Operating Guide

iC7-Hybrid EtherNet/IP

EtherNet/IP OS7IP

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Contents

1 Introduction and Safety

1.1 Purpose of the Operating Guide

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

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

Read the instructions before configuring EtherNet/IP, 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 series products:

- Safety guides, which provide important safety information related to installing iC7 series drives and power converters.
- Installation guides, which cover the mechanical and electrical installation of drives, power converters, or functional extension options.
- Design guides, which provide technical information to understand the capabilities of the iC7 series drives or power converters for integration into motor control and monitoring systems.
- Operating guides, which include instructions for control options, and other components for the drive.
- Application guides, which provide instructions on setting up the drive or power converter for a specific end use. Application guides for application software packages also provide an overview of the parameters and value ranges for operating the drives or power converters, configuration examples with recommended parameter settings, and troubleshooting steps.
- *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.

Latest versions of Danfoss product guides are available for download at https://www.danfoss.com/en/service-and-support/documentation/.

1.3 Safety Symbols

The following symbols are used in Danfoss documentation and products.

⚠ DANGER

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

⚠ WARNING

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

⚠ CAUTION

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

NOTICE

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

	ISO warning symbol for general warnings
	ISO warning symbol for hot surfaces and burn hazard
	ISO warning symbol for high voltage and electric shock
	Symbol for indicating the required discharge time of the capacitors in the product.
	ISO action symbol for referring to the instructions

1.4 Qualified Personnel

Correct and reliable transport, storage, installation, operation, and maintenance are required for the trouble-free and safe operation of the product. 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 guide.

1.5 Safety Precautions

⚠ WARNING

HIGH VOLTAGE

Drives and power converters contain high voltage when connected to AC mains input, DC supply, or load sharing. Failure to perform installation, startup, and maintenance by qualified personnel can result in death or serious injury.

- Only qualified personnel are allowed to perform installation, startup, and maintenance.

⚠ WARNING

UNINTENDED START

When the drive or power converter 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.

- Stop the drive or power converter before configuring parameters.
- Make sure that the drive or power converter cannot be started by an external switch, a fieldbus command, an input reference signal from the control panel, or after a cleared fault condition.
- Disconnect the drive or power converter from the mains whenever safety considerations make it necessary to avoid an unintended motor start.
- Check that the drive or power converter and any driven equipment are in operational readiness.

⚠ WARNING

DISCHARGE TIME

The drive or power converter contains DC-link capacitors, which can remain charged even when the drive or power converter 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 can result in death or serious injury.

- Stop the motor.
- Disconnect all power sources, including permanent magnet type motors.
- Wait for capacitors to discharge fully. The discharge time is specified on the drive or power converter product label.
- Measure the voltage level to verify full discharge.

⚠ WARNING

LEAKAGE CURRENT HAZARD

Leakage currents exceed 3.5 mA. Failure to ground the drive or power converter 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.

⚠ WARNING

EQUIPMENT HAZARD

Contact with rotating shafts and 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.

⚠ CAUTION

INTERNAL FAILURE HAZARD

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

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

1.6 Abbreviations

Table 1: 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

Table 1: Abbreviations - (continued)

Abbreviation	Definition
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 2: Version History

Version	Remarks
AQ528743855393, version 0101	First release.

2 Product 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 3: 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 the 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.

Table 4: 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 the transport type.
	Class 3	Cyclic connection using UDP transport. Maximum 6 Class-3 connections are supported.
	UCMM	Acyclic 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.

Each application in the iC7 series has a dedicated profile or profiles for fieldbus communication.

When using the Generator application, a communication profile must be selected. Communication profiles are selected in parameter ***Fieldbus Profile (1301)***. The parameter is applied only when the active control place is set to fieldbus control and when parameter ***Converter Mode (162)*** is set to ***Motor Control***. The supported profiles for motor control operation are iC Generic, iC Speed, and PROFIdrive Standard Telegram 1.

If parameter ***Converter Mode (162)*** is set to ***Grid Control*** when using any of the iC7-Hybrid application software, only the iC Hybrid profile is available.

Table 5: Communication Profiles and Supported Applications

Profile	Grid Converter	DC/DC Converter	Generator
iC Hybrid	X	X	X[1]
iC Generic	–	–	X[2]
iC Speed	–	–	X
PROFIdrive Application Class 1	–	–	X

*1) Available only when parameter **Converter Mode (162)** is set to **Grid Control**.*

*2) Available only when parameter **Converter Mode (162)** is set to **Motor Control**.*

2.3 iC Hybrid

2.3.1 Overview

The iC Hybrid profile is used in the iC7 series with Grid Converter, Grid Converter with Grid Codes and DC/DC Converter applications, and with the Generator application in grid control mode.

2.3.2 Control Word

Table 6: Control Word Bits in iC Hybrid Profile

Bit	Name	Description
0	Switch On Enabled	0: Pre-charging[1], closing the main circuit breaker[1], and running are prevented or interrupted. If the main circuit breaker is closed, it opens[1]. 1: Pre-charging[1], closing the main circuit breaker[1], and running are not prevented or interrupted.
1	MCB Close Enabled	0: Closing the main circuit breaker is prevented[1] or the main circuit breaker is opened[1], and running is prevented or interrupted. 1: Closing the main circuit breaker is not prevented[1].
2	Quick Stop	0: Activate Quick Stop. 1: Do not activate Quick Stop.
3	Start	0: Stop the unit if it is running, or stop the startup sequence if it is not completed. 1: Initiate the startup sequence (DC-link pre-charging[2], closing the main circuit breaker[2], and start running), or keep the unit running.
4	Pre-charge	0: Stop the DC-link pre-charging, if ongoing. 1: Start or continue the DC-link pre-charging.
5	–	Reserved
6	–	Reserved
7	Event Reset	0: No action. 1: Reset active warnings/faults.
8	–	Reserved
9	–	Reserved

Table 6: Control Word Bits in iC Hybrid Profile - (continued)

Bit	Name	Description
10	Data Valid	0: Ignore the current incoming process data values, instead use the last processed value when the Data Valid bit was true. 1: Use the current incoming process data values. For most of the control word commands to be acknowledged by the drive or power converter, the active control place must be set to fieldbus control in parameter group ***Control Places*** in parameter group ***2 Parameters***.
11	Watchdog	Incoming watchdog bit. With continuous toggling between 0 and 1, this bit can be used as a sign-of-life between the drive or power converter and fieldbus controller. The value of this bit is passed through the fieldbus status word as is.
12	Fieldbus Digital Input 1	0: Fieldbus Digital Input 1 inactive. 1: Fieldbus Digital Input 1 active. Select the value ***CTW B12*** for any input parameter to use this signal to activate a function.
13	Fieldbus Digital Input 2	0: Fieldbus Digital Input 2 inactive. 1: Fieldbus Digital Input 2 active. Select the value ***CTW B13*** for any input parameter to use this signal to activate a function.
14	Fieldbus Digital Input 3	0: Fieldbus Digital Input 3 inactive. 1: Fieldbus Digital Input 3 active. Select the value ***CTW B14*** for any input parameter to use this signal to activate a function.
15	Fieldbus Digital Input 4	0: Fieldbus Digital Input 4 inactive. 1: Fieldbus Digital Input 4 active. Select the value ***CTW B15*** for any input parameter to use this signal to activate a function.

1) If controlled by the grid converter unit.

2) If applicable.

2.3.3 Status Word

Table 7: Status Word Bits in iC Hybrid Profile

Bit	Name	Description
0	Ready to Switch On	0: Not ready to switch on. 1: Ready to switch on.
1	Ready to Run	0: The converter is not ready to start modulation. Check ***Grid Control Ready Status (5096)*** or ***DC/DC Control Ready Status (6520)*** and ***Application Ready Status Word (6525)***. 1: The converter is ready to start modulating.
2	Running	0: The converter is not modulating. 1: The converter is modulating.

Table 7: Status Word Bits in iC Hybrid Profile - (continued)

Bit	Name	Description
3	Fault	0: No faults are active. 1: One or more faults are active.
4	–	Reserved
5	Quick Stop	0: Quick stop active. 1: Quick stop not active.
6	–	Reserved
7	Warning	0: No warnings active. 1: One or more warnings are active.
8	–	Reserved
9	Control by PLC	0: The active control place is not fieldbus. 1: The active control place is fieldbus.
10	–	Reserved
11	Run Enabled	0: Run enable from the dedicated input signal is missing. 1: Run enable from the dedicated input signal is present.
12	–	Reserved
13	–	Reserved
14	–	Reserved
15	Watchdog Feedback	0: The watchdog signal is low. 1: The watchdog signal is high.

2.4 iC Generic

2.4.1 Overview

The iC Generic profile is used for motor control operation with the iC7 Series Generator application software.

2.4.2 Control Word

Table 8: iC Generic Profile Control Word Bits

Bit	Name	Description
0	Ramp Stop	0: The ramp stop request is inactive. The drive can be started. 1: The drive is ready to operate.
1	Coast Stop	0: A running drive coasts to a stop (modulation stops). 1: The coast request is inactive. The drive can be started.
2	Quick Stop	0: The drive stops with the Quick Stop function. 1: The Quick Stop request is inactive. The drive can be started.
3	Start	0: The drive stops operating with the method determined by the parameter ***Missing Start Response (4717)***. 1: The drive starts to operate on the rising edge of this signal.
4	–	Reserved

Table 8: iC Generic Profile Control Word Bits - (continued)

Bit	Name	Description
5	–	Reserved
6	–	Reserved
7	Event Reset	0: Event Reset Inactive 1: Event Reset Active A rising edge of this signal resets events (warnings, faults, and so on), which do not have active triggering conditions. After a fault the drive goes to a Switching On Inhibited state, which must be acknowledged with bit 0.
8	Reference Reverse	0: The speed reference remains normal. 1: The speed reference is reversed. The reference can also be reversed with a negative setpoint. Double negatives result in a forward reference.
9	–	Reserved
10	Data Valid	0: Ignores the current process data. Uses the previously processed data when the Data Valid bit was previously true. 1: Reads the current process data. For most of the control word commands to be acknowledged by the drive, fieldbus must be the commanding control place. See options in parameter group ***Control Places*** in parameter group ***2 Parameters***.
11	Watchdog	0: Watchdog low 1: Watchdog high Continuous toggling 0–1 can be used as a sign of life between the drive and the fieldbus master. The value of this bit is also passed through the fieldbus status word as is.
12	Fieldbus Digital Input 1	0: Fieldbus Digital Input 1 inactive 1: Fieldbus Digital Input 1 active Select the value ***CTW B12*** for any input parameter to use this signal for the activation of a selected function.
13	Fieldbus Digital Input 2	0: Fieldbus Digital Input 2 inactive 1: Fieldbus Digital Input 2 active Select the value ***CTW B13*** for any input parameter to use this signal for the activation of a selected function.
14	Fieldbus Digital Input 3	0: Fieldbus Digital Input 3 inactive 1: Fieldbus Digital Input 3 active Select the value ***CTW B14*** for any input parameter to use this signal for the activation of a selected function.
15	Fieldbus Digital Input 4	0: Fieldbus Digital Input 4 inactive 1: Fieldbus Digital Input 4 active Select the value ***CTW B15*** for any input parameter to use this signal for the activation of a selected function

2.4.3 Status Word

Table 9: iC Generic Profile Status Word Bits

Bit	Name	Description
0	Ready To Switch On	0: The drive is not ready to receive a start command because of at least 1 of the following conditions is true: Fault Active, Ramp Stop Active, Coast Stop Active, or Quick Stop Active. 1: The drive is ready to accept a start command.
1	Power Unit Ready	0: The drive cannot be set running because the ready conditions of the power unit are not met. Check parameter ***Motor Control Start Ready Status Word (6207)*** for any conditions that are not met. 1: All power unit ready conditions are met.
2	Drive Running	0: The drive is not running. 1: The drive is running.
3	Fault Active	0: No active drive faults. 1: One or more drive faults are active. Switching on is inhibited.
4	–	Reserved
5	Quick Stop Active	0: The quick stop command is inactive. A new start command is required. 1: The quick stop command is active. This command can also be given from another control source than fieldbus.
6	–	Reserved
7	Warning Active	0: All drive warnings are inactive. 1: One or more drive warnings are active.
8	–	Reserved
9	Fieldbus Control Active	0: Fieldbus is not the active control place. 1: Fieldbus is the active control place.
10	–	Reserved
11	Run Enabled	0: The digital input signal ***Run Enable Input (103)*** is inactive, and modulation is disabled. 1: The digital input signal ***Run Enable Input (103)*** is active, and modulation is enabled.
12	–	Reserved
13	–	Reserved
14	–	Reserved
15	Watchdog Feedback	0: The watchdog signal that the drive has received is low. 1: The watchdog signal that the drive has received is high.

2.5 iC Speed

2.5.1 Overview

The iC Speed profile is used with iC7 series Generator application software. The 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.

2.5.2 Control Word

Table 10: iC Speed Profile Control Word Bits

Bit number	Name	Description
0	Speed Preset Reference Selector 1	Use these bits to select between speed presets: 00: Preset reference 1 01: Preset reference 2 10: Preset reference 3 11: Preset reference 4
1	Speed Preset Reference selector 1	Use these bits to select between speed presets: 00: Preset reference 1 01: Preset reference 2 10: Preset reference 3 11: Preset reference 4
2	–	Reserved
3	Coast Stop	0: The drive coasts to a stop. 1: The coast request is inactive. The drive can be started.
4	Quick Stop	0: The drive stops with the Quick Stop function. 1: The Quick Stop request is inactive. The drive can be started.
5	Freeze Speed Reference	0: The speed reference (input of the ramp generator) is frozen to its latest value. 1: The speed reference can be changed freely.
6	Start	0: The drive stops operating with the method determined by parameter ***Missing Start Response (4717)***. 1: The drive starts to operate on the rising edge of this signal.
7	Event Reset	The rising edge of this signal resets events (warnings, faults, and so on), which do not have active triggering conditions. 0: Event reset inactive. 1: Event reset active.
8	–	Reserved
9	Speed Ramp	0: Ramp 1 is active. Configure ramp in parameter group ***2.4.1.2 Ramp 1***. 1: Ramp 2 is active. Configure ramp in parameter group ***2.4.1.3 Ramp 2***.

Table 10: iC Speed Profile Control Word Bits - (continued)

Bit number	Name	Description
10	Data Valid	0: Ignores the current process data. Uses the previously processed data when the Data Valid bit was previously true. 1: Reads the current process data (controlled by PLC). For most of the control word commands to be acknowledged by the drive, fieldbus must be the commanding control place. See options in parameter group ***Control Places*** in parameter group ***2 Parameters***.
11	–	Reserved.
12	Fieldbus Digital Input 1	0: Fieldbus Digital Input 1 inactive 1: Fieldbus Digital Input 1 active Select the value ***CTW B12*** for any input parameter to use this signal for the activation of a selected function.
13	Fieldbus Digital Input 2	0: Fieldbus Digital Input 2 inactive 1: Fieldbus Digital Input 2 active Select the value ***CTW B13*** for any input parameter to use this signal for the activation of a selected function.
14	Fieldbus Digital Input 3	0: Fieldbus Digital Input 3 inactive 1: Fieldbus Digital Input 3 active Select the value ***CTW B14*** for any input parameter to use this signal for the activation of a selected function.
15	Fieldbus Digital Input 3	0: Fieldbus Digital Input 4 inactive 1: Fieldbus Digital Input 4 active Select the value ***CTW B15*** for any input parameter to use this signal for the activation of a selected function.

2.5.3 Status Word

Table 11: iC Speed Profile Status Word Bits

Bit number	Name	Description
0	Control Ready	0: The device controls are not ready and do not react to process data. 1: The device controls are ready and react to process data.
1	Drive Ready	0: The drive is not ready for operation. 1: The drive is ready for operation.
2	Coast	0: There is an active coast stop command and the drive is in a coast stop state. 1: There are no active coast signals. The drive can be started.
3	Fault	0: There are no active faults. 1: There is at least 1 active fault. The drive cannot be started before the fault condition is cleared and the fault is reset.
4	–	Reserved
5	–	Reserved

Table 11: iC Speed Profile Status Word Bits - (continued)

Bit number	Name	Description
6	–	Reserved
7	Warning	0: There are no active warnings. 1: There is at least 1 active warning. The cause of the warning should be investigated and mitigated.
8	Speed Reference	0: Speed not at reference. The motor speed differs from the given speed reference, for example, due to ramping. 1: Speed at reference. The motor speed matches the given speed reference.
9	Fieldbus Control	0: Fieldbus control inactive. None of the basic command functions of the drive are affected by fieldbus commands. 1: Fieldbus control active. Fieldbus is the active control place, or configured as part of the advanced control place.
10	Limiter	0: Limiter inactive. All limiters (regulators) are inactive. 1: Limiter active. One or more limiters (regulator) are actively limiting the drive current, torque, and so on. See parameter ***Motor Regulator Status Word (1715)*** for further details.
11	Operation	0: The drive is not modulating (operating). 1: The drive is modulating (operating).
12	–	Reserved
13	–	Reserved
14	–	Reserved
15	–	Reserved

2.6 PROFIdrive Application Class 1

2.6.1 Overview

Standard telegram 1 is implemented according to PROFIdrive Application Class 1 profile as defined in the PROFIdrive standard and state machine diagram. It can be used with iC7 series Generator application software.

2.6.2 Control Word

Table 12: Control Word Bits in PROFIdrive Standard Telegram 1

Bit number	Name	Description
0	On-Off	0: The drive cannot operate. A running drive is stopped with a ramp to zero speed. A resettable Switching On Inhibited state is reset. 1: The drive is ready to operate.
1	Coast Stop	0: The drive coasts to a stop. 1: The coast request is inactive. The drive can be started.
2	Quick Stop	0: The drive stops with the quick stop function. 1: The quick stop request is inactive. The drive is ready to operate.

Table 12: Control Word Bits in PROFIdrive Standard Telegram 1 - (continued)

Bit number	Name	Description
3	Operation	0: The drive stops operating and coasts to a stop. 1: The drive starts to operate on the rising edge of this signal.
4	Ramp Generator	0: Reset ramp generator. The output of the RFG is set to 0. The drive decelerates along the current limit or along the voltage limit of the DC link. 1: Enable ramp generator (RFG).
5	Speed Reference	0: Freeze speed reference. The speed reference (input of the ramp generator) is frozen to its latest value. 1: Unfreeze speed reference. The speed reference can be changed freely.
6	Reference	0: Disable reference. The speed reference (ramp generator input) is forced to zero. 1: Enable reference. The speed reference can be changed freely.
7	Event Reset	0: Event reset inactive. 1: Event reset active. The rising edge of this signal resets events, which do not have active triggering conditions. After a fault, the drive goes to a Switching On Inhibited state, which must be acknowledged with bit 0.
8	–	Reserved
9	–	Reserved
10	Fieldbus Control	0: Ignores the current process data. Uses the previously processed data when the Data Valid bit was previously true. 1: Reads the current process data (controlled by PLC). For most of the control word commands to be acknowledged by the drive, fieldbus must be the commanding control place. See options in parameter group ***Control Places*** in parameter group ***2 Parameters***.
11	–	Reserved
12	Fieldbus Digital Input 1	0: Fieldbus Digital Input 1 inactive. 1: Fieldbus Digital Input 1 active. Select the value ***CTW B12*** for any input parameter to use this signal for the activation of a selected function.
13	Fieldbus Digital Input 2	0: Fieldbus Digital Input 2 inactive. 1: Fieldbus Digital Input 2 active. Select the value ***CTW B13*** for any input parameter to use this signal for the activation of a selected function.

Table 12: Control Word Bits in PROFIdrive Standard Telegram 1 - (continued)

Bit number	Name	Description
14	Fieldbus Digital Input 3	0: Fieldbus Digital Input 3 inactive. 1: Fieldbus Digital Input 3 active. Select the value ***CTW B14*** for any input parameter to use this signal for the activation of a selected function.
15	Fieldbus Digital Input 4	0: Fieldbus Digital Input 4 inactive. 1: Fieldbus Digital Input 4 active. Select the value ***CTW B15*** for any input parameter to use this signal for the activation of a selected function.

2.6.3 Status Word

Table 13: Status Word Bits in PROFIdrive Standard Telegram 1

Bit number	Name	Description
0	Ready to Switch On	0: Not ready to switch on 1: Ready to switch on. Motor control is ready, no active faults and switching on (control word bit 0) is allowed.
1	Ready to Operate	0: Not ready to be started. The drive cannot be set running with a start command. 1: Ready to be started. Control is switched on and a start command can be given.
2	Operation	0: The drive is not running. 1: The drive is running.
3	Faults	0: All drive faults are inactive. 1: One or more drive faults is active. Switching on is inhibited.
4	Coast Stop	0: The Coast Stop command is active. 1: The Coast Stop command is inactive.
5	Quick Stop	0: The Quick Stop command is active. Switching on is inhibited. The command can be given from fieldbus or IO. 1: The Quick Stop command is inactive. A new start command is required.
6	Switching On Inhibited	0: Switching on allowed. Nothing is inhibiting the drive from being switched on (control word bit 0 can be activated). 1: Switching on inhibited due to faults or quick stop. After faults have been acknowledged or the quick stop command is removed, the Off command must be given to reset the state.
7	Warning	0: All drive warnings are inactive. 1: One or more warnings are active.

Table 13: Status Word Bits in PROFIdrive Standard Telegram 1 - (continued)

Bit number	Name	Description
8	Speed Error Within/Out of Tolerance Range	0: Speed error out of tolerance range. The actual speed differs from the speed reference more than 1% of motor nominal speed. 1: Speed error within the tolerance range. The actual speed differs from the speed reference less than 1% of motor nominal speed
9	Fieldbus Control Active/Inactive	0: Fieldbus control inactive. None of the basic command functions of the drive are affected by fieldbus commands. 1: Fieldbus control active. Fieldbus is the active control place or configured as part of the advanced control place.
10	Speed Reached/Speed not Reached	0: Speed not reached. The actual speed is below the comparison value set with parameter ***Limit Supervision 1 Threshold (5253)***. 1: Speed reached. The actual speed is above the comparison value set with parameter ***Limit Supervision 1 Threshold (5253)***.
11	–	Reserved.
12	–	Reserved.
13	–	Reserved.
14	–	Reserved.
15	–	Reserved.

2.6.4 PROFIdrive State Machine

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

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

See Figure 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.

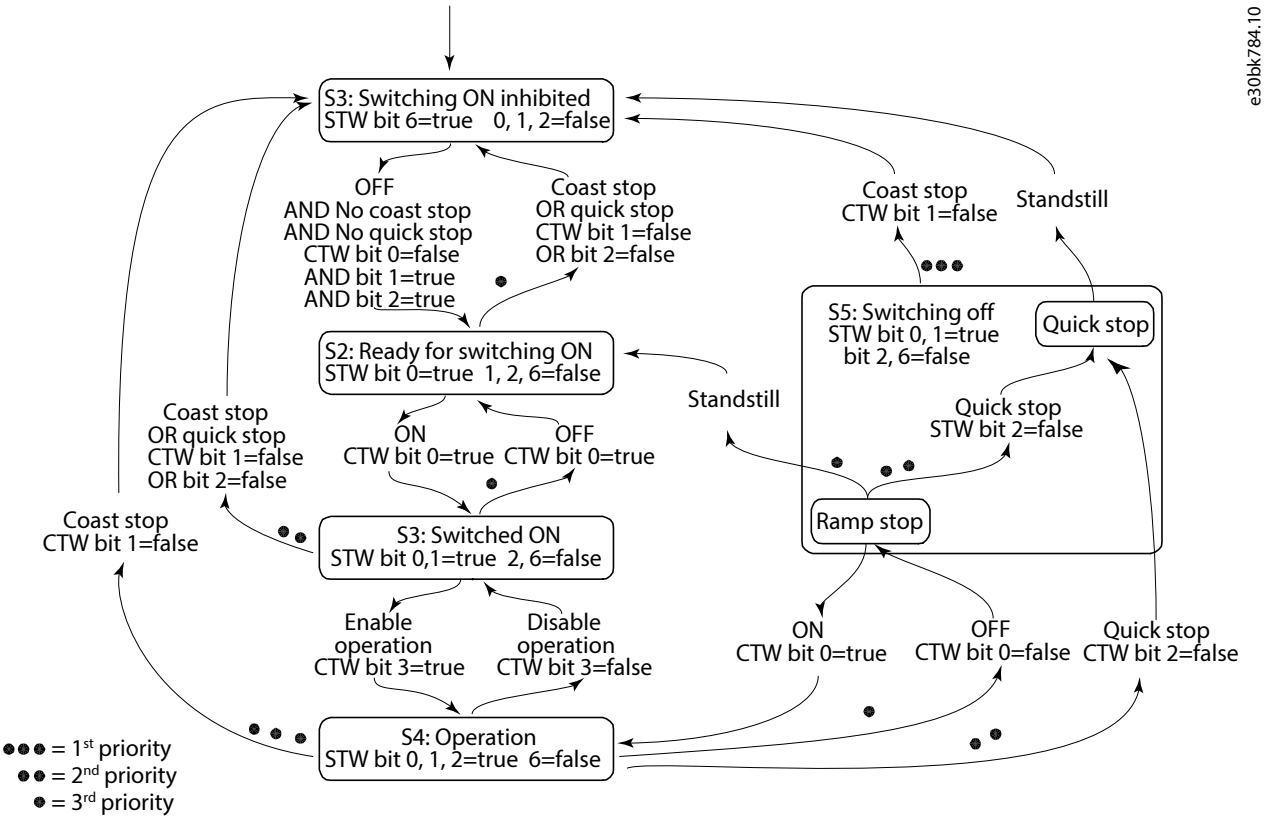

Figure 1: General State Diagram

2.7 Network Topologies

2.7.1 Overview

Communication interface X1/X2 is used for fieldbus connection.

The communication interface in the iC7 drives and power converters 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

2.7.2 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.

NOTICE

When line topology is used, take precautions to avoid timeout in the PLC when more than 8 drives or power converters are installed in series. Each drive or power converter 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 units connected in series	Minimum update time [ms]
<8	2
8–16	4
16–32	8
33–50	16
>50	Not recommended

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

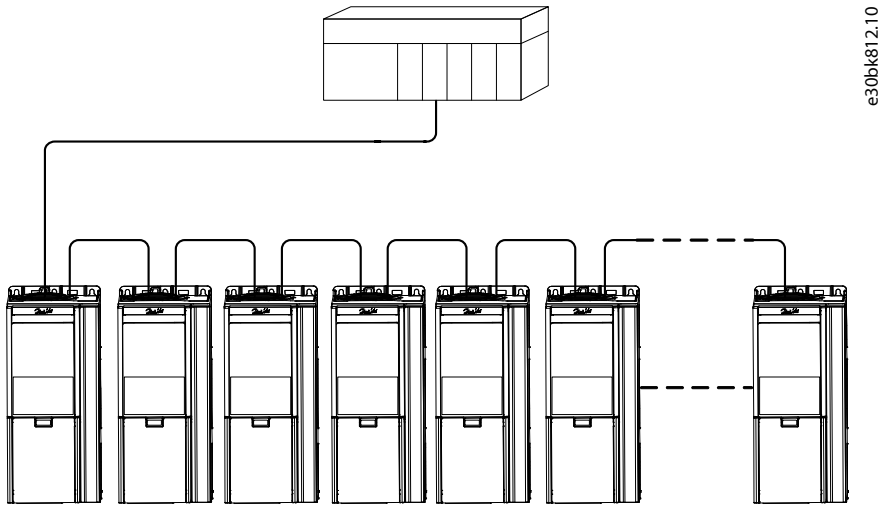

Figure 2: Example of Line Topology

NOTICE

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

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

2.7.3 Star Topology

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

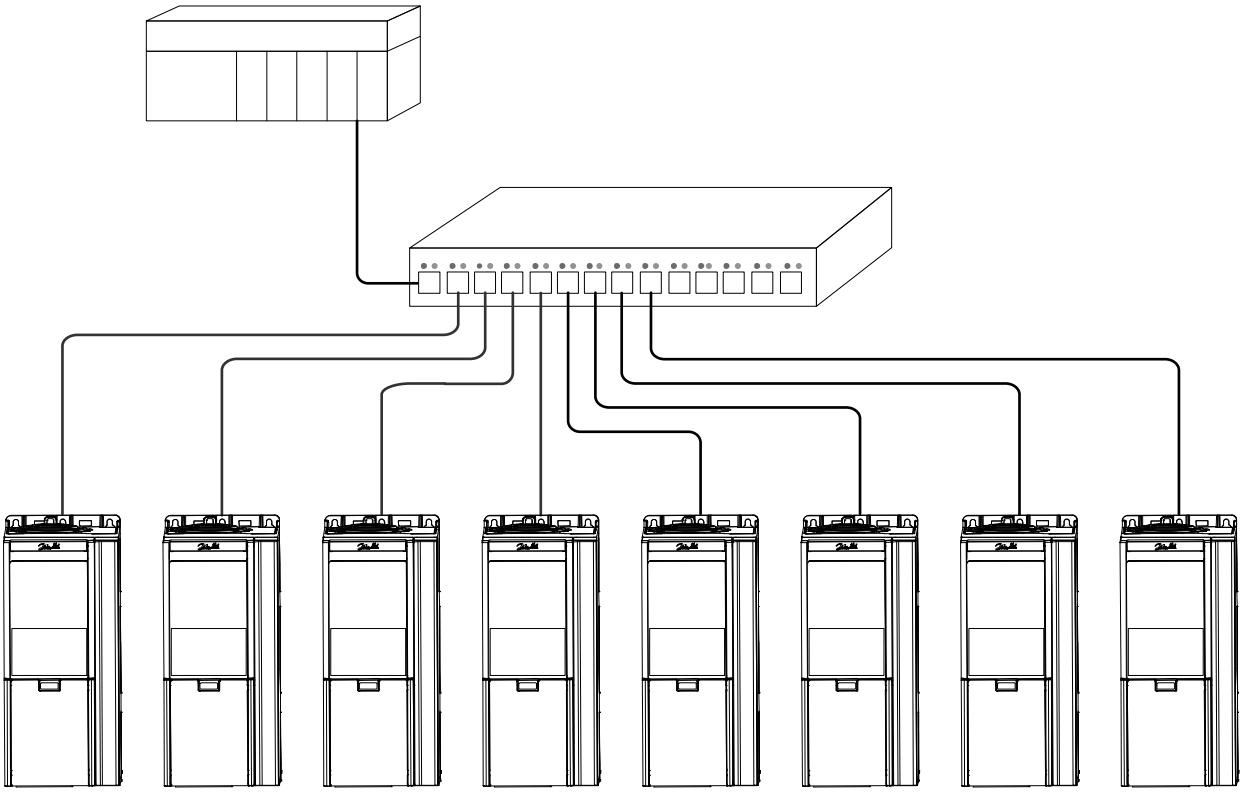

Figure 3: Example of Star Topology

2.7.4 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.

NOTICE

When ring topology is used, take precautions to avoid timeout in the PLC when more than 8 drives or power converters are installed in series. Each drive or power converter 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 units connected in series	Minimum update time [ms]
<8	2
8–16	4
16–32	8
33–50	16
>50	Not recommended

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 can block 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.

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

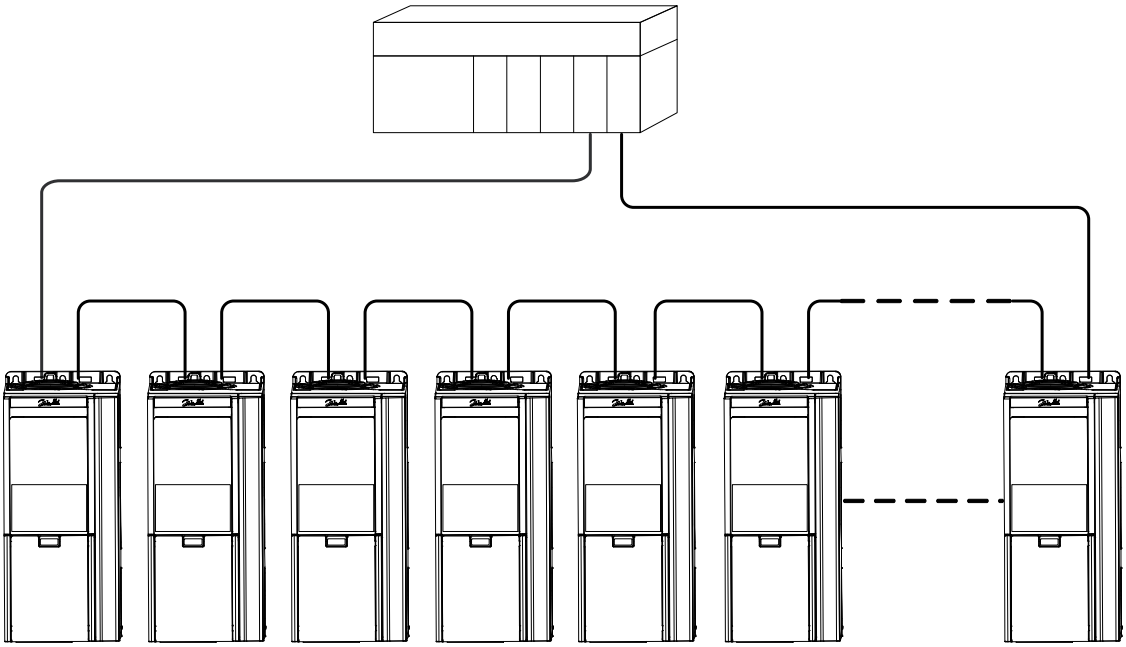

Figure 4: Example of Ring Topology

3 Fieldbus Cable Connections

3.1 Prerequisites for Installation

Communication interfaces are integrated in the control board in iC7 drives and power converters.

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 product-specific 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 Figure 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. For information on ordering the EMC plate, refer to the product-specific design guide.

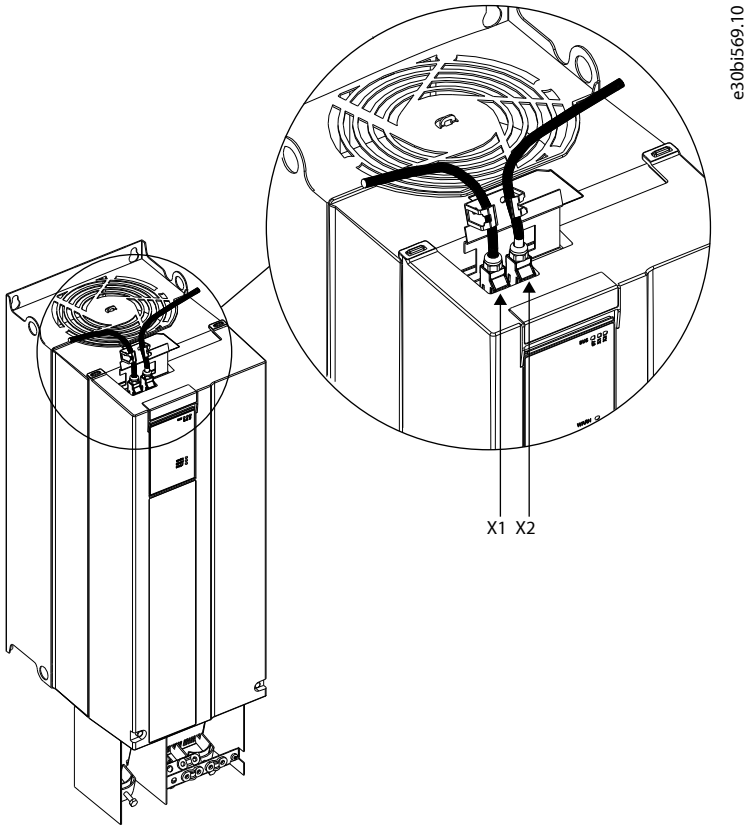

Figure 5: Location of the Communication Interface, X1/X2 in FA02-FA12 Frames (with the Optional EMC Plate)

3.2.2 Communication Interface X1/X2 in Frames FB09–FB12/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 Figure 6 and Figure 7.

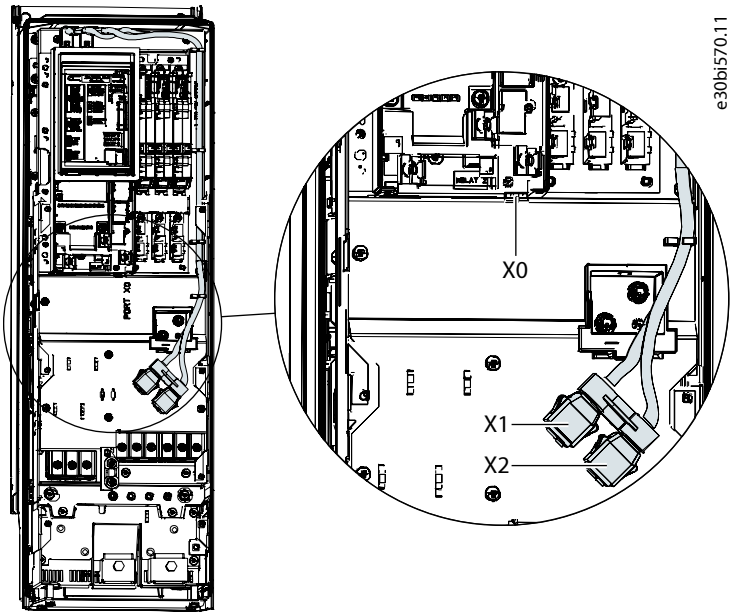

Figure 6: Communication Port X0, X1, and X2 Locations in FK06–FK08 Frames

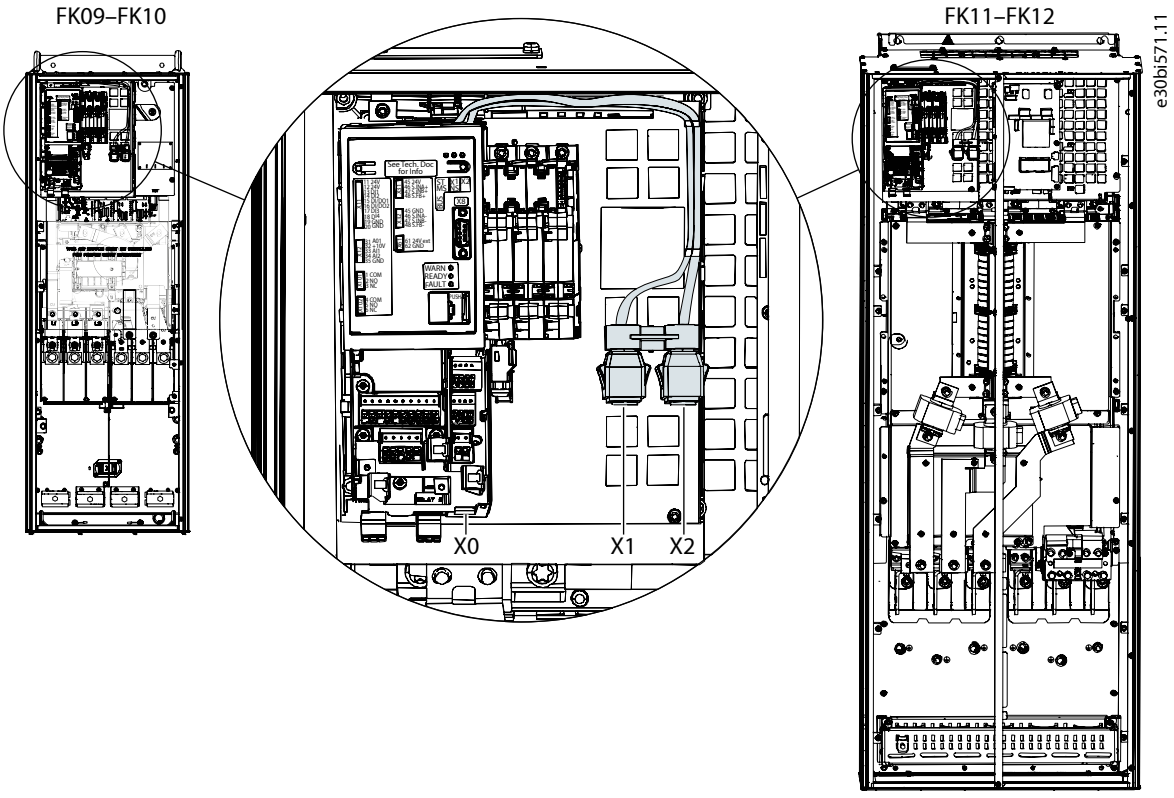

Figure 7: Communication Port X0, X1, and X2 Locations in FB09–FB12/FK09–FK12 Frames

3.3 Installation in System Modules

3.3.1 Communication Interface X1/X2 in System Modules

For systems that use system modules, the communication interface ports are located at the bottom facing side of the modular control unit as shown in Figure 8.

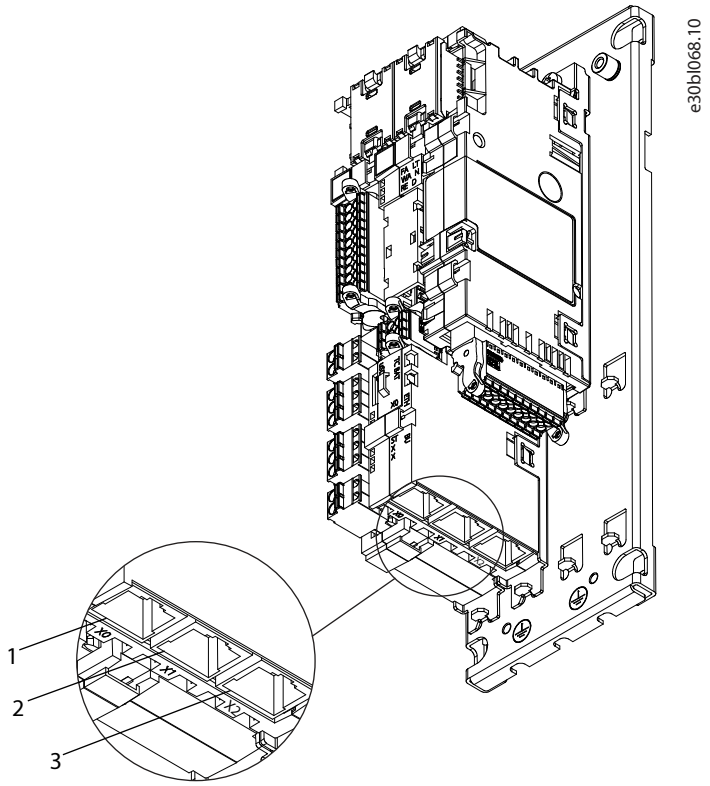

Figure 8: Communication Port X0, X1, and X2 Locations in the Modular Control Unit

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

3.4 EMC-compliant Installation

3.4.1 Overview

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

3.4.2 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 unit on a conductive backplate.
- Keep the ground wire connections as short as possible.

3.4.3 Cable Routing

For more information on cabling, refer to the product-specific design guide and installation guide included in the shipment.

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.
- A minimum of 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°.

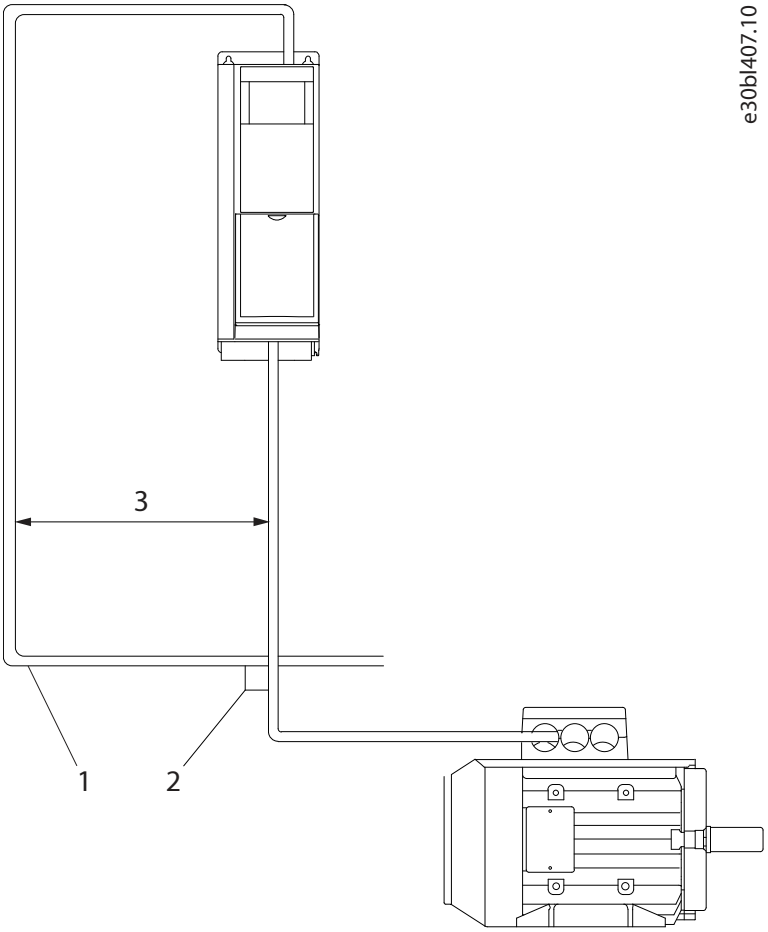

Figure 9: Cable Routing

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

4 Configuration

4.1 Configuring the 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 ***Communication Interfaces***.

> **!** IMPORTANT: To ensure that outgoing IP packets are routed correctly, configure the IP addresses of the X1/X2 interfaces to a different subnet than the IP address of the X0 interface.

Table 14: IPv4 Settings

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 ***Automatic*** 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	Request to enable or disable Address Conflict Detection for the interface. The change does not take effect before a power cycle is performed. If no conflicts are detected, ACD activity shows 0. If an address conflict occurs, the ACD activity shows 1, and the IPv4 interface reverts to an automatically assigned IP address in the 169.254.xxx.xxx range.
	Disable (default)	
DNS server 1, 2	xxx.xxx.xxx.xxx	The user-requested Domain Name Server 1 for the interface (for manual IP addressing mode only).

Table 15: Ethernet Port Configuration (X1/X2)

Parameter name	Parameter number	Selections	Description
Link Configuration X1	7048	• Auto negotiation • 10 Mbps full duplex • 10 Mbps half duplex • 100 Mbps full duplex • 100 Mbps half duplex	Configures the Ethernet link parameter
Link Configuration X2	7049		

4.2 Selecting the Fieldbus Profile

For more information about the available profiles for the application in use, see 2.2 Communication Profiles and Objects.

1. Navigate to *Parameters* > *Control Places* > *Fieldbus Control* > *Fieldbus Profile*.
2. Select the fieldbus profile.

The selection affects the interpretation of the control word and status word. Selecting a profile may also automatically set specific values for certain parameters or affect control schemes. For details, refer to the application guide.

4.3 Configuring Fieldbus Protection Settings for the DC/DC Converter Application

When using the iC7 series DC/DC Converter application, the fieldbus profile is selected automatically.

1. Navigate to ***Parameters*** > ***Protections and Responses*** > ***Fieldbus Protections***.
2. Configure fieldbus protection settings.

Table 16: Fieldbus Protection Setting Parameters for DC/DC Converter

Parameter	Parameter number	Value	Description
Fieldbus Fault Response	1304	• No response • Info • Warning • Fault (default) See Table 17 for descriptions of the events.	Select the behavior when a fieldbus fault, for example, loss of I/O connection occurs.
No Fieldbus Connection Response	1305	• No response (default) • Info • Warning • Fault See Table 17 for descriptions of the events.	Select the response if there is no fieldbus connection.
Process Data Timeout Response	1306	• No response • Info (default) • Warning • Fault	Select the response when a process data timeout occurs.
Process Data Timeout Delay	1340	50.0–3.4 x 10^{38} s (Default value: 1000.0 s)	Set a delay for the triggering of the Process Data Timeout event. If process data has not been updated within this delay time, the event is triggered.
Fieldbus Watchdog Response	5244	• No response • Info • Warning (default) • Fault	Select the drive response for the fieldbus watchdog event.

Table 16: Fieldbus Protection Setting Parameters for DC/DC Converter - (continued)

Parameter	Parameter number	Value	Description
Fieldbus Watchdog Delay	5245	0.0–3000.0 s (Default value: 5.00 s)	Set a delay for activating the fieldbus watchdog event.
Fieldbus Watchdog Start Delay	5246	0.0–3000.0 s (Default value: 30.00 s)	Set the startup delay time for activating the fieldbus watchdog event. The counter starts when the converter wakes up.

Table 17: Event Descriptions

Value	Description
No response	The event is ignored.
Info	The event is logged in the event log.
Warning	The drive or power converter issues a warning.
Fault	The drive or power converter issues a fault and modulation is stopped.

4.4 Configuring Fieldbus Protection Settings for the Grid Converter Application

When using the iC7 series DC/DC Converter application, the fieldbus profile is selected automatically.

1. Navigate to ***Parameters*** > ***Protections and Responses*** > ***Fieldbus Protections***.
2. Configure fieldbus protection settings.

Table 18: Fieldbus Protection Setting Parameters for Grid Converter

Parameter	Parameter number	Value	Description
Fieldbus Fault Response	1304	• No response • Info • Warning • Warning, Current Lim. Ramp – Persistent • Fault (default) • Fault, Open MCB See Table 19 for descriptions of the events.	Select the behavior when a fieldbus fault, for example, loss of I/O connection occurs.
No Fieldbus Connection Response	1305	• No response (default) • Info • Warning • Warning, Current Lim. Ramp – Persistent • Fault • Fault, Open MCB See Table 19 for descriptions of the events.	Select the response if there is no fieldbus connection.

Table 18: Fieldbus Protection Setting Parameters for Grid Converter - (continued)

Parameter	Parameter number	Value	Description
Process Data Timeout Response	1306	• No response • Info (default) • Warning • Warning, Current Lim. Ramp – Persistent • Fault • Fault, Open MCB See Table 19 for descriptions of the events.	Select the response to a process data timeout.
Process Data Timeout Delay	1340	50.0–3.4 x 10^{38} s (Default value: 1000.0 s)	Set the timeout time. If process data is not received within the time set, a process data timeout is triggered.
Fieldbus Watchdog Response	5244	• No response • Info • Warning (default) • Warning, Current Lim. Ramp – Persistent • Fault • Fault, Open MCB	Select the drive response for the fieldbus watchdog event.
Fieldbus Watchdog Delay	5245	0.0–3000.0 s (Default value: 5.00 s)	Set a delay for activating the fieldbus watchdog event.
Fieldbus Watchdog Start Delay	5246	0.0–3000.0 s (Default value: 30.00 s)	Set the startup delay time for activating the fieldbus watchdog event. The counter starts when the converter wakes up.

Table 19: Event Descriptions

Value	Description
No response	The event is ignored.
Info	The event is logged in the event log.
Warning	The drive or power converter issues a warning.
Warning, Current Lim. Ramp – Persistent	The drive or power converter issues a warning, and the positive/negative active current limits are ramped to preset values. The current limit overrides stay active until the warning is acknowledged by a reset.
Fault	The drive or power converter issues a fault and stops modulation.
Fault, Open MCB	The drive or power converter issues a fault, stops modulation, and opens the main circuit breaker.

4.5 Configuring Fieldbus Protection Settings for the Generator Application

1. Navigate to ***Parameters*** > ***Protections and Responses*** > ***Fieldbus Protections***.
2. Configure fieldbus protection settings.

Table 20: Fieldbus Protection Setting Parameters for Generator

Parameter	Parameter number	Value	Description
Fieldbus Fault Response	1303	• No response • Info (default) • Warning • Warning, ramp to coast • Fault, coast See Table 21 for descriptions of the events.	Select the behavior when a fieldbus fault, for example, loss of I/O connection occurs.
Process Data Timeout Response	5291	• No response (default) • Info • Warning • Fault, ramp to coast • Fault, coast See Table 21 for descriptions of the events.	Select the response to a process data timeout.
Process Data Timeout Delay	1340	50.0–3.4 x 10^{38} s (Default value: 1000.0 s)	Set a delay for the triggering of the Process Data Timeout event. If process data has not been updated within this delay time, the event is triggered.
Fieldbus Watchdog Response	5244	• No response (default) • Info • Warning • Fault, ramp to coast • Fault, coast See Table 21 for descriptions of the events.	Select the drive response for the fieldbus watchdog event.
Fieldbus Watchdog Delay	5245	0.0–3000.0 (Default value: 5.0 s)	Set a delay for activating the fieldbus watchdog event.
Fieldbus Watchdog Start Delay	5246	0.0–3000.0 (Default value: 30.0 s)	Set a startup delay time for activating the fieldbus watchdog event. Counter begins when drive wakes up.
FB Monitoring Control Place Dependency	1338	• Disabled • Enabled (default)	Set the control place dependency for fieldbus monitoring functions (Fieldbus Fault, Process Data Timeout, and Fieldbus Watchdog). When enabled the monitoring functions are active only in the fieldbus control place. When disabled the functions are active regardless of control place.

Table 21: Event Descriptions

Value	Description
No response	The event is ignored.
Info	The event is logged in the event log.
Warning	The drive or power converter issues a warning.
Fault, ramp to coast	The drive or power converter issues a fault, and ramps the motor speed to 0 before stopping modulation.
Fault, coast	The drive or power converter issues a fault and modulation is stopped.

4.6 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 https://www.danfoss.com/en/products/dds/system-modules/ic7-system-modules/ic7-hybrid/#tab-software.

   Each iC7 series 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.

4.7 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*.

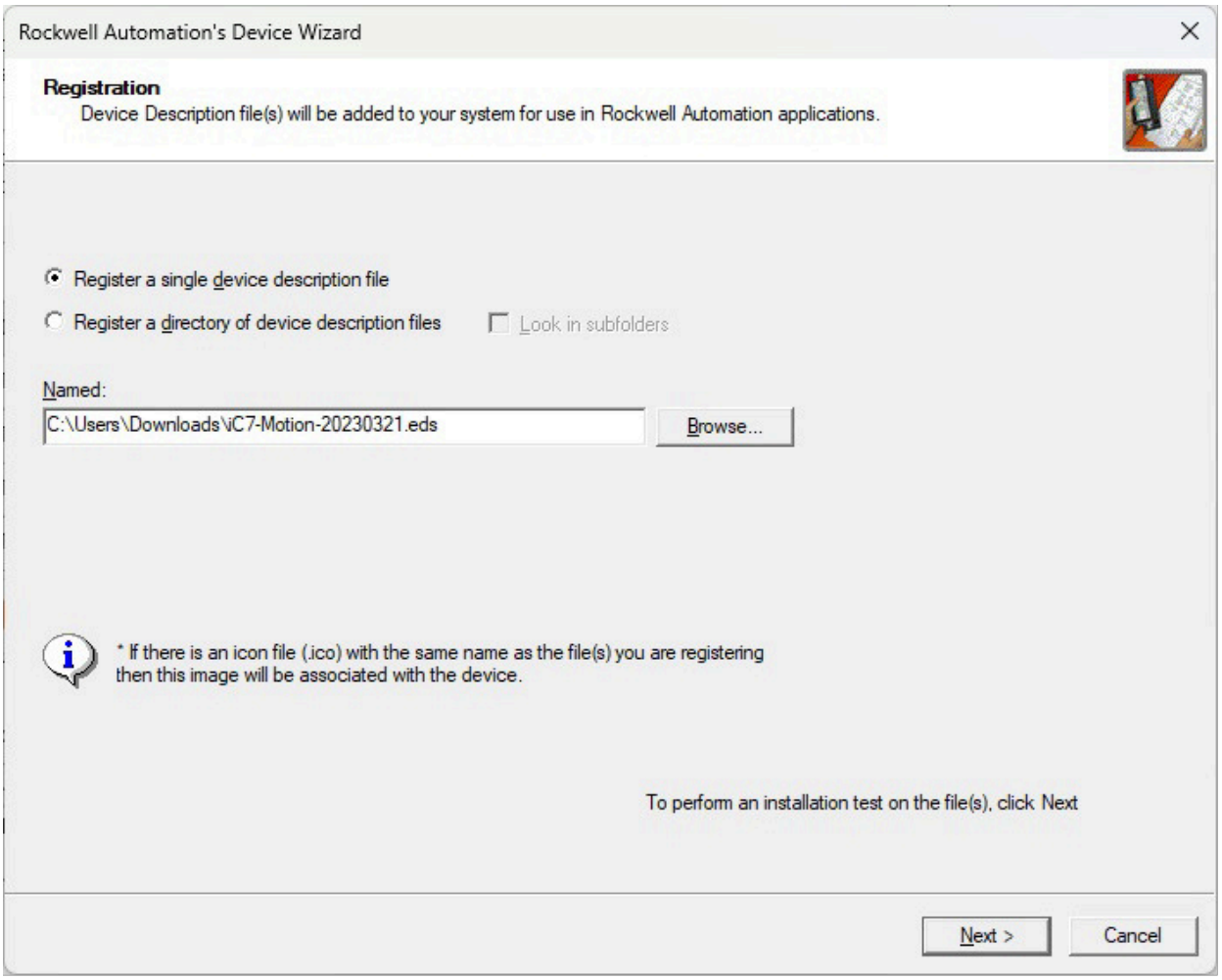

Figure 10: EDS File Registration

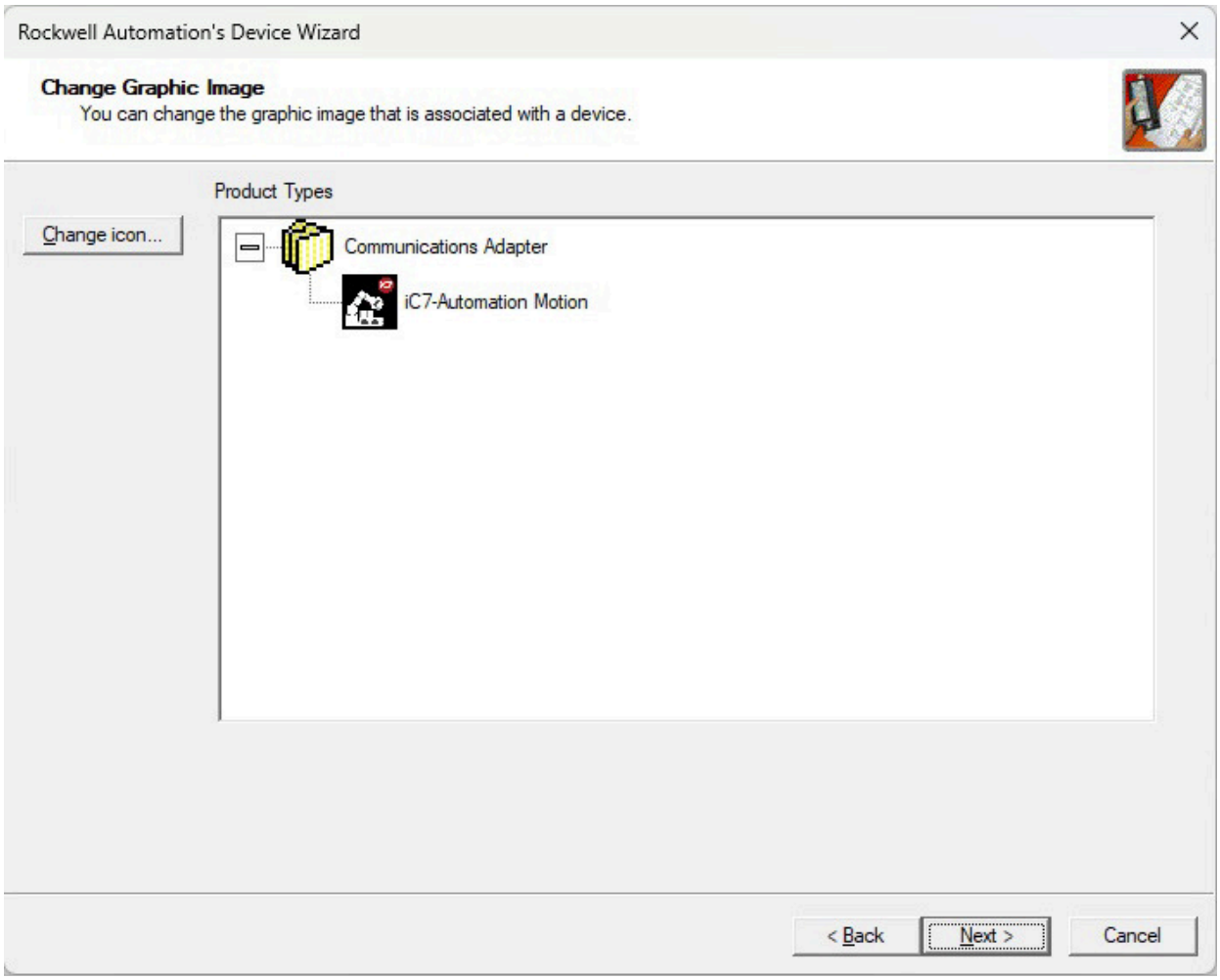

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Figure 11: Changing the Graphic Image

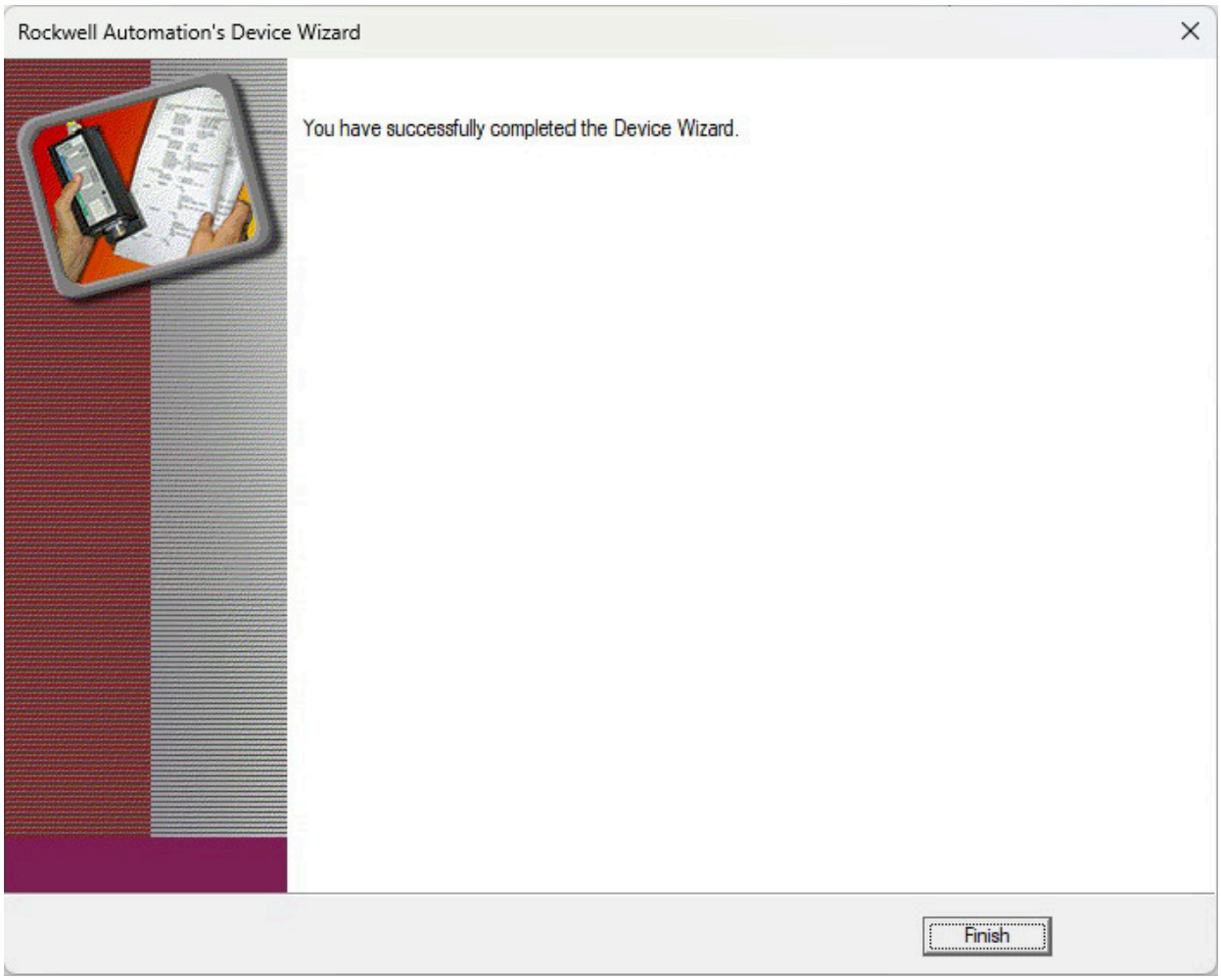


Figure 12: Completion of EDS Registration

4.8 Configuring EtherNet/IP Connections

1. Configure I/O connection settings.

Table 22: I/O Connection Settings between Rockwell Scanner and the Drive

Name	Value
IP address	192.168.6.120
Connection	EO 130/180
Parameter	• Fieldbus Status Word (STW) • Fieldbus Speed Main Actual Value (MAV) • Heat Sink Temperature • DC-link Voltage

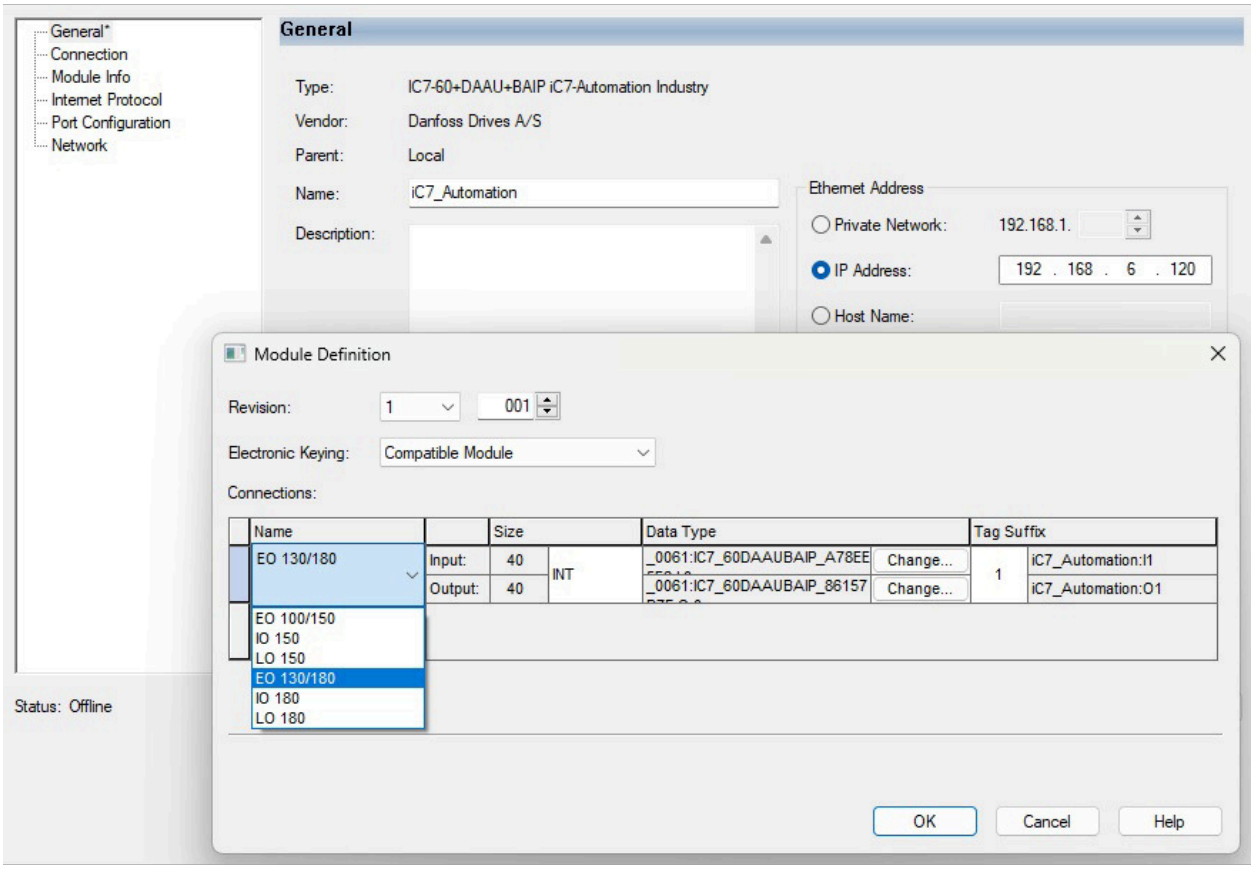


Figure 13: Example of I/O Connection Settings between the Rockwell Scanner and the Drive

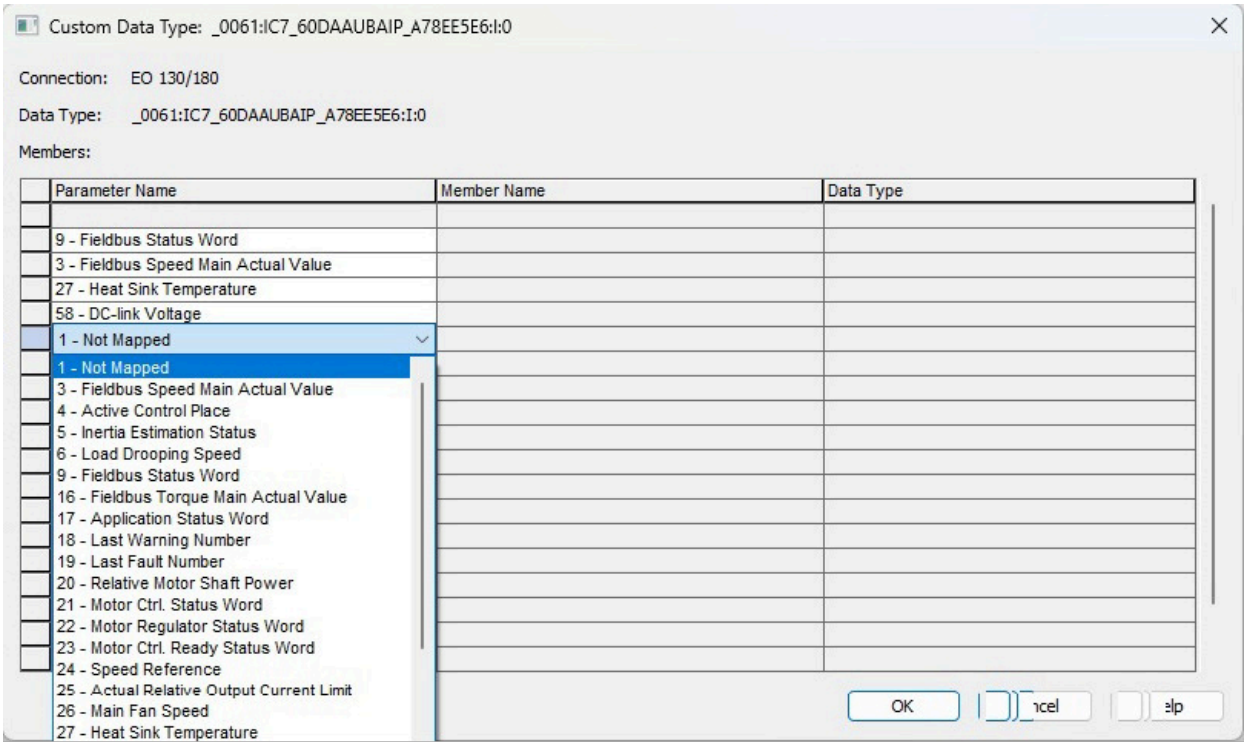


Figure 14: Example of Parameters for I/O Connections between Rockwell Scanner and the Drive

2. Configure Class-1 connection settings.

The class-1 connection is a cyclic I/O connection using TCP transport. The EtherNet/IP interface supports 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 23 for more information.

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

Table 23: Assembly Instance Options

Instance	Direction	Size	Data
100	Originator → Target	4 bytes	• Control word • Reference
150	Target → Originator	4 bytes	• Status word • Main actual value
130	Originator → Target	80 bytes	Freely selectable
180	Target → Originator	80 bytes	Freely selectable

Table 24: 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		

Table 25: Supported Transport Types

Direction	Transport type
Originator → Target	Point-to-point
Target → Originator	• Point-to-point • Multicast
Trigger	Cyclic
Packet rate	1 ms minimum supported

3. Configure Class-3 connection settings.

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

Table 26: Class-3 Connection Parameters

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

4. Configure UCMM settings.

The Unconnected Messages, UCMM is an acyclic 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 27: 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 6.1.1 Overview.

4.9 Reference Handling

4.9.1 Generator Application

In the Generator application, the Main Reference [REF] and the Main Actual Value [MAV] are tied to the motor speed in Hz. These variables are interfaced as signed 16-bit integer values and are both scaled linearly based on the signal and scale parameter pairs given in Table 28.

Table 28: Reference and Main Actual Handling Parameters

Parameter	Parameter number	Unit	Range	Data type
Fieldbus Speed Signal Max	6312	–	-32768–32767	Signed 16
Fieldbus Speed Signal Min	6313	–	-32768–32767	Signed 16
Fieldbus Speed Scale Max	6310	[Hz]	-1000–1000	Float 32
Fieldbus Speed Scale Min	6311	[Hz]	-1000–1000	Float 32

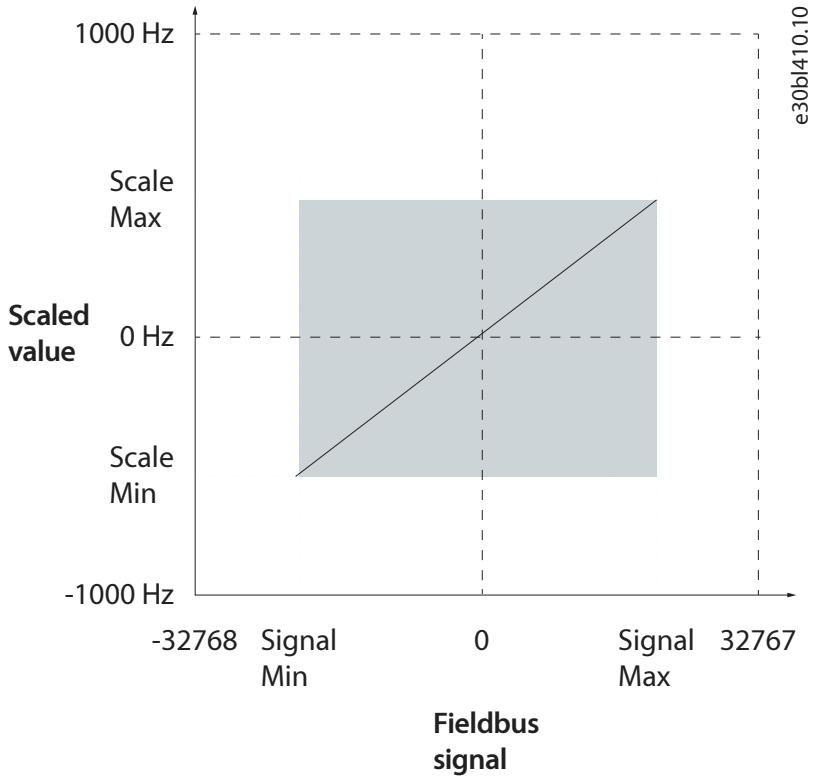


Figure 15: Example of Fieldbus Speed Reference

When the PROFIdrive Standard Telegram 1 profile is selected (parameter ***Fieldbus Profile (1301)***), these parameters are automatically set so that the following reference handling scheme is implemented:

- Signal Max = +32767 = 0x7FFF ↔ Scale Max = +199.99% of motor nominal speed (parameter ***Motor Nominal Speed (402)***).
- Signal Min = -32768 = 0x8000 ↔ Scale Min = -200.00% of motor nominal speed (parameter ***Motor Nominal Speed (402)***).

5 Troubleshooting

5.1 Configuring Port Mirroring Settings

Enable or 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*.

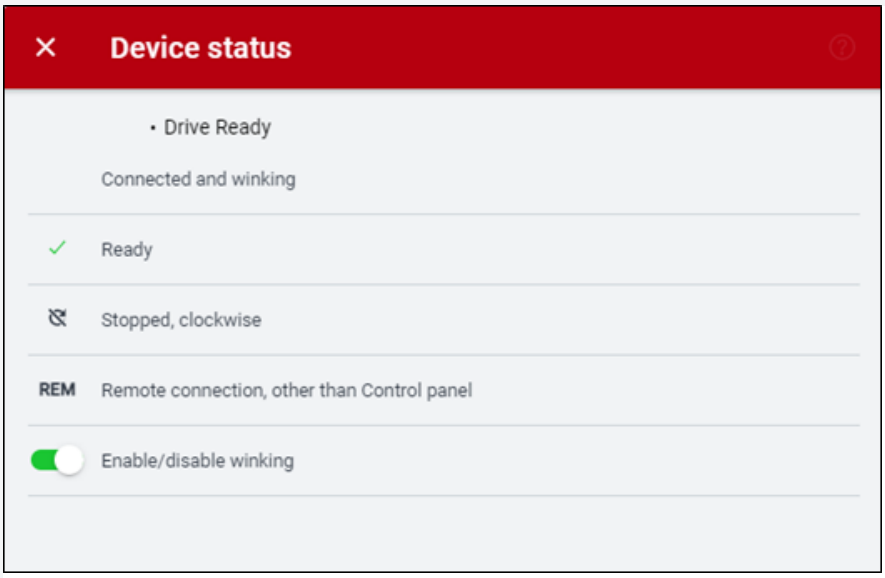
Table 29: Port Mirroring Settings

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	Enables the Port Mirroring feature.

5.2 Identifying a Unit

The winking function makes the fieldbus indicator LEDs ST, X1, and X2 flash yellow to make it easy to identify a unit. The function is enabled in MyDrive® Insight.

1. In MyDrive® Insight, click the device name in live mode.
2. Select *Device Status*.
3. To activate or deactivate the feature, click the toggle switch.



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See 5.3 Fieldbus Indicator LEDs for more information on interpreting the LED signals and where the LEDs are located.

5.3 Fieldbus Indicator LEDs

The fieldbus indicator LEDs are in the top right corner of the control panel and the bottom part of the front-facing side of the modular control unit.

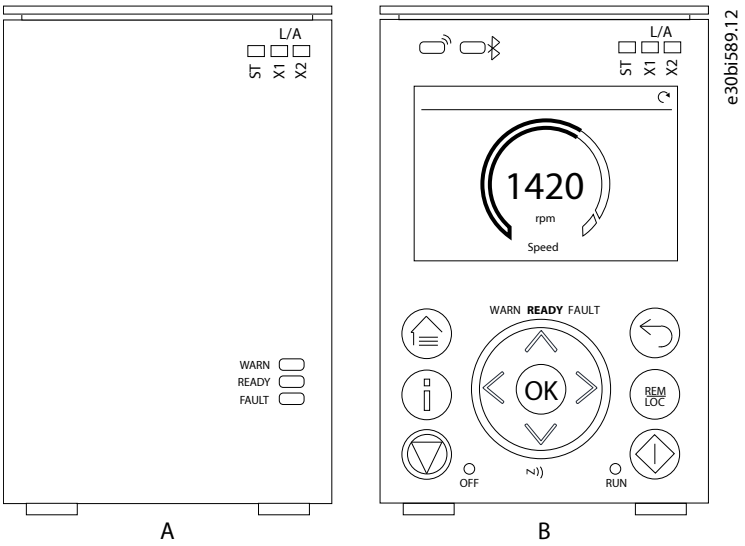
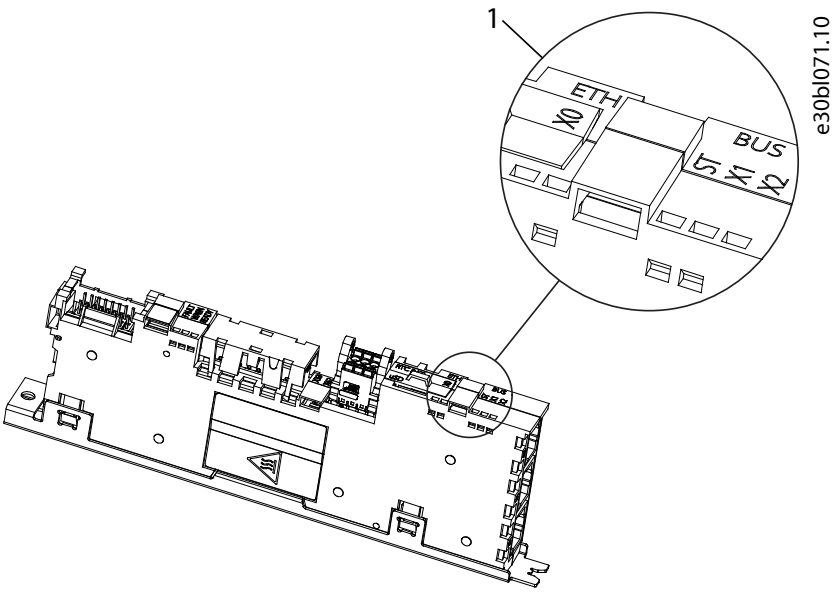


Figure 16: Fieldbus Indicator LEDs on Control Panel



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

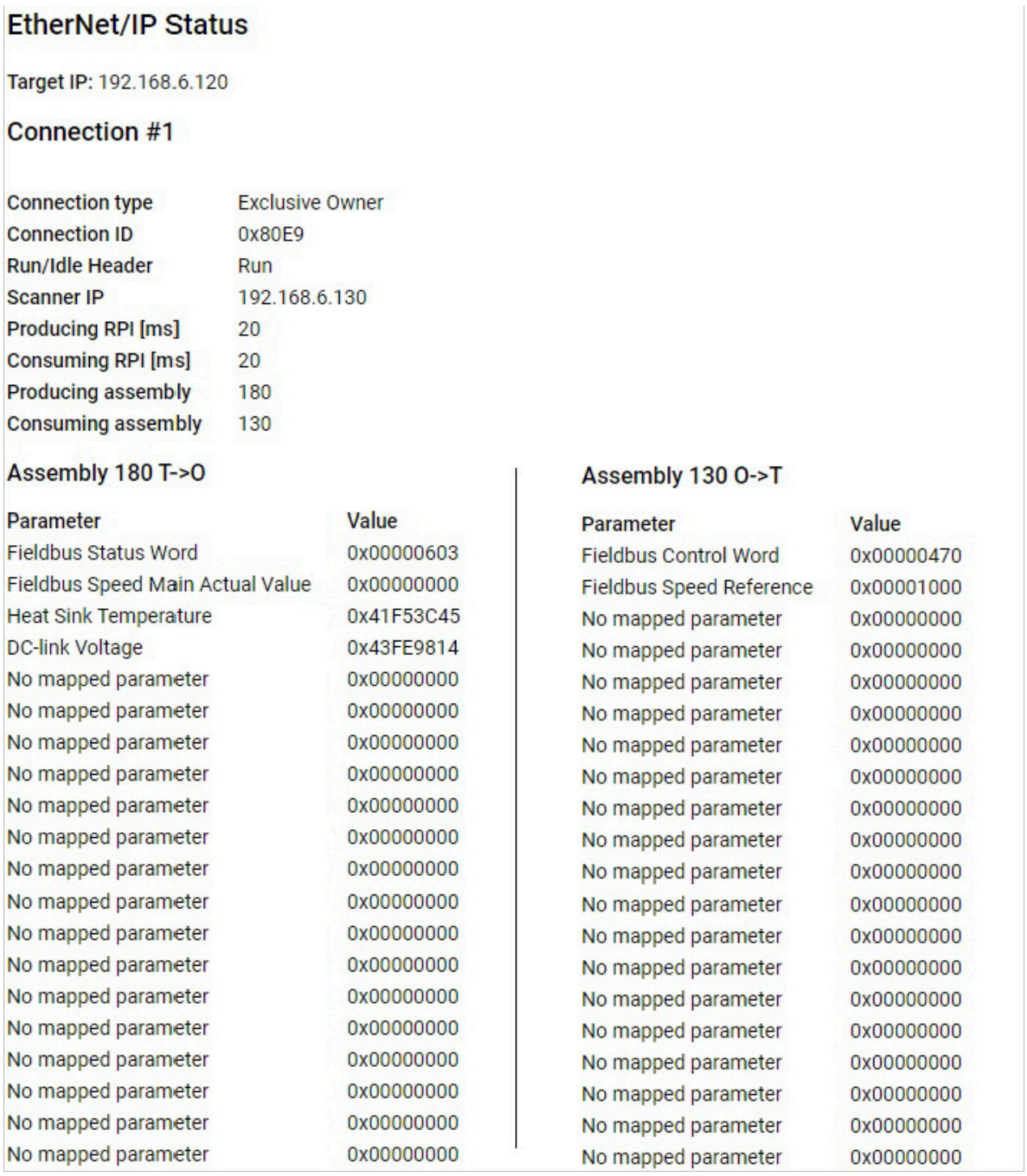
Figure 17: Fieldbus Indicator LEDs on Modular Control Board

- 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 30: 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).
	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 timeouts.
	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



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
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
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
No mapped parameter	0x00000000
No mapped parameter	0x00000000
No mapped parameter	0x00000000
No mapped parameter	0x00000000

e30bl215.10

Figure 18: Example of an EtherNet/IP Report

6 EtherNet/IP Features

6.1 Supported CIP Objects

6.1.1 Overview

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.

6.1.2 Class ID 0x01 Identity Object

Table 31: 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)	Variable frequency 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 ***get_attribute_all***

6.1.3 Supported Services in Class ID 0x01

Table 32: 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

6.1.4 Class ID 0x04 Assembly Objects

Table 33: Instance Attributes for Class ID 0x04 Assembly Objects in the DC/DC Converter and Grid Converter Applications

Instance	Access	Name	Size	Description
110	Set	[CTW], [REF]	4 bytes	Consuming assembly 110
130	Set	Free configurable	80 bytes	Consuming assembly 130
160	Get	[STW], [MAV]	4 bytes	Producing assembly 160
180	Get	Free configurable	80 bytes	Producing assembly 180
768	Set	Configuration	4 bytes	Configuration assembly 768 (for instance 100, 150)
769	Set	Configuration	80 bytes	Configuration assembly 769 (for instance 130, 180)

Table 34: Instance Attributes for Class ID 0x04 Assembly Objects in the Generator

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

6.1.5 Class ID 0x06 Connection Manager

Table 35: 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.

6.1.6 Class ID 0x47 DLR (Device Level Ring)

Table 36: 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 that no IP Address has been configured for the device.
		Supervisor MAC address	Array of 6 USINTs	Ethernet MAC address
12	Get	Capability flags	DWORD	DLR capabilities of the device. iC7series drives are beacon-based nodes.

6.1.7 Class ID 0x48 Quality of Service Object

Table 37: 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.

6.1.8 Class ID 0xF5 TCP/IP Interface Object

Table 38: 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
8	Get/Set	TTL value	USINT	Time-to-Live value for IP multicast packets. The 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: 0 = Disabled (default) 1 = Enabled
11	Get	Last conflict detected	Struct of:	–
		ACD activity	USINT	State of ACD activity when the last conflict was detected.
		Remote MAC	Array of 6 USINT	MAC address of a 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 the TCP connection is closed.

6.1.9 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 Ethernet port X1.
- Instance 3 relates to Ethernet port X2.

Table 39: 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 are 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.
		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.

Table 39: Instance Attributes for Class ID 0xF6 Link Object - (continued)

Attribute	Access	Name	Datatype	Description
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 an SQE test error message is generated.
		Deferred transmissions	UDINT	Frames for which the 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	The speed at which the interface shall be forced to operate speed in Mbps.
7	Get	Interface type	SHORT_STRING	Type of interface: 1 = internal 2 = twisted pair
8	Get	Interface state	USINT	Current state of the interface: 0 = Unknown state 1 = Operational 2 = Disabled

Table 39: Instance Attributes for Class ID 0xF6 Link Object - (continued)

Attribute	Access	Name	Datatype	Description
9	Get/Set	Admin state		Administrative state: 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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