

ENGINEERING
TOMORROW



Operating Guide

iC7 Series EtherNet/IP

EtherNet/IP OS7IP



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1 Introduction

1.1 Purpose of the Operating Guide

This operating guide provides information about configuring the system, controlling the drive, accessing parameters, configuring, troubleshooting, and some typical application examples.

The operating guide is intended for use by qualified personnel, who are familiar with the iC7 drives, Ethernet technology, and the PC or PLC that is used as a master in the system.

Read the instructions before configuring Ethernet, and follow the procedures in this guide.

1.2 Additional Resources

Additional resources are available to help understand the features, and safely install and operate the iC7 products:

- The safety guide, which provides important safety information related to installing iC7 drives.
- The installation guides, which cover the mechanical and electrical installation of drives, functional extension options, or other extra components.
- The application guides, which provide instructions on setting up the drive for a specific end-use.
- Facts Worth Knowing about AC Drives, available for download on www.danfoss.com.
- Other supplemental publications, drawings, and guides are available at www.danfoss.com/service-and-support/documentation/.

Latest versions of Danfoss product documentation are available for download at <http://drives.danfoss.com/downloads/portal/>.

1.3 Safety Symbols

The following symbols are used in this guide:

⚠ D A N G E R ⚠

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

⚠ W A R N I N G ⚠

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

⚠ C A U T I O N ⚠

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

N O T I C E

Indicates information considered important, but not hazard-related (for example, messages relating to property damage).

1.4 Qualified Personnel

Correct and reliable transport, storage, installation, operation, and maintenance are required for the trouble-free and safe operation of the drive. Only qualified personnel are allowed to install and operate this equipment.

Qualified personnel are defined as trained staff, who are authorized to install, commission, and maintain equipment, systems, and circuits in accordance with pertinent laws and regulations. Also, the qualified personnel must be familiar with the instructions and safety measures described in this manual.

1.5 Safety Precautions

⚠ W A R N I N G ⚠

HIGH VOLTAGE

AC drives contain high voltage when connected to AC mains input, DC supply, or load sharing. Failure to perform installation, start-up, and maintenance by qualified personnel can result in death or serious injury.

- Only qualified personnel must perform installation, start-up, and maintenance.

⚠ W A R N I N G ⚠**UNINTENDED START**

When the drive is connected to the AC mains or connected on the DC terminals, the motor may start at any time, causing risk of death, serious injury, and equipment or property damage.

- Press [Off] on the control panel - if present - before configuring parameters.
- Make sure that the drive cannot be started by external switch, a fieldbus command, an input reference signal from the control panel, via remote operation using MyDrive® software tools, or after a cleared fault condition.
- Disconnect the drive from all power sources whenever personal safety considerations make it necessary to avoid unintended motor start.
- Check that the drive, motor, and any driven equipment are in operational readiness.

⚠ D A N G E R ⚠**DISCHARGE TIME**

The drive contains DC-link capacitors, which can remain charged even when the drive is not powered. High voltage can be present even when the warning indicator lights are off.

Failure to wait the specified time after power has been removed before performing service or repair work could result in death or serious injury.

- Stop the motor.
- Disconnect AC mains, permanent magnet type motors, and DC-link connections to other drives.
- Wait for the capacitors to discharge fully before performing any service or repair work. The exact discharge time is shown on the front cover of the drive.
- Use a measuring device to make sure that there is no voltage, before opening the drive or performing any work on the cables.

⚠ W A R N I N G ⚠**LEAKAGE CURRENT HAZARD**

Leakage currents exceed 3.5 mA. Failure to ground the drive properly can result in death or serious injury.

- Ensure that the minimum size of the ground conductor complies with the local safety regulations for high touch current equipment.

⚠ W A R N I N G ⚠**EQUIPMENT HAZARD**

Contact with rotating shafts or electrical equipment can result in death or serious injury.

- Ensure that only trained and qualified personnel perform installation, start-up, and maintenance.
- Ensure that electrical work conforms to national and local electrical regulations.
- Follow the procedures in this guide.

⚠ C A U T I O N ⚠**INTERNAL FAILURE HAZARD**

An internal failure in the drive can result in serious injury when the drive is not properly closed.

- Ensure that all safety covers are in place and securely fastened before applying power.

1.6 Abbreviations

Abbreviation	Definition
ACD	Address Conflict Detection
CIP	Common Industrial Protocol
CTW	Control word
DHCP	Dynamic host configuration protocol
DLR	Device Level Ring
DNS	Domain Name Server
EMC	Electromagnetic compatibility
EO	Exclusive Owner
I/O	Input/Output
IO	Input Only
IP	Internet protocol
IRT	Isochronous real time
CP	Control panel
LED	Light-emitting diode
LO	Listen Only
MAV	Main actual value
MRV	Main reference value
MS	Module Status (LED)
PC	Personal computer
PLC	Programmable logic controller
REF	Reference
RPM	Revolution Per Minute
SNMP	Simple Network Management Protocol
STW	Status word
TCP	Transmission Control Protocol
UCMM	Unconnected Message Manager

1.7 Version History

This guide is regularly reviewed and updated. All suggestions for improvement are welcome.

The original language of this guide is English.

Table 1: Version History

Version	Remarks
AQ456329199699, version 01	Initial version

2 Overview

2.1 EtherNet/IP Features and Technical Data

Fieldbus options for iC7 are integrated in the control board. Fieldbuses are enabled on communication interfaces X1 and X2 only. Modbus TCP is offered as standard, and other protocols such as PROFINET RT, and EtherNet/IP can be selected in the configurator when ordering a drive, or alternatively, they can be activated later by a proof-of-purchase token.

Table 2: EtherNet/IP Model Codes

Model code	Description
+BAIP	EtherNet/IP OS7IP

EtherNet/IP is an Ethernet-based automation standard that adapts the Common Industrial Protocol (CIP) to standard Ethernet technology. The EtherNet/IP and CIP technologies are managed by ODVA organization.

The EtherNet/IP interface is designed to communicate with any system complying with the CIP EtherNet/IP standard. EtherNet/IP provides users with network tools to deploy standard Ethernet technology for manufacturing applications while enabling internet and enterprise connectivity.

EtherNet/IP™ is a trademark of ODVA, Inc.

Table 3: EtherNet/IP Features

Feature	Technical data	
Minimum packet rate supported	1 ms	
Connections	Class 1	I/O connection using TCP transport. The EtherNet/IP interface supports maximum 1 Class-1 connection, but several listen-only connections can be established if multicast is selected as transport type.
	Class 3	Cyclic connection using UDP transport. Maximum 6 Class-3 connections are supported.
	UCMM	Non-cyclic connection using TCP transport. This type of connection is used for explicit messaging.
Network management	DLR	Device Level Ring Protocol for detecting and recovering from faults in ring-based networks.
	SNMP	Simple Network Management Protocol

2.2 Communication Profiles and Objects

The iC7 series supports several communication profiles and mandatory objects. The supported profiles depend on the application software installed.

The fieldbus profile can be selected from the PLC configuration tool via a Profile Selector Assembly.

Communication profiles are selected in parameter *10.3.1.2 Fieldbus profile*. See [Table 10](#) for more information.

For more information on fieldbus communication profiles and objects, see [2.3 iC Speed Profile](#) and [2.4 PROFIdrive](#).

Table 4: Communication Profiles and Supported Applications for iC7-Automation

Product	Application Software	Profile
iC7-Automation	Industry	<ul style="list-style-type: none"> PROFIdrive iC Speed Profile
	Motion	<ul style="list-style-type: none"> PROFIdrive iC Speed Profile

2.3 iC Speed Profile

The iC Speed profile is used with the iC7 series. iC Speed profile differs from the PROFIdrive profile, because it does not have a state machine. It is only controlled by the actual state 1/0 of the control bits, not the sequence in which they are manipulated.

2.3.1 Control Word (CTW) in iC Speed Profile

Table 5: iC Speed Profile Control Word Bits

Bit number	Name	Description
0+1	Preset reference selector	00 = Preset reference 1 01 = Preset reference 2 10 = Preset reference 3 11 = Preset reference 4
2	Reserved	Reserved for future use. Any control words sent to the device should keep this bit at 0 to ensure compatibility with future extensions of the control word.
3	No coast/Coast	1 = No function. 0 = Causes the frequency converter immediately to coast the motor.
4	No quick stop/Quick stop	1 = No function. 0 = Quick stops the frequency converter and ramps down the motor speed to stop as defined in the quick-stop ramp parameter.
5	No hold/Hold – output frequency	1 = No function. 0 = Holds the present output frequency (in Hz).
6	Start/No start	1 = If the other starting conditions are fulfilled, the selection allows the frequency converter to start the motor. 0 = Stops the frequency converter and ramps down the motor speed as defined in the ramp-down parameter.
7	Fault acknowledge	0→1 = Acknowledge faults. Acknowledge is edge-triggered when logic is changed from 0 to 1. Faults can only be acknowledged if the trigger condition has been removed and any required acknowledgment has been done. 0 = No function.
8	Jog/No jog	1 = Sets the output frequency to the jog speed defined in the jog speed parameter. 0 = No function.
9	Ramp select	1 = Ramp 2 is active. 0 = Ramp 1 is active.

Bit number	Name	Description
10	Data valid	1 = Uses the process data (control by PLC). 0 = Ignores the current process data. This is linked to the submodule where the CTW is present. If signals are to be covered, the CTW/STW profile (for example, the iC Speed Profile) must be part of the signals list. Uses the previously processed data when the data valid bit was true (no control by PLC).
11	Reserved	Reserved for future use.
12	User defined	These bits are reserved for application-specific advanced control. For more information, refer to the <i>Parameter Descriptions</i> chapter in the application guide.
13	User defined	
14	User defined	
15	User defined	

2.3.2 Status Word (STW) in iC Speed Profile

Table 6: iC Speed Profile Status Word Bits

Bit number	Name	Description
0	Control ready/Control not ready	1 = The device controls are ready and react to process data. 0 = The device controls are not ready and do not react to process data.
1	Frequency converter ready/Frequency converter not ready	1 = The frequency converter is ready for operation. 0 = The frequency converter is not ready for operation. This does not involve faults and warnings as they are indicated in their respective bits elsewhere.
2	Coasting/No coast	1 = There are no active coast signals, and the motor can start when a start signal is given. 0 = The frequency converter has an active coast signal and has released the motor.
3	Fault/No fault	1 = A fault has occurred, and an acknowledge signal is required to re-establish operation. 0 = There are no faults.
4	Reserved	Reserved
5	Reserved	Reserved
6	Reserved	Reserved
7	Warning/No warning	1 = A warning has occurred. 0 = There are no warnings.
8	Speed=reference/ Speed<>reference	1 = The present motor speed matches the present speed reference within a given tolerance. The tolerance is product specific. 0 = The motor runs, but the present speed is different from the present speed reference, for example while the speed ramps up or down during start or stop.
9	Bus control/Local operation	1 = The device is controlled and reacting to I/O and process data. 0 = The device does not react on commands from fieldbus, for 1 of the following reasons:

Bit number	Name	Description
		<ul style="list-style-type: none"> CTW Bit 10 = 0. HMI is in local mode. MyDrive® Insight has taken control. Control places do not include fieldbus.
10	Frequency limit ok/Out of frequency limit	1 = The output frequency is within the defined motor limits. 0 = The output frequency has exceeded the motor limits defined in parameters. The speed limits are set by parameters: <ul style="list-style-type: none"> P 5.8.3.1 Positive Speed Limit P 5.8.3.2 Negative Speed Limit P 5.8.3.3 Minimum Speed Limit
11	In operation/No operation	1 = The process is running, and the motor could be running or starting at any time. 0 = There are no active start requests, and the process does not run. The motor is in a coasted state and is not started.
12	Reserved	Reserved
13	Reserved	Reserved
14	User defined	These bits are reserved for application-specific advanced control. For more information, refer to the <i>Parameter Descriptions</i> chapter in the application guide.
15	User defined	

2.4 PROFIdrive

Standard telegram 1 is implemented according to PROFIdrive Application Class 1 profile as defined in the PROFIdrive standard and state machine diagram.

2.4.1 Control Word (CTW) in PROFIdrive

Table 7: Control Word Bits in PROFIdrive

Bit number	Name	Description
0	On-Off	1 = On. 0 = Off.
1	Coast stop	1 = No coast stop. 0 = Coast stop.
2	Quick stop	1 = No quick stop. 0 = Quick stop.
3	Operation	1 = Enable operation. 0 = Disable operation.
4	Ramp generator	1 = Enable ramp generator (RFG). 0 = Reset ramp generator. Output of the RFG is set to 0. The drive decelerates along the current limit or along the voltage limit of the DC link.
5	Freeze	1 = Unfreeze ramp generator. 0 = Freeze ramp generator. Freezes the present output frequency (in Hz).

Bit number	Name	Description
6	Enable set-point	1 = Enable setpoint. 0 = Disable setpoint.
7	Fault acknowledge	0 → 1 = Acknowledge faults. Acknowledge is edge-triggered when changing from logic 0 to logic 1. 0 = No function.
8	Jog 1	1 = Jog 1 on. 0 = Jog 1 off. Operation is enabled, the drive is in standstill, and STW1 bit 4, 5, 6 = 0. The drive runs up along the ramp to jogging setpoint 1.
9	Jog 2	1 = Jog 2 on. 0 = Jog 2 off. Operation is enabled, the drive is in standstill, and STW1 bit 4, 5, 6 = 0. The drive runs up along the ramp to jogging setpoint 1.
10	Control by PLC	1 = Uses the process data (control by PLC). 0 = Ignores the current process data. This is linked to the submodule where the CTW is present. If signals are to be covered, the CTW/STW profile (for example, the iC Speed Profile) must be part of the signals list.
11	Reserved	Reserved for future use.
12	User defined	These bits enable mapping application functionality of the drive to the control word. Mapping is done through parameters. For more information, refer to the <i>Parameter Descriptions</i> chapter in the application guide.
13	User defined	
14	User defined	
15	User defined	

2.4.2 Status Word (STW) in PROFIdrive

Table 8: Status Word Bits in PROFIdrive

Bit number	Name	Description
0	Ready to switch on	1 = Ready to switch on. 0 = Not ready to switch on.
1	Ready to operate	1 = Ready to operate. 0 = Not ready to operate.
2	Operation enabled	1 = Operation enabled. 0 = Operation disabled.
3	Operation fault	1 = Fault present. 0 = No fault.
4	Coast stop	1 = Coast stop not activated (No OFF2). 0 = Coast stop activated (OFF2).
5	Quick stop	1 = Quick stop not activated (No OFF3).

Bit number	Name	Description
		0 = Quick stop activated (OFF3).
6	Switching on inhibited	1 = Switching on inhibited. 0 = Switching on not inhibited.
7	Warning	1 = A warning has occurred. 0 = There are no warnings.
8	Speed=reference/ Speed<>reference	1 = The present motor speed matches the present speed reference within a given tolerance. The tolerance is product specific. 0 = The motor runs, but the present speed is different from the present speed reference. It could, for example, be the case while the speed ramps up/down during start/stop.
9	Bus control/Local operation	1 = The device is controlled and reacting to I/O and process data. 0 = The device does not react to commands from the fieldbus for 1 of the following reasons: <ul style="list-style-type: none"> • CTW bit 10 = 0. • HMI is in local mode. • MyDrive® Insight has taken control. • Control places do not include fieldbus.
10	Frequency limit ok/Out of frequency limit	1 = The output frequency is within the defined motor limits. 0 = The output frequency has exceeded the defined motor limits given by parameters. The speed limits are set by parameters: <ul style="list-style-type: none"> • <i>P 5.8.3.4 High Speed Warning</i> • <i>P 5.8.3.9 Low Speed Monitor Limit</i>
11	User defined	These bits enable mapping application functionality of the drive to the status word. Mapping is done through parameters. For more information, refer to the <i>Parameter Descriptions</i> chapter in the application guide.
12	User defined	
13	User defined	
14	User defined	
15	User defined	

2.4.3 PROFIdrive State Machine

In the PROFIdrive control profile, the control bits perform different functions:

- 0–3 perform the basic start-up and power-down functions.
- 4–10 perform application-oriented control.
- 12–15 can be configured for different purposes.

See [Illustration 1](#) for the basic state transition diagram, where control bits 0–3 control the transitions and the corresponding status bit indicates the actual state. The black dots indicate the priority of the control signals. Fewer dots indicate lower priority, and more dots indicate higher priority.

The general state diagram is defined in the PROFIdrive standard.

e30bk784.10

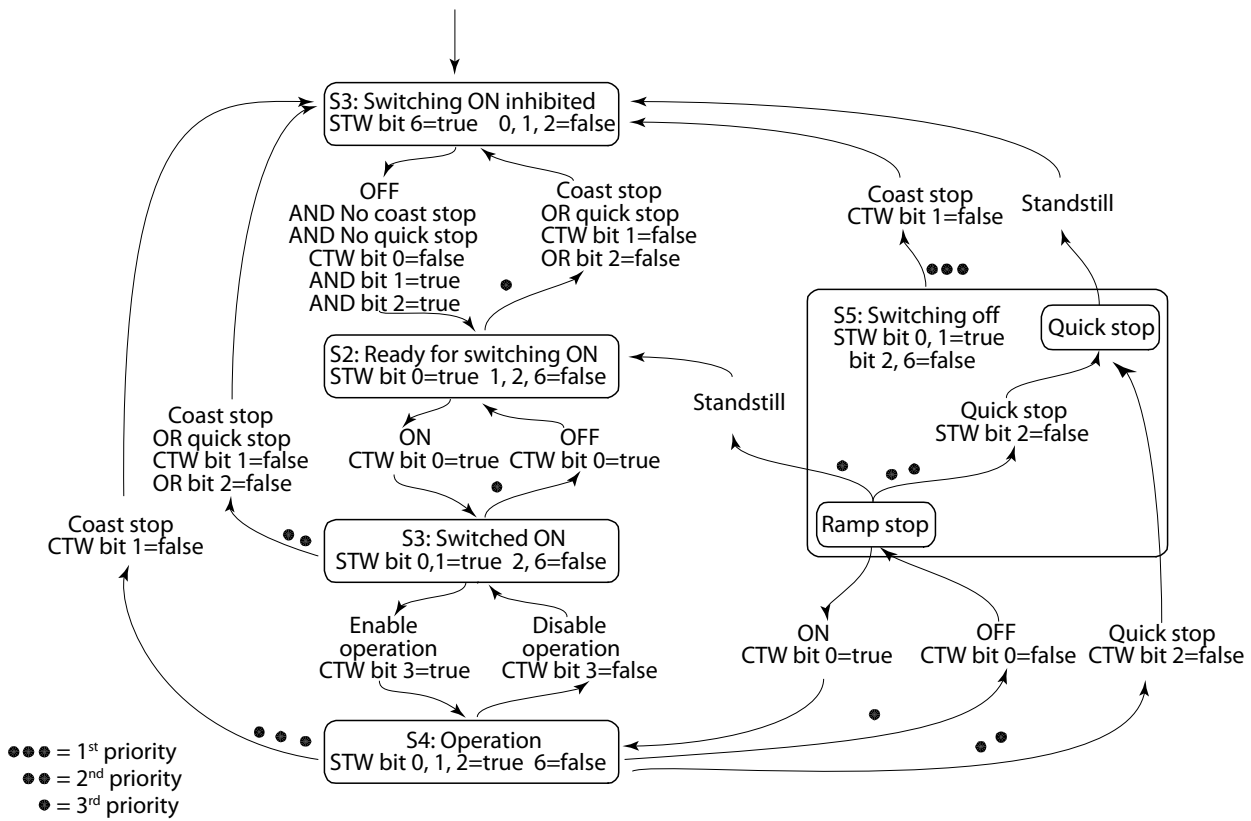


Illustration 1: General State Diagram

2.5 Network Topologies

Communication interface X1/X2 is used for fieldbus connection.

The iC7 series communication interface has 2 Ethernet ports (X1 and X2) and an embedded switch with 2 Ethernet RJ45 connectors. It has 1 MAC and IP address, and is considered a single device in the network. The communication interface supports 3 network topologies:

- Line topology
- Star topology
- Ring topology

2.5.1 Line Topology

In many applications, line topology enables simpler cabling and the use of fewer Ethernet switches. Observe network performance and the number of devices in a line topology. Too many devices in a line may exceed network update time limits.

N O T I C E

When line topology is used, take precautions to avoid timeout in the PLC when more than 8 drives are installed in series. Each drive in the network adds a small delay to the communication due to the built-in Ethernet switch. When the update time is too short, the delay can lead to a timeout in the PLC.

- Set the update time as shown in the table. The numbers given are typical values and can vary from installation to installation.

Number of drives connected in series	Minimum update time [ms]
<8	2
8–16	4
16–32	8
33–50	16
>50	Not recommended

N O T I C E

Using tools such as MyDrive® Insight may influence system performance in a line topology.

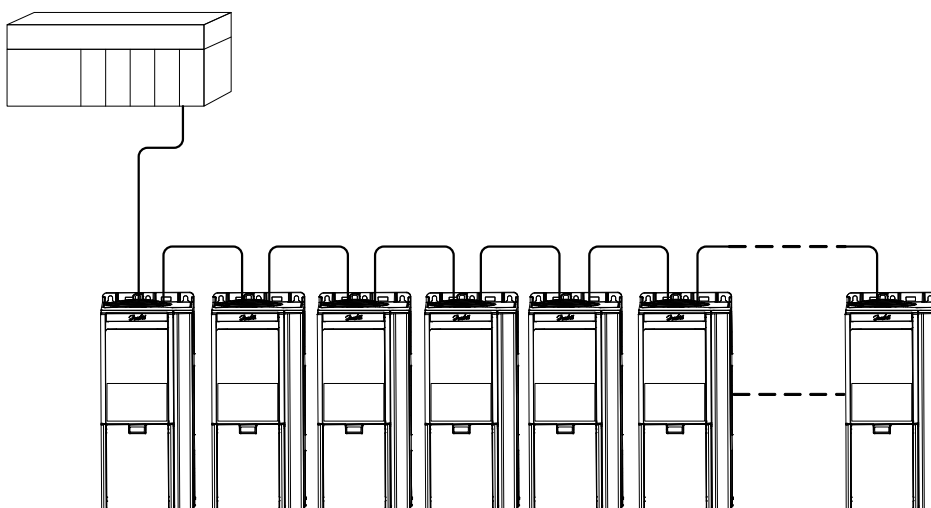


Illustration 2: Example of Line Topology

N O T I C E

Installing drives of different current ratings in line topology may result in unwanted power-off behavior.

- Mount the drives with the longest discharge time first in the line topology. In normal operation, the drives with bigger current ratings have a longer discharge time.

2.5.2 Star Topology

In a star network, all devices are connected to the same switch or switches. Star topology reduces the damage caused by single cable failure. In a star topology, a single cable failure affects a single drive instead of all drives. In many applications, this topology enables simpler cabling depending on the location and distance of the device.

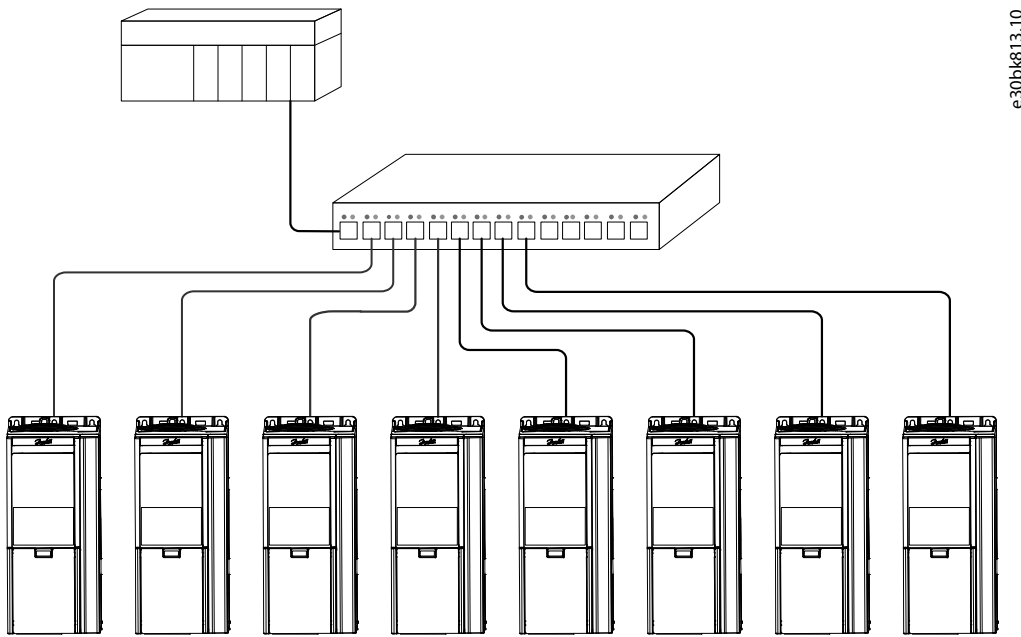


Illustration 3: Example of Star Topology

2.5.3 Ring Topology

Ring topology enables the same simpler cabling and reduced cabling costs as line topology, but also reduces the damage caused by a single cable failure in a similar manner as star topology.

The ring topology protocol depends on the protocol in use.

For EtherNet/IP, the device level ring (DLR) is used. A DLR network consists of an active ring supervisor and any number of ring nodes. The iC7 drive acts as a ring node with its 2 Ethernet ports X1/X2. The ring supervisor is typically a PLC and it is responsible for generating a beacon at regular intervals. The DLR protocol contains several fault detection and ring recovery mechanisms. The ring supervisor is capable of blocking traffic on 1 port to avoid loops, faults are detected when beacon traffic is interrupted, and/or link/node failure is detected by adjacent nodes. Any DLR related settings are handled via the ring supervisor.

NOTICE

Do not use non-DLR compliant devices throughout the DLR domain.

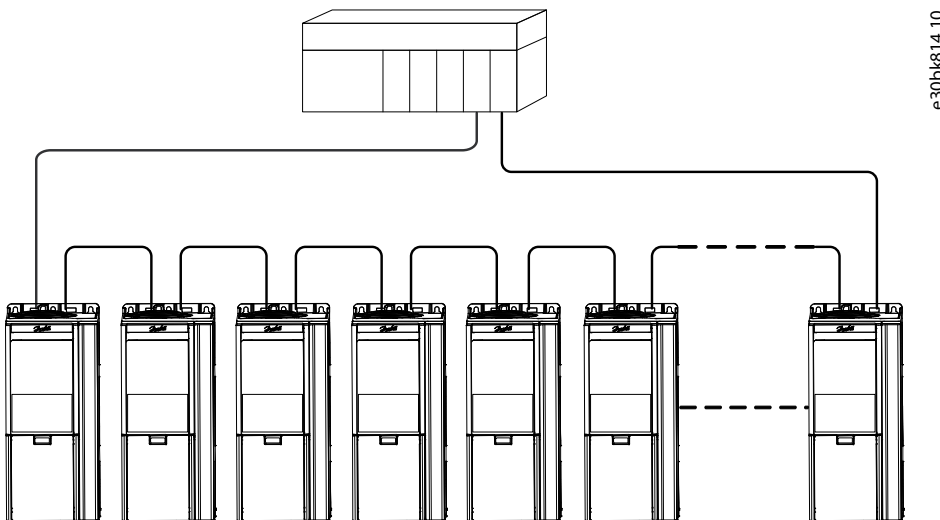


Illustration 4: Example of Ring Topology

3 Fieldbus Cable Connections

3.1 Prerequisites for Installation

Communication interfaces are integrated in the control board in iC7 drives.

The position of the connections differs based on the control board concept and frame, for example. For more information on the location of the connections, cabling, and shielding, refer to the drive design guide.

3.2 Installation in Frequency Converters

3.2.1 Communication Interface X1/X2 in Frames FA02–FA12

The communication interface is on the top of the frequency converter as shown in [Illustration 5](#). Industrial-grade RJ45 connectors are recommended for optimal connection. A combined shield/fixing plate, the Fieldbus EMC plate, is available as an accessory to strengthen the mechanical fixation of the cables.

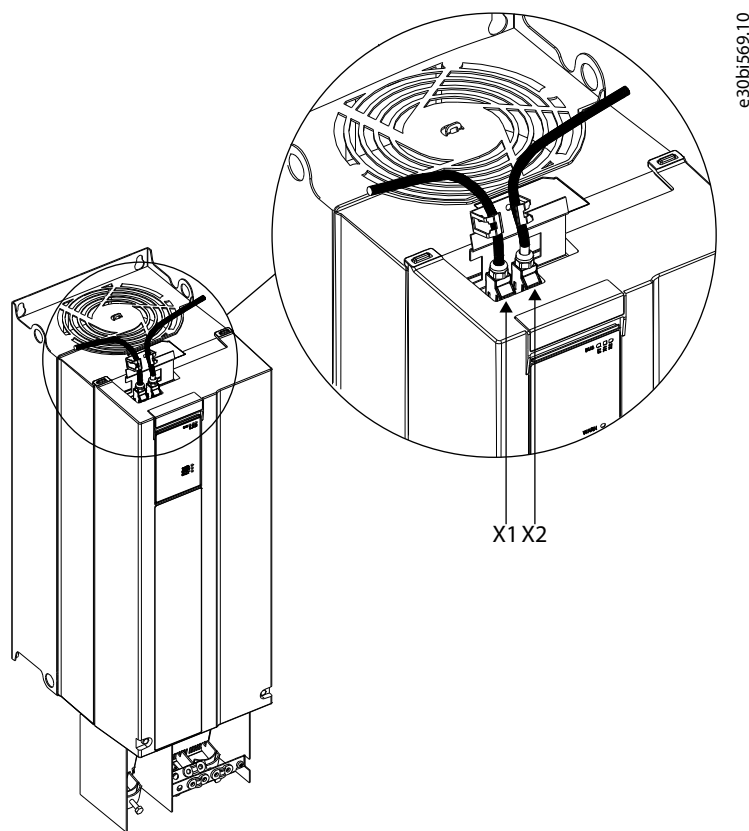


Illustration 5: Location of the Communication Interface, X1/X2 in FA02-FA12 Frames (with the Optional EMC Plate)

3.2.2 Communication Interface X1/X2 in Frames FK06–FK12

The communication interface ports are located inside the frequency converter. The position of the ports and the recommended wiring path are shown in [Illustration 6](#) and [Illustration 7](#).

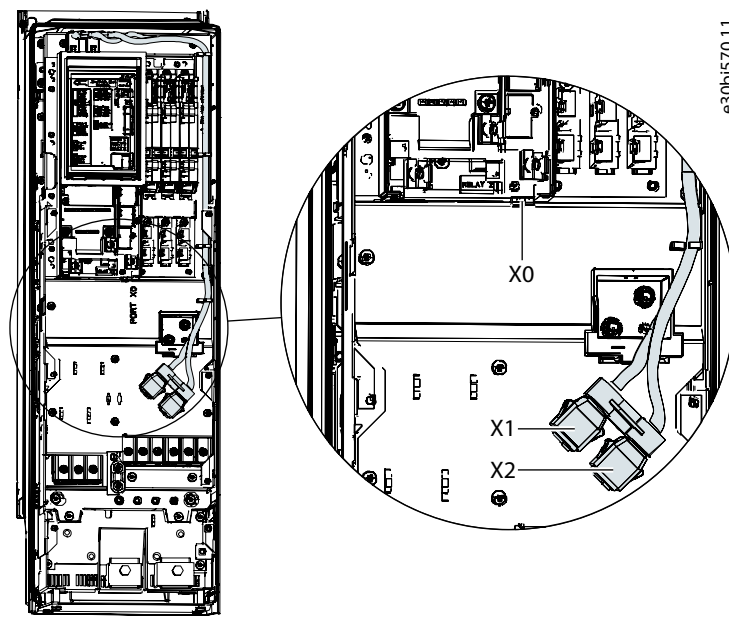


Illustration 6: Communication Port X0, X1, and X2 Locations in FK06–FK08 Frames

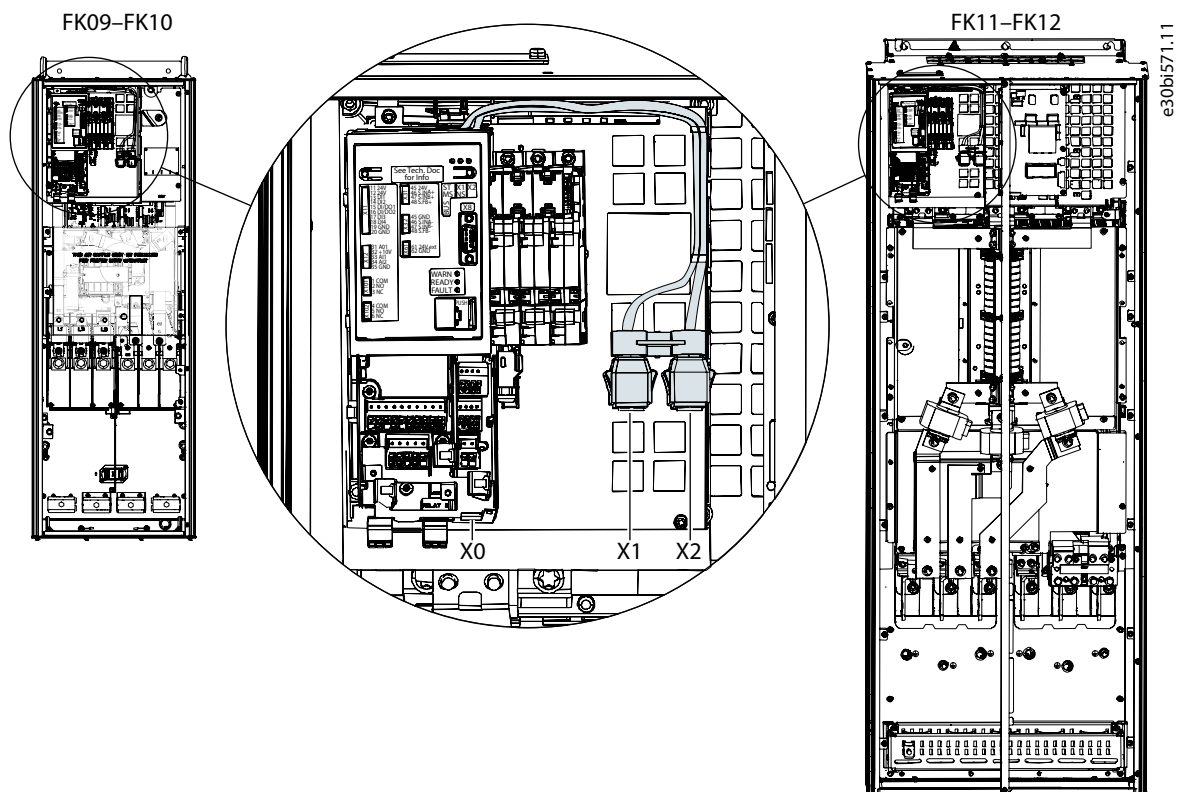


Illustration 7: Communication Port X0, X1, and X2 Locations in FK09–FK12 Frames

3.3 Installation in System Modules

3.3.1 Communication Interface X1/X2 in System Modules

The position of the communication interface ports in the system modules is shown in [Illustration 8](#).

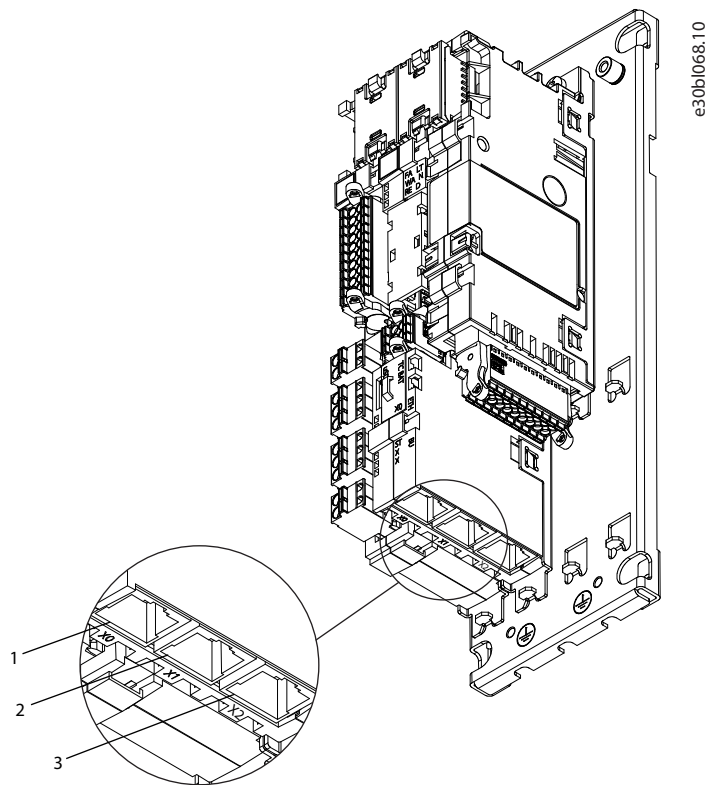


Illustration 8: Communication Port X0, X1, and X2 Locations in System Modules

1	Ethernet port (X0)	3	Ethernet port (X2)
2	Ethernet port (X1)		

3.4 EMC-compliant Installation

To obtain an EMC-compliant installation, follow the instructions provided in the drive-specific design guide and the installation guide included in the shipment.

3.4.1 Grounding

- Ensure that all stations connected to the fieldbus network are connected to the same ground potential. When distances between the stations in a fieldbus network are long, connect the individual station to the same ground potential. Install equalizing cables between the system components.
- Establish a grounding connection with low HF impedance, for example, by mounting the drive on a conductive backplate.
- Keep the ground wire connections as short as possible.

3.4.2 Cable Routing

NOTICE

EMC INTERFERENCE

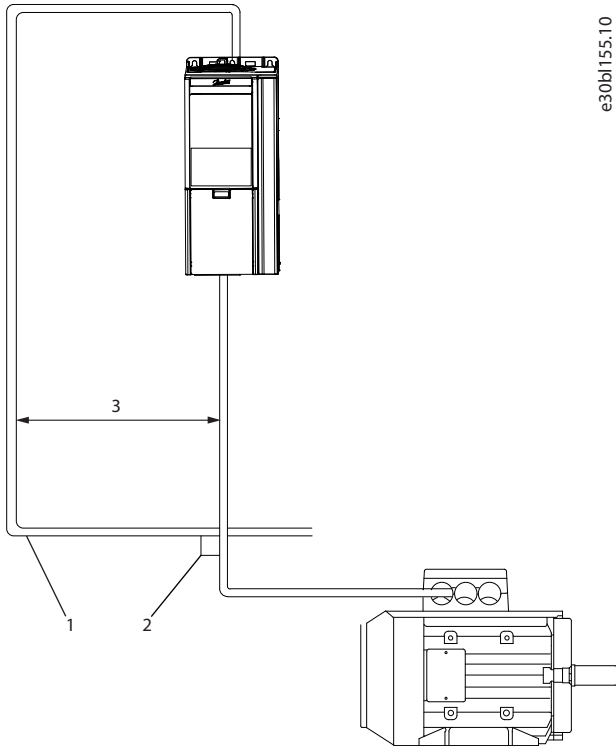
Failure to isolate fieldbus communication, motor, and brake resistor cables can result in unintended behavior or reduced performance.

- Use shielded cables for motor and control wiring, and separate cables for fieldbus communication, motor wiring, and brake resistor.
- Minimum 200 mm (7.9 in) clearance between power, motor, and control cables is required. For power sizes above 315 kW (450 hp), increase the minimum distance to 500 mm (20 in).

NOTICE

CABLE ROUTING

When the fieldbus cable intersects a motor cable or a brake resistor cable, ensure that the cables intersect at an angle of 90°.



e30b1155.10

Illustration 9: Cable Routing

1	Fieldbus cable	3	≥200 mm (7.9 in) (≥ 500 mm (20 in) for power sizes >315 kW (450 hp))
2	90° intersection		

4 EtherNet/IP Configuration

4.1 Configuring Ethernet Interface

The X1 and X2 interfaces are internally connected with an Ethernet switch and share the same physical MAC layer, and the same IP settings apply to both interfaces.

IPv4 settings are configured in MyDrive® Insight or in the control panel.

1. Configure IPv4 settings.
 - In MyDrive® Insight, go to *Setup and Service* → *Interface configuration* → *Interface X1/X2* → *IPv4 settings*.
 - In the control panel, navigate to parameter group *10.2 Communication Interfaces*.

Function	Value	Description
Interface X1/X2 MAC address	00:1B:08:xx:xx:xx	The MAC address of interface X1/X2. The value is read-only.
IPv4 addressing method	Disable	Only link-local IP address in the 169.254.xxx.xxx range is active.
	Static IP	A static IP address is entered manually.
	Automatic	IP address is assigned via a DHCP or BOOTP server.
Requested IPv4 address	xxx.xxx.xxx.xxx	If <i>Automatic</i> is selected as the IPv4 addressing method and no DHCP/BOOTP server is present, the X1/X2 interface automatically configures an IP address and subnet mask in the 169.254.xxx.xxx range.
Requested IPv4 subnet mask	xxx.xxx.xxx.xxx	The requested IPv4 subnet mask for the interface.
Requested IPv4 gateway address	xxx.xxx.xxx.xxx	Requested IPv4 gateway address for the interface.
Enable ACD	Enable/disable (default)	Request to enable or disable Address Conflict Detection for the interface. The change will not take effect before a power cycle is performed. If no conflicts are detected, ACD activity displays 0. If an address conflict occurs, the ACD activity displays 1, and the IPv4 interface will revert to an automatically assigned IP address in the 169.254.xxx.xxx range.
DNS server 1, 2	xxx.xxx.xxx.xxx	The user-requested Domain Name Server 1 for the interface (for manual IP addressing mode only).

4.2 General Connectivity Settings

General connectivity settings are in parameter group *10 Connectivity* → *Integrated Communication* → *Protocols* → *General Settings*.

Table 10: General Connectivity Parameters

Menu index	Parameter	Parameter number	Value	Description
10.3.1.2	<i>Fieldbus profile</i>	1301	<ul style="list-style-type: none"> iC Speed Profile (default) PROFIdrive Standard telegram 1 	Select the fieldbus profile. The selection affects the interpretation of the control word and status word.
10.3.1.3	<i>Fieldbus Fault Response</i>	1303	<ul style="list-style-type: none"> Info (default) Warning Fault, ramp to coast Fault, coast See Table 11 for descriptions of the events.	Select the behavior when a fieldbus fault, for example, loss of I/O connection occurs.
10.3.1.4	<i>No Fieldbus Connection Response</i>	1327	<ul style="list-style-type: none"> Info (default) Warning Fault, ramp to coast Fault, coast See Table 11 for descriptions of the events.	Select the response if there is no fieldbus connection.
10.3.1.6	<i>Process Data Timeout Time</i>	1340	0.05–18000 s (Default value: 1.00 s)	Set the timeout time. If process data is not received within the time set, a process data timeout is triggered.
10.3.1.12	<i>Process Data Timeout Response</i>	1341	<ul style="list-style-type: none"> Info Warning Warning – Change Control Place Warning – Change Control Place Persistent Fault, ramp to coast Fault (default) See Table 11 for descriptions of the events.	Select the response in case there is no fieldbus connection.
10.3.1.13	<i>Process Data Timeout Control Place</i>	112	<ul style="list-style-type: none"> Local control (default) Fieldbus control I/O control Advanced control See Table 12 for descriptions of the control places.	Select the alternate control place to be used if there is a fieldbus timeout. This is only valid with a timeout warning or info.

Table 11: Event Descriptions

Value	Description
Info	The event is logged in the event log.
Warning	The drive issues a warning.
Fault, ramp to coast	The drive issues a fault, ramps down, and coasts.

Value	Description
Fault	The drive issues a fault, and coasts the motor.
Warning - Change Control Place	The drive issues a warning. The control place changes to the selected alternative while timeout warning is active. The control place changes back to the original control place when fieldbus process data returns.
Warning - Change Control Place – Persistent	The drive issues a warning. The control place changes to the selected alternative if timeout warning is active. The control place requires a reset command to change back to the original control place after fieldbus process data returns.

Table 12: Control Place Descriptions

Value	Description
Local control	The drive is controlled by a connected control panel.
Fieldbus control	The drive is controlled via a fieldbus.
I/O control	The drive is controlled via I/O.
Advanced control	The drive is controlled via a combination of I/O and fieldbus.

4.3 Configuring EtherNet/IP Scanner

Danfoss provides an electronic data sheet (EDS), which contains the necessary information for the offline configuration of EtherNet/IP communication.

1. Download the EDS files from www.danfoss.com/en/products/dds/low-voltage-drives/ic7-drives/ic7-automation/#tab-software.

Each iC7 application requires its own EDS file. Check that the EDS file version is compatible with the firmware version.

2. To configure a drive with EtherNet/IP for operation with a PLC system, install the EDS file.

4.4 Configuring Rockwell Scanner

To configure a Rockwell (Allen-Bradley) scanner to operate with an EtherNet/IP device, install the EDS file using the EDS hardware installation tool.

1. In Rockwell EDS Hardware Installation Tool, go to *Tools* → *EDS Hardware Installation Tool*.

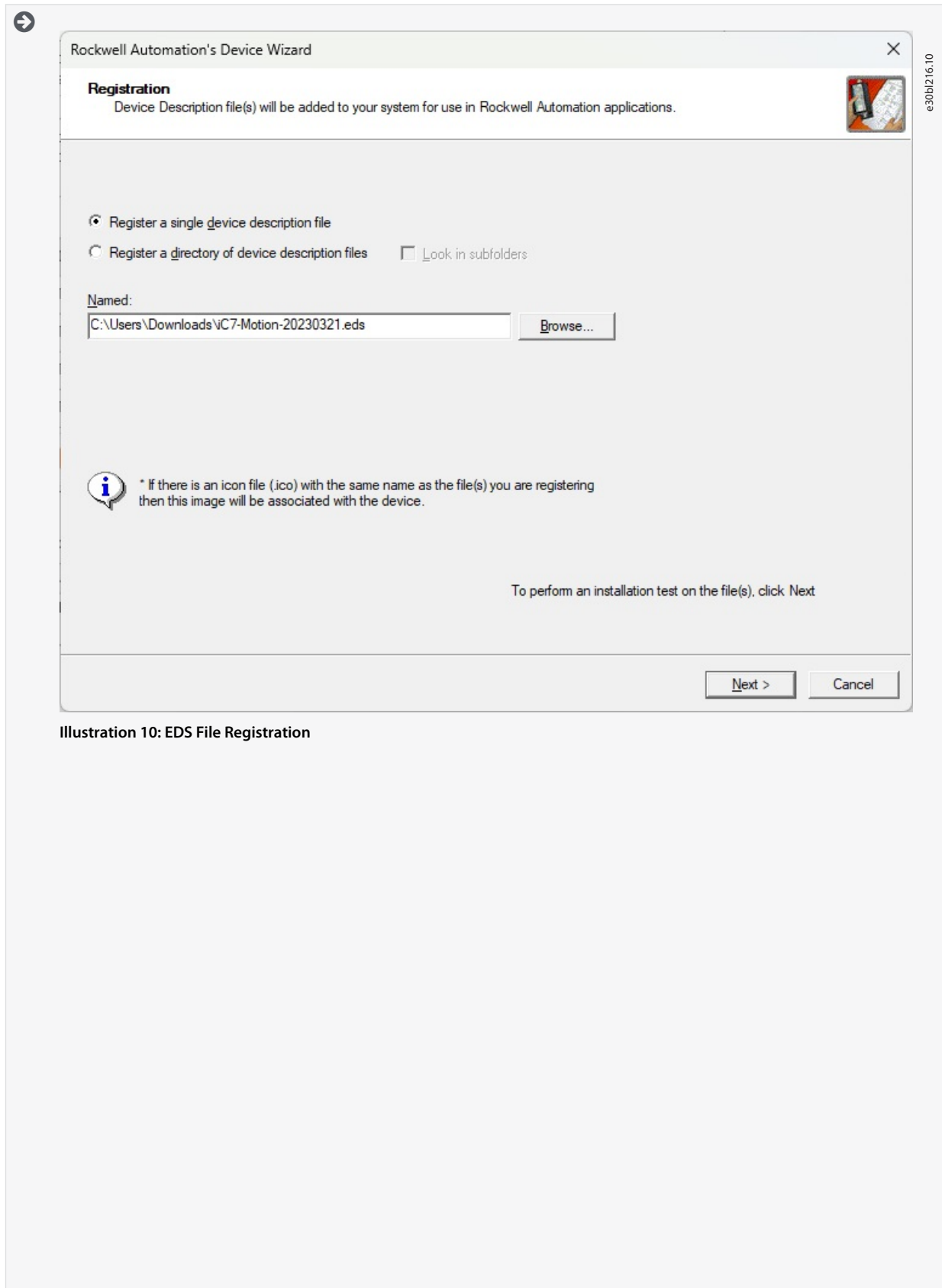


Illustration 10: EDS File Registration

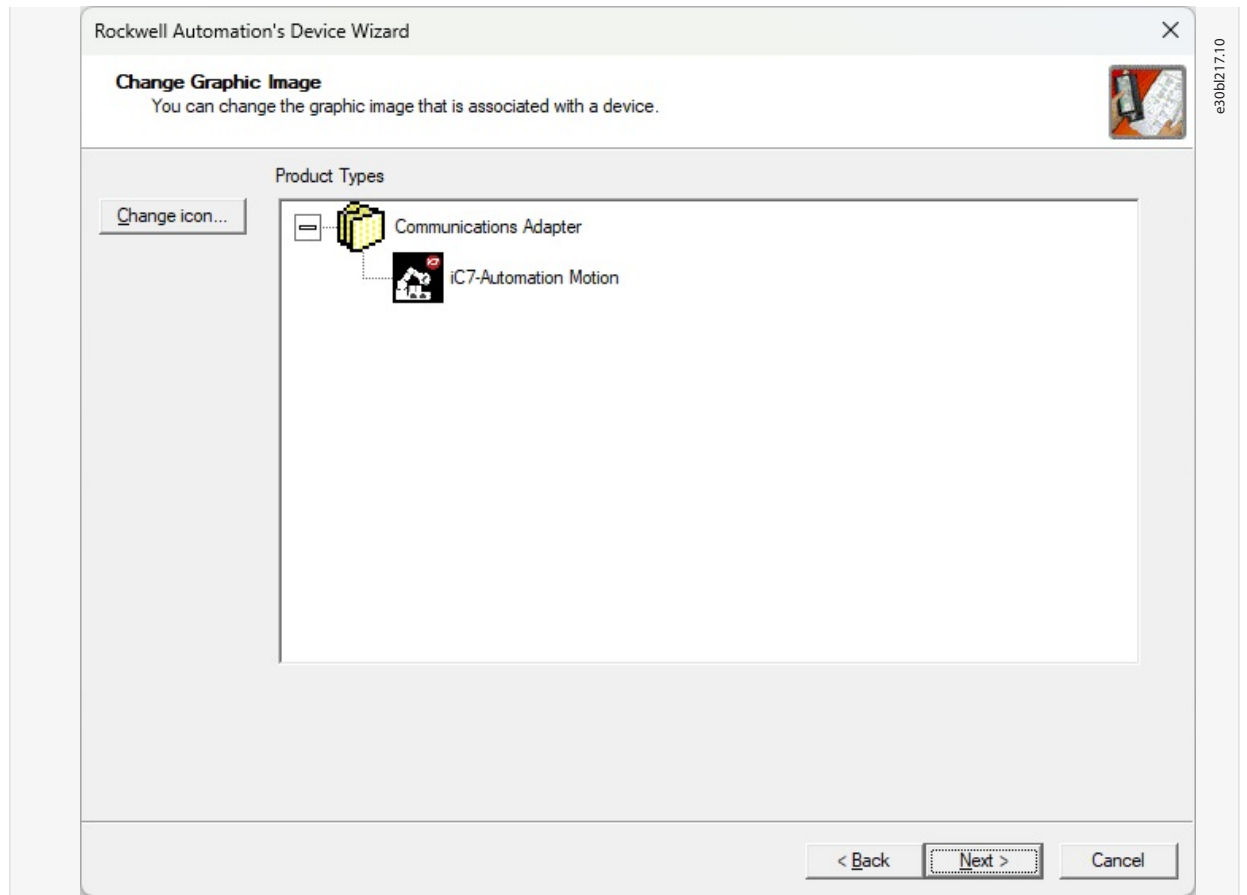


Illustration 11: Changing the Graphic Image

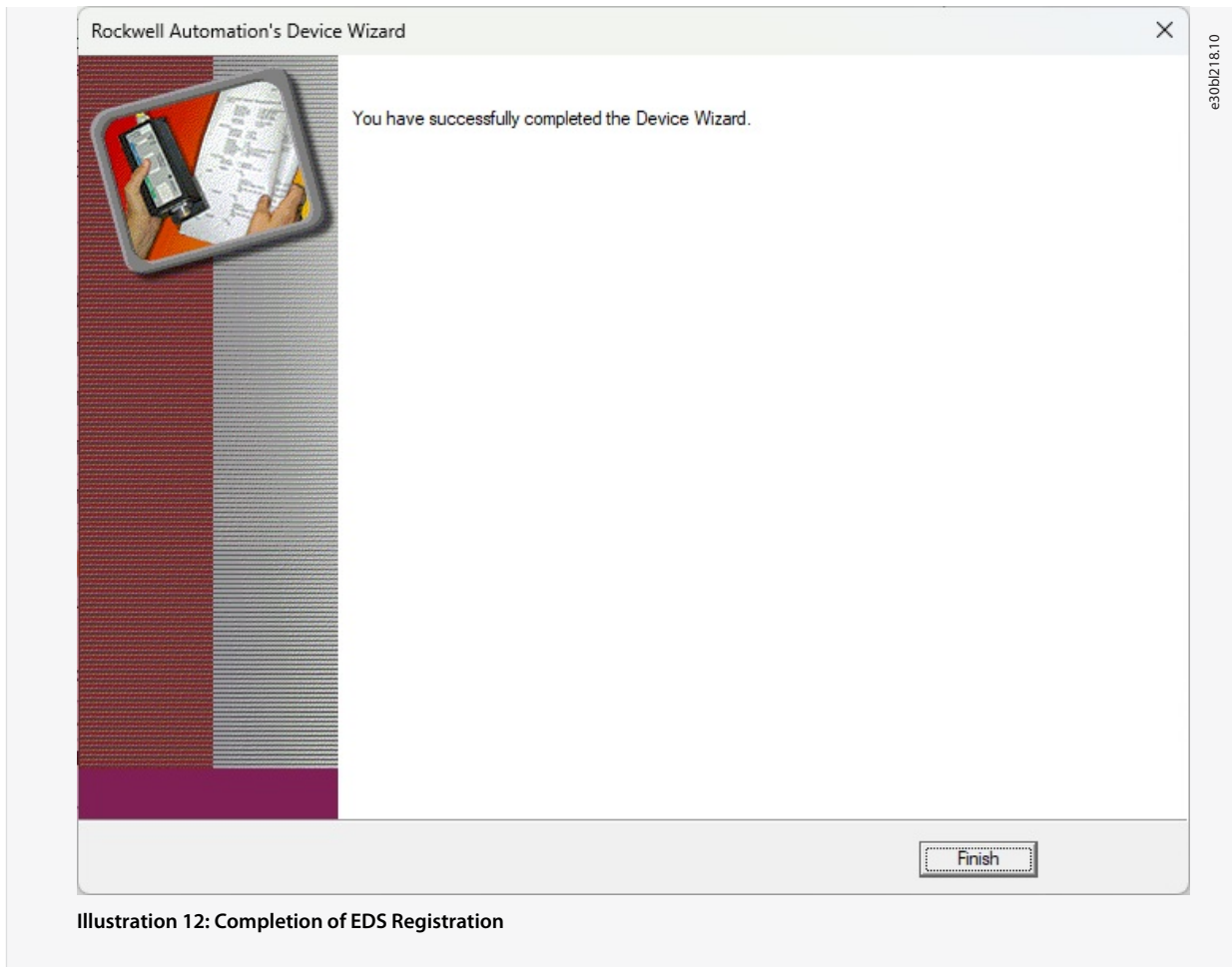


Illustration 12: Completion of EDS Registration

4.5 Configuring EtherNet/IP Connections

4.5.1 IO Connection Settings

Table 13: IO Connection Settings between Rockwell Scanner and iC7 Automation Drive

Name	Value
IP address	192.168.6.120
Connection	EO 130/180
Parameter name	<ul style="list-style-type: none"> Fieldbus Statusword (STW) Fieldbus Speed Main Actual Value (MAV) Heat Sink Temperature DC-link Voltage

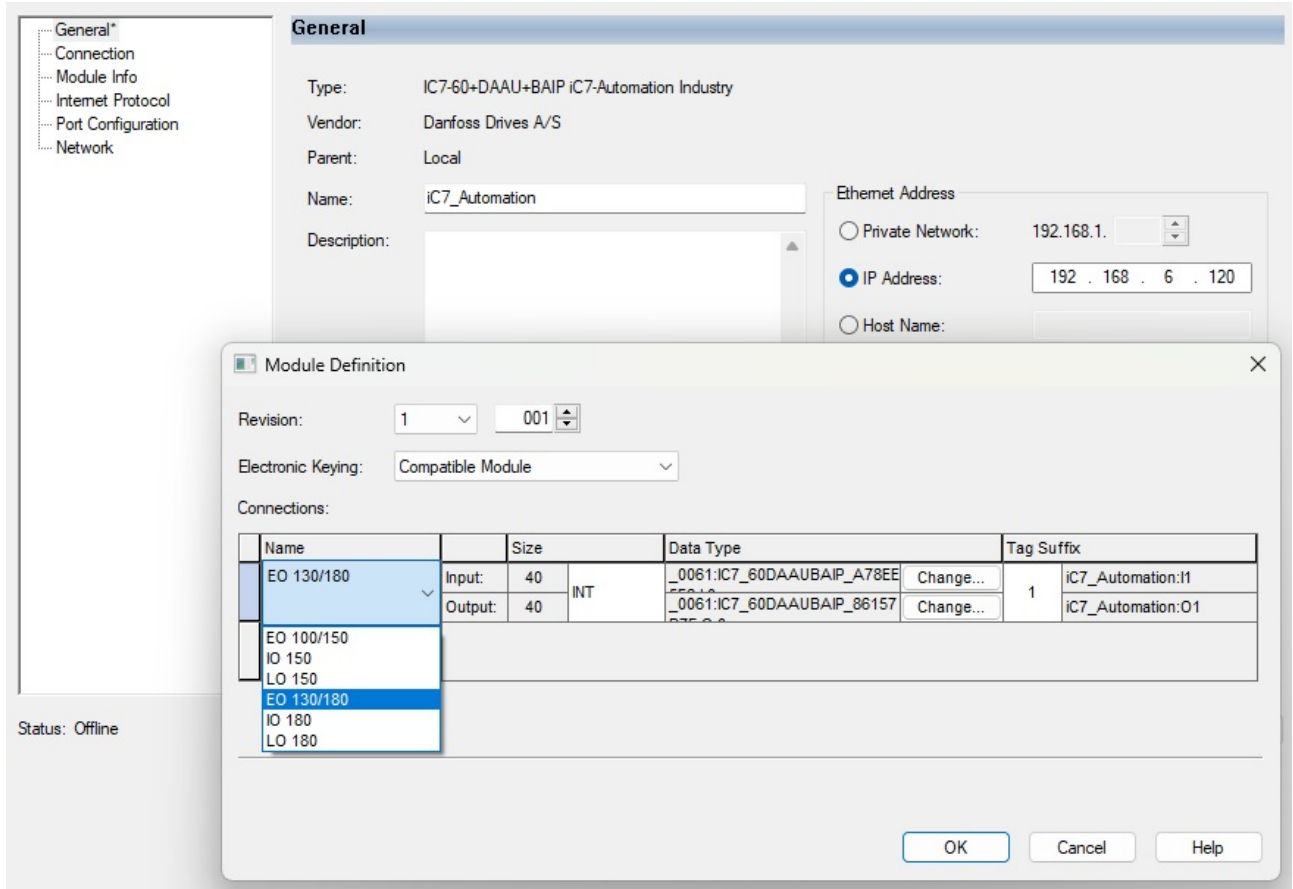


Illustration 13: IO Connection Settings 1

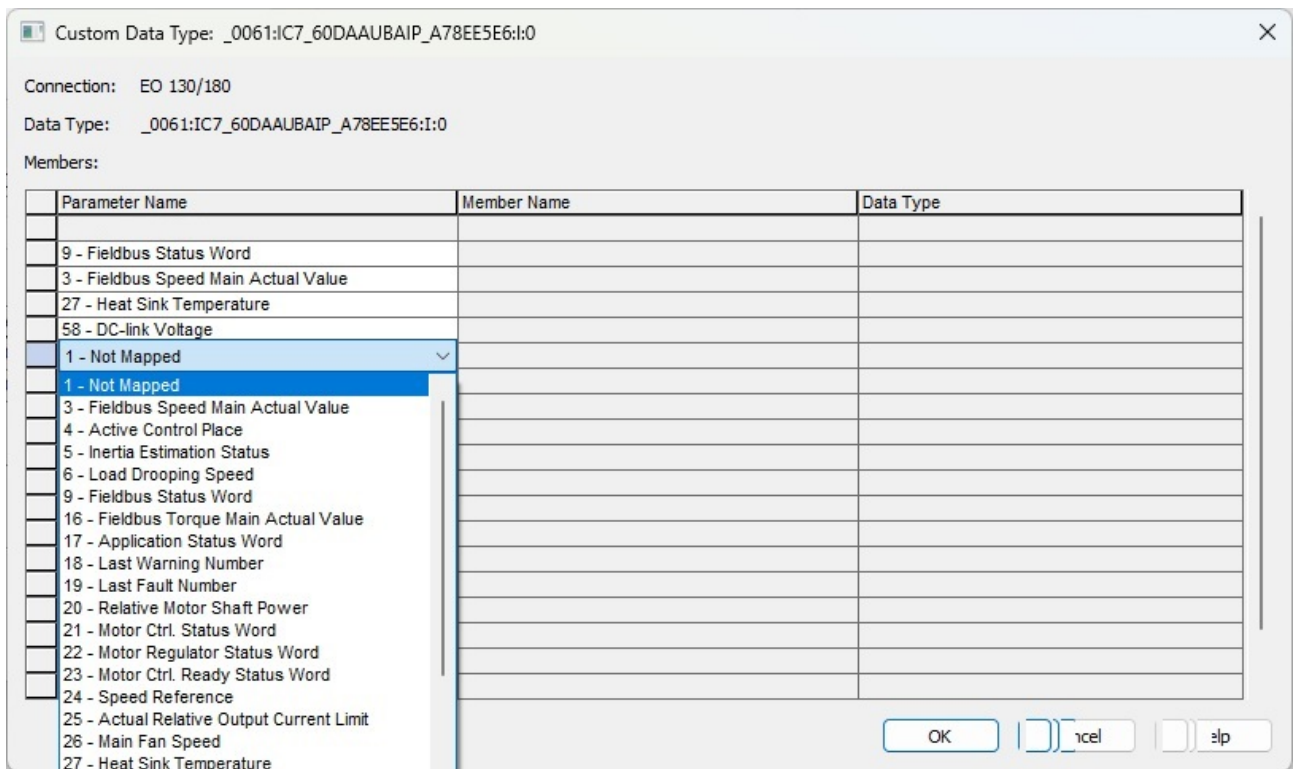


Illustration 14: IO Connection Settings 2

4.5.2 Class-1 Connection

The class-1 connection is a cyclic I/O connection using TCP transport. The EtherNet/IP interface supports maximum 1 Class-1 connection, but several listen-only connections can be established if multicast is selected as the transport type.

The connection is established with a forward open command. See [Table 14](#) for more information.

4.5.2.1 I/O Assembly Instances

I/O assembly instances are defined process control objects with defined content comprising control and status information.

Table 14: Assembly Instance Options

Instance	Direction	Size	Data
100	Originator -> Target	4 bytes	<ul style="list-style-type: none"> Control word(profile selectable) Reference
150	Target -> Originator	4 bytes	<ul style="list-style-type: none"> Status word Main actual value
130	Originator -> Target	80 bytes	Free selectable
180	Target -> Originator	80 bytes	Free selectable

4.5.2.2 Connection Manager

Table 15: Supported Connections

Connection Point	Type	Description
EO 100/150	Exclusive Owner	The device is controlled by 1 scanner in this assembly.
EO 130/180		
IO 100	Input Only	The scanner receives input data from the device. The data is not sent to the device.
IO 130		
LO 150	Listen Only	A Listen Only connection can be attached to an existing Exclusive Owner or Input Only connection.
LO 180		

4.5.2.3 Transport Types

Table 16: Supported Transport Types

Direction	Transport type
Originator -> Target	Point-to-point
Target -> Originator	<ul style="list-style-type: none"> Point-to-point Multicast
Trigger	Cyclic
Packet rate	1 ms minimum supported

4.5.3 Class-3 Connection

Class-3 Connection is a cyclic connection using UDP transport. The EtherNet/IP interface supports maximum 6 Class-3 connections. This type of connection is used for explicit messaging.

The connection is established with a forward open-command.

Table 17: Class-3 Connection Parameters

Connection name	Message parameters
Given name for the connection	Service code
	Class
	Instance
	Attribute
	Member
	Request data

4.5.4 Unconnected Messages, UCMM

The Unconnected Messages, UCMM is a non-cyclic connection using TCP transport. This connection is used for explicit messaging. The connection is established on-the-fly and does not require a forward open-command.

Table 18: UCMM Connection Parameters

Connection name	Message parameters
Unconnected messages, UCMM	Service code
	Class
	Instance
	Attribute
	Member
	Request data

For information on accessing CIP objects explicitly, see [6.1 Supported CIP Objects](#).

4.6 iC7-Automation Reference Handling

The speed reference is scaled as a normalized relative value in percent (N2). The value is transmitted in hexadecimal:

- 0% = 0 hex
- 100% = 4000 hex
- -100% = C000 hex

Table 19: Reference Handling Parameters

Menu index	Parameter	Parameter number	Unit	Range
4.2.2.3	<i>Nominal Speed</i>	402	[rpm]	0–100000
5.8.3.1	<i>Positive Speed Limit</i>	1729	[rpm]	0–35400
5.8.3.2	<i>Negative Speed Limit</i>	1728	[rpm]	-35400–0

For some applications, reversing is not wanted.

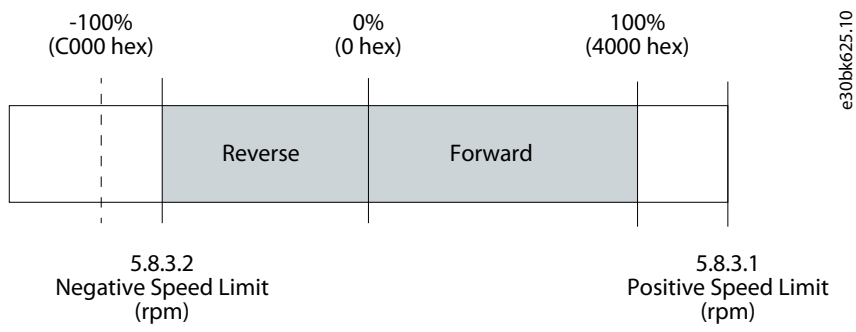


Illustration 15: Example of Fieldbus Speed Reference

5 Troubleshooting

5.1 Configuring Port Mirroring Settings

Enable/disable the port-mirroring function for network troubleshooting with a network analyzer tool.

1. In MyDrive Insight, go to *Setup and Service* → *Interface Configuration* → *Port Mirroring Settings*.

Function	Selections	Description
Source port	- X1 - X2	Frames are mirrored from this port.
Destination port	- X1 - X2	Frames are mirrored to this port.
Block RX from destination port	Enable/disable	Device does not receive any frames from Destination Port when enabled.
Enable port mirroring	Enable/disable	Enable the Port Mirroring feature.

5.2 Identifying a Drive

For easy identification of a drive, the winking function makes the fieldbus indicator LEDs ST, X1, and X2 flash yellow. The function is enabled in MyDrive® Insight under *Device Status* by clicking the device name in live mode.

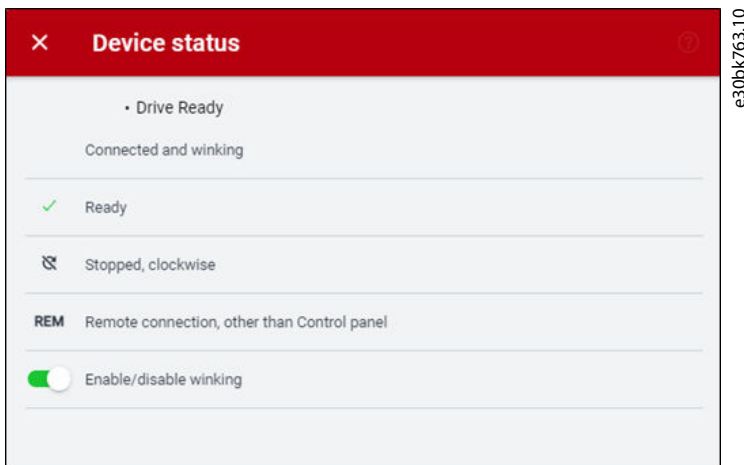


Illustration 16: Enabling Winking in MyDrive® Insight

See [Table 21](#) for more information on interpreting the LED signals.

5.3 Fieldbus Indicator LEDs

The fieldbus indicator LEDs are in the top right corner of the control panel.

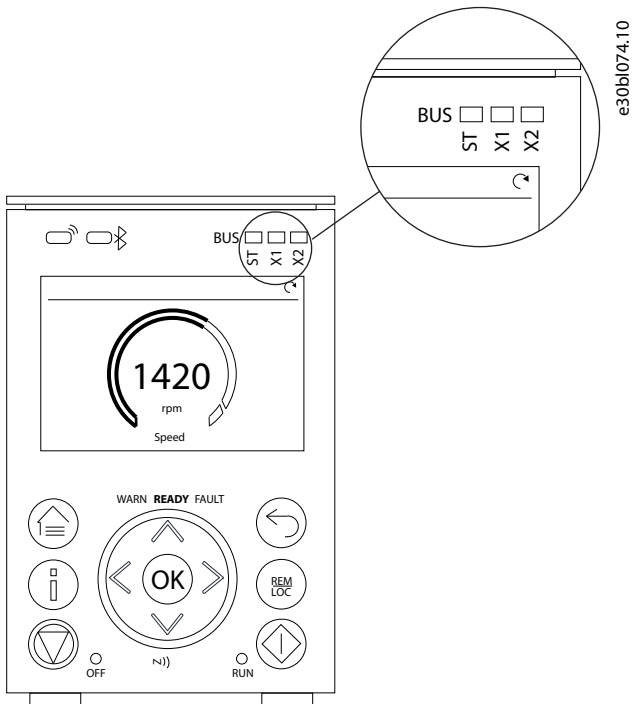


Illustration 17: Fieldbus Indicator LED Location on Control Panel

For more information on control panels, refer to the application guides.

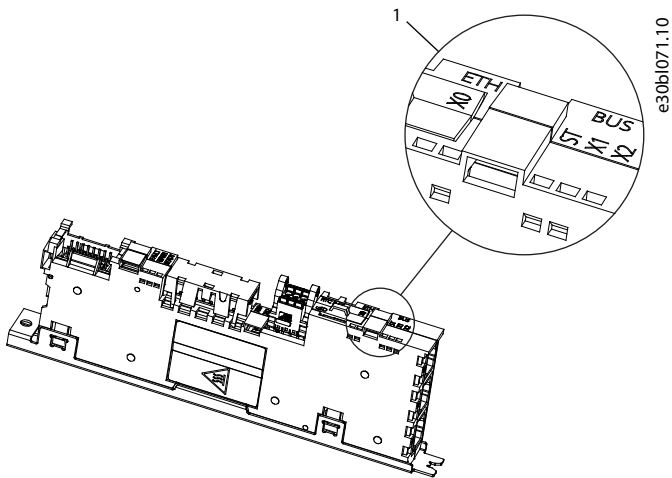


Illustration 18: Fieldbus Indicator LEDs on Modular Control Board

1 Fieldbus indicator LEDs (ST, X1, and X2)

- The LED labeled *ST* shows the module status.
- The LED labeled *X1* shows the network status on Ethernet port X1.
- The LED labeled *X2* shows the network status on Ethernet port X2.

Table 21: Fieldbus Indicator LED Functions

LED label	Status	LED pattern	Description
ST	Standby	Flashing green	Device needs commissioning.
	Operational	Solid green	Device is operational.
	Recoverable fault	Flashing red	Device has detected a recoverable fault (MAR).

LED label	Status	LED pattern	Description
	Unrecoverable fault	Solid red	Device has detected an unrecoverable fault (MAU).
	Flash LED	Flashing red/green	Flash LED service
X1/X2	No link/no IP	LED off	Unknown status
	No connections	Flashing green	No established EtherNet/IP connections
	Connected	Solid green	EtherNet/IP connection
	Connection timeout	Flashing red	One or more Ethernet/IP connection timeout
	Duplicate IP	Solid red	IP address assigned to the device is already in use.
	Flash LED	Flashing red/green	Flash LED service

5.4 EtherNet/IP Report

e30bl21.5.10

EtherNet/IP Status

Target IP: 192.168.6.120

Connection #1

Connection type	Exclusive Owner
Connection ID	0x80E9
Run/Idle Header	Run
Scanner IP	192.168.6.130
Producing RPI [ms]	20
Consuming RPI [ms]	20
Producing assembly	180
Consuming assembly	130

Assembly 180 T->O

Parameter	Value
Fieldbus Status Word	0x00000603
Fieldbus Speed Main Actual Value	0x00000000
Heat Sink Temperature	0x41F53C45
DC-link Voltage	0x43FE9814
No mapped parameter	0x00000000
No mapped parameter	0x00000000
No mapped parameter	0x00000000
No mapped parameter	0x00000000
No mapped parameter	0x00000000
No mapped parameter	0x00000000
No mapped parameter	0x00000000
No mapped parameter	0x00000000
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No mapped parameter	0x00000000
No mapped parameter	0x00000000
No mapped parameter	0x00000000
No mapped parameter	0x00000000
No mapped parameter	0x00000000

Assembly 130 O->T

Parameter	Value
Fieldbus Control Word	0x00000470
Fieldbus Speed Reference	0x00001000
No mapped parameter	0x00000000
No mapped parameter	0x00000000
No mapped parameter	0x00000000
No mapped parameter	0x00000000
No mapped parameter	0x00000000
No mapped parameter	0x00000000
No mapped parameter	0x00000000
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No mapped parameter	0x00000000
No mapped parameter	0x00000000

Illustration 19: Example of EtherNet/IP Report

6 EtherNet/IP Features

6.1 Supported CIP Objects

As in all implementations of CIP, EtherNet/IP shares the common object model. Objects are a common method to describe the specific application implemented in a device.

Data is structured in classes, instances, and attributes:

- A class is a group of objects with the same structure. These groups of objects within a class are called instances.
- Every instance provides the same data elements called attributes.
- Each class provides services to access data or to change the state of an object.

6.1.1 Class ID 0x01 Identity Object

Table 22: Instance Attributes for Class ID 0x01 Identity Object

Attribute	Access	Name	Data type	Description
1	Get	Vendor ID	UINT (97)	Danfoss Drives
2	Get	Device type	UINT (2)	AC drive
3	Get	Product code	UINT	CIP product code
4	Get	Revision	STRUCT	CIP revision
5	Get	Status	WORD	EtherNet/IP status word
6	Get	Serial number	UDINT	Serial number
7	Get	Product name	STRING	Name of iC7 application
8	Get	State	UINT	0 = N/A 1 = Device self-testing 2 = Standby 3 = Operational 4 = Major recoverable fault 5 = Major unrecoverable fault 6–254 = Reserved 255 = Default for <i>get_attribute_all</i>

6.1.2 Supported Services in Class ID 0x01

Table 23: Supported Services in Class ID 0x01

Service	Value
Reset Service Parameter	0 = Emulated Power Cycle 1 = Factory Reset
Flash LED Service Parameter	Duration in seconds Flashing red/green/off

6.1.3 Class ID 0x04 Assembly Objects

Table 24: Instance Attributes for Class ID 0x04 Assembly Objects

Instance	Access	Name	Size	Description
100	Set	[CTW], [REF]	4 bytes	Consuming assembly 100
130	Set	[STW], [MAV]	80 bytes	Consuming assembly 130
150	Get	Free configurable	4 bytes	Producing assembly 150
180	Get	Free configurable	80 bytes	Producing assembly 180
768	Set	Configuration	4 bytes	Configuration assembly 769 (for instance 100, 150)
769	Set	Configuration	80 bytes	Configuration assembly 769 (for instance 130, 180)

6.1.4 Class ID 0x06 Connection Manager

Table 25: Instance Attributes for Class ID 0x06 Connection Manager

Attribute	Access	Name	Data type	Description
1	Get	Open requests	UINT	Number of forward open requests received.
2	Get	Open format rejects	UINT	Number of forward open requests rejected due to bad format.
3	Get	Open resource rejects	UINT	Number of forward open requests rejected due to lack of resources.
4	Get	Open other rejects	UINT	Number of forward open requests rejected due to other reasons.
5	Get	Close requests	UINT	Number of forward close requests received.
6	Get	Close format requests	UINT	Number of forward close requests rejected due to bad format.
7	Get	Close other requests	UINT	Number of forward close requests rejected due to other reasons.
8	Get	Connection timeouts	UINT	Number of connection timeouts.

6.1.5 Class ID 0x47 DLR (Device Level Ring)

Table 26: Instance Attributes for Class ID 0x47 DLR (Device Level Ring)

Attribute	Access	Name	Datatype	Description
1	Get	Network topology	USINT	Current network topology mode: 0 = Linear 1 = Ring
2	Get	Network status	USINT	Status of network: 0 = Normal 1 = Ring fault 2 = Unexpected loop detected 3 = Partial network fault 4 = Rapid fault/restore cycle
10	Get	Active supervisor address	Struct of:	
		Supervisor IP address	UDINT	A Value of 0 indicates no IP Address has been configured for the device
		Supervisor MAC address	Array of 6	Ethernet MAC address

Attribute	Access	Name	Datatype	Description
			USINTs	
12	Get	Capability flags	DWORD	DLR capabilities of the device. iC7 Series are beacon-based nodes.

6.1.6 Class ID 0x48 Quality of Service Object

Table 27: Instance Attributes for Class ID 0x48 Quality of Service Object

Attribute	Access	Name	Datatype	Description
1	Get/Set	802.1Q tag enable	USINT	Enables or disables sending 802.1Q frames on CIP and IEEE 1588 messages. A value of 0 indicates tagged frames disabled. A value of 1 indicates tagged frames enabled.
4	Get/Set	DCSP urgent	USINT	DSCP value for CIP transport class 0/1 urgent priority messages.
5	Get/Set	DCSP scheduled	USINT	DSCP value for CIP transport class 0/1 scheduled priority messages.
6	Get/Set	DCSP high	USINT	DSCP value for CIP transport class 0/1 high priority messages.
7	Get/Set	DCSP low	USINT	DSCP value for CIP transport class 0/1 low priority messages.
8	Get/Set	DCSP explicit	USINT	DSCP value for CIP explicit messages (transport class 2/3 and UCMM) and all other EtherNet/IP encapsulation messages.

6.1.7 Class ID 0xF5 TCP/IP Interface Object

Table 28: Instance Attributes for Class ID 0xF5 TCP/IP Interface Object

Attribute	Access	Name	Datatype	Description
1	Get	Status	DWORD	Interface status
2	Get	Config. capability	DWORD	Interface capability flags
3	Get/Set	Config control	DWORD	Interface control flags
4	Get	Physical link object	Struct of:	
		Path size	UINT	Size of path
		Path	Padded EPATH	Logical segments identifying the physical link object
5	Get/Set	Interface config:	Struct of:	TCP/IP network interface configuration
		IP address	UDINT	The device IP address
		Network mask	UDINT	The device network mask
		Gateway address	UDINT	Default gateway address
		Name server	UDINT	Primary name server
		Name server 2	UDINT	Secondary name server
		Domain name	STRING	Default domain name
6	Get/Set	Host name	STRING	Host name

Attribute	Access	Name	Datatype	Description
8	Get/Set	TTL value	USINT	Time-to-Live value for IP multicast packets. Default value is 1.
9	Get/Set	Multicast config	Struct of:	
		Num Mcast	UINT	Number of IP multicast addresses to allocate for EtherNet/IP.
		Multicast start address	UDINT	Starting multicast address from which to begin allocation, A block of Num Mcast addresses is allocated starting with this address.
10	Get/Set	Select ACD	BOOL	Enable ACD: <ul style="list-style-type: none"> 0 = Disabled (default) 1 = Enabled
11	Get	Last conflict detected	Struct of:	
		ACD activity	USINT	State of ACD activity when last conflict detected
		Remote MAC	Array of 6 USINT	MAC address of remote node from the ARP PDU in which a conflict was detected.
		ArpPdu	Array of 28 USINT	Copy of the raw ARP PDU in which a conflict was detected.
13	Get/Set	Encap. inactivity timeout		Number of seconds of inactivity before TCP connection is closed

6.1.8 Class ID 0xF6 Link Object

3 instances of the link object are implemented:

- Instance 1 relates to the internal interface of the option after the built-in switch.
- Instance 2 relates to fieldbus port X1.
- Instance 3 relates to fieldbus port X2.

Table 29: Instance Attributes for Class ID 0xF6 Link Object

Attribute	Access	Name	Datatype	Description
1	Get	Interface speed	UDINT	Interface speed in Mbps
2	Get	Interface flags	DWORD	Interface status flags
3	Get	Physical address	ARRAY of 6 USINTs	MAC layer address
4	Get	Interface counters	Struct of:	
		In octets	UDINT	Octets received on the interface
		In Ucast packets	UDINT	Unicast packets received on the interface
		In NUcast packets	UDINT	Non-unicast packets received on the interface
		In discards	UDINT	Inbound packets received on the interface but discarded.
		In errors	UDINT	Inbound packets that contain errors (does not include In Discards)
		In unknown protos	UDINT	Inbound packets with unknown protocol

Attribute	Access	Name	Datatype	Description
		Out octets	UDINT	Octets sent on the interface
		Out Ucast packets	UDINT	Unicast packets sent on the interface
		Out NUcast packets	UDINT	Non-unicast packets sent on the interface
		Out discards	UDINT	Outbound packets discarded
		Out errors	UDINT	Outbound packets that contain errors
5	Get	Media counters	Struct of:	
		Alignment errors	UDINT	Frames received that are not an integral number of octets in length
		FCS errors	UDINT	Frames received that do not pass the FCS check
		Single collisions	UDINT	Successfully transmitted frames which experienced exactly 1 collision
		Multiple collisions	UDINT	Successfully transmitted frames which experienced more than 1 collision
		SQE test errors	UDINT	Number of times SQE test error message is generated
		Deferred transmissions	UDINT	Frames for which 1st transmission attempt is delayed because the medium is busy
		Late collisions	UDINT	Number of times a collision is detected later than 512 bit times into the transmission of a packet
		Excessive collisions	UDINT	Frames for which transmission fails due to excessive collisions
		MAC transmit errors	UDINT	Frames for which transmission fails due to an internal MAC sub layer transmit error
		Carrier sense errors	UDINT	Times that the carrier sense condition was lost or never asserted when attempting to transmit a frame
		Frame too long	UDINT	Frames received that exceed the maximum allowed frame size
		MAC receive errors	UDINT	Frames for which reception on an interface fails due to an internal MAC sub layer receive error
6	Set	Interface control	Struct of:	
		Control bits	WORD	Interface control bits
		Forces interface speed	UINT	Speed at which the interface shall be forced to operate speed in Mbps
7	Get	Interface type	SHORT_STRING	Type of interface: <ul style="list-style-type: none"> • 1 = internal • 2 = twisted pair
8	Get	Interface state	USINT	Current state of the interface: <ul style="list-style-type: none"> • 0 = Unknown state • 1 = Operational • 2 = Disabled

Attribute	Access	Name	Datatype	Description
9	Get/Set	Admin state		Administrative state: <ul style="list-style-type: none">• 1 = Enable• 2 = Disable
10	Get	Interface label	SHORT_STRING	Human readable identification
11	Get	Interface capabilities	Struct of:	Interface speed and Duplex mode

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