



Startup of Axioline E-EtherCAT® IO-Link devices with CODESYS

Quick start guide
UM QS EN AXL E EC IOL CODESYS

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Startup of Axioline E-EtherCAT[®] IO-Link devices with CODESYS

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This document is valid for all Axioline E-EtherCAT[®] IO-Link devices.

Please observe the following notes

User group of this manual

The use of products described in this manual is oriented exclusively to:

- Qualified electricians or persons instructed by them, who are familiar with applicable standards and other regulations regarding electrical engineering and, in particular, the relevant safety concepts.
- Qualified application programmers and software engineers, who are familiar with the safety concepts of automation technology and applicable standards.

Explanation of symbols used and signal words



This is the safety alert symbol. It is used to alert you to potential personal injury hazards. Obey all safety measures that follow this symbol to avoid possible injury or death.

There are three different categories of personal injury that are indicated with a signal word.

DANGER This indicates a hazardous situation which, if not avoided, will result in death or serious injury.

WARNING This indicates a hazardous situation which, if not avoided, could result in death or serious injury.

CAUTION This indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.



This symbol together with the signal word **NOTE** and the accompanying text alert the reader to a situation which may cause damage or malfunction to the device, hardware/software, or surrounding property.



This symbol and the accompanying text provide the reader with additional information or refer to detailed sources of information.

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1 Basics and example project

1.1 Information about this document

This document describes the special features when starting up Axioline E EtherCAT® IO-Link devices with the CODESYS engineering tool from 3S-Smart Software Solutions GmbH.

The document is aimed at experienced CODESYS users. It does not cover a complete project, just specific features associated with the use of Axioline E devices.

It is assumed the user has knowledge and experience in the operation of PCs and Windows operating systems, and knowledge of CODESYS software and Ethernet basics.

1.2 System requirements

1.2.1 Software requirements

At the time of creating this document, CODESYS version V3.5 SP6 Patch 3 was used.

1.2.2 Hardware requirements for CODESYS

Please refer to the CODESYS documentation for the hardware requirements.

1.2.3 Axioline E EtherCAT® IO-Link devices

The document is valid for the following Axioline E-EtherCAT® IO-Link devices.

Designation	Order No.	Firmware	ESI
AXL E EC IOL8 DI4 M12 6P	2701524	as of v2.2.0.0	PHOENIX_CONTACT_AXL_E_EC_IOL8_6P-200 + PHOENIX_CONTACT_AXL_E_EC_IOL8_Modules-200.xml
AXL E EC IOL8 DI4 M12 6M	2701531	as of v2.2.0.0	PHOENIX_CONTACT_AXL_E_EC_IOL8_6M-200 + PHOENIX_CONTACT_AXL_E_EC_IOL8_Modules-200.xml

1.3 Example network configuration

This example project comprises a PC with CODESYS, as EtherCAT[®] Soft PLC and AXL E-EtherCAT[®] IO-Link devices.

The example system is shown in Figure 1-1.

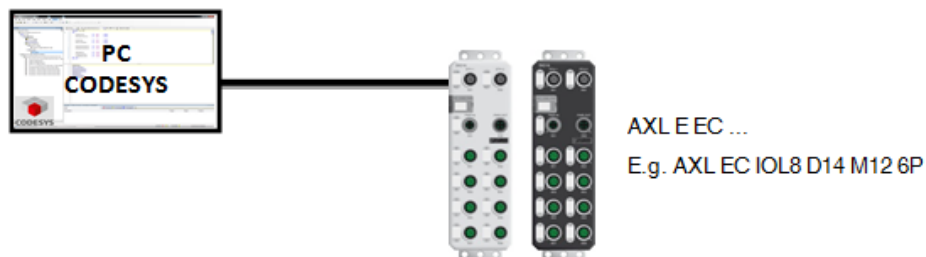


Figure 1-1 Example system

1.4 General startup steps

Proceed as follows to start up Axioline E-EtherCAT[®]-IO-Link devices:

- Install the devices and provide a power supply.
- Create a new project in the engineering tool.
- Add the controller and I/O devices to the project.
- Assign the addresses/names.
- Compile the project and send it to the controller.
- Establish communication with the I/O device and test this.

2 Creating the CODESYS project

To integrate the Axioline E EtherCAT® IO-Link devices into the network, proceed as described in the manufacturer's documentation for your controller. This section only explains fundamental steps that are relevant to the Axioline E system.

2.1 Creating/opening a project

- In CODESYS, create a new project or open an existing project.

A new project is created in this example.

- Click on “File, New Project ...” (Alternatively CTRL + N).

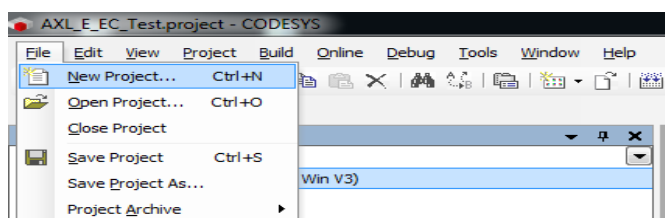


Figure 2-1 Creating a new project

- In the window that opens, enter a name for the project (1) and confirm by pressing “OK” (2).

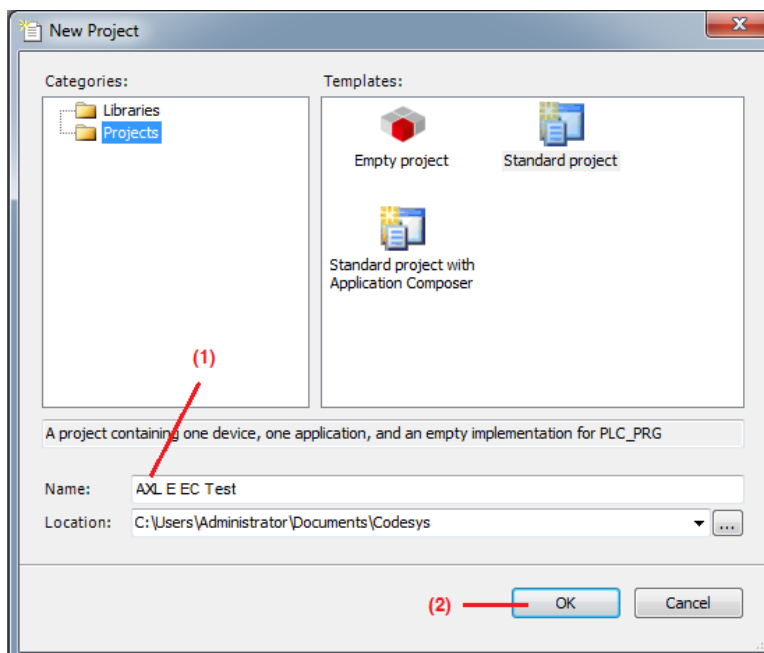


Figure 2-2 Assigning a project name

2.2 Adding the EtherCAT® master

In this example, an EtherCAT® SoftPLC is used. The following steps are specifically for this controller. Please perform the steps necessary for your controller according to the corresponding documentation.

- Open the context menu by right-clicking on the “Device (CODESYS Control Win V3)” object.
- Select “Add Device”.

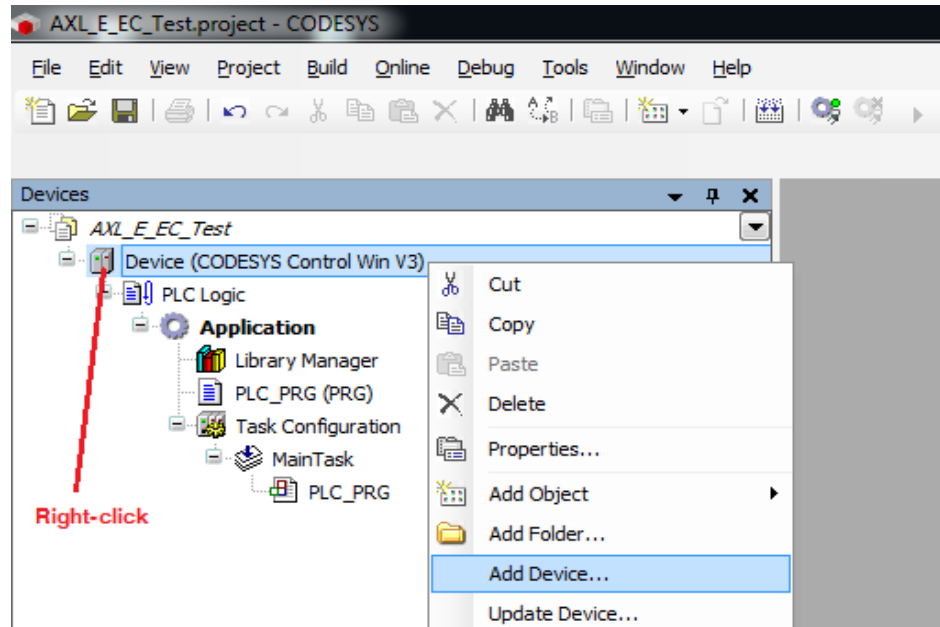


Figure 2-3 Selecting “Add Device”.

Creating the CODESYS project

- In the window that opens, select “fieldbuses, EtherCAT®, Master, EtherCAT® Master” by double-clicking on them.
- Press the “Add Device” button to add the EtherCAT® SoftPLC.

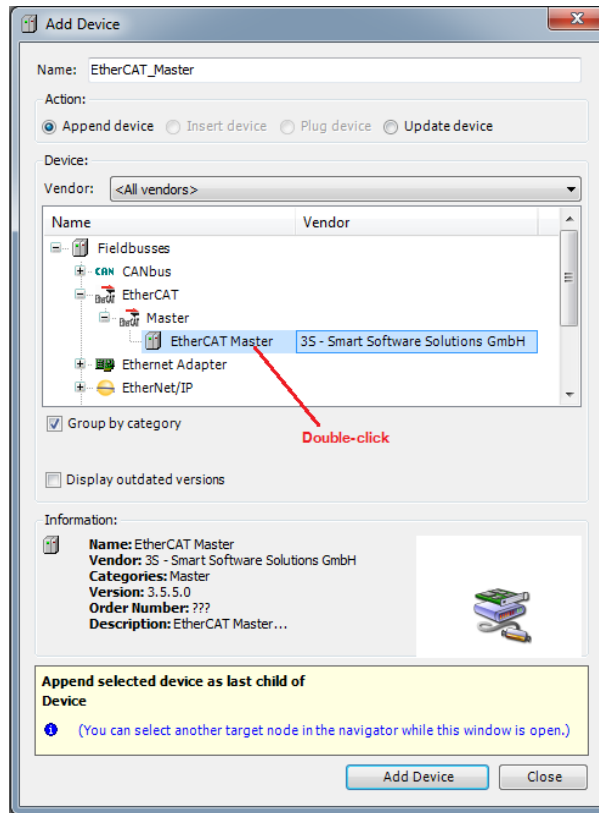


Figure 2-4 Adding EtherCAT® SoftPLC

The controller then appears in the project tree.

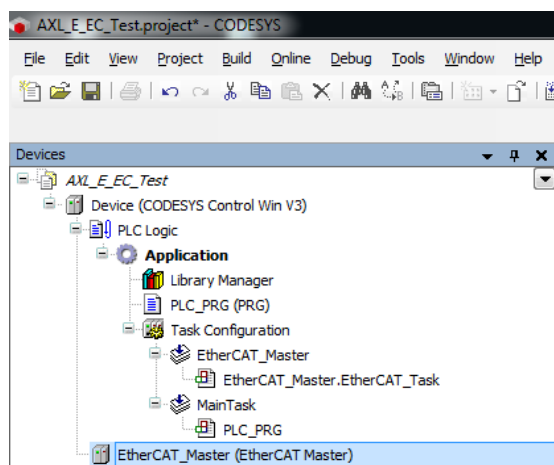


Figure 2-5 Project tree

2.3 Setting the gateway

If you start up CODESYS for the first time, perform a communication configuration for the gateway.

To do so, proceed as follows:

- Double-click on the object “Device (CODESYS Control Win V3)” in your project tree.
- In the “Communication Settings” tab, click on the menu below on the “Scan network...” entry.

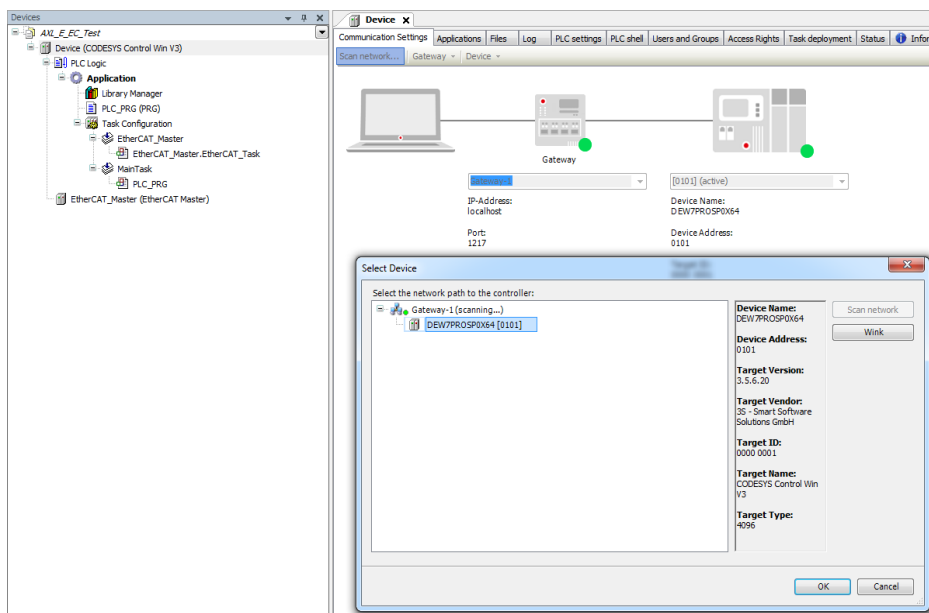


Figure 2-6 Scanning the network

The address or name of your computer is displayed as the network path.

- Select this entry and confirm by pressing “OK”.

For additional information, please refer to CODESYS documentation.

2.4 Setting the EtherCAT® master

In this example, an EtherCAT® SoftPLC is used. In this case, it is necessary to set the network adapter.

To do so, perform the following steps:

- Double-click on the object “EtherCAT_Master” in your project tree.
- Then in the “EtherCAT® NIC settings” field in the “Master” tab, press the “Browse” button.
- In the window that opens, select the desired network adapter.

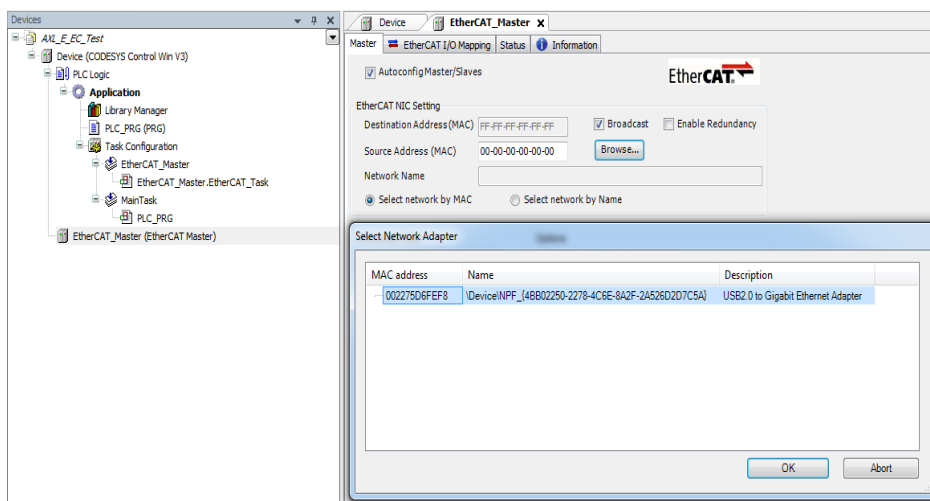


Figure 2-7 Selecting the network adapter

- Confirm your selection with “OK”.

Observe the requirements for the network adapter according to the corresponding CODESYS documentation.

2.5 Installing the I/O device description file

If you have not worked previously with Axioline E EtherCAT® devices in your engineering system, first of all install the necessary device description files.

Make sure you use the latest ESI file. It is available on the Internet at www.phoenixcontact.net/products.

For Axioline E EtherCAT® IO-Link master, it is necessary for two ESI files to be installed, namely “PHOENIX_CONTACT_AXL_E_EC_IOL8_6x-xxx” and “PHOENIX_CONTACT_AXL_E_EC_IOL8_Modules-xxx”.

- Call “Install device...” via the “Tools” menu.

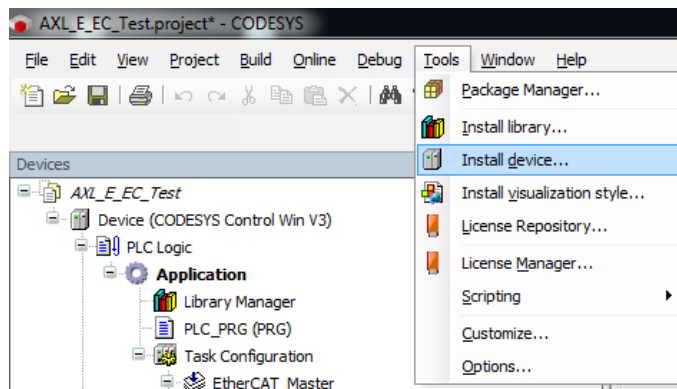


Figure 2-8 Installing devices

- Then navigate to the directory in which your ESI files are stored.
- In the bottom right of the screen, select the “EtherCAT XML Device description...” option.
- Start the installation by double-clicking on the respective ESI file.

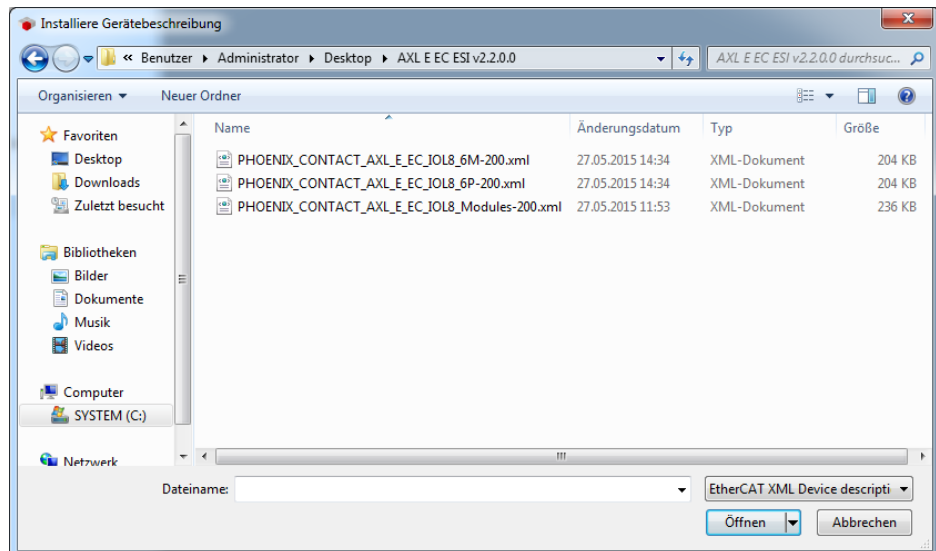


Figure 2-9 Selecting the ESI file

2.6 Adding the I/O device to the project

Perform the following steps to add the Axioline E EtherCAT® device to the project:

- Right-click on the EtherCAT Master® “EtherCAT_Master”.
- Then in the context menu, select the entry “Add Device...”.

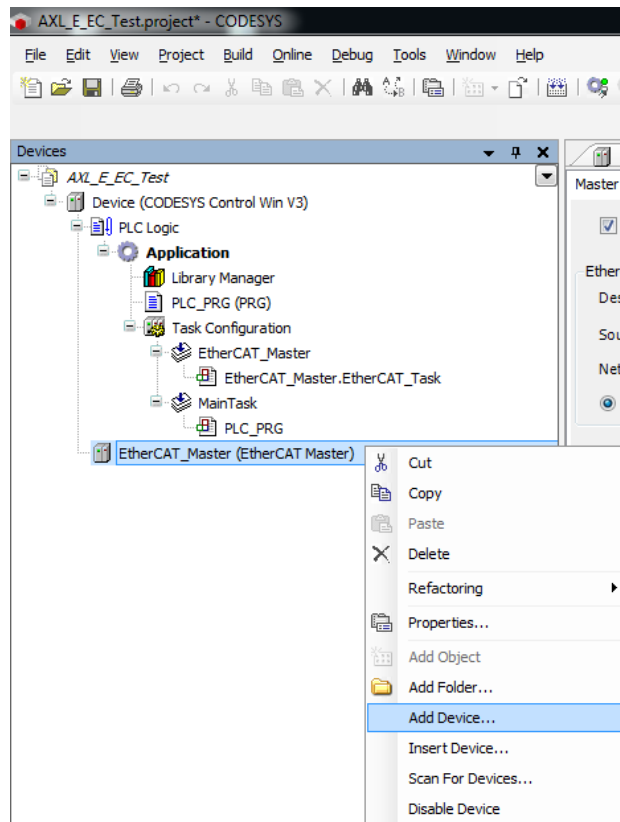


Figure 2-10 Adding a device

- In the window that opens, in the “Manufacturer” drop-down menu select the “Phoenix Contact” entry. Only Phoenix Contact devices are shown here.
- Then select your connected Axioline E device and click the “Add Device” button (alternatively: double-click on the device).

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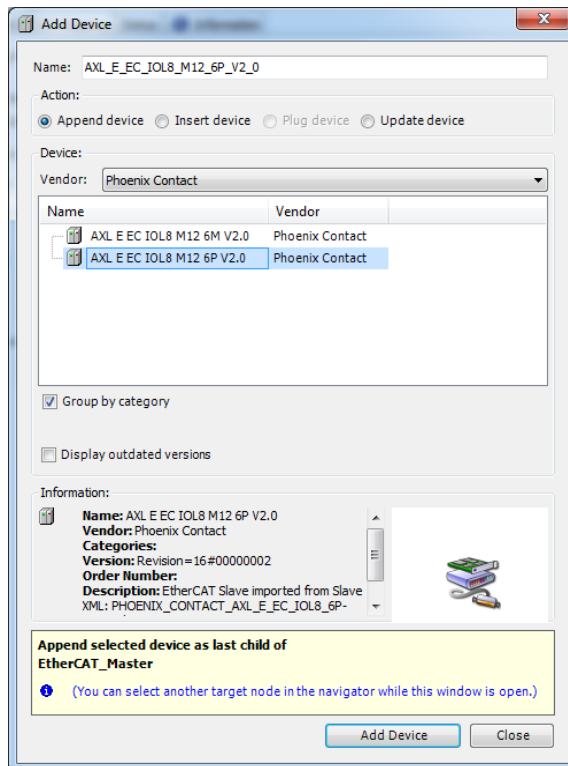


Figure 2-11 Selecting the device

The Axioline E device can then be found in your project tree.

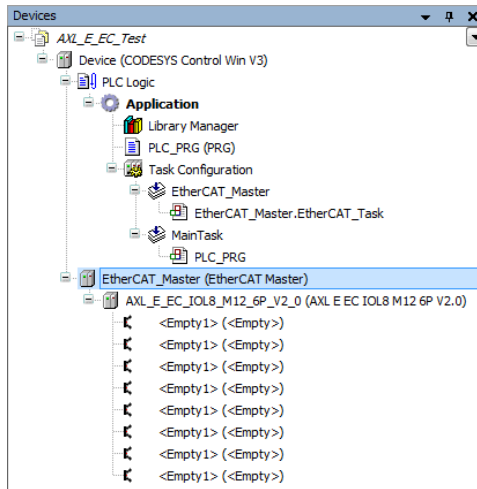


Figure 2-12 Project tree

3 Setting Axioline E-EtherCAT® IO-Link device

3.1 Performing the IO-Link port configuration

The Axioline E EtherCAT® IO-Link device operates on the basis of the Modular Device Profile (ETG.5001) and is identified as profile implementation “5001” (Modular Device Profile).

A port configuration is required for Axioline E EtherCAT® IO-Link devices, which parameterizes the operating mode for the respective IO-Link port. The supported modules can be found in the ESI file

“PHOENIX_CONTACT_AXL_E_EC_IOL8_Modules-xxx.xml”.

Perform the following for the port configuration:

- Right-click on the desired port in the project tree.
- Then in the context menu, select the entry “Plug Device...”.

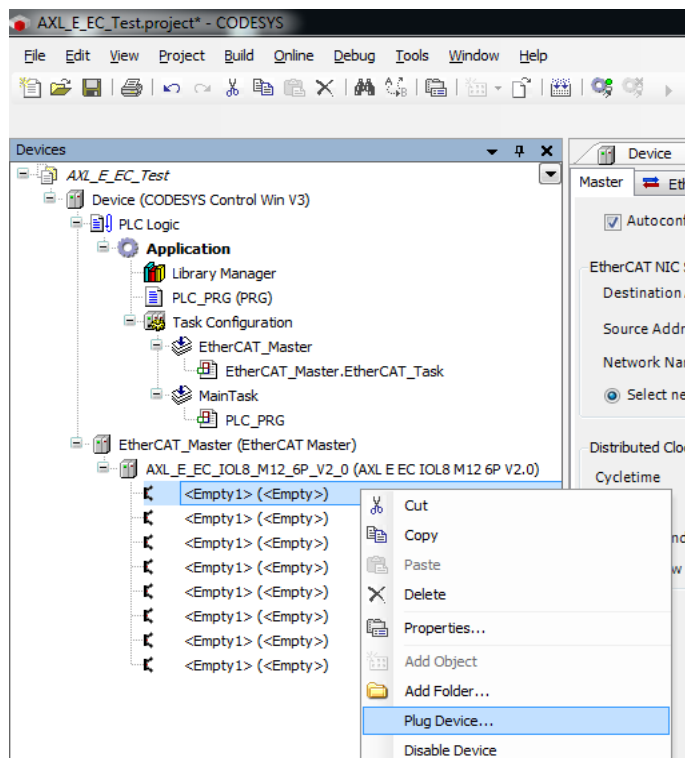


Figure 3-1 Selecting “Plug Device”

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The selected modules are then displayed in the window that opens.

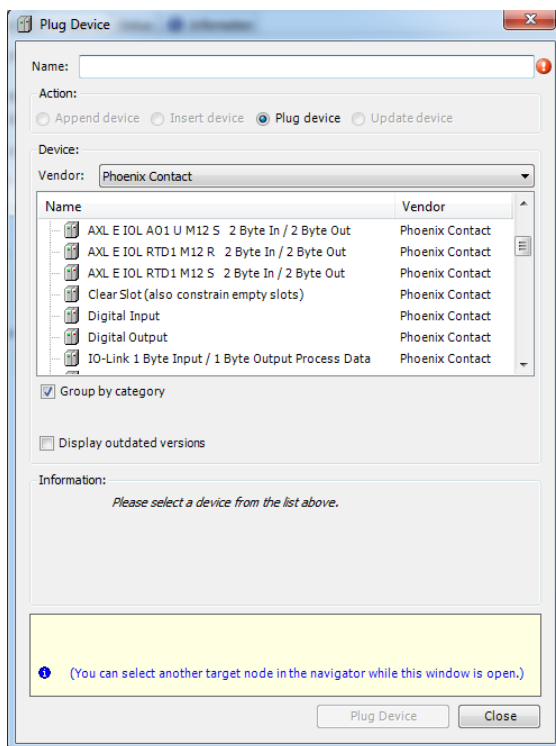


Figure 3-2 Module list

- To set the port, double-click on the desired module or press the “Plug Device” button.
- Execute this step for each port.



If the exact IO-Link process data length of the connected device is not available in the modules of the device description file, select the next largest constellation.



In order to ensure correct functioning of the IO-Link master, unused ports should always be assigned the “Clear Slot” module.

Setting Axioline E-EtherCAT® IO-Link device

A potential port configuration may appear as follows:

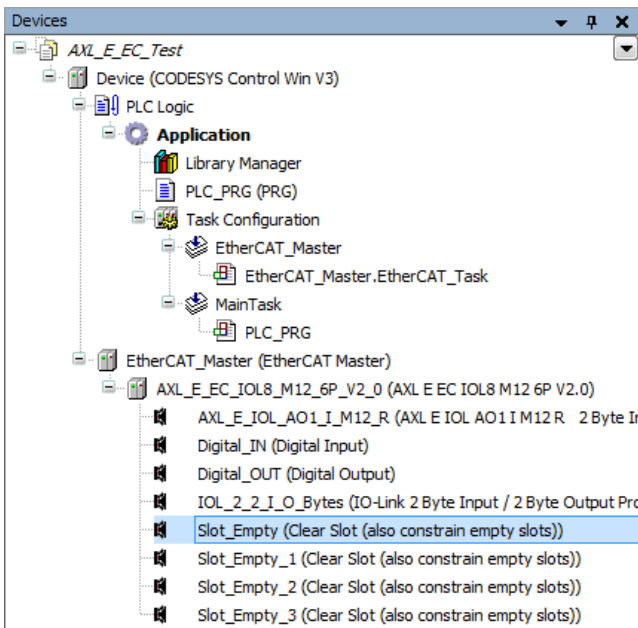


Figure 3-3 Example port configuration

Depending on the port configuration determined, the Startup parameters are automatically accordingly created by the engineering tool. These can be found under the device settings in the “Startup parameters” tab.

Line	Index/Subindex	Name	Value	Bitlength	Abort if error	Jump to line if error	Next line	Comment
1	16#2100:16#00	Safe State Mode IOL-Port	4	8	<input type="checkbox"/>	<input type="checkbox"/>	0	Safe State Mode IOL-Port
2	16#8000:16#04	Device ID	65596	32	<input type="checkbox"/>	<input type="checkbox"/>	0	Device ID
3	16#8000:16#05	Vendor ID	176	32	<input type="checkbox"/>	<input type="checkbox"/>	0	Vendor ID
4	16#8000:16#0A	Command_3	5381	32	<input type="checkbox"/>	<input type="checkbox"/>	0	Command_3
5	16#8000:16#24	Command_4	2	8	<input type="checkbox"/>	<input type="checkbox"/>	0	Command_4
6	16#8000:16#25	Command_5	2	8	<input type="checkbox"/>	<input type="checkbox"/>	0	Command_5
7	16#8000:16#28	Command_6	3	16	<input type="checkbox"/>	<input type="checkbox"/>	0	Command_6
8	16#2110:16#00	Safe State Mode IOL-Port	0	8	<input type="checkbox"/>	<input type="checkbox"/>	0	Safe State Mode IOL-Port
9	16#8010:16#04	Device ID	0	32	<input type="checkbox"/>	<input type="checkbox"/>	0	Device ID
10	16#8010:16#05	Vendor ID	0	32	<input type="checkbox"/>	<input type="checkbox"/>	0	Vendor ID
11	16#8010:16#0A	Command_3	4097	32	<input type="checkbox"/>	<input type="checkbox"/>	0	Command_3
12	16#8010:16#24	Command_4	1	8	<input type="checkbox"/>	<input type="checkbox"/>	0	Command_4
13	16#8010:16#25	Command_5	0	8	<input type="checkbox"/>	<input type="checkbox"/>	0	Command_5
14	16#8010:16#28	Command_6	1	16	<input type="checkbox"/>	<input type="checkbox"/>	0	Command_6
15	16#2120:16#00	Safe State Mode IOL-Port	0	8	<input type="checkbox"/>	<input type="checkbox"/>	0	Safe State Mode IOL-Port
16	16#8020:16#04	Device ID	0	32	<input type="checkbox"/>	<input type="checkbox"/>	0	Device ID
17	16#8020:16#05	Vendor ID	0	32	<input type="checkbox"/>	<input type="checkbox"/>	0	Vendor ID
18	16#8020:16#0A	Command_3	4098	32	<input type="checkbox"/>	<input type="checkbox"/>	0	Command_3
19	16#8020:16#24	Command_4	0	8	<input type="checkbox"/>	<input type="checkbox"/>	0	Command_4
20	16#8020:16#25	Command_5	1	8	<input type="checkbox"/>	<input type="checkbox"/>	0	Command_5
21	16#8020:16#28	Command_6	2	16	<input type="checkbox"/>	<input type="checkbox"/>	0	Command_6
22	16#2130:16#00	Safe State Mode IOL-Port	4	8	<input type="checkbox"/>	<input type="checkbox"/>	0	Safe State Mode IOL-Port
23	16#8030:16#04	Device ID	0	32	<input type="checkbox"/>	<input type="checkbox"/>	0	Device ID
24	16#8030:16#05	Vendor ID	0	32	<input type="checkbox"/>	<input type="checkbox"/>	0	Vendor ID
25	16#8030:16#0A	Command_3	4867	32	<input type="checkbox"/>	<input type="checkbox"/>	0	Command_3
26	16#8030:16#24	Command_4	2	8	<input type="checkbox"/>	<input type="checkbox"/>	0	Command_4
27	16#8030:16#25	Command_5	2	8	<input type="checkbox"/>	<input type="checkbox"/>	0	Command_5
28	16#8030:16#28	Command_6	3	16	<input type="checkbox"/>	<input type="checkbox"/>	0	Command_6
29	16#2140:16#00	Safe State Mode IOL-Port	0	8	<input type="checkbox"/>	<input type="checkbox"/>	0	Safe State Mode IOL-Port
30	16#8040:16#04	Device ID	0	32	<input type="checkbox"/>	<input type="checkbox"/>	0	Device ID
31	16#8040:16#05	Vendor ID	0	32	<input type="checkbox"/>	<input type="checkbox"/>	0	Vendor ID
32	16#8040:16#0A	Command_3	4096	32	<input type="checkbox"/>	<input type="checkbox"/>	0	Command_3
33	16#8040:16#24	Command_4	0	8	<input type="checkbox"/>	<input type="checkbox"/>	0	Command_4
34	16#8040:16#25	Command_5	0	8	<input type="checkbox"/>	<input type="checkbox"/>	0	Command_5
35	16#8040:16#28	Command_6	0	16	<input type="checkbox"/>	<input type="checkbox"/>	0	Command_6

Figure 3-4 Startup parameters

3.2 Setting IO-Link device identification

The Axioline E-EtherCAT® IO-Link masters support the detection and adjustment of connected IO-Link devices. For this purpose, both the Vendor ID and Device ID can be set.



As soon as the contents of the vendor ID and/or device ID do not equal "0", the "Type Compatible" IO-Link inspection level is activated. It is only when both the parameterized vendor ID and device ID match the IDs that are read (in the device) that communication is established with the device (COM state bit of the corresponding port = 1), otherwise this is rejected (red IO-Link LED on).

Perform the following steps to set the device identification:

- Perform the port configuration according to section "Performing the IO-Link port configuration" on page 17.
- Switch over the ports, for which device identification has been performed, to IO-Link operating mode.

The port configuration can appear as follows, for instance:

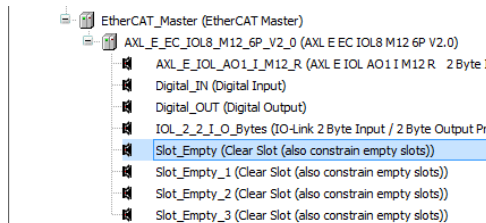


Figure 3-5 Example port configuration

- Double-click on the IO-Link port to be configured, Port 4 in this case.
- On the "Startup parameters" tab, you will find all startup parameters which can be set for the respective module and port. You can double-click the respective field to change the parameters.

For example, for the electronic pressure sensor PN 7593 from ifm, the following settings are necessary: Vendor ID 310d (01 36 h), Device ID 402d (00 01 92 h).

The screenshot shows the 'Startup parameters' tab for the 'AXL_EC_IOL8_M12_6P_V2_0' device. It displays a table with columns for Line, IndexSubindex, Name, Value, and Bitlength. The rows are numbered 1 through 7. The rows for 'Device ID' (Line 2) and 'Vendor ID' (Line 3) are highlighted with a red border.

Line	IndexSubindex	Name	Value	Bitlength
1	16#2100:16#00	Safe State Mode IOL-Port	4	8
2	16#8000:16#04	Device ID	402	32
3	16#8000:16#05	Vendor ID	310	32
4	16#8000:16#0A	Command_3	4867	32
5	16#8000:16#24	Command_4	2	8
6	16#8000:16#25	Command_5	2	8
7	16#8000:16#28	Command_6	3	16

Figure 3-6 Example settings



In the "Value" field, enter the decimal values, i.e. you must convert every hexadecimal byte to decimal in advance and enter it in the corresponding field, in this example:

Device ID: 00_{hex} = 0_{dec}; 01_{hex} = 1_{dec}; 136_{hex} = 310_{dec}

Vendor ID: 01_{hex} = 1_{dec}; 192_{hex} = 402_{dec}

3.3 Setting the IO-Link data storage mechanism (parameter server)

The Axioline E-EtherCAT® IO-Link masters support the data storage mechanism, which enables a parameter exchange between the master and device.



Connected devices must support at least IO-Link specification v1.1 in order to use the function.

The options are as follows:

- 0_{dec} Deactivated
- 1_{dec} Download only
- 2_{dec} Upload only
- 3_{dec} Download/upload allowed
- 4_{dec} Cleared



For additional information on the individual functions, please refer to the device-specific data sheet.

To set the data storage mechanism, follow the following steps:

- Double-click on the Axioline E device.
- Then select the “Startup parameters” tab and press the “Add” button.
- Scroll through the window that opens until you find the “IO-Link parameter port X” entries.
- Open this parameter for the port in question and select “Data Storage”.

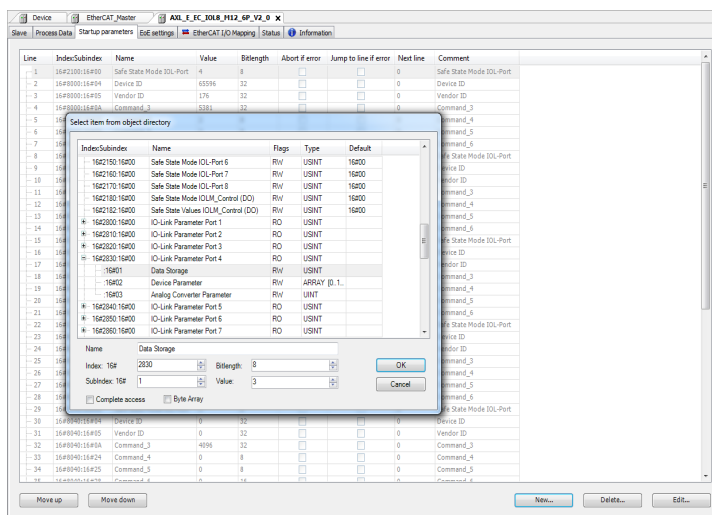


Figure 3-7 Selecting the “Data Storage” parameter

- In the “Value” field, set the behavior by entering the corresponding value (0_{dec} ... 4_{dec}).

The following steps should be taken in order for the data storage mechanism to function:

Use of “Upload only” > “Download only”

- 1 Connect a pre-parameterized IO-Link device to the corresponding port.
- 2 Configure the port to “Upload only (2_{dec})”.
- 3 Download the program and switch the controller to online mode.
 - The parameters are now read by the device and saved to the master on the port.
- 4 The device can now be replaced by a new device.
- 5 Reparameterize the port to “Download only (1_{dec})”
- 6 Download the program and switch the controller to online mode.
- 7 As soon as the master has started and the device has been recognized, the parameters are transmitted.

Use of “Download/upload allowed”

- 1 Connect a pre-parameterized IO-Link device to the corresponding port.
- 2 Configure the port to “Download/upload allowed (3_{dec})”.
- 3 Download the program and switch the controller to online mode.
 - The parameters are now read by the device and saved to the master on the port.
- 4 The device can now be replaced by a new device.
 - The parameters are written to the device by the master.

3.4 Setting substitute value behavior (failsafe behavior)

If EtherCAT® communication fails, all device outputs are set to the parameterized substitute values. The Axioline E-EtherCAT® IO-Link device has a modular design, i.e. the operating mode can be flexibly set for each port.

3.4.1 Ports in “Digital output” operating mode

If ports are available in their configuration with the “Digital output” operating mode, the replacement value behavior can be set via the following parameters.

Safe State Mode IOLM_Control (DO): globally sets the behavior for all ports

- 0_{dec} Set all outputs to 0
- 1_{dec} Set all outputs to 1
- 2_{dec} All outputs retain the last value
- 3_{dec} Set replacement value sample (-> Safe State Values IOLM_Control (DO))

Safe State Values IOLM_Control (DO)

- The replacement value sample can be used to set the behavior per port.
- This only applies if “Set replacement value sample” was selected in the previous parameter.

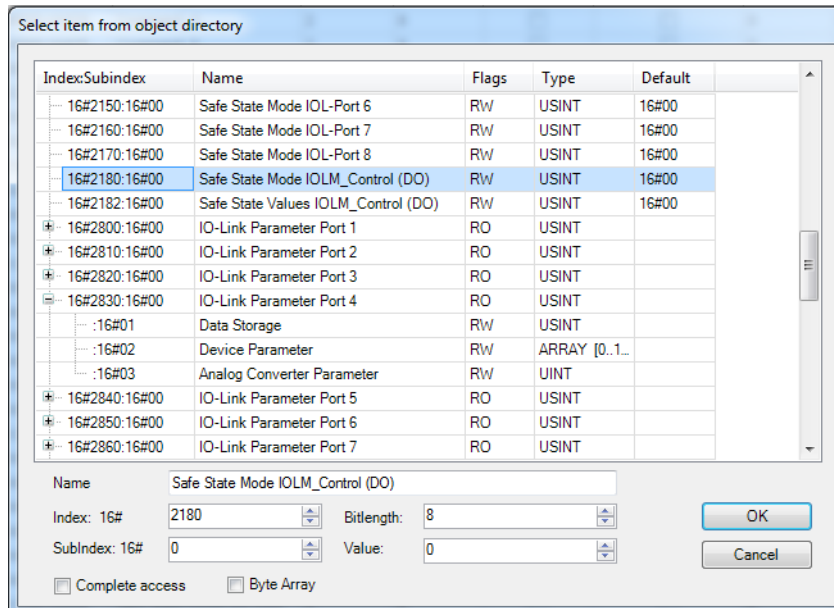


Figure 3-8 Parameters for replacement value behavior

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The replacement value behavior can be set via the Startup parameters. Perform the following steps:

- Double-click on the Axioline E device.
- Then select the “Startup parameters” tab and press the “Add” button.
- Scroll through the window that opens until you find the entries, as shown in Figure 3-9.
- Select the corresponding CoE object and enter the corresponding value into the “Value” field.

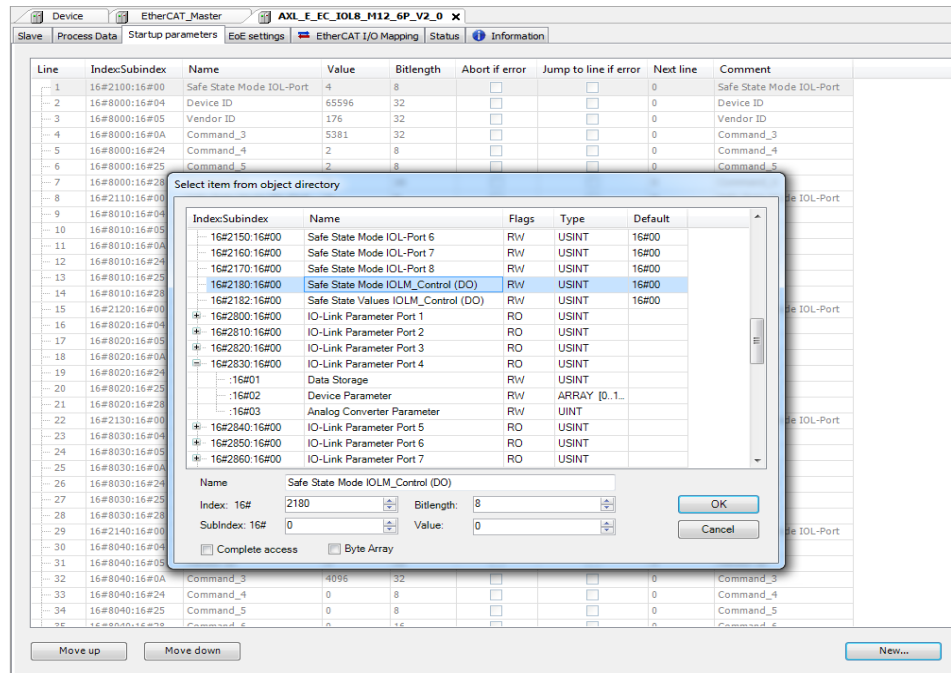


Figure 3-9 Setting substitute value behavior via Startup parameters

- Confirm your entry with “OK”.

Example: Setting the replacement value sample

Port 2, 5, and 8 work in “Digital output” mode and should be set in the event of an error.

Port	1	2	3	4	5	6	7	8
Bit	0	1	2	3	4	5	6	7
Substitute value	0	1	0	0	1	0	0	1

If the bit pattern is converted to decimal, this results in a value of 146.

- Enter this value into the “Safe State Values IOLM_Control (DO)” parameter in order to set the desired behavior.



For additional information, refer to the device-specific data sheet.

3.4.2 Ports in the “IO-Link” operating mode

If ports are available in their configuration with the IO-Link or AXL E IOL ... operating mode, the replacement value behavior can be set directly via the port startup parameters.

By default, “IO-Link master command (4_{dec})” is set for the ports. The “IO-Link master command” option enables the use of IO-Link-specific mechanisms for valid/invalid OUT process data. As such, the IO-Link device determines itself which replacement value behavior should be used.

Alternatively, the Axioline E-EtherCAT® IO-Link can also specify the replacement value behavior. In doing so, the following options are available.

- 0_{dec} Set data to 0
- 1_{dec} Set data to 1
- 2_{dec} Hold last value

Follow the following steps to set the behavior.

- Double-click on the corresponding IO-Link port.
- On the “Startup parameters” tab, you will find all startup parameters which can be set for the respective module and port.
You can double-click the respective field to change the parameters.
- The replacement value behavior can be changed in parameter “Safe State Mode IOL-Port” (Default 4_{dec}).

Line	Index/Subindex	Name	Value	Bitlength	Abort if error	Jump to line if error	Next line	Comment
1	16#2100:16#00	Safe State Mode IOL-Port	2	8	<input type="checkbox"/>	<input type="checkbox"/>	0	Safe State Mode IOL-Port
2	16#8000:16#04	Device ID	402	32	<input type="checkbox"/>	<input type="checkbox"/>	0	Device ID
3	16#8000:16#05	Vendor ID	310	32	<input type="checkbox"/>	<input type="checkbox"/>	0	Vendor ID
4	16#8000:16#0A	Command_3	4867	32	<input type="checkbox"/>	<input type="checkbox"/>	0	Command_3
5	16#8000:16#24	Command_4	2	8	<input type="checkbox"/>	<input type="checkbox"/>	0	Command_4
6	16#8000:16#25	Command_5	2	8	<input type="checkbox"/>	<input type="checkbox"/>	0	Command_5
7	16#8000:16#28	Command_6	3	16	<input type="checkbox"/>	<input type="checkbox"/>	0	Command_6

Figure 3-10 Setting substitute value behavior



For additional information, refer to the device-specific data sheet.

3.5 Ethernet over EtherCAT® (EoE) and Web-based Management

The device has a web server, which generates the required pages for web-based management and, depending on the requirements of the user, sends them to a standard web browser. Web-based management can be used to access static information (e.g., technical data, MAC address) or dynamic information (e.g., IP address, status information).

The web server can optionally be called via EoE.

- In order to call web-based management via EoE, switch to the “EoE settings” tab.

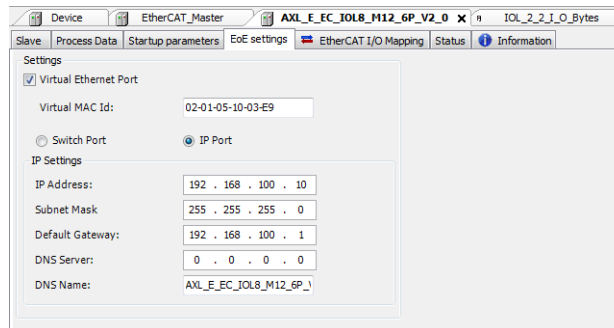


Figure 3-11 Web-based management



When using CODESYS Control Win V3, the Microsoft Loopback adapter must be installed as a virtual Ethernet adapter. A description of how this installation is performed can be found online.

3.6 Synchronization

The Axioline E-EtherCAT® IO-Link device supports FreeRun and SM Synchronous modes for synchronization of process data updates.

By default, SM Synchronous is activated (process data update when an SM event occurs).



For additional information, refer to the device-specific data sheet and CODESYS documentation.

3.7 Reading out emergency messages including IO-Link device events

Axioline E-EtherCAT® device A supports diagnostic alarms, so-called emergency messages. IO-Link device events are also supported, which are converted to Emergency messages.

The diagnostics are saved to the device and the controller is informed via incoming and outgoing diagnostics.



For a list of supported alarms and additional information, refer to the device-specific data sheet.

In order to read out the diagnostic alarms in CODESYS, perform the following steps:

- Double-click on the object “Device (CODESYS Control Win V3)”.
- Switch to the “Log” tab.
- You can explicitly filter by emergency messages in the log window by deselecting (clicking) everything marked in the blue field, up to the errors.

For example, an incoming and outgoing emergency message can be seen here:

Severity	Time Stamp	Description	Component
Warning	08.06.2015 11:25:10.054	Emergency from device: 1001 Error code: 16#00 Error register: 16#80 Error field: 16#00 16#08 16#04 16#00 16#00	IoDrvEtherCAT
Error	08.06.2015 11:25:05.606	Emergency from device: 1001 Error code: 16#8104 Error register: 16#80 Error field: 16#00 16#08 16#04 16#00 16#00	IoDrvEtherCAT
Error	08.06.2015 11:25:04.470	Emergency from device: 1001 Error code: 16#00 Error register: 16#80 Error field: 16#00 16#08 16#04 16#00 16#00	IoDrvEtherCAT
Information	08.06.2015 11:24:19.257	InitSlaves successful	IoDrvEtherCAT
Information	08.06.2015 11:24:19.257	All slaves done !	IoDrvEtherCAT
Information	08.06.2015 11:24:19.253	All slaves operational	IoDrvEtherCAT
Information	08.06.2015 11:24:19.245	Set operational mode	IoDrvEtherCAT
Information	08.06.2015 11:24:19.182	All slaves safe-operational	IoDrvEtherCAT
Information	08.06.2015 11:24:19.173	SDO write ok: Address: 1001 Index: 16#8070 SubIndex: 40 Data: 16#00 Result: 16#00	IoDrvEtherCAT
Information	08.06.2015 11:24:19.153	SDO write ok: Address: 1001 Index: 16#8070 SubIndex: 37 Data: 16#00 Result: 16#00	IoDrvEtherCAT
Information	08.06.2015 11:24:19.137	SDO write ok: Address: 1001 Index: 16#8070 SubIndex: 36 Data: 16#00 Result: 16#00	IoDrvEtherCAT
Information	08.06.2015 11:24:19.117	SDO write ok: Address: 1001 Index: 16#8070 SubIndex: 10 Data: 16#1000 Result: 16#00	IoDrvEtherCAT
Information	08.06.2015 11:24:19.102	SDO write ok: Address: 1001 Index: 16#8070 SubIndex: 5 Data: 16#00 Result: 16#00	IoDrvEtherCAT
Information	08.06.2015 11:24:19.085	SDO write ok: Address: 1001 Index: 16#8070 SubIndex: 4 Data: 16#00 Result: 16#00	IoDrvEtherCAT
Information	08.06.2015 11:24:19.069	SDO write ok: Address: 1001 Index: 16#2170 SubIndex: 0 Data: 16#00 Result: 16#00	IoDrvEtherCAT
Information	08.06.2015 11:24:19.053	SDO write ok: Address: 1001 Index: 16#8060 SubIndex: 40 Data: 16#00 Result: 16#00	IoDrvEtherCAT
Information	08.06.2015 11:24:19.038	SDO write ok: Address: 1001 Index: 16#8060 SubIndex: 37 Data: 16#00 Result: 16#00	IoDrvEtherCAT
Information	08.06.2015 11:24:19.021	SDO write ok: Address: 1001 Index: 16#8060 SubIndex: 36 Data: 16#00 Result: 16#00	IoDrvEtherCAT
Information	08.06.2015 11:24:19.006	SDO write ok: Address: 1001 Index: 16#8060 SubIndex: 10 Data: 16#1000 Result: 16#00	IoDrvEtherCAT
Information	08.06.2015 11:24:18.989	SDO write ok: Address: 1001 Index: 16#8060 SubIndex: 5 Data: 16#00 Result: 16#00	IoDrvEtherCAT
Information	08.06.2015 11:24:18.973	SDO write ok: Address: 1001 Index: 16#8060 SubIndex: 4 Data: 16#00 Result: 16#00	IoDrvEtherCAT
Information	08.06.2015 11:24:18.957	SDO write ok: Address: 1001 Index: 16#2160 SubIndex: 0 Data: 16#00 Result: 16#00	IoDrvEtherCAT

Figure 3-12 Emergency messages



For additional information, refer to the device-specific data sheet.

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4 Starting up a CODESYS project

4.1 Creating variables

The Axioline E IO-Link master has a modular design. The port configuration enables the operating mode and process data width to be determined for each port. The required CoE objects are then automatically created by the CODESYS engineering tool.

In this example project, the Structured Text programming language is used.

- Double-click on the object “Device, PLC logic, Application, Task Configuration, Main-Task, PLC_PRG”.
- In the upper field, perform the variable declaration.

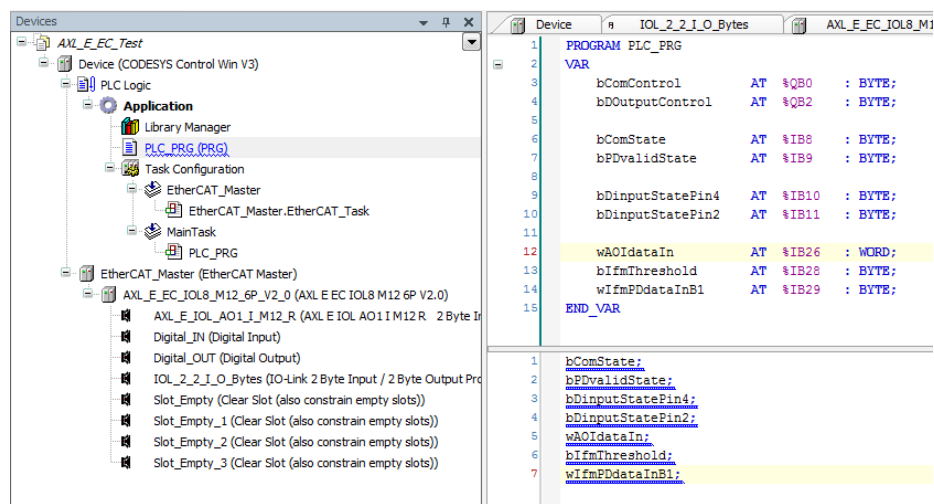


Figure 4-1 Variable declaration

Your actual program can be found in the lower field.

In this example, variables are only called in order to update process data cyclically.

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The required I/O addresses can be found on the “EtherCAT I/O mapping” tab in the device settings of the Axioline E IO-Link master.

Variable	Mapping	Channel	Address	Type	Unit	Description
COM-Control		COM-Control	%QB0	USINT		COM-Control
Reserved		Reserved	%QB1	USINT		Reserved
Digital Output Control C/Q		Digital Output Control C/Q	%QB2	USINT		Digital Output Control C/Q
Reserved		Reserved	%QB3	USINT		Reserved
AXL_E_IOL_AO1_I_M12_R output byte 0		AXL_E_IOL_AO1_I_M12_R output byte 0	%QB4	USINT		AXL_E_IOL_AO1_I_M12_R output byte 0
AXL_E_IOL_AO1_I_M12_R output byte 1		AXL_E_IOL_AO1_I_M12_R output byte 1	%QB5	USINT		AXL_E_IOL_AO1_I_M12_R output byte 1
IOL_2_2_I_0_Bytes output byte 0		IOL_2_2_I_0_Bytes output byte 0	%QB6	USINT		IOL_2_2_I_0_Bytes output byte 0
IOL_2_2_I_0_Bytes output byte 1		IOL_2_2_I_0_Bytes output byte 1	%QB7	USINT		IOL_2_2_I_0_Bytes output byte 1
State of IO-Link Ch.1		State of IO-Link Ch.1	%IB0	USINT		State of IO-Link Ch.1
State of IO-Link Ch.2		State of IO-Link Ch.2	%IB1	USINT		State of IO-Link Ch.2
State of IO-Link Ch.3		State of IO-Link Ch.3	%IB2	USINT		State of IO-Link Ch.3
State of IO-Link Ch.4		State of IO-Link Ch.4	%IB3	USINT		State of IO-Link Ch.4
State of IO-Link Ch.5		State of IO-Link Ch.5	%IB4	USINT		State of IO-Link Ch.5
State of IO-Link Ch.6		State of IO-Link Ch.6	%IB5	USINT		State of IO-Link Ch.6
State of IO-Link Ch.7		State of IO-Link Ch.7	%IB6	USINT		State of IO-Link Ch.7
State of IO-Link Ch.8		State of IO-Link Ch.8	%IB7	USINT		State of IO-Link Ch.8
COM-States		COM-States	%IB8	USINT		COM-States
PD-Valid States		PD-Valid States	%IB9	USINT		PD-Valid States
Digital Input States C/Q		Digital Input States C/Q	%IB10	USINT		Digital Input States C/Q
Digital Input States of DI (Pin 2)		Digital Input States of DI (Pin 2)	%IB11	USINT		Digital Input States of DI (Pin 2)
Timestamp		Timestamp	%IL2	ULINT		Timestamp
AXL_E_IOL_AO1_I_M12_R input byte 0		AXL_E_IOL_AO1_I_M12_R input byte 0	%IB26	USINT		AXL_E_IOL_AO1_I_M12_R input byte 0
AXL_E_IOL_AO1_I_M12_R input byte 1		AXL_E_IOL_AO1_I_M12_R input byte 1	%IB27	USINT		AXL_E_IOL_AO1_I_M12_R input byte 1
IOL_2_2_I_0_Bytes input byte 0		IOL_2_2_I_0_Bytes input byte 0	%IB28	USINT		IOL_2_2_I_0_Bytes input byte 0
IOL_2_2_I_0_Bytes input byte 1		IOL_2_2_I_0_Bytes input byte 1	%IB29	USINT		IOL_2_2_I_0_Bytes input byte 1

Figure 4-2 I/O addresses

4.2 Compiling and building a project

In order for the created project to be transmitted to the controller, no errors must be present.

Perform the following steps in order to check your project for potential errors:

- Verify the program created to ensure no errors are present by pressing the “Compile” button.

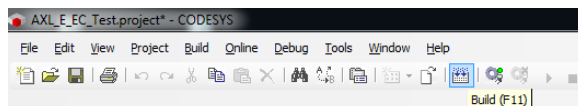


Figure 4-3 Compiling the program and checking for errors

In the “Messages” window, you will gain helpful warnings and error messages which occur during the compilation.

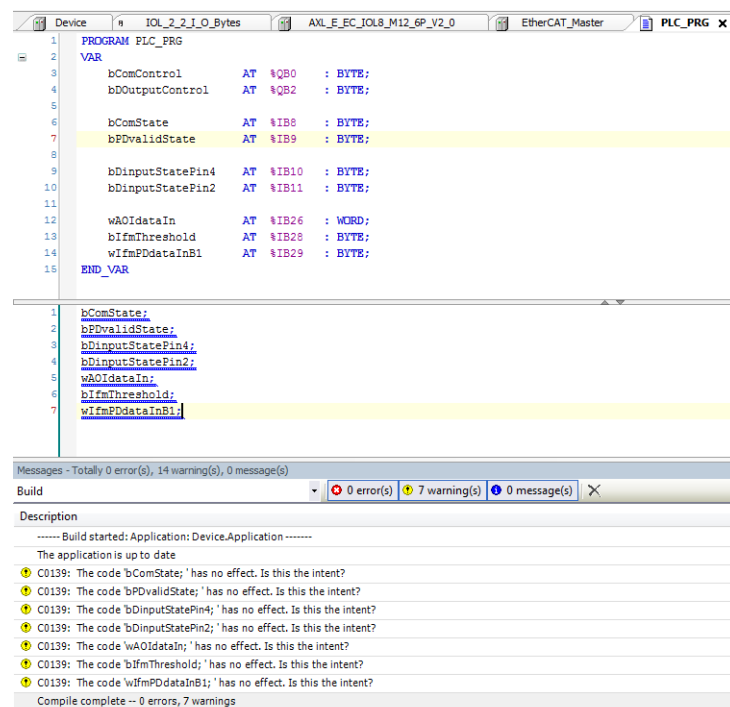


Figure 4-4 Error messages and warnings

Eliminate any errors which have occurred so the project can be transmitted to the controller.

Please refer to the corresponding CODESYS documentation for more information.

4.3 Transmitting the project to the controller and starting it

It is assumed that you have already created and compiled a project in CODESYS. Both the controller and the I/O device are included in and can be accessed from your project.

Perform the following steps in order to send your project to the controller:

- Click on the “Login” icon in the tool bar.



Figure 4-5 Clicking on the “Login” icon

If a project can already be found on the controller, the following warning is displayed:

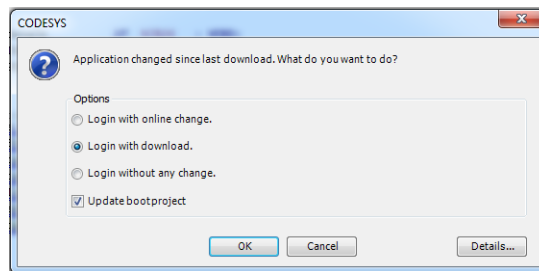


Figure 4-6 Warning

- Confirm the message with “OK”.
- Then switch your controller to RUN mode by clicking on the “Start” symbol in the tool bar.

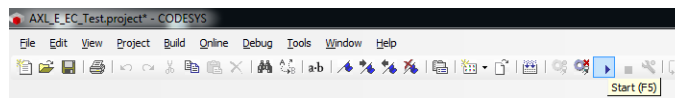


Figure 4-7 Start: switching the controller to RUN mode

Once communication is successfully established, a green arrow is displayed next to the controller and your I/O device.

The controller state can be detected in the bottom tool bar with the “Running” entry.

Starting up a CODESYS project

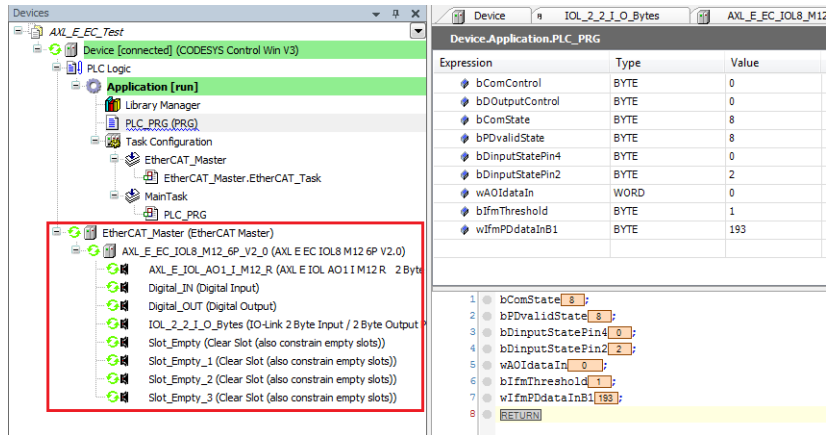


Figure 4-8 Controller is running

4.4 Testing the communication

A project is created which cannot be run, yet only variables are created in order to be able to read or write process data.

4.4.1 Reading digital inputs

The process data of the permanently wired inputs and IO-Link ports in the “Digital Input” operating state can be found in the I/O mapping under the entries “Digital Input State of DI (Pin2)” and “Digital Input States C/Q”.

Variable	Mapping	Channel	Address	Type	Unit	Description
		State of IO-Link Ch.3	%IB2	USINT		State of IO-Link Ch.3
		State of IO-Link Ch.4	%IB3	USINT		State of IO-Link Ch.4
		State of IO-Link Ch.5	%IB4	USINT		State of IO-Link Ch.5
		State of IO-Link Ch.6	%IB5	USINT		State of IO-Link Ch.6
		State of IO-Link Ch.7	%IB6	USINT		State of IO-Link Ch.7
		State of IO-Link Ch.8	%IB7	USINT		State of IO-Link Ch.8
		COM-States	%IB8	USINT		COM-States
		PD-Valid States	%IB9	USINT		PD-Valid States
		Digital Input States C/Q	%IB10	USINT		Digital Input States C/Q
		Digital Input States of DI (Pin 2)	%IB11	USINT		Digital Input States of DI (Pin 2)
		Timestamp	%IL2	ULINT		Timestamp
		AXL_E_IOL_AO1_I_M12_R input byte 0	%IB26	USINT		AXL_E_IOL_AO1_I_M12_R input byte 0
		AXL_E_IOL_AO1_I_M12_R input byte 1	%IB27	USINT		AXL_E_IOL_AO1_I_M12_R input byte 1
		IOL_2_2_I_O_Bytes input byte 0	%IB28	USINT		IOL_2_2_I_O_Bytes input byte 0
		IOL_2_2_I_O_Bytes input byte 1	%IB29	USINT		IOL_2_2_I_O_Bytes input byte 1

Figure 4-9 Process data

In order to read process data or inputs, perform the following steps:

- In order for the process data to be displayed, it is necessary to declare variables and link these with the I/O addresses. To do this, proceed as described in Section “Creating variables” on page 29.

Your program may appear as follows:

```

1 PROGRAM PLC_PRG
2 VAR
3   bComControl      AT %QB0   : BYTE;
4   bDOutputControl  AT %QB2   : BYTE;
5
6   bComState        AT %IB8   : BYTE;
7   bPValidState     AT %IB9   : BYTE;
8
9   bInputStatePin4  AT %IB10  : BYTE;
10  bInputStatePin2  AT %IB11  : BYTE;
11
12  wAOIdataIn       AT %IB26   : WORD;
13  bIfmThreshold    AT %IB28   : BYTE;
14  wIfmPDataInB1   AT %IB29   : BYTE;
15 END_VAR

1 bComState;
2 bPValidState;
3 bInputStatePin4;
4 bInputStatePin2;
5 wAOIdataIn;
6 bIfmThreshold;
7 wIfmPDataInB1;

```

Figure 4-10 Program (example)

Starting up a CODESYS project

- Switch your controller to RUN mode by clicking on the “Start” symbol in the tool bar.



Figure 4-11 Start: switching the controller to RUN mode

- The online process data values can then be seen directly next to your variables in an orange box.

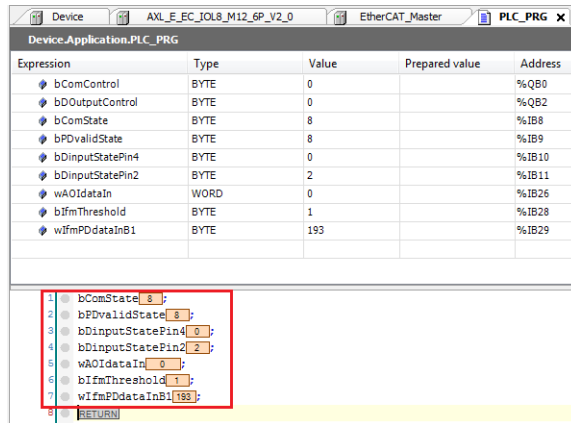


Figure 4-12 Variable values

4.4.2 Writing digital outputs

In the case of the Axioline E EtherCAT® IO-Link device, process data of the IO-Link ports is in “Digital output” operating mode in the I/O mapping under the “Digital Output Control C/Q” entries.

Variable	Mapping	Channel	Address	Type	Unit	Description
		COM-Control	%QB0	USINT		COM-Control
		Reserved	%QB1	USINT		Reserved
		Digital Output Control C/Q	%QB2	USINT		Digital Output Control C/Q
		Reserved	%QB3	USINT		Reserved

Figure 4-13 Process data of the IO-Link ports

In order to write process data or outputs, perform the following steps:

- In order for the process data to be displayed, it is necessary to declare variables and link these with the I/O addresses.
To do so, perform the following steps according to Section “Creating variables” on page 29.

Your program may appear as follows

```

1 PROGRAM PLC_PRG
2 VAR
3   bComControl AT %QB0 : BYTE;
4   bDOutputControl AT %QB2 : BYTE;
5
6   bComState AT %IB8 : BYTE;
7   bFDvalidState AT %IB9 : BYTE;
8
9   bDinputStatePin4 AT %IB10 : BYTE;
10  bDinputStatePin2 AT %IB11 : BYTE;
11
12  wAOIdataIn AT %IB26 : WORD;
13  bIfmThreshold AT %IB28 : BYTE;
14  wIfmPDdataInB1 AT %IB29 : BYTE;
15 END_VAR
16
17 bComState;
18 bFDvalidState;
19 bDinputStatePin4;
20 bDinputStatePin2;
21 wAOIdataIn;
22 bIfmThreshold;
23 wIfmPDdataInB1;
24
25 bDOutputControl := 4;

```

Figure 4-14 Clicking the “Process Data Assignment” button

- Switch your controller to RUN mode by clicking on the “Start” symbol in the tool bar.

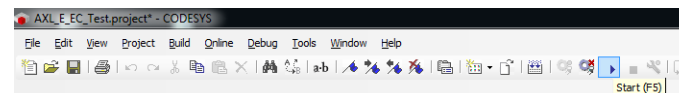


Figure 4-15 Start: switching the controller to RUN mode

- The online process data values can then be seen directly next to your variables in an orange box.

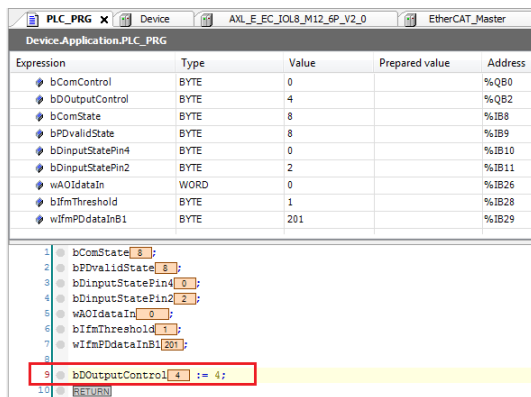


Figure 4-16 Variable values

The output is then switched.

You can also optionally modify this value online via the force list.

- Add the variable created for output control to the monitoring list. To do so, right-click on the variable and select “Add Watch” in the context menu.

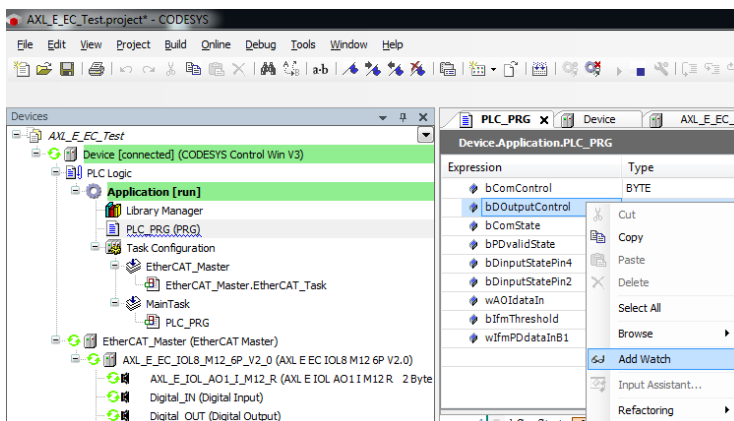


Figure 4-17 “Add Watch”

- Then enter the value to be written into the “Prepared value” cell.
- Then right-click on the variable in the monitoring list and select the “Write values” entry in the context menu.

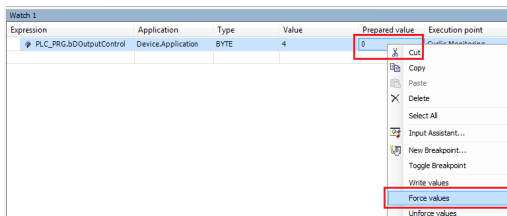


Figure 4-18 “Writing values”

4.4.3 Reading/writing IO-Link process data

The process image is automatically and separately created per port according to the selected port configuration. The I/O addresses can be found on the “EtherCAT I/O mapping” tab in the device settings.

Variable	Mapping	Channel	Address	Type	Unit	Description
+		COM-Control	%QB0	USINT		COM-Control
+		Reserved	%QB1	USINT		Reserved
+		Digital Output Control C/Q	%QB2	USINT		Digital Output Control C/Q
+		Reserved	%QB3	USINT		Reserved
+		AXL_E_IOL_A01_I_M12_R output byte 0	%QB4	USINT		AXL_E_IOL_A01_I_M12_R output byte 0
+		AXL_E_IOL_A01_I_M12_R output byte 1	%QB5	USINT		AXL_E_IOL_A01_I_M12_R output byte 1
+		IOL_2_2_I_0_Bytes output byte 0	%QB6	USINT		IOL_2_2_I_0_Bytes output byte 0
+		IOL_2_2_I_0_Bytes output byte 1	%QB7	USINT		IOL_2_2_I_0_Bytes output byte 1
+		State of IO-Link Ch.1	%IB0	USINT		State of IO-Link Ch.1
+		State of IO-Link Ch.2	%IB1	USINT		State of IO-Link Ch.2
+		State of IO-Link Ch.3	%IB2	USINT		State of IO-Link Ch.3
+		State of IO-Link Ch.4	%IB3	USINT		State of IO-Link Ch.4
+		State of IO-Link Ch.5	%IB4	USINT		State of IO-Link Ch.5
+		State of IO-Link Ch.6	%IB5	USINT		State of IO-Link Ch.6
+		State of IO-Link Ch.7	%IB6	USINT		State of IO-Link Ch.7
+		State of IO-Link Ch.8	%IB7	USINT		State of IO-Link Ch.8
+		COM-States	%IB8	USINT		COM-States
+		PD-Valid States	%IB9	USINT		PD-Valid States
+		Digital Input States C/Q	%IB10	USINT		Digital Input States C/Q
+		Digital Input States of DI (Pin 2)	%IB11	USINT		Digital Input States of DI (Pin 2)
+		Timestamp	%IL2	ULINT		Timestamp
+		AXL_E_IOL_A01_I_M12_R input byte 0	%IB26	USINT		AXL_E_IOL_A01_I_M12_R input byte 0
+		AXL_E_IOL_A01_I_M12_R input byte 1	%IB27	USINT		AXL_E_IOL_A01_I_M12_R input byte 1
+		IOL_2_2_I_0_Bytes input byte 0	%IB28	USINT		IOL_2_2_I_0_Bytes input byte 0
+		IOL_2_2_I_0_Bytes input byte 1	%IB29	USINT		IOL_2_2_I_0_Bytes input byte 1

Figure 4-19 Process image and I/O addresses

For testing purposes, read or write IO-Link process data according to Section “Reading digital inputs” on page 34 and Section “Writing digital outputs” on page 36.



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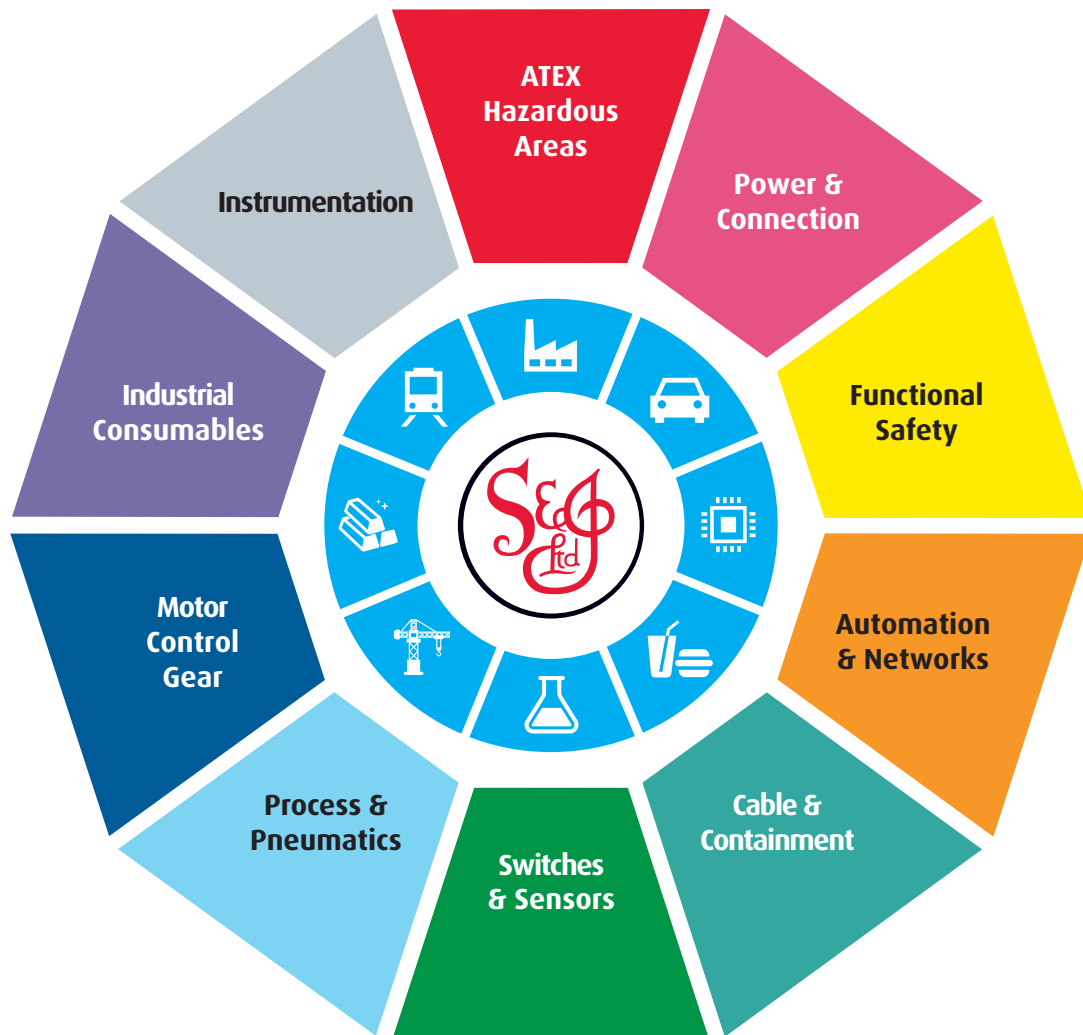
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