IO-Link Master 8

Ports IP20

Ethernet/IP AY1020

Operators Manual

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Chapter 1. Introduction

This document provides installation, configuration, and embedded web interface information for the ifm IO- Link master (AY1020).

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

- Upload the latest AY1020 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

1.1. Installation and Configuration Overview

The AY1020 installation includes the following procedures.

1. Connect the power and Ethernet cable (*Page 11*).
2. Configure the IP address using the embedded web interface (*Page 13*).
3. Connect the IO-Link and digital I/O devices (*Page 23*).
4. Use the web interface to configure the following:
   a. AY1020 ports for your environment using the web interface (*Page 27*):
      - IO-Link settings, such as the **Port Mode**, which by default is set to IO-Link but depending on the device, you may need to set it to Digital In or Digital Out.
      - EtherNet/IP settings
      - Modbus/TCP settings
   b. If necessary, configure the dedicated digital I/O ports(*Page 47*).
   c. If desired, upload the appropriate IODD files for your IO-Link devices (*Page 51*).
   d. If desired, configure the IO-Link device parameters (*Page 59*).
   e. If desired, implement AY1020 features or options (*Page 65*), such as:
      - Data storage, automatic or manual - upload or download
      - Device validation
      - Data validation
   f. Use the **Diagnostic** pages to monitor or troubleshoot your devices.
5. If desired, connect to a PLC or HMI/SCADA (depending on your protocol):
   - ***EtherNet/IP***, which is discussed in detail starting in *Chapter 12. EtherNet/IP Interface* on Page 85 through Chapter 15.
     - If appropriate, connect SLC, PLC-5, or MicroLogix PLCs.
     - Add EDS files to RSLinx for normal AY1020-to-PLC communications
   - ***Modbus/TCP***: connect PLCs or HMI/ SCADA devices, which is discussed in detail starting in *Chapter 16. Modbus/TCP Interface* on Page 127 through Chapter 18.

Chapter 2. Hardware Installation

Note: *The AY1020 must be installed in a suitable fire, electrical, mechanical enclosure.*

2.1. Connecting to the Network

The AY1020 provides two Fast Ethernet (10/100BASE-TX) standard RJ45 connections. You can use this procedure to connect the AY1020 to the network.

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

2.2. Connecting the Power

The AY1020 provides two redundant power inputs with screw terminals on the top and bottom of the unit.

Note: *Use either power terminals (top or bottom) but **DO NOT** use both to supply power*

Signal	Description
V-	24VDC Power Supply Return
V-	24VDC Power Supply Return
V+	Primary +24VDC Supply
V+	Secondary +24VDC Supply

to the AY1020.

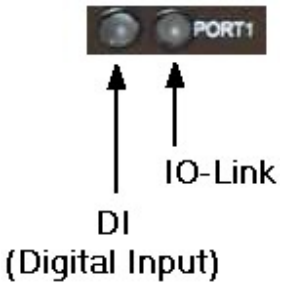
Power Requirements	Values
Voltage Input Range	18 to 30VDC
Input Power	24VDC @4A
Output power	24VDC @ 200mA†
† The total supply of current for all connected IO-Link devices.	

You can use this procedure to connect the AY1020 to a power supply.

Note: *Power should be disconnected from the power supply before connecting it to the AY1020. Otherwise, your screwdriver blade can inadvertently short your terminal connections to the grounded enclosure.*

1. Insert positive and negative wires (12-24AWG) into the V+ and V- contacts.
2. Tighten the wire-clamp screws to prevent the wires from coming loose.

3. Apply the power and verify that the following LEDs are lit indicating that you are ready to attach your IO-Link or digital I/O devices.
   - **PWR** - green lit LED indicates the AY1020 is receiving power.
   - **MS**, first the flashing green and red LEDs display that it is in self-test mode.
     - The green LED is flashing to indicate that the AY1020 is in standby mode.
     - The green LED is lit to indicate that the AY1020 is operational.
   - **NS**, first it flashes green and red indicating that it is in self-test mode.
     - Off indicates there is no IP address.
     - Steady red indicates a duplicate IP address on the network.
   - **LINK** should be lit (green) to indicate a valid network connection.
   - **ACT** blinks if there is network traffic between the AY1020 and the network.
   - Port LEDs should display in this manner if there is no device attached:
     - IO-Link port LED should be flashing green indicating that it is searching for an IO-Link device.
     - Digital input should be off to indicate that there is no device attached to the port.



If the LEDs indicate that you are ready to attach devices, go to *Chapter 5. Connecting Devices* on Page 23.

If the LEDs do not meet the above conditions, you can refer to the *AY1020 LEDs* table on *Page 194* in the *Troubleshooting and Technical Support* chapter.

Chapter 3. Initial Configuration

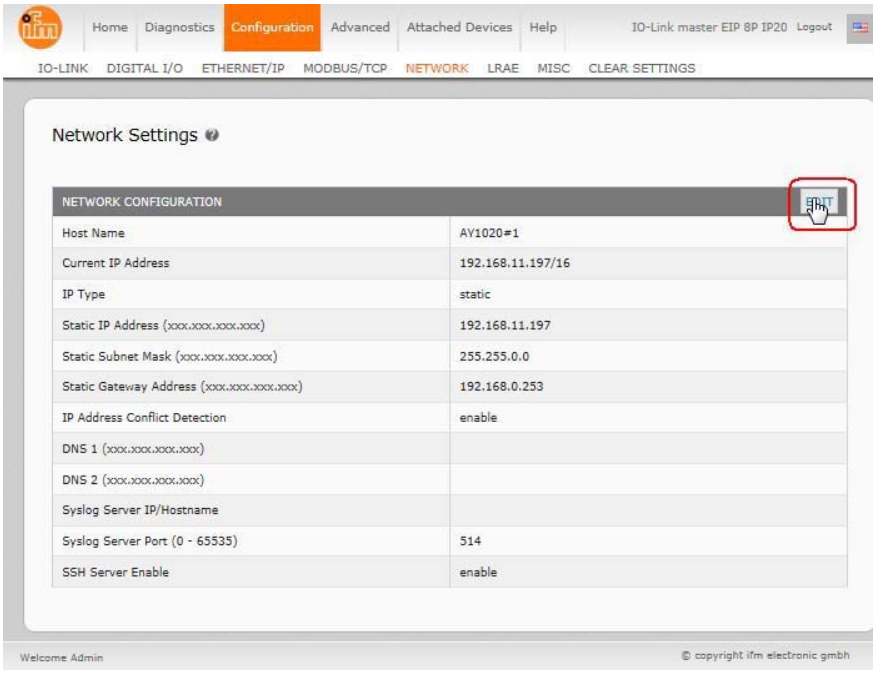
The following topics are discussed in this chapter.

3.1. Using the Web Interface to Program the Network

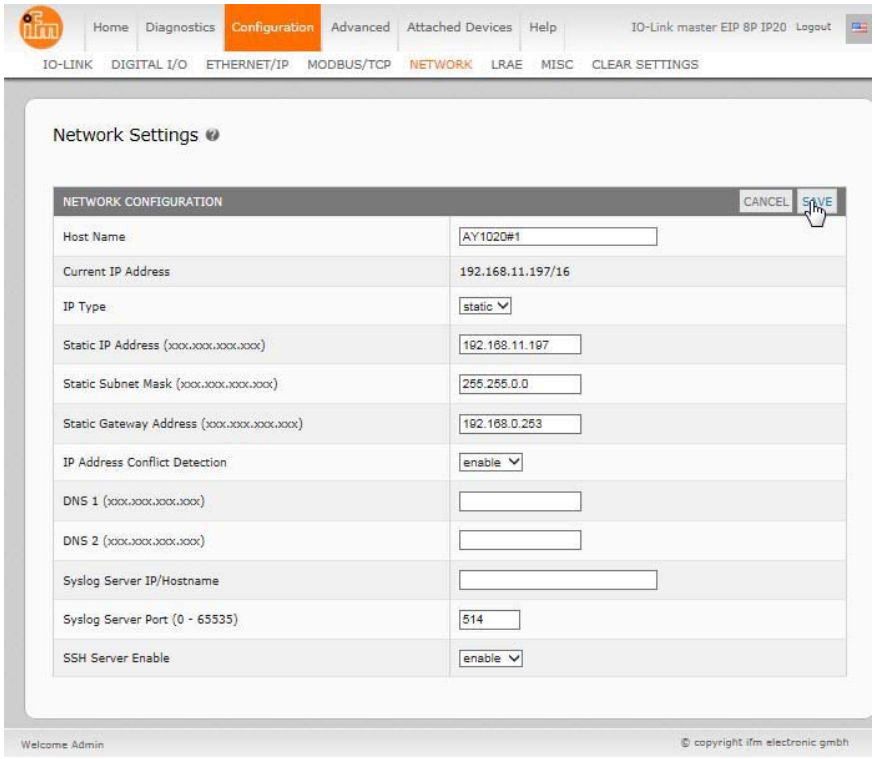
This subsection discusses using the web interface to configure the IP address. The default IP address is **192.168.1.250**.

The AY1020 is shipped from the factory with the Admin account enabled without a password. You can configure the Admin, Operator, and User *passwords*..

1. Open your browser and enter the IP address of the AY1020.
2. Click **Configuration | NETWORK**.
3. Click the **EDIT** button.



4. Optionally, change the host name to identify this AY1020.
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 you want the AY1020 to send syslog messages to a syslog server:
   a. Enter the syslog server's IP address (or host name if using DNS).
   b. Enter the syslog server's port number (default is 514).
7. If you want to enable the SSH server, click **Enable**.
8. Click **SAVE** to save the changes.



9. If the AY1020 does not redirect you to the new page, open a session using the new IP address.

You should verify that you have the latest software installed on the AY1020 and if necessary, update the software. Refer to *Chapter 4. Updating Images and Applications* on Page 19 for information about locating the latest files and uploading the software.

After verifying that you have the latest software, you are ready to configure the AY1020 port characteristics.

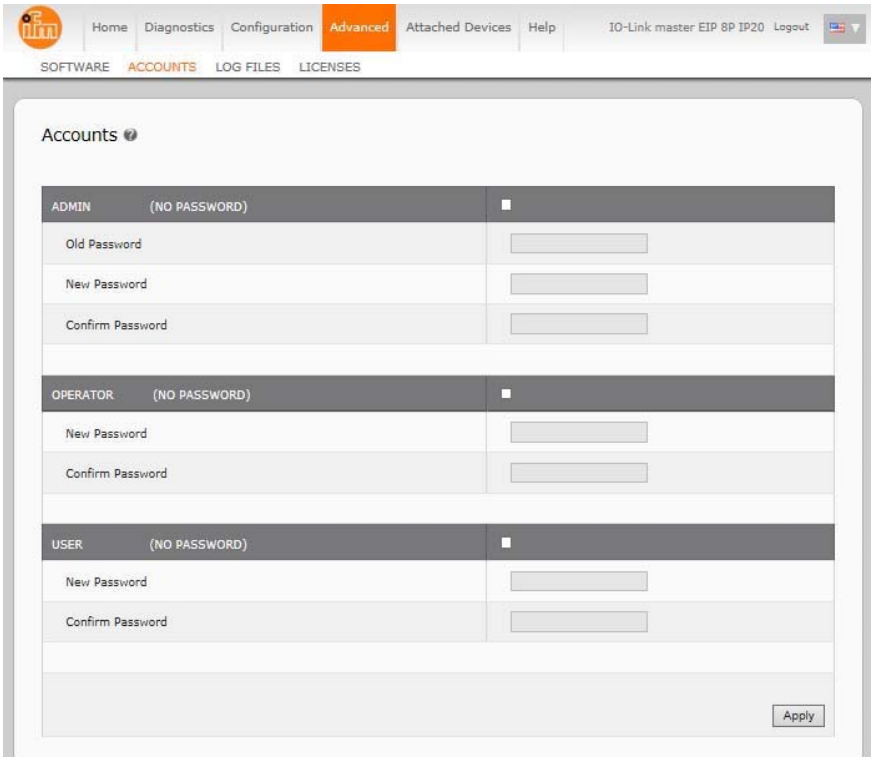
3.2. Setting User Accounts and Passwords

The AY1020 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	Yes	Yes	View-only
Configuration - EtherNet/IP Settings	Yes	Yes	View-only
Configuration - Modbus/TCP	Yes	Yes	View-only
Configuration - Network	Yes	View-only	No
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

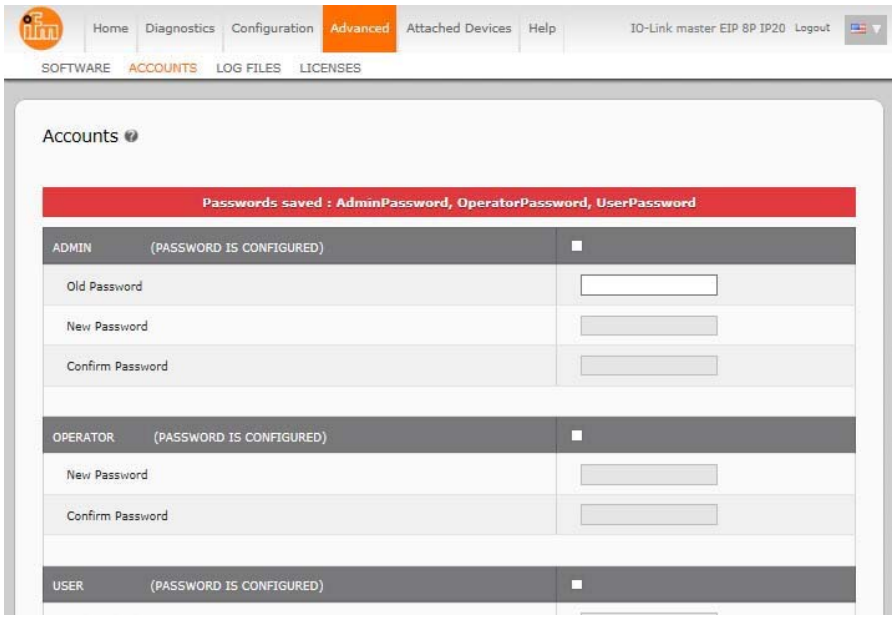
You can use this procedure to set up passwords for the AY1020.

1. Open your browser and enter the AY1020 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 (top navigation bar).
12. Re-open the web interface by selecting the appropriate user type in the drop list and entering the password.

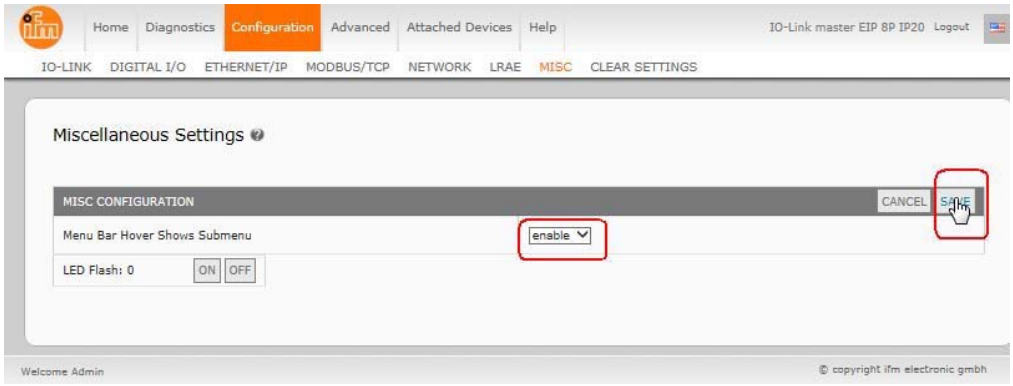
3.3. Configuring Miscellaneous Settings

The **Miscellaneous Settings** page includes these 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 submenu and avoid opening the default menu for a category.



- **LED Flash**

  You can force the IO-Link port LEDs on the AY1020 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 AY1020. Click the **OFF** button to disable the LED tracker. The LEDs remain flashing until you disable the LED tracker feature.

Chapter 4. Updating Images and Applications

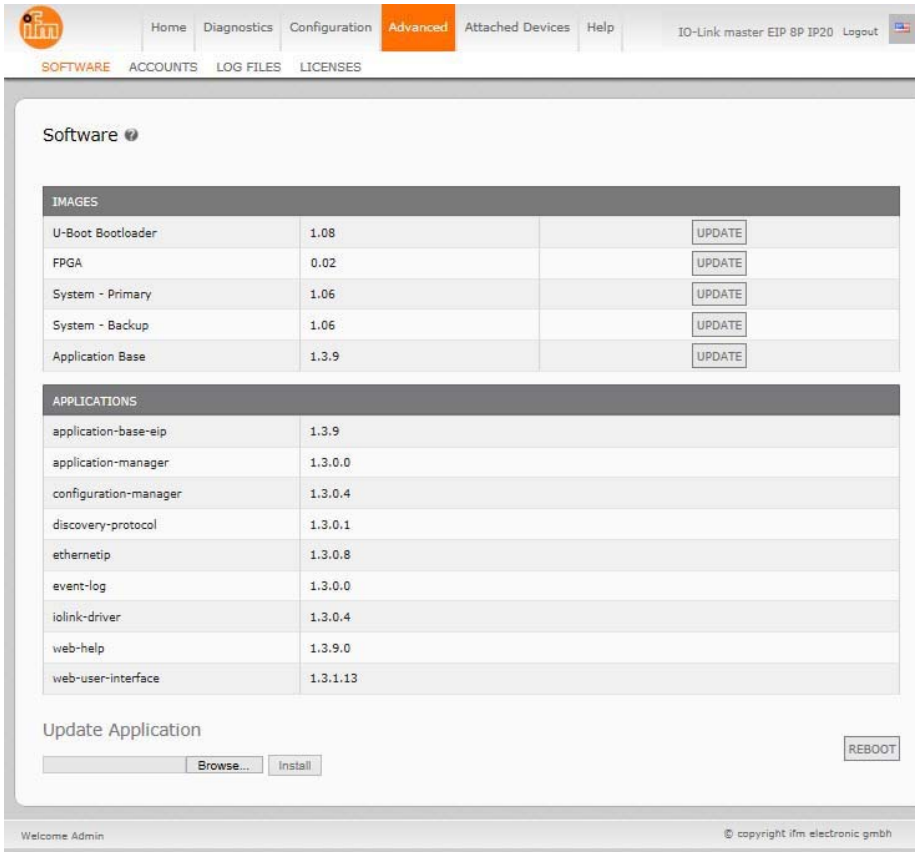
This chapter provides an overview of the software (images and applications) on the AY1020. In addition it contains procedures to update images (*Page 21*) and application subassemblies (*Page 22*).

After verifying that the AY1020 contains the latest software, the next step is to configure the port characteristics using *Chapter 6. IO-Link Port Configuration* on Page 27.

4.1. Images and Application Subassemblies Overview

The AY1020 is loaded with the latest images at the factory but you may need to update images or application subassemblies to have access to the latest features.

You can view all image and application versions in the AY1020 **ADVANCED | Software** page.



4.1.1. Images

The following table discusses AY1020 images.

AY1020 Images	
U-Boot Bootloader	U-Boot is a high-level Bootloader that has networking and console command line capabilities. Among other things, it implements a TFTP server and ifm Corporation's new discovery protocol. This verifies that a Linux kernel image exists in NAND, then copies it to RAM and starts the AY1020. The U-Boot version is displayed after the image name.
FPGA	The FPGA partition/image contains configuration data used by programmable hardware within the AY1020 unit.
uImage - Primary/ Backup	The uImage contains the Linux kernel and the RAM-resident root file system. It does not contain industrial protocol support or application-specific features. There is a Primary and Backup version loaded on the AY1020. The AY1020 automatically reloads the Backup uImage if the file system corrupted. The uImage version is displayed after the Primary/Backup uImage.
Application Base	The Application Base image comprises a flash-resident file system containing applications and protocol support. The Application Base is built from a collection of application subassemblies -- each of which may be updated individually between releases of the application base as a whole. The application subassemblies in the Application Base image are displayed in the lower portion of the **SOFTWARE** page. The Application Base assembly has a 2-tuple version number: (for example, 1.10).

4.1.2. Application Subassemblies

Application subassemblies are the components of the Application Base image. Application subassemblies have 3-tuple or 4-tuple version numbers (for example, 1.10.1). The first two values in a subassembly version correspond to the version of the application base assembly for which it was built and tested.

For example, a subassembly with version 1.10.3 was tested with application base version 1.10. When using the **Software** page, an application subassembly can install only if its version number matches that of the installed application base assembly. A subassembly with a version of 1.20.2.4 only installs if the application base version is 1.20. It will not install on a device with application base version 1.09 or 1.20.

AY1020 Application Subassemblies	
application-manager	The Application Manager version loaded on the AY1020.
configuration-manager	The Configuration Manager version loaded on the AY1020.
discovery-protocol	The Discovery Protocol version loaded on the AY1020.
ethernetip	The EtherNet/IP and Modbus/TCP interfaces version loaded on the AY1020.
event-log	The Event log version loaded on the AY1020.
iolink-driver	The IO-Link driver version loaded on the AY1020.
web-help	The web interface help version loaded on the AY1020.
web-user-interface	The web interface version loaded on the AY1020.

4.2. Using the Web Interface to Update Software

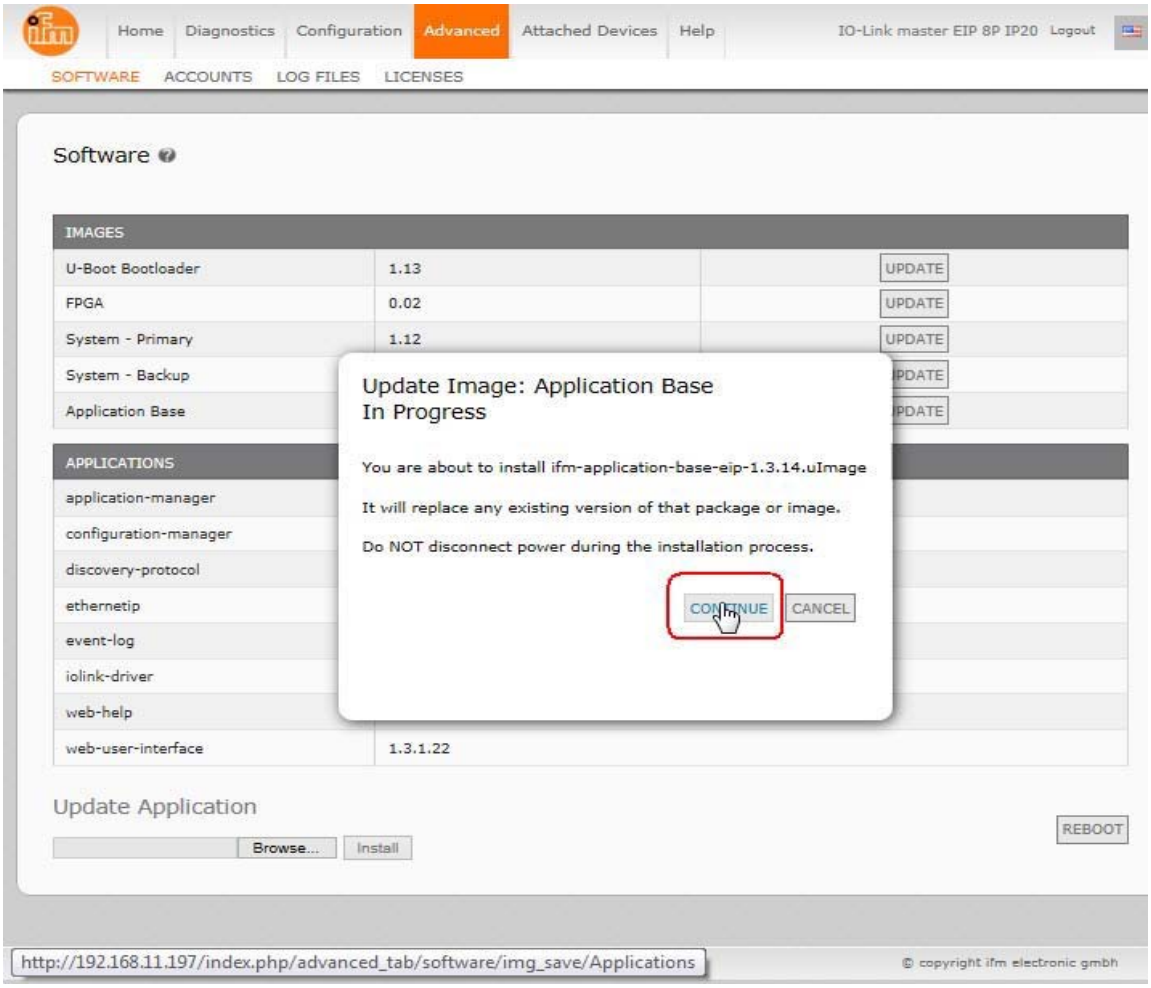
The upper portion of this page is used to update the AY1020 images. The lower portion of this page is used for updating application subassemblies that are integrated in the Application Base.

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

4.2.1. Updating Images

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

1. Download the latest image from the ifm web site.
2. Open your browser and enter the IP address of the AY1020.
3. Click **Advanced** | **SOFTWARE**.
4. Click the **UPDATE** button next to the image you want to update.
5. Click the **Browse** button and click **Open**.
6. Click the **Install** button.



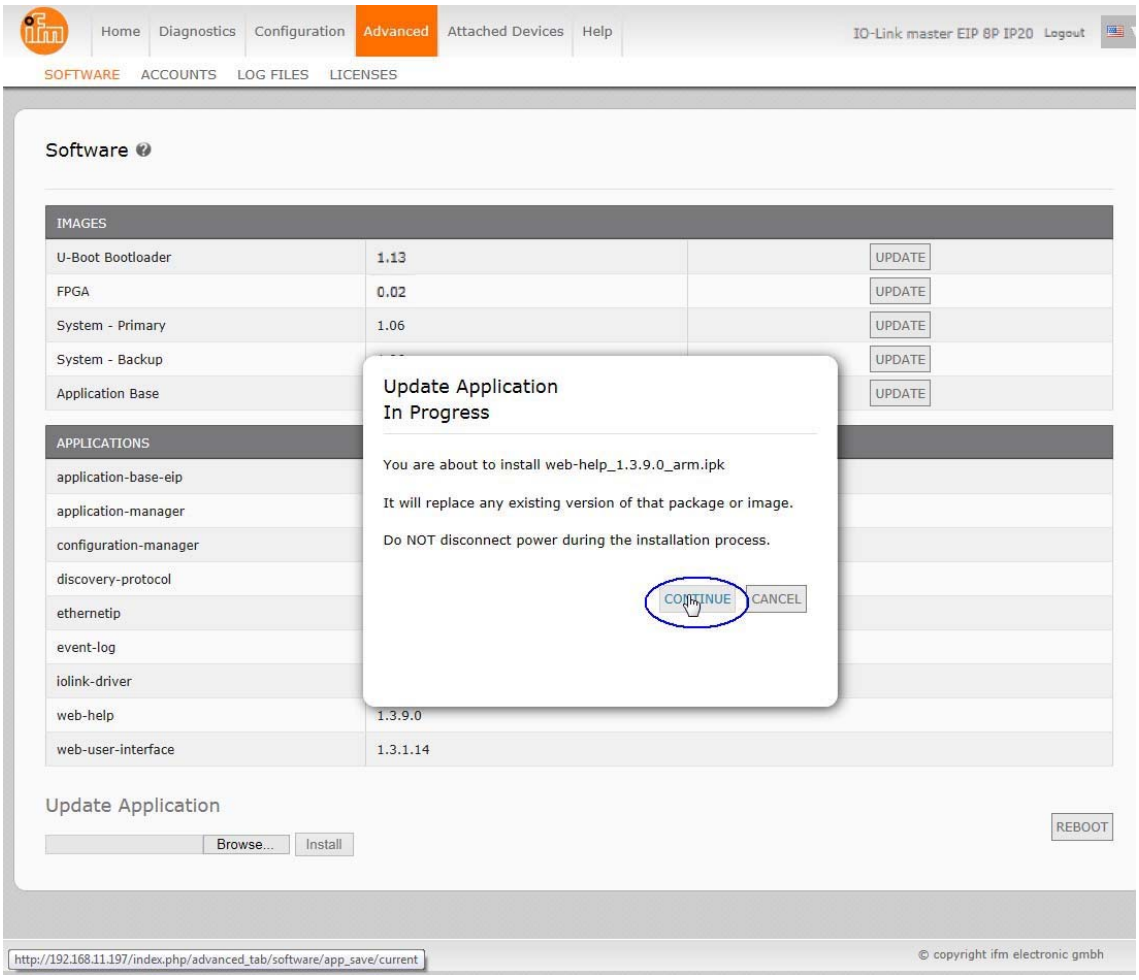
7. Click the **CONTINUE** button to the *Update Image* message.

8. Click **OK** to close the *Update Image Successful* message.
   Note: *Some images may require the AY1020 web server to restart.*

4.2.2. Updating Application Subassemblies

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

1. Download the latest application from the ifm web site.
2. Open your browser and enter the IP address of the AY1020.
3. Click **Advanced** and **SOFTWARE**.
4. Click the **Browse** button under **Update Application** navigate to the file location, highlight the image file, and click **Open**.
5. Click the **Install** button.
6. Click the **CONTINUE** button to the *Update Application* message.



7. Click **OK** to close the *Update Application Successful* message.

Chapter 5. Connecting Devices

This chapter discusses connecting devices to the AY1020.

After connecting your devices to the AY1020, you may need to use the next chapter to configure an appropriate IP address for your environment using *Chapter 3. Initial Configuration* on Page 13 before doing any port configuration.

5.1. Connecting to IO-Link Ports

The following provides information about the IO-Link ports.

Signal	Description	Specifications
L+	Power Supply Output (+)	200mA @ 24V (maximum)
L-	Power Supply Output (-)	
DI	Digital Input	
C/Q	Communication signal, which supports SDCI (IO-Link) or SIO (standard input/output)	200mA @ 24V (maximum)

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

- *Connecting IO-Link Devices* on Page 24
- *Connecting Digital Input Devices to IO-Link Ports* on Page 24

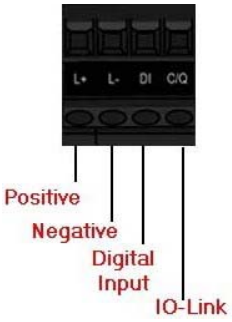
5.1.1. Tips When Connecting Devices to the AY1020

The following tips may be useful when connecting devices to the AY1020 because it may be difficult to manipulate the wire-clamp screws on the adjacent ports.

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

5.1.2. Connecting IO-Link Devices

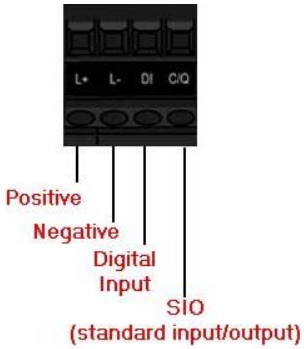
Use the following procedure to connect IO-Link devices to the IO-Link ports.



1. Insert the IO-Link device negative wire into the **L-** contact and tighten the wire-clamp screws to prevent the wire from coming loose.
2. Insert the IO-Link device positive wire into the **L+** contact and tighten the wire-clamp screws to prevent the wire from coming loose.
3. If applicable, insert the DI wire into the **DI** contact and tighten the wire-clamp screws to prevent the wire from coming loose.
4. Insert the IO-Link wire into the **C/Q** contact and tighten the wire-clamp screws to prevent the wire from coming loose.
5. If necessary, configure IO-Link parameters for each port. Refer to *6.1. Preparing for Port Configuration* on Page 27 or the help system for detailed port configuration information.

5.1.3. Connecting Digital Input Devices to IO-Link Ports

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



1. Insert the IO-Link device negative wire into the **L-** contact and tighten the wire-clamp screws to prevent the wire from coming loose.
2. Insert the IO-Link device positive wire into the **L+** contact and tighten the wire-clamp screws to prevent the wire from coming loose.
3. If applicable, insert the DI wire into the **DI** contact and tighten the wire-clamp screws to prevent the wire from coming loose.
4. Refer to *6.1. Preparing for Port Configuration* on Page 27 or the help system for detailed port configuration information.

5.2. Connecting Digital IO Ports

The AY1020 provides four digital IO ports.

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

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

5.2.1. Connecting to DI

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

1. Insert the IO-Link device negative wire into the **L-** contact and tighten the wire-clamp screws to prevent the wire from coming loose.
2. Insert the IO-Link device positive wire into the **L+** contact and tighten the wire-clamp screws to prevent the wire from coming loose.
3. Insert the DI wire into the **DI** contact and tighten the wire-clamp screws to prevent the wire from coming loose.
4. Go to the **Configuration | Digital I/O Settings** page to configure the port. If necessary, refer to the help system or *6.2. IO-Link Configuration Page* on Page 29.

5.2.2. Connecting to DIO

1. Insert the IO-Link device negative wire into the **L-** contact and tighten the wire-clamp screws to prevent the wire from coming loose.
2. Insert the IO-Link device positive wire into the **L+** contact and tighten the wire-clamp screws to prevent the wire from coming loose.
3. Insert the DI wire into the **DIO** contact and tighten the wire-clamp screws to prevent the wire from coming loose.
4. Go to the **Configuration | Digital I/O Settings** page to configure the port. If necessary, refer to the help system or *6.2. IO-Link Configuration Page* on Page 29.

Chapter 6. IO-Link Port Configuration

This chapter discusses port configuration, which includes these topics:

- *Preparing for Port Configuration*
- *IO-Link Configuration Page* on Page 29
- *EtherNet/IP Settings Configuration Page* on Page 34
- *Modbus/TCP Settings Configuration Page* on Page 41

Note: *See Chapter 7. Dedicated Digital I/O Port Configuration on Page 47 for information about configuring dedicated digital I/O ports.*

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

6.1. Preparing for Port Configuration

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

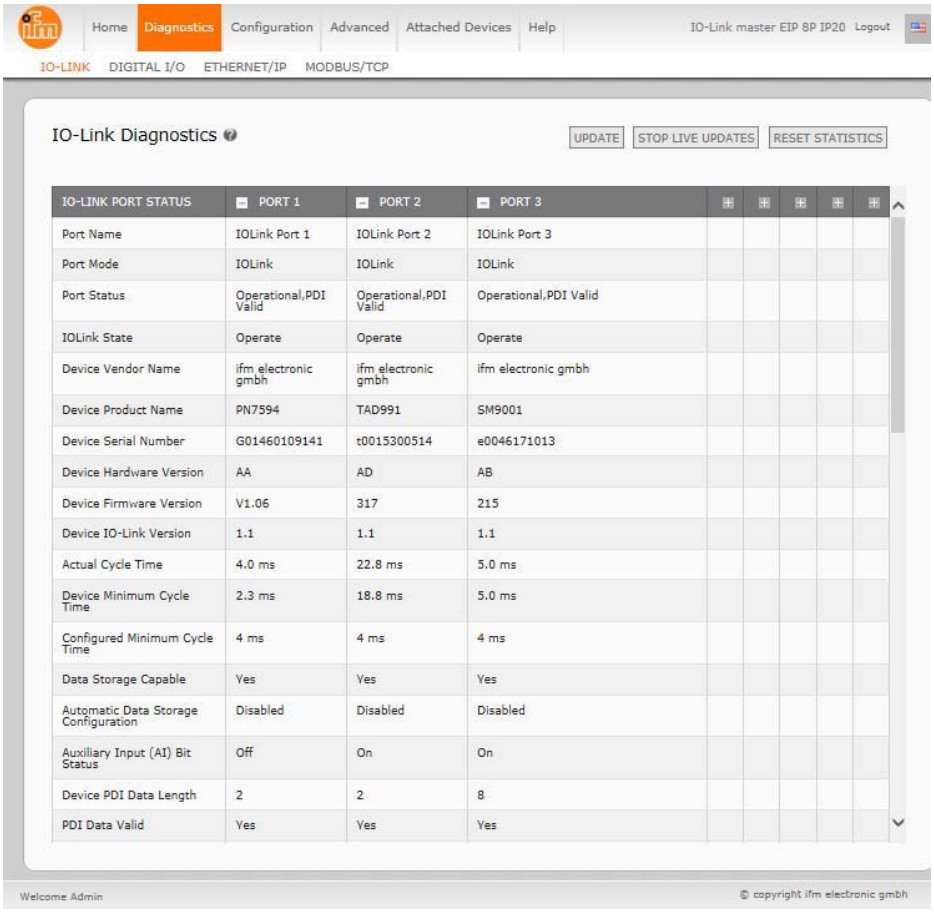
1. If necessary, log into the IO-Link master.
2. Click **Diagnostics**| I**O-Link Diagnostics**.
3. Review the **Port Status** and **IOLink State**.

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

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

4. Review the **Device IO-Link Version**.
   - If the field is blank, it is not a valid IO-Link device, which could mean that it is a digital device and the port has not been configured accordingly
   - Otherwise, 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.

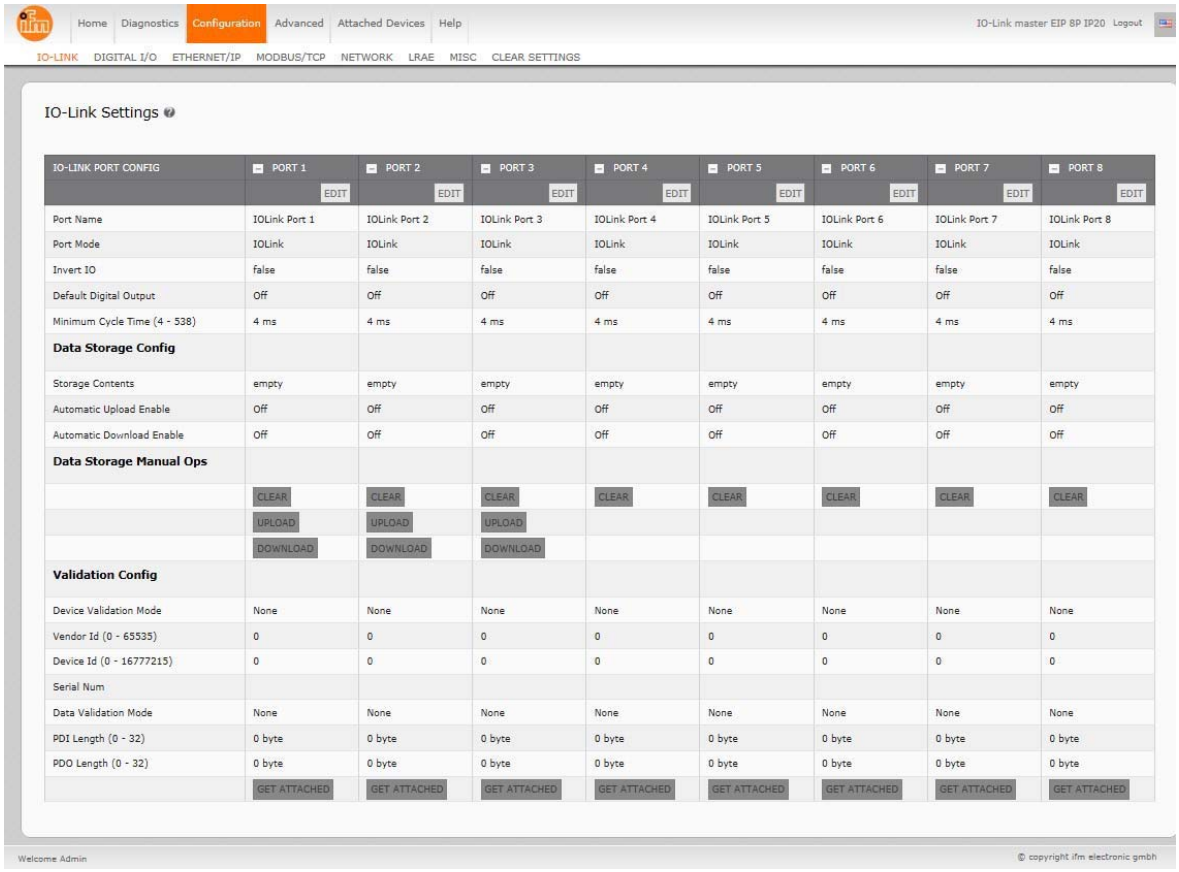


IO-LINK PORT STATUS	PORT 1	PORT 2	PORT 3
Port Name	IOLink Port 1	IOLink Port 2	IOLink Port 3
Port Mode	IOLink	IOLink	IOLink
Port Status	Operational,PDI Valid	Operational,PDI Valid	Operational,PDI Valid
IOLink State	Operate	Operate	Operate
Device Vendor Name	ifm electronic gmbh	ifm electronic gmbh	ifm electronic gmbh
Device Product Name	PN7594	TAD991	SM9001
Device Serial Number	G01460109141	t0015300514	e0046171013
Device Hardware Version	AA	AD	AB
Device Firmware Version	V1.06	317	215
Device IO-Link Version	1.1	1.1	1.1
Actual Cycle Time	4.0 ms	22.8 ms	5.0 ms
Device Minimum Cycle Time	2.3 ms	18.8 ms	5.0 ms
Configured Minimum Cycle Time	4 ms	4 ms	4 ms
Data Storage Capable	Yes	Yes	Yes
Automatic Data Storage Configuration	Disabled	Disabled	Disabled
Auxiliary Input (AI) Bit Status	Off	On	On
Device PDI Data Length	2	2	8
PDI Data Valid	Yes	Yes	Yes

For additional information about the **IO-Link Diagnostics** page, see the help system or *11.1. IO-Link Port Diagnostics* on Page 74.

6.2. IO-Link Configuration Page

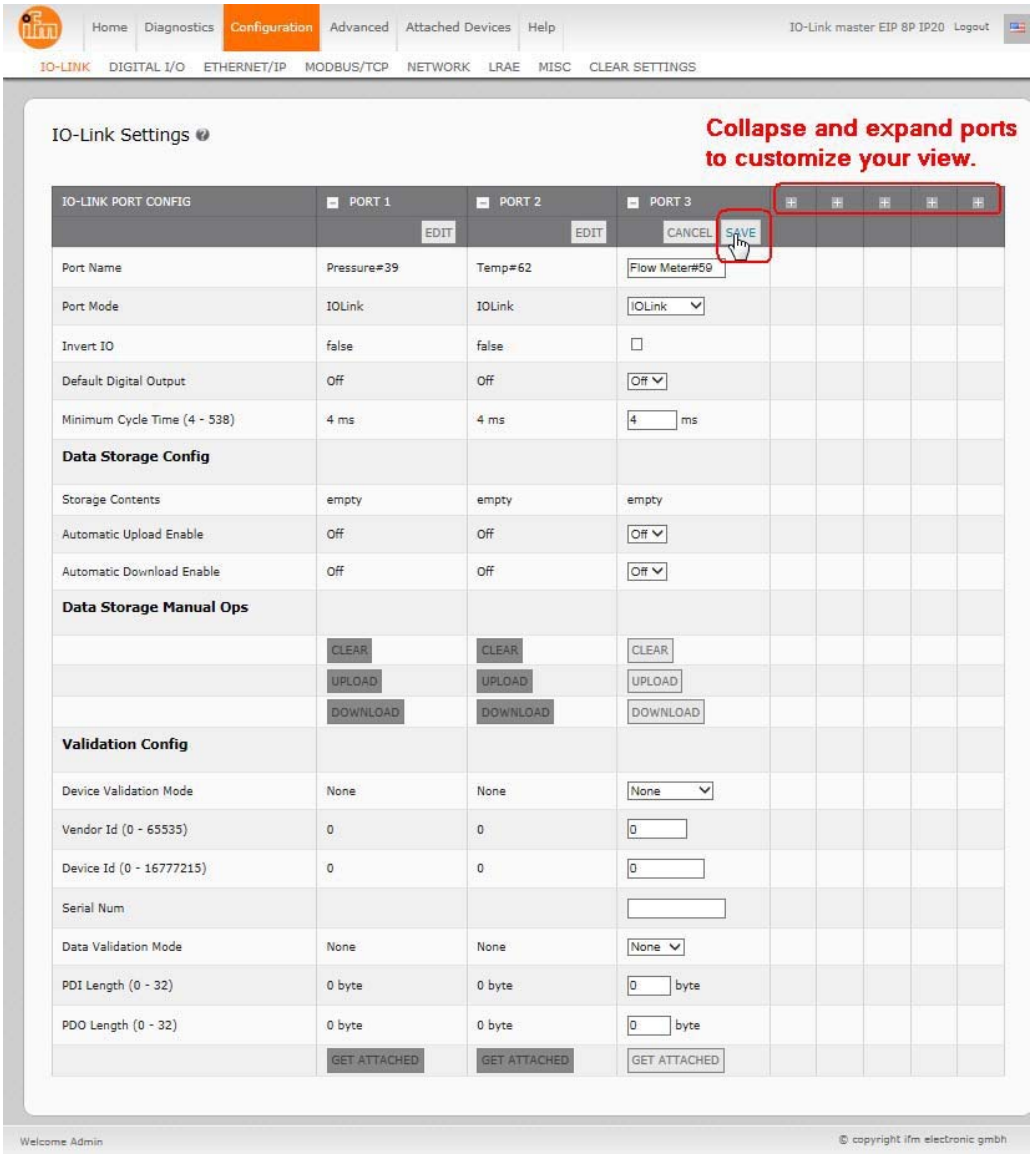
Use the **Configuration | IO-Link Settings** page to configure IO-Link port characteristics for the IO-Link master. This subsection discusses:



6.2.1. Editing IO-Link Settings

You can use this procedure to configure IO-Link characteristics for each port. The following table or help system provides information about each option.

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. 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 configure Data Storage until the IO-Link device is configured. Do not enable Automatic Download and then attempt device configuration as Automatic Download will change the settings back to what is stored on the AY1020.*

5. Click the **SAVE** button for each port.

6. Return to the **IO-Link Diagnostics** page to verify that your changes have taken affect.

6.2.2. IO-Link Settings Parameters

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

IO-LINK Settings Page	
Port Name	User defined port or device description. • Standard ASCII characters • Max length = 80 characters
Port Mode *Default*: IO-Link	Selected IO-Link Port Mode. Valid settings are: • **Reset** • **IO-Link** • **Digital In** • **Digital Out**
Invert IO *Default*: False	If enabled and the *Port Mode* is Digital In or Digital Out, inverts the I/O value. • **False** (Disabled - Do not invert IO) • **True** (Enabled - Invert IO) ***Note:*** *Does not affect the Auxiliary Input.*
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 that the IO-Link device may operate at. The valid range is 4-65535 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.
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 data storage is cleared from the IO-Link master port, the storage data on the IO-Link device is uploaded, and saved on the IO-Link master for that port. • If the IO-Link device on this port is replaced and the settings on the IO-Link device are different, the settings stored on the IO-Link master are overwritten with the settings from the second device if the **Automatic Data Storage Download Enable** option is also enabled. • If settings are changed on the IO-Link device, the new settings are then uploaded to data storage on the IO-Link master. You may want to enable **Automatic Upload** after you have initially configured the IO-Link device attached to the port.

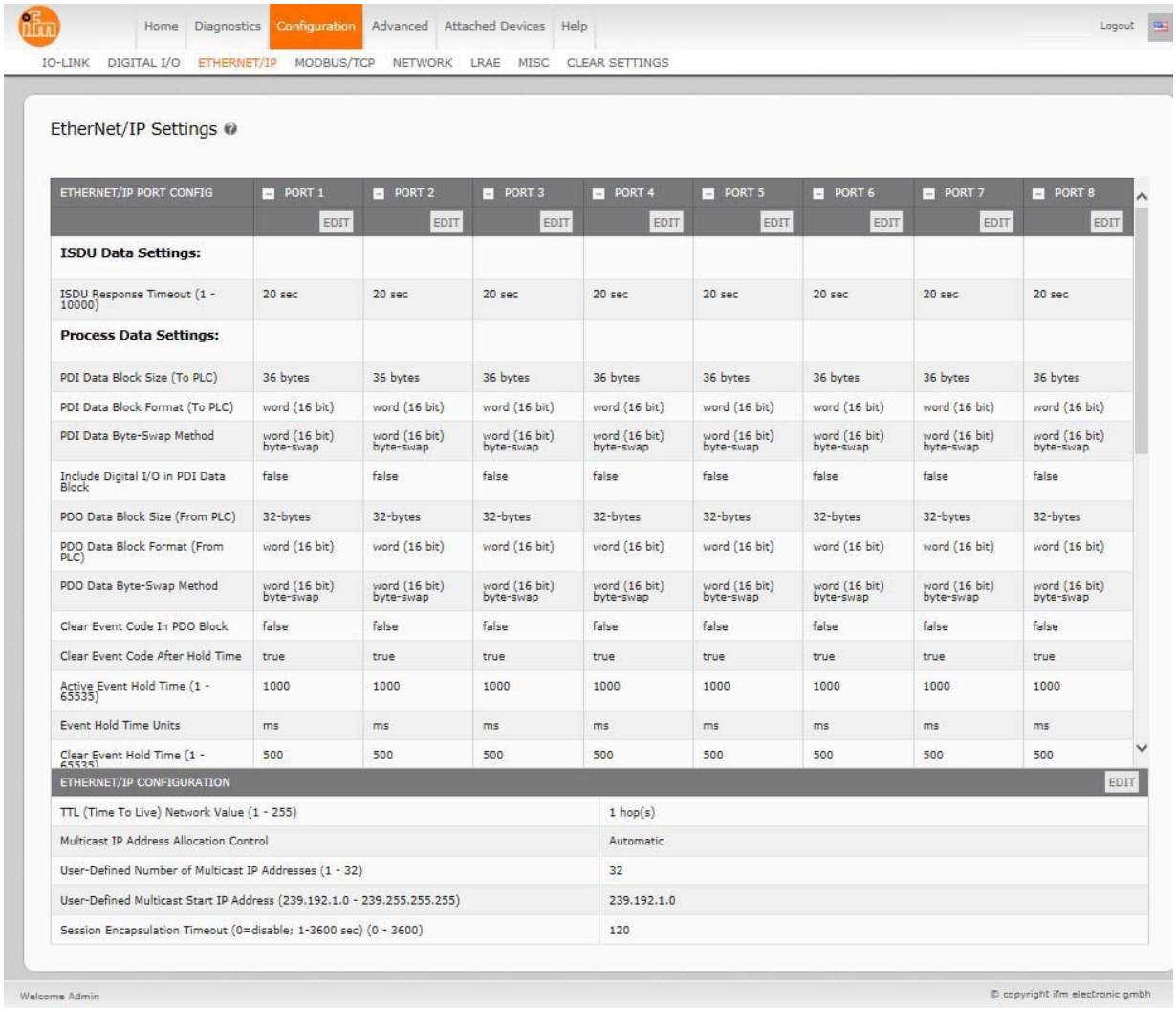
IO-LINK Settings Page (Continued)	
Automatic Data Storage Download Enable *Default*: Off	The data stored on the IO-Link master port is downloaded to the IO-Link device if: 1. This option is selected. 2. The data stored on the IO-Link master port contains the same Vendor ID and Product ID as the IO-Link device connected to the port. 3. The data stored on the IO-Link master port is different than that of the IO-Link device.
Data Storage Manual Ops	**Manual Data Storage Ops** provide 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 IO-Link master. **DOWNLOAD** - this downloads the stored IO-Link device configuration from the IO- Link master 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
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 propagates 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 propagates 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 propagates 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 propagates the PDI length in this field.

IO-LINK Settings Page (Continued)	
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 propagates the PDO length in this field
GET ATTACHED (Button)	After opening a port for editing, you can click the **GET ATTACHED** button instead of manually entering data in the following fields: • Vendor Id • Device Id • Serial Num • PDI Length • PDO Length

6.3. EtherNet/IP Settings Configuration Page

Use the **EtherNet/IP Settings** page to configure EtherNet/IP options. This subsection includes the following topics:

Note: *The IO-Link master may work out of the box for ControlLogix PLCs.*

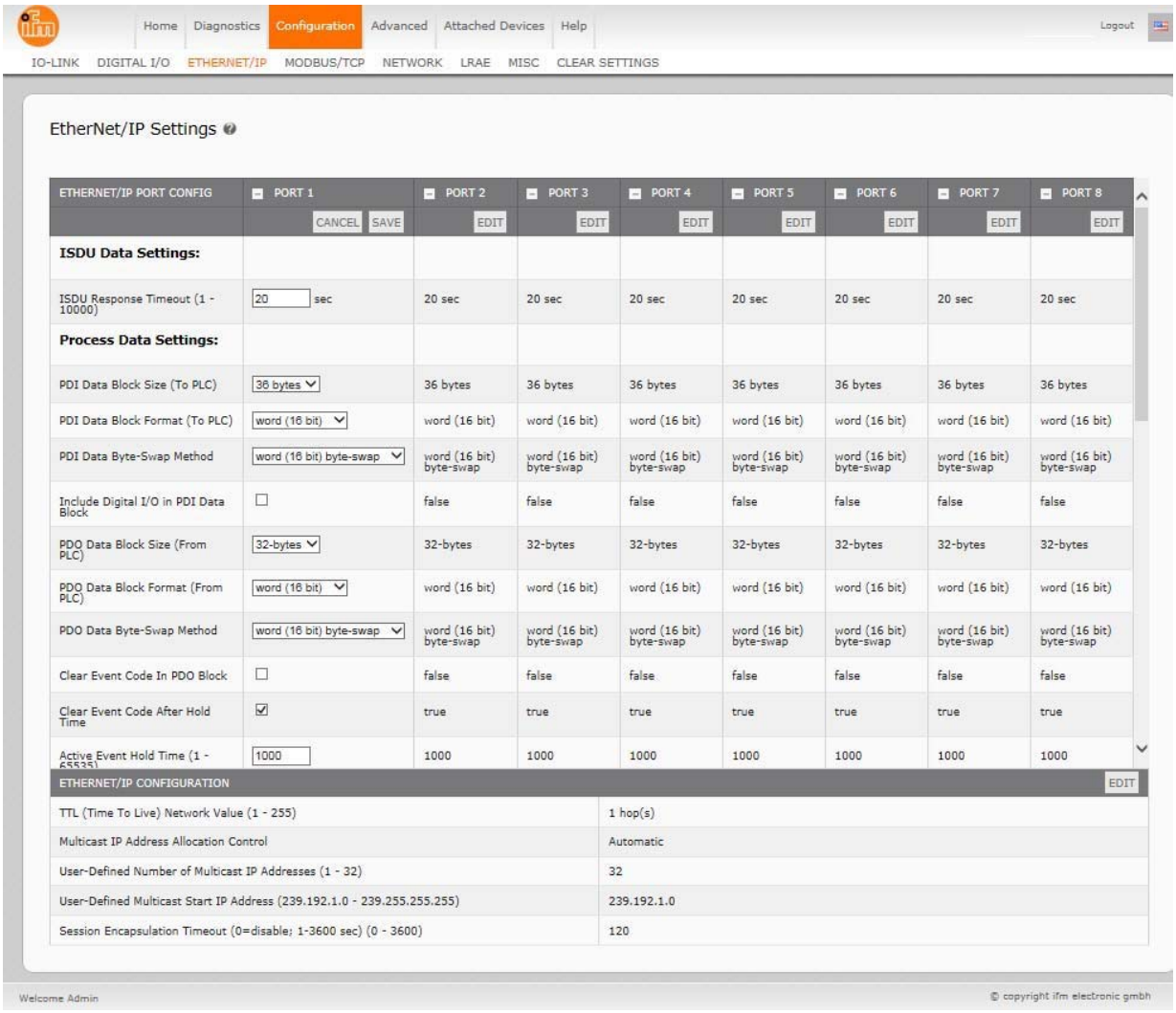


Note: *This illustrate a partial screen shot, scroll through the settings table to view all of the available settings.*

6.3.1. 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.

6.3.2. 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) • **16-bytes** (12 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 ***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).*
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.*

EtherNet/IP Settings Page (Continued)	
PDO Data Block Size (From PLC) *Default*: 32-bytes	The configurable PDO data block length. Supported optional lengths are: • Event code not included: - 4-bytes = all data - 8-bytes = all data - 16-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 - 8-bytes = 2 byte event code, 6 data bytes - 16-bytes = 2 byte event code, 14 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 - 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 - 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 - 16-bytes = event code dword, 3 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.*

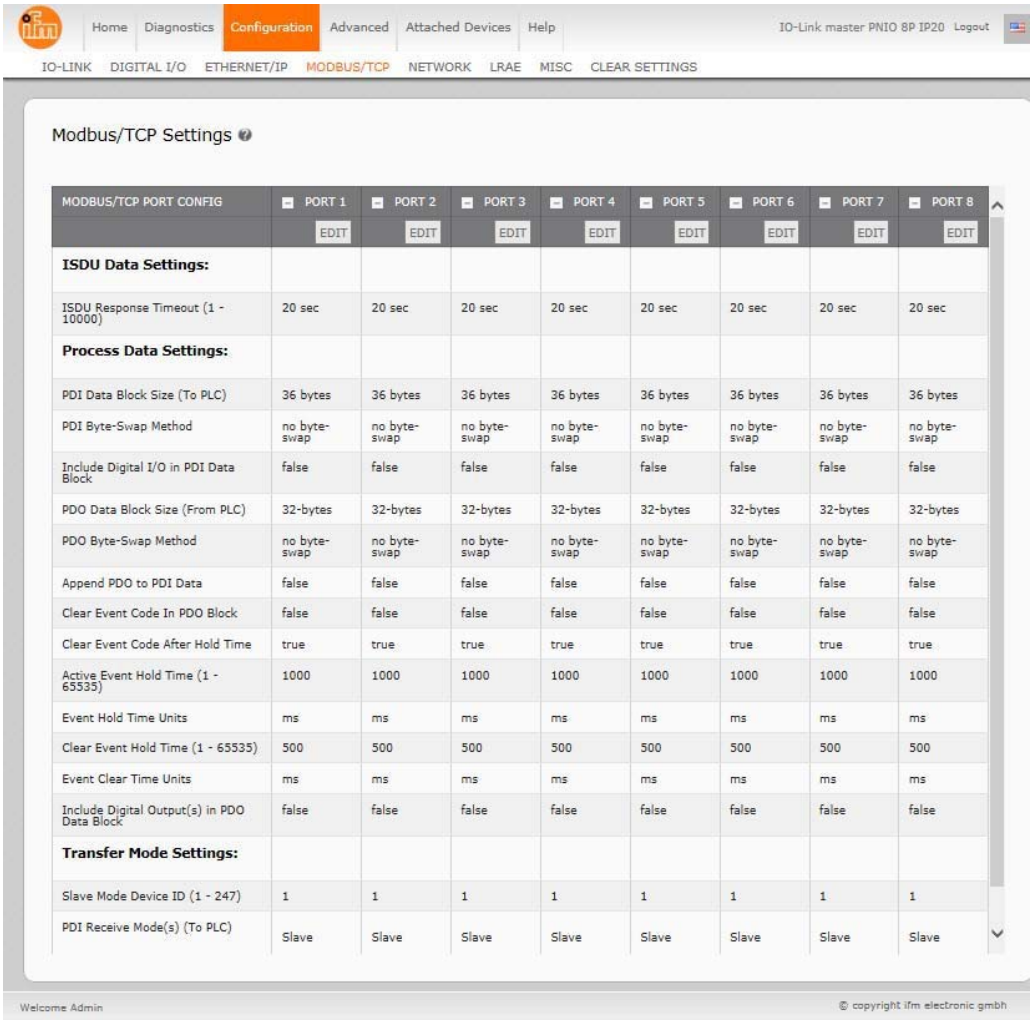
	EtherNet/IP Settings Page (Continued)
PDO Data Byte-Swap Method *Default*: Word (16-bit) byte-swap	If enabled, the IO-Link master swaps the data bytes in word (2 byte) format or dword (4 byte) format. Supported values are: • **No byte-swap** – data passed through as received • **Word (16-bit) byte-swap** – data is byte-swapped in word format • **Dword (32-bit) byte-swap** – data is byte-swapped in dword format ***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 *Default*: True	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: • **True** (enable check box) = clear event code after hold time • **False** = do not clear event code after hold time
Event Active 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**
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**
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.

EtherNet/IP Settings Page (Continued)	
Transfer Mode Settings	
PDI Receive Mode(s) *Default*: Polling, Class1	Determines which PDI Receive (To PLC) Modes are enabled. Supported modes are: • **Polling** • **Class1** • **Write-to-TagOrFile**
PDO Transmit Mode *Default*: Class 1	Supported modes are: • **Off** • **PLC-Writes** • **Class1** • **Read-from-TagOrFile**
Read/Write Tag/File Settings	
PLC IP Address *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

	EtherNet/IP Settings Page (Continued)
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**

6.4. Modbus/TCP Settings Configuration Page

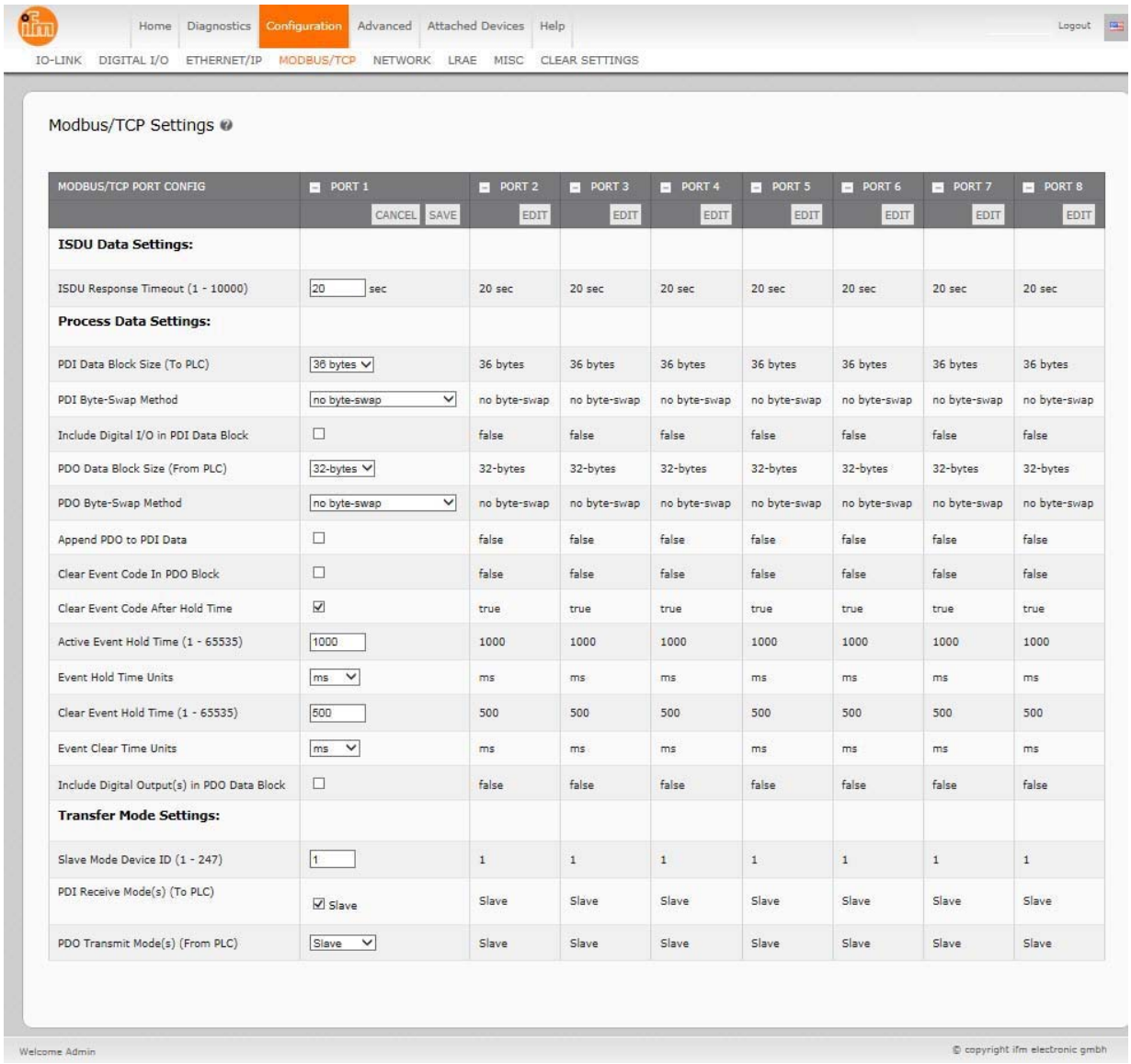
You can use the **Configuration | Modbus/TCP Settings** page to configure Modbus/TCP with the IO-Link master. This subsection includes these topics:



MODBUS/TCP PORT CONFIG	PORT 1	PORT 2	PORT 3	PORT 4	PORT 5	PORT 6	PORT 7	PORT 8
	EDIT	EDIT	EDIT	EDIT	EDIT	EDIT	EDIT	EDIT
ISDU Data Settings:								
ISDU Response Timeout (1 - 10000)	20 sec	20 sec	20 sec	20 sec	20 sec	20 sec	20 sec	20 sec
Process Data Settings:								
PDI Data Block Size (To PLC)	36 bytes	36 bytes	36 bytes	36 bytes	36 bytes	36 bytes	36 bytes	36 bytes
PDI Byte-Swap Method	no byte-swap	no byte-swap	no byte-swap	no byte-swap	no byte-swap	no byte-swap	no byte-swap	no byte-swap
Include Digital I/O in PDI Data Block	false	false	false	false	false	false	false	false
PDO Data Block Size (From PLC)	32-bytes	32-bytes	32-bytes	32-bytes	32-bytes	32-bytes	32-bytes	32-bytes
PDO Byte-Swap Method	no byte-swap	no byte-swap	no byte-swap	no byte-swap	no byte-swap	no byte-swap	no byte-swap	no byte-swap
Append PDO to PDI Data	false	false	false	false	false	false	false	false
Clear Event Code In PDO Block	false	false	false	false	false	false	false	false
Clear Event Code After Hold Time	true	true	true	true	true	true	true	true
Active Event Hold Time (1 - 65535)	1000	1000	1000	1000	1000	1000	1000	1000
Event Hold Time Units	ms	ms	ms	ms	ms	ms	ms	ms
Clear Event Hold Time (1 - 65535)	500	500	500	500	500	500	500	500
Event Clear Time Units	ms	ms	ms	ms	ms	ms	ms	ms
Include Digital Output(s) in PDO Data Block	false	false	false	false	false	false	false	false
Transfer Mode Settings:								
Slave Mode Device ID (1 - 247)	1	1	1	1	1	1	1	1
PDI Receive Mode(s) (To PLC)	Slave	Slave	Slave	Slave	Slave	Slave	Slave	Slave

6.4.1. Editing Modbus/TCP Settings

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



MODBUS/TCP PORT CONFIG	PORT 1	PORT 2	PORT 3	PORT 4	PORT 5	PORT 6	PORT 7	PORT 8
	CANCEL SAVE	EDIT	EDIT	EDIT	EDIT	EDIT	EDIT	EDIT
ISDU Data Settings:								
ISDU Response Timeout (1 - 10000)	20 sec	20 sec	20 sec	20 sec	20 sec	20 sec	20 sec	20 sec
Process Data Settings:								
PDI Data Block Size (To PLC)	36 bytes	36 bytes	36 bytes	36 bytes	36 bytes	36 bytes	36 bytes	36 bytes
PDI Byte-Swap Method	no byte-swap	no byte-swap	no byte-swap	no byte-swap	no byte-swap	no byte-swap	no byte-swap	no byte-swap
Include Digital I/O in PDI Data Block	☐	false	false	false	false	false	false	false
PDO Data Block Size (From PLC)	32-bytes	32-bytes	32-bytes	32-bytes	32-bytes	32-bytes	32-bytes	32-bytes
PDO Byte-Swap Method	no byte-swap	no byte-swap	no byte-swap	no byte-swap	no byte-swap	no byte-swap	no byte-swap	no byte-swap
Append PDO to PDI Data	☐	false	false	false	false	false	false	false
Clear Event Code In PDO Block	☐	false	false	false	false	false	false	false
Clear Event Code After Hold Time	☑	true	true	true	true	true	true	true
Active Event Hold Time (1 - 65535)	1000	1000	1000	1000	1000	1000	1000	1000
Event Hold Time Units	ms	ms	ms	ms	ms	ms	ms	ms
Clear Event Hold Time (1 - 65535)	500	500	500	500	500	500	500	500
Event Clear Time Units	ms	ms	ms	ms	ms	ms	ms	ms
Include Digital Output(s) in PDO Data Block	☐	false	false	false	false	false	false	false
Transfer Mode Settings:								
Slave Mode Device ID (1 - 247)	1	1	1	1	1	1	1	1
PDI Receive Mode(s) (To PLC)	☑ Slave	Slave	Slave	Slave	Slave	Slave	Slave	Slave
PDO Transmit Mode(s) (From PLC)	Slave	Slave	Slave	Slave	Slave	Slave	Slave	Slave

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

4. Make appropriate selections for the IO-Link device that you will connect to that port. You can use the help system if you require definitions or values for the options or *Modbus/TCP Settings Parameters* on Page 43.
5. Scroll to the top of the page and click the **SAVE** button. Make sure that the port now displays the **EDIT** button.

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

6.4.2. Modbus/TCP Settings Parameters

The following table illustrates the **Modbus/TCP Settings** page.

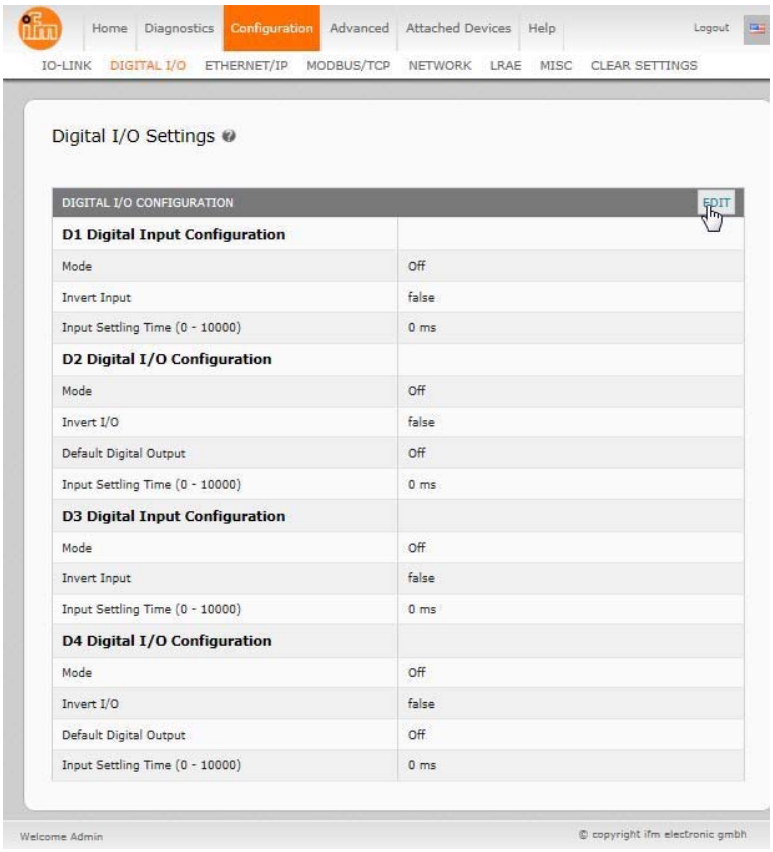
Modbus/TCP Settings Page	
ISDU Response Timeout *Default* = 20 seconds	The time that the IO-Link master's Modbus/TCP interface waits for a response to an ISDU request. The timeout needs to set long enough to allow all commands within the ISDU request to be processed. Valid range: **1-10,000** seconds
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 ***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.*

Modbus/TCP Settings Page (Continued)	
PDO Data Block Size *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 ***Note:*** *Because both IO-Link and Modbus/TCP use big-endian byte ordering, byte swapping typically is not required for word and dword data.* *Byte swapping is most commonly required when sending byte (8-bit) data to the IO-Link device and it is desired to send the least significant byte of the holding register first. For these cases, word (16 bit) byte-swap is typically used.*
Append PDO to PDI Data *Default*: False	If selected, the IO-Link master appends any PDO data to the end of the PDI data. • **False** = Do not append PDO data • **True** (enable check box) = Append PDO data
Clear Event Code in PDO Block *Default*: False	If enabled, the IO-Link master expects the first word of the PDO block to be used for event code handling. Values are: • **True** (enable check box) = expect event code • **False** = no event code, expect only PDO data
Clear Event Code After Hold Time *Default*: True	If enabled, the IO-Link master clears any event code reported in the PDI data block after the **Event Active Hold Time**. Values are: • **True** (enable check box) = clear event code after hold time • **False** = do not clear event code after hold time

Modbus/TCP Settings Page (Continued)	
Event Active 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**
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**
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 is Slave. ***Note:*** *Not selecting slave mode disables Modbus/TCP access to the PDI data block.*
PDO Transmit Mode *Default*: Slave	Selectable Modes are: • **Disabled** • **Slave**

Chapter 7. Dedicated Digital I/O Port Configuration

Use the **Configuration | Digital I/O** page to configure port characteristics for the AY1020.



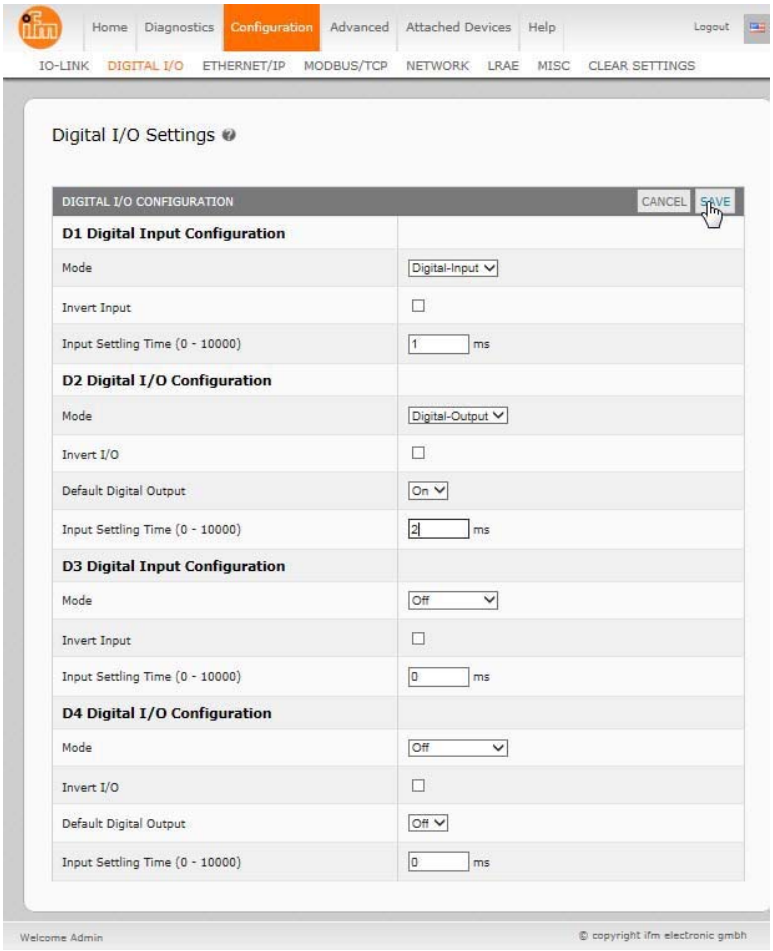
This section discusses dedicated digital IO port (D1 through D4) configuration.

- *Editing Digital I/O Settings* on Page 48
- *Digital I/O Setting Parameters* on Page 49

7.1. Editing Digital I/O Settings

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

1. If necessary, open the AY1020 web interface with your web browser using the IP address.
2. Click **Configuration** | **Digital I/O**.
3. Click the **EDIT** button.
4. Make appropriate selections for the digital I/O device or devices that you will connect to the ports. You can use the help system if you require definitions or values for the options or *Digital I/O Setting Parameters* on Page 49.



5. Click the **SAVE** button.

7.2. Digital I/O Setting Parameters

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

Digital I/O Settings Page	
D1 Digital Input Configuration	
Mode *Default* = Off	Selects the **Mode**: • Off – No monitoring of the digital input pin. • Digital-Input – monitors the digital input status
Invert Input *Default*= False	If **Mode** is set to **Digital-Input**, the input status is inverted.
Input Settling Time (0 - 10000ms) *Default*= 0ms	If non-zero and **Mode** is set to **Digital-Input**, the required time that the input status must remain constant before an input status change is reported.
D2 Digital I/O Configuration	
Mode *Default*= Off	Selects the **Mode**: • Off – No monitoring or setting of the digital I/O pin. • Digital-Input – monitors the digital input status • Digital-Output – sets the digital output to either the default setting or value received from a controller.
Invert I/O *Default*= False	If selected: • If **Mode** is set to **Digital-Input**, the input status is inverted. • If **Mode** is set to **Digital-Output**, the output setting is inverted.
Default Digital Output *Default*= Off	If **Mode** is set to **Digital Output**, defines the default digital output setting: • At startup before a controller can set the digital output. • When communication to all controller(s) has been lost. Possible settings: • Off - low voltage • On – high voltage
Input Settling Time (0 - 10000ms) *Default*= 0ms	If non-zero and **Mode** is set to **Digital-Input**, the required time that the input status must remain constant before an input status change is reported.

Digital I/O Settings Page	
D3 Digital Input Configuration	
Mode *Default*= Off	Selects the **Mode**: • Off – No monitoring of the digital input pin. • Digital-Input – Monitors the digital input status
Invert Input *Default*= False	If **Mode** is set to **Digital-Input**, the input status is inverted.
Input Settling Time (0 - 10000) *Default*= 0ms	If non-zero and **Mode** is set to **Digital-Input**, the required time that the input status must remain constant before an input status change is reported.
D4 Digital I/O Configuration	
Mode *Default*= Off	Selects the **Mode**: • Off – No monitoring or setting of the digital I/O pin. • Digital-Input – Monitors the digital input status • Digital-Output – sets the digital output to either the default setting or value received from a controller.
Invert I/O *Default*= False	If selected: • If **Mode** is set to **Digital-Input**, the input status is inverted. • If **Mode** is set to **Digital-Output**, the output setting is inverted.
Default Digital Output *Default*= Off	If **Mode** is set to **Digital Output**, defines the default digital output setting: • At startup before a controller can set the digital output. • When communication to all controller(s) has been lost. Possible settings: • Off - low voltage • On – high voltage
Input Settling Time (0 - 10000) *Default*= 0ms	If non-zero and **Mode** is set to **Digital-Input**, the required time that the input status must remain constant before an input status change is reported.

Chapter 8. Loading and Managing IODD Files

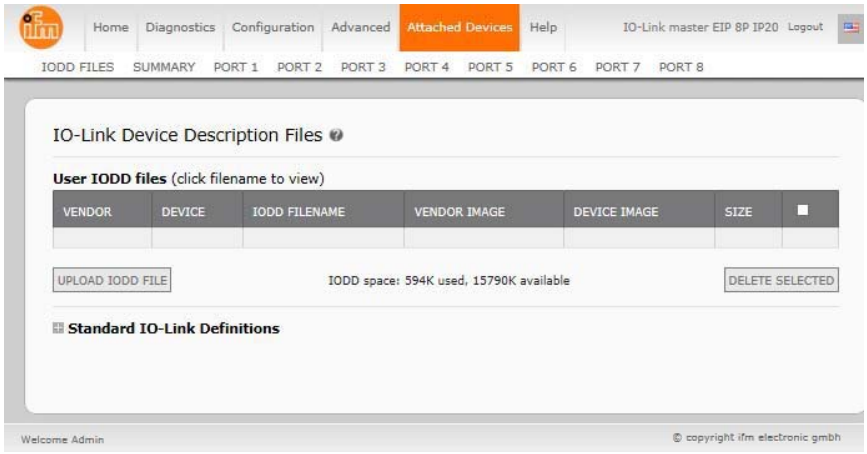
There are several **Attached Devices** pages that support IO-Link Device Description (IODD) file management.

- *IO-Link Device Descriptions Files Page* - load IODD files from the IO-Link device manufacturer.
- *IO-Link Device Configuration Summary Page* on Page 57 - verify the correct files were loaded for each IO- Link device.
- The **Port** pages are discussed in *Chapter 9. Configuring IO-Link Devices* on Page 59.

8.1. IO-Link Device Descriptions Files Page

Use the **IO-Link Device Description Files** page to update (upload) and delete IO-Link Device Description (IODD) files associated with this AY1020. In addition, you can review the IODD **xml** file using the **VIEW** button after loading the IODD file.

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



The AY1020 provides 15790K of space to store IODD files. The AY1020 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**

8.1.1. Preparing IODD Files to Upload

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

- Some IODD zip files contain the xml files and supporting image files for a single product. This type of zip file can be immediately loaded onto the AY1020.
- Some IODD zip files contain the files for multiple products. If you upload this type of IODD zip file, the AY1020 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 AY1020 notifies you what files are missing. Use the **UPDATE** feature to upload the missing images.
    - Zip the **xml** with all of the images and the AY1020 ignores (and not upload) any unused files and notifies which files did not upload.

Note: *Image files are not required for IO-Link device configuration.*

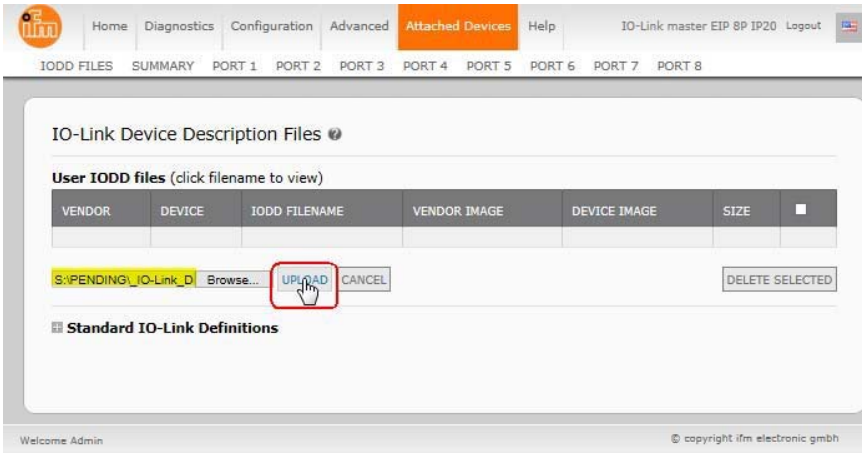
Use the appropriate discussion for your IODD files.

- *Uploading IODD Zip Files*
- *Uploading xml Files or Supporting Files* on Page 54

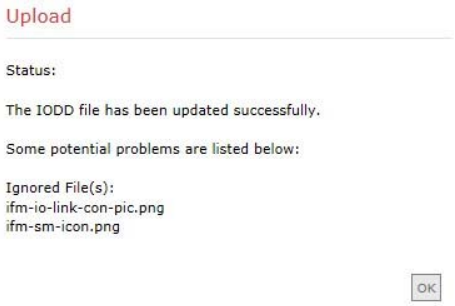
8.1.2. Uploading IODD Zip Files

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

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



Note: *Only images referenced in the xml file load to the AY1020 and the remaining files are ignored.*

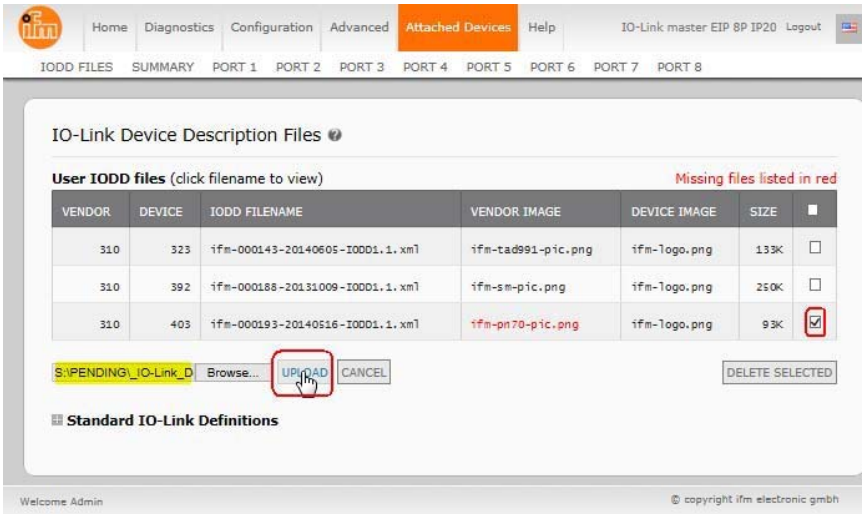


5. If desired, you can view the **xml** file by clicking the **IODD FILENAME** in the table.
6. Optionally, verify that the correct **xml** file was loaded using the **Summary** page (*Page 57*).

8.1.3. Uploading xml Files or Supporting Files

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

1. Click **Attached Devices** and **IODD FILES**.
2. Click the **UPLOAD IODD FILE** button.
3. Click the **Browse...** button.
4. Highlight the **xml** or image file and click **Open**.
   Note: *The **xml** file must be loaded before the AY1020 will load the associated image files.*
5. Click the **UPLOAD** button.
6. Optionally, use the following steps to load image files:
   a. Select the row in the table that contains the **xml** file.

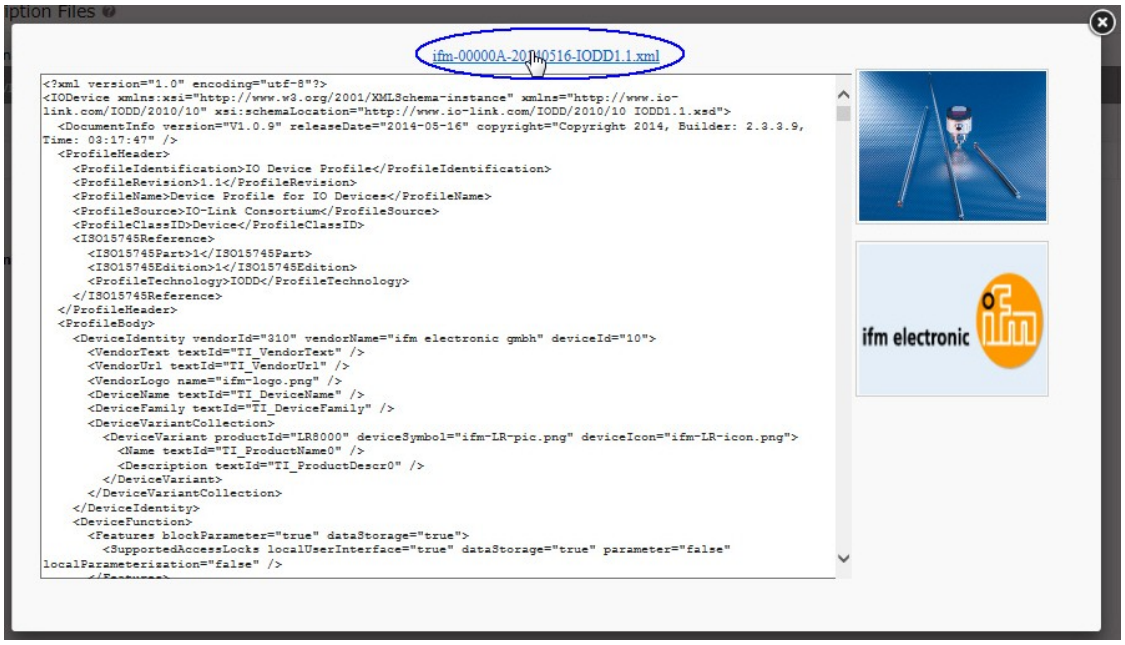


   b. Click the **UPLOAD IODD FILE** button.
   c. Click the **Browse** button.
   d. Highlight the image and click **Open**.
   e. Click the **UPLOAD** button.
   f. If desired, you can view the **xml** file by clicking the IODD FILENAME in the table.
   g. Optionally, verify that the correct **xml** file was loaded using the **Summary** page (*Page 57*).

8.1.4. Viewing and Saving IODD Files

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

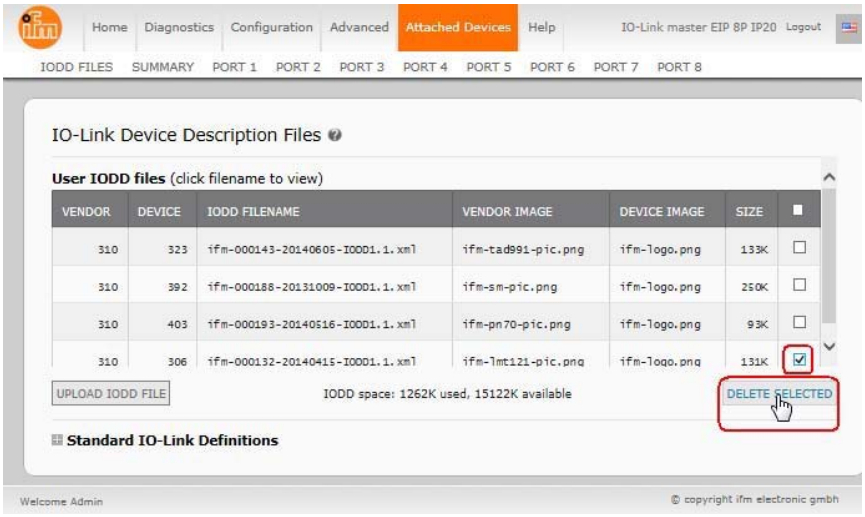
1. If necessary, click **Attached Devices** and **IODD Files**.
2. Click the **IODD FILENAME** in the table that you want to review. A pop up window displays the contents of the IODD file.
3. Optionally, click the file name hyperlink at the top of the window to view the formatted file or if you want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



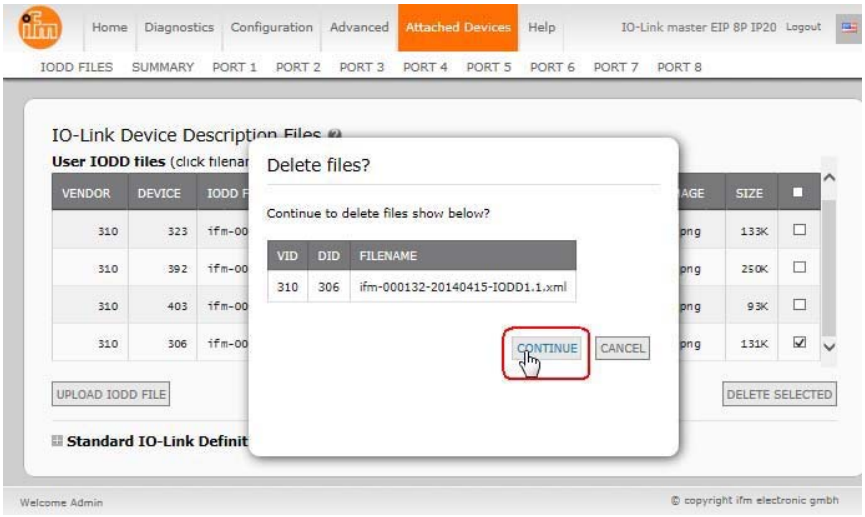
8.1.5. Deleting IODD Files

Use the following procedure to delete an IODD file set from the AY1020.

1. If necessary, click **Attached Devices** and **IODD Files.**
2. Check the corresponding row of the IODD file that you want to delete.
3. Click the **DELETE SELECTED** button.



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



8.2. IO-Link Device Configuration Summary Page

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

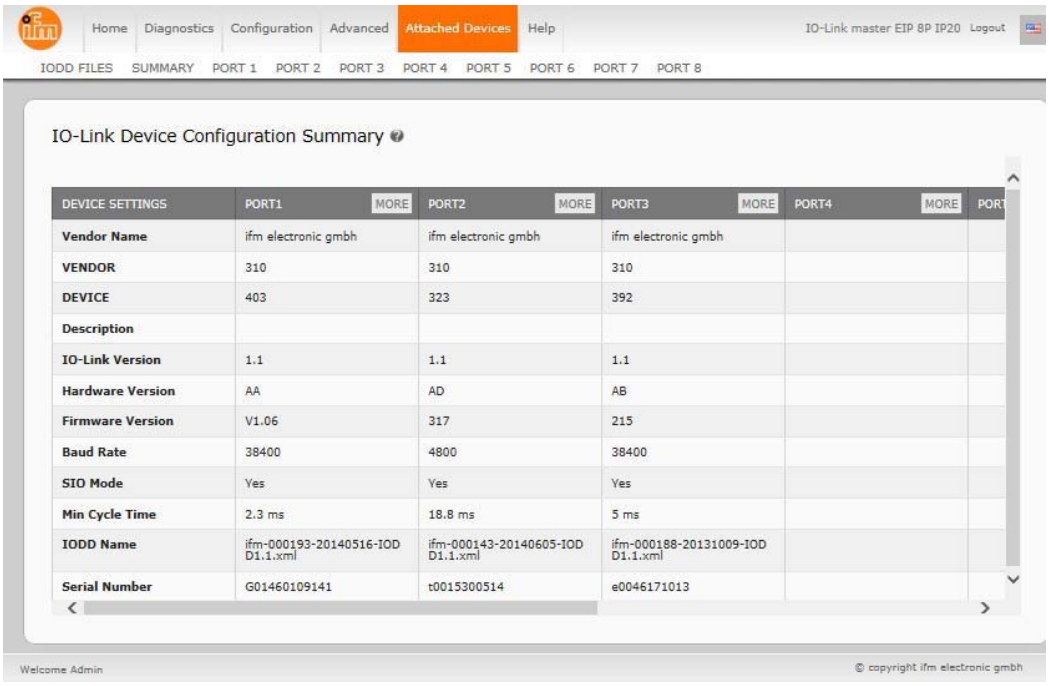
A file name displayed in the **IODD Name** field for a port indicates that a valid IODD file is associated with that device. If the field is empty, that indicates that a valid IODD file has not been loaded.

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

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

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

   Note: *The **Configuration Summary** page takes several minutes to completely load as each device is queried.*
3. Click the **MORE** button or the corresponding **Port** (in the navigational bar) to configure the IO-Link device parameters for a specific device. See *Chapter 9. Configuring IO-Link Devices* on Page 59 for more information.



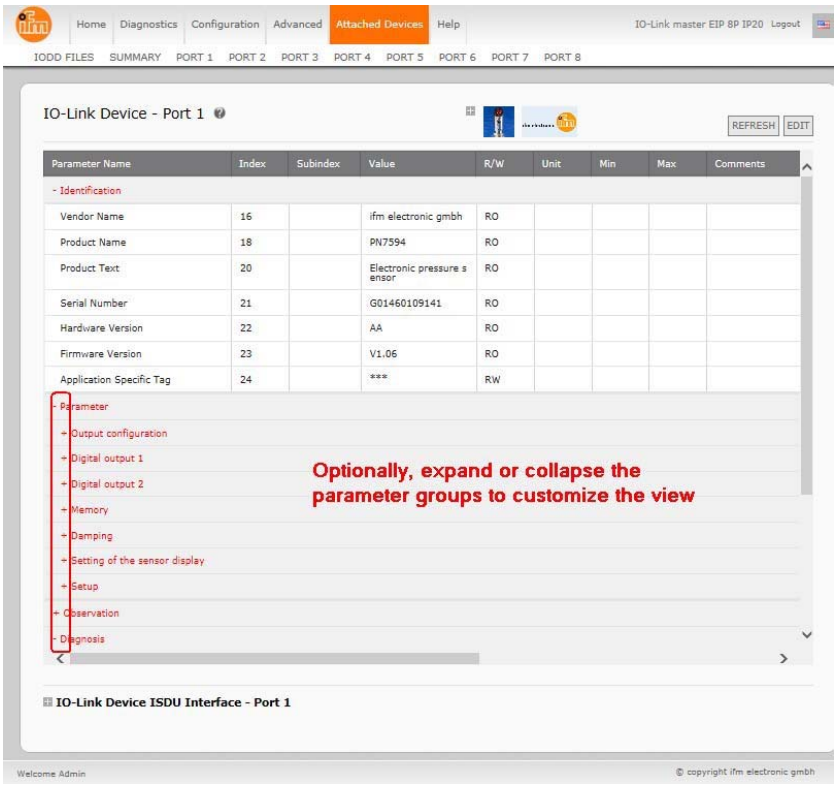
Chapter 9. Configuring IO-Link Devices

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

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

9.1. Port Pages Overview

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



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 AY1020. To use the **IO-Link Device Port** table for configuring IO-Link devices, refer to the following subsections:
  - *Editing Parameters - IO-Link Device - Port Table* on Page 60
  - *Resetting IO-Link Device Parameters to Factory Defaults* on Page 61
- **IO-Link Device ISDU Interface - Port**, which can be used with or without IODD files loaded. Refer to the following information to use the **IO-Link Device ISDU Interface - Port** method:
  - The *IO-Link Device Operator Manual* from the device manufacturer is needed to use the **IO-Link Device ISDU Interface** since ISDU block index and ISDU sub-index numbers are required.
  - *Editing Parameters - IO-Link Device ISDU Interface - Port* on Page 62

9.2. Editing Parameters - IO-Link Device - Port Table

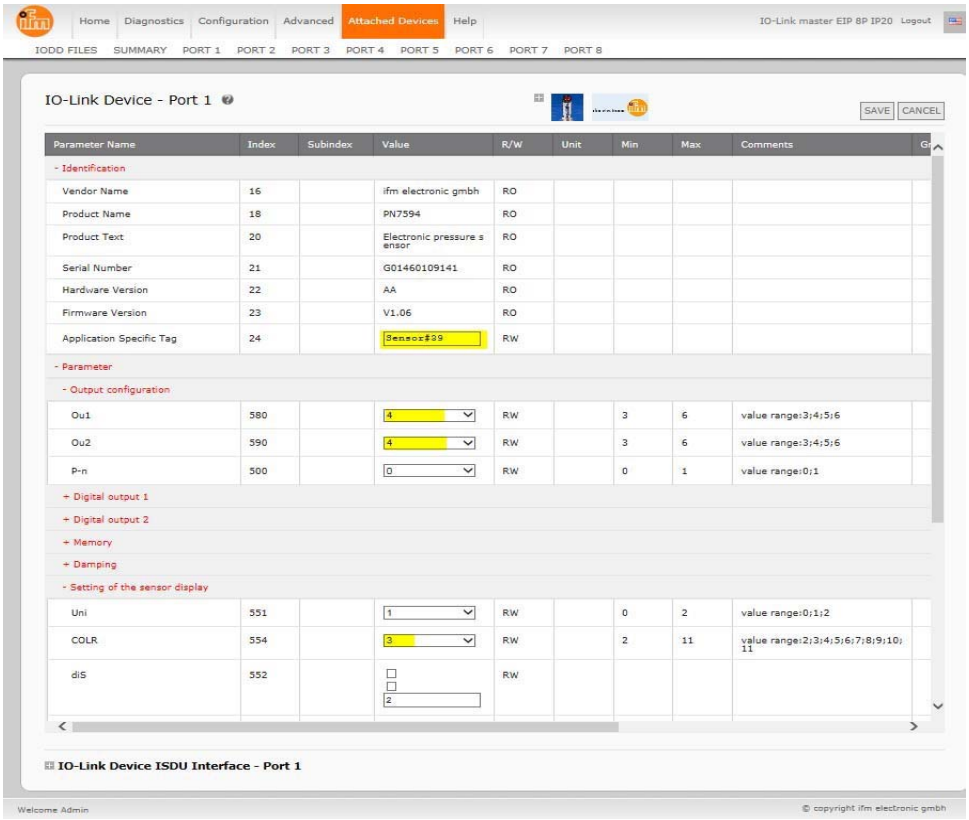
Use the following procedure to edit IO-Link device parameters using the **IO-Link Device Port** table.

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

1. If you have not done so, load the IODD file from the IO-Link device manufacturer (*Chapter 8. Loading and Managing IODD Files* on Page 51).
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 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 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.



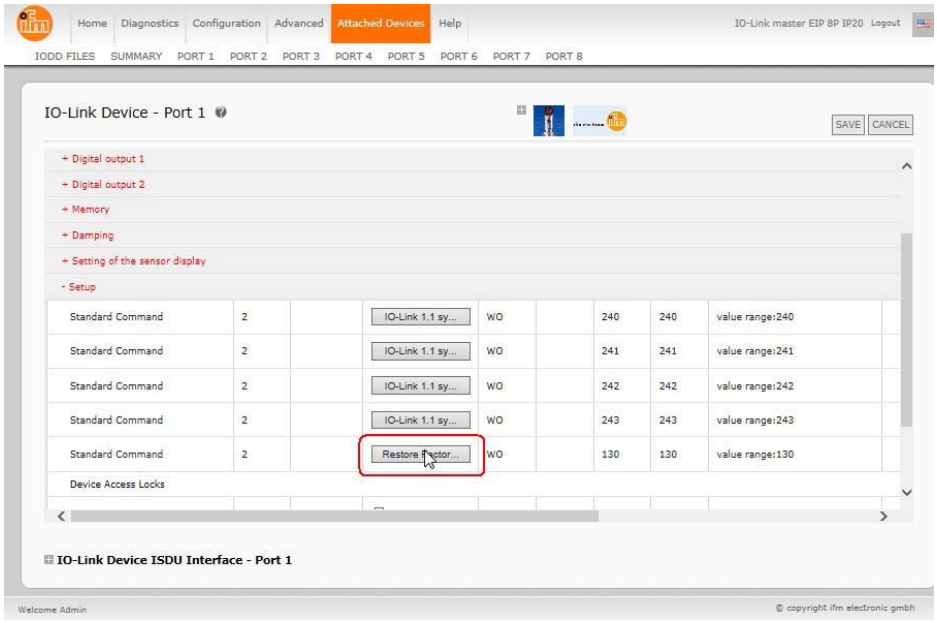
5. Click the **SAVE** button after editing the parameters.
6. Optionally, click the **REFRESH** button to confirm the parameter changes.

9.3. Resetting IO-Link Device Parameters to Factory Defaults

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

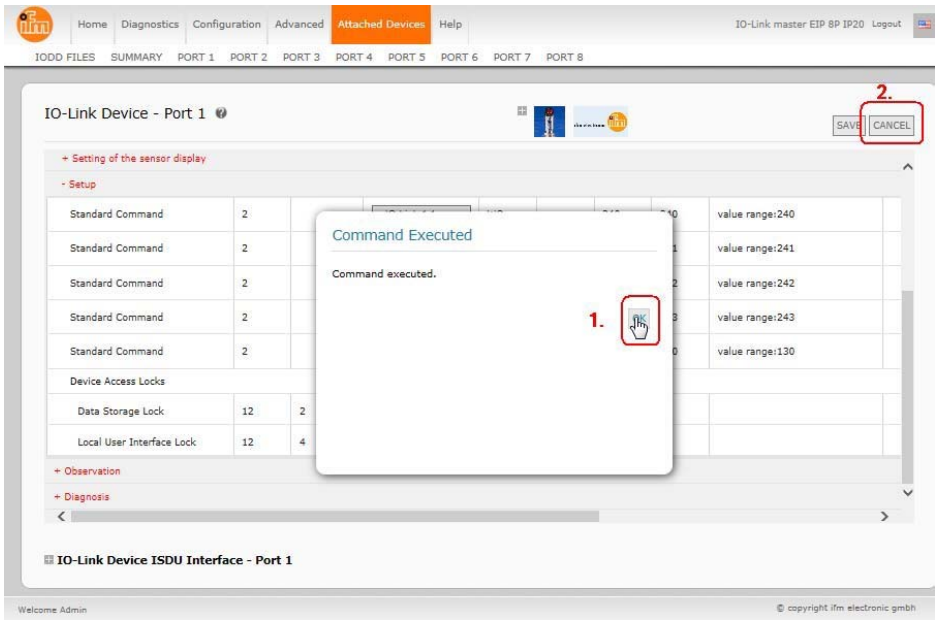
1. Click the **EDIT** button and locate the **Restore Factory** button.
2. Click the **Restore Factory** or **Load Factory Settings** button.

   Note: *The name of the button is determined by the IO-Link device manufacturer.*



3. Click **OK** when the *Command Executed* message appears.
4. Click **Cancel** to close the **IO-Link Device - Port** table.

   Note: *If you click **SAVE**, the default values are not loaded.*



5. Optionally, click the **REFRESH** button to verify the settings.

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

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

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

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

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

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

Please note:

- 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.

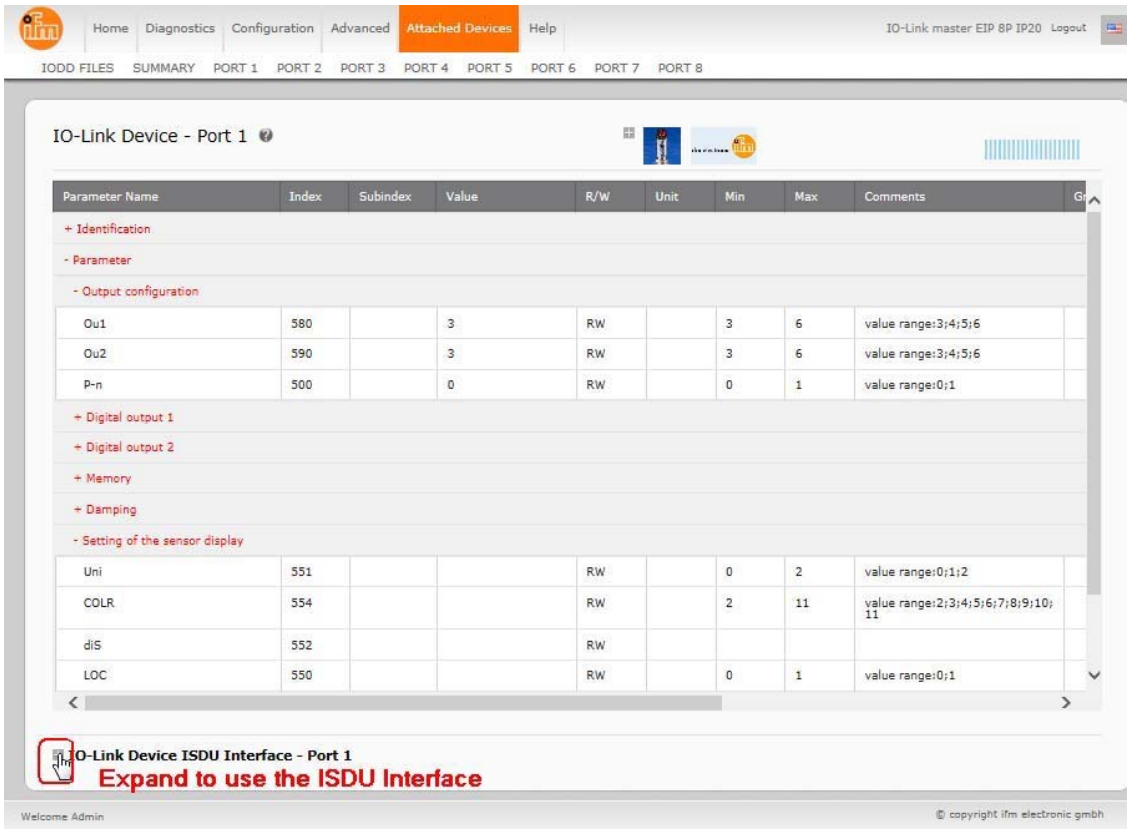
- This message means that the IO-Link device defines the entry as an invalid setting.

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

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.*

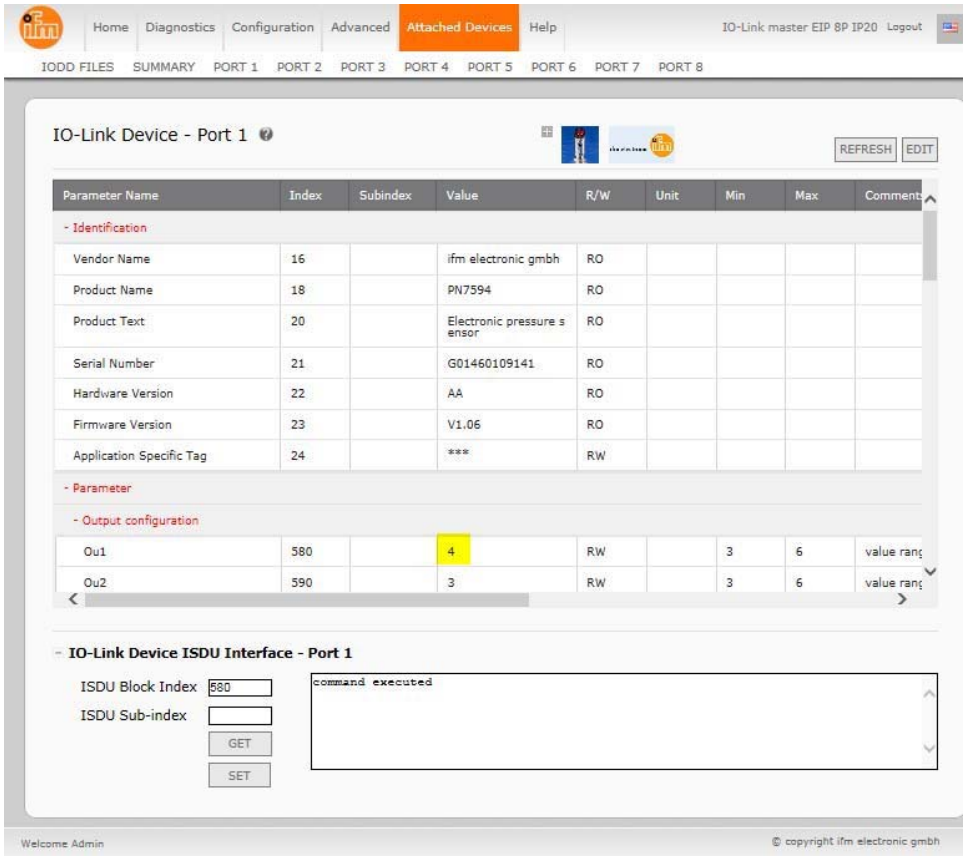
1. Click the **+** next to the **IO-Link Device ISDU Interface** to open the interface.



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.



Chapter 10. Utilizing AY1020 Features

This chapter discusses using the following features:

- Data Storage (automatic and manual) to upload or download IO-Link device parameters
- Device Validation (identical or compatible) to dedicate a port or ports to specific IO-Link devices
- Data Validation (strict or loose) to verify data integrity
- **Menu Bar Hover Shows Submenu**, which provides an option to navigate the submenu structure quickly. The

following AY1020 web interface features are discussed in previous chapters, for example:

- Loading and managing IODD files from IO-Link device manufacturers (*Page 51*).
- Changing IO-Link device parameters (*Page 59*).
- Configuring IO-Link, EtherNet/IP, and Modbus/TCP characteristics (*Page 27*).

10.1. Data Storage

Data storage is typically supported by IO-Link v1.1 devices. *Data storage* means that you can upload parameters from the IO-Link device to the AY1020 and/or download parameters from the AY1020 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 device supports data storage, you can check one of the following:

- **IO-Link Diagnostics** page - check the **Data Storage Capable** field, if it displays **Yes**, the device supports data storage.
- **IO-Link Configuration** page - check to see if **UPLOAD** and **DOWNLOAD** buttons display under the **Data Storage Manual Ops** group.

You can refer to the appropriate discussion for your environment.

- *Uploading Data Storage* on Page 66
- *Downloading Data Storage* on Page 68

10.1.1. Uploading Data Storage

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

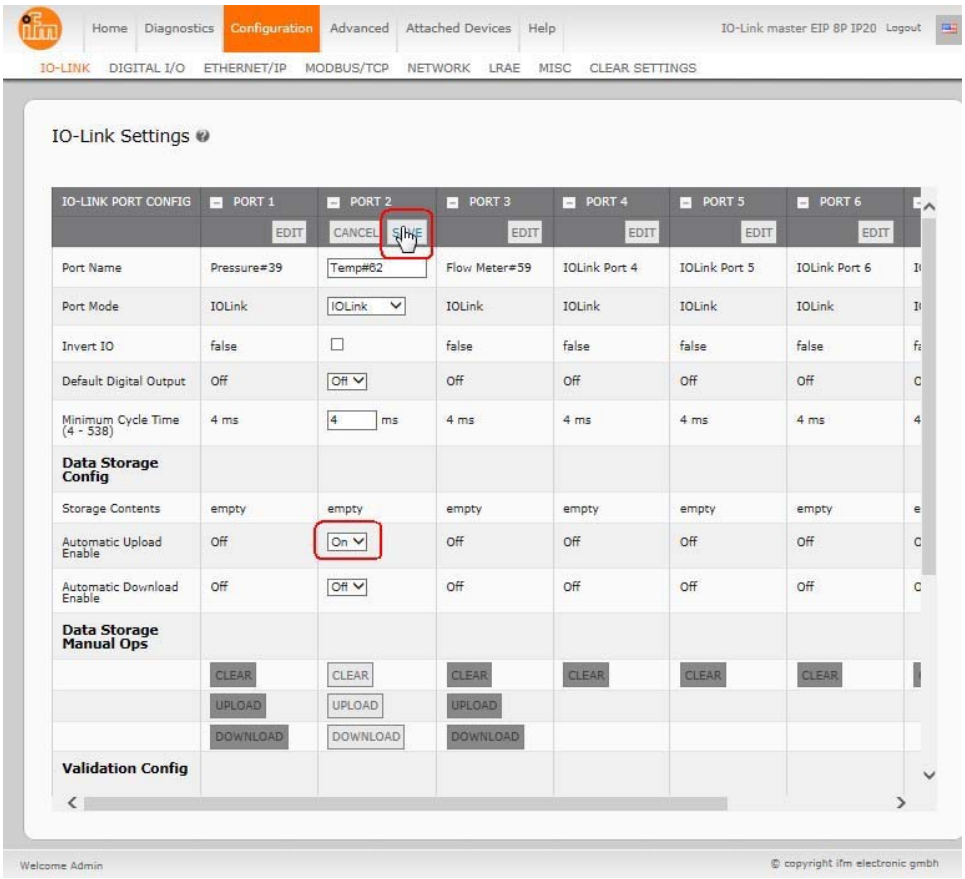
- Automatically
- Manually

10.1.1.1. Uploading - Automatic Data Storage

If the **Automatic Upload Enable** option is selected and the data storage is cleared from the AY1020 port, the storage data on the IO-Link device is uploaded and saved on the AY1020 for that port.

Use this procedure to enable automatic data storage for selected ports.

1. Click **Configuration | IO-Link**.
2. Click the **EDIT** button or buttons for the ports for which you want to store the data on the AY1020.
3. Select **On** in the drop list for **Automatic Data Storage Upload Enable**.



4. Click **SAVE**.

   The data storage clears for the AY1020 port and the storage data on the IO-Link device uploads and saves on the AY1020 port.

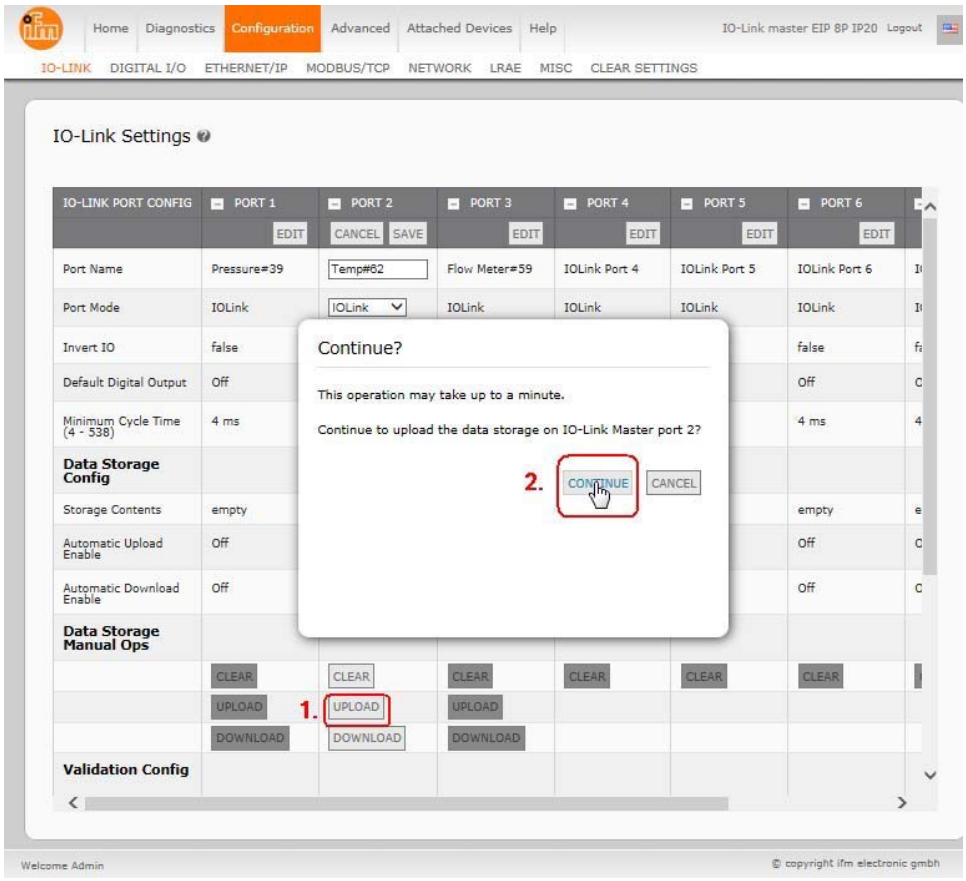
5. When this page is refreshed, the **Storage Contents** field displays the **Vendor ID** and **Device ID**.

10.1.1.2. Uploading Manual Data Storage

If you select the **Manual Data Storage Control Ops Upload** option, the AY1020 uploads and stores the IO-Link device configuration on the AY1020.

Use this procedure to manually download data storage for a selected port or ports.

1. Click **Configuration| IO-Link**.
2. Click the **EDIT** button or buttons for the ports for which you want to store the data on the AY1020.
3. Scroll down to **Manual Data Storage Control Ops**.
4. Click the **UPLOAD** button or buttons for the ports for which you want to store the data on the AY1020.
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.

   The data storage clears for the AY1020 port and the storage data on the IO-Link device uploads and saves on the AY1020 port.
7. Click **CANCEL** or **SAVE** depending on whether you made other configuration changes.

10.1.2. Downloading Data Storage

There are two methods to download Data Storage:

- Automatically
- Manually

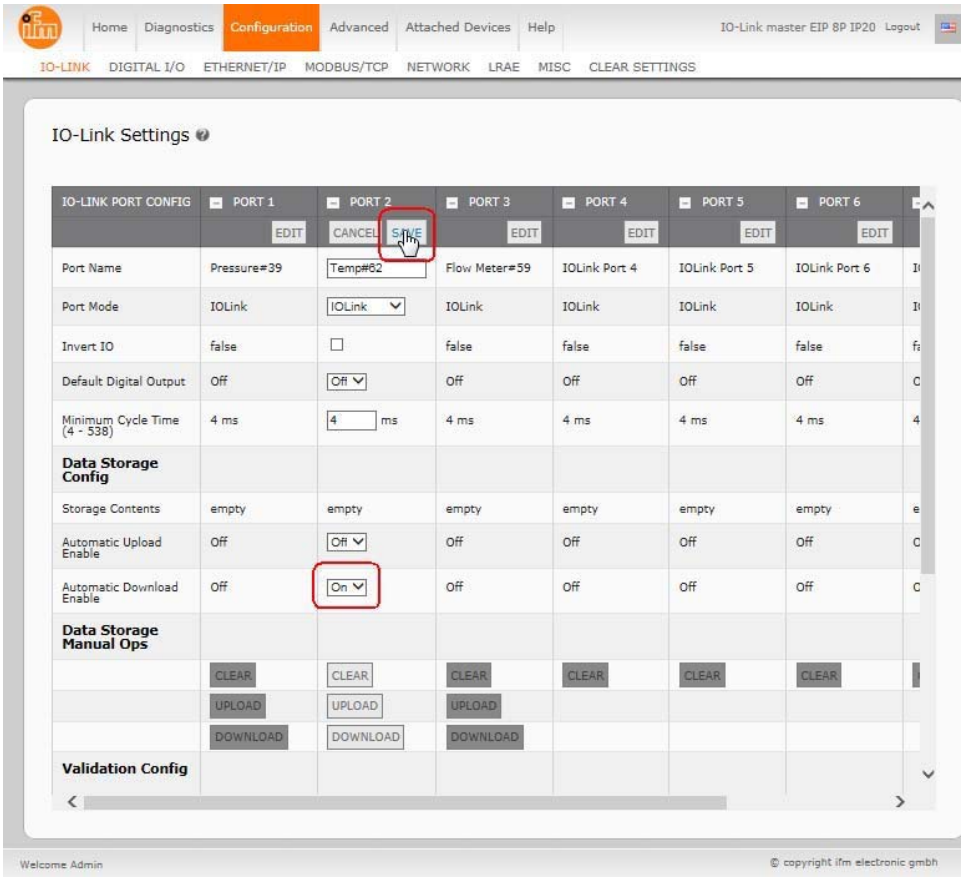
10.1.2.1. Downloading- Automatic Data Storage

If you select the **Automatic Download Enable** option, the data stored on the AY1020 port is downloaded to the IO-Link device if:

- This option is selected.
- The data stored on the AY1020 port contains the same Vendor ID and Product ID as the IO-Link device connected to the port.
- The data stored on the AY1020 port is different than that of the IO-Link device. Use this

procedure to enable automatic data storage for selected ports.

1. Click **Configuration | IO-Link Settings**.
2. Click the **EDIT** button or buttons for the ports for which you want to store the data on the AY1020.
3. Select **On** in the drop list for **Automatic Data Storage Download Enable**.
4. Click **SAVE**.



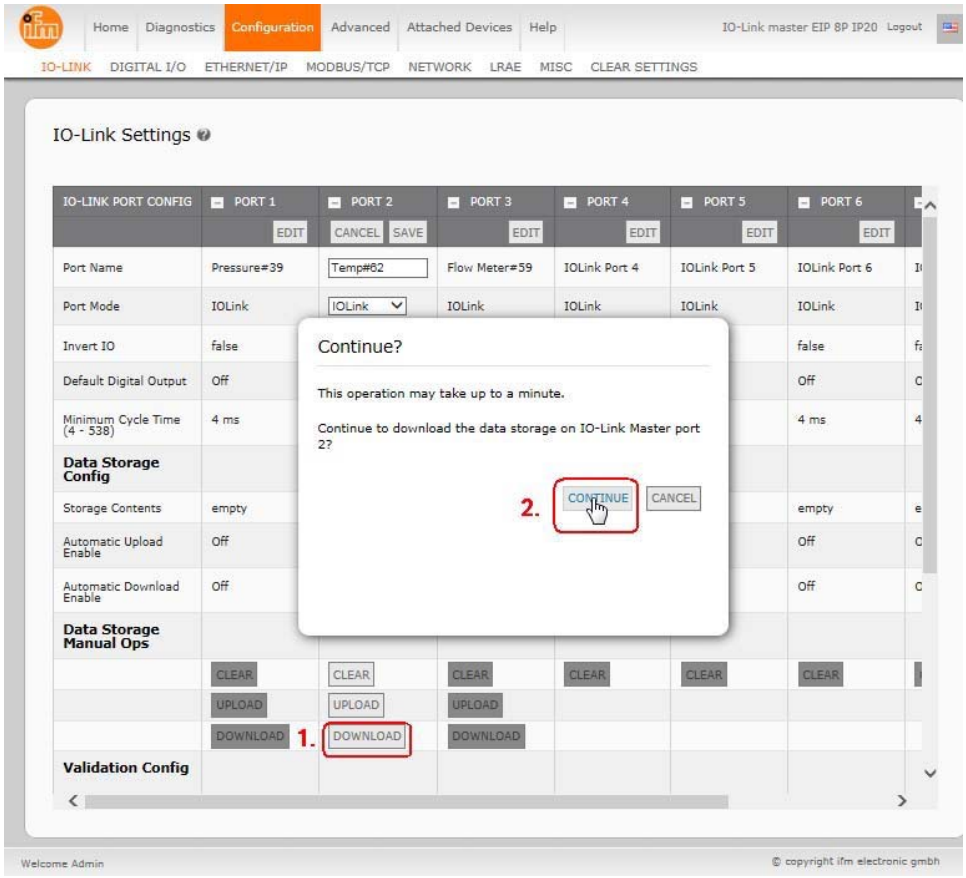
When an IO-Link device, which is the same model with different parameters is attached to the port, data storage is automatically downloaded from the AY1020 to the IO-Link device.

10.1.2.2. Downloading Manual Data Storage

The **Data Storage Manual Ops DOWNLOAD** button downloads the stored IO-Link device configuration from the AY1020 to the IO-Link device attached to this port if the Vendor ID and Device ID match.

Use this procedure to manually upload data storage for a selected port or ports.

1. Click **Configuration | IO-Link Settings.**
2. Click the **EDIT** button or buttons for the ports for which you want to store the data on the AY1020.
3. Scroll down to **Data Storage Manual Ops**.
4. Click the **DOWNLOAD** button or buttons for the ports for which you want to download the data on the IO- Link device.
5. Click the **CONTINUE** button to the *Continue to download the data storage on IO-Link Master port [number]* message.



6. Click the **Ok** button to the *Data storage download successful on Port [number]* message.
7. Click **CANCEL** or **SAVE** depending on whether you have completed editing the port.

When an IO-Link device, which is the same model with different parameters is attached to the port, data storage is downloaded from the AY1020 to the IO-Link device.

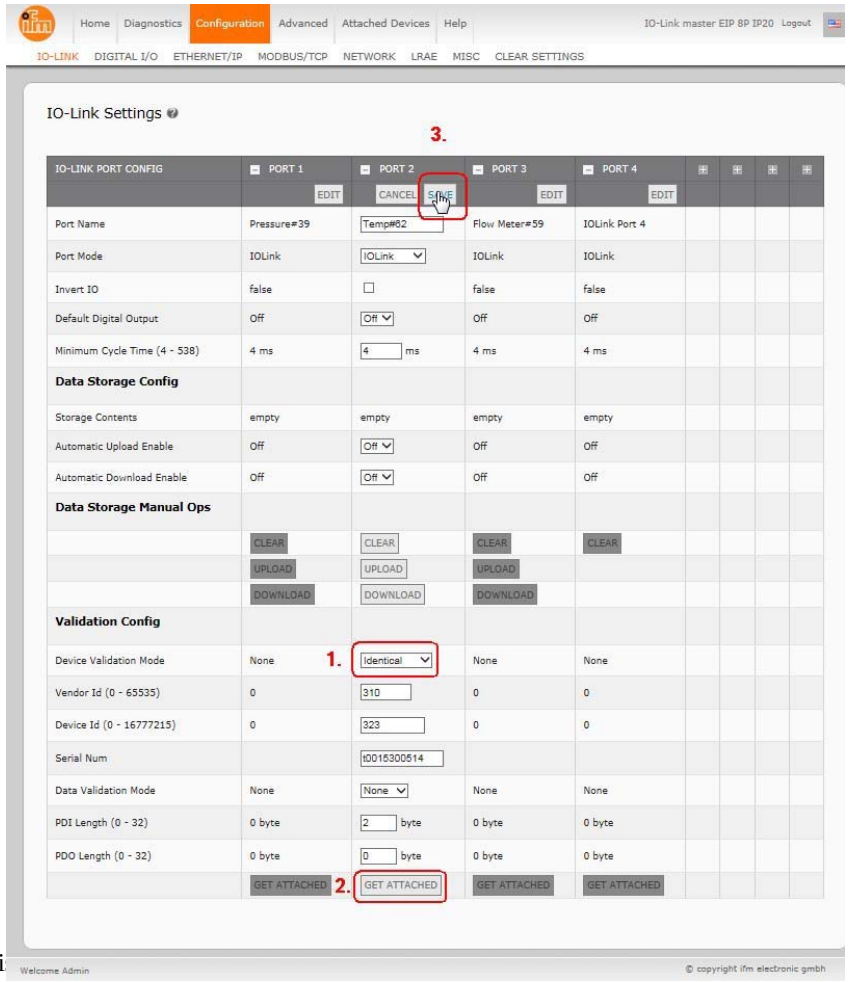
10.2. Device Validation

Device validation is supported by many IO-Link devices. You can use this procedure to configure device validation.

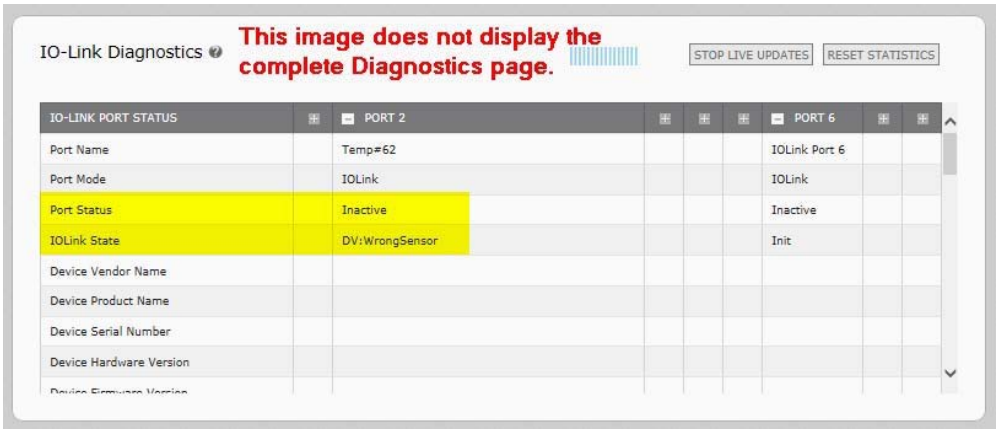
1. Click **Configuration | IO-Link Settings**.
2. Click the **EDIT** button.
3. Select **Compatible** or **Identical** for the **Device Validation** mode.
4. Click the **GET ATTACHED** button or manually complete the Vendor ID, Device, ID, and serial number.

   If the device does not have a serial number, you should not select **Identical** because the AY1020 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.



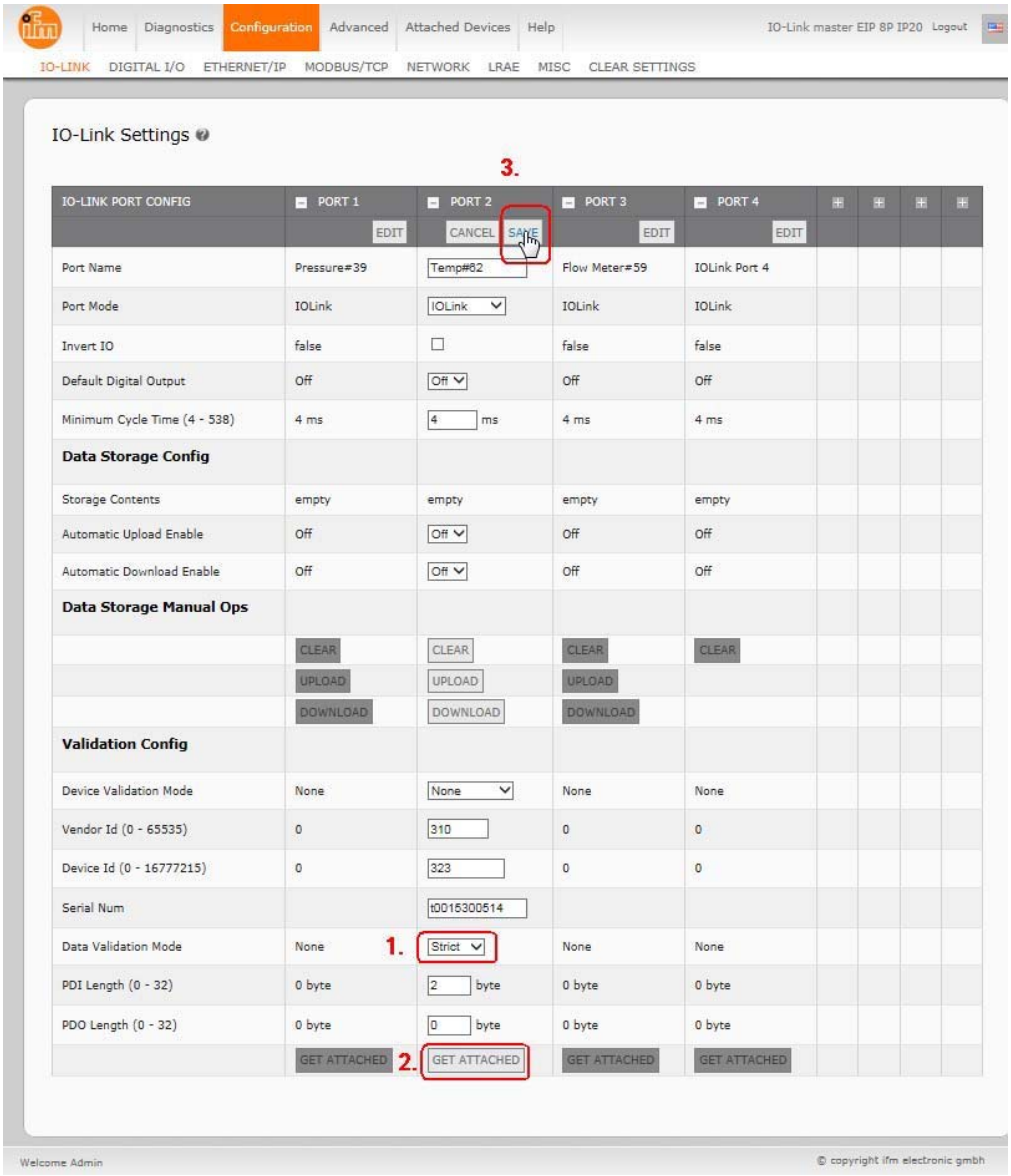
In addition, the **IO-Link Diagnostics** page di



10.3. Data Validation

Data validation is supported by many IO-Link v1.1 devices. 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.

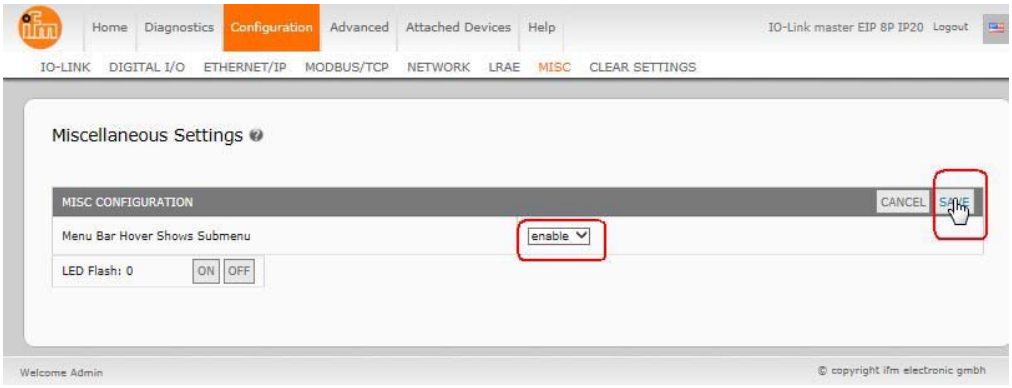
If data validation fails, the IO-Link port LED flashes red and the **IO-Link Diagnostics** page displays an error.

10.4. 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 submenus for a category when you hover over the category name.

For example, if you hover over **Advanced**, the **SOFTWARE**, **ACCOUNTS**, **LOG FILES**, and **LICENSES** submenus display. You can click any submenu 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**.



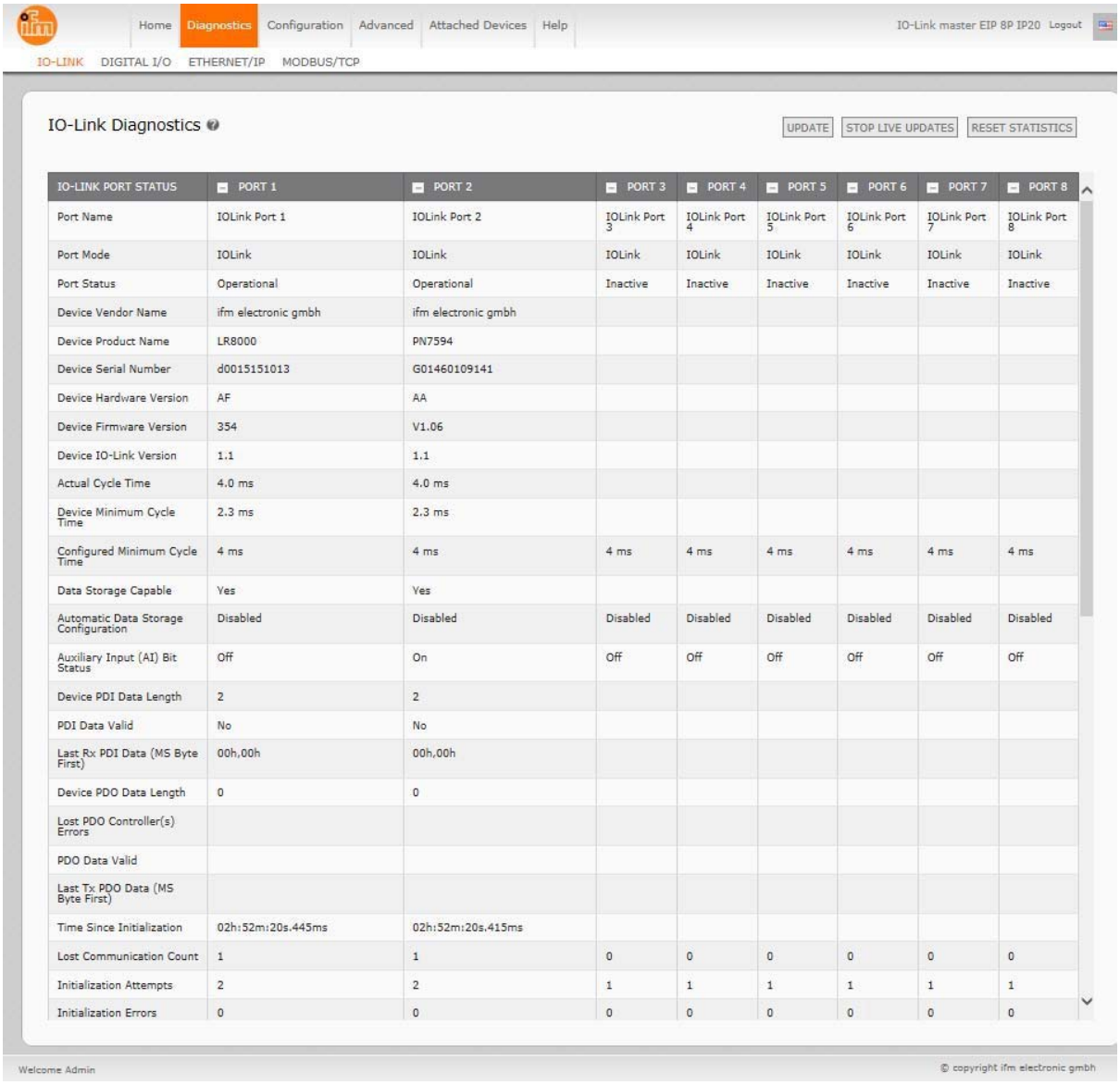
Chapter 11. Using the Diagnostics Pages

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

- *IO-Link Port Diagnostics*
- *Digital I/O Diagnostics* on Page 77
- *EtherNet/IP Diagnostics* on Page 78
- *Modbus/TCP Diagnostics* on Page 82

11.1. IO-Link Port Diagnostics

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



IO-LINK PORT STATUS	PORT 1	PORT 2	PORT 3	PORT 4	PORT 5	PORT 6	PORT 7	PORT 8
Port Name	IOLink Port 1	IOLink Port 2	IOLink Port 3	IOLink Port 4	IOLink Port 5	IOLink Port 6	IOLink Port 7	IOLink Port 8
Port Mode	IOLink	IOLink	IOLink	IOLink	IOLink	IOLink	IOLink	IOLink
Port Status	Operational	Operational	Inactive	Inactive	Inactive	Inactive	Inactive	Inactive
Device Vendor Name	ifm electronic gmbh	ifm electronic gmbh						
Device Product Name	LR8000	PN7594						
Device Serial Number	d0015151013	G01460109141						
Device Hardware Version	AF	AA						
Device Firmware Version	354	V1.06						
Device IO-Link Version	1.1	1.1						
Actual Cycle Time	4.0 ms	4.0 ms						
Device Minimum Cycle Time	2.3 ms	2.3 ms						
Configured Minimum Cycle Time	4 ms	4 ms	4 ms	4 ms	4 ms	4 ms	4 ms	4 ms
Data Storage Capable	Yes	Yes						
Automatic Data Storage Configuration	Disabled	Disabled	Disabled	Disabled	Disabled	Disabled	Disabled	Disabled
Auxiliary Input (AI) Bit Status	Off	On	Off	Off	Off	Off	Off	Off
Device PDI Data Length	2	2						
PDI Data Valid	No	No						
Last Rx PDI Data (MS Byte First)	00h,00h	00h,00h						
Device PDO Data Length	0	0						
Lost PDO Controller(s) Errors								
PDO Data Valid								
Last Tx PDO Data (MS Byte First)								
Time Since Initialization	02h:52m:20s.445ms	02h:52m:20s.415ms						
Lost Communication Count	1	1	0	0	0	0	0	0
Initialization Attempts	2	2	1	1	1	1	1	1
Initialization Errors	0	0	0	0	0	0	0	0

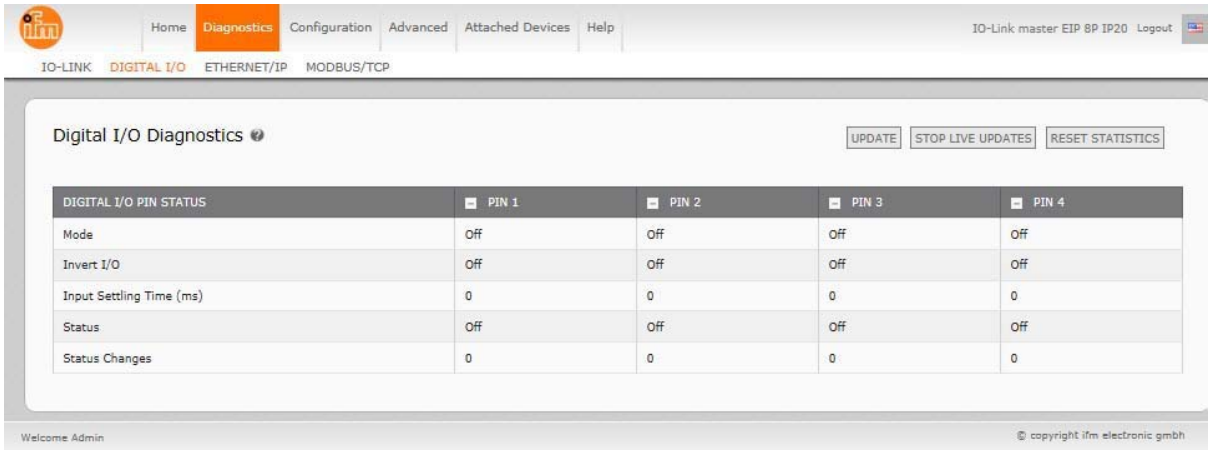
The following table provides information about the **IO-Link Diagnostics** page.

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.
Device Vendor Name	Displays the Device Vendor Name as stored in ISDU Index 16.
Device Product Name	The Device Product Name as stored in ISDU Index 18.
Device Serial Number	The Device Serial Number as stored in ISDU Index 21.
Device Hardware Version	The Device Hardware Version as stored in ISDU Index 22.
Device Firmware Version	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 Minimum Cycle Time	Configured in the **Configuration | IO-Link** page, this is the minimum cycle time the IO-Link master will allow the port to operate at. The Actual Cycle Time, which is negotiated between the IO-Link master and the device, will be at least as long as the greater of the Configured Minimum Cycle Time and the Device Minimum Cycle Time.
Data Storage Capable	Displays whether the IO-Link device on a port supports the data storage feature. Not all IO-Link devices support the data storage feature.
Automatic Data Storage Configuration	Displays whether a port is configured to automatically upload data from the IO-Link device or download data from the AY1020 to the IO-Link device.
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.
Device PDO Data Length	The supported Device PDO Data Length, in bytes, as stored in ISDU Index 0.
Lost PDO Controller(s) Errors	The number of times that the PDO controller(s) were present and then lost connection.

IO-Link Diagnostics (Continued)	
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.
Lost Communication Count	The number of times that communication has been lost to the IO-Link device.
Initialization Attempts	The number of times the IO-Link port was initialized.
Initialization Errors	The number of port initialization errors that occurred.
Process Data Errors	The number of process data errors the port received.
Process Data Retries	The number of process data retries the port performed.
Internal Communication Errors	The number of IO-Link master internal communication errors that occurred on this port.
Device Communication Errors	The number of device specific communication errors that occurred.
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.
Minimum ISDU Read Cmd Resp Time	The minimum, or shortest, read ISDU command response time.
Maximum ISDU Read Cmd Resp Time	The maximum, or longest, read ISDU command response time.
Average ISDU Read Cmd Resp Time	The average ISDU read command response time.
Average ISDU Read Cmd Byte Time	The average per-byte read ISDU command response time.
ISDU Write Cmd Attempts	The number of write ISDU command attempts.
ISDU Write Cmd Errors	The number of write ISDU command errors.
Minimum ISDU Write Cmd Resp Time	The minimum, or shortest, write ISDU command response time.
Maximum ISDU Write Cmd Resp Time	The maximum, or longest, write ISDU command response time.
Average ISDU Write Cmd Resp Time	The average ISDU write command response time.
Average ISDU Write Cmd Byte Time	The average per-byte ISDU write command response time.

11.2. Digital I/O Diagnostics

The **Digital I/O Diagnostics** page may be useful when trying to troubleshoot port issues related to configuration.

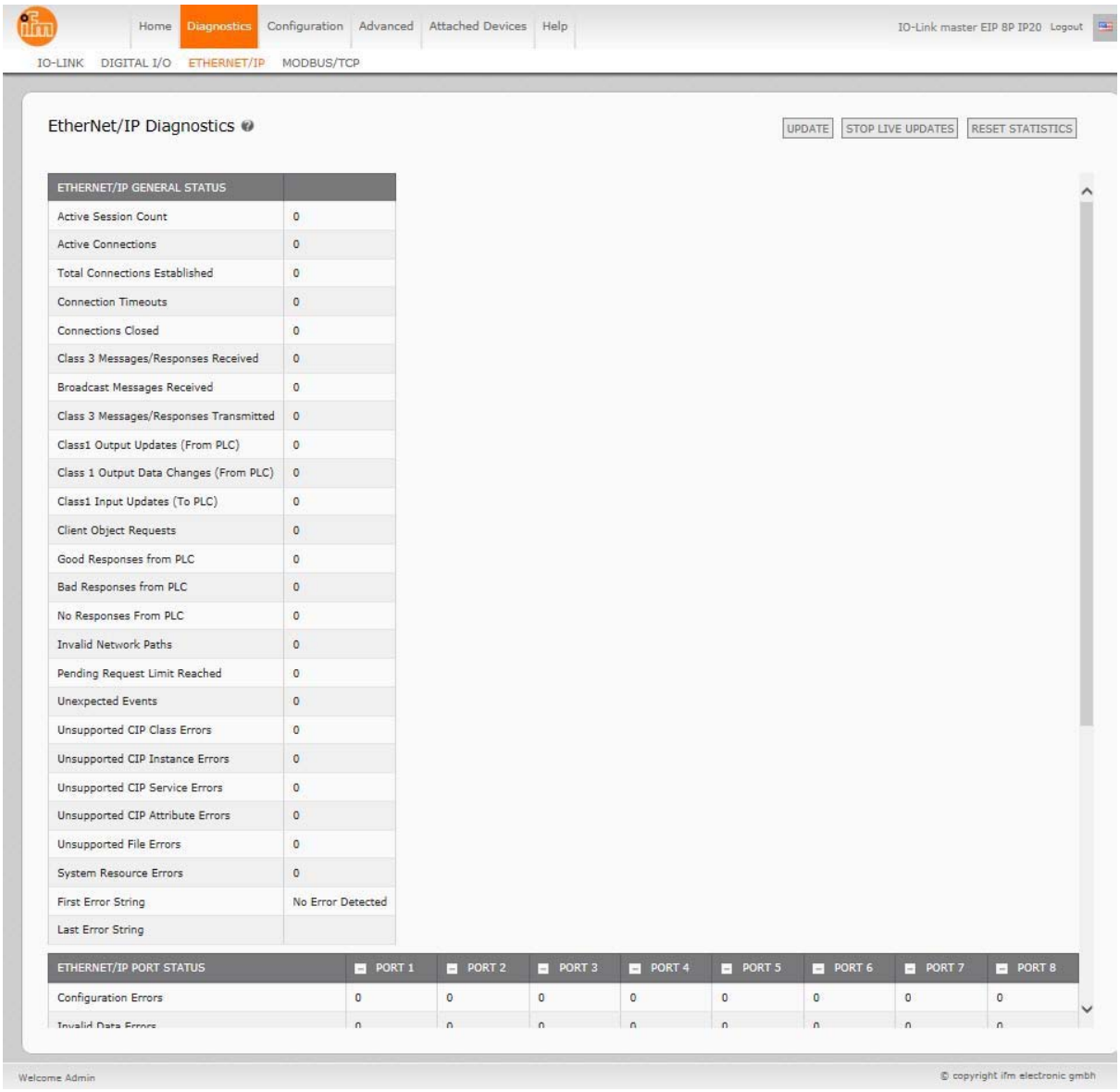


The following table provides information about the **Digital I/O Diagnostics** page.

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

11.3. 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).

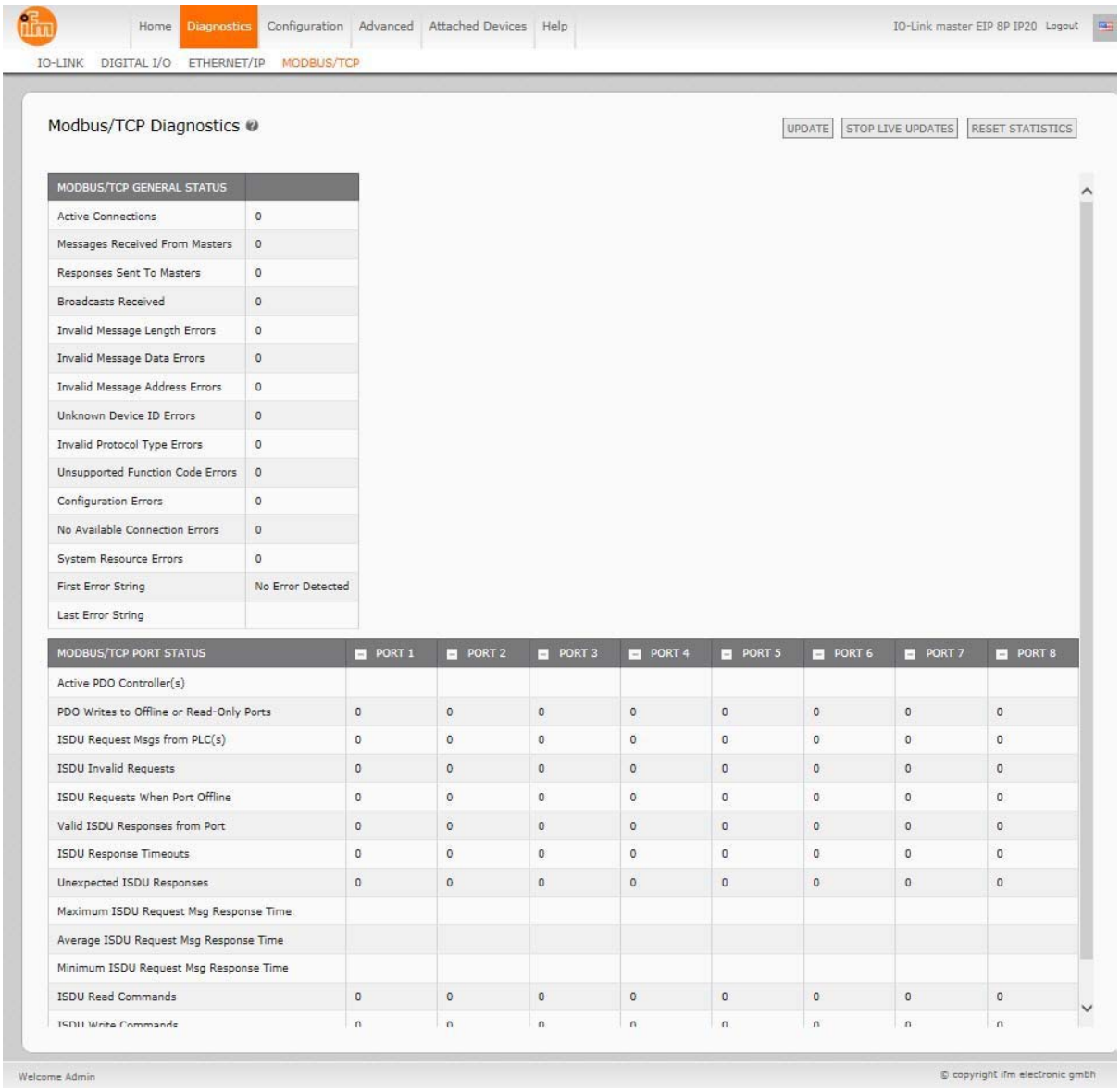
EtherNet/IP Diagnostics (Continued)	
Total Connections Established	The total number of connections that have been established.
Connection Timeouts	The number of connections that have closed due to timing out.
Connections Closed	The number connections that have closed due to a standard processes.
Class 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.

EtherNet/IP Diagnostics (Continued)	
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.

EtherNet/IP Diagnostics (Continued)	
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.

11.4. 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.

Modbus/TCP Diagnostics (Continued)	
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 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.
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.

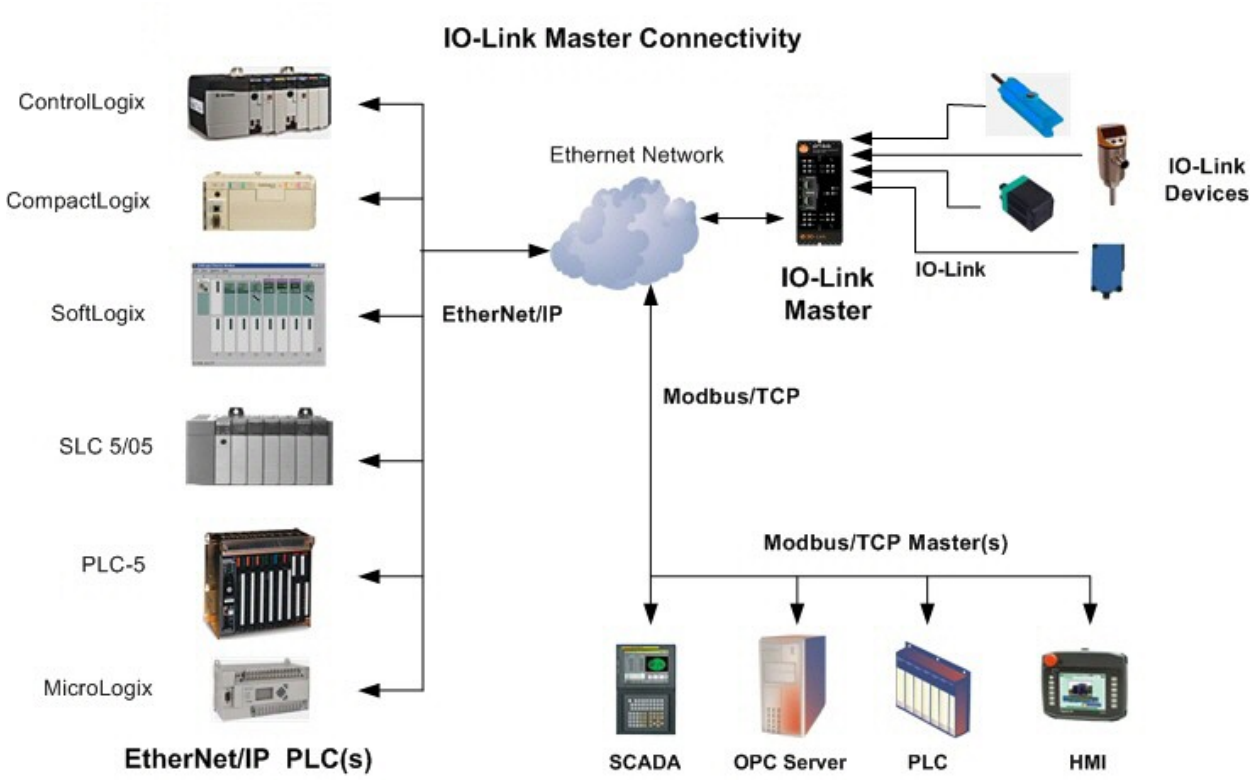
Modbus/TCP Diagnostics (Continued)	
ISDU Requests When Port Offline	Displays the number of ISDU requests received over Modbus/TCP when the IO-Link port was offline. This can occur when: • The IO-Link port is initializing, such as after start-up. • There is no IO-Link device attached to the port. • The 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.

Chapter 12. EtherNet/IP Interface

12.1. Introduction

This section is intended to describe the EtherNet/IP and Modbus/TCP interfaces provided by the AY1020.

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.



12.1.1. 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 AY1020)
  - 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.

12.1.2. 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)

12.1.3. 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.
AY1020	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 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	Service Process Data Unit. Otherwise called ISDU, refers to the Service Data units on IO-Link devices that are used for information, status and configuration settings.
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.

12.2. Data Transfer Methods

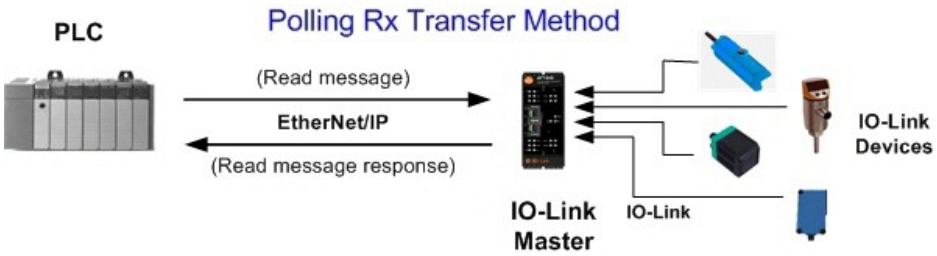
The AY1020 provides a selection of process data transfer methods and a number of options to customize the process data handling.

12.2.1. Receive Process Data Methods

The AY1020 supports the following receive process data methods:

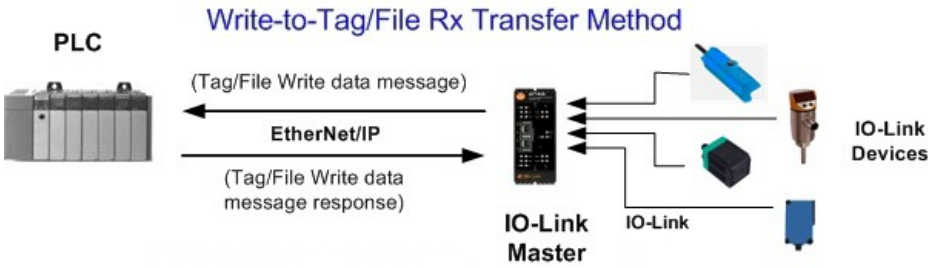
12.2.1.1. Polling-PLC Requests Data

Also called *Slave-Mode* for some industrial protocols, the polling method requires the controller to request data from the AY1020 via messages. The AY1020 does not respond until it receives a request for data.



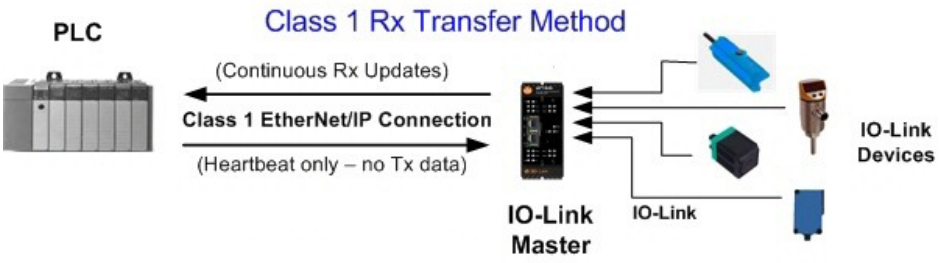
12.2.1.2. Write-to-Tag/File-AY1020 Writes Data Directly Into PLC Memory

Also called *Master-Mode* for some industrial protocols, the Write-to-Tag/File method requires the AY1020 to send messages that write data directly into a tag or file on the PLC. The AY1020 sends changed data to the PLC immediately and, optionally, can be configured to also send “heartbeat” update messages at a regular time interval.



12.2.1.3. Class 1 Connection (Input Only)-PLC and AY1020 Utilize an I/O Connection

Also called *I/O Mode* for some industrial protocols, the Class 1 connection method requires the AY1020 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 AY1020 continually sends input data to the PLC at a PLC configurable rate.



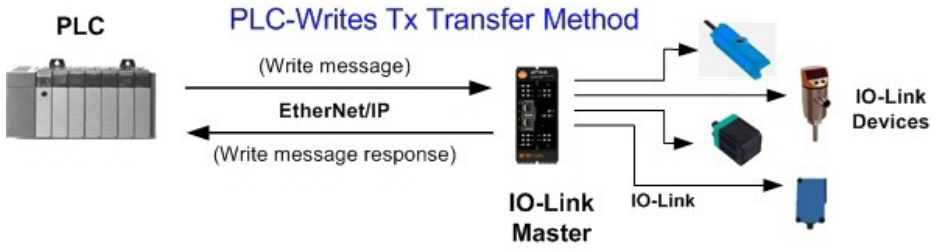
12.2.2. Transmit Process Data Methods

The AY1020 supports the following transmit process data methods:

- *PLC-Writes* on Page 89
- *Read-from-Tag/File-AY1020 Reads Data from PLC Memory* on Page 89
- *Class 1 Connection (Input and Output)-PLC and AY1020 Utilize an I/O Connection* on Page 90

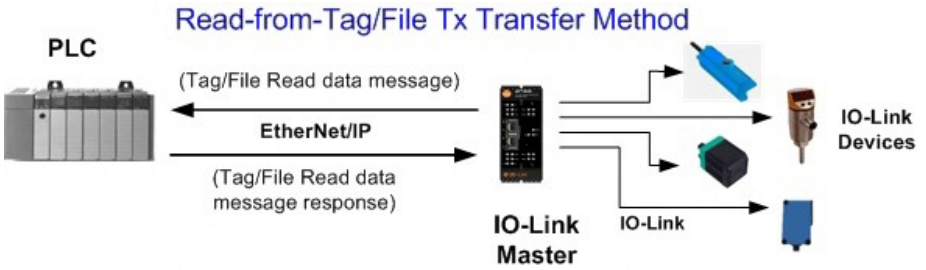
12.2.2.1. PLC-Writes

Also called *Slave-Mode* for some industrial protocols, the PLC-Writes method requires the PLC to send data to the AY1020 via write messages.



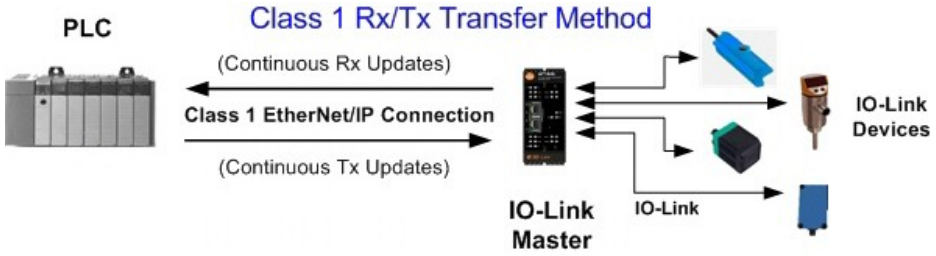
12.2.2.2. Read-from-Tag/File-AY1020 Reads Data from PLC Memory

Also called *Master-Mode* for some industrial protocols, the Read-from-Tag/File method requires the AY1020 to read data from a tag or file on the PLC. In this method, the AY1020 requests data from the PLC at configurable time intervals.



12.2.2.3. Class 1 Connection (Input and Output)-PLC and AY1020 Utilize an I/O Connection

Also called *I/O Mode* for some industrial protocols, the Class 1 connection method requires the AY1020 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 AY1020 continually exchange data at a configurable rate.



Chapter 13. EtherNet/IP CIP Object Definitions

The following are the vendor specific CIP Object definitions as supported in the AY1020:

- *IO-Link Port Information Object Definition (71 hex)*
- *PDI (Process Data Input) Transfer Object Definition (72 hex)* on Page 97
- *PDO (Process Data Output) Transfer Object Definition (73 hex)* on Page 98
- *ISDU Read/Write Object Definition (74 hex)* on Page 99

The following are standard CIP Object Definitions that are supported in the AY1020.

- *Identity Object (01hex, 1 instance)* on Page 101
- *Message Router Object (02 hex)* on Page 103
- *Connection Manager Object (06 hex)* on Page 104
- *Port Object (F4 hex-1 instance)* on Page 105
- *TCP Object (F5 hex-1 instance)* on Page 107
- *Ethernet Link Object (F6 hex-1 instance)* on Page 109
- *PCCC Object (67 hex-1 instance)* on Page 111

13.1. IO-Link Port Information Object Definition (71 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.

13.1.1. 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	8 (8-Port models)	Get
3	Num Instances	UINT	8 (8-Port models) ***Note:*** *Instance number determines the IO-Link port.*	Get

13.1.2. 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

13.1.3. 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

13.1.4. 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.

13.1.4.1. 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.

13.1.4.2. 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.

13.1.4.3. 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.

13.1.4.4. 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.

13.1.4.5. 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.

13.1.4.6. 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.

13.1.4.7. 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.

13.1.4.8. 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.

13.1.4.9. 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.

13.1.4.10. 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.

13.1.4.11. 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.

13.1.4.12. 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.

13.1.4.13. 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 AY1020 PDI and PDO data as well as the Class 1 I/O connection all to the same data format.

13.1.4.14. 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 AY1020 PDI and PDO data as well as the Class 1 I/O connection all to the same data format.

13.1.4.15. 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 AY1020 PDI and PDO data as well as the Class 1 I/O connection all to the same data format.

13.1.4.16. 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**

13.2. 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 AY1020.

13.2.1. 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

13.2.2. 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

13.2.3. 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

13.2.4. Instance Attribute 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 AY1020.

All PDI data is returned in the configured PDI format (8-bit, 16-bit or 32-bit). Refer to *13.2. PDI (Process Data Input) Transfer Object Definition (72 hex)* on Page 97 for a detailed explanation of the PDI data block.

13.3. 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 AY1020.
- Write PDO data block to the AY1020.

13.3.1. 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

13.3.2. 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
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

13.3.3. 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

13.3.4. 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 AY1020.
- Set Attribute Single allows writing the PDO data to one IO-Link port on the AY1020.
- Set Attribute All messages allow writing of PDO data to all IO-Link ports on the AY1020.

All PDO data is received and returned in the configured PDO format (8-bit, 16-bit or 32-bit). Refer to *13.3. PDO (Process Data Output) Transfer Object Definition (73 hex)* on Page 98 for a detailed explanation of the PDO data block.

13.4. 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 AY1020.
- Request the ISDU response(s) from the AY1020.
- Send both blocking and non-blocking ISDU requests.

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

13.4.1. 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	8 (8-Port Models)	Get
3	Num Instances	UINT	8 (8-Port Models) ***Note:*** *Instance number determines IO- Link port on the AY1020.*	Get

13.4.2. 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

13.4.3. 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

13.4.4. 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.

13.4.5. Instance Attribute Definitions

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

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

Get Attribute Single messages returns the ISDU response for a specific port through the AY1020. The response may need to be read multiple times until a response of Success, Failure, or Timed Out has been received.

13.4.5.2. 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 AY1020. The ISDU request message need be sent only once for each ISDU read/write request.

13.5. Identity Object (01hex, 1 instance)

The Identity Object provides identification of and general information about the AY1020.

13.5.1. 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

13.5.2. 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 (ifm)	Get
2	Device Type	UINT	2B hex (Generic Device)	Get
3	Product Code	UINT	As defined by ifm	Get
4	Revision (Product or Software release) *Structure of:* 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

13.5.3. 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 AY1020.

Status Word Bit	Setting	Description
0	0	Ownership Flag. Does not apply to the AY1020.
1	0	Reserved.
2	0	AY1020 is operating on the default configuration.
	1	The AY1020 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 AY1020 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 AY1020.
10	0	No recoverable major fault.
	1	A major recoverable fault exists. This is a fault that the AY1020 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 AY1020 may be required.
11	0	No major unrecoverable fault.
	1	A major unrecoverable fault has occurred in the AY1020. If the major fault is not corrected with a system reset or a power cycle, refer to the User Guide or call ifm support.
12-15	0	Reserved.

13.5.4. 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

13.6. 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.

13.6.1. 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

13.6.2. 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	UINT	Number of supported standard class codes	Get
	Classes	Array of UINT	List of supported standard class codes	Get
2	Max Connections	UINT	128	Get

13.6.3. 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

13.7. Connection Manager Object (06 hex)

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

13.7.1. 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

13.7.2. 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

13.7.3. 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

13.8. Port Object (F4 hex-1 instance)

The Port Object enumerates the CIP ports present on the AY1020.

13.8.1. 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

13.8.2. 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

13.8.3. 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

13.9. TCP Object (F5 hex-1 instance)

The TCP/IP Interface Object provides the mechanism to retrieve the TCP/IP attributes for the AY1020.

13.9.1. 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

13.9.2. 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

Attribute ID	Name	Data Type	Data Value(s)	Access Rule
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 *Structure of:* Path Size Path	UINT Array of USINT	2 [0]=20 hex [1]=F6 hex [2]=24 hex [3]=01 hex	Get
5	Interface Configuration *Structure of:* IP Address Network Mask Gateway Address Name Server Name Server 2 Domain Name Length Domain Name	UDINT UDINT UDINT UDINT UDINT UINT STRING	<IP address> <Network mask> <Gateway Address> <Name server> <Name server2> <Length of name> <Domain name>	Set/Get
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

13.9.3. 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

13.10. 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 AY1020.

13.10.1. 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

13.10.2. 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

13.10.3. 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

13.11. 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

13.11.1.Instances

The PCCC Object supports Instance 1.

13.11.2. 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

13.11.3. 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 requestor ID
Vendor	UINT	Vendor number of requestor
Serial Number	UDINT	ASA Serial number of requestor
CMD	USINT	Command byte
STS	USINT	0
TNSW	UINT	Transport word
FNC	USINT	Function Code.
PCCC_params	Array of USINT	CMD/FMC specific parameters

13.11.4. 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 requestor ID
Vendor	UINT	Vendor number of requestor
Serial Number	UDINT	ASA Serial number of requestor
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

13.11.5. 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

13.12. 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 AY1020, 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 AY1020.
- Write the PDO data block to the AY1020.

13.12.1. 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	24 (8-Port Models)	Get
3	Num Instances	UINT	24 (8-Port Models)	Get

13.12.2. Instance Definitions

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

Assembly Instance Number	Description	Data Type	Data Values	Access Rule
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 1-8	BYTE Array Valid read lengths: 0-360	0-255	Get
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

Assembly Instance Number	Description	Data Type	Data Values	Access Rule
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

13.12.3. 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

13.12.4. 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

13.12.5. 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.

13.12.6. Instance Attribute Definitions: Attribute 4-Data Length

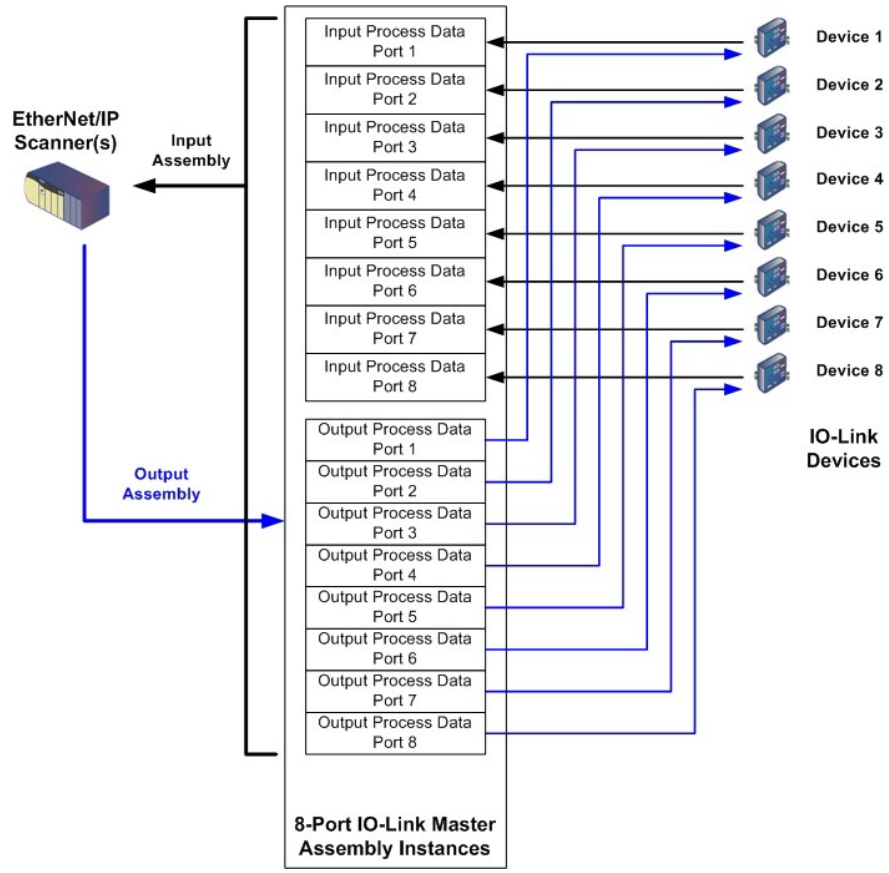
This is the maximum data length for each Assembly instance.

13.12.7. 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 AY1020. There is one Assembly input and output instance assigned to each IO-Link port.



13.12.8. 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.

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)								

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)
Write (Output) Process Data Output	117 (Port 1)								
	118 (Port 2)								
	119 (Port 3)								
	120 (Port 4)								
	121 (Port 5)								
	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.*

Chapter 14. SLC/PLC-5/MicroLogix Interface

The AY1020 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 AY1020 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 AY1020.*

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)

	IO-Link Port 1	IO-Link Port 2	IO-Link Port 3	IO-Link Port 4	Access	Length
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 AY1020. 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 Port 1, 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.

Chapter 15. EDS Files

This chapter discusses the following topics:

15.1. Overview

You do not need to add the AY1020 to RSLinx for normal AY1020-to-PLC communications. However, you can easily add the AY1020 and its associated Electronic Data Sheet (EDS) files to RSLinx.

The files named **AY1020_*.ico** are icon files and files named **AY1020_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. Downloading the Files

You can download the EDS files provided for the AY1020 from the web ifm site.

15.3. Adding the AY1020 to RSLinx

You can use these steps to add the AY1020 to RSLinx.

1. Open RSLinx.
2. Under **Communications**, select **Configure Drivers**.
3. Under **Available Drivers**, select **Remote Devices via Linx Gateway**.
4. Select **Add New**.
5. Use the default driver name or type your own driver name and click **OK** to continue.
6. Type the IP address for the device under **Server's IP Address or Hostname** and select **OK**.
7. Select **RSWho** to verify that **RSLinx** can communicate with the AY1020.

Note: *A yellow question mark appears by the AY1020(s) in the RSWho window when the associated EDS file(s) are not installed.*

15.4. Adding EDS Files to RSLinx

You can use this procedure to add the EDS files to RSLinx.

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 **ifm/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. To change the icons, perform the following tasks.
   a. Select an AY1020.
   b. Select **Change icon**.
   c. Browse to the **ifm/EtherNetIP** directory and select the icon associated with your AY1020.
7. Click **Finish** to exit.

If RSLinx does not display the device after adding AY1020 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:

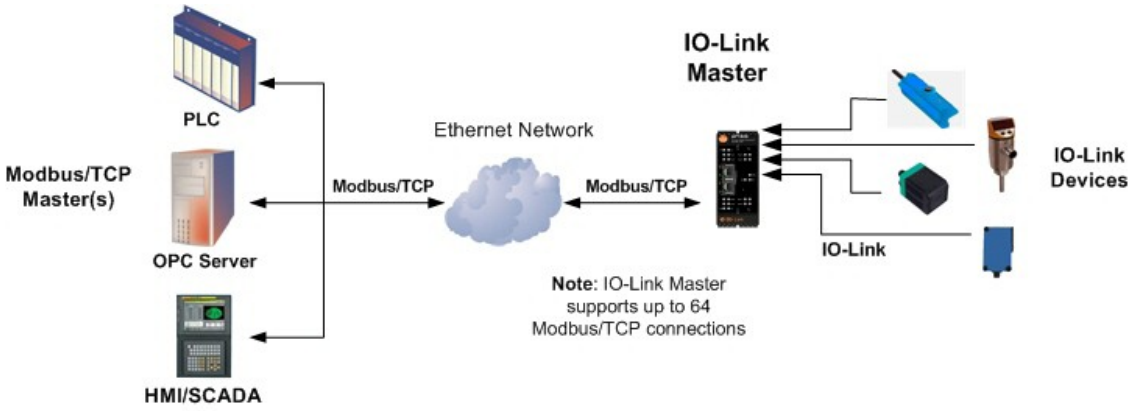
   ```
   \Program Files\Rockwell Software\RSCOMMON\Harmony.hrc
   \Program Files\Rockwell Software\RSCOMMON\Harmony.rsh
   ```

3. Restart RSLinx. The AY1020 or AY1020s should now appear with the associated icon or icons.

Chapter 16. Modbus/TCP Interface

The AY1020 provides a slave-mode Modbus/TCP interface that provides:

- Read access to the PDI and PDO data blocks for each IO-Link port
- Write access to the PDO data block for each IO-Link port
- Write access to send SPDU requests to each IO-Link port
- Read access to SPDU responses from each IO-Link port
- Read access to the Port Information Block for each IO-Link port



Modbus/TCP to IO-Link

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 Holder 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 SPDU 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 SPDU 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

	IO-Link Port 1	IO-Link Port 2	IO-Link Port 3	IO-Link Port 4	Access	Length
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

	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 SPDU 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 SPDU 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

	IO-Link Port 5	IO-Link Port 6	IO-Link Port 7	IO-Link Port 8	Access	Length
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.

Chapter 17. Functionality Descriptions

This chapter discusses the following:

- *Process Data Block Descriptions*
- *Event Handling* on Page 140
- *ISDU Handling* on Page 144

17.1. Process Data Block Descriptions

This subsection discusses the following:

- *Input Process Data Block Description*
- *Output Process Data Block Description* on Page 137

17.1.1. 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 AY1020 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 AY1020 software or hardware fault. **Bits 4-7:** Reserved (0)

Parameter Name	Data Type	Description
Auxiliary I/O  	BYTE	Auxiliary I/O: ***Note:*** *The auxiliary bit on the IO-Link port is DI on the AY1020.* **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) If **Include Digital I/O in PDI Data Block** is enabled: **Bits 4-7**: **Bit 4 (0x10)** – L+ input status **Bit 5 (0x20)** – DI I/O status **Bit 6 (0x40)** – L- input status **Bit 7 (0x80)** – C/Q I/O 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.*

17.1.1.1. 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)

17.1.1.2. 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)	

17.1.1.3. 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)		

17.1.2. 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.*

17.1.2.1. 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 Digitial 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 (08x08) - C/Q setting
3	0 (Unused)
4	PDO Data Byte 0
5	PDO Data Byte 1
..	..
..	..
N + 3	PDO Data Byte (N-1)

17.1.2.2. 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 I**nclude 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 (08x08) - C/Q setting
2	PDO Data Word 0
3	PDO Data Word 1
..	..
..	..
N+1	PDO Data Word (N-1)

17.1.2.3. 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 (0x0002)** – DI setting **Bit 19 (0x0008)** – 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)	

17.2. Event Handling

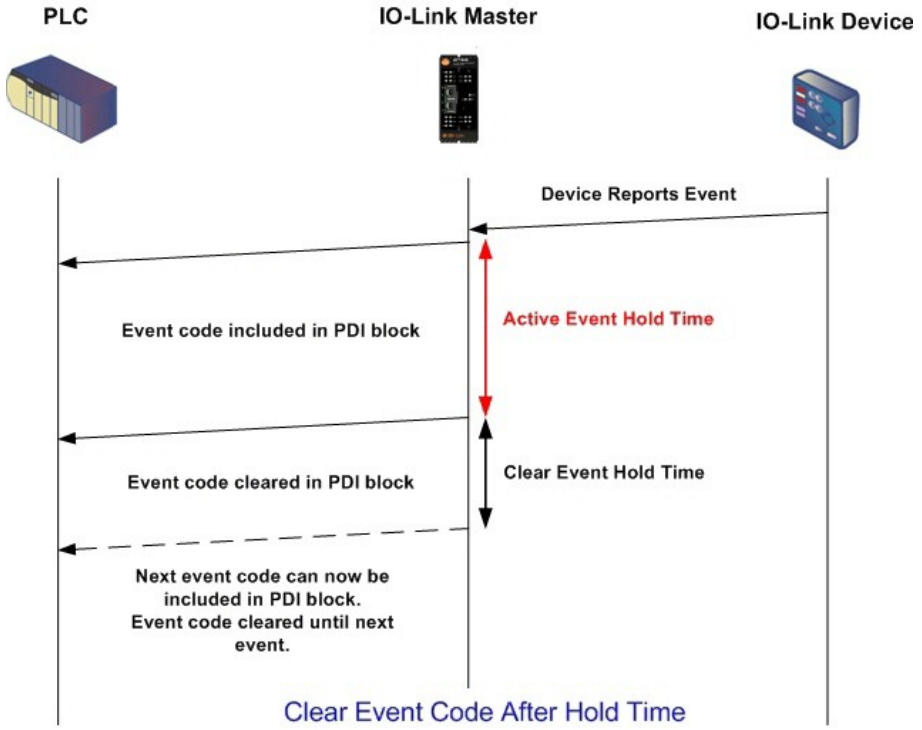
The AY1020 event handling is designed to provide real-time updates of event codes received directly from the IO-Link device. The IO-Link event code:

- 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 AY1020 keeps, or holds, the active event code in the PDI block until the configured *Active Event Hold Time* has passed.
    - The AY1020 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 AY1020 monitors the PDO block received from the PLC.
    - The AY1020 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 AY1020 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.

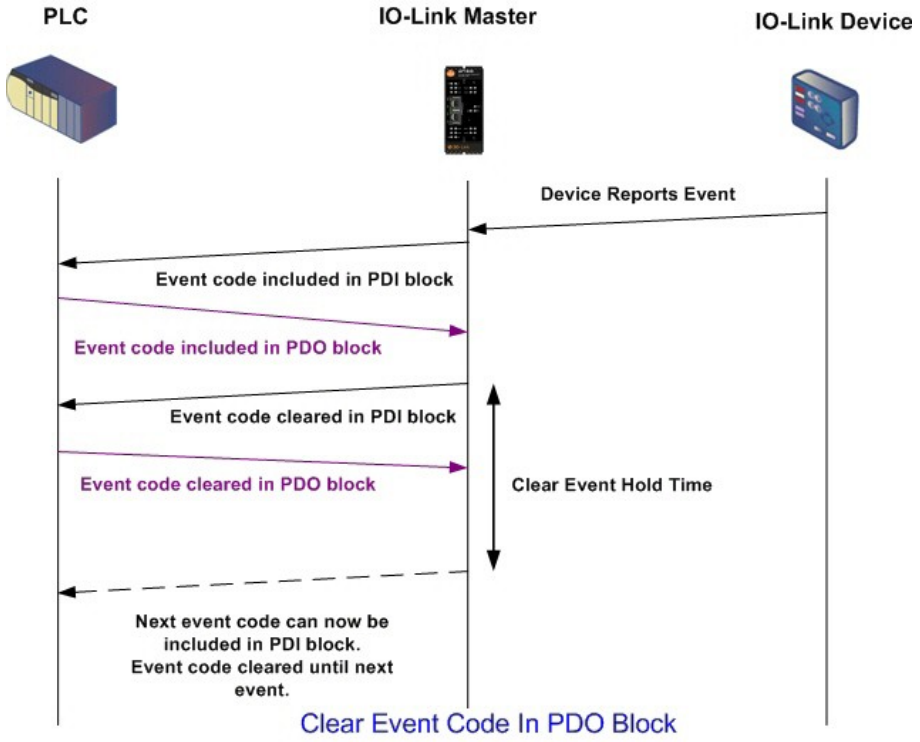
17.2.1. Clear Event After Hold Time Process

This illustrates clearing the event after the hold time process.



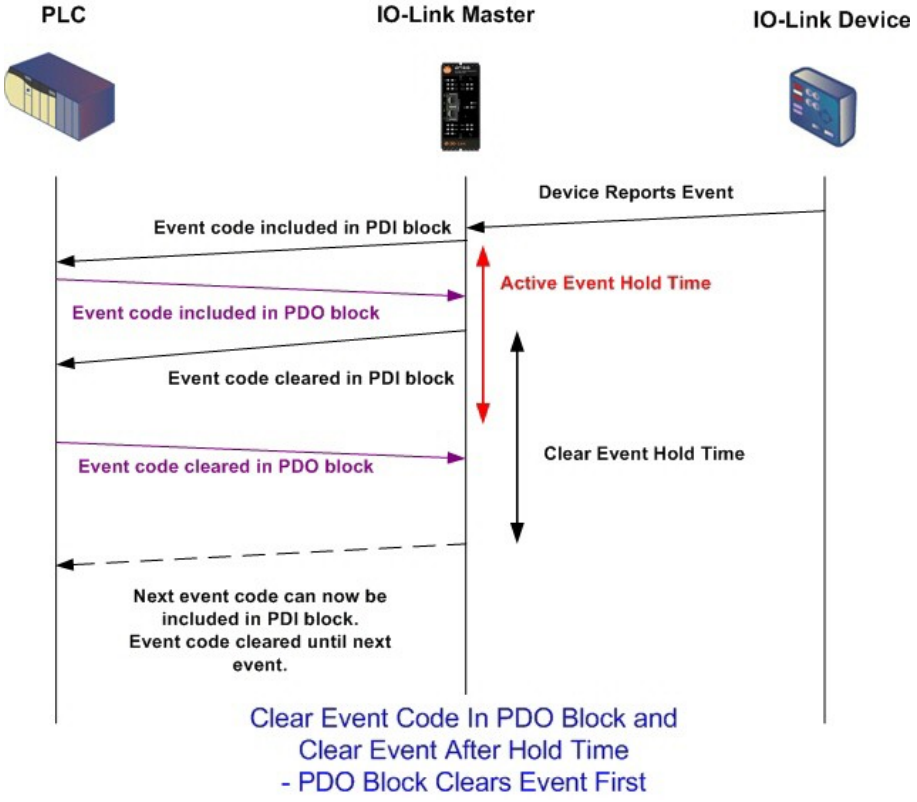
17.2.2. Clear Event in PDO Block Process

This illustrates clearing the event in the PDO block process.



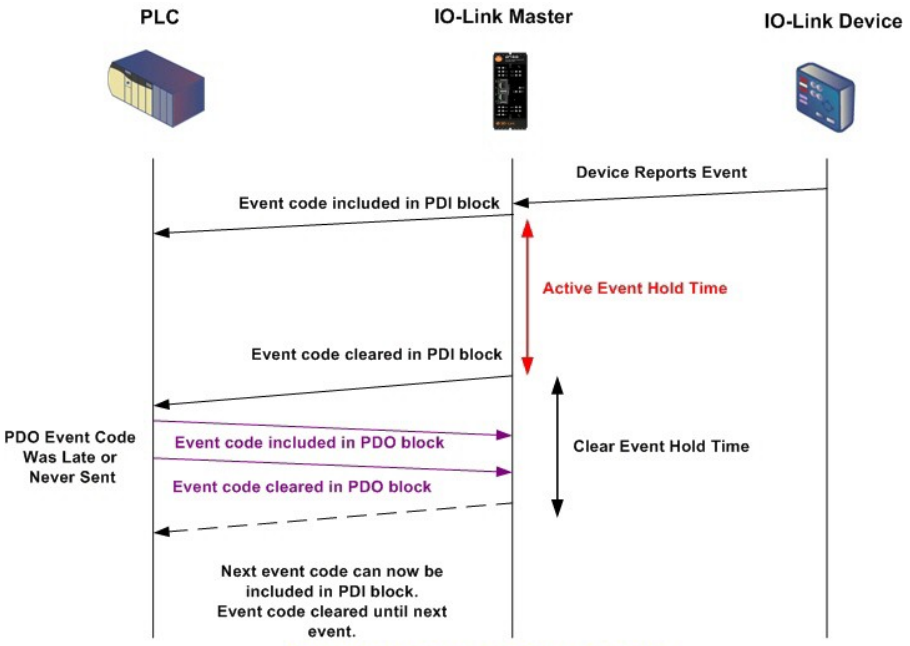
17.2.3. Clear Event Code in PDO Block and Clear Event After Hold Time Process- PDO Block First

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



17.2.4. 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

17.3. ISDU Handling

The AY1020 provides a very flexible ISDU interface that is used by all supported industrial protocols. The ISDU interface contains the following:

- An ISDU *request* may contain one or multiple individual ISDU read and/or write *commands*.
- Individual ISDU command based byte swapping capabilities.
- Variable sized command structures to allow access to wide range of ISDU block sizes.
- A single ISDU request may contain as many ISDU read and/or write commands as allowed by the industrial protocol payload. For example, if an industrial protocol provides up to 500 byte read/write payloads, then an ISDU request may contain multiple commands of various lengths that can total up to 500 bytes in length.
- For the ControlLogix family of EtherNet/IP PLCs, both blocking and non-blocking ISDU request methods are provided.
  - The AY1020 implements blocking ISDU requests by not responding to an ISDU request message until all commands have been processed.
  - The AY1020 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 AY1020 will not return a completed status until all of the ISDU commands have been processed.

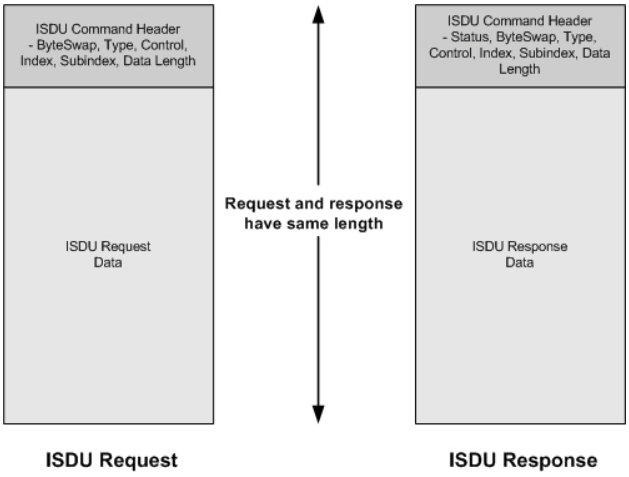
17.3.1. ISDU Request/Response Structure

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

- *Single ISDU Command Request*
- *Multiple ISDU Command Structure* on Page 146

17.3.1.1. Single ISDU Command Request

This illustrates a single ISDU command request.



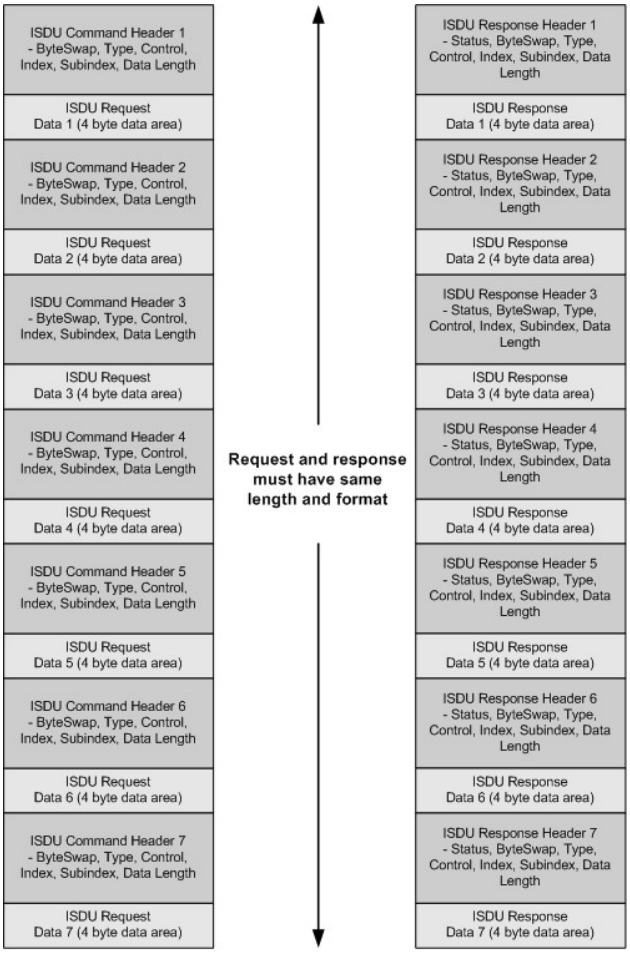
Single Command ISDU Request/Response

17.3.1.2. Multiple ISDU Command Structure

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

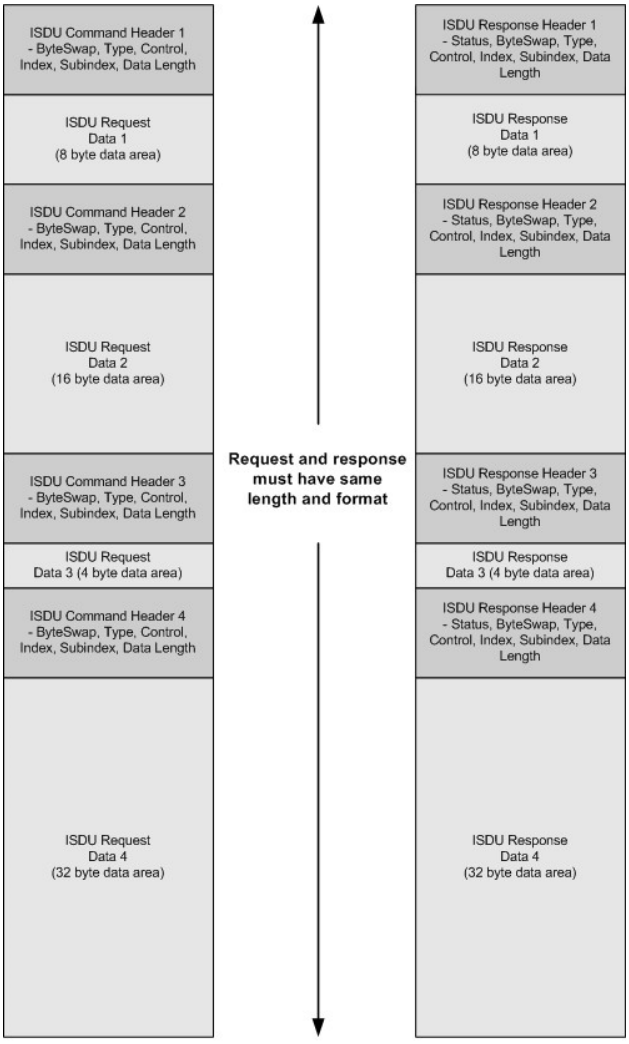
- ISDU commands of same data size (*Page 146*)
- ISDU commands of different data sizes (*Page 147*)

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

17.3.2. ISDU Request Message Format-From PLC to AY1020

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.*

17.3.2.1. 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.*

17.3.2.2. 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.*

17.3.3. 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.

17.3.3.1. 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.*

17.3.3.2. 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.

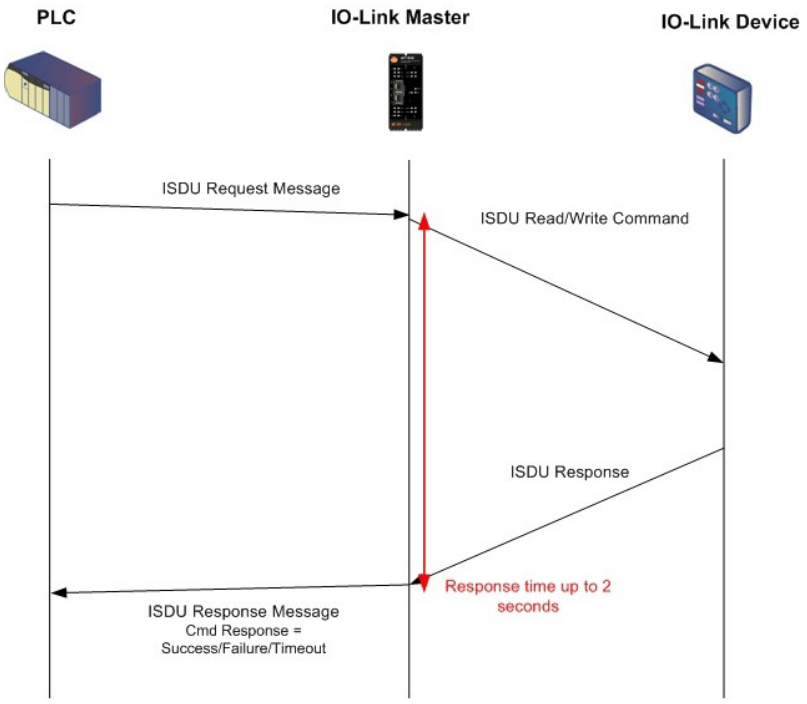
Name	Data Type	Parameter Descriptions
Status, Byte-Swapping, RdWrControlType	UINT	Indicates the control, type, byte swapping and status of the ISDU command. **Bits 0-3, Type Field:** 0 = NOP (No operation) 1 = Read operation 2 = Write operation 3 = Read/Write "OR" 4 = Read/Write "AND" **Bits 4-7, Control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

17.3.4. ISDU Blocking and Non-Blocking Methods

The AY1020 supports both blocking and non-blocking ISDU requests. The following diagrams demonstrate how each mode works.

17.3.4.1. Single Command Blocking

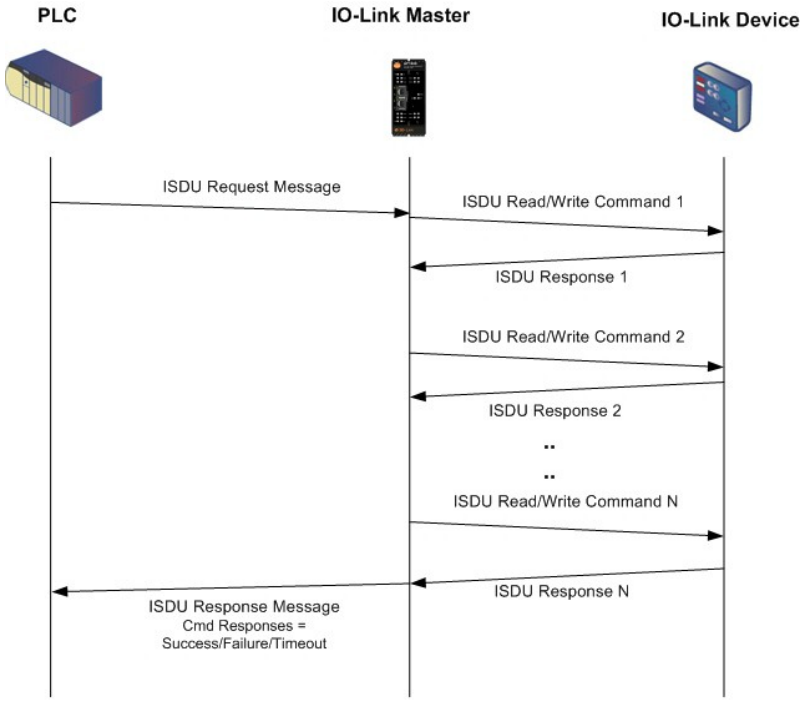
The following illustrates the single command blocking method.



Single Command ISDU Blocking Process

17.3.4.2. Multiple Command Blocking

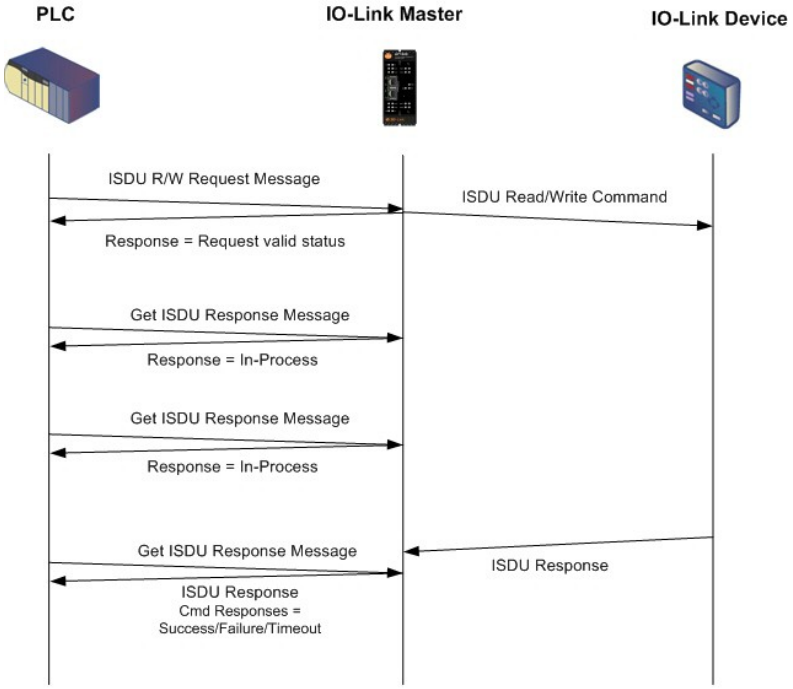
This illustrates the multiple command blocking method.



Multiple Command ISDU Blocking Process

17.3.4.3. Single Command Non-Blocking

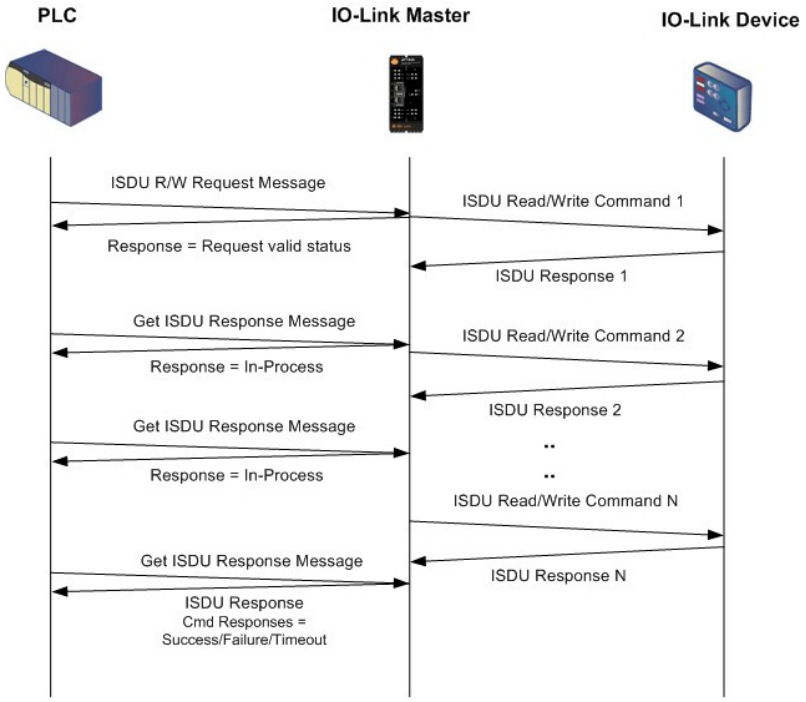
This illustrates the single command non-blocking method.



Single Command ISDU Non-Blocking Process

17.3.4.4. Multiple Command Non-Blocking

This illustrates the multiple command non-blocking method.



Multiple Command ISDU Non-Blocking Process