IO-Link Master

DATALOGIC

IO-Link

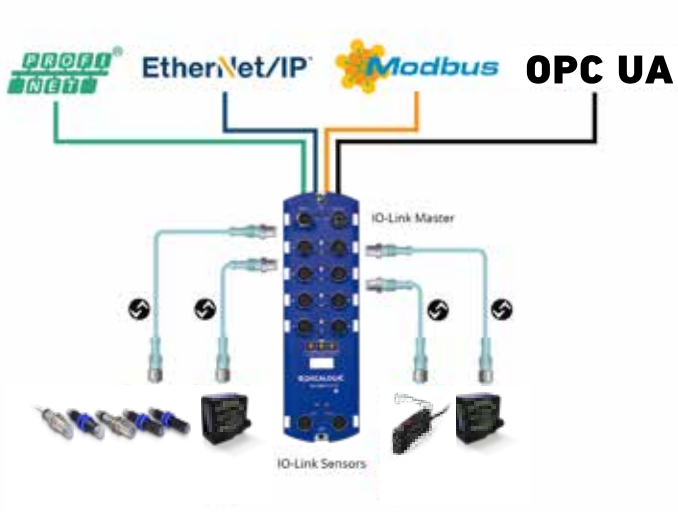
CBX-8IOL-XXXX

- Eight M12 IO-Link ports to PROFINET or Ethernet IP, which allows up to eight sensor or actuator connections on a single master
- L-Coded power connectors
- Rugged IP67 housing design for harsh environments
- Dual Ethernet ports
- Additional digital input on every port
- Power port sharing capability
- PLC access to IO-Link ISDU blocks without complex programming
- Supports the IOL_CALL function
- OPC-UA based technology
- Web server User Interface
- Download/Upload and handling of IODD files directly on Master unit

APPLICATIONS

- Processing and Packaging machinery
- Conveyor lines, material handling
- Ceramics intralogistics
- Automated warehousing
- Industry 4.0 based applications

GENERAL VIEW



CBX-8IOL Master

The IO-Link Master is a very versatlie industrial standard device.
It provides the best solution about IO-Link gateway systems the embedded OPC-UA based technology.
This new device series combines all the IO-Link standard technology benefits with OPC-UA and Field busses like Ethernet-IP, Profinet and Modbus all together in one family with two different devices to select the appropriate bus technology.
The IO-Link Master is able to run simultaneously different technologies allowing the use of OPC-UA without the need of a PLC included in the system saving hardware and software cost. The IO-link data can be sent by an IO-Link sensor directly up to any SCADA or HMI software system.
The unique and integrated WEB server Technology allows to get connected with your sensor bank just with a ethernet based device and using any commercial internet browser, setting and reading sensor parameters in the most efficient and easy way.

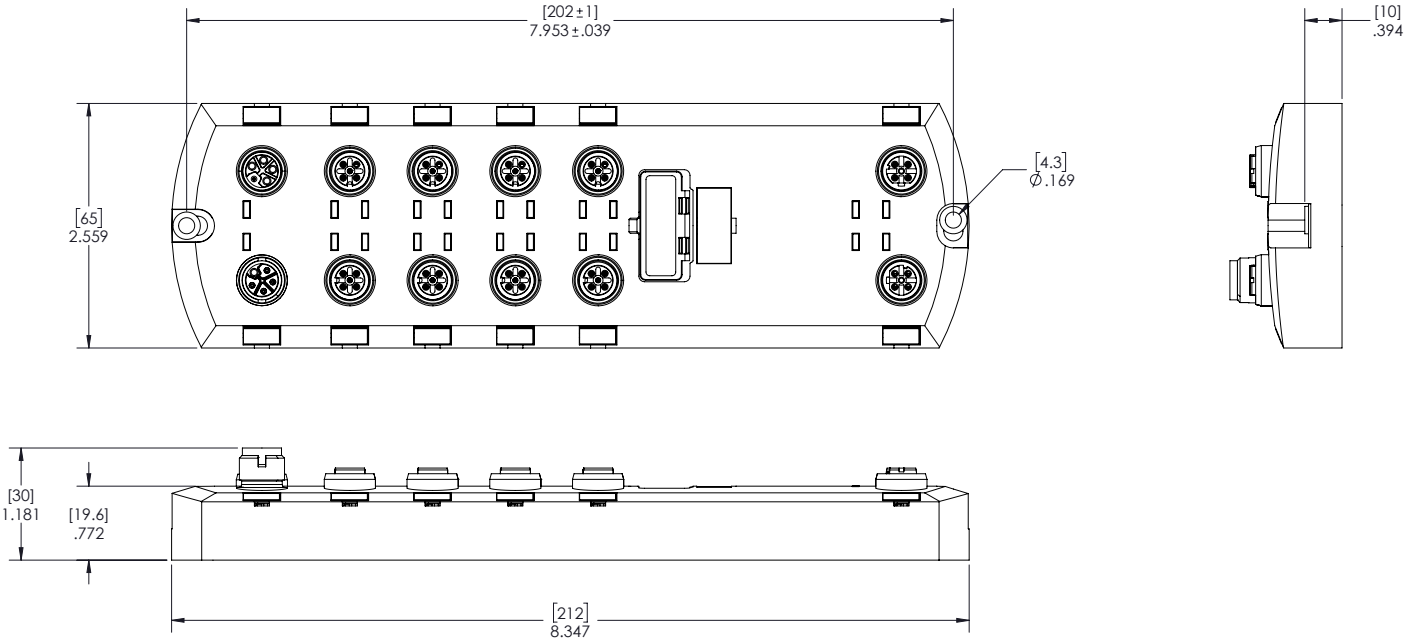
TECHNICAL DATA

SPECIFICATION	PROFINET	EIP
Hardware		
Network Interface	10/100BASE-TX	
Enclosure	Molded Polyamide 66 (potted)	
Ingress Protection Rating	IP67	
Installation and Grounding Method	Machine or panel mount Two-hole M4 or #8	
Network Protocols	PROFINET IO, Modbus/TCP (slave)	EtherNet/IP™, Modbus/TCP (slave)
Channels	8 x IO-Link / Digital I/O (configurable)	
	8 x Digital Input DI	
	2 x Ethernet	
LED Indicators	Power, Module Status, Network Status, IO-Link, DI and Ethernet Port Status	
Dimensions	212 x 65 x 30 mm (8.35 x 2.56 x 1.18)	
Product Weight	454g (1.0 lb)	
Electrical Specifications		
Power Connectors	1 x Power Input	
	1 x Power Output	
Connector type	M12, L-coded, 4 + FE	
Power Connector Pin-Out	Pin 1 – US+ (Master electronics & sensor supply)	
	Pin 2 – UA- (Actuator supply)	
	Pin 3 – US- (Master electronics & sensor supply)	
	Pin 4 – UA- (Actuator supply)	
	Pin 5 – FE	
DC Input Voltage Range	20 VDC – 30 VDC	
Power Supply In		
Module electronics and sensor (Us)	16A (max.)	
Actuator supply (UA)	16A (max.)	
Power Consumption (module electronics)	120mA @ 24VDC	
Power Supply Out		
US	16A (max.) *	
UA	16A (max.) **	
**** US output available is determined by subtracting the following from the available input current:***	Module electronics Total C/Q current for all IO-Link ports Total sensor supply current	
***** UA output available is the same as the available***	UA input current	
Environmental Specifications		
Operating Temperature	-25°C to +60°C	
Storage Temperature	-40°C to +70°C	
Operating Humidity (Non-Condensing)	10% to 95%	
Storage Humidity (Non-Condensing)	10% to 95%	
Ingress Protection	IP67 (EN / IEC 60529)	
Shock / Vibrations	EN60068-2-6	
	EN60068-2-27	
Environmental / Mechanical Approvals	IEC 61131-2	
Ethernet Interface Ports		
Number of Ports	2	
Connector Type	M12 D-coded, 4-pin	
Ethernet Specification	10/100BASE-TX	
Standards	IEEE 802.3: 10BASE-T	
	IEEE 802.3u: 100BASE-TX	
Auto-MD/MDI-X	Yes	
Auto-Negotiation	Yes	
Link Distance	100 m	
Cable Types	---	Unshielded or Shielded twisted pair (Cat 5 or higher)
IPv4 Addressing	---	Yes
IO-Link Ports Specifications		
IO-Link Version	Supports V1.0 and V1.1	
Connectors	8 (PORT 1 – 8)	
Connector type	M12, A-coded Female, 5-position	
Channels	8 x IO-Link / Digital I/O (configurable)	
	8 x DI	

Port Pinout	Pin 1 = L+	
	Pin 2 = DI	
	Pin 3 = L-	
	Pin 4 = C/Q	
	Pin 5 = no connect	
SPECIFICATION	**PROFINET**	**EIP**
IO-Link Ports Specifications		
Configurations per Port		
Pin 4 (configurable):	DI (SIO mode)	
	DO (SIO mode)	
Pin 3	DI	
Output Current L+/L- (sensor)	1.6 A (Port 1)	
	1.0 A (Port 3)	
	500 mA (Port 2, 4 – 8; each)	
Output Current C/Q	200 mA	
Output Current per Master (C/Q & L+/L-)	6.7 A (max.)	
IO-Link Mode Transfer Rates	4.8K (COM1)	
	38.4K (COM2)	
	230.4K (COM3)	
Baud Rate Recognition	Automatic	
Cable Length	20 m (max.)	
Protection	Overload and short circuit protection (Self recovers)	
Cable Length (Maximum)	20 m	
IO-Link Ports – Digital Input SIO Mode (Port Pin 4)		
Input Characteristics	IEC 61131-2 Type 1 and Type 3 Compliant	
Input Threshold	High: 10.5 – 13.0V	
	Low: 8.0 – 11.5V	
Typical Input Current	3 mA	
Cable length (max.)	30 m	
IO-Link Ports – Digital Output SIO Mode (Port Pin 4)		
Typical Output Voltage	24 VDC	
Output Current (max.)	200 mA	
Output Current per Master	1.6 A (max.)	
Lamp Load (max.)	4W	
Protection	Overload and short circuit protection	
Output Function	PNP/NPN (Push-Pull)	
Cable length (maximum)	30 m	
IO-Link Ports – Digital Input (Port Pin 3; dedicated)		
Input Characteristics	IEC 61131-2 Type 1 and Type 3 Compliant	
Typical Input Current	3 mA	
Input Threshold	High: 6.8 – 8.0V Low: 5.2 – 6.4V	
Reverse Polarity Protected	Yes (-40V to +40V)	
Cable length (maximum)	30 m	
PROFINET IO Specifications		
Web Page Configuration	PROFINET IO Device Name	---
	IOL_CALL Function Block Timeout (1-20)	---
Diagnostics	Yes	---
GSD Files	Yes	---
Diagnostics	Yes	---
EtherNet/IP Interface Specifications		
Supported PLCs		
Including but not limited to:	Control Logix	---
	Compact Logix	---
	RSLogix	---
	SLC 500	---
	PLC5	---
	MicroLogix	---
Other Class 1 or Class 3 EtherNet/IP PLCs may be supported		
ISDU Read & Writes	---	Up to 40 individual commands in one EtherNet/IP message
ISDU Commands	---	Selectable byte swapping (none, 16-bit, or 32-bit)
	---	Selectable payload sizes (4 to 232 bytes)
	---	ISDU block index
	---	ISDU sub-index
	---	Length of read or write
	---	Data payload

Web Page Configuration	Port configuration for ISDU Data, Process Data, Transfer Mode, Read/Write, Write PDI to Tag/File, Read PDO from Tag/File.	
	---	EtherNet/IP configuration
	---	Time to Live (TTL) Network Value
	---	Multicast IP Address Allocation Control
	---	User-Defined Number of Multicast IP Addresses
	---	User-Defined Multicast Starting IP Address
	---	Session Encapsulation Timeout
Diagnostics	---	Yes
Electronic Data Sheet (EDS)	---	Yes
Sample PLC Programs	---	Yes
SPECIFICATION	**PROFINET**	**EIP**
Modbus TCP		
Supported Controllers (Modbus TCP Masters)	PLC	
	HMI	
	SCADA	
	OPC Server	
Supported Clients	Any Modbus TCP Client	
	Applications on phones/tables	
Web Page Configuration	Port configuration for ISDU Response Timeout, Process Data, and Transfer Mode.	
Diagnostics	Yes	
IO-Link Master Features		
Configuration	Embedded web interface, IO-Link, EtherNet/IP, and Modbus TCP	
Data Storage	Automatic or Manual - Upload and/or Download	
Device Validation	Yes	
Data Validation	Yes	
Diagnostics	IO-Link, EtherNet/IP, and Modbus TCP	
Powerful Web Interface	**Provides the following capabilities:**	
	Password protected with Admin, Operator, and User accounts	
	ISDU batch handling	
	Load IODD files to configure the IO-Link device	
	IODD Handler parses xml files making them readable and configurable	
	Log files	
Remote Parameterization	Yes	
Export Information		
Packaged Shipping Weight	1.2 lb, 544.3 g	
Package Dimensions (L x W x H)	10.5 x 4.5 x 1.5 ; 267 x 114 x 38mm	
UPC Code	7-56727-99609-5	
Country of Origin	USA	
ECCN	5A992	
Schedule B Number	8517.62.0050	
Regulatory Approvals		
Immunity	European Standard EN 61000-6-2	
	International Standard IEC 61000-6-2	
EN/IEC 61131-2 and EN/IEC 61131-9	IEC 1000-4-2/EN 61000-4-2: Electrostatic Discharge (ESD)	
	IEC 1000-4-3/EN 61000-4-3: Radiated, Radio-Frequency (RF)	
	IEC 1000-4-4/EN 61000-4-4: Fast Transient/Burst	
	IEC 1000-4-5/EN 61000-4-5: Surge	
	IEC 1000-4-6/EN 61000-4-6: Conducted disturbance	
	IEC 1000-4-8/EN 61000-4-8: Magnetic field	
	IEC 1000-4-11/EN 61000-4-11: Dips and Voltage Variations	
Emission	European Standard EN 61000-6-4	
	International Standard IEC 61000-6-4	
	AS/NZS CISPR-11	
FCC Part15 Subpart B	Class A limit	
	Canadian EMC requirements ICES-001	
Safety	CSA C22.2 No. 61010-1-12 / CSA C22.2 No. 61010-1-201	
	UL 61010-1 / UL 61010-1-201	
	UL File # E360395	
Vibration	EN 60068-2-6/ IEC 60068-2-6	
Mechanical Shock	EN 60068-2-27/ IEC 60068-2-27	
Environmental / Mechanical Test Approvals	IEC 61131-2	
Other	The components of this product comply with the requirements of the EMC/EMI Directive 2014/30/EU, Directive 2011/65/EU on the Restriction of the use of certain Hazardous Substances (RoHS2).	
Regulatory Approval Symbols	CE FC cULus LISTED	

DIMENSIONS



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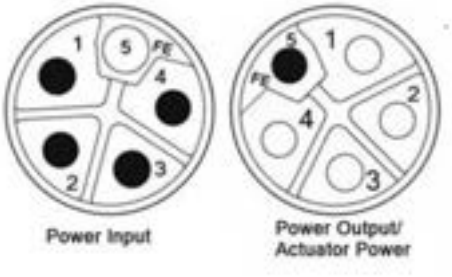
CONNECTIONS

CONNECTING THE POWER

The CBX-IOL-8-PNIO 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 for IP67 compliance.

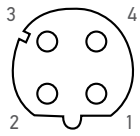
PIN	POWER INPUT (MALE)	POWER OUTPUT OR ACTUATOR POWER (FEMALE)	DESCRIPTION
1	US+	US+ or +V	IO-Link Master's system electronics and IO-Link devices
2	UA-	UA- or 0V	Actuator supply
3	US-	US- or 0V	IO-Link Master's system electronics and IO-Link devices
4	UA+	UA+ or +V	Actuator supply
5	FE		



CONNECTING 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	Tx-



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.

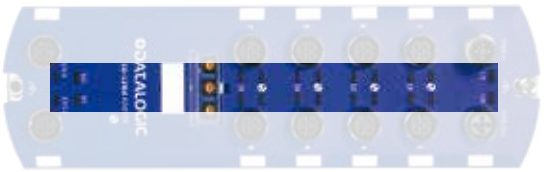
INDICATORS AND SETTINGS

SETTINGS

Follow these steps to change the default rotary switch settings:

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

INDICATORS



CBX-IOL-8-xxx LEDs

The CBX-IOL-8-EIP (8-port IP67 model with an L-coded power connector) provides these LEDs.

LED Activity During Power On Sequence - CBX-IOL-8-xxx LEDs

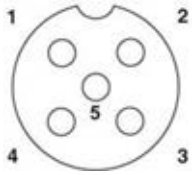
1. The **US** LED lights.
2. The **ETH1/ETH2** LED lights on the connected port.
3. The **MOD** and **NET** LEDs are lit.
4. The IO-Link LEDs flash (if no IO-Link device attached) or are lit if an IO-Link device is attached.
The **MOD** LED is solid green, the IO-Link Master is ready for operation.

CBX-IOL-8-EIP 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
MOD (Module Status)	The **MOD** LED provides the following information: ▪ Off = No module status ▪ Green and red flashing = Self-test ▪ Green flashing = Standby – not configured ▪ Green solid = Operational ▪ Red flashing = Minor recoverable fault - check the **EtherNet/IP Diagnostics** page to locate the issue ▪ Red solid = Major unrecoverable fault
NET (Network)	The **NET** LED provides the following information: ▪ Off = No IP address ▪ Green and red flashing = Self-test ▪ Green flashing = An IP address is configured, but no CIP connections are established, and an Exclusive Owner connection has not timed out ▪ Green solid= Active EtherNet/IP or Modbus connection and no EtherNet/IP connection time-outs ▪ Red flashing = One or more EtherNet/IP connection time-outs ▪ Red solid = Duplicate IP address on network
1-8	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 ▪ 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
Port 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
ETH1/ETH2	The **ETH1/ETH2** LEDs provide the following information: ▪ Green solid = Link ▪ Green flashing = Activity

IO-LINK SETTING AND CONNECTIONS

The CBX-IOL-8-EIP 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	COLOR	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:

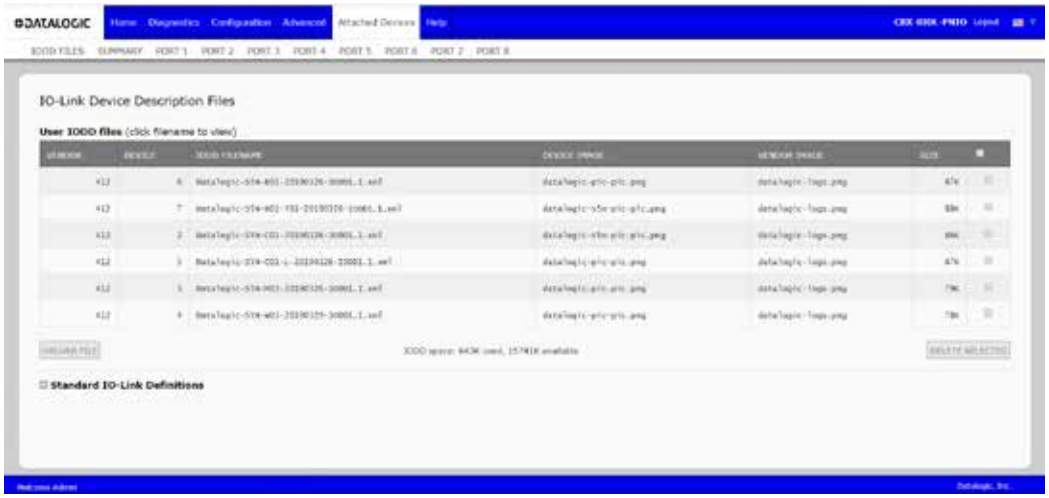
- COM1 at 4.8Kbps
- COM2 at 38.4Kbps
- COM3 at 230.4Kbps

There are active over-current limiter electronics for each port in the CBX-IOL-8-EIP 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.
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 CBX-IOL-8-EIP are as follows.

WEB SERVER GUI

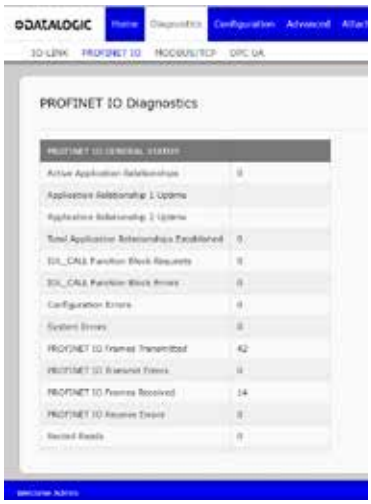
1 • Home

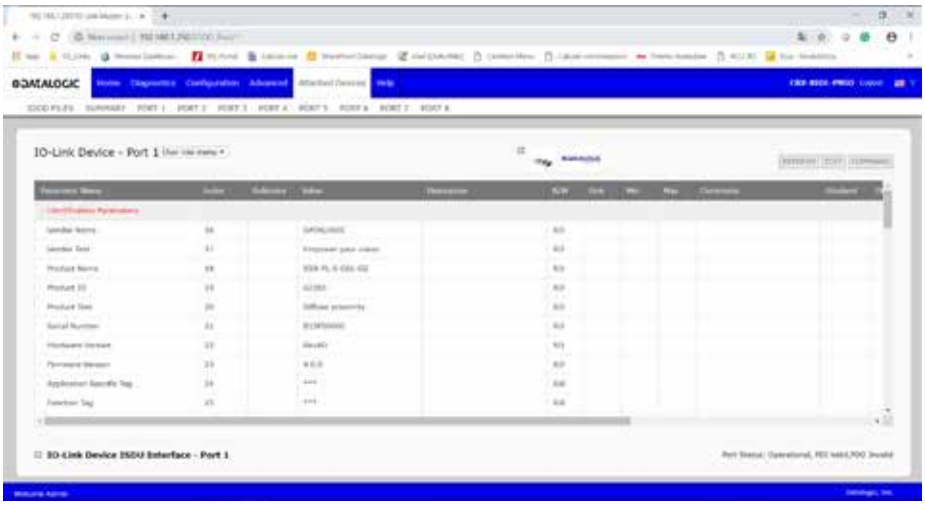
2 • IO-Link Settings



3 • IO-Link Device Description Files

4 • IO-Link Device - Port 1





5 • PROFINET IO Diagnostics

MODEL SELECTION AND ORDER INFORMATION

MODEL	DESCRIPTION	ORDER No.
CBX-8IOL-EIP	CBX-8IOL-EIP 8P IOL M12 ETHERNET IP MASTER	95ACC8180
CBX-8IOL-PNIO	CBX-8IOL-PNIO 8P IOL M12 PROFINET MASTER	95ACC8190

CABLES

TYPE	DESCRIPTION	STYLES	LENGTH	MODEL	ORDER No.
M12 L-coded Axial	5-poles	PVC Grey	3m	CS-M1-02-B-03	95ACC0007
M12 Male/M8 Female double headed axial	4-poles	PVC Black	3m	CS-H1-02-B-03	95ACC0008
M12 Male/M12 Female double headed axial	4-poles	PVC Black	3m	CS-I1-02-B-03	95ACC0009

Rev. 00, 07/2019

USER'S MANUAL

> IO-LINK MASTER

Profinet IO and Modbus/TCP

DATALOGIC

ORIGINAL INSTRUCTIONS (ref. 2006/42/EC)

Datalogic S.r.l.
Via S. Vitalino 13
40012 Calderara di Reno
Italy

IO-LINK MASTER User's Manual
Ed.: 05/2019

821006340 Rev. A

CONTENTS

1 INTRODUCTION

This document provides installation, configuration, and embedded web interface information for the Datalogic IO-Link Master (IOLM), including detailed information on PROFINET IO and Modbus/TCP.

The web interface provides a platform for the user to easily configure, review diagnostic pages, and access advanced features, e.g.:

- 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

2 HARDWARE INSTALLATION

2.1 CBX-IOL-8-PNIO HARDWARE INSTALLATION

This section provides detailed information on the hardware installation of the CBX-IOL-8-PNIO.

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.

Note: Optionally, you can leave the rotary switch set to the default and use the web interface to set the network 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. This makes IP address setting through 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 power.

Switch Setting	Node Address
000 (Default setting)	Use the network configuration stored in the flash. The default network configuration values are: • IP address = 192.168.1.250 • Subnet mask = 255.255.255.0 • IP gateway = 0.0.0.0
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 192.168.1.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.

Follow these steps to change the default rotary switch settings:

1. Gently 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 onthe bottom of the window.
3. Turn each dial to the appropriate position using a small flathead screwdriver.

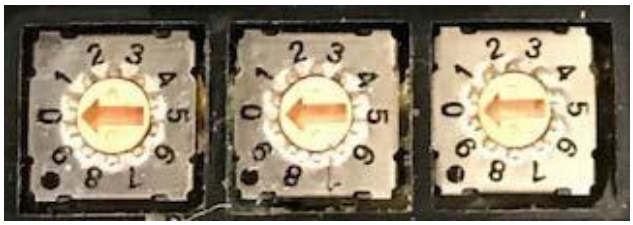


Figure 1 - Rotary switches

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.

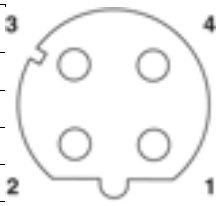
4. Close the window and make sure that it snaps shut tightly.

Failure to close 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.

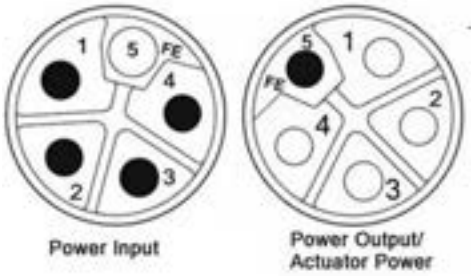
1. Securely connect one end of a shielded twisted-pair (Cat 5 or higher) M12 Ethernet cable to either Ethernet port.
2. Connect the other end of the cable to the network.
3. Optionally, use the other Ethernet port to daisy-chain to another Ethernet device.
4. If you did not connect both Ethernet ports, 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 CBX-IOL-8-PNIO 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 for IP67 compliance.



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) 1A (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
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.* *†† V_A output available is the same as the available V_A 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.
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 **ETH1/ETH2** LED lights on the connected port.
   c. The **MOD** and **NET** LEDs are lit.
   d. The IO-Link LEDs flash (if no IO-Link device is 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. The **MOD** LED is solid green, the IO-Link Master is ready for operation. Go to the next installation step:

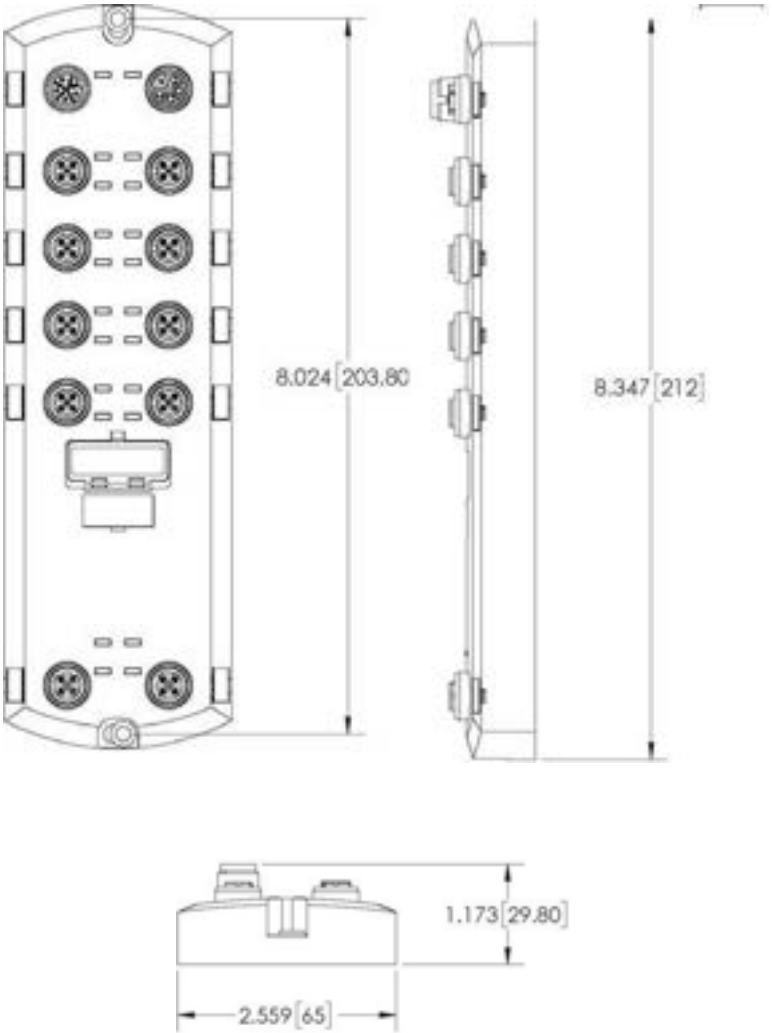
- Program the IP address using the web interface. Refer to chap. 3 for configuring network information.
- If you are using the rotary switches to set the IP address, then you are ready to attach devices. Refer to chap. 4.

If the LEDs do not meet the above conditions, you can refer to par. 12.2.1 (CBX-IOL-8-PNIO LEDs).

2.1.4 Mounting the CBX-IOL-8-PNIO

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 8Nm.



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 chap. 9 (PROFINET IO Reference Information) to complete configuration after attaching the IO-Link devices.

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-Datalogic-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 (DR-8-PNIO) as shown in **Figure 2**.

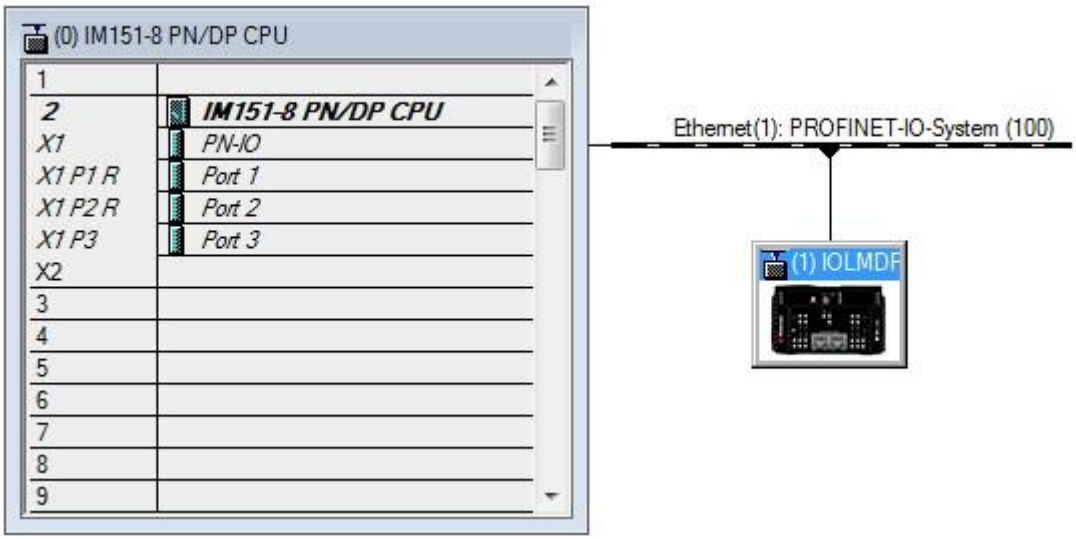
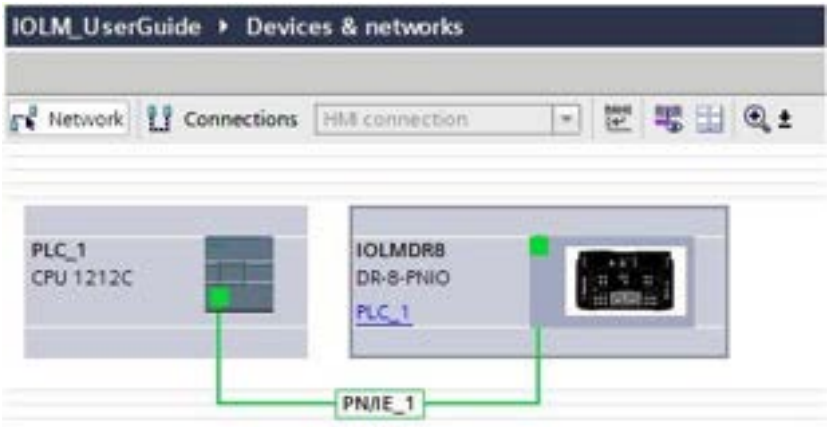


Figure 2 - Inserting an IOLM DR-8-PNIO into a PROFINET IO System

3.3.2 TIA Portal V13

Select the IOLM from the *Hardware Catalog* window (Other field devices | PROFINET IO | Gateway | Datalogic | DR-8-PNIO) and drag it into the **Device configuration | Network** view. Then connect the IOLM to the IO controller.



3.4 IP ADDRESS ASSIGNMENT

Datalogic 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).
- **DHCP** - The IOLM supports the Dynamic Host Configuration Protocol for IP address assignment.
- **LOCAL** - The IOLM supports a device specific method for IP address assignment.

3.4.1 Assigning an IP Address via IO Controller (DCP)

An IO controller can assign an IP address to the Datalogic IOLM gateway via DCP. The IO controller and the Datalogic IOLM gateway have to be on the same subnet. The IOLM default IP address is: 192.168.1.250 and the subnet mask is 255.255.255.0.

Use the appropriate procedure for your environment.

- STEP 7 V5.5
- TIA Portal V13

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.

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

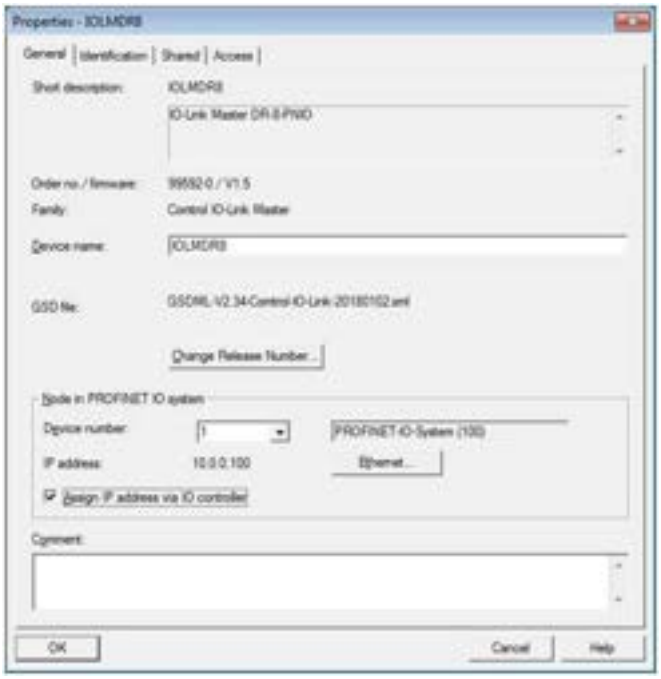
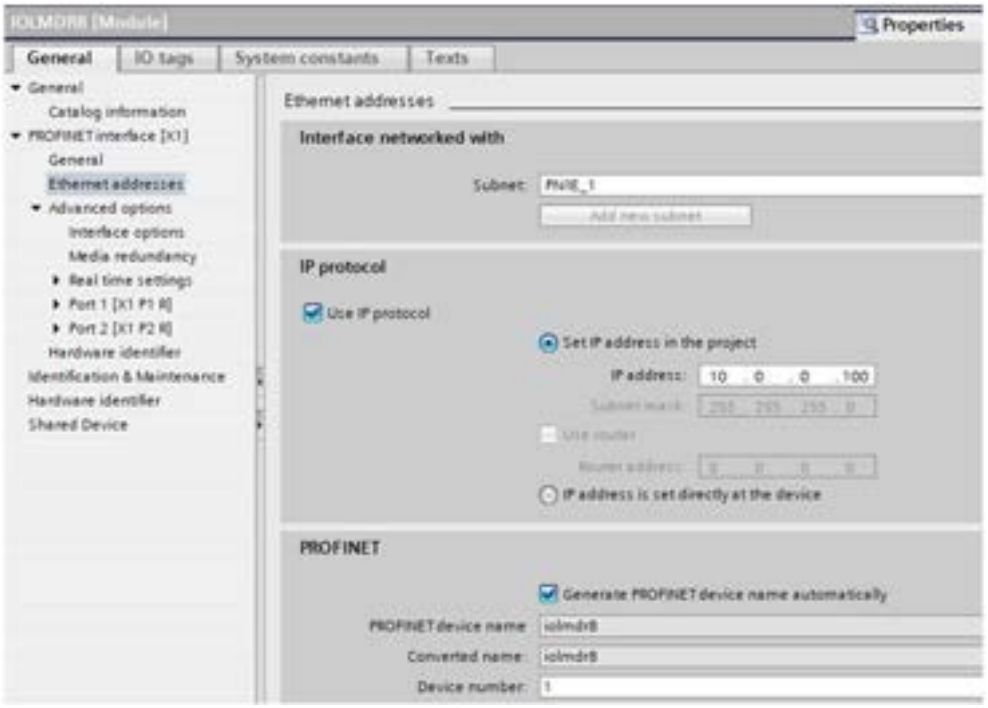


Figure 3 - IOLM Properties

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

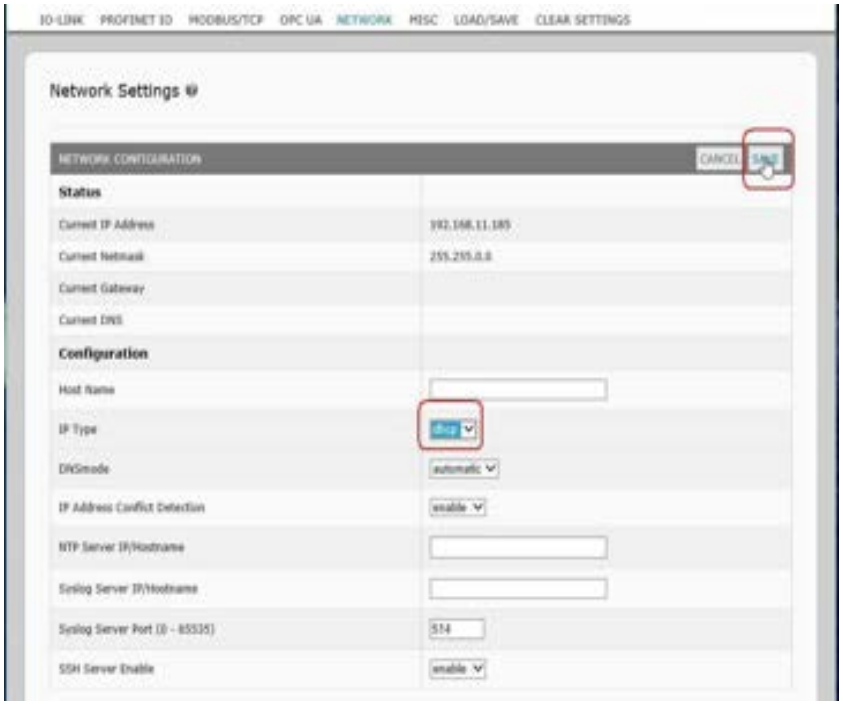
The Datalogic IOLM gateway supports DHCP for IP address assignment. DHCP is disabled by default. Use the following steps to enable DHCP.

Note: The IOLM default IP address is: 192.168.1.250 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 4 - 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 4) 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. Refer to par. 3.5.

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

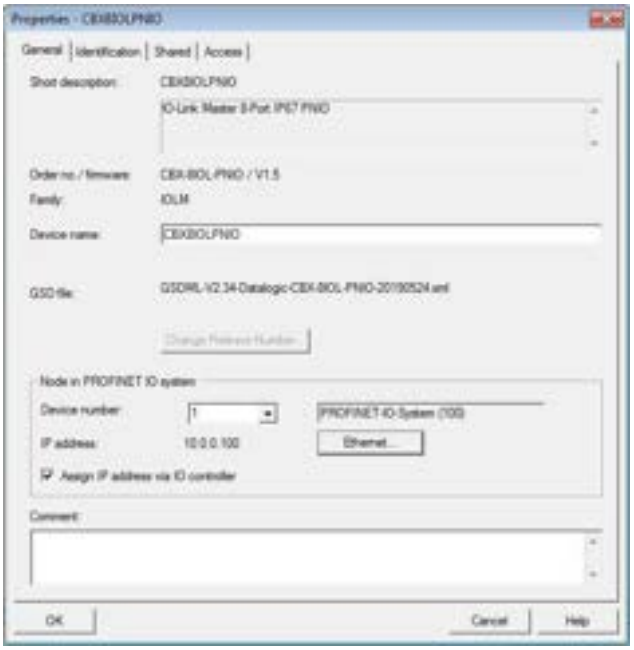
Use the appropriate procedure for your environment:

- STEP 7 V5.5
- TIA Porta V13

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 5) 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 an Datalogic IO-Link Master with a default IP address of 192.168.1.250.

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 5**, 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.

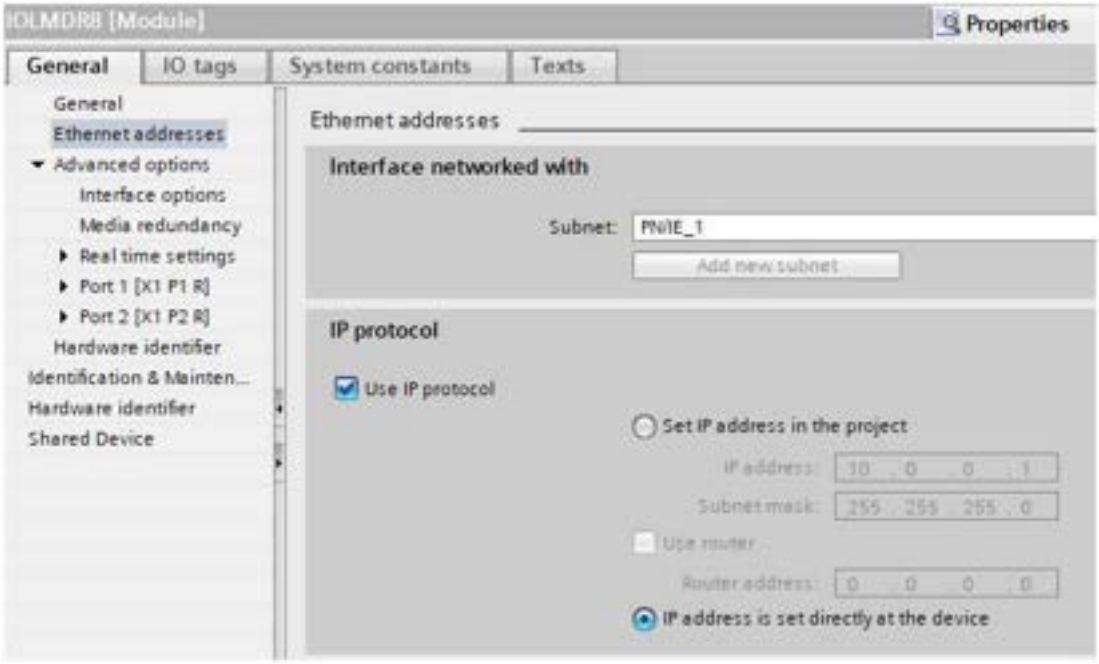
Figure 5 - Configure IP Address and Device Name

The next configuration step is to assign the device name. Refer to par. 3.5.

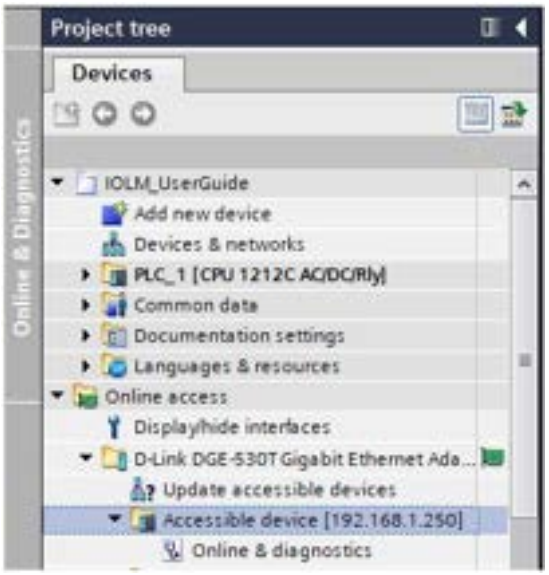
3.4.3.2 TIA Portal V13

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 192.168.1.250 or the previous IP address that the IOLM was assigned by IO controller.

7. Double-click the Accessible device [192.168.1.250], then double-click the **Online & diagnostics** to open up the Online access view.
8. Click the **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.

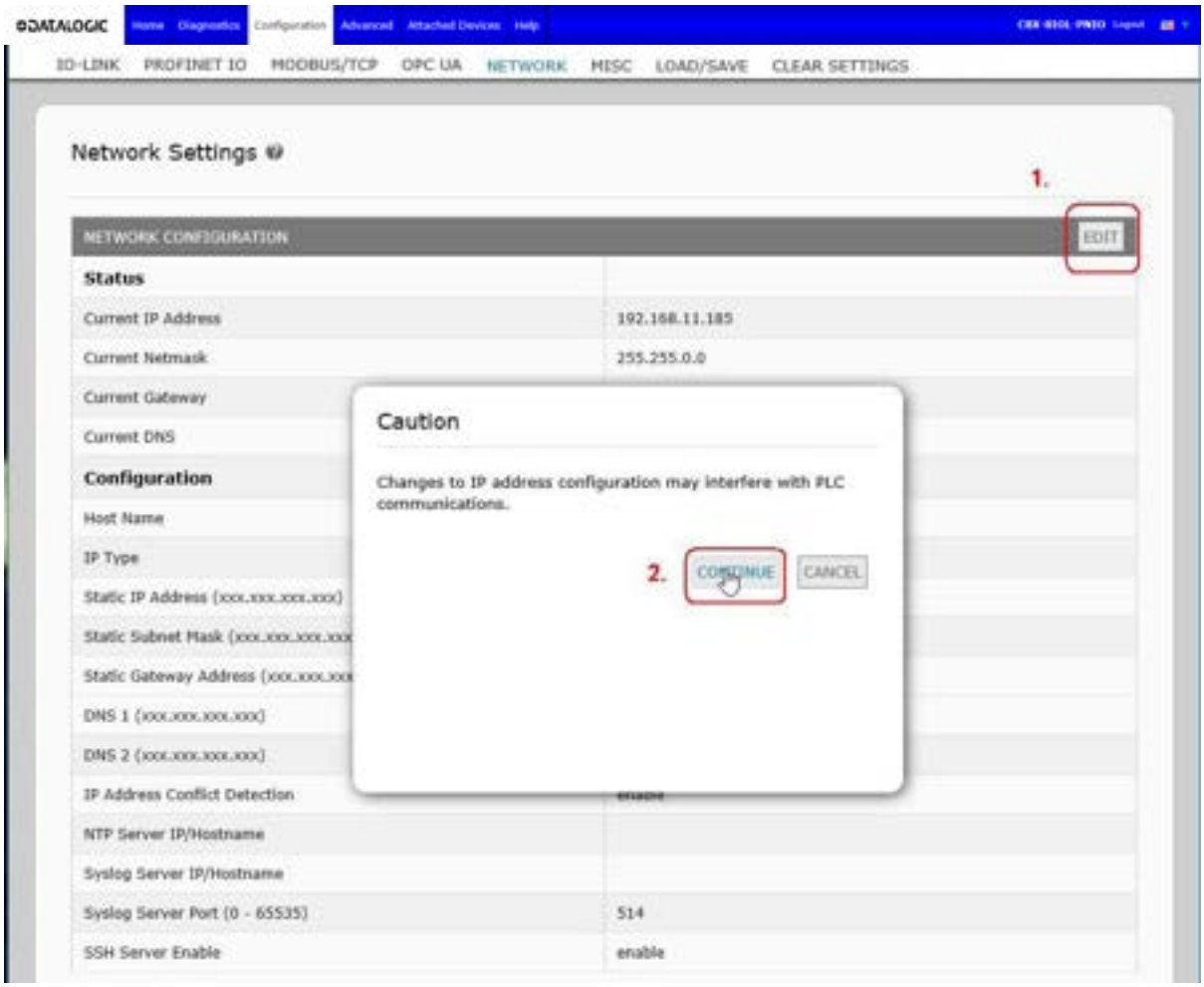
The next configuration step is to assign the device name. Refer to par. 3.5.

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: 192.168.1.250 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. Refer to par. 3.5.

3.5 DEVICE NAME ASSIGNMENT

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

- STEP 7
- Web interface

3.5.1 Assign the Device Name in STEP 7

Use the appropriate procedure for your environment:

- STEP 7 V5.5
- TIA Portal V13

3.5.1.1 STEP 7 V5.5

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

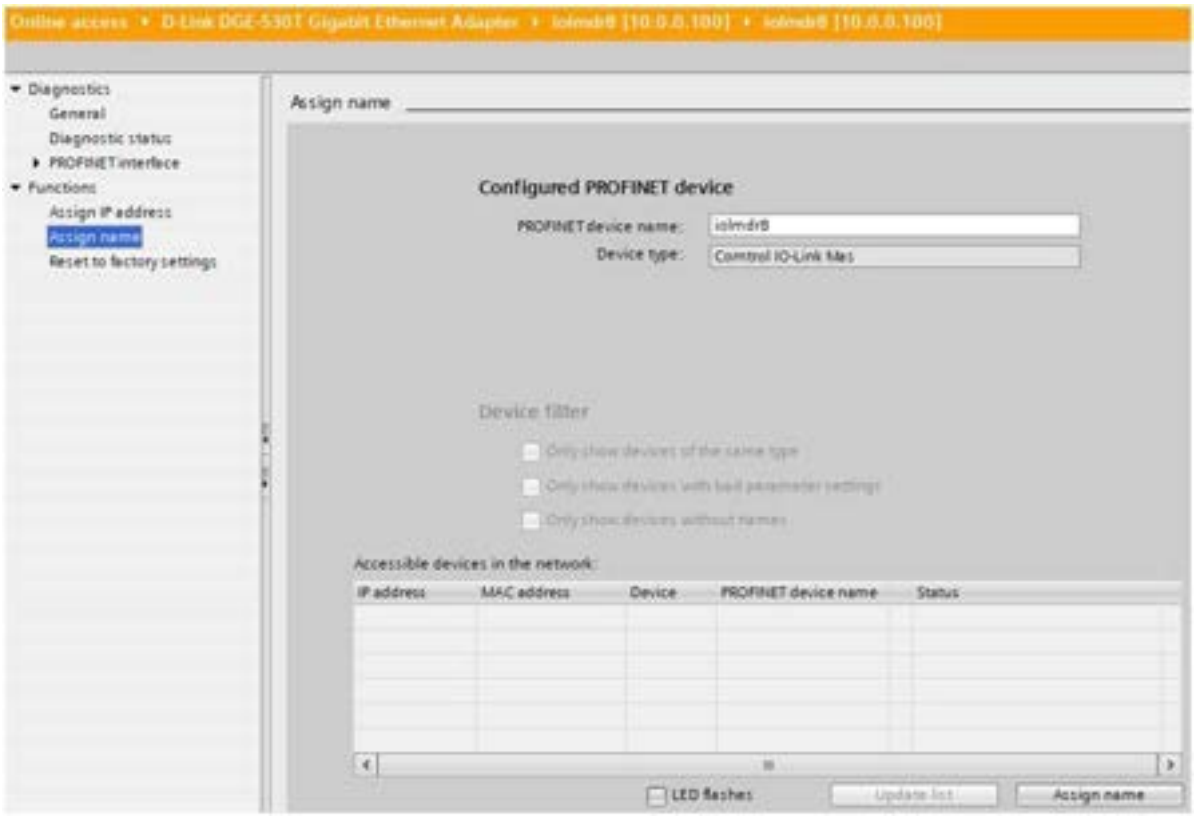
1. Select the IOLM, open the *Edit Ethernet Node* window using the **PLC | Ethernet | Edit Ethernet Node** menu.
2. Click the **Browse** button to open the *Browse Network* window.
   The unit should be displayed as an IO-Link Master with an empty device name.
3. Select the unit and click the **OK**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

4. Set the device name. PROFINET IO Device Names are not case-sensitive.

If there is a cyclic communication between the device and an IO controller, the cyclic communication must be stopped before changing the device name.

3.5.1.2 TIA Portal V13

1. Use the same procedure in par. 3.4.3.2 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.



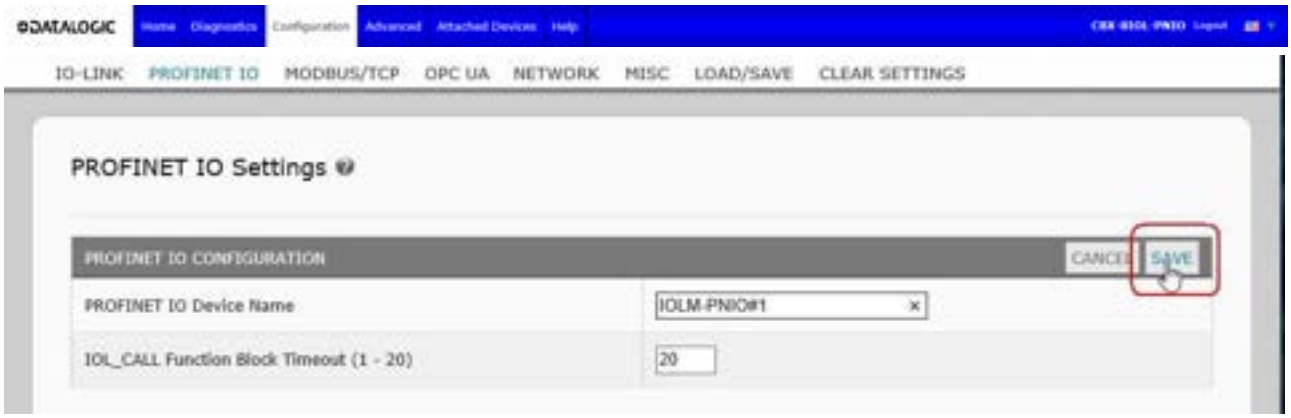
3.5.2 Using the Web Interface to Assign the Device Name

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

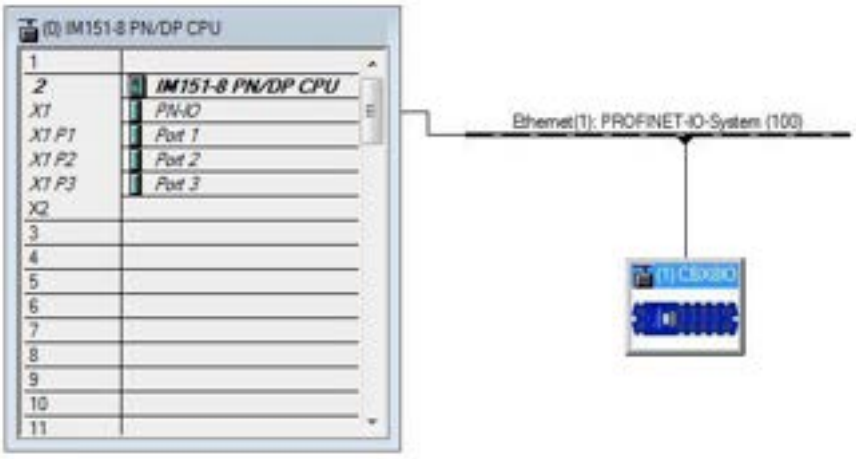
Use the appropriate procedure for your environment:

- STEP 7 V.5.5
- TIA Portal V13

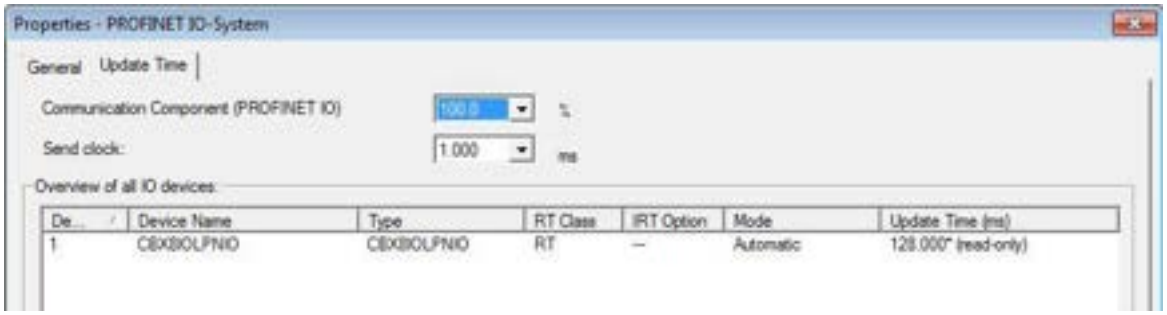
3.6.1 STEP 7 V5.5

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.

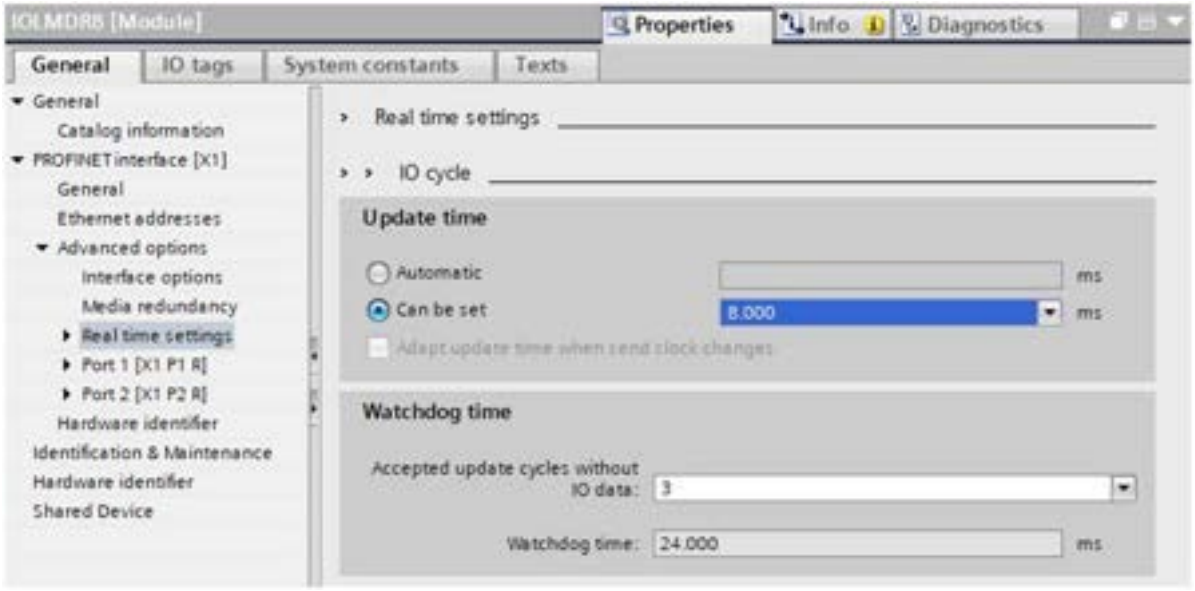


3. Set the desired update time. The fastest IO device update time is 8ms.

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 8ms.



3.7 CONFIGURING IO-LINK PORTS

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

- IO-Link port modules (refer to par. 3.7.1)
- Port status modules (refer to par. 3.7.3)

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.

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

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
- TIA Portal V13

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. 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 request_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 par. 7.2(Data Storage) 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**.

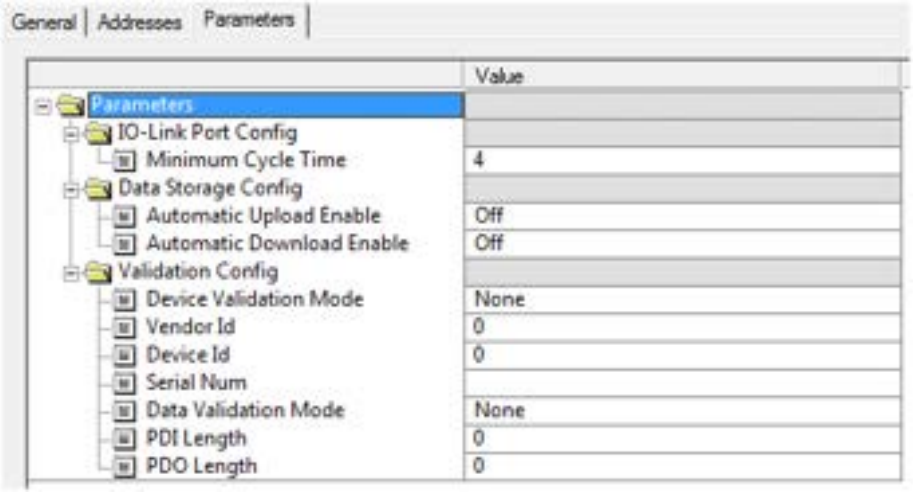
Serial Num	This is required if you select Identical for the **Device Validation Mode**.
Data Validation Mode (Default: None)	There are three **Data Validation Modes**: • **None** - no data validation is performed on the port. • **Loose** - the slave device's PDI/PDO lengths must be less than or equal 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.

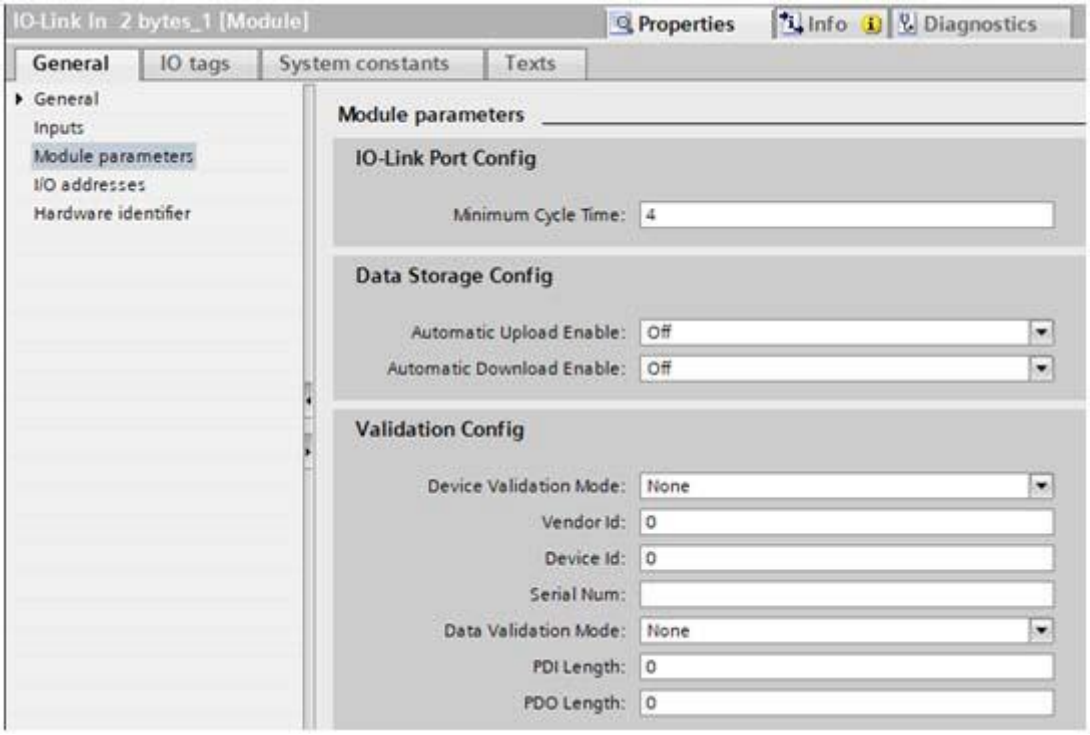
   Available parameters are shown in this figure. The table above describes how to use the parameters.



3.7.1.1.2 TIA Portal V13

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

1. Open the **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. The table above 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:

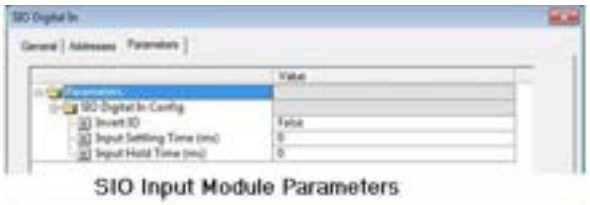
- STEP 7 V5.5
- TIA Portal V13

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)

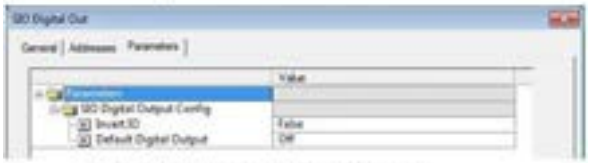
3.7.1.2.1 STEP 7 V5.5

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.



SIO Input Module Parameters

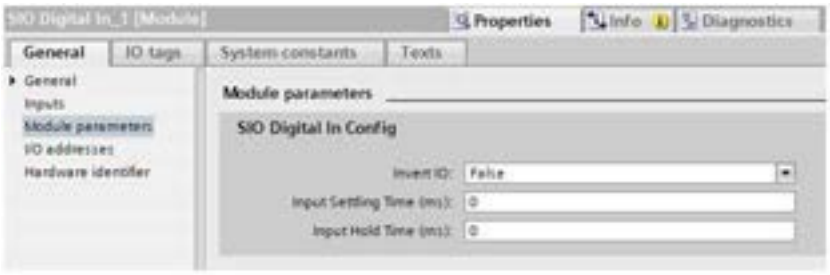


SIO Output Module Parameters

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**.



SIO Input Module Parameters

SIO Output Module Parameters

3.7.2 Port Status Modules

There are two **Port Status** modules:

1. IO-Link Status Module
2. 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.

3. 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.
4. 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:

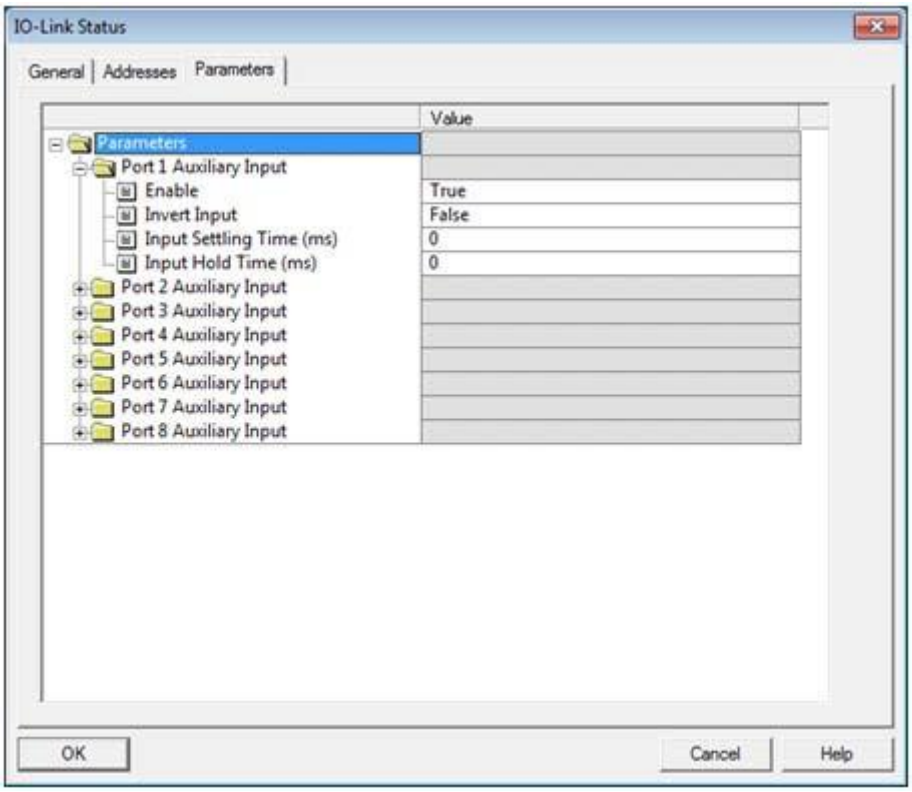
- STEP 7 V5.5
- TIA Portal V13

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:

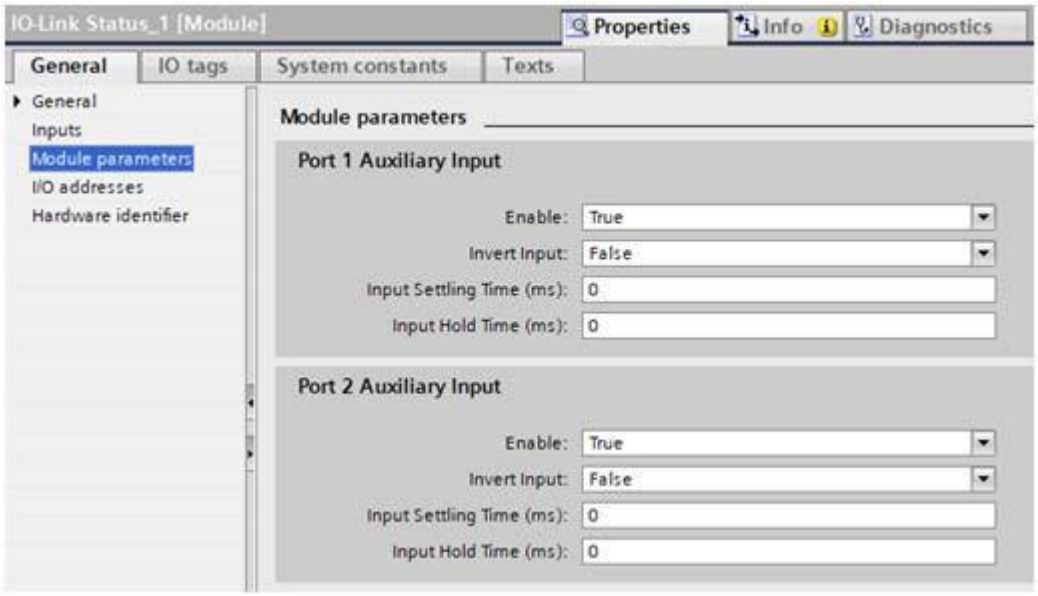
1. Double-click the IO-Link Status module.
2. Select the **Parameters** table



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**.



3.7.2.3 Digital I/O Module

Digital I/O module has 1-byte input and 1-byte output. There are four digital I/O ports: DIO 1-4.

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
- TIA Portal V13

3.7.2.3.1 STEP 7 V5.5

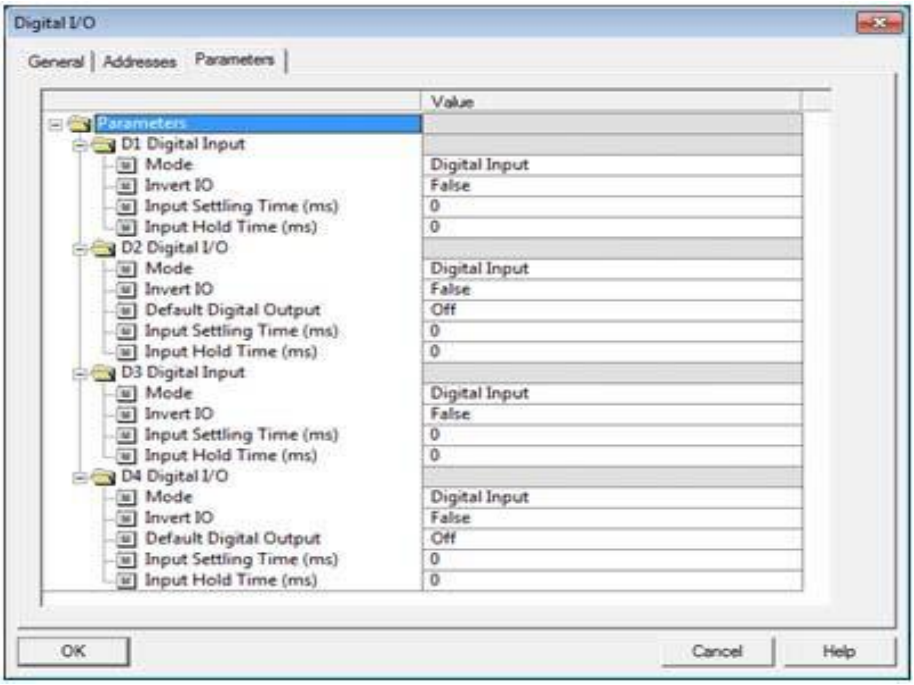
Use the following procedure to configure digital output.

1. Double-click 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.

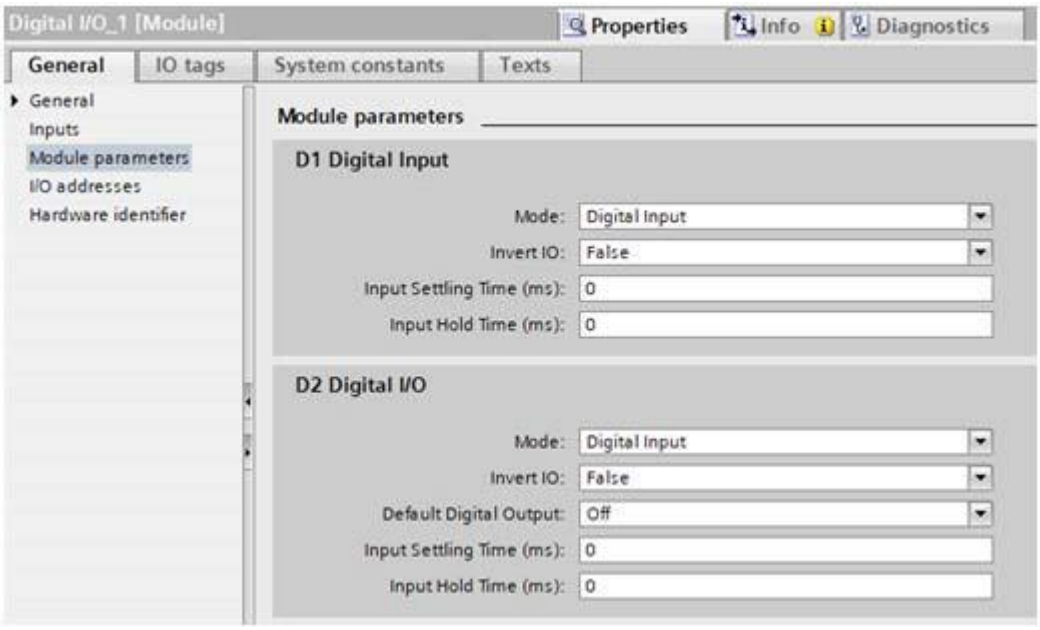
Note: Only Bit 1 and Bit 3 of the Digital I/O module output are in use. Changing the value of other bits has no effects.



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.



3.7.3 Port Status Modules

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.

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.

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.
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.**
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.**
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 CONNECTING DEVICES

4.1 OVERVIEW

The **C/Q** pin for the IO-Link ports in SIO mode for all models:

- **DI** – sinking input
  The **DI** pin on the IO-Link ports for all models is a sinking input.
- **DO** – PNP/NPN (push/pull) output

The following table provides definitions of the terminology used above.

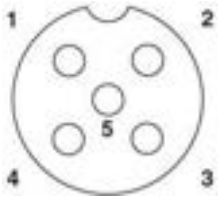
Term	Definition
PNP output	This is an output that can source current: the (+) side of the device is connected to the output and the (-) side of the device is connected to (-) of the supply. The device is powered when the output LED is on.
NPN output	This is an output that sinks current: the (-) of the device is connected to the output and the (+) side of the device is connected to (+) side of the supply. The device is powered when the output LED is off.
Sinking input	This sinks current into the IO-Link Master so a positive voltage will cause the input to turn on. ***Note:*** *Using NPN with inputs is not correct as NPN describes an output situation. However, some vendors describe their inputs as accepting a certain type of sensor output, so in this case a sinking input will accept a PNP output sensor.*

4.2 CBX-IOL-8-PNIO IO-LINK PORTS

The CBX-IOL-8-PNIO 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 4.8 Kbps
- COM2 at 38.4 Kbps
- COM3 at 230.4 Kbps

There are active over-current limiter electronics for each port in the CBX-IOL-8-PNIO 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 CBX-IOL-8-PNIO are as follows.

CBX-IOL-8-PNIO	**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. 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.	500mA/ port pair (1A output power budget per port pair)	1.05A/port pair	Yes	200mA*/ port	400mA*/ port	Yes
* 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.

5 LOADING AND MANAGING IODD FILES

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

5.1 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.

5.1.1 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 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.

5.1.2 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.

5.1.3 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.

5.1.4 Viewing and Saving IODD Files

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

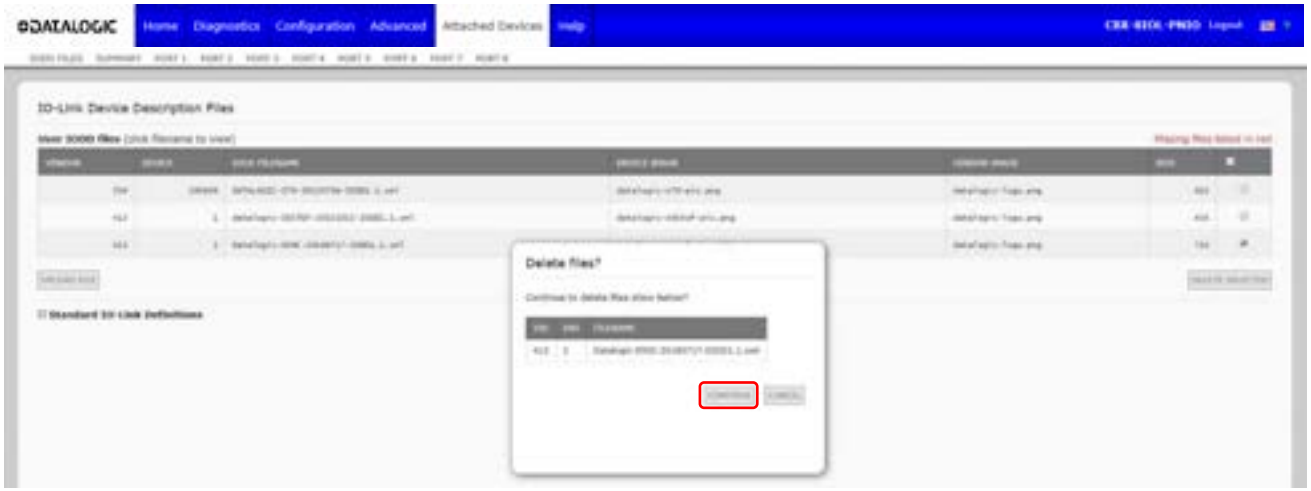
1. If necessary, click **Attached Devices** and **IODD Files**.
2. Click the **IODD FILENAME** in the table that you want to review. A pop-up window displays the contents of the IODD file.
3. Optionally, click the file name hyperlink at the top of the window to view the formatted file or if you want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

5.1.5 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.



5.2 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 chap. 6 more information.

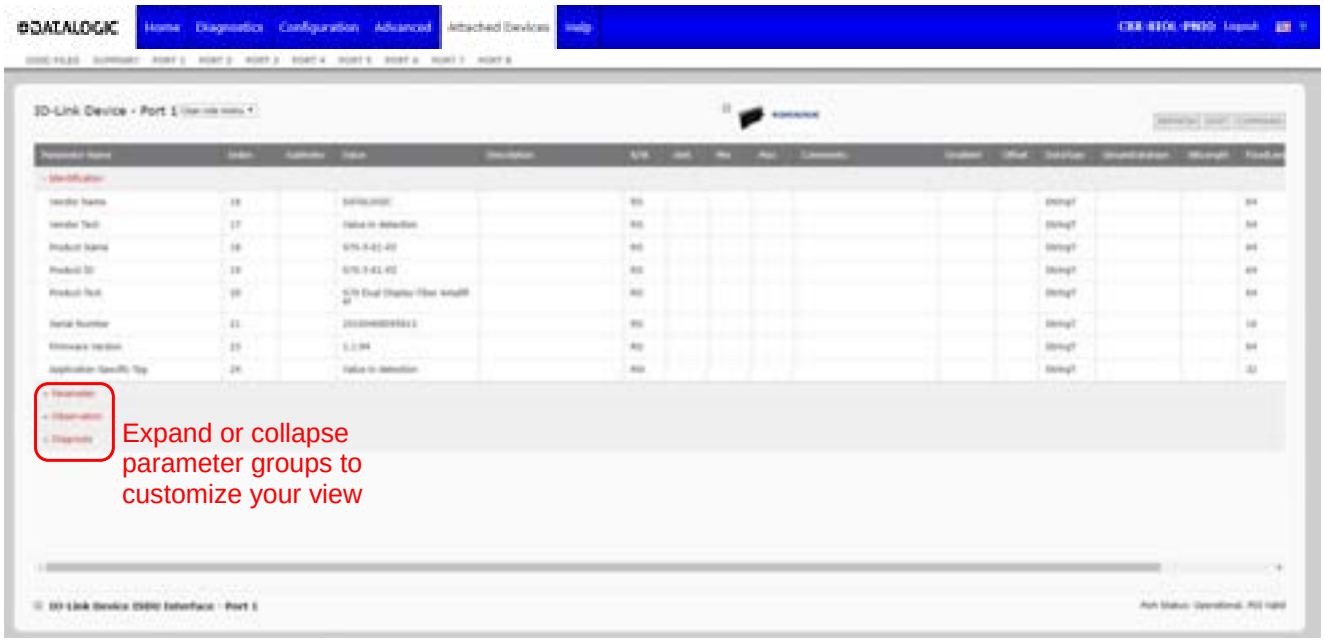
6 CONFIGURING IO-LINK DEVICES

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.

6.1 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:

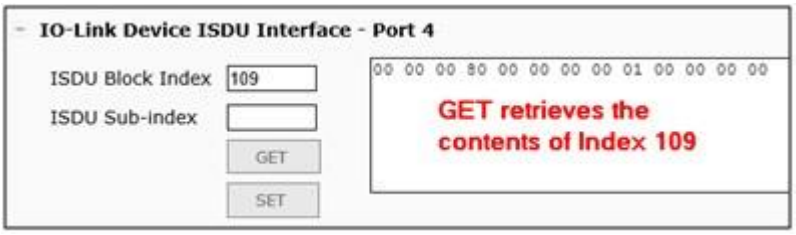
- **IO-Link Device Port** table (GUI), which depends on the appropriate IODD file loaded from the IO-Link device manufacturer onto the IOLM.
- **IO-Link Device ISDU Interface - Port**, which can be used with or without IODD files loaded.

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.

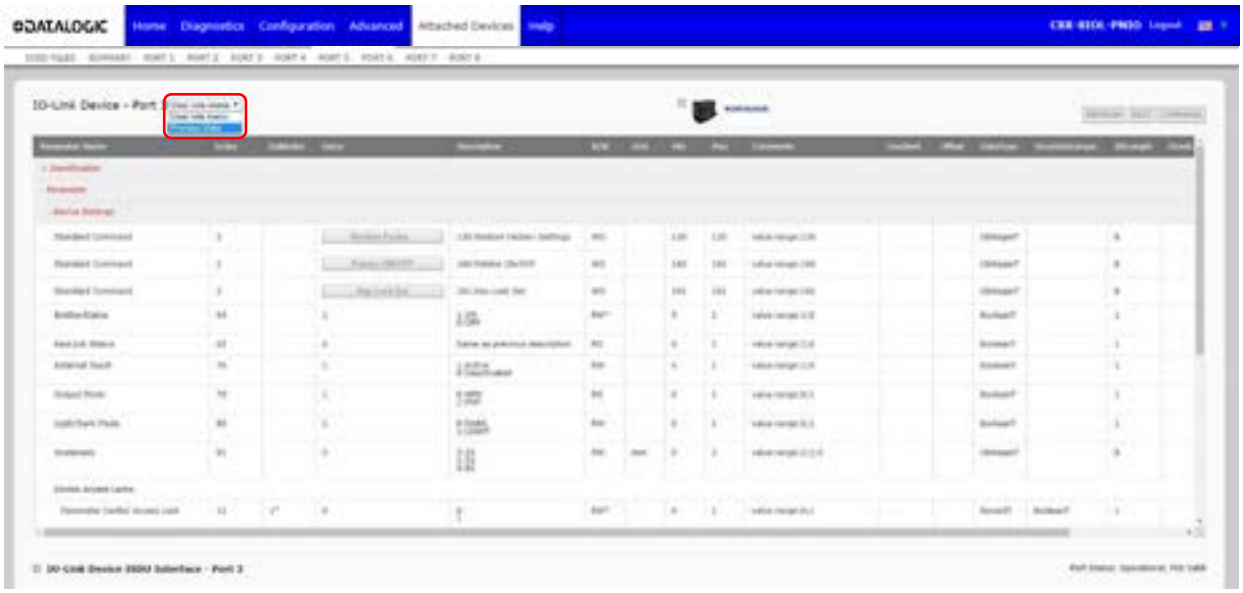
Index	Subindex	Value	Description	R/W	Unit	Min	Max	Comments	Gradient	Offset	DataType	SimpleDataType	BitLength
109	1*	2248		RO				dynamic parameter			RecordT	UIntegerT	16
109	2*	2515		RO				dynamic parameter			RecordT	UIntegerT	16
109	3*	3		RO				dynamic parameter			RecordT	UIntegerT	8
109	4*	1		RO				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.

6.2 EDITING PARAMETERS – IO-LINK DEVICE – PORT TABLE

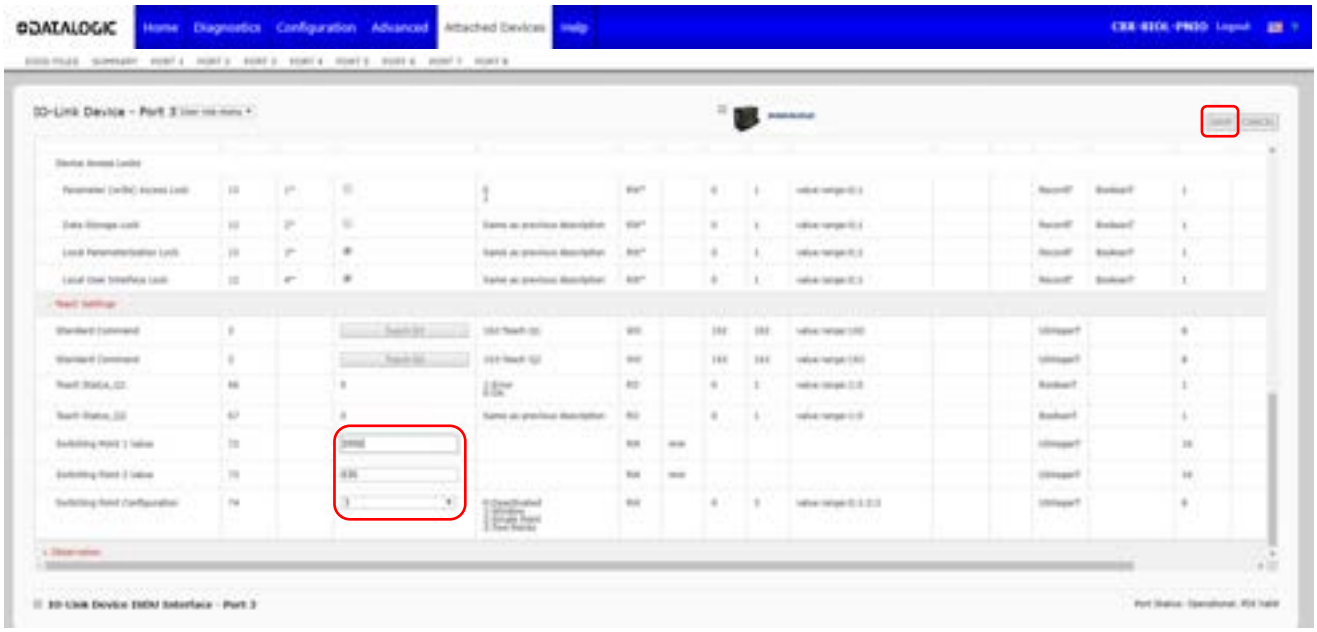
Use the following procedure to edit IO-Link device parameters using the **IO-Link Device Port** table.

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 (see Loading and Managing IODD Files).
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.



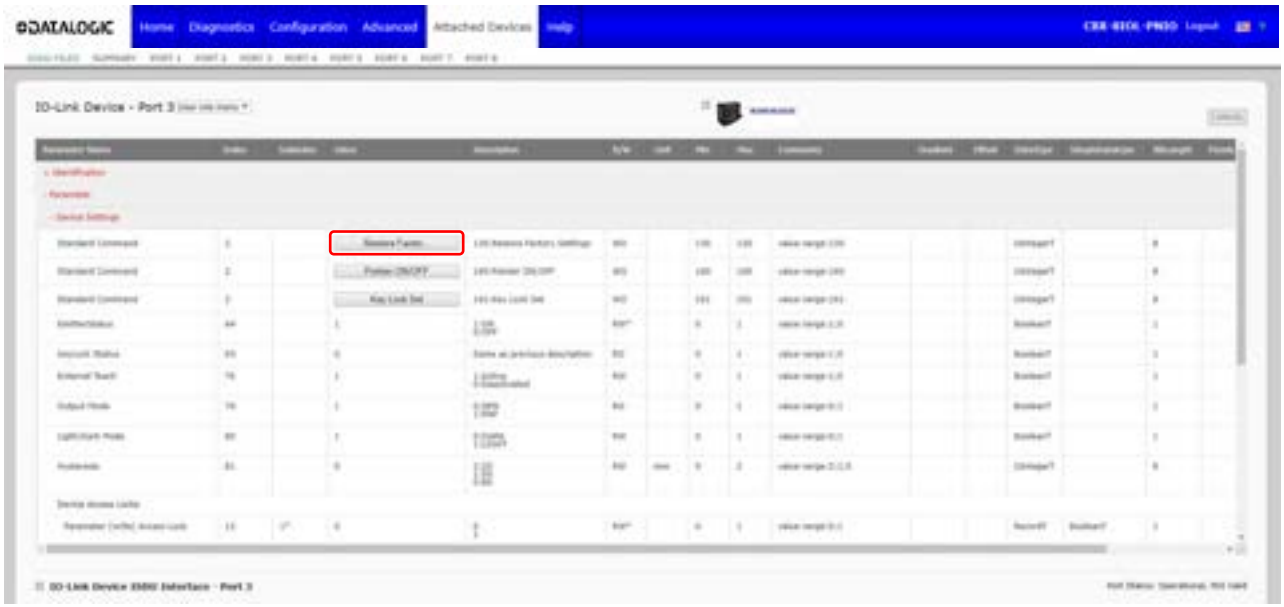
5. Click the **SAVE** button after editing the parameters.

6.3 RESETTING IO-LINK DEVICE PARAMETERS TO FACTORY DEFAULT

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.

6.4 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.

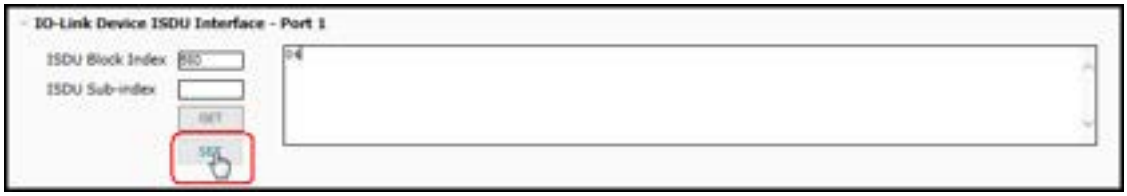
If an IODD file has not been loaded for an IO-Link device, refer to the IO-Link Device Instruction Manual to determine the ISDU indexes.

6.4.1 Overview

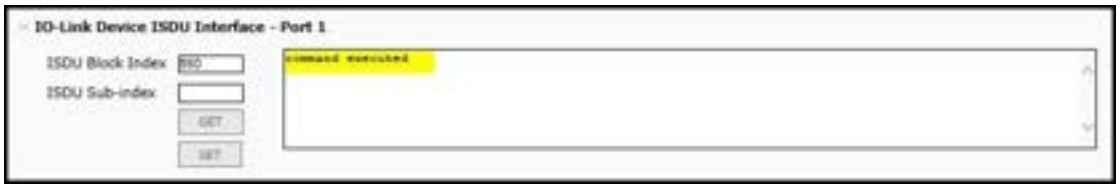
The following provides some basic information about the command usage and responses when using the ISDU Interface.

- 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.

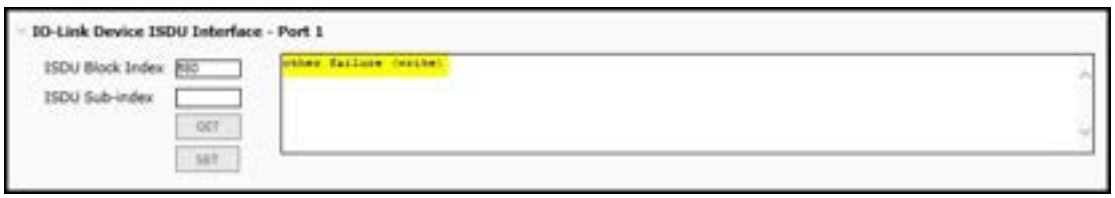
- The **SET** button sends the value to the IO-Link device.



- 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.



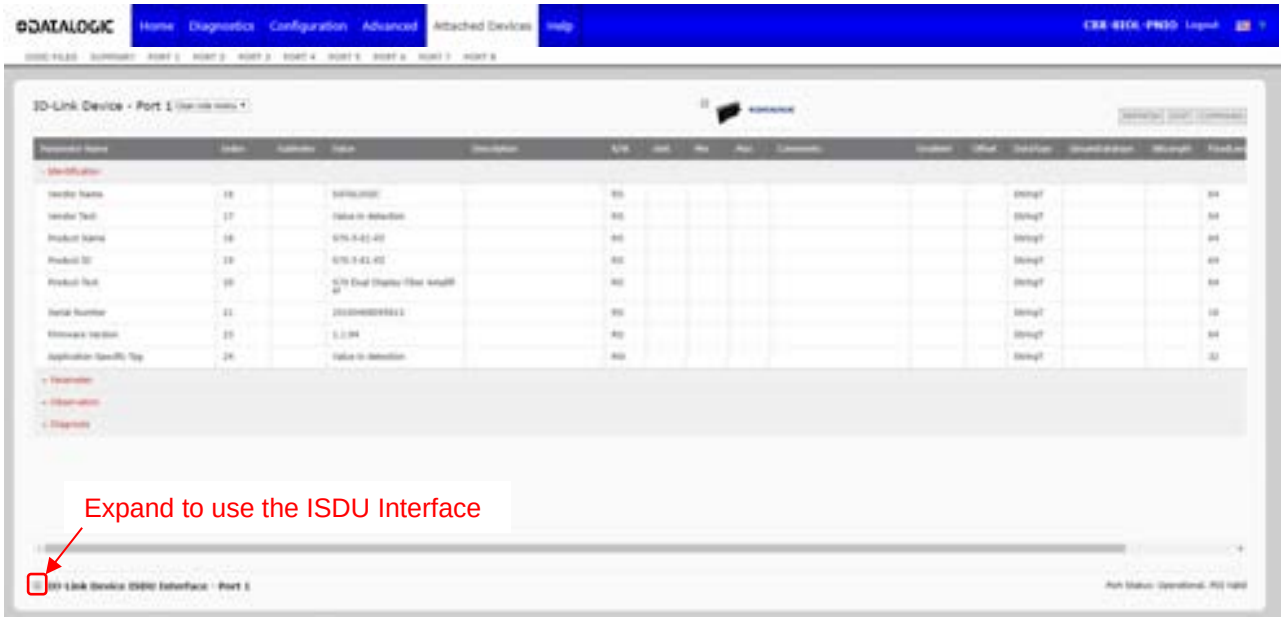
- This message indicates that the IO-Link device cannot read the specified ISDU Block Index and Sub-index.

6.4.2 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.

7 UTILIZING IOLM FEATURES

7.1 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 - EtherNet/IP Settings	Yes	Yes	View-only
Configuration - Modbus/TCP	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.

7.2 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.

7.2.1 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 do 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.

7.2.2 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 whose 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.

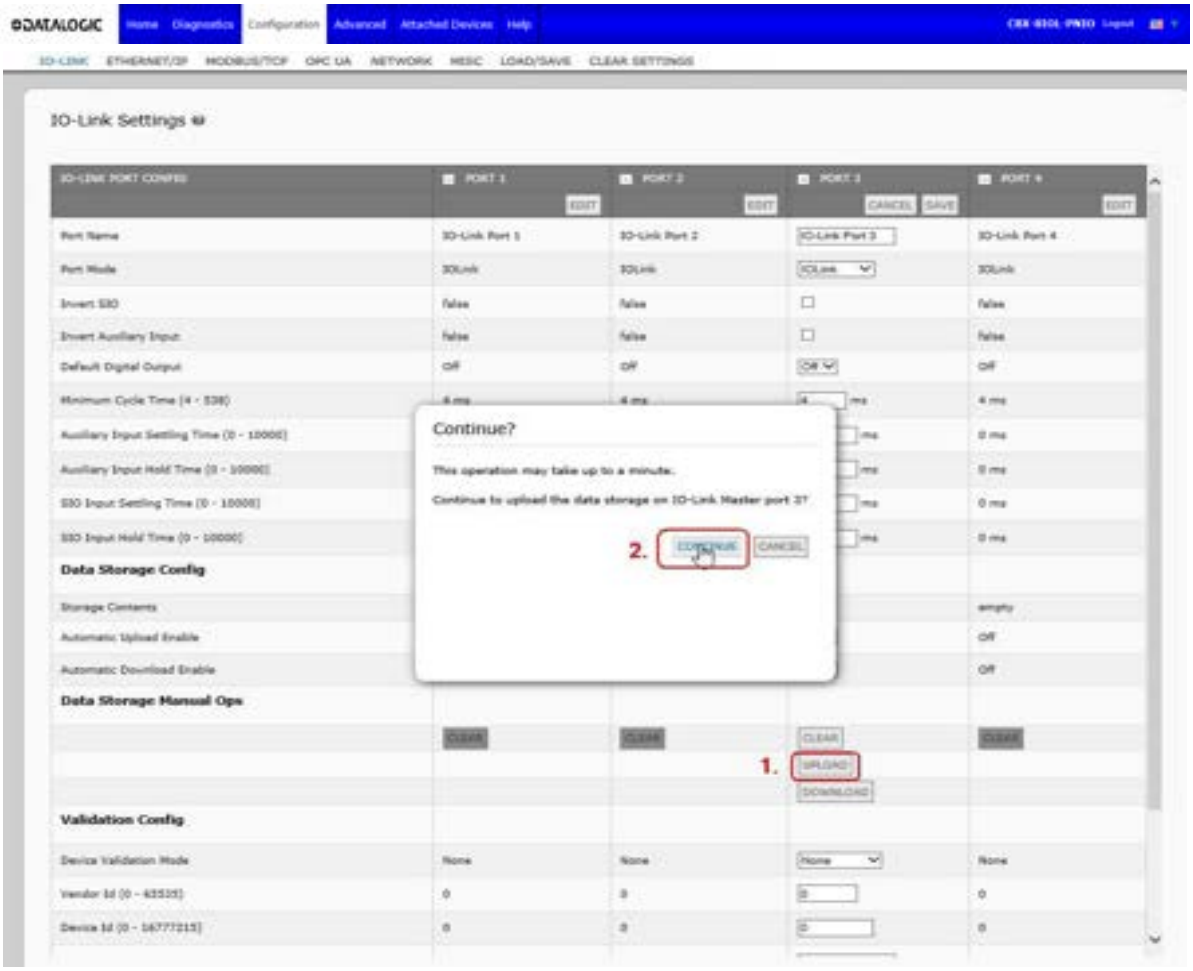
- ***Data Storage Manual Ops: DOWNLOAD -*** Selecting the **DOWNLOAD** button downloads the data storage from the that port to the IO-Link device.

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.

7.2.3 Automatic Device Configuration

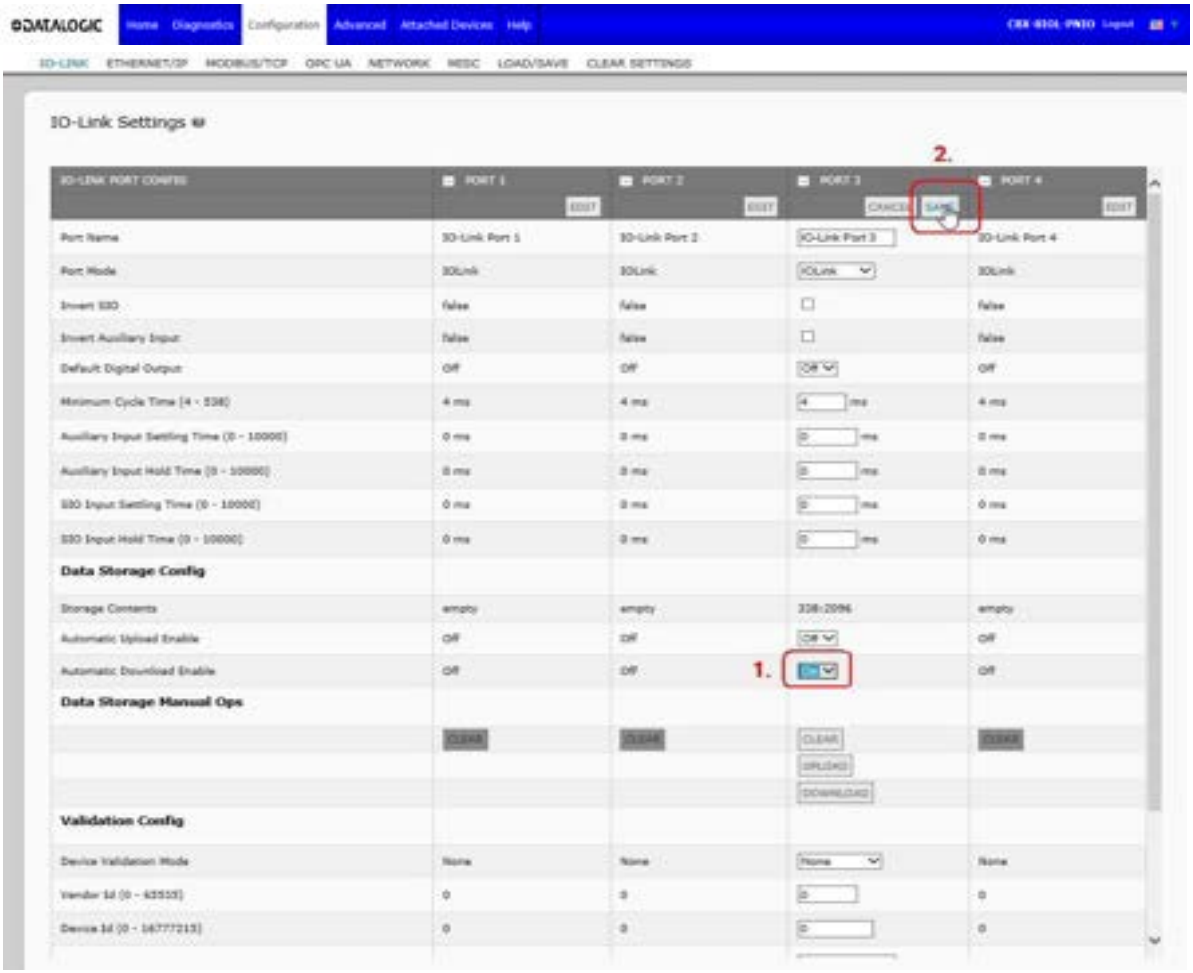
Use the following steps to use an IOLM port to configure multiple IO-Link devices with the same configuration parameters.

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 devices as you want to configure.

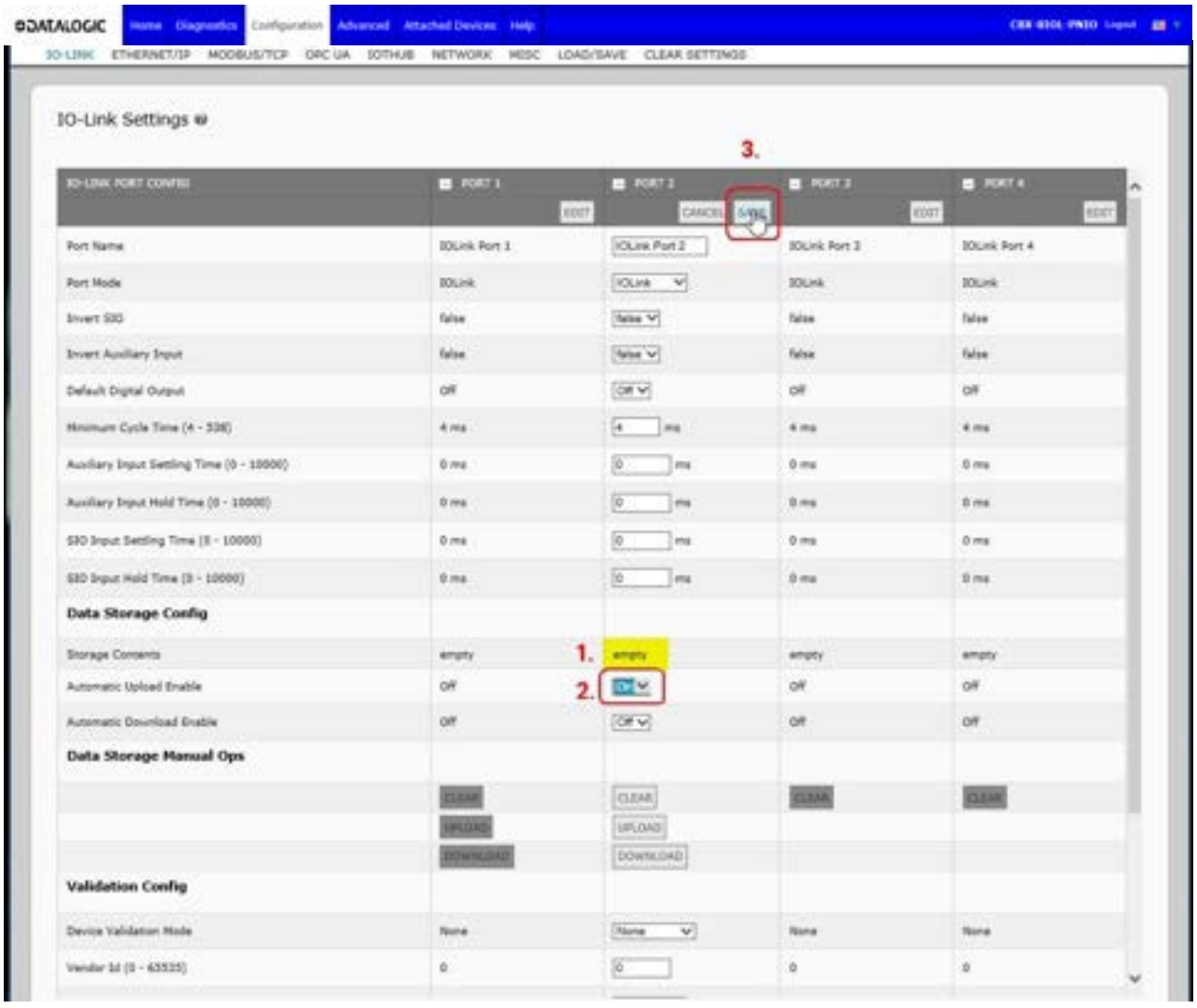
7.2.4 Automatic Device Configuration Backup

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 may not 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.

7.3 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.

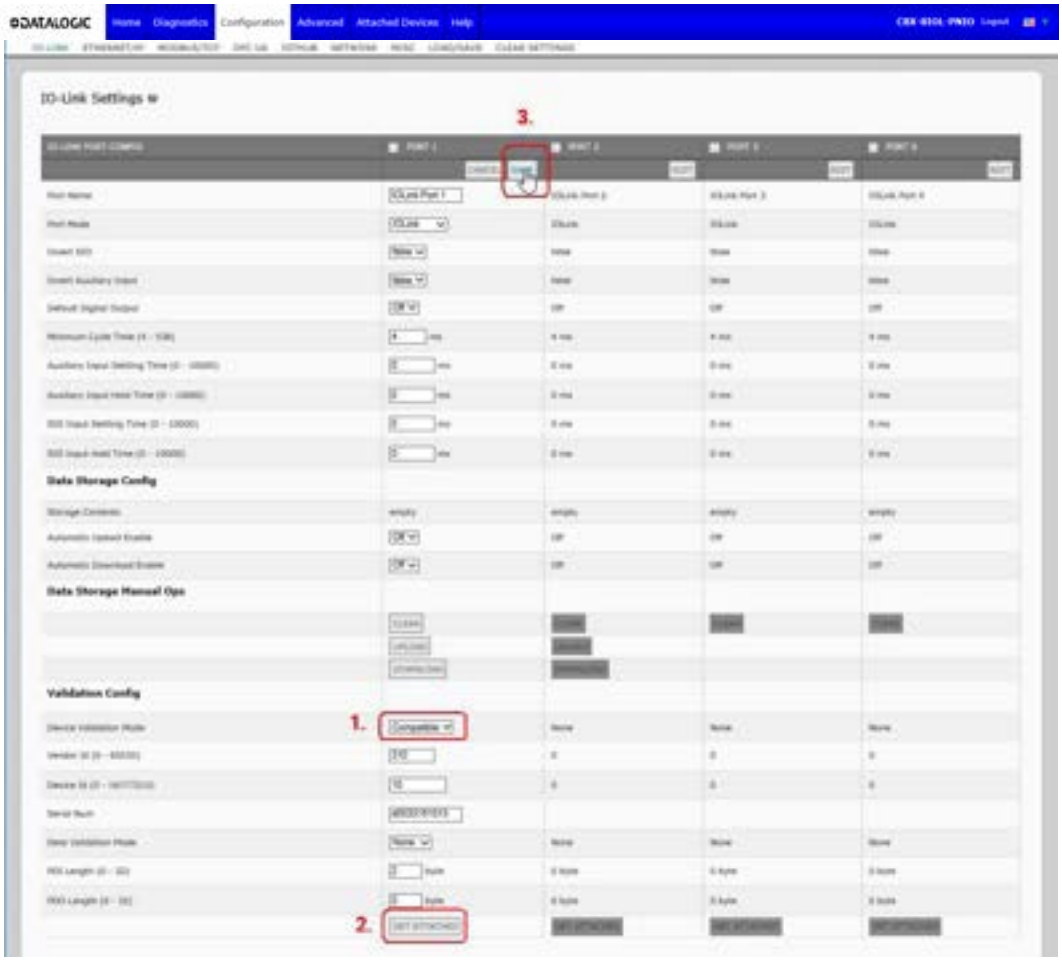
Use this procedure to configure device validation.

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.



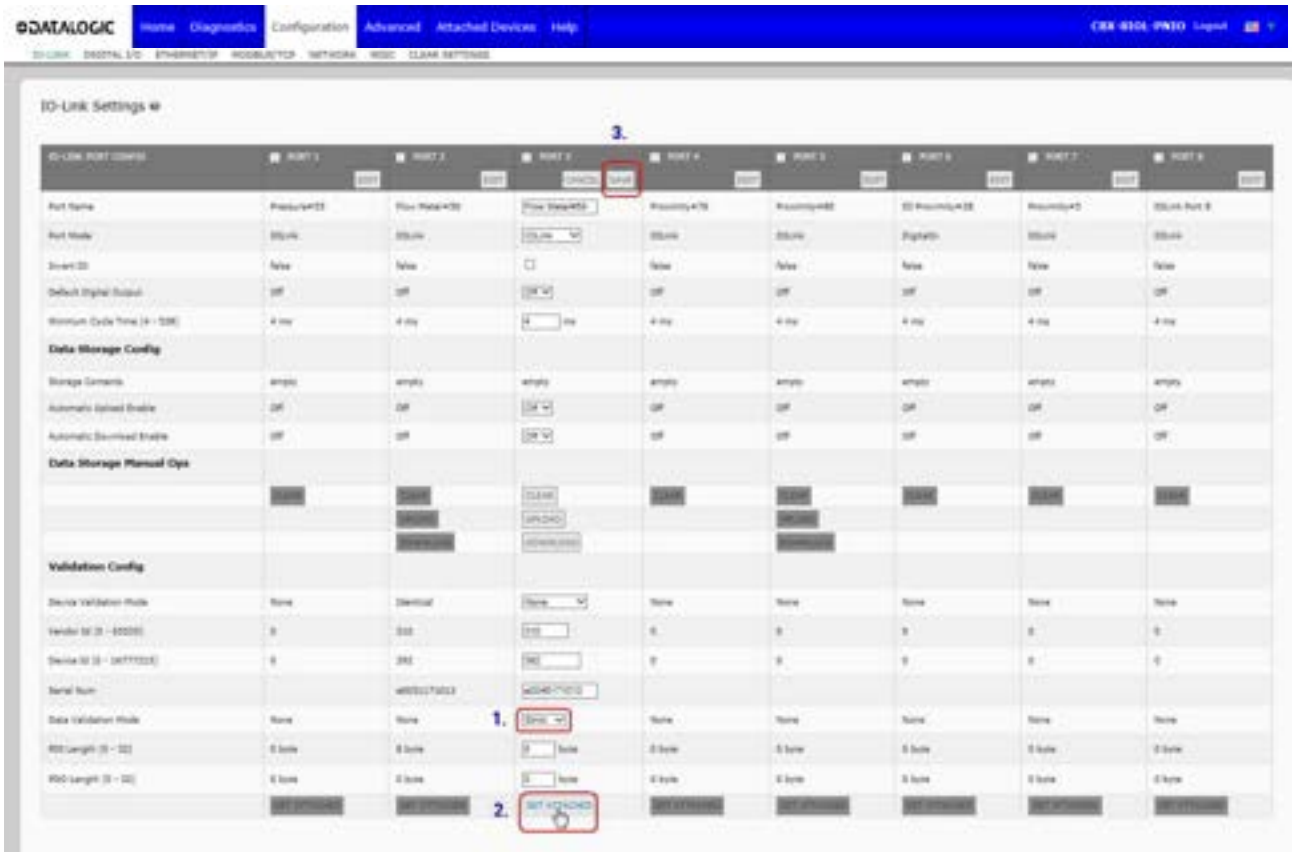
5. Click the **SAVE** button. If the wrong or incompatible device is connected to the port, the IO-Link port LED flashes red and no IO-Link activity occurs on the port until the issue is resolved.
   In addition, the **IO-Link Diagnostics** page displays the following information.

7.4 DATA VALIDATION

You can use this procedure to configure data validation.

Note: You must configure device 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.

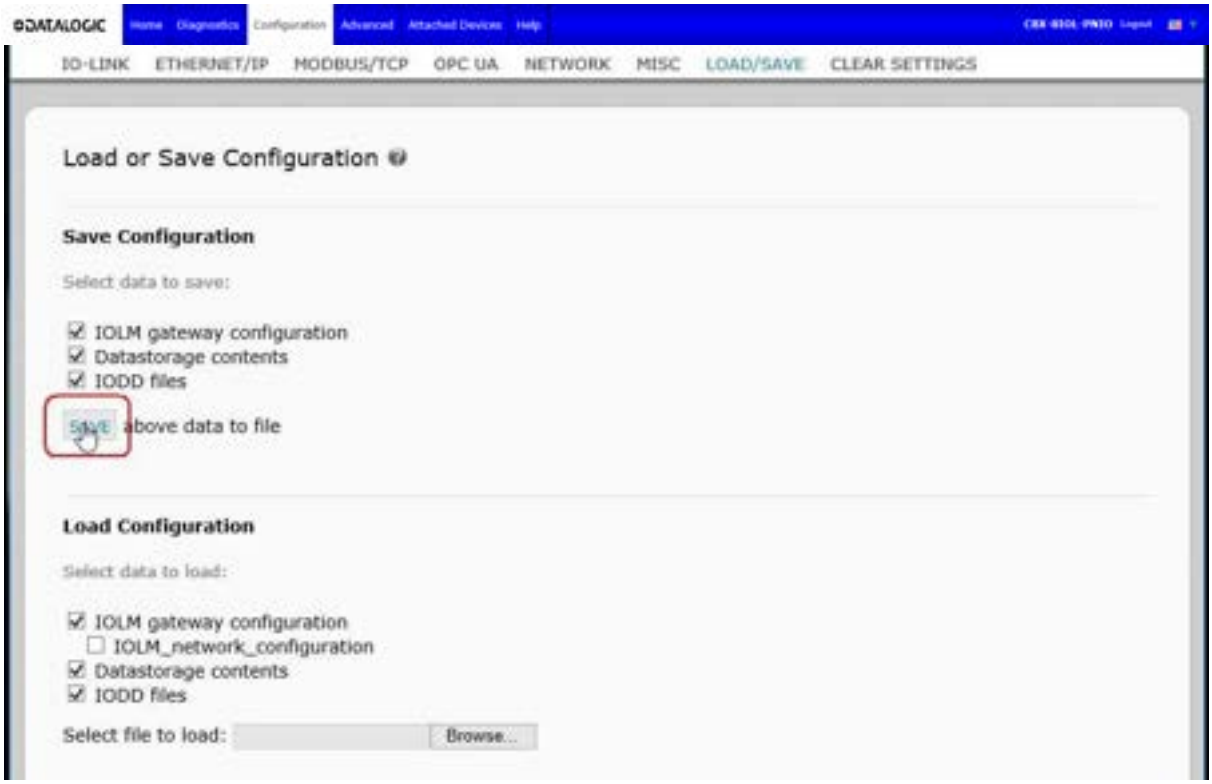
7.5 IOLM CONFIGURATION FILES

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

7.5.1 Saving Configuration Files

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

1. Click **Configuration | Load/Save**.
2. Click the **SAVE** button.

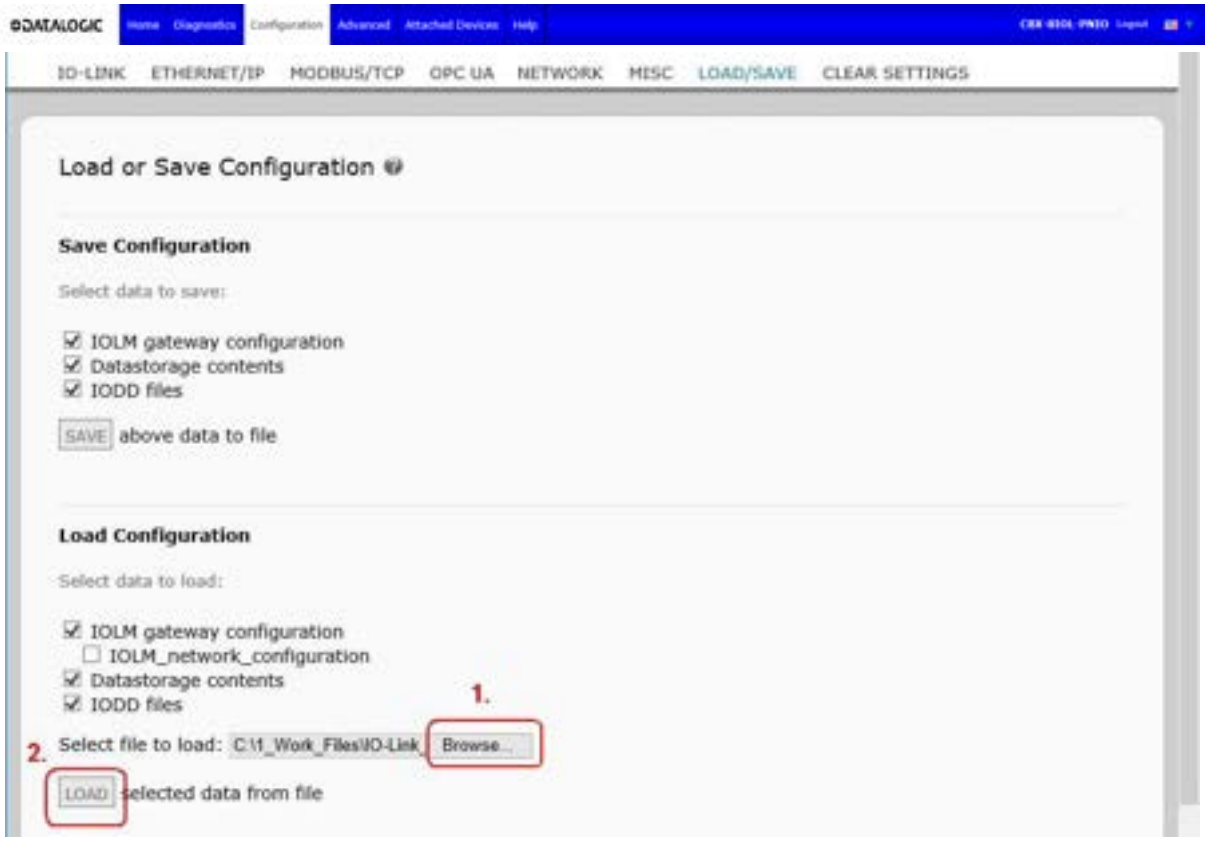


3. Click the **Save as** option and browse to the location that you want to store the configuration file.

7.5.2 Loading Configuration Files

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

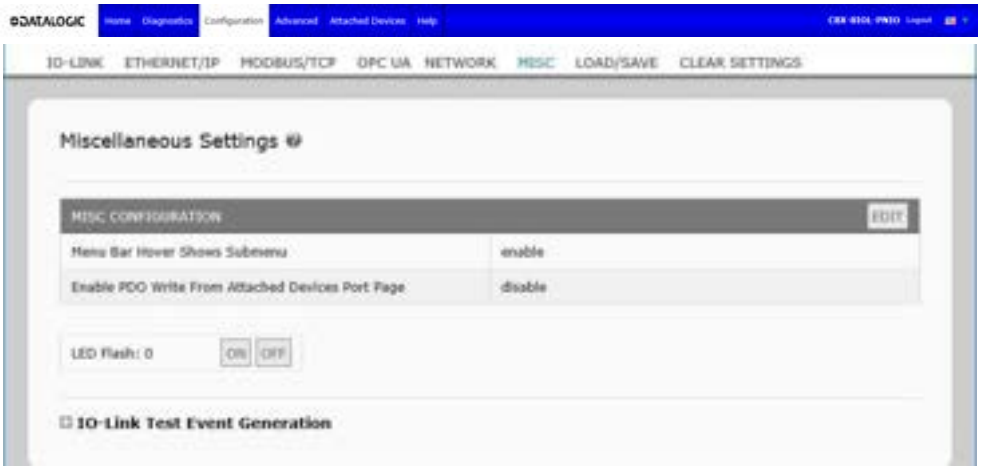
1. Click **Configuration | Load/Save**.
2. Click the **Browse** button and locate the configuration file (**.dcz** extension).
3. Click the **LOAD** button.



4. Click the **OK** button to close the *Configuration Uploaded* message that notifies you of what configuration parameters loaded.

7.6 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 par. 7.6.2 or 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.

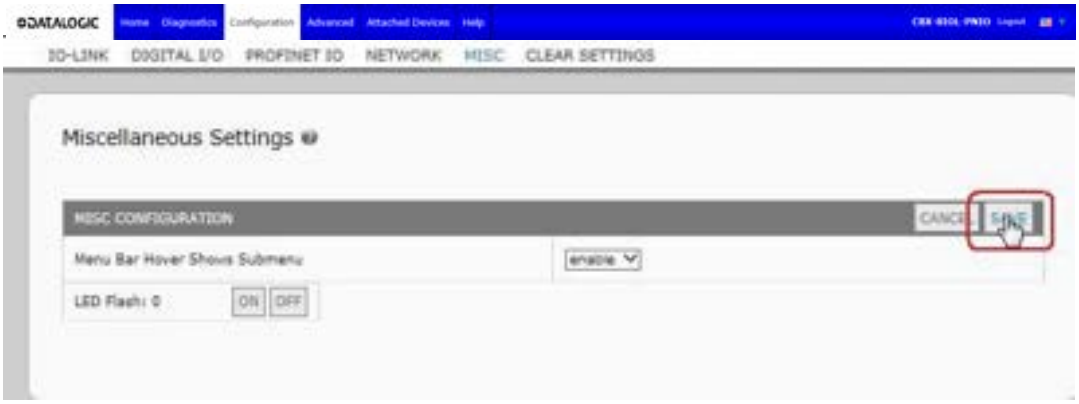
  - Click the **ON** button to enable the LED tracker feature on the IOLM. The LEDs remain flashing until you disable the LED tracker feature
  - Click the **OFF** button to disable the LED tracker.

7.6.1 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**.



7.6.2 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**.

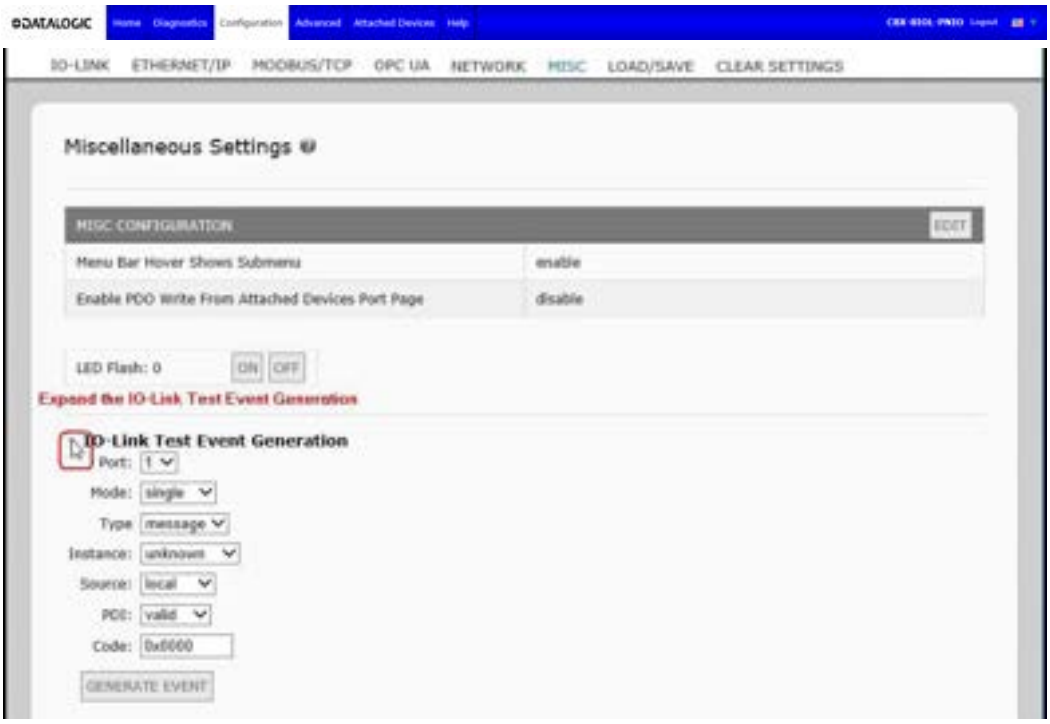
Use this procedure to enable PDO write from the **Attached Devices | Port** page.

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.

7.6.3 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**.

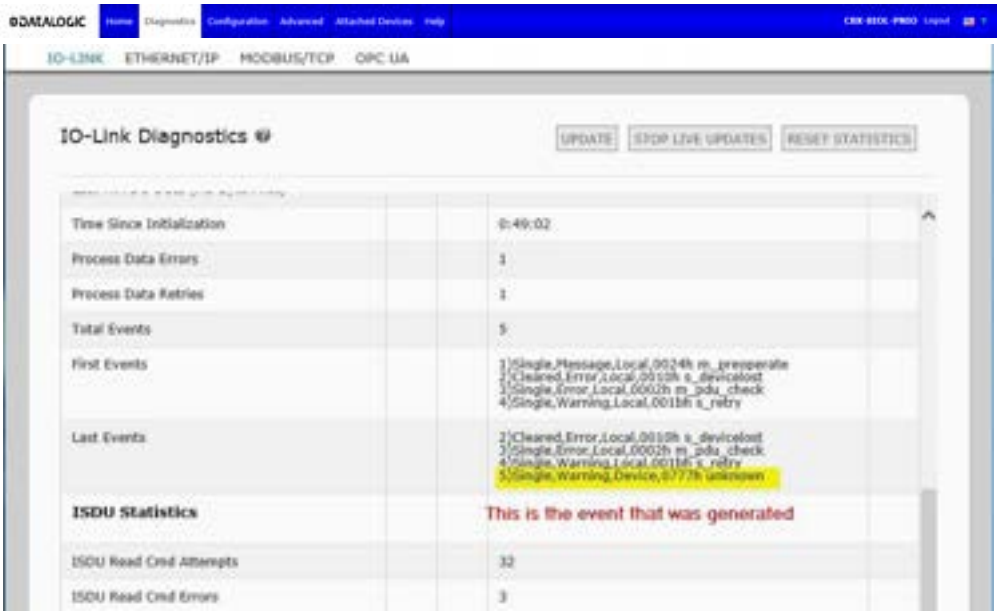


3. Select the port and type of event that you want to test.
   Use the following table to determine what type of event you want to generate.

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**.



7.7 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.

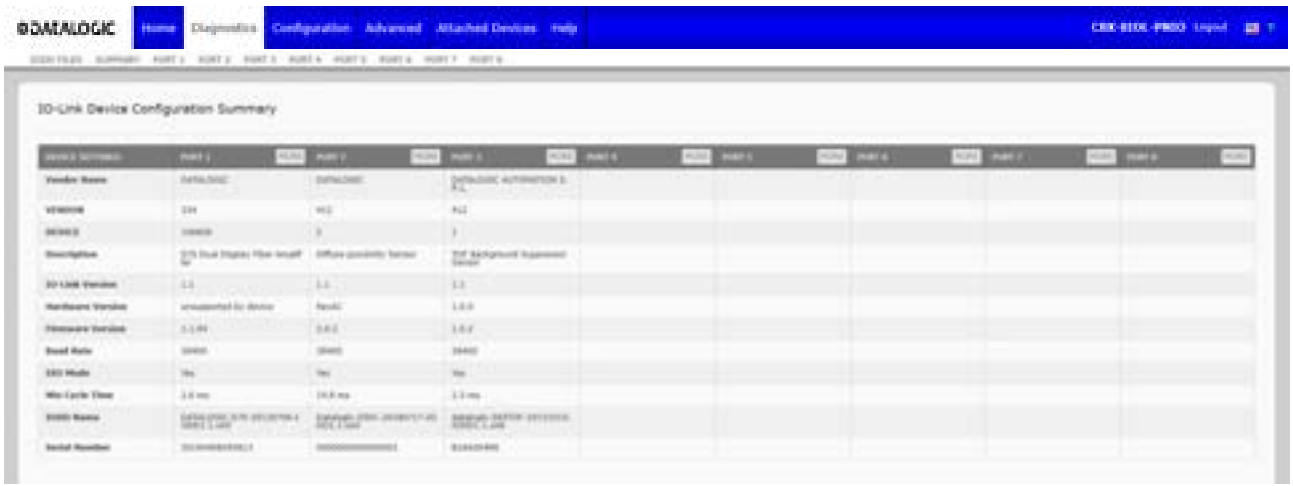
1. Click **Configuration | Clear Settings**.

2. Click the **OK** button to the *Done Configuration Cleared* message.

8 USING THE DIAGNOSTIC PAGES

8.1 IO-LINK PORT DIAGNOSTICS

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



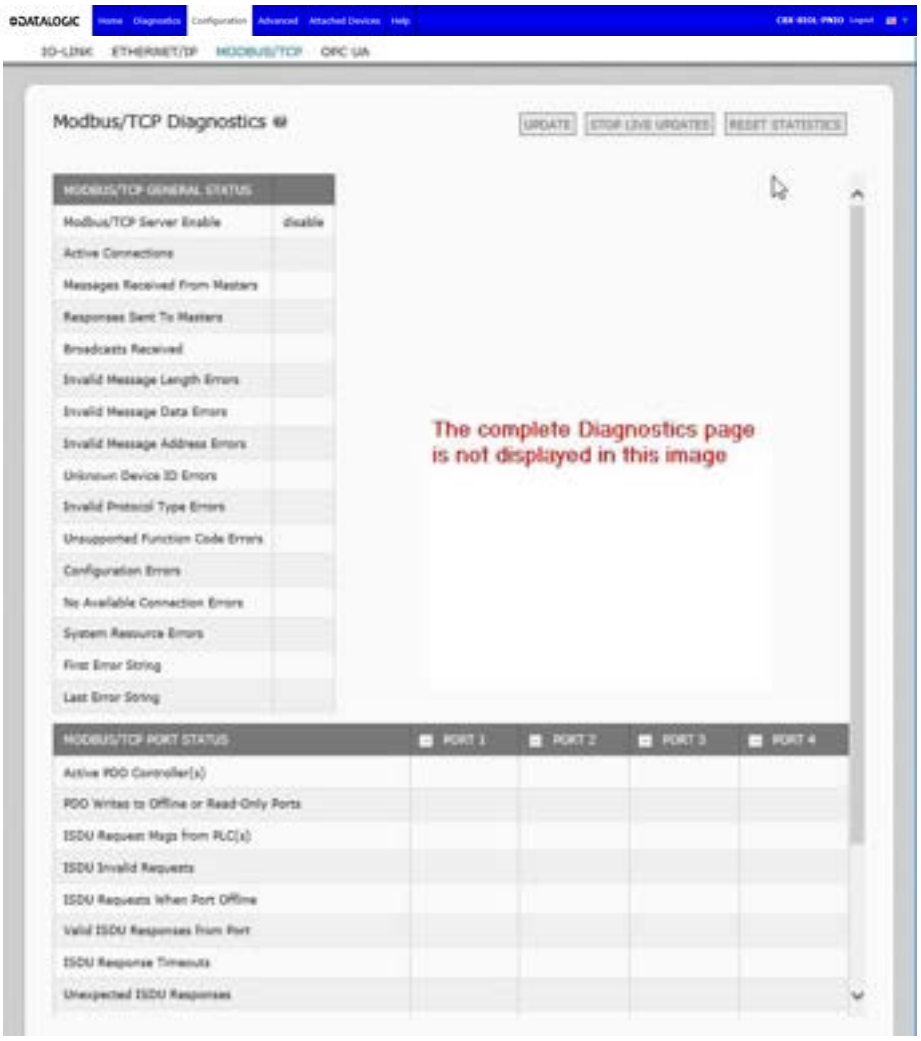
The following table provides information about the **IO-Link Diagnostics** page.

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.
	Configured in the **Configuration | IO-Link** page, this is the minimum cycle time

Configured 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 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.

8.2 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.



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.

8.3 PROFINET IO DIAGNOSTIC 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

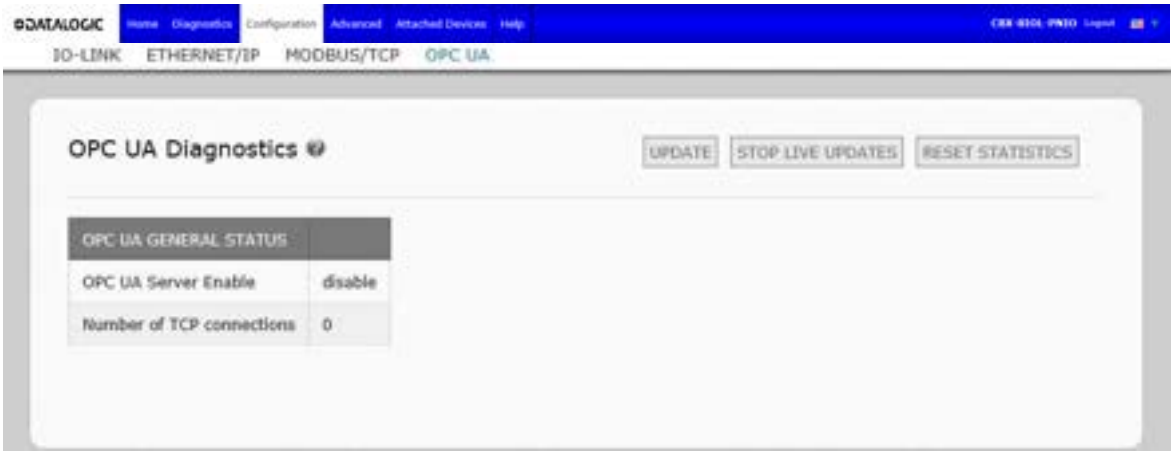
	system error on the IO-Link such as operating system errors or full message queues. These errors typically occur when the PLC(s) are sending messages to the IO-Link Master faster than the IO-Link Master can process them.
PROFINET IO Frames Transmitted	The total number of transmitted PROFINET IO frames.
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 digital I/O pins have changed.
Digital IO Writes	The number of times that the status of the digital output pins has 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.

8.4 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.

9 PROFINET IO REFERENCE INFORMATION

9.1 SAMPLE IO-LINK MASTER GATEWAY CONFIGURATION

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

Device overview

Module	...	Rack	Slot	I address	Q address	Type	Article number
CBXBIOLPNIO		0	0			CBX-BIOL-PNIO	CBX-BIOL-PNIO
Interface		0	0 X1			CBXBIOLPNIO	
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 by...	
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				
IO-Link Status_1		0	9	1...4		IO-Link Status	

Figure 6 - TIA Porta V13 - Datalogic 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.

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

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

	i	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

Figure 8 - 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.

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

9.2 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.

Using the same example in par. 9.1, 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 par. 9.1,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.

9.3 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.

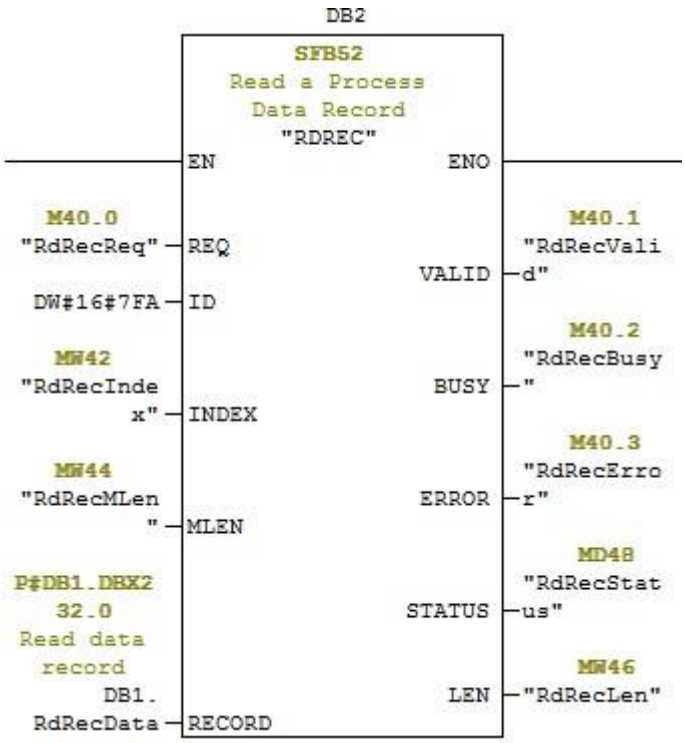


Figure 9 - SFB52 Read a Process Data Record

9.4 READ AND WRITE ISDU WITH THE FB IOL_CALL

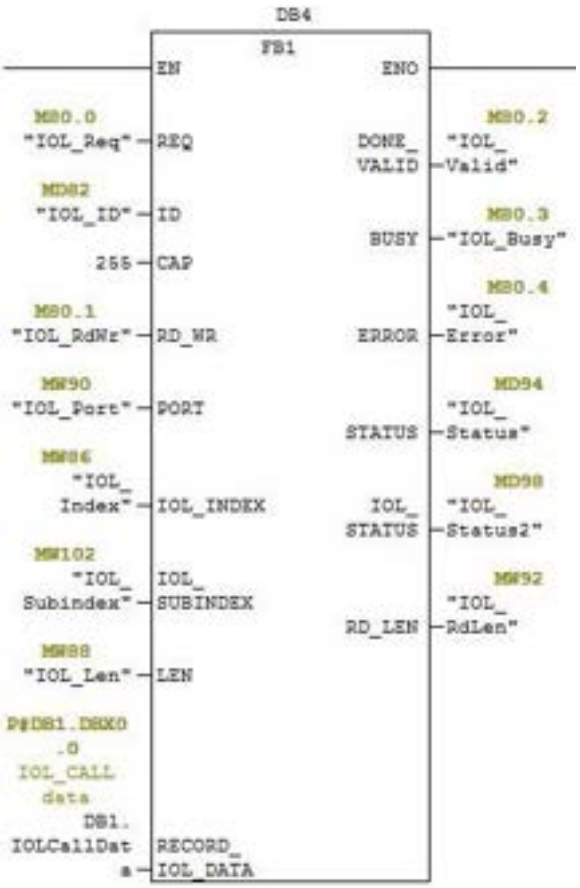
The function block **IOL_CALL** represents the conversion of the communication standardized for the IO-Link technology to and from IO-Link devices. The supports the **IOL_CALL** function block. It can be used to access an ISDU of an IO-Link device.

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.

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

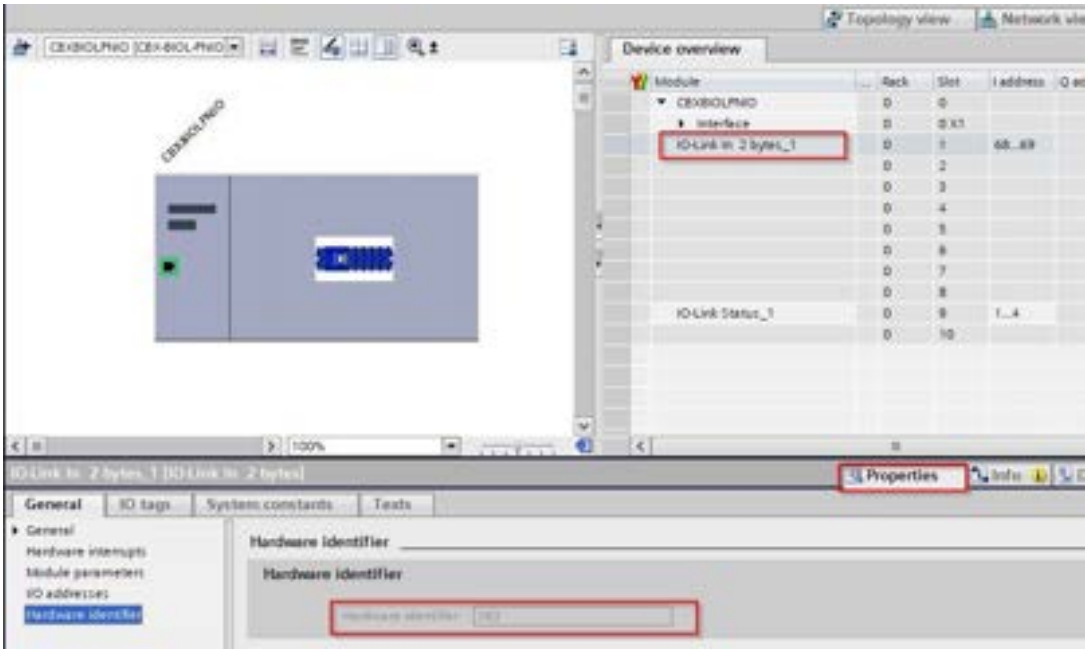
The IOL_CALL function block has a 20 seconds timeout value. If the request takes longer than 20 seconds, the process is aborted and a timeout error is returned. The IOLM also has a timeout value for IOL_CALL request. The default timeout value is 20 seconds. It can be changed through the web page (Configuration | PROFINET IO).

9.4.1 Using the IO-Link Library in the TIA Portal

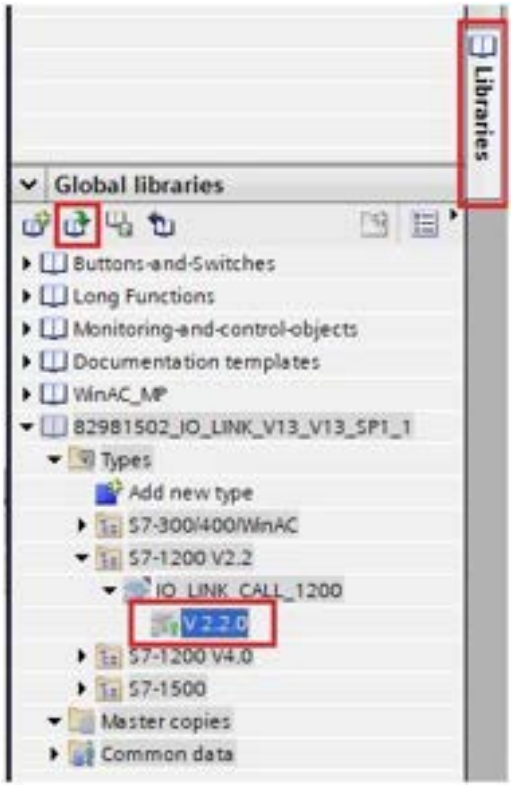
Use the following procedure to use the IO-Link library in the TIA Portal.

1. Download the IO-Link library from Siemens: http://support.automation.siemens.com/WW/view/en/82981502.

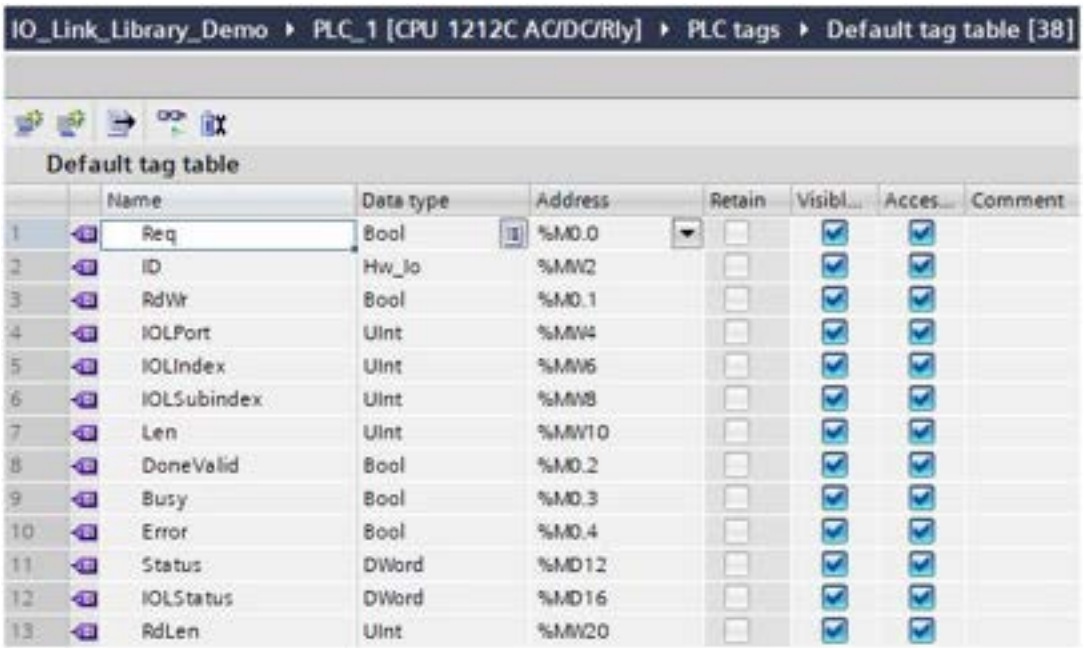
   For TIA Portal V13, download the **Archive_IO_LINK_CALL.zip** archive. For STEP 7 V5.5 and V14, download **82981502_IO_LINK_Library_V3.1**.
2. Unzip the library to a working directory.
3. Configure the TIA Portal project.
   a. Create a new or open an existing TIA Portal project.
   b. Configure the PLC, Datalogic 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.

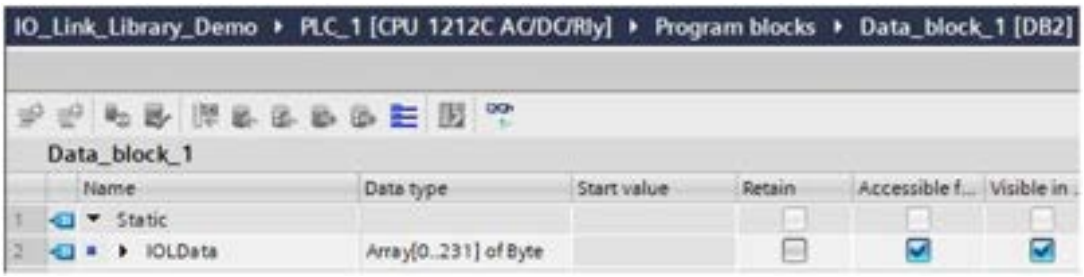


6. Create tags and data block by going to **PLC tags**, create some tags that will be used as the parameters of IO_LINK_CALL.

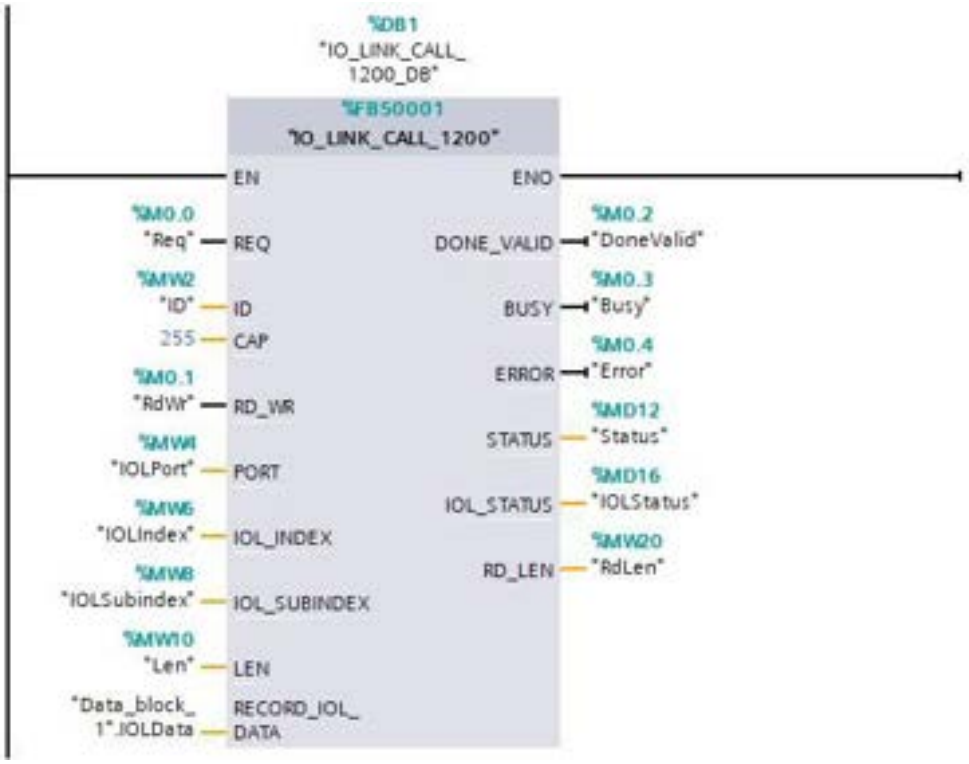


	Name	Data type	Address	Retain	Visibl...	Acces...	Comment
1	Req	Bool	%M0.0		☑	☑	
2	ID	Hw_Io	%MW2		☑	☑	
3	RdWr	Bool	%M0.1		☑	☑	
4	IOLPort	UInt	%MW4		☑	☑	
5	IOLIndex	UInt	%MW6		☑	☑	
6	IOLSubindex	UInt	%MW8		☑	☑	
7	Len	UInt	%MW10		☑	☑	
8	DoneValid	Bool	%M0.2		☑	☑	
9	Busy	Bool	%M0.3		☑	☑	
10	Error	Bool	%M0.4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

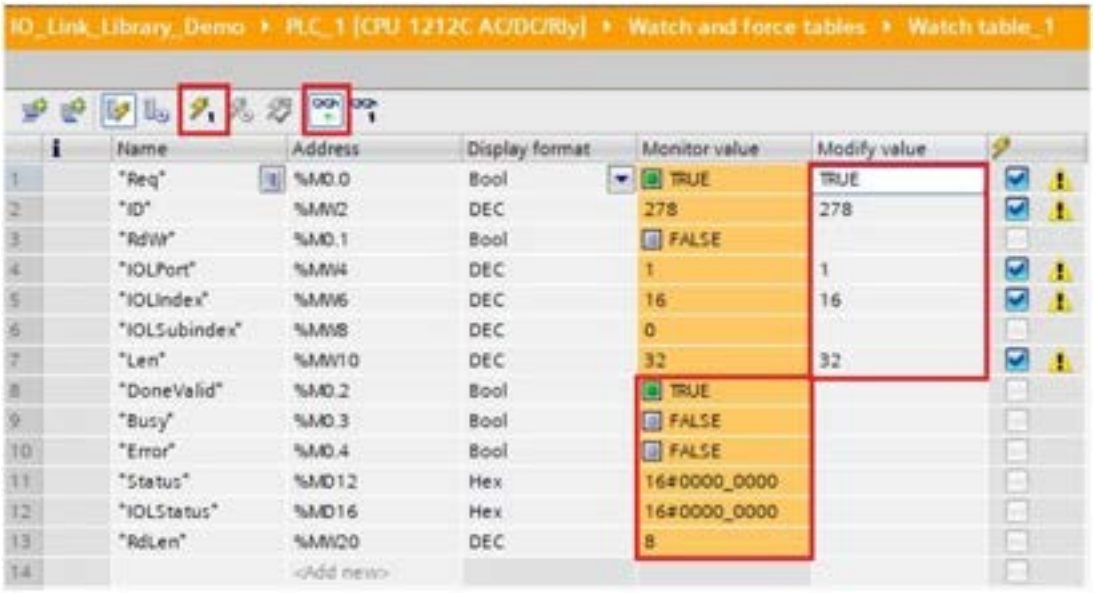
7. Add a new data block and create a 232-byte array, which will be used to store the ISDU data.



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.

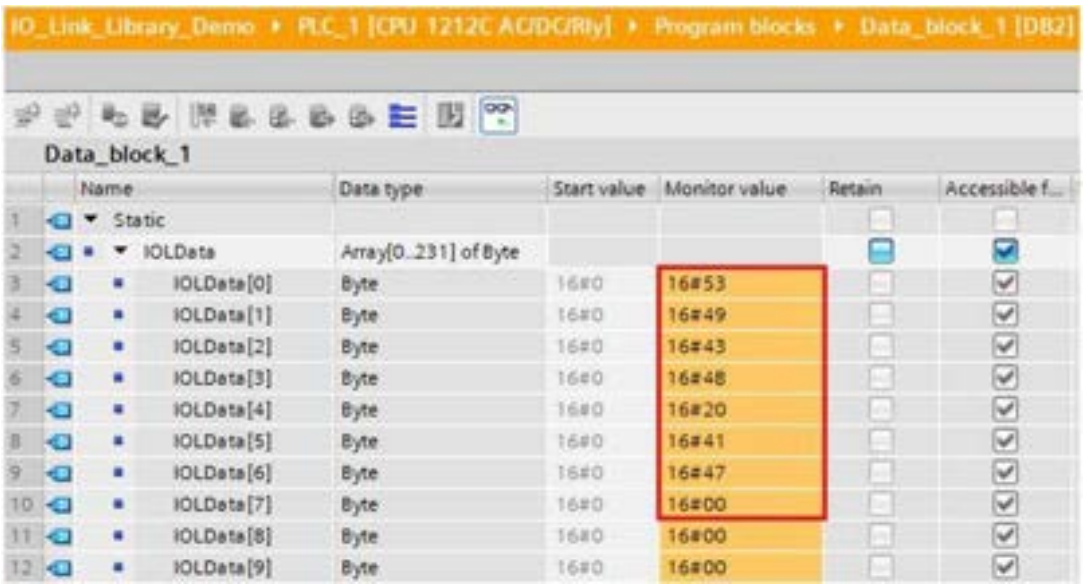


9. Test **IO_LINK_CALL**.
   a. Create a new watch table and enter the parameters of **IO_LINK_CALL**.
   b. Click the **Monitor all** button to start monitoring all tags.
   c. Enter the hardware identifier of the IO-Link module as the modify value of tag ID.
   d. Enter the IO-Link port number (1 based), 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.



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**.



9.5 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.

9.5.1 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.

9.5.2 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 summarizes 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 Datalogic 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.

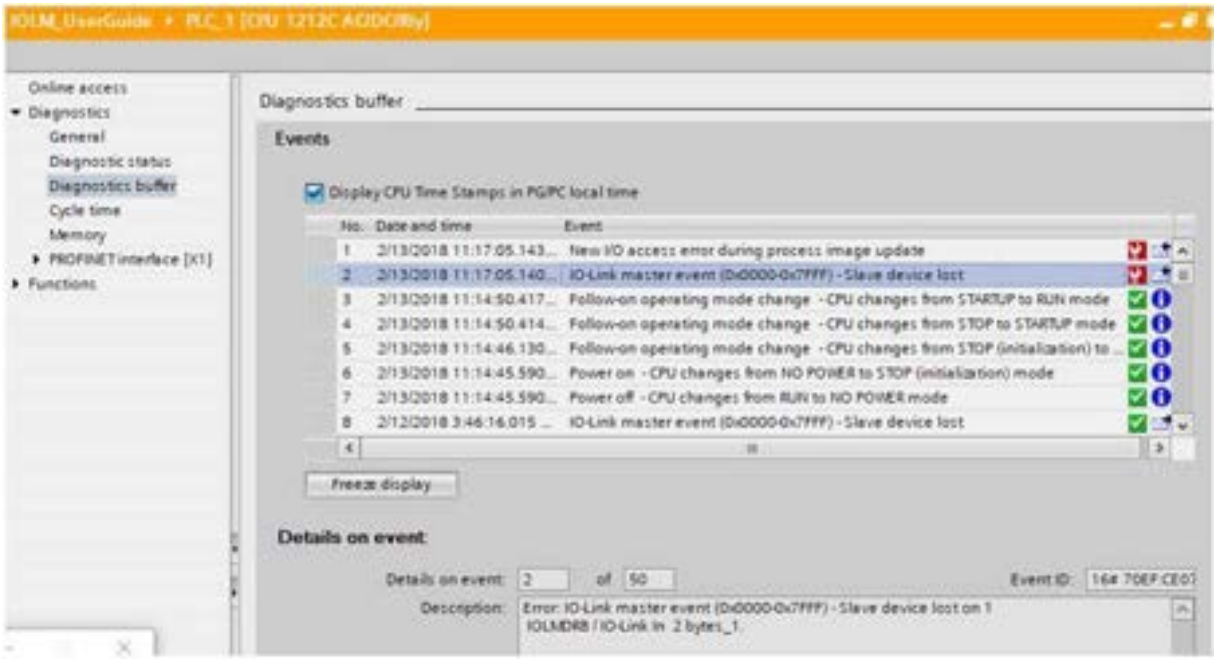


Figure 10 - TIA Portal V13: IO-Link Events Through PROFINET Channel Diagnostics

10 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.

10.1 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)

10.2 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

10.2.1 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

10.3 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:

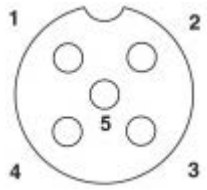
- Only PDO data may be written.
- The PDO data for one or more ports may be written with one Write Holding Registers message.
- Partial PDO data writes are not allowed.
- The length of the Write message must be equal to the total of the configured PDO lengths for all ports to be written. The one exception 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.

11 FUNCTIONALITY DESCRIPTIONS

11.1 PROCESS DATA BLOCK DESCRIPTIONS

11.1.1 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)
Auxiliary I/O	BYTE	The auxiliary bit on the IO-Link port is: •  **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)
		IOLM DR-8-PNIO - 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.*

11.1.1.1 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)

11.1.1.2 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)	

11.1.1.3 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)		

11.1.2 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.*

11.1.2.1 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)

11.1.2.2 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)

11.1.2.3 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)	

11.2 EVENT HANDLING

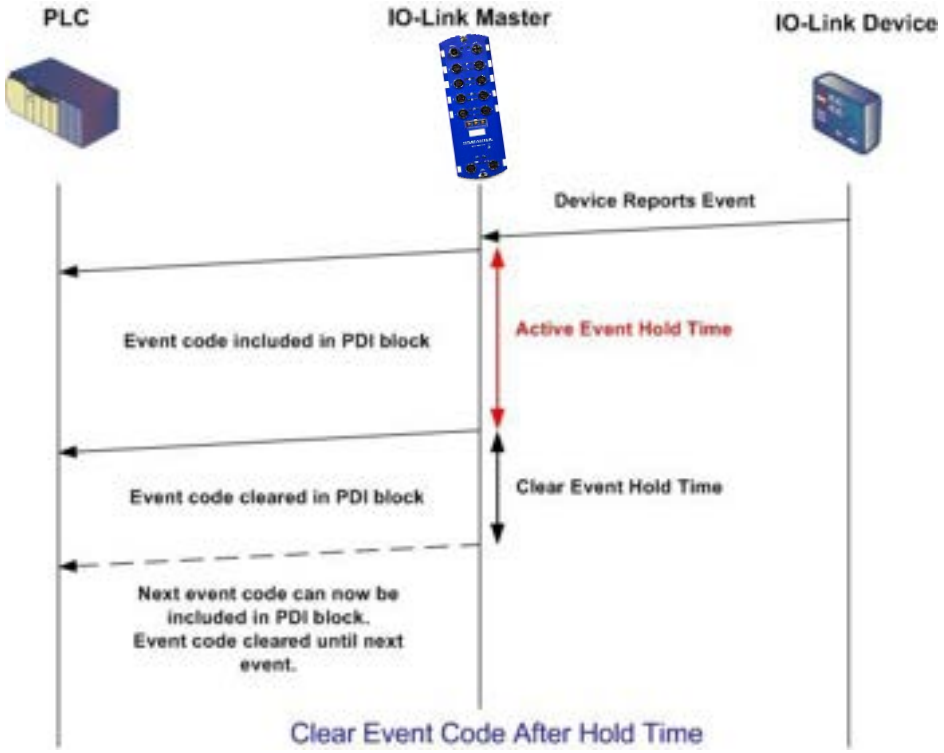
The IOLM event handling is designed to provide real-time updates of event codes received directly from the IO-Link device. The IO-Link event code:

- 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.

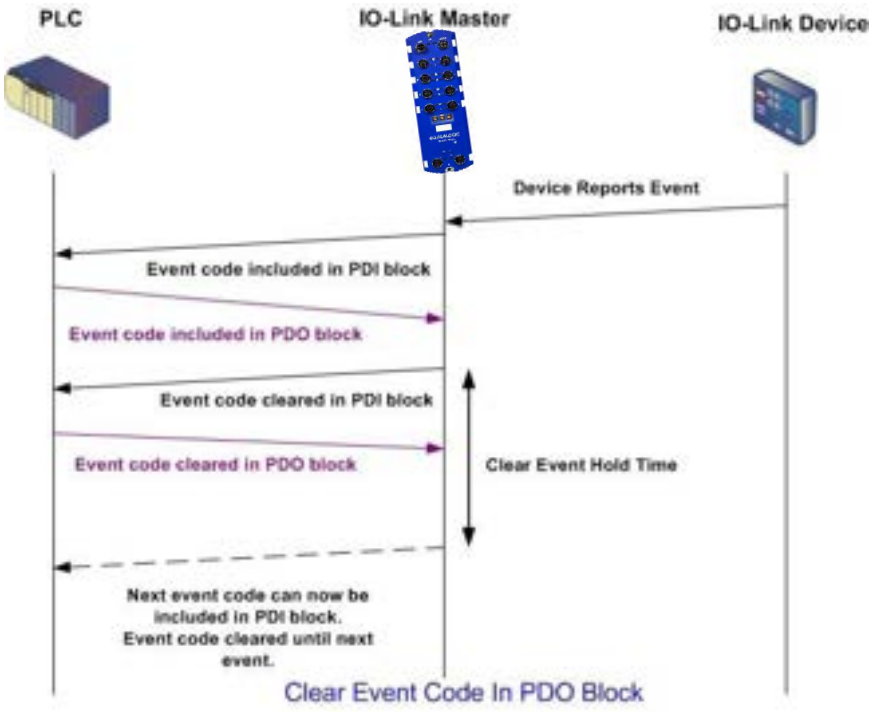
11.2.1 Clear Event After Hold Time Process

This illustrates clearing the event after the hold time process.



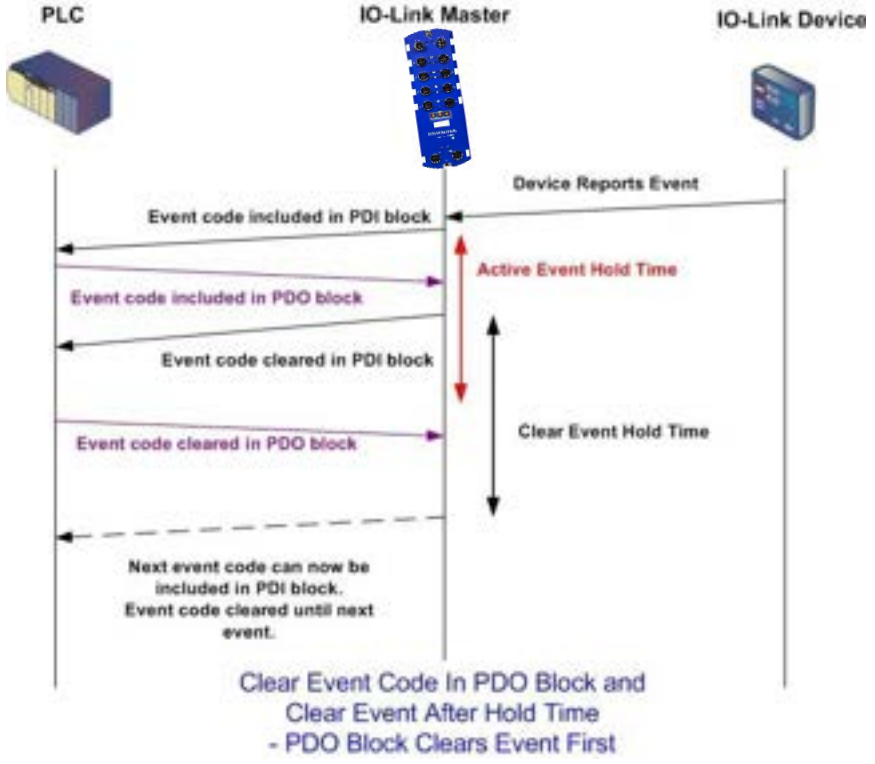
11.2.2 Clear Event in PDO Block Process

This illustrates clearing the event in the PDO block process.



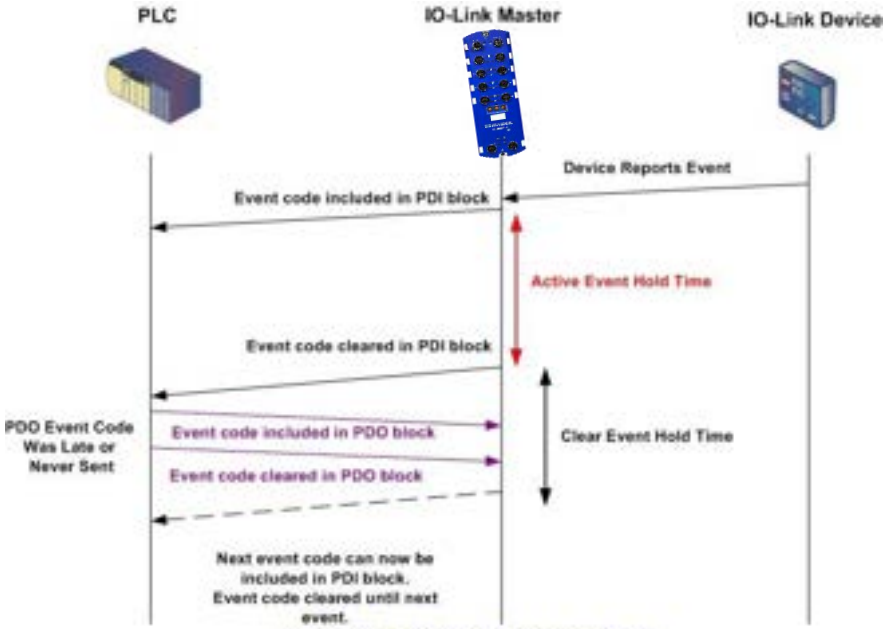
11.2.3 Clear Event Code in PDO Block and Clear Event After Hold Time Process- PDO Block First

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



11.2.4 Clear Event Code in PDO Block and Clear Event After Hold Time Process- 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.



Clear Event Code In PDO Block and Clear Event After Hold Time - Hold Time Expires and Clears Event

11.3 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 a 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 the ISDU commands have been processed.

11.3.1 ISDU Request/Response Structure

ISDU requests may contain a single command or multiple, nested commands.

11.3.1.1 Single ISDU Command Requests

This illustrates a single ISDU command request.

Single Command ISDU Request/Response

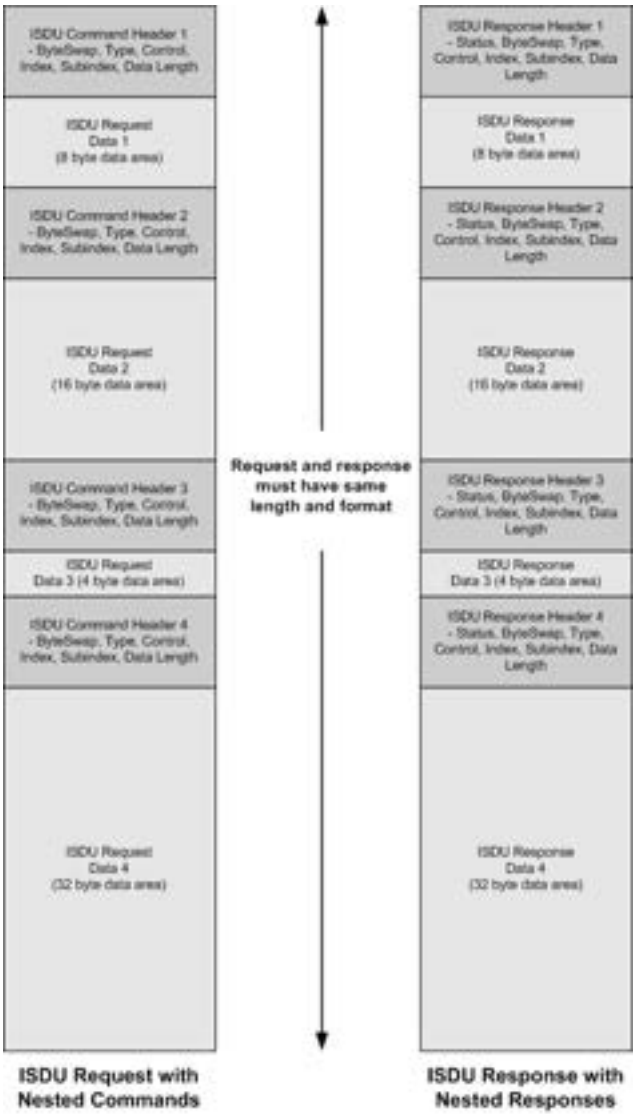
11.3.1.2 Multiple ISDU Command Structure

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.

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

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

- **Multiple Command ISDU Request/Response of Different Data Lengths**



Example - Multiple Command ISDU Request/Response of Different Data Area Lengths

11.3.2 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.

11.3.2.1 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.*

11.3.2.2 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.*

11.3.3 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.

11.3.3.1 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.*

11.3.3.2 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.

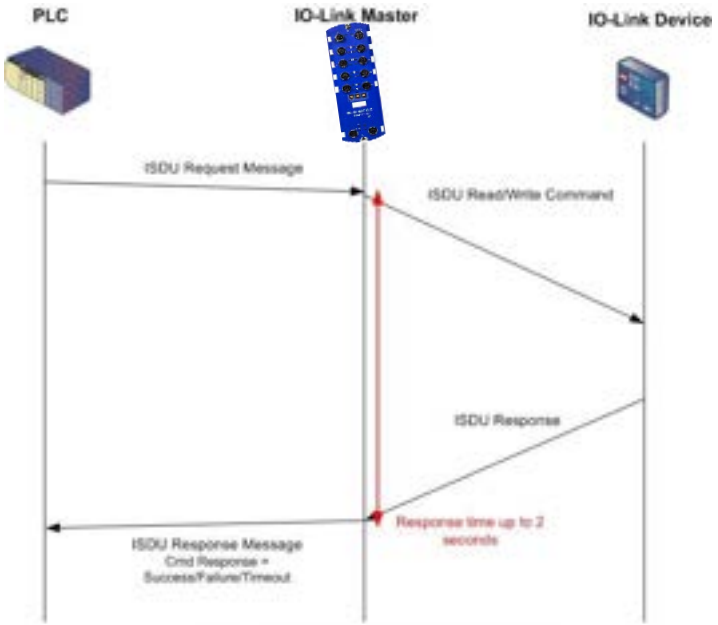
Name	Data Type	Parameter Descriptions
Status, Byte-Swapping, RdWrControlType	UINT	Indicates the control, type, byte swapping and status of the ISDU command. **Bits 0-3, Type Field:** 0 = NOP (No operation) 1 = Read operation 2 = Write operation 3 = Read/Write “OR” 4 = Read/Write “AND” **Bits 4-7, Control 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.*

11.3.4 ISDU Blocking and Non-Blocking Methods

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

11.3.4.1 Single Command Blocking

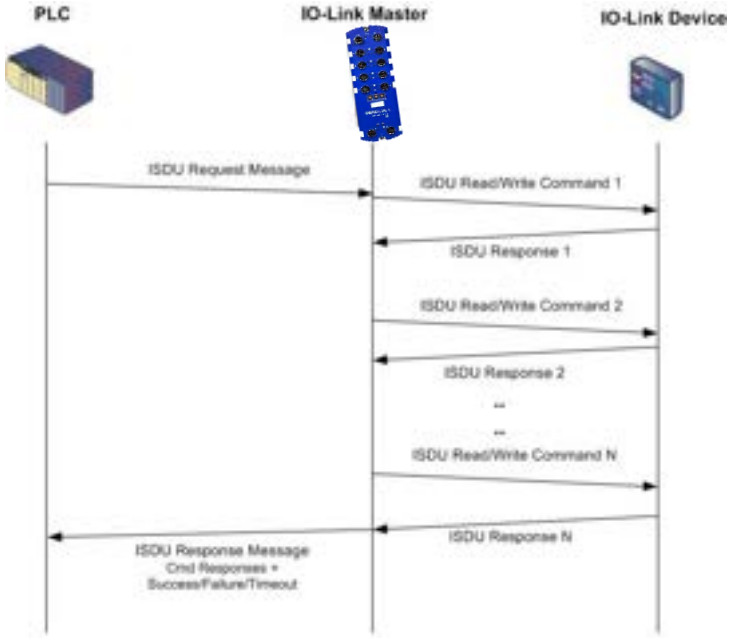
The following illustrates the single command blocking method.



Single Command ISDU Blocking Process

11.3.4.2 Multiple Command Blocking

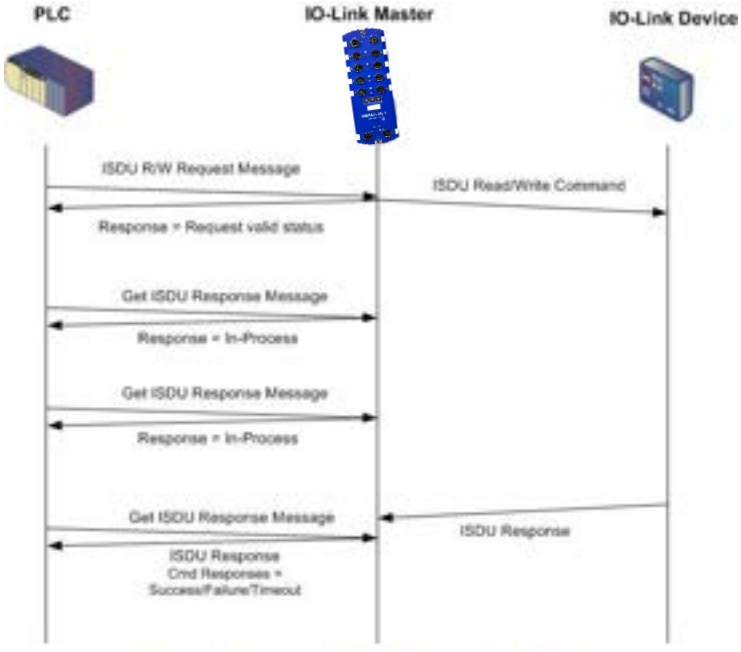
This illustrates the multiple command blocking method.



Multiple Command ISDU Blocking Process

11.3.4.3 Single Command Non-Blocking

This illustrates the single command non-blocking method.



Single Command ISDU Non-Blocking Process

11.3.4.4 Multiple Command Non-Blocking

This illustrates the multiple command non-blocking method.

Multiple Command ISDU Non-Blocking Process

12 TROUBLESHOOTING AND TECHNICAL SUPPORT

12.1 TROUBLESHOOTING

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

- Check to make sure LEDs are not reporting an issue. Refer to par. 12.2.
- 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 CBX-IOL-8-PNIO 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**
  - **EtherNet/IP Diagnostics**
  - **Modbus/TCP Diagnostics**
  - **OPC UA Diagnostics**
- If you have a spare IO-Link Master, try replacing the IO-Link Master.

12.2 IOLM LEDs

12.2.1 CBX-IOL-8-PNIO-LEDs

The CBX-IOL-8-PNIO (8-port IP67 model with an L-coded power connector) provides these LEDs.

LED Activity During Power On Sequence - CBX-IOL-8-PNIO
1. The **US** LED lights.
2. The **ETH1/ETH2** LED lights on the connected port.
3. The **MOD** and **NET** LEDs are lit.
4. The IO-Link LEDs flash (if no IO-Link device attached) or are lit if an IO-Link device is attached.
The **MOD** LED is solid green, the IO-Link Master is ready for operation.

CBX-IOL-8-PNIO 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.
MOD (Module Status)	The **MOD** LED provides the following information: • Off = No module status • Green and red flashing = Self-test • Green flashing = Standby – not configured • Green solid = Operational • Red flashing = Minor recoverable fault - check the **EtherNet/IP Diagnostics** page to locate the issue • Red solid = Major unrecoverable fault
NET (Network)	The **NET** LED provides the following information: • Off = No IP address • Green and red flashing = Self-test • Green flashing = An IP address is configured, but no CIP connections are established, and an Exclusive Owner connection has not timed out • Green solid= Active EtherNet/IP or Modbus connection and no EtherNet/IP connection time-outs • Red flashing = One or more EtherNet/IP connection time-outs • Red solid = Duplicate IP address on network
1-8 	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. • Red solid = PDI of the attached IO-Link device is invalidGreen 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). • Off = DI signal is low or disconnected • Yellow = DI signal is high
ETH1/ETH2	The **ETH1/ETH2** LEDs provide the following information: • Green solid = Link • Green flashing = Activity

12.3 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.

12.4 USING LOG FILES

The IO-Link Master provides four 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.

12.4.1 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.

12.4.2 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.

12.4.3 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.

DATALOGIC

www.datalogic.com

USER'S MANUAL

> IO-LINK MASTER

Ethernet/IP and Modbus/TCP

DATALOGIC

ORIGINAL INSTRUCTIONS (ref. 2006/42/EC)

Datalogic S.r.l.
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Italy

IO-LINK MASTER User's Manual
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821006330 Rev. A

CONTENTS

1 INTRODUCTION

This document provides installation, configuration, and embedded web interface information for the Datalogic IO-Link Master (IOLM), including detailed information on EtherNet/IP and Modbus/TCP.

The web interface provides a platform for the user to easily configure, review diagnostic pages, and access advanced features, e.g.:

- 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

2 HARDWARE INSTALLATION

2.1 CBX-IOL-8-EIP HARDWARE INSTALLATION

This section provides detailed information on the hardware installation of the CBX-IOL-8-EIP.

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.

Note: Optionally, you can leave the rotary switch set to the default and use the web interface to set the network 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. This makes IP address setting through 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 power.

Switch Setting	Node Address
000 (Default setting)	Use the network configuration stored in the flash. The default network configuration values are: • IP address = 192.168.1.250 • Subnet mask = 255.255.255.0 • IP gateway = 0.0.0.0
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 192.168.1.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.

Follow these steps to change the default rotary switch settings:

1. Gently 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 onthe bottom of the window.
3. Turn each dial to the appropriate position using a small flathead screwdriver.

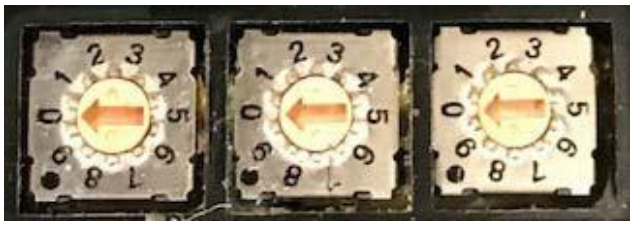


Figure 1 - Rotary switches

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.

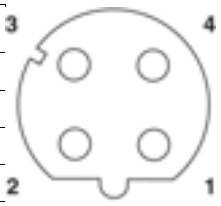
4. Close the window and make sure that it snaps shut tightly.

Failure to close 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.

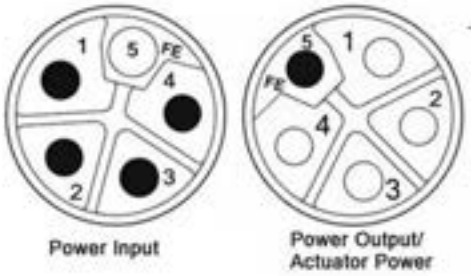
1. Securely connect one end of a shielded twisted-pair (Cat 5 or higher) M12 Ethernet cable to either Ethernet port.
2. Connect the other end of the cable to the network.
3. Optionally, use the other Ethernet port to daisy-chain to another Ethernet device.
4. If you did not connect both Ethernet ports, 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 CBX-IOL-8-EIP 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 for IP67 compliance.



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) 1A (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
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.* *†† V_A output available is the same as the available V_A 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.
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 **ETH1/ETH2** LED lights on the connected port.
   c. The **MOD** and **NET** LEDs are lit.
   d. The IO-Link LEDs flash (if no IO-Link device is 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. The **MOD** LED is solid green, the IO-Link Master is ready for operation. Go to the next installation step:

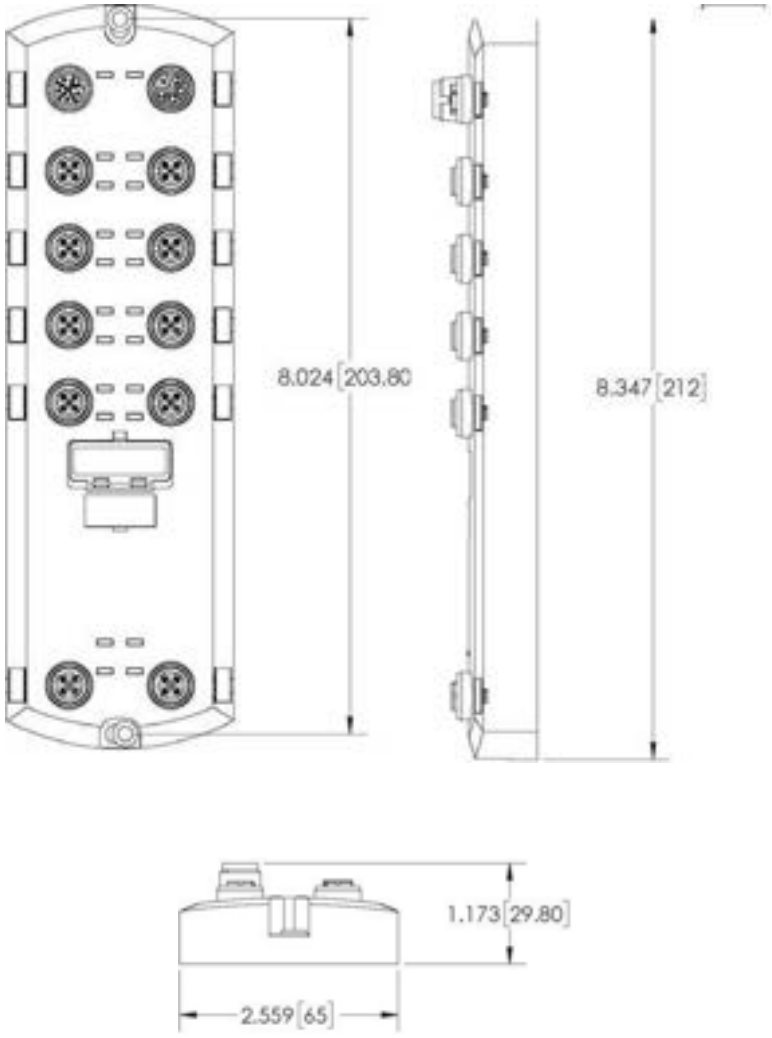
- Program the IP address using the web interface. Refer to chap. 3 for configuring network information.
- If you are using the rotary switches to set the IP address, then you are ready to attach devices. Refer to chap. 4.

If the LEDs do not meet the above conditions, you can refer to par. 17.2.1 (CBX-IOL-8-EIP LEDs).

2.1.4 Mounting the CBX-IOL-8-EIP

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 8Nm.



3 CONFIGURING THE NETWORK INFORMATION

This subsection discusses using the web interface to configure the IP address. The default IP address is **192.168.1.250** and the Subnet Mask is: **255.255.255.0**.

You may need to change your host system IP address so that it can communicate with the CBX-IOL-8-EIP default IP address: 192.168.1.250. The CBX-IOL-8-EIP is shipped from the factory with the Admin account enabled without a password. You can configure the Admin, Operator, and User passwords.

1. Click Configuration | NETWORK.
2. Click the EDIT button.
3. Click the CONTINUE button.
4. Optionally, enter a host name to identify this CBX-IOL-8-EIP.
5. Select the IP type, Static or DHCP.
    - If using a static IP address, enter the static IP address, subnet mask and IP gateway address.
    - If using DNS:
        - Enter the DNS primary server IP address.
        - Optionally, enter the DNS secondary server IP address.
6. If desired, enter the NTP server IP or host name.
7. If you want the CBX-IOL-8-EIP to send syslog messages to a syslog server:
    - Enter the syslog server's IP address (or host name if using DNS).
    - Enter the syslog server's port number (default is 514).
8. If you want to enable the SSH server, click Enable.
9. Click SAVE to save the changes.
10. If the CBX-IOL-8-EIP does not redirect you to the new page, open a session using the new IP address.

Note: The CBX-IOL-8-EIP does not need to be rebooted.

You should verify that you have the latest software installed on the CBX-IOL-8-EIP and if necessary, update the software.

You are now ready to configure the CBX-IOL-8-EIP port characteristics.

4 CONNECTING DEVICES

4.1 OVERVIEW

The **C/Q** pin for the IO-Link ports in SIO mode for all models:

- **DI** – sinking input
  The **DI** pin on the IO-Link ports for all models is a sinking input.
- **DO** – PNP/NPN (push/pull) output

The following table provides definitions of the terminology used above.

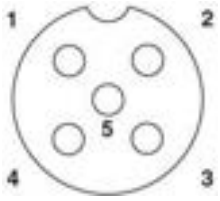
Term	Definition
PNP output	This is an output that can source current: the (+) side of the device is connected to the output and the (-) side of the device is connected to (-) of the supply. The device is powered when the output LED is on.
NPN output	This is an output that sinks current: the (-) of the device is connected to the output and the (+) side of the device is connected to (+) side of the supply. The device is powered when the output LED is off.
Sinking input	This sinks current into the IO-Link Master so a positive voltage will cause the input to turn on. ***Note:*** *Using NPN with inputs is not correct as NPN describes an output situation. However, some vendors describe their inputs as accepting a certain type of sensor output, so in this case a sinking input will accept a PNP output sensor.*

4.2 CBX-IOL-8-EIP IO-LINK PORTS

The CBX-IOL-8-EIP 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 4.8 Kbps
- COM2 at 38.4 Kbps
- COM3 at 230.4 Kbps

There are active over-current limiter electronics for each port in the CBX-IOL-8-EIP 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 CBX-IOL-8-EIP are as follows.

CBX-IOL-8-EIP	**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. 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.	500mA/ port pair (1A output power budget per port pair)	1.05A/port pair	Yes	200mA*/ port	400mA*/ port	Yes
* 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 chap. 5 for configuration information.

5 IO-LINK PORT CONFIGURATION

This section includes information on port configuration.

5.1 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**| I**O-Link Diagnostics**.
3. Review the **Port Status** and **IOLink State**.

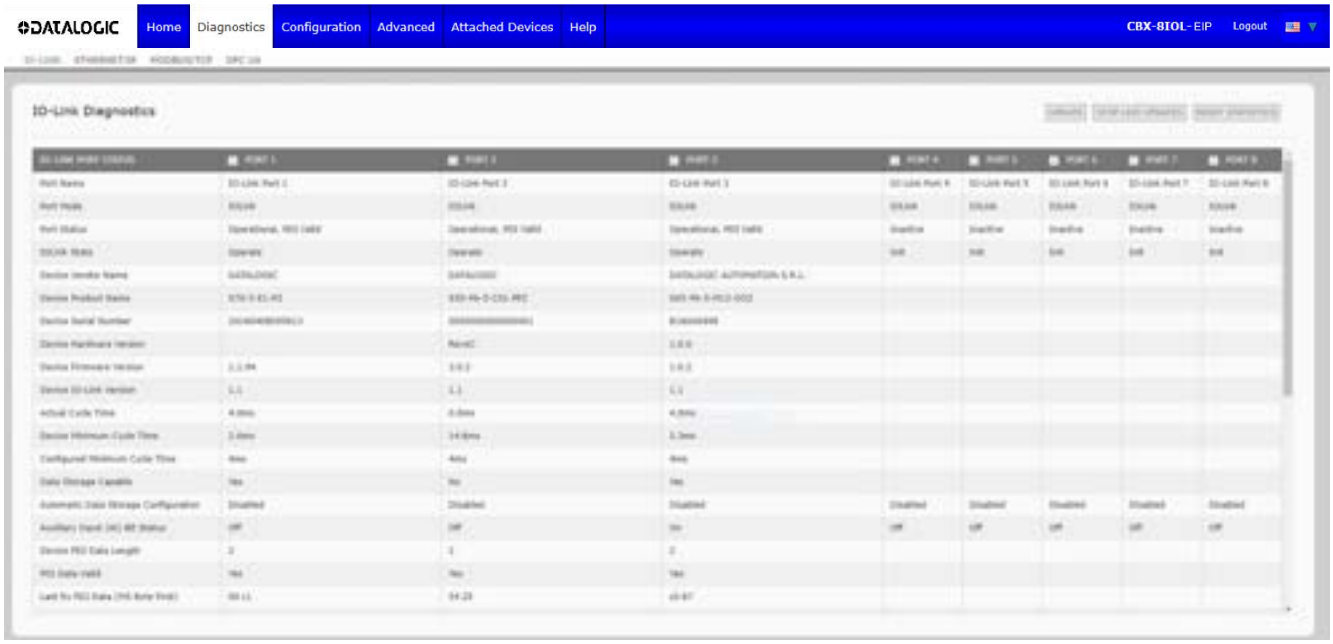
Port Status	Operational, PDI Valid	An IO-Link device is operating on the port that has received valid PDI data.
	Operational	An IO-Link device is operating on the port that has not received valid PDI data.
	Inactive	One of the following conditions exists: • A valid IO-Link device is not connected to the port. • A digital input or output device is connected to the port, but the configured **Port Mode** is not correct.
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.

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 (Pin 2 with M12 connectors).

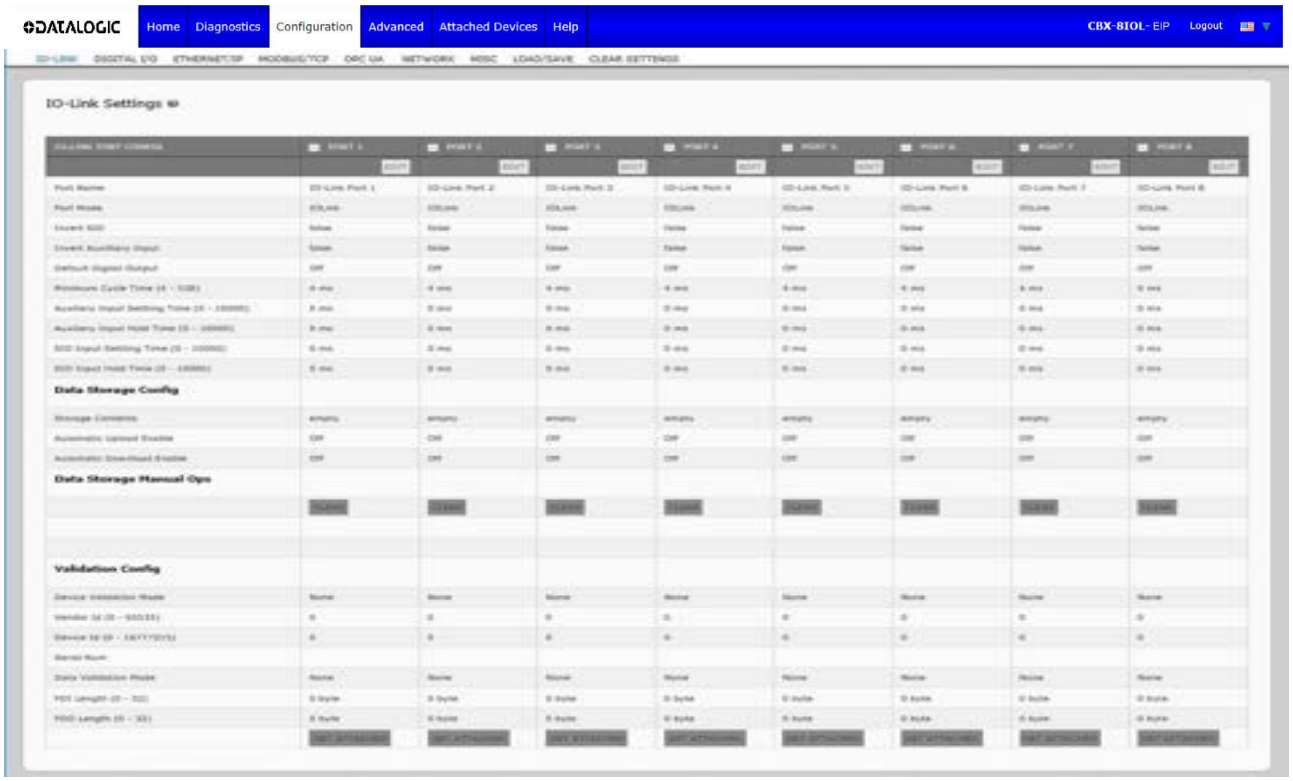


For additional information about the **IO-Link Diagnostics** page, see the help system or par. 9.1.

5.2 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.

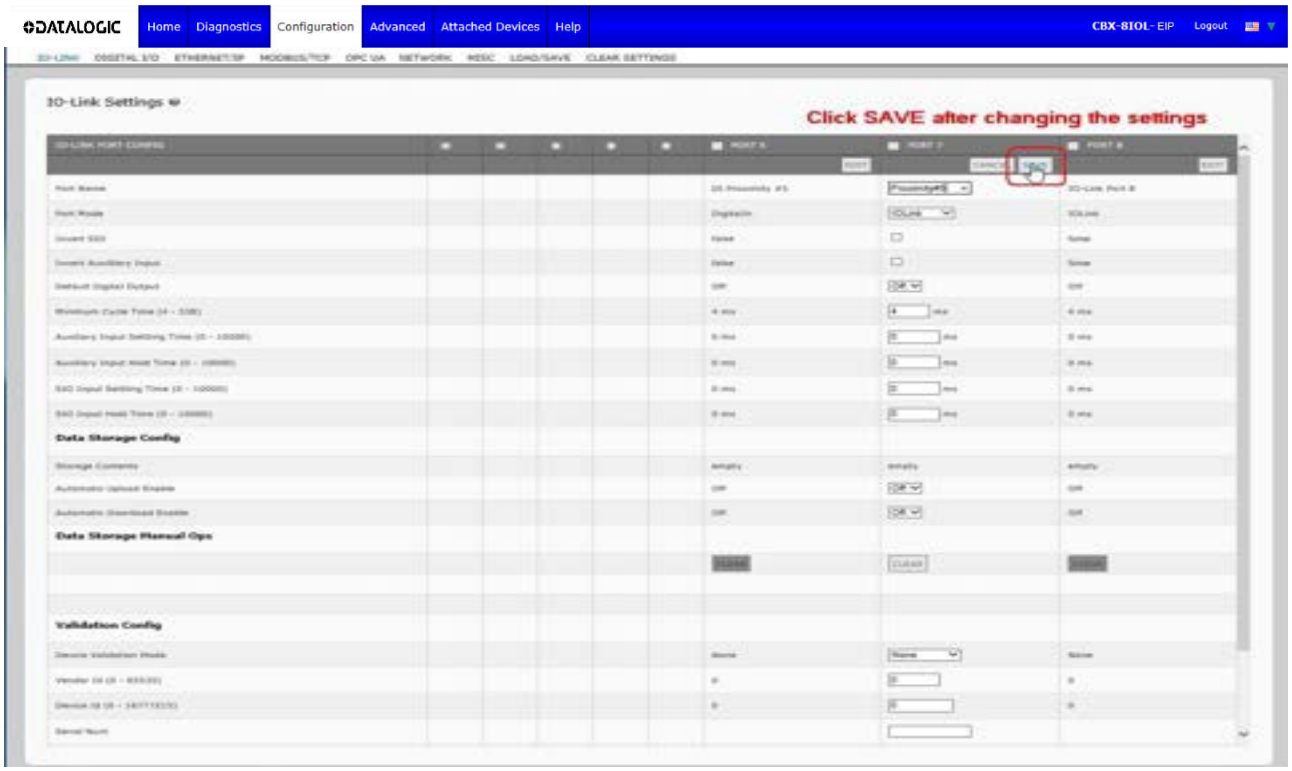
Note: Data Storage, Device Validation, and Data Validation are discussed in chap. 8.



5.2.1 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 chap. 8.

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

5.2.2 IO-Link Settings Parameters

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

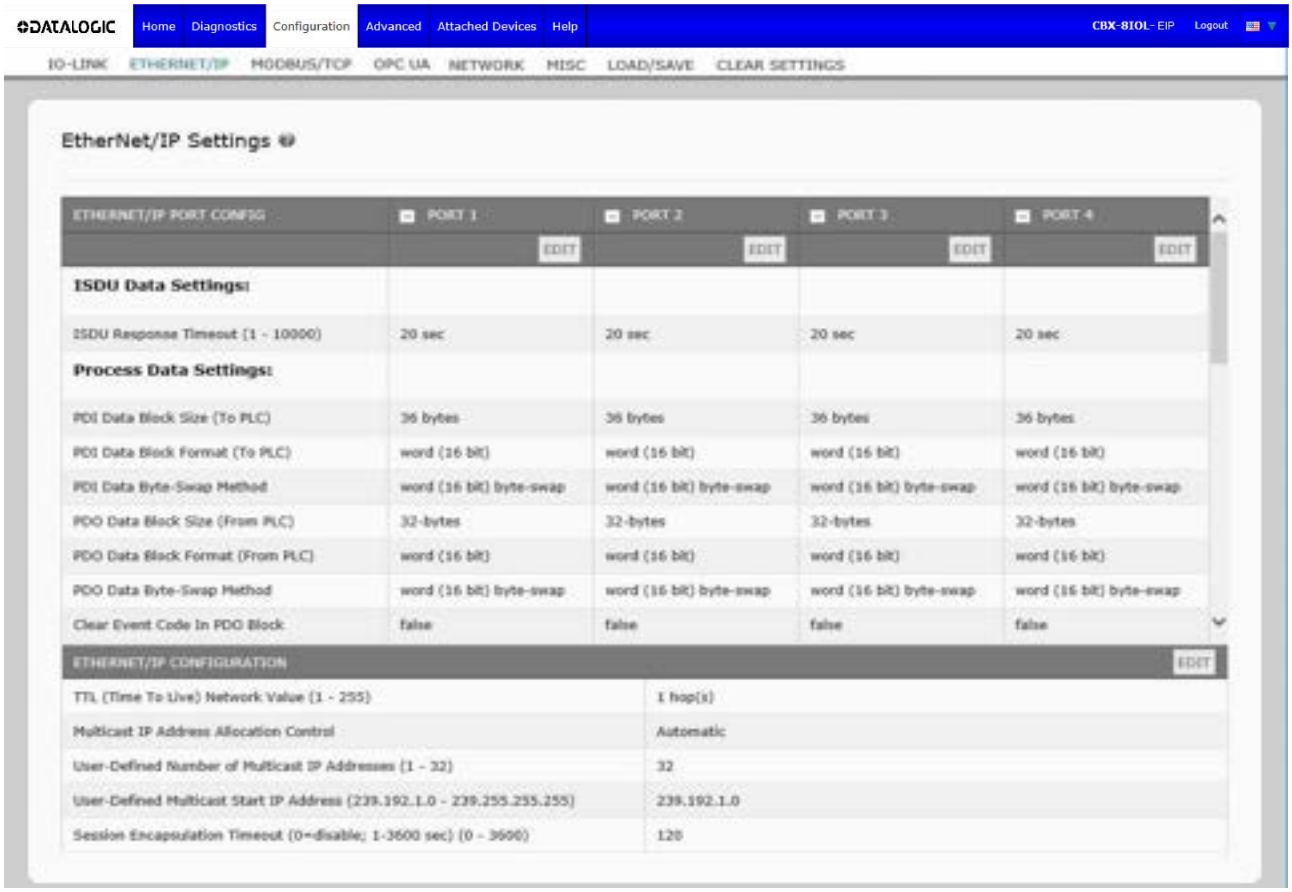
IO-LINK Settings Page	
Port Name	User defined port or device description. • Standard ASCII characters • Max length = 80 characters
Port Mode *Default*: IO-Link	Selected IO-Link port mode. Valid settings are: • **Reset** - Select to disable a port or to reset/restart an IO-Link port. • **IO-Link** - Select 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.
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.
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. • **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*. 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

5.3 ETHERNET/IP SETTINGS CONFIGURATION PAGE

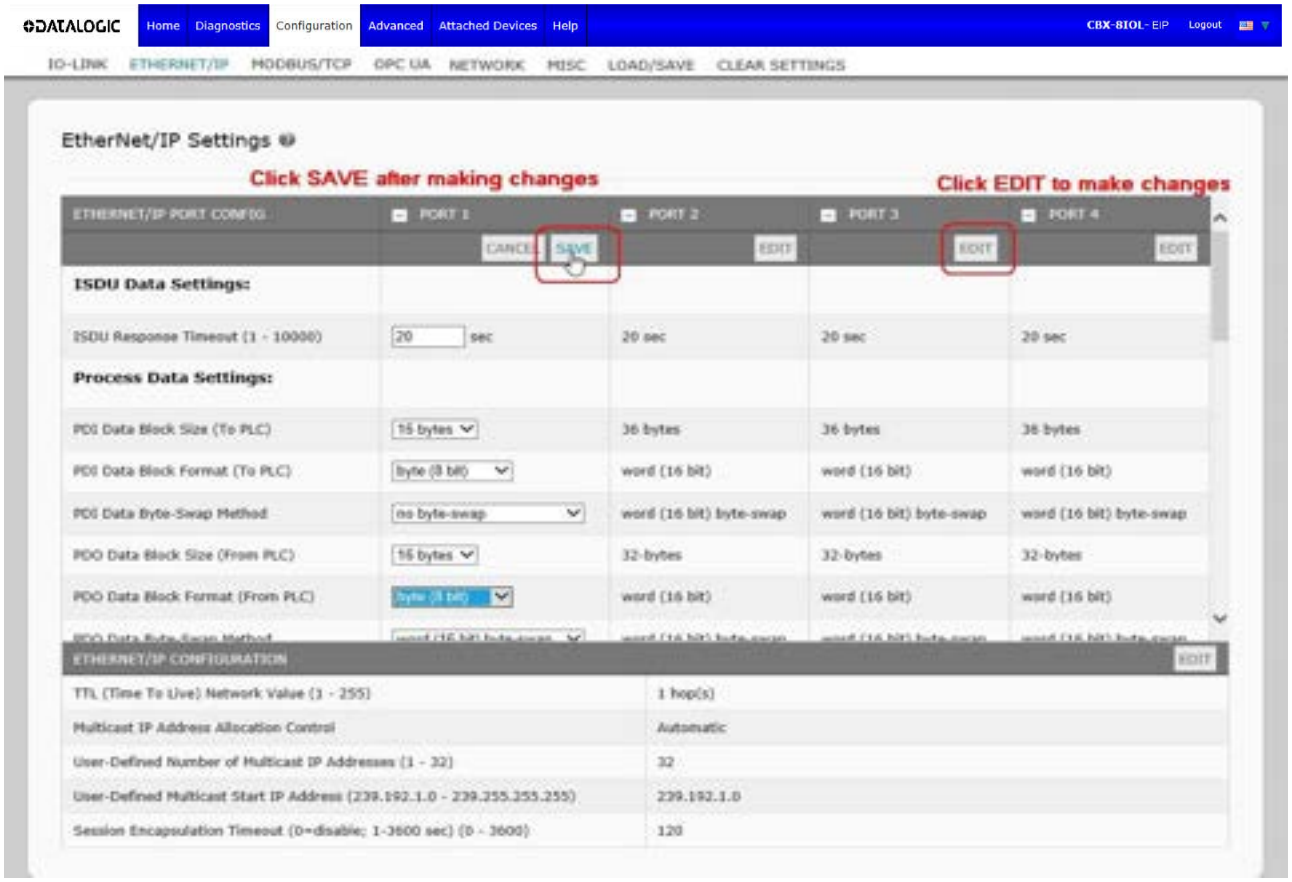
Use the **EtherNet/IP Settings** page to configure EtherNet/IP options.



5.3.1 Editing Ethernet/IP Settings

You can use this procedure to configure EtherNet/IP characteristics for each port.

1. If necessary, open the IO-Link Master web interface with your web browser using the IP address.
2. Click **Configuration** | **EtherNet/IP**.
3. Click the **EDIT** button for each 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 device that is connected to the port.

   You can use the help system if you require definitions or values for the options or refer to *EtherNet/IP Settings Parameters* in the next subsection.
5. Scroll to the top of the page and click the **SAVE** button. Make sure that the port now displays the **EDIT** button.

5.3.2 Ethernet/IP Settings Parameters

The **Configuration | EtherNet/IP Settings** page supports the following options.

EtherNet/IP Settings Page	
ISDU Data Settings	
ISDU Response Timeout *Default*: 20 seconds	The time that the IO-Link Master's EtherNet/IP 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 (To PLC) *Default*: 36-bytes	The configurable PDI data block length. Supported optional lengths are: • **4-bytes** (header only) • **8-bytes** (4 bytes data) • **10-bytes** (6 bytes data) • **16-bytes** (12 bytes data) • **20-bytes** (16 bytes data) • **24-bytes** (20 bytes data) • **36-bytes** (32 bytes data)
PDI Data Block Format (To PLC) *Default*: Word-16	Data format of PDI data block to be transferred to the PLC(s) in Class 1 and/or Write-to-Tag/File PDI Transfer Modes. Supported formats are: • **Byte-8 (8-bit** or SINT) • **Word-16 (16-bit** or INT) • **Dword-32 (32-bit** or DINT) ***Note:*** *The Data Block Format is independent of the PDI Data Byte-Swap Method.* *This setting is not used for the SLC, PLC-5 and MicroLogix PLCs which are always Word-16.*
PDI Data Byte-Swap Method *Default*: Work (16-bit) byte swap	If enabled, the IO-Link Master swaps the data bytes in word (2 byte) format or dword (4 byte) format. Supported values are: • **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 byte order** – data passed through after being reversed ***Note:*** *The byte swapping must be set correctly in order to convert from IO-Link (big-endian byte order), to EtherNet/IP (little-endian byte order).*
	The configurable PDO data block length. Supported optional lengths are: • Event code not included: - 4-bytes = all data - 8-bytes = all data - 10-bytes = all data - 16-bytes = all data - 20-bytes = all data - 24-bytes = all data - 32-bytes = all data - 34-bytes = 32 bytes data, 2 pad bytes - 36-bytes = 32 bytes data, 4 pad bytes • Event code included - PDO Data Format = Byte8: - 4-bytes = 2 byte event code, 2 data bytes

PDO Data Block Size (From PLC) *Default*: 32-bytes	- 8-bytes = 2 byte event code, 6 data bytes - 10-bytes = 2 byte event code, 8 data bytes - 16-bytes = 2 byte event code, 14 data bytes - 20-bytes = 2 byte event code, 18 data bytes - 24-bytes = 2 byte event code, 22 data bytes - 32-bytes = 2 byte event code, 30 data bytes - 34-bytes = 2 byte event code, 32 data bytes - 36-bytes = 2 byte event code, 32 data bytes, 2 byte pad • Event code included - PDO Data Format = word (16-bit): - 4-bytes = event code word, data word - 8-bytes = event code word, 3 data words - 10-bytes = event code word, 4 data words - 16-bytes = event code word, 7 data words - 20-bytes = event code word, 9 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 - 36-bytes = event code word, 16 data words, pad word • Event code included - PDO Data Format = dword (32-bit): - 4-bytes = event code dword - 8-bytes = event code dword, data dword - 10-bytes = event code dword, data dwords - 16-bytes = event code dword, 3 data dwords - 20-bytes = dword event code, 4 data dwords - 24-bytes = dword event code, 5 data dwords - 32-bytes = dword event code, 7 data dwords - 34-bytes = dword event code, 7 data dwords, 2 data bytes 36-bytes = dword event code, 8 data dwords
PDO Data Block Format (From PLC) *Default*: Word-16	Data format of PDO data block received from the PLC(s) in Class 1 or Read from TagOrFile PDO Transfer Modes. Formats include: • **Byte-8 (8-bit)** • **Word-16 (16-bit)** • **Dword-32 (32-bit)** ***Note:*** *The Data Block Format is independent of the PDO Data Byte-Swap Method.* *This setting is not used for the SLC, PLC-5 and MicroLogix PLCs which are always Word-16.*
PDO Data Byte-Swap Method *Default*: Word (16-bit) byte- swap	If enabled, the IO-Link Master swaps the data bytes in word (2 byte) format or dword (4 byte) format. Supported values are: • **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 byte order** – data passed through after being reversed ***Note:*** *The byte swapping must be set correctly in order to convert from EtherNet/IP (little-endian byte order), to IO-Link (big-endian byte order).*
Clear Event Code in PDO Block *Default*: False	If enabled, the IO-Link Master expects the first 2 bytes, word, or dword of the PDO block to be used for event code handling. Supported values are: • **True** (enable check box) = expect event code • **False** = no event code, expect only PDO data
Clear Event Code After Hold Time	If enabled, the IO-Link Master clears any event code reported in the PDI data block after the **Event Active Hold Time**. Supported values are:

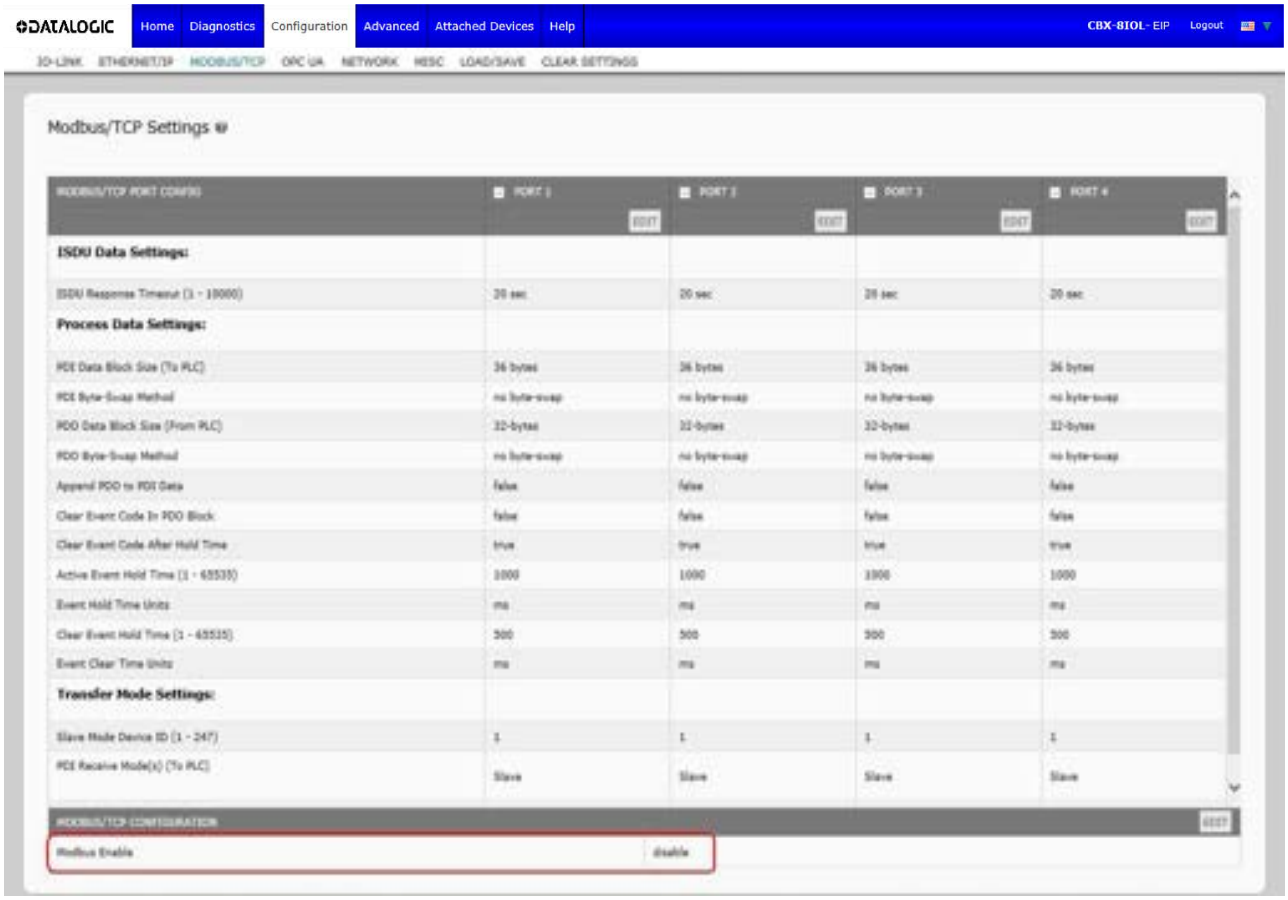
Default: True	• **True** (enable check box) = clear event code after hold time • **False** = do not clear event code after hold time
Active Event Hold Time *Default*: 1000 ms	If **Clear Event Code After Hold** time is enabled, the time period an event code is reported in the PDI block before it is cleared. • Valid range: **1-65535** • Valid units: - **ms** (milliseconds) - **sec** (seconds) - **min** (minutes) - **hours** - **days**
Event Hold Time Units *Default*: ms	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 *Default*: 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 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	
PDI Receive Mode(s) to PLC *Default*: Polling, Class1	Determines which PDI Receive (To PLC) Modes are enabled. Supported modes are: • **Polling** • **Class1** **Write-to-TagOrFile**
PDO Transmit Mode from PLC *Default*: Class 1	Supported modes are: • **Off** • **PLC-Writes** • **Class1** **Read-from-TagOrFile**
Read/Write Tag/File Settings	
PLC IP Address (xxx.xxx.xxx.xxx) *Default*: 0.0.0.0	The PLC IP Address is required if either **Write-to-TagOrFile** or **Read-from-TagOrFile** mode are enabled.

	Format: xxx.xxx.xxx.xxx
PLC Controller Slot Number *Default*: 0	The PLC Controller Slot Number is required if either **Write-to-TagOrFile** or **Read-from-TagOrFile** mode are enabled. Valid range: **0-64**
PLC Type *Default*: ControlLogix	Indicates the type of PLC that the tag(s) or file(s) are written to and/or read from. Supported PLC Types are: • **ControlLogix** • **SLC** • **PLC-5** **MicroLogix**
Write PDI to Tag/File Settings	
PDI Tag/File Name *Default*: *blank*	The tag or file name to place the PDI data block. • ControlLogix family: - Tags must be same type as **PDI Data Format** (SINT, INT or DINT). - Tags must be an array. - Tags must be at least as long as the **PDI Data Block Length**. • SLC/PLC-5/MicroLogix: - Files must be of INTEGER (16-bit) type. - Files must be named with standard file name conventions (i.e: N10:0, N21:30, etc) The file must be at least as long as the **PDI Data Block Length**.
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
Maximum PLC Update Rate *Default*: 40ms	The maximum rate at which the IO-Link Master updates the PDI tag or file. This parameter is used to ensure that the PLC receives all state changes. Setting the update rate to 10 ms effectively disables this feature. The valid range is 10 to 65535 ms.
Heartbeat Update Enable *Default*: False	If selected, the IO-Link Master updates the PDI data block at the **Heartbeat Update Rate**. • **False** = Heartbeat update disabled • **True** (enable check box) = Heartbeat update enabled
Heartbeat Update Rate *Default*: 1000ms	If **Heartbeat Update Enable** is selected, the rate at which the IO-Link Master updates the PDI data block in the **Write-to-Tag/File** mode. The valid range is 50 to 65535 ms.
Read PDO from Tag/File Settings	
PDO Tag/File Name *Default*: *blank*	The tag or file name that the IO-Link Master reads the PDO data block from. • ControlLogix family: - Tags must be same type as **PDO Data Format** (SINT, INT or DINT). - Tags must be an array. - Tags must be at least as long as the **PDO Data Block Length**. • SLC/PLC-5/MicroLogix: - Files must be of INTEGER (16-bit) type. - Files must be named with standard file name conventions (i.e: N10:0, N21:30, etc) The file must be at least as long as the **PDO Data Block Length**.
PLC Poll Rate *Default*: 1000ms	The frequency which the IO-Link Master reads the PDO data block in the Read-from-Tag/File mode. Valid range: **50-65535 ms**
TTL (Time To Live) Network Value (1-255) (Default: 1)	The TTL value indicates how many network “hops” can be made for Multicast packets. It is used to prevent Multicast packets from being forwarded beyond its own subnet(s). Each network router decreases the hop count when forwarding the Multicast packet.

	Once the hop count reaches zero, the Multicast packet is no longer forwarded.
Multicast IP Address Allocation Control (Default: Automatic)	This setting indicates how the starting Multicast address is determined. • Automatic – The IO-Link Master determines the starting Multicast IP address based on an EtherNet/IP specification algorithm. User-Defined – The user sets the starting Multicast address.
User-Defined Number of Multicast IP Addresses (1-32) (Default: 32)	When the Multicast IP Address Allocation Control is set to User-Defined, the maximum number of Multicast addresses that the IO-Link Master may use.
User-Defined Multicast Start IP Address (239.192.1.0-239.255.255.255) (Default: 239.192.1.0)	When the multicast IP Address Allocation Control is set to User-Defined, the Multicast starting IP address for the IO-Link Master. Make sure you avoid redundant Multicast IP addresses on a network.
Session Encapsulation Timeout (0=disable; 1-3600 sec) (0 - 3600) (Default = 120)	Defines the inactivity period before an established session between a controller, such as a PLC, and the IOLM will time out. If such a timeout occurs, the current session is closed and a new session must be established before communications can resume between the controller and the IOLM.

5.4 MODBUS/TCP SETTINGS CONFIGURATION PAGE

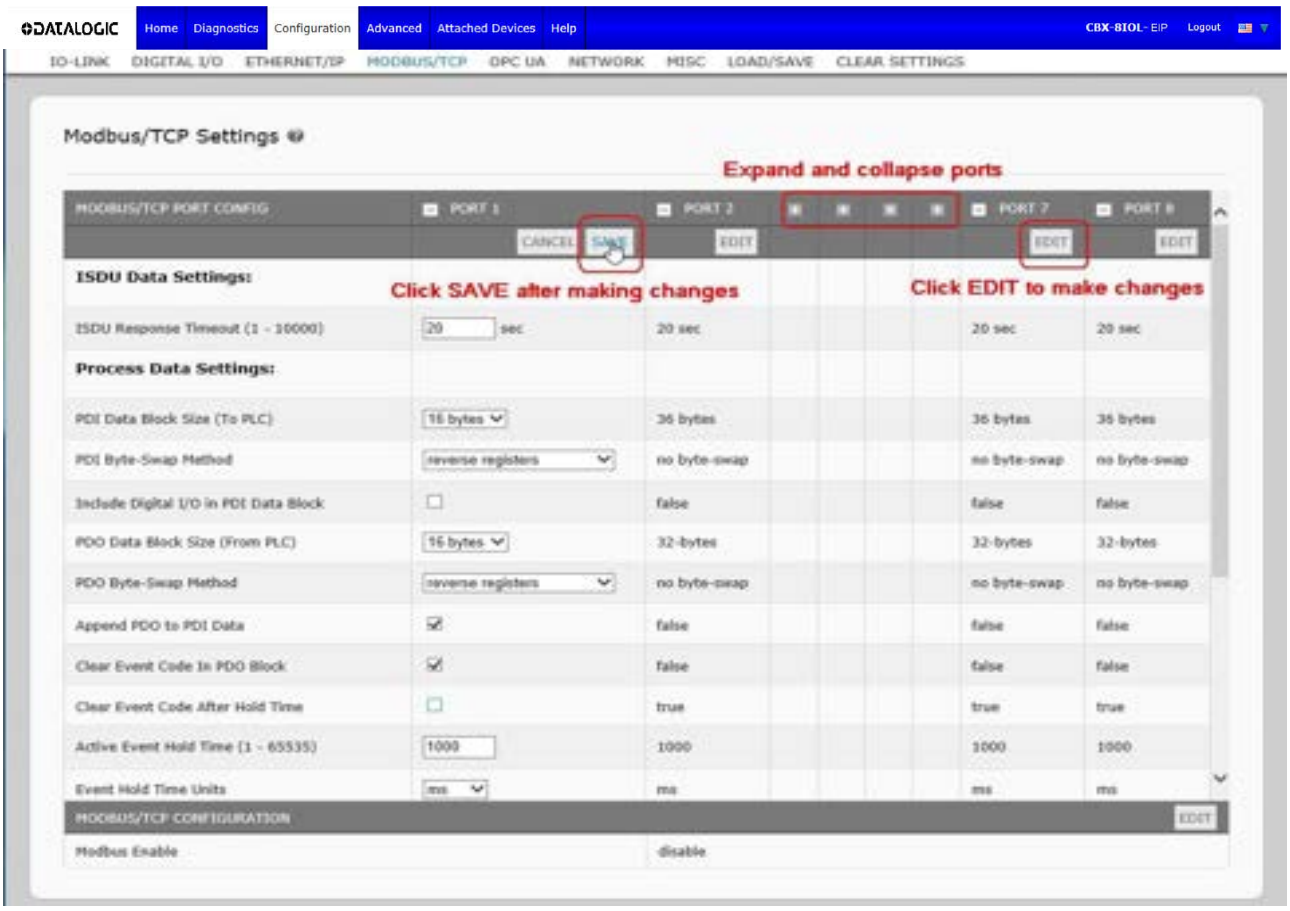
You can use the **Configuration | Modbus/TCP Settings** page to configure Modbus/TCP with the IO-Link Master.



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

5.4.1 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 par. 5.4.2.
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**.

5.4.2 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)
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) – Include the digital I/O pins status in PDI data block header ***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

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
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**
	Valid Units:

Event Clear Time 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**
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.

5.5 OPC UA SETTINGS CONFIGURATION PAGE

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

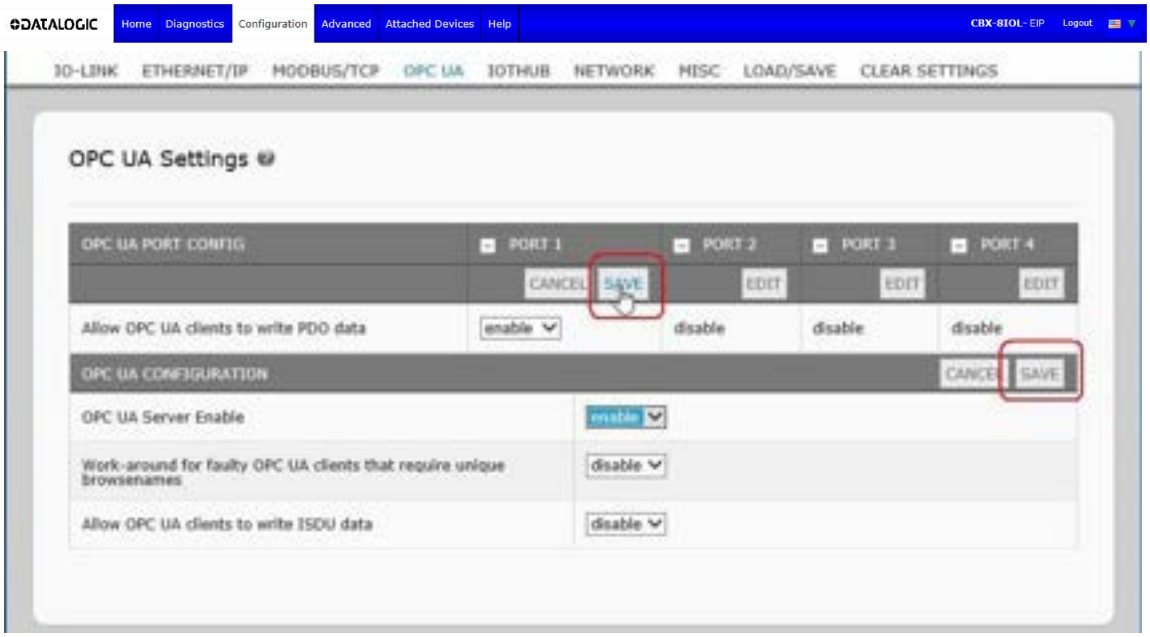
Note: Not all models support OPC UA.

Note: OPC UA is disabled by default.

5.5.1 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 par. 5.5.2.
5. Click the **SAVE** button.

5.5.2 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.

6 LOADING AND MANAGING IODD FILES

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

6.1 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.

6.1.1 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.

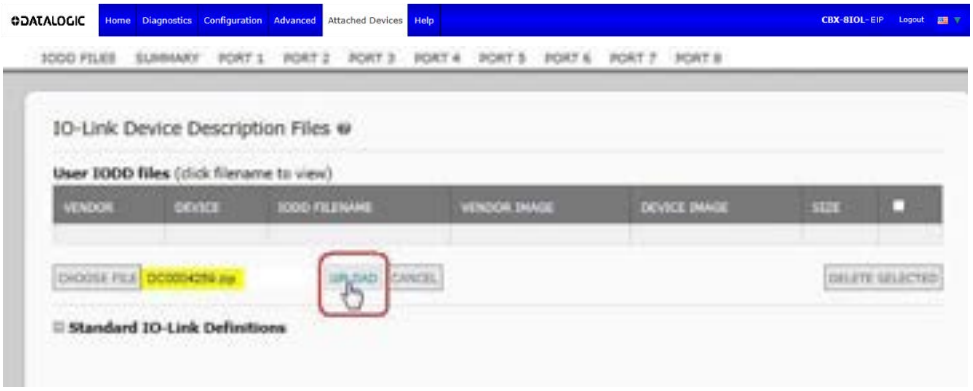
- Open the **xml** file and search for the **productID**, which identifies the IO-Link device.
- Zip the **xml** file along with the supporting images. There are several ways to locate the supporting images:
  - Locate the appropriate images using the **xml** file.
  - Load only the **xml** file and the IOLM notifies you what files are missing. Use the **UPDATE** feature to upload the missing images.
  - Zip the **xml** with all 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.

6.1.2 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.

6.1.3 Uploading xml Files or Supporting Files

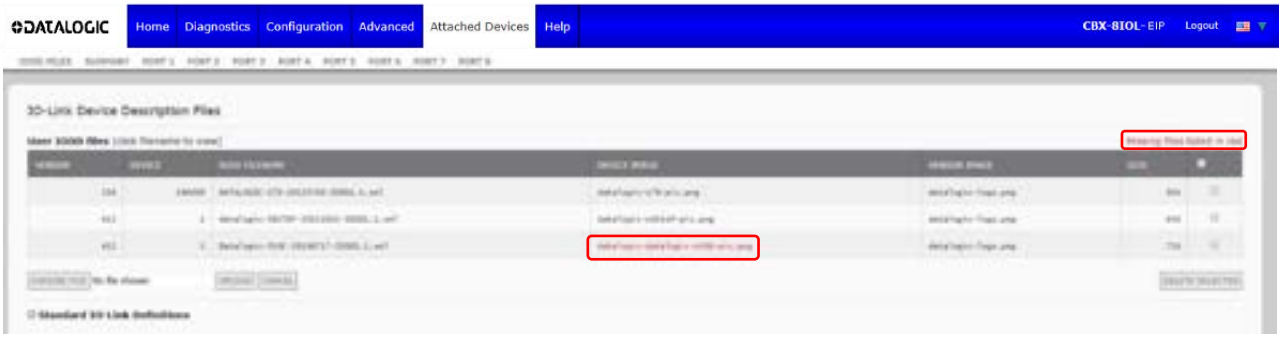
You can use the following procedure to upload **xml** or supporting image files.

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.

6.1.4 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.

6.1.5 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.

6.2 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 chap. 7 more information.

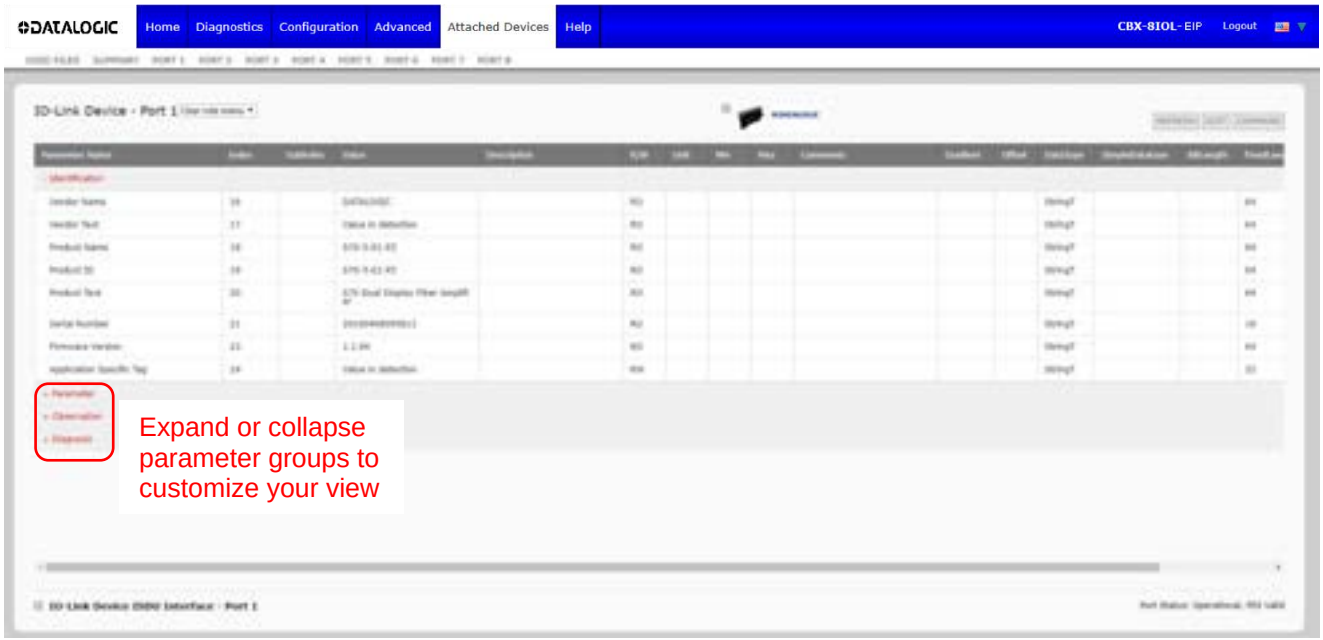
7 CONFIGURING IO-LINK DEVICES

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.

7.1 PORT PAGES OVERVIEW

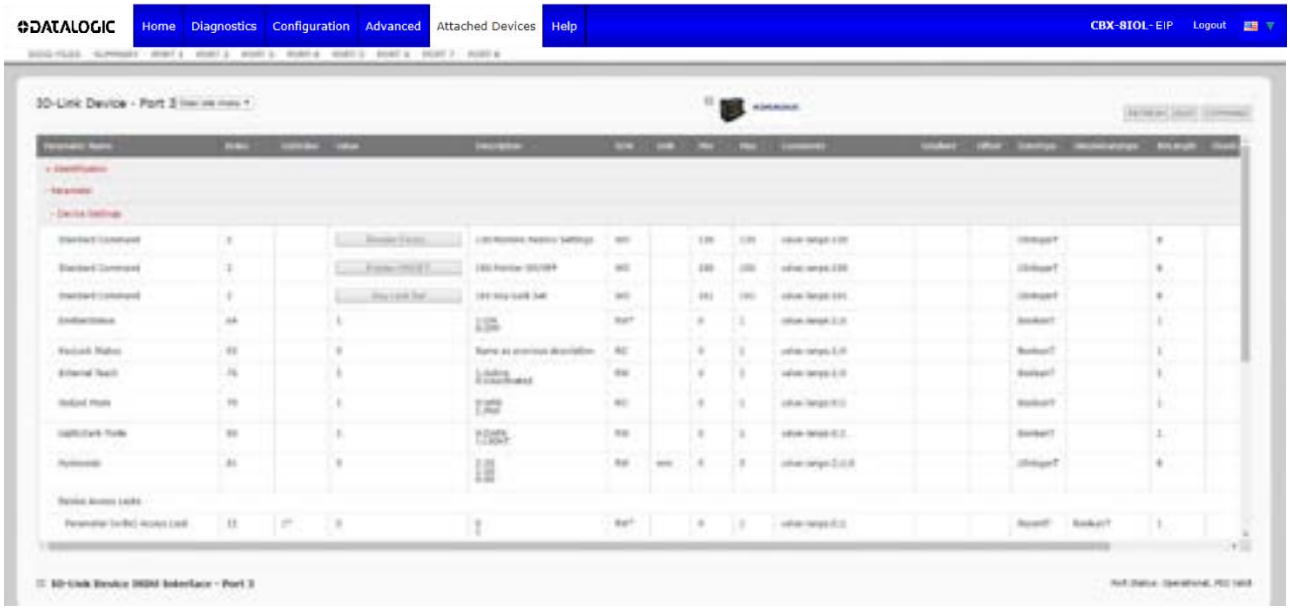
You can use the **Attached Devices |** Port page for a port to review and easily edit the IO-Link device configuration or view Process Data.



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.
- **IO-Link Device ISDU Interface - Port**, which can be used with or without IODD files loaded.

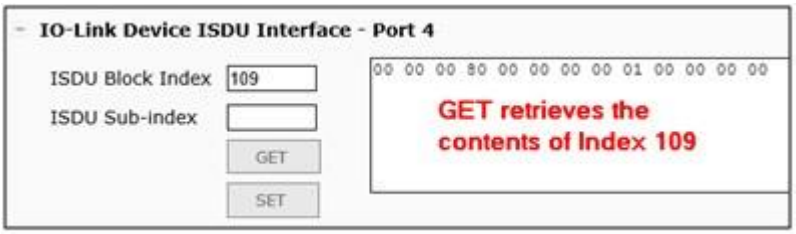
The **IO-Link Device Port** table provides detailed information about the indexes and sub-indexes. Not all indexes have sub-indexes.



- 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.

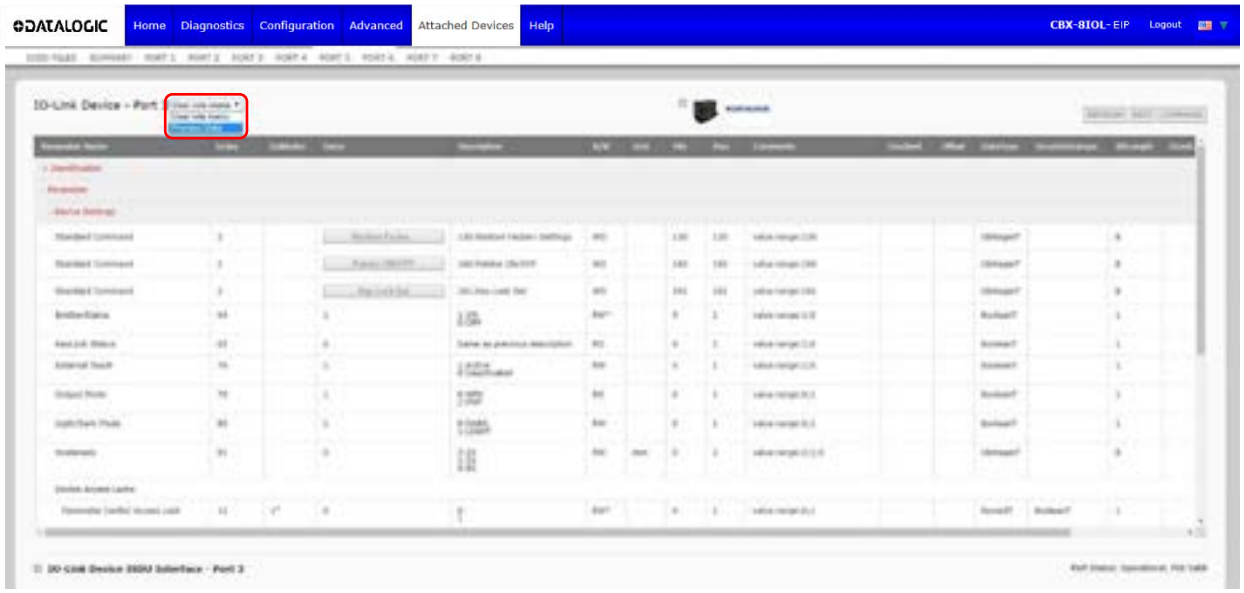
Index	Subindex	Value	Description	R/W	Unit	Min	Max	Comments	Gradient	Offset	DataType	SimpleDataType	BitLength
109	1*	2248		RO				dynamic parameter			RecordT	UIntegerT	16
109	2*	2515		RO				dynamic parameter			RecordT	UIntegerT	16
109	3*	3		RO				dynamic parameter			RecordT	UIntegerT	8
109	4*	1		RO				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.

7.2 EDITING PARAMETERS – IO-LINK DEVICE – PORT TABLE

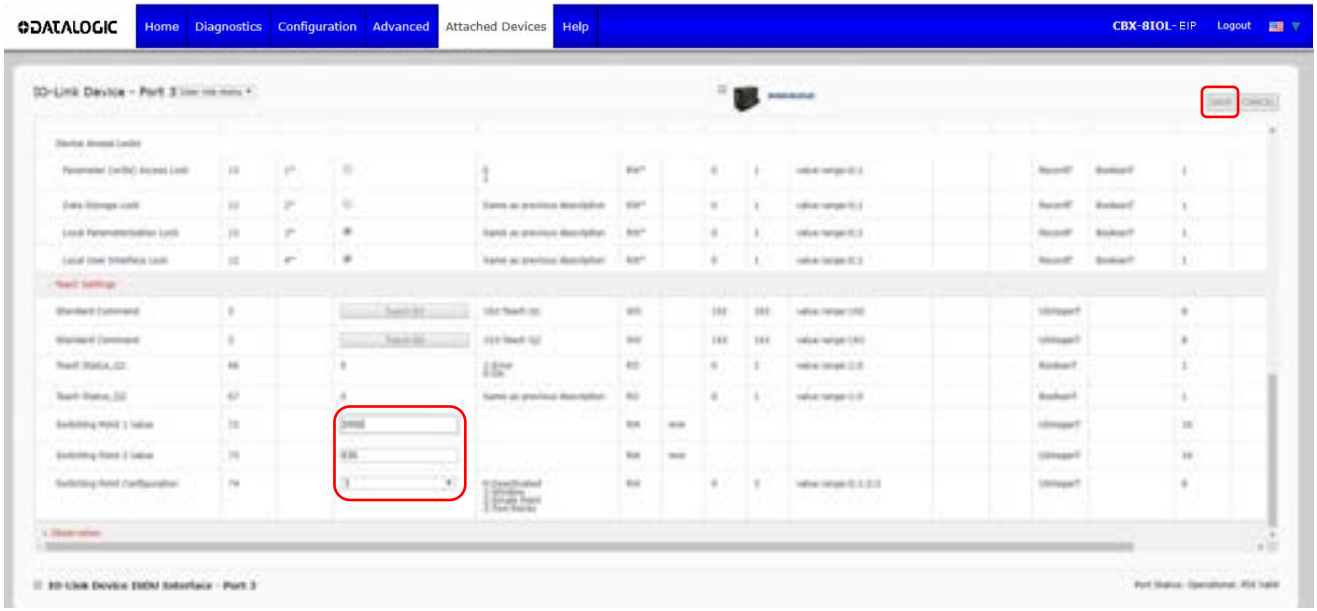
Use the following procedure to edit IO-Link device parameters using the **IO-Link Device Port** table.

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 (see Loading and Managing IODD Files).
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.



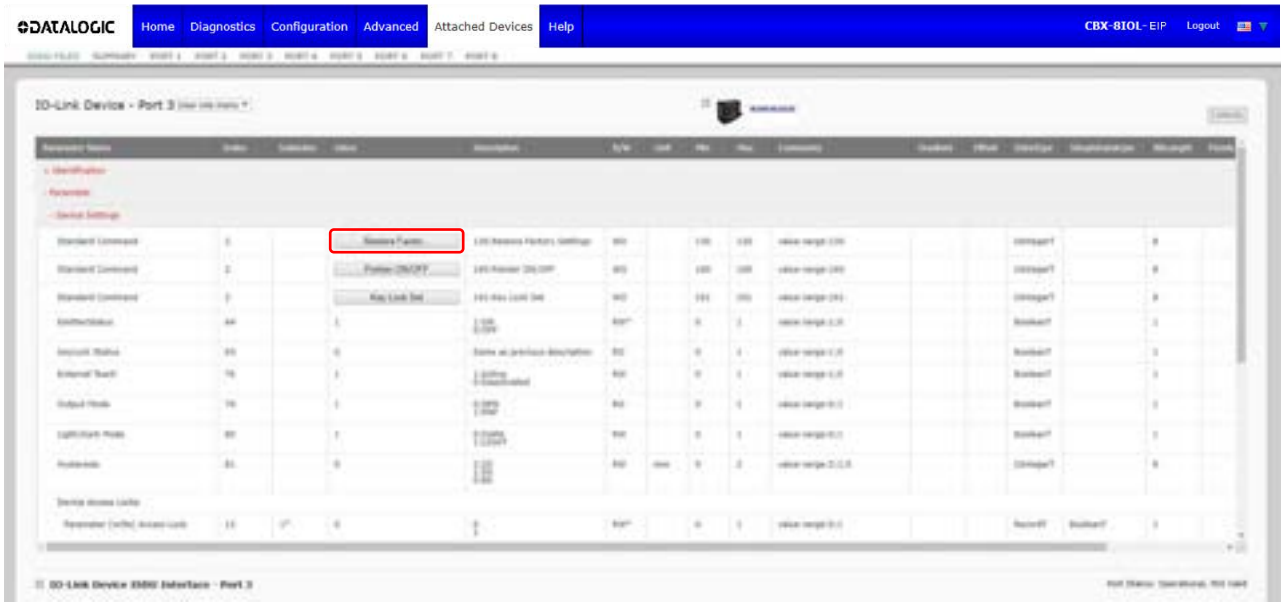
5. Click the **SAVE** button after editing the parameters.

7.3 RESETTING IO-LINK DEVICE PARAMETERS TO FACTORY DEFAULT

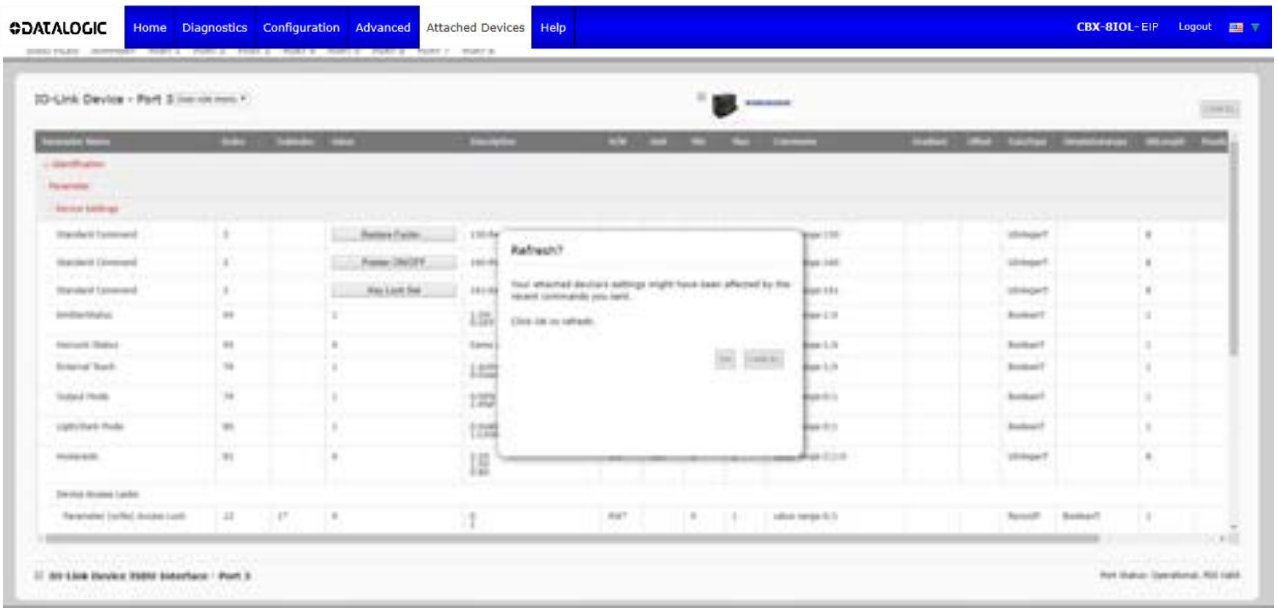
In the event you want to reset the IO-Link device to factory default, typically the IODD file provides the ability from the IO-Link device manufacturer. Use the following example to reset an IO-Link device.

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.



7.4 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.

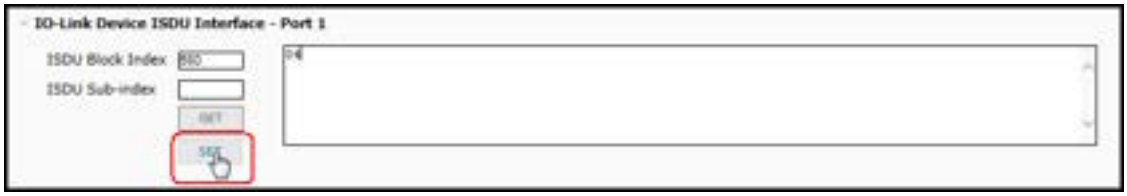
If an IODD file has not been loaded for an IO-Link device, refer to the IO-Link Device Instruction Manual to determine the ISDU indexes.

7.4.1 Overview

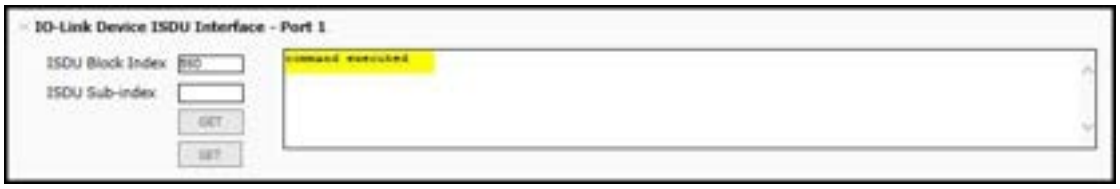
The following provides some basic information about the command usage and responses when using the ISDU Interface.

- 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.

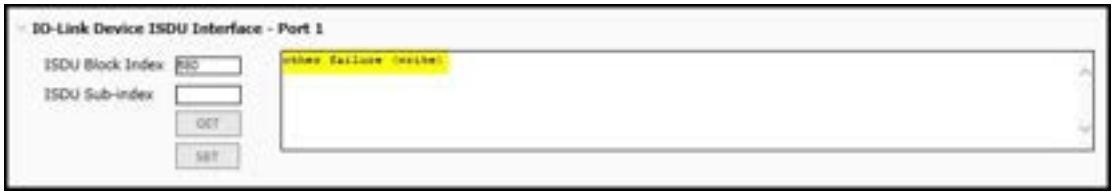
- The **SET** button sends the value to the IO-Link device.



- 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.



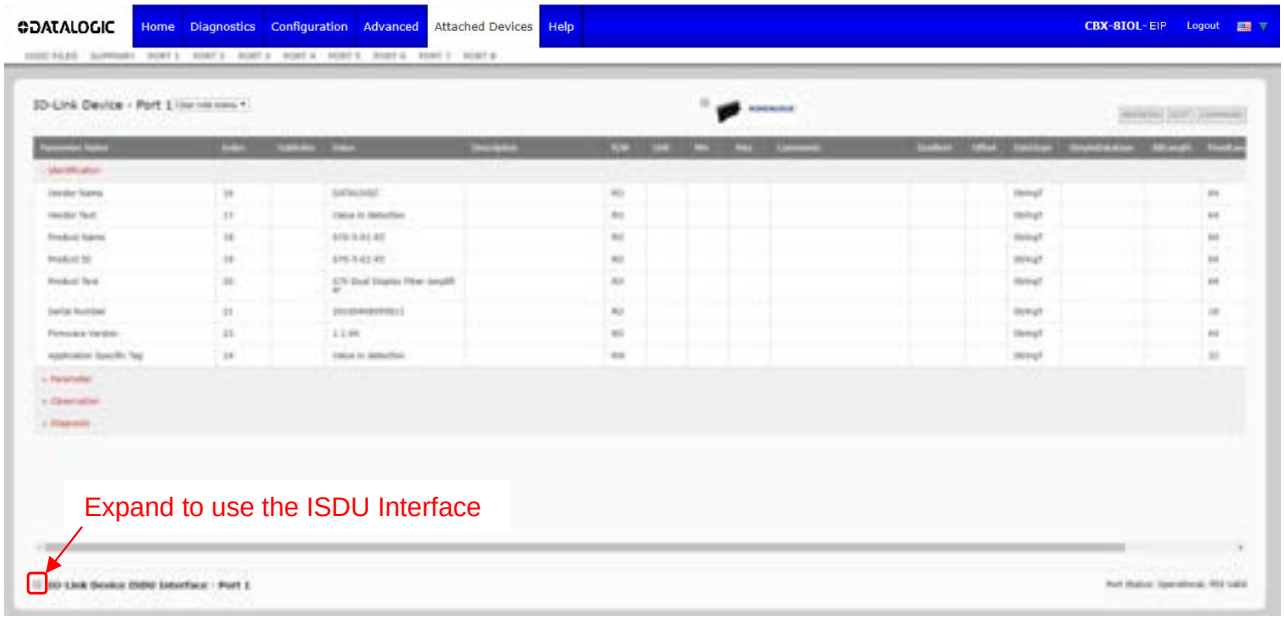
- This message indicates that the IO-Link device cannot read the specified ISDU Block Index and Sub-index.

7.4.2 How to Use the Interface

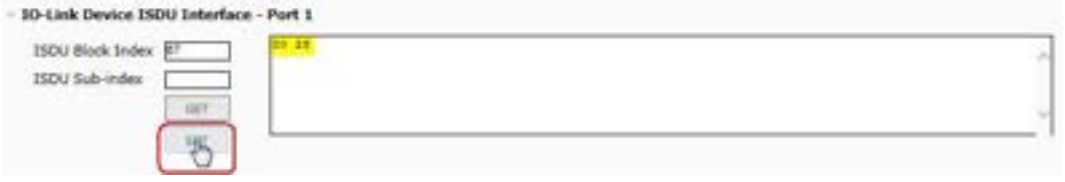
Use the following procedure to edit parameters using the **IO-Link Device ISDU Interface - Port**.

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.

8 UTILIZING IOLM FEATURES

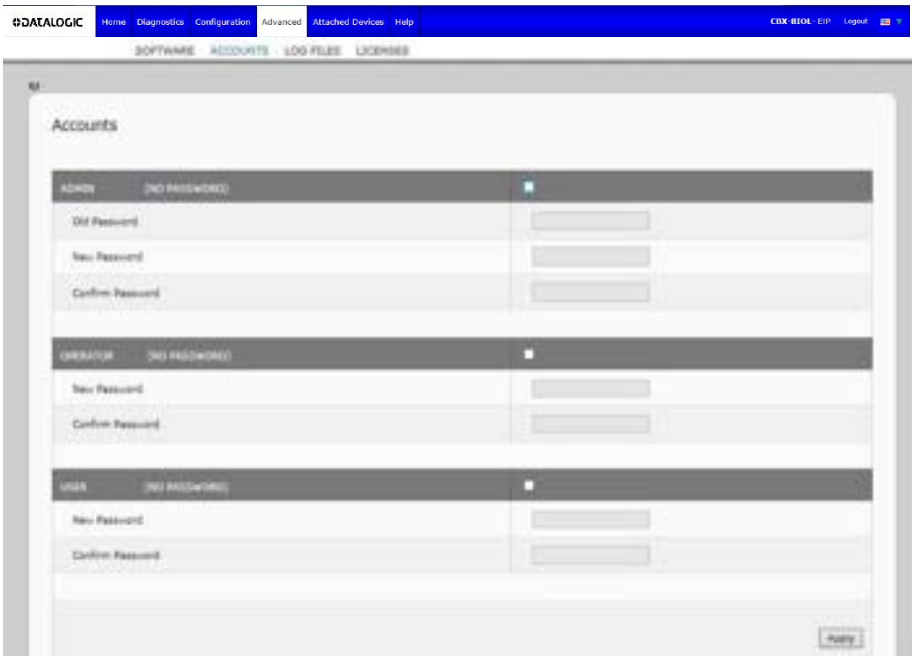
8.1 SETTING USER ACCOUNTS AND PASSWORDS

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 - EtherNet/IP Settings	Yes	Yes	View-only
Configuration - Modbus/TCP	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.

8.2 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.

8.2.1 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 do 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.

8.2.2 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 whose 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.

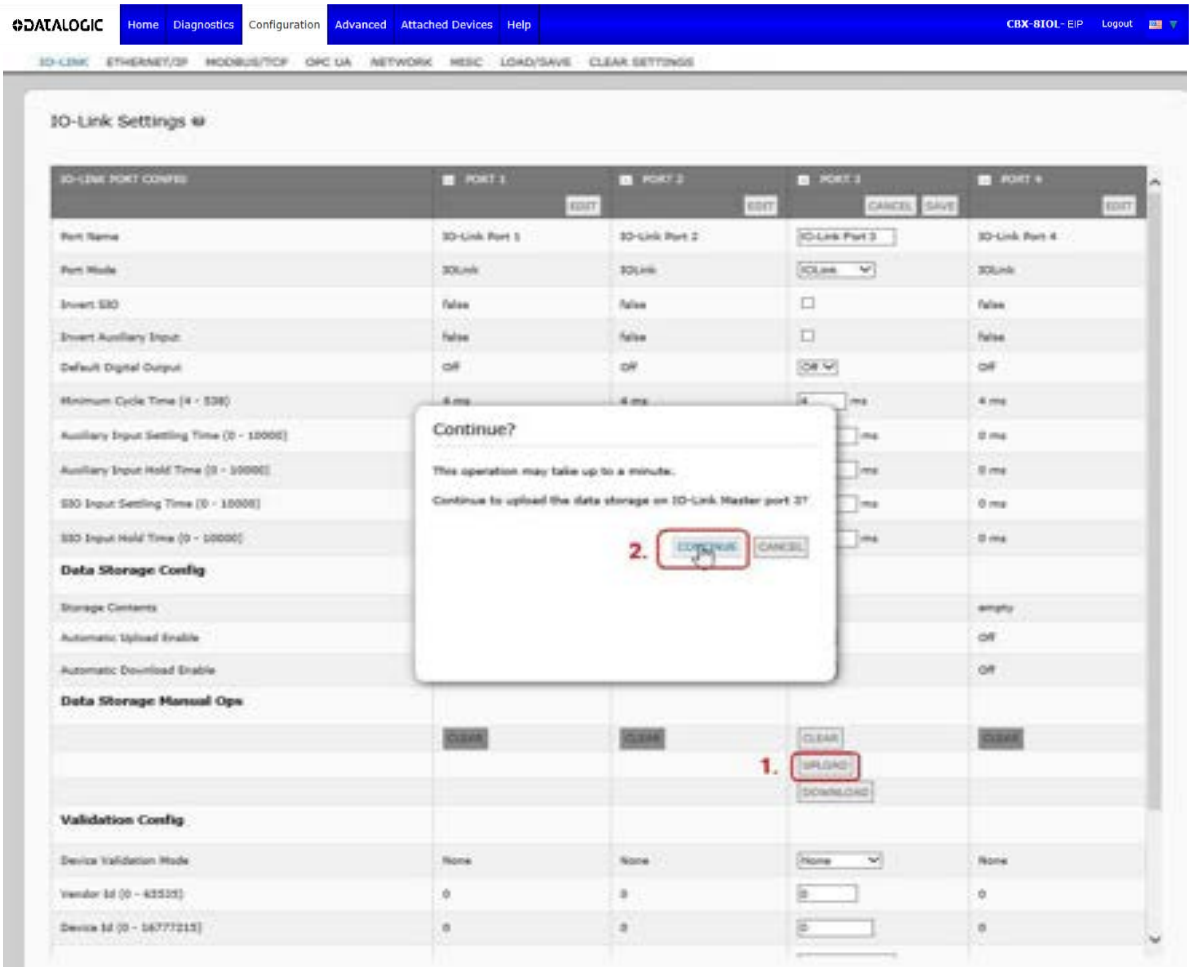
- ***Data Storage Manual Ops: DOWNLOAD -*** Selecting the **DOWNLOAD** button downloads the data storage from the that port to the IO-Link device.

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.

8.2.3 Automatic Device Configuration

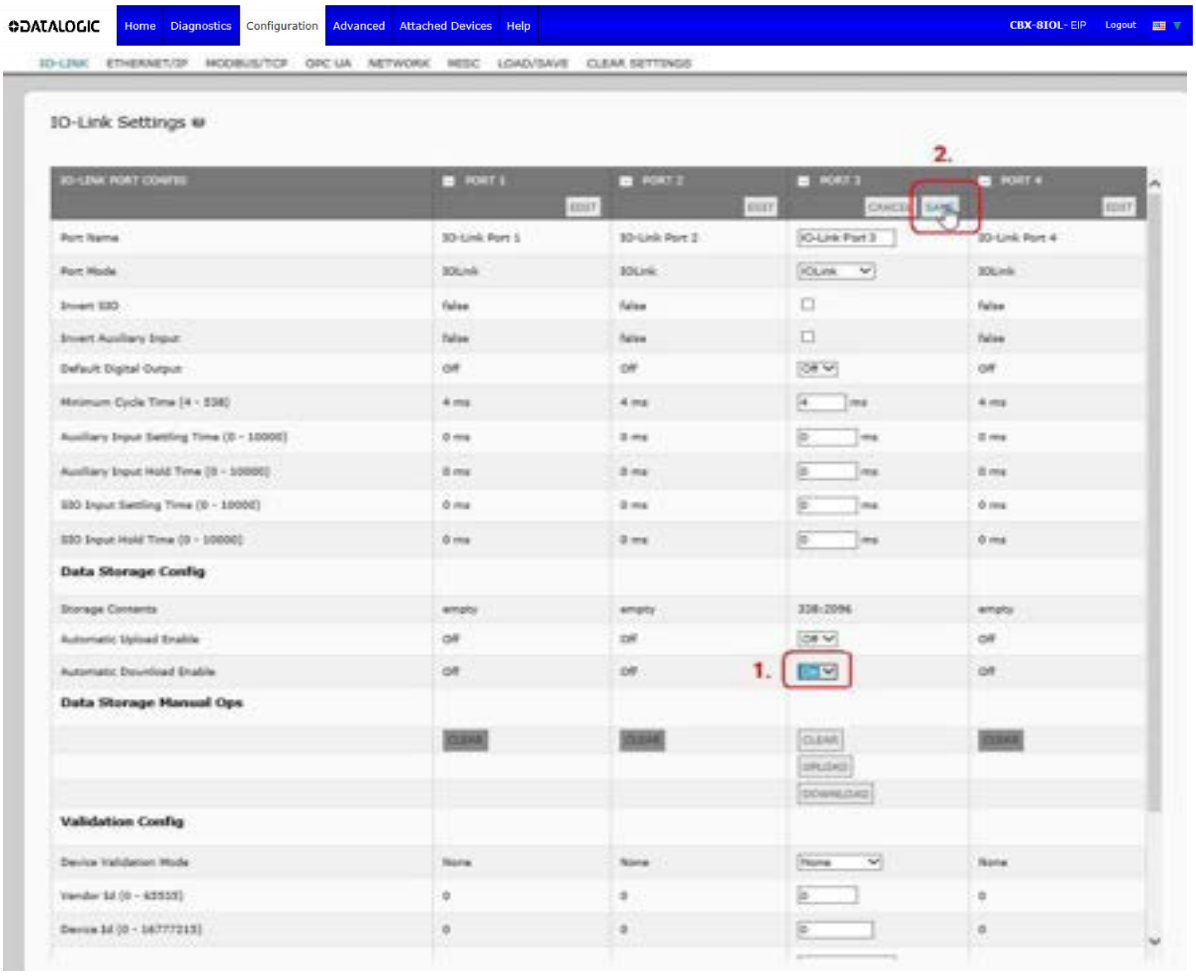
Use the following steps to use an IOLM port to configure multiple IO-Link devices with the same configuration parameters.

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**.



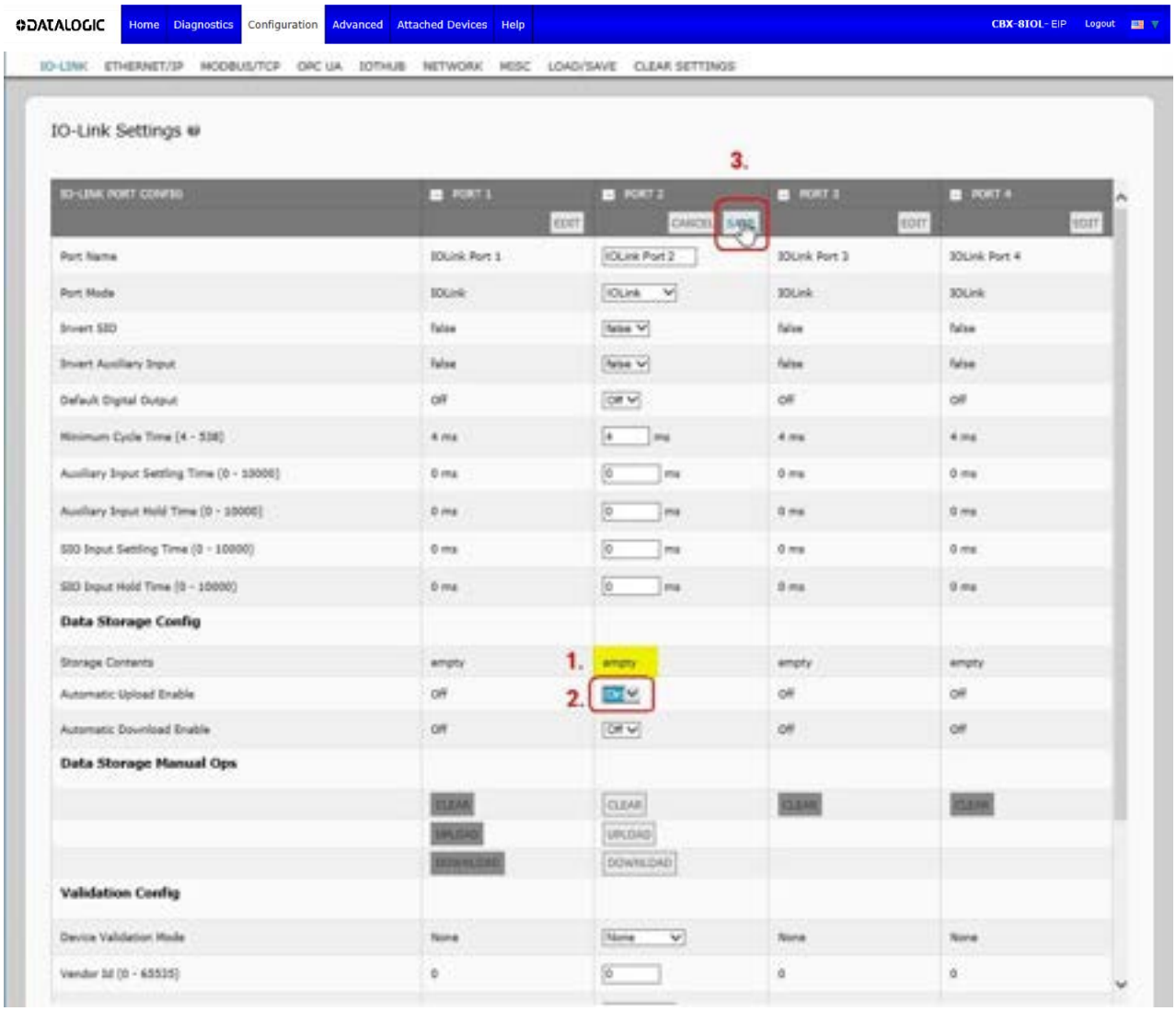
8. Click **SAVE**.
9. Click **Diagnostics | IO-Link**.
10. Replace the IO-Link device on that port with the IO-Link device for which you want configured automatically.
11. Verify that the IO-Link device displays operational **Port Status** and the appropriate IO-Link State.
12. Repeat Steps 10 and 11 for as many devices as you want to configure.

8.2.4 Automatic Device Configuration Backup

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

Remember, if you adjust parameters using **Teach** buttons those values may or may not 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.

8.3 DEVICE VALIDATION

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

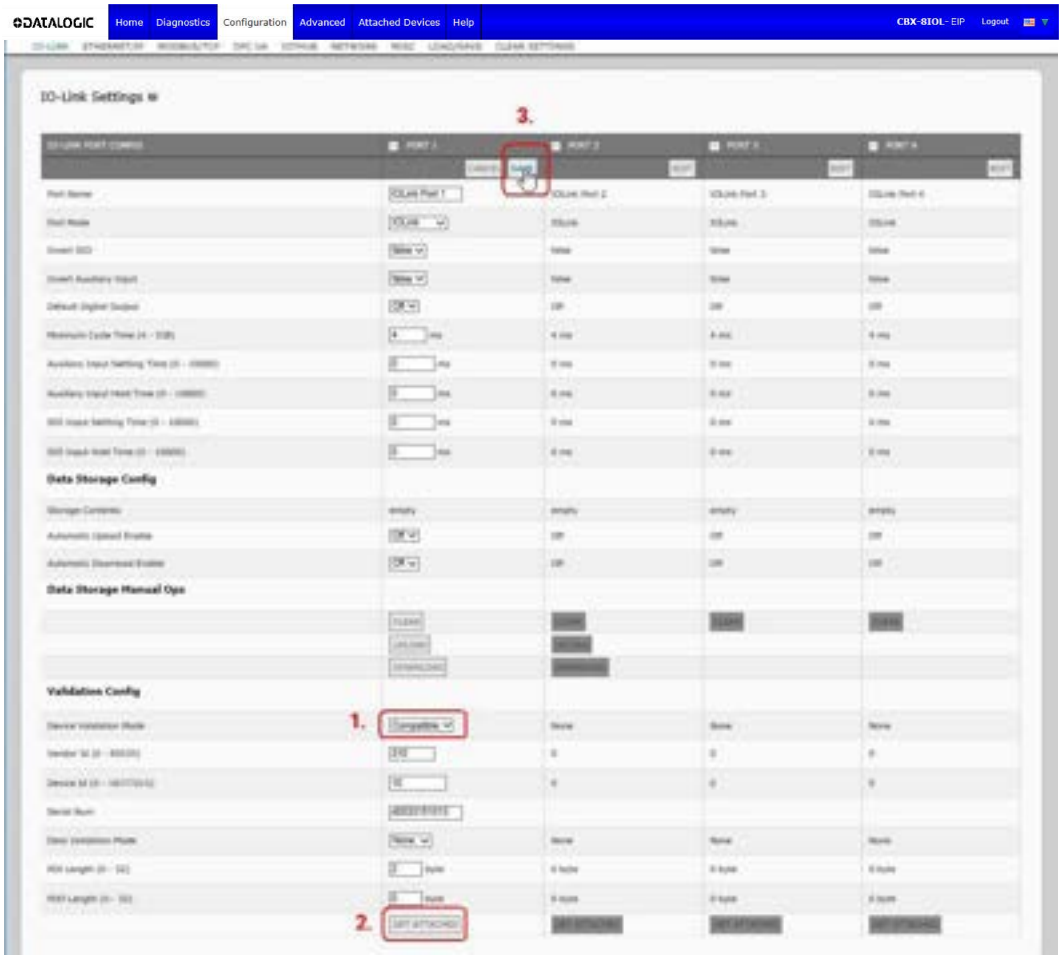
- **None** - this disables **Device Validation Mode**.
- **Compatible** - permits a compatible IO-Link device (same Vendor ID and Device ID) to function on the corresponding port.
- **Identical** - only permits an IO-Link device (same Vendor ID, Device ID, and serial number) to function on the corresponding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

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.

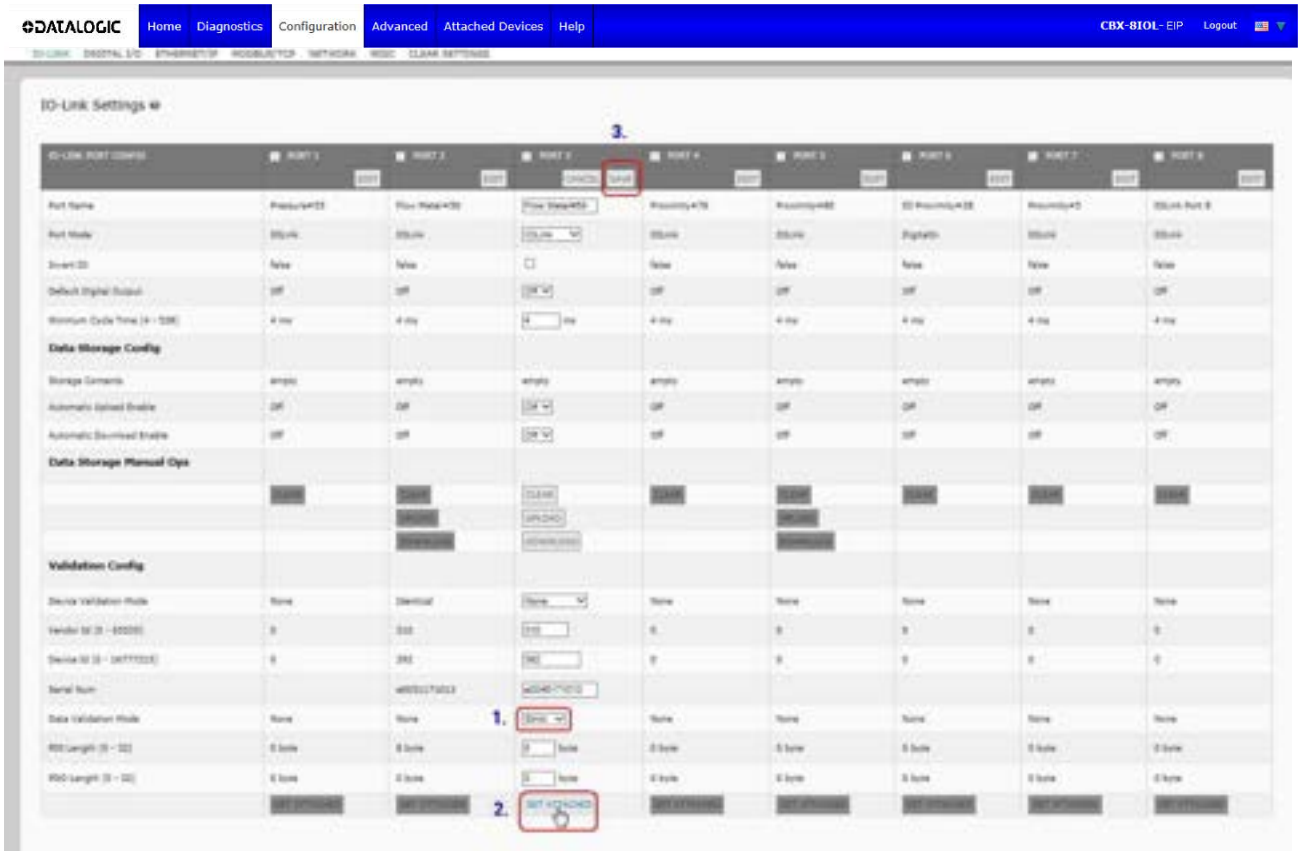


5. Click the **SAVE** button. If the wrong or incompatible device is connected to the port, the IO-Link port LED flashes red and no IO-Link activity occurs on the port until the issue is resolved.
   In addition, the **IO-Link Diagnostics** page displays the following information.

8.4 DATA VALIDATION

You can use this procedure to configure data validation.

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.

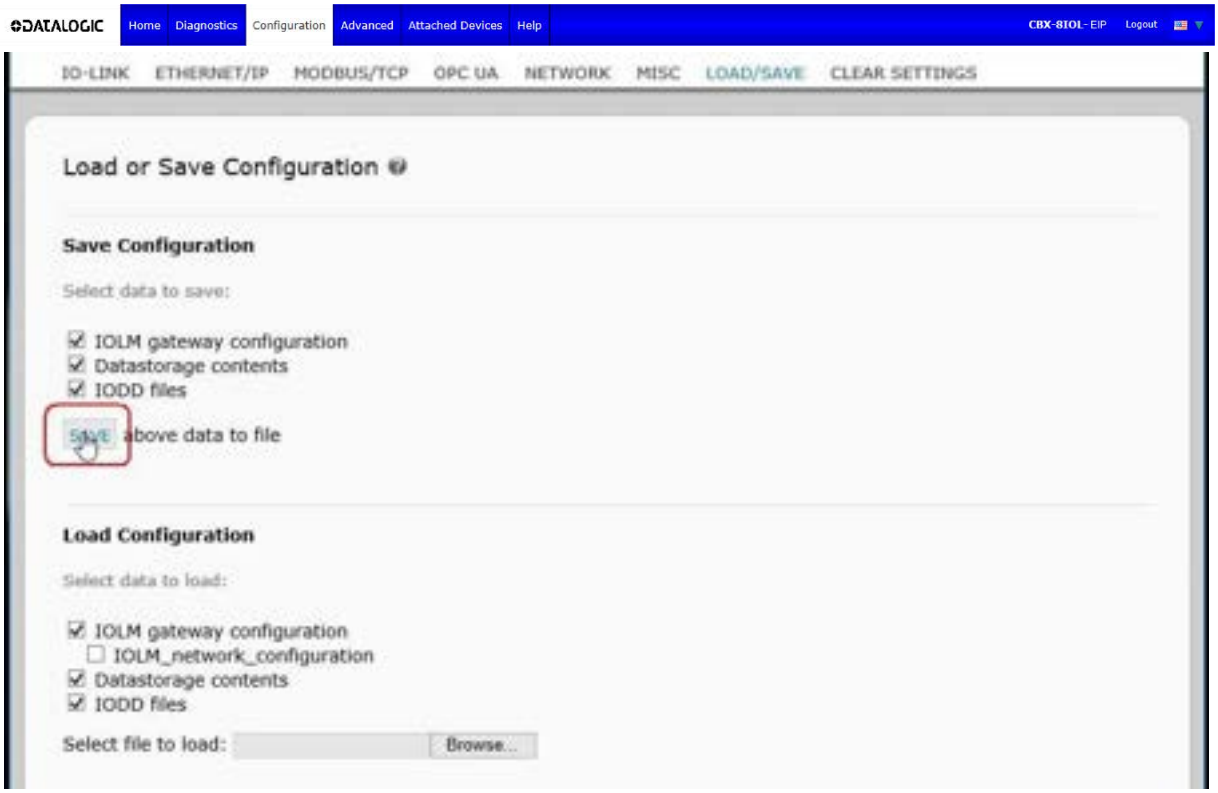
8.5 IOLM CONFIGURATION FILES

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

8.5.1 Saving Configuration Files

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

1. Click **Configuration | Load/Save**.
2. Click the **SAVE** button.

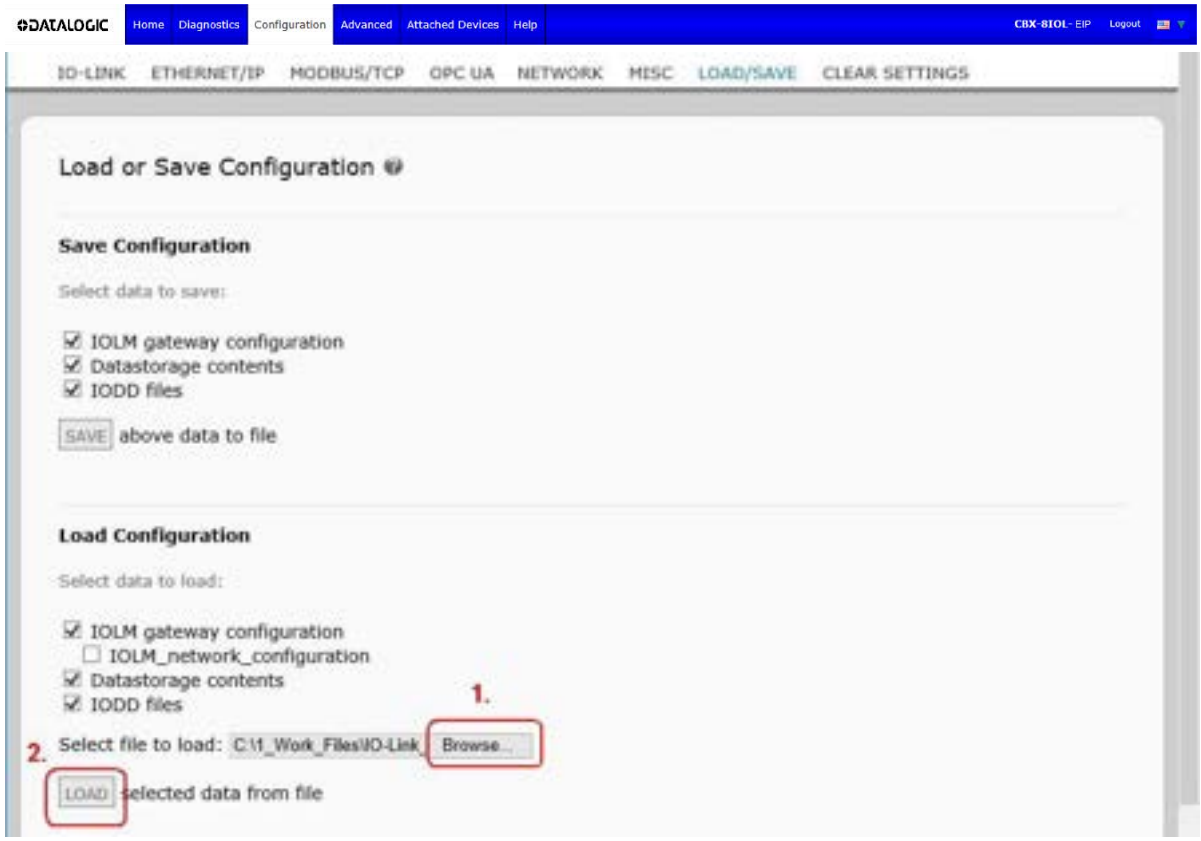


3. Click the **Save as** option and browse to the location that you want to store the configuration file.

8.5.2 Loading Configuration Files

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

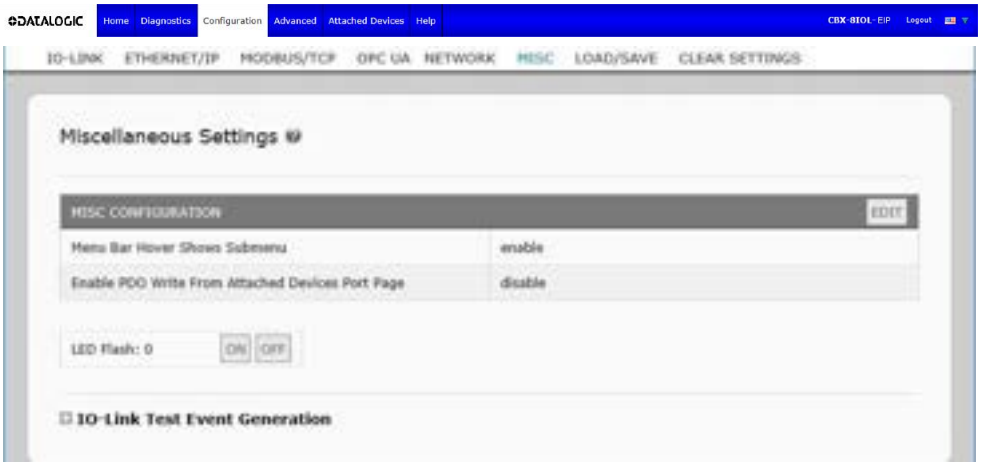
1. Click **Configuration | Load/Save**.
2. Click the **Browse** button and locate the configuration file (**.dcz** extension).
3. Click the **LOAD** button.



4. Click the **OK** button to close the *Configuration Uploaded* message that notifies you of what configuration parameters loaded.

8.6 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 par. 8.6.2 or 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.

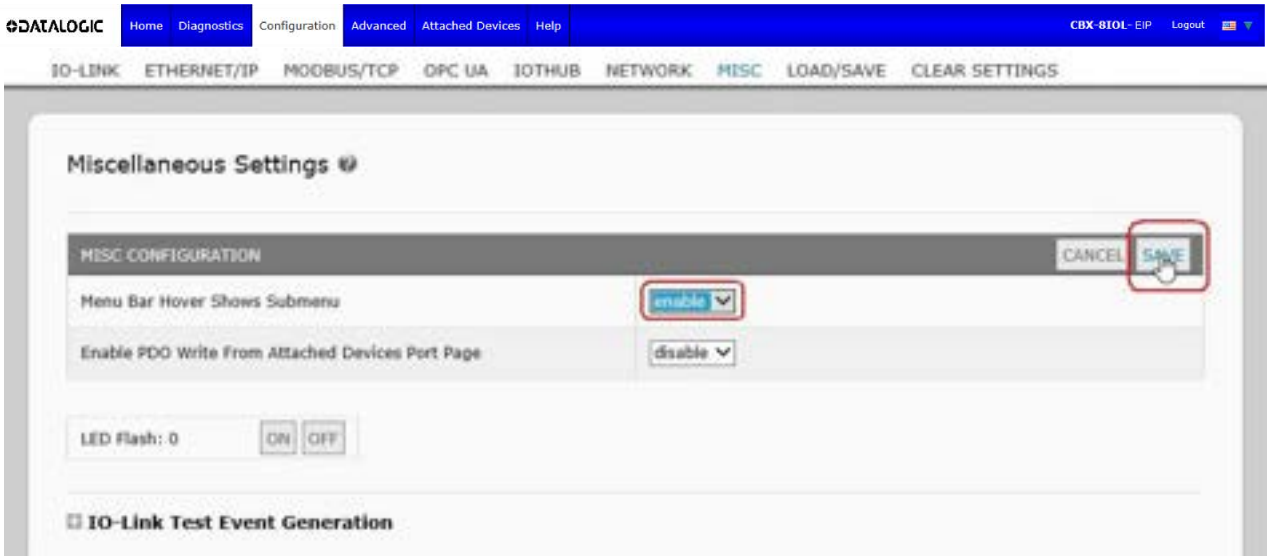
  - Click the **ON** button to enable the LED tracker feature on the IOLM. The LEDs remain flashing until you disable the LED tracker feature
  - Click the **OFF** button to disable the LED tracker.

8.6.1 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**.



8.6.2 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**.

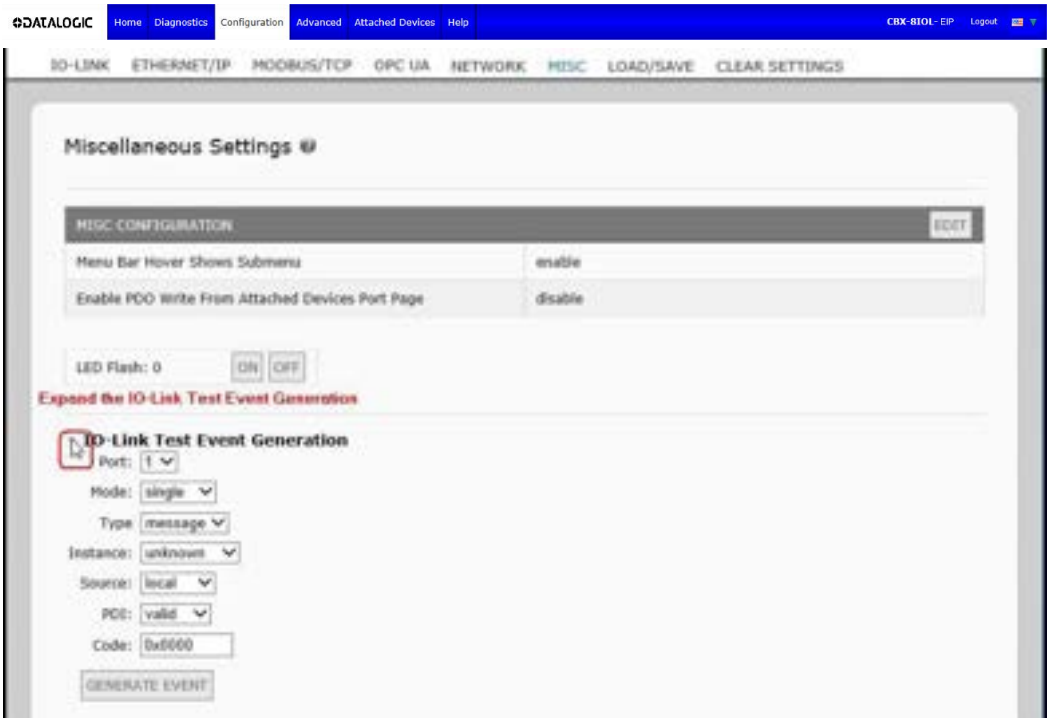
Use this procedure to enable PDO write from the **Attached Devices | Port** page.

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.

8.6.3 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**.

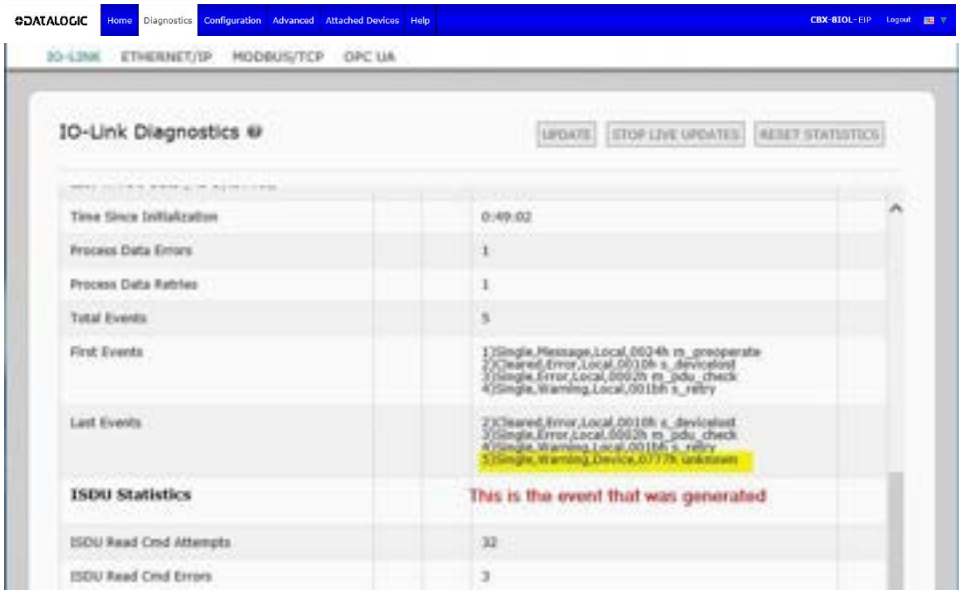


3. Select the port and type of event that you want to test.
   Use the following table to determine what type of event you want to generate.

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**.



8.7 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.

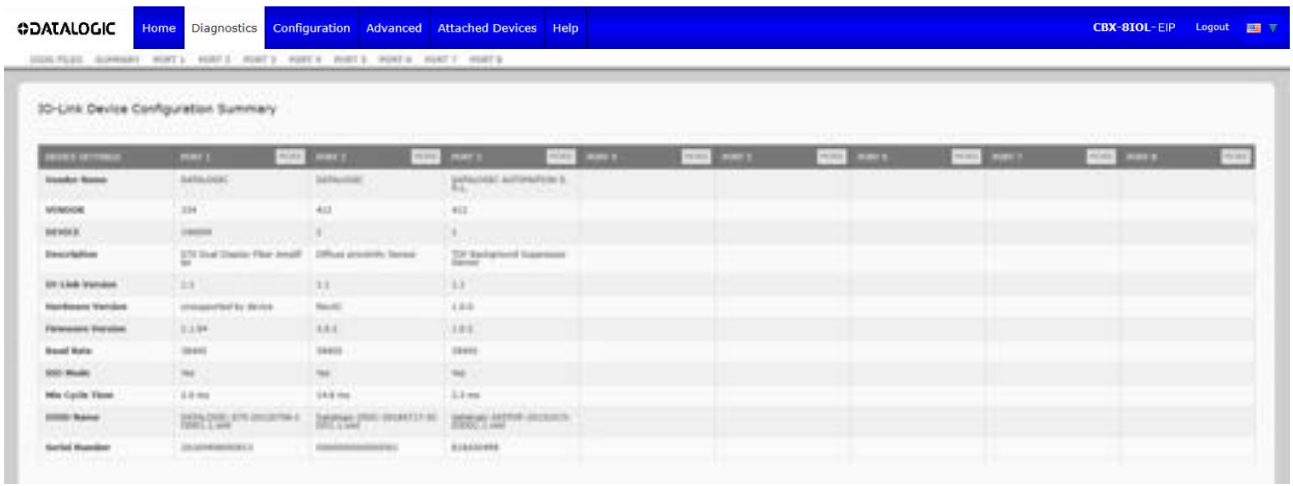
1. **Click Configuration | Clear Settings**.

2. Click the **OK** button to the *Done Configuration Cleared* message.

9 USING THE DIAGNOSTIC PAGES

9.1 IO-LINK PORT DIAGNOSTICS

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



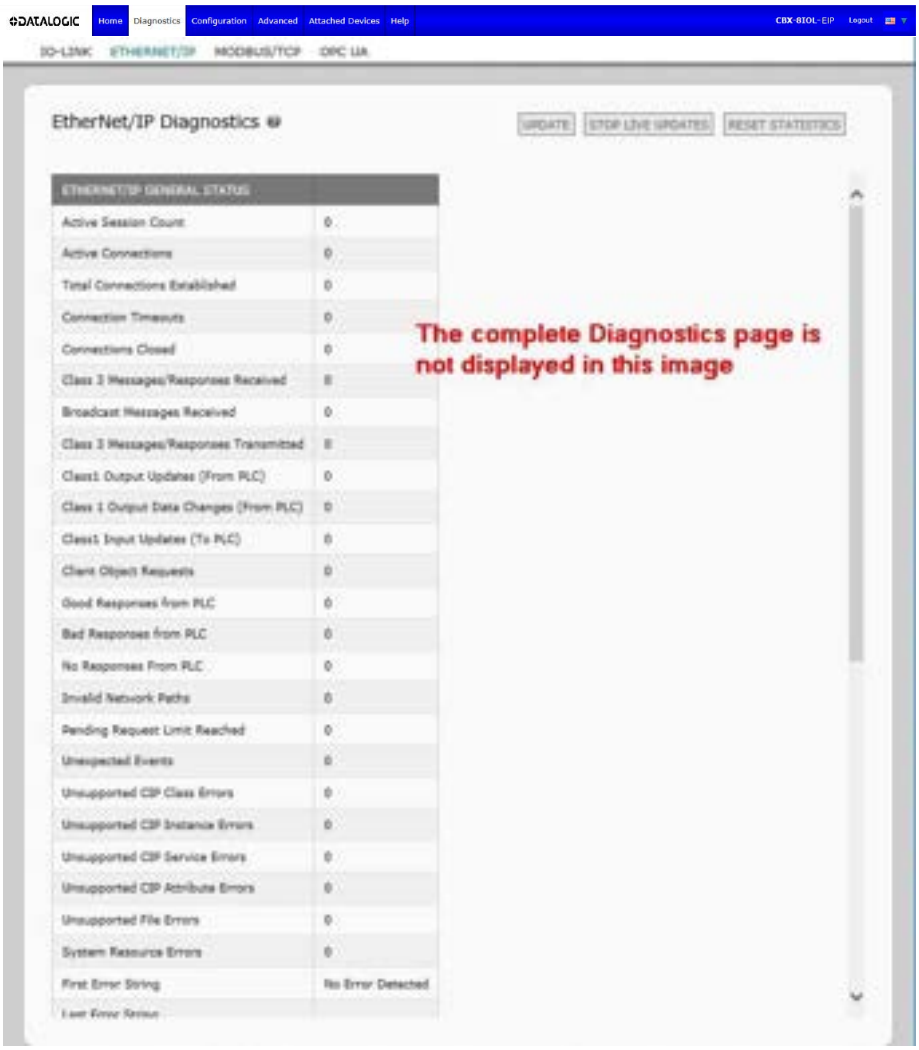
The following table provides information about the **IO-Link Diagnostics** page.

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.
	Configured in the **Configuration | IO-Link** page, this is the minimum cycle time

Configured 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 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.

9.2 ETHERNET/IP DIAGNOSTICS

The **EtherNet/IP Diagnostics** page may be useful when trying to troubleshoot EtherNet/IP communications and port issues related to EtherNet/IP configuration.



The following table provides information about the **EtherNet/IP Diagnostics** page.

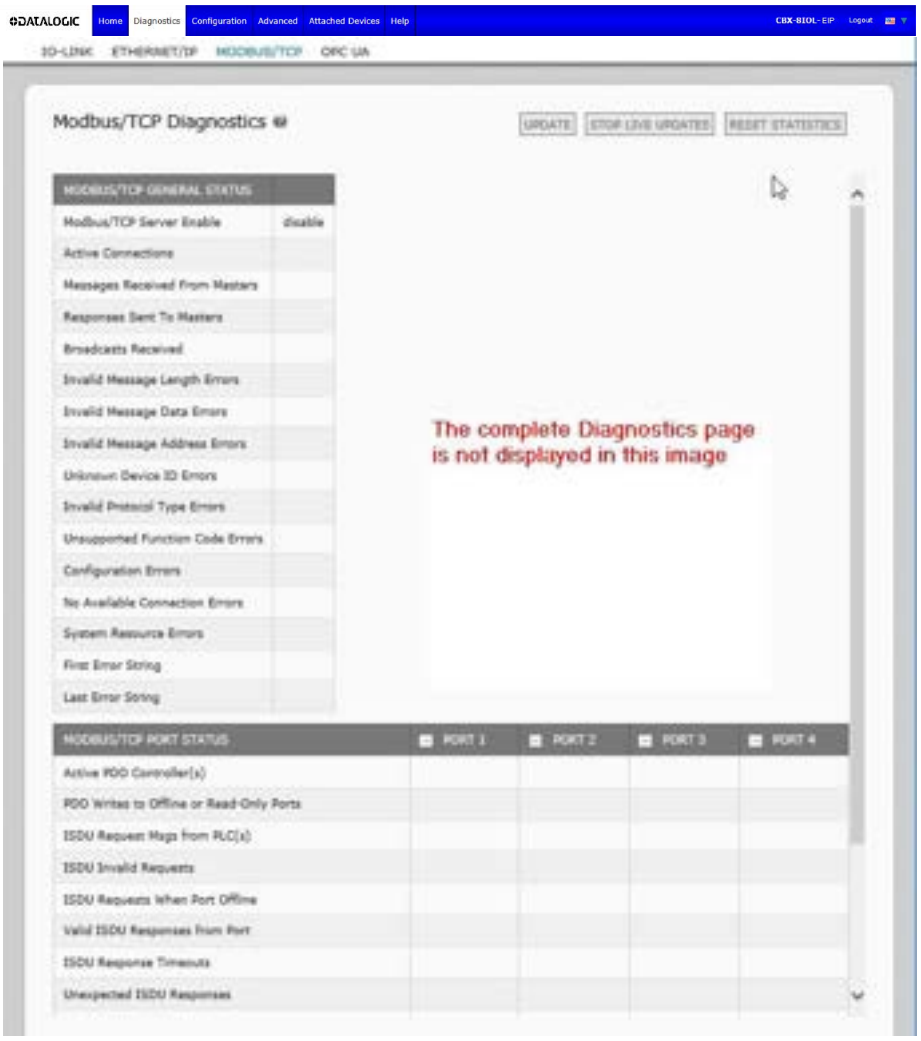
EtherNet/IP Diagnostics	
Active Session Count	The number of active Ethernet/IP sessions. A session can: • Support both Class 1 I/O and Class 3 Messages • Can be initiated by either the PLC or the IO-Link Master • Can be terminated by either the PLC or the IO-Link Master
Active Connections	The current number of active connections (both Class 1 and 3).
Total Connections Established	The total number of connections that have been established.
Connection Timeouts	The number of connections that have closed due to timing out.
Connections Closed	The number connections that have closed due to standard processes.
Class 3 Messages/ Responses Received	The number of Class 3 messages and responses received from the PLC or PLCs.
Broadcast Messages Received	The number of broadcast messages received from PLC or PLCs.
Class 3 Messages/ Responses Transmitted	The number of Class 3 messages and responses sent to the PLC or PLCs.

Class 1 Output Updates (From PLC)	The number of Class 1 output data updates received from the PLC or PLCs.
Class 1 Output Data Changes (From PLC)	The number of changes in Class 1 output data received from the PLC.
Class 1 Input Data Updates (To PLC)	The number of Class 1 input data updates sent to the PLC or PLCs.
Client Object Requests	The number of Class 3 requests to the IO-Link Master vendor specific objects.
Good Responses from PLC	The number of good responses from messages sent to PLC or PLCs.
Bad Responses from PLC	Displays the number of bad responses from messages sent to the PLC or PLCs. Bad responses are typically returned for such errors as: • Incorrect tag or file names • Incorrect tag or file data types • Incorrect tag or file data sizes • PLC is overloaded and cannot handle the amount of Ethernet traffic • PLC malfunction
No Responses from PLC	Displays the number of no responses from messages sent to the PLC or PLCs. No responses are typically returned for such errors as: • Incorrect IP address • Incorrect PLC configuration • PLC malfunction • PLC is overloaded and cannot handle the amount of Ethernet traffic
Invalid Network Paths	Displays the number of network path errors on messages sent to the PLC or PLCs. These are typically caused by incorrect IP address settings.
Pending Request Limit Reached	Displays the number of pending request limit errors. These errors occur when the PLC is sending a continuous stream of messages to the IO-Link Master faster than the IO-Link Master can process them.
Unexpected Events	Displays the number of unexpected event errors. Unexpected event errors occur when the IO-Link Master receives an unexpected message from the PLC such as an unexpected response or unknown message.
Unsupported CIP Class Errors	Displays the number of unsupported CIP class errors. These errors occur when a message that attempts to access an invalid class is received by the IO-Link Master.
Unsupported CIP Instance Errors	Displays the number of unsupported CIP instance errors. These errors occur when a message that attempts to access an invalid instance is received by the IO-Link Master.
Unsupported CIP Service Errors	Displays the number of unsupported CIP service errors. These errors occur when a message that attempts to access an invalid service is sent to the IO- Link Master.
Unsupported CIP Attribute Errors	Displays the number of unsupported CIP request attribute errors. These errors occur when a message that attempts to access an invalid attribute is sent to the IO-Link Master.
Unsupported File Errors	Displays the number of messages from SLC/PLC-5/MicroLogix PLCs that attempt to access an unsupported file address.
System Resource Errors	Displays the number of system resource errors. These errors indicate a system error on the IO-Link Master such as operating system errors or full message queues. These errors typically occur when the PLC or PLCs 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.
EtherNet/IP Port Specific Diagnostics	
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.
Invalid 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.
Active PDO Controller(s)	Lists the controller interface(s) type, (Class 1 or Class 3), and IP address 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.
Undeliverable PDI Updates (To PLC)	Displays the number of PDI update messages that could not be delivered to the PLC in the Write-to-Tag/File method. Undeliverable updates may result when: The IO-Link Master cannot complete an Ethernet connection to the PLC. The PDI data is changing faster than the **Maximum PLC Update Rate**.
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 EtherNet/IP with one or more invalid commands.
ISDU Requests When Port Offline	Displays the number of ISDU requests received over EtherNet/IP 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.
ISDU Read Commands	Displays the number of ISDU read commands received over EtherNet/IP.
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 Write Commands	Displays the number of ISDU write commands received over EtherNet/IP.
ISDU NOP Commands	Displays the number of ISDU NOP (no operation) commands received over EtherNet/IP.

9.3 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.



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

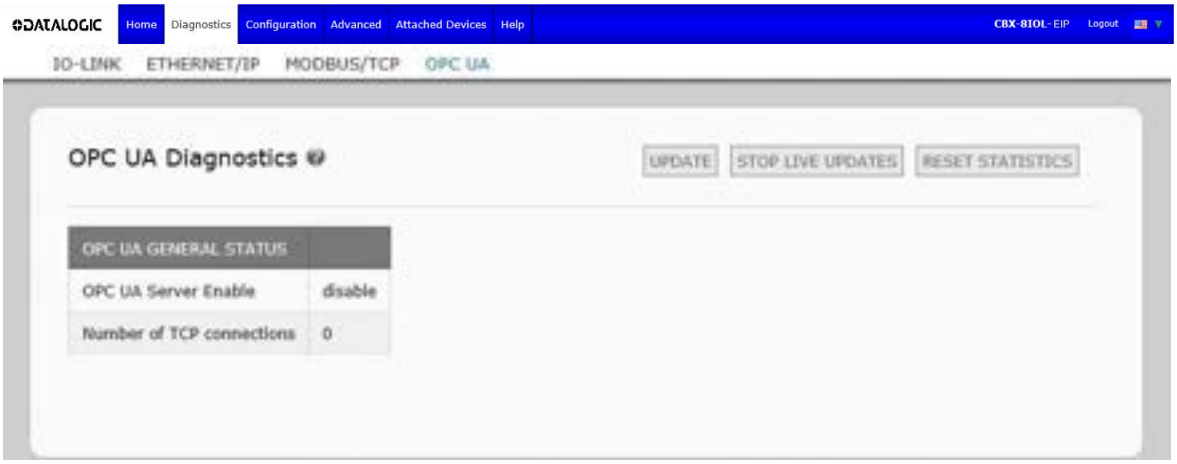
Modbus/TCP Diagnostics	
Active Connections	Displays the current number of active Modbus/TCP connections.
Messages Received from Masters	Displays the number of Modbus messages received from Modbus/TCP Masters.
Responses Sent to Masters	Displays the number of Modbus responses sent to Modbus/TCP Masters.
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.

9.4 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.

10 ETHERNET/IP INTERFACE

10.1 INTRODUCTION

This section is intended to describe the EtherNet/IP interface provided by the IOLM.

These interfaces provide the ability to retrieve port and device status information, input and output process data and access to IO-Link device ISDU (SPDU) data blocks.

Note: Indexed Service Data Unit (ISDU) is sometimes referred to as Service Protocol Data Unit (SPDU). See par. 11.3 for more information.

10.1.1 Functionality Summary

The EtherNet/IP interface consists of:

- Input Process Data blocks that include:
  - Port communication status
  - PDI valid status
  - Auxiliary Input status of IO-Link connector (DI on the IOLM DR-8-EIP and Pin 2 on the CBX-IOL-8- EIP)
  - The active event code (zero if no active event)
  - The input process data received from the port. This may be
    - IO-Link mode: IO-Link device input process data
    - I/O Input mode: Input bit status
    - I/O Output mode: Output bit status (configurable option)
- Output Process Data blocks that include:
  - The active event code to clear ((configurable option)
  - The output process data to be sent to the port. This may be
    - IO-Link mode: IO-Link device output process data
    - I/O Output mode: Output bit status
- ISDU (ISDU) interface:
  - Provides single and nested batch read/write capabilities
  - Requires use of MSG instructions
  - Provides both blocking and non-blocking message capabilities
    - Blocking message responses are not returned until all the ISDU command(s) have completed.
    - Non-blocking messages return immediately. The PLC must then request the ISDU command(s) response status until a valid response is returned.
- Web based configuration and diagnostic pages:
  - IO-Link interface configuration and diagnostics
  - EtherNet/IP interface configuration and diagnostics
- EtherNet/IP interface support for ControlLogix, SLC, MicroLogix, and PLC-5 PLC families.
- Modbus/TCP slave interface.
- Example PLC programs to aid the PLC programmer.

10.1.2 Data Type Definitions

The following data type definitions apply.

Data Type Definitions	
BOOL	Boolean; TRUE if = 1; False if = 0
USINT	Unsigned Short Integer (8 bit)
CHAR	Character (8 bit)
SINT	Short Integer (8 bit)
UINT	Unsigned Integer (16 bit)
INT	Signed Integer (16 bit)
UDINT	Unsigned Double Integer (32 bit)
DINT	Signed Double Integer (32 bit)
STRING	Character String (1 byte per character)
BYTE	Bit String (8 bit)
WORD	Bit String (16 bits)
DWORD	Bit String (32 bits)

10.1.3 Terms and Definitions

This section uses the following terms and definitions.

Term	Definition
Class 1	Otherwise called **implicit** messaging, is a method of communication between EtherNet/IP controllers and devices that: • Uses Ethernet UDP messages. • Is cyclic in nature. Input and/or output data is exchanged between the controllers and devices at regular time intervals.
Class 3	Otherwise called **explicit** messaging, is a method of communication between EtherNet/IP controllers and devices that: • Uses Ethernet TCP/IP messages. • By itself is not cyclic in nature. The controller and devices must send individual messages to each other.
EtherNet/IP	An Ethernet based industrial communication protocol utilized to communicate between controllers, often times PLCS, and devices.
Ethernet TCP/IP	Standard Ethernet communications protocol utilizing socket communication interfaces that **guarantees delivery** to the intended device.
Ethernet UDP/IP	Standard Ethernet communications protocol utilizing socket communication interfaces that **does not guarantee delivery**. The data may or may get to the intended device.
IOLM	IO-Link gateway that provides communication between IO-Link devices and Ethernet protocols such as EtherNet/IP and Modbus/TCP.
Multicast	Multicast addressing involves Ethernet devices sending messages to each other using a multicast address. Multicast addressing: • Uses a specified IP address range designated for multicast communication. • Allows either one or multiple devices to receive the same messages.
Point-to-Point	Point-to-Point, otherwise called **unicast**, addressing involves Ethernet devices sending messages directly to each other using their own IP addresses. Messages are sent to only one device.
PDI data (Process Data Input)	Process data received from an IO-Link device or I/O interface that can be provided to external controllers such as PLCs, HMIs, SCADA, and OPC UA Servers.
PDO data (Process Data Output)	Process data received from external controllers such as PLCs, HMIs, SCADA, and OPC Servers and sent to an IO-Link device or I/O interface. ***Note:*** *IO-Link devices may or may not support PDO data.*
ISDU	Indexed Service Data Unit. Otherwise called ISDU, refers to the Service Data units

	on IO-Link devices that are used for information, status and configuration settings.
Class 1	Otherwise called **implicit** messaging, is a method of communication between EtherNet/IP controllers and devices that: • Uses Ethernet UDP messages. Is cyclic in nature. Input and/or output data is exchanged between the controllers and devices at regular time intervals.

10.2 DATA TRANSFER METHODS

The IOLM provides a selection of process data transfer methods and a number of options to customize the process data handling.

10.2.1 Receive Process Data Methods

10.2.1.1 Polling-PLC Requests Data

Also called *Slave-Mode* for some industrial protocols, the polling method requires the controller to request data from the IOLM via messages. The IOLM does not respond until it receives a request for data.

10.2.1.2 Write-to-Tag/File-IOLM Writes Data Directly into PLC Memory

Also called Master-Mode for some industrial protocols, the Write-to-Tag/File method requires the IOLM to send messages that write data directly into a tag or file on the PLC. The IOLM sends changed data to the PLC immediately and, optionally, can be configured to also send “heartbeat” update messages at a regular time interval.

10.2.1.3 Class 1 Connection (Input Only)-PLC and IOLM Utilize an I/O Connection

Also called I/O Mode for some industrial protocols, the Class 1 connection method requires the IOLM and PLC to connect to each via an I/O connection. For EtherNet/IP, a connection over UDP must first be created. Once the connection is established, the IOLM continually sends input data to the PLC at a PLC configurable rate.

10.2.2 Transmit Process Data Methods

10.2.2.1 PLC-Writes

Also called Slave-Mode for some industrial protocols, the PLC-Writes method requires the PLC to send data to the IOLM via write messages.

10.2.2.2 Read-from-Tag/File-IOLM Reads Data from PLC Memory

Also called Master-Mode for some industrial protocols, the Read-from-Tag/File method requires the IOLM to read data from a tag or file on the PLC. In this method, the IOLM requests data from the PLC at configurable time intervals.

10.2.2.3 Class 1 Connection (Input and Output)-PLC and IOLM Utilize an I/O Connection

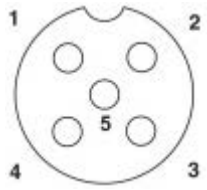
Also called I/O Mode for some industrial protocols, the Class 1 connection method requires the IOLM and PLC to connect to each via an I/O connection. For EtherNet/IP, a connection over UDP must first be created. Once the connection is established, the PLC and IOLM continually exchange data at a configurable rate.

11 FUNCTIONALITY DESCRIPTIONS

11.1 PROCESS DATA BLOCK DESCRIPTIONS

11.1.1 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)
Auxiliary I/O	BYTE	The auxiliary bit on the IO-Link port is: •  **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)
		IOLM DR-8-EIP - 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.*

11.1.1.1 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)

11.1.1.2 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)	

11.1.1.3 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)		

11.1.2 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.*

11.1.2.1 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)

11.1.2.2 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)

11.1.2.3 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)	

11.2 EVENT HANDLING

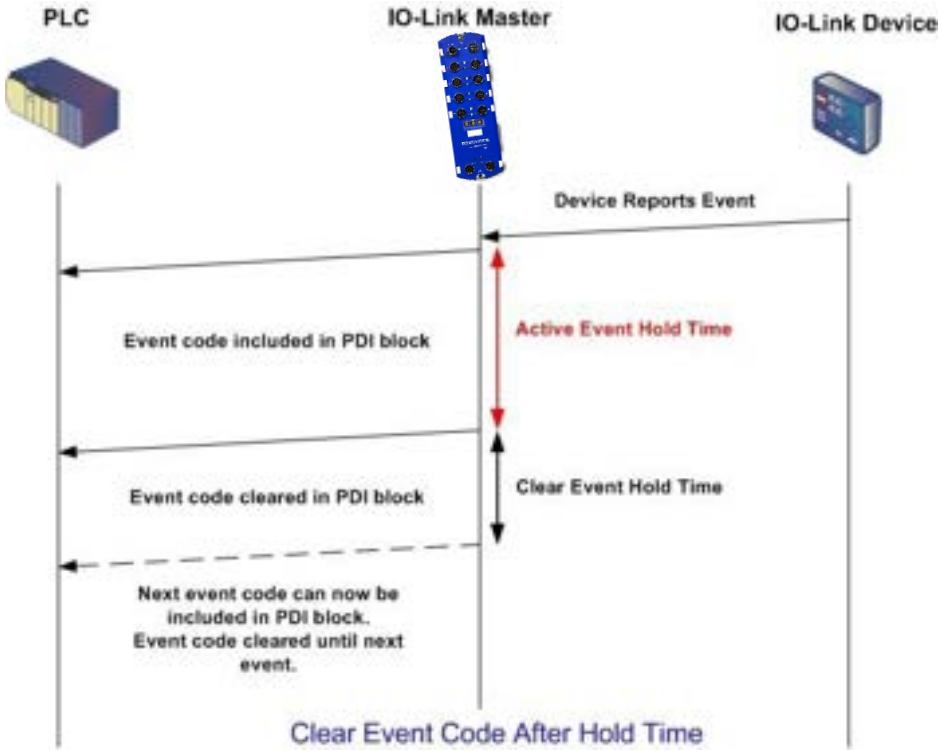
The IOLM event handling is designed to provide real-time updates of event codes received directly from the IO-Link device. The IO-Link event code:

- 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.

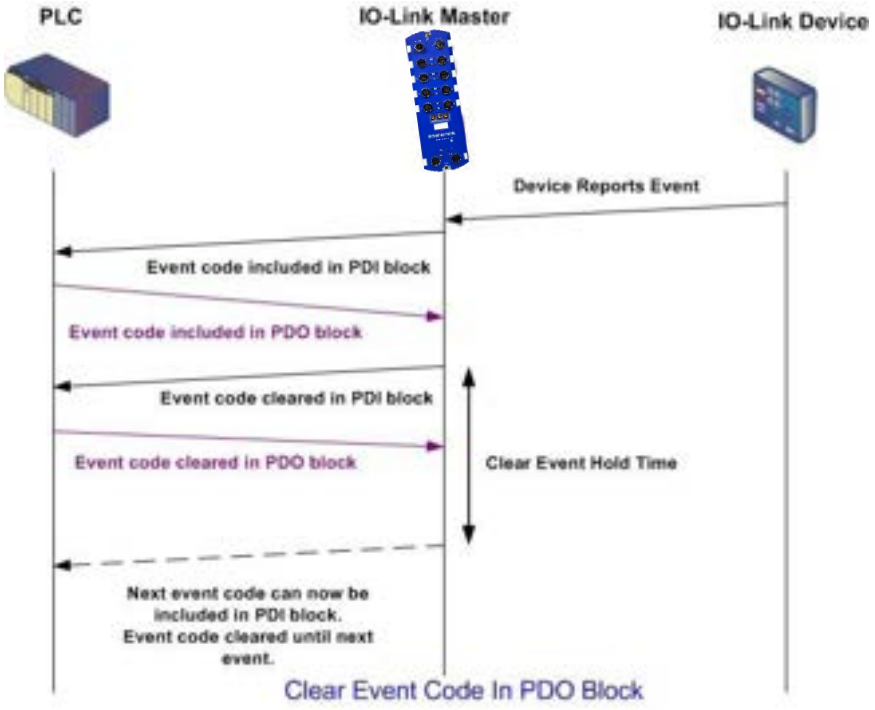
11.2.1 Clear Event After Hold Time Process

This illustrates clearing the event after the hold time process.



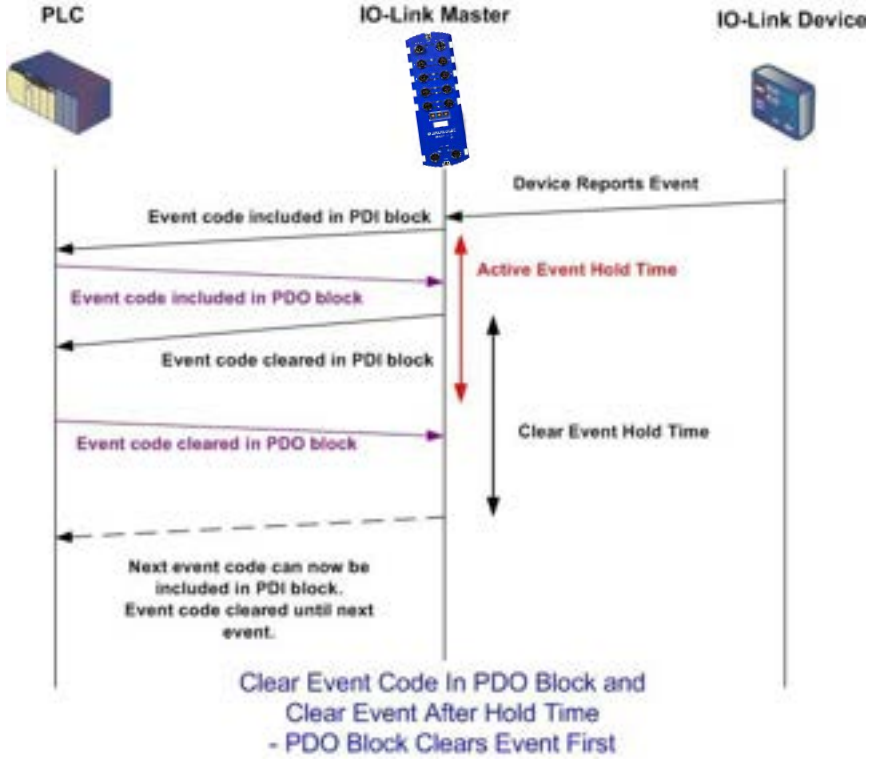
11.2.2 Clear Event in PDO Block Process

This illustrates clearing the event in the PDO block process.



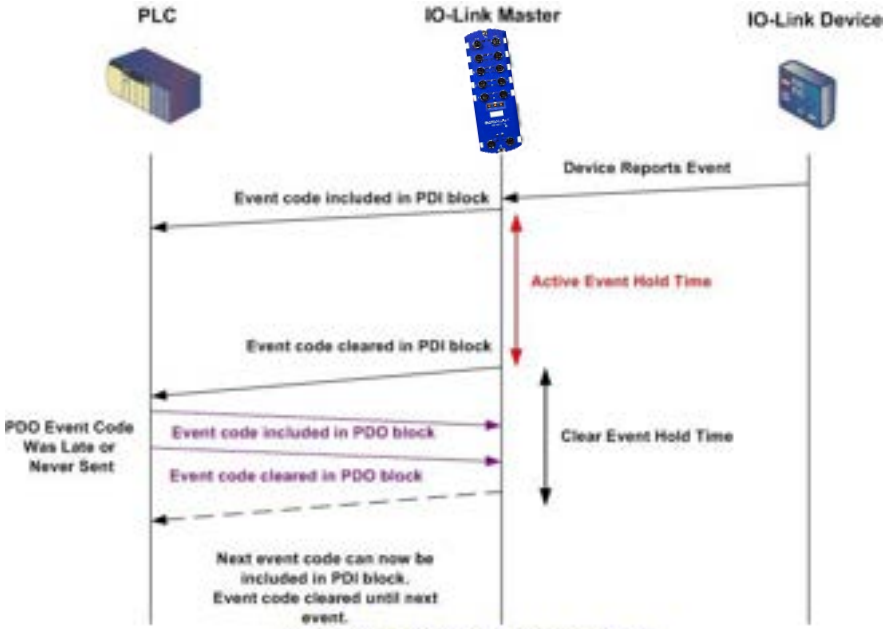
11.2.3 Clear Event Code in PDO Block and Clear Event After Hold Time Process- PDO Block First

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



11.2.4 Clear Event Code in PDO Block and Clear Event After Hold Time Process- 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.



Clear Event Code In PDO Block and Clear Event After Hold Time - Hold Time Expires and Clears Event

11.3 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 a 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 the ISDU commands have been processed.

11.3.1 ISDU Request/Response Structure

ISDU requests may contain a single command or multiple, nested commands.

11.3.1.1 Single ISDU Command Requests

This illustrates a single ISDU command request.

Single Command ISDU Request/Response

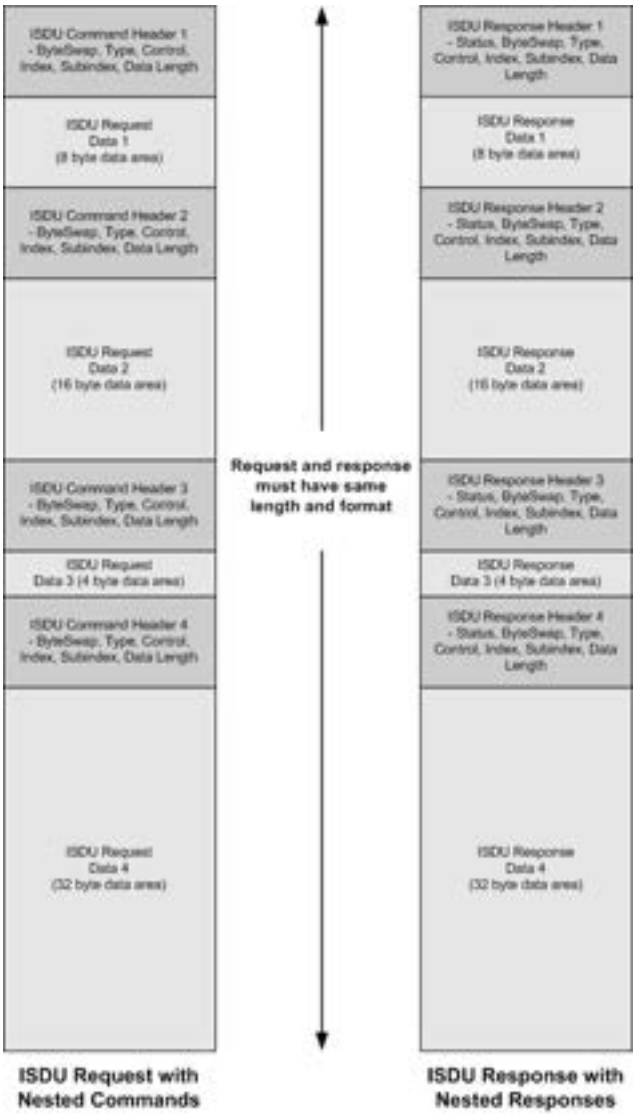
11.3.1.2 Multiple ISDU Command Structure

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.

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

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

- **Multiple Command ISDU Request/Response of Different Data Lengths**



Example - Multiple Command ISDU Request/Response of Different Data Area Lengths

11.3.2 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.

11.3.2.1 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.*

11.3.2.2 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.*

11.3.3 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.

11.3.3.1 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.*

11.3.3.2 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.

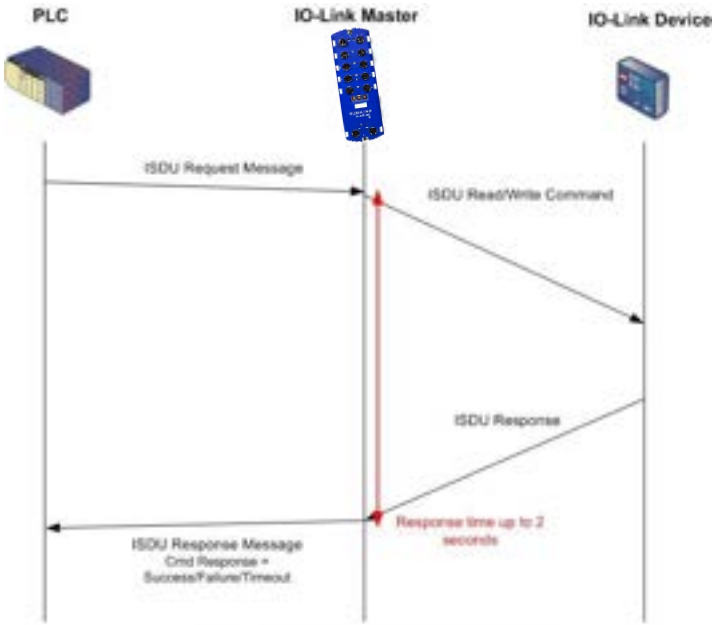
Name	Data Type	Parameter Descriptions
Status, Byte-Swapping, RdWrControlType	UINT	Indicates the control, type, byte swapping and status of the ISDU command. **Bits 0-3, Type Field:** 0 = NOP (No operation) 1 = Read operation 2 = Write operation 3 = Read/Write “OR” 4 = Read/Write “AND” **Bits 4-7, Control 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.*

11.3.4 ISDU Blocking and Non-Blocking Methods

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

11.3.4.1 Single Command Blocking

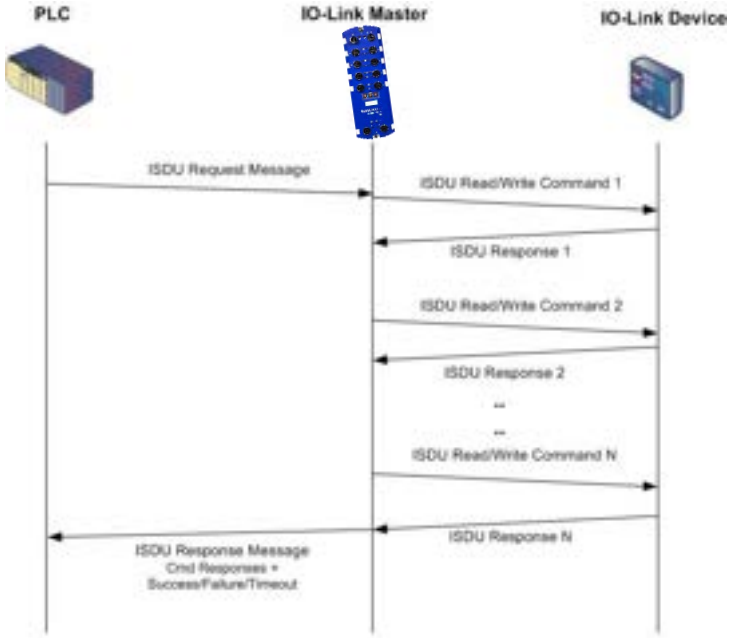
The following illustrates the single command blocking method.



Single Command ISDU Blocking Process

11.3.4.2 Multiple Command Blocking

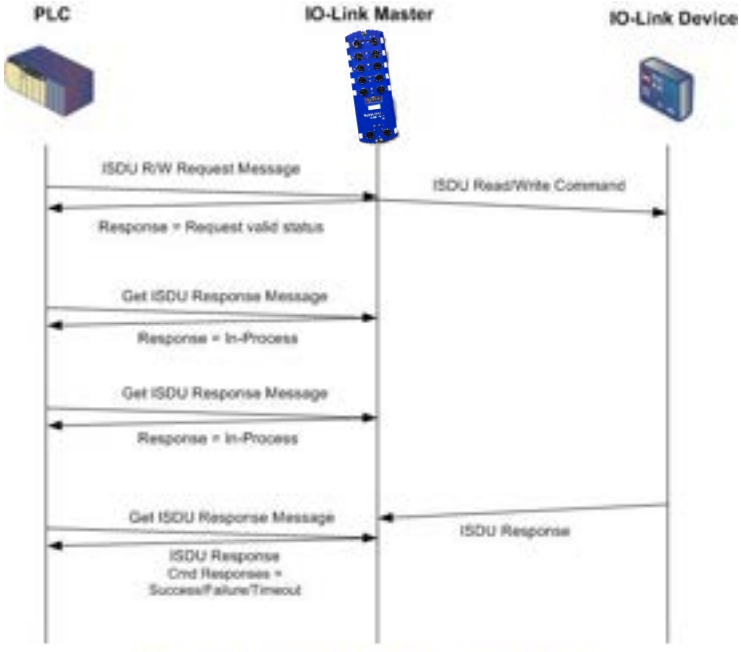
This illustrates the multiple command blocking method.



Multiple Command ISDU Blocking Process

11.3.4.3 Single Command Non-Blocking

This illustrates the single command non-blocking method.



Single Command ISDU Non-Blocking Process

11.3.4.4 Multiple Command Non-Blocking

This illustrates the multiple command non-blocking method.

Multiple Command ISDU Non-Blocking Process

12 ETHERNET/IP CIP OBJECT DEFINITIONS

The following are the vendor specific and standard CIP Object definitions as supported in the IOLM.

12.1 IO-LINK PORT INFORMATION OBJECT DEFINITION (72 HEX)

The IO-Link Device Information object defines the attributes by which the PLC can request standard device information stored in the IO-Link device's ISDU blocks.

12.1.1 Class Attributes

The following table shows the class attributes for IO-Link port information object definition (71 hex).

Attribute ID	Name	Data Type	Data Value(s)	Access Rule
1	Revision	UINT	1	Get
2	Max Instance	UINT	4 (4-Port models)8 (8-Port models)	Get
3	Num Instances	UINT	4 (4-Port models)8 (8-Port models) ***Note:*** *Instance number determines the IO-Link port.*	Get

12.1.2 Instance Attributes

The following table shows the instance attributes for IO-Link port information object definition (71 hex).

Attribute ID	Name	Data Type	Data Value(s)	Access Rule
1	Vendor Name	Array of 64 SINTs	0-255	Get
2	Vendor Text	Array of 64 SINTs	0-255	Get
3	Product Name	Array of 64 SINTs	0-255	Get
4	Product Id	Array of 64 SINTs	0-255	Get
5	Product Text	Array of 64 SINTs	0-255	Get
6	Serial Number	Array of 16 SINTs	0-255	Get
7	Hardware Revision	Array of 64 SINTs	0-255	Get
8	Firmware Revision	Array of 64 SINTs	0-255	Get
9	Device PDI Length	INT	0-32	Get
10	Device PDO Length	INT	0-32	Get
11	PDI Block Length	INT	4-36	Get
12	PDO Block Length	INT	0-36	Get
13	Input Assembly PDI Offset	INT	0-108 (8-bit format) 0-54(16-bit format) 0-27 (32-bit format)	Get
14	Input Assembly PDO Offset	INT	16-246 (8-bit format) 8-123(16-bit format) 4-62 (32-bit format)	Get
15	Output Assembly PDO Offset	INT	0-102 (8-bit format) 0-51 (16-bit format) 0-26 (32-bit format)	Get
16	Control Flags	INT	Bit settings	Get

12.1.3 Common Services

The following table shows the common services for IO-Link port information object definition (71 hex).

Service Code	Implemented in Class	Implemented in Instance	Service Name
01 hex	Yes	Yes	Get_Attributes_All
0E hex	Yes	Yes	Get_Attribute_Single

12.1.4 Instance Attribute Definitions

These attributes provide access to the standard ISDU information blocks on the IO-Link devices. These ISDUs are read at IO-Link device initialization time and then provided once the IO-Link device is operational.

12.1.4.1 Attribute 1-Vendor Name

Data	Attribute 1 - Vendor Name Description
64 ASCII characters	Requested from ISDU block index 16, contains the Vendor Name description of the IO-Link device.

12.1.4.2 Attribute 2-Vendor Text

Data	Attribute 2 - Vendor Text Description
64 ASCII characters	Requested from ISDU block index 17, contains the Vendor Text description of the IO-Link device.

12.1.4.3 Attribute 3-Product Name

Data	Attribute 3 - Product Name Description
64 ASCII characters	Requested from ISDU block index 18, contains the Product Name description of the IO-Link device.

12.1.4.4 Attribute 4-Product ID

Data	Attribute 4 - Product ID Description
64 ASCII characters	Requested from ISDU block index 19, contains the Product ID description of the IO-Link device.

12.1.4.5 Attribute 5-Product Text

Data	Attribute 5 - Product Text Description
64 ASCII characters	Requested from ISDU block index 20, contains the Product Text description of the IO-Link device.

12.1.4.6 Attribute 6-Serial Number

Data	Attribute 6 - Serial Number Description
16 ASCII characters	Requested from ISDU block index 21, contains the Vendor Specific Serial Number of the IO-Link device.

12.1.4.7 Attribute 7-Hardware Revision

Data	Attribute 7 - Hardware Revision Description
64 ASCII characters	Requested from ISDU block index 22, contains the Hardware Revision of the IO-Link device.

12.1.4.8 Attribute 8-Firmware Revision

Data	Attribute 8 - Firmware Revision Description
64 ASCII characters	Requested from ISDU block index 23, contains the Firmware Revision of the IO-Link device.

12.1.4.9 Attribute 9-Device PDI Length

Data	Attribute 9 - Device PDI Length Description
INT (0-32)	Requested from ISDU block index 0, sub-index 5. Contains the number of PDI data bytes provided by the IO-Link device.

12.1.4.10 Attribute 10-Device PDO Length

Data	Attribute 10 - Device PDO Length Description
INT	Requested from ISDU block index 0, sub-index 6. Contains the number of PDO data bytes required by the IO-Link device.

12.1.4.11 Attribute 11-PDI Data Block Length

Data	Attribute 11 - PDI Data Block Length Description
INT	The configured PDI block length in units based on the configurable PDI data format (8-bit, 16-bit, 32-bit). This contains the PDI block header, (port status, auxiliary bit, event code) status and the PDI data.

12.1.4.12 Attribute 12-PDO Data Block Length

Data	Attribute 12 - PDO Data Block Length Description
INT	The configured PDO data block length in units based on the configurable PDO data format (8-bit, 16-bit, 32-bit). Depending on the configuration, this may include both the returned event code and the PDO data.

12.1.4.13 Attribute 13-Input Assembly PDI Offset

Data	Attribute 13 - Input Assembly PDI Offset Description
INT	Based from the start of the first Input Assembly instance, the PDI data block's offset for the corresponding port's PDI data block. This index is based on the configurable PDI data format (8-bit, 16- bit, 32-bit). To use this offset effectively, it is recommended to set IOLM PDI and PDO data as well as the Class 1 I/O connection all to the same data format.

12.1.4.14 Attribute 14-Input Assembly PDO Offset

Data	Attribute 14 - Input Assembly PDO Offset Description
INT	Based from the start of the first Input Assembly instance, the PDO data block's offset for the corresponding port's PDO data block. This index is based on the configurable PDO data format (8-bit, 16- bit, 32-bit). To use this offset effectively, it is recommended to set IOLM PDI and PDO data as well as the Class 1 I/O connection all to the same data format.

12.1.4.15 Attribute 15-Output Assembly PDO Offset

Data	Attribute 15 - Output Assembly PDO Offset Description
INT	Based from the start of the first Output Assembly instance, the PDO data block's offset for the corresponding port's PDO data block. This index is based on the configurable PDO data format (8-bit, 16- bit, 32-bit). To use this offset effectively, it is recommended to set IOLM PDI and PDO data as well as the Class 1 I/O connection all to the same data format.

12.1.4.16 Attribute 16-Control Flags

Data	Attribute 16 - Control Flags Description
INT (bit-mapped word)	**Bit 0 (01h):** 1 = Indicates that the event code to clear is expected in the PDO block 0 = Indicates that the event code to clear is not expected in the PDO block. **Bit 1 (02h):** 1 = Indicates that the IO-Link device is SIO mode capable 0 = Indicates that the IO-Link device is not SIO mode capable **Bits 2 (04h)** 1 = Indicates that Class 1 Rx (receive PDI block) is enabled 0 = Indicates that Class 1 Rx (receive PDI block) is disabled **Bit 3 (08h):** 1 = Indicates that Class 1 Tx (transmit PDO) is enabled 0 = Indicates that Class 1 Tx (transmit PDO) is disabled **Bit 4 (10h):** 1 = Indicates that the digital output settings for DI and C/Q are expected in the PDO block 0 = Indicates that the digital output settings for DI and C/Q are not expected in the PDO block. **Bit 5 -15: Reserved**

12.2 PDI (PROCESS DATA INPUT) TRANSFER OBJECT DEFINITION (72 HEX)

The PDI Transfer object defines the attributes by which the PLC can request the PDI data block from the IOLM.

12.2.1 Class Attributes

The following table displays Class Attributes for the PDI Transfer Object Definition (72 hex).

Attribute ID	Name	Data Type	Data Value(s)	Access Rule
1	Revision	UINT	1	Get
2	Max Instance	UINT	1	Get
3	Num Instances	UINT	1	Get

12.2.2 Instance Attributes

The following table displays Instance Attributes for the PDI Transfer Object Definition (72 hex).

Attribute ID	Name	Data Type	Length	Data Values	Access Rule
1	Port 1 PDI data block	Array of BYTEs	4-36 bytes	0-255	Get
2	Port 2 PDI data block	Array of BYTEs	4-36 bytes	0-255	Get
3	Port 3 PDI data block	Array of BYTEs	4-36 bytes	0-255	Get
4	Port 4 PDI data block	Array of BYTEs	4-36 bytes	0-255	Get
8-Port Models Only:					
5	Port 5 PDI data block	Array of BYTEs	4-36 bytes	0-255	Get
6	Port 6 PDI data block	Array of BYTEs	4-36 bytes	0-255	Get
7	Port 7 PDI data block	Array of BYTEs	4-36 bytes	0-255	Get
8	Port 8 PDI data block	Array of BYTEs	4-36 bytes	0-255	Get

12.2.3 Common Services

The following table shows Common Services for the PDI Transfer Object Definition (72 hex).

Service Code	Implemented in Class	Implemented in Instance	Service Name
01 hex	Yes	Yes	Get_Attributes_All
0E hex	Yes	Yes	Get_Attribute_Single

12.2.4 Instance Attributes Definitions – Attribute 1 to 4-PDI Data Blocks

These attributes provide access to the PDI data blocks.

- Get Attribute Single requests return the PDI data block for a specific port.
- Get Attribute All requests return all PDI data blocks from the IOLM.

All PDI data is returned in the configured PDI format (8-bit, 16-bit or 32-bit). Refer to PDI (Process Data Input) Transfer Object Definition (72 hex) for a detailed explanation of the PDI data block.

12.3 PDO (PROCESS DATA OUTPUT) TRANSFER OBJECT DEFINITION (73 HEX)

The PDO Transfer object defines the attributes by which the PLC can:

- Request the PDO data block from the IOLM.
- Write PDO data block to the IOLM.

12.3.1 Class Attributes

The following table displays the Class Attributes for the PDO Transfer Object Definition (73 hex).

Attribute ID	Name	Data Type	Data Value	Access Rule
1	Revision	UINT	1	Get
2	Max Instance	UINT	1	Get
3	Num Instances	UINT	1	Get

12.3.2 Instance Attributes

The following table displays the Instance Attributes for the PDO Transfer Object Definition (73 hex).

Attribute ID	Name	Data Type	Length	Data Value	Access Rule
1	Port 1 PDO data block	Array of BYTEs	0-36 bytes	0-255	Get/Set
2	Port 2 PDO data block	Array of BYTEs	0-36 bytes	0-255	Get/Set
3	Port 3 PDO data block	Array of BYTEs	0-36 bytes	0-255	Get/Set
4	Port 4 PDO data block	Array of BYTEs	0-36 bytes	0-255	Get/Set
8-Port Models Only:					
5	Port 5 PDO data block	Array of BYTEs	0-36 bytes	0-255	Get/Set
6	Port 6 PDO data block	Array of BYTEs	0-36 bytes	0-255	Get/Set
7	Port 7 PDO data block	Array of BYTEs	0-36 bytes	0-255	Get/Set
8	Port 8 PDO data block	Array of BYTEs	0-36 bytes	0-255	Get/Set

12.3.3 Common Services

The following table displays the Common Services for the PDO Transfer Object Definition (73 hex).

Service Code	Implemented in Class	Implemented in Instance	Service Name
01 hex	Yes	Yes	Get_Attributes_All
0E hex	Yes	Yes	Get_Attribute_Single
10 hex	No	Yes	Set_Attribute_Single
02 hex	No	Yes	Set_Attribute_All

12.3.4 Instance Attribute Definitions – Attribute 1 to 4-PDO Data Blocks

These attributes provide write access to the PDO data blocks.

- Get Attribute Single requests return the current PDO data block for a specific port.
- Get Attribute All requests return all current PDO data blocks from the IOLM.
- Set Attribute Single allows writing the PDO data to one IO-Link port on the IOLM.
- Set Attribute All messages allow writing of PDO data to all IO-Link ports on the IOLM.

All PDO data is received and returned in the configured PDO format (8-bit, 16-bit or 32-bit). Refer to PDO (Process Data Output) Transfer Object Definition (73 hex) for a detailed explanation of the PDO data block.

12.4 ISDU READ/WRITE OBJECT DEFINITION (74 HEX)

The ISDU Read/Write object defines the attributes by which the PLC can:

- Send an ISDU request containing one or more read and/or write ISDU commands to an IO-Link device via the IOLM.
- Request the ISDU response(s) from the IOLM.
- Send both blocking and non-blocking ISDU requests.

Refer to the ISDU Handling chapter for a detailed description of the ISDU functionality.

12.4.1 Class Attributes

The following table shows the Class Attributes for the ISDU Read/Write Object Definition (74 hex).

Attribute ID	Name	Data Type	Data Value(s)	Access Rule
1	Revision	UINT	1	Get
2	Max Instance	UINT	4 (4-Port Models)8 (8-Port Models)	Get
3	Num Instances	UINT	4 (4-Port Models)8 (8-Port Models) ***Note:*** *Instance number determines IO-Link port on the IOLM.*	Get

12.4.2 Instance Attributes

The following table shows the Instance Attributes for the ISDU Read/Write Object Definition (74 hex).

Attribute ID	Name	Data Type	Data Value(s)	Access Rule
1	ISDU Response	ISDU response data block	0-255	Get
2	ISDU Read/Write Request	ISDU request data block	0-255	Set

12.4.3 Common Services

The following table shows the Common Services for the ISDU Read/Write Object Definition (74 hex).

Service Code	Implemented in Class	Implemented in Instance	Service Name
01 hex	Yes	No	Get_Attributes_All
0E hex	Yes	Yes	Get_Attribute_Single
10 hex	No	Yes	Set_Attribute_Single
02 hex	No	No	Set_Attribute_All

12.4.4 Object Specific Services

The following table shows the Object Specific Services for the ISDU Read/Write Object Definition (74 hex).

Service Code	Implemented in Class	Implemented in Instance	Service Name
4B hex	No	Yes	Blocking ISDU Request

The Blocking ISDU Request service allows one message instruction to both send an ISDU request and receive the response. Using this service causes the message to be active for several seconds.

12.4.5 Instance Attribute Definitions

The following attributes provide access to the ISDU blocks on the IO-Link devices.

12.4.5.1 Attribute 1-ISDU Read/Write Response (Non-Blocking only)

Get Attribute Single messages returns the ISDU response for a specific port through the IOLM. The response may need to be read multiple times until a response of Success, Failure, or Timed Out has been received.

12.4.5.2 Attribute 2-ISDU Read/Write Request (Non-Blocking only)

Set Attribute Single messages can send read/write type ISDU requests to the IO-Link devices via the IOLM. The ISDU request message need be sent only once for each ISDU read/write request.

12.5 IDENTITY OBJECT (01HEX, 1 INSTANCE)

The Identity Object provides identification of and general information about the IOLM.

12.5.1 Class Attributes

This table shows the Class Attributes for the Identity Object (01 hex, 1 Instance).

Attribute ID	Name	Data Type	Data Value(s)	Access Rule
1	Revision	UINT	1	Get
2	Max Class	UINT	1	Get
3	Max Instance	UINT	1	Get
6	Maximum Number Class Attribute	UINT	7	Get
7	Maximum Number Instance Attributes	UINT	7	Get

12.5.2 Instance Attributes

This table shows the Instance Attributes for the Identity Object (01 hex, 1 Instance).

Attribute ID	Name	Data Type	Data Value(s)	Access Rule
1	Vendor ID	UINT	909 (Datalogic)	Get
2	Device Type	UINT	2B hex (Generic Device)	Get
3	Product Code	UINT	As defined by Datalogic	Get
4	Revision (Product or Software release) Major Revision Minor Revision	 USINT USINT	 1 to 127 1 to 255	 Get
5	Status	WORD	See Below	Get
6	Serial Number	UDINT	1-FFFFFFFF hex	Get
7	Product Name Structure of: Name Length Name String	 USINT STRING	 Length of string See below	 Get Get

12.5.3 Status Word

Refer to Page 52 of Volume 3.5 of the CIP Common Specification.

The following applies to the Identity Object status word for the IOLM.

Status Word Bit	Setting	Description
0	0	Ownership Flag. Does not apply to the IOLM.
1	0	Reserved.
2	0	IOLM is operating on the default configuration.
	1	The IOLM has a configuration other than the default configuration.
3	0	Reserved.
4-7	0101 (0x50)	Indicates that there is a major fault (either Bit 10 or Bit 11 is set).
	0100 (0x40)	Indicates the stored configuration is invalid.
	0011 (0x30)	Indicates the system is operational and there are no I/O (Class 1) connections.
	0110 (0x60)	Indicates the system is operational and there is at least one active I/O (Class 1) connection.
	0000	Indicates the system is not operational. It may be in any of the following states: • System startup. • Configuration in process. • Idle. • Critical (major) fault.
8	0	No recoverable minor fault. No error history entry reported within the last ten seconds.
	1	Recoverable minor fault. The IOLM has reported an error within the last ten seconds and a major fault has not been detected.
9	1	Unrecoverable minor fault. Does not apply to the IOLM.
10	0	No recoverable major fault.
	1	A major recoverable fault exists. This is a fault that the IOLM may be able to recover from by a system reset. If the system does not recover automatically, a system reset message or a power cycle of the IOLM may be required.
11	0	No major unrecoverable fault.
	1	A major unrecoverable fault has occurred in the IOLM. If the major fault is not corrected with a system reset or a power cycle, refer to the User Guide or call Datalogic support.
12-15	0	Reserved.

12.5.4 Common Services

Service Code	Implemented in Class	Implemented in Instance	Service Name
01 hex	Yes	Yes	Get_Attribute_All
05 hex	No	Yes	Reset
0E hex	Yes	Yes	Get_Attribute_Single

12.6 MESSAGE ROUTER OBJECT (02 HEX)

The Message Router Object provides a messaging connection point through which a Client may address a service to any object or instance residing in the physical device.

12.6.1 Class Attributes

This table displays the Class Attributes for the Message Router Object (02 hex).

Attribute ID	Name	Data Type	Data Value	Access Rule
1	Revision	UINT	1	Get
2	Max Class	UINT	1	Get
3	Max Instance	UINT	1	Get
4	Optional Attribute List	UINT	2	Get
5	Option Service List	UINT	1	Get
6	Maximum Number Class Attribute	UINT	7	Get
7	Maximum Number Instance Attribute	UINT	2	Get

12.6.2 Instance Attributes

This table displays the Instance Attributes for the Message Router Object (02 hex).

Attribute ID	Name	Data Type	Data Value(s)	Access Rule
1	Object List *Structure of:* Number Classes	 UINT Array of UINT	 Number of supported standard class codes List of supported standard class codes	Get Get
2	Max Connections	UINT	128	Get

12.6.3 Common Services

This table displays the Common Services for the Message Router Object (02 hex)

Service Code	Implemented in Class	Implemented in Instance	Service Name
01 hex	Yes	No	Get_Attribute_All
0E hex	Yes	Yes	Get_Attribute_Single
0A hex	No	Yes	Multiple_Service_Req

12.7 CONNECTION MANAGER OBJECT (06 HEX)

This object provides services for connection and connection-less communications. This object has no supported attributes.

12.7.1 Class Attributes Object (06 hex)

The following table displays the Class Attributes for the Connection Manager Object (06 hex).

Attribute ID	Name	Data Type	Data Value(s)	Access Rule
1	Revision	UINT	1	Get
2	Max Class	UINT	1	Get
3	Max Instance	UINT	1	Get
4	Optional Attribute List	UINT	8	Get
6	Maximum number Class Attribute	UINT	7	Get
7	Maximum Number Instance Attributes	UINT	8	Get

12.7.2 Instance Attributes (02 hex)

This table displays the Instance Attributes for the Message Router Object (02 hex).

Attribute ID	Name	Data Type	Data Value(s)	Access Rule
1	Open Requests	UINT	0-0xffffffff	Set/Get
2	Open Format Rejects	UINT	0-0xffffffff	Set/Get
3	Open Resource Rejects	UINT	0-0xffffffff	Set/Get
4	Open Other Rejects	UINT	0-0xffffffff	Set/Get
5	Close Requests	UINT	0-0xffffffff	Set/Get
6	Close Format Requests	UINT	0-0xffffffff	Set/Get
7	Close Other Requests	UINT	0-0xffffffff	Set/Get
8	Connection Time Outs	UINT	0-0xffffffff	Set/Get

12.7.3 Common Services Object (06 hex)

This table displays the Common Services for the Connection Manager Object (06 hex).

Service Code	Implemented in Class	Implemented in Instance	Service Name
01 hex	Yes	Yes	Get_Attribute_All
02 hex	No	Yes	Set_Attribute_ALL
0E hex	Yes	Yes	Get_Attribute_Single
10 hex	No	Yes	Set_Attribute_Single
4E hex	N/A	N/A	Forward_Close
52 hex	N/A	N/A	Unconnected_Send
54 hex	N/A	N/A	Forward_Open
5A hex	N/A	N/A	Get_Connection_Owner
5B hex	N/A	N/A	Large_Forward_Open

12.8 PORT OBJECT (F4 HEX-1 INSTANCE)

The Port Object enumerates the CIP ports present on the IOLM.

12.8.1 Class Attributes

This table illustrates the Class Attributes for the Port Object (F4 hex - 1 Instance).

Attribute ID	Name	Data Type	Data Value(s)	Access Rule
1	Revision	UINT	1	Get
2	Max Instance	UINT	1	Get
3	Num Instances	UINT	1	Get
6	Maximum Number Class Attributes	UINT	9	Get
7	Maximum Number Instance Attributes	UINT	7	Get
8	Entry Port	UINT	1	Get
9	All Ports	Array of UINT	[0]=0 [1]=0 [2] = 1 (Vendor Specific) [3] = 1 (Backplane) [4]=TCP_IP_PORT_TYPE (4) [5]=TCP_IP_PORT_NUMBER(2)	Get

12.8.2 Instance Attributes

This table illustrates the Instance Attributes for the Port Object (F4 hex - 1 Instance).

Attribute ID	Name	Data Type	Data Value(s)	Access Rule
1	Port Type	UINT	1	Get
2	Port Number	UINT	1	Get
3	Port Object *Structure of:* 16 bit word count in path Path	 UINT Array of UINT	 2 [0]=6420 hex [1]=0124 hex	 Get Get
4	Port Name *Structure of:* String Length Port Name	 USINT Array of USINT	 10 “Backplane”	 Get Get
7	Node Address	USINT[2]	0x10, 0x00	Get

This table illustrates the Instance Attributes for the Port Object (F4 hex - 2 Instance).

Attribute ID	Name	Data Type	Data Value(s)	Access Rule
1	Port Type	UINT	4 (TCP/IP)	Get
2	Port Number	UINT	2 (TCP/IP)	Get
3	Port Object *Structure of:* 16 bit word count in path Path	 UINT Array of UINT	 2 [0]=F520 hex [1]=0124 hex	 Get Get
4	Port Name *Structure of:* String Length Port Name	 USINT Array of USINT	 17 “Ethernet/IP Port”	 Get Get
7	Node Address	USINT[2]	0x10, 0x00	Get

12.8.3 Common Services

This table illustrates the Common Services for the Port Object (F4 hex - 1 Instance).

Service Code	Implemented in Class	Implemented in Instance	Service Name
01 hex	Yes	Yes	Get_Attribute_All
0E hex	Yes	Yes	Get_Attribute_Single

12.9 TCP OBJECT (F5 HEX-1 INSTANCE)

The TCP/IP Interface Object provides the mechanism to retrieve the TCP/IP attributes for the IOLM.

12.9.1 Class Attributes

This table shows the Class Attributes for the TCP Object (F5 hex - I Instance).

Attribute ID	Name	Data Type	Data Value	Access Rule
1	Revision	UINT	1	Get
2	Max Instance	UINT	1	Get
3	Num Instances	UINT	1	Get
4	Optional Attribute List	UINT	4	Get
6	Maximum Number Class Attribute	UINT	7	Get
7	Maximum Number Instance Attribute	UINT	9	Get

12.9.2 Instance Attributes

This table shows the Instance Attributes for the TCP Object (F5 hex - I Instance).

Attribute ID	Name	Data Type	Data Value(s)	Access Rule
1	Status	DWORD	0 = The Interface Configuration attribute has not been configured. 1 = The Interface Configuration attribute contains configuration obtained from DHCP or nonvolatile storage. 2 = The IP address member of the Interface Configuration attribute contains configuration obtained, in part, from the hardware rotary switch settings. • Upper 3 bytes from nonvolatile storage. • Least significant byte from rotary switches.	Get
2	Configuration Capability	DWORD	34 hex (DHCP, Settable and Hardware) 04 hex = DHCP 10 hex = Settable 20 hex = Hardware configurable	Get
3	Configuration Control	DWORD	Interface control Flags: 0 = The device shall use statically-assigned IP configuration values. 2 = The device shall obtain its interface configuration values via DHCP.	Set/Get
4	Physical Link Object	UINT Array of USINT	2 [0]=20 hex [1]=F6 hex [2]=24 hex [3]=01 hex	Get

	Structure of: Path Size Path			
5	Interface Configuration	UDINT UDINT UDINT UDINT UDINT UINT STRING	<IP address> <Network mask> <Gateway Address> <Name server> <Name server2> <Length of name> <Domain name>	Set/Get
	IP Address Network Mask Gateway Address Name Server Name Server 2 Domain Name Length Domain Name			
6	Host Name Structure of: Host Name Length Host Name String	UINT STRING	0 to 15 <Default =IP NULL (0)>	Set/Get
8	TTL (Time-to-Live) value for IP multicast packets.	USINT	1 to 255 <Default = 1>	Set/Get
9	IP Multicast Address Configuration	*Struct of:* USINT - Alloc Control USINT - Reserved UINT - Num Mcast UDINT - Start Mcast Address	Alloc Control: 0 = Default Algorithm 1 = Configuration Num Mcast: 1 to 32 Start Mcast Address: 239.192.1.0 to 239.255.255.255	Set/Get

12.9.3 Common Services

This table shows the Common Services for the TCP Object (F5 hex - I Instance).

Service Code	Implemented in Class	Implemented in Instance	Service Name
01 hex	Yes	Yes	Get_Attribute_All
02 hex	No	Yes	Set_Attribute_All
0E hex	Yes	Yes	Get_Attribute_Single
10 hex	No	Yes	Set_Attribute_Single

12.10 ETHERNET LINK OBJECT (F6 HEX-1 INSTANCE)

The Ethernet Link Object maintains link-specific counters and status information for the Ethernet communications interface on the IOLM.

12.10.1 Class Attributes

This table displays the Class Attributes for the Ethernet Link Object (F6 hex - 1 Instance).

Attribute ID	Name	Data Type	Data Value(s)	Access Rule
1	Revision	UINT	3	Get
2	Max Instance	UINT	1	Get
3	Num Instances	UINT	1	Get
4	Optional Attribute List	UINT	4	Get
6	Maximum Number Class Attributes	UINT	7	Get
7	Maximum Number Instance Attributes	UINT	1	Get

12.10.2 Instance Attributes

This table displays the Instance Attributes for the Ethernet Link Object (F6 hex - 1 Instance).

Attribute ID	Name	Data Type	Data Value(s)	Access Rule
1	Interface speed (Current operational speed)	UDINT	10=10 Mbit 100=100 Mbit	Get
2	Interface Flags (Current operational status)	DWORD	Bit 0 =link status (0=inactive) (1=active) Bit 1=Half/Full Duplex (0=half duplex) (2=full duplex) Bits 2-4: 00 = negotiation in progress 01 = negotiation failed 02 = negotiation failed speed OK 03 = negotiation success	Get
3	Physical Address	Array of 6 USINT	MAC Address	Get
7	Interface Type	USINT	2 = Twisted Pair	Get
8	Interface State	USINT	1 = Interface is enabled and operational	Get
9	Admin State	USINT	1 = Interface enabled	Get
10	Interface Label	USINT16 Array of USINT	Length = 1 to 64 ASCII characters <Default = IP address in “xxx.xxx.xxx.xxx” format>	Get

12.10.3 Common Services

This table displays the Common Services for the Ethernet Link Object (F6 hex - 1 Instance)

Service Code	Implemented in Class	Implemented in Instance	Service Name
01 hex	Yes	Yes	Get_Attribute_All
0E hex	Yes	Yes	Get_Attribute_Single

12.11 PCCC OBJECT (67 HEX-1 INSTANCE)

The PCCC Object provides the ability to encapsulate and then transmit and receive PCCC messages between devices on an Ethernet/IP network. This object is used to communicate to MicroLogix, SLC 5/05 and PLC-5 PLCs over EtherNet/IP.

The PCCC Object does not support the following:

- Class Attributes
- Instance Attributes

12.11.1 Instance

The PCCC Object supports Instance 1.

12.11.2 Common Services

The following table displays the Common Services for the PCCC Object.

Service Code	Implemented in Class	Implemented in Instance	Service Name
4B hex	No	Yes	Execute_PCCC

12.11.3 Message Structure Execute_PCCC: Request Message

This table displays the message structure for the Execute_PCCC Request Message for the PCCC Object.

Name	Data Type	Description
Length	USINT	Length of requester ID
Vendor	UINT	Vendor number of requester
Serial Number	UDINT	ASA Serial number of requester
CMD	USINT	Command byte
STS	USINT	0
TNSW	UINT	Transport word
FNC	USINT	Function Code.
PCCC_params	Array of USINT	CMD/FMC specific parameters

12.11.4 Message Structure Execute_PCCC: Response Message

This table displays the message structure for the Execute PCCC Response Message for the PCCC Object.

Name	Data Type	Description
Length	USINT	Length of requester ID
Vendor	UINT	Vendor number of requester
Serial Number	UDINT	ASA Serial number of requester
CMD	USINT	Command byte
STS	USINT	Status Byte
TNSW	UINT	Transport word. Same value as request.
EXT_STS	USINT	Extended status. (If error)
PCCC_params	Array of USINT	CMD/FMC specific result data

12.11.5 Supported PCCC Command Types

The following table displays the Supported PCCC Command Types for the PCCC Object.

CMD	FNC	Description
0F hex	A2 hex	SLC 500 protected typed read with 3 address fields
0F hex	AA hex	SLC 500 protected typed write with 3 address fields

12.12 ASSEMBLY OBJECT (FOR CLASS 1 INTERFACE)

The EtherNet/IP specification requires that all Class 1 interfaces be provided through the Assembly Object interface. The Assembly Object interface is used to directly tie Vendor Specific objects to a standard interface, which the EtherNet/IP controller, or PLC, uses to communicate to the device.

For the IOLM, the Assembly Object corresponds to the PDI and PDO Transfer objects. Each instance of the Assembly Object corresponds to one or more of the PDI and/or PDO Transfer Object attributes.

The Assembly Object is linked to the Process IO vendor specific object, which provides access to the PDI and PDO data. The Assembly object defines the interface by which a Class 1 PLC or controller can:

- Request the PDI data block from the IOLM.
- Write the PDO data block to the IOLM.

12.12.1 Class Attributes

This table shows the Class Attributes for the Assembly Object for a Class 1 interface.

Attribute ID	Name	Data Type	Data Value(s)	Access Rule
1	Revision	UINT	1	Get
2	Max Instance	UINT	12 (4-Port Models24 (8-Port Models)	Get
3	Num Instances	UINT	12 (4-Port Models24 (8-Port Models)	Get

12.12.2 Instance Definitions (8-Port Models)

This table shows the Instance Definitions for the Assembly Object for a Class 1 interface for the 8-port models.

Assembly Instance Number	Description	Data Type	Data Values	Access Rule
101	PDI data blocks from Ports 1 to 8. PDO data blocks from ports 1-8	BYTE Array Valid read lengths: 1-576	0-255	Get
102	PDI data blocks from Ports 2 to 8. PDO data blocks from Ports 1-8	BYTE Array Valid read lengths: 1-540	0-255	Get
103	PDI data blocks from Ports 3 to 8. PDO data blocks from Ports 1-8	BYTE Array Valid read lengths: 1-504	0-255	Get
104	PDI data blocks from Port 4-8. PDO data blocks from Ports 1-8	BYTE Array Valid read lengths: 1-468	0-255	Get
105	PDI data blocks from Ports 5-8 PDO data blocks from Ports 1-8	BYTE Array Valid read lengths: 0-432	0-255	Get
106	PDI data blocks from Ports 6 to 8. PDO data blocks from Ports 1-8	BYTE Array Valid read lengths: 0-396	0-255	Get
107	PDI data blocks from Ports 7 to 8. PDO data blocks from Ports 1-	BYTE Array Valid read lengths: 0-360	0-255	Get

	8			
108	PDI data blocks from Port 8. PDO data blocks from Ports 1-8	BYTE Array Valid read lengths: 0-324	0-255	Get
109	PDO data blocks from Ports 1-8	BYTE Array Valid read lengths: 0-288	0-255	Get
110	PDO data blocks from Ports 2-8	BYTE Array Valid read lengths: 0-252	0-255	Get
111	PDO data blocks from Ports 3-8	BYTE Array Valid read lengths: 0-216	0-255	Get
112	PDO data blocks from Port 4-8	BYTE Array Valid read lengths: 0-180	0-255	Get
113	PDO data blocks from Ports 5-8	BYTE Array Valid read lengths: 0-144	0-255	Get
114	PDO data blocks from Ports 6-8	BYTE Array Valid read lengths: 0-108	0-255	Get
115	PDO data blocks from Ports 7-8	BYTE Array Valid read lengths: 0-72	0-255	Get
116	PDO data blocks from Port 8	BYTE Array Valid read lengths: 0-36	0-255	Get
117	PDO data blocks to Ports 1-8	BYTE Array Valid read lengths: 0-288	0-255	Set
118	PDO data blocks to Ports 2-8	BYTE Array Valid read lengths: 0-252	0-255	Set
119	PDO data blocks to Ports 3-8	BYTE Array Valid read lengths: 0-216	0-255	Set
120	PDO data blocks to Ports 4-8	BYTE Array Valid read lengths: 0-180	0-255	Set
121	PDO data blocks to Ports 5-8	BYTE Array Valid read lengths: 0-144	0-255	Set
122	PDO data blocks to Ports 6-8	BYTE Array Valid read lengths: 0-108	0-255	Set
123	PDO data blocks to Ports 7-8	BYTE Array Valid read lengths: 0-72	0-255	Set
124	PDO data blocks to Port 8	BYTE Array Valid read lengths: 0-36	0-255	Set

12.12.3 Instance Attributes

This table shows the Instance Attributes for the Assembly Object for a Class 1 interface.

Attribute ID	Name	Data Type	Data Value(s)	Access Rule
3	Data	Array of BYTE	0-255	Get/Set
4	Data Length	UINT	Maximum number of bytes in attribute 3	Get

12.12.4 Common Services

This table shows the Common Services for the Assembly Object for a Class 1 interface.

Service Code	Implemented in Class	Implemented in Instance	Service Name
01 hex	Yes	No	Get_Attributes_All
0E hex	Yes	Yes	Get_Attribute_Single
10 hex	No	Yes	Set_Attribute_Single
02 hex	No	No	Set_Attribute_All

12.12.5 Instance Attribute Definitions: Attribute 3-Request/Write Data

Dependent on the instance number, this is either the PDI data block and/or the PDO data block.

12.12.6 Instance Attribute Definitions: Attribute 4-Data Length

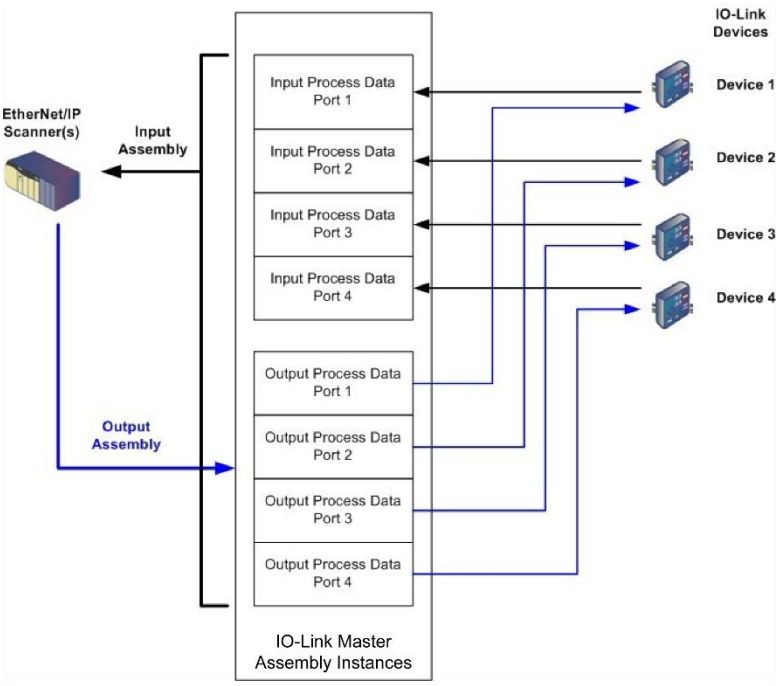
This is the maximum data length for each Assembly instance.

12.12.7 Overview of Assembly Interface

The Assembly interface is designed to:

- Provide access to all Input and Output assemblies.
- Maximize flexibility for the PLC programmer.
- Minimize required PLC and IO-Link communication bandwidth.
- Be as easy to use as possible.

The following diagram illustrates the Assembly instances for a four port IOLM. There is one Assembly input and output instance assigned to each IO-Link port.



12.12.8 Grouping of Assembly Instances

In order to minimize the number of required I/O connections, the input and output assembly instances are organized as follows. The Input Assembly instances are grouped into one continuous array with no gaps between the instances. The same is also true for Output Assembly Instances.

12.12.8.1 8-Port Models

Assembly Controller Access									
	Assembly Instance Number	Controller Port 1 Access		Controller Port 2 Access		Controller Port 3 Access		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	101 (Port 1)								
	102 (Port 2)								
	103 (Port 3)								
	104 (Port 4)								
	105 (Port 5)								
	106 (Port 6)								
	107 (Port 7)								
	108 (Port 8)								
Read (Input) Process Data Output	109 (Port 1)								
	110 (Port 2)								
	111 (Port 3)								
	112 (Port 4)								
	113 (Port 5)								
	114 (Port 6)								
	115 (Port 7)								
	116 (Port 8)								
Write (Output) Process Data	117 (Port 1)								
	118 (Port 2)								
	119 (Port 3)								
	120 (Port 4)								
	121 (Port 5)								

Output	**122 (Port 6)**								
	123 (Port 7)								
	124 (Port 8)								

Where:

- All accessible data can be read (input) and written (output) from one I/O connection.
- Controller Read (Input) access:
  - One or more input instances may be read with one I/O connection. (i.e. If addressing the instance 101, all input instances for both PDI and PDO data, 101 to 116 (for 8-port models), may be read in one connection.)
  - The length of the Read (Input) connection can range from 1 to the total length for all input instances.
  - Multiple controllers can read access to the Input Assembly instances at one time.
- Controller Write (Output) access:
  - Only output instances may be written.
  - One or more output instances may be written to with one connection.
  - The length of the Write (Output) connection must be equal to the total length of the output instance(s).
  - Only one controller may have write access to an output instance.

Note: In order to receive all PDI and PDO data in one Class 1 connection, it may be necessary to decrease the size of one or more PDI and/or PDO blocks via the embedded EtherNet/IP configuration web page.

13 CONTROLLOGIX FAMILY – EXAMPLE PLC PROGRAMS

The example RSLogix 5000 PLC program is intended to provide basic working functionality:

- Through a Class 1 connection, provide a PDI data block with the IO-Link port status, auxiliary bit status and the PDI data.
- Through explicit messages, provide the ability to send both read and write ISDU requests to the IO-Link devices and receive the responses.
- Through explicit messages, provide the Device Information block.

Perform the following steps to run the example PLC program on your ControlLogix family PLC.

13.1 IMPORT THE PLC PROGRAM INTO RSLOGIX 5000

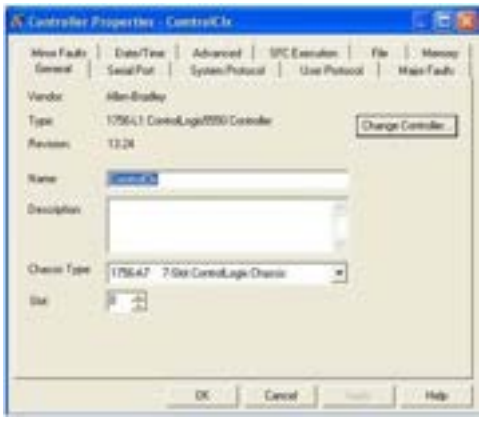
Both the standard **.ACD** file and library file have been provided. If your version of RSLogix 5000 will not open the **.ACD** file, then you will need to import the **.L5K** file.

13.2 CONFIGURE THE CONTROLLER

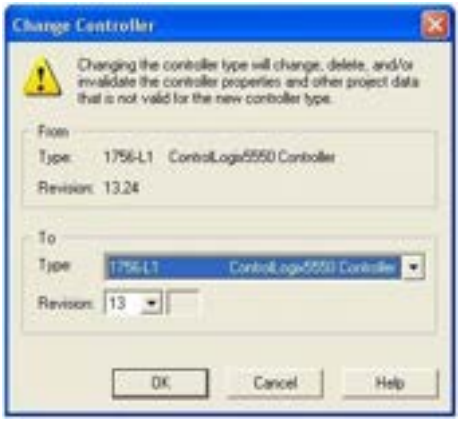
The following are the controller settings used by Datalogic to create the example PLC program.

Note: You may need to change the controller settings to match those of your PLC.

1. Open the RSLogix 5000 *Properties* page, click the *General* tab, enter the name, and click the **Change Controller** button.



2. Select the controller type and click **OK**.



3. Set the **System Overhead Time Slice** to 50% and click **OK**.

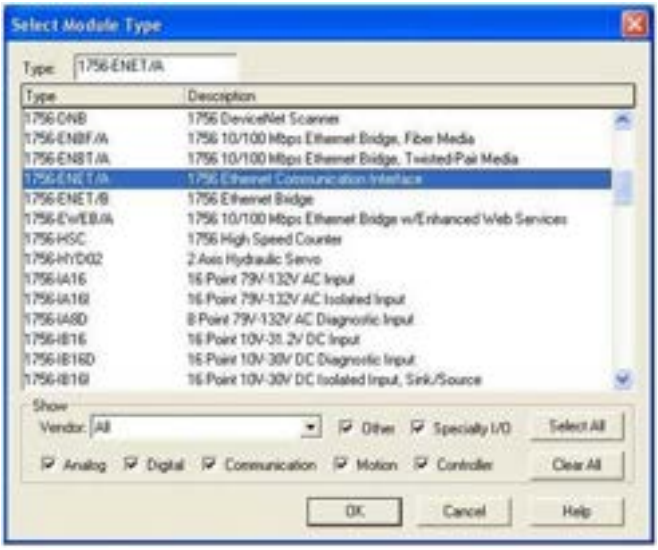
13.3 ADD THE ETHERNET/IP MODULE INTERFACE

If the controller has been changed or if the Ethernet module is different, you will need to add the EtherNet/IP module to the PLC program.

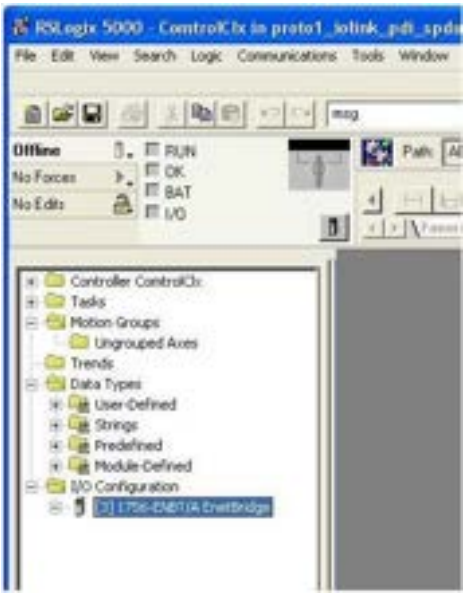
You can use this procedure to add the Ethernet module for your PLC in the corresponding slot.

1. Click **IO Configuration** and select **New Module**.

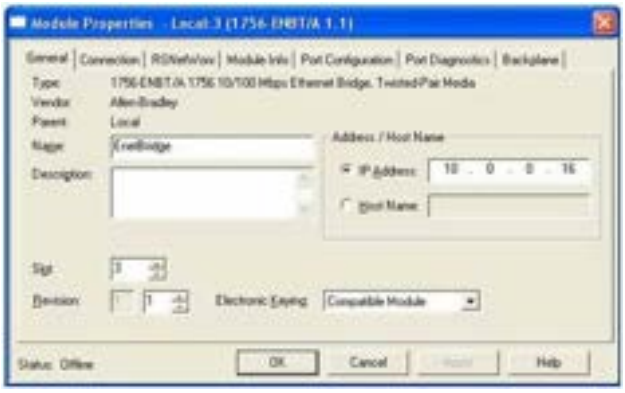
2. Select the **Ethernet Module Type** and click **OK**.



3. Right click the **Ethernet Module** and select **Properties**.



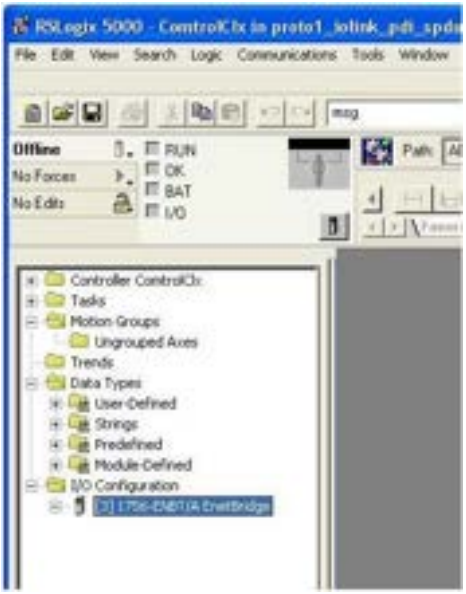
4. Set the **Name**, **IP Address**, **Slot**, and **Revision** for your PLC and then click **OK**.



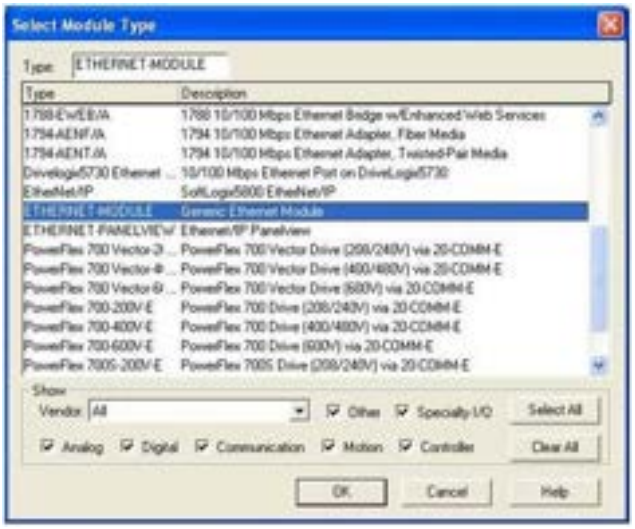
13.4 CONFIGURE THE ETHERNET MODULE

You can use these procedure as a guideline to configure the Ethernet module.

1. Right-click the **Ethernet interface module** and select **New Module**.



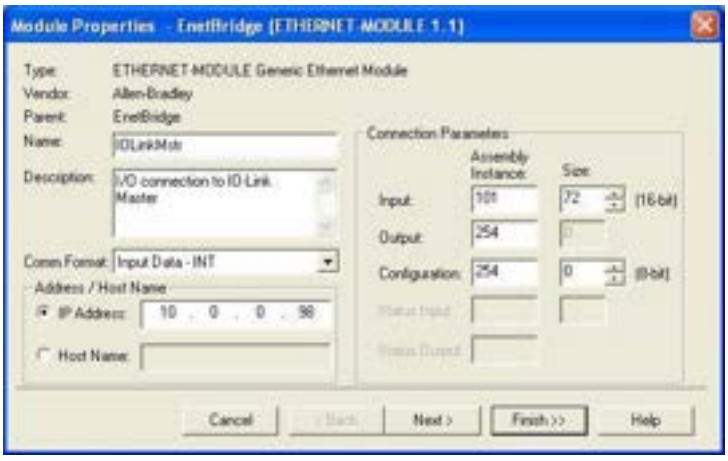
2. Select **ETHERNET MODULE** Generic Ethernet Module and then click **OK**.



3. Enter the following parameters on the *Module Properties* pane:
   a) Enter **IOLinkMstr** for the module **Name**.
   b) If desired, enter a **Description** for the module.
   c) Select **INPUT Data – INT** (16 bit) for the **Comm Format**.
   d) Enter the IP Address of the IOLM module.
   e) Enter the **Connection Parameters**:
      - Enter **101** for the **Input - Assembly Instance**.
      - Enter **72** for the **Input-Size** (input data length in 16-bit words).
      - Enter **254** for the **Output - Assembly Instance**.
      - If not already set to zero, enter **0** for the **Output-Size** (output data length).

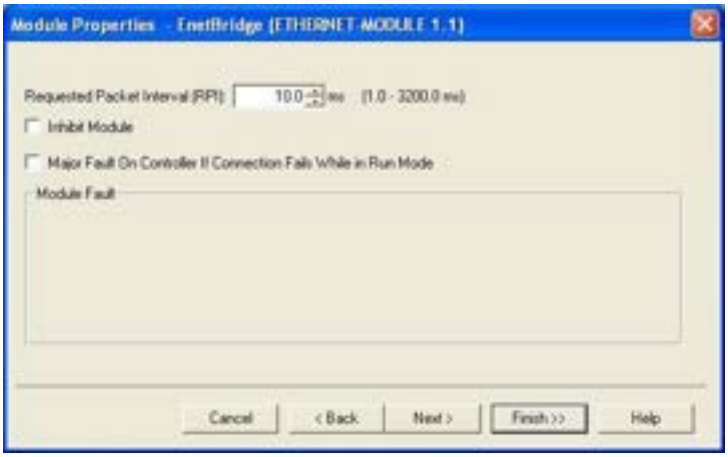
- Set the **Configuration - Assembly Instance** to **254**.
- Set the **Configuration-Size** to **0**. (There are no configuration parameters).

f) Click **Next**.

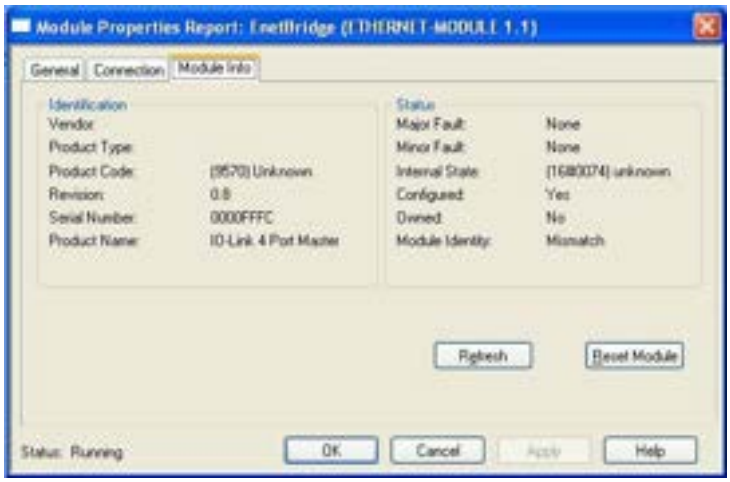


Note: Your version of RSLogix 5000 may only allow one Class 1 connection to a specific EtherNet/IP device.

4. Enter the **Requested Packet Interval**.
   a) Enter the interval value that best suits your system. For the example program, it is recommended to set the interval to **10** ms.
   b) Click **OK**.



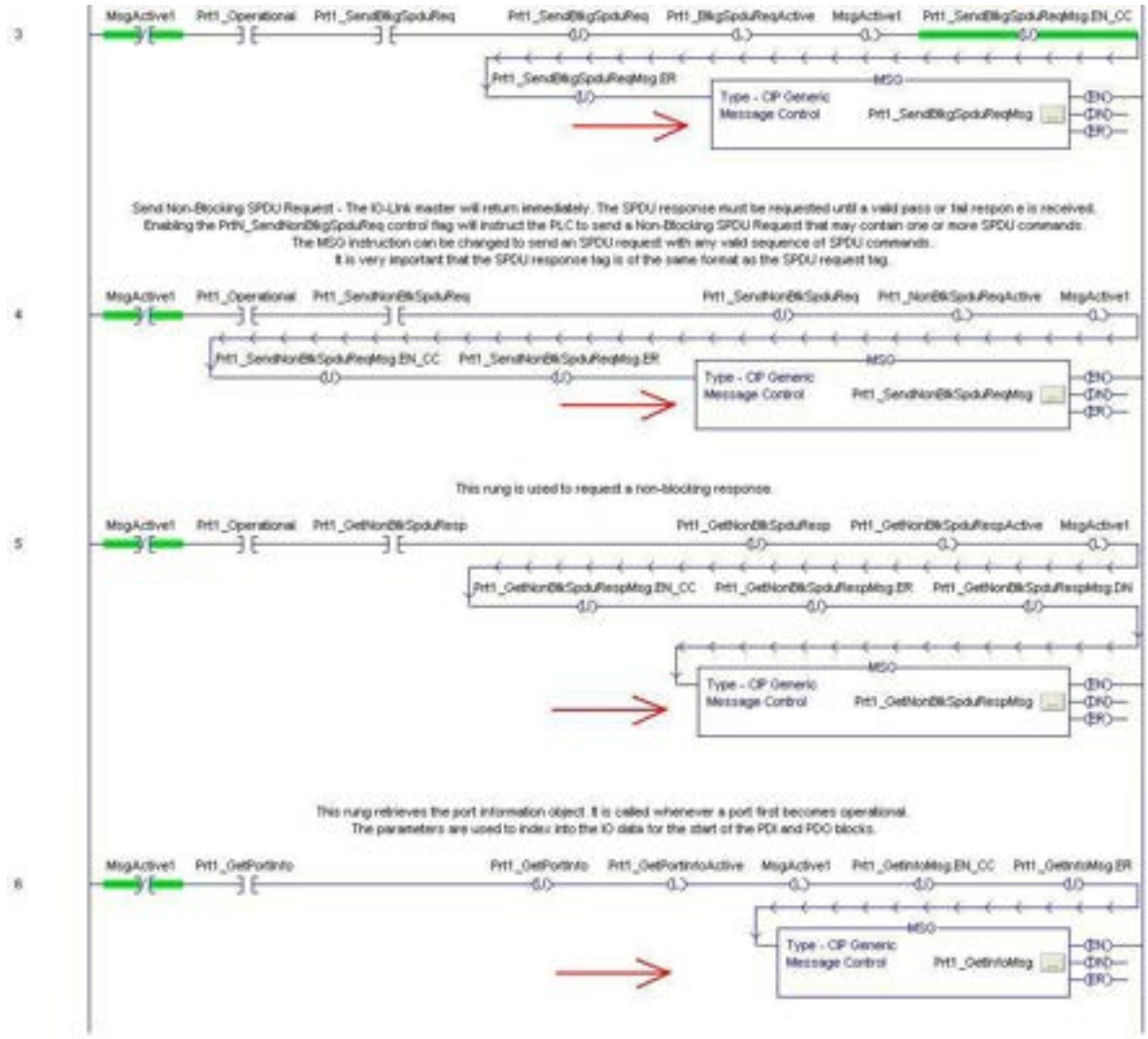
5. Review the *Module Information* pane.



Note: This pane is not updated until the program is downloaded to the PLC and both PLC and IOLM are running.

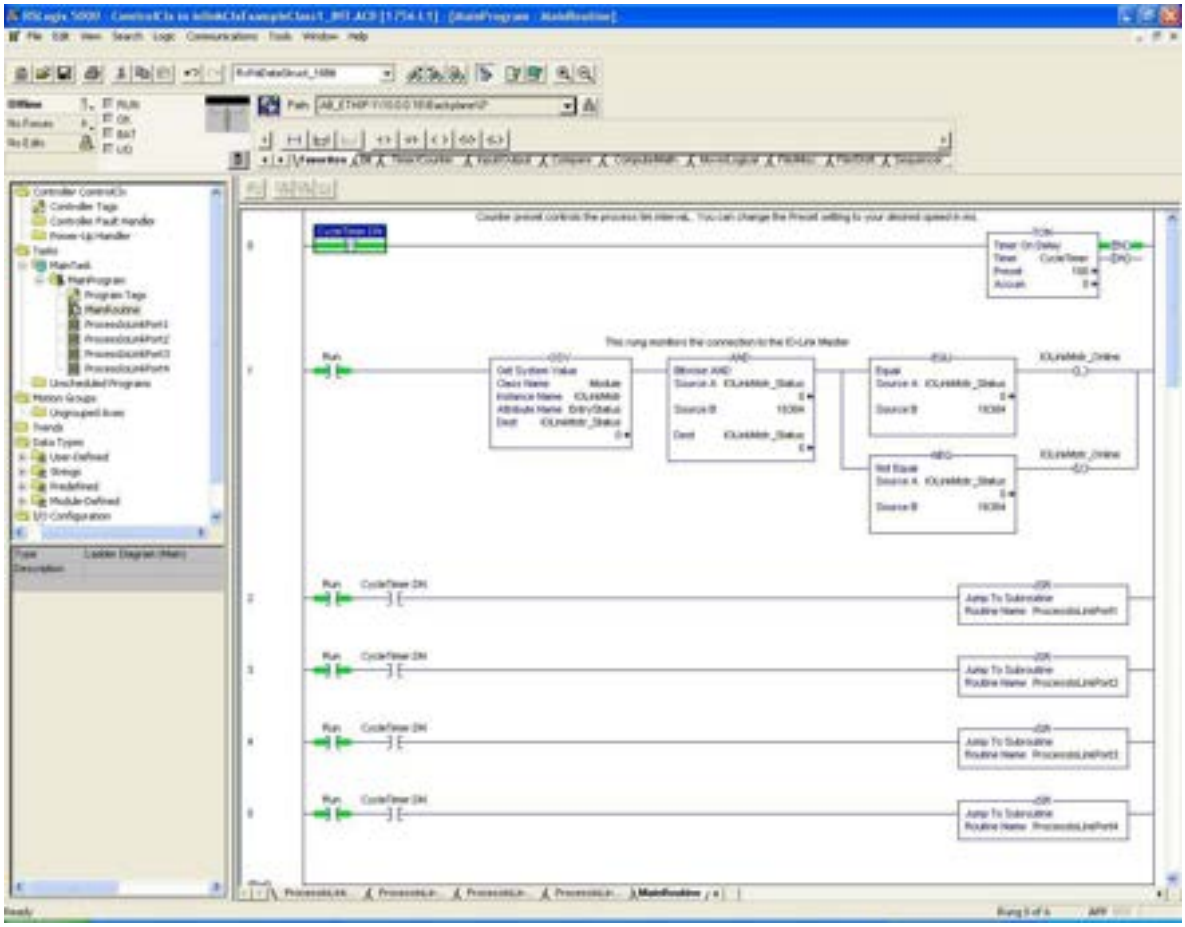
6. Under **Controller Tags**, observe the input tags created for the module. The example PLC program requires the **IOLinkMstr.I** (input data tag). The **IOLinkMstr.C** (configuration tag) is unused and can be ignored.

7. Under **MainProgram**, configure the **Communication Path** for all messages in all four **ProcessIlLinkPortN** subroutines.



8. Enter **IOLinkMstr** for the **Path** for all MSG instructions in all four subroutines.

9. Save the RSLogix5000 program.
10. Download to the PLC.
11. Start the PLC.
12. Click MainRoutine and review the RSLogix 5000 screen.

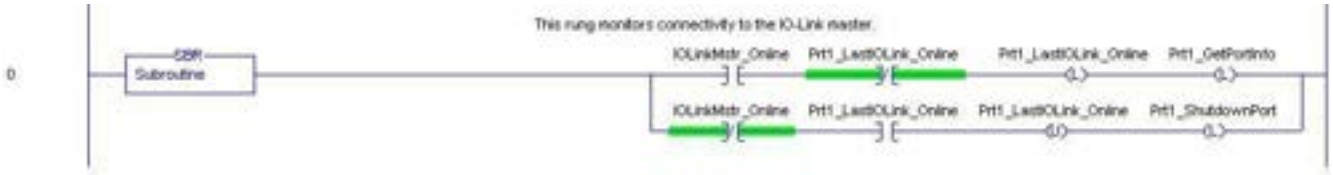


13.5 EXAMPLE PLC PROGRAM OPERATION

The example PLC Program has been designed to operate with the default IOLM settings. It provides only Input Process data but can be modified to also transmit PDO data to the IOLM. The PLC program performs the following tasks:

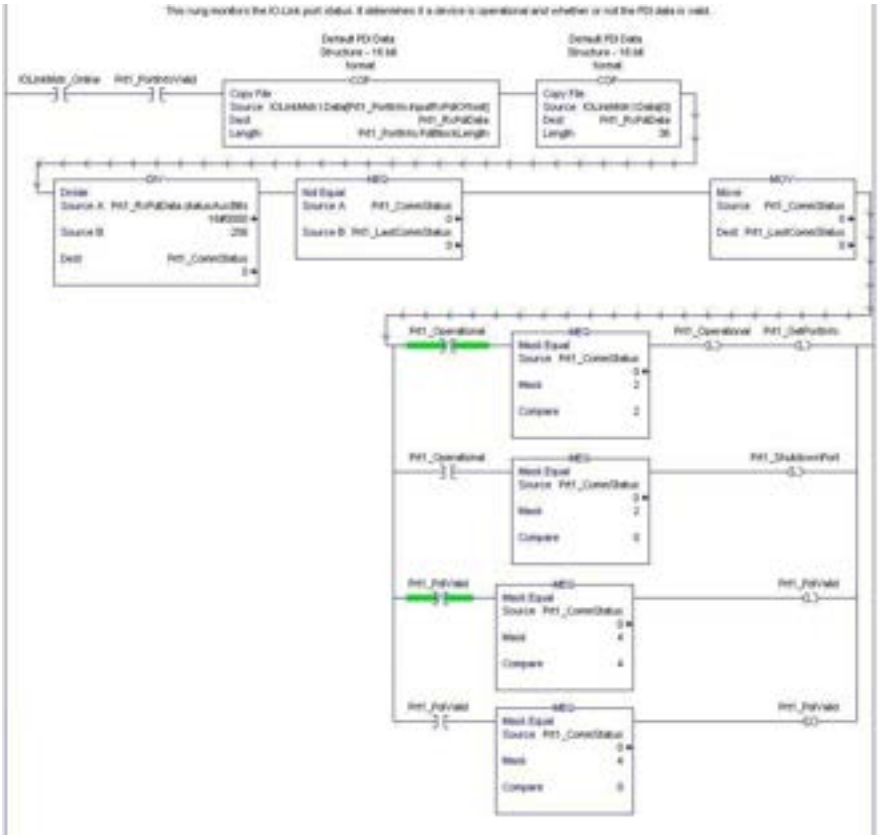
1. The **MainProgram** calls each of the four **ProcessIoLinkPortN** subroutines once every 100 ms. The frequency of these calls can be adjusted by changing the **CycleTimer** Preset value on rung 0.
2. Each **ProcessIoLinkPortN** subroutine is designed to handle all status and communication between the EtherNet/IP controller and one port on the IOLM.

   a. Rung 0:



This rung monitors the interface to the IO-Link. It sets the flags that control a port initialization or shutdown.

   b. Rung 1:



- Using the parameters received in the **PortInfo** tag, automatically indexes into the input data block.
- Copies the PDI data block into the **PrtN_RxPdiData** tag.
- Monitors the IO-Link port status.

  - When the device transitions to active (2): The **PrtN_Operational** tag is enabled (latched). This enables explicit message communication to the IOLM on Rungs 3-6.
  - When the device status transitions to inactive (0) or initializing (1): The **PrtN_Shutdown** flag is enabled (latched) which causes a full shutdown of the port.

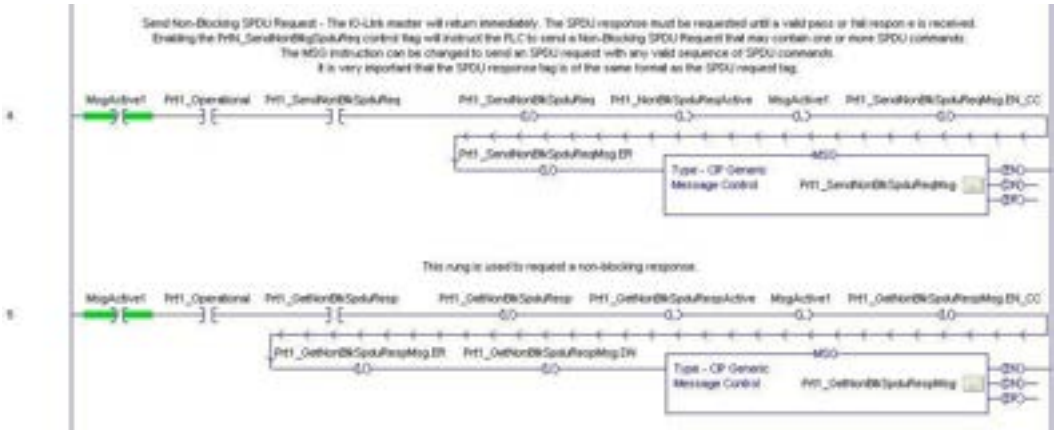
c. Rung 2:

This rung clears all flags necessary to cleanly shut down a port.

d. Rung 3:

When the **PrtN_SendBlkISDUReq** tag is enabled, this rung sends an explicit message to the IOLM. This message starts a blocking ISDU process where the IOLM will not return a MSG response until all ISDU commands have been processed.

e. Rung 4-5:

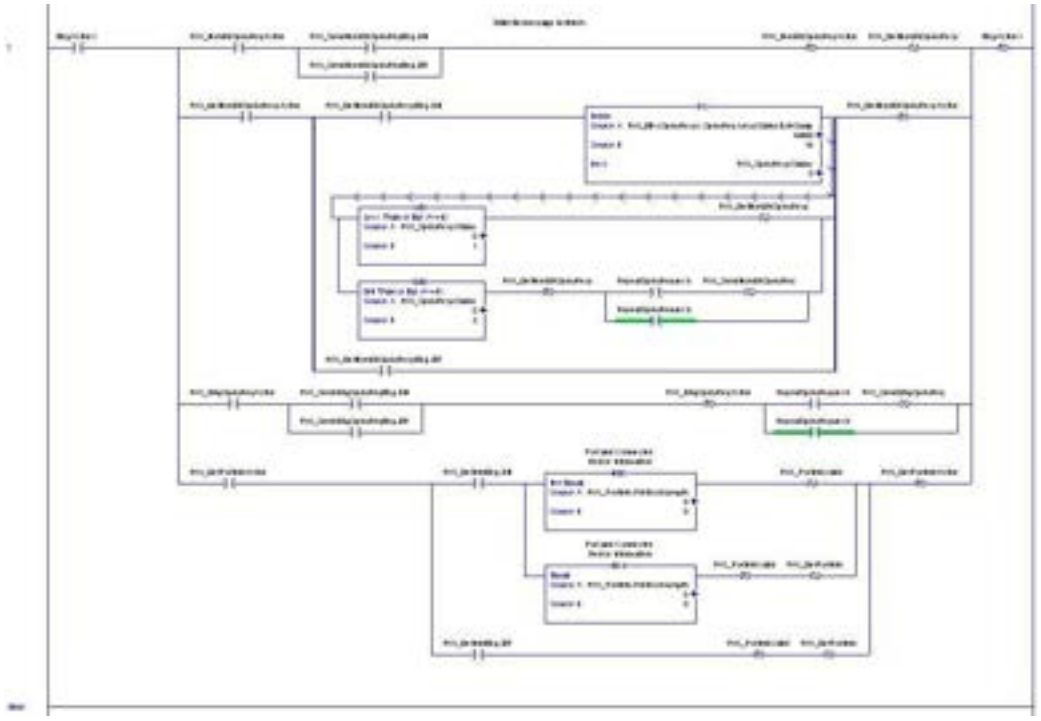


- When the **PrtN_SendNonBlkISDUReq** tag is enabled, this rung sends an explicit message to the IOLM.
  - This message starts a blocking ISDU process where the IOLM returns a MSG response immediately after verifying the ISDU request.
  - The IOLM then processes all ISDU commands within the request.
  - The IO-Link returns In-Process statuses until all ISDU commands have been processed.
- When the **PrtN_GetNonBlkISDUResp** tag is enabled, this rung sends an explicit message to the IOLM to retrieve the ISDU response.
- Run 7 enables (latches) **GetNonBlkISDUResp** as soon the MSG in Rung 4 has completed successfully.
- The ISDU response is retrieved until the response received indicates either a success (2) or an error (3 or 4).

f. Rung 6:

- When the **PrtN_GetPortInfo** tag is enabled, this rung sends an explicit message to request the IO-Link port information block.
- The **PrtN_GetDevInfo** tag is enabled in Rung 0 whenever the IOLM connection status transitions from inactive to active.

g. Rung 7:

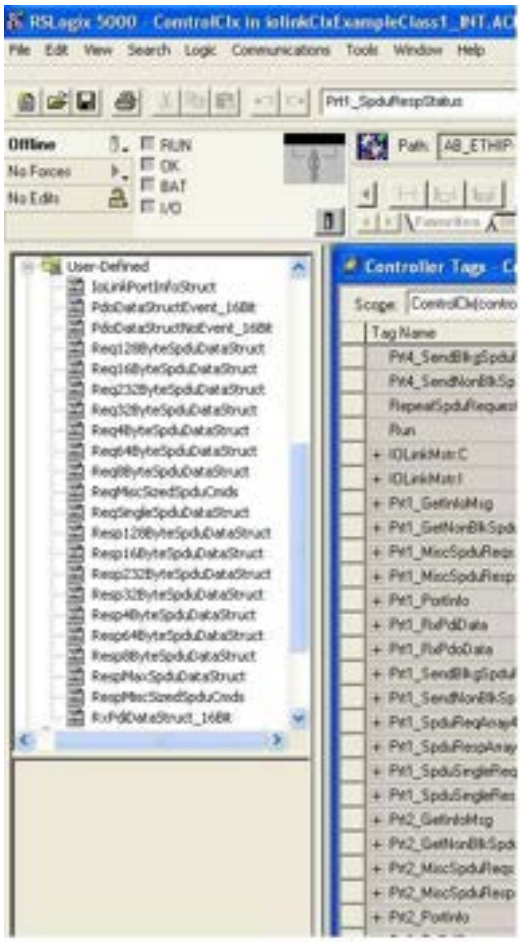


This rung monitors the various explicit messages for completion.

- Controls the non-blocking ISDU request process by enabling messages to retrieve the ISDU response until the request has completed.
- Sets the various flags when a get port information message has completed.

13.6 USER DEFINED DATA STRUCTURES

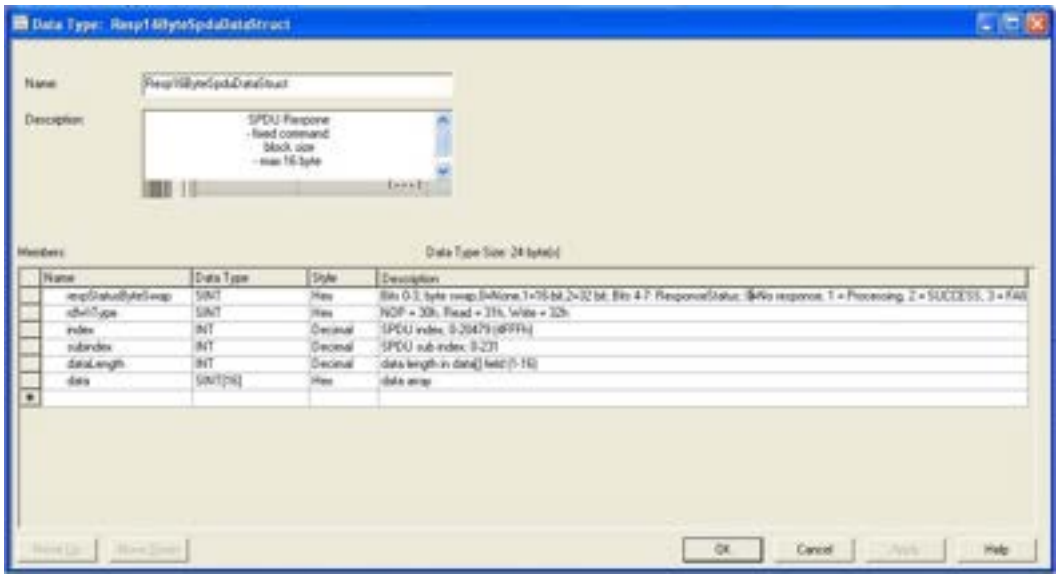
The example PLC program contains a number of User Defined Data Structures that may be used or modified as need be.



The following illustrations show a few of the User Defined Data Structure formats.

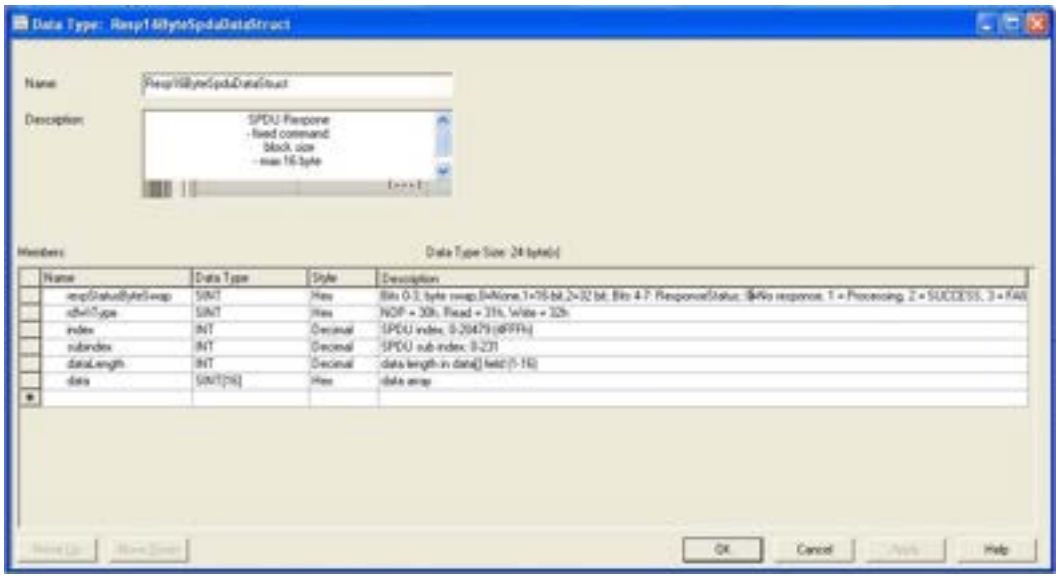
13.6.1 User Defined Structure Example 1

This displays the first example of a User Defined Data Structure.



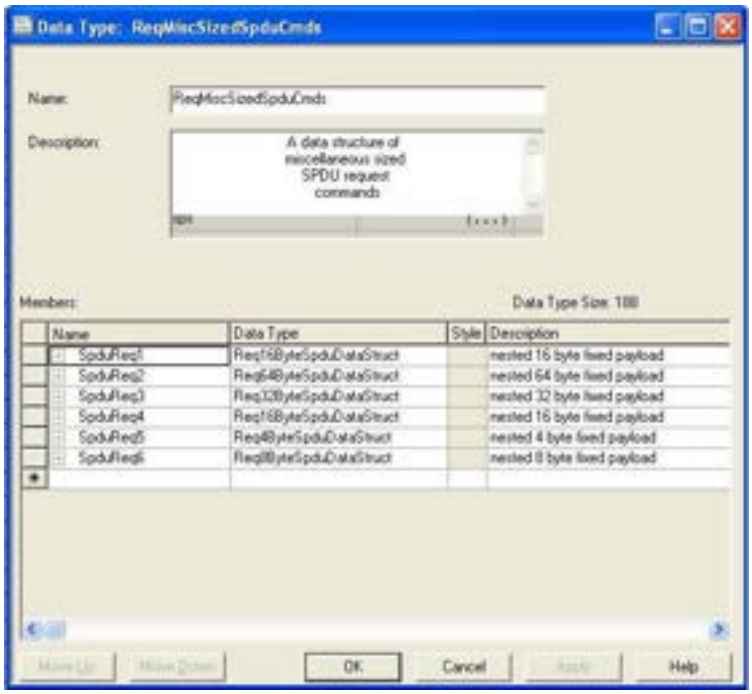
13.6.2 User Defined Structure Example 2

This is the second example of a User Defined Structure.



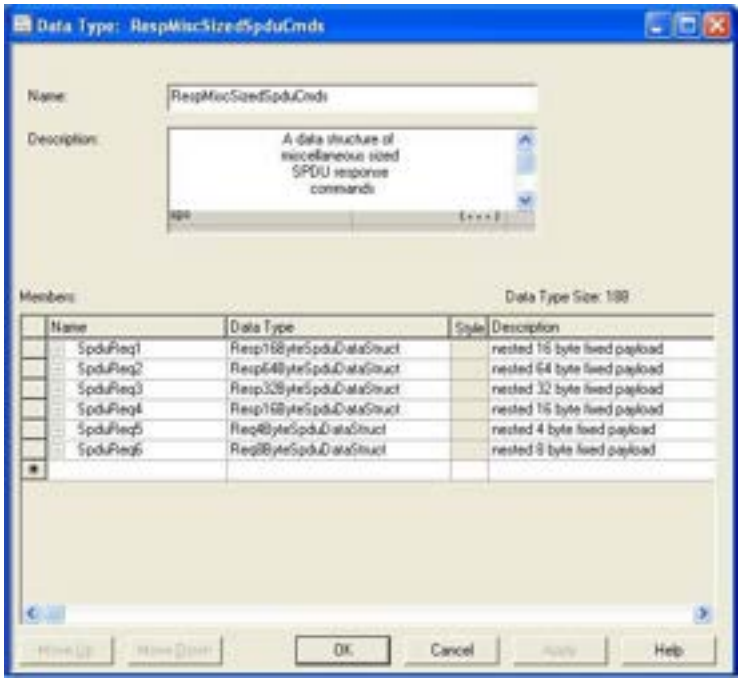
13.6.3 User Defined Structure Example 3

This is the third example of a User Defined Structure.



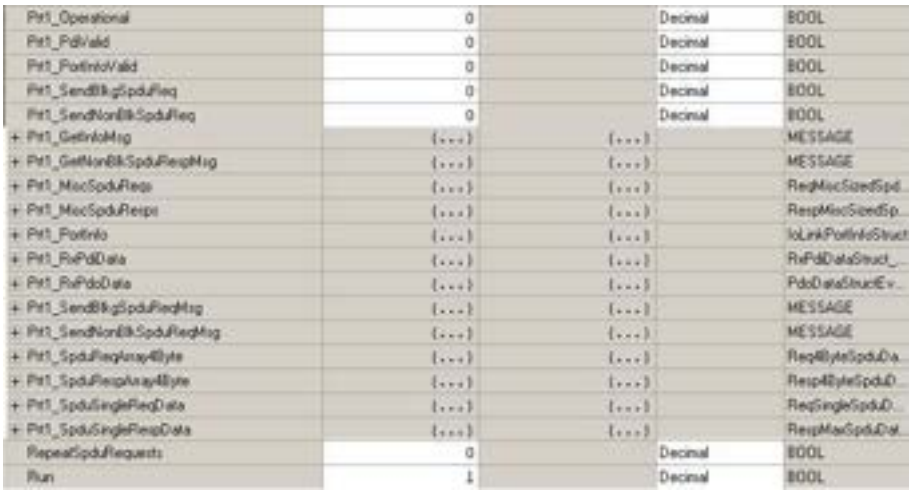
13.6.4 User Defined Structure Example 4

This is the fourth example of a User Defined Structure.



13.7 EXAMPLE PLC PROGRAM TAG DEFINITIONS

The following tag definitions apply to the example IOLM PLC program.



Tag Name	Value Range	Description
PrtN_Operational (init state = false)	BOOL	Controlled by the subroutine, the port operational status. The port must be operational before communication to the IO-Link port is allowed. • 0 = false • 1= true
PrtN_PdiValid (init state = false)	BOOL	Controlled by the subroutine, the PDI (Input Process data block) valid status. • 0 = false • 1= true
PrtN_PortInfoValid (init state = false)	BOOL	Controlled by the subroutine, the port information valid status. The port information must be retrieved before the device can become operational. • 0 = false • 1= true
PrtN_SendBlkgISDUReq (init state = false)	BOOL	*Controlled by the User or some other part of a PLC program*, directs the subroutine whether to send a blocking ISDU request to the IOLM. • 0 = false (do not send message) • 1= true (send message)
PrtN_SendNonBlkISDUReq (init state = false)	BOOL	Controlled by the User or some other part of a PLC program, directs the subroutine whether to begin the non-blocking ISDU request process. If true, the subroutine sends a non-blocking ISDU request to the IOLM. • 0 = false (do not send message) • 1= true (send message)
PrtN_GetInfoMsg	MSG instruction parameters	Used by the subroutine, the message data used to get the port information from the IOLM. ***Note:*** *This tag should not be modified by any other part of the PLC program or through the RSLogix 5000 user interface.*
PrtN_GetNonBlkISDURespMsg	MSG instruction parameters	Used by the subroutine, the message data used to get the non-blocking ISDU response from the IOLM. ***Note:*** *This tag should not be modified by any other part of the PLC program or through the RSLogix 5000 user interface.*
PrtN_MiscISDUReqs	User defined data structure	Group of ISDU commands used as the default ISDU request format for the example PLC program. Can be modified by the user or other part of a PLC program.

		Refer to par. 13.7.3 _bookmark226for more information.
PrtN_MiscISDUResps	User defined data structure	Group of ISDU command responses that is returned by the IOLM after and ISDU request completion. Must be in same overall format as **PrtN_MiscISDUReqs**. Refer to par. 13.7.4 for a complete description.
PrtN_PortInfo	User defined data structure	Contains common device information parameters automatically read by the IOLM during initialization of the IO-Link device interface.
PrtN_RxPdiData	User defined data structure	This tag contains the latest PDI data block as received from the Class 1 interface. It is updated with every **ProcessIoLinkPortN** subroutine call. Refer to par. 13.7.2 for more information.
PrtN_SendBlkgISDUReqMsg	MSG instruction parameters	MSG instruction parameters used to send a blocking ISDU Request message. ***Note:*** *This tag should not be modified by any other part of the PLC program or through the RSLogix 5000 user interface.*
PrtN_SendNonBlkISDUReqMsg	MSG instruction parameters	MSG instruction parameters used to send a non-blocking ISDU Request message. ***Note:*** *This tag should not be modified by any other part of the PLC program or through the RSLogix 5000 user interface.*
PrtN_ISDUReqArray4Byte	ISDU command parameters	An alternative ISDU request format.
PrtN_ISDURespArray4Byte	ISDU response parameters	An alternative ISDU response format. Must be used with **PrtN_ISDUReqArray4Byte**.
PrtN_ISDUSingleReqData	ISDU command parameters	An alternative ISDU request format.
PrtN_ ISDUSingleRespData	ISDU response parameters	An alternative ISDU response format. Must be used with **PrtN_ISDUReqArray4Byte**.
RepeatISDURequests	BOOL	If enabled, instructs all subroutines to repeat any ISDU requests upon completion. Intended for testing purposes. May be enabled by end user.
Run	BOOL	**MainProgram** only. Allows the **ProcessIoLinkPortN** subroutine calls if enabled (1). Prevents the **ProcessIoLinkPortN** subroutine calls if disabled (0).

13.7.1 PrtN_DeviceInformation Definition

The IOLM requests this information from the IO-Link device during the IO-Link device initialization process. It is then made accessible via explicit messages. The example PLC program automatically requests this information block when the device status transitions to active.

Parameter Name	Data	Description
VendorName	64 ASCII characters	Requested from ISDU data block index 16, contains the Vendor Name description of the IO-Link device.
VendorText	64 ASCII characters	Requested from ISDU data block index 17, contains the Vendor Text description of the IO-Link device.
ProductName	64 ASCII characters	Requested from ISDU data block index 18, contains the Product Name description of the IO-Link device.
ProductId	64 ASCII characters	Requested from ISDU data block index 19, contains the Product ID description of the IO-Link device.
ProductText	64 ASCII characters	Requested from ISDU data block index 20, contains the Product Text description of the IO-Link device.
SerialNum	16 ASCII characters	Requested from ISDU data block index 21, contains the Vendor Specific Serial Number of the IO-Link device.
HardwareRev	64 ASCII characters	Requested from ISDU data block index 22, contains the Hardware Revision of the IO-Link device.
FirmwareRev	64 ASCII characters	Requested from ISDU data block index 23, contains the Firmware Revision of the IO-Link device.
DevicePdiLength	INT	Length of valid PDI data from IO-Link device or port (if not in I/O Link mode).
DevicePdoLength	INT	Length of valid PDO data that can accepted by the IO-Link device or port (if not in I/O Link mode).
PdiBlockLength	INT	The configured PDI data block length. This includes the header bytes and any PDI data.
PdoBlockLength	INT	The configured PDO data block length. This includes the header bytes and any PDO data.
InputRxPdiOffset	INT	Provides the index into the Class 1 I/O input data received from the IOLM. The index corresponds to the configured PDI data format of the port on the IOLM. Used to automatically index into the input data and retrieve the PDI data block.
InputRxPdoOffset	INT	Provides the index into the Class 1 I/O input data received from the IOLM. The index corresponds to the configured PDO data format of the port on the IOLM. Used to automatically index into the input data and retrieve the PDO data block.
OutputPdoOffset	INT	Provides the index into the Class 1 I/O output data sent to the IOLM. The index corresponds to the configured PDO data format of the port on the IOLM. Used to automatically index into the output data and transmit the PDO data block.
ControlFlags	Bit- mapped INT	Bit 0 (01h): 1 =Indicates that the event code to clear is expected in the PDO block 0 = Indicates that the event code to clear is not expected in the PDO block. The PDO data block only contains PDO data. Bit 1 (02h): 1 =Indicates that the IO-Link device is SIO mode capable 0 =Indicates that the IO-Link device is not SIO mode capable

13.7.2 PrtN_RxPdiData Definition

The PDI data block is received from the IOLM over a Class 1 I/O connection. The data is then copied into the PDI data block in each subroutine.

– Prt1_RxPdiData	{...}	{...}		RxPdiDataStruct_...
+ Prt1_RxPdiData.statusAuxBits	16#0000		Hex	INT
+ Prt1_RxPdiData.event	16#0000		Hex	INT
– Prt1_RxPdiData.pdiData	{...}	{...}	Hex	INT[16]
+ Prt1_RxPdiData.pdiData[0]	16#0000		Hex	INT
+ Prt1_RxPdiData.pdiData[1]	16#0000		Hex	INT
+ Prt1_RxPdiData.pdiData[2]	16#0000		Hex	INT
+ Prt1_RxPdiData.pdiData[3]	16#0000		Hex	INT
+ Prt1_RxPdiData.pdiData[4]	16#0000		Hex	INT
+ Prt1_RxPdiData.pdiData[5]	16#0000		Hex	INT
+ Prt1_RxPdiData.pdiData[6]	16#0000		Hex	INT
+ Prt1_RxPdiData.pdiData[7]	16#0000		Hex	INT
+ Prt1_RxPdiData.pdiData[8]	16#0000		Hex	INT
+ Prt1_RxPdiData.pdiData[9]	16#0000		Hex	INT
+ Prt1_RxPdiData.pdiData[10]	16#0000		Hex	INT
+ Prt1_RxPdiData.pdiData[11]	16#0000		Hex	INT
+ Prt1_RxPdiData.pdiData[12]	16#0000		Hex	INT
+ Prt1_RxPdiData.pdiData[13]	16#0000		Hex	INT
+ Prt1_RxPdiData.pdiData[14]	16#0000		Hex	INT
+ Prt1_RxPdiData.pdiData[15]	16#0000		Hex	INT

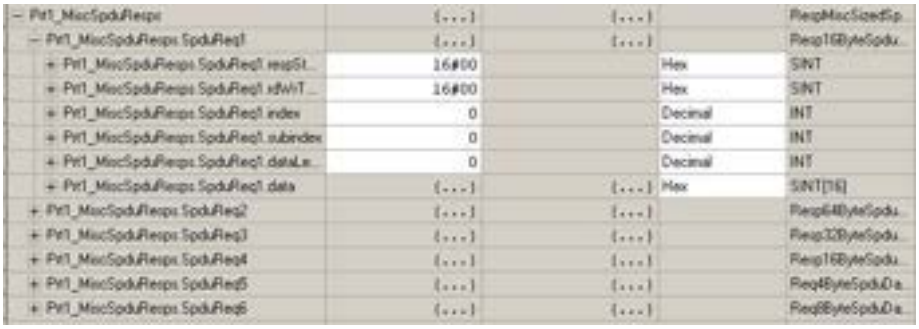
13.7.3 PrtN_MiscISDUReqs

This tag is used as the default ISDU request. It contains several ISDU commands that are configured to read standard ISDU blocks supported by most IO-Link devices. This User Defined Structure may be changed to include any set of ISDU commands. The only constraint is that the entire Request and response must be no larger than the maximum MSG instruction payload of 500 bytes.

– Prt1_MiscSpduReqs	{...}	{...}		ReqMiscSizedSpd...
– Prt1_MiscSpduReqs.SpduReq1	{...}	{...}		Req16ByteSpduD...
+ Prt1_MiscSpduReqs.SpduReq1.byteSwap	16#00		Hex	SINT
+ Prt1_MiscSpduReqs.SpduReq1.rdwrType	16#31		Hex	SINT
+ Prt1_MiscSpduReqs.SpduReq1.index	0		Decimal	INT
+ Prt1_MiscSpduReqs.SpduReq1.subindex	0		Decimal	INT
+ Prt1_MiscSpduReqs.SpduReq1.dataLen...	16		Decimal	INT
+ Prt1_MiscSpduReqs.SpduReq1.data	{...}	{...}	Hex	SINT[16]
– Prt1_MiscSpduReqs.SpduReq2	{...}	{...}		Req64ByteSpduD...
+ Prt1_MiscSpduReqs.SpduReq2.byteSwap	16#00		Hex	SINT
+ Prt1_MiscSpduReqs.SpduReq2.rdwrType	16#51		Hex	SINT
+ Prt1_MiscSpduReqs.SpduReq2.index	16		Decimal	INT
+ Prt1_MiscSpduReqs.SpduReq2.subindex	0		Decimal	INT
+ Prt1_MiscSpduReqs.SpduReq2.dataLen...	64		Decimal	INT
+ Prt1_MiscSpduReqs.SpduReq2.data	{...}	{...}	Hex	SINT[64]
– Prt1_MiscSpduReqs.SpduReq3	{...}	{...}		Req32ByteSpduD...
+ Prt1_MiscSpduReqs.SpduReq3.byteSwap	16#00		Hex	SINT
+ Prt1_MiscSpduReqs.SpduReq3.rdwrType	16#41		Hex	SINT
+ Prt1_MiscSpduReqs.SpduReq3.index	10		Decimal	INT
+ Prt1_MiscSpduReqs.SpduReq3.subindex	0		Decimal	INT
+ Prt1_MiscSpduReqs.SpduReq3.dataLen...	32		Decimal	INT
+ Prt1_MiscSpduReqs.SpduReq3.data	{...}	{...}	Hex	SINT[32]
– Prt1_MiscSpduReqs.SpduReq4	{...}	{...}		Req16ByteSpduD...
+ Prt1_MiscSpduReqs.SpduReq4.byteSwap	16#00		Hex	SINT
+ Prt1_MiscSpduReqs.SpduReq4.rdwrType	16#31		Hex	SINT
+ Prt1_MiscSpduReqs.SpduReq4.index	21		Decimal	INT
+ Prt1_MiscSpduReqs.SpduReq4.subindex	0		Decimal	INT
+ Prt1_MiscSpduReqs.SpduReq4.dataLen...	16		Decimal	INT
+ Prt1_MiscSpduReqs.SpduReq4.data	{...}	{...}	Hex	SINT[16]
– Prt1_MiscSpduReqs.SpduReq5	{...}	{...}		Req4ByteSpduDa...
+ Prt1_MiscSpduReqs.SpduReq5.byteSwap	16#00		Hex	SINT
+ Prt1_MiscSpduReqs.SpduReq5.rdwrType	16#11		Hex	SINT
+ Prt1_MiscSpduReqs.SpduReq5.index	22		Decimal	INT
+ Prt1_MiscSpduReqs.SpduReq5.subindex	0		Decimal	INT
+ Prt1_MiscSpduReqs.SpduReq5.dataLen...	4		Decimal	INT
+ Prt1_MiscSpduReqs.SpduReq5.data	{...}	{...}	Hex	SINT[4]
– Prt1_MiscSpduReqs.SpduReq6	{...}	{...}		Req8ByteSpduDa...
+ Prt1_MiscSpduReqs.SpduReq6.byteSwap	16#00		Hex	SINT
+ Prt1_MiscSpduReqs.SpduReq6.rdwrType	16#21		Hex	SINT
+ Prt1_MiscSpduReqs.SpduReq6.index	23		Decimal	INT
+ Prt1_MiscSpduReqs.SpduReq6.subindex	0		Decimal	INT
+ Prt1_MiscSpduReqs.SpduReq6.dataLen...	8		Decimal	INT
+ Prt1_MiscSpduReqs.SpduReq6.data	{...}	{...}	Hex	SINT[8]

13.7.4 PrtN_MiscISDUResp

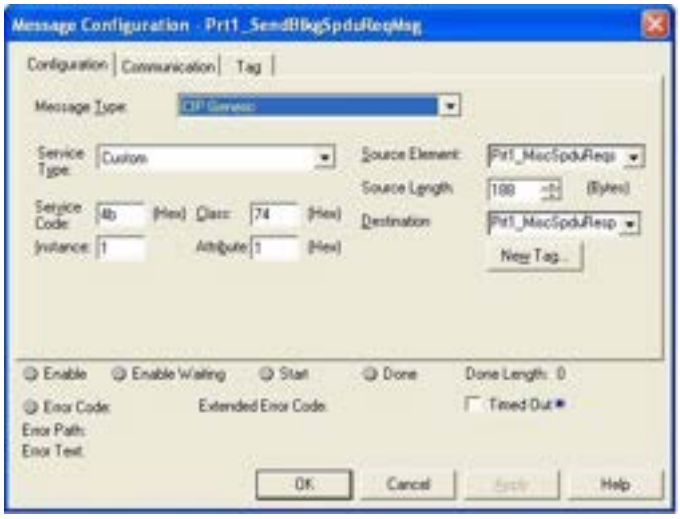
This tag contains the response to the ISDU request. It must be of the same size and structure as the **request** structure.



13.7.5 Using Other ISDU Request/Response Command Formats

Other ISDU request/response formats may be used instead of the default request command set. The following steps demonstrate how to change the ISDU request/response formats:

1. If one ISDU request/response is required, create a new request and response tag with any of the defined ISDU User Defined structures. The one requirement is that the request and response formats must be the same. For example, if a 16 byte nested format is use for the request, then a 16 byte nested response structure must be used.
2. If multiple ISDU requests of the same nested lengths are required, created request and response arrays of the same User Defined format.
3. If multiple ISDU requests of different nested lengths are required, create new User Defined Data Structures for the request and response containing user defined command structures. Then create tags using the new user Defined data structures. You may also want to modify the **ReqMiscSizedISDUCmds** and **RespMiscSizedISDUCmds** User Defined data structures.
4. Modify the appropriate **MSG** instruction settings:



a) Change the **Source Element** to that of the new ISDU request tag.

b) Change the **Source Length** to that of the new **Source Element**. That information is often displayed on the User Defined Structure definition pane.

c) Change the **Destination** to that of the new response tag.

14 SLC/PLC-5/MICROLOGIX INTERFACE

The IOLM provides support for the SLC, PLC-5 and MicroLogix PLCs. The following features are supported:

- Rx PDI data, both Polling and Write-to-File modes.
- Tx PDO data, both PLC-Writes and Read-From-File modes.
- PCCC based messages transferred by means of the PCCC CIP object, including:
  - SLC Typed Read Message
  - SLC Typed Write Message
  - PLC-5 Typed Read Message (Logical ASCII address format)
  - PLC-5 Typed Write Message (Logical ASCII address format)
- Receive, transmit and statistics data.
- Standard PLC-5/SLC file naming conventions.
- Controlled message rate to the PLC when operating in the Write-to-File receive method. This is accomplished by setting the **Maximum PLC Update Rate**.

The primary differences between the PLC-5/SLC interface and the ControlLogix interfaces are:

- Since the PLC-5 and SLC PLCs operate on a file memory system, the PLC-5/SLC interface provides Write-to-File and Read-from-File communication methods in place of Write-to-Tag and Read-from-Tag communication methods. The Write-to-File methods operate in a very similar manner to the Write-to-Tag method available for the ControlLogix family of PLCs.
- Polling is performed through the PLC-5/SLC specific messages instead of accessing the Serial Port Data Transfer object.
- When configuring the IOLM to operate in Write-to-File or Read-from-File, enter the file name starting with an **N** (i.e. N10:0).

Note: While ControlLogix PLCs support the SLC and PLC-5 messages, using those messages on ControlLogix PLCs is not recommended due to data size and performance considerations.

14.1 REQUIREMENTS

Your PLC-5/SLC/MicroLogix PLC must support:

- MultipHop
- ControlLogix devices
- EtherNet/IP

The following tables list PLCs that support EtherNet/IP and the required firmware version for each PLC.

Note: Older versions of the PLC firmware may or may not provide EtherNet/IP functionality. You must verify that an older version of the PLC firmware provides EtherNet/IP functionality before you can use it with IOLM.

If you need to update your PLC firmware, contact your Rockwell distributor.

14.2 PLC-5 AND SLC 5/05 PLC REQUIREMENTS

The following PLCs support Ethernet/IP.

14.2.1 SLC 5/05

Models	Catalog Numbers	Required Firmware Version for Ethernet/IP
SLC 5/05	1747-L551 1747-L552 1747-L553	Series A: FRN 5 or later Series C: FRN 3 or later

Reference: SLC 500 Instruction Set, Appendix A Firmware History, Rockwell Publication 1747-RM001D-EN-P.

14.2.2 PLC-5

Models	Catalog Numbers	Required Firmware Version for Ethernet/IP
Ethernet PLC-5	1785-L20E 1785-L40E 1785-L80E	*Base Ethernet/IP functionality:* • Series C: Revision N and later • Series D: Revision E and later • Series E: Revision D and later *Full Ethernet/IP Compliance:* • Series C: Revision R and later • Series D: Revision H and later • Series E: Revision G and later
Enhanced PLC-5 Attached to Ethernet Module	1785-L11B 1785-L20B 1785-L30B 1785-L40B 1785-L40L 1785-L60B 1785-L60L 1785-L80B	Series B: Revision N.1 or later Series C: Revision N or later Series D: Revision E or later Series E: Revision D or later
ControlNet PLC-5 Attached to Ethernet Module	1785-L20C15 1785-L40C15 1785-L60C15 1785-L80C15	Series C: Revision N or later Series D: Revision E or later Series E: Revision D or later All revisions
Ethernet Module	1785-Enet	Series B: • Base Ethernet/IP functionality: All Revisions • Full Ethernet/IP Compliance: Revision D and later

References:

- Enhanced & Ethernet PLC-5 Series and Enhancement History, Rockwell Publication G19099
- ControlNet Processor Phase, Series, and Enhancement History, Rockwell Publication G19102
- PLC-5 Programmable Controllers System Selection Guide, Rockwell Publication 1785-SG001A-EN-P
- Ethernet Interface Module Series B, Revision D Product Release Notes, Rockwell Publication 1785- RN191E-EN-P

Note: Older versions of firmware may or may not provide Ethernet/IP functionality.

14.3 PLC-5 AND SLC MESSAGES

The following PCCC messages are supported for the PLC-5 and SLC 5/05 PLCs.

Message Type	PCCC Message ID	Maximum Message Size	Maximum Serial Packet Size
SLC Typed Read	162	**CLX**: 242 SINTs (121 INTs) **SLC**: 206 SINTs (103 INTs) **PLC-5**: 240 SINTs (120 INTs)	**CLX**: 238 SINTs (119 INTs) **SLC**: 202 SINTs (101 INTs) **PLC-5**: 236 SINTs (118 INTs)
SLC Typed Write	170	**CLX**: 220 SINTs (110 INTs) **SLC**: 206 SINTs (103 INTs) **PLC-5**: 238 SINTs (119 INTs)	216 SINTs (108 INTs) **SLC**: 202 SINTs (101 INTs) **PLC**-5: 234 SINTs (117 INTs)
PLC-5 Typed Read	104	**CLX**: 234 SINTs (117 INTs) **SLC**: 252 SINTs (126 INTs) **PLC-5**: 238 SINTs (119 INTs)	230 SINTs (115 INTs) **SLC**: 248 SINTs (124 INTs) **PLC**-5: 234 SINTs (117 INTs)
PLC-5 Typed Write	103	**CLX**: 226 SINTs (113 INTs) **SLC**: 226 SINTs (113 INTs) **PLC-5**: 224 SINTs (112 INTs)	**CLX**: 222 SINTs (111 INTs) **SLC**: 222 SINTs (111 INTs) **PLC-5**: 220 SINTs (110 INTs)

The Receive Port Information is provided in one continuous file. The following file addresses are used to retrieve the various parameters.

	IO-Link Port 1	IO-Link Port 2	IO-Link Port 3	IO-Link Port 4	Access	Length
PDI Data Block	N10:0	N20:0	N30:0	N40:0	Read-Only	Configurable per port ***Note:*** *See below for details.*
Receive PDO Data Block	N11:0	N21:0	N31:0	N41:0	Read-Only	Configurable per port ***Note:*** *See below for details.*
Transmit PDO Data Block	N12:0	N22:0	N32:0	N42:0	Write-Only	Configurable per port ***Note:*** *See below for details.*
Receive ISDU Response	N13:0	N23:0	N33:0	N43:0	Read-Only	4 INTs to Max Msg Size
Transmit ISDU Request	N14:0	N24:0	N34:0	N44:0	Write-Only	4 INTs to Max Msg Size
Port Information Block (Continuous Block)						464 Bytes (232 INTs)
Vendor Name	N15:0	N25:0	N35:0	N45:0	Read	64 Chars (32 INTs)
Vendor Text	N15:32	N25:32	N35:32	N45:32	Read	64 Chars (32 INTs)
Product Name	N15:64	N25:64	N35:64	N45:64	Read	64 Chars (32 INTs)
Product ID	N15:96	N25:96	N35:96	N45:96	Read	64 Chars (32 INTs)
Product Text	N15:128	N25:128	N35:128	N45:128	Read	64 Chars (32 INTs)
Serial Number	N15:160	N25:160	N35:160	N45:160	Read	16 Chars (8 INTs)
Hardware Revision	N15:168	N25:168	N35:168	N45:168	Read	64 Chars (32 INTs)
Firmware Revision	N15:200	N25:200	N35:200	N45:200	Read	64 Chars (32 INTs)

This table provides information for 8-port models.

	IO-Link Port 5	IO-Link Port 6	IO-Link Port 7	IO-Link Port 8	Access	Length
PDI Data Block	N50:0	N60:0	N70:0	N80:0	Read-Only	Configurable per port ***Note:*** *See below for details.*
Receive PDO Data Block	N51:0	N61:0	N71:0	N81:0	Read-Only	Configurable per port ***Note:*** *See below for details.*
Transmit PDO Data Block	N52:0	N62:0	N72:0	N82:0	Write-Only	Configurable per port ***Note:*** *See below for details.*
Receive ISDU Response	N53:0	N63:0	N73:0	N83:0	Read-Only	4 INTs to Max Msg Size
Transmit ISDU Request	N54:0	N64:0	N74:0	N84:0	Write-Only	4 INTs to Max Msg Size
Port Information Block (Continuous Block)						464 Bytes (232 INTs)
Vendor Name	N55:0	N65:0	N75:0	N85:0	Read	64 Chars (32 INTs)
Vendor Text	N55:32	N65:32	N75:32	N85:32	Read	64 Chars (32 INTs)
Product Name	N55:64	N65:64	N75:64	N85:64	Read	64 Chars (32 INTs)
Product ID	N55:96	N65:96	N75:96	N85:96	Read	64 Chars (32 INTs)
Product Text	N55:128	N65:128	N75:128	N85:128	Read	64 Chars (32 INTs)
Serial Number	N55:160	N65:160	N75:160	N85:160	Read	16 Chars (8 INTs)
Hardware Revision	N55:168	N65:168	N75:168	N85:168	Read	64 Chars (32 INTs)
Firmware Revision	N55:200	N65:200	N75:200	N85:200	Read	64 Chars (32 INTs)

14.4 PROCESS DATA (PDI AND PDO) ACCESS VIA PCCC MESSAGES

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

	File Number	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 (Ports 5-8 Only Supported on 8-Port Models)	N10:0 (Port 1)								
	N20:0 (Port 2)								
	N30:0 (Port 3)								
	N40:0 (Port 4)								
	N50:0 (Port 5)								
	N60:0 (Port 6)								
	N70:0 (Port 7)								
	N80:0 (Port 8)								
Read (Input) Process Data Output (Ports 5-8 Only Supported on 8-Port Models)	N11:0 (Port 1)								
	N21:0 (Port 2)								
	N31:0 (Port 3)								
	N41:0 (Port 4)								
	N51:0 (Port 5)								
	N61:0 (Port 6)								
	N71:0 (Port 7)								
	N81:0 (Port 8)								

	File Number	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)
Write (Output) Process Data Output (Ports 5-8 Only Supported on 8-Port Models)	N12:0 (Port 1)								
	N22:0 (Port 2)								
	N32:0 (Port 3)								
	N42:0 (Port 4)								
	N52:0 (Port 5)								
	N62:0 (Port 6)								
	N72:0 (Port 7)								
	N82:0 (Port 8)								

PCCC Read/Write Access *where*:

- All PDI data can be read with one PCCC read message.
- All PDO data can be read with one PCCC read message.
- All PDO data can be written with one PCCC write message.
- Controller Read access:
  - The PDI data from one or more ports may be read with one message. (That is, if addressing Port 1, N10:0, ports one to four may be read in one message.)
  - The PDO data from one or more ports may be read with one message. (That is, if addressing Port1, N11:0, 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 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.

15 EDS FILES

15.1 OVERVIEW

You do not need to add the IOLM to Rockwell software for normal IOLM-to-PLC communications. However, you can easily add the IOLM and its associated Electronic Data Sheet (EDS) files to Rockwell software.

The files named **IOLM_*.ico** are icon files and files named **IOLM_dd_NNNN-x.xx.eds** are ODVA electronic data sheet files where:

- **dd** is the model name
- **NNNN** is the product ID number
- **x.xx** is the version number

15.2 CONFIGURING RSLINX

You can use these steps to add the IOLM to RSLinx.

1. Open RSLinx.
2. If there is not an EtherNet/IP driver configured, use these steps:
   a. Under **Communications**, select **Configure Drivers**.
   b. Under **Available Drivers**, select **EtherNet/IP Driver**.
   c. Select **Add New**.
   d. Use the default driver name or type your own driver name and click **OK** to continue.
3. Select the adapter of the network card used to communicate with the IOLM and click **OK**.
4. Select **RSWho** to verify that **RSLinx** can communicate with the IOLM.

Note: A yellow question mark appears by the IOLM(s) in the RSWho window when the associated EDS file(s) are not installed.

15.3 ADDING EDS FILES TO ROCKWELL SOFTWARE

You can use this procedure to add the EDS files to Rockwell software.

1. **Open the** EDS Hardware Installation Tool**. (Select** Start > All Programs > Rockwell Software > RSLinx Tools**.)**
2. Click **Add**.
3. **Click** Register a directory of EDS files**.**
4. Browse to the **Datalogic/EtherNetIP** directory and click **Next** to continue.
5. Verify that there is a green check beside each EDS file name and select **Next** to continue.
6. Click **Finish** to exit.

If RSLinx does not display the device after adding IOLM and the EDS files to RSLinx, perform the following procedure:

1. Select **File > Exit and Shutdown** to exit and shutdown RSLinx.
2. Remove the following files from your hard drive:

   \Program Files\RockwellSoftware\RSCOMMON\Harmony.hrc
   \Program Files\RockwellSoftware\RSCOMMON\Harmony.rsh
3. Restart RSLinx. The IOLM or IOLMs should now appear with the associated icon or icons.

16 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.

16.1 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)

16.2 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

16.2.1 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

16.3 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.

17 TROUBLESHOOTING AND TECHNICAL SUPPORT

17.1 TROUBLESHOOTING

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

- Check to make sure LEDs are not reporting an issue. Refer to par. 17.2.
- 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 CBX-IOL-8-EIP 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**
  - **EtherNet/IP Diagnostics**
  - **Modbus/TCP Diagnostics**
  - **OPC UA Diagnostics**
- If you have a spare IO-Link Master, try replacing the IO-Link Master.

17.2 IOLM LEDs

17.2.1 CBX-IOL-8-EIP-LEDs

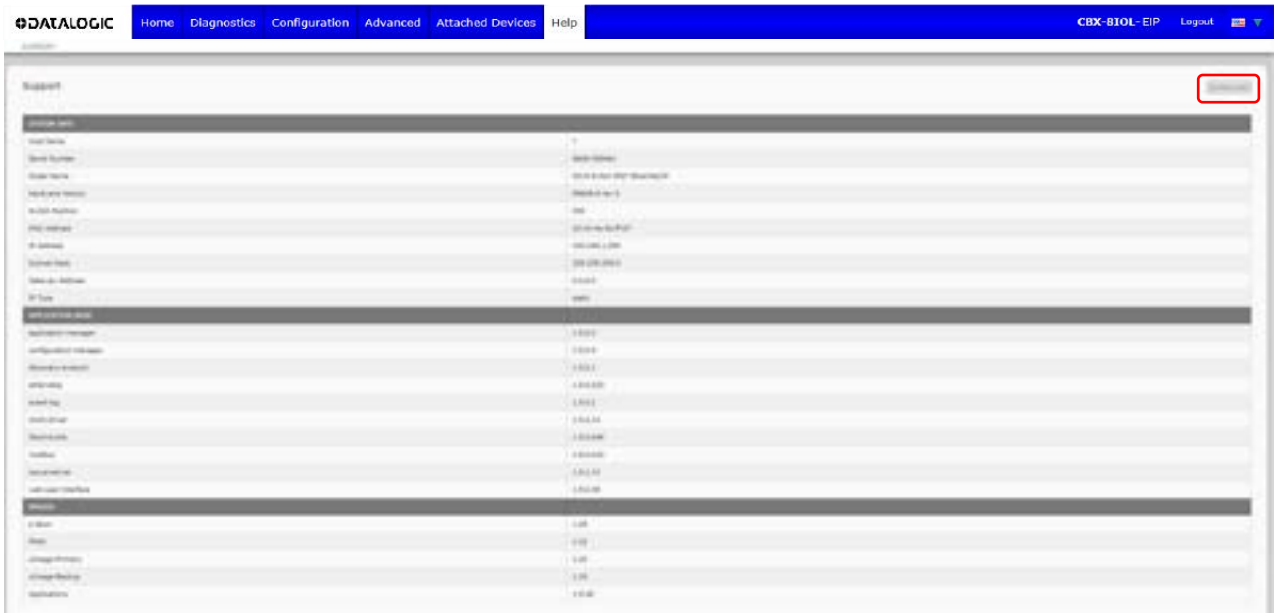
The CBX-IOL-8-EIP (8-port IP67 model with an L-coded power connector) provides these LEDs.

LED Activity During Power On Sequence - CBX-IOL-8-EIP
1. The **US** LED lights.
2. The **ETH1/ETH2** LED lights on the connected port.
3. The **MOD** and **NET** LEDs are lit.
4. The IO-Link LEDs flash (if no IO-Link device attached) or are lit if an IO-Link device is attached.
The **MOD** LED is solid green, the IO-Link Master is ready for operation.

CBX-IOL-8-EIP 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.
MOD (Module Status)	The **MOD** LED provides the following information: • Off = No module status • Green and red flashing = Self-test • Green flashing = Standby – not configured • Green solid = Operational • Red flashing = Minor recoverable fault - check the **EtherNet/IP Diagnostics** page to locate the issue • Red solid = Major unrecoverable fault
NET (Network)	The **NET** LED provides the following information: • Off = No IP address • Green and red flashing = Self-test • Green flashing = An IP address is configured, but no CIP connections are established, and an Exclusive Owner connection has not timed out • Green solid= Active EtherNet/IP or Modbus connection and no EtherNet/IP connection time-outs • Red flashing = One or more EtherNet/IP connection time-outs • Red solid = Duplicate IP address on network
1-8	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. • Red solid = PDI of the attached IO-Link device is invalidGreen 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). • Off = DI signal is low or disconnected Yellow = DI signal is high
ETH1/ETH2	The **ETH1/ETH2** LEDs provide the following information: • Green solid = Link Green flashing = Activity

17.3 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.



17.4 USING LOG FILES

The IO-Link Master provides four 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
- 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.

17.4.1 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.

17.4.2 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.

17.4.3 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.

DATALOGIC

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