

ENGINEERING
TOMORROW



Operating Guide

iC7-Marine PROFINET

PROFINET RT



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Contents

1 Introduction and Safety

1.1 Purpose of the Operating Guide	5
1.2 Additional Resources	5
1.3 Safety Symbols	5
1.4 Qualified Personnel	6
1.5 Safety Precautions	6
1.6 Abbreviations	7
1.7 Trademarks	8
1.8 Version History	8

2 Product Overview

2.1 PROFINET Features and Technical Data	10
2.2 Communication Profiles and Objects	10
2.3 iC Speed Profile	11
2.3.1 Overview	11
2.3.2 Control Word (CTW)	11
2.3.3 Status Word (STW)	12
2.4 PROFIdrive - Standard Telegram 1	13
2.4.1 Overview	13
2.4.2 Control Word (CTW)	13
2.4.3 Status Word (STW)	15
2.4.4 PROFIdrive State Machine	16
2.5 iC Active Front End Profile	16
2.5.1 Overview	16
2.5.2 Control Word (CTW)	17
2.5.3 Status Word	18
2.6 Submodules	19
2.7 Functional Extension Options	19
2.8 Network Topologies	20
2.8.1 Overview	20
2.8.2 Line Topology	20
2.8.3 Star Topology	21
2.8.4 Ring Topology	22

3 Fieldbus Cable Connections

3.1 Prerequisites for Installation	24
3.2 Communication Interface X1/X2 in Frames FA02–FA12	24
3.3 Communication Interface X1/X2 in Frames FK06–FK12	24
3.4 Communication Interface X1/X2 in System Modules	25
3.5 EMC-compliant Installation	26
3.5.1 Overview	26
3.5.2 Grounding	26
3.5.3 Cable Routing	27

4 Configuration

4.1 Configuring the Ethernet Interface	28
4.2 Configuring Name of Station	28
4.3 GSDML File (Device Description File)	29
4.4 Reference and Main Actual Handling	29
4.4.1 Propulsion & Machinery Application	29
4.4.2 Active Front End Application	30
4.5 General Connectivity Settings	31
4.5.1 Propulsion & Machinery Application Connectivity Settings	31
4.5.2 Active Front End Application Connectivity Settings	33

5 Parameter Access

5.1 Overview	35
5.2 PROFIdrive Parameter Numbers	35

6 Troubleshooting

6.1 Diagnostics	36
6.2 PROFINET Report	36
6.3 Configuring Port Mirroring Settings	37
6.4 Identifying a Unit	37
6.5 Fieldbus Indicator LEDs	38

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, PROFINET technology, and the PC or PLC that is used as a master in the system.

Read the instructions before configuring PROFINET, 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.

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).

The guide also includes ISO warning symbols related to hot surfaces and burn hazard, high voltage and electrical shock, and referring to the instructions.

	ISO warning symbol for hot surfaces and burn hazard
	ISO warning symbol for high voltage and electrical shock
	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, start-up, and maintenance by qualified personnel can result in death or serious injury.

- Only qualified personnel are allowed to perform installation, start-up, 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 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.

NOTICE

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 codes.
- 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
CTW	Control word
DAP	Device access point
DCP	Discovery and configuration protocol
DHCP	Dynamic host configuration protocol
DO	Drive object
DU	Drive unit
EMC	Electromagnetic compatibility

Table 1: Abbreviations (continued)

Abbreviation	Definition
I/O	Input/Output
IP	Internet protocol
IRT	Isochronous real time
LED	Light-emitting diode
LLDP	Link layer discovery protocol
LSB	Least significant bit
MAP	Module access point
MAV	Main actual value
MRC	Media redundancy client
MRM	Media redundancy manager
MRP	Media redundancy protocol
MRV	Main reference value
MSB	Most significant bit
PAP	Parameter access point
PC	Personal computer
PCD	Process channel data
PDEV	P-Device
PLC	Programmable logic controller
PNU	Parameter number
PPO	Process parameter object
REF	Reference
RFG	Ramp frequency generator
RT	Real time
STW	Status word

1.7 Trademarks

PROFIBUS® and PROFINET® are registered trademarks of PROFIBUS and PROFINET International (PI).

PROFIdrive® is a registered trademark licensed by PROFIBUS and PROFINET International (PI).

1.8 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
AQ481922043454, version 0101	First release.

2 Product Overview

2.1 PROFINET 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 can be selected in the configurator when ordering a drive or power converter, or alternatively, they can be activated later by a proof-of-purchase token.

Table 3: PROFINET Model Codes

Model code	Description
+BAPR	PROFINET RT OS7PR

PROFINET is the Ethernet-based automation standard of PROFIBUS and PROFINET International (PI) for the implementation of an integrated and consistent automation solution based on Industrial Ethernet. PROFINET supports the integration of distributed field devices and time-critical applications in switched Ethernet networks. It also supports the integration of component-based distributed automation systems for vertical and horizontal integration of networks.

Table 4: PROFINET Features

Feature	Technical data
Cyclic response	1 ms update cycle
	PROFINET RT Conformance Class B (CC-B)
	Data consistency with submodule
Diagnostics	PROFINET Extended Diagnostics
	PROFINET Diagnostics (ALARM CR)
Connection	MRP (Media Redundancy Protocol)
	LLDP/SNMP
	Netload Class III, Advanced robustness against net load
	IPv4
	Addressing mode: DCP, STATIC, DHCP/BOOTP
System integration	Supported GSDML versions: <ul style="list-style-type: none"> GSDML version 2.42: current version GSDML version 2.35: compatible with legacy systems GSDML version 2.31: compatible with legacy systems
PROFIenergy	Version 1.3

2.2 Communication Profiles and Objects

The iC7 series complies with PROFINET and PROFIdrive standards, mandatory PNU objects, PROFINET Extended Diagnostics, and a range of vendor-specific profiles for product-specific applications.

Communication profiles are selected in parameter *Fieldbus Profile* (parameter number **1301**).

Table 5: Communication Profiles and Supported Applications for iC7-Marine

Profile	Propulsion & Machinery	Active Front End
PROFIdrive Application Class 1	X	–
PROFIdrive version 1.3	X	X
PROFIdrive standard PNUs	X	X
iC Speed Profile	X	–
iC Active Front End Profile	–	X

2.3 iC Speed Profile

2.3.1 Overview

The iC speed profile is used with the iC7 series motor applications. 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.

2.3.2 Control Word (CTW)

Table 6: 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 drive to immediately coast the motor.
4	No quick stop/Quick Stop	1: No function. 0: Quick stops the drive and ramps down the motor speed to stop as defined with the quick stop ramp parameter.
5	No hold/Hold output frequency	1: No function. 0: Hold the present output frequency (in Hz).
6	Start/No start	1: If the other starting conditions are fulfilled, this selection allows the drive to start the motor. 0: Stops the drive and ramps down the motor speed as defined with the ramp down parameter.
7	Fault acknowledge	0 ⇒ 1: Acknowledge faults. Acknowledge is edge-triggered, when the logic is changed from 0 to 1. Faults can only be acknowledged if the triggering condition has been removed and any required acknowledgment has been done. 0: No function.

Table 6: iC Speed Profile Control Word Bits (continued)

Bit number	Name	Description
8	Jog/No jog	1: Sets the output frequency to the jog speed defined with the jog speed parameter. 0: No function.
9	Ramp select	1: Ramp 2 is active. 0: Ramp 1 is active.
10	Data valid	1: Use process data (control by PLC). 0: Ignore 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. Use 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	

2.3.3 Status Word (STW)

Table 7: 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	Drive ready/Drive not ready	1: The drive is ready for operation. 0: The drive 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 drive 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.

Table 7: iC Speed Profile Status Word Bits (continued)

Bit number	Name	Description
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	Fieldbus control active/inactive	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: <ul style="list-style-type: none"> • Fieldbus is not the active control place. • Fieldbus signals are not configured to be part of the Advanced Control Place.
10	Limiters inactive/active	1: All drive limiters (regulators) are inactive. 0: At least one drive limiter (regulator) is actively limiting the drive current or torque, for example. See parameter <i>Motor Regulator Status Word</i> (parameter number 1715) for further details.
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	Reserved	Reserved
15	Reserved	Reserved

2.4 PROFIdrive - Standard Telegram 1

2.4.1 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 motor applications.

2.4.2 Control Word (CTW)

Table 8: Control Word Bits in PROFIdrive Standard Telegram 1

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.

Table 8: Control Word Bits in PROFIdrive Standard Telegram 1 (continued)

Bit number	Name	Description
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).
6	Enable setpoint	1: Enable setpoint. 0: Disable setpoint.
7	Fault acknowledge	0 ⇒ 1: Acknowledge faults. Acknowledging 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, drive is at 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, drive is at standstill, and STW1 bit 4, 5, 6: 0. The drive runs up along the ramp to jogging setpoint 2.
10	Control by PLC	1: Uses process data (control by PLC). 0: Ignores the current process data. This is linked to a 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 the mapping of 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	

2.4.3 Status Word (STW)

Table 9: Status Word Bits in PROFIdrive Standard Telegram 1

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). 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 error within/out of tolerance range	1: The present motor speed matches the present speed reference within 1% of motor nominal speed. 0: The motor runs, but the present speed is more than 1% different from the reference. It could, for example, be the case while the speed ramps up/down during start/stop.
9	Fieldbus control active/inactive	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: <ul style="list-style-type: none"> • Fieldbus is not the active control place. • Fieldbus signals are not configured to be part of the Advanced Control Place.
10	Speed reached/Speed not reached	1: The actual speed is above the comparison value set with parameter Limit Supervision 1 Threshold (parameter number 5253). 0: The actual speed is below the comparison value set with parameter Limit Supervision 1 Threshold (parameter number 5253).
11	Reserved	Reserved
12	Reserved	Reserved
13	Reserved	Reserved
14	Reserved	Reserved
15	Reserved	Reserved

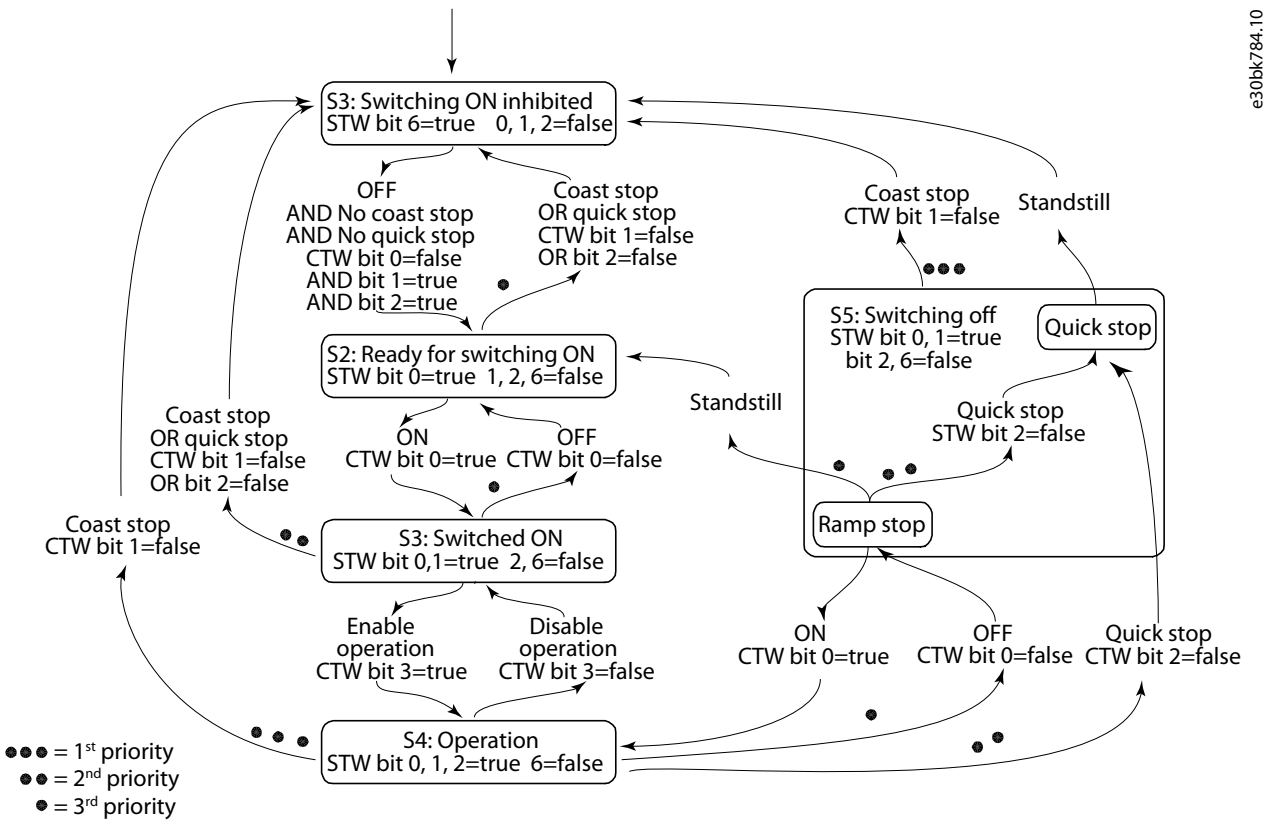
2.4.4 PROFIdrive State Machine

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.



e30bk784.10

Figure 1: General State Diagram

2.5 iC Active Front End Profile

2.5.1 Overview

The iC Active Front End profile is used in the iC7 series with the Active Front End application.

2.5.2 Control Word (CTW)

Table 10: iC Active Front End Profile Control Word Bits

Bit number	Name	Description
0	Switch On Enable	1: Precharging ⁽¹⁾ , MCB closure ⁽¹⁾ and running are not prevented/interrupted. 0: Precharging ⁽¹⁾ , MCB closure ⁽¹⁾ , and running are prevented/interrupted. MCB is opened if closed.
1	MCB Close Enable	1: MCB closure is not prevented ⁽¹⁾ 0: MCB closure is prevented ⁽¹⁾ or MCB is opened ⁽¹⁾ , running is prevented/interrupted
2	Quick Stop Inverse	1: No action 0: Initiate quick stop
3	Start	1: Initiate/continue the startup sequence (DC-link precharging ⁽²⁾ , MCB closure ⁽²⁾ and starting modulation) or keep the unit running. 0: Interrupt the start-up sequence, if ongoing; stop modulation, if running A rising edge is required for starting DC-link precharging. Depending on parameter number 5114 , a rising edge can also be required for the unit to start modulation.
4	Pre Charge	1: Start/continue the DC-link precharging. 0: Stop the DC-link precharging, if ongoing. Only used when the DC-link precharging is controlled by the converter unit.
5	–	Reserved
6	–	Reserved
7	Fault Reset	1: Reset active faults (or other events) 0: No action Edge sensitive: a reset command is issued when a rising edge is detected.
8	–	Reserved
9	–	Reserved
10	Data Valid	1: Use the current incoming process data values 0: Ignore the current incoming process data values, instead use the last processed value when Data Valid bit was true.
11	Watchdog	Incoming fieldbus watchdog bit.
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	

1) If controlled by the converter unit.

2) If applicable

2.5.3 Status Word

Table 11: iC Active Front End Profile Status Word Bits

Bit number	Name	Description
0	Ready to Switch On	1: Ready to switch on. 0: Not ready to switch on. This bit is TRUE if all of the following conditions are fulfilled: <ul style="list-style-type: none"> • Switch on enable present • MCB close enable present • Quick stop not requested • No fault active If charging and MCB closure are controlled by the converter unit, when this bit is TRUE it is expected that the startup sequence can be successfully performed.
1	Converter Ready	1: The converter is ready to start modulation if Ready to Switch On bit is high and all start/run interlocks are present. 0: The converter is not ready to start modulation. Check Grid Ctrl. Ready Status Word and MCB closure .
2	Running	1: The unit is running (modulating). 0: The unit is not running (modulating).
3	Fault	1: One or more faults active. 0: No faults active.
4	--	Reserved
5	Quick Stop Inverse	1: Quick Stop not active. 0: Quick Stop active.
6	--	Reserved
7	Warning	1: One or more warnings active. 0: No warnings active.
8	--	Reserved
9	Control by PLC	1: The active control place is fieldbus. 0: The active control place is not fieldbus.
10	--	Reserved
11	Run Enabled	1: Run enable from dedicated input signal is present. 0: Run enable from dedicated input signal is missing.
12	--	Reserved
13	--	Reserved
14	--	Reserved
15	Watchdog	Outgoing fieldbus watchdog bit.

2.6 Submodules

In iC7 series, the exchange of process data values is done through submodules:

- Profile signals
- Process data input and output signals. The available signal content can be browsed in the iC7-Marine device description files (see [4.3 GSDML File \(Device Description File\)](#) for further information).

Table 12: Submodule Sizes

Application	Cyclic input data	Cyclic output data
PROFIdrive Standard telegram 1	[STW] [MAV]	[CTW] [REF]
iC Speed Profile	[STW] [MAV]	[CTW] [REF]
CTW2/STW2	[STW2]	[CTW2]
iC Active Front End Profile	[STW] [MAV]	[CTW] [REF]

Table 13: Signal Module Sizes

Application	Cyclic input data	Cyclic output data
Propulsion & Machinery	4 signals (16 bytes)	4 signals (16 bytes)
	8 signals (32 bytes)	8 signals (32 bytes)
	12 signals (48 bytes)	12 signals (48 bytes)
	16 signals (64 bytes)	16 signals (64 bytes)
	20 signals (80 bytes)	20 signals (80 bytes)
Active Front End	4 signals (16 bytes)	n/a
	8 signals (32 bytes)	
	12 signals (48 bytes)	
	16 signals (64 bytes)	
	20 signals (80 bytes)	

Each of the selections in a signal module can comprise the following data types:

- Boolean
- Unsigned 8/16/32
- Signed 8/16/32
- Float32

The buffer size adapts to the data type of the selected signals. If a Boolean type is mapped, only bit 0 is used in the chosen signal address, and the remaining 7 bits are not used.

The actual interpretation of the value that is read or written depends on the data type and representation. For example, motor current is a real-type 32-bit value that is represented as float, and publishing the motor current as an actual value does not need any scaling and factoring.

2.7 Functional Extension Options

Each functional extension option is defined by its own PROFINET device model with a module and submodule(s).

Slot 1 contains the application and the subsequent slots contain the installed options. Each option supports a module access point (MAP), and other submodules contain the process data.

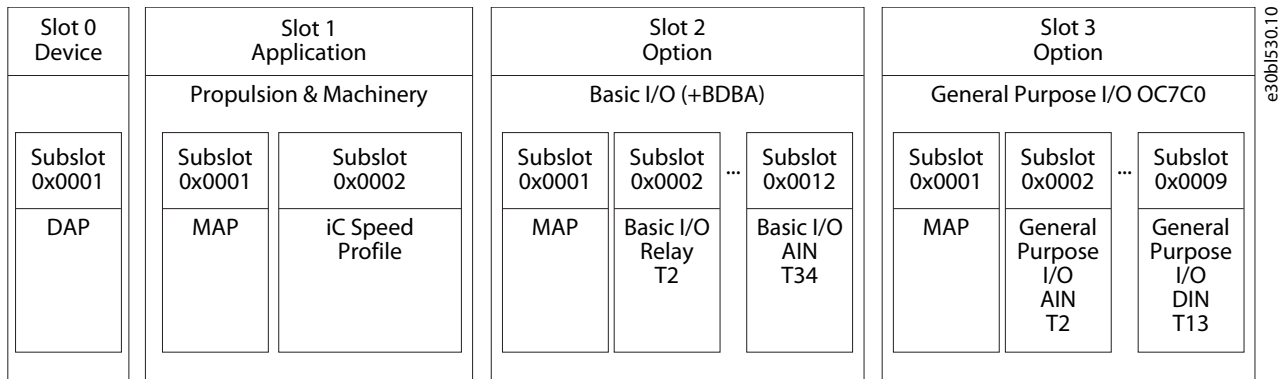


Figure 2: Example of a PROFINET Device Model with Functional Extension Options Installed in an iC7-Marine Drive

2.8 Network Topologies

2.8.1 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

2.8.2 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.

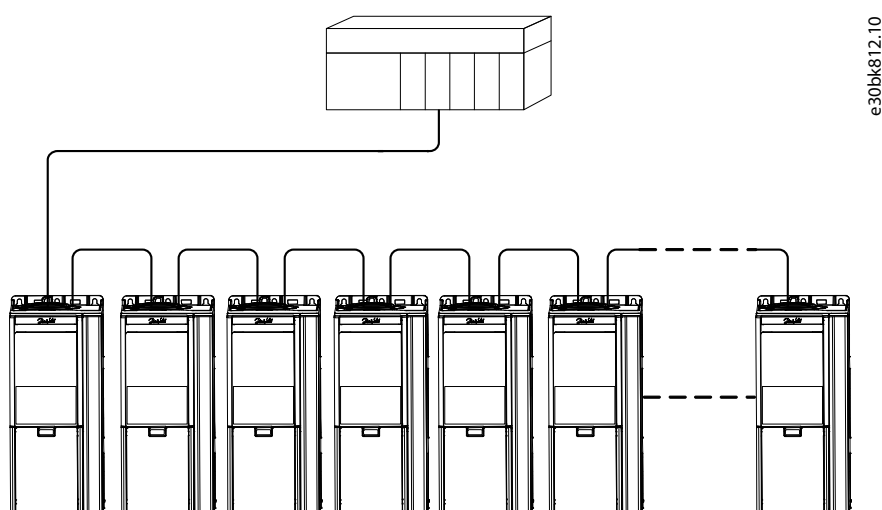


Figure 3: Example of Line Topology

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.

2.8.3 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.

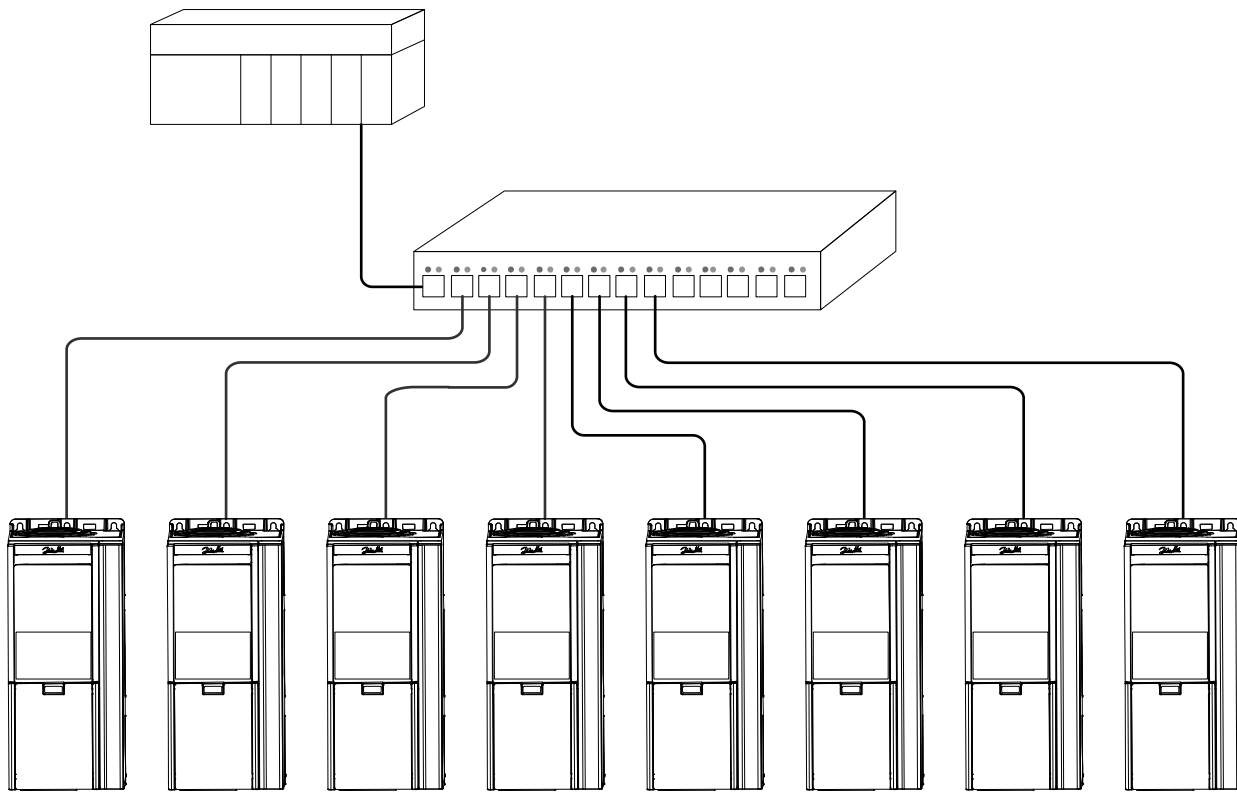


Figure 4: Example of Star Topology

2.8.4 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 PROFINET, the Media Redundancy Protocol (MRP) is used. The MRP is designed to react deterministically on a cable failure. One of the nodes in the network has the role of Media Redundancy Manager (MRM), which observes and controls the ring topology to react to network faults. Usually this device is a PLC or network switch.

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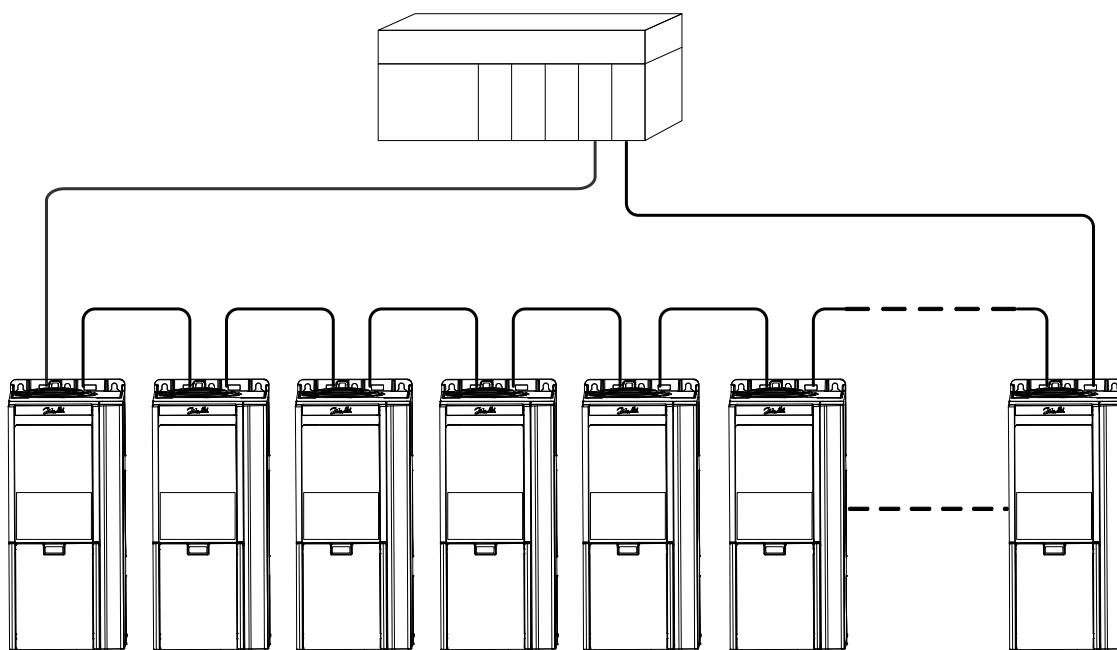


Figure 5: Example of Ring Topology

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 Communication Interface X1/X2 in Frames FA02–FA12

The communication interface is on the top of the frequency converter as shown in [Figure 6](#). 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.

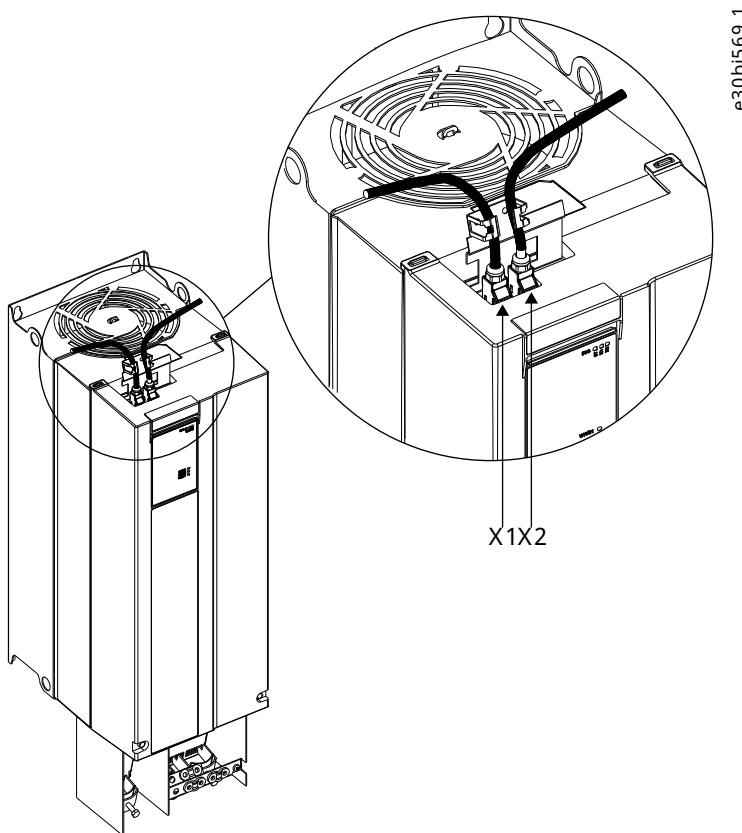


Figure 6: Location of the Communication Interface, X1/X2 in FA02-FA12 Frames (with the Optional EMC Plate)

3.3 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 [Figure 7](#) and [Figure 8](#).

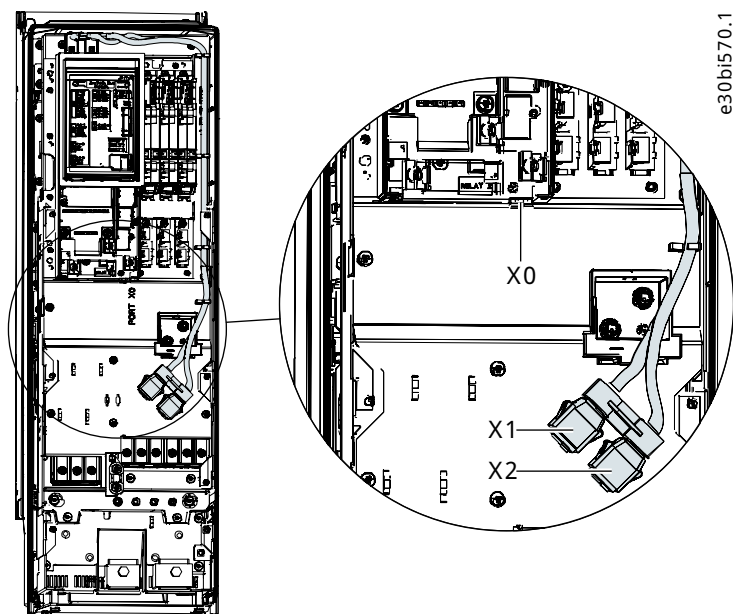


Figure 7: Communication Port X0, X1, and X2 Locations in FK06–FK08 Frames

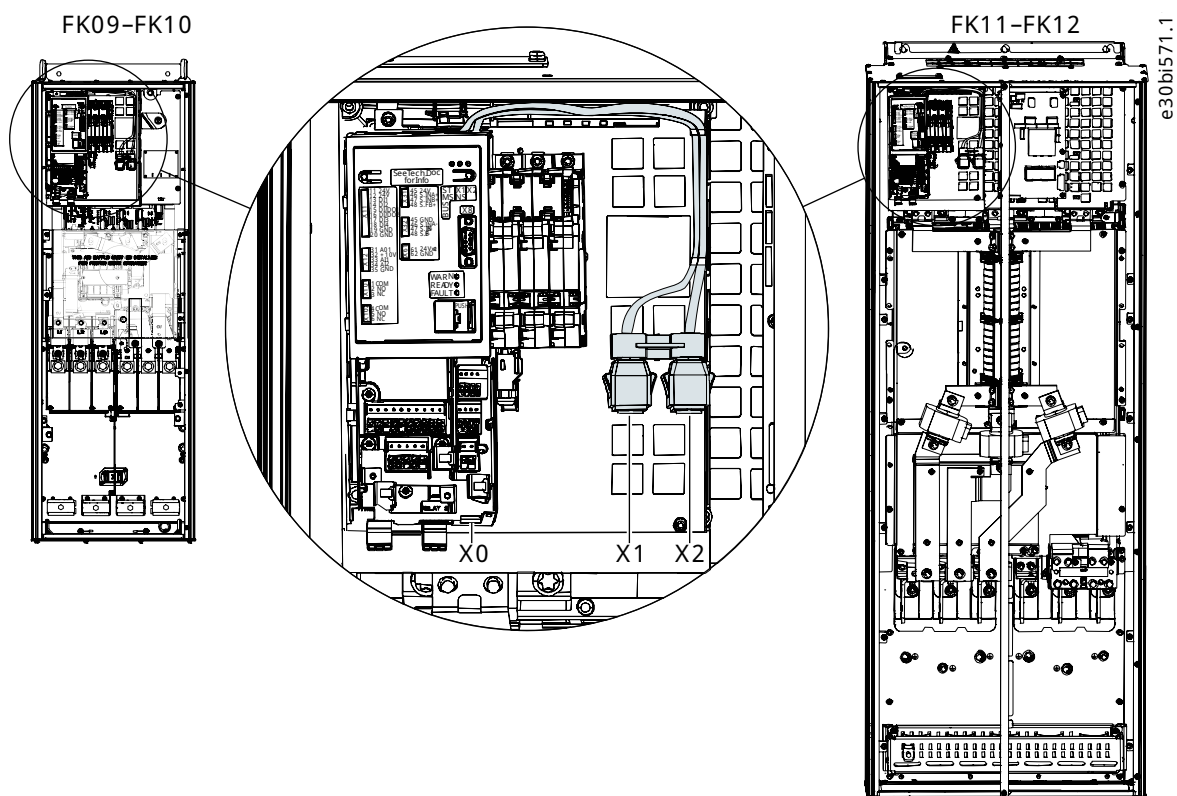


Figure 8: Communication Port X0, X1, and X2 Locations in FK09–FK12 Frames

3.4 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 9](#).

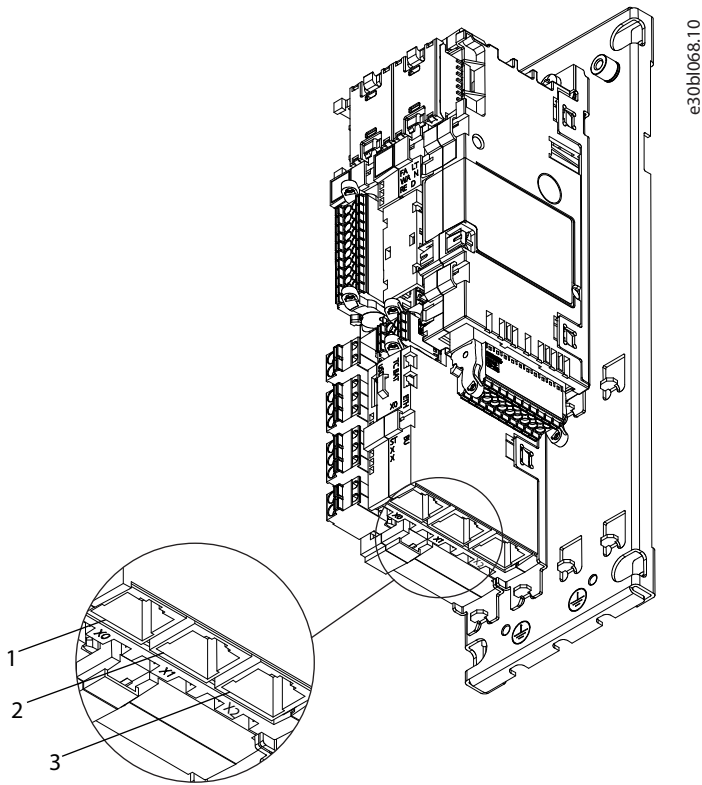


Figure 9: Communication Port X0, X1, and X2 Locations in the Modular Control Unit

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

3.5 EMC-compliant Installation

3.5.1 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.

3.5.2 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.

3.5.3 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°.

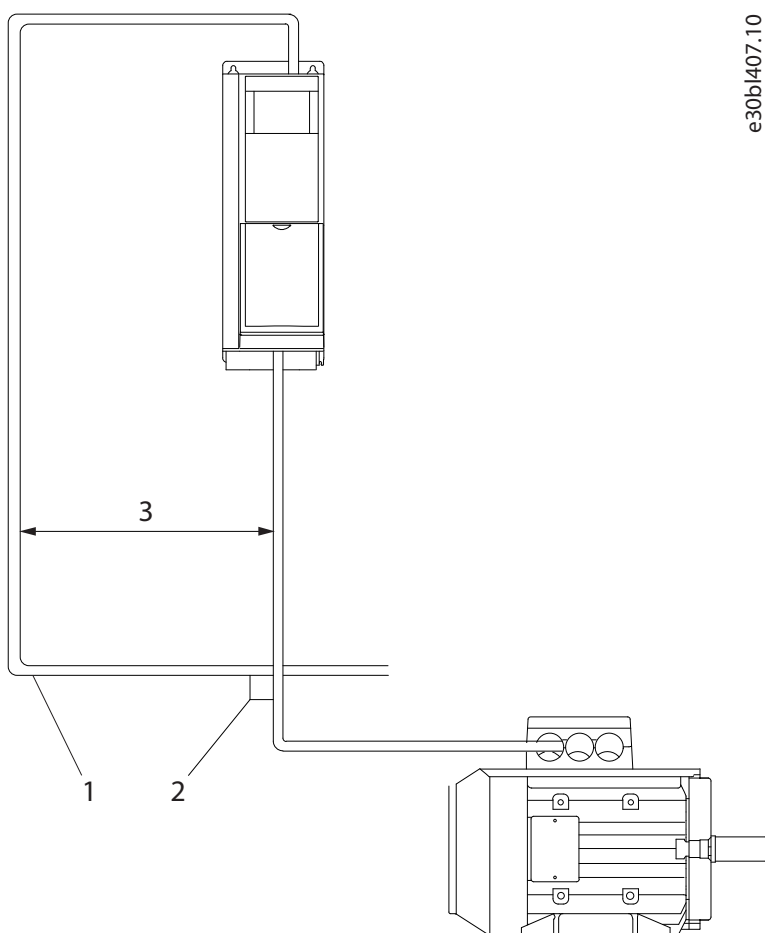


Figure 10: Cable Routing

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 **10.2 Communication Interfaces**.

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.
	DCP (default)	DCP is used with PROFINET where a PLC assigns the IP address, subnet mask, and other relevant parameters.
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. The recommended setting for PROFINET is Disable .
	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).

4.2 Configuring Name of Station

1. Navigate to parameter **Name of Station** (parameter number **7080**).

Menu index	Parameter name	Parameter number	Value	Additional information
10.3.2.2.1	Name of Station	7080	Accepted characters: <ul style="list-style-type: none"> • Lower case letters (a–z) • Numbers (0–9) • Special characters: dash (-), full stop (.) The value can be up to 127 characters or digits in total. The maximum length for each component separated by a full stop or dash is 63 characters or digits. Spaces are not allowed.	Each PROFINET device has a unique Name of Station.

4.3 GSDML File (Device Description File)

To configure a PROFINET controller, the configuration tool needs a GSDML file for each type of device in the network. The GSDML file is a PROFINET xml file containing the necessary communication setup data for a device. Each product in the iC7 series has a unique GSDML file.

Download the GSDML files for the iC7 series from <https://www.danfoss.com/en/service-and-support/downloads/dds/fieldbus-configuration-files/>. Check that the GSDML file version is compatible with the firmware version.

4.4 Reference and Main Actual Handling

4.4.1 Propulsion & Machinery Application

For the Propulsion & Machinery application the Main Reference [REF] and the Main Actual Value [MAV] are tied to the motor speed. 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 15](#).

Table 15: Reference Scaling Parameters

Menu index	Parameter	Parameter number	Unit	Range	Data type
2.2.2.1.20	<i>Fieldbus Speed Signal Max</i>	6312	-	-32768–32767	Signed 16
2.2.2.1.21	<i>Fieldbus Speed Signal Min</i>	6313	-	-32768–32767	Signed 16
2.2.2.1.22	<i>Fieldbus Speed Scale Max</i>	6310	[Hz]	-1000–1000	Float 32
2.2.2.1.23	<i>Fieldbus Speed Scale Min</i>	6311	[Hz]	-1000–1000	Float 32

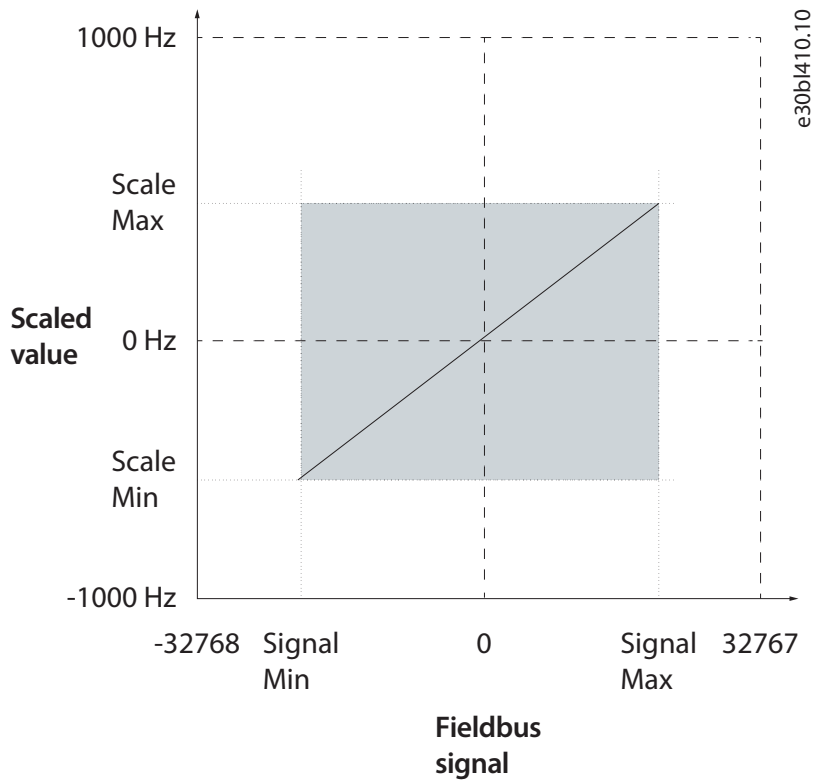


Figure 11: Example of Fieldbus Speed Reference

When the PROFIdrive Standard Telegram 1 profile is selected (parameter number **1309**), 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 number **402**).
- Signal Min = -32768 = 0x8000 ↔ Scale Min = -200.00% of motor nominal speed (parameter number **402**).

4.4.2 Active Front End Application

For the Active Front End application, the Main Reference [REF] and Main Actual Value [MAV] are tied to the DC-link voltage of the converter. Both of these signals are interfaced as 32-bit floating-point values. They are expressed in % of the **Grid Nominal Voltage** parameter (parameter number **6537**).

4.5 General Connectivity Settings

4.5.1 Propulsion & Machinery Application Connectivity Settings

Table 16: General Connectivity Settings for Propulsion & Machinery

Menu index	Parameter	Parameter number	Value	Description
2.8.4.1	<i>Fieldbus profile</i>	1301	<ul style="list-style-type: none"> iC Generic Profile (Default, not supported for PROFINET.) iC Speed Profile PROFIdrive Standard telegram 1 	Select the fieldbus profile. The selection affects the interpretation of the control word and status word.
2.12.13.1	<i>Fieldbus Fault Response</i>	1303	<ul style="list-style-type: none"> Info (default) Warning Fault, Ramp to Coast Fault, coast See Table 17 for descriptions of the events.	Select the behavior when a fieldbus fault, for example loss of I/O connection occurs.
2.12.13.2	<i>Process Data Timeout Response</i>	1341	<ul style="list-style-type: none"> Info (default) Warning Fault, Ramp to Coast Fault, Coast See Table 17 for descriptions of the events.	Select the response in case there is no fieldbus connection.
2.12.13.3	<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.
2.12.13.4	<i>Fieldbus Watchdog Response</i>	5244	<ul style="list-style-type: none"> No response (default) Warning Fault, Ramp to Coast Fault, Coast See Table 17 for descriptions of the events.	Select the response in case the fieldbus watchdog bit (bit 11) has not changed its value within the specific watchdog delay time. This is only available with the iC Generic profile.
2.12.13.5	<i>Fieldbus Watchdog Delay</i>	5245	0.00–3000 s (Default: 5.00 s)	Set a delay time for after which the fieldbus watchdog event is triggered if the watchdog bit has not changed its value.

Table 16: General Connectivity Settings for Propulsion & Machinery (continued)

Menu index	Parameter	Parameter number	Value	Description
2.12.13.6	Fieldbus Watchdog Start Delay	5246	0.00–3000 s (Default: 30.00 s)	Set a delay time for after which the fieldbus watchdog event is triggered if the watchdog bit has not changed its value. This time applies only immediately after powering the control unit of the drive.
2.12.13.7	FB Monitoring Ctrl. Place Dependency	1338	<ul style="list-style-type: none"> • Disabled • Enabled 	Set the control place dependency for Fieldbus Fault , Process Data Timeout , and Fieldbus Watchdog . When enabled, these functions are active only in the fieldbus control place. When disabled, these functions are active regardless of the control place.

Table 17: Event Descriptions for Propulsion & Machinery

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.
Fault, Coast	The drive issues a fault and coasts the motor.

4.5.2 Active Front End Application Connectivity Settings

Table 18: General Connectivity Settings for Active Front End

Menu index	Parameter	Parameter number	Value	Description
2.9.8.1	<i>Fieldbus Fault Response</i>	1304	<ul style="list-style-type: none"> • Info (default) • Warning • Fault • 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.
2.9.8.2	<i>No Fieldbus Connection Response</i>	1305	<ul style="list-style-type: none"> • Info (default) • Warning • Fault • Fault, open MCB See Table 19 for descriptions of the events.	Select the behavior in case no active fieldbus connection has been established.
2.9.8.3	<i>Process Data Timeout Response</i>	1306	<ul style="list-style-type: none"> • Info (default) • Warning • Fault • Fault, open MCB See Table 19 for descriptions of the events.	Select the response in case there is no fieldbus connection.
2.9.8.4	<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.
2.9.8.5	<i>Fieldbus Watchdog Response</i>	5244	<ul style="list-style-type: none"> • Info (default) • Warning • Fault • Fault, open MCB See Table 19 for descriptions of the events.	Select the response in case the fieldbus watchdog bit (bit 11) has not changed its value within the specific watchdog delay time.

Table 18: General Connectivity Settings for Active Front End (continued)

Menu index	Parameter	Parameter number	Value	Description
2.9.8.6	<i>Fieldbus Watchdog Delay</i>	5245	0.00–3000 s (Default: 5.00 s)	Set a delay time for after which the fieldbus watchdog event is triggered if the watchdog bit has not changed its value.
2.9.8.7	<i>Fieldbus Watchdog Start Delay</i>	5246	0.00–3000 s (Default: 30.00 s)	Set a delay time for after which the fieldbus watchdog event is triggered if the watchdog bit has not changed its value. This time applies only immediately after powering the control unit of the drive.

Table 19: Event Descriptions for Active Front End

Value	Description
Info	The event is logged in the event log.
Warning	The drive issues a warning.
Fault	A fault is issued, and the modulation is stopped
Fault, open MCB	A fault is issued, the modulation is stopped, and the MCB is opened, if controlled by the converter.

5 Parameter Access

5.1 Overview

iC7 series supports access to parameters via Base Mode Parameter Access. The data mechanism transmits requests and replies acyclically. The requests and replies are transmitted by the Acyclic Data Exchange mechanism.

For detailed instructions on how to access parameters, refer to the documentation provided by the PLC manufacturer.

5.2 PROFIdrive Parameter Numbers

PROFIdrive specifies a list of standard PNUs and maps them to the areas defined in [Table 20](#). For more details on PROFIdrive PNUs, refer to the latest version of the PROFIdrive standard.

The iC7 series supports all mandatory PNU objects and some optional and the device-specific parameter access range. The PROFIdrive parameters are not accessible via MyDrive® Insight or the control panel.

Table 20: Supported PNUs

PNU	Description
922	Telegram selection
923	List of all parameters for signals
944	Fault message counter
947	Fault number
950	Scaling of the fault buffer
964	Drive unit identification
965	Profile identification number
972	Drive reset
974	Base mode parameter access service identification
975	Drive object identification
976	Load device parameter set
977	Transfer in non-volatile memory (global)
980–989	Number list of defined parameters
60000	Velocity reference value
61000	NameOfStation (read only)
61001	IpOfStation (read only)
61002	MacOfStation (read only)
61003	DefaultGatewayOfStation (read only)
61004	SubnetMaskOfStation (read only)

6 Troubleshooting

6.1 Diagnostics

The iC7 series supports diagnostic event messaging for control systems by using faults and warnings. The faults and warnings are enabled by default. Whenever one occurs, it is indicated on the display of a control system. If diagnosis interrupt is used by the control system, it is possible to read out the fault or warning event within the PLC program and to react accordingly.

Table 21: Diagnostics Parameters

Menu index	Parameter name	Parameter number	Value	Description
10.3.2.3.1	<i>Diagnostics Fault</i>	7081	<ul style="list-style-type: none"> • Enabled (default) • Disabled 	Enables diagnostic fault. When disabled, the device does not send any PROFINET diagnosis message with severity Fault when a fault is present on the device.
10.3.2.3.2	<i>Diagnostics Warning</i>	7083	<ul style="list-style-type: none"> • Enabled (default) • Disabled 	Enables diagnostic warning. When disabled, the device does not send any PROFINET diagnosis message with severity Maintenance required when a warning is present on the device.

6.2 PROFINET Report

The PROFINET report is available in MyDrive® Insight, in parameter **10.3.2.1.1**. The report shows the current status of:

- Connections
- Configuration
- Mapped signals and their values



Figure 12: Example of a PROFINET Report

6.3 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 22: Port Mirroring Settings

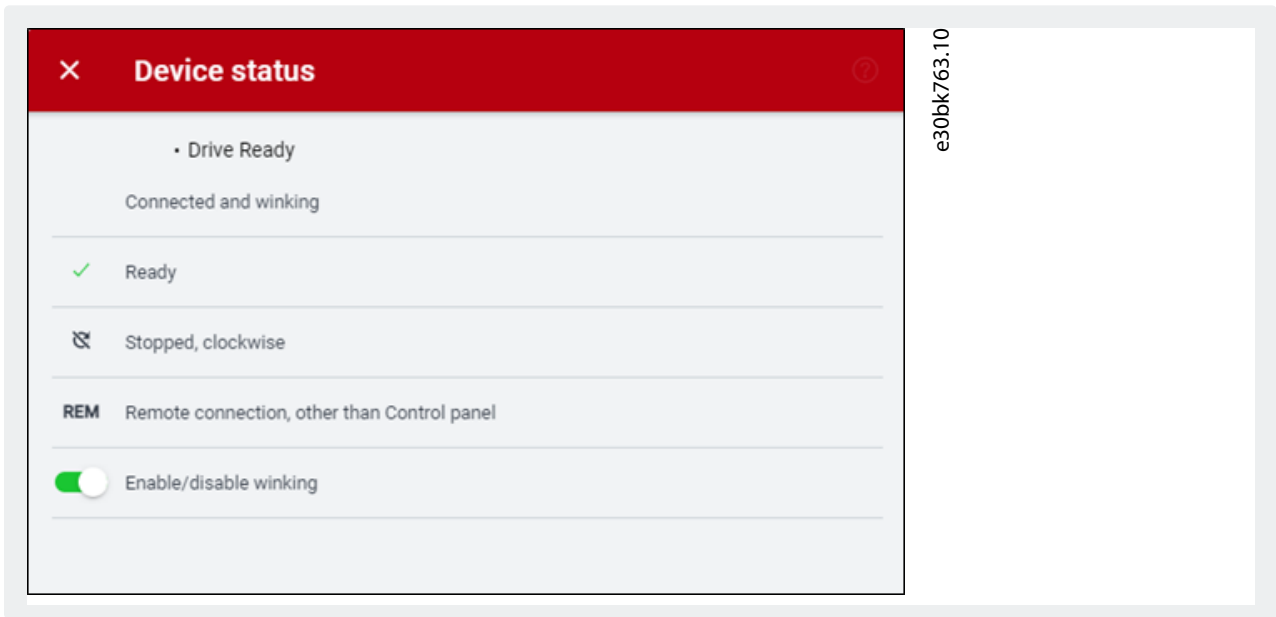
Function	Selections	Description
Source port	<ul style="list-style-type: none"> • X1 • X2 	Frames are mirrored from this port.
Destination port	<ul style="list-style-type: none"> • X1 • X2 	Frames are mirrored to this port.
Block RX from destination port	Enable/Disable	Device does not receive any frames from Destination Port when enabled.
Enable port mirroring	Enable/Disable	Enables the Port Mirroring feature.

6.4 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*.

- To activate or deactivate the feature, click the toggle switch.

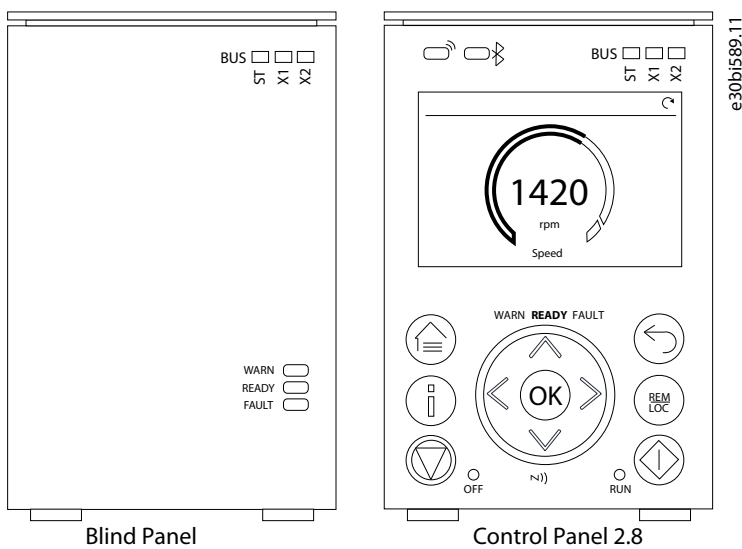


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See [6.5 Fieldbus Indicator LEDs](#) for more information on interpreting the LED signals and where the LEDs are located.

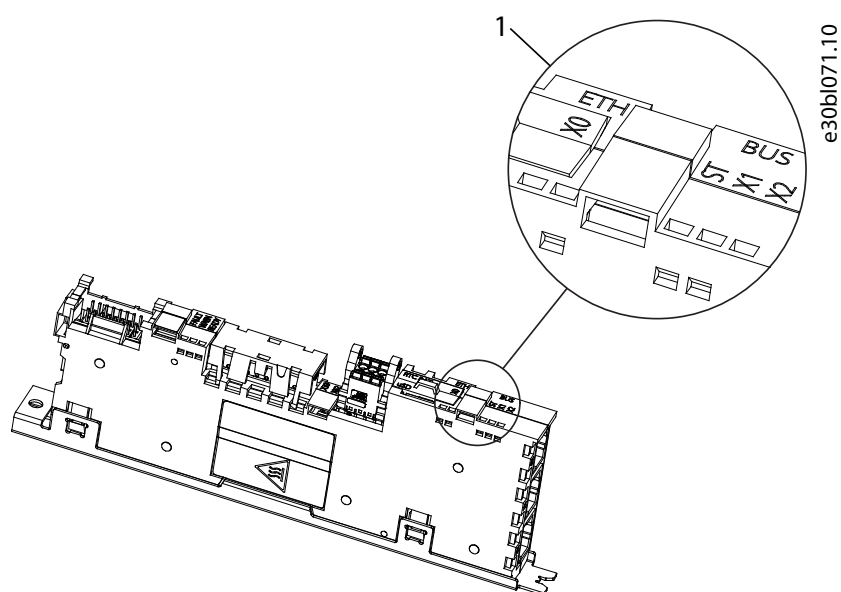
6.5 Fieldbus Indicator LEDs

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.



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Figure 13: Fieldbus Indicator LEDs on Control Panel



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

Figure 14: 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 23: Fieldbus Indicator LED Functions

LED label	Status	LED pattern	Description
ST	DCP blink	Flashing yellow	PROFINET discovery protocol active, 3 s flashing.
	Not configured	Off	PROFINET not configured.
	IO connection faulted	Steady red	A PROFINET IO connection has faulted.
	Configuration mismatch	Flashing red	PROFINET configuration mismatch.
	Configured/No IO connection	Flashing green	Device is configured from PLC master but no IO connection has been established.
	All IO connections OK	Solid green	PROFINET IO connection to device established.
X1/X2	DCP blink	Flashing yellow	PROFINET discovery protocol active, 3 s flashing.
	Link down	Off	–
	Invalid configuration/Duplicated IP address	Solid red	IP configuration error
	Link up	Solid green	Ethernet link is active.

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