ROBOTICS

Application manual

EtherNet/IP Scanner/Adapter

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Application manual
EtherNet/IP Scanner/Adapter
RobotWare 6.12

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Original instructions.

Table of contents

Overview of this manual 7
Product documentation 9
Safety 11
Network security 12
Terminology 13

1 Introduction 15

1.1 What is EtherNet/IP? 15
1.2 EtherNet/IP for IRC5 16

2 Hardware overview 17

2.1 Main computer 17
2.2 Ethernet switches 25
2.3 I/O devices 26

3 Software overview 27

3.1 Information about the adapter device 27
3.2 Information about the internal scanner 29

4 Installing and configuring the internal adapter device 31

4.1 Recommended working procedure 31
4.2 Configuring the EtherNet/IP network settings 32
4.3 Configuring the internal adapter device 33
4.4 Configuring the safe internal adapter device (CIP Safety) 34

5 Installing and configuring the internal scanner 39

5.1 Recommended working procedure 39
5.2 Creating and configuring the internal scanner 41
5.2.1 Using EDS files to create device templates 44
5.3 Creating and configuring the safe internal scanner (CIP Safety) 45
5.4 Explicit messaging services 51
5.4.1 Information 51
5.4.2 EtherNet/IP command at startup 54
5.4.3 EtherNet/IP command via RAPID 55
5.5 QuickConnect 57
5.6 Communication between two IRC5 controllers 58

6 System parameters 61

6.1 Introduction 61
6.1.1 EtherNet/IP system parameters 62
6.2 Type Industrial Network 65
6.2.1 Connection 65
6.3 Type Ethernet/IP Device 66
6.3.1 Major Revision 66
6.3.2 Minor Revision 67
6.3.3 Address 68
6.3.4 Vendor ID 69
6.3.5 Device Type 70
6.3.6 Product Code 71
6.3.7 QuickConnect 72
6.3.8 Safe Device 74
6.3.9 Standard Connection 75
6.3.10 Safe Output Connection 76
6.3.11 Safe Intput Connection 77
6.3.12 Output Assembly 78

6.3.13 Input Assembly 79
6.3.14 Output Size 80
6.3.15 Input Size 81
6.3.16 Configuration Assembly 82
6.3.17 Configuration Size 83
6.3.18 Configuration Data 84
6.3.19 Ownership 85
6.3.20 Input Connection Type 86
6.3.21 Connection Priority 87
6.3.22 Output RPI 88
6.3.23 Input RPI 89
6.3.24 Connection Timeout Multiplier 90
6.4 EtherNet/IP IO Connection 91
6.4.1 Device Label 91
6.4.2 Output Assembly 92
6.4.3 Input Assembly 93
6.4.4 Configuration Assembly 94
6.4.5 Output Size 95
6.4.6 Input Size 96
6.4.7 Output RPI 97
6.4.8 Input RPI 98
6.4.9 Data Direction 99
6.4.10 Safe Connection 100
6.4.11 Input Connection Type 101
6.4.12 Connection Priority 102
6.4.13 Configuration Size 103
6.4.14 Configuration Data 104
6.5 Type EtherNet/IP Command 105
6.5.1 Path 105
6.5.2 Service 106

7 Troubleshooting 107

7.1 Frequently asked questions 107
7.2 Troubleshooting 109

Index 111

Overview of this manual

About this manual

This manual describes the option *EtherNet/IP Scanner/Adapter* and contains instructions for the configuration.

Usage

This manual should be used during installation and configuration of the EtherNet/IP Scanner/Adapter and upgrading of the option EtherNet/IP Scanner/Adapter.

Who should read this manual?

This manual is intended for

- Personnel responsible for installations and configurations of industrial network hardware/software
- Personnel responsible for I/O system configuration
- System integrators

Prerequisites

The reader should have the required knowledge of

- Mechanical installation work
- Electrical installation work
- System parameters and how to configure them
- RobotStudio

References

Document references

Reference	Document ID
Operating manual - RobotStudio	*3HAC032104-001*
Operating manual - IRC5 with FlexPendant	*3HAC050941-001*
Product manual - IRC5	*3HAC047136-001*
Technical reference manual - System parameters	*3HAC050948-001*
Technical reference manual - RAPID Instructions, Functions and Data types	*3HAC050917-001*
Application manual - DeviceNet Master/Slave	*3HAC050992-001*
Application manual - Controller software IRC5	*3HAC050798-001*
Product specification - Controller IRC5	*3HAC047400-001*
Application manual - Functional safety and SafeMove2	*3HAC052610-001*

Other references

Reference	Description
www.odva.org	The web site of ODVA (Open DeviceNet Vendor Association).

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Reference	Description
EtherNet/IP™ Specification, Edition 1.2	ODVA Specification comprises two volumes from the library: *Volume One: Common Industrial Protocol (CIP) Specification* and *Volume Two: EtherNet/IP Adaptation of CIP*.

Revisions

Revision	Description
-	First edition. Released with RobotWare 6.0.
A	Released with RobotWare 6.01. • Minor corrections. • Added information about different ways to connect to networks in section *Main computer on page 17*. • System parameters *Address*, *Subnet Mask*, and *Gateway* removed from *Industrial Network*.
B	Released with RobotWare 6.02. • Updated the path to the template files, see *Template I/O configuration file on page 28*.
C	Released with RobotWare 6.04. • *Request Packet Interval* parameter is replaced with O->T RPI and T->O RPI. • Information about local I/O devices in the device templates option.
D	Released with RobotWare 6.05. Added new parameter *Connection Timeout Multiplier on page 90* in section System Parameters.
E	Released with RobotWare 6.06. Minor correction.
F	Released with RobotWare 6.07. • Clarified the limitations for Isolated Lan 3 in the section *Isolated LAN 3 or LAN 3 as part of the private network on page 18*. • Added *EtherNet/IP on different networks on page 18* to the *Main computer on page 17* section. • Added information about CIP Safety, mainly described in the new sections *Configuring the safe internal adapter device (CIP Safety) on page 34* and *Creating and configuring the safe internal scanner (CIP Safety) on page 45*.
G	Released with RobotWare 6.08. Added CIP Safety scanner.
H	Released with RobotWare 6.09. • Section "Installing and configuring the internal scanner" updated with info regarding definition of IP-address.
J	Released with RobotWare 6.10.01. • Cfg name removed from entire manual.
K	Released with RobotWare 6.11. • Added NOTE regarding IP addresses in section *Creating and configuring the internal scanner on page 41*. • Note regarding use of WAN and LAN for internal devices added in section *Main computer on page 17*.
L	Released with RobotWare 6.12. • Local I/O replaced by Scalable I/O in relevant places.

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.

Terminology

Terms

Term	Explanation
Adapter	I/O device that is controlled by a scanner in an Ethernet network. Previously, ABB documentation used the term *slave*.
CIP	Common Industrial Protocol. Protocol that DeviceNet and EtherNet/IP are based on.
Client	See Scanner. Some documents use the term *client*, whereas the ABB documentation use the term *Scanner* for EtherNet/IP industrial network.
EDS	Electronic Data Sheet. EDS files contain the configuration details relevant to CIP devices.
Explicit Messages	An explicit message is a request or response oriented communication with other devices. These messages are mostly configuration data.
External adapter	Describes an EtherNet/IP adapter on the EtherNet/IP network connected to the IRC5 controller (not the robot controller acting as EtherNet/IP adapter).
External scanner	Describes an EtherNet/IP scanner on the EtherNet/IP network connected to the IRC5 controller (not the robot controller acting as EtherNet/IP scanner).
Implicit Messages	Implicit messages are exchanged between I/O connections. No messaging protocol is contained within the message data as with Explicit messaging. Implicit messages can be point to point (unicast) or multicast and are used to transmit application specific I/O data.
Internal adapter	Describes when the robot controller acts as an EtherNet/IP adapter on the EtherNet/IP network.
Internal scanner	Describes when the robot controller acts as an EtherNet/IP scanner on the EtherNet/IP network.
LAN	Connector for Local Area Network.
M12	Ethernet contact with IP67 classification.
Master	See term *Scanner*.
ODVA	Open DeviceNet Vendor Association. Organization for networks built on CIP, for example DeviceNet and EtherNet/IP.
RJ45	Standard Ethernet contact.
Scanner	Controls other I/O devices (adapters) in an Ethernet network. Previously, ABB documentation used the term *Master*.
Server	See term *Adapter*. Some documents use the term *server*, whereas the ABB documentation use the term *adapter* for EtherNet/IP industrial network.

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Term	Explanation
Slave	See term *Adapter*.
WAN	Port for Wide Area Network.

1 Introduction

1.1 What is EtherNet/IP?

General

EtherNet/IP is a communications link to connect industrial devices.

The EtherNet/IP (EtherNet Industrial Protocol) is managed by ODVA (Open DeviceNet Vendors Association). It is a well established industrial Ethernet communication system with good real-time capabilities. EtherNet/IP extends commercial off-the-shelf Ethernet to the CIP (Common Industrial Protocol)— the same upper-layer protocol and object model found in DeviceNet and ControlNet. CIP allows EtherNet/IP and DeviceNet system integrators and users to apply the same objects and profiles for plug-and-play interoperability among devices from multiple vendors and in multiple sub-nets. Combined, DeviceNet, ControlNet and EtherNet/IP promote transparency from sensors to the enterprise software.

Examples of applications

Here are some examples of EtherNet/IP applications:

- Peer-to-peer data exchange where an EtherNet/IP product can produce and consume messages
- Scanner/adapter operation defined as a proper subset of peer-to-peer
- An EtherNet/IP product can function as a client or server, or both

Standardization

EtherNet/IP is standardized according to the International standard IEC 61158 and EtherNet/IP devices are certified by ODVA for interoperability and conformance.

Data

The following table specifies a number of EtherNet/IP data.

Network type	Ethernet based Control Level network with CIP application protocol
Installation	Standard Off the Shelf (COTS) Ethernet cables and connectors. 10/100/1000 Mbit/s TX Ethernet cable or fibre optics. RJ45, M12 or fibre optic connectors.
Speed	10, 100, 1000 Mbit/s

EDS file

The configuration process is based on EDS files (Electronic Data Sheet) which are required for each EtherNet/IP device. EDS files are provided by the device manufacturers. It contains electronic descriptions of all relevant communication parameters and objects of the EtherNet/IP device.

1.2 EtherNet/IP for IRC5

General

The EtherNet/IP network is running on the IRC5 main computer and does not require any additional hardware. EtherNet/IP as described in this manual requires the main computer DSQC1000.

Options

With option *EtherNet/IP Scanner/Adapter*, the IRC5 controller can act as a scanner, adapter, or both on the EtherNet/IP network.

Tip

If only EtherNet/IP adapter functionality is required, then the option *EtherNet/IP Anybus Adapter* can also be used.

For more information see *Application manual - EtherNet/IP Anybus Adapter*.

Specification overview

Item	Specification
Industrial Network type	EtherNet/IP
Conform to	EtherNet/IP protocol conformance test A-9
Data rate	10/100 Mbit
Connection type	Cyclic
Connection size	Maximum 509 input bytes and 505 output bytes
Transport Class	Class 1 I/O implicit

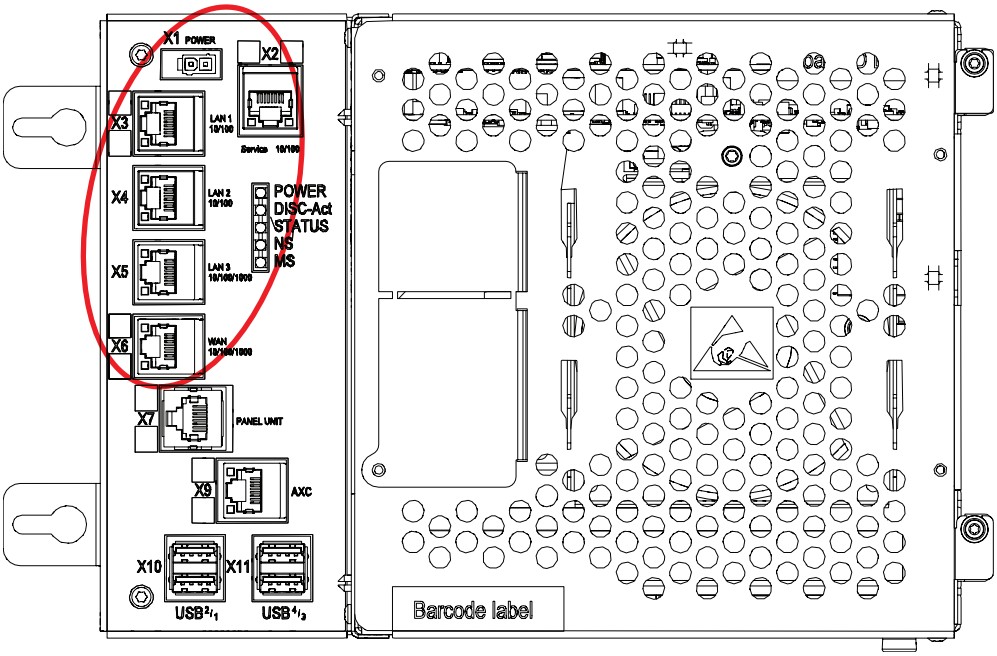
2 Hardware overview

2.1 Main computer

Connections

The I/O network can be connected to one of the the Ethernet ports WAN, LAN 2, or LAN 3 on the main computer.

The following figure illustrates where the Ethernet port connectors, are placed on the main computer.



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Connector	Label	Description
X2	Service	Port to the robot's private network. Intended to be left empty so that service personnel can use it to connect to the computer unit.
X3	LAN 1	Port to the robot's private network. Normally used to connect the FlexPendant.
X4	LAN 2	Port to the robot's private network.
X5	LAN 3	By default LAN 3 is configured for an isolated LAN3 network. Can be reconfigured to be a part of the private network.
X6	WAN	Wide Area Network that can host a public industrial network.

Note

It is not supported to connect multiple ports of the main computer (X2 - X6) to the same external switch, unless static VLAN isolation is applied on the external switch.

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Intended use of WAN and LAN ports

The WAN port is a public network interface to the controller, typically connected to the factory network with a public IP address provided by the network administrator.

The LAN ports are intended for connecting network based process equipment to the controller, for example industrial networks, cameras, and welding equipment.

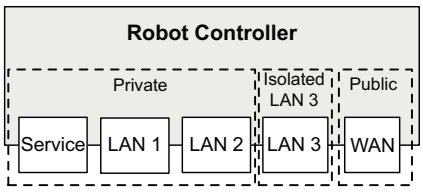
LAN 2 can only be used as a private network to the IRC5 controller.

> **Note**
>
> The internal adapter and the scanner can be configured on both the LAN port and the WAN port.

Isolated LAN 3 or LAN 3 as part of the private network

The default configuration is that LAN 3 is configured as an isolated network. This allows several robot controller to be connected to the same network, see *EtherNet/IP on dedicated industrial network on page 22*.

> **Note**
>
> The isolated LAN 3 cannot be used to connect to any HMI device (RobotStudio, Robot Web Services, or PC SDK client) since it does not support the protocol needed for communication.



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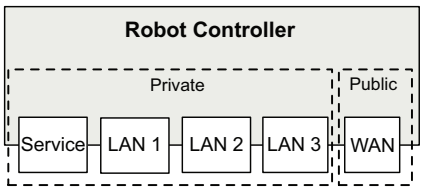
An alternative configuration is that LAN 3 is part of the private network. The ports Service, LAN 1, LAN 2, and LAN 3 then belong to the same network and act just as different ports on the same switch. This is configured by changing the system parameter *Interface*, in topic *Communication* and type *Static VLAN*, from "LAN 3" to "LAN". See *Technical reference manual - System parameters*.



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EtherNet/IP on different networks

When the WAN port is used for connecting to an industrial network, the traffic shares the same media as the factory network and will share bandwidth with other non industrial network traffic.

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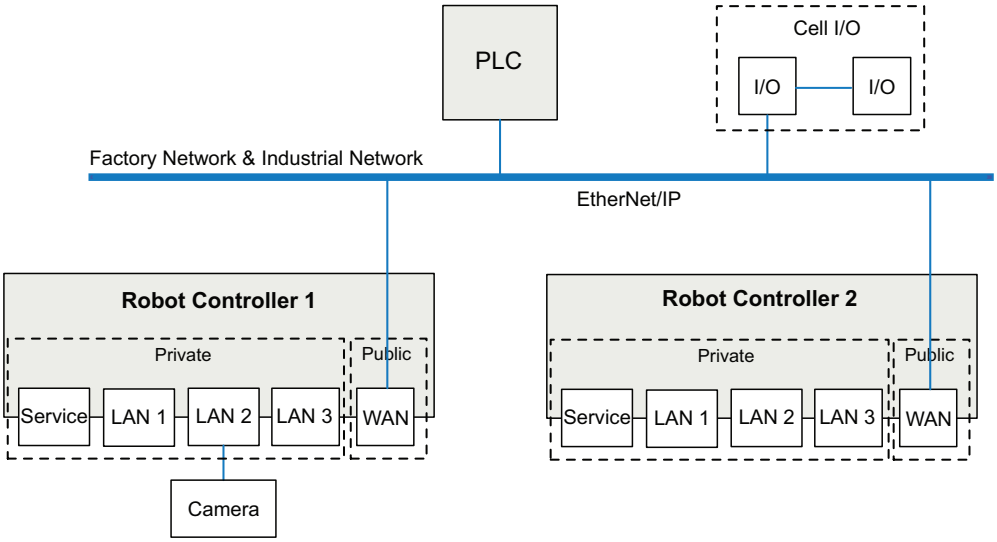
For standard EtherNet/IP (not CIP Safety), it is possible to configure the internal adapter on one port and configure the external I/O devices on any other port(s) or same as the internal adapter.

The following figure illustrates the network when the internal adapter is configured on the WAN port and I/O devices are configured on private, isolated and WAN network:



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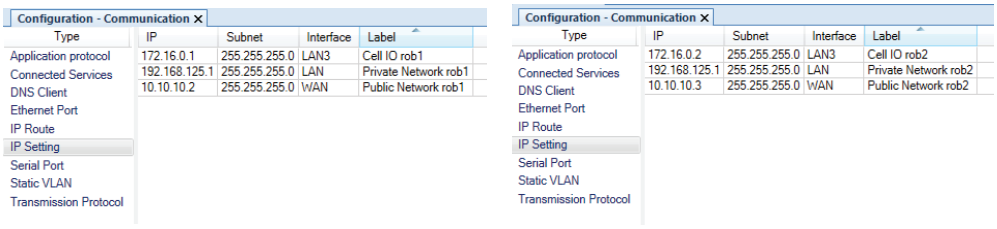

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Note

The illustration is an example to demonstrate the EtherNet/IP on different networks.

The private network can contain I/O, sensors, etc. for the robot controller. However, it is not possible to connect several robot controllers to the same private network.

By connecting to the isolated LAN 3 port it is possible to connect several robot controllers to a dedicated industrial network.

Continues on next page

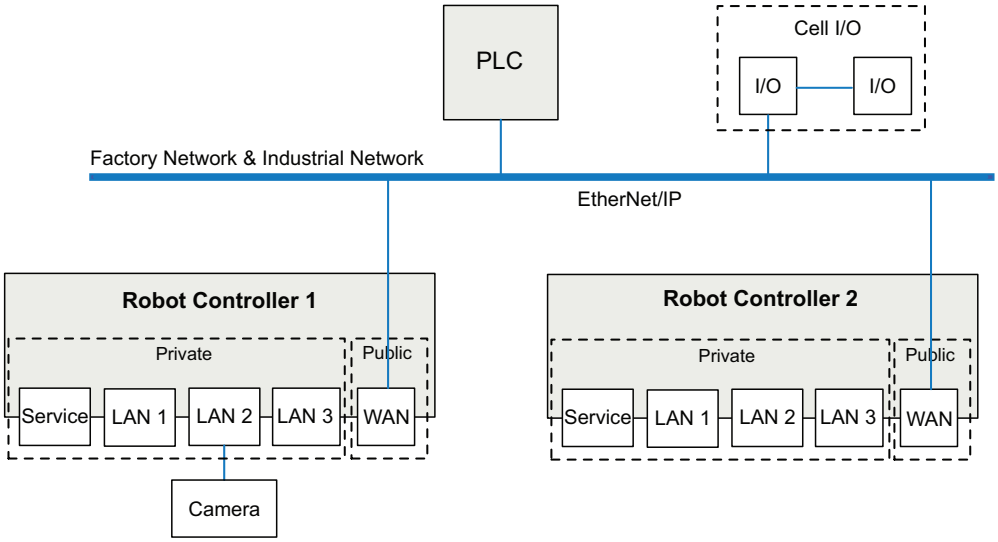
One EtherNet/IP network connected to the robot controller

If EtherNet/IP is used on the public network (WAN port) without an Anybus adapter, EtherNet/IP cannot be used on the private network. Equipment not using EtherNet/IP (for example a camera) can be connected to the private network. To use EtherNet/IP on both the public and private network, an Anybus adapter must be used. See *Using Anybus adapter to connect two EtherNet/IP networks on page 23*.

EtherNet/IP on factory network

When the WAN port is used for connecting to an industrial network, the traffic shares the same media as the factory network and will share bandwith with other non industrial network traffic.

The following figure illustrates the network when connecting a scanner and an adapter to the WAN port of the main computer:



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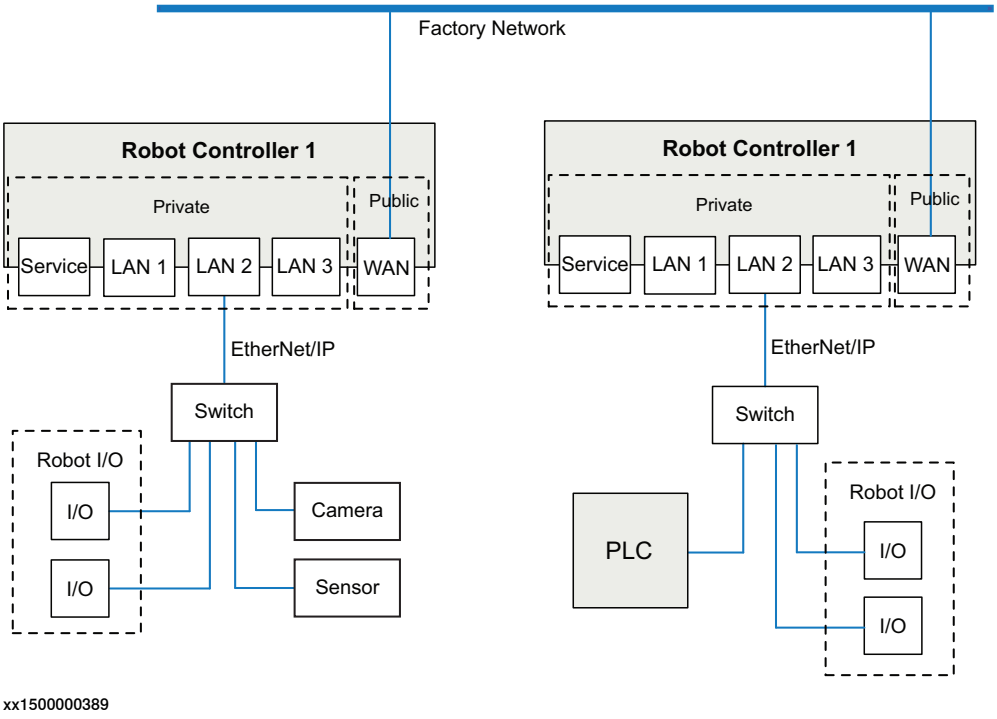
EtherNet/IP on private network

The private network can contain I/O, sensors, etc. for the robot controller. However, it is not possible to connect several robot controllers to the same private network.

The following illustration shows two robot controllers with EtherNet/IP (and other IP traffic) on each private network. The factory network cannot communicate with the robot controller using EtherNet/IP.



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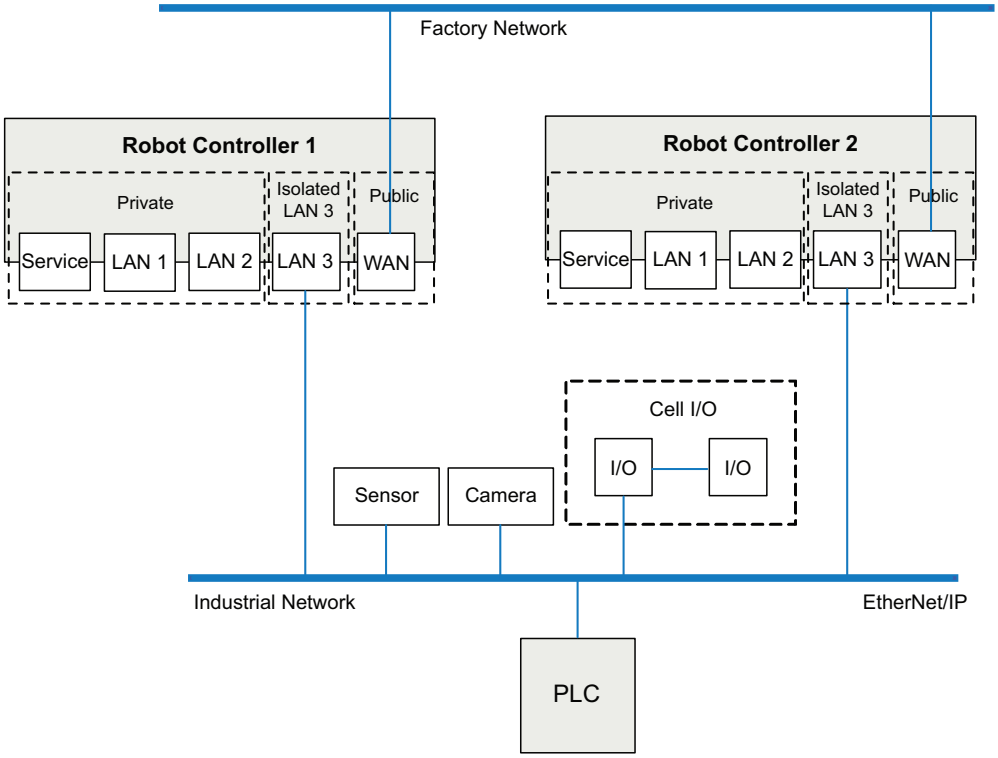
2.1 Main computer
Continued

EtherNet/IP on dedicated industrial network

By connecting to the isolated LAN 3 port it is possible to connect several robot controllers to a dedicated industrial network.



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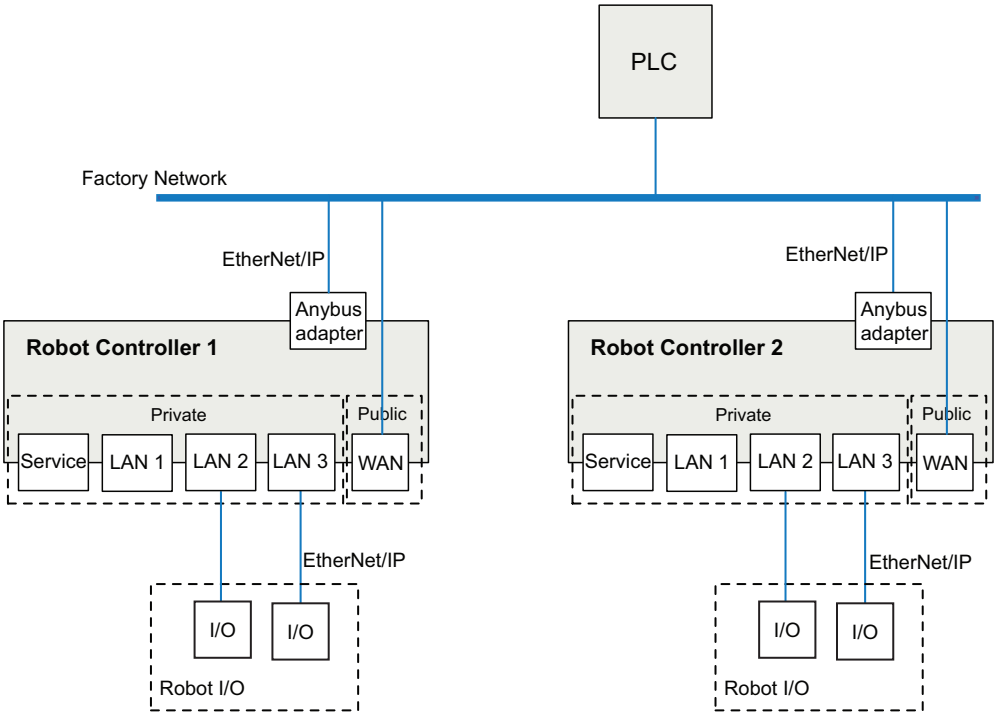
Using Anybus adapter to connect two EtherNet/IP networks

EtherNet/IP on shared factory network and private network

To be able to use EtherNet/IP on both the public and the private network, an Anybus adapter must be used. If the same factory network is used both for EtherNet/IP communication and other communication, both the Anybus adapter and the WAN port must be connected to the factory network. For information about the EtherNet/IP Anybus adapter, see *Application manual - EtherNet/IP Anybus Adapter*.



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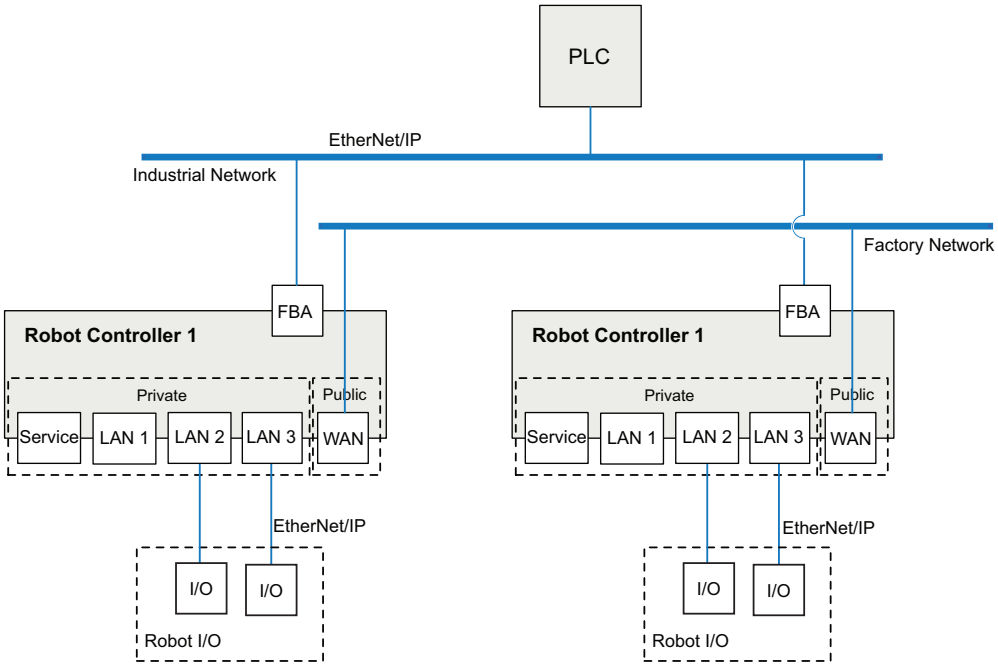
2.1 Main computer

Continued

EtherNet/IP on dedicated industrial network

If the EtherNet/IP communication shall be separated from other Ethernet communication, an Anybus adapter must be installed and connected to the public EtherNet/IP industrial network and the WAN port connected to the factory network. For information about the EtherNet/IP Anybus adapter, see *Application manual - EtherNet/IP Anybus Adapter*.



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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 I/O 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 EtherNet/IP compliant I/O device on the EtherNet/IP network. All I/O devices should comply with the EtherNet/IP standard and be conformance tested by ODVA. I/O devices may be mounted inside the IRC5 controller.

3 Software overview

3.1 Information about the adapter device

General

To use the EtherNet/IP adapter device, the IRC5 controller must be installed with the option *841-1 EtherNet/IP Scanner/Adapter*.

The EtherNet/IP adapter device can be used to:

- connect a PLC to the IRC5 controller.
- connect the IRC5 controller to another IRC5 controller which acts as a scanner.

Industrial Network

When the robot system is installed with the EtherNet/IP Scanner/Adapter option, a predefined industrial network with the name *EtherNetIP* is created at system startup.

Predefined internal adapter device

When the robot system is installed with the EtherNet/IP Scanner/Adapter option, a predefined internal adapter device with the name *EN_Internal_Device* is created at system startup. This internal device is used to define the internal adapter device in the IRC5 controller, which will enable a PLC to connect to the IRC5 controller. There can be only one internal adapter device defined in the IRC5 controller.

I/O device

The input and output map starts at bit 0.

EDS file

An Electronic Data Sheet file, EDS file, is available for the internal adapter device, matching the configuration of the predefined *EtherNet/IP Internal Adapter Device EN_Internal_Device*.

The EDS file, *enip.eds*, for the adapter device can be obtained from the RobotStudio or the IRC5 controller.

- **In the RobotWare installation folder in RobotStudio**: *...\RobotPackages\RobotWare_RPK_<version>\utility\service\EDS*
- **On the IRC5 Controller**: *<SystemName>\PRODUCTS\<RobotWare_xx.xx.xxxx>\utility\service\EDS*

> **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**.

Continues on next page

Template I/O configuration file

A template I/O configuration file is available for the internal adapter device. The file contains preconfigured names for all available inputs and outputs. The file can be loaded to the controller, using RobotStudio or the FlexPendant, to facilitate and speed up the configuration.

The I/O template configuration file, *EN_Internal_Device.cfg*, can be obtained from the RobotStudio or the IRC5 controller.

- **In the RobotWare installation folder in RobotStudio**: *...\RobotPackages\RobotWare_RPK_<version>\utility\service\ioconfig\EtherNetIP*
- **On the IRC5 Controller**: *<SystemName>\PRODUCTS\<RobotWare_xx.xx.xxxx>\utility\service\ioconfig\EtherNetIP*

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**.

Assembly

The internal adapter device has the following *Assembly* values.

Assembly	Value
Output	112
Input	100
Configuration	0

Behavior

Cyclic I/O connection is supported and the size of the I/O connection is defined by the predefined EtherNet/IP Internal Adapter Device, EN_Internal_Device.

Note

If the EtherNet/IP adapter device loses connection with its scanner, the configured input signals are cleared (reset to zero). The output signals are kept and are possible to change.

When the connection is re-established, the EtherNet/IP adapter device updates the input and output signals.

3.2 Information about the internal scanner

General

To use the EtherNet/IP internal scanner, the IRC5 controller must be installed with the option *841-1 EtherNet/IP Scanner/Adapter*.

The EtherNet/IP internal scanner can be used to:

- connect EtherNet/IP I/O devices to the IRC5 controller.
- connect the IRC5 controller to another IRC5 controller which acts as an adapter.

Industrial Network

When the robot system is installed with the EtherNet/IP Scanner/Adapter option, a predefined industrial network *EtherNetIP* is created at system startup.

Device Templates

There are predefined device templates available for the internal scanner. These device templates can be used when defining a new I/O device by using the Configuration Editor in RobotStudio or FlexPendant, see *Creating and configuring the internal scanner on page 41*. Examples of present device templates are:

- *ABB EtherNet/IP Adapter Device* is used on the scanner side when connecting to another IRC5 EtherNet/IP adapter.
- *ABB EtherNet/IP Anybus Adapter Device* is used on the scanner side to connect to an IRC5 EtherNet/IP adapter using the EtherNet/IP Anybus Adapter Device.
- *ABB Robotics EtherNet/IP IO Device - 16DO/16DI* is local IO device from ABB.
- *ABB Robotics EtherNet/IP IO Device - 16DI/16DO/8RO/8RI/4AI/16DI/16DO* is local IO device from ABB.
- *Aros Hyperion - 16DO/16DI*

Apart from the existing device templates listed above, you can create device templates to define a new I/O device. For more information, refer *Using EDS files to create device templates on page 44*.

Number of allowed I/O devices

A maximum number of 20 user defined I/O devices can be defined in the IRC5 system, for more information see *Device Type* of *I/O System* section in*Technical reference manual - System parameters*.

The following are counted as user defined I/O devices:

- All EtherNet/IP adapter devices connected to the IRC5 EtherNet/IP scanner.
- Simulated EtherNet/IP I/O devices.

> **Note**
>
> The internal adapter device is not counted as a user defined I/O device.

Continues on next page

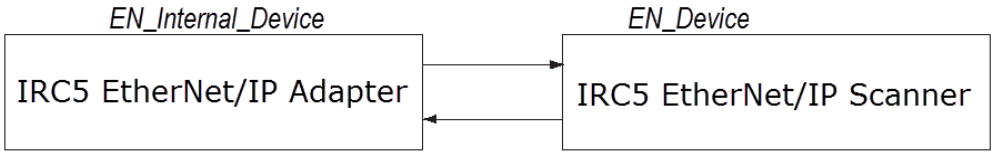
It is possible to use ABB I/O devices or I/O devices from other vendors. Only the EtherNet/IP Scanner/Adapter option is required to run I/O devices from other vendors.

The values of input and output *Assembly* are used by the EtherNet/IP scanner to locate the input and output data in the I/O device. The *Assembly* values for different I/O devices are available in the EDS file and in the User Manual. We recommend you to refer the User Manual for the *Assembly* values of the I/O device.

Connecting two IRC5 systems

When connecting two IRC5 systems, the internal adapter should be seen and configured as any other ordinary device from the other IRC5 system, which is acting as a scanner. See *Communication between two IRC5 controllers on page 58*.

The following picture illustrates how to use the predefined internal device (EN_Internal_Device) and the device template ABB EtherNet/IP Adapter Device (EN_Device).



xx1400001944

4 Installing and configuring the internal adapter device

4.1 Recommended working procedure

General

This section describes the recommended working procedure when installing and configuring the EtherNet/IP adapter device. The working procedure helps to understand the dependencies between the different steps.

When the IRC5 controller is connected to an external scanner, the IRC5 controller acts as an ordinary adapter device on the EtherNet/IP network.

Basic steps

Use this procedure to install and configure an EtherNet/IP adapter device.

	Action	See
1	Use RobotStudio to configure the topic Communication.	*Technical reference manual - System parameters*
2	Use RobotStudio to configure the EtherNet/IP network settings.	*Configuring the EtherNet/IP network settings on page 32*
3	Configure the adapter device in the IRC5 controller using RobotStudio or the FlexPendant.	*Configuring the internal adapter device on page 33*

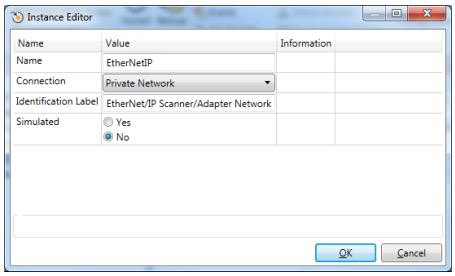
4.2 Configuring the EtherNet/IP network settings

General

The following procedure describes how to change the EtherNet/IP network settings using RobotStudio.

Industrial Network configuration

Use this procedure to configure the EtherNet/IP network settings in the IRC5 controller, using RobotStudio.

	Action	Note
1	Start RobotStudio and connect to the IRC5 controller. Request write access.	
2	Open the **Configuration Editor** and select **I/O System**.	For more information about the parameters, see *System parameters on page 61*.
3	In the **Type** list click **Industrial Network** and edit the parameter *EtherNetIP*. Enter the parameter values for the industrial network. • **Connection**, select one previously configured in *IP Setting* in topic *Communication*. • **Identification Label**, user defined. Click **OK**.	 xx1400001924
4	Restart the controller or continue with the next step of the configuration.	*Configuring the internal adapter device on page 33*

Note

Note that the adapter device and the internal scanner use the same *Connection*. This means that the network settings are shared between the adapter and internal scanner if the IRC5 controller acts as both on the EtherNet/IP network.

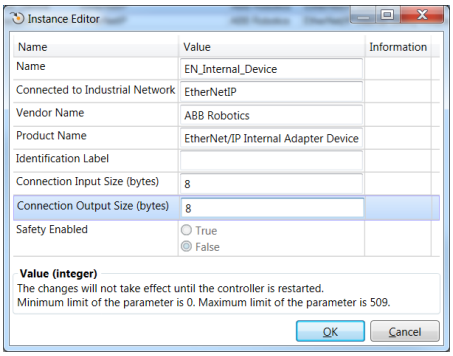
Note

Gateway is chosen from one of the configured instances of *IP Route* (see *Technical reference manual - System parameters*). The gateway is matched with the configured *IP Setting* pointed out by the *Connection* parameter for the *Industrial Network* (see *Connection on page 65*). If the gateway is found to be on the same network as defined by the *IP Setting* for the *Industrial Network*, it is chosen.

4.3 Configuring the internal adapter device

Internal adapter device configuration

Use this procedure to configure the internal adapter device in the IRC5 controller, using RobotStudio.

	Action	Note
1	Start RobotStudio and connect to the IRC5 controller. Request write access.	
2	Open the **Configuration Editor** and select **I/O System**.	For more information about the parameters, see *System parameters on page 61*.
3	In the **Type** list, click **EtherNet/IP Internal Device**, right-click in the workspace on the EN_Internal_Device item and select **Edit EtherNet/IP Internal Device**. Edit the parameter values, if applicable. • **Connected to Industrial Network**, shall be EtherNetIP. • **Identification Label**, user defined. • If the size needs to be changed, change the default values for **Connection Input Size** and **Connection Output Size** to the desired size. **Note** This step is optional. Click **OK**.	 xx1400001925
4	In the **Type** list click **Signal**. Add I/O signals for the internal adapter device.	
5	Restart the controller.	

4.4 Configuring the safe internal adapter device (CIP Safety)

Prerequisites

The user is required to clear any pre-existing configuration from any safety device before installing it onto a safety network.

Limitations

- The CIP Safety internal adapter does not support multicast connections.
- When configuring *Requested Packet Interval (RPI)* on the PLC, the value must be larger or equal to 20 milliseconds.
- The size of safety data assemblies is fixed to 8 bytes and not configurable.
- If backups have been created for RW systems version 6.05.XX-6.07.XX with the CIP Safety Adapter option (997-3) present, a migration must be performed in RobotStudio before restoring the backup in RobotWare 6.08 or later.

Clearing a pre-existing configuration

The first scanner (originator) that successfully establishes a producing connection to the ABB CIP safety adapter becomes the owner of that adapter's inputs. It is necessary to reset the ownership when the originator's SNN or NodeID is changed.

The ownership is established to prevent errant or unauthorized connections from hijacking an input resource in a validated safety system. Only one owner is allowed.

It is possible to reset the ownership by executing the **Reset CIP Safety** function which resets all persistent memory of the adapter. On the FlexPendant, tap the **ABB** menu, select **Control Panel**, then **Safety Controller**. In the Configuration tab, tap the button **Reset CIP Safety**. After controller restart, the CIP Safety configuration will be restored except from the ownership.

> **Note**
>
> It is the responsibility of the user to guarantee the safety of the system after resetting CIP Safety. The user needs to guarantee that the desired ownership is established after the reset.

Resetting the safety controller

The function **Reset safety controller to factory settings** clears all user settings and loads a default configuration. The firmware of the safety controller is not affected.

In rare cases the safety controller can get locked in safety state, for example when loading an incompatible or poorly configured safety configuration or replacing the robot controller. Then it is not possible to load another safety configuration without first resetting the safety controller to factory settings.

Use this procedure to reset the safety controller from the FlexPendant:

	Action
1	Tap the ABB menu.
2	Tap Restart and Advanced.

Continues on next page

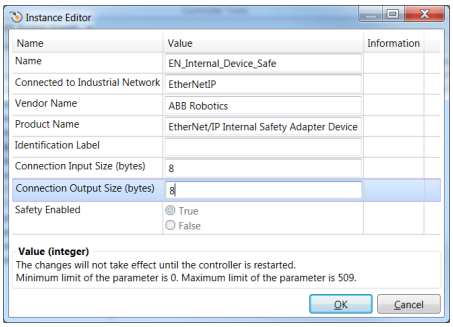
	Action
3	Select the type of restart procedure that is desired and select the checkbox **Reset safety controller to factory settings**.
4	Tap **Next** and **Restart** to reset the safety controller and restart the robot controller.
5	Synchronize the safety controller with the robot controller, see *Application manual - Functional safety and SafeMove2*.
6	A new safety configuration can now be loaded and validated, see *Application manual - Functional safety and SafeMove2*.

Note

It is also possible to reset the safety controller to factory settings from RobotStudio, see *Application manual - Functional safety and SafeMove2*.

Safe internal adapter device configuration

This procedure describes how to configure the safe internal adapter device. This requires a CIP Safety option (997-3 or 997-4).

	Action	Note
1	Start RobotStudio and connect to the IRC5 controller. Request write access.	
2	Open the **Configuration Editor** and select **I/O System**.	For more information about the parameters, see *System parameters on page 61*.
3	In the **Type** list, click **EtherNet/IP Internal Device**, right-click in the workspace on the EN_Internal_Device_Safe item and select **Edit EtherNet/IP Internal Device**. Edit the parameter values, if applicable. • **Connected to Industrial Network**, shall be EtherNetIP. • **Identification Label**, user defined. • If the size for non-safe signals needs to be changed, change the default values for **Connection Input Size** and **Connection Output Size** to the desired size. (The size for safe signals is always 8 in and 8 out.) Click **OK**.	 xx1800000947

Configure the safe fieldbus parameters

	Action
1	In the **Controller** tab, click **Safety**, then select **Visual SafeMove**.
2	In the SafeMove ribbon, click on the **Safe IO Configurator**.
3	Select the **Signals** view.
4	Expand the node **CIP Safety** and then **EN_Internal_Device_Safe (Internal CIP Safety Adapter)**.
5	Setup the parameters for the safe fieldbus (see table below).

Continues on next page

Parameters for *CIP Safety Adapter*

Setting	Description
NodeId	The same as the IP address of the internal safety adapter device.
SNN	The *Safety Network Number (SNN)* provides a unique network identifier for each network in the safety system. Typically it is generated automatically by the configuration tool or selected arbitrary by the user. This value is a 6 byte long, written as a hexadecimal string. The values "0000_0000_0000" and "FFFF_FFFF_FFFF" are illegal. **Note** The user should assign SNN numbers for each safety network or safety sub-net that are unique system-wide. **CAUTION** Originators (scanners) having an automatic SNN setting feature, i.e. automatically generated data and time, can only use this feature when the safety system is not being relied upon and is not in safety state.
Configuration signature	The configuration signature, also called *Safety Configuration ID (SCID)*, uniquely identifies the configuration of the *ABB CIP Safety Adapter* and can be used to confirm the integrity of the adapter configuration over time. The signature is checked whenever an originator tries to connect to the adapter. If the signatures match, the connection is established. If the signature does not match, the error response *Configuration signature mismatch* is returned. The signature is printed in the safety report and must be copied to any external safety scanner (PLC) that wants to connect to the robot controller. The following alternatives are provided • **Not used** - The configuration signature is not used. • **Auto generated** - An automatically generated signature found under *"Configuration Signature - Date"*, *"- Time"*, and *"- ID"* in the safety report. • **User generated** - A user defined signature. Alternatively, the user can manually write the signature encoded as a 10 bytes long hexadecimal string in the text-box below. The signature can then be found under *"Configuration Signature checksum"* in the safety report. **Note** When configuring safety connections without the configuration signature, i.e. not used, the user is responsible for ensuring that originators (scanners) and targets (adapters) have the correct configurations. **Note** The configuration signature should only be considered verified after user testing. User testing is the means by which all downloads are validated.

Continues on next page

Note

The settings must correspond to the settings made in the safety PLC.

Create safe signals

It is important that the offset of the signals are the same for both the internal adapter and the external scanner.

	Action
1	In the **Safe IO Configurator**, under **EN_Internal_Device_Safe (Internal CIP Safety Adapter)**, expand the node **Input signals** or **Output signals**, depending on which type of signal you want to create.
2	Click on an empty line and type the signal name.
3	Set **Default value**.

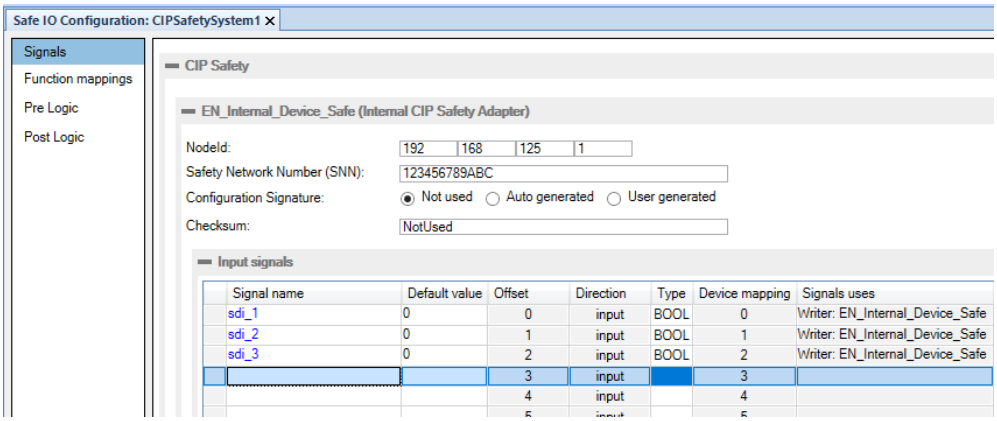
Note

The usage of a signal cannot be changed from the **Safe IO Configuration**, but in the column **Signal uses** it is shown what functions use each signal.

Tip

It is possible to use a spreadsheet application, or text editor, to edit the names of the signals and then copy-paste them into RobotStudio.

Example of input signals configured for CIP Safety internal adapter device:



xx1800000948

Note

For information about Function mappings, Pre Logic and Post Logic, see *Application manual - Functional safety and SafeMove2*.

Restart the controller

After configuring the safe internal adapter, restart the robot controller for the changes to take effect.

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Validate the safe fieldbus and signal configuration

Validate the safe fieldbus parameters, including I/O settings and signals used for safety interlocking, by comparing the safety report with the configured values.

The user must visually verify that the data in the safety report is correct and that it is the same as entered in the Visual SafeMove configuration GUI.

After controller restart the configuration is applied. The user must verify that no safe fieldbus related event logs were generated, that the status of the connection in the originator indicates "running", and that the connection to the intended adapter device has been established.

Do not set the status of the configuration to validated or locked until the validation is performed. For more information about configuration status, see *Application manual - Functional safety and SafeMove2*.

5 Installing and configuring the internal scanner

5.1 Recommended working procedure

General

This section describes the recommended working procedure when installing and configuring the EtherNet/IP internal scanner.

Limitations

The following limitations apply to the Internal CIP Safety scanner described in *Creating and configuring the safe internal scanner (CIP Safety) on page 45*.

- ABB CIP Safety Internal scanner can connect up to 8 CIP Safety external safety devices at the same time.
- ABB CIP Safety Internal scanner does not support CIP Safety multicast connections.
- The ABB CIP Safety scanner only supports the CIP Safety connection Type2, thus, requires that external 3rd party devices are configured prior to connecting. The configuration can typically be done using vendor specific Safety Network Configuration Tool (SNCT). For details, see 3rd party manuals.
- The ABB CIP Safety scanner does not connect to a modular CIP Safety I/O device with modules that are not directly accessible from the EtherNet/IP network, thus, from our scanner. To access such modules the scanner should send a special *Forward Open* request containing CIP Routing information (for details see *THE CIP NETWORKS LIBRARY* volume 1: *Common Industrial Protocol Specification*, chapter 10: *Bridging and Routing*).

> **Note**
>
> On the market there are CIP Safety EtherNet/IP I/O devices of modular construction available that do not require CIP routing information when establishing connection, for example, PILZ PSS u2 P0 F/S EIP. The ABB CIP Safety Scanner in RobotWare 6.08 connects to such.

The following devices are supported:

- Safety HarshIO Modules (TCDEC-8B4P-DYU-G, TCDEC-8B4B-DYU-G)
- PILZ (PSS u2 P0 F/S EIP) with safety modules
- ABB CIP Safety Adapter

Basic steps

Use this procedure to install and configure an EtherNet/IP scanner.

	Action	See
1	Use RobotStudio to configure the topic Communication.	*Technical reference manual - System parameters*
2	Use RobotStudio to configure the EtherNet/IP network settings.	*Configuring the EtherNet/IP network settings on page 32*

Continues on next page

	Action	See
3	Set the IP address on the external device.	User Manual from the vendor of the external device.
4	Configure the I/O devices connected to the EtherNet/IP industrial network using RobotStudio or FlexPendant.	*Creating and configuring the internal scanner on page 41*

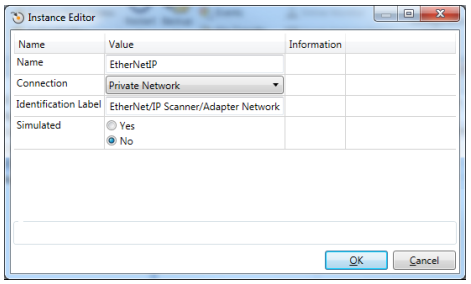
Additional configuration

Action	See
Creating device templates by using EDS files	*Using EDS files to create device templates on page 44*.
Configuring *QuickConnect* functionality.	*QuickConnect on page 72*.
Setting up communication between two IRC5 controllers.	*Communication between two IRC5 controllers on page 58*.

5.2 Creating and configuring the internal scanner

Internal scanner configuration

Use this procedure to configure the EtherNet/IP scanner in the IRC5 controller, using the **Configuration Editor** in RobotStudio.

	Action	Note
1	Start RobotStudio and connect to the IRC5 controller. Request write access.	
2	Click **Configuration Editor** and select **I/O System**.	
3	In the **Type** list, click **Industrial Network** and then right-click in the workspace on the EtherNetIP item and select **Edit Industrial Network**.	For more information about the parameters, see *System parameters on page 61*.
4	Enter the parameter values for the industrial network. • **Connection**, select one previously configured in *IP Setting* in topic *Communication*. Click **OK**.	 xx1400001924
5	In the **Type** list, click **EtherNet/IP Device** and then right-click in the workspace and select **New EtherNet/IP Device**.	

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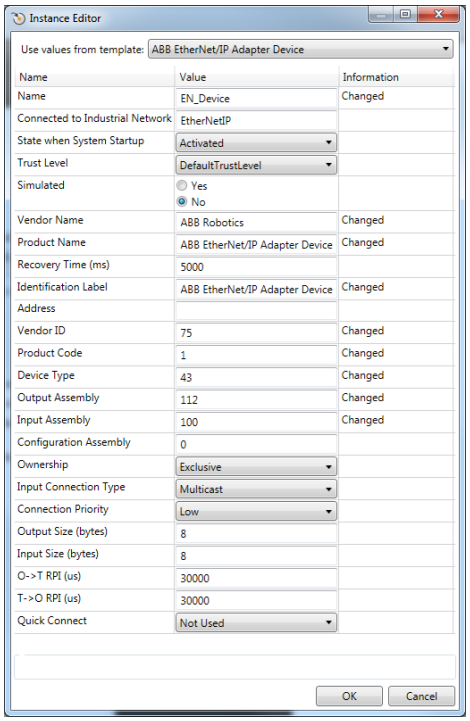
	Action	Note
6	Enter the parameter values for the new I/O device. • **Use values from template**, select the *ABB EtherNet/IP Adapter Device* option. **Note** **Use values from template** drop-down list shows the existing templates and templates created by using EDS file (See *Using EDS files to create device templates on page 44*). • **Connected to Industrial Network**, shall be *EtherNetIP*. • **Identification Label**, user defined. **Note** Continue editing the parameters if necessary. • **Address**, enter the IP address that has been defined for the device. **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. • Change the size in **Connection Input Size** and **Connection Output size**, as desired. This step is optional. Click **OK**.	 xx1400001940

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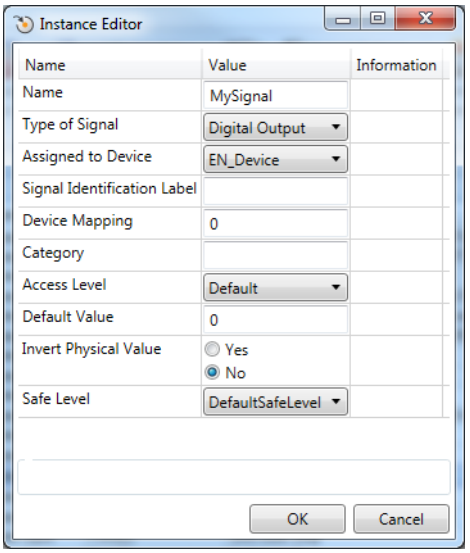
	Action	Note
7	In the **Type** list click **Signal**. Add I/O signals for the new I/O device.	 xx1400001941
8	Restart the IRC5 controller to connect to the configured device.	

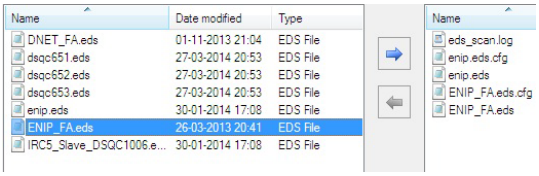
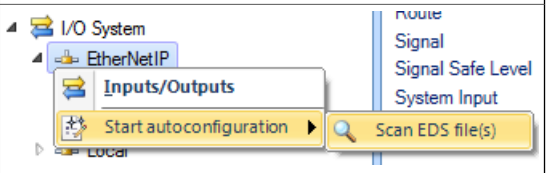
Continues on next page

5.2.1 Using EDS files to create device templates

Procedure

It is possible to create device templates from the EDS files. A device template is created for each valid connection found in the Connection Manager section in the EDS file.

Use this procedure to create device templates by using EDS files.

	Action	Note
1	Start RobotStudio and connect to the IRC5 controller. Request write access. To proceed with the steps, the system should be in manual mode.	
2	To proceed with the steps, the system should be in manual mode.	
3	Click **File Transfer** and locate the folder EDS in HOME directory. Select the required EDS file and click the Right Arrow button to transfer the files. **Note** Transfer the EDS files for the devices involved in the EtherNet/IP network	 xx1400002221
4	Click **I/O System** to expand the folder. Select **EtherNetIP** and right-click in the workspace and select **Scan EDS file(s)** • Files are parsed. • Click Yes to continue with the device templates creation. • Click Ok to continue with report generation in the event log. **Note** The EDS reader does not check if the file is syntactically correct. It is important that the device created from the device template is inspected manually.	 xx1400002222
5	The device templates are created and available as options in **Use values from template** while creating a new I/O device.	

5.3 Creating and configuring the safe internal scanner (CIP Safety)

Safe internal scanner configuration

This procedure describes how to configure the CIP Safety scanner in the IRC5 controller. This requires the option *CIP Safety Scanner* (997-4).

Before configuring the internal CIP Safety scanner, an internal CIP Safety adapter must be configured, see *Configuring the safe internal adapter device (CIP Safety) on page 34*.

The configuration of the internal CIP Safety scanner actually consists of configuring external adapter devices that the ICR5 controller will communicate with and creating a representation of these devices in RobotStudio.

Note

Each external 3rd party device needs configuring using vendor specific tools (that is, SNCT) prior to connecting with the ABB CIP Safety internal scanner. Such configuration includes IP-address, SNN, and any other configuration which is specific for the device. If connecting to an external ABB CIP Safety adapter, see *Configuring the safe internal adapter device (CIP Safety) on page 34*.

Creating a representation of an external adapter device in RobotStudio can be divided in three steps:

1. Creating EtherNet/IP I/O connections for the device. These are communication channels that allow exchange of I/O data between the IRC5 controller and the device. See *Configure I/O connection on page 45*.
2. Creating EhterNet/IP adapter device and attaching the connections created in the previous step. See *Configure adapter device on page 46*.
3. Configuring safety parameters of the device in Visual SafeMove. See *Configure external device safety parameters on page 47*.

Configure I/O connection

	Action	Note/Illustration
1	Start RobotStudio and connect to the IRC5 controller. Request write access.	
2	Click **Configuration Editor** and select **I/O System**.	
3	In the **Type** list, click **Industrial Network** and then right-click in the workspace on the EtherNetIP item and select **Edit Industrial Network**.	For more information about the parameters, see *System parameters on page 61*.

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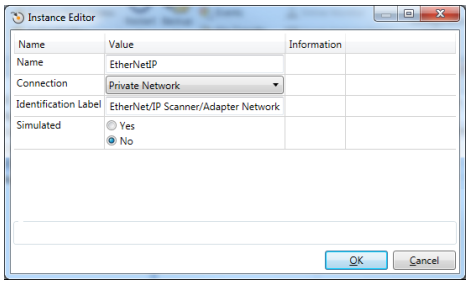
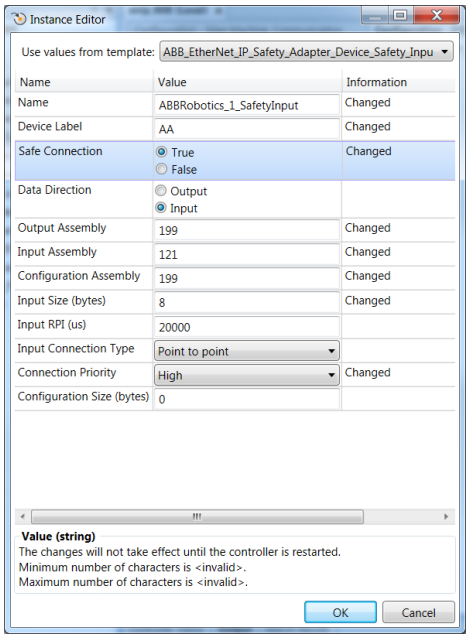
5.3 Creating and configuring the safe internal scanner (CIP Safety)
Continued

	Action	Note/Illustration
4	Enter the parameter values for the industrial network. • **Connection**, select one previously configured in *IP Setting* in topic *Communication*. The connection for the scanner must be the same as for the adapter. Click **OK**.	 xx1400001924
5	In the **Type** list, click **EtherNet/IP IO Connection** and then right-click in the workspace and select **New EtherNet/IP IO Connection**.	
6	Enter the parameter values for the new I/O connection. **Safe Connection** , shall be **True** for safe connections. Click **OK**. **Note** If **Data Direction** is set to **Output**, the parameters **Output Size** and **Output RPI** are shown while input parameters are hidden. If **Data Direction** is set to **Input**, the parameters **Input Size** and **Input RPI** are shown while output parameters are hidden. Do not set **Output Size** and **Output RPI** to anything else than zero and then change **Data Direction** to **Input** (or vice versa).	 xx1800000950
7	Repeat step *5* and *6* for each connection.	Each adapter device can use up to three connections, one for safe inputs, one for safe outputs and one for standard inputs/outputs.

Configure adapter device

	Action	Note/Illustration
1	In the **Type** list, click **EtherNet/IP Device** and then right-click in the workspace and select **New EtherNet/IP Device**.	

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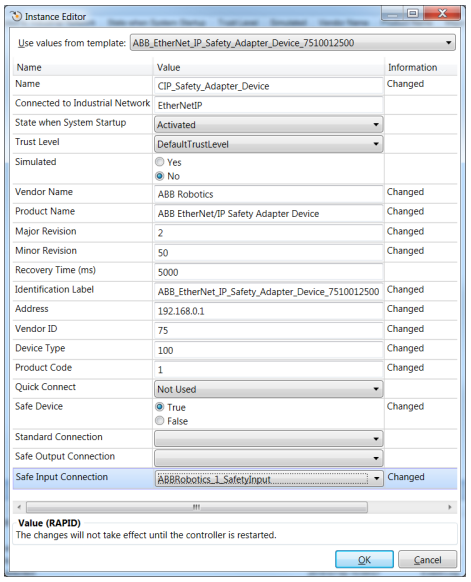
	Action	Note/Illustration
2	Enter the parameter values for the new I/O device. • **Use values from template** drop-down list shows the existing templates and templates created by using EDS file (See *Using EDS files to create device templates on page 44*). • **Connected to Industrial Network**, shall be *EtherNetIP*. • **Identification Label**, user defined. • **Safe Device**, shall be **True**. • For **Standard Connection**, **Safe Output Connection** or **Safe Input Connection**, select the connection created in *Configure I/O connection on page 45*. Note that up to three connections can be used for the same device (one for non-safe, one for safe output and one for safe input). The same connection can be used for multiple devices as long as the devices are similar in all aspects of the connection configuration. Click **OK**.	 xx1800000949

Configure external device safety parameters

	Action
1	In the **Controller** tab, click **Safety**, then select **Visual SafeMove**.
2	In the SafeMove ribbon, click on the **Safe IO Configurator**.
3	Select the **Signals** view.
4	Expand the node **CIP Safety** and then **External Devices**.
5	Click on **Add new device**.
6	Expand the node for the new device.
7	Setup the parameters for the safe external device (see table below).

Parameters for safe external device

Setting	Description
Name	The same name as for the *EtherNet/IP Device*. See *Configure adapter device on page 46*.
Input size	The same input size as for the *EtherNet/IP IO Connection*. See *Configure I/O connection on page 45*.
Output size	The same output size as for the *EtherNet/IP IO Connection*. See *Configure I/O connection on page 45*.
NodeId	The same as the IP address for the *EtherNet/IP Device*. See *Configure adapter device on page 46*.

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Setting	Description
SNN	The *Safety Network Number (SNN)* provides a unique network identifier for each network in the safety system. Must match the device configuration in the SNCT tool. **Note** The user should assign SNN numbers for each safety network or safety sub-net that are unique system-wide.
Configuration signature	The configuration signature, also called *Safety Configuration ID (SCID)*, uniquely identifies the configuration of the external device and can be used to confirm the integrity of the adapter configuration over time. The signature is checked whenever an originator tries to connect to the adapter. If the signatures match, the connection is established. If the signature does not match, the error response *Configuration signature mismatch* is returned. **Note** When configuring safety connections without the configuration signature, i.e. not used, the user is responsible for ensuring that originators (scanners) and targets (adapters) have the correct configurations.
Max fault	Number of allowed erroneous packets before a connection is dropped. It is recommended to keep the default value (5).
Format type	Safety format. 0=Auto, 1=Base, 2=Extended. Most devices use the format Extended (2).
Timeout multiplier	Number of multipliers of Connection RPI that is allowed before the connection will time out. It is recommended to keep the default value (2).
Time Coordination message mulitplier	Minimum number of multipliers of 128 µs (CIP Safety time increments) it could take for the time coordination message to travel from sender to receiver. It is recommended to keep the default value (2).

Create safe signals

It is important that the offset of the signals are the same for both the internal scanner and the external adapter.

	Action
1	In the **Safe IO Configurator**, under the external device node you have just created, expand the node **Input signals** or **Output signals**, depending on which type of signal you want to create.
2	Right-click in the table and select **Insert signal**.
3	Type a **Signal name** and **Default value**.

Note

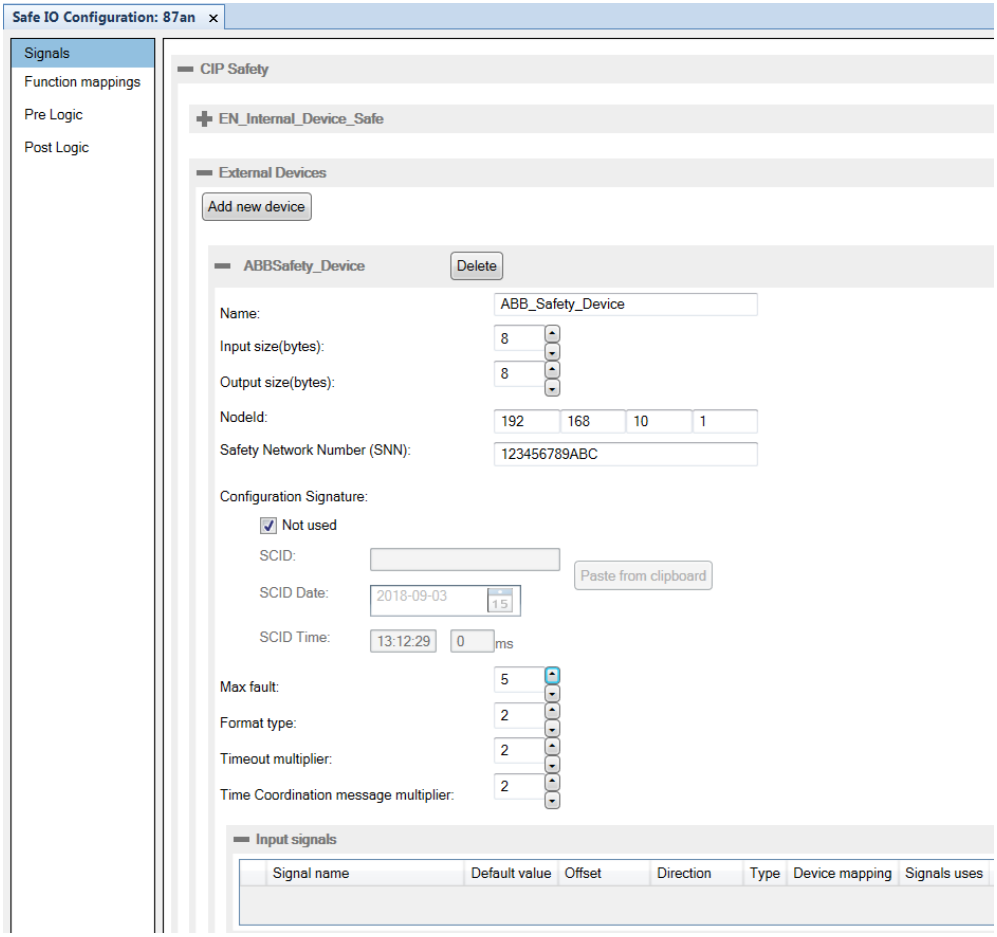
The usage of a signal cannot be changed from the **Safe IO Configuration**, but in the column **Signal uses** it is shown what functions use each signal.

Continues on next page

Tip

It is possible to use a spreadsheet application, or text editor, to edit the names of the signals and then copy-paste them into RobotStudio.

Example of input signals configured for CIP Safety external device:



xx1800001536

Note

For information about Function mappings, Pre Logic and Post Logic, see *Application manual - Functional safety and SafeMove2*.

Restart the controller

After configuring the safe internal scanner, restart the robot controller for the changes to take effect.

Validate the safe fieldbus and signal configuration

Validate the safe fieldbus parameters, including I/O settings and signals used for safety interlocking, by comparing the safety report with the configured values.

Continues on next page

The user must visually verify that the data in the safety report is correct and that it is the same as entered in the Visual SafeMove configuration GUI.

After controller restart the configuration is applied. The user must verify that no safe fieldbus related event logs were generated, that the status of the connection in the originator indicates "running", and that the connection to the intended adapter device has been established.

Do not set the status of the configuration to validated or locked until the validation is performed. For more information about configuration status, see *Application manual - Functional safety and SafeMove2*.

Replacement of device

If any safety device is replaced, the replacement device must be configured properly, and the operation of the replacement device must be validated.

5.4 Explicit messaging services

5.4.1 Information

General

It is possible to configure I/O devices through explicit messaging services. This could be done either at startup by defining the EtherNet/IP command to the configured device, or at runtime from RAPID through the *Fieldbus Command Interface* (FCI).

> **Note**
>
> For information about which explicit messaging services are available for a specific I/O device and how to set the parameters, refer to the supplier documentation of the I/O device and the *Common Industrial Protocol (CIP) Specification*, see *References on page 7*.

EtherNet/IP command system parameters

The EtherNet/IP specific system parameters in the *EtherNet/IP Command* type are:

- Path (`Path`), see *Path on page 105*.
- Service (`Service`), see *Service on page 106*.
- Download Order (`-OrderNr`), see *Technical reference manual - System parameters*.

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

The *Path* parameter

Following is a short description of the syntax used in the `Path` parameter.

```
"Path length, 20 Class 24 Instance 30 Attribute, Data type, Data
     type length"
```

The following table provides a description of the parameters used in the syntax:

Parameter	Description
Path length	The byte count for the "20 64 24 01 30 05" string. This is an optional parameter.
Class	The EtherNet/IP class number.
Instance	The instance number of the class.
Attribute	The attribute of the specified instance.
Data type	The data format of the attribute. This is an optional parameter.
Data type length	The length in bytes of the specified Data type. The highest allowed value is 0x20 (32 bytes). This parameter is ignored, but is accepted if entered.

Continues on next page

5.4.1 Information
Continued

The following table provides a list of the allowed data types for the parameter *Data type*:

Data Type	Value	Description
CIP_EXPL_BOOL	C1	Logical Boolean with values TRUE and FALSE
CIP_EXPL_SINT	C2	Signed 8-bit integer value
CIP_EXPL_INT	C3	Signed 16-bit integer value
CIP_EXPL_USINT	C6	Unsigned 8-bit integer value
CIP_EXPL_UINT	C7	Unsigned 16-bit integer value
CIP_EXPL_UDINT	C8	Unsigned 32-bit integer value
CIP_EXPL_REAL	CA	32-bit floating point value
CIP_EXPL_STRING	D0	Character string (1 byte per character)
CIP_EXPL_BYTE	D1	Bit string - 8-bits
CIP_EXPL_WORD	D2	Bit string - 16-bits
CIP_EXPL_DWORD	D3	Bit string - 32-bits
CIP_EXPL_SHORT_STRING	DA	Character string (1 byte per character, 1 byte length indicator)

The following table provides a list of what delimiter to use for the parameter *Value*, if the data is an array:

Data Type	Delimiter	Example
CIP_EXPL_BOOL CIP_EXPL_SINT CIP_EXPL_INT CIP_EXPL_USINT CIP_EXPL_UINT CIP_EXPL_UDINT CIP_EXPL_REAL CIP_EXPL_BYTE CIP_EXPL_WORD CIP_EXPL_DWORD	The values are delimited by space.	"123 214 125 2 44" An array of 5 elements. The Data Type specifies the type of each element.
CIP_EXPL_STRING CIP_EXPL_SHORT_STRING	The values are delimited by semicolon.	"Hello;This;Is;My;Name" An array of 5 elements of string type.

The *Service* parameter

The *Service* parameter describes what type of operation that should be performed against the specified *Path* parameter.

Following are the allowed values for *Service*:

Operation	Value	Description
Set Attribute Single	16	Set the value specified in parameter *Value* of the *EtherNet/IP Command*.
Reset	5	Performs a reset of the specified device.

Continues on next page

The *Download Order* parameter

The *Download Order* parameter is used to specify in what order the commands are sent to the I/O device.

If an EtherNet/IP Command is rejected by the I/O device, the EtherNet/IP scanner will generate an event message with the error code returned by the I/O device.

5.4.2 EtherNet/IP command at startup

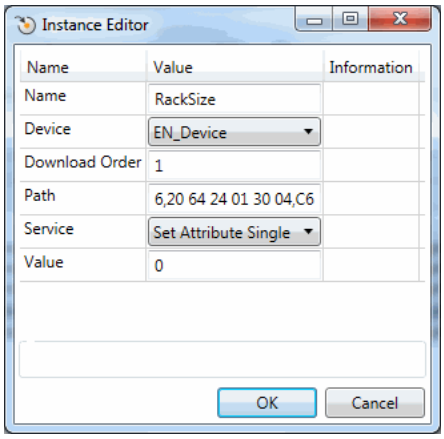
Information

It is possible to configure EtherNet/IP Commands that will be sent to a device at startup:

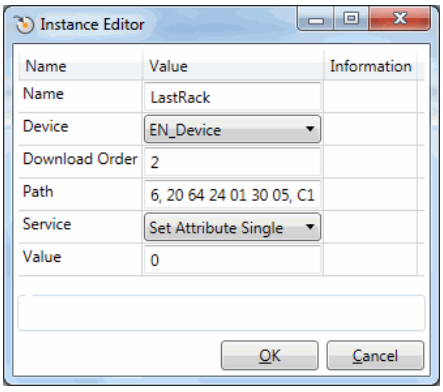
EtherNet/IP command at startup	Description
EtherNet/IP Command	This is specific to the I/O device and will only be sent to the assigned I/O device.

Example using *EtherNet/IP Command*

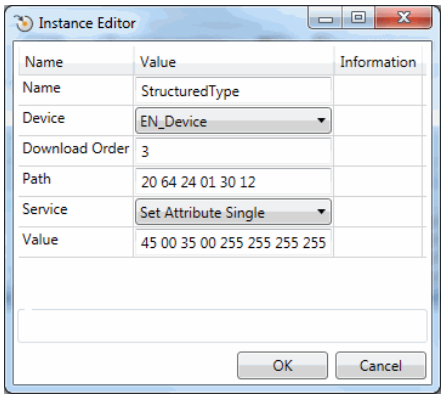
Following is a configuration example from RobotStudio that sends four EtherNet/IP commands at startup to I/O device, *EN_Device*. There are four different specific commands that are sent to the device to perform specific operations on it. The example shows how to use the *Path* and *Service* parameters.



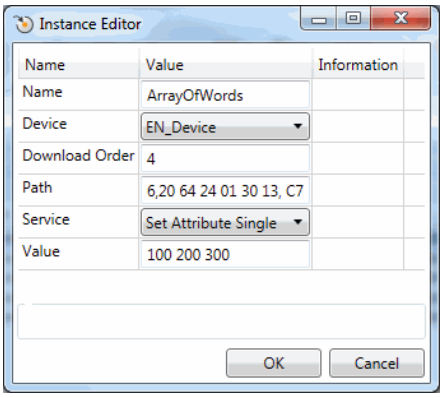
xx1300000349



xx1300000348



xx1300000351



xx1300000347

Note

If a class, instance, or attribute below 0x10 is specified, it is important to include a "0" before the value. For example, the value 8 is written as 08 in the *Path* string.

5.4.3 EtherNet/IP command via RAPID

Information

For more information about the RAPID instructions, see *Technical reference manual - RAPID Instructions, Functions and Data types*.

Example

In this example, data packed as a `rawbytes` variable is read from an EtherNet/IP I/O device.

```
PROC get_quickconnect_value()
  VAR iodev dev;
  VAR rawbytes rawdata_out;
  VAR rawbytes rawdata_in;
  VAR num input_int;
  VAR byte return_status;
  VAR byte return_errcodecnt;
  VAR num return_errcode;
  VAR byte value;

  ! Empty contents of rawdata_out and rawdata_in
  ClearRawBytes rawdata_out;
  ClearRawBytes rawdata_in;

  ! Add Fieldbus command header to rawdata_out with service
       "GET_ATTRIBUTE_SINGLE" and path to QuickConnect attribute
       on I/O unit.
  PackDNHeader "0E", "6,20 F5 24 01 30 0C", rawdata_out;

  ! Open FCI device
  Open "/FCI1:" \File:="TheUnit", dev \Bin;

  ! Write the contents of rawdata_out to dev
  WriteRawBytes dev, rawdata_out \NoOfBytes :=
       RawBytesLen(rawdata_out);

  ! Read the answer from dev
  ReadRawBytes dev, rawdata_in;

  ! Close FCI device
  Close dev;

  ! Unpack rawdata_in to the variable return_status
  UnpackRawBytes rawdata_in, 1, return_status \Hex1;

  ! The first byte is always the general status byte. 0 means
       success, see the CIP standard error codes.
  IF return_status = 0 THEN
    TPWrite "Status OK from device. Status code:
         "\Num:=return_status;
    ! Unpack the read data value that follows the status byte.
```

Continues on next page

5.4.3 EtherNet/IP command via RAPID

Continued

```
    UnpackRawBytes rawdata_in, 2, value \Hex1;
    TPWrite "Read value: " \Num:=value;
  ELSE
    ! If the general status was not ok there is extended error
         information that can be retreived. First byte, after the
         general status byte, tells how many extended error words
         can be found.
    UnpackRawBytes rawdata_in, 2, return_errcodecnt \Hex1;
    ! Unpack the number of extended status words. In this example
         only the first one is unpacked.
    UnpackRawBytes rawdata_in, 3, return_errcode \IntX := UINT;
    TPWrite "Error code from device: "\Num:=return_status;
    TPWrite "Additional error code count from device:
         "\Num:=return_errcodecnt;
    TPWrite "Additional error code from device:
         "\Num:=return_errcode;
  ENDIF
ENDPROC
```

5.5 QuickConnect

Overview

The *QuickConnect* functionality provides the connection between the EtherNet/IP scanner and the device to quickly disconnect and reconnect to the Ethernet network, both mechanically and logically. With the *QuickConnect* functionality activated, the device will be connected and operational by the EtherNet/IP Scanner under 500 ms.

Requirements

A QuickConnect system requires an electrical lock signal that indicates, when power has been applied to the QuickConnect devices. This signal must be implemented by the system builder and is used to start the QuickConnect sequence.

Additional system component requirements:

- Managed network switch(es)
- QuickConnect device(s):

  A QuickConnect device has *QuickConnect* functionality disabled as default. This functionality must be activated for proper function.

  It can be done using:

  - Configuration data via the configuration *Assembly* (see *Configuration Assembly on page 82*)
  - Third party tool before connecting the module to IRC5 controller Ethernet/IP scanner
  - EtherNet/IP command
  - QuickConnect parameter on Device (see *QuickConnect on page 72*)

> **Note**
>
> When connecting QuickConnect devices, it is essential that network switches allow *gratuitous ARP* to exist on the network. Gratuitous ARP is issued by QuickConnect devices during startup to inform other network devices that they are ready to join the network.

Sequence

1. The IRC5 controller deactivates current connections to QuickConnect devices, and the robot arm physically disengages the current tool.
2. The robot arm physically attaches to the new QuickConnect devices.
3. The new QuickConnect devices power up.
4. The IRC5 controller acknowledges a successful attachment to a new tool via an electrical lock signal.
5. Upon receiving the electrical lock signal, the IRC5 controller waits a specific time[I] for the QuickConnect devices to power up before activating the devices.

I The QuickConnect time can be found in the EDS file for the QuickConnect device.

5.6 Communication between two IRC5 controllers

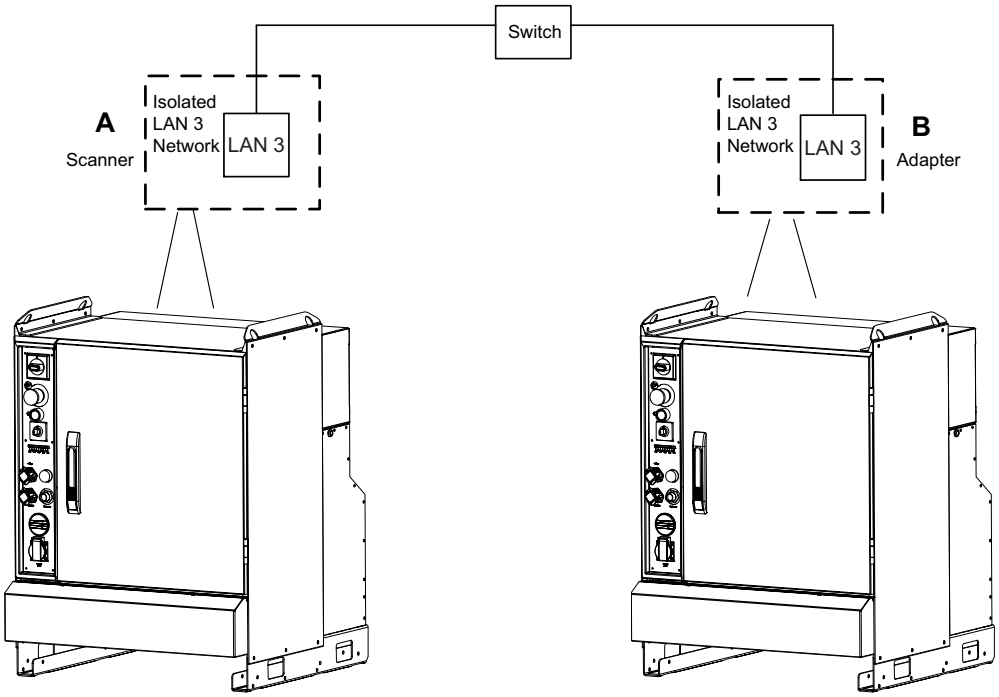
General

When two IRC5 controllers are connected to each other through EtherNet/IP, one of them must be acting as an adapter device and the other one must be acting as a scanner.

> **Note**
>
> It is possible to configure both the scanner and an adapter device in the same IRC5 controller.

Illustration

The following figure illustrates communication between two IRC5 controllers.



xx1400001945

> **Note**
>
> The switch is optional. You can use an Ethernet cable when there is no switch.

Also see illustration in section *EtherNet/IP on dedicated industrial network on page 22*.

Limitations

The address specified in the *Industrial Network* cannot be the same on the two controllers since they shall be interconnected.

Continues on next page

Configuring the scanner/adapter controllers

The following procedures describe the configuration of a hardware setup like the one illustrated in section *Illustration on page 58*.

	Action	Info/Note
1.	Configure the EtherNet/IP industrial network address for both the IRC5 controllers. See *Technical reference manual - System parameters*.	**Note** Be sure to use different EtherNet/IP addresses for the two IRC5 controllers to avoid duplicated addresses on the interconnected network.
2.	Configure the EtherNet/IP adapter device according to the configuration procedure for the EtherNet/IP internal adapter device. See *Configuring the internal adapter device on page 33*.	
3.	Configure the EtherNet/IP scanner to connect to the EtherNet/IP internal adapter device. See *Creating and configuring the internal scanner on page 41*.	**Note** Use ABB EtherNet/IP Adapter Device template when configuring the EtherNet/IP scanner to connect to the EtherNet/IP Adapter.
4.	Configure signals on the created device.	
5.	Physically interconnect the two IRC5 controllers.	
6.	Restart the adapter controller.	
7.	Restart the scanner controller.	The scanner will now connect to the internal adapter controller.
8.	Now it is possible to set output signals on one controller.	The output signals shall appear as inputs on the other controller.

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6 System parameters

6.1 Introduction

About the system parameters

There are both EtherNet/IP specific parameters and more general parameters. This chapter describes all EtherNet/IP specific system parameters. The parameters are divided into the type they belong to. For information about other parameters, see *Technical reference manual - System parameters*.

Continues on next page

6.1.1 EtherNet/IP system parameters

Industrial Network

These parameters belong to the type *Industrial Network* in the topic *I/O System*.

Parameter	For more information, see ...
Name	*Technical reference manual - System parameters*
Connection	*Technical reference manual - System parameters*
Identification Label	*Technical reference manual - System parameters*
Simulated	*Technical reference manual - System parameters*

EtherNet/IP Device

These parameters belong to the type *EtherNet/IP Device* in the topic *I/O System*. In the manual, the parameters are listed under *Device* as each industrial network shall use its own configuration, for example EtherNet/IP Device and DeviceNet Device.

Parameter	For more information, see ...
Name	*Technical reference manual - System parameters*
Connected to Industrial Network	*Technical reference manual - System parameters*
State when System Startup	*Technical reference manual - System parameters*
Trust Level	*Technical reference manual - System parameters*
Simulated	*Technical reference manual - System parameters*
Vendor Name	*Technical reference manual - System parameters*
Product Name	*Technical reference manual - System parameters*
Major Revision	*Major Revision on page 66*
Minor Revision	*Minor Revision on page 67*
Recovery Time	*Technical reference manual - System parameters*
Identification Label	*Technical reference manual - System parameters*
Address	*Address on page 68*
Vendor ID	*Vendor ID on page 69*
Device Type	*Device Type on page 70*
Product Code	*Product Code on page 71*
Quick Connect	*QuickConnect on page 72*
Safe Device	*Safe Device on page 74*
Standard Connection	*Standard Connection on page 75*
Safe Output Connection	*Safe Output Connection on page 76*
Safe Input Connection	*Safe Intput Connection on page 77*
Output Assembly [i]	*Output Assembly on page 78*
Input Assembly [i]	*Input Assembly on page 79*
Output Size [i]	*Output Size on page 80*

Continues on next page

Parameter	For more information, see ...
Input Size[i]	*Input Size on page 81*
Configuration Assembly[i]	*Configuration Assembly on page 82*
Ownership[i]	*Ownership on page 85*
Input Connection Type[i]	*Input Connection Type on page 86*
Connection Priority[i]	*Connection Priority on page 87*
Configuration Size[i]	*Configuration Size on page 83*
Configuration Data[i]	*Configuration Data on page 84*
Output RPI[i]	*Output RPI on page 88*
Input RPI[i]	*Input RPI on page 89*
Connection Timeout Multiplier[i]	*Connection Timeout Multiplier on page 90*

i For CIP Safety devices, this parameter is not present in the type *EtherNet/IP Device* but is configured in the type *EtherNet/IP IO Connection*.

EtherNet/IP IO Connection

These parameters belong to the type *EtherNet/IP IO Connection* in the topic *I/O System*. This type is only used for the option *CIP Safety Scanner* (997-4).

Parameter	For more information, see ...
Name	*Technical reference manual - System parameters*
Device Label	*Device Label on page 91*
Output Assembly	*Output Assembly on page 92*
Input Assembly	*Input Assembly on page 93*
Configuration Assembly	*Configuration Assembly on page 94*
Output Size	*Output Size on page 95*
Input Size	*Input Size on page 96*
Output RPI	*Output RPI on page 97*
Input RPI	*Input RPI on page 98*
Data Direction	*Data Direction on page 99*
Safe Connection	*Safe Connection on page 100*
Input Connection Type	*Input Connection Type on page 101*
Connection Priority	*Connection Priority on page 102*
Configuration Size	*Configuration Size on page 103*
Configuration Data	*Configuration Data on page 104*

EtherNet/IP Command

These parameters belong to the type *EtherNet/IP Command* in the topic *I/O System*.

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

Continues on next page

6.1.1 EtherNet/IP system parameters

Continued

Parameter	For more information, see ...
Download Order	*Technical reference manual - System parameters*
Path	*Path on page 105*
Service	*Service on page 106*
Value	*Technical reference manual - System parameters*

6.2 Type Industrial Network

6.2.1 Connection

Parent

Connection belongs to the type *Industrial Network*, in the topic *I/O System*.

Description

The parameter *Connection* specifies the *IP Setting* that the option *EtherNet/IP Scanner/Adapter* shall use.

Usage

The *Connection* parameter is used to select one of the available connection connectors to use.

Prerequisites

The option *EtherNet/IP Scanner/Adapter* must be installed.

Default value

Private Network

Allowed values

Valid instances of *IP Setting*

6.3 Type Ethernet/IP Device

6.3.1 Major Revision

Parent

Major Revision belongs to the type *Device*, in the topic *I/O System*.

Usage

Used together with *Minor Revision* to define the revision of the device.

Prerequisites

The option *EtherNet/IP Scanner/Adapter* must be installed.

Default value

Default value is 0.

Allowed values

An integer between 0 and 127.

6.3.2 Minor Revision

Parent

Minor Revision belongs to the type *Device*, in the topic *I/O System*.

Usage

Used together with *Major Revision* to define the revision of the device.

Prerequisites

The option *EtherNet/IP Scanner/Adapter* must be installed.

Default value

Default value is 0.

Allowed values

An integer between 0 and 127.

6.3.3 Address

Parent

Address belongs to the type *Device*, in the topic *I/O System*.

Description

The parameter *Address* specifies the address of the I/O device on the network.

Usage

Address specifies the address that the I/O device uses on the network, to which the scanner should set up a connection.

Prerequisites

The option *EtherNet/IP Scanner/Adapter* must be installed.

Default value

Empty

Allowed values

The value can be between 0.0.0.0 - 255.255.255.255.

There are limitations for the values set by the vendor of the device. However, it is dependent on the selected network. The selected network is determined by the network address and subnet mask.

6.3.4 Vendor ID

Parent

Vendor ID belongs to the type *Device*, in the topic *I/O System*.

Description

Vendor ID is used as an identification of the I/O device to secure communication to the correct type of device.

Usage

This parameter is used as an identification of the I/O device to secure communication to the correct device.

The value of *Vendor ID* can be found in the Electronic Data Sheet (EDS) for the device (called VendCode in EDS file) in EtherNet/Ip network, or by using a predefined device template in DeviceNet network.

Prerequisites

The option *DeviceNet Master/Slave* or *EtherNet/IP Scanner/Adapter* must be installed.

Default value

The default value is 0.

Allowed values

Allowed values are the integers 0-65535.

Additional information

The I/O device vendor number is assigned by Open DeviceNet Vendor Associations (ODVA) to the vendor of the specific I/O device.

6.3.5 Device Type

Parent

Device Type belongs to the type *Device*, in the topic *I/O System*.

Description

The parameter *Device Type* specifies the device type of this I/O device as defined by the Open DeviceNet Vendor Association.

Usage

This parameter is used as an identification of the I/O device to secure communication to the correct device.

The value of this parameter can be found in the Electronic Data Sheet (EDS) for the device (called ProdType in EDS file) in EtherNet/IP network, or by using a predefined device template in DeviceNet network.

Prerequisites

The option *DeviceNet Master/Slave* or *EtherNet/IP Scanner/Adapter* must be installed.

Default value

The default value is 0.

Allowed values

Allowed values are the integers 0-65535.

6.3.6 Product Code

Parent

Product Code belongs to the type *Device*, in the topic *I/O System*.

Description

Product Code is used as an identification of the I/O device to secure communication to the correct I/O device.

Usage

This parameter is used as an identification of the I/O device to secure communication to the correct device.

The value of *Product Code* can be found in Electronic Data Sheet (EDS) for the device (called ProdCode in EDS file) in EtherNet/IP network, or by using a predefined device template in DeviceNet network.

Prerequisites

The option *DeviceNet Master/Slave* or *EtherNet/IP Scanner/Adapter* must be installed.

Default value

Default value is 0.

Allowed values

Allowed values are the integers 0-65535.

Additional information

The device product code is defined by the vendor of the device and shall be unique for the actual product type.

6.3.7 QuickConnect

Parent

QuickConnect belongs to the type *Device*, in the topic *I/O System*.

Description

The *QuickConnect* functionality provides the connection between the *EtherNet/IP Scanner* and the I/O device to quickly disconnect and reconnect, both mechanically and logically, to the Ethernet network. When the *QuickConnect* functionality is activated, the device is connected and operational by the *EtherNet/IP Scanner*, under 500 ms.

Usage

The parameter *QuickConnect* specifies if the *QuickConnect* attribute shall be set or not set on the I/O device.

There are three different alternatives:

1. Not Used: *QuickConnect* will not be used and the *EtherNet/IP Scanner* will not care about the *QuickConnect* attribute on the I/O device.
2. Activated: The *EtherNet/IP Scanner* will try to activate the *QuickConnect* attribute on the I/O device.
3. Deactivated: The *EtherNet/IP Scanner* will try to deactivate the *QuickConnect* attribute on the I/O device.

Note

While using *QuickConnect*, make sure to turn off autonegotiation on the link that is disconnected. For example, in the connector on the switch (or in the connector for the IRC5 controller) and in the connector on the I/O device.

An error message appears if trying to activate or deactivate the *QuickConnect* functionality on an I/O device that does not support *QuickConnect*.

Note

If *Configuration Data* is used to activate or deactivate the *QuickConnect* parameter in a device, set the *QuickConnect* to Not Used. Based on priority, the *Configuration Data* parameter overrides the *QuickConnect* parameter.

Prerequisites

The option *EtherNet/IP Scanner/Adapter* must be installed.

Default value

Not Used

Allowed values

Not Used

Activated

Continues on next page

Deactivated

6.3.8 Safe Device

Parent

Safe Device belongs to the type *Device*, in the topic *I/O System*.

Description

Safe Device is set to TRUE for CIP Safety devices.

Usage

If *Safe Device* is set to TRUE, some parameters are hidden for the device. Those parameters are instead configured in the type *EtherNet/IP IO Connection*.

Prerequisites

The option *CIP Safety Scanner* must be installed.

Default value

Default value is FALSE.

Allowed values

TRUE or FALSE.

6.3.9 Standard Connection

Parent

Standard Connection belongs to the type *Device*, in the topic *I/O System*.

Description

Connection to use for standard (not CIP Safety) signals.

Usage

Select the name of the instance of *EtherNet/IP IO Connection* to use.

Prerequisites

The option *CIP Safety Scanner* must be installed.

Connections are only used for safe devices (parameter *Safe Device* = TRUE). For standard devices, *Standard Connection* is not used.

Default value

Empty

Allowed values

A string with maximum 32 characters.

6.3.10 Safe Output Connection

Parent

Safe Output Connection belongs to the type *Device*, in the topic *I/O System*.

Description

Connection to use for standard (not CIP Safety) signals.

Usage

Select the name of the instance of *EtherNet/IP IO Connection* to use.

Prerequisites

The option *CIP Safety Scanner* must be installed.

Connections are only used for safe devices (parameter *Safe Device* = TRUE). For standard devices, *Safe Output Connection* is not used.

Default value

Empty

Allowed values

A string with maximum 32 characters.

6.3.11 Safe Intput Connection

Parent

Safe Intput Connection belongs to the type *Device*, in the topic *I/O System*.

Description

Connection to use for standard (not CIP Safety) signals.

Usage

Select the name of the instance of *EtherNet/IP IO Connection* to use.

Prerequisites

The option *CIP Safety Scanner* must be installed.

Connections are only used for safe devices (parameter *Safe Device* = TRUE). For standard devices, *Safe Intput Connection* is not used.

Default value

Empty

Allowed values

A string with maximum 32 characters.

6.3.12 Output Assembly

Parent

Output Assembly belongs to the type *Device*, in the topic *I/O System*.

Description

Output Assembly specifies where the output data for an I/O device is located. The output assembly is vendor specific and can be found in the electronic data sheet (EDS) file.

Prerequisites

The option *EtherNet/IP Scanner/Adapter* must be installed.

Default value

The default value is 0.

Allowed values

Integer between 0 and 65535.

6.3.13 Input Assembly

Parent

Input Assembly belongs to the type *Device*, in the topic *I/O System*.

Description

Input Assembly specifies where the input data for an I/O device is located. The input assembly is vendor specific and can be found in the electronic data sheet (EDS) file.

Prerequisites

The option *EtherNet/IP Scanner/Adapter* must be installed.

Default value

The default value is 0.

Allowed values

Integer between 0 and 65535.

6.3.14 Output Size

Parent

Output Size belongs to the type *Device*, in the topic *I/O System*.

Description

Output Size defines the output data size in bytes for an I/O device.

> **Note**
>
> When working with the internal adapter device, the *Output Size* is the *Input Size* from the scanner point of view.

Usage

Output Size is an EtherNet/IP specific parameter.

Prerequisites

The option *EtherNet/IP Scanner/Adapter* must be installed.

Limitations

A limitation is the maximum device size for the *Device*.

Default value

The default value is 8 bytes (64 signal bits).

Allowed values

Allowed values are the integers 0-505 (0-4040 signal bits), specifying the data size in bytes.

> **Note**
>
> When working with the internal adapter device, the allowed values are 0-509 (0-4072 signal bits), specifying the data size in bytes.

6.3.15 Input Size

Parent

Input Size belongs to the type *Device*, in the topic *I/O System*.

Description

Input Size defines the input data size in bytes for an I/O device.

Note

When working with the internal adapter device, the *Input Size* is the *Output Size* from the scanner point of view.

Usage

Input Size is an EtherNet/IP specific parameter.

Prerequisites

The option *EtherNet/IP Scanner/Adapter* must be installed.

Limitations

A limitation is the maximum device size for the *Device*.

Default value

The default value is 8 bytes (64 signal bits).

Allowed values

Allowed values are the integers 0-509 (0-4072 signal bits), specifying the data size in bytes.

Note

When working with the internal adapter device, the allowed values are 0-505 (0-4040 signal bits), specifying the data size in bytes.

6.3.16 Configuration Assembly

Parent

Configuration Assembly belongs to the type *Device*, in the topic *I/O System*.

Description

The *Configuration Assembly* parameter specifies where the configuration data for a device is located.

Usage

Configuration Assembly is optional and is used if an I/O device needs some extra configuration parameters. The *Configuration Assembly* parameter is vendor specific and can be found in the electronic data sheet (EDS) file.

Prerequisites

The option *EtherNet/IP Scanner/Adapter* must be installed.

Default value

The default value is 0 (means that this parameter is ignored).

Allowed values

Integer between 0 and 65535.

6.3.17 Configuration Size

Parent

Configuration Size belongs to the type *Device*, in the topic *I/O System*.

Description

Configuration Size specifies the size of the *Configuration Assembly*.

Usage

The *Configuration Size* is optional and is used if the *Configuration Assembly* is specified.

Prerequisites

The option *EtherNet/IP Scanner/Adapter* must be installed.

Default value

The default value is 0.

Allowed values

Integer between 0 and 400, specifying the data size in bytes.

6.3.18 Configuration Data

Parent

Configuration Data belongs to the type *Device*, in the topic *I/O System*.

Description

Configuration Data specifies the data for the *Configuration Assembly*.

Usage

Configuration Data is optional and is used if the *Configuration Assembly* as well as the *Configuration Size* is specified.

Configuration Data is divided into rows of data numbered 00 through 24. Each row can hold 16 bytes in binary form, i.e., a string with hexadecimal representation of byte values delimited by space.

Prerequisites

The option *EtherNet/IP Scanner/Adapter* must be installed.

Default value

The default value is all zeros "00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00".

Allowed values

Allowed values are 00 to FF.

Example: "00 00 00 00 34 FA 66 17 00 00 01 00 00 C9 00 00"

6.3.19 Ownership

Parent

Ownership belongs to the type *Device*, in the topic *I/O System*.

Description

The *Ownership* parameter specifies how the I/O connection shall act between the scanner and the I/O device. There are three different types of Ownership:

- Exclusive Owner: An I/O connection where the data of an I/O device can be controlled only by one scanner.
- Input Only: An I/O connection where only the scanner can receive input data from an I/O device. There is no output data.
- Listen Only: An I/O connection where only the scanner can receive input data from an I/O device. This type of *Ownership* can only be attached to an connection of type; Exclusive Owner or Input Only. If this underlying connection closes, then the connection with Ownership of type; Listen Only will also be closed. There is no output data.

Note

Some EtherNet/IP devices might not support the Input Only connection.

Prerequisites

The option *EtherNet/IP Scanner/Adapter* must be installed.

Default value

The default value is Exclusive Owner.

Allowed values

Exclusive Owner, Input Only, or Listen Only.

6.3.20 Input Connection Type

Parent

Input Connection Type belongs to the type *Device*, in the topic *I/O System*.

Description

The *Input Connection Type* parameter specifies how I/O data is send from the I/O device to the scanner. There are two different connection types:

- Point-to-point (Unicast): A connection where the data is send from one point to another point. In this case there is just one sender and one receiver.
- Multicast: A connection where the data is send from one or more points to a set of other points. In this case there is one sender and multiple receivers.

Note

Some EtherNet/IP I/O devices might not support Point-to-point as input connection type.

Prerequisites

The option *EtherNet/IP Scanner/Adapter* must be installed.

Default value

The default value is Multicast.

Allowed values

Multicast or Point-to-point

6.3.21 Connection Priority

Parent

Connection Priority belongs to the type *Device*, in the topic *I/O System*.

Description

The *Connection Priority* parameter specifies how I/O data is prioritized on the network. Network priority is accomplished by using Quality of Service (QoS) mechanisms in the device.

Note

Refer the user manual for EtherNet/IP device that supports QoS.

Prerequisites

The option *EtherNet/IP Scanner/Adapter* must be installed.

Default value

The default value is Low.

Allowed values

Low

High

Schedule

Urgent

6.3.22 Output RPI

Parent

Output RPI belongs to the type *Device*, in the topic *I/O System*.

Description

Output RPI (Originator to Target Request Packet Interval) is the time between I/O packets from the scanner to the I/O device.

Usage

Use this parameter to decide at which interval the scanner shall produce output data to the I/O device.

The Request Packet Interval is specified in micro seconds.

Note

In case of connection problems, it is recommended to increase the Connection Timeout Multiplier. See *Connection Timeout Multiplier on page 90*.

Prerequisites

The option *EtherNet/IP Scanner/Adapter* must be installed.

Default value

The default value is 50000.

Allowed values

The minimum limit is 1 and maximum limit is 4.294967E+09.

6.3.23 Input RPI

Parent

Input RPI belongs to the type *Device*, in the topic *I/O System*.

Description

Input RPI (Target to Originator Request Packet Interval) is the time between I/O packets from the I/O device to the scanner.

Usage

Use this parameter to decide at which interval the scanner shall consume input data from the I/O device.

The Request Packet Interval is specified in micro seconds.

Note

In case of connection problems, it is recommended to increase the Connection Timeout Multiplier. See *Connection Timeout Multiplier on page 90*.

Prerequisites

The option *EtherNet/IP Scanner/Adapter* must be installed.

Default value

The default value is 50000.

Allowed value

The minimum limit is 1 and maximum limit is 4.294967E+09.

6.3.24 Connection Timeout Multiplier

Parent

Connection Timeout Multiplier belongs to the type *Device*, in the topic *I/O System*.

Description

Connection Timeout Multiplier specifies the multiplier applied to the expected packet rate value to derive the value for the Inactivity/Watchdog Timer.

Usage

The *Connection Timeout Multiplier* is a number among 4, 8, 16, 32, 64, 128, 256. It is used together with RPI to calculate the timeout on connections. *RPI* multiplied by *Connection Timeout Multiplier* gives the maximum time before dropping the connection.

Note

For the IRB 14000 and IRB 14050 robots this parameter may have to be tuned depending on your network setup.

Prerequisites

The option *EtherNet/IP Scanner/Adapter* must be installed.

Allowed values

Allowed values are 4, 8, 16, 32, 64, 128, 256, 512.

Default value is 4.

6.4 EtherNet/IP IO Connection

6.4.1 Device Label

Parent

Device Label belongs to the type *EtherNet/IP IO Connection*, in the topic *I/O System*.

Description

Name of the device associated with this connection.

Usage

Optional parameter to use.

Prerequisites

The option *CIP Safety Scanner* must be installed.

Allowed values

A string with maximum 80 characters.

The default value is an empty string.

6.4.2 Output Assembly

Parent

Output Assembly belongs to the type *EtherNet/IP IO Connection*, in the topic *I/O System*.

Description

Output Assembly specifies where the output data for an I/O device is located. The output assembly is vendor specific and can be found in the electronic data sheet (EDS) file.

Prerequisites

The option *EtherNet/IP Scanner/Adapter* must be installed.

Default value

The default value is 0.

Allowed values

Integer between 0 and 65535.

6.4.3 Input Assembly

Parent

Input Assembly belongs to the type *EtherNet/IP IO Connection*, in the topic *I/O System*.

Description

Input Assembly specifies where the input data for an I/O device is located. The input assembly is vendor specific and can be found in the electronic data sheet (EDS) file.

Prerequisites

The option *EtherNet/IP Scanner/Adapter* must be installed.

Default value

The default value is 0.

Allowed values

Integer between 0 and 65535.

6.4.4 Configuration Assembly

Parent

Configuration Assembly belongs to the type *EtherNet/IP IO Connection*, in the topic *I/O System*.

Description

The *Configuration Assembly* parameter specifies where the configuration data for a device is located.

Usage

Configuration Assembly is optional and is used if an I/O device needs some extra configuration parameters. The *Configuration Assembly* parameter is vendor specific and can be found in the electronic data sheet (EDS) file.

Prerequisites

The option *EtherNet/IP Scanner/Adapter* must be installed.

Default value

The default value is 0 (means that this parameter is ignored).

Allowed values

Integer between 0 and 65535.

6.4.5 Output Size

Parent

Output Size belongs to the type *EtherNet/IP IO Connection*, in the topic *I/O System*.

Description

Output Size defines the output data size in bytes for an I/O device.

Note

When working with the internal adapter device, the *Output Size* is the *Input Size* from the scanner point of view.

Usage

Output Size is an EtherNet/IP specific parameter.

Prerequisites

The option *EtherNet/IP Scanner/Adapter* must be installed.

Limitations

A limitation is the maximum device size for the *Device*.

Default value

The default value is 8 bytes (64 signal bits).

Allowed values

Allowed values are the integers 0-505 (0-4040 signal bits), specifying the data size in bytes.

Note

When working with the internal adapter device, the allowed values are 0-509 (0-4072 signal bits), specifying the data size in bytes.

6.4.6 Input Size

Parent

Input Size belongs to the type *EtherNet/IP IO Connection*, in the topic *I/O System*.

Description

Input Size defines the input data size in bytes for an I/O device.

Note

When working with the internal adapter device, the *Input Size* is the *Output Size* from the scanner point of view.

Usage

Input Size is an EtherNet/IP specific parameter.

Prerequisites

The option *EtherNet/IP Scanner/Adapter* must be installed.

Limitations

A limitation is the maximum device size for the *Device*.

Default value

The default value is 8 bytes (64 signal bits).

Allowed values

Allowed values are the integers 0-509 (0-4072 signal bits), specifying the data size in bytes.

Note

When working with the internal adapter device, the allowed values are 0-505 (0-4040 signal bits), specifying the data size in bytes.

6.4.7 Output RPI

Parent

Output RPI belongs to the type *EtherNet/IP IO Connection*, in the topic *I/O System*.

Description

Output RPI (Originator to Target Request Packet Interval) is the time between I/O packets from the scanner to the I/O device.

Usage

Use this parameter to decide at which interval the scanner shall produce output data to the I/O device.

The Request Packet Interval is specified in micro seconds.

Prerequisites

The option *EtherNet/IP Scanner/Adapter* must be installed.

Default value

The default value is 50000.

Allowed values

The minimum limit is 1 and maximum limit is 4.294967E+09.

6.4.8 Input RPI

Parent

Input RPI belongs to the type *EtherNet/IP IO Connection*, in the topic *I/O System*.

Description

Input RPI (Target to Originator Request Packet Interval) is the time between I/O packets from the I/O device to the scanner.

Usage

Use this parameter to decide at which interval the scanner shall consume input data from the I/O device.

The Request Packet Interval is specified in micro seconds.

Prerequisites

The option *EtherNet/IP Scanner/Adapter* must be installed.

Default value

The default value is 50000.

Allowed value

The minimum limit is 1 and maximum limit is 4.294967E+09.

6.4.9 Data Direction

Parent

Data Direction belongs to the type *EtherNet/IP IO Connection*, in the topic *I/O System*.

Description

Data Direction states if the connection is receiving or sending data.

Usage

Data Direction is set to Output for safe output connections. It is set to Input for safe input connections.

Data Direction is not used for non-safe connections.

Prerequisites

The option *CIP Safety Scanner* must be installed.

Default value

Default value is Input.

Allowed values

Output or Input.

6.4.10 Safe Connection

Parent

Safe Connection belongs to the type *EtherNet/IP IO Connection*, in the topic *I/O System*.

Description

Safe Connection states if the connection is a safe (CIP Safety) connection.

Usage

Each safe device can use two safe connections (one for input and one for output) and one non-safe connection (for both input and output).

Prerequisites

The option *CIP Safety Scanner* must be installed.

Default value

Default value is FALSE.

Allowed values

TRUE or FALSE.

6.4.11 Input Connection Type

Parent

Input Connection Type belongs to the type *EtherNet/IP IO Connection*, in the topic *I/O System*.

Description

The *Input Connection Type* parameter specifies how I/O data is send from the I/O device to the scanner. There are two different connection types:

- Point-to-point (Unicast): A connection where the data is send from one point to another point. In this case there is just one sender and one receiver.
- Multicast: A connection where the data is send from one or more points to a set of other points. In this case there is one sender and multiple receivers.

> **Note**
>
> Some EtherNet/IP I/O devices might not support Point-to-point as input connection type.

Prerequisites

The option *EtherNet/IP Scanner/Adapter* must be installed.

Default value

The default value is Multicast.

Allowed values

Multicast or Point-to-point

6.4.12 Connection Priority

Parent

Connection Priority belongs to the type *EtherNet/IP IO Connection*, in the topic *I/O System*.

Description

The *Connection Priority* parameter specifies how I/O data is prioritized on the network. Network priority is accomplished by using Quality of Service (QoS) mechanisms in the device.

Note

Refer the user manual for EtherNet/IP device that supports QoS.

Prerequisites

The option *EtherNet/IP Scanner/Adapter* must be installed.

Default value

The default value is Low.

Allowed values

Low

High

Schedule

Urgent

6.4.13 Configuration Size

Parent

Configuration Size belongs to the type *EtherNet/IP IO Connection*, in the topic *I/O System*.

Description

Configuration Size specifies the size of the *Configuration Assembly*.

Usage

The *Configuration Size* is optional and is used if the *Configuration Assembly* is specified.

Prerequisites

The option *EtherNet/IP Scanner/Adapter* must be installed.

Default value

The default value is 0.

Allowed values

Integer between 0 and 400, specifying the data size in bytes.

6.4.14 Configuration Data

Parent

Configuration Data belongs to the type *EtherNet/IP IO Connection*, in the topic *I/O System*.

Description

Configuration Data specifies the data for the *Configuration Assembly*.

Usage

Configuration Data is optional and is used if the *Configuration Assembly* as well as the *Configuration Size* is specified.

Configuration Data is divided into rows of data numbered 00 through 24. Each row can hold 16 bytes in binary form, i.e., a string with hexadecimal representation of byte values delimited by space.

Prerequisites

The option *EtherNet/IP Scanner/Adapter* must be installed.

Default value

The default value is all zeros "00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00".

Allowed values

Allowed values are 00 to FF.

Example: "00 00 00 00 34 FA 66 17 00 00 01 00 00 C9 00 00"

6.5 Type EtherNet/IP Command

6.5.1 Path

Parent

Path belongs to the type *EtherNet/IP Command*, in the topic *I/O System*.

Description

Path defines the path to EtherNet/IP object instance or attribute.

Usage

Path is used to describe the path to the instance or attribute, the data type identifier and the data size that are to be affected by the explicit message. Information about how to define this can be found in the [Params] section of the EDS file.

Default value

The default value is an empty string.

Allowed values

A string with maximum 30 characters.

Related information

For more information and examples, see *Explicit messaging services on page 51*.

For information about which explicit messaging services are available for a specific I/O device and how to set the parameters, refer to the supplier documentation of the I/O device and the *Common Industrial Protocol (CIP) Specification*, see *References on page 7*.

Example

```
6,20 01 24 08 30 01,C6,1
```

Description:

- *6* is the length of the path - that is, the number of hexadecimal figures until the next comma. This is an optional parameter.
- Path *(20 01 24 08 30 01)* is a software description of EtherNet/IP class, instance and attribute.
- *C6* is the hexadecimal value for the data type identifier.
- *1* is the data size - that is, the number of bytes as a hexadecimal value. This is an optional parameter.

6.5.2 Service

Parent

Service belongs to the type *EtherNet/IP Command*, in the topic *I/O System*.

Description

Service defines the explicit service that should be performed on EtherNet/IP object instance or attribute pointed out in *Path*.

Usage

Service is used to define the type of action to be used.

Default value

The default value is *Set Attribute Single*.

Allowed values

Following values are allowed:

- *Apply Attributes*
- *Create*
- *Reset* (0x05 or 5 in the configuration file)
- *Set Attribute Single* (0x10 or 16 in the configuration file)

7 Troubleshooting

7.1 Frequently asked questions

What happens if the gateway is left empty?

The default gateway for the IRC5 system will be used. If there is no physical gateway, leave the gateway empty.

A physical gateway is not available on the desired network. What should be specified as the gateway?

It is recommened to leave this field empty.

Is it recommended to configure the WAN connector and the selected LAN connector on the same subnet?

No, the EtherNet/IP address for the WAN connector must belong to another subnet than the address of the selected LAN connector.

For example, if the address of the LAN connector is 111.122.133.144, the address for the selected LAN connector cannot be 111.122.133.145 if the subnet mask 255.255.255.0 (but it can be 111.122.**134**.145) is being used.

How to identify the desired EtherNet/IP I/O devices on the network?

There are two ways to identify the EtherNet/IP devices on the industrial network.

There is a list with the I/O device names, IP addresses and corresponding MAC addresses. In the window **Inputs and Outputs**, tap **View** and select **Industrial Networks**. Select the desired EtherNet/IP network and tap **I/O Device Identification** in the command bar. A window will be displayed with all the devices on the selected EtherNet/IP industrial network and their corresponding IP and MAC addresses.

Another way is to open the **Inputs and Outputs** window, tap **View** and select **Devices**. Select the EtherNet/IP device to be identified, tap **Actions** in the command bar and select **Unit Identification**. A message box will be shown displaying the MAC address for the selected device.

The desired industrial network and factory network is on the same logical network but is it possible to have one logical network for the factory network and one logical network for the Ethernet/IP network? Is it possible to have a switch that separates the traffic?

1. In the I/O configuration under Industrial Newtork, configure the IP address, subnet mask, gateway and destination of the Ethernet/IP network.
2. Restart the controller using the restart mode **Start Boot Application**.
3. Change the network settings (these are used for the WAN connector) and choose the correct system.
4. Make sure that these two networks are on separate subnets.
5. Restart the controller.

Can tool change be done without using dedicated QuickConnect I/O devices?

Yes. If time is really not important, there are many different I/O devices available today which can serve as tool changer equipment.

Continues on next page

The only requirement for proper and deterministic behaviour is that, the I/O device must issue gratuituos ARP requests when powered on. If so, the connection time will be determined by the I/O device startup time.

If the I/O device does not support gratuitous ARP, the connection time will be dependent on the refresh of ARP timers in the robot communication software. Typically 20 seconds can be expected but it can take up to some minutes. Also, the error log "71058 Lost communication with I/O device" will be issued.

7.2 Troubleshooting

Error log "71367 No contact with device" is shown after startup

	Action
1	Check cabling.
2	Ensure that the device address matches the configuration.
3	Ensure that all addresses are unique, and not used by more than one device.
4	If the address is changed, the power supply to the device must be cycled (switched OFF and then back ON) to ensure the address has been changed.
5	Verify that the configured *Input Assembly* and *Output Assembly* correspond to the data in the EDS file for your I/O device.
6	Verify the configured *Input Size* and *Output Size*.
7	Verify if the device needs the *Configuration Assembly*. See the EDS file. Too low Request Packet Interval is configured. See the manual of device.

Error log "71201 Unknown industrial network" is shown after startup

	Action
1	Ensure that the Industrial Network option *EtherNet/IP Scanner/Adapter* is installed.
2	Check the EtherNet/IP address.
3	Check the gateway settings.
4	When using any of the LAN connectors make sure to configure the WAN connector and the LAN connector on separate subnets.

Error log "71058 Lost communication with I/O unit" is shown when activating QuickConnect I/O devices

This error occurs when connecting to the device when it is not ready to join the network.

	Action
1	Check that the QuickConnect device is activated for *QuickConnect* functionality.
2	Check if the electrical lock signal is working as expected.
3	Check if the IRC5 controller waits for sufficient amount of time after electrical lock has been engaged before connecting to the device.
4	Check if the network allows the gratuitous ARP request correctly. This is essential when doing QuickConnect on devices with the same IP address. The Spanning Tree Protocol should be disabled at the switch.

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Index

C
CIP, 15
Connection, 65
ControlNet, 15
cyclic I/O connection, 28

D
DeviceNet, 15
DeviceNet master
  configuration, 59

E
EDS file, 15, 27
EtherNet/IP, 15
  adapter, 27, 30
  data, 15
  EtherNet/IP device template, 29
  I/O devices, 29
  predefined network, 29
  scanner, 29, 41, 45
  specification, 16
  standardization, 15
EtherNet/IP adapter device, 27
  configuration, 27
EtherNet/IP device
  EtherNet/IP Internal Adapter Device, 27
EtherNet/IP Internal Adapter Device, 27
EtherNet/IP scanner, 29
  configuration, 41, 45
Explicit messaging services, 51

F
Fieldbus Command Interface, 51

G
gateway, 32

I
I/O connection
  cyclic, 28
I/O devices, 29
  ABB I/O devices, 30
integrator responsibility, 11
internal DeviceNet slave
  configuration, 59

N
network security, 12

O
ODVA, 15

P
predefined device template, 29
predefined network, 29
private network, 21

Q
QoS, 25
Quality of Service, 25
QuickConnect, 57

S
safety, 11
Spanning Tree Protocol, 109
system integrator requirements, 11
system parameters, 61
  Address, 68
  Configuration Assembly, 82, 94
  Configuration Size, 83, 103
  Connection Priority, 87, 102
  Connection Timeout Multiplier, 90
  Data Direction, 99
  Device Label, 91
  Device Type, 70
  Input Assembly, 79, 93
  Input Connection Type, 63, 86, 101
  Input RPI, 89, 98
  Input Size, 81, 96
  Major Revision, 66
  Minor Revision, 67
  Output Assembly, 78, 92
  Output RPI, 88, 97
  Output Size, 80, 95
  Ownership, 85
  Path, 105
  Product Code, 71
  QuickConnect, 72
  Safe Connection, 100
  Safe Device, 74
  Safe Intput Connection, 77
  Safe Output Connection, 76
  Service, 106
  Standard Connection, 75
  Vendor ID, 69

T
template I/O configuration file, 28
topic I/O System
  EtherNet/IP Command, 63
  EtherNet/IP Device, 62
  EtherNet/IP IO Connection, 63
  Industrial Network, 62
troubleshooting, 109

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