the IOLM to a UL Listed power supply and UL Listed power cord.

NOTE
Power should be disconnected from the power supply before connecting it to the IOLM. Otherwise, your screwdriver blade can inadvertently short your terminal connections to the grounded enclosure.

1. Insert positive and negative wires (12-24AWG) into the V+ and V- contacts.

NOTE
Use either power terminal (top or bottom) but DO NOT use both to supply power to the IOLM.

2. Tighten the wire-clamp screws to prevent the wires from coming loose.
3. Apply the power and verify that the following LEDs are lit indicating that you are ready to program the IP address and then attach your IO-Link or digital I/O devices.

LED Activity During Power On Sequence - MD 248i-12-8K/L4-2R2K	
uBoot Bootloader v1.00 through v1.23	**uBoot Bootloader v1.24 or higher**
1. The **PWR** LED lights. 2. The **ETH** LED lights on the connected port. 3. The IO-Link LEDs flash (if no IO-Link device attached) or are lit if an IO-Link device is attached. If a PLC is connected, the NS LED is lit and green.	1. The **PWR** LED lights. 2. The **ETH** LED lights on the connected port. 3. The **MS** and **NS** LEDs light red/amber. 4. The IO-Link LEDs flash (if no IO-Link device attached) or are lit if an IO-Link device is attached. If a PLC is connected, the NS LED is lit and green.

If the LEDs indicate that you are ready to go to the next installation step, Refer to Chapter 3 Configuring the IOLM with STEP 7 on Page 21 to configure the network information.

If the LEDs do not meet the above conditions, you can refer to MD 248i-12-8K/L4-2R2K LEDs on Page 152 in the Troubleshooting and Technical Support chapter for more information.

2.3.3 Mounting

You may want to mount the IOLM after programming the IP address and connecting the IO-Link and digital input/output devices.

1. Slide the metal latch down, hook the top of MD 248i-12-8K/L4-2R2K to the DIN rail and release the latch.
2. Verify that is tightly mounted.

NOTE
You may want to connect the IO-Link devices before attaching the MD 248i-12-8K/L4-2R2K to the DIN rail. Use Chapter 5 Connecting Devices on Page 57 if you require IO-Link cabling information.

The power receptacle is keyed for your safety so that it cannot be inserted into an IO-Link port

3 Configuring the IOLM with STEP 7

3.1 Overview

PROFINET IO configuration procedures vary between software versions but the following configuration steps are required in all cases. Refer to your STEP 7 documentation, if you require step-by-step procedures.

1. Download, unzip, and upload the GSD file for the IO-Link Master (IOLM).
2. Insert the IOLM in the PROFINET IO system.
3. Configure the IP address for the IOLM.
4. Assign the PROFINET Device Name.
5. Set the IO Device Update Time.
6. Configure the IO-Link ports.
   a. Configure IO-Link port modules.
   b. Configure port status modules.
   c. If desired, configure data storage, automatic or manual - upload or download.
   d. If desired, configure device validation and data validation.
7. Use Chapter 12 PROFINET IO Reference Information on Page 113 to complete configuration after attaching the IO-Link devices.

The following subsections provides PROFINET IO configuration procedures using **STEP 7 V5.5** and TIA Portal V13:

- Installing the GSD File
- Configuring the IOLM
- IP Address Assignment on Page 22
- Device Name Assignment on Page 32
- Setting the IO Device Update Time on Page 34
- Configuring IO-Link Ports on Page 35

3.2 Installing the GSD File

Use the following procedure to install the GSD file for PROFINET IO using STEP 7 V5.5.

1. Unzip **GSDML-V2.xx-Leuze-IOLink-yyyymmdd.zip** to a working directory.
2. Use the appropriate steps:

STEP 7 V5.5:

a. Open **SIMATIC STEP 7 | HW Config.**
b. Use **Menu Options | Install GSD Files** to install the GSD file.

TIA Portal V13:

a. Open the TIA Portal and switch to the **Project** view.
b. Use **Menu Options | manage general station description files (GSD)** to install the GSD file.

NOTE	
	If an older version of the GSD file was installed before, you may need to remove the IOLM object from an existing project, and reinsert it after the new GSDML file is installed.

3.3 Configuring the IOLM

Use the appropriate procedure for your environment.

- STEP 7 V5.5
- TIA Portal V13

3.3.1 STEP 7 V5.5

Select the IOLM from the Hardware Catalog window and insert it into a PROFINET-IO- System in the **HW Config (PROFINET IO -> Additional Field Device -> Gateway -> Leuze IO-Link Master -> IOLM MD248i)** as shown in Figure 1.

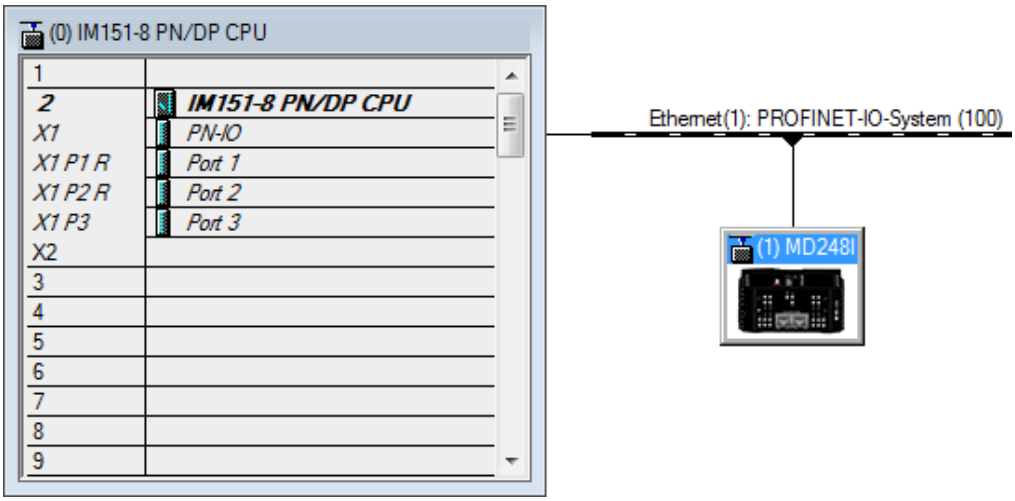


Figure 3: Inserting an IOLM MD248i into a PROFINET IO System

3.3.2 TIA Portal V13

Select the IOLM from the **Hardware** catalog window (Other field devices | PROFINET IO | Gateway | Leuze Corporation | MD248i) and drag it into the **Device configuration | Network** view. Then connect the IOLM to the IO controller.

3.4 IP Address Assignment

Leuze IOLM gateways support three methods for IP address assignment according to *GSDML Specification*.

- **DCP** - The IOLM supports IP address assignment via Discovery and basic Configuration Protocol (DCP). See 3.4.1 Assigning an IP Address via IO Controller (DCP) on Page 22 for procedures.
- **DHCP** - The IOLM supports the Dynamic Host Configuration Protocol for IP address assignment. See 3.4.2 Assigning an IP Address via DHCP on Page 25 for procedures.
- **LOCAL** - The IOLM supports a device specific method for IP address assignment. See 3.4.3 Assigning an IP Address Statically (LOCAL) on Page 27 for procedures.

3.4.1 Assigning an IP Address via IO Controller (DCP)

An IO controller can assign an IP address to the Leuze IOLM gateway via DCP. The IO controller and the Leuze IOLM gateway have to be on the same subnet. The IOLM default IP address is: 192.168.60.101 and the subnet mask is 255.255.255.0.

Use the appropriate procedure for your environment.

- STEP 7 V5.5
- TIA Portal V13 on Page 28

3.4.1.1 STEP 7 V5.5

Use the following procedure to assign an IP address via DCP.

1. Double-click the **X1 PNIO-IO** interface of the IO control to open the Properties window.
2. On the **General** tab, click the **Properties** button, which opens the Ethernet interface Properties window.
3. Uncheck the **Use different method to obtain IP address** option.
4. Manually enter the IP address and subnet mask for the IO controller.

   In this example the IO controller was assigned an IP address of 10.0.0.31 and a subnet mask of 255.0.0.0.
5. Double-click the IOLM, check **Assign IP address via IO controller** as shown in Figure 3.
6. On the **General** tab, click the **Ethernet** button, which opens the Ethernet interface properties window, where you can specify what IP address the IO controller should assign to the IOLM.

Steps 2 through 4 are necessary in STEP 7 V5.5 so that both the IO controller and the IOLM are on the same subnet. Otherwise, the **Assign IP address via IO controller** function may not work correctly.

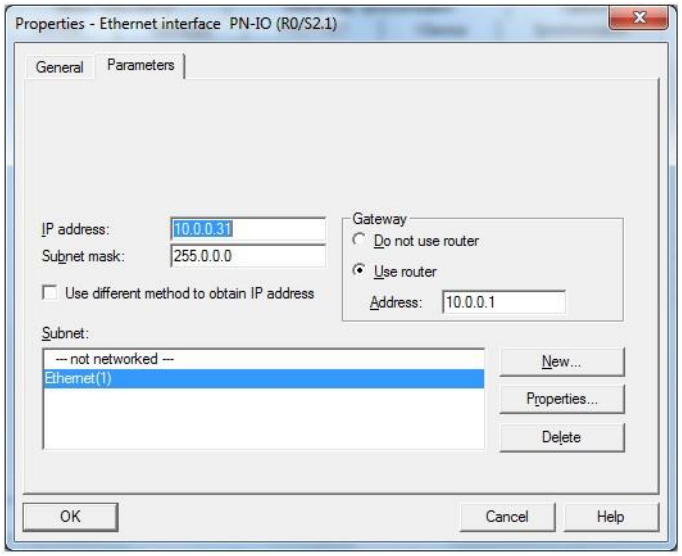


Figure 4: IO Controller Ethernet Interface Properties

In this example, IP address 10.0.0.100 is assigned to the IOLM via the IO controller.

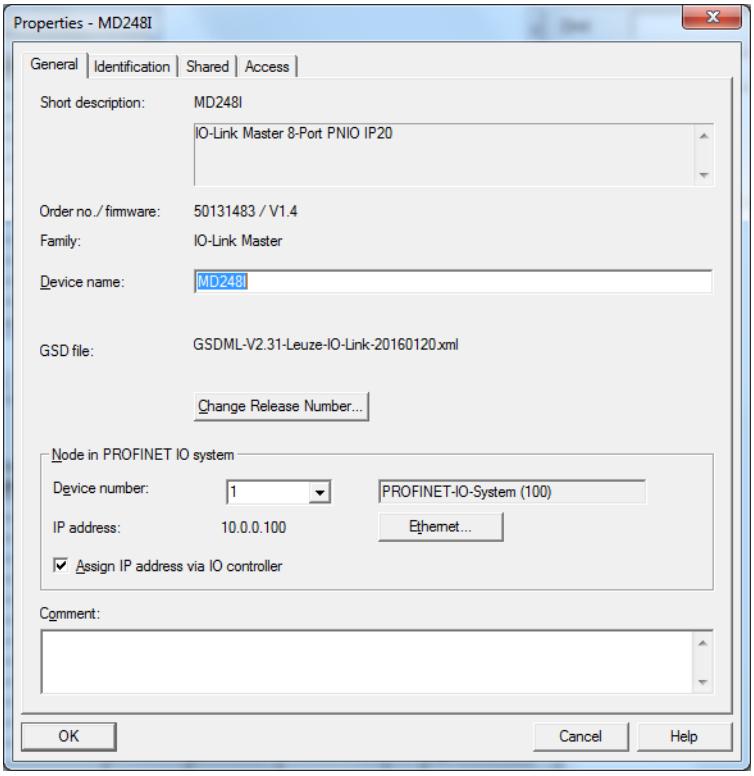
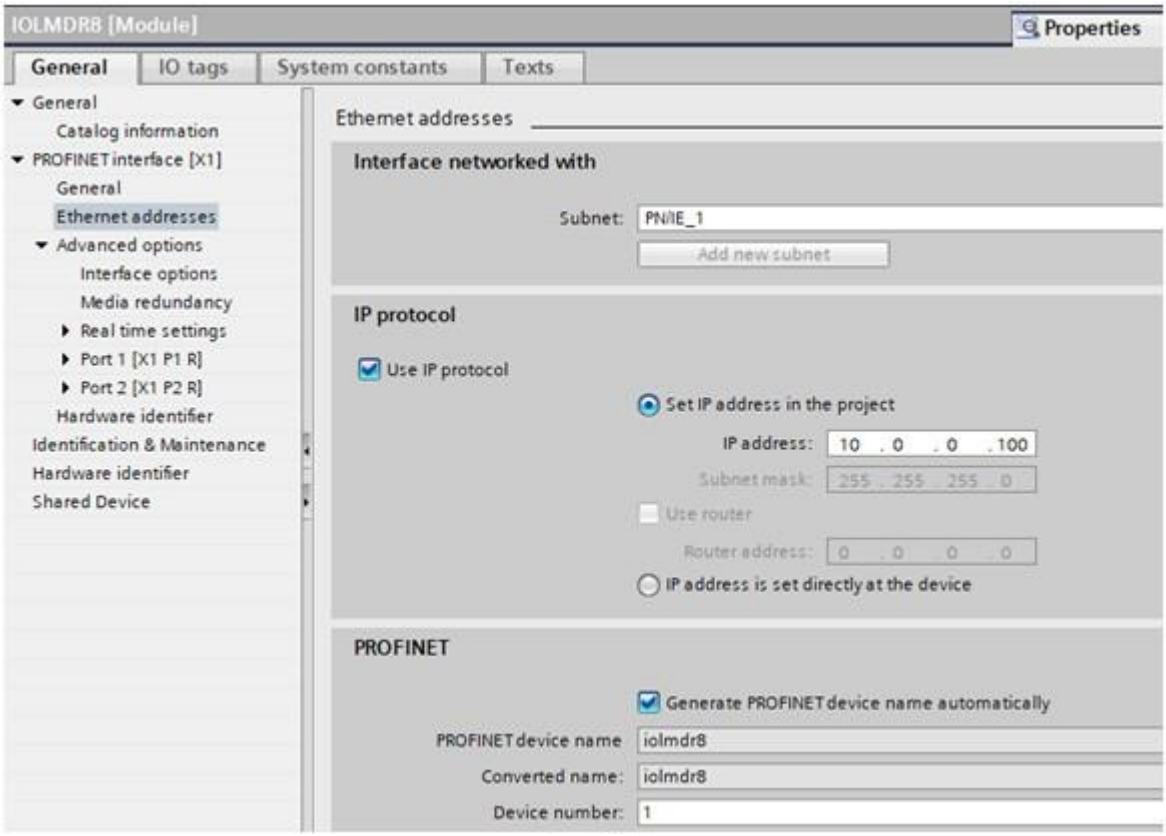


Figure 5: IOLM Properties

3.4.1.2 TIA Portal V13

Use the following procedure to assign an IP address via DCP.

1. Double-click the IOLM in the **Device configuration | Network** view.
2. On the **Properties | General tag**, select **Ethernet addresses**.
   a. Make sure that the **User IP protocol** option is checked and the **Set IP address in the project** is selected.
   b. Enter the desired IP address for the IOLM. In this example the IP address 10.0.0.100 is assigned to the IOLM via the IO controller.



3.4.2 Assigning an IP Address via DHCP

The Leuze IOLM gateway supports DHCP for IP address assignment. DHCP is disabled by default. Use the following steps to enable DHCP.

NOTE	
	The IOLM default IP address is: 192.168.60.101 and the subnet mask is 255.255.255.0. You may need to change your laptop or PC IP address range to access the IOLM web interface to change the IP address without changing your settings.

1. Open a web browser and enter the IOLM IP address.
2. Click **Configuration | Network**.
3. Click **EDIT** button.

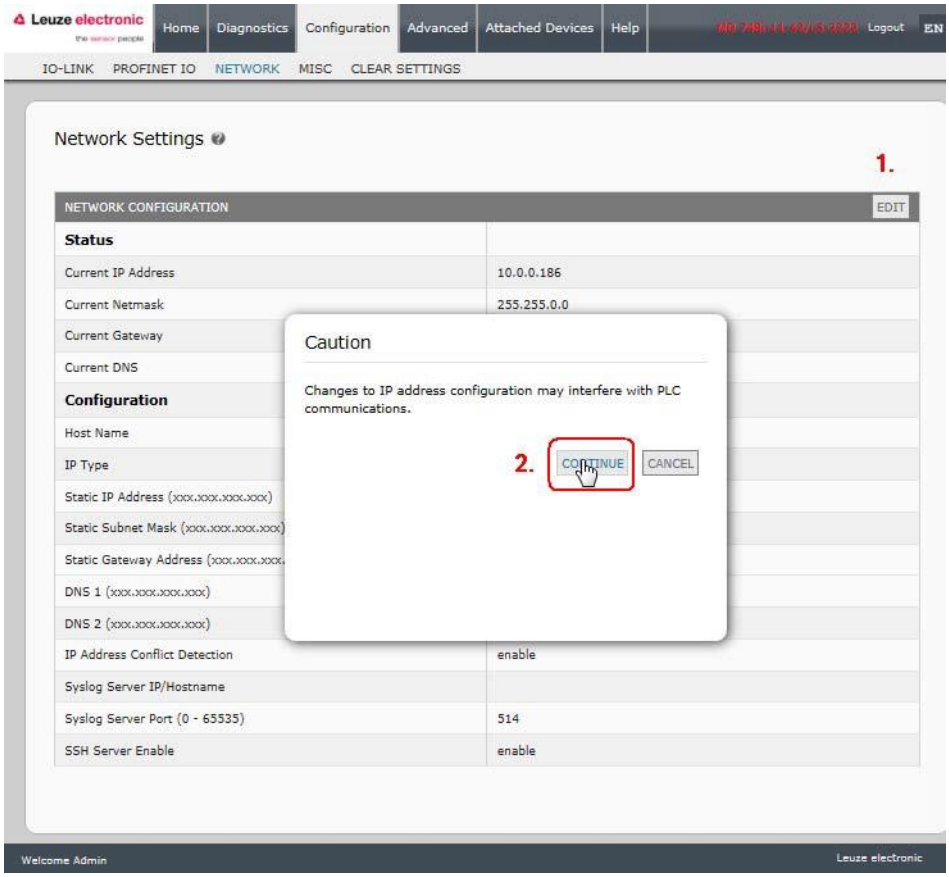
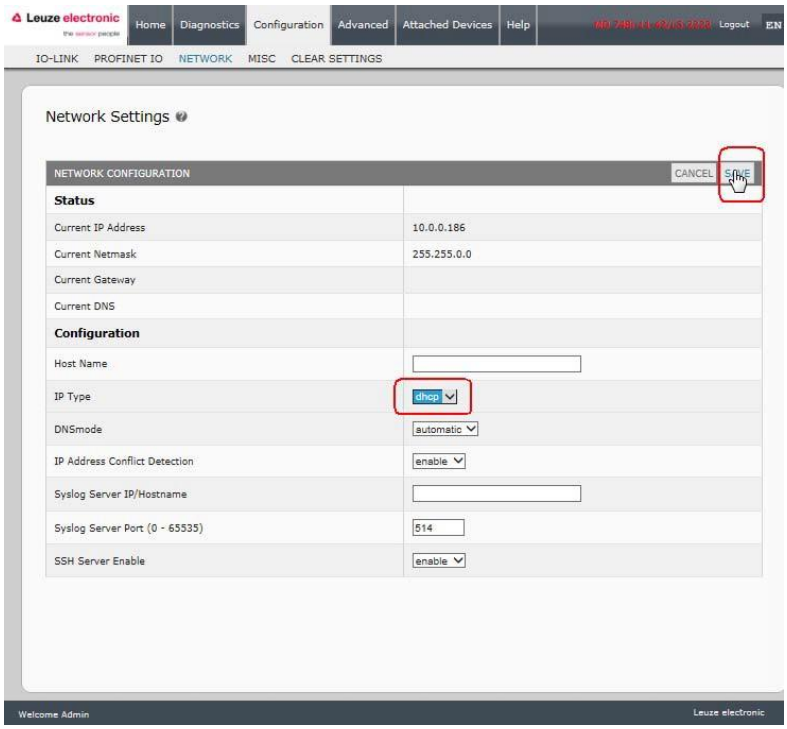


Figure 6: Web Network Configuration Page

4. Change **IP Type** from **static** to **dhcp**.



5. Click the **SAVE** button.

Once DHCP is enabled, the IOLM attempts to obtain an IP address from a DHCP server. If a new IP address is assigned by a DHCP server, then the IOLM switches to the new IP address immediately. This may interfere with communications between the device and the IO controller.

The **Obtain IP address from a DHCP** server option in the Edit Ethernet Node window in STEP 7 (Figure 7:) is not supported. DHCP can only be enabled or disabled via the web interface.

	NOTE
	An IO controller can overwrite DHCP IP assignment by assigning IP address via DCP.

The next configuration step is to assign the device name, go to 3.5 Device Name Assignment on Page 32.

3.4.3 Assigning an IP Address Statically (LOCAL)

IP addresses can also be assigned statically using one of the following methods:

- The **LOCAL** method as defined in the GSDML Specification
- Embedded web interface

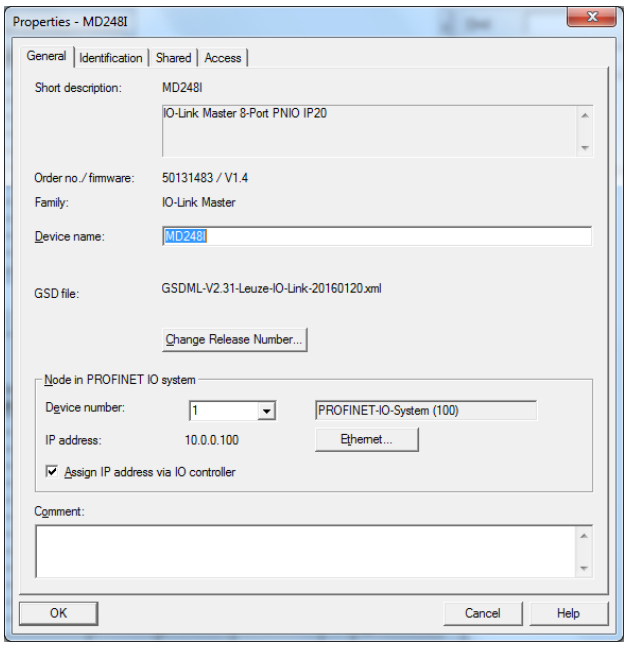
Use the appropriate procedure for your environment:

- STEP 7 V5.5
- TIA Portal V13 on Page 28

3.4.3.1 STEP 7 V5.5

Use the following procedure if you want to use the LOCAL method using STEP 7.

1. In the STEP 7 HW Config window, double-click the IOLM object to open up the Properties window.



2. Uncheck the **Assign IP address via IO controller** option and click **OK**.
3. Download and run the project.

   The IO controller will not attempt to assign IP address to the IOLM. You must assign a static IP address to the IOLM manually.
4. Select the IOLM in **HW Config**, open the Edit Ethernet Node window (Figure 4) by using menu **PLC** | **Ethernet** | **Edit Ethernet Node** option.
5. Once opened, click the Browse button, which opens the Browse Network window.

   The IOLM should be displayed as a Leuze IO-Link Master with a default IP address of 192.168.60.101.

6. Select the IOLM and click the **OK** button to return to the Edit Ethernet Node window.
7. Enter the desired IP configurations.

   In Figure 7:, the IOLM was configured to use a static IP address 10.0.0.100, subnet mask 255.0.0.0 and no router.
8. Click the **Assign IP Configuration** button, the IP configuration is assigned to the IOLM.

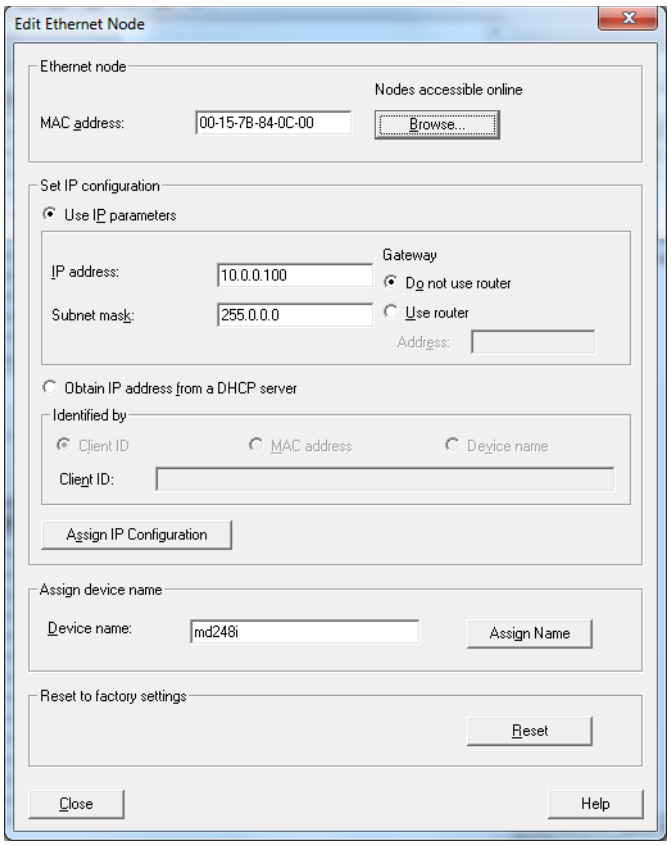


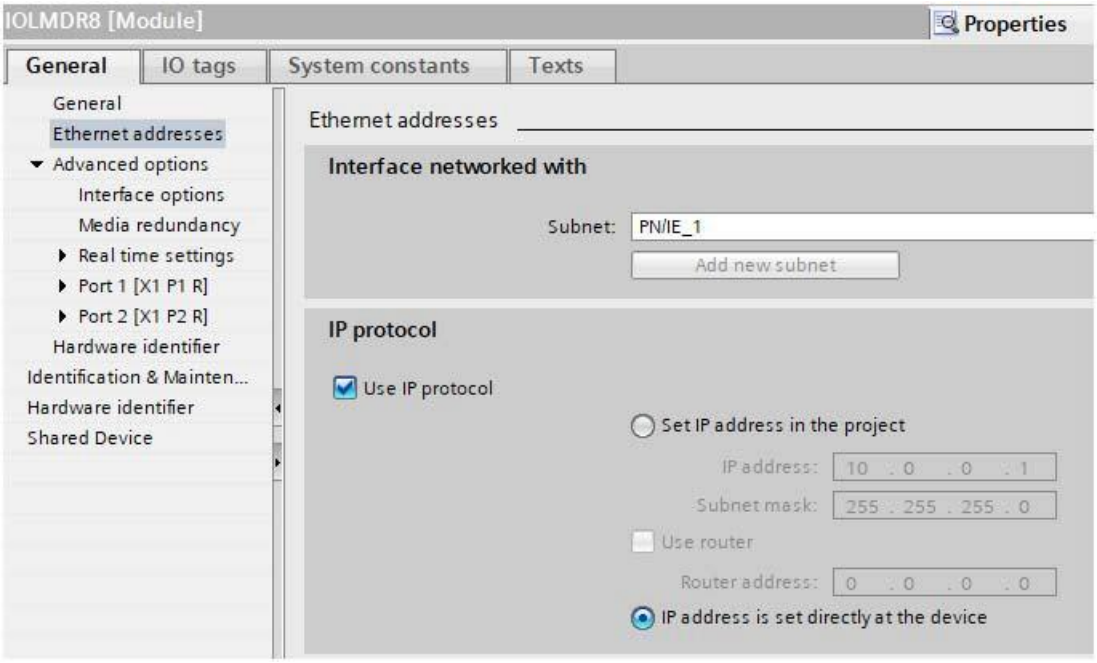
Figure 7: Configure IP Address and Device Name

The next configuration step is to assign the device name, go to 3.5 Device Name Assignment on Page 32.

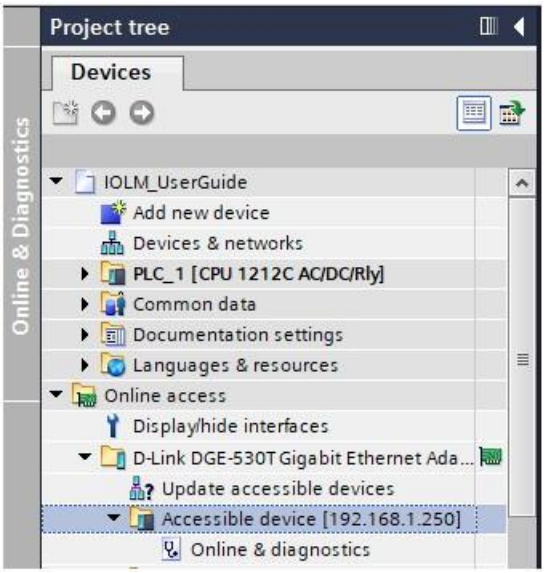
3.4.3.2 TIA Portal V13

Use the following procedure if you want to set the LOCAL method using TIA Portal.

1. Double-click the IOLM in the **Device configuration | Network** view.
2. On the **Properties | General tag**, select Ethernet addresses.
3. Make sure that the **User IP protocol** option is checked and the IP address is set directly at the device is selected.
4. Download and run the project. The IO controller will not attempt to assign IP address to the IOLM. You must assign a static IP address to the IOLM manually.



5. In the TIA Portal Project view, navigate to **Project tree | Online access**, double-click the **Ethernet adapter that is used as PROFINET IO network in your system**, then double-click **Update accessible devices**.



6. Once the accessible devices list is updated, find the IOLM by using the default IP address 192.168.60.101 or the previous IP address that the IOLM was assigned by IO controller.
7. Double-click the **Accessible device** [192.168.60.101], then double-click the **Online & diagnostics** to open up the Online access view.
8. Click **Functions | Assign IP address**, enter the desired IP configurations. In the following figure, the IOLM was configured to use a static IP address 10.0.0.100, subnet mask 255.0.0.0 and no router.
9. Click the **Assign IP address** button, the IP configuration is assigned to the IOLM.

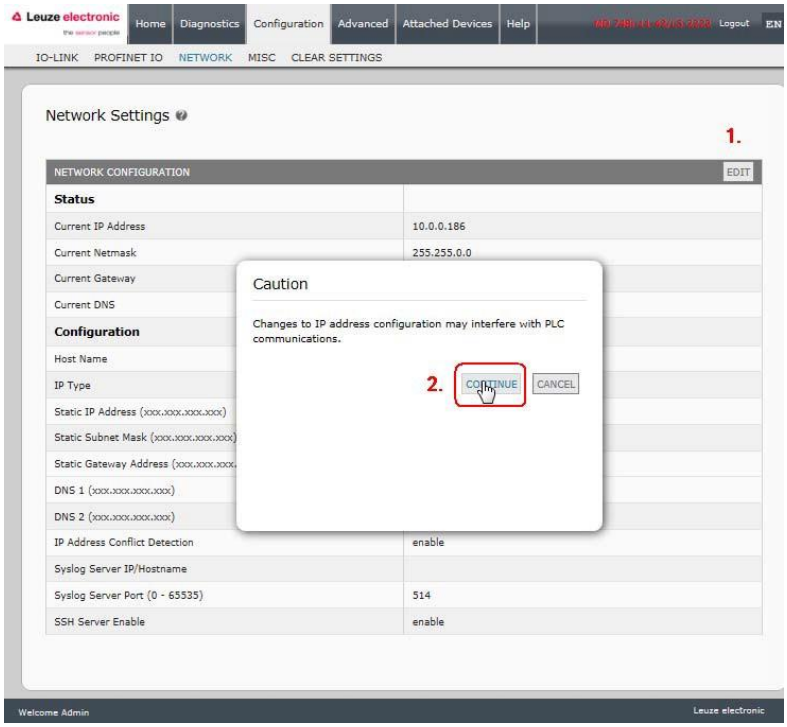
The next configuration step is to assign the device name, go to 3.5 Device Name Assignment on Page 32.

3.4.3.3 Assign IP Address Statically Using the Web Page

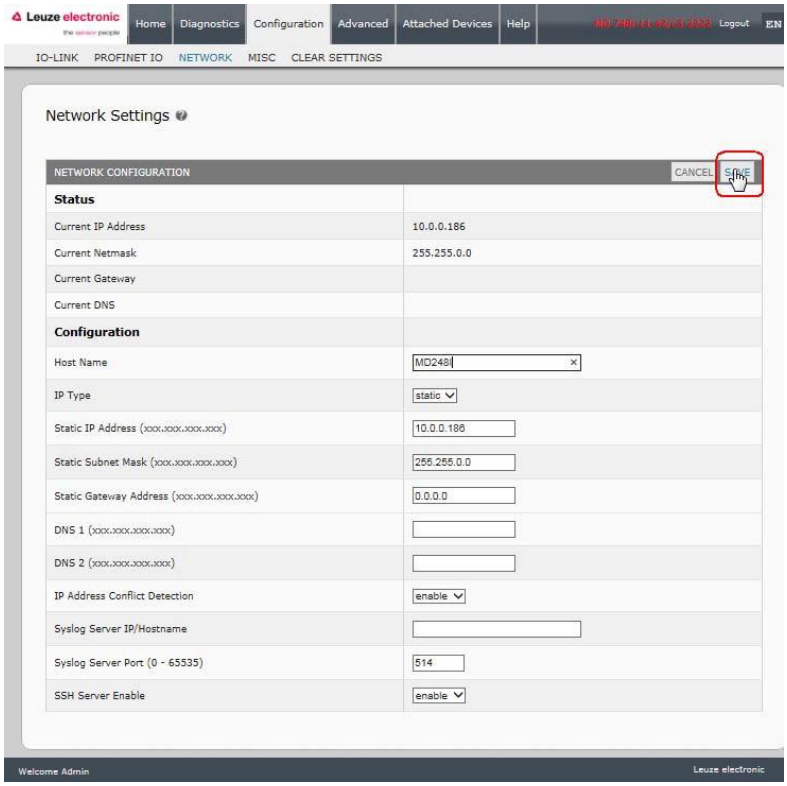
You can use the following procedure to configure a static IP address. The IOLM web interface switches to the new IP address immediately.

	NOTE
	The IOLM default IP address is: 192.168.60.101 and the subnet mask is 255.255.255.0. You may need to change your laptop or PC IP address range to access the IOLM web interface to change the IP address without changing your settings.

1. Open a web browser and enter the IOLM IP address.
2. Click **Configuration | Network**.
3. Click the **EDIT** button.



4. If necessary, change the **IP Type** to **static**.
5. Enter an IP address, subnet mask, and gateway address.
6. If applicable, enter the DNS1 and DNS2 addresses.



7. Click the **SAVE** button.

The next configuration step is to assign the device name, go to 3.5 Device Name Assignment on Page 32.

3.5 Device Name Assignment

Use one of the following methods to configure the Device Name.

- STEP 7 - refer to the following procedure
- Web interface - see 3.5.2 Using the Web Interface to Assign the Device Name on Page 33 for information about using the IOLM **Configuration | PROFINET IO** page.

3.5.1 Assign the Device Name in STEP 7

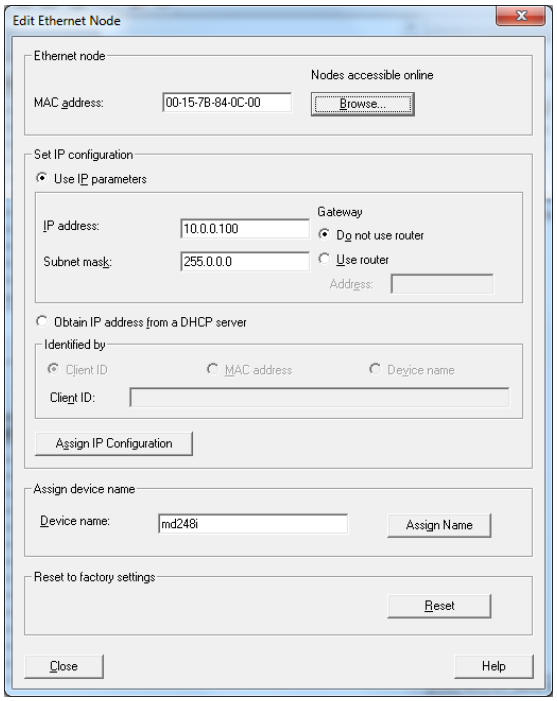
Use the appropriate procedure for your environment:

- STEP 7 V5.5
- TIA Portal V13 on Page 39

3.5.1.1 STEP 7 V5.5

Use the following procedure to configure the Device Name using STEP 7.

1. Select the IOLM, open the *Edit Ethernet Node* window using the **PLC | Ethernet | Edit Ethernet Node** menu.
2. Click the **Browse** button to open the *Browse Network* window.
   The unit should be displayed as an IO-Link Master with an empty device name.
3. Select the unit and click the **OK** button to return to the *Edit Ethernet Node* window.

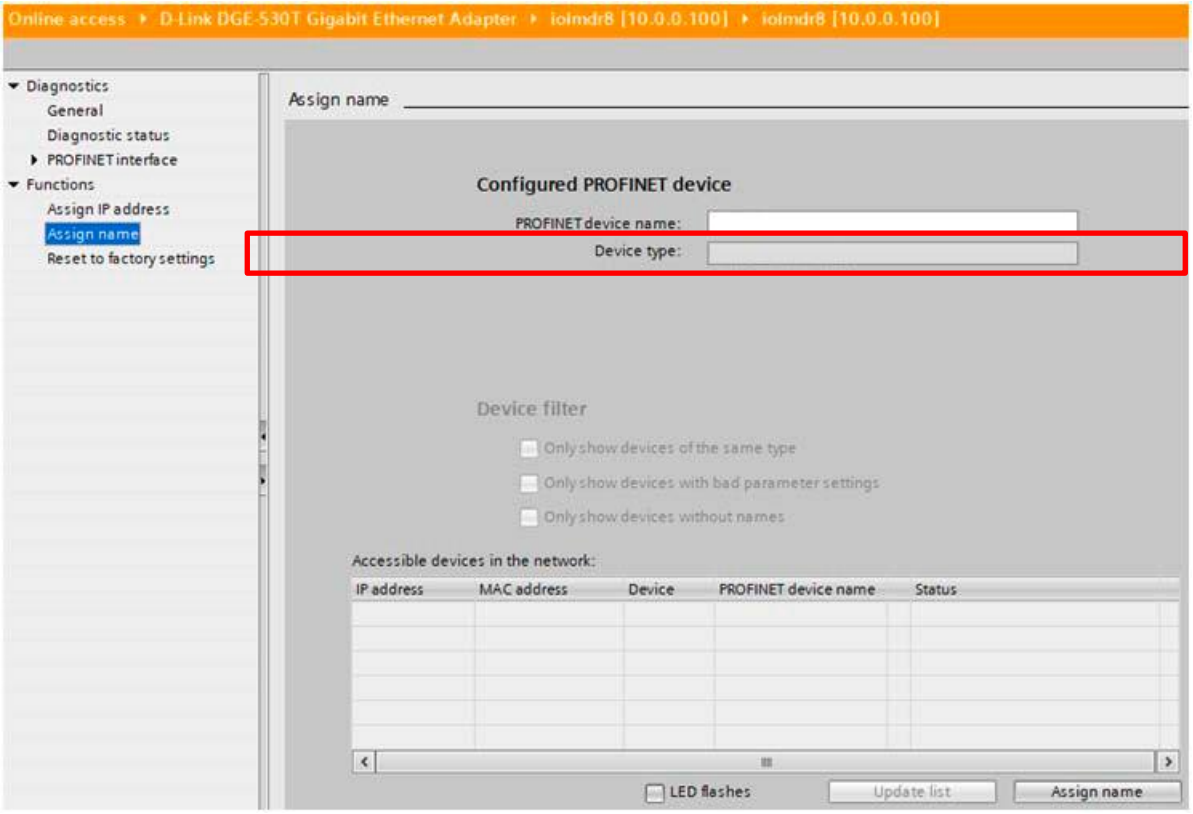


4. Set the device name. PROFINET IO Device Names are not case-sensitive. In this example, the device name was set to MD248I.

If there is a cyclic communication between the device and an IO controller, the cyclic communication has to be stopped before the device name can be changed.

3.5.1.2 TIA Portal V13

1. Use the same procedure in 3.4.3.2 TIA Portal V13 on Page 28 to access the **Online access** view.
2. Click **Functions | Assign name**, enter the device name and click the **Assign name** button. PROFINET IO Device Names are not case-sensitive. In this example, the device name was set to iolmdr8.



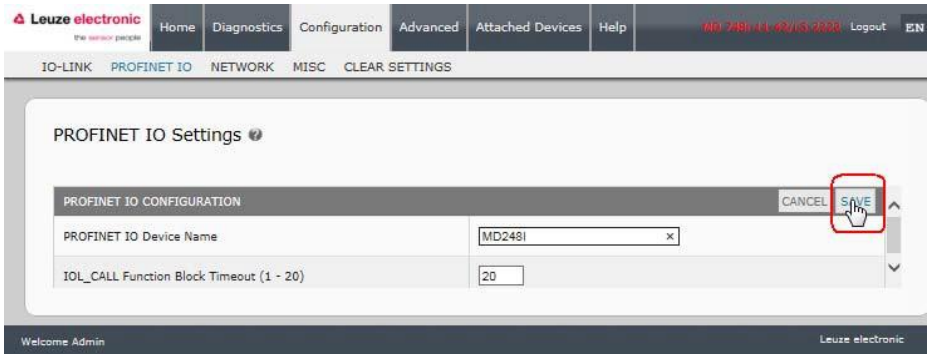
3.5.2 Using the Web Interface to Assign the Device Name

You can use the **Configuration | Profinet IO Settings** page to assign the device name for PROFINET IO with the IO-Link Master.

NOTE	
	Changes to device name using the web interface take effect immediately. It may interfere with the communication between the device and IO controller.

1. If necessary, open the IOLM web interface with your web browser using the IP address.
2. Click **Configuration** | **PROFINET IO Settings**.
3. Click the **EDIT** button.
4. Enter the **PROFINET IO Device Name**.

   The **PROFINET IO Device Name** is the same as the name later used to configure PROFINET IO for the IOLM. The **PROFINET IO Device Name** is not case- sensitive.
5. If necessary, change the **IOL_CALL Function Block Timeout** (1-20) value to reflect your environment.
6. Click **SAVE**.



Parameter	Description
PROFINET IO Device Name (Default: empty)	The device name must be specified according to DNS conventions. • Restricted to a total of 240 characters (letters, digits, dash or period) • Parts of the name within the device name; in other words, a string between two periods, must not exceed a maximum of 63 characters. • No special characters such as umlauts (ä, ö etc.), brackets, underscore, slash, blank etc. The dash is the only permitted special character. • The device name must not begin or end with the "-" character. • The device name must not begin with numbers. • The device name must not have the structure n.n.n.n (n = 0...999). • The device name must not begin with the character string "port-xyz-" (x , y, z = 0...9).
IOL_CALL Function Block Timeout (1-20) (Default: 20)	The timeout value in seconds for IOL_CALL function block.

3.6 Setting the IO Device Update Time

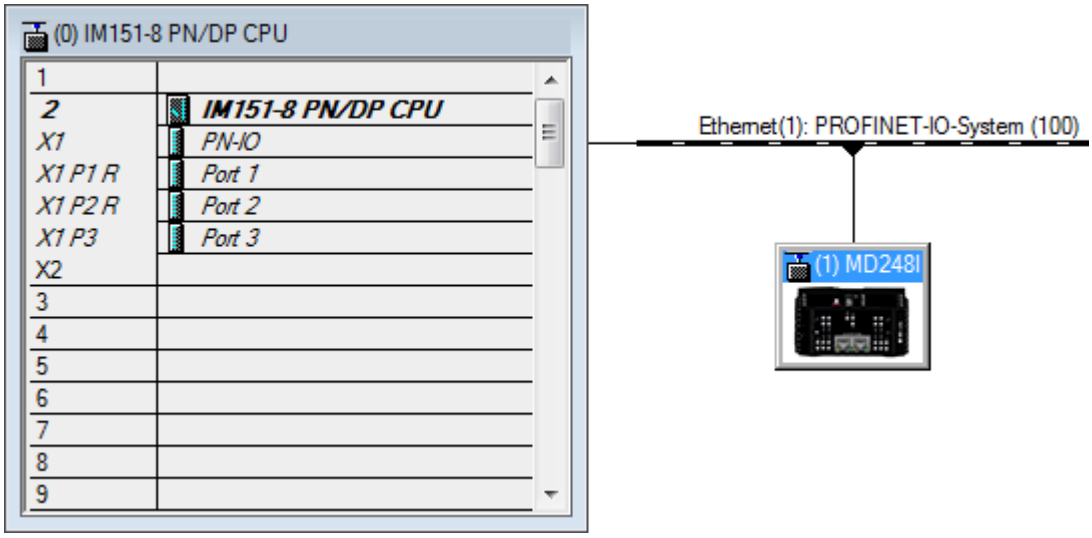
Use the appropriate procedure for your environment:

- STEP 7 V5.5
- TIA Portal V13 on Page 35

3.6.1 STEP 7 V5.5

Use the following procedure to set the IO Device Update Time.

1. Double-click the **Ethernet(1): PROFINET-IO-System (100).**



2. In the *Properties - PROFINET IO-System* window, select the **Update Time** tab, as shown in the image below.

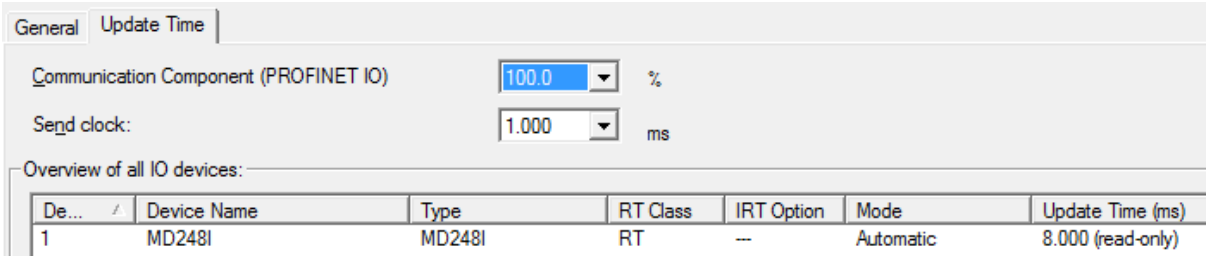


Figure 8: Configuring IO Device Update Timer

3. Set the desired update time. The fastest IO device update time is 8 ms.

3.6.2 TIA Portal V13

Use the following procedure to set the IO Device Update Time.

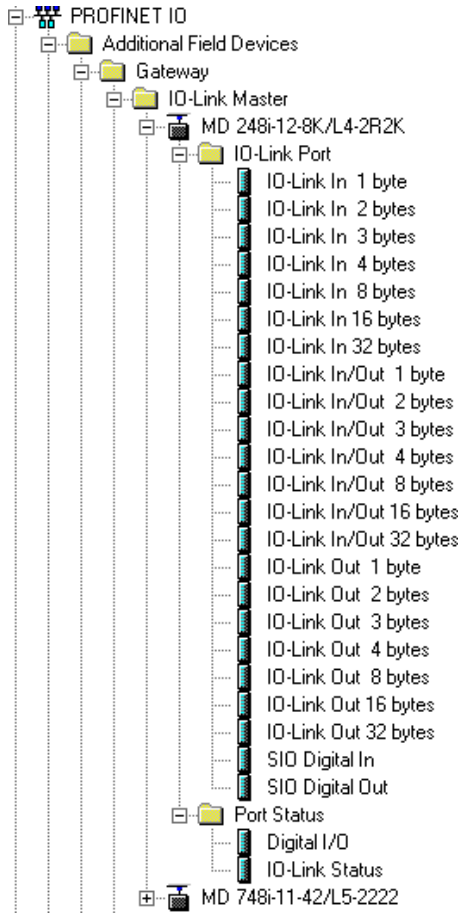
1. Double-click the IOLM in the **Device configuration | Network** view.
2. On the **Properties** | **General tag**, select **PROFINET interface [X1] | Advanced options | Real time settings**.
3. Select the **Can be set** option and set the update time to the desired value from the list. The fastest IO device update time is 8 ms.

3.7 Configuring IO-Link Ports

The IO-Link Master gateway has two categories of IO modules:

- 3.7.1 IO-Link Port Modules on Page 36
- 3.7.2 Port Status Modules on Page 42

IO modules are used to configure IO-Link ports and exchange PDI and PDO data with various IO-Link devices and digital I/O devices. The following image shows available modules of the IOLM.



3.7.1 IO-Link Port Modules

An IO-Link port can be configured as one of the following:

- IO-Link Mode
- SIO Digital In Mode
- SIO Digital Out Mode.

IO-Link Port modules are used to configure the mode of an IO-Link port.

All the IO-Link modules start with the **IO-Link** (that is: IO-Link In, IO-Link Out and IO-Link In/Out) configure the corresponding IO-Link port as IO-Link Mode. An SIO Digital In module configures the IO-Link port as SIO Digital In Mode. Similarly, an SIO Digital Out module configures the port as SIO Digital Out Mode.

- An **IO-Link module** can be input only, output only or both. In addition, there are different modules with various IO data sizes (1 to 32 bytes). For example, the IO-Link In/Out 4 bytes module is for an IO-Link device that supports up to 4-byte PDI data and 4-byte PDO data. If you do not find an exact matching IO size, select the next size (larger). For instance, use IO-Link in 16-bytes module for an IO-Link device that has 10-byte PDI data. The unused PDI data is filled with zeros.
- For **SIO Digital In module**, the PDI data is fixed at 1-byte. A high voltage on the IO-Link port C/Q Pin results in a 0x01 PDI data; a low voltage on the C/Q Pin results in a 0x00 PDI data.
- For **SIO Digital Out module**, the PDO data is fixed at 1-byte. A zero output value from an SIO Digital Out module sets the IO-Link port C/Q pin to low voltage. Any non-zero output value sets the C/Q pin to high voltage.

IO-Link Port Module Input Data Format	
Byte Offset	**Description**
0	PDI Data Block byte 0
1	PDI Data Block byte 1
…	…
31	PDI Data Block byte 31

IO-Link Port Module Output Data Format	
Byte Offset	**Description**
0	PDO Data Block byte 0
1	PDO Data Block byte 1
…	…
31	PDO Data Block bytes 31

IO-Link Port modules are allowed in Slot 1 to 4 on the MD 748i-11-42/L5-2222 model, or Slot 1 to 8 on the IOLM DR-8-PNIO models. Slot 1 is corresponding to IO-Link Port 1. Slot 2 is for IO-Link Port 2, so on and so forth. If a slot is unpopulated, the corresponding IO-Link port is not configured. That port uses the previously configured settings, or default settings if it has not been configured before.

3.7.1.1 IO-Link Port Settings (IO-Link Port Module Parameters)

Additional IO-Link port settings can be configured by using module parameters. Use the appropriate procedure for your environment:

- STEP 7 V5.5 on Page 46
- TIA Portal V13 on Page 47

IO-Link Port Module Parameters	
IO-Link Port Config	
Minimum Cycle Time (Default: 4) Valid range: 4-538ms	The minimum or fastest cycle time at which the IO-Link device may operate. You can leave the **Minimum Cycle Time** set to the default value and the IO-Link Master negotiates with the IO-Link device for its minimum cycle time. The *IO-Link Diagnostics* page displays the **Actual Cycle Time**, which is the negotiated cycle time.
Data Storage Config	
Automatic Data Storage Upload Enable *Default*: Off	When this option is initially set to **On**, the IOLM saves the data storage (if the data storage is empty) from the IO-Link device to that port. Some IO-Link devices update the data storage contents if you use the Teach buttons on the IO-Link device, but that is determined by the IO-Link device manufacturer.

IO-Link Port Module Parameters	
	Automatic upload occurs when the **Automatic Upload Enable** option is set to **On** and one of these conditions exists: • There is no upload data stored on the gateway. • The IO-Link device executes a requests_ at upload function (generally because you have changed the configuration via Teach buttons). Do not enable both **Automatic Upload** and **Automatic Download** at the same time, the results are not reliable among IO-Link device manufacturers. When a port contains data storage for an IO-Link device and if you attach a device whose Vendor and Device ID do not match, the IO-Link LED on the IOLM flashes red to indicate a wrong device is attached. In addition, the *IO-Link Diagnostics* page displays **DV: Wrong Sensor** in the **IOLink State** field. You should not enable **Automatic Upload** until after you have configured the IO-Link device attached to the port unless you want to capture the default settings. Refer to 94 Data Storage on Page 94 for more information.
Automatic Data Storage Download Enable *Default*: Off	The data stored on the IOLM port is downloaded to the IO-Link device if: 1. This option is selected. 2. The data stored on the IOLM port contains the same Vendor ID and Product ID as the IO-Link device connected to the port. 3. The data stored on the IOLM port is different than that of the IO-Link device. 4. The IO-Link device requests an upload and the Automatic Upload Enable option is set to Off. If you change configuration parameters on the IO-Link device and want the parameters to remain loaded on the IO-Link device, you must disable the **Automatic Download** option because otherwise the IOLM will reload the data storage on the port down to the IO-Link device. Do not enable both **Automatic Upload** and **Automatic Download** at the same time, the results are not reliable among IO-Link device manufacturers.
Validation Config	

Device Validation Mode (Default: None)	**Device Validation Mode** provides these options:
	• **None** - this disables Device Validation Mode.
	• **Compatible** - permits a compatible IO-Link device (same Vendor ID and Device ID) to function on the corresponding port.
	• **Identical** - only permits an IO-Link device to function on the corresponding port as defined in the following fields.
	  • **Vendor ID**
	  • **Device ID**
	  • **Serial Number**

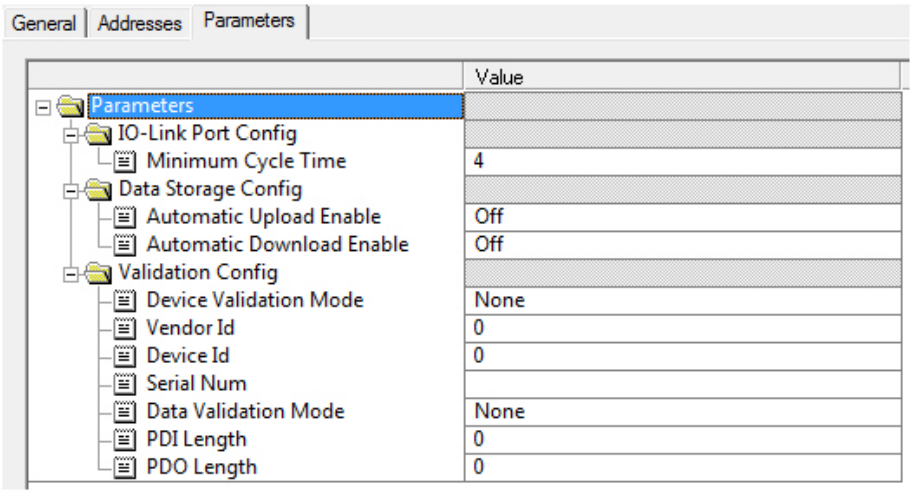
Vendor Id (0-65535)	This is required if you select a **Device Validation Mode** other than **None**.
Device Id (0-16777215)	This is required if you select a **Device Validation Mode** other than **None**.
Serial Num	This is required if you select **Identical** for the **Device Validation Mode**.

IO-Link Port Module Parameters	
Data Validation Mode (Default: None)	There are three Data Validation Modes: • **None** - no data validation is performed on the port. • **Loose** - the slave device's PDI/PDO lengths must be less than or equal to the user-configured values. • **Strict** - the slave device's PDI/PDO lengths must be the same as the user- configured values.
PDI Length (0-32)	This is input length of the PDI data field. This is required if you select a **Data Validation Mode** other than **None**.
PDO Length (0-32)	This is input length of the PDO data field. This is required if you select a **Data Validation Mode** other than **None**.

3.7.1.1.1 STEP 7 V5.5

Use the following information to configure IO-Link port module parameters.

1. Double-click an IO-Link Port module.
2. Select the **Parameters** table.

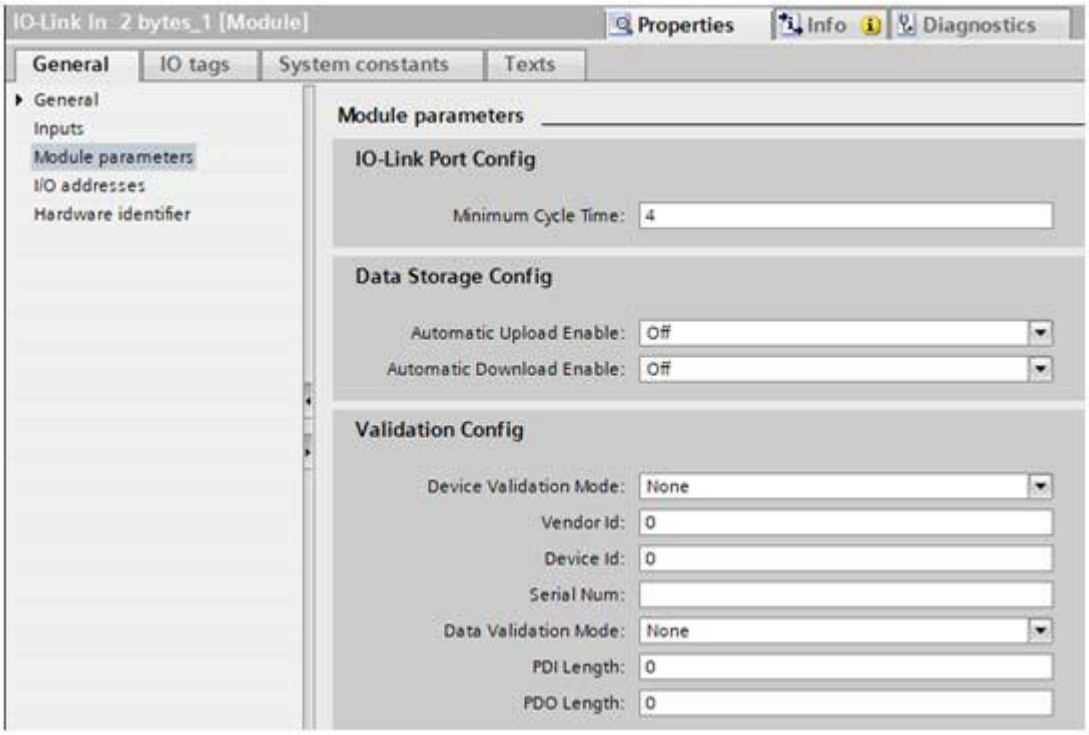


Available parameters are shown in this figure and the table (Page 37) describes how to use the parameters.

3.7.1.1.2 TIA Portal V13

Use the following information to configure IO-Link port module parameters.

1. Open the IOLM **Device** view.
2. Click an IO-Link Port module.
3. On the **Properties | General tag**, select **Module parameters**. Available parameters are shown in the following figure and the table (Page 37) describes how to use the parameters.



3.7.1.2 SIO Digital In/Out Module Parameters

Use the appropriate procedure to configure SIO digital in/out module parameters.

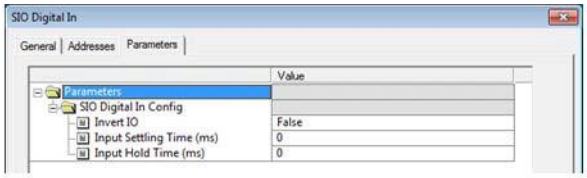
- STEP 7 V5.5 on Page 41
- TIA Portal V13 on Page 42

SIO Digital Input and Output Module Parameters	
SIO Digital Input	
Invert IO (Default: False)	If enabled, this inverts the I/O value. • **False** (Disabled - Do not invert IO) • **True** (Enabled - Invert IO) ***Note!*** *This does not affect the Auxiliary Input.*
Input Settling Time (0 - 10000ms) *Default*= 0ms	If non-zero and **Mode** is set to **Digital-Input**, the required time that the input status must remain constant before an input status change is reported.
Input Hold Time (0 - 10000ms) (Default: 0ms)	This is how long the IOLM keeps the input at its present value. For example, if the IOLM detects the input to go to high, and the hold time is X milliseconds, then the IOLM reports the input as high for X milliseconds, even though the input itself may have gone away already. If X is zero, then you get the behavior currently in the field.
SIO Digital Output	
Invert IO (Default: False)	If enabled, this inverts the I/O value. • **False** (Disabled - Do not invert IO) • **True** (Enabled - Invert IO) ***Note!*** *This does not affect the Auxiliary Input.*
Default Digital Output (Default: Off)	Defines the default digital output value that is used at startup and when there is no active PDO controller. • **Off** (low voltage) • **On** (high voltage)

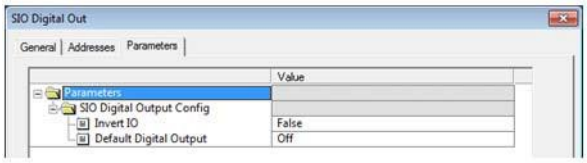
3.7.1.2.1 STEP 7 V5.5

Use the following procedure to configure SIO digital in/out module parameters.

1. Double-click an SIO Digital In or SIO Digital Output module.
2. Select the **Parameters** table. Available parameters are shown in the next images and the table (Page 37) describes SIO digital input and output module parameters.



SIO Input Module Parameters

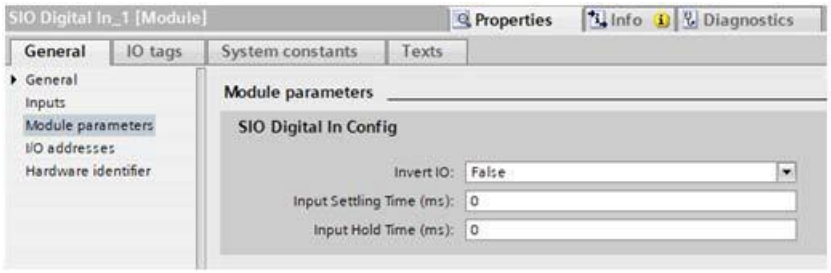


SIO Output Module Parameters

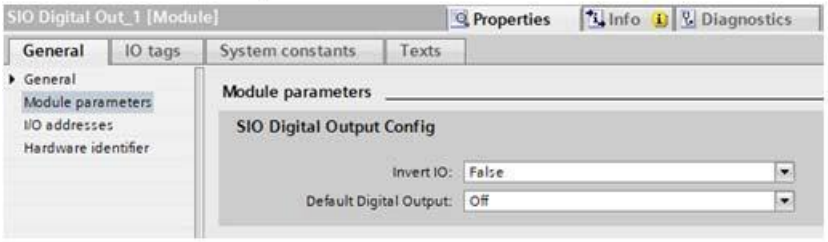
3.7.1.2.2 TIA Portal V13

Use the following procedure to configure SIO digital in/out module parameters.

1. Open the **IOLM Device** view. Click an SIO Digital In or SIO Digital Output module.
2. On the **Properties | General tag**, select **Module parameters**. Available parameters are shown in the next images and the table (Page 37) describes SIO digital input and output module parameters.



SIO Input Module Parameters



SIO Output Module Parameters

3.7.2 Port Status Modules

There are two **Port Status** modules:

- IO-Link Status Module
- Digital I/O Module.

3.7.2.1 IO-Link Status Module

IO-Link Status module is a 4-byte input only module that provides status information of all IO-Link ports. The following table shows the data format of IO-Link Status module.

Byte Offset	Status Byte Description
0	IO-Link Active
1	IO-Link PDI Valid
2	IO-Link Auxiliary Input
3	IO-Link Error

Each IO-Link port is mapped into one bit of each byte in the IO-Link Status module as shown in this table. For IO-Link Active status byte (offset 0), a bit one means the corresponding IO-Link port is active. An IO-Link port is considered as active when it is configured correctly and has a working IO-Link device attached.

A bit one in IO-Link PDI Valid status byte (offset 1) means the PDI data from the corresponding IO-Link port is valid. PDI Valid is only applicable to IO-Link port modules that have input data.

- If there are any errors detected when communicating with the IO-Link device, the corresponding bit in the IO-Link Error status byte (offset 2) will be set to 1.
- If a high voltage is detected on the auxiliary input of an IO-Link port, the corresponding bit in the IO-Link Auxiliary Input status byte (offset 3) will be set to 1.

See the following table for the description of each byte of the **IO-Link Status** module.

Status Byte	Status Bit Description
IO-Link Active	• **0**: IO-Link port is not active, no IO-Link device is detected. • **1**: IO-Link port is active, an IO-Link device is detected and operational.
IO-Link PDI Valid	• **0**: IO-Link port PDI data is not valid. • **1**: IO-Link port PDI data is valid.
IO-Link Auxiliary Input	• **0**: Low voltage detected on the auxiliary pin of an IO-Link port. • **1**: High voltage detected on the auxiliary pin of an IO-Link port.
IO-Link Error	• **0**: No error detected • **1**: An error detected. The further information about the error is available in PROFINET IO channel diagnostics.

3.7.2.2 Auxiliary Input Parameters

Use the appropriate procedure for your environment:

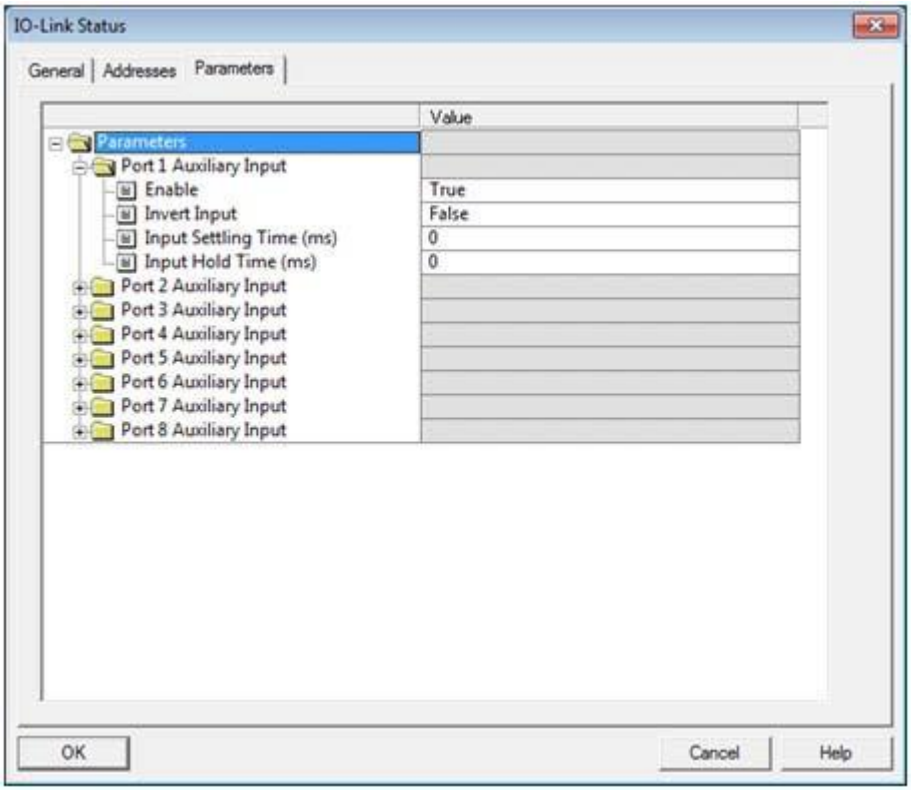
- STEP 7 V5.5
- TIA Portal V13 on Page 45

Port N Auxiliary Input Parameters	
Enable (Default: False)	If enabled, the auxiliary input of Port n will be used. • True (Enabled – Enable auxiliary input) • False (Disable – Do not use auxiliary input)
Invert Input (Default: False)	If enabled, this inverts the auxiliary input of port n. • False (Disabled - Do not auxiliary input) • True (Enabled – Invert auxiliary input)
Input Settling Time (ms) (Default: 0)	The auxiliary input settling time that remains constant before that input is considered/accepted
Input Hold Time (ms) (Default: 0)	This is how long the IO-Link Master keeps the input at its present value. For example, if the IO-Link Master detects the input to go to high, and the hold time is X milliseconds, then the IO-Link Master reports the input as high for X milliseconds, even though the input itself may have gone away already. If X is zero, then you get the behavior currently in the field.

3.7.2.2.1 STEP 7 V5.5

Use this procedure to set the auxiliary input parameters.

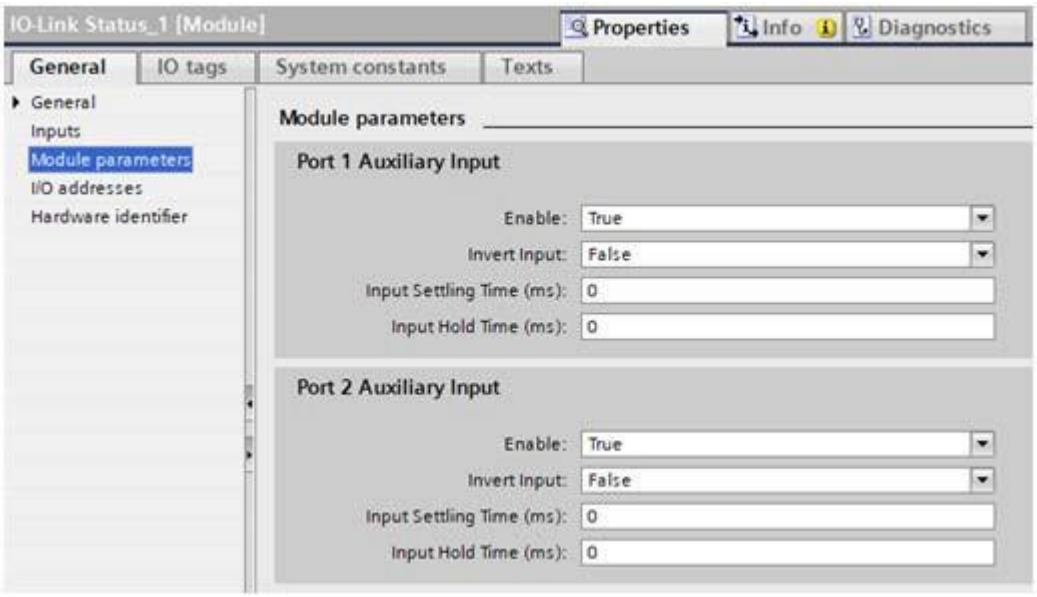
1. Double-click the IO-Link Status module.
2. Select the **Parameters** table. Available parameters are shown in the next image and the table (Page 43) describes Auxiliary Input parameters.



3.7.2.2.2 TIA Portal V13

Use this procedure to set the auxiliary input parameters.

1. Open the **IOLM Device** view.
2. Click the **IO-Link Status** module.
3. On the **Properties | General tag**, select **Module parameters**. Available parameters are shown in the next image and the table (Page 43) describes Auxiliary Input parameters.



3.7.2.3 Digital I/O Module

Digital I/O module has 1-byte input and 1-byte output. There are a total of four digital I/O ports: DIO 1-4 on applicable models (MD 248i-12-8K/L4-2R2K).

DIO 2 and DIO 4 can be configured as outputs. Use the following table to map DIO pins into bits of Digital IO module.

For input, a bit one means that high voltage is detected on that DIO pin. A zero means low voltage is detected on the DIO pin. Bits 4-7 are not in use and always return as zeros.

Digital I/O Module Bit Map								
	Bit 7	**Bit 6**	**Bit 5**	**Bit 4**	**Bit 3**	**Bit 2**	**Bit 1**	**Bit 0**
DIO Input	0	0	0	0	DIO 4	DIO 3	DIO 2	DIO 1
DIO Output	-	-	-	-	DIO 4	-	DIO 2	-

To use DIO 2 and DIO 4 as outputs, first they need to be configured as digital output.

Digital I/O Module Parameters	
Mode (Default: Digital Input)	• **Off** - Disable the digital I/O • **Digital Input** - monitors the digital input status on the DIO terminal screw connection • **Digital Output** - sets the digital output to either the default setting or value received from a controller. ***Note!*** *The Digital Output option is only available on D2 and D4.*
Invert I/O (Default: False)	If enabled, this inverts the I/O value. If **Mode** is set to **Digital Input**, this inverts the input status. If **Mode** is set to **Digital Output**, this inverts the output. • **False** (Disabled - Do not invert IO) • **True** (Enabled - Invert IO)
Default Digital Output (Default: Off)	Defines the default digital output value at startup before a controller can set the digital output, or when communication to all controller(s) has been lost. • **Off** (low voltage) • **On** (high voltage) ***Note!*** *Only available on D2 and D4.*
Input Settling Time 0-10000ms (Default: 0ms)	If non-zero and **Mode** is set to **Digital Input**, the required time that the input status must remain constant before an input status change is reported.
Input Hold Time 0-10000ms (Default 0ms)	This is how long the IOLM keeps the input at its present value. For example, if the IOLM detects the input to go to high, and the hold time is X milliseconds, then the IOLM reports the input as high for X milliseconds, even though the input itself may have gone away already. If X is zero, then you get the behavior currently in the field.

Use the appropriate procedure for your environment:

- STEP 7 V5.5 on Page 46
- TIA Portal V13 on Page 47

3.7.2.3.1 STEP 7 V5.5

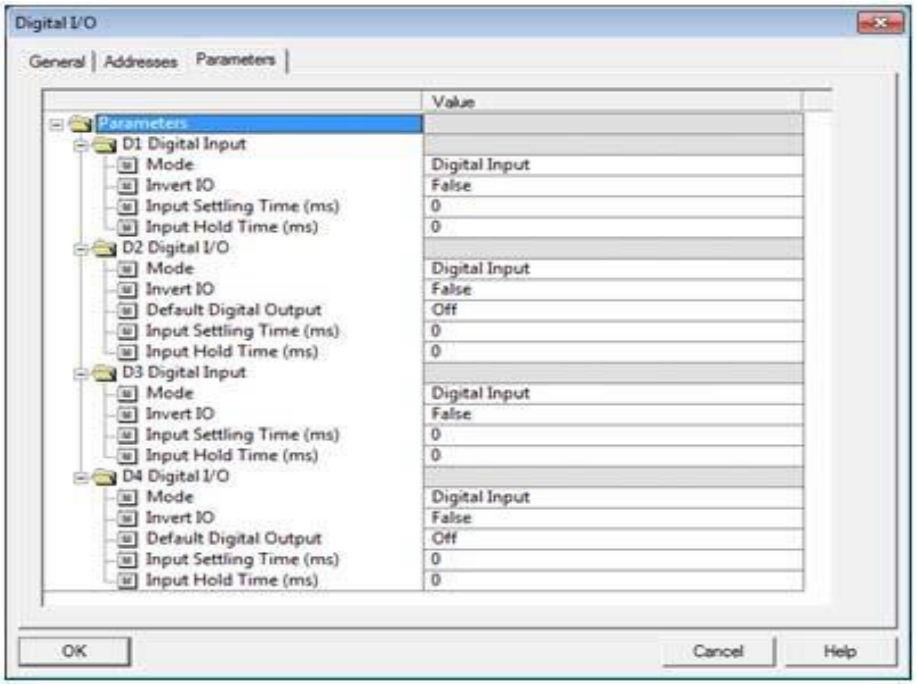
Use the following procedure to configure digital output.

1. Double-lick the **Digital I/O** module to open up the *Parameters* window, as shown in the following figure.
2. Change the parameter **Mode** of DIO 2 and DIO 4 to **Digital Output**.

   Once configured, writing a one to Bit 1 and Bit 3 of the Digital I/O module output sets DIO 2 and DIO 4 pins to high. Clearing Bit 1 and Bit 3 to zero sets DIO 2 and DIO 4 pins to low.

NOTE	
	Only Bit 1 and Bit 3 of the Digital I/O module output are in use. Changing the value of other bits has no effects.

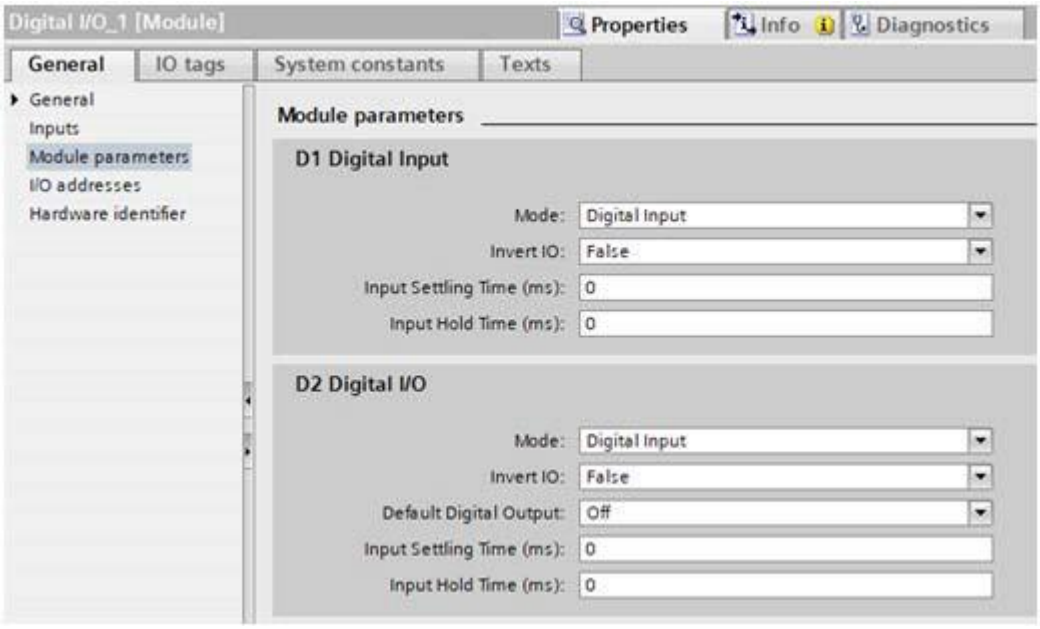
The table (Page 45) shows the description of available parameters of Digital I/O Module.



3.7.2.3.2 TIA Portal V13

Use the following procedure to configure digital output.

1. Open the IOLM **Device** view.
2. Click the Digital I/O module.
3. On the **Properties | General tag**, select **Module** parameters. Available parameters are shown in the next image and the table (Page 45) describes Digital I/O module parameters.



3.7.3 Configuring IO-Link Ports with the Web Interface

IO-Link port settings (for example, port mode, minimum cycle time, data storage, validation, and device validation) should be configured through STEP 7 by adding correct modules and setting modules' parameters. Optionally, the same settings can be changed through the web interface.

	NOTE
	Any changes made through the web interface are overwritten when an application relation is established between a gateway and an IO controller.

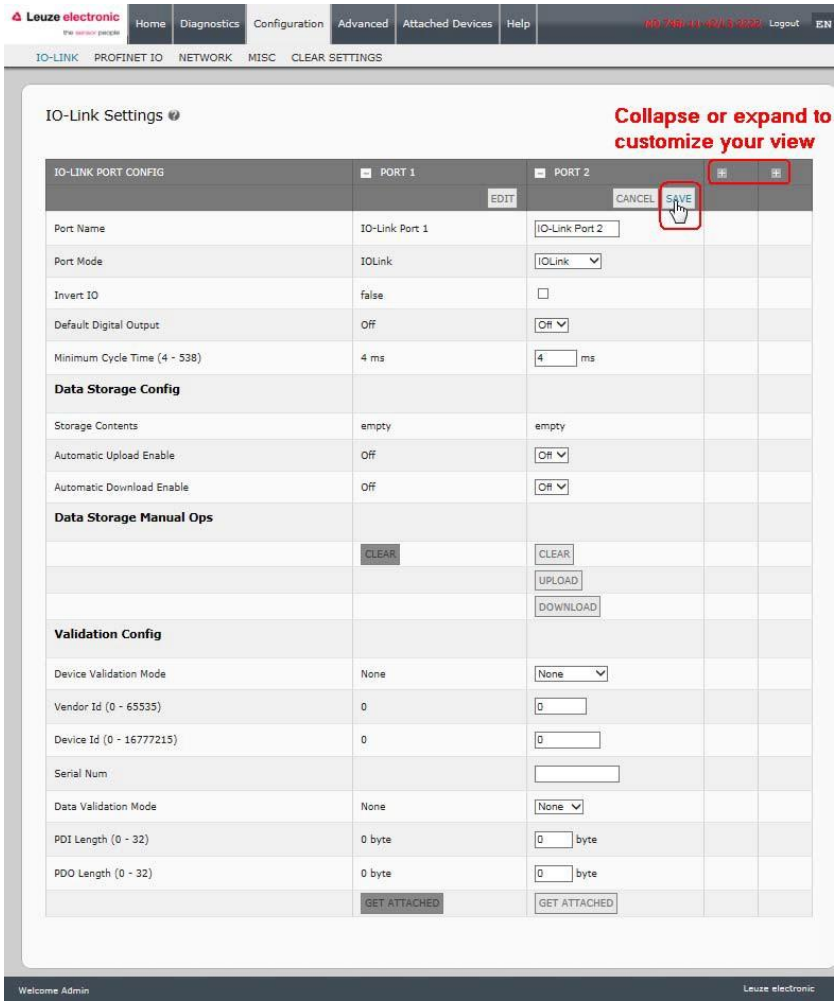
This page provides special features such as Data Storage, Device Validation, and Data Validation.

	NOTE
	Do not configure Data Storage until the IO-Link device is configured. Data Storage, Device Validation, and Data Validation are discussed in Chapter 10 Utilizing IOLM Features on Page 92.

You can use this procedure to configure IO-Link settings for each IO-Link port.

If an IO-Link device is attached to the port, no configuration is required for operation. If a digital input or output device is attached, it is necessary to change the **Port Mode**.

1. If necessary, open the IO-Link Master web interface with your web browser using the IP address.
2. Click **Configuration** | **IO-Link Settings**.
3. Click the **EDIT** button for the port or ports that you want to configure.



	NOTE
	You can click each **EDIT** button and open all ports to quickly configure port parameters.

4. Make appropriate selections for the device that you connected to that port.

   Make sure you select the **DigitalIn** option for a digital input device and the **DigitalOut** option for a digital output device for the **Port Mode**.

   The IOLM negotiates the **Minimum Cycle Time** so it is not necessary to set a cycle time unless you need a specific cycle time.

   You can use the help system if you require definitions or values for the options or refer to the following table.

	NOTE
	Do not configure Data Storage until the IO-Link device is configured.

	NOTE
	Do not enable **Automatic Download** and then attempt device configuration as Automatic Download changes the settings back to what is stored on the IOLM. Data Storage, Device

NOTE	
	Validation, and Data Validation are discussed in Chapter 10 Utilizing IOLM Features on Page 92.

5. Click the **SAVE** button for each port.
6. Return to the **IO-Link Diagnostics** page to verify that your changes have taken affect.

The **Configuration | IO-Link Settings** page supports the following options.

IO-LINK Settings Page	
Port Name	User defined port or device description. • Standard ASCII characters • Max length = 80 characters
Port Mode *Default*: IO-Link	Selected IO-Link port mode. Valid settings are: • **Reset** - Select to disable a port or to reset/restart an IO-Link port. • **IO-Link** - Select to connect and operate an IO-Link device on the port. • **Digital In** - Select if a DI device is attached to the port. • **Digital Out** - Select if a DO device is attached to the port.
Invert SIO *Default*: False	If enabled and the **Port Mode** is **Digital In** or **Digital Out**, this option inverts the SIO value. • **False** (Disabled - Do not invert SIO) • **True** (Enabled - Invert SIO) ***Note!*** *This option does not affect the Auxiliary Input.*
Invert Auxiliary Input	If this option is enabled, the Auxiliary bit is inverted.
Default Digital Output *Default*: Off	If the port mode is **Digital Out**, defines the default digital output value that is used at startup and when there is no active PDO controller. • **Off** (low voltage) - 0 • **On** (high voltage) - 24V
Minimum Cycle Time *Default*: 4	The minimum, or fastest, cycle time at which the IO-Link device may operate. The valid range is 4-538 ms. You can leave the **Minimum Cycle Time** set to the default value and the IO-Link Master negotiates with the IO-Link device for its minimum cycle time. The **IO-Link Diagnostics** page displays the **Actual Cycle Time**, which is the negotiated cycle time.
Auxiliary Input Settling Time (0 - 10000)	The auxiliary input settling time that remains constant before that input is considered/accepted
Auxiliary Input Hold Time (0 - 10000)	This is how long the IO-Link Master keeps the input at its present value. For example, if the IO-Link Master detects the input to go to high, and the hold time is X milliseconds, then the IO-Link Master reports the input as high for X milliseconds, even though the input itself may have gone away already. If X is zero, then you get the behavior currently in the field.

IO-LINK Settings Page	
SIO Input Settling Time (0 - 10000)	The SIO input settling time that remains constant before that input is considered/ accepted.
SIO Input Hold Time (0 - 10000)	This is how long the IO-Link Master keeps the input at its present value. For example, if the IO-Link Master detects the input to go to high, and the hold time is X milliseconds, then the IO-Link Master reports the input as high for X milliseconds, even though the input itself may have gone away already. If X is zero, then you get the behavior currently in the field.
Data Storage Config	
Storage Contents	Indicates that the data storage for the port is **empty** or displays the Vendor ID and Product ID of the data stored on that port.
Automatic Data Storage Upload Enable *Default*: Off	When this option is initially set to **On**, the IOLM saves the data storage parameters (if the data storage is empty) from the IO-Link device to the IOLM. Automatic upload occurs when the **Automatic Upload Enable** option is set to **On** and one of these conditions exists: • There is no upload data stored on the gateway and the IO-Link device is connected to the port. • The IO-Link device has the **DS_upload** bit on (generally because you have changed the configuration via Teach buttons or web page). When a port contains data storage for an IO-Link device and if you attach a device whose Vendor and Device ID do not match, the IO-Link LED on the IOLM flashes red to indicate a wrong device is attached. In addition, the *IO-Link Diagnostics* page displays **DS: Wrong Sensor** in the **IOLink State** field. ***Note!*** *Not all device parameters are sent to data storage, this is determined by the IO-Link device manufacturer.*
Automatic Data Storage Download Enable *Default*: Off	The data storage parameters on the IOLM are downloaded to the connected IO-Link device if: 1. The Automatic Download option is enabled. 2. The data stored on the IOLM port contains the same Vendor ID and Product ID as the IO-Link device connected to the port. 3. Data storage parameters are also downloaded to the IO-Link device if configuration changes are made on the device causing the **DS_upload** bit to turn on and automatic upload is not enabled. 4. The IO-Link device requests an upload and the **Automatic Upload Enable** option is set to **Off**. If you change configuration parameters on the IO-Link device and want the parameters to remain loaded on the IO-Link device, you must disable the **Automatic Download** option because otherwise the IOLM will reload the data storage on the port down to the IO-Link device.

IO-LINK Settings Page	
Data Storage Manual Ops	The **Manual Data Storage Ops** option provides the following functionality, if data storage is supported by the IO-Link device. • **CLEAR** - this clears any stored data for an IO-Link device on this port. • **UPLOAD** - this uploads and stores the IO-Link device configuration on the IOLM. • **DOWNLOAD** - this downloads the stored IO-Link device configuration from the IOLM to the IO-Link device attached to this port if the Vendor ID and Device ID match.
Validation Config	

Device Validation Mode
(Default: None)
	Device Validation Mode provides these options:
	• None - this disables Device Validation Mode.
	• **Compatible** - permits a compatible IO-Link device (same Vendor ID and Device ID) to function on the corresponding port.
	• **Identical** - only permits an IO-Link device to function on the corresponding port as defined in the following fields.
	  • Vendor ID
	  • Device ID
	  • Serial Number
	  *Note!*
	Connecting an IO-Link device that is different than the configured with Data Validation enabled will generate a DV: wrong sensor error.

Vendor Id (0-65535)	This is required if you select a **Device Validation Mode** other than *None*. The Vendor ID can be manually entered in this field or click the **GET ATTACHED** button and the IO-Link Master populates the **Vendor ID** in this field.
Device Id (0-16777215)	This is required if you select a **Device Validation Mode** other than *None*. The **Device ID** can be manually entered in this field or click the **GET ATTACHED** button and the IO-Link Master populates the **Device ID** in this field.
Serial Num	This is required if you select **Identical** for the **Device Validation Mode**. The **Serial Number** can be manually entered in this field or click the **GET ATTACHED** button and the IO-Link Master populates the serial number in this field.
Data Validation Mode (Default: None)	There are three Data Validation Modes: • **None** - no data validation is performed on the port. • **Loose** - the slave device's PDI/PDO lengths must be less than or equal to the user-configured values. • **Strict** - the slave device's PDI/PDO lengths must be the same as the user-configured values.

IO-LINK Settings Page	
PDI Length (0-32)	This is input length of the PDI data field. This is required if you select a **Data Validation Mode** other than *None*. The **PDI Length** can be manually entered in this field or click the **GET ATTACHED** button and the IO-Link Master populates the PDI length in this field.
PDO Length (0-32)	This is input length of the PDO data field. This is required if you select a **Data Validation Mode** other than *None*. The **PDO Length** can be manually entered in this field or click the **GET ATTACHED** button and the IO-Link Master populates the PDO length in this field
GET ATTACHED (Button)	After opening a port for editing, you can click the **GET ATTACHED** button to automatically populate the following fields with data from the IO-Link device: • Vendor Id • Device Id • Serial Num • PDI Length • PDO Length

4 Updating Images and Applications

This chapter provides an overview of the software (images and applications) on the IOLM. In addition it contains procedures to update images (Page 55) and application sub-assemblies (Page 56).

After verifying that the IOLM contains the latest software, the next step is to configure the port characteristics using Chapter 3 Configuring the IOLM with STEP 7 on Page 21 (on applicable models).

4.1 Images and Application Sub-Assemblies Overview

The IOLM is loaded with the latest images at the factory but you may need to update images or application sub-assemblies to have access to the latest features. You can view all image and application versions in the IOLM **ADVANCED | Software** page.

4.1.1 Images

The following table discusses IOLM images.

IOLM Images	
U-Boot Bootloader	U-Boot is a high-level Bootloader that has networking and console command line capabilities. Among other things, it implements a TFTP server and Leuze Corporation's new discovery protocol. This verifies that a Linux kernel image exists in NAND, then copies it to RAM and starts the IOLM. The U-Boot version is displayed after the image name.
FPGA	The FPGA partition/image contains configuration data used by programmable hardware within the IOLM unit.FPGA images are unique to the hardware and protocol type. Make sure you download the correct image for your platform.
uImage - Primary/ Backup	The uImage contains the Linux kernel and the RAM-resident root file system. It does not contain industrial protocol support or application-specific features. There is a Primary and Backup version loaded on the IOLM. The IOLM automatically reloads the Backup uImage if the file system corrupted. The uImage version is displayed after the Primary/Backup uImage.
Application Base	The Application Base image comprises a flash-resident file system containing applications and protocol support. The Application Base is built from a collection of application subassemblies -- each of which may be updated individually between releases of the application base as a whole. The application sub-assemblies in the Application Base image are displayed in the lower portion of the **SOFTWARE** page. The Application Base assembly has a 3-tuple version number: (for example, 1.3.18).

4.1.2 Application Subassemblies

Application sub-assemblies are the components of the Application Base image. Application sub-assemblies have a 4-tuple version number (for example, 1.3.18.3). The first two values in a subassembly version correspond to the version of the application base assembly for which it was built and tested.

For example, a subassembly with version 1.3.18.3 was tested with application base version 1.3.18. When using the **Software** page, an application subassembly can install only if its version number matches that of

the installed application base assembly. A subassembly with a version of 1.20.2.4 only installs if the application base version is 1.20.2. It will not install on a device with application base version 1.21.5.

IOLM Application Sub assemblies	
application-manager	The Application Manager version loaded on the IOLM.
configuration-manager	The Configuration Manager version loaded on the IOLM.
discovery-protocol	The Discovery Protocol version loaded on the IOLM.
event-log	The Event log version loaded on the IOLM.
iolink-driver	The IO-Link driver version loaded on the IOLM.
libiolinkutils	The IO-Link utilities library version loaded on the IOLM.
modbus	If applicable, the Modbus/TCP interface version loaded on the IOLM.
opcua-server	If applicable, the opcua-server interface version loaded on the IOLM.
profinetio	The PROFINET IO version loaded on the IOLM.
web-help	The web interface help version loaded on the IOLM.
web-user-interface	The web interface version loaded on the IOLM.

4.2 Using the Web Interface to Update Software

The upper portion of the **Advanced | Software** page is used to update the IOLM images. The lower portion of this page is used for updating application sub-assemblies that are integrated in the Application Base.

Typically, the latest application sub-assemblies are available in the Application Base image. There may times when a feature enhancement or bug fix is available in an application subassembly and not yet available in the Application Base image.

4.2.1 Updating Images

Use this procedure to upload images using the **SOFTWARE** page.

1. Download the latest image from the Leuze web site.

NOTE	
	Make sure that you download the appropriate software for your model. For example, the FPGA images are unique for different hardware models and protocol.

2. Open your browser and enter the IP address of the IOLM.
3. Click **Advanced** | **SOFTWARE**.
4. Click the **UPDATE** button next to the image you want to update.
5. Click the **Browse** button, navigate to the file location, highlight the image, and click **Open**.
6. Click the **Install** button.
7. Click the **CONTINUE** button to the *Update Image* message.
8. Click **OK** to close the *Update Image Successful* message.

NOTE	
	Some images may require the IOLM web server to restart.

4.2.2 Updating Application Subassemblies

Use this procedure to upload applications using the **Software** page.

1. Download the latest application from the Leuze web site.
2. Open your browser and enter the IP address of the IOLM.
3. Click **Advanced** and **SOFTWARE**.
4. Click the **Browse** button under **Update Application** navigate to the file location, highlight the application, and click **Open**.
5. Click the **Install** button.
6. Click the **CONTINUE** button to the *Update Application* message.
7. Click **OK** to close the *Update Application Successful* message.

5 Connecting Devices

This chapter discusses connecting devices to the IOLM. Use the appropriate discussion for your IOLM model.

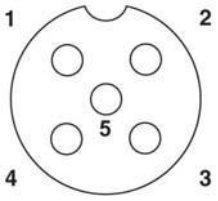
- MD 748i-11-42/L5-2222 IO-Link Ports
- MD 748i-11-82/L5-2222 and MD 748iC-11-82/L5-2222 F001 IO-Link Ports on Page 58
- MD 248i-12-8K/L4-2R2K IO-Link and DIO Ports on Page 60

5.1 MD 748i-11-42/L5-2222 IO-Link Ports

The MD 748i-11-42/L5-2222 provides four IO-Link ports (depending on the model) with M12, 5-pin female/A coded connectors.

This table provides signal information for the IO-Link connectors.

Pin	Signal	Description
1	L+	IO-Link device power supply (+24V)
2	DI	Digital input
3	L-	IO-Link device power supply (0V)
4	C/Q	Communication signal, which supports SDCI (IO- Link) or SIO (standard input/output) digital I/O
5	N/A	Not connected



The standard SDCI (IO-Link) transmission rates are supported:

- COM1 at 4.8Kbps
- COM2 at 38.4Kbps
- COM3 at 230.4Kbps

This table provides current and power information that you may need regarding the IO-Link ports.

Current and Power	MD 748i-11-42/ L5-2222
Maximum C/Q Current	200mA
Maximum L+/L- Current Output	500mA
C/Q & DI Input: Maximum (L+) Minimum (L-)	Power Input +0.5VDC -0.5VDC

Use the following procedure to attach IO-Link or digital input/output devices to the ports.

1. Securely attach the IO-link cable between the IO-Link or digital IO device and the IO-Link port.

NOTE
Make sure that you tighten the cables properly to maintain IP67 integrity.

2. If necessary, securely attach a connector cap to prevent dust or liquids from getting into any unused ports. Connector caps were shipped with the IOLM.

	NOTE
	IO-Link ports must have an approved cable or protective cover attached to the port to guarantee IP67 compliance.

3. If necessary, configure IO-Link port parameters using the **Configuration | IO-Link Settings** page to configure the port mode.

- If an IO-Link device is attached to the port, the IO-Link LED should now be lit green and the device is receiving power.
- If a digital input or output device is attached to the IO-Link port, after the port is configured for digital input or output on the **IO-Link Settings** page, the IO-Link LED does not light but when an event occurs:
  - Digital input causes the DI LED to flash.
  - Digital output causes the IO-Link LED to flash

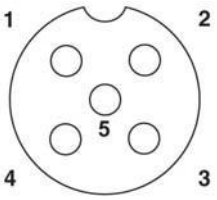
You can refer to the help system or 3.7 Configuring IO-Link Ports on Page 35 for configuration information.

5.2 MD 748i-11-82/L5-2222 and MD 748iC-11-82/L5-2222 F001 IO-Link Ports

The MD 748i-11-82/L5-2222 and MD 748iC-11-82/L5-2222 F001 provides eight IO-Link ports with M12, 5-pin female/A coded connectors. Each port has robust over-current protection and short circuit protection on its L+/ L- power output and C/Q IO-Link signal. The pin-out for each IO-Link port is per the IO-Link standard and is provided in the following table:

This table provides signal information for the IO-Link connectors.

Pin	Signal	Description
1	L+	IO-Link device power supply (+24V)
2	DI	Digital input
3	L-	IO-Link device power supply (0V)
4	C/Q	Communication signal, which supports SDCI (IO- Link) or SIO (standard input/output) digital I/O
5	FE	Functional Earth (electronics wiring)



The standard SDCI (IO-Link) transmission rates are supported:

- COM1 at 4.8Kbps
- COM2 at 38.4Kbps
- COM3 at 230.4Kbps

There are active over-current limiter electronics for each port in the MD 748i-11-82/L5-2222 and MD 748iC- 11-82/L5-2222 F001 that detects the overload/short-circuit condition within a few milliseconds and shuts off the output power to protect the port and the devices connected to it. The port's power output self-recovers and restores to normal immediately after the overload or short-circuit condition is removed.

The over-current limiter circuit for L+/L- pins is separate circuits than the over-current limiter circuit for the C/Q output pin. When a port is affected by overload/short-circuit condition, it does not affect the operation of the other ports. All other ports will continue to operate normally without any glitch or interruption. The

current output capacity, cutoff current, and power sharing/budgeting for L+/L- and C/Q signal for the ports on the MD 748i-11-82/L5-2222 and MD 748iC-11-82/L5-2222 F001 are as follows.

MD 748i-11-82/L5-2222 and MD 748iC-11-82/L5-2222 F001	**L+/L-**			**C/Q**		
Port	Output Current Capacity (max.)	Overload Cutoff Current	Short-Circuit Protection	Output Current Capacity (max.)	Overload Cutoff Current	Short-Circuit Protection
Port 1: Independent over-current limiter circuits/IC for L+/L- and C/Q pins	1.6A	1.65A	Yes	200mA	400mA	Yes
Port 3: Independent over-current limiter circuits/IC for L+/L- and C/Q pins	1A	1.05A	Yes	200mA	400mA	Yes
Ports 2 and 4 (Pair)						
Ports 5 and 7 (Pair)						
Ports 6 and 8 (Pair)						
There's one independent over- current limiter that protects L+/L- pins on each pair of ports, for example: Port 2 and 4.						
This allows you to do power budgeting on pair of ports that allows flexibility in the application. The combined overload cutoff current on a pair of ports is 1.05A for the L+/ L- pins. As long as the cutoff current of 1.05A is not exceeded, the current output could be budgeted between a pair of ports such as, Port 2 and 4 any way you want.	500mA/ port pair (1A output power budget per port pair)	1.05A/port pair	Yes	200mA*/ port	400mA*/ port	Yes
For example, Port 2 output can be at 900mA and Port 4 output can be at 100mA. Or, Port 2 could be left open and Port 4 output can be at 1A.						
* Each port's C/Q pin has its own independent over-current limiter circuit and are not combined. The current output of C/Q pin for each port is also independently controlled and cannot be budgeted with other ports.						

Use the following procedure to attach IO-Link or digital input/output devices to the ports.

1. Securely attach the IO-link cable between the IO-Link or digital input/output device and the IO-Link port.

NOTE
Make sure that you tighten the cables properly to maintain IP67 integrity.

2. If necessary, securely attach a connector cap to prevent dust or liquids from getting into any unused ports. Connector caps were shipped with the IOLM.

NOTE
IO-Link ports must have an approved cable or protective cover attached to the port to guarantee IP67 compliance.

3. If necessary, configure IO-Link port parameters using the **Configuration | IO-Link Settings** page to configure the port mode.
   - If an IO-Link device is attached to the port, the IO-Link LED should now be lit green and the device is receiving power.
   - If a digital input or output device is attached to the IO-Link port, after the port is configured for digital input or output on the **IO-Link Settings** page, the IO-Link LED does not light but when an event occurs:
     - Digital input causes the DI LED to flash.
     - Digital output causes the IO-Link LED to flash

You can refer to the help system or 3.7 Configuring IO-Link Ports on Page 35 for configuration information.

5.3 MD 248i-12-8K/L4-2R2K IO-Link and DIO Ports

The following provides information about the IO-Link ports.

Label	Signal	Description	Value
1	L+	Power Supply Output (+)	200mA @ 24V (Maximum)
2	L-	Power Supply Output (-)	
3	DI	Digital Input	Not applicable.
4	C/Q	Communication signal, which supports SDCI (IO-Link) or SIO (standard input/output) digital I/O	200mA @ 24V (Maximum)

NOTE
Depending on your model, the terminal blocks maybe labeled numerically or with the signal abbreviations.

The standard SDCI (IO-Link) transmission rates are supported:

- COM1 at 4.8Kbps
- COM2 at 38.4Kbps
- COM3 at 230.4Kbps

Use the appropriate procedure to connect devices to the IO-Link ports.

- Tips When Connecting Devices to the MD 248i-12-8K/L4-2R2K on Page 61
- Connecting IO-Link Devices on Page 61
- Connecting Digital Input Devices to IO-Link Ports on Page 62
- Connecting DIO Devices to IO-Link Ports on Page 62

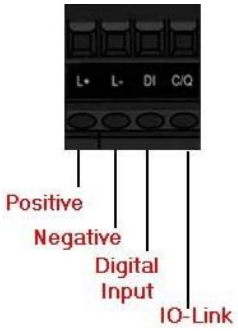
5.3.1 Tips When Connecting Devices to the MD 248i-12-8K/L4-2R2K

The following tips may be useful when connecting devices to the MD 248i-12-8K/L4-2R2K because it may be difficult to manipulate the wire-clamp screws on the adjacent ports.

- If you are going to connect devices to Digital I/O ports (**D1** through **D4**), connect the digital devices before connecting devices to IO-Link ports.
- Connect a device to IO-Link Port 1 before IO-Link Port 2
- Connect a device to IO-Link Port 4 before IO-Link Port 3
- Connect a device to IO-Link Port 5 before IO-Link Port 6
- Connect a device to IO-Link Port 8 before IO-Link Port 7

5.3.2 Connecting IO-Link Devices

Use the following procedure to connect IO-Link devices to the IO-Link ports.

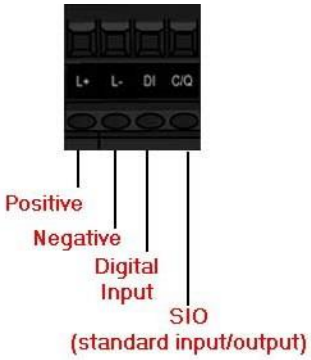


1. Insert the IO-Link device negative wire into the **L-** contact and tighten the wire-clamp screws to prevent the wire from coming loose.
2. Insert the IO-Link device positive wire into the **L+** contact and tighten the wire-clamp screws to prevent the wire from coming loose.
3. If applicable, insert the DI wire into the **DI** contact and tighten the wire-clamp screws to prevent the wire from coming loose.
4. Insert the IO-Link wire into the **C/Q** contact and tighten the wire-clamp screws to prevent the wire from coming loose.
5. If necessary, configure IO-Link parameters for each port. Refer to 6.1 Preparing for Port Configuration on Page 64 or the help system for detailed port configuration information.

5.3.3 Connecting Digital Input Devices to IO-Link Ports

You can use an IO-Link port as a digital in port if you wish to do so.

1. Insert the IO-Link device negative wire into the **L-** contact and tighten the wire-clamp screws to prevent the wire from coming loose.
2. Insert the IO-Link device positive wire into the **L+** contact and tighten the wire-clamp screws to prevent the wire from coming loose.
3. If applicable, insert the DI wire into the **DI** contact and tighten the wire-clamp screws to prevent the wire from coming loose.
4. Refer to the help system for detailed port configuration information.



5.3.4 Connecting DIO Devices to IO-Link Ports

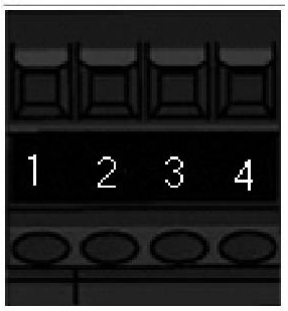
You can use an IO-Link port to connect and operate a digital input or output device.

1. Insert the IO-Link device negative wire into the **L-** contact and tighten the wire-clamp screws to prevent the wire from coming loose.
2. Insert the IO-Link device positive wire into the **L+** contact and tighten the wire-clamp screws to prevent the wire from coming loose.
3. If applicable, insert the DI or DO wire into the **C/Q** contact and tighten the wire-clamp screws to prevent the wire from coming loose.
4. Refer to the help system for detailed port configuration information.

5.3.5 Connecting Devices to the Digital IO Ports

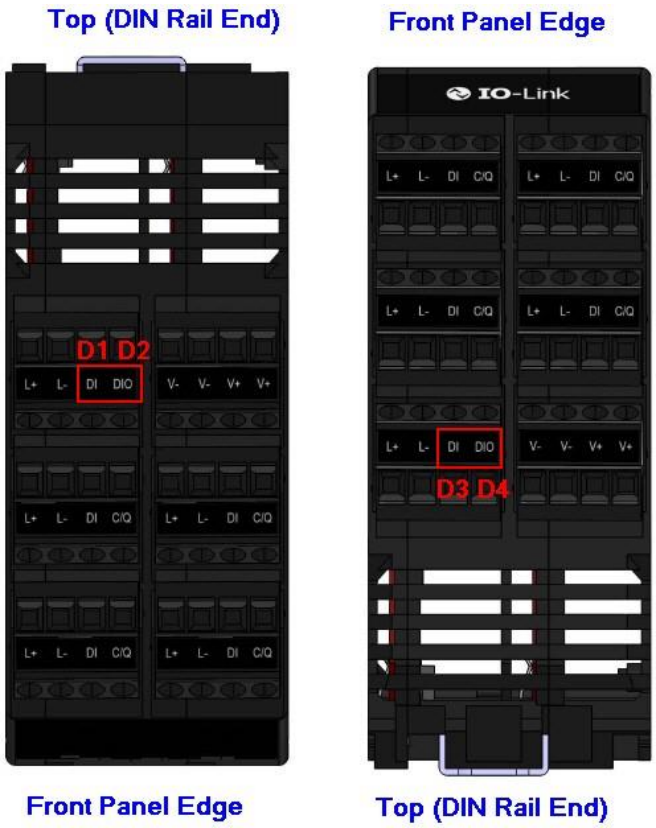
The MD 248i-12-8K/L4-2R2K provides two digital input (DI) ports and two digital IO ports.

Label	Signal	Description	Specifications
1	L+	Power Supply (+)	200mA @ 24V (maximum)
2	L-	Power Supply (-)	
3	DI	Digital Input	
4	DIO	Digital I/O	200mA @ 24V (maximum)



Note!
Depending on your model, the terminal blocks maybe labeled numerically or with the signal abbreviations.

You can connect a digital input device to DI and/or DIO. DIO supports digital out.



5.3.5.1 Connecting to DI

Use this procedure to connect a digital input device using the **DI** terminal on a DIO port.

1. Insert the IO-Link device negative wire into the **L-** contact and tighten the wire-clamp screws to prevent the wire from coming loose.
2. Insert the IO-Link device positive wire into the **L+** contact and tighten the wire-clamp screws to prevent the wire from coming loose.
3. Insert the DI wire into the **DI** contact and tighten the wire-clamp screws to prevent the wire from coming loose.
4. Go to the **Configuration | Digital I/O Settings** page to configure the port. If necessary, refer to the help system or 6.2 IO-Link Configuration Page on Page 66.

5.3.5.2 Connecting to DIO

1. Insert the IO-Link device negative wire into the **L-** contact and tighten the wire-clamp screws to prevent the wire from coming loose.
2. Insert the IO-Link device positive wire into the **L+** contact and tighten the wire-clamp screws to prevent the wire from coming loose.
3. Insert the DI wire into the **DIO** contact and tighten the wire-clamp screws to prevent the wire from coming loose.
4. Go to the **Configuration | Digital I/O Settings** page to configure the port. If necessary, refer to the help system or Chapter 7 Dedicated Digital I/O Port Configuration (MD 248i-12-8K/L4-2R2K) on Page 77.

6 IO-Link Port Configuration

This chapter discusses port configuration, which includes these topics:

- Preparing for Port Configuration
- IO-Link Configuration Page on Page 66
- PROFINET IO Settings Configuration Page on Page 70
- Modbus/TCP Settings Configuration Page on Page 70
- OPC UA Settings Configuration Page on Page 75 (not supported on all models)

NOTE	
	See Chapter 7. Dedicated Digital I/O Port Configuration (MD 248i-12-8K/L4-2R2K) on Page 77 for information about configuring dedicated digital I/O ports.

Depending on your environment, the IO-Link Master you may not need to change many of the default options.

6.1 Preparing for Port Configuration

Before beginning port configuration, you may want to verify that the connected device is functioning.

1. If necessary, log into the IO-Link Master.
2. Click **Diagnostics | IO-Link Diagnostics**.
3. Review the **Port Status** and **IOLink State**.

Port Status	Operational, PDI Valid	An IO-Link device is operating on the port that has received valid PDI data.
	Operational	An IO-Link device is operating on the port that has not received valid PDI data.
	Inactive	One of the following conditions exists: • A valid IO-Link device is not connected to the port. • A digital input or output device is connected to the port but the configured **Port Mode** is not correct.
IOLink State	Operate	Port is functioning correctly in IO-Link mode but has not received valid PDI data. This may also display during a data storage upload or download.
	Init	The port is attempting initialization.
	Reset	One of the following conditions exists: • The **Port Mode** configuration is set to **Reset**. • The **Port Mode** configuration is set to **DigitalIn** or **DigitalOut**.
	DS: Wrong Sensor	Hardware failure (IO-Link LED also flashes red) because there is Data Storage on this port, which does not reflect the attached device.
	DV: Wrong Sensor	Hardware failure (IO-Link LED also flashes red) because Device Validation is configured for this port and the wrong device is attached.
	DS: Wrong Size	Hardware failure (IO-Link LED also flashes red) because the size of the configuration on the device does not match the size of the configuration stored on the port.
	Comm Lost	Temporary state after a device is disconnected and before the port is re-initialized.
	Pre-operate	Temporary status displayed when the device: • Is starting up after connection or power-up. • Uploading or downloading automatic data storage.

NOTE
If a digital input or output device is connected to an IO-Link port, there is no valid data until the port is set to the correct Port Mode.

4. Review the **Device IO-Link Version**.
   - If the field is blank, it is not a valid IO-Link device, which could mean that it is a digital device and the port has not been configured for digital input or digital output.
   - The field displays the Device IO-Link version.

5. Optionally, review the following to see if you need to change the **Configured Minimum Cycle Time**:
   - **Actual Cycle Time**
   - **Device Minimum Cycle Time**
   - **Configured Minimum Cycle Time**

   The **Configured Minimum Cycle Time** is the minimum cycle time that the IO-Link Master allows the port to operate at. The **Actual Cycle Time** is negotiated between the IO-Link Master and the device and will be at least as long as the greater of the **Configured Minimum Cycle Time** and the **Device Minimum Cycle Time.**
6. Verify that the **Auxiliary Input Bit Status** field displays **On**, if the device is connected to DI.

For additional information about the **IO-Link Diagnostics** page, see the help system or 11.1. IO-Link Port Diagnostics on Page 102.

6.2 IO-Link Configuration Page

You can use the **Configuration | IO-Link Settings** page to configure IO-Link port settings. When the IO-Link device is attached to a port, it begins operating without requiring any configuration. The IOLM and attached IO-Link device automatically negotiate the **Minimum Cycle Time**. If required by an application, you can set a specific **Minimum Cycle Time**.

This page provides special features such as Data Storage, Device Validation, and Data Validation.

NOTE
Data Storage, Device Validation, and Data Validation are discussed in Chapter 10. Utilizing IOLM Featureson Page 92.

This subsection discusses:

- Editing IO-Link Port Settingson Page 66
- IO-Link Settings Parameterson Page 67.

6.2.1 Editing IO-Link Port Settings

You can use this procedure to configure IO-Link settings for each IO-Link port.

If an IO-Link device is attached to the port, no configuration is required for operation. If a digital input or output device is attached, it is necessary to change the **Port Mode**.

1. If necessary, open the IO-Link Master web interface with your web browser using the IP address.
2. Click **Configuration | IO-Link Settings**.
3. Click the **EDIT** button for the port or ports that you want to configure.

NOTE
You can click each EDIT button and open all ports to quickly configure port parameters.
4. Make appropriate selections for the device that you connected to that port.

   Make sure you select the **DigitalIn** option for a digital input device and the **DigitalOut** option for a digital output device for the **Port Mode**.

   The IOLM negotiates the **Minimum Cycle Time** so it is not necessary to set a cycle time unless you need a specific cycle time.

   You can use the help system if you require definitions or values for the options or refer to the following subsection (IO-Link Settings Parameters).

NOTE	
	Do not enable Automatic Download and then attempt device configuration as Automatic Download changes the settings back to what is stored on the IOLM. Data Storage, Device Validation, and Data Validation are discussed in Chapter 10. Utilizing IOLM Features on Page 92.

5. Click the **SAVE** button for each port.
6. Return to the **IO-Link Diagnostics** page to verify that your changes have taken affect.

6.2.2 IO-Link Settings Parameters

The **Configuration | IO-Link Settings** page supports the following options.

IO-LINK Settings Page	
Port Name	User defined port or device description. • Standard ASCII characters • Max length = 80 characters
Port Mode *Default*: IO-Link	Selected IO-Link port mode. Valid settings are: • **Reset** - Select to disable a port or to reset/restart an IO-Link port. • **IO-Link** - Select to connect and operate an IO-Link device on the port. • **Digital In** - Select if a DI device is attached to the port. • **Digital Out** - Select if a DO device is attached to the port.
Invert SIO *Default*: False	If enabled and the Port Mode is Digital In or Digital Out, this option inverts the SIO value. • **False** (Disabled - Do not invert SIO) • **True** (Enabled - Invert SIO) Note: This option does not affect the Auxiliary Input.
Invert Auxiliary Input	If this option is enabled, the Auxiliary bit is inverted.
Default Digital Output *Default*: Off	If the port mode is Digital Out, defines the default digital output value that is used at startup and when there is no active PDO controller. • **Off** (low voltage) - 0 • **On** (high voltage) - 24V
Minimum Cycle Time *Default*: 4	The minimum, or fastest, cycle time at which the IO-Link device may operate. The valid range is 4-538 ms. You can leave the **Minimum Cycle Time** set to the default value and the IO-Link Master negotiates with the IO-Link device for its minimum cycle time. The **IO-Link Diagnostics** page displays the **Actual Cycle Time**, which is the negotiated cycle time.
Auxiliary Input Settling Time (0 - 10000)	The auxiliary input settling time that remains constant before that input is considered/accepted
Auxiliary Input Hold Time (0 - 10000)	This is how long the IO-Link Master keeps the input at its present value. For example, if the IO-Link Master detects the input to go to high, and the hold time is X milliseconds, then the IO-Link Master reports the input as high for X milliseconds, even though the input itself may have ceased. If X is zero, then you get the behavior currently in the field.

IO-LINK Settings Page	
SIO Input Settling Time (0 - 10000)	The SIO input settling time that remains constant before that input is considered/ accepted.
SIO Input Hold Time (0 - 10000)	This is how long the IO-Link Master keeps the input at its present value. For example, if the IO-Link Master detects the input to go to high, and the hold time is X milliseconds, then the IO-Link Master reports the input as high for X milliseconds, even though the input itself may have ceased. If X is zero, then you get the behavior currently in the field.
Data Storage Config	
Storage Contents	Indicates that the data storage for the port is **empty** or displays the Vendor ID and Product ID of the data stored on that port.
Automatic Data Storage Upload Enable *Default*: Off	When this option is initially set to **On**, the IOLM saves the data storage parameters (if the data storage is empty) from the IO-Link device to the IOLM. Automatic upload occurs when the **Automatic Upload Enable** option is set to **On** and one of these conditions exists: • There is no upload data stored on the gateway and the IO-Link device is connected to the port. • The IO-Link device has the **DS_upload** bit on (generally because you have changed the configuration via Teach buttons or web page). When a port contains data storage for an IO-Link device and if you attach a device whose Vendor and Device ID do not match, the IO-Link LED on the IOLM flashes red to indicate a wrong device is attached. In addition, the IO-Link Diagnostics page displays **DS: Wrong Sensor** in the **IOLink State** field. ***Note!*** *Not all device parameters are sent to data storage, this is determined by the IO-Link device manufacturer.*
Automatic Data Storage Download Enable *Default*: Off	The data storage parameters on the IOLM are downloaded to the connected IO-Link device if: 1. The Automatic Download option is enabled. 2. The data stored on the IOLM port contains the same Vendor ID and Product ID as the IO-Link device connected to the port. 3. Data storage parameters are also downloaded to the IO-Link device if configuration changes are made on the device causing the **DS_upload** bit to turn on and automatic upload is not enabled. 4. The IO-Link device requests an upload and the **Automatic Upload Enable** option is set to **Off**. If you change configuration parameters on the IO-Link device and want the parameters to remain loaded on the IO-Link device, you must disable the **Automatic Download** option because otherwise the IOLM will reload the data storage on the port down to the IO-Link device.
Data Storage Manual Ops	The **Manual Data Storage Ops** option provides the following functionality, if data storage is supported by the IO-Link device. • **CLEAR** - this clears any stored data for an IO-Link device on this port.

IO-LINK Settings Page	
	• **UPLOAD** - this uploads and stores the IO-Link device configuration on the IOLM. • **DOWNLOAD** - this downloads the stored IO-Link device configuration from the IOLM to the IO-Link device attached to this port if the Vendor ID and Device ID match.
Validation Config	

Device Validation Mode
(Default: None)
	Device Validation Mode provides these options:
	• **None** - this disables **Device Validation Mode**.
	• **Compatible** - permits a compatible IO-Link device (same Vendor ID and Device ID) to function on the corresponding port.
	• **Identical** - only permits an IO-Link device to function on the corresponding port as defined in the following fields.
	  • Vendor ID
	  • Device ID
	  • Serial Number
	Note!
	Connecting an IO-Link device that is different than the configured with Data Validation enabled will generate a DV: wrong sensor error.

Vendor Id (0-65535)	This is required if you select a **Device Validation Mode** other than None. The **Vendor ID** can be manually entered in this field or click the **GET ATTACHED** button and the IO-Link Master populates the **Vendor ID** in this field.
Device Id (0-16777215)	This is required if you select a **Device Validation Mode** other than None. The **Device ID** can be manually entered in this field or click the **GET ATTACHED** button and the IO-Link Master populates the **Device ID** in this field.
Serial Num	This is required if you select **Identical** for the **Device Validation Mode**. The **Serial Number** can be manually entered in this field or click the **GET ATTACHED** button and the IO-Link Master populates the serial number in this field.
Data Validation Mode (Default: None)	There are three **Data Validation Modes**: • **None** - no data validation is performed on the port. • **Loose** - the slave device's PDI/PDO lengths must be less than or equal to the user-configured values. • **Strict** - the slave device's PDI/PDO lengths must be the same as the user-configured values.
PDI Length (0-32)	This is input length of the PDI data field. This is required if you select a **Data Validation Mode** other than None. The **PDI Length** can be manually entered in this field or click the **GET ATTACHED** button and the IO-Link Master populates the PDI length in this field.
PDO Length (0-32)	This is input length of the PDO data field. This is required if you select a **Data Validation Mode** other than None.

IO-LINK Settings Page	
	The **PDO Length** can be manually entered in this field or click the **GET ATTACHED** button and the IO-Link Master populates the PDO length in this field.
GET ATTACHED (Button)	After opening a port for editing, you can click the **GET ATTACHED** button to automatically populate the following fields with data from the IO-Link device: • Vendor Id • Device Id • Serial Num • PDI Length • PDO Length

6.3 PROFINET IO Settings Configuration Page

The following table provides information about the Configuration| PROFINET IO page options.

You can refer to Chapter 3. Configuring the IOLM with STEP 7 on Page 21 for configuration procedures. You must have Administrator or Operator privileges to change any settings on this page.

PROFINET IO Settings Page	
PROFINET IO Device Name	The **PROFINET IO Device Name** is the same as the name later used to configure PROFINET IO for the IO-Link Master. The device name must be specified according to DNS conventions. • Restricted to a total of 240 characters (letters, digits, dash or period) • Parts of the name within the device name; in other words, a string between two periods, must not exceed a maximum of 63 characters. • No special characters such as umlauts (ä, ö etc.), brackets, underscore, slash, blank etc. The dash is the only permitted special character. • The device name must not begin or end with the "-" character. • The device name must not begin with numbers. • The device name must not have the structure n.n.n.n (n = 0...999). • The device name must not begin with the character string "port-xyz-" (x ,y, z = 0...9).
IOL_CALL Function Block Timeout (1-20)	The **IOL_CALL Function Block Timeout** range is 1 - 20 and the default is 20.

6.4 Modbus/TCP Settings Configuration Page

You can use the **Configuration | Modbus/TCP Settings** page to configure Modbus/TCP with the IO-Link Master. Additional Modbus information is available in the following chapters:

- Chapter 14. Functionality Descriptions on Page 132
- Chapter 13. Modbus/TCP Interface on Page 125

This subsection includes these topics:

NOTE	
	Modbus is disabled by default. To use Modbus, click the ***EDIT*** button and select Enable.

6.4.1 Editing Modbus/TCP Settings

1. If necessary, open the IO-Link Master web interface with your web browser using the IP address.
2. Click **Configuration | Modbus/TCP**.
3. Click the **EDIT** button for the port that you want to configure.

NOTE	
	You can click each ***EDIT*** button and open all ports to quickly configure port parameters.

4. Make appropriate selections for the IO-Link device that you will connect to that port. You can use the help system if you require definitions or values for the options or Modbus/TCP Settings Parameters on Page 71.
5. Scroll to the top of the page and click the **SAVE** button.

   Make sure that the port now displays the **EDIT** button.

   If it displays the **SAVE** and **CANCEL** buttons, that means that one of the parameters contains an incorrect value. If necessary, scroll down the page, make the needed corrections, and click **SAVE**.

6.4.2 Modbus/TCP Settings Parameters

The following table provides detailed information about the Modbus/TCP Settings page.

Modbus/TCP Settings Page	
ISDU Data Settings	
ISDU Response Timeout *Default* = 20 seconds	The time that the IO-Link Master's Modbus/TCP interface waits for a response to an ISDU request. The timeout needs to set long enough to allow all commands within the ISDU request to be processed. Valid range: **1-10,000** seconds
Process Data Settings	
PDI Data Block Size *Default*: 36-bytes	The configurable PDI data block length. Optional lengths are: • **4-bytes** (header only) • **8-bytes** (4 bytes data) • **16-bytes** (12 bytes data) • **24-bytes** (20 bytes data) • **36-bytes** (32 bytes data)

Modbus/TCP Settings Page	
PDI Byte-Swap Method *Default*: No byte-swap	If enabled, the IO-Link Master swaps the data bytes in word (2 byte) format or dword (4 byte) format. Options include: • **No byte-swap** – data passed through as received • **Word (16-bit) byte-swap** – data is byte-swapped in word format • **Dword (32-bit) byte-swap** – data is byte-swapped in dword format • **Reverse registers** – data passed through after being reversed ***Note!*** *Because both IO-Link and Modbus/TCP use big-endian byte ordering, byte swapping typically is not required for word and dword data.* *Byte swapping is most commonly required when receiving byte (8-bit) data and it is desired to place the first data byte in the least significant byte position of the holding register. For these cases, word (16 bit) byte-swap is typically used.*
Include Digital I/O in PDI Data Block *Default*: False	If enabled, the IO-Link Master includes the current digital I/O pins D1 to D4 status in the PDI data block header. • **False** – Do not include the digital I/O pins status • **True** (enable check box) ***Note!*** *Does not affect the Auxiliary Input.*
PDO Data Block Size (From PLC) *Default*: 32-bytes	The configurable PDO data block length. Optional lengths are: Event code not included: • **4-bytes** = 2 data words • **8-bytes** = 4 data words • **16-bytes** = 8 data words • **24-bytes** = 12 data words • **32-bytes** = 16 data words • **34-bytes** = 16 data words, 1 pad word Event code included: • **4-bytes** = event code word, 1 data word • **8-bytes** = event code word, 3 data words • **16-bytes** = event code word, 7 data words • **24-bytes** = event code word, 11 data words • **32-bytes** = event code word, 15 data words • **34-bytes** = event code word, 16 data words

Modbus/TCP Settings Page	
PDO Byte-Swap Method *Default*: No byte-swap	If enabled, the IO-Link Master swaps the data bytes in word (2 byte) format or dword (4 byte) format. Options include: • **No byte-swap** – data passed through as received • **Word (16-bit) byte-swap** – data is byte-swapped in word format • **Dword (32-bit) byte-swap** – data is byte-swapped in dword format • **Reverse registers** – data passed through after being reversed ***Note!*** *Because both IO-Link and Modbus/TCP use big-endian byte ordering, byte swapping typically is not required for word and dword data.* *Byte swapping is most commonly required when sending byte (8-bit) data to the IO-Link device and it is desired to send the least significant byte of the holding register first. For these cases, word (16 bit) byte-swap is typically used.*
Append PDO to PDI Data *Default*: False	If selected, the IO-Link Master appends any PDO data to the end of the PDI data. • **False** = Do not append PDO data • **True** (enable check box) = Append PDO data
Clear Event Code in PDO Block *Default*: False	If enabled, the IO-Link Master expects the first word of the PDO block to be used for event code handling. Values are: • **True** (enable check box) = expect event code • **False** = no event code, expect only PDO data
Clear Event Code After Hold Time *Default*: True	If enabled, the IO-Link Master clears any event code reported in the PDI data block after the **Event Active Hold Time.** Values are: • **True** (enable check box) = clear event code after hold time • **False** = do not clear event code after hold time

Modbus/TCP Settings Page	
Active Event Hold Time *Default*: 1000 ms	If **Clear Event Code After Hold Time** is enabled, the time period an event code is reported in the PDI block before it is cleared. Valid range: **1-65535** Valid Units are: • **ms** (milliseconds) • **sec** (seconds) • **min** (minutes) • **hours** • **days**
Event Hold Time Units	Valid Units: • **ms** (milliseconds) • **sec** (seconds) • **min** (minutes) • **hours** • **days**
Clear Event Hold Time *Default*: 500 ms	Once an event code has been cleared, the time an event code stays cleared in the PDI block before another event code can be reported. Valid range: **1-65535** Valid Units: • **ms** (milliseconds) • **sec** (seconds) • **min** (minutes) • **hours** • **days**
Event Clear Time Units	Valid Units: • **ms** (milliseconds) • **sec** (seconds) • **min** (minutes) • **hours** • **days**
Include Digital Output(s) in PDO Data Block *Default*: False	If enabled, the IO-Link Master expects the digital output settings to be included in the PDO data block. • **False** – The digital pin setting(s) are not included in the PDO data block • **True** (enable check box) – The digital pin setting(s) are included in the PDO data block
Transfer Mode Settings	
Slave Mode Device ID *Default*: 1	The Modbus Device ID used to access this IO-Link port. Range: **1-247**

Modbus/TCP Settings Page	
PDI Receive Mode(s) *Default*: Slave	Determines which PDI Receive (To PLC) Modes are enabled. The selectable modes are: • **Slave** • **Master**
PDO Transmit Mode *Default*: Slave	Selectable Modes are: • **Disabled** • **Slave** • **Master**
Modbus Master PLC IP Address	The IP address of the Modbus slave.
Modbus Master PLC Device ID (1-247) (Default: 1)	The Modbus Device ID used to access the slave.
Modbus Master PLC PDI Data Address (base 1) (1-65535) (Default: 1)	The address of the slave's PDI (determined by the slave).
Modbus Master PLC Max Update Rate (0-10000) (Default: 0)	How often to write PDI to the slave.
Modbus Master PLC PDO Data Address (base 1) (1-65535) (Default:1)	The address of the slave's PDO (determined by the slave).
Modbus Master PLC Poll Rate (40- 65535) (Default: 40)	How often to read PDO from the slave.

6.5 OPC UA Settings Configuration Page

Use the **Configure | OPC UA Settings** page to configure OPC UA with the IOLM.

NOTE	
	Not all models support OPC UA

This subsection includes these topics:

NOTE
OPC UA is disabled by default.

6.5.1 Edit OPC UA Settings

You can use this procedure to edit OPC UA settings.

1. If necessary, open the IO-Link Master web interface with your web browser using the IP address.
2. Click **Configuration | OPC UA**.
3. Click the **EDIT** button.
4. Make the appropriate selections for your environment. You can use the help system if you require definitions or values for the options or 5.5.2. OPC UA Settings Parameters on Page 43.
5. Click the **SAVE** button.

6.5.2 OPC UA Settings Parameters

The following table provides information about the OPC UA Setting page.

Option	OPC UA Configuration Descriptions
OPC UA Port CONFIG	
Allow OPC UA clients to write PDO data (Default = disable)	Determines whether OPC UA clients are allowed to write PDO data to the IO-Link devices.
OPC UA CONFIGURATION	
OPC UA Server Enable (Default = disable)	This option controls whether or not the OPC UA server runs on the IO-Link Master.
Work-around for faulty OPC UA clients that require unique browsenames (Default = disable)	Enables an alternative set of browsenames where each node's browsename is unique. Normally only browsepaths are required to be unique.
Allow OPC UA clients to write ISDU data (Default = disable)	Determines whether OPC UA clients are allowed to write ISDU data to the IO-Link devices.

7 Dedicated Digital I/O Port Configuration (MD 248i-12-8K/L4-2R2K)

This section discusses the dedicated digital IO port (D1 through D4) configuration, including these topics:

- Digital I/O Settings Page
- Editing Digital I/O Settings on Page 77
- Digital I/O Setting Parameters on Page 77

NOTE	
	Dedicated DIO ports are only available on the MD 248i-12-8K/L4-2R2K.

7.1 Digital I/O Settings Page

Use the **Configuration | Digital I/O** page to configure the dedicated DIO port characteristics for the MD 248i-12- 8K/L4-2R2K. **D1** and **D2** are located next to IO-Link Port 1 and **D3** and **D4** are located next to IO-Link Port 4.

7.2 Editing Digital I/O Settings

You can use this procedure to configure digital I/O characteristics for the digital I/O ports.

1. If necessary, open the IOLM 8-PNIO web interface with your web browser using the IP address.
2. Click Configuration | Digital I/O.
3. Click the **EDIT** button.
4. Make appropriate selections for the digital I/O device or devices that you will connect to the ports. You can use the help system if you require definitions or values for the options or Digital I/O Setting Parameters on Page 77.
5. Click the **SAVE** button.

7.3 Digital I/O Setting Parameters

The **Configuration | Digital I/O Settings** page supports the following options.

Digital I/O Settings Page (MD 248i-12-8K/L4-2R2K) **D1 Digital Input Configuration**	
Mode *Default* = Off	Selects the **Mode**: • **Off** – No monitoring of the digital input pin. • **Digital-Input** – monitors the digital input status
Invert Input *Default*= False	If **Mode** is set to **Digital-Input**, the input status is inverted.
Input Settling Time (0 - 10000ms) *Default*= 0ms	If non-zero and **Mode** is set to **Digital-Input**, the required time that the input status must remain constant before an input status change is reported.

Digital I/O Settings Page (MD 248i-12-8K/L4-2R2K)	
Input Hold Time (0 - 10000ms) (Default: 0ms)	This is how long the IOLM keeps the input at its present value. For example, if the IOLM detects the input to go to high, and the hold time is X milliseconds, then the IOLM reports the input as high for X milliseconds, even though the input itself may have ceased. If X is zero, then you get the behavior currently in the field.
D2 Digital I/O Configuration	
Mode *Default*= Off	Selects the **Mode**: • **Off** – No monitoring or setting of the digital I/O pin. • **Digital-Input** – monitors the digital input status • **Digital-Output** – sets the digital output to either the default setting or value received from a controller.
Invert I/O *Default*= False	If selected: • If **Mode** is set to **Digital-Input**, the input status is inverted. • If **Mode** is set to **Digital-Output**, the output setting is inverted.
Default Digital Output *Default*= Off	If **Mode** is set to **Digital Output**, defines the default digital output setting: At startup before a controller can set the digital output. When communication to all controller(s) has been lost. Possible settings: **Off** - low voltage **On** – high voltage
Input Settling Time (0 - 10000ms) *Default*= 0ms	If non-zero and **Mode** is set to **Digital-Input**, the required time that the input status must remain constant before an input status change is reported.
Input Hold Time (0 - 10000ms) (Default: 0ms)	This is how long the IOLM keeps the input at its present value. For example, if the IOLM detects the input to go to high, and the hold time is X milliseconds, then the IOLM reports the input as high for X milliseconds, even though the input itself may have ceased. If X is zero, then you get the behavior currently in the field.
D3 Digital Input Configuration	
Mode *Default*= Off	Selects the **Mode**: • **Off** – No monitoring of the digital input pin. • **Digital-Input** – Monitors the digital input status
Invert Input *Default*= False	If **Mode** is set to **Digital-Input**, the input status is inverted.

Digital I/O Settings Page (MD 248i-12-8K/L4-2R2K)	
Input Settling Time (0 - 10000) *Default*= 0ms	If non-zero and **Mode** is set to **Digital-Input**, the required time that the input status must remain constant before an input status change is reported.
Input Hold Time (0 - 10000ms) (Default: 0ms)	This is how long the IOLM keeps the input at its present value. For example, if the IOLM detects the input to go to high, and the hold time is X milliseconds, then the IOLM reports the input as high for X milliseconds, even though the input itself may have ceased. If X is zero, then you get the behavior currently in the field.
D4 Digital I/O Configuration	
Mode *Default*= Off	Selects the **Mode**: • **Off** – No monitoring or setting of the digital I/O pin. • **Digital-Input** – Monitors the digital input status • **Digital-Output** – sets the digital output to either the default setting or value received from a controller.
Invert I/O *Default*= False	If selected: • If **Mode** is set to **Digital-Input**, the input status is inverted. • If **Mode** is set to **Digital-Output**, the output setting is inverted.
Default Digital Output *Default*= Off	If **Mode** is set to **Digital Output**, defines the default digital output setting: At startup before a controller can set the digital output. When communication to all controller(s) has been lost. Possible settings: **Off** - low voltage **On** – high voltage
Input Settling Time (0 - 10000) *Default*= 0ms	If non-zero and **Mode** is set to **Digital-Input**, the required time that the input status must remain constant before an input status change is reported.
Input Hold Time (0 - 10000ms) (Default: 0ms)	This is how long the IOLM keeps the input at its present value. For example, if the IOLM detects the input to go to high, and the hold time is X milliseconds, then the IOLM reports the input as high for X milliseconds, even though the input itself may have ceased. If X is zero, then you get the behavior currently in the field.

8 Loading and Managing IODD Files

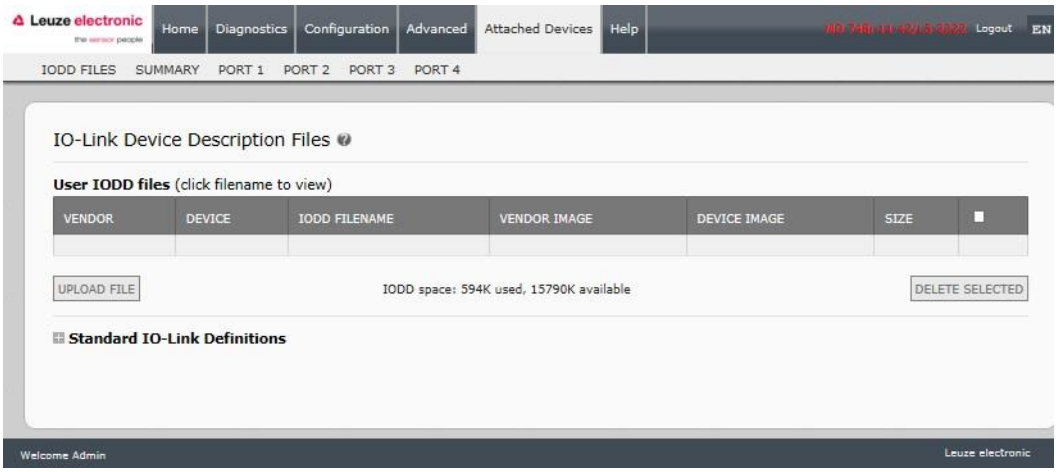
There are several **Attached Devices** pages that support IO-Link Device Description (IODD) file management.

- IO-Link Device Description Files Page- load IODD files from the IO-Link device manufacturer onto the IOLM.
- IO-Link Device Configuration Summary Page on Page 85 - verify the correct files were loaded for each IO- Link device or use the page to retrieve information about the baud rate, SIO mode, and device number.
- The **Port** pages are discussed in Chapter 9 Configuring IO-Link Devices on Page 87.

8.1 IO-Link Device Description Files Page

Use the **IO-Link Device Description Files** page to update (upload) and delete IO-Link Device Description (IODD) files associated with this IOLM. In addition, you can review the IODD **xml** file by clicking the **IODD FILENAME** in the table after loading the IODD file.

NOTE
You will need to download the appropriate IODD files from your IO-Link device manufacturer.



The IOLM provides 15790K of space to store IODD files. The IOLM includes the following default IODD files, which cannot be deleted.

- **IODD-StandardDefinitions1.0.1.xml**
- **IODD-StandardUnitDefinitions1.0.1.xml**
- **IODD-StandardDefinitions1.1.xml**
- **IODD-StandardUnitDefinitions1.1.xml**

NOTE
You can use the **Configuration | Save/Load** feature to backup your IODD files. You can save the configuration file from an IOLM that has IODD files installed and then load that configuration file to another IOLM to quickly load the IODD files.

8.1.1 Preparing IODD Files to Upload

After downloading the IODD files for the IO-Link device from the IO-Link sensor or actuator manufacturer, you may need to unzip the file and locate the appropriate **xml** file for the device.

- Some IODD zip files contain the **xml** files and supporting image files for a single product. This type of zip file can be immediately loaded onto the IOLM.
- Some IODD zip files contain the files for multiple products. If you upload this type of IODD zip file, the IOLM loads the first **xml** file and the associated image files, which may or may not correspond to the IO- Link device connected to the port. If you need to zip the appropriate files, the following information may be useful:
- Unzip the package and locate the **xml** file needed for your IO-Link device.
- Open the **xml** file and search for the **productID**, which identifies the IO-Link device.
- Zip the **xml** file along with the supporting images. There are several ways to locate the supporting images:
- Locate the appropriate images using the **xml** file.
- Load only the **xml** file and the IOLM notifies you what files are missing. Use the **UPDATE** feature to upload the missing images.
- Zip the **xml** with all of the images and the IOLM ignores (and not upload) any unused files and notifies which files did not upload.

NOTE
Image files are not required for IO-Link device configuration.

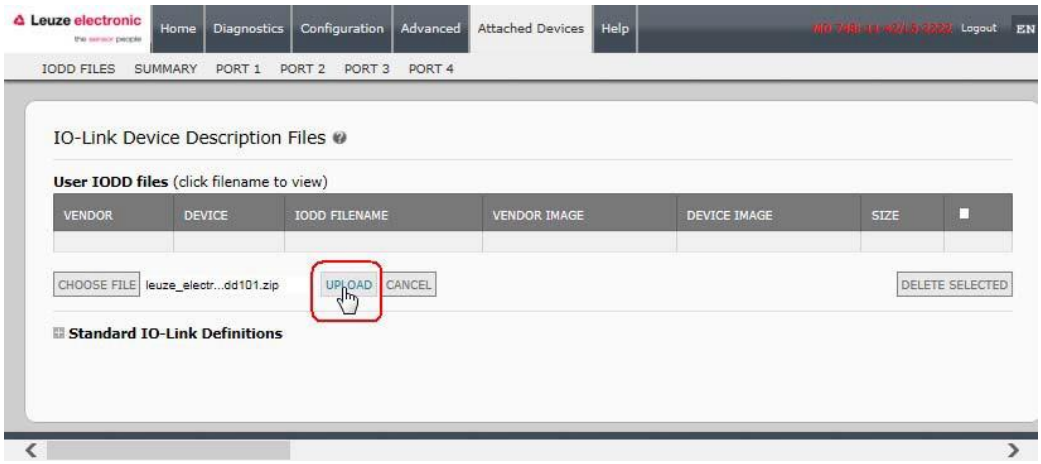
Use the appropriate discussion for your IODD files.

- Uploading IODD Zip Files
- Uploading xml Files or Supporting Files on Page 83

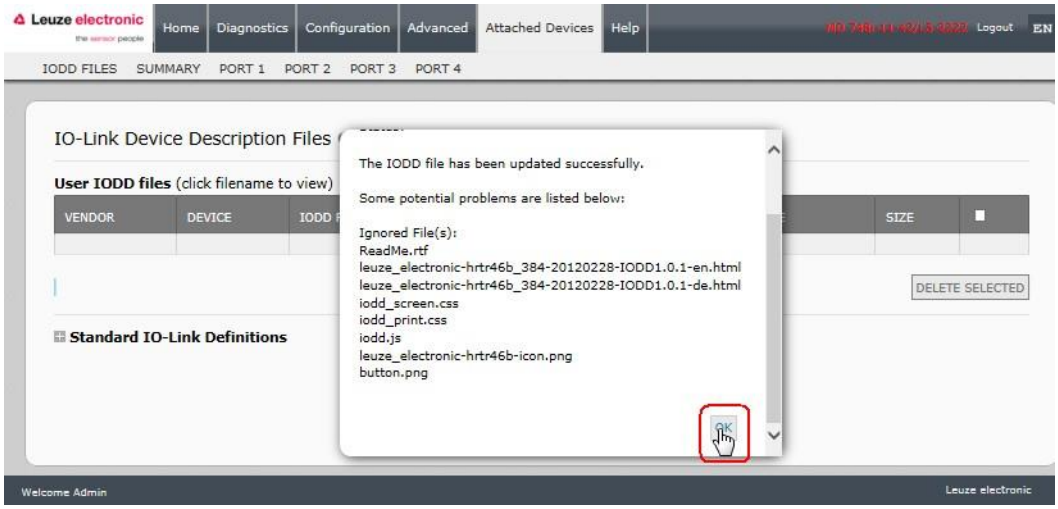
8.1.2 Uploading IODD Zip Files

You can use the following procedure to upload IODD zip files.

1. Click Attached Devices and IODD FILES.
2. Click the **UPLOAD FILE** button.
3. Click the **CHOOSE FILE** button and browse to the file location.
4. Highlight the **zip** file, click **Open** and then the **UPLOAD** button.

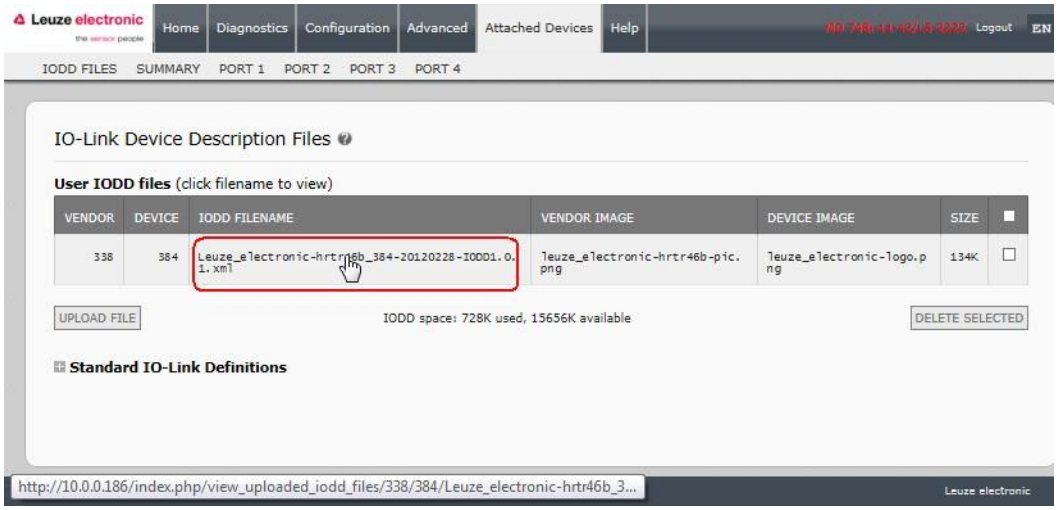


5. If necessary, click **OK**

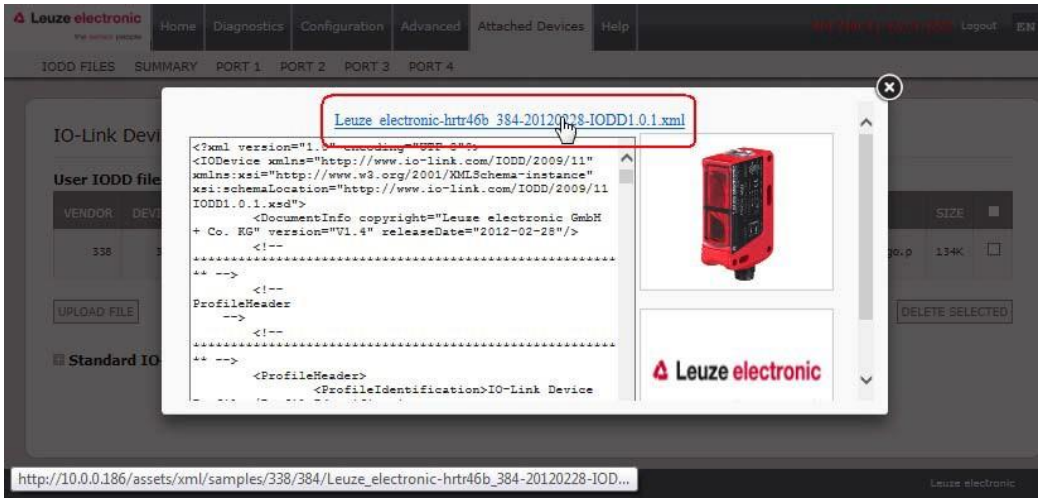


NOTE	
	Only images referenced in the xml file load to the IOLM and the remaining files are ignored.

6. If desired, you can view the **xml** file by clicking the **IODD FILENAME** in the table.



7. Click the hyperlink at the top of the page if you want to view the **xml** file in your browser.



8. Optionally, verify that the correct **xml** file was loaded using the **Summary** page (Page 85).

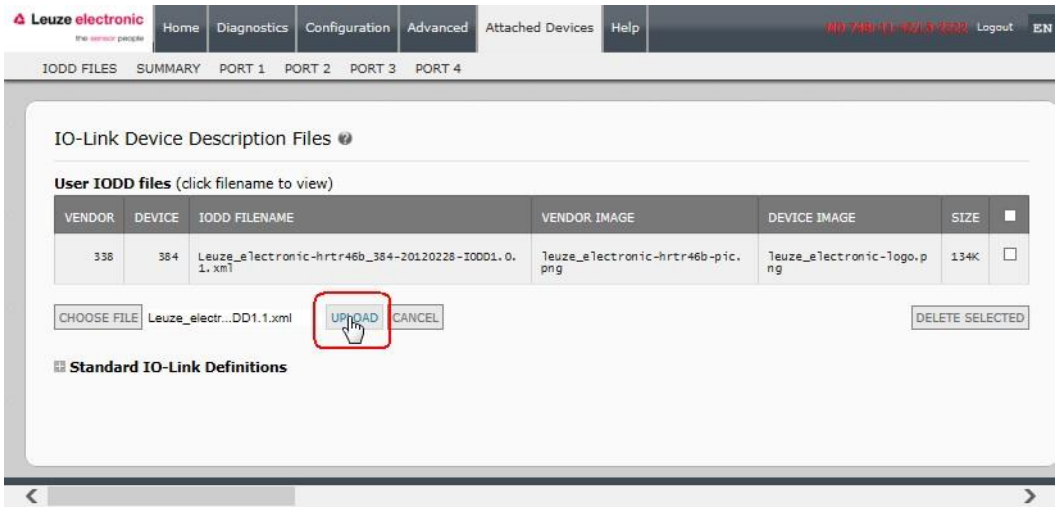
8.1.3 Uploading xml Files or Supporting Files

You can use the following procedure to upload **xml**, or supporting image files.

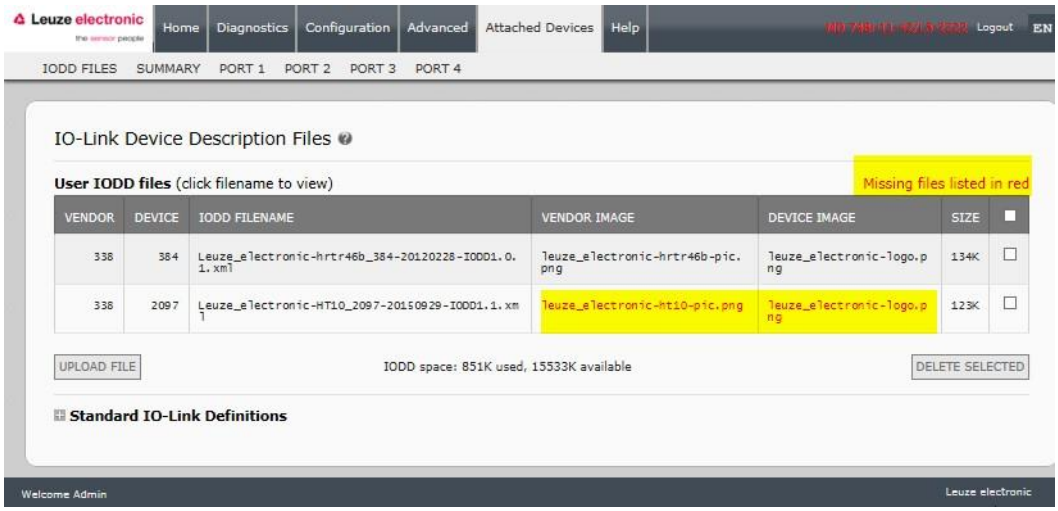
1. Click Attached Devices and IODD FILES.
2. Click the **UPLOAD FILE** button.
3. Click the **CHOOSE FILE** button and browse to the file location.
4. Highlight the **xml** or image file and click **Open**.

NOTE
The **xml** file must be loaded before the IOLM will load the associated image files.

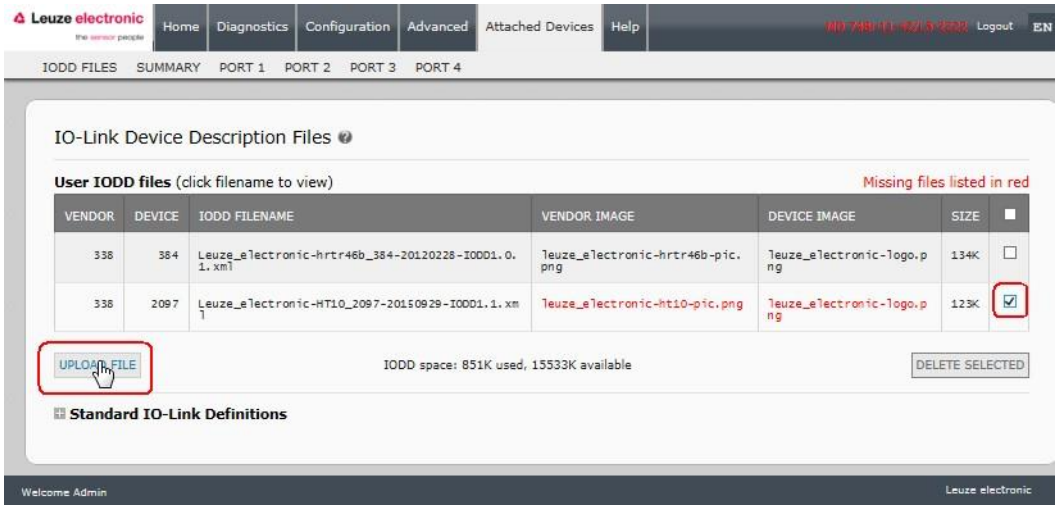
5. Click the **UPLOAD** button.



NOTE
The IOLM notifies you what files are missing. The missing files do not affect the operation of the IODD Port page but the product image and logo for the IO-Link device company do not display.



6. Optionally, use the following steps to load image files:
   a. Select the row in the table that contains the **xml** file by clicking the check box.
   b. Click the **UPLOAD FILE** button.

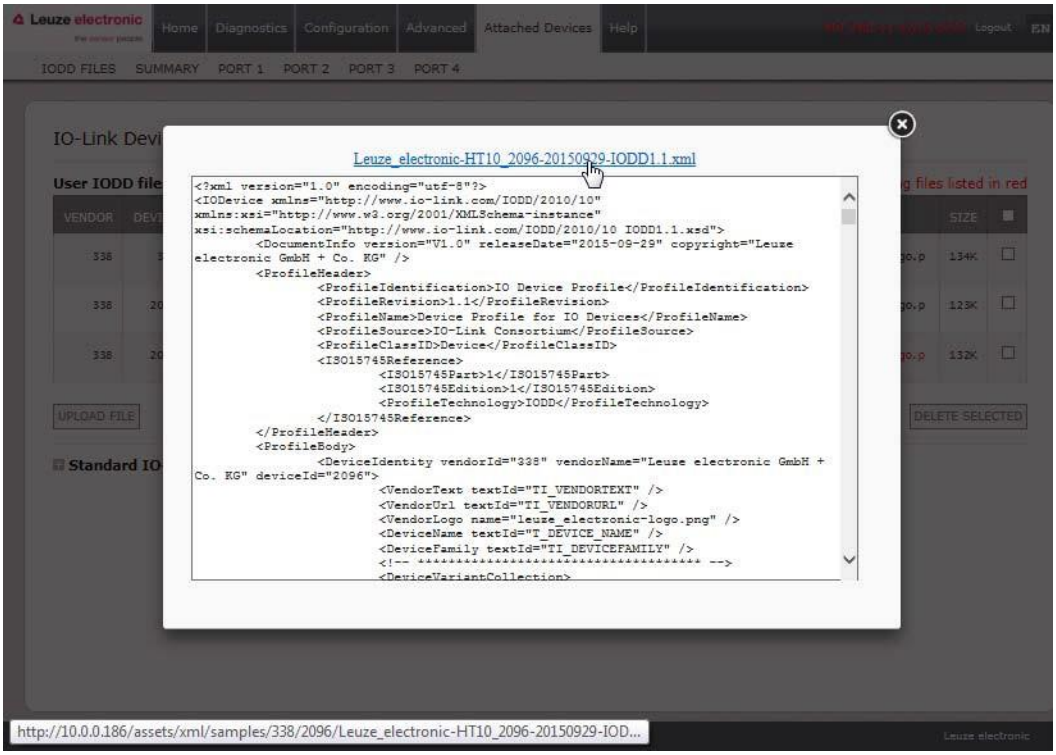


c. Click the **Choose File** button and browse to the file location.
d. Highlight the file and click **Open**.
e. Click the **UPLOAD** button.
f. Optionally, verify that the correct **xml** file was loaded using the **Summary** page (Page 85).

8.1.4 Viewing and Saving IODD Files

Use the following procedure to view the contents of an IODD file.

1. If necessary, click Attached Devices and IODD Files.
2. Click the **IODD FILENAME** in the table that you want to review. A pop up window displays the contents of the IODD file.
3. Optionally, click the file name hyperlink at the top of the window to view the formatted file or if you want to save a copy of the file to another location.

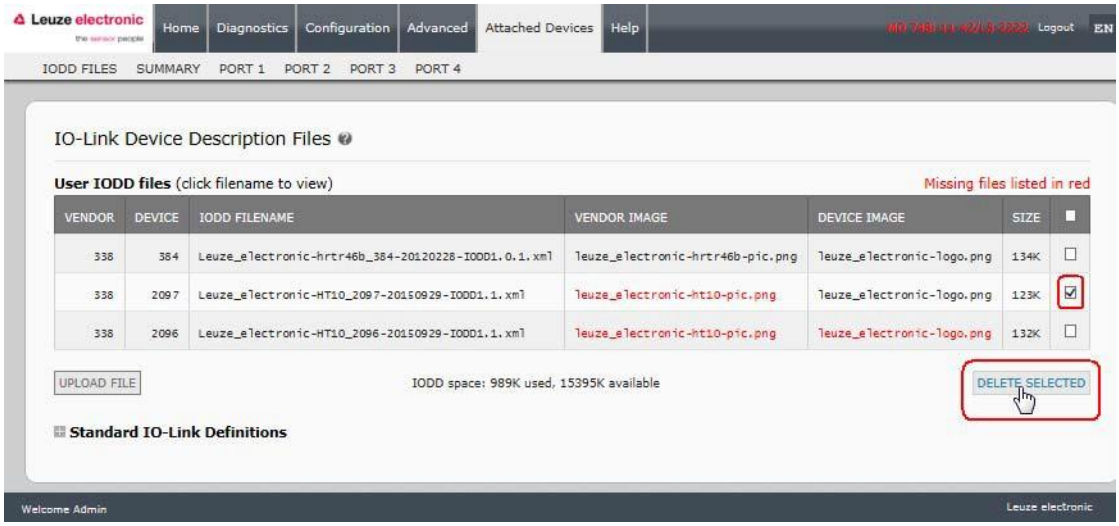


8.1.5 Deleting IODD Files

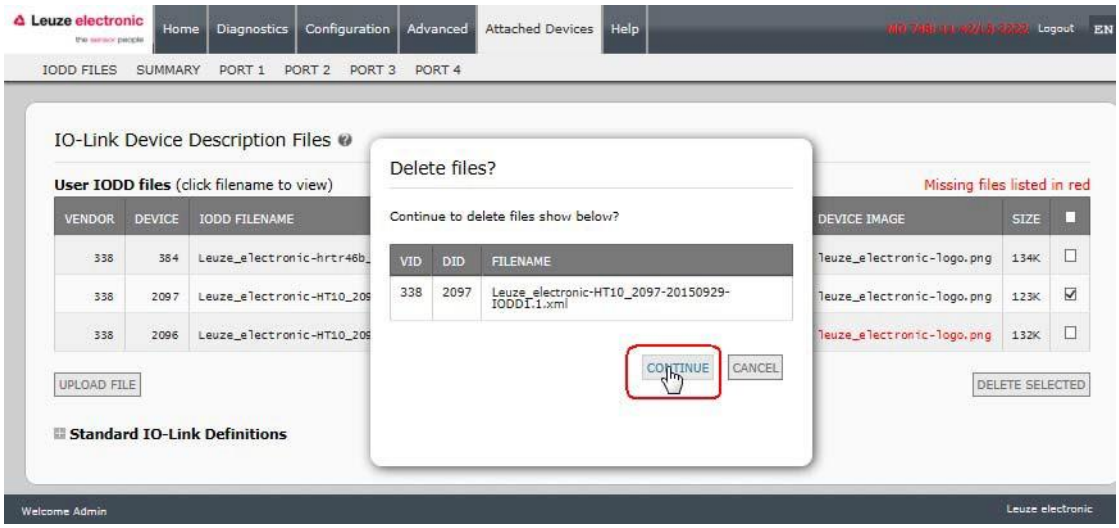
Use the following procedure to delete an IODD file set from the IOLM.

1. If necessary, click Attached Devices and IODD Files.

2. Check the corresponding row of the IODD file that you want to delete.
3. Click the **DELETE SELECTED** button.



4. Click **CONTINUE** to the *Delete files?* message.



8.2 IO-Link Device Configuration Summary Page

The **IO-Link Device Configuration Summary** page provides basic device configuration (device profile) information for ports with valid IO-Link devices attached. The **Configuration Summary** page retrieves information that resides on the IO-Link device from the manufacturer.

A file name displayed in the **IODD Name** field for a port indicates that a valid IODD file is associated with that device. If the field is empty, that indicates that a valid IODD file has not been loaded.

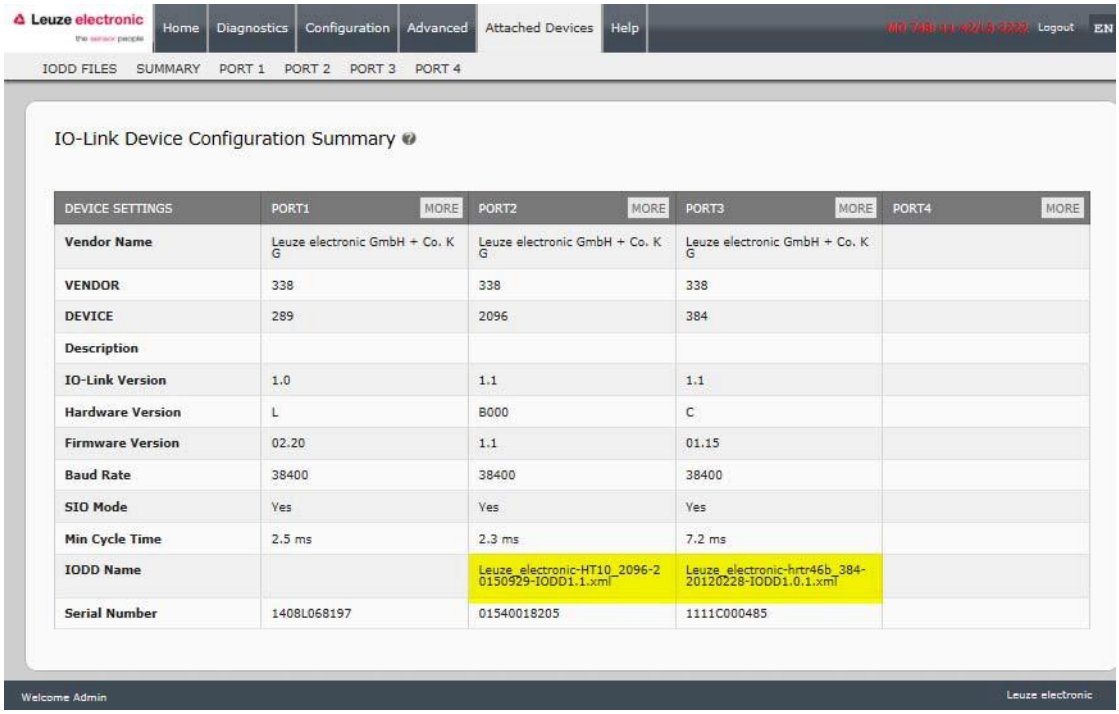
You can review complete IODD file information on a port by port basis by clicking the **MORE** button next to the port in question or by clicking the **PORT** menu selection in the navigational bar.

Use the following steps to access the **IO-Link Device Configuration Summary** page.

1. Click **Attached Devices**.
2. Click **SUMMARY**.

NOTE	
	The **Configuration Summary** page takes several minutes to completely load as each device is queried.

3. Click the **MORE** button or the corresponding **Port** (in the navigational bar) to configure the IO-Link device parameters for a specific device. See Chapter 9 Configuring IO-Link Devices on Page 87 for more information.



9 Configuring IO-Link Devices

This chapter discusses using the **Attached Devices | Port** pages to change IO-Link device parameters.

NOTE
Optionally, you can use traditional methods such as: PLC interfaces or HMI/SCADAs, depending on your protocol to configure the IO-Link devices.

9.1 Port Pages Overview

You can use the **Attached Devices | Port** page for a port to review and easily edit the IO-Link device configuration or view Process Data.

The **Port** page provides two IO-Link device configuration methods:

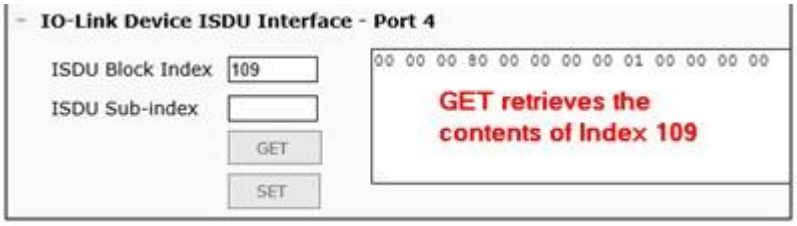
- **IO-Link Device Port** table (GUI), which depends on the appropriate IODD file loaded from the IO-Link device manufacturer onto the IOLM. To use the **IO-Link Device Port** table for configuring IO-Link devices, refer to the following subsections:
  - Editing Parameters - IO-Link Device - Port Table on Page 88
  - Resetting IO-Link Device Parameters to Factory Defaults on Page 89
- **IO-Link Device ISDU Interface - Port**, which can be used with or without IODD files loaded. Refer to the following information to use the **IO-Link Device ISDU Interface - Port** method:
  - The *IO-Link Device Operator Manual* from the device manufacturer is needed to use the **IO-Link Device ISDU Interface** since ISDU block index and ISDU sub-index numbers are required.
  - Editing Parameters - IO-Link Device ISDU Interface - Port on Page 89

The **IO-Link Device Port** table provides detailed information about the indexes and sub-indexes. Not all indexes have sub-indexes.

- If the IODD file follows IO-Link specifications, an asterisk next to RW means that parameter is not included in Data Storage.
- If a Sub-index has an asterisk next to it in the GUI, that means that sub-index is not sub-indexable. This may be useful information when using the IO-Link Device ISDU Interface or programming your PLC.

This example shows that Index 109 contains 10 sub-indexes.

When you perform a **GET** on Index 109 using the ISDU Interface, these are the results:



109	1*
109	2*
109	3*
109	4*
109	5*
109	6*
109	7*
109	8*
109	9*
109	10*

The GUI displays this information about Index 109.

Index	Subindex	Value	Description	R/W	Unit	Min	Max	Comments	Gradient	Offset	DataType	SimpleDatatype	BitLength
109	1*	2246		RO				dynamic parameter			RecordT	UIntegerT	16
109	2*	2515		RO				dynamic parameter			RecordT	UIntegerT	16
109	3*	3		RO				dynamic parameter			RecordT	UIntegerT	8
109	4*	1		RO				dynamic parameter			RecordT	UIntegerT	8
109	5*	1		RO				dynamic parameter			RecordT	UIntegerT	8
109	6*	0		RO				dynamic parameter			RecordT	UIntegerT	8
109	7*	0		RO				dynamic parameter			RecordT	UIntegerT	8
109	8*	0		RO				dynamic parameter			RecordT	UIntegerT	16
109	9*	0		RO				dynamic parameter			RecordT	UIntegerT	8
109	10*	0		RO				dynamic parameter			RecordT	UIntegerT	8

Which can be illustrated as:

00 00	00 80	00	00	00	00	01	00 00	00	00
1	2	3	4	5	6	7	8	9	10

Access the **Process Data** page by selecting **Process Data** from the drop box next to the port number. This shows a typical **Process Data** page.

If the correct IODD file has not been loaded or the IO-Link device does not support PDO, then you will receive this message.

9.2 Editing Parameters - IO-Link Device - Port Table

Use the following procedure to edit IO-Link device parameters using the **IO-Link Device Port** table.

NOTE	
	You may want to verify that the **Automatic Download Enable for Data Storage** option on the **Configuration | IO-Link Settings** page is NOT set to **On** as this can cause unreliable results on the corresponding port.

1. If you have not done so, load the IODD file from the IO-Link device manufacturer (Chapter 8 Loading and Managing IODD Files on Page 80).
2. Access the appropriate **Port** page by clicking **Attached Devices** and then the **Port** number that you want to configure.
3. Click the **EDIT** button after all of the device information is populated in the table.
4. Scroll down the table and make appropriate parameter changes for your environment.

	NOTE
	An IODD file may not contain all IO-Link device settings depending on the IO-Link device manufacturer. If you need to change a parameter that is not displayed in the **IO-Link Device - Port** table, you can refer to the IO-Link Device Operators Manual and use the **IO-Link Device ISDU Interface** to change the settings.

You may need to scroll to the right in the table to view applicable parameter values if the parameter is not selectable in a drop list.

5. Click the **SAVE** button after editing the parameters.

9.3 Resetting IO-Link Device Parameters to Factory Defaults

In the event you want to reset the IO-Link device to factory default, typically the IODD file provides the ability from the IO-Link device manufacturer. Use the following example to reset an IO-Link device.

1. Click the **COMMAND** button and locate the **Restore Factory** button.
2. Click the Restore Factory or Load Factory Settings button.

	NOTE
	The name of the button is determined by the IO-Link device manufacturer.

3. Click **OK** when the *Refresh* message appears.

9.4 Editing Parameters - IO-Link Device ISDU Interface - Port

The **IO-Link Device ISDU Interface** follows these guidelines:

- If necessary, convert hexadecimal ISDU index numbers to decimal, you must enter the decimal value for the ISDU Block Index and ISDU Sub-index numbers.
- You must enter the hexadecimal value for the IO-Link device parameters.

If the appropriate IODD files has been loaded, you can use the **IO-Link Device - Port** table to determine the index numbers and acceptable values for each parameter.

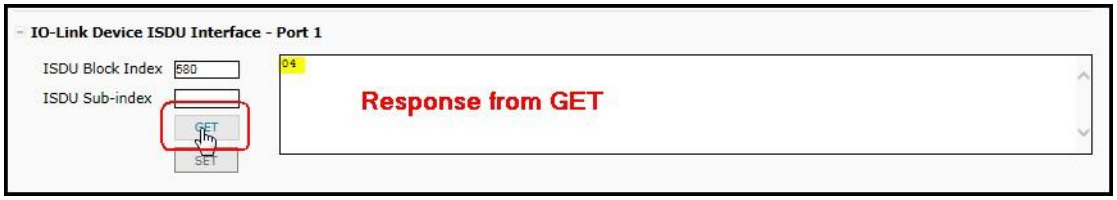
	NOTE
	An IODD file may not contain every IO-Link device setting depending on the IO-Link device manufacturer. If you need to change a parameter that is not displayed in the **IO-Link Device - Port** table, you can refer to the IO-Link Device Operators Manual.

If an IODD file has not been loaded for an IO-Link device, you can use the *IO-Link Device Operator's Manual* to determine the ISDU indexes.

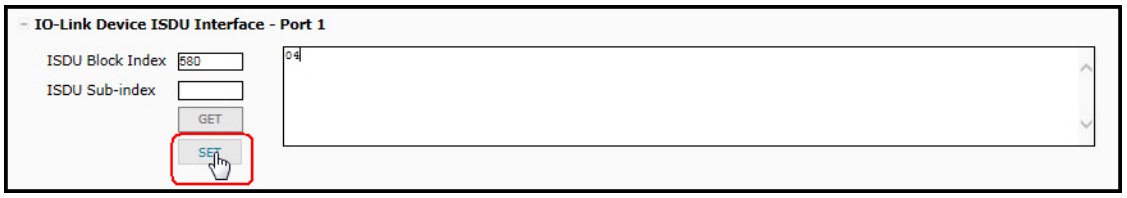
9.4.1 Overview

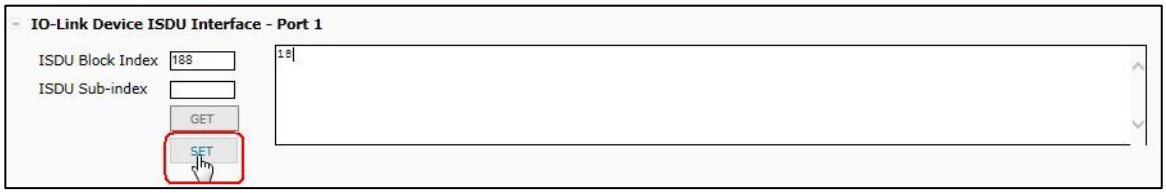
The following provides some basic information about the command usage and responses when using the ISDU Interface.

- You must enter the decimal value for the ISDU Block Index and ISDU Sub-index.
- The **GET** button retrieves the parameter value in hex from the IO-Link device. You may want to retrieve values to determine the data length.

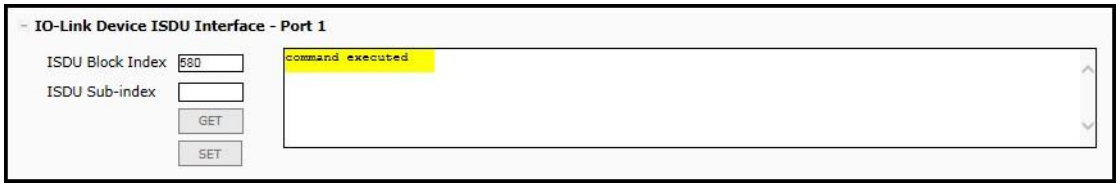


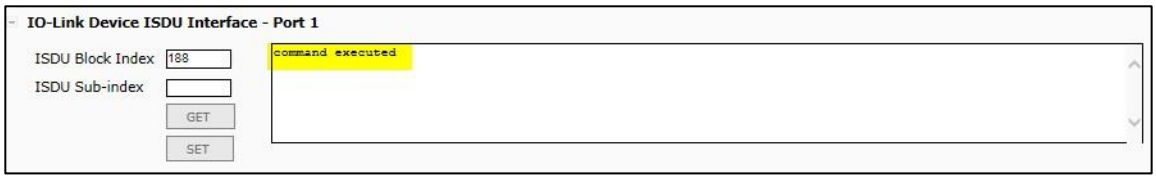
- The **SET** button sends the value to the IO-Link device.



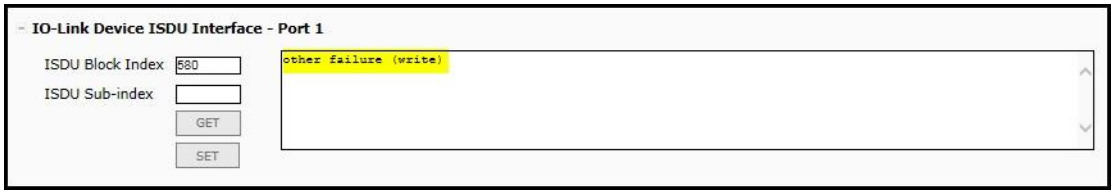


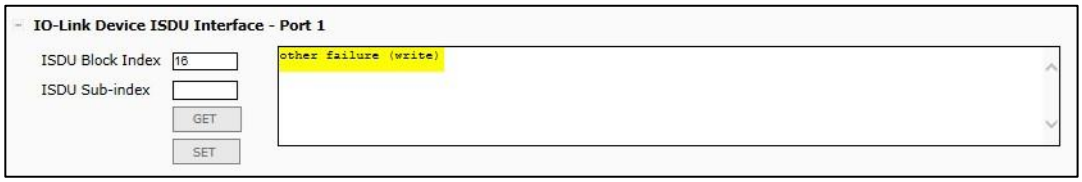
- After successfully changing a parameter, the IO-Link Master responds with a command executed notification.



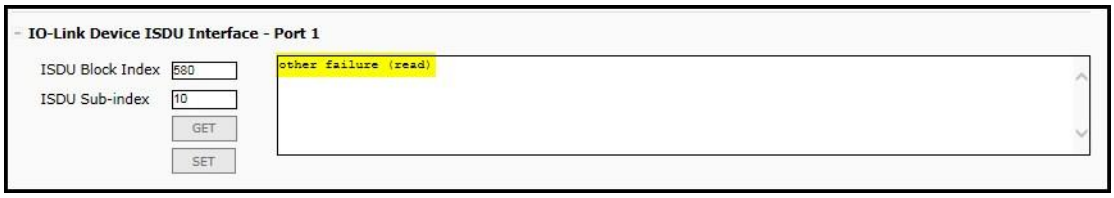


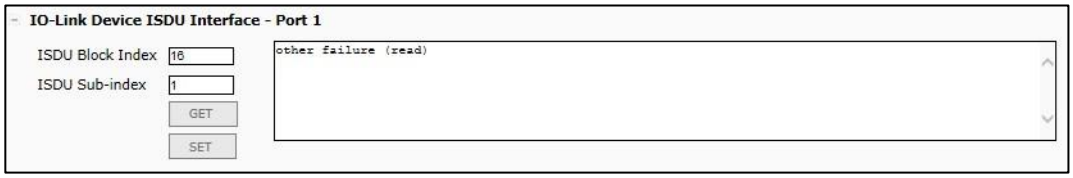
- This message means that the IO-Link device defines the entry as an invalid setting.





- This message indicates that the IO-Link device cannot read the specified ISDU Block Index and Sub-index.



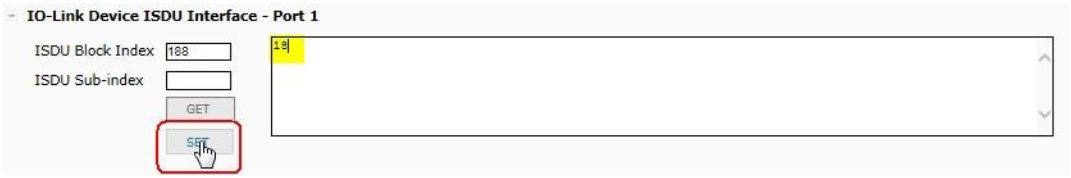


9.4.2 How to Use the Interface

Use the following procedure to edit parameters using the **IO-Link Device ISDU Interface - Port**.

NOTE	
	You may want to verify that the **Automatic Download Enable for Data Storage** option on the **Configuration | IO-Link Settings** page is NOT set to **On** as this can cause unreliable results on the corresponding port.

1. Click the **+** next to the **IO-Link Device ISDU Interface** to open the interface.
2. Enter the ISDU Block Index number (decimal) that you want to edit.
3. If applicable, enter the ISDU Sub-index (decimal).
4. Edit the parameter (hex) and click the **SET** button.



5. Verify that a *command executed* message returns.
6. If the IODD file is loaded, optionally click **REFRESH** to verify your changes.

10 Utilizing IOLM Features

This chapter discusses using the following features:

- Setting User Accounts and Passwords
- 10.2 Data Storage on Page 94, which provides automatic and manual data storage to upload or download IO-Link v1.1 device parameters
- 10.3 Device Validation on Page 96, which supports identical or compatible device validation to dedicate a port or ports to specific IO-Link devices
- 10.4 Data Validation on Page 96, which supports strict or loose data validation to verify data integrity
- 10.5 IOLM Configuration Files on Page 97 that supports a method to back up configuration files or load the same configuration to multiple IOLM units
- 10.6 Configuring Miscellaneous Settings on Page 97, which provides the following options:
  - 10.6.1 Using the Menu Bar Hover Shows Submenu Option on Page 98
  - 10.6.2 Enable PDO Write From Attached Devices Port Page on Page 98
  - 10.6.3 IO-Link Test Event Generator on Page 99
- 10.7 Clearing Settings on Page 101, which allows you to reset the IOLM to factory default values

NOTE	
	You must configure data storage, device validation, data validation in PROFINET IO using Step 7. You can use data storage on the web page for temporary data storage related tasks.

10.1 Setting User Accounts and Passwords

The IOLM is shipped from the factory without passwords. See the following table if you want to see how permissions are granted.

Page	Admin	Operator	User
Log-in	Yes	Yes	Yes
Home	Yes	Yes	Yes
Diagnostics - All	Yes	Yes	Yes
Configuration - IO-Link Settings	Yes	Yes	View-only
Configuration - Digital I/O Settings (Applicable models)	Yes	Yes	View-only
Configuration - Modbus/TCP	Yes	Yes	View-only
Configuration - PROFINET IO	Yes	Yes	View-only
Configuration - OPC UA	Yes	Yes	View-only
Configuration - Network	Yes	View-only	No
Configuration - Misc	Yes	Yes	Yes
Configuration - Load/Save	Yes	Yes	View-only
Configuration - Clear Settings	Yes	No	No
Advanced - Software	Yes	No	No
Advanced - Accounts	Yes	No	No
Advanced - Log Files	Yes	Yes	Yes
Advanced - Licenses	Yes	Yes	Yes
Attached Devices - IO-Link Device Description Files	Yes	Yes	View-only
Attached Devices - IO-Link Device Configuration Summary	Yes	Yes	View-only
Attached Devices - IO-Link Device - Port	Yes	Yes	View-only

You can use this procedure to set up passwords for the IOLM.

1. Open your browser and enter the IOLM IP address.
2. Click Advanced | ACCOUNTS.
3. Click the **ADMIN** check box.
4. If applicable, enter the old password in the **Old Password** text box.
5. Enter the new password in the **New Password** text box.
6. Re-enter the password in the **Confirm Password** text box.
7. Optionally, click the **Operator** check box, enter a new password, and re-enter the password in the **Confirm Password** text box.
8. Optionally, click the **User** check box, enter the new password, and re-enter the password in the **Confirm Password** text box.
9. Click **Apply**.
10. Close the new window that displays a *Password saved* banner.
11. Click the **Log out** button on the top navigation bar.

12. Re-open the web interface by selecting the appropriate user type in the drop list and entering the password.

10.2 Data Storage

Data storage is typically supported by IO-Link **v1.1** devices. *Data storage* means that you can upload parameters from an IO-Link device to the IOLM and/or download parameters from the IOLM to the IO-Link device. This feature can be used to:

- Quickly and easily replace a defective IO-Link device
- Configure multiple IO-Link devices with the same parameters as fast as it takes to connect and disconnect the IO-Link device

To determine whether an IO-Link (v1.1) device supports data storage, you can check one of the following:

- **IO-Link Diagnostics** page - check the **Data Storage Capable** field to see if it displays **Yes**.
- **IO-Link Configuration** page - check to see if **UPLOAD** and **DOWNLOAD** buttons display under the **Data Storage Manual Ops** group. If only a **Clear** button displays, the device on the port does not support data storage.

10.2.1 Uploading Data Storage to the IOLM

The IO-Link device manufacturer determines which parameters are saved for data storage. Remember, the IOL-Link device should be configured before enabling data storage unless you are using data storage to back up the default device configuration.

There are two methods to upload Data Storage using the **Configuration | IO-Link** page:

- **Automatic Enable Upload** - If a port is set to **On** for this option, the IOLM saves the data storage parameters (if the data storage is empty) from the IO-Link device to the IOLM.

When this option is enabled and another IO-Link device (different Vendor ID and Device ID), the **IO-Link Diagnostics** page displays a *DS: Wrong Sensor* in the **IOLink State** field and the IO-Link port LED flashes red, indicating a hardware fault.

Automatic upload occurs when the **Automatic Upload Enable** option is set to **On** and one of these conditions exists:

- There is no upload data stored on the gateway and the IO-Link device is connected to the port.
- The IO-Link device has the **DS upload** bit on; generally because you have changed the configuration through Teach buttons or the web interface.

	NOTE
	Not all device parameters are sent to data storage. The IO-Link device manufacturer determines what parameters are sent to data storage.

- **Data Storage Manual Ops: UPLOAD -** Selecting the **UPLOAD** button saves the data storage from the IO-Link device to the IOLM. The contents of the data storage does not change unless it is uploaded again or cleared. Another IO-Link device with a different Vendor ID and Device ID can be attached to the port without causing a hardware fault.

10.2.2 Downloading Data Storage to the IO-Link Device

There are two methods to download Data Storage using the **Configuration | IO-Link Device** page:

- **Automatic Download Enable** - An automatic download occurs when the **Automatic Download Enable** option is set to **On** and one of these conditions exists:

- The original IO-Link device is disconnected and an IO-Link device who's configuration data differs from the stored configuration data.
- The IO-Link device requests an upload and the **Automatic Upload Enable** option is set to **Off**.

NOTE
Do not enable both Automatic Upload and Download at the same time, the results are not reliable among IO-Link device manufacturers.

- **Data Storage Manual Ops: DOWNLOAD -** Selecting the **DOWNLOAD** button downloads the data storage from the that port to the IO-Link device.

If an IO-Link device with a different Vendor ID and Device ID is attached to the port and a manual download is attempted, the IOLM issues a hardware fault.

10.2.3 Automatic Device Configuration

Use the following steps to use an IOLM port to configure multiple IO-Link devices with the same configuration parameters.

NOTE
You must configure data storage in PROFINET IO using Step 7. You can use data storage on the web page for temporary data storage related tasks.

1. If necessary, configure the IO-Link device as required for the environment.
2. Click Configuration| IO-Link.
3. Click the **EDIT** button for the port for which you want to store the data on the IOLM.
4. Click the **UPLOAD** button.
5. Click the **CONTINUE** button to the Continue to upload the data storage on IO-Link Master port *[number]* message.
6. Click the **OK** button to the Data storage upload successful on Port *[number]* message.
7. Set the Automatic Download Enable option to On.
8. Click **SAVE**.
9. Click Diagnostics | IO-Link.
10. Replace the IO-Link device on that port with the IO-Link device for which you want configured automatically.
11. Verify that the IO-Link device displays operational **Port Status** and the appropriate IO-Link State.
12. Repeat Steps 10 and 11 for as many device as you want to configure.

10.2.4 Automatic Device Configuration Backup

The following procedure shows how to utilize data storage to automatically backup an IO-Link device configuration.

NOTE
You must configure data storage in PROFINET IO using Step 7. You can use data storage on the web page for temporary data storage related tasks.

Remember, if you adjust parameters using **Teach** buttons those values may or not may be updated in the data storage, which depends on the IO-Link device manufacturer. If you are unsure, you can always use the manual **UPLOAD** feature to capture the latest settings.

1. Click **Configuration** | **IO-Link**.
2. Click the **EDIT** button for the port for which you want to store the data on the IOLM.
3. Select **On** in the drop list for **Automatic Data Storage Upload Enable**.
4. Click **SAVE**.

   When the **Configuration** | **IO-Link** page is refreshed, the **Storage Contents** field displays the **Vendor ID** and **Device ID**. In addition, the **IO-Link Diagnostics** page displays **Upload-Only** in the **Automatic Data Storage** Configuration field.

10.3 Device Validation

Device validation is supported by many IO-Link devices. **Device Validation Mode** provides these options:

- **None** - this disables Device Validation Mode.
- **Compatible** - permits a compatible IO-Link device (same Vendor ID and Device ID) to function on the corresponding port.
- **Identical** - only permits an IO-Link device (same Vendor ID, Device ID, and serial number) to function on the corresponding port.

NOTE
You must configure device validation in PROFINET IO using Step 7.

Use this procedure to configure device validation.

1. Click Configuration | IO-Link Settings.
2. Click the **EDIT** button.
3. Select Compatible or Identical for the Device Validation mode.

NOTE
Identical Device Validation requires a device serial number to operate.

4. Click the **GET ATTACHED** button or manually complete the Vendor ID, Device, ID, and serial number.

   If the device does not have a serial number, you should not select **Identical** because the IOLM requires a serial number to identify a specific device.
5. Click the **SAVE** button. If the wrong or incompatible device is connected to the port, the IO-Link port LED flashes red and no IO-Link activity occurs on the port until the issue is resolved.

   In addition, the **IO-Link Diagnostics** page displays the following information.

10.4 Data Validation

You can use this procedure to configure data validation.

NOTE
You must configure data validation in PROFINET IO using Step 7.

1. Click **Configuration | IO-Link Settings.**
2. Click the **EDIT** button on the port you want to configure for data validation.
3. Select **Loose** or **Strict** to enable data validation.
   - **Loose** - the slave device's PDI/PDO lengths must be less than or equal to the user-configured values.
   - **Strict** - the slave device's PDI/PDO lengths must be the same as the user-configured values.
4. Click the **GET ATTACHED** button or manually enter the PDI and PDO length.
5. Click the **SAVE** button.

If data validation fails, the IO-Link port LED flashes red and the **IO-Link Diagnostics** page displays an error.

10.5 IOLM Configuration Files

You can use the web interface to save or load IOLM configuration files. Use the following procedures to save or load configuration files.

- Saving Configuration Fileson Page 97
- Loading Configuration Files on Page 97

10.5.1 Saving Configuration Files

Use this procedure to save configuration files for the IOLM. The configuration files includes all port settings, network settings, and encrypted passwords.

1. Click **Configuration** | **Load/Save**.
2. Click the **SAVE** button.
3. Click the **Save as** option and browse to the location that you want to store the configuration file.

10.5.2 Loading Configuration Files

Use this procedure to load a configuration file onto the IOLM.

1. Click **Configuration** | **Load/Save**.
2. Click the **Browse** button and locate the configuration file (**.dcz** extension).
3. Click the **LOAD** button.
4. Click the **OK** button to close the *Configuration Uploaded* message that notifies you of what configuration parameters loaded.

10.6 Configuring Miscellaneous Settings

The **Miscellaneous Settings** page includes the following options:

- **Menu Bar Hover Shows Submenu**

  This option displays sub-menus for a category when you hover over the category name.

  For example, if you hover over **Advanced**, the **SOFTWARE**, **ACCOUNTS**, **LOG FILES**, and **LICENSES** sub- menus display. You can click any sub-menu and avoid opening the default menu for a category.

- **Enable PDO Write From Attached Devices Port Page**

When enabled, it allows you to write PDO data to IO-Link slaves from the **Attached Devices | Port** page in the web user interface. See 10.6.2 Enable PDO Write From Attached Devices Port Page on Page 98 for more information.

NOTE
The PDO write will not allow writes if the IOLM has a PLC connection. **This should never be enabled in a production environment**.

- **LED Flash**

  You can force the IO-Link port LEDs on the IOLM into a flashing tracker pattern that allows you to easily identify a particular unit.

  - Click the **ON** button to enable the LED tracker feature on the IOLM. The LEDs remain flashing until you disable the LED tracker feature
  - Click the **OFF** button to disable the LED tracker.

10.6.1 Using the Menu Bar Hover Shows Submenu Option

Use this procedure to enable the **Menu Bar Hover Shows Submenu** option. If you enable this feature it displays the sub-menus for a category when you hover over the category name.

For example, if you hover over **Advanced**, the **SOFTWARE**, **ACCOUNTS**, **LOG FILES**, and **LICENSES** sub- menus display. You can click any sub-menu and avoid opening the default menu for a category.

1. Click **Configuration** | **MISC**.
2. Click the **EDIT** button.
3. Click Enable next to the Menu Bar Hover Shows Submenu option.
4. Click **SAVE**.

10.6.2 Enable PDO Write From Attached Devices Port Page

The purpose of this feature is for a **non-production** type of demonstration of the IOLM. You can enable this feature to get familiar with IO-Link or if you are commissioning a system and want to be able to test / get familiar with devices. It allows you to interact with a PDO device that does not have a PLC connection.

You must have set and signed into the IO-Link Master using an **admin** password.

NOTE
The PDO write will not allow writes if the IOLM has a PLC connection. **This should never be enabled in a production environment**.

Use this procedure to enable PDO write from the **Attached Devices | Port** page.

1. If necessary, log into the IOLM using the Administrator account.
2. Click **Configuration** | **MISC**.
3. Click the **EDIT** button.
4. Click **Enable** next to the **Enable PDO Write From Attached Devices Port Page** option.
5. Click the **SAVE** button.
6. If this will not cause an unstable environment, click the **CONTINUE** button.

10.6.3 IO-Link Test Event Generator

You can use the **IO-Link Test Event Generator** to send messages to an IOLM port. The generated events are displayed in the **Diagnostics | IO-Link Settings** page under the **Last Events** field and the syslog. This can test a port to verify that it is functioning correctly through

1. Click **Configuration** | **Misc**.
2. Expand the **IO-Link Test Event Generator**.
3. Select the port and type of event that you want to test.

Use the following table to determine what type of event you want to generate.

IO-Link Test Event Generator Descriptions	
Port	The port number to which you want to send an event.
Mode	This is the first item in the event generated. • **Single**: generates **Single** in the event. • **Coming**: generates **Active** in the event • **Going**: generates **Cleared** in the event
Type	This is the second item in the event generated. • **Message**: generates **Message** in the event. • **Warning**: generates **Warning** in the event. • **Error**: generates **Error** in the event.
Instance	This is the level in which the event is generated. This is not displayed in the generated event. • unknown • physical • datalink • applayer • application
Source	This is the source in which the event is generated. This is the third item in the generated event. • **local**: simulation generated from the IOLM, which displays as **Local** in the event. • **remote**: simulation of an IO-Link device event, which displays as **Device** in the generated event.
PDI	This indicates whether to send valid or invalid PDI, which is not displayed in the generated event. • valid • invalid

Code	This is the fourth and fifth items in the generated event. • 0x0000: generates a **s_pdu_check** event • 0x0001: generates a **s_pdu_flow** event • 0x0002: generates a **m_pdu_check** event • 0x0003: generates a **s_pdu_illegal** event • 0x0004: generates a **m_pdu_illegal** event • 0x0005: generates a **s_pdu_buffer** event • 0x0006: generates a **s_pdu_inkr** event • 0x0007: generates an **s_pd_len** event • 0x0008: generates an **s_no_pdin** event • 0x0009: generates an **s_no_pdout** event • 0x000a: generates an **s_channel** event • 0x000b: generates an **m_event** event • 0x000c: generates an **a_message** event • 0x000d: generates an **a_warning** event • 0x000e: generates an **a_device** event • 0x000f: generates an **a_parameter** event • 0x0010: generates a **devicelost** event • 0x0011, 13 - 17: generates an unknown event • 0x0012: generates a **s_desina** event

4. Click **Diagnostics** and scroll down to **Last Events**.

10.7 Clearing Settings

You can return the IOLM to factory default values and can choose whether you want to restore these default values:

- Uploaded IODD files
- IO-Link data storage
- Hostname, network settings (DHCP/Static, static IP address, static network mask, and static IP gateway) Use the following procedure to restore factory default values on the IOLM.

1. Click **Configuration** | **Clear Settings**.
2. Click the **OK** button to the *Done Configuration Cleared* message.

11 Using the Diagnostic Pages

This chapter provides information about the following **Diagnostics** pages.

NOTE
Not all models support OPC UA.

11.1 IO-Link Port Diagnostics

Use the **IO-Link Diagnostics** page to determine the status of the IO-Link configuration.

The following table provides information about the **IO-Link Diagnostics** page.

IO-Link Diagnostics	
Port Name	This is an optional friendly port name, which can be configured in the **Configuration** | **IO-Link** page.
Port Mode	Displays the active device mode: • **Reset** = The port is configured to disable all functionality. • **IO-Link** = The port is configured to IO-Link mode. • **Digital In** = The port is configured to operate as a digital input. • **Digital Out** = The port is configured to operate as a digital output.
Port Status	Displays the port status: • **Inactive** = The port is in active state. Typically, this indicates that the device is either not attached or not detected. • **Initializing** = The port is in the process of initializing. • **Operational** = The port is operational and, if in IO-Link mode, communications to the IO-Link device has been established. • **PDI Valid** = The PDI data is now valid. • **Fault** = The port has detected a fault and is unable to re-establish communications.
IO-Link State	• **Operate** - Port is functioning correctly in IO-Link mode but has not received valid PDI data. This may also display during a data storage upload or download. • **Init** - The port is attempting initialization. • **Reset** - One of the following conditions exists: • The Port Mode configuration is set to **Reset**. • The Port Mode configuration is set to **DigitalIn** or **DigitalOut**. • **DS - Wrong Sensor** - Hardware failure (IO-Link LED also flashes red) because there is Data Storage on this port, which does not reflect the attached device. • **DV - Wrong Sensor** - Hardware failure (IO-Link LED also flashes red) because Device Validation is configured for this port and the wrong device is attached. • **DS - Wrong Size** - Hardware failure (IO-Link LED also flashes red) because the size of the configuration on the device does not match the size of the configuration stored on the port. • **Comm Lost** - Temporary state after a device is disconnected and before the port is re-initialized. • **Pre-operate** - Temporary status displayed when the device: • Is starting up after connection or power-up. • Uploading or downloading automatic data storage.
Device Vendor Name	Displays the Device Vendor Name as stored in ISDU Index 16.

Device Product Name	Displays the device product name as stored in ISDU Index 18.
Device Serial Number	Displays the device serial number as stored in ISDU Index 21.
Device Hardware Version	Displays the device hardware version as stored in ISDU Index 22.
Device Firmware Version	Displays the device firmware version as stored in ISDU Index 23.
Device IO-Link Version	The supported device IO-Link version as stored in ISDU Index 0.
Actual Cycle Time	This is the actual, or current, cycle time of the IO-Link connection to the device.
Device Minimum Cycle Time	This is the minimum, or fastest, cycle time supported by the connected IO-Link device.
IO-Link Diagnostics	
Configured Minimum Cycle Time	Configured in the **Configuration | IO-Link** page, this is the minimum cycle time the IO-Link Master will allow the port to operate at. The **Actual Cycle Time**, which is negotiated between the IO-Link Master and the device, will be at least as long as the greater of the **Configured Minimum Cycle Time** and the **Device Minimum Cycle Time**.
Data Storage Capable	Displays whether the IO-Link device on a port supports the data storage feature. Not all IO-Link devices support the data storage feature.
Automatic Data Storage Configuration	Displays whether a port is configured to automatically upload data from the IO-Link device or download data from the IOLM to the IO-Link device. Disabled displays if automatic upload or download are not enabled.
Auxiliary Input (AI) Bit Status	The current status of the auxiliary bit as received on DI (Pin 2 on the MD 748I- 11-42/L5-2222, MD 748i-11-82/L5-2222, and MD 748iC-11-82/L5-2222 F001) of the IO-Link port.
Device PDI Data Length	The supported Device PDI Data Length, in bytes, as stored in ISDU Index 0.
PDI Data Valid	Current status of PDI data as received from the IO-Link device.
Last Rx PDI Data (MS Byte First)	The last Rx PDI data as received from the IO-Link device.
PDO Lock Enable	If enabled on the **Configuration| IO-Link Settings** page, an industrial protocol application (PROFINET IO, EtherNet/IP, or Modbus TCP) can lock the write access to the PDO value so that the PDO value cannot be changed by other protocols (including OPC UA or the Web interface). Such a lock is released when the PLC to IO-Link Master network link disconnects.
PDO Locked	Indicates whether or not one of the industrial protocol applications has locked the write access to the PDO value.
Device PDO Data Length	The supported Device PDO Data Length, in bytes, as stored in ISDU Index 0.

PDO Data Valid	Status of PDO data being received from controller(s).
Last Tx PDO Data (MS Byte First	The last Tx PDO data.
Time Since Initialization	The time since the last port initialization.
Process Data Errors	The number of process data errors the port received.
Process Data Retries	The number of process data retries the port performed.
Total Events	The total number of events that were received on this port.
First Events	Up to the first, or oldest, three events that were received on this port.
Last Events	Up to the last, or most recent, three events that were received on this port.
ISDU Statistics	
ISDU Read Cmd Attempts	The number of read ISDU command attempts.
ISDU Read Cmd Errors	The number of read ISDU command errors.
ISDU Write Cmd Attempts	The number of write ISDU command attempts.
ISDU Write Cmd Errors	The number of write ISDU command errors.

11.2 Digital I/O Diagnostics (MD 248i-12-8K/L4-2R2K)

The **Digital I/O Diagnostics** page may be useful when trying to troubleshoot port issues related to configuration. The following table provides information about the **Digital I/O Diagnostics** page.

Digital I/O Diagnostics	
Mode	Displays the current configured operating mode of the digital I/O pin. • Off • Digital-Input • **Digital-Output** (Pins D2 and D4 only)
Invert I/O	Displays the current configured Invert I/O setting: • **True** (Invert I/O) • **False** (Do not invert I/O)
Input Settling Time (ms)	Displays the current configured input settling time.
Status	Displays the current status of the digital I/O pin. • **On** (high voltage) • **Off** (low voltage)
Status Changes	Displays the number of times that the status of the digital I/O pin has changed.

11.3 Modbus/TCP Diagnostics

The **Modbus/TCP Diagnostics** page may be useful when trying to troubleshoot Modbus/TCP communications or port issues related to Modbus/TCP configuration.

	NOTE
	The complete **Modbus/TCP Diagnostics** page is not illustrated.

The following table provides information about the **Modbus/TCP Diagnostics** page.

Modbus/TCP Diagnostics	
Active Connections	Displays the current number of active Modbus/TCP connections.
Messages Received from Masters	Displays the number of Modbus messages received from Modbus/TCP Masters.
Responses Sent to Masters	Displays the number of Modbus responses sent to Modbus/TCP Masters.
Broadcasts Received	Displays the number of broadcast Modbus/TCP messages received.
Invalid Message Length Errors	Displays the number of Modbus messages received with incorrect length fields.
Invalid Message Data Errors	Displays the number of invalid message data errors. These errors occur when the IO-Link Master receives a message that cannot be performed due to invalid data.
Invalid Message Address Errors	Displays the number of invalid message address errors. These errors occur when the IO-Link Master receives a message that cannot be performed due to an invalid address.
Unknown Device ID Errors	Displays the number of unknown device ID errors. These errors occur when the IO-Link Master receives a message that is addressed to a device ID other than the configured **Slave Mode Device ID.**
Invalid Protocol Type Errors	Displays the number of invalid message protocol type errors. These errors occur when the IO-Link Master receives a Modbus/TCP message that specifies a non-Modbus protocol.
Unsupported Function Code Errors	Displays the number of invalid Modbus function code errors. These errors occur when the IO-Link Master receives a message that cannot be performed due to an unsupported Modbus function code.
Configuration Errors	Displays the number of improper configuration errors. These errors occur when the IO-Link Master receives a message that cannot be performed due to an invalid configuration.
No Available Connection Errors	Displays the number of Modbus/TCP connection attempts that were rejected due to no available connections. This occurs when the number of Modbus/TCP connections has reached the limit.
System Resource Errors	Displays the number of system resource errors. These errors indicate a system error on the IO-Link such as operating system errors or full message queues. These errors typically occur when the PLC(s) are sending messages to the IO-Link Master faster than the IO-Link Master can process them.
First Error String	Text description of the first error that occurred.
Last Error String	Text description of the last error that occurred.
Modbus/TCP Port Specific Diagnostics	
Active PDO Controller(s)	Lists IP addresses that are controlling the PDO data.

PDO Writes to Offline or Read-Only Ports	Displays the number of PDO write messages that were dropped due to any of the following: • The port is configured in IO-Link mode: • There is no device connected to the port. • The IO-Link device is off-line. • The IO-Link device does not support PDO data. • The PDO Transmit Mode (To PLC) is disabled. • The port is configured in Digital Input mode.
ISDU Request Msgs From PLC(s)	Displays the number of ISDU request messages received from the PLC(s) or other controllers. These request messages may contain one or multiple ISDU commands.
ISDU Invalid Requests	Displays the number of ISDU requests received over Modbus/TCP with one or more invalid commands.
ISDU Requests When Port Offline	Displays the number of ISDU requests received over Modbus/TCP when the IO-Link port was offline. This can occur when: • The IO-Link port is initializing, such as after start-up. • There is no IO-Link device attached to the port. • The IO-Link device is not responding. • Communication to the IO-Link device has been lost.
Valid ISDU Responses From Port	Displays the number of valid ISDU response messages returned from the IO-Link port interface and available to the PLC(s). The response messages contain results to the ISDU command(s) received in the request message.
ISDU Response Timeouts	Displays the number of ISDU requests that did not receive a response within the configured **ISDU Response Timeout**.
Unexpected ISDU Responses	Displays the number of unexpected ISDU responses. Unexpected responses may occur when an ISDU response is received after the ISDU request has timed out. This typically requires setting the **ISDU Response Timeout** to a longer value.
Maximum ISDU Request Msg Response Time	Displays the maximum time period required to process all commands within an ISDU request message. The response is not available until all ISDU command(s) contained in the request have been processed.
Average ISDU Request Msg Response Time	Displays the average time period required to process the ISDU request message(s). The response is not available until all ISDU command(s) contained in the request have been processed.
Minimum ISDU Request Msg Response Time	Displays the minimum time period required to process all commands within an ISDU request message. The response is not available until all ISDU command(s) contained in the request have been processed.
ISDU Read Commands	Displays the number of ISDU read commands received over Modbus/TCP.

ISDU Write Commands	Displays the number of ISDU write commands received over Modbus/TCP.
ISDU NOP Commands	Displays the number of ISDU NOP (no operation) commands received over Modbus/TCP.

11.4 PROFINET IO Diagnostics Page

The **PROFINET IO Diagnostics** page may be useful when trying to troubleshoot communications or port issues related to PROFINET IO configuration. The following table provides information about the **PROFINET IO Diagnostics** page.

PROFINET IO Diagnostics	
Active Application Relationships	Displays the current number of active PROFINET IO connections.
Application Relationship 1 Uptime	The uptime of the first application relationship.
Application Relationship 2 Uptime	The uptime of the second application relationship.
Total Application Relationships Established	The total number of application relationships that have been established since power up.
IOL_CALL Function Block Requests	The total number of **IOL_CALL** function block requests received.
IOL_CALL Function Block Errors	The number of errors when handling **IOC_CALL** function block requests.
Configuration Errors	The number of system configuration related errors.
System Errors	Displays the number of system resource errors. These errors indicate a system error on the IO-Link such as operating system errors or full message queues. These errors typically occur when the PLC(s) are sending messages to the IO-Link Master faster than the IO-Link Master can process them.
PROFINET IO Frames Transmitted	The total number of transmitted PROFINET IO frames.
PROFINET IO Transmit Errors	The number of errors when transmitting PROFINET IO frames.
PROFINET IO Frames Received	The total number of received PROFINET IO frames.
PROFINET IO Receive Errors	The number of errors when receiving PROFINET IO frames.
Record Reads	The total number of record read requests received.
Record Read Errors	The number of errors when handing record read requests.
Digital IO Input Status Changes	The number of times that the status of the all digital I/O pins have changed.
Digital IO Writes	The number of times that the status of the digital output pins have changed.
Digital IO Write Errors	The number of errors when writing to digital output pins.
IP Assignment	The current IP assignment method.
Ethernet Port 1 Link Status	Current link status of Ethernet Port 1.
Ethernet Port 2 Link Status	Current link status of Ethernet Port 2.

First Error String	Text description of the first error that occurred.
Last Error String	Text description of the last error that occurred.
PROFINET IO Port Status	
Application Relationship	The application relationship (1 or 2) that the IO-Link port belongs to.
PDI Reads	The number of PDI reads.
PDI Reads Truncated	The number of PDI reads that are truncated due to size.
PDI Read Errors	The number of errors when reading PDI.
PDO Writes	The number of PDI writes.
PDO Write Errors	The number of errors when reading PDO.
SIO Input Status Changes	The number of time the status of C/Q pin has changed when a port is in SIO input mode.
SIO Output Writes	The number of time the status of C/Q pin has changed when a port is in SIO output mode.
SIO Output Write Errors	The number of errors when writing to C/Q pin when a port is in SIO output mode.
Auxiliary Input Status Changes	The number of time the status of auxiliary pin has changed.
Event Reads	The number of IO-Link events.
Event Read Errors	The number of errors when reading IO-Link events.
Get Port Mode Errors	The number of errors when getting IO-Link port mode.
Set Port Mode Errors	The number of errors when setting IO-Link port mode.
ISDU Request Msgs From PLC(s)	Displays the number of ISDU request messages received from the PLC(s) or other controllers. These request messages may contain one or multiple ISDU commands.
ISDU Invalid Requests	Displays the number of ISDU requests received over PROFINET IO with one or more invalid commands.
Valid ISDU Responses From Port	Displays the number of valid ISDU response messages returned from the IO-Link port interface and available to the PLC(s). The response messages contain results to the ISDU command(s) received in the request message.
ISDU Response Timeouts	Displays the number of ISDU requests that did not receive a response within the configured **ISDU Response Timeout**.
Maximum ISDU Request Msg Response Time	Displays the maximum time period required to process all commands within an ISDU request message. The response is not available until all ISDU command(s) contained in the request have been processed.

Average ISDU Request Msg Response Time	Displays the average time period required to process the ISDU request message(s). The response is not available until all ISDU command(s) contained in the request have been processed.
Minimum ISDU Request Msg Response Time	Displays the minimum time period required to process all commands within an ISDU request message. The response is not available until all ISDU command(s) contained in the request have been processed.
ISDU Read Commands	Displays the number of ISDU read commands received over PROFINET IO.
ISDU Read Failures	The number of errors when processing ISDU read commands.
ISDU Write Commands	Displays the number of ISDU write commands received over PROFINET IO.
ISDU Write Failures	The number of errors when processing IDSU write commands.
Process Alarms	The number of process alarms sent to PLC.
Return of Submodule Alarms	The number of Return of Submodule alarms sent to PLC.
Channel Diagnostics Alarms Added	The number of channel diagnostics alarms sent to PLC.
Channel Diagnostics Alarms Removed	The number of channel diagnostics alarms removed from PLC.
Alarm Errors	The number errors when handling PROFINET IO alarms.

11.5 OPC UA Diagnostics Page

The **OPC UA Diagnostics** page displays status for OPC UA:

- Whether the OPC UA feature is enabled or disabled
- Number of TCP connections

NOTE	
	Not all models support OPC UA.

12 PROFINET IO Reference Information

12.1 Sample IO-Link Master Gateway Configuration

This section demonstrates how to configure and use an IO-Link gateway.

(1) MD248I

Slot	Module	Order number	I address	Q address	Diagnostic address:	Com...	Access
0	MD248I	50131483			2042*		Full
X1	Interface				2041*		Full
X1 P1	Port 1				2040*		Full
X1 P2	Port 2				2039*		Full
1	IO-Link In 2 bytes		5...6				Full
2	IO-Link In/Out 2 bytes		7...8	1...2			Full
3	SIO Digital In		9				Full
4	SIO Digital Out			3			Full
5							
6							
7							
8							
9	IO-Link Status		0...3				Full
10	Digital I/O		4	0			Full
11							

Device overview

Module	...	Rack	Slot	I address	Q address	Type
IOLMDR8		0	0			DR-8-PNIO
Interface		0	0 X1			IOLMDR8
IO-Link In 2 bytes_1		0	1	6...7		IO-Link In 2 bytes
IO-Link In/Out 2 bytes_1		0	2	8...9	2...3	IO-Link In/Out 2 bytes
SIO Digital In_1		0	3	10		SIO Digital In
SIO Digital Out_1		0	4		4	SIO Digital Out
		0	5			
		0	6			
		0	7			
		0	8			
Digital I/O_1		0	9	5	1	Digital I/O
IO-Link Status_1		0	10	1...4		IO-Link Status
		0	11			

Figure 9: TIA Portal V13 - Leuze IOLM gateway Configuration Example

- The first IO-Link device, which supported 2 bytes of PDI data, was connected to IO-Link Port 1. The PDI data were mapped into the process image at address IW 6 of the IO controller, as shown in the figure above. The IO controller could read the current PDI data from the IO-Link device at IW 6.
- The second IO-Link device, which supported 2 bytes of PDI data and 2 bytes of PDO data, was connected to IO-Link Port 2. The PDI data were mapped into the process image at address IW 8. The PDO data were mapped into process image at address QW 2. The IO controller could access PDI and PDO via the two memory locations.
- IO-Link Port 3 and Port 4 were configured as SIO Digital In and SIO Digital Out. The IO controller could read the input status of the C/Q pin of Port 3 at IB 10, and set the output C/Q pin value of Port 4 by writing to QB 4. IO-Link port status was reported through the module in Slot 10. The 4-byte port status was available at IB 1 to IB 4.

- A Digital I/O module was plugged in Slot 9. DIO 2 and 4 were configured as digital outputs. The IO controller could reads digital input status at IB 5 and set digital output at QB 1.

Using a variable table, as shown in the following, we monitored and modified the IO data directly.

	Address	Symbol	Display format	Status value	Modify value
1	IB 1	"Status_Active"	BIN	2#0000_1111	
2	IB 2	"Status_PDIValid"	BIN	2#0000_1111	
3	IB 3	"Status_AuxiliaryInput"	BIN	2#0011_1101	
4	IB 4	"Status_Error"	BIN	2#0000_0000	
5	IW 6	"P1_IOLinkIn2bytes"	HEX	W#16#07B9	
6	IW 8	"P2_IOLinkIn2bytes"	HEX	W#16#0000	
7	IB 10	"P3_SIOInput"	HEX	B#16#01	
8	QB 4	"P4_SIOOutput"	HEX	B#16#01	B#16#01
9	IB 5	"DIO_Input"	BIN	2#0000_0000	
10	QB 1	"DIO_Output"	BIN	2#0000_1010	2#0000_1010

Figure 10: STEP 7 V5.5 - Monitoring and Modifying IO Data

	Name	Address	Display form..	Monitor value	Modify value
1	"Status_Active"	%IB1	Bin	2#0000_1111	
2	"Status_PDIValid"	%IB2	Bin	2#0000_1111	
3	"Status_AuxiliaryInput"	%IB3	Bin	2#0000_1101	
4	"Status_Error"	%IB4	Bin	2#0000_0000	
5	"P1_IOLinkIn2bytes"	%IW6	Hex	16#07B0	
6	"P2_IOLinkIn2bytes"	%IW8	Hex	16#0000	
7	"P2_IOLinkOut2bytes"	%QW2	Hex	16#0000	
8	"P3_SIOInput"	%IB10	Hex	16#01	
9	"P4_SIOOutput"	%QB4	Hex	16#01	16#01
10	"DIO_Input"	%IB5	Bin	2#0000_1111	
11	"DIO_Output"	%QB1	Bin	2#0000_1010	2#0000_1010

Figure 11: TIA Portal V13 - Monitoring and Modifying IO Data

IB 1-4 were input data from **IO-Link Status** module (Slot 10). IB 1 was IO-Link Active, IB 2 was PDI Valid, IB 3 was Auxiliary Input, and IB 4 was IO-Link Error. According to the current value of IB 1, Ports 1-4 were active. IB 2 showed the PDI data of Ports 1-4 were valid. IB 3 showed that the auxiliary input pins of Ports 1, 3, and 4 were high. No errors were detected so IB 4 was zero.

The PDI data of Port 1 was shown in IW 6. The PDI data of Port 2 was shown in IW 8.

In this example, we connected the C/Q pin, auxiliary input pin of Port 3 and Port 4 together, creating a testing loopback. Then we modified QB 4 to 0x01, which turned the C/Q Pin of Port 4 to high. IB 10 showed the status of the C/Q pin of Port 3 was high (0x01) as a result. The high status of auxiliary input pins of Ports 3 and 4 was reflected in IB 3.

To test the digital I/O ports, we created testing loopbacks by connecting DIO 1 to 2, and DIO 3 to 4 with wires. Then we changed QB 1 to 2#0000_1010, which set the DIO 2 and DIO 4 to high. IB 5 showed the input status of DIO 1-4 were high (2#0000_1111).

Slot 5-8 (Port 5-8) and Slot 11 were open. They could be used by another IO controller via a second application relationship.

12.2 Read PDI Data as Record Data

For IO modules that have input data, the Port Qualifier and PDI data can also be read by using the SFB52 **RDREC** (read record). The following table shows the available record read indexes for the IO-Link Master.

Index	Description
100..131	1-32 byte of PDI data from an IO-Link Port module in Slot 1
200..231	1-32 byte of PDI data from an IO-Link Port module in Slot 2
300..331	1-32 byte of PDI data from an IO-Link Port module in Slot 3
400..431	1-32 byte of PDI data from an IO-Link Port module in Slot 4
500	1-4 byte of PDI data from a Port Status module in Slot 11
600	1-4 byte of PDI data from a Port Status module in Slot 12

Table 1: Available Record Read Index for MD 748i-11-42/L5-2222

Index	Description
100..131	1-32 byte of PDI data from an IO-Link Port module in Slot 1
200..231	1-32 byte of PDI data from an IO-Link Port module in Slot 2
300..331	1-32 byte of PDI data from an IO-Link Port module in Slot 3
400..431	1-32 byte of PDI data from an IO-Link Port module in Slot 4
500..531	1-32 byte of PDI data from an IO-Link Port module in Slot 5
600..631	1-32 byte of PDI data from an IO-Link Port module in Slot 6
700..731	1-32 byte of PDI data from an IO-Link Port module in Slot 7
800..831	1-32 byte of PDI data from an IO-Link Port module in Slot 8
900	1-4 byte of PDI data from a Port Status module in Slot 9
1000	1-4 byte of PDI data from a Port Status module in Slot 10
1100	1-4 byte of PDI data from a Port Status module in Slot 11

Table 2: Available Record Read Index for MD 248i-12-8K/L4-2R2K

Using the same example in 12.1 Sample IO-Link Master Gateway Configuration on Page 113; a record read request of 2-bytes at index 100 would return the current PDI data of the IO-Link device attached to Port 1. A record read request of 1-byte at Index 900 would return the current IO-Link port active status.

Reading partial PDI data via record read request is supported. For an instance, an IO-Link device that supports 32-bytes PDI data is connected to IO-Link Port 5. A record read request of 32-bytes at Index 500 returns the whole 32-bytes of PDI data. Another record read request of 4-bytes at Index 529 returns the last 4-bytes of the PDI data. This provides flexibility in being able to get only the interested data from a large PDI data block.

If a record read requests more data than the IO module or IO-Link device supports, IO-Link Master returns the available PDI data and fills the remaining data with zeros. Again using the same example in 12.1 Sample IO-Link Master Gateway Configuration on Page 113; a record read request of 4-bytes at Index 100 returned 0x09 0x0E 0x00 0x00, where 0x09 and 0x0E were the actual PDI data.

IO-Link Master returns an error if a record read request contains an invalid index.

Writing PDO Data to an IO-Link device via data record write service is not supported. This is because that the new PDO data written by a record write will only last for one update cycle. The next cycle the IO controller overwrites the new PDO data with the old cyclic data from the process image.

12.3 Using the SFB52 RDREC

To use the SFB52 **RDREC**, specify the index of the requested module in **INDEX**. Specify the maximum number of bytes you want to read in **MLEN**. The selected length of the target area **RECORD** should have at least the length of **MLEN** bytes.

TRUE on output parameter **VALID** verifies that the data record has been successfully transferred into the target area **RECORD**. In this case, the output parameter **LEN** contains the length of the fetched data in bytes.

The output parameter **ERROR** indicates if a data record transmission error has occurred. In this case, the output parameter **STATUS** contains the error information.

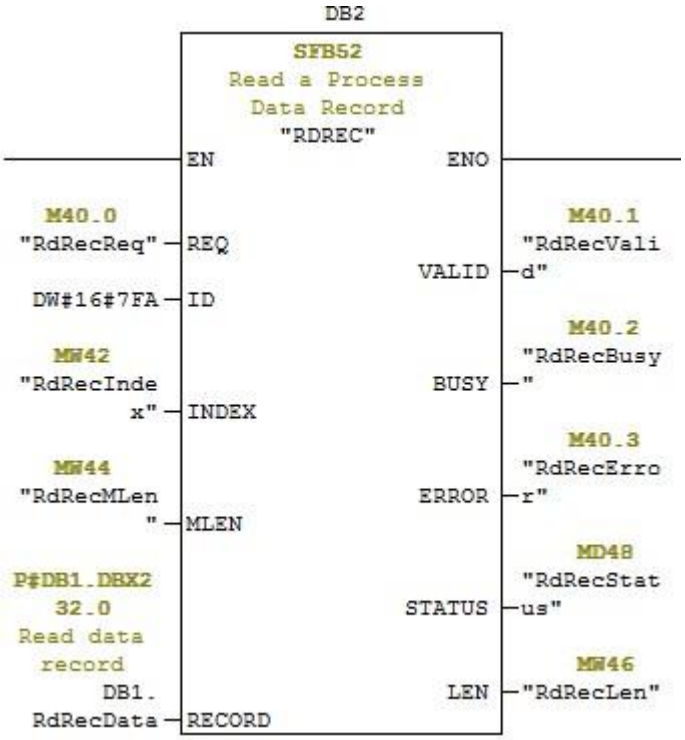


Figure 12: SFB52 Read a Process Data Record

12.4 Read and Write ISDU with the FB IOL_CALL

The function block **IOL_CALL** represents the conversion of the communication standardized for the IO-Link technology to and from IO-Link devices. The supports the **IOL_CALL** function block. It can be used to access an ISDU of an IO-Link device.

The **IOL_CALL** function block and the library description are available at:
http://support.automation.siemens.com/WW/view/en/82981502

To use **IOL_CALL** function block, do the following:

1. Set **CAP** to 255.
2. Specify **PORT** to be the IO-Link port number (1 to 8) at which the IO-Link device is connected.
3. Set **IOL_INDEX** and **IOL_SUBINDEX** to be the index and subindex of the requested ISDU. **RECORD_IOL_DATA** requires the full specification of the DB parameters, i.e. **P#DB1.DBX0.0** byte 232.
   The target area **RECORD_IOL_DATA** must have enough available bytes to hold the requested ISDU block up to 232 bytes.

4. Set **RD_WR** to 0 for read and 1 for write. For write, also specify the length of the data to be written in **LEN**. A positive edge on **REQ** starts the **IOL_CALL** request.

BUSY is set to 1 when the **IOL_CALL** request is in progress. Once completed, **DONE_VALID** is set to 1 if there was no error. Otherwise, **ERROR** is set and **STATUS** and **IOL_STATUS** contain the error information. For the remainder of the **IOL_CALL** function block parameters and complete error information, refer to the **IOL_CALL** library description.

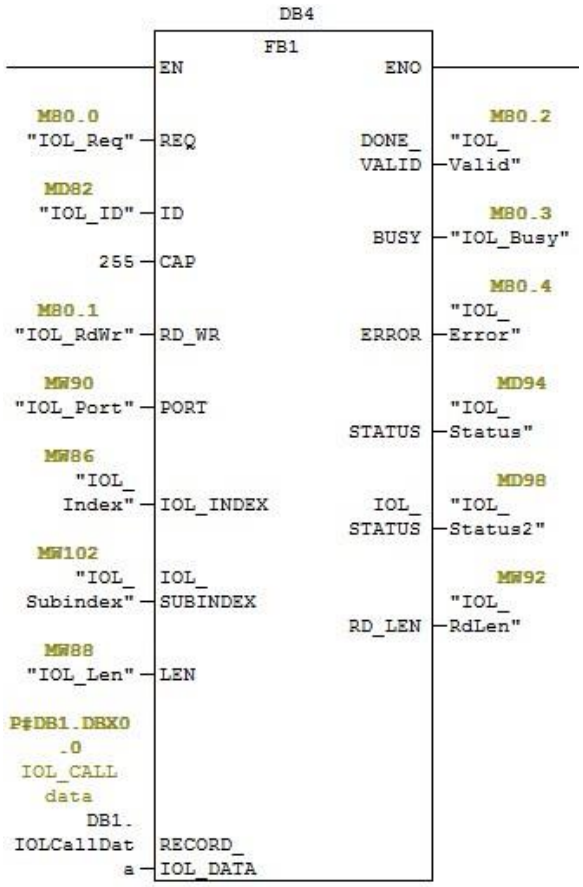


Figure 13: IOL_CALL Function Block

Parameter	Description
CAP	Access point of the **IOL_CALL** function. Use 255.
PORT	IO-Link port number at which the IO-Link device is operated, port number 1 through 8. All other values: not supported.
IOL_INDEX	Address parameter **INDEX** (IO-Link device). 0 - 32767: index of ISDU
IOL_SUBINDEX	Address parameter **SUBINDEX** (IO- Link device). • 0: not support • 1 - 255: subindex of ISDU

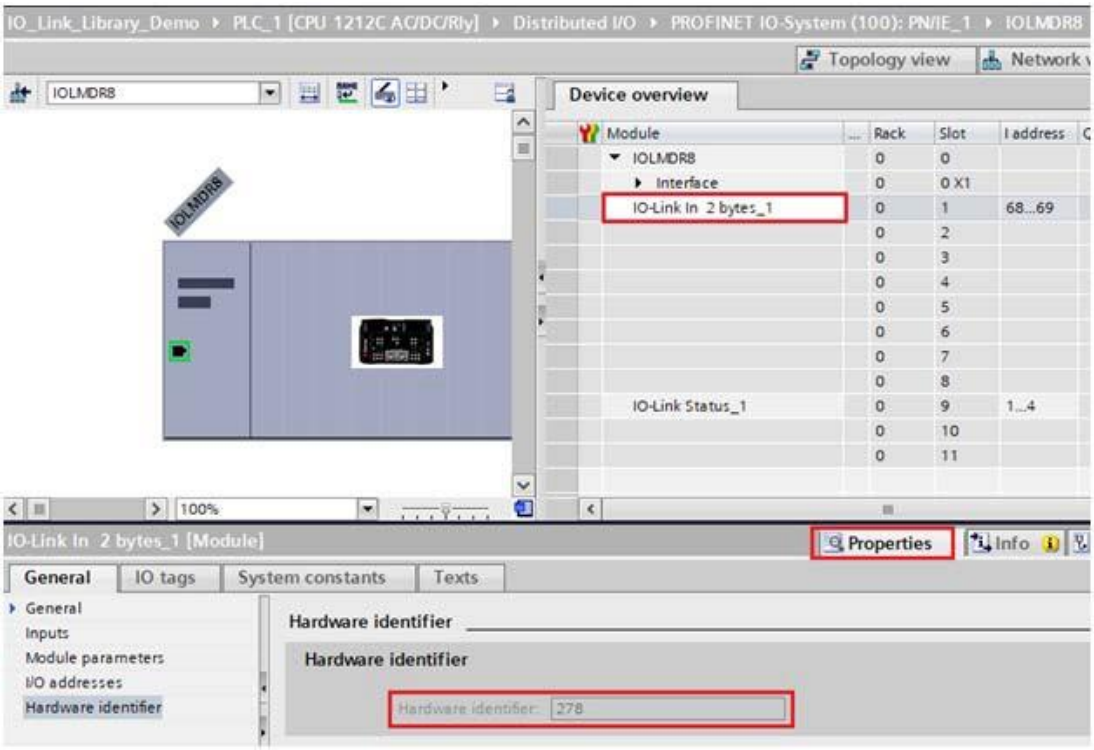
The **IOL_CALL** function block has a 20 seconds timeout value. If the request takes longer than 20 seconds, the process is aborted and a timeout error is returned. The IOLM also has a timeout value for

IOL_CALL request. The default timeout value is 20 seconds. It can be changed through the web page (**Configuration | PROFINET IO**).

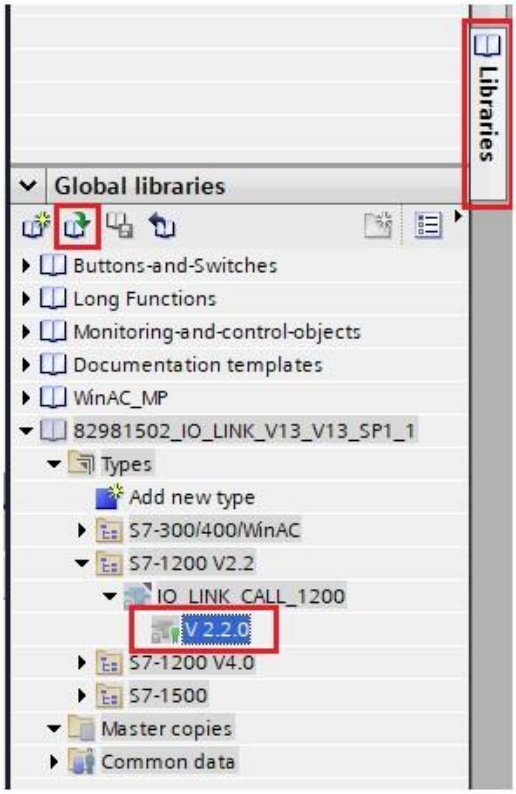
12.4.1 Using the IO-Link Library In the TIA Portal

Use the following procedure to use the IO-Link library in the TIA Portal.

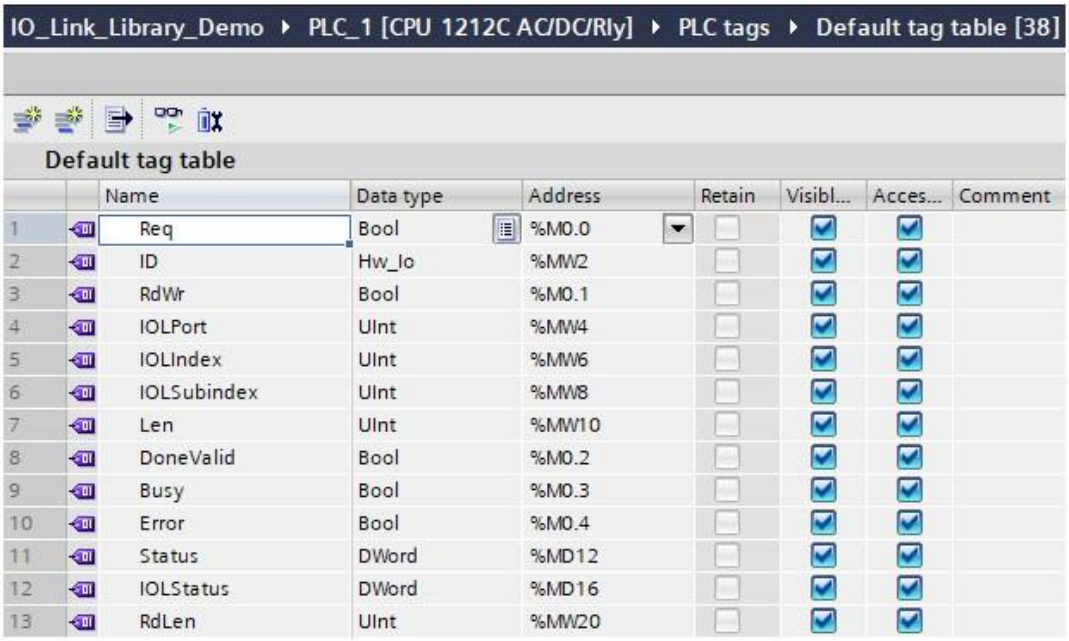
1. Download the IO-Link library from Siemens:
   http://support.automation.siemens.com/WW/view/en/82981502.
   For TIA Portal V13, download the **Archive_IO_LINK_CALL.zip** archive. For STEP 7 V5.5 and V14, download **82981502_IO_LINK_Library_V3.1**.
2. Unzip the library to a working directory.
3. Configure the TIA Portal project.
   a. Create a new or open an existing TIA Portal project.
   b. Configure the PLC, Leuze IOLM gateway and all the IO-Link ports.
   c. Compile and download the project.
   d. Make sure that everything is working as expected.
4. Take a note of the hardware identifier of the IO-Link module, which will be used to access IO-Link device ISDU.



5. Open the IO-Link library.
   a. In TIA Portal, click the **Open global library** button on the **Libraries** tab.
   b. Navigate to the above working directory, where the IO-Link library was unzipped.
   c. Select the **IO_LINK_V13.al13** and click **Open**. Depending on the version of TIA Portal, the library may need to be upgraded.
   d. After opened, there should be an **82981502_IO_LINK_xxx** library. **IO_LINK_CALL_1200 V 2.2.0** is the one that will be used.

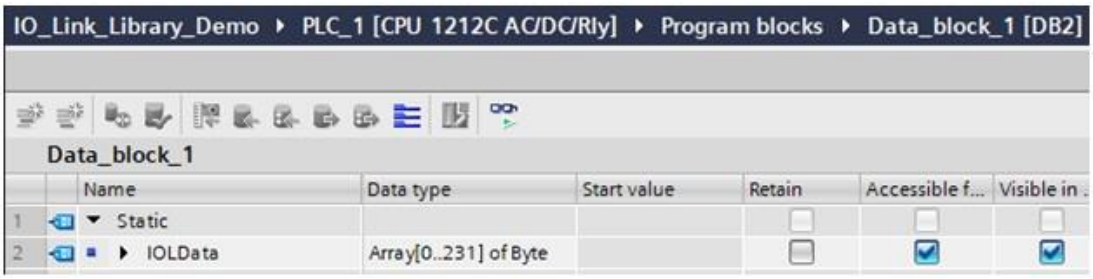


6. Create tags and data block by going to **PLC tags**, create some tags that will be used as the parameters of **IO_LINK_CALL**.



	Name	Data type	Address	Retain	Visibl...	Acces...	Comment
1	Req	Bool	%M0.0		☑	☑	
2	ID	Hw_Io	%MW2		☑	☑	
3	RdWr	Bool	%M0.1		☑	☑	
4	IOLPort	UInt	%MW4		☑	☑	
5	IOLIndex	UInt	%MW6		☑	☑	
6	IOLSubindex	UInt	%MW8		☑	☑	
7	Len	UInt	%MW10		☑	☑	
8	DoneValid	Bool	%M0.2		☑	☑	
9	Busy	Bool	%M0.3		☑	☑	
10	Error	Bool	%M0.4		☑	☑	
11	Status	DWord	%MD12		☑	☑	
12	IOLStatus	DWord	%MD16		☑	☑	
13	RdLen	UInt	%MW20		☑	☑	

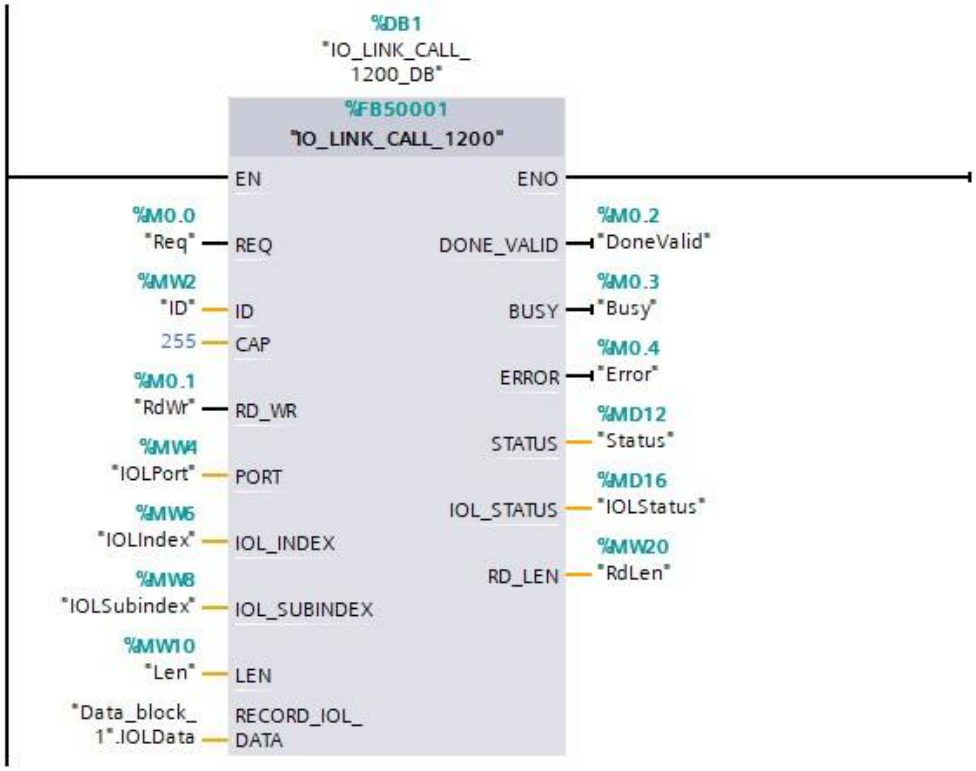
7. Add a new data block and create a 232-byte array, which will be used to store the ISDU data.



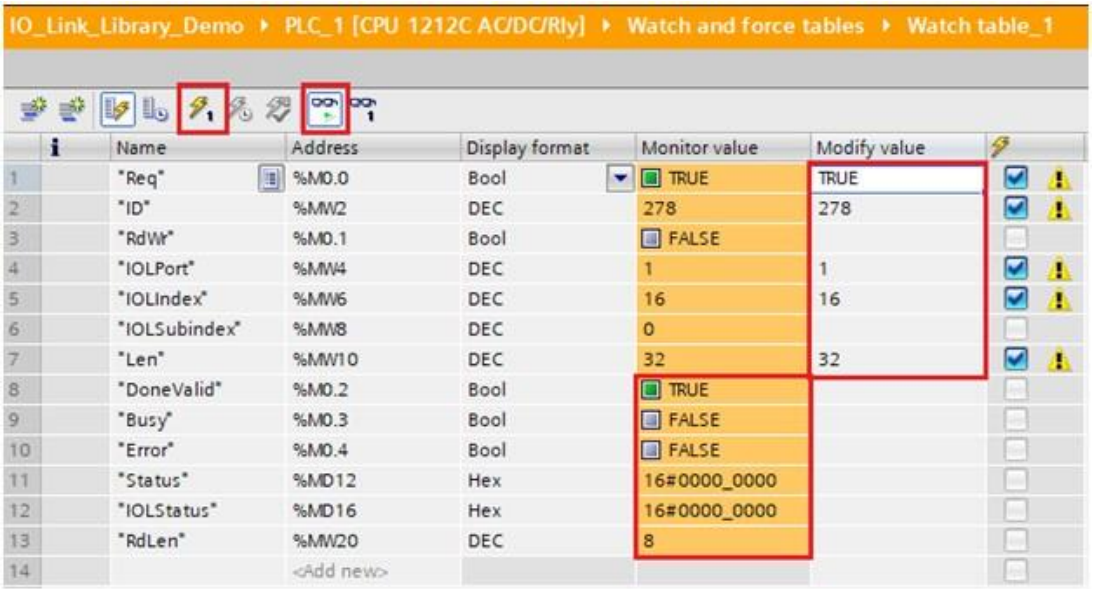
	Name	Data type	Start value	Retain	Accessible f...	Visible in ...
1	Static					
2	IOLData	Array[0..231] of Byte			☑	☑

8. Insert IO_LINK_CALL.
   a. Open the **Main** block.

b. From the Global libraries, select **82981502_IO_LINK_xxx** | **Types** | **S7-1200V2.2** | **IO_LINK_CALL_1200** | **V2.2.0** and insert it into a new network.
c. Enter the parameters using the above tags. Enter **255** for the parameter CAP.
d. Compile and download the project.



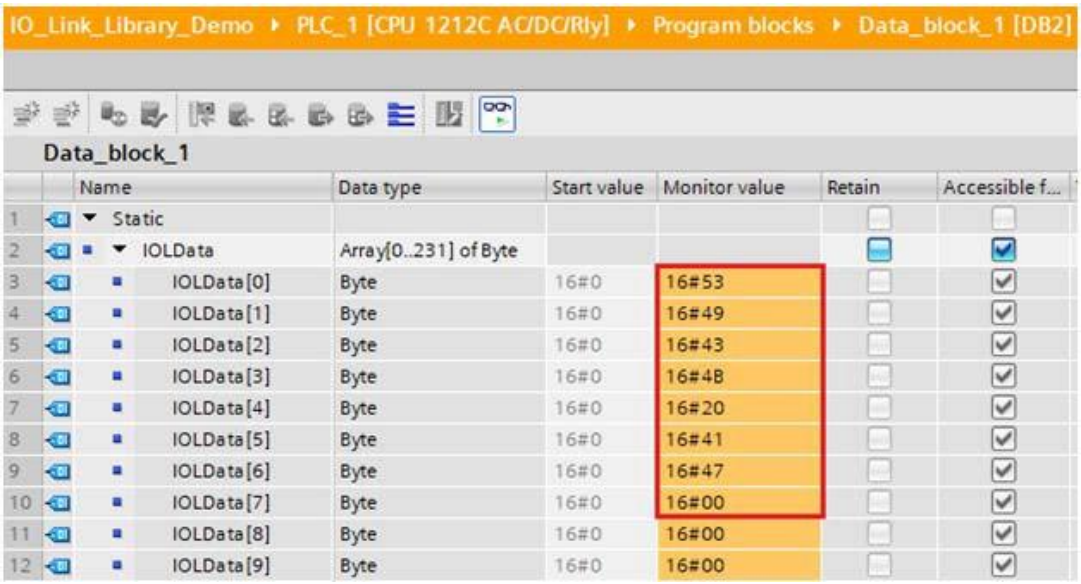
9. Test IO_LINK_CALL.
   a. Create a new watch table and enter the parameters of **IO_LINK_CALL**.
   b. Click the **Monitor all** button to start monitoring all tags.
   c. Enter the hardware identifier of the IO-Link module as the modify value of tag ID.
   d. Enter the IO-Link port number (1 based), index, subindex, and length of the requested ISDU as the modify value of the corresponding tags.
   e. Finally set the **Req tag** to be true and click the **Modify once** button.



	Name	Address	Display format	Monitor value	Modify value
1	"Req"	%M0.0	Bool	TRUE	TRUE
2	"ID"	%MW2	DEC	278	278
3	"RdWr"	%M0.1	Bool	FALSE	
4	"IOLPort"	%MW4	DEC	1	1
5	"IOLIndex"	%MW6	DEC	16	16
6	"IOLSubindex"	%MW8	DEC	0	
7	"Len"	%MW10	DEC	32	32
8	"DoneValid"	%M0.2	Bool	TRUE	
9	"Busy"	%M0.3	Bool	FALSE	
10	"Error"	%M0.4	Bool	FALSE	
11	"Status"	%MD12	Hex	16#0000_0000	
12	"IOLStatus"	%MD16	Hex	16#0000_0000	
13	"RdLen"	%MW20	DEC	8	
14		<Add new>			

10. The **IO_LINK_CALL** is trigged on the positive edge of parameter REQ.

Once completed, check the value of tag **DoneValid**, **Busy**, **Error**, **Status**, **IOLStatus**, and **RdLen**. If the ISDU request was completed successfully, the **DoneValid** should be true. The **RdLen** contains the number of bytes returned. The actual data is stored in **Data_block_1.IOLData**.



	Name	Data type	Start value	Monitor value	Retain	Accessible f...
1	Static					
2	IOLData	Array[0..231] of Byte				
3	IOLData[0]	Byte	16#0	16#53		
4	IOLData[1]	Byte	16#0	16#49		
5	IOLData[2]	Byte	16#0	16#43		
6	IOLData[3]	Byte	16#0	16#48		
7	IOLData[4]	Byte	16#0	16#20		
8	IOLData[5]	Byte	16#0	16#41		
9	IOLData[6]	Byte	16#0	16#47		
10	IOLData[7]	Byte	16#0	16#00		
11	IOLData[8]	Byte	16#0	16#00		
12	IOLData[9]	Byte	16#0	16#00		

12.5 Diagnostic Alarm

Events from IO-Link Master and IO-Link devices are mapped to PROFINET alarms and channel diagnostics according to the IO-Link on *PROFINET Working Document Version 13.4.2015* with some modifications.

12.5.1 IO-Link Event Mapping Overview

IO-Link events are mapped into **PROFINET Alarms and Channel Diagnostics** using the following table. Each appearing IO-Link event (mode Coming) results in adding channel diagnostics. Each disappearing IO-Link event (mode Going) results in removing channel diagnostics. IO-Link events that have mode Single will be mapped to PROFINET process alarm.

IO-Link Event Mapping	
IO-Link Event Mode	PROFINET
Single	Process alarm
Coming	Add channel diagnostics
Going	Remove channel diagnostics

In addition, only IO-Link events that have the type of Error or Warning are mapped to PROFINET channel diagnostics. Type Message IO-Link events are not mapped.

12.5.2 IO-Link EventCode Mapping

IO-Link events that are generated by IO-Link devices (remote events) are mapped to PROFINET diagnostics using **ChannelErrorType** 0x500 and0x501.

- For an **EventCode** that is between 0x0000 and 0x7FFF, **ChannelErrorType** 0x500 is used. The **EventCode** is directly mapped to **ExtChannelErrorType**.
- For an **EventCode** that is between 0x8000-0xFFFF, **ChannelErrorType** 0x501 is used. The **EventCode** is mapped to **ExtChannelErrorType** with the MSB set to 0.

- For IO-Link events that are generated by IO-Link Master (local events), **ChannelErrorType** 0x502 is used. **EventCode** is directly mapped to **ExtChannelErrorType**.

The following table summaries how IO-Link **EventCode** is mapped to PROFINET diagnostics.

IO-Link EventCode Mapping				
Source	**EventCode**	**ChannelError Type**	**ExtChannel ErrorType**	**Comment**
IO-Link Device (remote)	0x0000-0x7FFFF	0x500	0x0000-0x7FFFF	Direct mapping of **EventCode** to **ExtChannelErrorType** (e.g. **EventCode** 0x6321 will be mapped to **ExtChannelErrorType** 0x6321)
IO-Link Device (remote)	0x8000-0xFFFF	0x501	0x0000-0x7FFFF	Mapping of **EventCode** to **ExtChannelErrorType**. Set MSB (**EventCode**) to “0” (e.g. **EventCode** 0x8005 | **ExtChannelErrorType** 0x0005
IO-Link Master (local)	0x0000-0x7FFFF	0x502	0x0000-0x7FFFF	Direct mapping of local **EventCode** to **ExtChannelErrorType**

The following table lists some of the **EventCode** that the Leuze IO-Link Master generates.

IO-Link EventCode	ExtChannelErrorType	Description
0x0001	0x0001	Slave PDU Flow
0x0002	0x0002	Master PDU checksum error
0x0003	0x0003	Slave illegal PDU
0x0004	0x0004	Master illegal PDU
0x0005	0x0005	Slave PDU buffer
0x0006	0x0006	Slave PD INKR
0x0007	0x0007	Slave PD length
0x0008	0x0008	Slave no PDI
0x0009	0x0009	Slave no PDO
0x000A	0x000A	Slave channel
0x000B	0x000B	Master event
0x000C	0x000C	Application message
0x000D	0x000D	Application warning
0x000E	0x000E	Application device
0x000F	0x000F	Application parameter
0x0010	0x0010	Slave device lost
0x0012	0x0012	Slave DESINA
0x001A	0x001A	Slave wrong sensor
0x001B	0x001B	Slave retry
0x001E	0x001E	Power short circuit
0x001F	0x001F	Power sensor
0x0020	0x0020	Power actuator
0x0021	0x0021	Power fault
0x0022	0x0022	Power reset
0x0023	0x0023	Slave fallback
0x0024	0x0024	Master preoperate
0x0028	0x0028	Data storage ready
0x0029	0x0029	Data storage identity fault
0x002A	0x002A	Data storage size fault

0x002B	0x002B	Data storage upload fault
0x002C	0x002C	Data storage download fault
0x002F	0x002F	Data storage device locked fault

The following images show a *Slave device lost* event that was available in the diagnostics when an IO-Link device was disconnected from an IO-Link port. In the figure, Slot 2 means that the device was connected to IO-Link Port 2. The event will be removed from the diagnostics when the device is reconnected to the same IO-Link port.

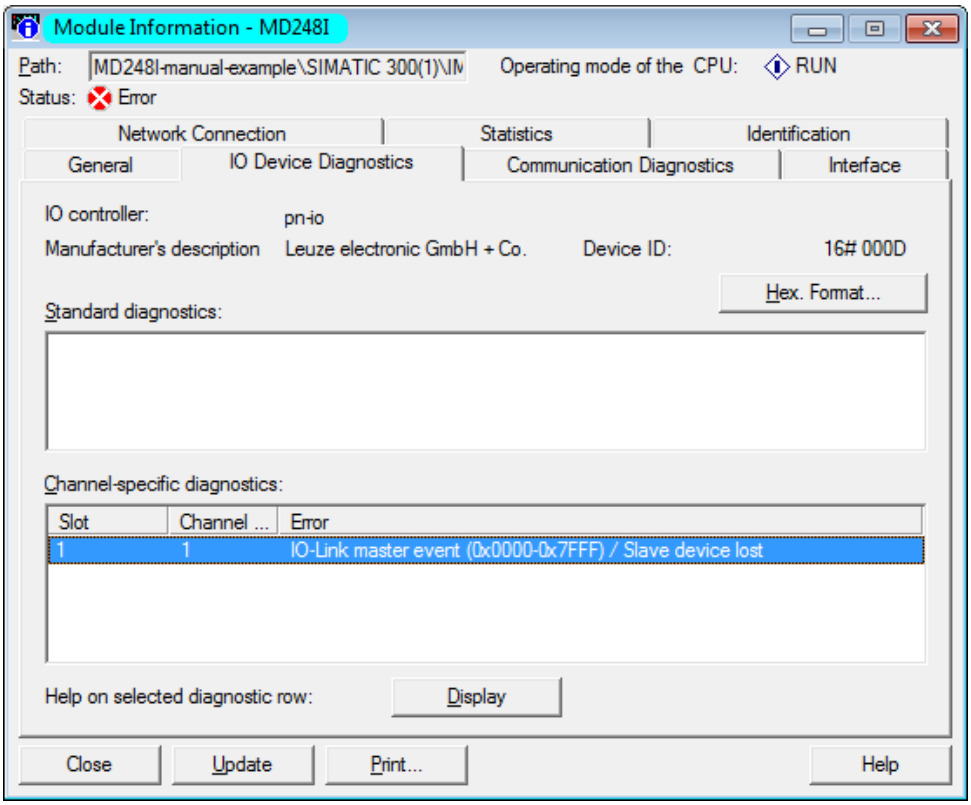


Figure 14: IO-Link Events through PROFINET Channel Diagnostics

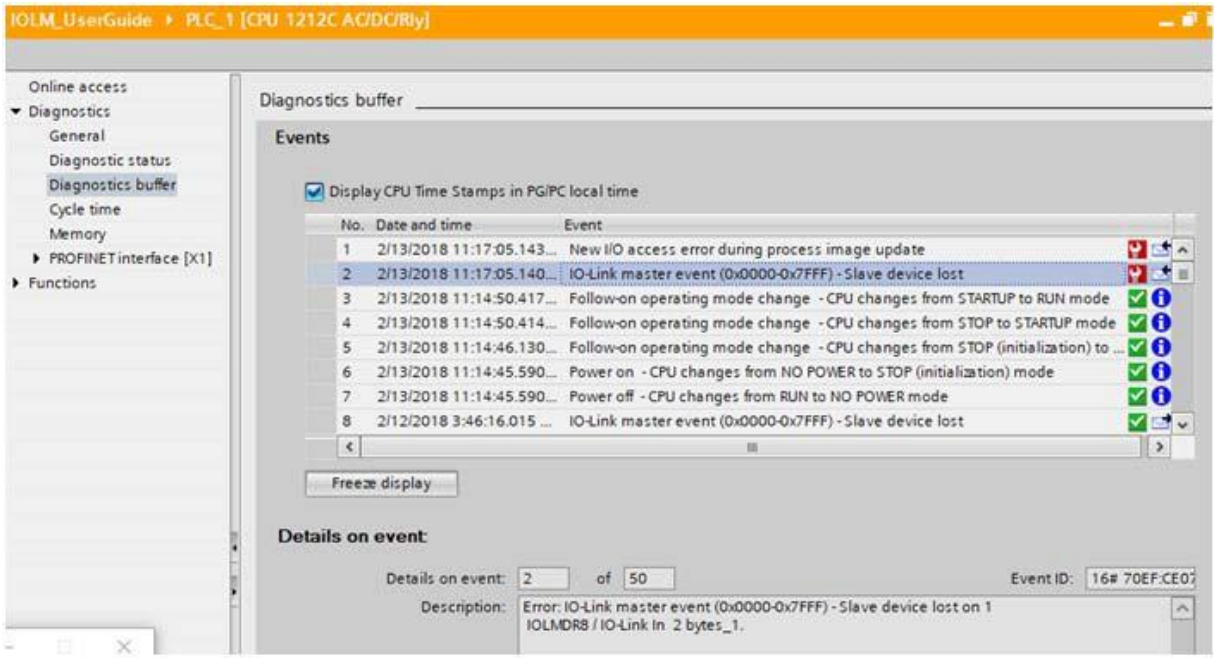


Figure 15: TIA Portal V13: IO-Link Events Through PROFINET Channel Diagnostics

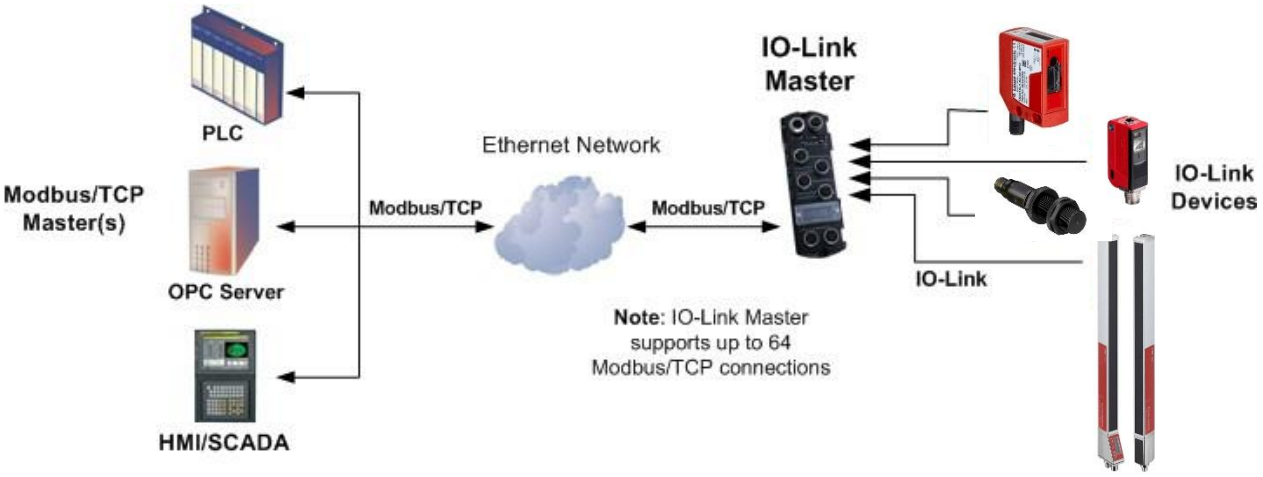
13 Modbus/TCP Interface

The IOLM provides a slave-mode Modbus/TCP interface that provides:

- Read access to the Process Data Input (PDI) and Process Data Output (PDO) data blocks for each IO-Link port
- Write access to the PDO data block for each IO-Link port
- Write access to send ISDU requests to each IO-Link port
- Read access to ISDU responses from each IO-Link port
- Read access to the Port Information Block for each IO-Link port

The Modbus interface is disabled by default. To enable Modbus/TCP:

1. Click **Configuration** | **Modbus/TCP**.
2. Click the **EDIT** button in the **Modbus/TCP Configuration** table.
3. Select **enable** in the **Modbus Enable** drop box.
4. Click the **SAVE** button.



Modbus/TCP to IO-Link

Refer to Chapter 14 Functionality Descriptions on Page 132 for detailed information about process data block descriptions, event handing, and ISDU handling.

- 14.1.1.1 Input Process Data Block-8 Bit Data Format on Page 133
- 14.1.1.2 Input Process Data Block-16 Bit Data Format on Page 134
- 14.1.1.3 Input Process Data Block-32 Bit Data Format on Page 134
- 14.1.2.1 Output Process Data Block-8 Bit (SINT) Data Format on Page 135
- 14.1.2.2 Output Process Data Block-16 Bit (INT) Data Format on Page 136
- 14.1.2.3 Output Process Data Block-32 Bit (DINT) Data Format on Page 137
- 14.2 Event Handling on Page 138
- 14.3 ISDU Handling on Page 139

13.1 Modbus Function Codes

This table shows the supported Modbus function codes.

Message Type	Function Code	Maximum Message Size
Read Holding Registers	3	250 Bytes (125 Words)
Write Single Register	6	2 bytes (1 Word)
Write Multiple Registers	16 (10 hex)	246 Bytes (123 Words)
Read/Write Holding Registers	23 (17 hex)	Write: 242 bytes (121 Words Read: 246 bytes (123 Words)

13.2 Modbus Address Definitions

The address definitions for the Modbus/TCP interface are shown in the following tables.

	IO-Link Port 1	IO-Link Port 2	IO-Link Port 3	IO-Link Port 4	Access	Length
Multiple Port PDI Data Block(s)	999 (Base 0) 1000 (Base 1)	1999 (Base 0) 2000 (Base 1)	2999 (Base 0) 3000 (Base 1)	3999 (Base 0) 4000 (Base 1)	Read-Only	Configurable per port (s)
Port Specific PDI Data Block	1000 (Base 0) 1001 (Base 1)	2000 (Base 0) 2001 (Base 1)	3000 (Base 0) 3001 (Base 1)	4000 (Base 0) 4001 (Base 1)	Read-Only	Configurable per port
Multiple Port PDO Data Block(s)	1049 (Base 0) 1050 (Base 1)	2049 (Base 0) 2050 (Base 1)	3049 (Base 0) 3050 (Base 1)	4049 (Base 0) 4050 (Base 1)	Read/ Write	Configurable per port(s)
Port Specific PDO Data Block	1050 (Base 0) 1051 (Base 1)	2050 (Base 0) 2051 (Base 1)	3050 (Base 0) 3051 (Base 1)	4050 (Base 0) 4051 (Base 1)	Read/ Write	Configurable per port
Receive ISDU Response	1100 (Base 0) 1101 (Base 1)	2100 (Base 0) 2101 (Base 1)	3100 (Base 0) 3101 (Base 1)	4100 (Base 0) 4101 (Base 1)	Read-Only	4 to 125 Words
Transmit ISDU Request	1300 (Base 0) 1301 (Base 1)	2300 (Base 0) 2301 (Base 1)	3300 (Base 0) 3301 (Base 1)	4300 (Base 0) 4301 (Base 1)	Write-Only	4 to 123 Words
Port Information Block (Continuous Block)						232 Words
Vendor Name	1500 (Base 0) 1501 (Base 1)	2500 (Base 0) 2501 (Base 1)	3500 (Base 0) 3501 (Base 1)	4500 (Base 0) 4501 (Base 1)	Read-Only	64 Chars 32 Words
Vendor Text	1532 (Base 0) 1533 (Base 1)	2532 (Base 0) 2533 (Base 1)	3532 (Base 0) 3533 (Base 1)	4532 (Base 0) 4533 (Base 1)	Read-Only	64 Chars 32 Words

Product Name	1564 (Base 0) 1565 (Base 1)	2564 (Base 0) 2565 (Base 1)	3564 (Base 0) 3565 (Base 1)	4564 (Base 0) 4565 (Base 1)	Read-Only	64 Chars 32 Words
Product Id	1596 (Base 0) 1597 (Base 1)	2596 (Base 0) 2597 (Base 1)	3596 (Base 0) 3597 (Base 1)	4596 (Base 0) 4597 (Base 1)	Read-Only	64 Chars 32 Words
Product Text	1628 (Base 0) 1629 (Base 1)	2628 (Base 0) 2629 (Base 1)	3628 (Base 0) 3629 (Base 1)	4628 (Base 0) 4629 (Base 1)	Read-Only	64 Chars 32 Words
Serial Number	1660 (Base 0) 1661 (Base 1)	2660 (Base 0) 2661 (Base 1)	3660 (Base 0) 3661 (Base 1)	4660 (Base 0) 4661 (Base 1)	Read-Only	16 Chars 8 Words
Hardware Revision	1668 (Base 0) 1669 (Base 1)	2668 (Base 0) 2669 (Base 1)	3668 (Base 0) 3669 (Base 1)	4668 (Base 0) 4669 (Base 1)	Read-Only	64 Chars 32 Words
Firmware Revision	1700 (Base 0) 1701 (Base 1)	2700 (Base 0) 2701 (Base 1)	3700 (Base 0) 3701 (Base 1)	4700 (Base 0) 4701 (Base 1)	Read-Only	64 Chars 32 Words
Device PDI Length	1732 (Base 0) 1733 (Base 1)	2732 (Base 0) 2733 (Base 1)	3732 (Base 0) 3733 (Base 1)	4732 (Base 0) 4733 (Base 1)	Read-Only	1 Word
Device PDO Length	1733 (Base 0) 1734 (Base 1)	2733 (Base 0) 2734 (Base 1)	3733 (Base 0) 3734 (Base 1)	4733 (Base 0) 4734 (Base 1)	Read-Only	1 Word

13.2.1 8-Port Models

	IO-Link Port 5	IO-Link Port 6	IO-Link Port 7	IO-Link Port 8	Access	Length
Multiple Port PDI Data Block(s)	4999 (Base 0) 5000 (Base 1)	5999 (Base 0) 6000 (Base 1)	6999 (Base 0) 7000 (Base 1)	7999 (Base 0) 8000 (Base 1)	Read-Only	Configurable per port (s)
Port Specific PDI Data Block	5000 (Base 0) 5001 (Base 1)	6000 (Base 0) 6001 (Base 1)	7000 (Base 0) 7001 (Base 1)	8000 (Base 0) 8001 (Base 1)	Read-Only	Configurable per port
Multiple Port PDO Data Block(s)	5049 (Base 0) 5050 (Base 1)	6049 (Base 0) 6050 (Base 1)	7049 (Base 0) 7050 (Base 1)	8049 (Base 0) 8050 (Base 1)	Read/ Write	Configurable per port(s)
Port Specific PDO Data Block	5050 (Base 0) 5051 (Base 1)	6050 (Base 0) 6051 (Base 1)	7050 (Base 0) 7051 (Base 1)	8050 (Base 0) 8051 (Base 1)	Read/ Write	Configurable per port
Receive ISDU Response	5100 (Base 0) 5101 (Base 1)	6100 (Base 0) 6101 (Base 1)	7100 (Base 0) 7101 (Base 1)	8100 (Base 0) 8101 (Base 1)	Read-Only	4 to 125 Words

Transmit ISDU Request	5300 (Base 0) 5301 (Base 1)	6300 (Base 0) 6301 (Base 1)	7300 (Base 0) 7301 (Base 1)	8300 (Base 0) 8301 (Base 1)	Write-Only	4 to 123 Words
Port Information Block (Continuous Block)						232 Words
Vendor Name	5500 (Base 0) 5501 (Base 1)	6500 (Base 0) 6501 (Base 1)	7500 (Base 0) 7501 (Base 1)	8500 (Base 0) 8501 (Base 1)	Read-Only	64 Chars 32 Words
Vendor Text	5532 (Base 0) 5533 (Base 1)	6532 (Base 0) 6533 (Base 1)	7532 (Base 0) 7533 (Base 1)	8532 (Base 0) 8533 (Base 1)	Read-Only	64 Chars 32 Words
Product Name	5564 (Base 0) 5565 (Base 1)	6564 (Base 0) 6565 (Base 1)	7564 (Base 0) 7565 (Base 1)	8564 (Base 0) 8565 (Base 1)	Read-Only	64 Chars 32 Words
Product Id	5596 (Base 0) 5597 (Base 1)	6596 (Base 0) 6597 (Base 1)	7596 (Base 0) 7597 (Base 1)	8596 (Base 0) 8597 (Base 1)	Read-Only	64 Chars 32 Words
Product Text	5628 (Base 0) 5629 (Base 1)	6628 (Base 0) 6629 (Base 1)	7628 (Base 0) 7629 (Base 1)	8628 (Base 0) 8629 (Base 1)	Read-Only	64 Chars 32 Words
Serial Number	5660 (Base 0) 5661 (Base 1)	6660 (Base 0) 6661 (Base 1)	7660 (Base 0) 7661 (Base 1)	8660 (Base 0) 8661 (Base 1)	Read-Only	16 Chars 8 Words
Hardware Revision	5668 (Base 0) 5669 (Base 1)	6668 (Base 0) 6669 (Base 1)	7668 (Base 0) 7669 (Base 1)	8668 (Base 0) 8669 (Base 1)	Read-Only	64 Chars 32 Words
Firmware Revision	5700 (Base 0) 5701 (Base 1)	6700 (Base 0) 6701 (Base 1)	7700 (Base 0) 7701 (Base 1)	8700 (Base 0) 8701 (Base 1)	Read-Only	64 Chars 32 Words
Device PDI Length	5732 (Base 0) 5733 (Base 1)	6732 (Base 0) 6733 (Base 1)	7732 (Base 0) 7733 (Base 1)	8732 (Base 0) 8733 (Base 1)	Read-Only	1 Word
Device PDO Length	5733 (Base 0) 5734 (Base 1)	6733 (Base 0) 6734 (Base 1)	7733 (Base 0) 7734 (Base 1)	8733 (Base 0) 8734 (Base 1)	Read-Only	1 Word

13.3 Multiple Port Process Data (PDI/PDO) Access via Modbus/TCP

The process data has been grouped together in order to minimize the number of Modbus messages required to interface to the IO-Link master. The PDI and PDO data for multiple ports can be received or transmitted by one message.

	Modbus Holding Register Address (Base 1)	Controller Port 1 Access		Controller Port 2 Access		Controller Port 3 Access		Controller Port 4 Access	
		Read (Input)	Write (Output)	Read (Input)	Write (Output)	Read (Input)	Write (Output)	Read (Input)	Write (Output)
Read (Input) Process Data Input	1000 (Port 1)								
	2000 (Port 2)								
	3000 (Port 3)								
	4000 (Port 4)								
Read (Input) Process Data Output	1050 (Port 1)								
	2050 (Port 2)								
	3050 (Port 3)								
	4050 (Port 4)								
Write (Output) Process Data Output	1050 (Port 1)								
	2050 (Port 2)								
	3050 (Port 3)								
	4050 (Port 4)								

	Modbus Holding Register Address (Base 1)	Controller Port 5 Access		Controller Port 6 Access		Controller Port 7Access		Controller Port 8 Access	
		Read (Input)	Write (Output)	Read (Input)	Write (Output)	Read (Input)	Write (Output)	Read (Input)	Write (Output)
Read (Input) Process Data Input	5000 (Port 5)								
	6000 (Port 6)								
	7000 (Port 7)								
	8000 (Port 8)								
Read (Input) Process Data Output	5050 (Port 5)								
	6050 (Port 6)								
	7050 (Port 7)								
	8050 (Port 8)								
Write (Output) Process Data Output	5050 (Port 5)								
	6050 (Port 6)								
	7050 (Port 7)								
	8050 (Port 8)								

To receive and transmit process data for eight ports, it may be necessary to adjust the size of the PDI/PDO data blocks.

Modbus Read/Write Access *where*:

- All PDI data can be read with one Modbus Read Holding Registers message.
- All PDO data can be read with one Modbus Read Holding Registers read message.
- All PDO data can be written with one Modbus Write Holding Registers message.
- Controller Read access:
  - The PDI data from one or more ports may be read with one message. (i.e.: If addressing port 1, at address 1000, ports one to four may be read in one message.)
  - The PDO data from one or more ports may be read with one message. (i.e.: If addressing port 1, at address 1050, ports one to four may be read in one message.)
  - Partial PDI and PDO data reads are allowed.
  - The length of the Read message can range from 1 to the total, configured PDI or PDO length for all ports starting at the addressed port.
- Controller Write (Output) access:
  - Only PDO data may be written.
  - The PDO data for one or more ports may be written with one Write Holding Registers message.
  - Partial PDO data writes are not allowed.
  - The length of the Write message must be equal to the total of the configured PDO lengths for all ports to be written. The one exception is that the data length of the last port to be written must be equal to or greater than the device PDO length for that port.

14 Functionality Descriptions

This chapter discusses the following for Modbus/TCP:

- Process Data Block Descriptions
- Event Handling on Page 138
- ISDU Handling on Page 139

14.1 Process Data Block Descriptions

This subsection discusses the following:

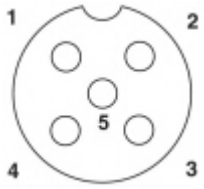
- Input Process Data Block Description
- Output Process Data Block Description on Page 135

14.1.1 Input Process Data Block Description

The Input Process Data Block format is dependent on the configured PDI Data Format. The following tables describe the Input Process Data Block in the possible formats.

Parameter Name	Data Type	Description

Port Status	BYTE	The status of the IO-Link device.
		Bit 0 (0x01):
		0 = IO-Link port communication initialization process is inactive 1 = IO-Link port communication initialization process is active
		Bit 1 (0x02):
		0 = IO-Link port communication is not operational 1 = IO-Link port communication is operational
		Bit 2 (0x04):
		0 = IO-Link input process data is not valid. 1 = IO-Link input process data is valid.
		Bit 3 (0x08):
		0= No fault detected 1= Fault detected
		• A minor communication fault is indicated by the Operational status bit being set to 1. A minor communication fault results from:
		  • A temporary loss of communication to the IO-Link device.
		  • A recoverable IOLM software or hardware fault.
		• A major communication fault is indicated by the Operational bit being set to 0.
		  • An unrecoverable loss of communication to the IO-Link device.
		  • An unrecoverable IOLM software or hardware fault.
		Bits 4-7: Reserved (0)

Parameter Name	Data Type	Description
Auxiliary I/O	BYTE	The auxiliary bit on the IO-Link port is: • Pin 2 on the MD 748i-11-42/L5-2222, MD 748i-11-82/L5-2222, and MD 748iC-11-82/L5-2222 F001  • DI (labeled as 3 on the device) on the MD 248i-12-8K/L4-2R2K, IOLM DR-8-PNIO-P, and IOLM DR-8-PNIO-T  **Bit 0 (0x01)**: The status of the auxiliary bit. 0 = off 1 = on **Bits 1-3**: Reserved (0) If **Include Digital I/O in PDI Data Block** is disabled: **Bits** 4-7: Reserved (0) *MD 248i-12-8K/L4-2R2K - Dedicated DIO Ports Only* If **Include Digital I/O in PDI Data Block** is enabled: Bits 4-7: **Bit 4 (0x10)** – D1 = DI status **Bit 5 (0x20)** – D2 = DIO status **Bit 6 (0x40)** – D3 = D2 status **Bit 7 (0x80)** – D4 = DIO status
Event Code	INT	16-bit event code received from the IO-Link device.
PDI Data *Default Length* = 32 bytes	Array of up to 32 BYTEs	The PDI data as received from the IO-Link device. May contain from 0 to 32 bytes of PDI data. The definition of the PDI data is device dependent. ***Note!*** *Length is configurable using the web page interface.*

14.1.1.1 Input Process Data Block-8 Bit Data Format

The following table provides detailed information about the Input Process Data Block-8 Bit data format.

Byte	Bit 7 Bit 0
0	Port Status
1	Auxiliary I/O
2	Event Code LSB
3	Event Code MSB
4	PDI Data Byte 0
5	PDI Data Byte 1
..	..
..	..
N+3	PDI Data Byte (N-1)

14.1.1.2 Input Process Data Block-16 Bit Data Format

The following table provides detailed information about the Input Process Data Block-16 data format.

Word	Bit 15 Bit 8	Bit 7 Bit 0
0	Port Status	Auxiliary I/O
1	Event Code	
2	PDI Data Word 0	
3	PDI Data Word 1	
..	..	
..	..	
N+1	PDI Data Word (N-1)	

14.1.1.3 Input Process Data Block-32 Bit Data Format

The following table provides detailed information about the Input Process Data Block-32 Bit data format.

Long Word	Bit 31 Bit 24	Bit 23 Bit 16	Bit 15 Bit 0
0	Port Status	Auxiliary I/O	Event Code
2	PDI Data Long Word 0		
3	PDI Data Long Word 1		
..	..		
N	PDI Data Long Word (N-1)		

14.1.2 Output Process Data Block Description

The contents of the Output Process Data Block are configurable.

Parameter Name	Data	Description
Clear Event Code in PDO Block (Configurable option) *Default*: Not included	INT	If included, allows clearing of 16-bit event code received in the PDI data block via the PDU data block.
Include Digital Output(s) in PDO Data Block *Default*: Not included	INT	If included, allows setting the Digital Output Pins D2 and D4.
PDO Data *Default Length* = 32 bytes	Array of up to 32 BYTEs	The PDO data written to the IO-Link device. May contain from 0 to 32 bytes of PDO data. The definition and length of the PDO data is device dependent. ***Note!*** *Length is configurable via web page interface.*

14.1.2.1 Output Process Data Block-8 Bit (SINT) Data Format

Without either the **Clear Event Code in PDO Block or Include Digital Output(s) in PDO Data Block** options selected:

Byte	Bit 7 Bit 0
0	PDO Data Byte 0
1	PDO Data Byte 1
..	..
..	..
N-1	PDO Data Byte (N-1)

With the **Clear Event Code in PDO Block** option selected and without the **Include Digital Output(s) in PDO Data Block** option selected:

Byte	Bit 7 Bit 0
0	Event Code LSB
1	Event Code MSB
2	PDO Data Byte 0
3	PDO Data Byte 1
..	..
..	..
N+1	PDO Data Byte (N-1)

With both the **Clear Event Code in PDO Block** and **Include Digital Output(s) in PDO Data Block** options selected:

Byte	Bit 7 Bit 0
0	Event code LSB
1	Event code MSB
2	Digital Output Settings: Bit 1 (0x02) - DI setting Bit 3 (0x08) - C/Q setting
3	0 (Unused)
4	PDO Data Byte 0
5	PDO Data Byte 1
..	..
..	..
N + 3	PDO Data Byte (N-1)

14.1.2.2 Output Process Data Block-16 Bit (INT) Data Format

Without either the **Clear Event Code in PDO Block** or **Include Digital Output(s) in PDO Data Block** options selected:

Word	Bit 15 Bit 0
0	PDO Data Word 0
1	PDO Data Word 1
..	..
..	..
N-1	PDO Data Word (N-1)

With the Clear Event Code in PDO Block option selected and without the Include Digital Output(s) in PDO Data Block option selected:

Word	Bit 15 Bit 0
0	Event Code
1	PDO Data Word 0
2	PDO Data Word 1
..	..
..	..
N	PDO Data Word (N-1)

With both the Clear Event Code in PDO Block and Include Digital Output(s) in PCO Data Block options selected:

Word	Bit 15 Bit 0
0	Event Code
1	Digital Output Settings: Bit 1 (0x02) - DI setting Bit 3 (0x08) - C/Q setting
2	PDO Data Word 0
3	PDO Data Word 1
..	..
..	..
N+1	PDO Data Word (N-1)

14.1.2.3 Output Process Data Block-32 Bit (DINT) Data Format

Without either the **Clear Event Code in PDO Block** or **Include Digital Output(s) in PDO Data Block** options selected:

Long Word	Bit 31 Bit 0
0	PDO Data Long Word 0
1	PDO Data Long Word 1
..	..
..	..
N-1	PDO Data Long Word (N-1)

With the **Clear Event Code in PDO Block** option selected and without the **Include Digital Output(s) in PDO Data Block** option selected:

Long Word	Bit 31 Bit 16	Bit 15 Bit 0
0	0	Event Code
1	PDO Data Long Word 0	
2	PDO Data Long Word 1	
..	..	
..	..	
N - 1	PDO Data Long Word (N-1)	

With both the **Clear Event Code in PDO Block** and **Include Digital Output(s) in PDO Data Block** options selected:

Long Word	Bit 31 Bit 16	Bit 15 Bit 0
0	Digital Output Settings: **Bit 17 (0x2000)** – DI setting **Bit 19 (0x8000)** – C/Q setting	Event Code
1	PDO Data Long Word 0	
2	PDO Data Long Word 1	
..	..	
..	..	
N - 1	PDO Data Long Word (N-1)	

14.2 Event Handling

The IOLM event handling is designed to provide real-time updates of event codes received directly from the IO-Link device. The IO-Link event code:

- Is included in the second 16-bit word of the Input Process Data (PDI) block.
  - An active event is indicated by a non-zero value.
  - Inactive or no event is indicated by a zero value.
- Two methods are provided to clear an event:
  - Enable the Clear Event After Hold Time option.
- The IOLM keeps, or holds, the active event code in the PDI block until the configured *Active Event Hold Time* has passed.
- The IOLM then clears the event code in the PDI block and waits until the *Clear Event Hold Time* has passed before including another event code in the PDI block.
- Enable the Clear Event In PDO Block option.
  - The IOLM monitors the PDO block received from the PLC.
  - The IOLM expects the first entry of the PDO block to indicate an event code to be cleared.
  - If there is an active event code in the PDI block and the PDO block both contain the same event code, the event code is cleared in the PDI block.
  - The IOLM then clears event code in the PDI block and waits until the *Clear Event Hold Time* has passed before including another event code in the PDI block.
- The two methods can be used separately or together to control clearing of events.

The next subsections illustrate the event clearing process for the various event configurations.

14.2.1 Clear Event After Hold Time Process

This illustrates clearing the event after the hold time process.

14.2.2 Clear Event in PDO Block Process

This illustrates clearing the event in the PDO block process.

14.2.3 Clear Event Code in PDO Block and Clear Event After Hold Time Process- PDO Block First

This illustrates clearing the event code in the PDO block and clearing the event after the hold time process with the PDO block first.

14.2.4 Clear Event Code in PDO Block and Clear Event After Hold TimeProcess- Hold Time Expires

This illustrates clearing the event code in the PDO block and clearing the event after the hold time process with the hold time expired.

14.3 ISDU Handling

The IOLM provides a very flexible ISDU interface that is used by all supported industrial protocols. The ISDU interface contains the following:

- An ISDU *request* may contain one or multiple individual ISDU read and/or write *commands*.
- Individual ISDU command based byte swapping capabilities.
- Variable sized command structures to allow access to wide range of ISDU block sizes.
- A single ISDU request may contain as many ISDU read and/or write commands as allowed by the industrial protocol payload. For example, if an industrial protocol provides up to 500 byte read/write payloads, then an ISDU request may contain multiple commands of various lengths that can total up to 500 bytes in length.
- For the ControlLogix family of EtherNet/IP PLCs, both blocking and non-blocking ISDU request methods are provided.
  - The IOLM implements blocking ISDU requests by not responding to an ISDU request message until all commands have been processed.
  - The IOLM implements non-blocking ISDU requests by:
  - Responding to an ISDU request message immediately after receiving and verifying the ISDU request.
  - Requiring the PLC to monitor the ISDU request status with read messages. The IOLM will not return a completed status until all of the ISDU commands have been processed.

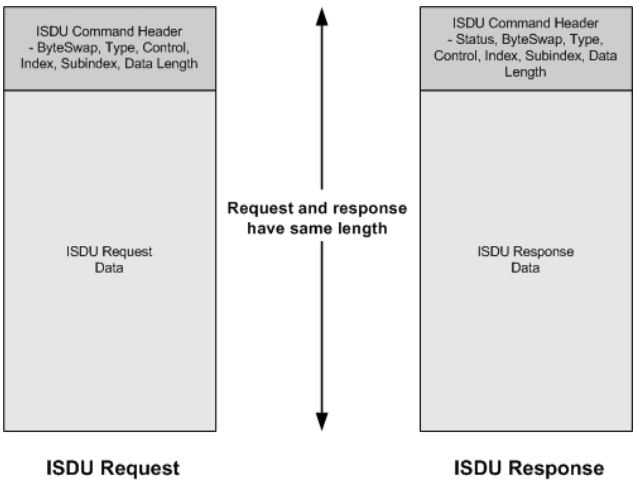
14.3.1 ISDU Request/Response Structure

ISDU requests may contain a single command or multiple, nested commands. This subsection discusses the following:

- Single ISDU Command Request
- Multiple ISDU Command Structure on Page 140

14.3.1.1 Single ISDU Command Request

This illustrates a single ISDU command request.

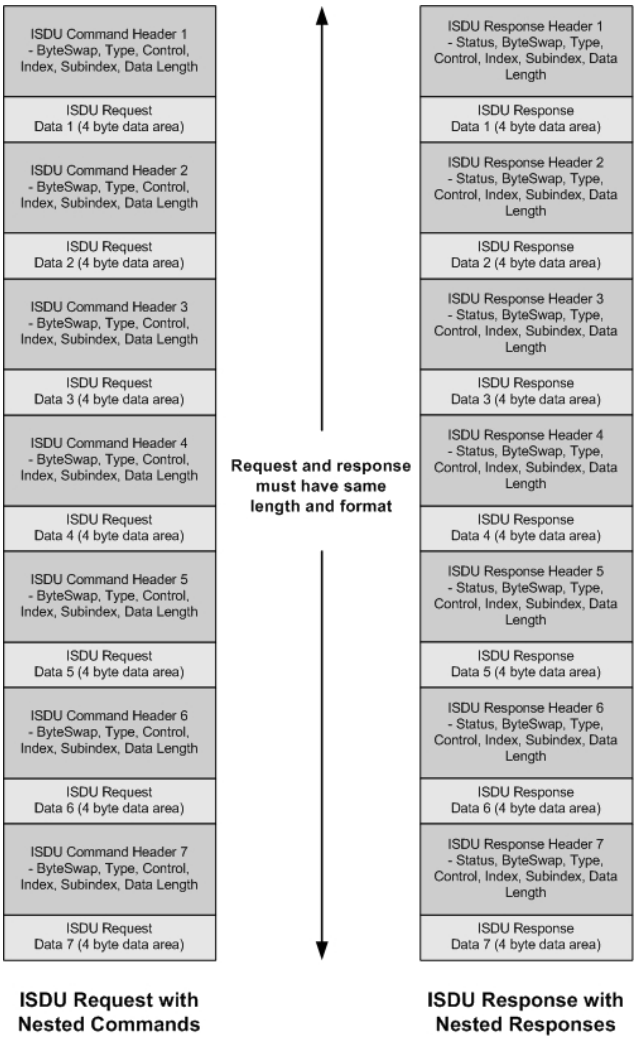


Single Command ISDU Request/Response

14.3.1.2 Multiple ISDU Command Structure

ISDU requests with multiple commands may consist of commands of the same data size or commands with different data sizes. The following are two examples of multiple ISDU commands.

- ISDU commands of same data size (Page 140)
- ISDU commands of different data sizes (Page 141)



Example - Multiple Command ISDU Request/Response of Same Data Area Length

Figure 16: Multiple Command ISDU Request/Response of Same Data Area Length

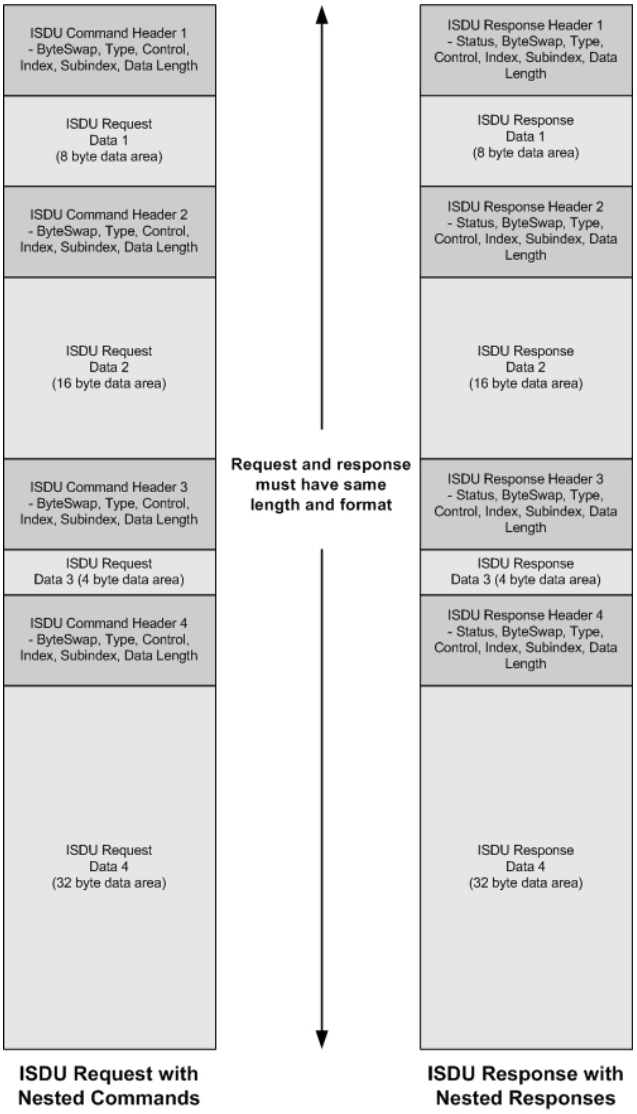


Figure 17: Multiple Command ISDU Request/Response of Different Data Lengths

14.3.2 ISDU Request Message Format-From PLC to IOLM

Write and read ISDU commands have the same message data format. Each ISDU request message is comprised of one or more commands. The command(s) can consist of either a series of nested commands or a single read command.

NOTE	
	A list of nested ISDU commands is terminated with either a control field of 0, (single/last operation), or the end of the message data.

14.3.2.1 Standard ISDU Request Command Format

This table displays a standard ISDU request command format with ControlLogix PLCs.

Name	Data Type	Parameter Descriptions
Byte Swapping	USINT	**Bits 0-3:** 0= No byte swapping. 1= 16-bit (INT) byte swapping of ISDU data. 2= 32-bit (DINT) byte swapping of ISDU data. **Bits 4-7:** Set to zero. Unused.
RdWrControlType	USINT	Provides the control and type of ISDU command. **Bits 0-3, Type Field:** 0 = NOP (No operation) 1 = Read operation 2 = Write operation 3 = Read/Write “OR” 4 = Read/Write “AND” **Bits 4-7, Control Field:** 0 = Single/Last Operation (length can vary from to 1 to 232) 1 = Nested batch command – fixed 4 byte data area 2 = Nested batch command – fixed 8 byte data area 3 = Nested batch command – fixed 16 byte data area 4 = Nested batch command – fixed 32 byte data area 5 = Nested batch command – fixed 64 byte data area 6 = Nested batch command – fixed 128 byte data area 7 = Nested batch command – fixed 232 byte data area
Index	UINT	The parameter address of the data object in the IO-Link device.
Subindex	UINT	The data element address of a structured parameter of the data object in the IO-Link device.
Datalength	UINT	Length of data to read or write. For nested batch commands, the data length can vary from 1 to the fixed data area size.
Data	Array of USINTs, UINTs, or UDINTs.	Size of array is determined by the Control field in RdWrControlType. ***Note!*** *Data is valid only for write commands.*

14.3.2.2 Integer (16-Bit Word) ISDU Request Command Format

This table shows an integer (16 bit word) ISDU request command format with a SLC, MicroLogix, PLC-5, or Modbus/TCP.

Name	Data Type	Parameter Description
Byte Swapping / RdWrControlType	UINT	Provides the control, type and byte swapping of ISDU command **Bits 0-3, Type Field:** 0 = NOP (No operation) 1 = Read operation 2 = Write operation 3 = Read/Write “OR” 4 = Read/Write “AND” **Bits 4-7, Control Field:** 0 = Single/Last Operation (length can vary from to 1 to 232) 1 = Nested batch command – fixed 4 byte data area 2 = Nested batch command – fixed 8 byte data area 3 = Nested batch command – fixed 16 byte data area 4 = Nested batch command – fixed 32 byte data area 5 = Nested batch command – fixed 64 byte data area 6 = Nested batch command – fixed 128 byte data area 7 = Nested batch command – fixed 232 byte data area **Bits 8-11:** 0= No byte swapping. 1= 16-bit (INT) byte swapping of ISDU data. 2= 32-bit (DINT) byte swapping of ISDU data. **Bits 12-15:** Set to zero. Unused.
Index	UINT	The parameter address of the data object in the IO-Link device.
Subindex	UINT	The data element address of a structured parameter of the data object in the IO-Link device.
Datalength	UINT	Length of data to read or write. For nested batch commands, the data length can vary from 1 to the fixed data area size.
Data	Array of USINTs, UINTs, or UDINTs.	Size of array is determined by the Control field in RdWrControlType. ***Note!*** *Data is valid only for write commands.*

14.3.3 ISDU Response Message Format

The ISDU responses have the same data format as requests with the only exception being the returned command status. Each ISDU response message is comprised of one or more responses to the single and/or nested command(s) received in the request.

14.3.3.1 Standard ISDU Response Command Format

The following table show the standard ISDU response command format with ControlLogix PLCs.

Name	Data Type	Parameter Description
Status	USINT	Indicates the byte alignment and status of the command response. **Byte swapping, bits 0-3:** 0= No byte swapping. 1= 16-bit (INT) byte swapping of TX/RX ISDU data. 2= 32-bit (DINT) byte swapping of TX/RX ISDU data. **Status, bits 4-7:** 0 = NOP (No operation) 1 = In process (Only valid for non-blocking requests) 2 = Success 3 = Failure: IO-Link device rejected the request. 4 = Timed out: IO-Link device did not respond
RdWrControlType	USINT	Provides the control and type of ISDU request **Bits 0-3, Type Field:** 0 = NOP (No operation) 1 = Read operation 2 = Write operation 3 = Read/Write “OR” 4 = Read/Write “AND” **Bits 4-7, Control Field:** 0 = Single/Last Operation (length can vary from to 1 to 232) 1 = Nested batch command – fixed 4 byte data area 2 = Nested batch command – fixed 8 byte data area 3 = Nested batch command – fixed 16 byte data area 4 = Nested batch command – fixed 32 byte data area 5 = Nested batch command – fixed 64 byte data area 6 = Nested batch command – fixed 128 byte data area 7 = Nested batch command – fixed 232 byte data area
Index	UINT	The parameter address of the data object in the IO-Link device.
Subindex	UINT	The data element address of a structured parameter of the data object in the IO-Link device.
Datalength	UINT	Length of data that was read or written. For nested batch commands, the data length can vary from 1 to fixed data area size.

Data	Array of USINTs, UINTs, or UDINTs.	Data required for read commands. Optionally can return the data of a write command. The size of the array is determined by the Control field in the RdWrControlType. ***Note!*** *Data field not required for single NOP commands.*

14.3.3.2 Integer (16-Bit Word) ISDU Response Command Format

The following table shows an integer (16-bit word) ISDU response command format with SLC, MicroLogix, PLC-5, or Modbus/TCP.

Name	Data Type	Parameter Descriptions
Status, Byte-Swapping, RdWrControlType	UINT	Indicates the control, type, byte swapping and status of the ISDU command. **Bits 0-3, Type Field:** 0 = NOP (No operation) 1 = Read operation 2 = Write operation 3 = Read/Write “OR” 4 = Read/Write “AND” **Bits 4-7, Control Field:** 0 = Single/Last Operation (length can vary from to 1 to 232) 1 = Nested batch command – fixed 4 byte data area 2 = Nested batch command – fixed 8 byte data area 3 = Nested batch command – fixed 16 byte data area 4 = Nested batch command – fixed 32 byte data area 5 = Nested batch command – fixed 64 byte data area 6 = Nested batch command – fixed 128 byte data area 7 = Nested batch command – fixed 232 byte data area **Byte swapping, bits 8-11:** 0= No byte swapping. 1= 16-bit (INT) byte swapping of TX/RX ISDU data. 2= 32-bit (DINT) byte swapping of TX/RX ISDU data. **Status, bits 12-15:** 0 = NOP (No operation) 1 = In process (Only valid for non-blocking requests) 2 = Success 3 = Failure: IO-Link device rejected the request. 4 = Timed out: IO-Link device did not respond
Index	UINT	The parameter address of the data object in the IO-Link device

Subindex	UINT	The data element address of a structured parameter of the data object in the IO-Link device.
Datalength	UINT	Length of data that was read or written. For nested batch commands, the data length can vary from 1 to fixed data area size.
Data	Array of USINTs, UINTs, or UDINTs	Data returned for read commands. Contains the data of a write command. The size of the array is determined by the Control field in **RdWrControlType**. ***Note!*** *Data field not required for single NOP commands.*

14.3.4 ISDU Blocking and Non-Blocking Methods

The IOLM supports both blocking and non-blocking ISDU requests. The following diagrams demonstrate how each mode works.

14.3.4.1 Single Command Blocking

The following illustrates the single command blocking method.

14.3.4.2 Multiple Command Blocking

This illustrates the multiple command blocking method.

14.3.4.3 Single Command Non-Blocking

This illustrates the single command non-blocking method.

14.3.4.4 Multiple Command Non-Blocking

This illustrates the multiple command non-blocking method.

15 Troubleshooting and Technical Support

This chapter provides the following information:

- Troubleshooting
- IOLM LEDs on Page 149
- Contacting Technical Support on Page 153
- Using Log Files on Page 153

15.1 Troubleshooting

Before contacting Technical Support, you may want to try the following:

- Check to make sure LEDs are not reporting an issue using IOLM LEDs on Page 149.
- Verify that the network IP address, subnet mask, and gateway are correct and appropriate for the network. Make sure that the IP address programmed into the IO-Link Master matches the unique reserved IP configured address assigned by the system administrator.
- If using DHCP, the host system needs to provide the subnet mask. The gateway is optional and is not required for a purely local network.
- Remember that if the rotary switches on the MD 748i-11-42/L5-2222, MD 748i-11-82/L5-2222, and MD 748iC-11-82/L5-2222 F001 are set to a non-default position, the rotary switches override the lower 3 digits (8 bits) of the static IP address configured in the **Network** page.
- Verify that the Ethernet hub and any other network devices between the system and the IO-Link Master are powered up and operating.
- Verify that you are using the correct types of cables on the correct connectors and that all cables are connected securely.
- Disconnect and re-connect the IO-Link device, or optionally, use the **Configuration | IO-Link** page to **Reset** the port, and then set the **Port Mode** back to **IOLink**.
- Reboot or power cycle the IOLM. Use the **Advanced | Software** page to reboot the IOLM.
- Verify that the **Port Mode** matches the device, for example: IO-Link, Digital In, Digital Out, or Reset (port is disabled).
- If you are receiving an error that indicates a hardware fault, check the **Configuration | IO-Link** page for the port experiencing the fault.
- Check the settings for the **Automatic Upload Enable** and **Automatic Download Enable** options. If the Vendor ID or Device ID of the attached device does not match, a hardware fault is generated.
- Make sure if the port contains data storage that the Vendor ID and Device ID match the device attached to the port. If it does not, **CLEAR** the data storage or move the device to another port.
- Check the Device Validation and Data Validation settings. If the attached device does not meet these settings, a hardware fault is issued.
- Open the IO-Link Master web interface and review the following pages to see if you can locate a problem:
  - **IO-Link Diagnostics**
  - **Digital I/O Diagnostics (MD 248i-12-8K/L4-2R2K)**
  - **Modbus/TCP Diagnostics**
  - **OPC UA Diagnostics**
  - **PROFINET IO**
- If you have a spare IO-Link Master, try replacing the IO-Link Master.

15.2 IOLM LEDs

The following tables provide LED descriptions.

- MD 748i-11-42/L5-2222 LEDson Page 149
- MD 748i-11-82/L5-2222 and MD 748iC-11-82/L5-2222 F001 LEDs on Page 150
- MD 248i-12-8K/L4-2R2K LEDs on Page 152

15.2.1 MD 748i-11-42/L5-2222 LEDs

The MD 748i-11-42/L5-2222 (4-port IP67 model) provides these LEDs.

LED Activity During Power On Sequence - MD 748i-11-42/L5-2222	
uBoot Bootloader v1.00 through v1.23	**uBoot Bootloader v1.24 or higher**
1. The **PWR** LED lights. 2. The **ETH** LED lights on the connected port. 3. The IO-Link LEDs flash (if no IO-Link device attached) or are lit if an IO-Link device is attached. If a PLC is connected: **NET** LED is lit and green.	1. The **PWR** LED lights. 2. The **ETH** LED lights on the connected port. 3. The **MOD** and **NET** LEDs light red/amber. 4. The IO-Link LEDs flash (if no IO-Link device attached) or are lit if an IO-Link device is attached. If a PLC is connected: **NET** LED is lit and green.

MD 748i-11-42/L5-2222 LEDs	
PWR	A lit green **PWR** LED indicates that the IO-Link Master is powered.

MOD (Module Status)	The **MOD** LED provides the following information:
	• Off = No errors or there is no PLC connection
	• Red flashing
	  • One or more errors detected when **NET** is off
	  • Fatal error when **NET** is also flashing
	• Red solid = Maintenance required or demanded

NET (Network Status)	The **NET** LED provides the following information: • Off = No PLC connection • Green solid = PLC connection established • Red flashing = Fatal error when MOD is also flashing

1-4 	This LED provides the following information about the IO-Link port.
	• Off = SIO mode - signal is low or disconnected.
	• Yellow = SIO mode - signal is high.
	• Red flashing = Hardware fault - make sure that configured IO-Link settings on the port do not conflict with the device that is attached:
	  • **Automatic Upload** and/or **Download** is enabled and it is not the same device.
	  • **Device Validation Mode** is enabled and it is not the correct device.
	  • **Data Validation Mode** is enabled but there is an error.
	• Red solid = PDI of the attached IO-Link device is invalid.
	• Green solid= An IO-Link device is connected and communicating.
	• Green flashing = Searching for IO-Link devices.

Ports 1-4 DI	The **DI** LED indicates digital input on DI (Pin 2). • Off = DI signal is low or disconnected • Yellow = DI signal is high
ETH 1 ETH 2	The **EIP** LEDs provide the following information: • Green flashing = Activity • Green solid = Link established

15.2.2 MD 748i-11-82/L5-2222 and MD 748iC-11-82/L5-2222 F001 LEDs

The MD 748i-11-82/L5-2222 and MD 748iC-11-82/L5-2222 F001 (8-port IP67 model with an L-coded power connector) provides these LEDs.

LED Activity During Power On Sequence - MD 748i-11-82/L5- 2222 and MD 748iC-11-82/L5-2222 F001
1. The **US** LED lights. 2. The **XF1/XF2** LED lights on the connected port. 3. The **MS** and **NS** LEDs light red/amber. 4. The IO-Link LEDs flash (if no IO-Link device attached) or are lit if an IO-Link device is attached. If a PLC is connected, the **NS** LED is lit and green.

MD 748i-11-82/L5-2222 and MD 748iC-11-82/L5-2222 F001 LEDs	
US	The **US** LED provides the following information: • Green solid = The IO-Link Master is powered. • Red solid = Power input voltage below 18VDC.
UA	The **UA** LED provides the following information: • Green solid = The IO-Link Master is powered. • Red solid = Power input voltage below 18VDC.

MS (Module Status)	The **MS** LED provides the following information:
	• Off = No errors or there is no PLC connection
	• Green and red flashing = Self-test
	• Green flashing = Standby – not configured
	• Green solid = Operational
	• Red flashing:
	  • One or more errors detected when **NS** is off
	  • Fatal error when **NS** is also flashing
	• Red solid = Maintenance required or demanded

NS (Network)	The **NS** LED provides the following information: • Off = No PLC connection • Green and red flashing = Self-test • Green flashing = An IP address is configured, but no connections are established • Green solid = PLC connection established • Red flashing = Fatal error when **MS** is also flashing • Red solid = Duplicate IP address on network

X0 - X7
 
	This LED provides the following information about the IO-Link port.
	• Off = SIO mode - signal is low or disabled
	• Yellow = SIO mode - signal is high
	• Red flashing = Hardware fault - make sure that configured IO-Link settings on the port do not conflict with the device that is attached:
	  • **Automatic Upload** and/or **Download** is enabled and it is not the same device.
	  • **Device Validation Mode** is enabled and it is not the correct device.
	  • **Data Validation Mode** is enabled but there is an error.
	• Solid red = PDI of the attached IO-Link device is invalid.
	• Green solid = An IO-Link device is connected and communicating
	• Green flashing = Searching for IO-Link devices

Port 1-4 DI	The **DI** LED indicates digital input on DI (Pin 2). • Of = DI signal is low or disconnected • Yellow = DI signal is high

XF1 XF2	The **ETH** LEDs provide the following information: • Green solid = Link • Green flashing = Activity

15.2.3 MD 248i-12-8K/L4-2R2K LEDs

The MD 248i-12-8K/L4-2R2K (8-port IP20 DIN rail model with 2 dedicated DIO ports) provides these LEDs.

LED Activity During Power On Sequence - MD 248i-12-8K/L4-2R2K	
uBoot Bootloader v1.00 through v1.23	**uBoot Bootloader v1.24 or higher**
1. The **PWR** LED lights. 2. The **ETH** LED lights on the connected port. 3. The IO-Link LEDs flash (if no IO-Link device attached) or are lit if an IO-Link device is attached. If a PLC is connected, the **NS** LED is lit and green.	1. The **PWR** LED lights. 2. The **ETH** LED lights on the connected port. 3. The **MS** and **NS** LEDs light red/amber. 4. The IO-Link LEDs flash (if no IO-Link device attached) or are lit if an IO-Link device is attached. If a PLC is connected, the **NS** LED is lit and green.

MD 248i-12-8K/L4-2R2K LEDs	
PWR	A lit green **PWR** LED indicates that the IO-Link Master is powered.

MS
(Module Status)
	The **MS** LED provides the following information:
	• Off = No errors or there is no PLC connection
	• Green and red flashing = Self-test
	• Green flashing = Standby – not configured
	• Green solid = Operational
	• Red flashing:
	  • One or more errors detected when **NS** is off
	  • Fatal error when **NS** is also flashing red
	• Red solid = Maintenance required or demanded

NS (Network Status)	The **NS** LED provides the following information: • Off = No PLC connection • Green and red flashing = Self-test • Green flashing = An IP address is configured, but no connections are established • Green solid = PLC connection established • Red flashing = Fatal error when **MS** is also flashing • Red solid = Duplicate IP address on network

MD 248i-12-8K/L4-2R2K LEDs	

Port 1-8	This LED provides the following information about the IO-Link port.
	• Of = SIO mode - signal is low or disabled
	• Yellow = SIO mode - signal is high
	• Red flashing = Hardware fault - make sure that configured IO-Link settings on the port do not conflict with the device that is attached:
	  • **Automatic Upload** and/or **Download** is enabled and it is not the same device.
	  • **Device Validation Mode** is enabled and it is not the correct device.
	  • **Data Validation Mode** is enabled but there is an error.
	• Red solid = PDI of the attached IO-Link device is invalid.
	• Green solid = An IO-Link device is connected and communicating
	• Green flashing = Searching for IO-Link devices

D1-4	The **D1** - **D4** LEDs indicates digital input. • Off = DI signal is low or disconnected • On = DI signal is high
Dual Ethernet Ports	The Ethernet LEDs provide the following information: • Green solid = Link • Yellow solid = Activity

15.3 Contacting Technical Support

You may want to access the **Help/SUPPORT** page when you call Technical Support, as they may request the information displayed on the **SUPPORT** page.

Use the **Contact** page for information in the event you need technical assistance.

15.4 Using Log Files

The IO-Link Master provides five different log files that you can view, export, or clear:

- **Syslog** (system log) displays line-by-line activity records.
- **dmesg** displays Linux kernel messages.
- **top** displays which programs are using most of the memory and CPU.
- **ps** displays the running programs
- **pnio** displays PROFINET IO activity
- All log files start up automatically during the startup cycle. Each log file has a size limit of 100KB.

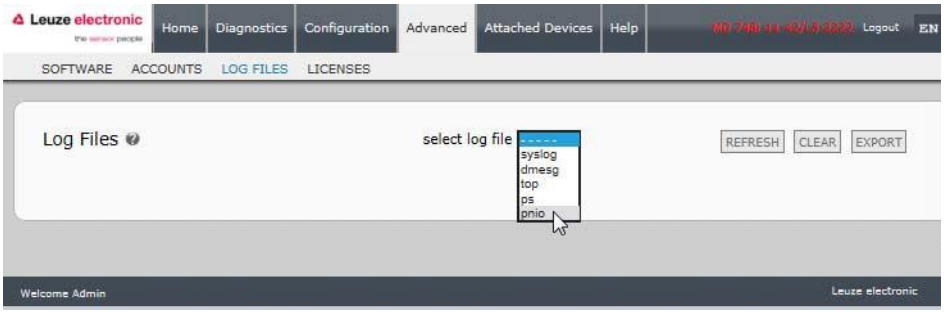
NOTE	
	Typically, log files are intended to be used by Technical Support in the event there is a problem. You can use the following procedures to:

- View a Log File
- Clear a Log File on Page 155
- Export a Log File on Page 154

15.4.1 View a Log File

Use this procedure to view a log file.

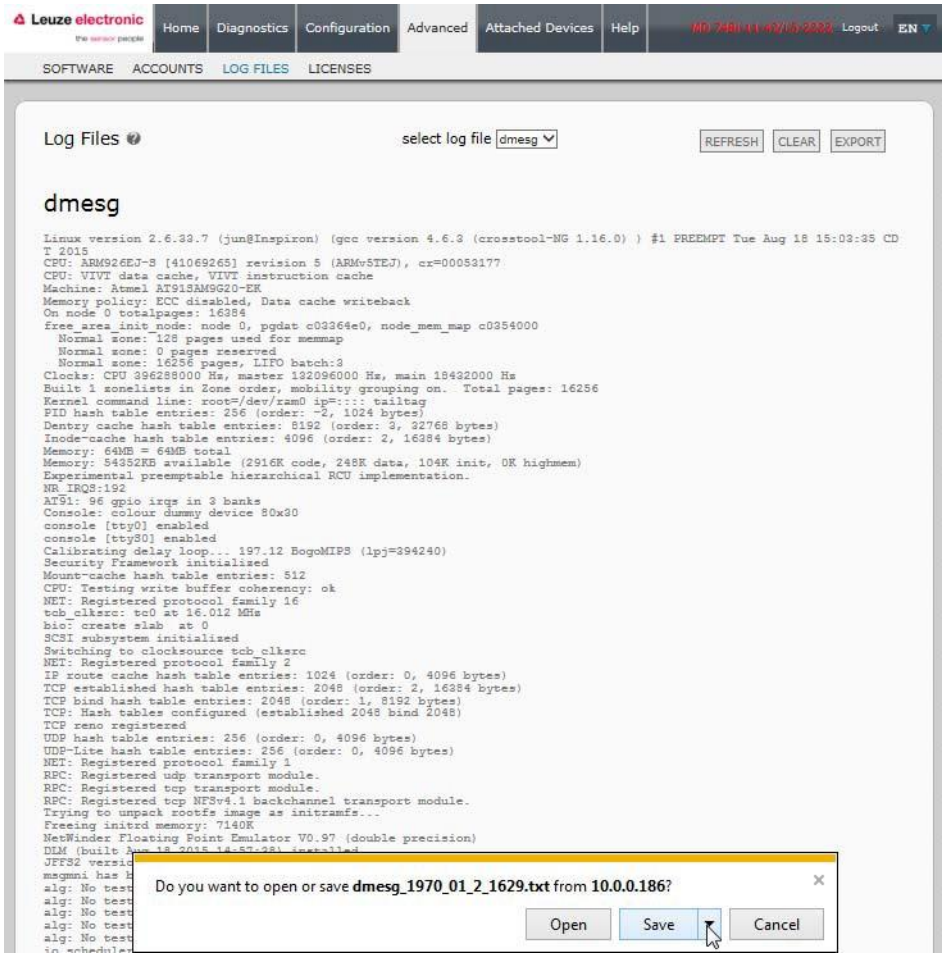
1. Open your browser and enter the IP address of the IO-Link Master.
2. Click **Advanced** and then **LOG FILES**.
3. Select the log file type from the drop-list.
4. Optionally, click the **REFRESH** button to get the latest information.
5. Optionally, export the log file.



15.4.2 Export a Log File

Use the following procedure to export a log file.

1. Open your browser and enter the IP address of the IO-Link Master.
2. Click **Advanced** and then **LOG FILES**.
3. Select the log file type from the drop-list.
4. Click the **EXPORT** button.
5. Click the **Save** button drop-list and click **Save** to save it to your user folder or **Save as** to browse to or create a new folder in which to place the log file.

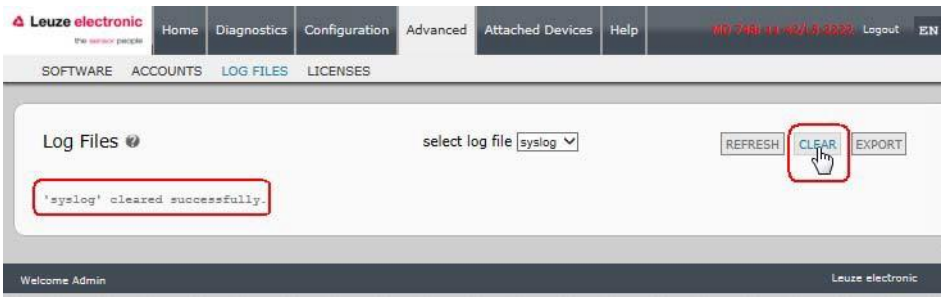


6. Depending on your browser, you may need to close the pop-up window.

15.4.3 Clear a Log File

Use this procedure to clear a log file.

1. Open your browser and enter the IP address of the IO-Link Master.
2. Click **Advanced** and then **LOG FILES**.
3. Optionally, export the log file.
4. Select the log file type from the drop-list.
5. Click the **CLEAR** button.



The log file automatically starts logging the latest information.