ROBOTICS

Application manual

PROFINET Controller/Device

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Application manual

PROFINET Controller/Device

RobotWare 7.5

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Revision: H

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Original instructions.

Table of contents

Overview of this manual

About this manual

This manual describes the following options and contains instructions on how to configure them in an OmniCore system.

- *PROFINET Controller*, option number 3020-1
- *PROFINET Device*, option number 3020-2

Usage

This manual should be used during installation and configuration of the PROFINET options.

Who should read this manual?

This manual is intended for:

- Personnel that are responsible for installations and configurations of industrial network hardware/software.
- Personnel that make the configurations of the I/O system.
- System integrators.

Prerequisites

The reader should have the required knowledge of:

- PROFINET network
- I/O system configuration
- OmniCore controller
- RobotStudio

References

ABB documents

Reference	Document ID
Technical reference manual - System parameters	*3HAC065041-001*
Product manual - OmniCore C30	*3HAC060860-001*
Product manual - OmniCore C90XT	*3HAC073706-001*
Product manual - OmniCore V250XT	*3HAC073447-001*
Operating manual - OmniCore	*3HAC065036-001*
Operating manual - RobotStudio	*3HAC032104-001*

Other references

Reference	Description
International standard IEC 61158 Type 3 International standard IEC 61784	The PROFINET industrial network standard is described in the international standards.
PROFINET Cabling and Interconnection Technology	Installation Guideline for PROFINET (Version 2.00, September 1998)

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Reference	Description
Commissioning PC Stations - Manual and Quick Start	Release 12/2006 C79000-G8976-C156-08
ET200SP Distributed I/O System	Manual from Siemens
www.profinet.com	The web site of PROFINET International

Revisions

Revision	Description
A	Released with RobotWare 7.0.
B	Released with RobotWare 7.0.1. • Cfg name removed from entire manual.
C	Released with RobotWare 7.0.2. • LLDP overview image corrected in section *PROFINET for OmniCore on page 16*. Image now shows that LAN3 is a private network port.
D	Released with RobotWare 7.1. • Information regarding group signals added in section *Signal Editor on page 42* and *Editing signals on page 58*. • Configuration of internal device added in chapter *Configuring the internal device on page 65*. • The following sections have been updated regarding PROFIsafe: *PROFINET for OmniCore on page 16*, *I/O devices on page 30*, *Information about the internal device on page 31*, *The I/O Engineering Tool user interface on page 35* and *Configuring the internal device on page 65*. • New chapter: *Setting up your PROFINET system on page 45*. • Information about a new flash pattern for PC-STAT added in section "Unidentified devices", in chapter *Troubleshooting scenarios on page 75*. • Appendix regarding TIA portal removed. • PROFINET parameters are described in the instructions instead of in a separate chapter. The section System Parameters is therefore removed.
E	Released with RobotWare 7.2. • Minor corrections in section "Network connections on the OmniCore". • New section: *Creating safety integers on page 72*. • Minor corrections in section "Connections on the main computer".
F	Released with RobotWare 7.3. • Limitations for selection of LLDP mode added in sections *Specification overview, internal controller on page 16* and *Configuring the PROFINET network properties on page 49*. • Information regarding the Parameterization Speedup parameter added in section *Poor performance using fast startup on page 76*. • Information about MDI settings added in section *Using Fast Device Startup on page 60*.
G	Released with RobotWare 7.4. • Information about certification added in section *PROFINET for OmniCore on page 16*. • Section "Network connections on OmniCore" replaced by *Ethernet networks on OmniCore on page 19*. • Updated sections due to removed connection between IOE and VSM: *The ribbon on page 37*, *Symbols on page 39*, *Configuration prerequisites on page 65* and *Saving the configuration on page 73*.

Continues on next page

Revision	Description
H	Released with RobotWare 7.5. • Information about Media Redundancy Protocol (MRP) added in section *Manually adding devices to your network on page 54*. • Information about temporary IP addresses added in section *Troubleshooting scenarios on page 75*.

Product documentation

Categories for user documentation from ABB Robotics

The user documentation from ABB Robotics is divided into a number of categories. This listing is based on the type of information in the documents, regardless of whether the products are standard or optional.

Tip

All documents can be found via myABB Business Portal, *www.abb.com/myABB*.

Product manuals

Manipulators, controllers, DressPack/SpotPack, and most other hardware is delivered with a **Product manual** that generally contains:

- Safety information.
- Installation and commissioning (descriptions of mechanical installation or electrical connections).
- Maintenance (descriptions of all required preventive maintenance procedures including intervals and expected life time of parts).
- Repair (descriptions of all recommended repair procedures including spare parts).
- Calibration.
- Decommissioning.
- Reference information (safety standards, unit conversions, screw joints, lists of tools).
- Spare parts list with corresponding figures (or references to separate spare parts lists).
- References to circuit diagrams.

Technical reference manuals

The technical reference manuals describe reference information for robotics products, for example lubrication, the RAPID language, and system parameters.

Application manuals

Specific applications (for example software or hardware options) are described in **Application manuals**. An application manual can describe one or several applications.

An application manual generally contains information about:

- The purpose of the application (what it does and when it is useful).
- What is included (for example cables, I/O boards, RAPID instructions, system parameters, software).
- How to install included or required hardware.
- How to use the application.
- Examples of how to use the application.

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Operating manuals

The operating manuals describe hands-on handling of the products. The manuals are aimed at those having first-hand operational contact with the product, that is production cell operators, programmers, and troubleshooters.

Safety

Safety regulations

Before beginning mechanical and/or electrical installations, ensure you are familiar with the safety information in the product manuals for the robot.

The integrator of the robot system is responsible for the safety of the robot system.

Network security

Network security

This product is designed to be connected to and to communicate information and data via a network interface. It is your sole responsibility to provide, and continuously ensure, a secure connection between the product and to your network or any other network (as the case may be).

You shall establish and maintain any appropriate measures (such as, but not limited to, the installation of firewalls, application of authentication measures, encryption of data, installation of anti-virus programs, etc) to protect the product, the network, its system and the interface against any kind of security breaches, unauthorized access, interference, intrusion, leakage and/or theft of data or information. ABB Ltd and its entities are not liable for damage and/or loss related to such security breaches, any unauthorized access, interference, intrusion, leakage and/or theft of data or information.

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1 Introduction

1.1 What is PROFINET?

General

PROFINET is an open standard for Industrial Ethernet. PROFINET satisfies requirements for automation technology. PROFINET solutions can be implemented for factory and process automation, for safety applications, and for the entire range of drive technology right up to clock-synchronized motion control.

Standardization

The use of open standards, simple operation, and the integration of existing system segments have driven the definition of PROFINET from the beginning. PROFINET is standardized in IEC 61158 and IEC 61784. The continual further development of PROFINET offers users a long term perspective for the implementation of their automation tasks.

Communication profiles

PROFINET has a modular design and different PROFINET communication profiles are all combinations of modular elements from the groups transmission technology, communication protocol, and application profiles.

1.2 PROFINET for OmniCore

General

The PROFINET network is running on the OmniCore main computer and does not require any additional hardware. PROFINET as described in this manual requires the main computer DSQC1025.

Options

There are two options available for PROFINET:

- *3020-1 PROFINET Controller*
- *3020-2 PROFINET Device*

Note

Note that the network settings are set for the *Connection*, i.e. the physical connector on the main computer used for the PROFINET network.

This means that the network settings are shared between the internal device and the internal controller if the OmniCore controller acts as both on the PROFINET network.

Note

In this manual, the *3020-2 PROFINET Device* and the *3023-2 PROFIsafe Device* are referred to as *internal device*.

The following option is available for PROFIsafe:

- *3023-2 PROFIsafe Device*

Note

With option *3023-2 PROFIsafe Device*, it is possible to configure safe modules for the internal device.

Compatibility

The PROFINET device is certified by PROFINET International (PI) with conformance class B/ NetLoad Class II.

The PROFINET controller is certified for the PROFINET version 2.4.

The PROFINET device is certified for the PROFINET version 2.4.

The PROFIsafe device is certified for the PROFINET version 2.4.

Specification overview, internal controller

Item	Specification
PROFINET version	2.4
GSD file versions supported	2.20–2.35
Number of I/O devices connected to controller	Maximum 50 I/O devices

Continues on next page

Item	Specification
LLDP mode	Legacy and Standard mode supported: • *Legacy mode* supports communication to I/O devices according to PROFINET I/O specification up to version 2.2. • *Standard mode* supports communication to I/O Devices according to PROFINET I/O specification after version 2.2. **Note** If one device in the configuration only supports legacy mode, all devices must run in legacy mode.
Startup mode	Legacy and Advanced mode supported.

Specification overview, internal device

Item	Specification
PROFINET version	2.4
PROFIsafe version	2.6.1
GSD version	2.35
Slot configuration	Slot 1-2: Digital input or output modules of variable size Slot 3-4: Safe digital input or output modules of fixed 8 bytes size
Connection size	Maximum 256 input bytes and 256 output bytes, and maximum 8 safe input bytes and 8 safe output bytes.

Default gateway

There is one default gateway for the entire system. The default gateway must hence be configured so that it matches both the requirements for PROFINET traffic and non-PROFINET traffic.

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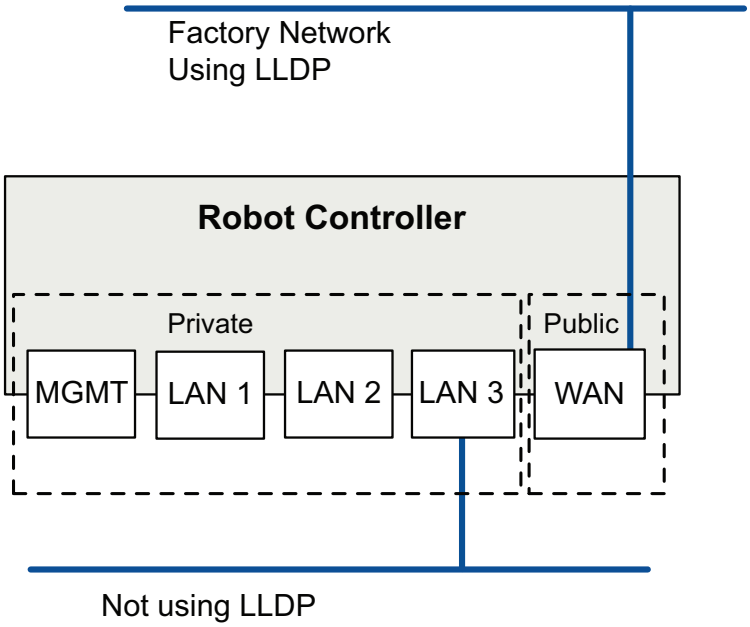
Link Layer Discovery Protocol (LLDP)

The OmniCore controller supports LLDP, but only on one port at a time. Any network connected to another port must have LLDP disabled (or use equipment not supporting LLDP).



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Device replacement

PROFINET controller supports the device replacement mechanism. When a device fails, a new, identical device can replace the failed one if plugged in the same topology location. And this does not need any engineering tool. The new device is automatically assigned the same parameters and name as the previous one.

The conditions for device replacement to work are:

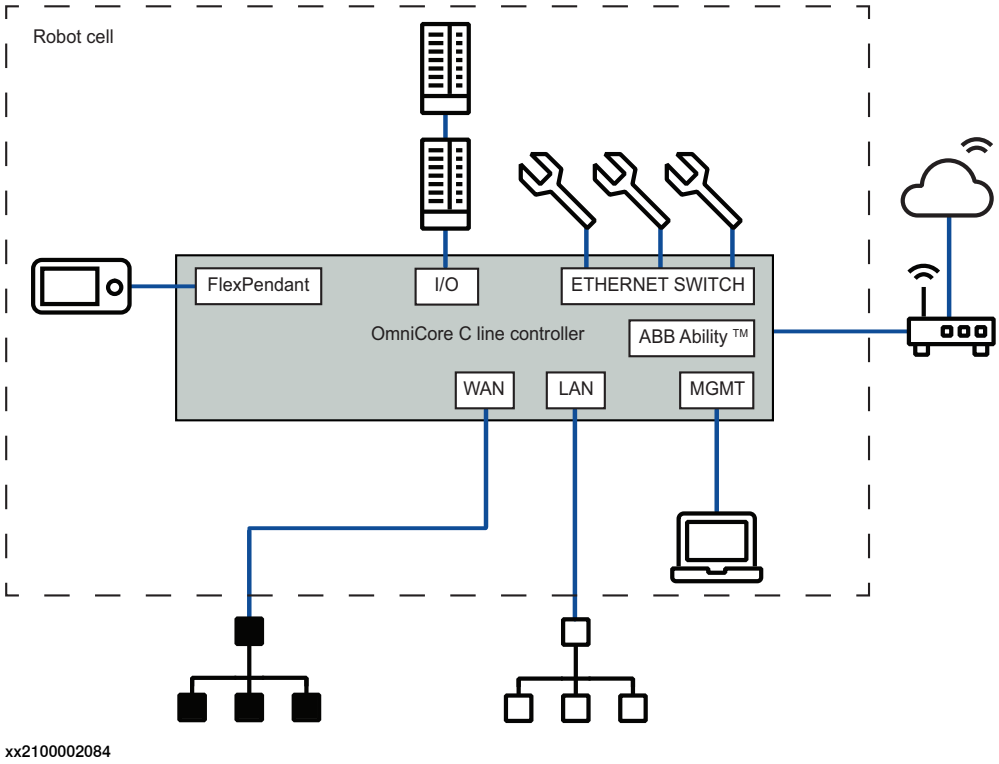
- You must replace a previously connected device by an identical device with an empty station name at the same topology location. For example, the new device is plugged in the same port as previously in a switch.
- This feature requires all switches and devices to support Link Layer Discovery Protocol (LLDP). The easiest way to achieve this is to only use Conformance Class B devices and switches in the PROFINET network.
- The device cannot be configured with FSU (Fast Startup Unit). In that case Device replacement will not work.

2 Hardware overview

2.1 Main computer PROFINET

2.1.1 Ethernet networks on OmniCore

Network segment overview



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2.1.1 Ethernet networks on OmniCore

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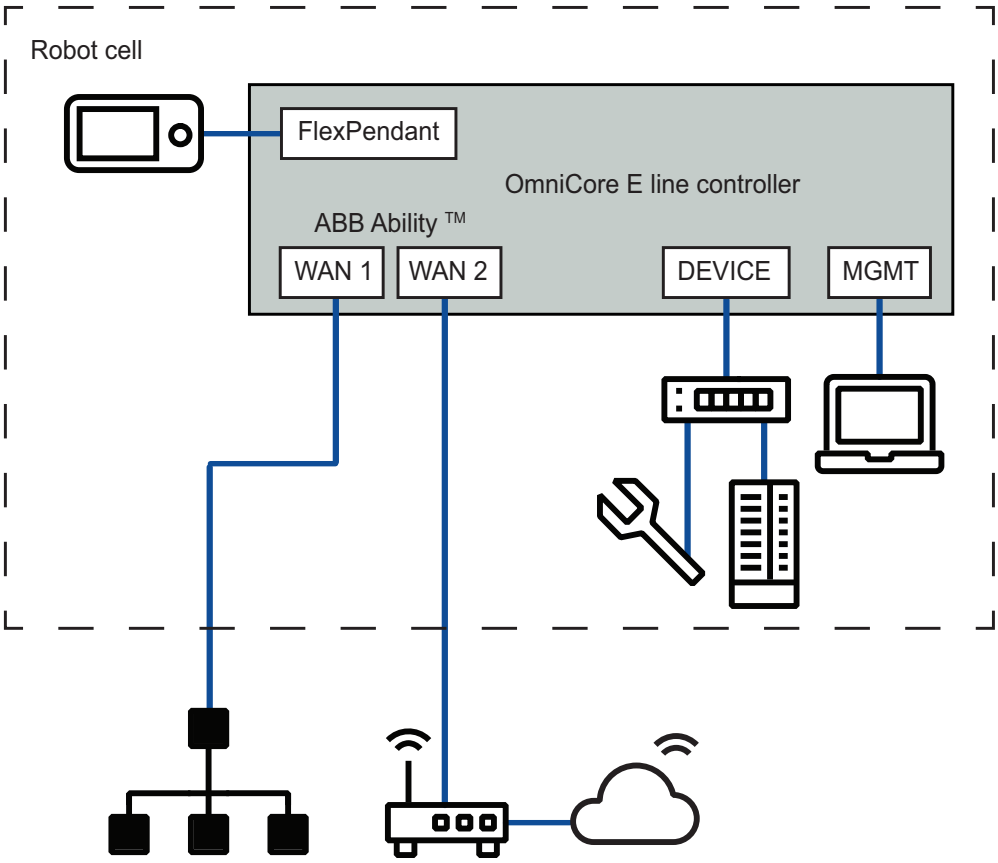

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The Ethernet networks used by OmniCore are distributed into the following segments:

Network segment	C line controller ports	E line controller ports	Usage
Private Network	I/O (Scalable I/O) ETHERNET SWITCH	DEVICE	Process equipment local to this specific robot.
	MGMT (Management)	MGMT (Management)	ABB service personnel.
	HMI (FlexPendant)	HMI (FlexPendant)	FlexPendant connection.
Ability Network	ABB Ability™	WAN 2	ABB Ability™ connection.
Public Network	WAN	WAN 1	Public/factory network.
I/O Network	LAN	-	Secondary public/factory network. Isolated from WAN.

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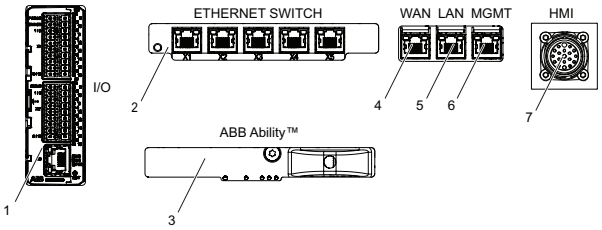
Connectors

Depending on the type of OmniCore controller (C line/E line), the labels and location of the Ethernet port connectors may vary.

> **Note**
>
> For information regarding location of the Ethernet port connectors, see the Product manual for the respective OmniCore controller.

Connectors on C line controllers



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	C line controller label	Description
1	I/O	ABB Scalable I/O. Connected to the controller's Private Network. Intended for chaining more ABB Scalable I/O units.
2	ETHERNET SWITCH	Connected to the controller's Private Network. Intended for connecting ABB Scalable I/O units and network based process equipment local to the controller.
3	ABB Ability™	Intended for connecting the controller to internet/ABB Ability™.
4	WAN	Connected to the controller's Public Network. Intended for connecting the robot controller to a factory wide industrial network.
5	LAN	Connected to the controller's I/O Network. Intended for connecting the robot controller to a factory wide industrial network isolated from WAN.
6	MGMT (Management)	Connected to the controller's Private Network. The MGMT port shall be used by service personnel in close proximity to the controller, with a single client connected to the controller. **Note** The management port shall never be used for more than one client at a time. ABB Robotics assumes no responsibility for any errors/hazards that may appear when more than one client is used.
7	HMI (FlexPendant)	Specific connector for connecting the FlexPendant.

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2.1.1 Ethernet networks on OmniCore

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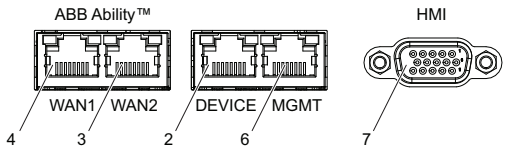
Connectors on E line controllers



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	E line controller label	Description
2	DEVICE	Connected to the controller's Private Network. Intended for connecting ABB Scalable I/O units and network based process equipment local to the controller.
3	WAN 2	Intended for connecting the controller to internet/ABB Ability™.
4	WAN 1	Connected to the controller's Public Network. Intended for connecting the robot controller to a factory wide industrial network.
6	MGMT (Management)	Connected to the controller's Private Network. The MGMT port shall be used by service personnel in close proximity to the controller, with a single client connected to the controller. **Note** The management port shall never be used for more than one client at a time. ABB Robotics assumes no responsibility for any errors/hazards that may appear when more than one client is used.
7	HMI (FlexPendant)	Specific connector for connecting the FlexPendant.

Industrial networks

Connection of industrial networks

A factory wide I/O network should be connected to the WAN/WAN1 port on the controller, or to the LAN port if the I/O network needs to be isolated from the network already connected to WAN/WAN1.

Note

For OmniCore E10:

A factory wide I/O network should be connected to the WAN1 port on the controller.

Note

It is not supported to connect multiple ports of the OmniCore controller to the same external switch unless static VLAN isolation is applied on the external switch.

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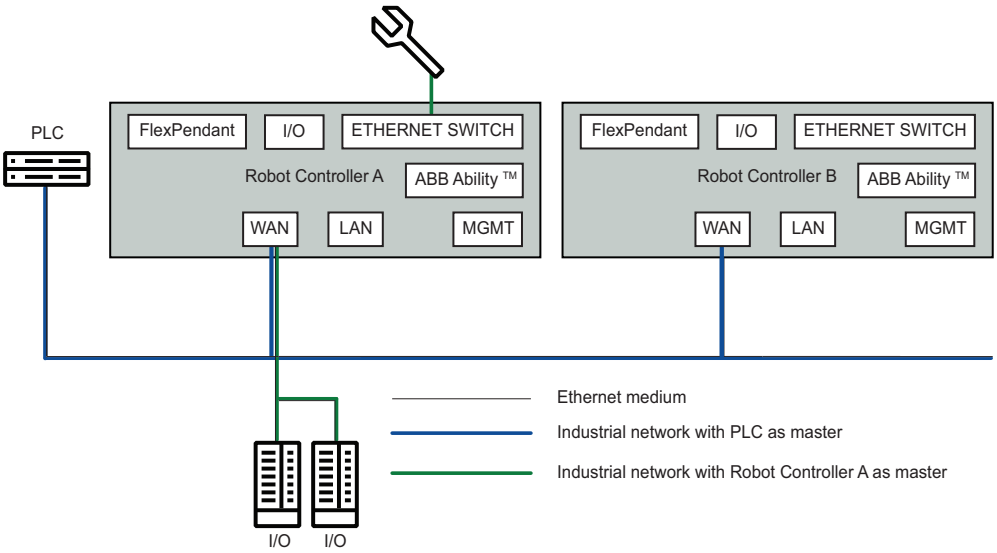
Note

Private Network segments of multiple controllers cannot be connected to each other.

Combined industrial networks

There are many possible solutions of combined industrial networks. For example, the robot controller can be both master and slave on the Public Network as well as master on the Private Network.



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This can be implemented by setting up an EtherNet/IP adapter on the Public Network and an EtherNet/IP scanner targeting both the Public and Private Networks at the same time. The traffic for both industrial networks on the Public Network can share the ethernet medium with each other and with other non-industrial network traffic.

Configuration

Reserved IP addresses

Before configuring IP addresses manually, it is important to be aware that some ranges are reserved by the robot controller. Configuring units or networks that collide with these reserved addresses will most likely cause network problems.

The following IP address ranges are allocated for internal functions on the controller:

- 192.168.125.0 - 255
- 192.168.126.0 - 255
- 192.168.127.0 - 255

No other robot controller connected network can be on a subnet that overlaps with any of the above reserved IP addresses. If a subnet mask in the class B range has to be used, then a private address of class B must be used to avoid any overlapping.

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2.1.1 Ethernet networks on OmniCore
Continued

Contact your local network administrator regarding network overlapping. See section "Communication" in *Technical reference manual - System parameters*.

Note

It is not recommended using leading zeros in dot-decimal notation of IP addresses. The numbers may wrongly be interpreted as octal numbers. Different behaviors on virtual and real controllers may be experienced.

Private Network

The Private Network has a static configuration with IP address 192.168.125.1/24 and hosts a DHCP server. The purpose of the Private Network is to connect the computers within the robot controller as well as I/O networks and process equipment local to the robot. Many IP addresses are reserved on this network, so it is recommended that new units get their IP address from the DHCP server.

Note

Never connect another DHCP server to any of the ports connected to the Private Network. There cannot be two DHCP servers on the same network. It might cause an erroneous behavior of both internal and external units.

Ability Network

Configuration of the IP settings for the Ability Network shall be done manually when the controller is equipped with a wired Connected Services Gateway (DSQC1041) that is connected to an Internet gateway, using an IP address provided by the network administrator.

Note

On OmniCore E line controllers, the WAN2 port is equivalent to a wired Connected Services Gateway (DSQC1041).

The IP address configuration is done either in RobotStudio or on the FlexPendant.

As an exception to the reserved ranges mentioned in section *Reserved IP addresses on page 23*, the Ability Network is allowed to configure IP addresses within the reserved range 192.168.126.0 - 255, but not within 192.168.125.0 - 255 or 192.168.127.0 - 255.

For security reasons, only outbound access on port 53 DNS and 443 HTTPS are allowed. The inbound access is blocked by an internal firewall and cannot be unblocked.

Note

For more information about connecting the Ability port to the internet, see *Application manual - Controller software OmniCore*.

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Public Network

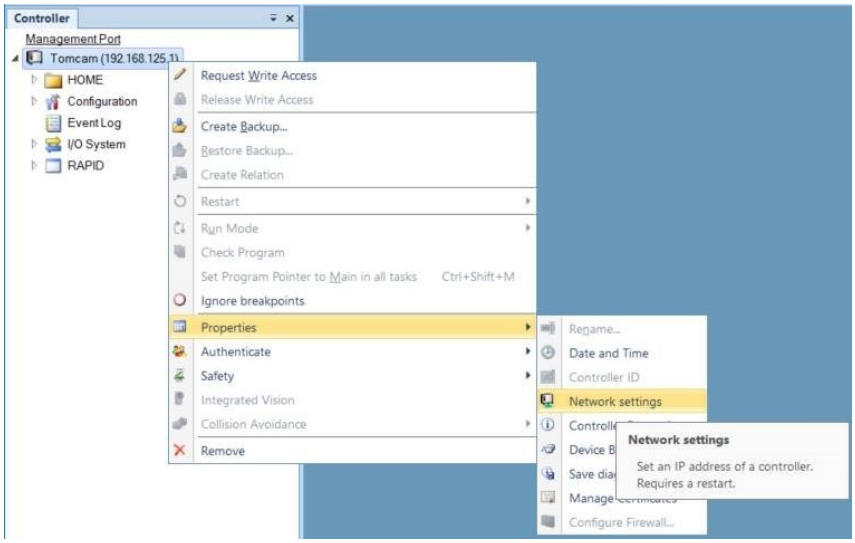
The Public Network interface is typically connected to the factory network with a public IP address provided by the network administrator. The Public Network segment can be used for:

- Connecting a PC running RobotStudio. For more information see *Operating manual - RobotStudio*.
- Mounting FTP or NFS disks from the controller.
- Running Industrial Ethernet protocols.

Most protocols are disabled by default in the controller firewall. See *Firewall settings on page 27* for information about how to enable these protocols.

The Public Network can be configured with a fixed IP address, or as a DHCP client, either in RobotStudio or from the FlexPendant:

- **Defining network settings in RobotStudio:**
  1. In the **Configuration** browser, right-click the controller and select **Properties** and then **Network settings**.



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  2. In the **Network settings** window, set the values for:
     - **IP address**: The IP address for the OmniCore controller on the EtherNet network.
     - **Subnet mask**: The subnet mask.
     - **Default gateway**: The default gateway.

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2.1.1 Ethernet networks on OmniCore

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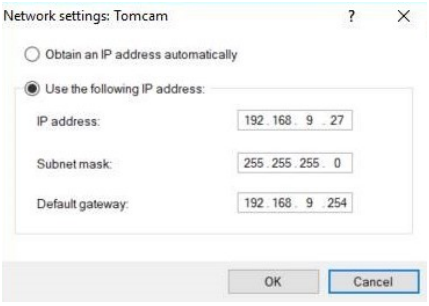

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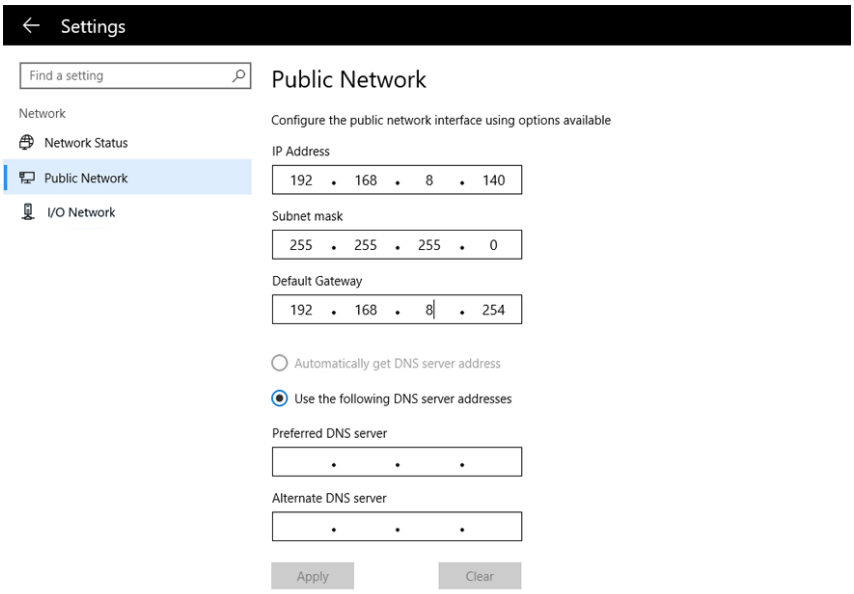
- **Defining network settings on the FlexPendant:**
  1. On the start screen, tap **Settings**, and then select **Network** from the menu.
  2. Select **Public Network** and define **IP Address** for the controller. Tap **Apply**.



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I/O Network

The I/O Network is needed when an Industrial Ethernet network must be isolated from the Public Network. It is configured from the FlexPendant:

1. On the start screen, tap **Settings**, and then select **Network** from the menu.

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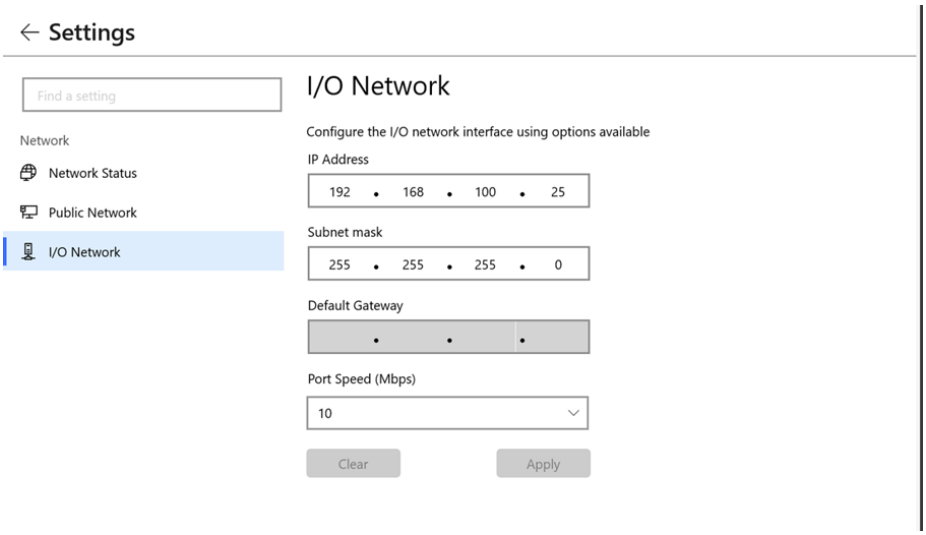
2 Select **I/O Network** and define **IP Address** for the controller. Tap **Apply**.



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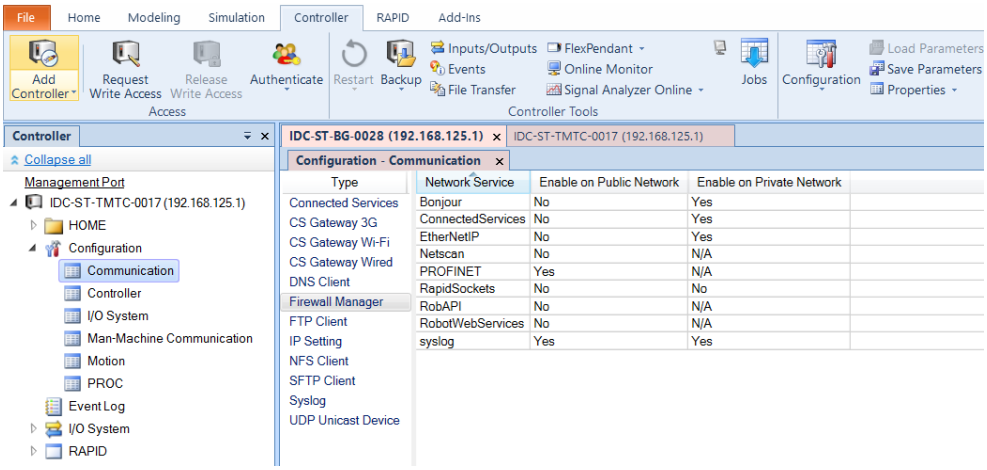
Firewall settings

The Firewall Management function is used to configure the network firewall on the controller. Configuration is done in RobotStudio under **Configuration\Communication\Firewall Manager** where pre-configured Network Services can be enabled or disabled:



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Note

Only pre-registered Network Services can be configured in the Firewall Manager settings. The user cannot add new Network Services in the Firewall Manager and can only change the parameters **Enable on Public Network** and **Enable on Private Network** for pre-registered Network Services.

Continues on next page

2.1.1 Ethernet networks on OmniCore
Continued

> **Note**
>
> Only users with UAS grant **Modify network security properties** can modify the firewall settings.

For more information, see *Technical reference manual - System parameters*.

2.2 Ethernet switches

Prerequisites

It is recommended that switches used in the I/O network support Quality of Service (QoS).

I/O devices mark their packets with a priority value. The priority value is used in order to get better I/O data throughput and shorter delays on the network.

Switches and routers are then able to differentiate the device's critical from the other non-critical traffic. To do this, the switches and routers must support Quality of Service.

2.3 I/O devices

Limitations

It is possible to connect any type of PROFINET-IO compliant I/O device on the PROFINET controller network. All I/O devices should comply with the PROFINET standard and be conformance tested by PROFINET international. I/O devices may be mounted inside the controller.

3 Software overview

3.1 Information about the internal device

General

To use the PROFINET internal device, the OmniCore controller must be installed with the option *3020-2 PROFINET Device*.

The PROFINET internal device can be used to:

- connect an OmniCore controller to a PLC.
- connect an OmniCore controller to another OmniCore controller which acts as a PROFINET controller.

Predefined network

When the robot system is installed with the *PROFINET* option, a predefined network with the name *PROFINET* is created at system startup.

Use the I/O Engineering Tool to configure the PROFINET network for initial use. For example, by setting the correct network name and IP settings. The DCP protocol can also be used to set station name and IP-address when running as a device.

Input and output size

PROFINET has an internal device with maximum 2048 digital input signals and maximum 2048 digital output signals. Apart from this, if PROFIsafe is used, 64 safety digital input signals and 64 safety digital output signals can also be added.

The following table shows the possible modules that can be configured for the internal device:

Slot	Possible modules	Comment
01	DO 8 bytes DO 16 bytes DO 32 bytes DO 64 bytes DO 128 bytes DO 256 bytes	
02	DI 8 bytes DI 16 bytes DI 32 bytes DI 64 bytes DI 128 bytes DI 256 bytes	

Continues on next page

Slot	Possible modules	Comment
03	SDO 8 bytes SD-IO 8 bytes SDO 8 bytes/4-bytes crc	**Note** The *SDO 8 bytes* and *SD-IO 8 bytes* module is compatible with PROFINET version 2.4. The *SDO 8 bytes/4-bytes crc* module is compatible with PROFINET version 2.6.1. **Note** If the *SD-IO module* (both input and output) is selected, slot 04 will not be available for configuration.
04	SDI 8 bytes SDI 8 bytes/4-bytes crc	**Note** The *SDI 8 bytes* module is compatible with PROFINET version 2.4. The *SDI 8 bytes/4-bytes crc* module is compatible with PROFINET version 2.6.1.

Tip

If a configuration mismatch between the connecting PLC and the internal device occurs, an event message is generated on the FlexPendant or the RobotStudio. This event message informs the user of the present slot configuration of the internal device.

Note

The *Input Size* sets the size on digital outputs and *Output Size* sets the size on digital inputs, seen from the PLC's point of view.

3.2 Information about the internal controller

General

To use the PROFINET internal controller, the OmniCore controller must be installed with the option *3020-1 PROFINET Controller*.

The PROFINET internal controller can be used to:

- connect PROFINET devices to the OmniCore controller.
- connect the OmniCore controller to another OmniCore controller which acts as a PROFINET device.

GSD files

In order to configure a PROFINET network with the I/O Engineering Tool, GSD files need to be imported into the tool. These files contains vital information about the PROFINET I/O devices and they are supplied by the vendor/manufacturer of the specific PROFINET module.

For information regarding how to import a GSD file, see *Importing the GSD files on page 52*.

3.3 Software for configuring a device

General

The PROFINET internal device needs to be configured in the I/O Engineering Tool before it can be connected to a PLC/PROFINET controller. Furthermore, the connecting PLC/PROFINET controller might need a PC software tool to configure all connection parameters used to connect to the OmniCore system.

GSD file for configuring the internal device for a PROFINET controller

The provided GSD file for the OmniCore PROFINET device is used to inform the connecting PLC / PROFINET controller of supported connection parameters.

The GSD file, *GSDML-V2.xx-ABB-Robotics-OmniCore-YYYYMMDD.xml*, for the internal device can be obtained from the RobotStudio or the OmniCore controller.

- **In the RobotWare installation folder in RobotStudio**:
  ...\DistributionPackages\ABB.RobotWare-x.x.x-xxx\RobotPackages\RobotControl_x.x.xxx\utility\service\GSDML
- **On the OmniCore Controller**:
  ...\products\RobotControl_x.x.x\utility\service\GSDML

> **Note**
>
> Navigate to the RobotWare installation folder from the RobotStudio **Add-Ins** tab, by right-clicking on the installed RobotWare version in the **Add-Ins** browser and selecting **Open Package Folder**.

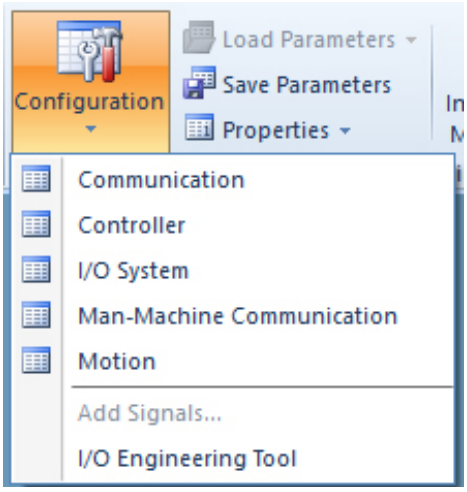
4 The I/O Engineering Tool user interface

4.1 The user interface

Start the I/O Engineering Tool

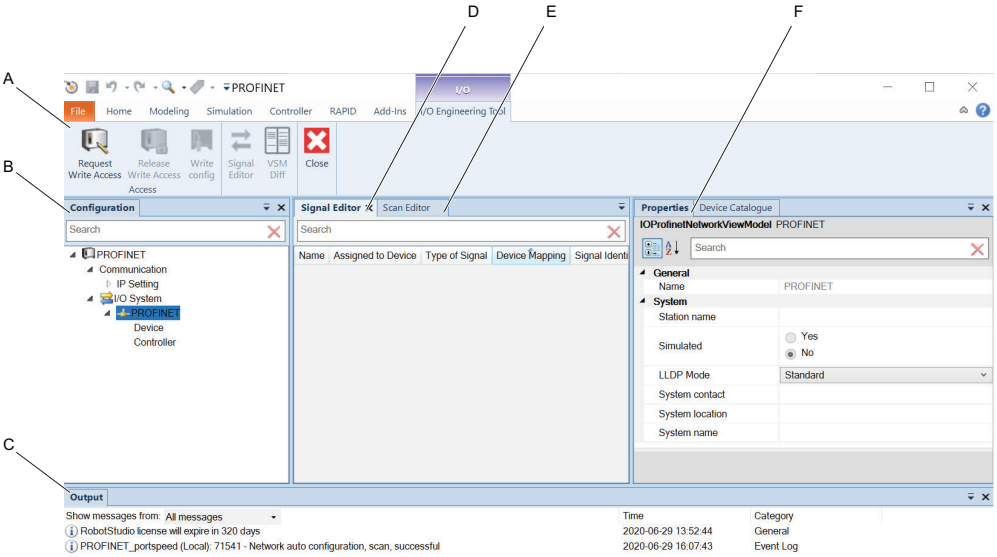
1 Start RobotStudio and connect to the robot system to configure.

2 In the ribbon of the **Controller** tab, click **Configuration** and select **I/O Engineering Tool**.



Overview of the user interface

This section presents an overview of the I/O Engineering Tool graphical user interface.



	Parts	Description
A	Ribbon	Displays command buttons organized in a logical sequence of function.
B	**Configuration** browser	Displays the I/O configuration tree with information of I/O system and its parameters.

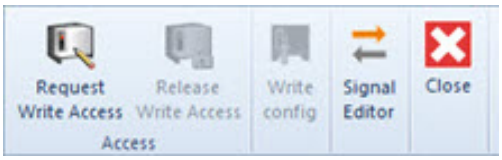
Continues on next page

	Parts	Description
C	**Output** window	Displays the information about the events that occur in controller and I/O devices.
D	**Signal Editor**	Displays the signals assigned to the selected I/O device. Enables to add or delete signals of I/O device.
E	**Scan Editor**	Displays the information of the I/O devices that are found on the network seen through the given port in the bus definition.
F	**Properties** browser	Displays all available properties and settings of the selected I/O device or Configuration nodes. The following tabs are available: • **Properties** tab - displays the properties of the selected I/O device. • **Device Catalogue** tab - displays the device catalogues used for configuring the I/O devices.

4.2 The ribbon

Layout of the ribbon

This section describes the functions of the command buttons.



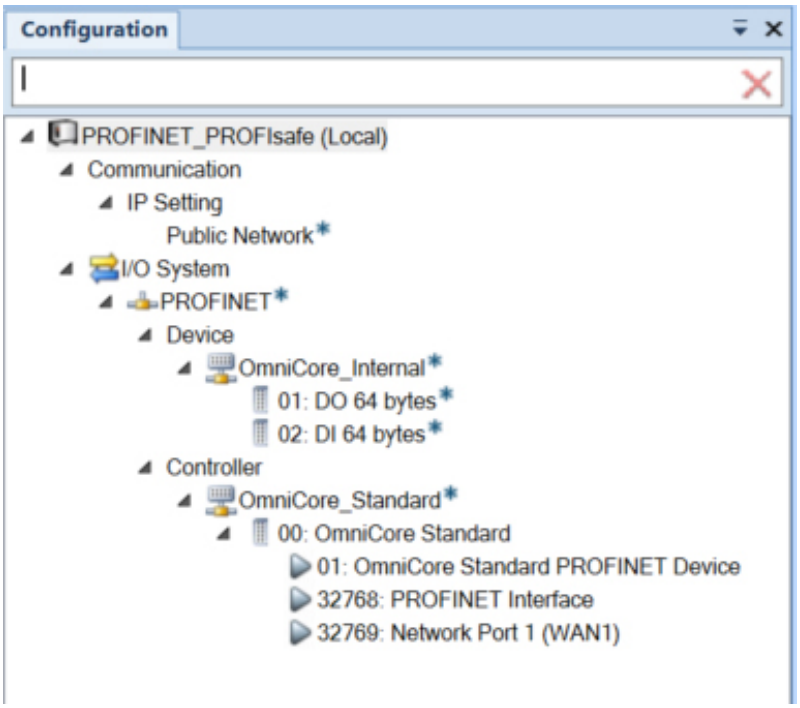
The ribbon contains following command buttons:

Button	Functions used for
Request Write Access	Requests write access.
Release Write Access	Releases the write access after editing I/O configuration.
Write config	Writes configuration to the controller and the pending changes to the controller. **Note** Needs write access.
Signal Editor	Displays the signals assigned to the I/O device.
Close	Closes the I/O Engineering Tool view.

4.3 Configuration browser

Introduction

The Configuration browser displays hierarchical structure of controller and configuration elements in the **I/O Engineering Tool** tab. The following figure displays the Configuration browser that contains *Communication* and *I/O System* node in tree structure. You can click each node to view the parameters and edit the selected parameter in the **Properties** tab.



Note

Correct the validation error on each element in the Configuration browser before writing the configuration to the controller.

Communication node

The Communication node contains parameters for configuring the main computer's connectivity using Ethernet ports. For more information on parameters, see *Communication* in *Technical reference manual - System parameters*.

The parameters are organized in the following elements:

Element	Description
IP Setting	Used to set an address to a network interface of the main computer. The parameters in the IP setting is visible in the **Properties** tab. It includes *Label*, *IP*, *Subnet*, and *Interface* parameters. Right-click to add new Industrial networks.

Continues on next page

I/O System node

The I/O System node contains parameters for I/O devices and signals. You can configure generic I/O devices and safe I/O devices in the I/O System node.

Element	Description
Industrial Network node (for example **PROFINET**)	It displays the industrial network that is used in the controller. The parameters of the corresponding industrial network is visible in the **Properties** tab. Right-click PROFINET node to show a shortcut menu with options: • Scan network • Import
Device	Under the **Device** node, the internal devices (where the robot controller acts as a PROFINET device) are shown. The parameters of the internal devices are displayed in the **Properties** tab.
Controller	The **Controller** node represents a network where the robot controller acts as PROFINET controller. Under the **Controller** node are representations of all real I/O devices that are connected to the industrial network where the robot controller acts as PROFINET controller. You can configure the parameters of the I/O devices in the **Properties** tab.

Symbols

The following symbols display the status of the I/O device, controller or entity.

Symbol	Explanation
	Indicates incomplete information. You can enter the pending information in the **Properties** tab.
	Indicates that there are unsaved changes.
	Indicates a sub-module belonging to an I/O module. The sub-module is used configure some parameters for the I/O module (e.g. input delay).
Yellow line mark	Identifier for a safety I/O device.
	Identifies an unknown device which is not mapped to a GSD definition.
	Identifies a device with an old configuration where signals are configured directly under the device. In a new configuration, the device would have slots for I/O modules that contains the signals.

Note

Point to the entity with error to view the corresponding validation error.

Continues on next page

Right-click menu

Within the Configuration browser tree structure, you can right-click the device or module to show a shortcut menu with various operations (not all are available for all devices):

Setting	Description
Delete	Removes the device from the Configuration browser tree structure. However, the slot position is available for a new or another slot, which can be inserted in the controller.

4.4 Properties browser

Properties tab

The **Properties** tab displays the parameters of the Communication node and I/O System node. You can configure the parameters visible in the **Properties** tab. For more information about parameters, see *Technical reference manual - System parameters*.

Device Catalogue tab

The **Device Catalogue** tab displays the predefined device templates or catalogues used to configure the I/O device. For PROFINET devices, GSD files are imported to configure the I/O devices. The installed device templates are visible in the **Device Catalogue** tab.

4.5 Signal Editor

Overview

The **Signal Editor** tab displays the signals that are assigned to the I/O device. It is used to view existing signals and to add new signals to the I/O device and its modules.

Signals can be added both on device level and module level. On device level, you can also define group signals that cover signals for several modules. See *Create group signals on page 58* for information about group signal configuration.

For more information about the signal attributes, see *Technical reference manual - System parameters*.

4.6 Scan Editor

Overview

The **Scan Editor** tab displays the I/O devices discovered in the controller network scan. It displays information such as *MAC*, *Station Name*, *IP*, *Subnet*, *Gateway*, *Vendor Id*, and *Device Id*.

When scan network is run, **Scan Editor** displays all the I/O devices connected to the given network port for the PROFINET bus. You can then configure the I/O devices that are found but not already configured in the controller. For more information, see *Scanning the network on page 53*.

Note

PROFINET station name follows the PROFINET naming convention. It uses lower case alphabets for naming station name.

Right-click menu

Within the **Scan Editor**, you can right-click the device row to show a menu of options:

Setting	Description
Add as	Selects a device and add it to the configuration tree.
Blink	Blink with the device status LEDs in order to identify it.
Factory Reset	Resets the IP settings of the device to factory reset.

The following buttons are available in the **Scan Editor**:

Setting	Description
Refresh	Lists all the devices that are reachable on this network.
Export	Exports a .csv file with all devices and the columns with data for each device.
Send Changes	To change a device's parameters, double-click on that device and enter the values that needs to be changed. Clicking **Send Changes** will save these changes in the device.

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5 Setting up your PROFINET system

5.1 Logging in with configuration grant

Log in with configuration grant

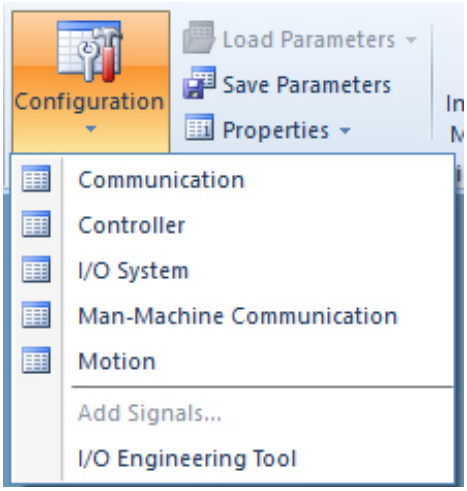
For configuration in I/O Engineering Tool, the user grant **Modify configuration** is required. See *Operating manual - RobotStudio*, section *Managing user rights and write access on a controller*.

5.2 Starting the I/O Engineering Tool

Start the I/O Engineering Tool

1 Start RobotStudio and connect to the robot system to configure.

2 In the ribbon of the **Controller** tab, click **Configuration** and select **I/O Engineering Tool**.

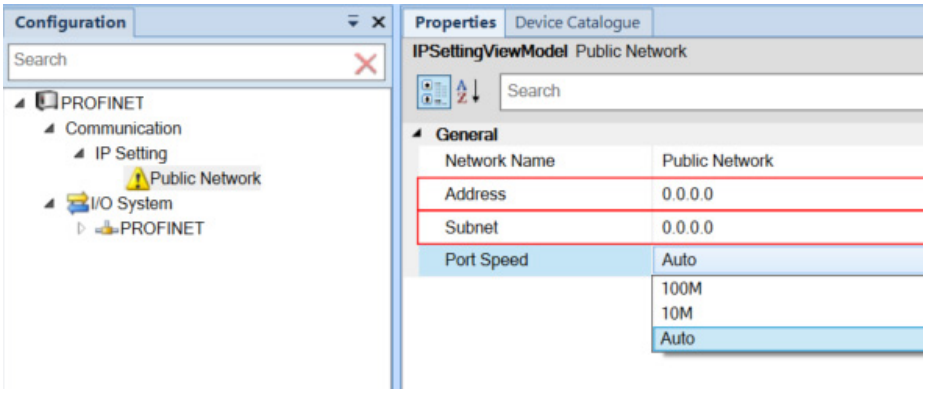


3 In the ribbon, click **Request Write Access** to be allowed to configure the controller.

5.3 Configuring the IP settings

Configure IP settings

1 In the **Configuration** browser, select **Public Network**.



Note

The symbol ⚠ indicates that the configuration of this network is incomplete. A red frame around a property field means that the property is not specified, or causes a validation error.

2 In the **Properties** browser, set the values for:

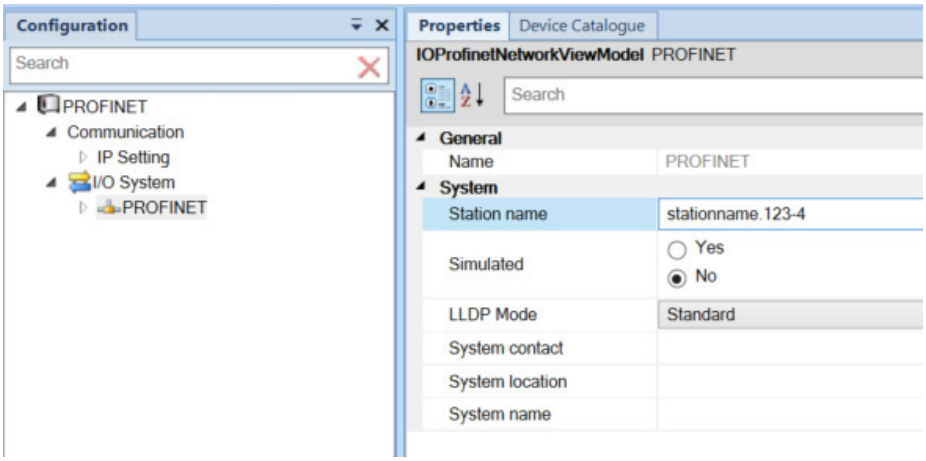
Parameter	Description
Address	Defines the IP address for the controller on the PROFINET network.
Subnet	Defines the subnet mask.
Port Speed	Defines the port speed to be used for the WAN port on the controller (100M, 10M or Auto). **Note** When selecting fixed speed (10M or 100M), auto cross over will be disabled.

5.4 Setting the station name

Set station name

1 In the **Configuration** browser, select **PROFINET** (under I/O system).
2 In the **Properties** browser, specify **Station name**.

> **Note**
>
> This is the name of the internal device as it appears on the Public network. For example, detectable by a PLC.

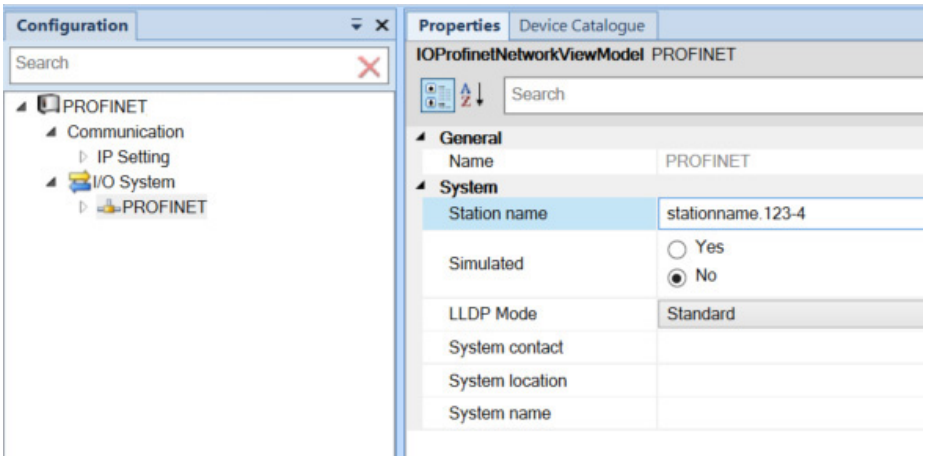


5.5 Configuring the PROFINET network properties

Configure the PROFINET network properties

1 In the **Configuration** browser, select **PROFINET** (under I/O system).

2 In the **Properties** browser, you can configure the following network properties:



Parameter	Description
Simulated	Select **Yes** or **No**, indicating if the industrial network and all its connected I/O devices should be treated as simulated.
LLDP Mode	Select **Standard** or **Legacy**, indicating what Link Layer Discovery Protocol mode should be supported. **Note** The controller supports LLDP, but only on one port at a time. Any network connected to another port must have LLDP disabled (or use equipment not supporting LLDP). **Note** If one device in the configuration only supports legacy mode, all devices must run in legacy mode.

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6 Configuring the internal controller and external devices

6.1 Configuring with I/O Engineering Tool

6.1.1 Configuration prerequisites

Prerequisites

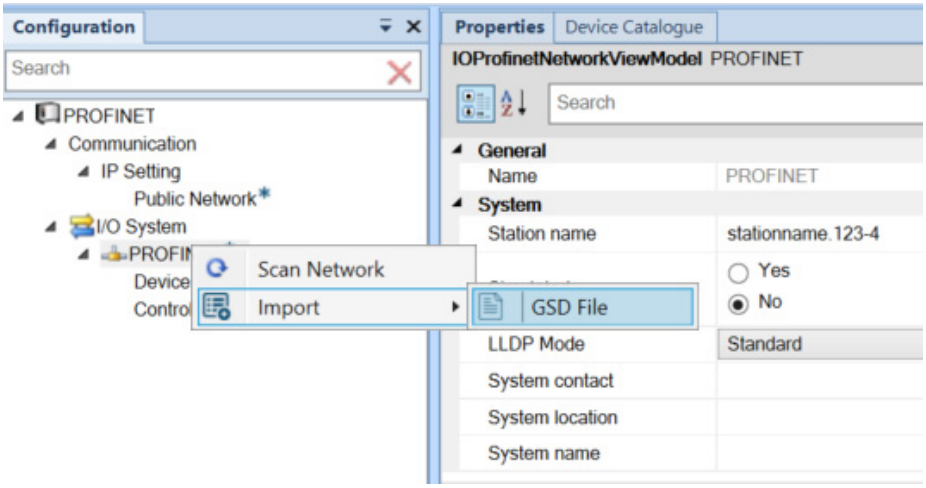
Before configuring the internal controller and external device, make sure to set up your system according to *Setting up your PROFINET system on page 45*.

6.1.2 Importing the GSD files

Import GSD files

A GSD file contains data about a device. It is necessary to add GSD files for all devices that should be added. It is also possible to add GSD files for any devices that may be added later.

1 In the **Configuration** browser, right-click on **PROFINET** (under I/O system), select **Import** and then **GSD File**.



2 Select the GSD file for the I/O device to add to the network.

6.1.3 Scanning the network

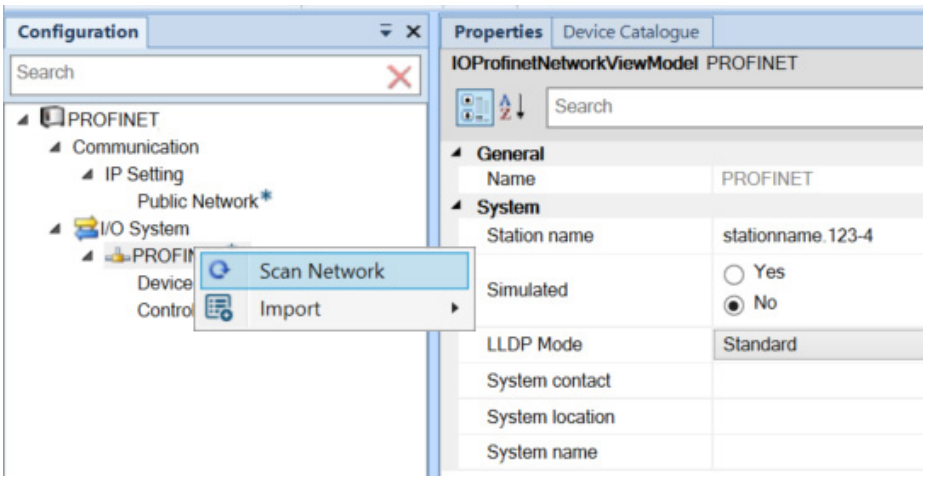
Scan the network

If the controller is connected to a physical PROFINET network with the I/O devices already in place, this describes how to scan the network to find available devices.

This scanning is performed on the network connected to the port selected in the network properties. See *Configuring the IP settings on page 47*.

If you want to configure the network before the physical network is in place, follow the instruction *Manually adding devices to your network on page 54*.

1 In the **Configuration** browser, right-click on **PROFINET** (under I/O system) and select **Scan Network**.



Tip

Use the **Blink** functionality to detect the correct unit when multiple devices are connected.

When a device is identified, the PC-STAT LED on the device will flash green with a frequency of 1Hz.

2 Add the detected device by right-clicking the device and selecting **Add as**. Select the configuration that corresponds to the physical device. The device is now displayed in the **Configuration** browser under the **PROFINET** / **Controller** node.

3 The properties for the device are added automatically in the **Properties** browser. Make sure these are correct.

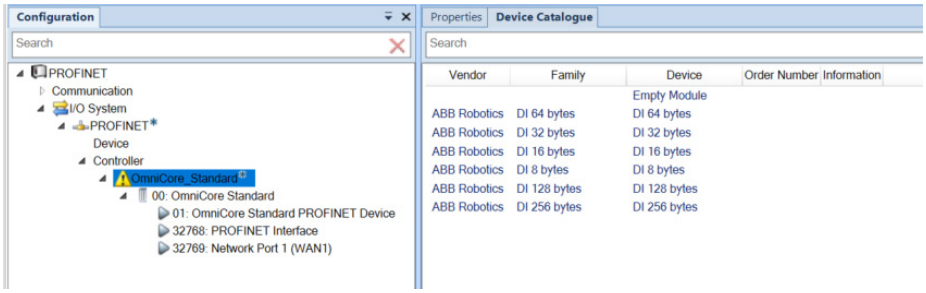
6.1.4 Manually adding devices to your network

Manually add devices to your network

1 In the **Configuration** browser, expand **PROFINET** and select **Controller**.

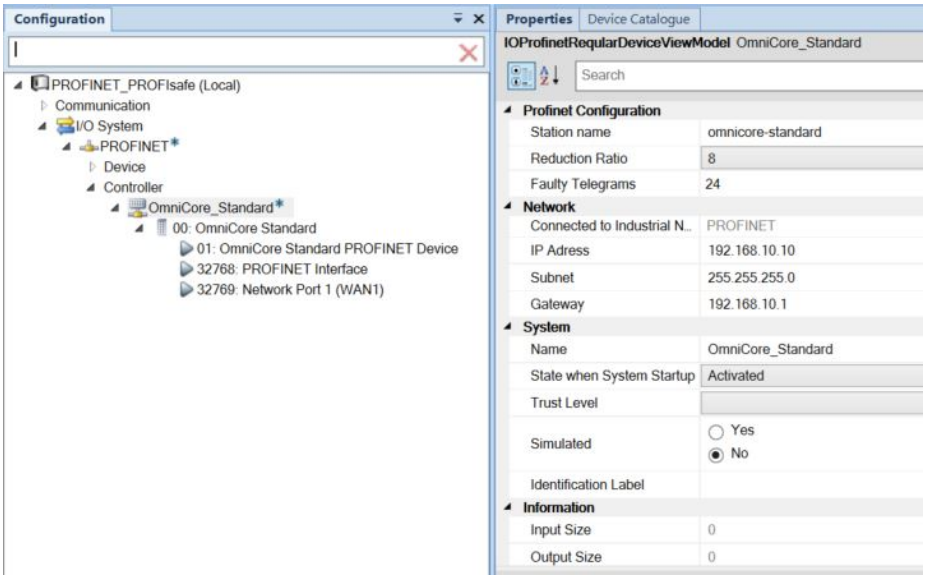
2 Select the **Device Catalogue** tab to show a list of available communication modules.

3 Double-click on a communication module in the list to add it to the controller.



The added communication module is automatically selected. If the communication module contains an internal I/O module (physically included on the communication module), it is added as the first I/O module under the communication module.

4 In the **Properties** tab, specify the properties for the communication module:



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Note

A red frame around a property field means that the property is not specified, or causes a validation error.

Parameter	Description	Allowed values
Station name	This parameter is used to identify a PROFINET device on the network. The name must be unique on the network.	
Reduction Ratio	This parameter indicates how frequently the cyclic I/O messages should be exchanged. For example, a **Reduction Ratio** of 4 means that I/O data is sent every 4 ms.	Valid range is 1 to 512.
Faulty Telegrams	The number of missed frames that lead to device timeout, for example the value 3 leads to a timeout for three missed frames in a row.	Valid range is 3 to 255.
IP Address	Defines the IP address for the external device on the PROFINET network.	
Subnet	Defines the subnet mask for the external device.	
Gateway	Defines the gateway for the external device.	
Name	The name of the external device is used as a reference to the specific external device when configuring the I/O signals and device commands.	A string with maximum 32 characters. The string must follow the RAPID rules described in *Technical reference manual - RAPID Overview*. The name must be unique among all named objects in the I/O system configuration. **Note** Names differing only in upper and lower case are considered to be equal.
State when System Startup	Defines the logical state that the robot system shall try to set for the external device at system startup. The available options are: • Establish communication (Activated) • Don't establish communication (Deactivated) • Restore the previously stored logical state for the external device at system shutdown (Last State)	

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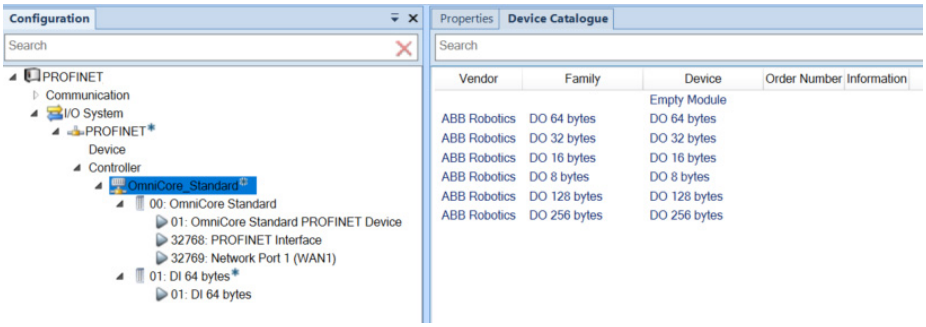
6.1.4 Manually adding devices to your network
Continued

Parameter	Description	Allowed values
Trust level	Defines the behavior for external devices at different execution situations in the robot controller. The **Trust Level** only affects physical devices controlled by an industrial network master in the robot controller. An internal slave device is not controlled by an industrial network master in the robot controller and is therefore not affected by this setting.	A string corresponding to the name of a defined Device Trust Level type. A string with maximum 32 characters. The string must follow the RAPID rules described in Technical reference manual -RAPID Overview. The string must follow the RAPID rules described in *Technical reference manual - RAPID Overview*. **Note** Names differing only in upper and lower case are considered to be equal.
Simulated	Select **Yes** or **No**, specifying if the industrial network and all its connected external devices should be treated as simulated.	
Identification Label	This parameter is an optional way to provide a label that will help the operator to identify the external device.	A string with maximum 80 characters.
Media Redundancy Protocol	Media Redundancy Protocol (MRP) is a data network protocol standardized by IEC 62439-2. It is a redundancy protocol supported by all PROFINET capable devices that will allow a network to be configured in a ring topology to overcome any single failure on the network.	Select **Enabled** or **Disabled**, specifying if the MRP should be enabled or not. **Note** The robot controller has no support for MRP.

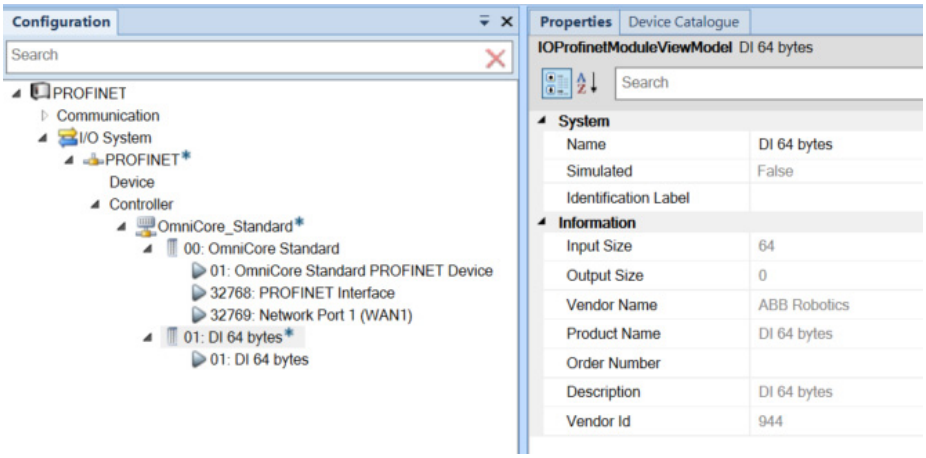
6.1.5 Adding I/O modules

Add I/O modules

1 To add I/O modules, select the communication module and double-click on the I/O modules in the **Device Catalogue**.



2 Select the sub-module in the **Configuration** browser and configure the module settings in the **Properties** browser. These properties are extracted from the GSD file for the I/O module.



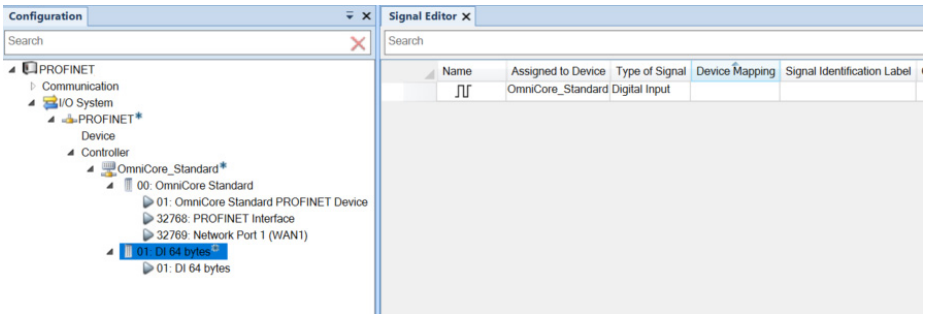
Note

Note that the channel configuration for all inputs and outputs may by default be disabled and may have to be activated before an input or output can be used on the specific channel.

6.1.6 Editing signals

Edit signals

1. In the ribbon, click **Request Write Access**.
2. If the signal editor is not visible, open it by clicking **Signal Editor**.
3. In the **Configuration** browser, select the I/O device or I/O module for which signals are to be configured.
4. In column **Name**, define a name for each signal.

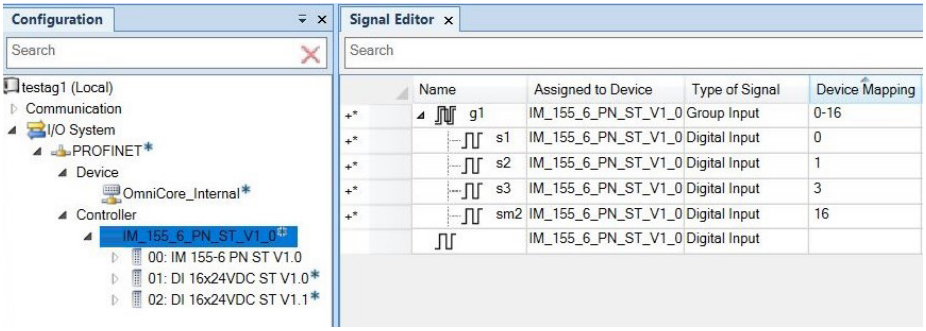


Create group signals

Group signals can be created on device level and on module level.

1. In the ribbon, click **Request Write Access**.
2. If the signal editor is not visible, open it by clicking **Signal Editor**.
3. In the **Configuration** browser, select the I/O device or I/O module for which a group signal is to be added.
4. Right-click and select **Insert** to add a new row.
5. Complete the following:
   - **Name**: Enter a name for the group signal.
   - **Device Mapping**: Define the span of signals to be included in the group.

     For example, if 0-16 is defined, all signals with a device mapping value within this span will be included in the group.



6.1.7 Saving the configuration

Save configuration

When the configuration is finished, save the configuration to the robot controller.

If you do not already have write access, click **Request Write Access** in the ribbon to be allowed to configure the controller.

In the ribbon, click **Write config**. When asked if you would like to restart the controller, answer **Yes** for the new configuration to take effect.

6.2 Using Fast Device Startup

About Fast Device Startup

The Fast Device Startup functionality is used in tool changing applications to shorten the connection time between the PROFINET controller and an I/O device. To be able to use this functionality, the I/O device needs to support this functionality. All devices must support fast startup in the communication chain; devices such as switches or other intermediate hardware that could affect the PROFINET communication. For more information, see *Poor performance using fast startup on page 76*.

Some manufacturers also call this functionalityFast Start Up (FSU) or Prioritized Startup.

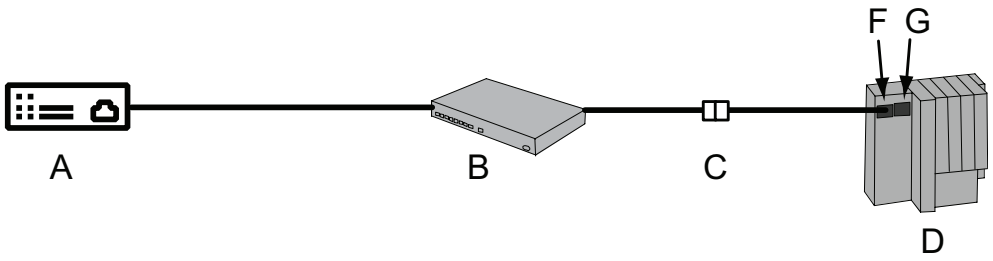
To activate Fast Device Startup against an I/O device, activate the system parameter *Fast Device Startup* and select the corresponding port(s) to be configured. See *Activating Fast Device Startup for external devices on page 62* and *Configuring port speed for external devices on page 63*.

Note

The I/O device with FSU functionality is connected with the OmniCore controller. When the power of the I/O device is switched off and switched on again, the OmniCore controller establishes contact with the I/O device using the fast startup sequence.

Three alternative connections

I/O device connected via a switch



xx1100000093

A	OmniCore controller acting as PROFINET controller
B	Switch
C	Connection point
D	I/O device
F	Port 1 on the device
G	Port 2 on the device

In this alternative the PROFINET controller connects to the I/O device via a switch. Enable fast device startup and select 100 MBit (full duplex) on port 1. The port number is usually displayed upon the I/O device itself.

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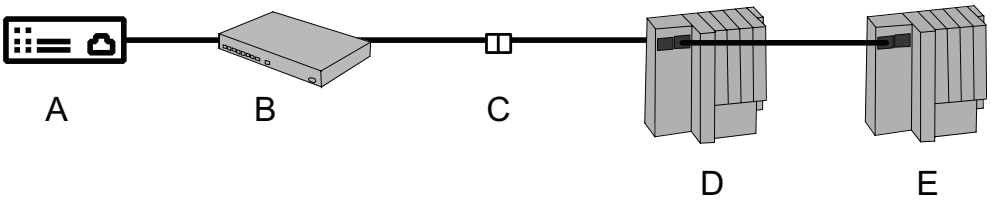
Two I/O devices connected in serial via a switch



xx1100000094

A	OmniCore controller acting as PROFINET controller
B	Switch
C	Connection point
D	I/O device
E	I/O device

In this alternative, both I/O devices are disconnected at the connection point. Both port 1 and port 2 on the first device (D) and port 1 on the second device (E) needs to be configured to support Fast Device Startup.

I/O device connected without a switch

xx1100000095

A	OmniCore controller acting as PROFINET controller
C	Connection point
D	I/O device

In this alternative there is a direct cable between the PROFINET controller and the I/O device. Enable fast device startup and select 100 MBit (full duplex) on the port. A crossed Ethernet cable needs to be used.

MDI settings for fixed port speed

When fixed port speed is used, the interface WAN on the robot controller has the Medium-dependent interface set as **MDI**.

Thus, Auto MDI-X functionality is disabled, and the user must be aware of the link-partners setting and what type of cable to use in order to achieve a link.

The following table displays the cable requirements for the Ethernet link:

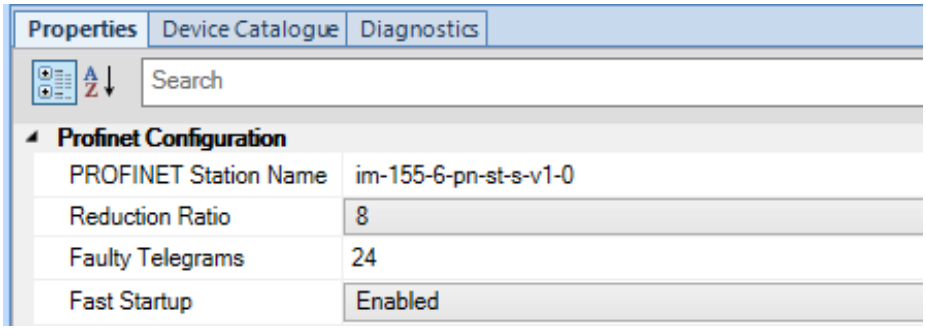
	MDI	**MDI-X**	**Auto MDI-X**
MDI	crossover	straight	any
MDI-X	straight	crossover	any
Auto MDI-X	any	any	any

Continues on next page

6.2.1 Activating Fast Device Startup for external devices

The following steps describe how to activate Fast Device Startup for an external device:

1. In the **Configuration** browser, select the external device for which Fast Device Startup should be activated.
2. In the **Properties** browser, set **Fast Startup** to **Enabled**.

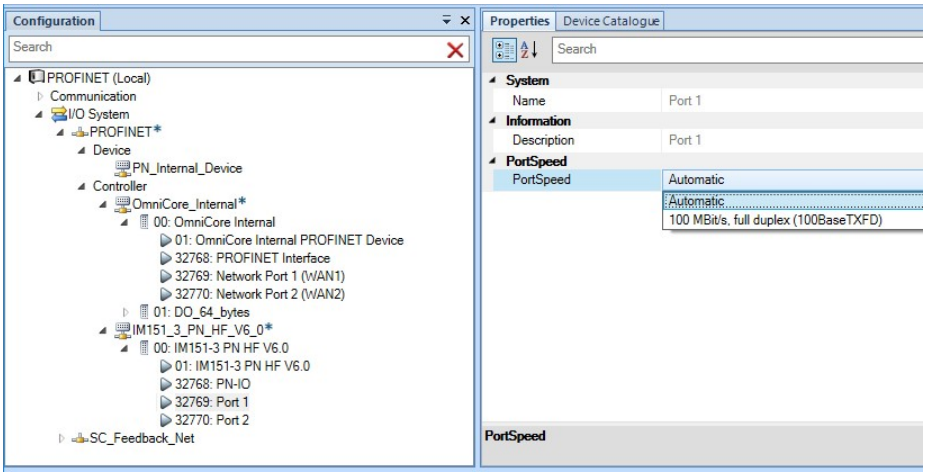


xx1800003277

6.2.2 Configuring port speed for external devices

The following steps describe how to configure port speed for an external device:

1. In the **Configuration** browser, select the external device. Select the port for which port speed should be configured.
2. In the **Properties** browser, select one of the available speed options in **PortSpeed**.



xx1900000905

Note

The GSD file defines what port speeds are allowed for the external device.

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7 Configuring the internal device

7.1 Configuring internal device with I/O Engineering Tool

7.1.1 Configuration prerequisites

Prerequisites

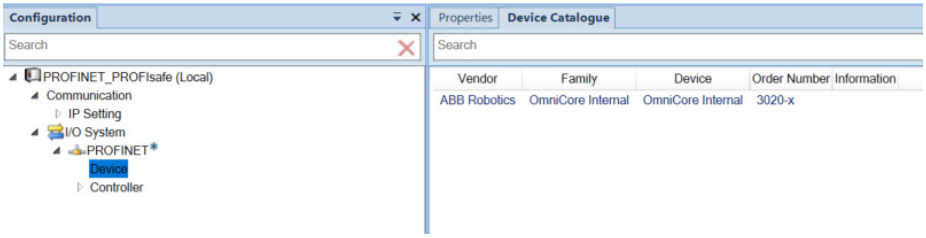
Before configuring the internal device, make sure to set up your system according to *Setting up your PROFINET system on page 45*.

7.1.2 Adding the internal device

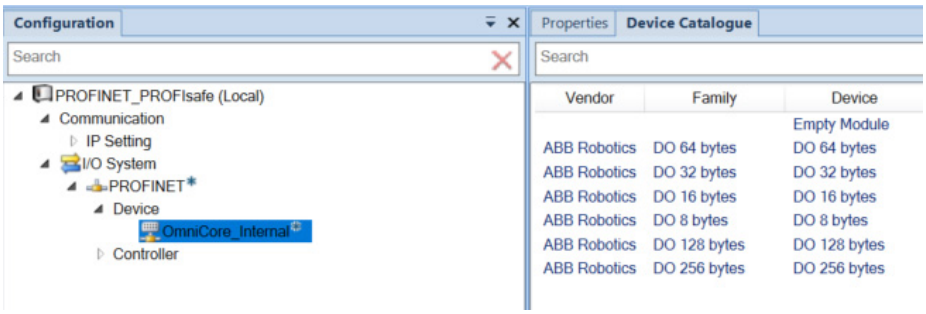
Add internal device

1 In the **Configuration** browser, expand **PROFINET** and select **Device**.

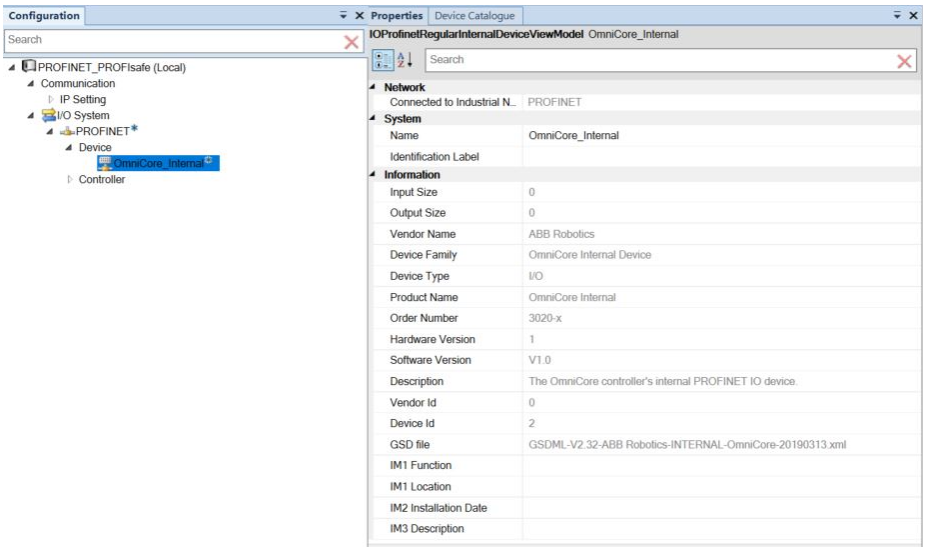
2 Select **Device Catalogue** to view a list of available devices.



3 Double-click a device in the list to add it to the configuration.



4 Select the internal device in the **Configuration** browser and configure the **Properties**:



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Parameter	Description	Allowed values
Name	The name of the internal device is used as a reference to the specific internal device when configuring the I/O signals and device commands.	

Continues on next page

Parameter	Description	Allowed values
Identification Label	This parameter is an optional way to provide a label that will help the operator to identify the internal device.	A string with maximum 80 characters.

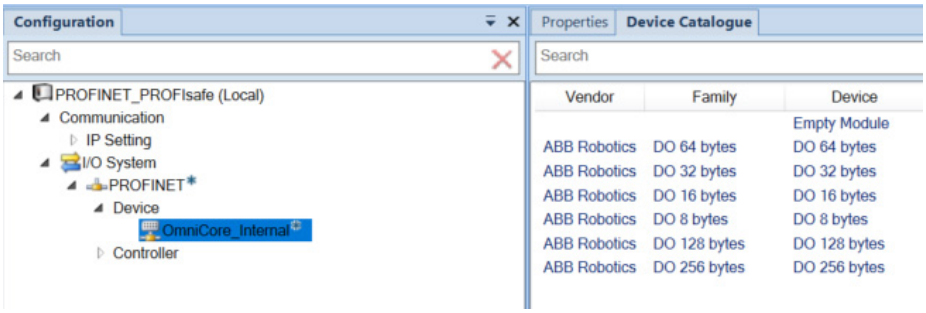
5 Continue by adding I/O modules to the internal device. See *Adding I/O modules to the internal device on page 68*.

7.1.3 Adding I/O modules to the internal device

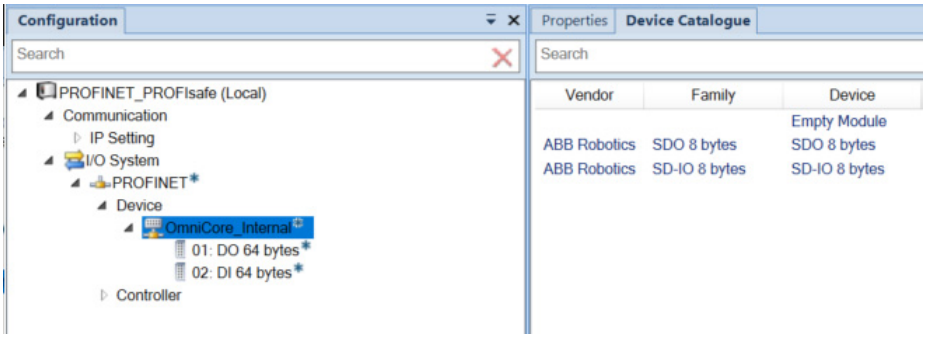
Add I/O modules to internal device

1 In the **Configuration** browser, expand **PROFINET** and **Device**. Select the internal device for which I/O modules should be added.

2 Select **Device Catalogue** to view a list of available I/O modules.



3 Double-click the I/O modules (output and input) in the list to be added to the internal device.



Note

There are a set of rules for which type of I/O modules that are allowed for each slot. Only the the modules presented in the **Device Catalogue** are allowed to select for that slot.

Note

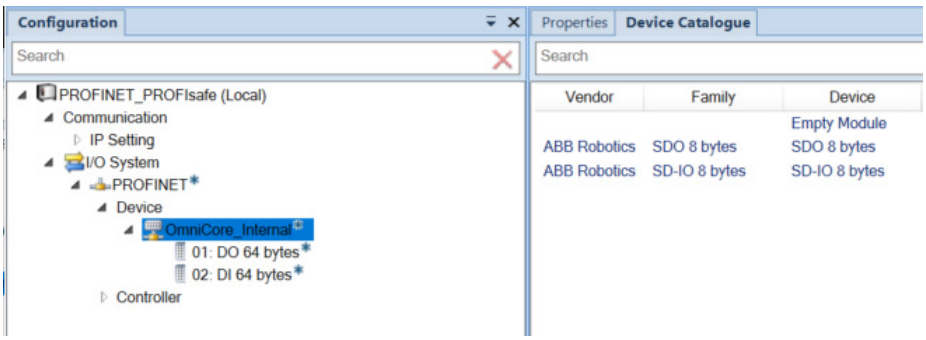
All unconfigured slots are configured in numerical order. For example, if the modules are deleted from slot 1 and 2, you may have to select a DO in slot 1 before being able to select a DI in slot 2.

Add safety I/O modules to internal device (for option 3023-2 PROFIsafe Device)

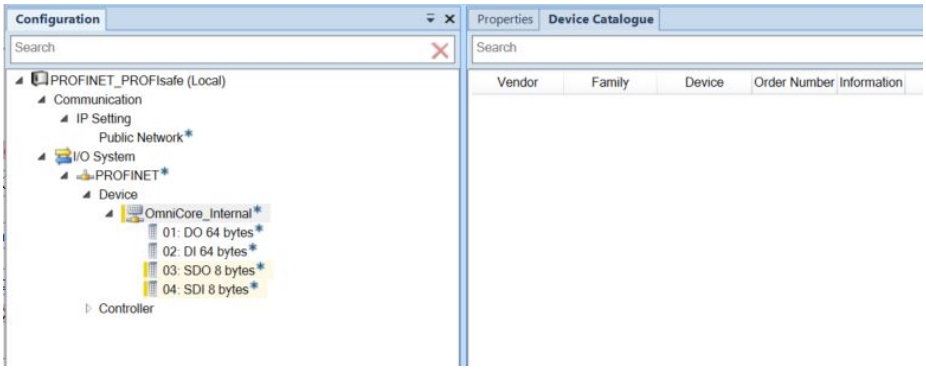
1 In the **Configuration** browser, expand **PROFINET** and **Device**. Select the internal device for which safe I/O modules should be added.

Continues on next page

2 Select **Device Catalogue** to view a list of available safe I/O modules.



3 Double-click the safe I/O modules (output and input) in the list to be added to the internal device.



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Note

There are a set of rules for which type of I/O modules that are allowed for each slot. Only the the modules presented in the **Device Catalogue** are allowed to select for that slot.

Note

All unconfigured slots are configured in numerical order. For example, if the modules are deleted from slot 1 and 2, you may have to select a DO in slot 1 before being able to select a DI in slot 2.

Note

A yellow marking beside the module symbol indicates a safe I/O module. If any safe module is included in the internal device, a yellow marker is shown by the internal device as well.

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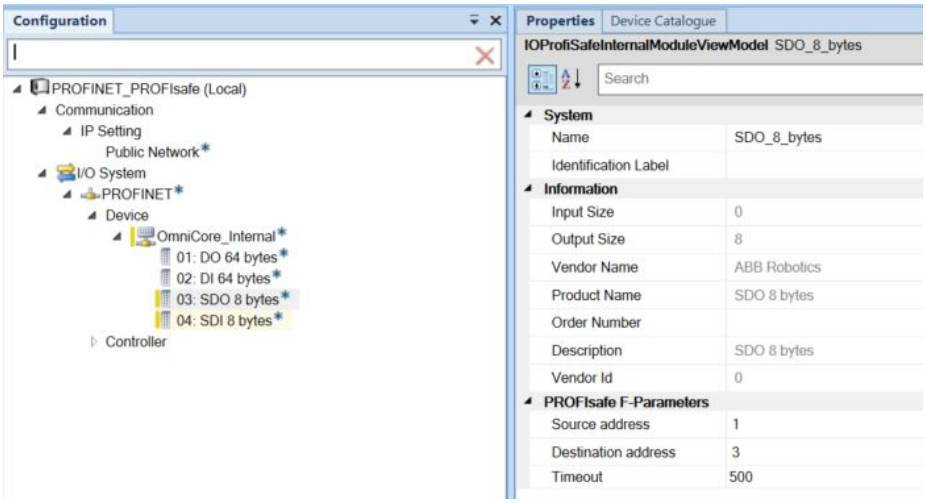
7.1.3 Adding I/O modules to the internal device
Continued

4 Select the safe I/O module in the **Configuration** browser and configure the **PROFIsafe F-Parameters**:



xx2000001934

PROFIsafe F-Parameter	Description
Source address	The PROFIsafe address **Source address** combined with the **Destination address** uniquely identifies the module. Both addresses are decimal values.
Destination address	The **Destination address** should be the same as the address switch on the module.
Timeout	A valid current safety message frame must arrive within the monitoring time, defined in milli seconds.

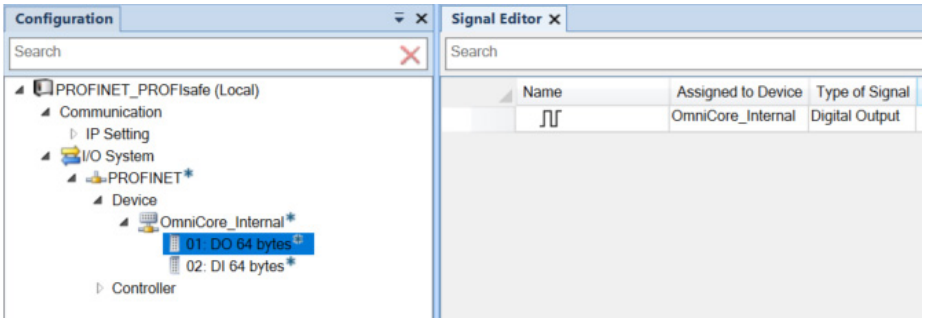
7.1.4 Editing signals

Edit signals

1 In the ribbon, select **Signal Editor**.

2 In the **Configuration** browser, select the I/O module for which signals are to be configured.

3 In the column **Name**, type the name each signal should have.

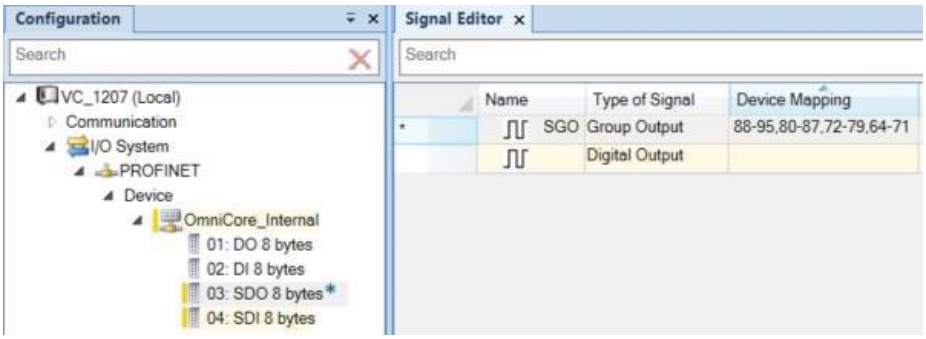


7.1.5 Creating safety integers

Create safety integers

When creating safety integers, the signal should be 32-bit long and the device mapping should have the most significant byte first.

1. In the ribbon, select **Signal Editor**.
2. In the **Configuration** browser, select the I/O module for which the signal is to be created.
3. In the column **Name**, type the name of the signal.



xx2100000038

4. In the column **Type of Signal**, select **Group Output** or **Group Input**.
5. In the column **Device Mapping**, enter the device mapping values. If the offset is 64, type the mapping using the format: 88-95,80-87,72-79,64-71. This will create a safety integer mapped 0-31.
6. Press **Enter** to create the signal.

7.1.6 Saving the configuration

Save configuration

When the configuration is finished, save the configuration to the robot controller.

If you do not already have write access, click **Request Write Access** in the ribbon to be allowed to configure the controller.

In the ribbon, click **Write config**. When asked if you would like to restart the controller, answer **Yes** for the new configuration to take effect.

Note

If a signal is used by the safety module, for example in the combinatory logic, it cannot be renamed or removed from the signal editor. This is displayed with a shield symbol.

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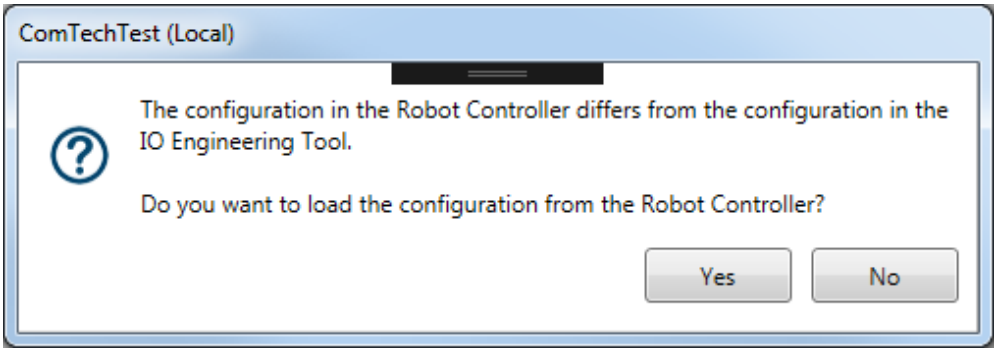
8 Troubleshooting

8.1 Troubleshooting scenarios

Inconsistency between IO Engineering Tool and system parameters

The configuration of the IO Engineering Tool is stored in a memory, that can be written to the robot controller. If the system parameters are updated on the robot controller in any other way while IO Engineering Tool is running (or in some cases of failure in communication), the configuration memory of the IO Engineering Tool will be inconsistent with the robot controller. In this case, the following message is shown.



Take Controller Configuration will read the system parameters from the robot controller to the IO Engineering Tool memory. This means that any configurations made in IO Engineering Tool but not yet written to the robot controller will be lost.

Keep local I/O Configuration will not apply any changes to the IO Engineering Tool memory. This means that when the configuration is written to the robot controller, the changes made in another tool will be overwritten.

Problem assigning IP address or station name

If an external PROFINET configuration tool is used to set IP address or station name for a controller or device, it may not be possible to perform that operation. In such a case, make sure that the device or PLC is not involved in any I/O data exchange. If, for example, a device or PLC is exchanging data with another device or PLC, it is not possible to change the IP address or station name of those devices.

Unidentified devices

Devices can be identified using RobotStudio, or other PROFINET tools. To identify the internal device in the robot controller, the PC-STAT LED will flash green with a frequency of 1 Hz.

- For RobotStudio, use the **Blink** functionality in the **Scan Editor**. See *Scan Editor on page 43* and *Scanning the network on page 53*.
- For other tools, see the respective supplier user manuals.

Continues on next page

Unable to connect to a device

If all parameters are correct, but it is still not possible to connect to an device using the PROFINET controller, make sure that the device does not already have an active connection with another controller. Most I/O devices do not accept that two controllers are connected against the same I/O device at the same time. That is, if the device does not allow shared device functionality.

Connections are lost randomly

Lost connections can occur for a number of reasons.

- Bad network
- Overloaded Ethernet switches
- Ethernet cable problems

Another possible reason is that the OmniCore PROFINET is not able to process all the PROFINET requests within the specified time frame. If, for example, 20 I/O devices are used with 1 ms reduction ratio (poll rate), the slightest variation of CPU load on the main computer might cause a protocol disturbance which can lead to a connection timeout. The maximum possible devices that can be used depends on the reduction ratios used, CPU load and data lengths transferred at every data cycle.

There can be connection loss while configuring PROFINET Controller on the same logical subnet as other applications, on the WAN port. It might cause sporadic loss of communication for the applications as well as for the PROFINET communication.

Poor performance using fast startup

In general the startup time for one I/O device using fast startup is less than a second, together with the robot controller. This is highly dependent upon the device itself. Check with the device vendor for detailed description about I/O devices that support fast startup with corresponding performance figures.

- If there are other intermediate hardware on the connection link, that might interfere with the PROFINET connection.
- If there is a chained setup containing multiple devices, there is an increased latency before all devices are running. Depending upon the number of chained devices the total connection time can be more than a second.
- Make sure that the port/ports used for fast startup is selected in the I/O configuration.
- Check with the device vendor for optimal settings when using the I/O device with fast startup. Sometimes device behavior is configurable with a vendor specific tool or through the network configuration tool. According to the GSD file.
- If the device does not support parameterization speedup, the connection time may be longer. If supported by the device, it is included in the GSD file.
- Check that the switch settings are correct according to below:
  - 100 Mbit speed rate with full duplex.
  - Auto negotiation shall be switched off.

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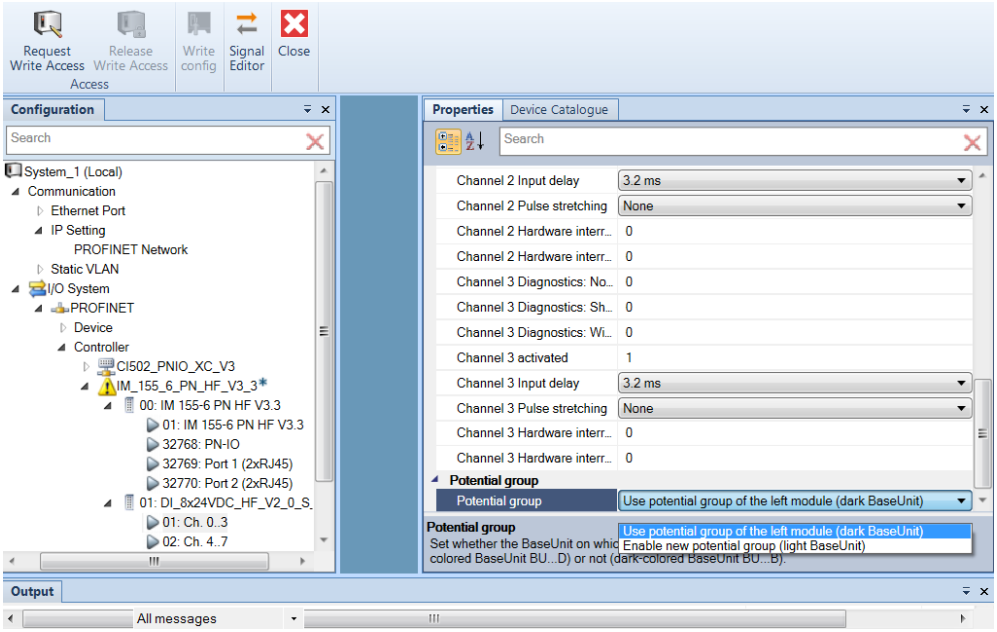
- Disable "switch intelligent features" such as flow control and MDIX (medium dependent interface crossover) that might cause delays during startup.

Configuring Siemens™ ET200SP I/O device

For Siemens™ ET200SP I/O devices, it is important to select the correct **Potential group**.

If the back plane of the device is dark, select **Use potential group of the left module (dark BaseUnit)**.

If the back plane of the device is light colored, select **Enable new potential group (light BaseUnit)**.



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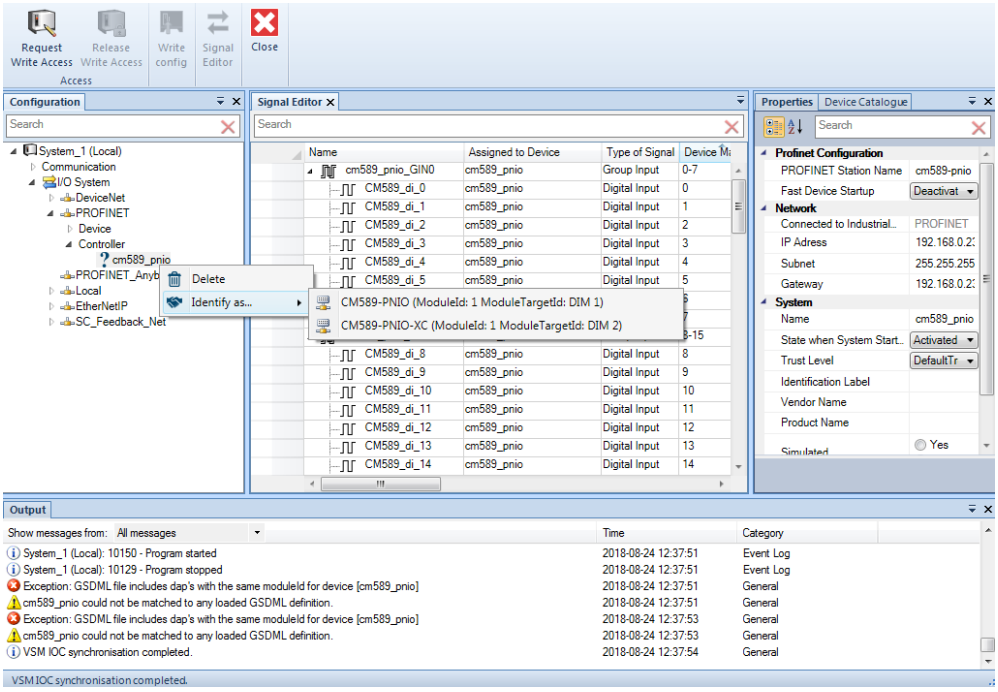
Duplicated module id in GSD file

If the error message "Exception: GSD file includes dap's with the same module id for device ...", then duplicates of the module id exist in the GSD file and you must select which one to use.

Right-click on the device, select **Identify as** and select the definition to use.



Missing GSD definition

If the warning message "... could not be matched to any loaded GSD definition" is shown, there can be two reasons:

- If the message "Exception: GSD file includes dap's with the same moduleId for device ..." is also shown, see *Duplicated module id in GSD file on page 78*.
- If the message "Exception: GSD file includes dap's with the same moduleId for device ..." is not shown, load the GSD definitions. See *Importing the GSD files on page 52*.

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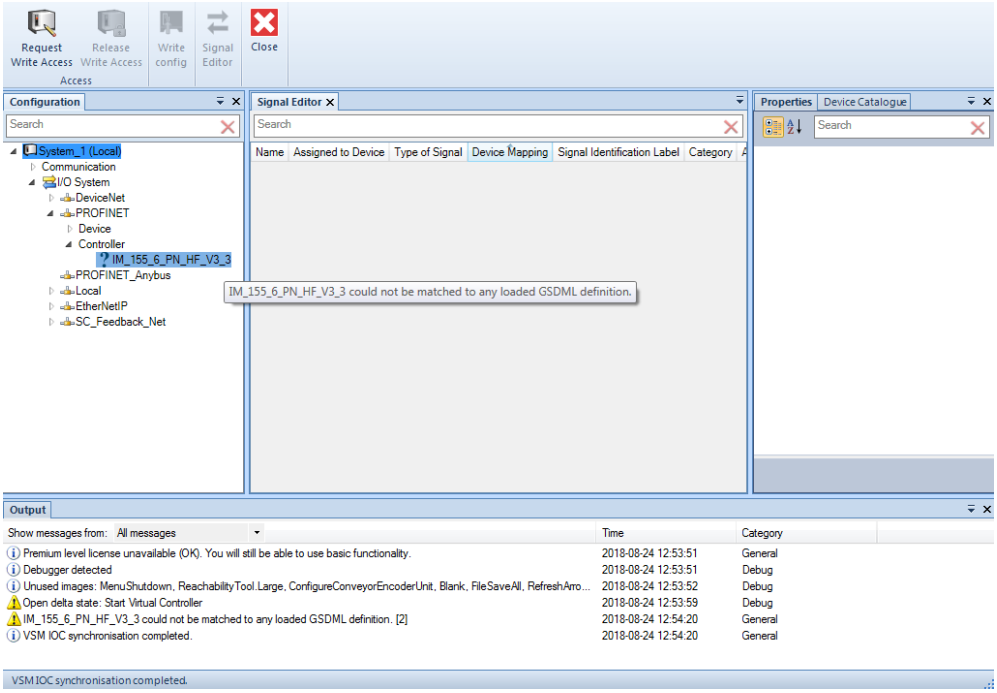

IP address goes to 0.0.0.0 after restart of robot controller

If a PROFINET controller, for example a PLC, sets a temporary IP address for the internal PROFINET device in the robot controller, then the IP address will go to 0.0.0.0 after a restart.

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Index

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