

ENGINEERING
TOMORROW



Operating Guide

iC7 Series Modbus

Modbus TCP OS7MT



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1 Introduction and Safety

1.1 Purpose of this Operating Guide

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

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

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

1.2 Additional Resources

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

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

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

1.3 Safety Symbols

The following symbols are used in this guide:

⚠ D A N G E R ⚠

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

⚠ W A R N I N G ⚠

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

⚠ C A U T I O N ⚠

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

N O T I C E

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

1.4 Qualified Personnel

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

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

1.5 Safety Precautions

⚠ W A R N I N G ⚠

HIGH VOLTAGE

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

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

⚠ W A R N I N G ⚠**UNINTENDED START**

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

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

⚠ D A N G E R ⚠**DISCHARGE TIME**

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

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

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

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

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

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

⚠ W A R N I N G ⚠**EQUIPMENT HAZARD**

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

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

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

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

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

1.6 Abbreviations

Abbreviation	Definition
ACD	Address Conflict Detection
BOOL	Boolean
CTW	Control word
DCP	Discovery and configuration protocol
DHCP	Dynamic host configuration protocol
EMC	Electromagnetic compatibility
I/O	Input/Output
IP	Internet protocol
CP	Control panel
LED	Light-emitting diode
LLDP	Link layer discovery protocol
LSB	Least significant bit
MAV	Main actual value
MEI	Modbus encapsulated interface
MRV	Main reference value
MSB	Most significant bit
PC	Personal computer
PCD	Process channel data
PLC	Programmable logic controller
PNU	Parameter number
PPO	Process parameter object
REF	Reference
SNMP	Simple network management protocol
STW	Status word
VLAN	Virtual LAN

1.7 Version History

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

The original language of this guide is English.

Table 1: Version History

Version	Remarks
AQ456329149698, version 01	Initial version

2 Overview

2.1 Modbus Features and Technical Data

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

Table 2: Modbus Model Codes

Model code	Description
+BAMT	Modbus TCP OS7MT

Modbus is a communication protocol developed by Modicon for sending information between electronic devices. In Modbus TCP, the device requesting the information is called the Modbus client, and the devices supplying information are called Modbus servers. The client can also write information to the server. Modbus is typically used to transmit signals from instrumentation and control devices back to a main controller or data gathering system.

Modbus does not feature a dedicated data channel, and therefore Modbus requests are handled as acyclic.

Table 3: Modbus TCP Features

Feature	Technical data
Cyclic response	5 ms response time per variable (read/write non-persistent storage)
Supported Modbus objects	Coils (1 bit): Read-write
	Input register (16 bits): Read-only
	Holding register (16 bits): Read-write
Connection	PRP (Parallel Redundancy Protocol)
	LLDP/SNMP
	IPv4
	Addressing mode: DCP, STATIC, DHCP/BOOTP
Configuration	MyDrive® Insight

2.2 Communication Profiles and Objects

Communication profiles are selected in parameter *10.3.1.2 Fieldbus profile*.

For Modbus, the fieldbus profile can also be selected via Holding Register location 1.

Table 4: Communication Profiles and Supported Applications

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

Product	Application Software	Profile
	DC/DC Converter	iC DC/DC Converter Profile
iC7-Marine	Propulsion and Machinery	<ul style="list-style-type: none"> • PROFIdrive • iC Speed Profile • iC Generic Profile
	Active Front End	iC Grid Converter Profile

2.2.1 iC Speed Profile

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

2.2.1.1 Control Word (CTW) in iC Speed Profile

Table 5: iC Speed Profile Control Word Bits

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

Bit number	Name	Description
10	Data valid	<p>1 = Uses the process data (control by PLC).</p> <p>0 = Ignores the current process data. This is linked to the submodule where the CTW is present. If signals are to be covered, the CTW/STW profile (for example, the iC Speed Profile) must be part of the signals list.</p> <p>Uses the previously processed data when the data valid bit was true (no control by PLC).</p>
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	

2.2.1.2 Status Word (STW) in iC Speed Profile

Table 6: iC Speed Profile Status Word Bits

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

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

2.2.2 PROFIdrive – Standard Telegram 1

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

2.2.2.1 Control Word (CTW) in PROFIdrive Standard Telegram 1

Table 7: 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.
3	Operation	1 = Enable operation. 0 = Disable operation.
4	Ramp generator	1 = Enable Ramp generator (RFG). 0 = Reset Ramp generator. Output of the RFG is set to 0. The drive decelerates along the current limit or along the voltage limit of the DC link.
5	Freeze	1 = Unfreeze ramp generator. 0 = Freeze ramp generator. Freezes the present output frequency (in Hz).

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

2.2.2.2 Status Word (STW) in PROFIdrive Standard Telegram 1

Table 8: 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).

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

2.2.2.3 PROFdrive State Machine

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

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

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

The general state diagram is defined in the PROFdrive standard.

e30bk784.10

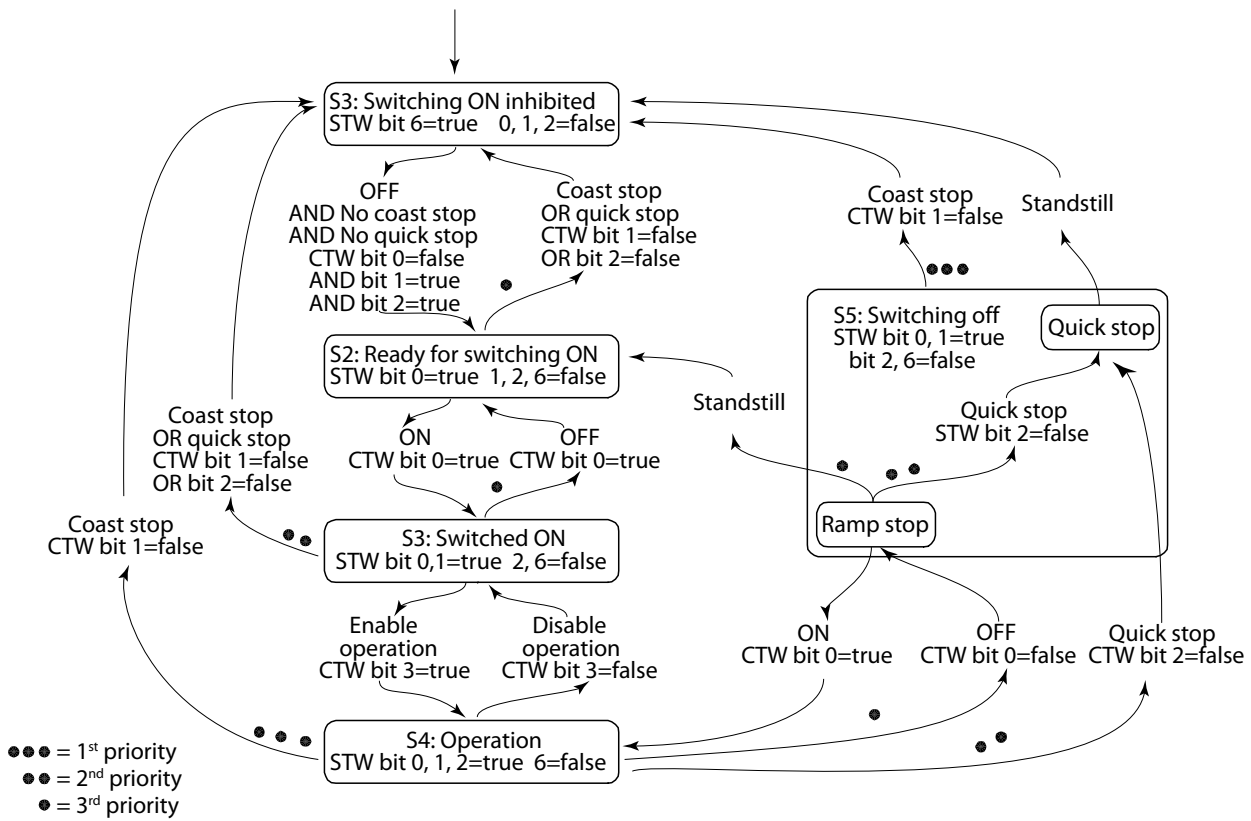


Illustration 1: General State Diagram

2.2.3 iC Grid Converter Profile

2.2.3.1 Control Word (CTW) in iC Grid Converter

Table 9: Fieldbus Control Word

Bit	Name	Description	Further information
0	Switch On Enable	0: Pre-charging ⁽¹⁾ , closing the main circuit breaker ⁽¹⁾ , and running are prevented or interrupted. If the main circuit breaker is closed, it is opened ⁽¹⁾ . 1: Pre-charging ⁽¹⁾ , closing the main circuit breaker ⁽¹⁾ , and running are not prevented or interrupted.	This bit is used with control word bit 3 to enable operation of the unit. When this bit is set to false while running, the unit stops. As shown in the state diagram, to transition from S1 to S2, this bit must be false, otherwise switching on keeps from being inhibited.
1	MCB Close Enable	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⁾ .	This bit is used to move from S1 to S2 and allows MCB to close when charging is completed. If the bit is removed anytime during operation, then the unit comes back to S1.
2	Quick Stop Inverse	0: Activate Quick Stop. 1: Do not activate Quick Stop.	This bit is used to request a quick stop to be executed. When the bit is set to false during operation, the unit stops modulation, and depending on the configuration an exception is issued.
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-charge ⁽²⁾ , closing the main circuit breaker ⁽²⁾ , and start running), or keep the unit running.	A rising edge is required for DC-link pre-charge to start. Depending on parameter number 5114, a rising edge can be required for the unit to start. In that case, if for any reason the unit cannot be started when the rising edge is detected, it will not start until a new rising edge is issued.

Bit	Name	Description	Further information
4	Pre-charge	0: Stop the DC-link pre-charge, if ongoing. 1: Start or continue the DC-link pre-charge.	This bit is only used when the DC-link pre-charge is controlled by the application.
5	--	Reserved	
6	--	Reserved	
7	Event Reset	0: No action 1: Reset active events.	This bit is used to acknowledge faults in the converter. A raising edge (a transition false to true) on this bit issues an event reset request.
8	--	Reserved	
9	--	Reserved	
10	Data Valid	0: Ignore the current incoming process data values, instead use the last processed value when the <i>Data Valid</i> bit was true. 1: Use the current incoming process data values.	For Modbus protocol, this bit currently applies to control word only. For bit 11 ("Watchdog"), the current control word value is used regardless. The default control word value is 0x5. When the <i>Data Valid</i> bit is false, the default value is used as the initial value, and whenever the fieldbus watchdog supervision fault is active (event number 5161 is active, when configured as a fault).
11	Watchdog	Incoming <i>Watchdog</i> bit from customer.	This is the input bit used for the fieldbus watchdog.
12	Vendor Specific Bit 1	0: Deactivate the vendor-specific function using digital input/output virtual slot 6412. 1: Activate the vendor-specific function using digital input/output virtual slot 6412.	
13	Vendor Specific Bit 2	0: Deactivate the vendor-specific function using digital input/output virtual slot 6413. 1: Activate the vendor-specific function using digital input/output virtual slot 6413.	
14	Vendor Specific Bit 3	0: Deactivate the vendor-specific function using digital input/output virtual slot 6414. 1: Activate the vendor-specific function using digital input/output virtual slot 6414.	
15	Vendor Specific Bit 4	0: Deactivate the vendor-specific function using digital input/output virtual slot 6415. 1: Activate the vendor-specific function using digital input/output virtual slot 6415.	

¹ If controlled by the grid converter unit

² If applicable

2.2.3.2 Status Word (STW) in iC Grid Converter

Table 10: Fieldbus Status Word

Bit	Name	Description	Additional Information
0	Ready to Switch On	0: Unit is not ready to switch on 1: Unit is ready to switch on	This bit indicates that the unit is ready to start the start-up sequence (charging and/or MCB closure, if controlled by the application). This bit is true, if: <ul style="list-style-type: none"> • <i>Switch On Enabled</i> is active • <i>MCB close Enabled</i> is active • Quick Stop is not requested • There are no active faults This bit has the same behavior as the corresponding digital input, if present.
1	Power Unit Ready	0: Power unit is not ready to run 1: Power unit is ready to run	When this bit is true, it indicates that the unit can be successfully started.
2	Running	0: Unit is in stop state 1: Unit is running	This bit indicates whether the unit is operating (modulating).
3	Fault	0: No active faults 1: One or more faults are active	This bit indicates the presence of one or more active fault level events.
4	--	Reserved	
5	Quick Stop Inverse	0: Quick stop is active 1: Quick Stop is not active	This bit indicates whether the quick stop command is active or not.
6	--	Reserved	
7	Warning	0: No active warnings. 1: One or more warnings are active	This bit indicates the presence of 1 or more active warning level events.
8	--	Reserved	
9	Controlled by PLC	0: The active control place is not the fieldbus 1: The active control place is the fieldbus	
10	--	Reserved	
11	Run Enabled	0: Run enable signal from dedicated input is missing 1: Run enable signal from dedicated input is present	
12	--	Reserved	
13	--	Reserved	
14	--	Reserved	
15	Watchdog	Bit used for the fieldbus watchdog.	Mirroring control word bit 11.

2.2.4 iC DC/DC Converter Profile

2.2.4.1 Control Word (CTW) in iC DC/DC Converter

Table 11: Fieldbus Control Word

Bit	Name	Description	Further Information
0	Switch On Enable	0: Running is prevented or interrupted 1: Running is not prevented or interrupted	
1	--	Reserved	
2	Quick Stop In-verse	0: Initiate quick stop 1: No action	
3	Start	0: Stop modulation if the unit is running 1: Start modulation or keep the unit running	Depending on parameter 5114, a rising edge is or is not required for the unit to start modulation.
4	--	Reserved	
5	--	Reserved	
6	--	Reserved	
7	Fault Reset	0: No action 1: Reset active faults and other events	Edge sensitive - a reset command is issued when a rising edge is detected.
8	--	Reserved	
9	--	Reserved	
10	Data Valid	0: Ignore the current incoming process data values, instead use the last processed value when the <i>Data Valid</i> bit was true. 1: Use the current incoming process data values	In Modbus protocol, the incoming process data refers to the control word only, excluding bit 11 <i>Watchdog</i> .
11	Watchdog	Incoming fieldbus <i>Watchdog</i> bit	
12	Vendor Specific Bit 1	0: Deactivate the vendor-specific function using digital input/output virtual slot 6412 1: Activate the vendor-specific function using digital input/output virtual slot 6412	
13	Vendor Specific Bit 2	0: Deactivate the vendor-specific function using digital input/output virtual slot 6413 1: Activate the vendor-specific function using digital input/output virtual slot 6413	
14	Vendor Specific Bit 3	0: Deactivate the vendor-specific function using digital input/output virtual slot 6414 1: Activate the vendor-specific function using digital input/output virtual slot 6414	
15	Vendor Specific Bit 4	0: Deactivate the vendor-specific function using digital input/output virtual slot 6415	

Bit	Name	Description	Further Information
		1: Activate the vendor-specific function using digital input/output virtual slot 6415	

2.2.4.2 Status Word (STW) in iC DC/DC Converter

Table 12: Fieldbus Status Word

Bit	Name	Description	Additional Information
0	Ready to Switch On	0: Not ready to switch on 1: Ready to switch on	This bit is true if all following conditions are satisfied: <ul style="list-style-type: none"> • Switch on enable is present. • Quick stop is not requested. • No faults are active.
1	Converter Ready	0: The converter is not ready to start (Check the <i>DC/DC Ctrl. Ready Status Word</i>) 1: The converter is ready to start modulating, if Ready to Switch On is true and all the start and run interlocks are present	
2	Running	0: The unit is not running (modulating) 1: The unit is running (modulating)	
3	Fault	0: No faults active 1: One or more faults are active	
4	--	Reserved	
5	Quick Stop Inverse	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	Outgoing fieldbus watchdog bit	

2.3 Network Topologies

Communication interface X1/X2 is used for fieldbus connection.

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

- Line topology
- Star topology
- Ring topology

2.3.1 Line Topology

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

NOTICE

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

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

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

NOTICE

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

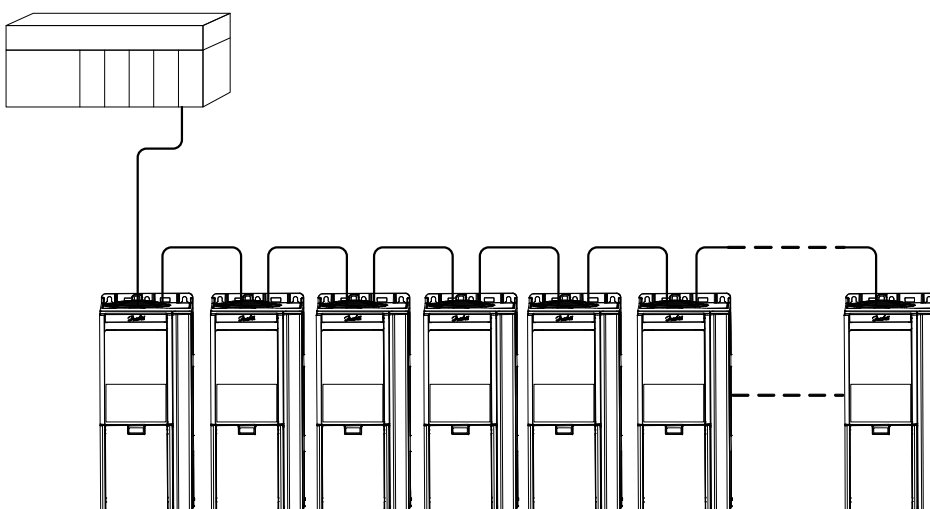


Illustration 2: Example of Line Topology

NOTICE

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

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

2.3.2 Star Topology

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

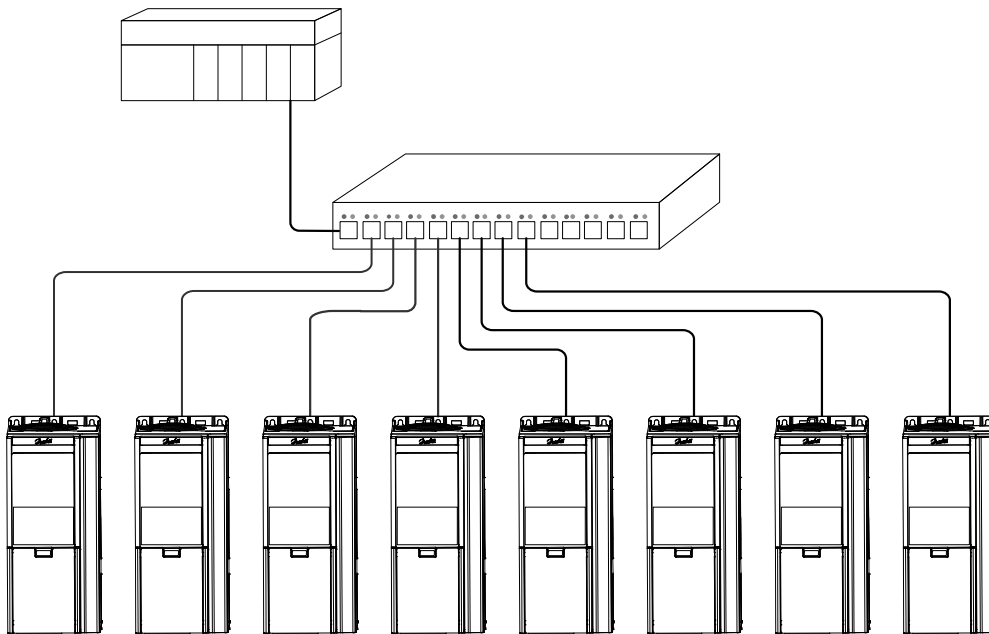


Illustration 3: Example of Star Topology

2.3.3 Ring Topology

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

The ring topology protocol depends on the protocol in use.

Modbus uses the parallel redundancy protocol (PRP). PRP is a layer 2 network protocol that enables a redundant topology in an Ethernet network. PRP provides uninterrupted switchovers in failure situations, and is independent of the application.

For more information on configuring parallel redundancy protocol (PRP), see [5.4 Configuring Parallel Redundancy Protocol](#).

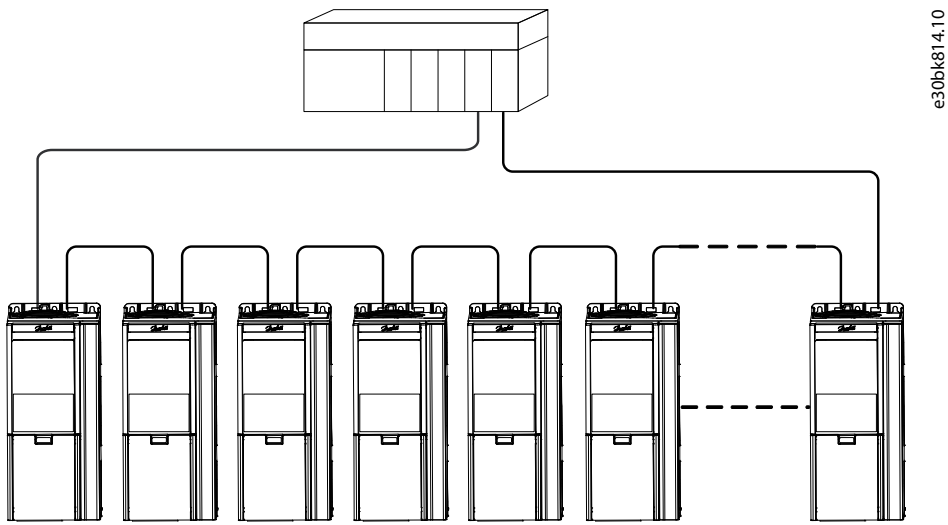


Illustration 4: Example of Ring Topology

3 Modbus Data Mapping

3.1 Mapping Modbus Coils

A Modbus coil is a single-bit binary data item which can be both read and written. Coils can be mapped to specific bits in a parameter by using the customization feature in MyDrive® Insight.

Only bit-type parameters can be mapped to coils. The source type must be INT, UINT, USINT, DINT, UDINT, WORD, or BOOL.

1. In MyDrive® Insight, go to *Customization* → *Live* → *MODBUS* → *Coils*.
 - a. To add a single coil, click the + *Add Item* icon.
 - b. To map multiple coils to a single parameter, click the – *Add Multiple Items* icon.

Table 13: Coil Mapping Settings

Column	Description
Location	Refers to the coil number. Coils are mapped from address 00000–0FFFF.
Reference type	<ul style="list-style-type: none"> - Terminal: Mapping a terminal on an option to a coil. - Parameter: Mapping a specific bit of a parameter to a coil. - Feature: functions such as store and restore.
Reference	The name of the mapped parameter, feature, or event.
Source type	Data type of mapped parameter
Index	Index pointer for array parameters
Bit number	Mapped bit number of the selected parameter. 0 refers to the 1st bit.
Permissions	Setting Read/Write permissions for each coil.
Watchdog	<ul style="list-style-type: none"> - Watchdog1: Process data timeout watchdog Timeout time is configured in parameter <i>10.3.1.6 Process Data Timeout Time</i>. The Watchdog timer is (re)triggered when writing to the mapped coil or register. - Watchdog2: Not used

3.2 Mapping Modbus Holding Registers

A Modbus holding register is a bit binary data item which can be both read and written.

Registers can be mapped to a specific parameter by using the customization feature in MyDrive® Insight.

The first 19 holding registers are pre-mapped or reserved and cannot be changed. From location 20 onwards, registers can be mapped freely.

N O T I C E

The parameter mapped to 1 register can be re-mapped to another register.

Table 14: Modbus Holding Registers

Location	Reference Type	Reference (parameter number)
1	Parameter	Fieldbus profile (1301)
2	Parameter	Fieldbus Control Word (1335)
3	Parameter	Fieldbus Main Reference (1339)
4	Parameter	Reserved
5	Parameter	Reserved
6	Parameter	Reserved
7	Parameter	Reserved
8	Parameter	Reserved
9	Parameter	Reserved
10	Parameter	Fieldbus Status Word (1307)
11	Parameter	Fieldbus Main Actual Value (1308)
12	Parameter	Reserved
13	Parameter	Reserved
14	Parameter	Reserved
15	Parameter	Reserved
16	Parameter	Reserved
17	Parameter	Reserved
18	Parameter	Reserved
19	Parameter	Reserved
20
...

1. In MyDrive® Insight, go to *Customization* → *Live* → *MODBUS* → *Holding Registers*.
 - a. To add a single register, click the + *Add Item* icon.

- b. To map multiple registers, click the – *Add Multiple Items* icon.

Column	Description
Location	Refers to the register number. Registers are mapped from address 40000–4FFFF.
Reference type	<ul style="list-style-type: none"> - Terminal: Mapping a terminal on an option to a register. - Parameter: Mapping a parameter to a register. - Constant: Mapping a constant value to a register. - Feature: Mapping a register to a feature, for example, <i>Factory restore</i>. - Event: Mapping events to registers.
Reference	The name of the mapped parameter, feature, or event. Value for <i>Constant</i> type.
Source type	Data type of mapped parameter
Index	Index pointer for array parameters
Length	Number of bytes for string-type parameters.
Register type	Data type of the mapped parameter By default, the Customizer selects a register type that matches the data type of the selected parameter.
Scaling	Scales the parameter value on the Modbus interface by dividing it by the scaling value entered.
Unit	Unit of the mapped parameter
Permissions	Setting Read/Write permissions for each register
Watchdog	<ul style="list-style-type: none"> - Watchdog1: Process data timeout watchdog Timeout time is configured in parameter <i>10.3.1.6 Process Data Timeout Time</i>. The Watchdog timer is triggered when writing to the mapped coil or register. - Watchdog2: Not used

Example

Mapping parameter of the REAL 32-bit datatype results in 2 consecutive register mappings.

Table 16: Example of a Holding Register Mapping

Location	Reference Type	Reference (parameter number)	Source Type	Register Type
20	Parameter	Motor Current (9000)	REAL	Two Consecutive Floating point
22	Parameter	Heat Sink Temperature (2950)	REAL	Two Consecutive Floating point
24

Events from the device event log can be mapped into holding registers, starting from the most recent event.

Each Event results in six consecutive register mappings.

Table 17: Example of an Event Register Mapping

Register	Description	Format
n	Timestamp	Seconds/milliseconds [SS.SSS] ⁽¹⁾
n+1		Hours/Minutes [HHMM] ⁽¹⁾

Register	Description	Format
n+2		Month/Day [MMDD] ⁽¹⁾
n+3		Year [YYYY] ⁽¹⁾
n+4	Event Type	MSB: 0 = Inactive event. MSB: 1 = Active event. LSB: 010 = Info. LSB: 011 = Warning. LSB: 100 = Fault.
n+5	Event Code	See the relevant application guide.

¹ Readable in hexadecimal format.

NOTICE

A mismatch between the datatype and register type issues a warning of possible data loss.

3.3 Mapping Modbus Input Registers

A Modbus input register is a 16-bit read-only value.

Input registers can be mapped to specific parameters by using the customization feature in MyDrive® Insight.

1. In MyDrive® Insight, go to *Customization* → *Live* → *MODBUS* → *Input Registers*.
 - a. To add a single register, click the + *Add Item* icon.
 - b. To map multiple registers, click the – *Add Multiple Items* icon.

Table 18: Input Register Settings

Column	Description
Location	Refers to the coil number. Registers are mapped from address 30001–39999.
Reference type	<ul style="list-style-type: none"> - Parameter: Mapping a register to a parameter. - Constant: Mapping a register to a constant value. - Event: Mapping events to registers.
Reference	The name of the mapped parameter, feature, or event. Value for <i>Constant</i> type.
Source type	Data type of mapped parameter
Index	Index pointer for array parameters
Length	Length as number of bytes for string-type parameters.
Register type	Data type of the mapped parameter By default, the Customizer selects a register type that matches the data type of the selected parameter.
Scaling	Scales the parameter value on the Modbus interface by dividing it by the scaling value entered.
Unit	Unit of the mapped parameter

3.4 Setting Permissions

Permissions can be set either in the *Permissions* column in the mapping view, or in the *Permissions* view in MyDrive® Insight.

1. In MyDrive® Insight, go to *Customization* → *Live* → *MODBUS* → *Permissions*.
2. Set the Read/Write permission for coils and registers:
 - By using the *Permissions* column in the mapping view.
 - By using the *Permissions* view in MyDrive® Insight.

N O T I C E

- The default selection *ALL* is overwritten by the individual settings for each coil, or register. If the permission is not set for a specific coil, or register, the selection *ALL* is predominant.

3.5 Saving Modbus Configuration to a Device

After the Modbus mapping is finalized, the configuration can be saved as a new project or added to an existing MyDrive® Insight project.

1. To save a configuration, click the *Save* icon.
2. To deploy the configuration directly into a device, click the *Download* icon to create and save an export package (*.vpkg).
3. After exporting the configuration, update and power-cycle the device with the exported software package.

Package name (Default: Fully Qualified Domain Name)	###
Package version (Default: 1.0.0)	###

4 Fieldbus Cable Connections

4.1 Prerequisites for Installation

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

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

4.2 Installation in Frequency Converters

4.2.1 Communication Interface X1/X2 in Frames FA02–FA12

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

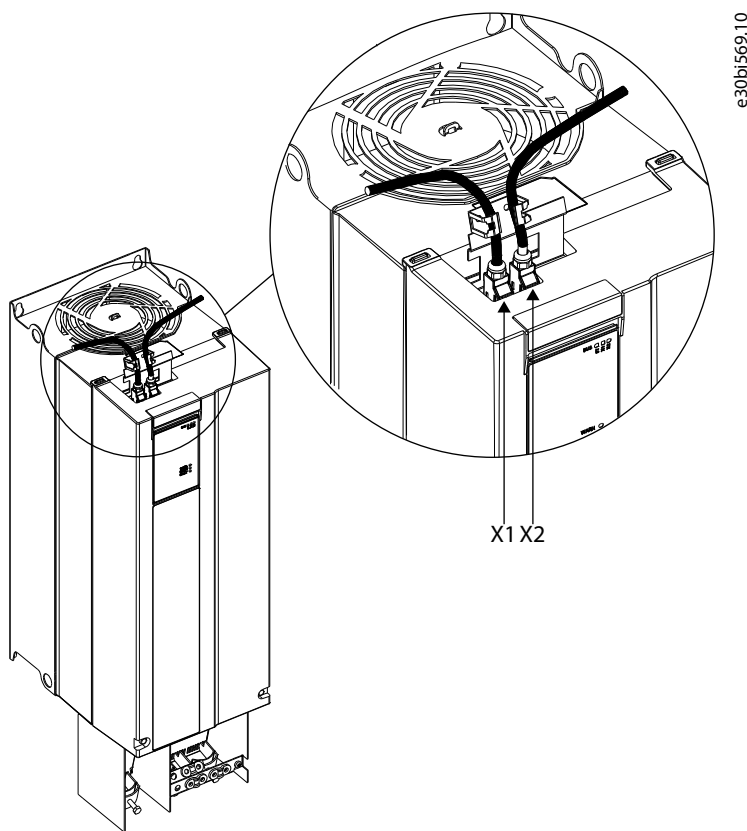


Illustration 5: Location of the Communication Interface, X1/X2 in FA02-FA12 Frames (with the Optional EMC Plate)

4.2.2 Communication Interface X1/X2 in Frames FK06–FK12

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

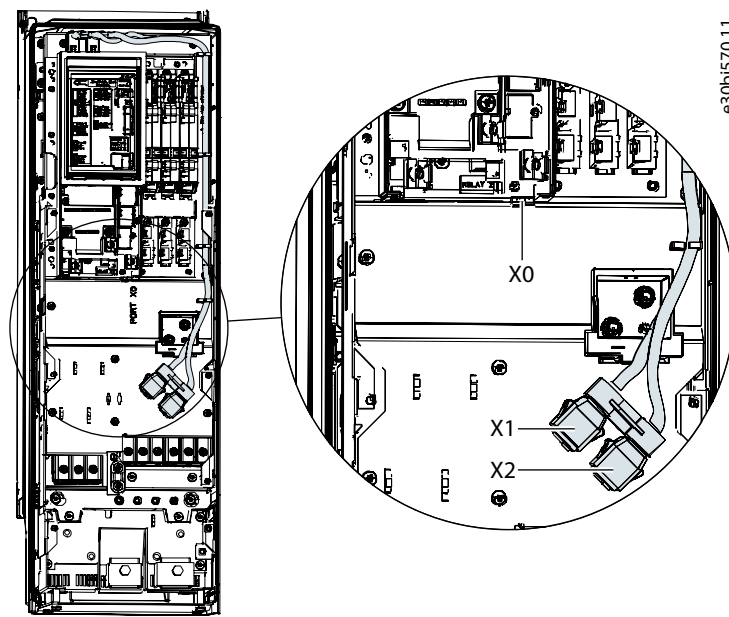


Illustration 6: Communication Port X0, X1, and X2 Locations in FK06–FK08 Frames

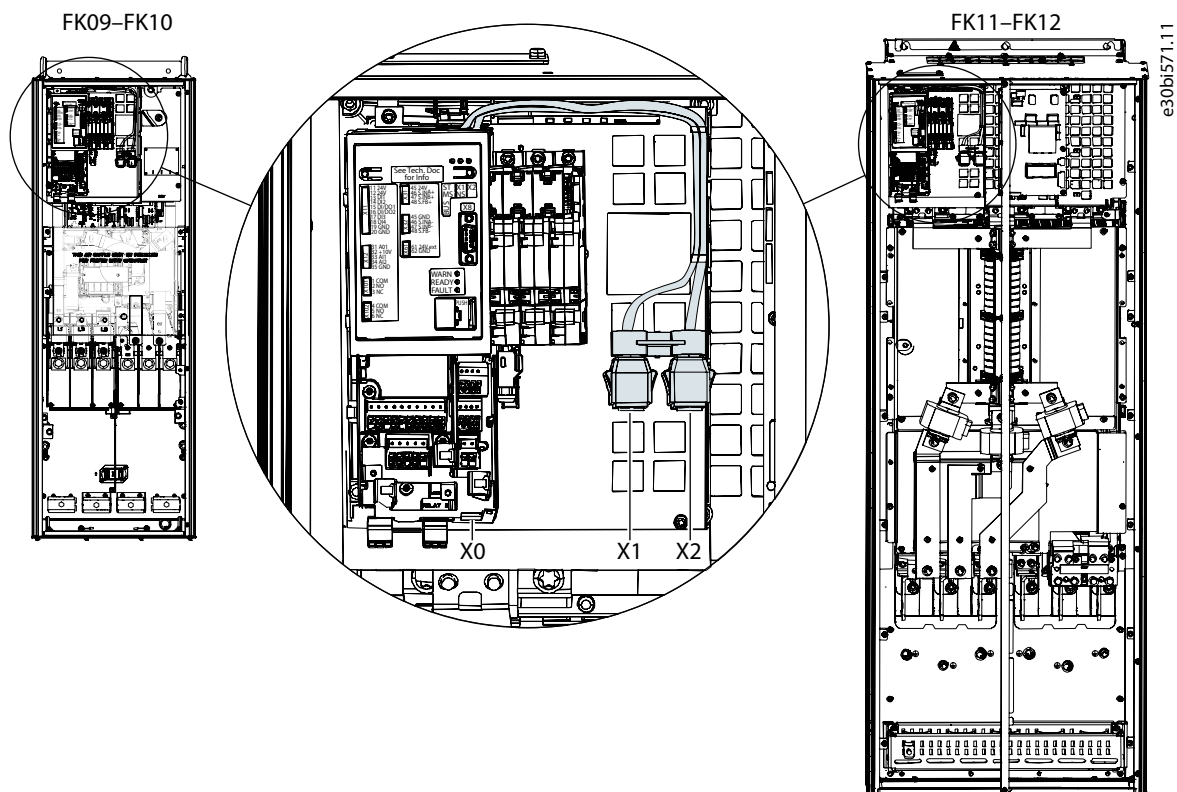


Illustration 7: Communication Port X0, X1, and X2 Locations in FK09–FK12 Frames

4.3 Installation in System Modules

4.3.1 Communication Interface X1/X2 in System Modules

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

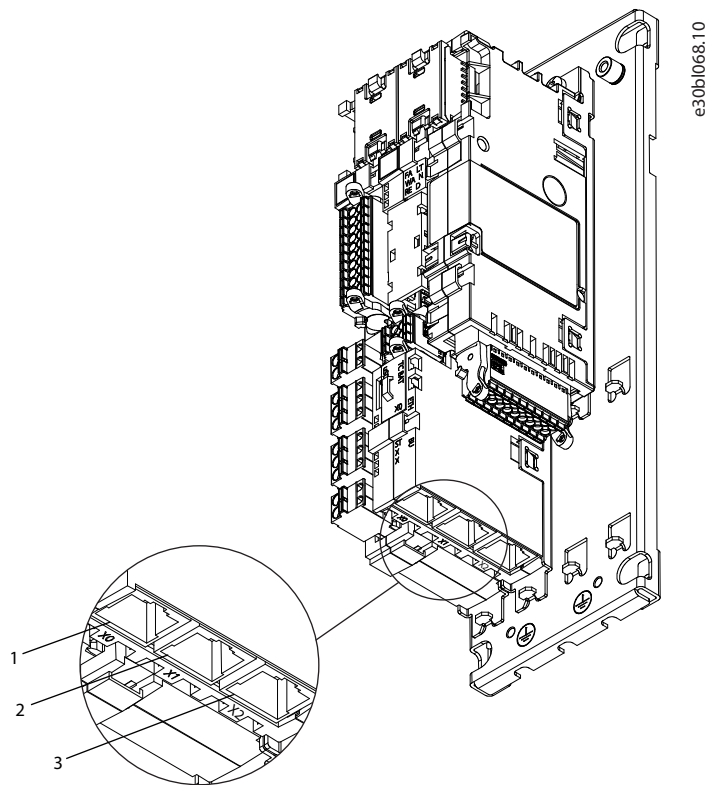


Illustration 8: Communication Port X0, X1, and X2 Locations in System Modules

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

4.4 EMC-compliant Installation

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

4.4.1 Grounding

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

4.4.2 Cable Routing

NOTICE

EMC INTERFERENCE

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

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

NOTICE

CABLE ROUTING

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

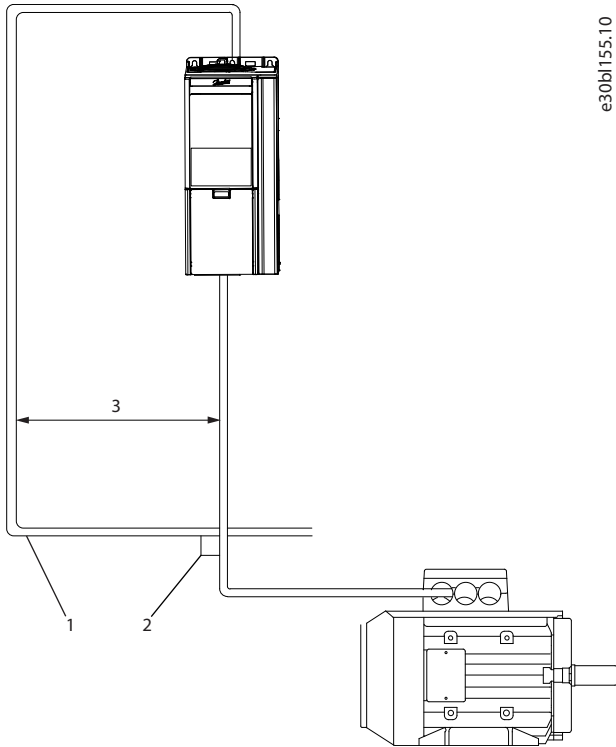


Illustration 9: Cable Routing

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

5 Modbus Configuration

5.1 General Connectivity Settings

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

Table 19: General Connectivity Parameters

Menu index	Parameter	Parameter number	Value	Description
10.3.1.2	<i>Fieldbus profile</i>	1301	<ul style="list-style-type: none"> iC Speed Profile (default) PROFIdrive Standard telegram 1 	Select the fieldbus profile. The selection affects the interpretation of the control word and status word.
10.3.1.3	<i>Fieldbus Fault Response</i>	1303	<ul style="list-style-type: none"> Info (default) Warning Fault, Ramp to Coast Fault, coast See Table 20 for descriptions of the events.	Select the behavior when a fieldbus fault, for example loss of I/O connection occurs.
10.3.1.4	<i>No Fieldbus Connection Response</i>	1327	<ul style="list-style-type: none"> Info (default) Warning Fault, Ramp to Coast Fault, coast See Table 20 for descriptions of the events.	Select the response if there is no fieldbus connection.
10.3.1.6	<i>Process Data Timeout Time</i>	1340	0.05–18000 s (Default value: 1.00 s)	Set the timeout time. If process data is not received within the time set, a process data timeout is triggered.
10.3.1.12	<i>Process Data Timeout Response</i>	1341	<ul style="list-style-type: none"> Info Warning Warning – Change Control Place Warning – Change Control Place Persistent Fault, Ramp to coast Fault (default) See Table 20 for descriptions of the events.	Select the response in case there is no fieldbus connection.
10.3.1.13	<i>Process Data Timeout Control Place</i>	112	<ul style="list-style-type: none"> Local control (default) Fieldbus control I/O control Advanced control See Table 21 for descriptions of the control places.	Select the alternate control place to be used if there is a fieldbus timeout. This is only valid with a timeout warning or info.

Table 20: Event Descriptions

Value	Description
Info	The event is logged in the event log.
Warning	The drive issues a warning.

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

Table 21: Control Place Descriptions

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

5.2 iC7-Automation Reference Handling

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

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

Table 22: Reference Handling Parameters

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

For some applications, reversing is not wanted.

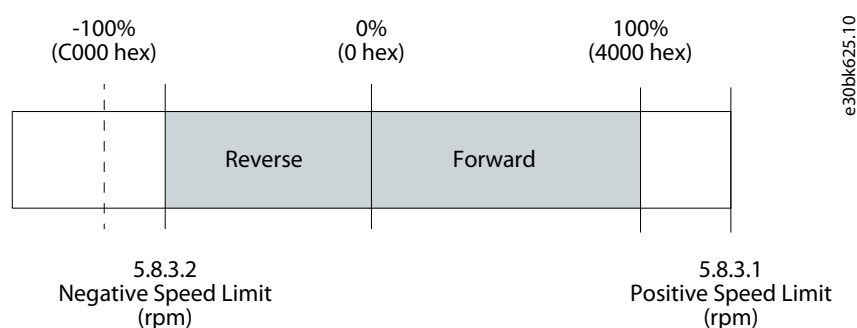


Illustration 10: Example of Fieldbus Speed Reference in iC7-Automation

5.3 Configuring Ethernet Interface

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

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

1. Configure IPv4 settings.

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

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

Table 24: Ethernet Port Configuration (X1/X2)

Menu Index	Function	Value	Description
10.2.5.2.5	Link configuration	- AutoNeg	Configures the Ethernet link parameter.
10.2.6.2.5		- 10 MbpsFullDuplex - 10 MbpsHalfDuplex - 100 MbpsFullDuplex - 100 MbpsHalfDuplex	

5.4 Configuring Parallel Redundancy Protocol

Parallel Redundancy Protocol (PRP) is based on the parallel transmission of information by sending duplicate frames to 2 independent network infrastructures known as LAN A and LAN B. Each PRP node has a connection to each of the networks called double attached nodes (DAN) in PRP terminology.

PRP is implemented in the end devices only. The Ethernet switches in the network have no specific PRP capabilities. Standard devices with a single network interface are referred to as single attached nodes (SAN) and can by default be connected directly to 1 of the 2 networks. Alternatively, a SAN can be connected via a redundancy box (RedBox) that connects 1 or more SANs to both LAN A and LAN B networks.

1. In MyDrive® Insight, go to *Interface configuration* → *Ethernet Redundancy* → *PRP* → *Settings* to configure PRP settings.

Function	Value	Description
PRP Interface	<ul style="list-style-type: none"> - Disabled (default) - Enabled X1/X2 	Enables or disables PRP on the X1/X2 interface.
Enable VLAN	<ul style="list-style-type: none"> - Disabled (default) - Enabled 	Enables or disables the transmissions of VLAN ID in the PRP supervision frames.
VLAN id	0-65535	VLAN ID used in PRP supervision frames when VLAN is enabled.

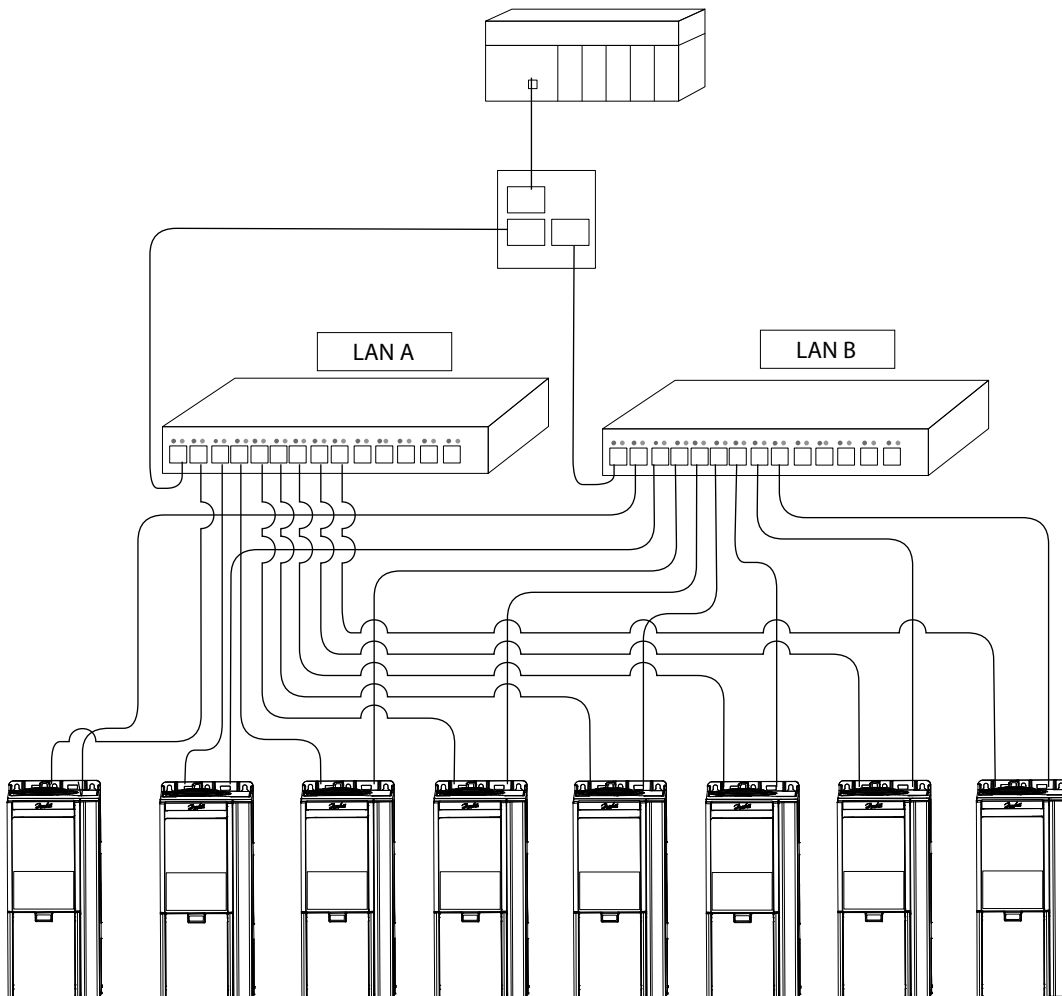
2. In MyDrive® Insight, go to *Interface configuration* → *Ethernet Redundancy* → *PRP* → *Status* to check PRP status.

Function	Description
Valid frames on LAN A	Valid frames received on LAN A with a valid sequence number.
Valid frames on LAN B	Valid frames received on LAN B with a valid sequence number.
Duplicate frames on LAN A	Valid frames received on LAN A dropped by duplicate detection.
Duplicate frames on LAN B	Valid frames received on LAN B dropped by duplicate detection.
Wrong LAN ID frames on LAN A	Valid frames received in LAN A with mismatching LAN ID.
Wrong LAN ID frames on LAN B	Valid frames received in LAN B with mismatching LAN ID.
Missing frames	The counter is incremented if there is a jump in the sequence number, indicative of frame drop in both LANs.
Out of sequence on LAN A	Valid and accepted frames received on LAN A with an unexpected sequence number.
Out of sequence on LAN B	Valid and accepted frames received on LAN B with an unexpected sequence number.
Out of sequence low on LAN A	Valid and accepted frames received on LAN A with a sequence number outside duplicate window.
Out of sequence low on LAN B	Valid and accepted frames received on LAN B with a sequence number outside duplicate window.
Warning count on LAN A	The counter is incremented if wrong frames or no PRP frames are received on LAN A.
Warning count on LAN B	The counter is incremented if wrong frames or no PRP frames are received on LAN B.

NOTICE

When configuring PRP, it is important to notice the assignment of the Ethernet ports:

- X1 = LAN A
- X2 = LAN B



e30bl146.10

Illustration 11: Example of Parallel Redundancy

5.5 Configuring Modbus Unit Identifier

In Modbus TCP, the device is addressed by its IP address, and the server ID is replaced by a single-byte unit identifier.

NOTICE

Value 255 (0xFF) must be used for the Modbus unit identifier (client ID).

When configuring the Modbus PLC client, a server ID, or a server address is used to address the serial Modbus RTU devices in the range of 1–247.

In Modbus TCP, an IP address and a single-byte unit identifier are used to address the device.

5.6 Configuring Modbus Data Settings

Use MyDrive® Insight or the control panel to select persistent storage and the byte and word order for Modbus communication.

- Using MyDrive® Insight or the control panel, navigate to parameter 10.3.3.2.

Table 25: Parameters for Modbus Data Settings

Menu index	Parameter name	Value	Description
10.3.3.2.1	<i>Persistent Storage</i>	<ul style="list-style-type: none"> - Disable - Enable 	Persistent Storage enables storing parameters written via Modbus in non-volatile memory. <div style="border: 1px solid black; padding: 5px; margin-top: 10px;"> <p style="text-align: center; margin: 0;">NOTICE</p> <p style="margin: 0;">Enabling <i>Persistent Storage</i> causes a decrease in Modbus communication performance.</p> </div>
10.3.3.2.3	<i>Byte Order</i>	<ul style="list-style-type: none"> - Little Endian - Big Endian (default) 	Byte order of holding register.
10.3.3.2.4	<i>Word Order</i>	<ul style="list-style-type: none"> - Little Endian (default) - Big Endian 	Word order when mapping parameters (for example, 32-bit REAL) in multiple registers.

6 Troubleshooting

6.1 Configuring Port Mirroring Settings

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

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

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

6.2 Identifying a Drive

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

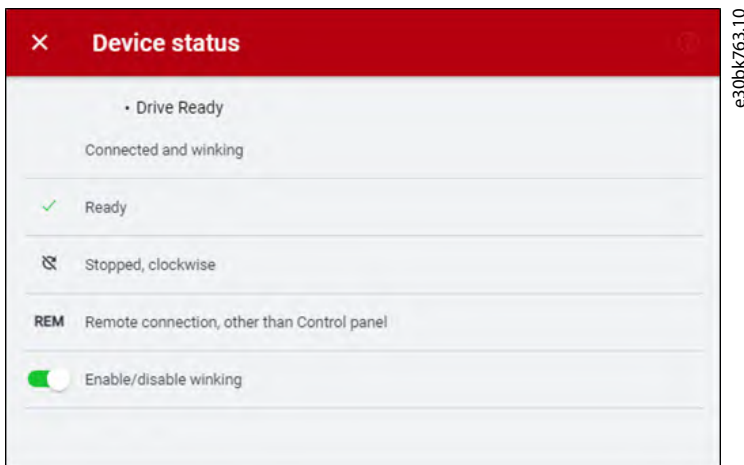


Illustration 12: Enabling Winking in MyDrive® Insight

See [Table 27](#) for more information on interpreting the LED signals.

6.3 Fieldbus Indicator LEDs

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

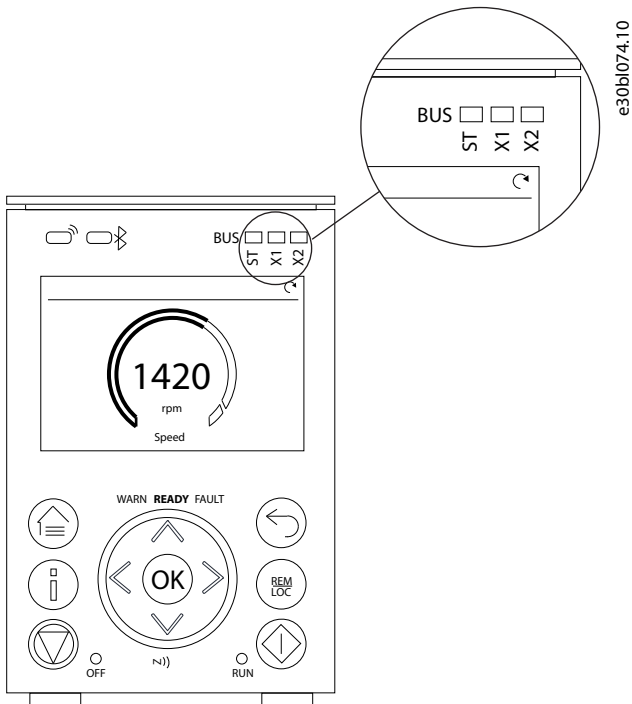


Illustration 13: Fieldbus Indicator LED Location on Control Panel

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

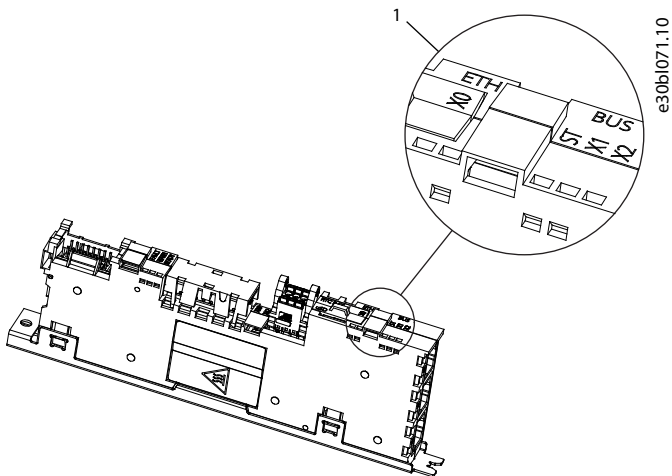


Illustration 14: Fieldbus Indicator LEDs on Modular Control Board

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

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

Table 27: Fieldbus Indicator LED Functions

LED label	Status	LED pattern	Description
ST	Standby	Flashing green	No active Modbus TCP connections.
	I/O connection ok	Solid green	Modbus TCP connection active.

LED label	Status	LED pattern	Description
	Lost Modbus connection	Flashing red	A Modbus TCP connection has failed, but 1 is still active (loss of I/O connection).
	Lost all Modbus connections	Steady red	Modbus TCP connections have failed (no I/O connection).
X1/X2	Link down	Off	–
	Link up	Solid green	Ethernet link is active.
	Cable fault	Solid yellow	The device has detected an Ethernet cable fault.
	Collision	Flashing yellow	Collision detected.
	Duplicated IP address	Solid red	IP configuration error.

7 Modbus Features

7.1 Data Objects

Table 28: Supported Modbus Object Types

Object type	Access	Size
Coil	Read/write	1 bit
Input register	Read only	16 bits
Holding register	Read/write	16 bits

7.2 Function Codes

The function code of a message frame contains 8 bits. Valid codes are in the range of 1–FF. Use function codes to send messages between client and server. When a message is sent from a client to a server device, the function code tells the server which action to perform. When the server responds to the client, it uses the function code to indicate either a normal (error-free) response, or that some error occurred (called an exception response). For a normal response, the server echoes the original function code. For an exception response, the server returns a code that is equivalent to the original function code with its most significant bit set to logic 1. Furthermore, the server places a unique code into the data field of the response message. It tells the client which error occurred, or the reason for the exception.

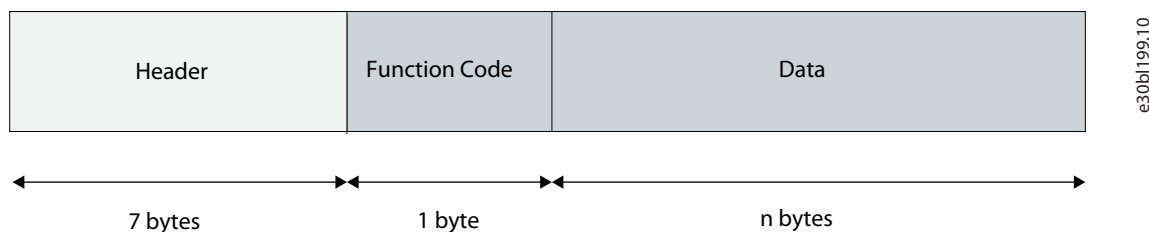


Illustration 15: Modbus TCP Frame

Table 29: Supported Modbus Function Codes

Function code		Modbus object type	Access type	Address range
Dec	Hex			
1	1	Read coils	Discrete (1 bit)	00001–09999
3	3	Read multiple holding registers	Register (16 bit)	40001–49999
4	4	Read input registers	Register (16 bit)	30001–39999
5	5	Write single coils	Discrete (1 bit)	00001–09999
6	6	Write single holding register	Register (16 bit)	40001–49999
15	F	Write multiple coils	Discrete (1 bit)	00001–09999
16	10	Write multiple holding registers	Register (16 bit)	40001–49999
23	17	Read/write multiple registers	Register (16 bit)	40001–49999
43	2B	Read device ident	MEI	-

7.3 Data Field

The data field is constructed using sets of 2 hexadecimal digits in the range of 00–FF hexadecimal. These digits are made up of 1 TCP character. The data field of messages sent from a client to a server device contains extra information, which the server must use to act as defined by the function code. It can include items such as coil, or register addresses, the quantity of items to be handled, and the count of actual data bytes in the field.

7.4 Read Device Identity

The Read Device Identity function code is for reading the device manifest data via Modbus Encapsulated Interface transport.

Table 30: Request Structure

Function code	0x2B
MEI Type	0x0E
MEI type specific data	Object ID See Table 31

Table 31: Object IDs

Object ID	Object Name / Description	Type
0x00	VendorName	ASCII String
0x01	ProductCode	ASCII String
0x02	MajorMinorRevision	ASCII String
0x03	VendoreUrl	ASCII String
0x04	ProductName	ASCII String
0x05	ModelName	ASCII String
0x06	UserApplicationName	ASCII String

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