ABB

ROBOTICS

Application manual
EtherNet/IP Scanner/Adapter

Application manual

EtherNet/IP Scanner/Adapter

RobotWare 7.12

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Overview of this manual

About this manual

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

- *EtherNet/IP Scanner*, option number 3024-1
- *EtherNet/IP Adapter*, option number 3024-2

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
Application manual - I/O Engineering	*3HAC082346-001*
Operating manual - RobotStudio	*3HAC032104-001*
Operating manual - OmniCore	*3HAC065036-001*
Product manual - OmniCore C30	*3HAC060860-001*
Product manual - OmniCore C90XT	*3HAC073706-001*
Product manual - OmniCore E10	*3HAC079399-001*
Product manual - OmniCore V250XT	*3HAC073447-001*
Technical reference manual - System parameters	*3HAC065041-001*
Technical reference manual - RAPID Instructions, Functions and Data types	*3HAC065038-001*
Application manual - DeviceNet Master/Slave	*3HAC066562-001*
Application manual - Controller software OmniCore	*3HAC066554-001*

Other references

Reference	Description
www.odva.org	The web site of ODVA (Open DeviceNet Vendor Association).
EtherNet/IP^{TM} *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
A	Released with RobotWare 7.0.
B	Released with RobotWare 7.0.1. • Cfg name removed from entire manual. • Information regarding Connection Timeout Multiplier added in section "Output RPI" and "Input RPI".
C	Released with RobotWare 7.1. • Added NOTE regarding IP addresses in section "Creating and configuring the internal scanner".
D	Released with RobotWare 7.2. • Local I/O replaced by Scalable I/O in relevant places. • Information concerning default gateway field removed from section *Frequently asked questions on page 45*. • Minor corrections in section "Connections on the main computer".
E	Released with RobotWare 7.7. • Section "Network connections on OmniCore" removed. It is included in the product manual for the robot controller. • Section *References on page 7* updated with references to the Omni-Core Product Manuals. • Number of maximum EtherNet IP devices updated in section *Information about the internal scanner on page 23*. • Section "Recommended working procedure" updated. • Minor corrections in *EtherNet/IP for OmniCore on page 16*. • Information about selection of interface ports added in *EtherNet/IP for OmniCore on page 16*, "Configuring the internal adapter device" and "Recommended working procedure".
F	Released with RobotWare 7.8. • Section *Troubleshooting on page 45* updated with information about subnet configuration.
G	Released with RobotWare 7.10. • Minor updates in *EtherNet/IP for OmniCore on page 16*. • Information about firewall settings added in *Information about the adapter device on page 21*.
H	Released with RobotWare 7.12. • Configuration of EtherNet/IP moved to I/O Engineering. Entire manual restructured.

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, 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.
- Troubleshooting.
- 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.

Product documentation

Continued

- Examples of how to use the application.

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 Ether-Net/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 OmniCore 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 OmniCore 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 Ether-Net/IP adapter on the EtherNet/IP network.
Internal scanner	Describes when the robot controller acts as an Ether-Net/IP scanner on the EtherNet/IP network.
LAN	Connector for Local Area Network.
M12	An external Ehternet adapter, distributed by ABB, that is easier to configure in OmniCore than adapters from other suppliers.
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*.

Terminology

Continued

Term	Explanation
Server	See term *Adapter*. Some documents use the term *server*, whereas the ABB documentation use the term *adapter* for EtherNet/IP industrial network.
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 OmniCore

General

The EtherNet/IP network is running on the OmniCore main computer and does not require any additional hardware.

Options

With option *3024-1 EtherNet/IP Scanner*, the OmniCore controller can act as a scanner on the EtherNet/IP network.

With option *3024-2 EtherNet/IP Adapter*, the OmniCore controller can act as an adapter.

> **Note**
>
> In this manual, the *3024-2 EtherNet/IP Adapter* is referred to as *internal device*.

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

Application protocols

For information about application protocols and port numbers, see section "OmniCore application protocols" in *Operating manual - Integrator's guide OmniCore*.

Interface ports

The EtherNet/IP scanner and adapter can be used on both the **Public Network** (WAN) and the **I/O Network** (LAN). See *Select an interface port on page 27* for information about how to select interface port for the adapter.

> **Note**
>
> No manual port selection is needed for the scanner, as the scanner automatically detects to which interface the device is connected.

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Network connections

EtherNet/IP on public 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 bandwidth 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:
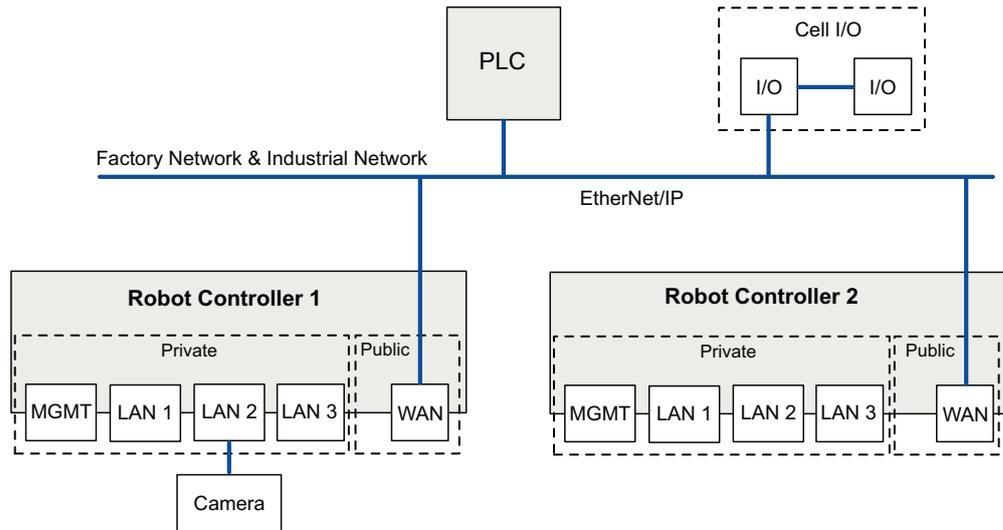
xx2300000128

EtherNet/IP on dedicated industrial network

By connecting to the I/O network it is possible to connect several robot controllers to a dedicated industrial network.

xx2300000131

Application manual - EtherNet/IP Scanner/Adapter
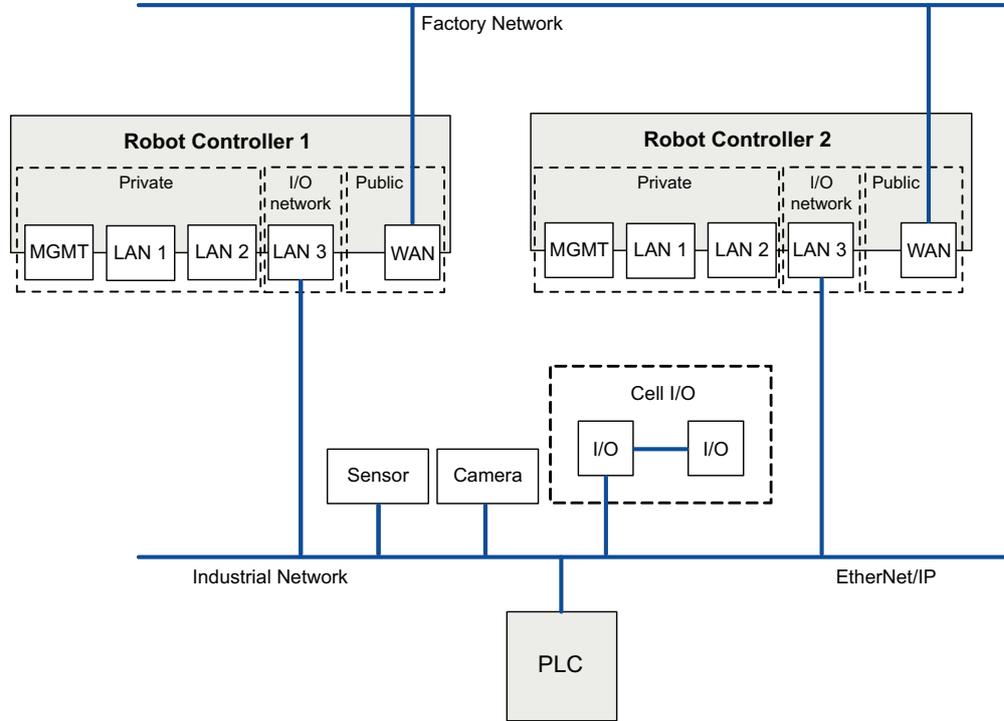
2 Hardware overview

2.1 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.

2.2 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 OmniCore controller.

3 Software overview

3.1 Information about the adapter device

General

To use the EtherNet/IP adapter device, the OmniCore controller must be installed with the option *3024-2 EtherNet/IP Adapter*.

The EtherNet/IP adapter device can be used to:

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

Industrial Network

When the robot system is installed with the *3024-2 EtherNet/IP 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 *3024-2 EtherNet/IP 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 OmniCore controller, which will enable a PLC to connect to the OmniCore controller. There can be only one internal adapter device defined in the OmniCore 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, *Omnicore.eds*, for the adapter device can be obtained from the RobotStudio or the OmniCore controller.

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

> **ℹ️ 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**.

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3 Software overview

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.

> **ℹ 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.

> **ℹ Note**
>
> Communication with configured EtherNet/IP Adapter devices is still possible with firewall setting set to ON. Communication initiated by the controller is always allowed.

3.2 Information about the internal scanner

General

To use the EtherNet/IP internal scanner, the OmniCore controller must be installed with the option *3024-1 EtherNet/IP Scanner*.

The EtherNet/IP internal scanner can be used to:

- connect EtherNet/IP I/O devices to the OmniCore controller.
- connect the OmniCore controller to another OmniCore 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. Examples of present device templates are:

- *ABB OmniCore EtherNet/IP Adapter Device* is used on the scanner side when connecting to another OmniCore EtherNet/IP adapter.
- ABB Scalable I/O Device: 16DO/16DI (base version)
- ABB Scalable I/O Device + Digital: 16DO/16DI + 16DO/16DI
- ABB Scalable I/O Device + Analog: 16DO/16DI + 4DO/4DI
- ABB Scalable I/O Device + Relay: 16DO/16DI + 8DO/8DI

Number of allowed I/O devices

A maximum number of 50 user defined I/O devices can be defined in the OmniCore 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 OmniCore EtherNet/IP scanner.
- Simulated EtherNet/IP I/O devices.

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

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 OmniCore systems

When connecting two OmniCore systems, the internal adapter should be seen and configured as any other ordinary device from the other OmniCore system, which is acting as a scanner. See *Communication between two OmniCore controllers on page 37*.

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4 Setting up your EtherNet/IP system

Log in with configuration grant

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

Start I/O Engineering

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

2   In the ribbon of the **Controller** tab, select **I/O Engineering**.

See *Application manual - I/O Engineering* for more information.

Configure IP settings

IP settings for the EtherNet/IP network used on the Public or I/O Network are defined in **Network Settings** in RobotStudio or on the FlexPendant. See *Operating manual - RobotStudio* and *Operating manual - Integrator's guide OmniCore*.

Configure firewall settings

The Firewall Management function is used to configure the network firewall on the controller. Configuration is done in RobotStudio under **Configuration\Communication\Firewall Manager** where pre-configured Network Services can be enabled or disabled. See *Operating manual - RobotStudio* and *Operating manual - Integrator's guide OmniCore*.

Configure the EtherNet/IP network properties

1   In the **Controller** tab in RobotStudio, select **I/O Engineering**. The **I/O Engineering** tab is displayed.

2   In the **Configuration** browser, select **EtherNetIP** (under I/O system).

3   In the **Properties** browser, you can configure the following:

Parameter	Description	Allowed values
Simulated	Select **Yes** or **No**, indicating if the industrial network and all its connected I/O devices should be treated as simulated.	The default value is No.
Identification Label	This parameter is an optional way to provide a label that will help the operator to identify the internal device.	A string with maximum 80 characters.

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5 Configuring the internal adapter

Prerequisites

Before configuring the internal adapter device, make sure to set up your system according to *Setting up your EtherNet/IP system on page 25*.

The option *3024-2 EtherNet/IP Adapter* is needed for EtherNet/IP adapter device configuration.

Select an interface port

The EtherNet/IP scanner and adapter can be used on both the **Public Network (WAN)** and the **I/O Network** (LAN):

> **ⓘ Note**
>
> No manual port selection is needed for the scanner, as the scanner automatically detects to which interface the device is connected.

1　In the **Configuration** browser, expand **EtherNetIP** and select the internal adapter device.

2　In the **Properties** browser, select the **Interface** to be used on the robot controller. Select between the following:

- **Public Network (WAN)**
- **I/O Network (LAN)**.

Configure the internal adapter properties

1　In the **Configuration** browser, expand **EtherNetIP** and select the internal adapter.

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

Parameter	Description	Allowed values
Name	Enter the name to be used for the device.	
Identification Label	This parameter is an optional way to provide a label that will help the operator to identify the device.	A string with maximum 80 characters.
Connection Input Size	Enter the input size.	0 - 505
Connection Output Size	Enter the output size.	0 - 509
Interface	Select the interface port to be used for the internal adapter.	**Public Network (WAN)** **I/O Network (LAN)**

Working with signals

I/O signals can be added to I/O devices in a project.

For detailed descriptions of all signal parameters, see *Technical reference manual - System parameters*.

5 Configuring the internal adapter

Continued

For more information about working with signals, see *Application manual - I/O Engineering*.

Save configuration

See *Application manual - I/O Engineering* for more information.

6 Configuring the internal scanner

Prerequisites

Before configuring the internal scanner, make sure to set up your system according to *Setting up your EtherNet/IP system on page 25*.

The option *3024-1 EtherNet/IP Scanner* is needed for EtherNet/IP internal scanner.

Set the IP address on the external device. See user manual from the vendor of the external device.

> **ℹ Note**
>
> No manual port selection is needed for the scanner, as the scanner automatically detects if the device is connected to the **Public Network** (WAN) or the **I/O Network** (LAN).

Import EDS files

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

1. In the **I/O Engineering** tab, select **Import files > EDS Files**, or right-click on **EtherNetIP** (under I/O system) and select **Manage EDS files**.
2. The **EDS Files** window is displayed. Click **Import** and browse for an EDS file, or **Import, Folder** to import a complete folder with EDS files.

> **ℹ Note**
>
> The **Used EDS files...** window shows all EDS files that are used in the current I/O project.
>
> The **Imported EDS files...** window shows all EDS files that are imported into the I/O project but are not used in the configuration.

> **ℹ Note**
>
> When a new I/O project is opened, only the used EDS files will be shown in the **Imported EDS files...** window. Click **Update** to display all previously imported, but not used, EDS files.

Configure the internal scanner properties

1. In the **Controller** tab in RobotStudio, select **I/O Engineering**. The **I/O Engineering** tab is displayed.
2. In the **Configuration** browser, select the internal scanner.

3   In the **Properties** browser, you can configure the following:

Parameter	Description	Allowed values
Simulated	Select **Yes** or **No**, indicating if the industrial network and all its connected I/O devices should be treated as simulated.	The default value is No.
Identification Label	This parameter is an optional way to provide a label that will help the operator to identify the internal device.	A string with maximum 80 characters.

Add devices to the internal scanner

1   In the **Configuration** browser, expand **EtherNetIP** and select the internal scanner.

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

> ℹ **Note**
>
> The EDS files that have been imported to the project define what devices can be selected. See .

3   Double-click on a device in the list to add it to the internal scanner.

4   All necessary device information is retrieved from the EDS file, but some parameters can be changed in the **Properties** tab if needed. See table below in for a description of each parameter.

Configure EtherNet/IP generic devices

Configuring generic devices is useful when no EDS file is available.

1   In the **Configuration** browser, expand **EtherNetIP** and select the internal scanner.

2   In the **Device Catalogue**, double-click on **EtherNetIP Generic Device** to add a generic device.

3   In the **Properties** tab, specify the properties for the generic device:

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

Parameter	Description	Allowed values
Name	The name of the internal scanner device is used as a reference to the specific device when configuring the I/O signals and device commands.	A string with maximum 32 characters. The string must follow the RAPID rules described in *Technical reference manual - RAPID Overview*. The name must be unique among all named objects in the I/O system configuration. **ℹ Note** Names differing only in upper and lower case are considered to be equal.
Identification Label	This parameter is an optional way to provide a label that will help the operator to identify the internal scanner device.	A string with maximum 80 characters.
Vendor Name	The name of the I/O device vendor.	A string with maximum 80 characters.
Product Name	The product name for this I/O device according to industrial network type standard.	A string with maximum 80 characters.
Vendor ID	This parameter is used as an identification of the I/O device to secure communication to the correct device.	Allowed values are the integers 0-65535.
Product Code	This parameter is used as an identification of the I/O device to secure communication to the correct device.	Allowed values are the integers 0-65535.
Device Type	This parameter is used as an identification of the I/O device to secure communication to the correct device.	Allowed values are the integers 0-65535.
Major Revision	Used together with **Minor Revision** to define the revision of the device.	Allowed value is an integer between 0 and 127.
Minor Revision	Used together with **Major Revision** to define the revision of the device.	Allowed value is an integer between 0 and 127.
Compatibility	This parameter makes it possible to install devices that can emulate the exact device.	
Trust Level	Select an existing trust level that defines the behavior for external devices at different execution situations in the robot controller. See *Application manual - I/O Engineering* for more information about how to create trust levels.	
Output Assembly	Specifies where the output data for an I/O device is located. The output assembly is vendor specific.	Allowed values are the integers 0-65535.
Output Size	Defines the output data size in bytes for an I/O device.	Allowed values are the integers 0-505 (0-4040 signal bits), specifying the data size in bytes.

Continued

Parameter	Description	Allowed values
Output RPI	*Output RPI* (Originator to Target Request Packet Interval) is the time between I/O packets from the scanner to the I/O device. 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. **ℹ Note** In case of connection problems, it is recommended to increase the Connection Timeout Multiplier.	The minimum limit is 1 and maximum limit is 4.294967E+09.
Input Assembly	Input Assembly specifies where the input data for an I/O device is located. The input assembly is vendor specific.	Allowed values are the integers 0-65535.
Input Size	Defines the input data size in bytes for an I/O device.	Allowed values are the integers 0-505 (0-4040 signal bits), specifying the data size in bytes.
Input RPI	*Input RPI* (Target to Originator Request Packet Interval) is the time between I/O packets from the I/O device to the scanner. 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. **ℹ Note** In case of connection problems, it is recommended to increase the Connection Timeout Multiplier.	The minimum limit is 1 and maximum limit is 4.294967E+09.
Input Connection Type	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. **ℹ Note** Some EtherNet/IP I/O devices might not support Point-to-point as input connection type.	
Configuration Assembly	Specifies where the configuration data for a device is located. The configuration assembly is vendor specific.	Allowed values are the integers 0-65535.
Configuration Size	*Configuration Size* specifies the size of the *Configuration Assembly*.	Integer between 0 and 400, specifying the data size in bytes.

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Parameter	Description	Allowed values
Ownership	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.	Allowed values are Exclusive Owner, Input Only, or Listen Only.
Connection Timeout Multiplier	*Connection Timeout Multiplier* specifies the multiplier applied to the expected packet rate value to derive the value for the Inactivity/Watchdog Timer. 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.	Allowed values are 4, 8, 16, 32, 64, 128, 256, 512.
Connection Priority	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.	Allowed values are Low, High, Schedule, Urgent.

Save configuration

See *Application manual - I/O Engineering* for more information.

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7 Additional configuration

7.1 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*
  - Third party tool before connecting the module to OmniCore controller Ethernet/IP scanner
  - EtherNet/IP command. See *Enabling device for QuickConnect operation on page 36*.

> ℹ **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.

> ℹ **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 OmniCore 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*.

Sequence

1 The OmniCore controller deactivates current connections to QuickConnect devices, and the robot arm physically disengages the current tool.

7 Additional configuration

2 The robot arm physically attaches to the new QuickConnect devices.

3 The new QuickConnect devices power up.

4 The OmniCore controller acknowledges a successful attachment to a new tool via an electrical lock signal.

5 Upon receiving the electrical lock signal, the OmniCore 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.

Enabling device for QuickConnect operation

This instruction describes how to enable a device for QuickConnect through RobotStudio.

> **ℹ️ Note**
>
> Before enabling the device through RobotStudio, read the supplier manual for the specific device and follow those instructions. Only continue with the procedures in RobotStudio if necessary.

Setting the QuickConnect attribute using the IO command

1 Start RobotStudio and connect to the OmniCore controller. Request write access.

2 In the **Controller** tab, select **I/O Engineering**.

3 In the **Configuration** browser, expand the internal scanner device and select **IO Commands**.

4 In the **Device Catalogue**, double-click **QuickConnect** to add the command to the device.

5 The command details can be viewed in the **Properties** tab. See *IO command system parameters on page 39* for detailed information about the parameters.

6 Save the I/O project and restart the controller.

7.2 Communication between two OmniCore controllers

General

When two OmniCore 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.
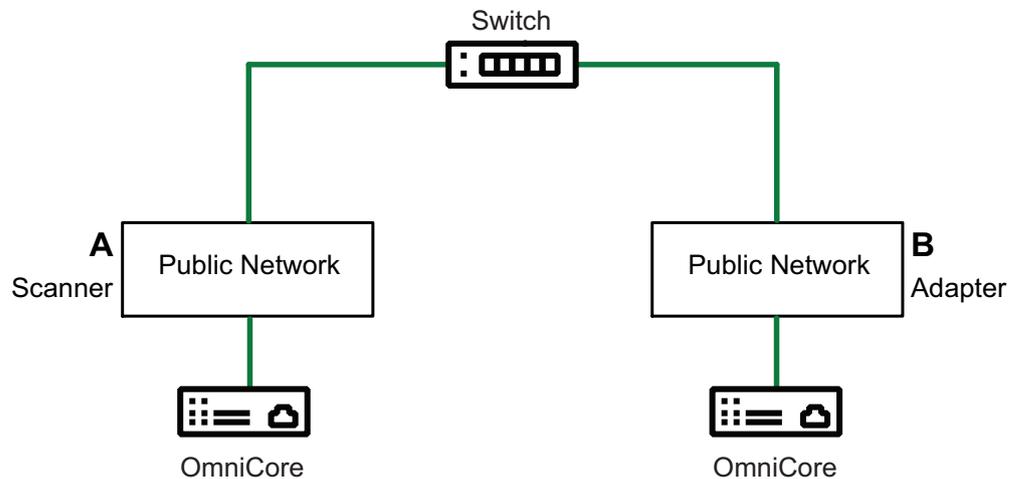
> **ℹ Note**
>
> It is possible to configure both the scanner and an adapter device in the same OmniCore controller.

Illustration

The following figure illustrates communication between two OmniCore controllers.

xx1900000773

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

Limitations

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

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7 Additional configuration

Configuring the scanner/adapter controllers

The following procedures describe the configuration of a hardware setup like the one illustrated in section *Illustration on page 37*.

1 Configure the EtherNet/IP industrial network address for both the OmniCore controllers. See *Technical reference manual - System parameters*.

> ### ℹ Note
>
> Be sure to use different EtherNet/IP addresses for the two OmniCore 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 *Communication between two OmniCore controllers on page 37*.

3 Configure the EtherNet/IP scanner to connect to the EtherNet/IP internal adapter device. See *Communication between two OmniCore controllers on page 37*.

> ### ℹ 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 OmniCore 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.

8 Explicit messaging services

8.1 Information

General

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

See *Explicit messaging services (IO command) at startup on page 42* and *Explicit messaging services (IO command) via RAPID on page 43*.

> **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*.

IO command system parameters

The IO command specific system parameters are:

- **Path** (`Path`).
- **Service** (`Service`).
- **Download Order** (`-OrderNr`).

> **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

8.1 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

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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.

8.2 Explicit messaging services (IO command) at startup

Information

It is possible to configure IO commands that will be sent to a device at startup.

The command is specific to the I/O device and will only be sent to the assigned I/O device.

Configuring IO commands in I/O Engineering

1   In the **Configuration** browser, expand the internal scanner device and select **IO Commands**.

2   In the **Device Catalogue**, double-click **EtherNetIP Generic Command** to add the command to the device.

3   The command details can be configured in the **Properties** tab. See for detailed information about the parameters.

Example using *IO Command*

The following is a configuration example from RobotStudio that sends four IO commands at startup to an 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.

Parameter				
Name	RackSize	LastRack	StructuredType	ArrayOfWords
Device	EN_Device	EN_Device	EN_Device	EN_Device
Download Order	1	2	3	4
Path	6, 20 64 24 01 30 04, C6	6, 20 64 24 01 30 05, C1	20 64 24 01 30 12	6, 20 64 24 01 30 13, C7
Service	Set Attribute Single	Set Attribute Single	Set Attribute Single	Set Attribute Single
Value	0	0	45 00 35 00 255 255 255 255	100 200 300

> **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.

> **Note**
>
> The path to different commands can be found in the EtherNet/IP specification from ODVA or in the vendor manual for the device.

8.3 Explicit messaging services (IO 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

8.3 Explicit messaging services (IO 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
```

9 Troubleshooting

9.1 Frequently asked questions

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 WAN 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.

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.

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.

9.2 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 "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 OmniCore 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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