Operating Guide

B&P Elektromotoren

iC7 Series BACnet MSTP

BACnet MSTP OS7BN



DESIGN AWARD 2023

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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, BACnet MSTP technology, MyDrive® Insight, and the PC or PLC that is used as a master in the system.

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

1.2 Additional Resources

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

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

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

1.3 Safety Symbols

The following symbols are used in Danfoss documentation and products.

⚠ DANGER

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

⚠ WARNING

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

⚠ CAUTION

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

NOTICE

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

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

1.4 Qualified Personnel

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

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

1.5 Safety Precautions

⚠ WARNING



HIGH VOLTAGE

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

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

⚠ WARNING

UNINTENDED START

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

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

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⚠ WARNING



DISCHARGE TIME

The drive or power converter contains DC-link capacitors, which can remain charged even when the drive or power converter is not powered. High voltage can be present even when the warning indicator lights are off. Failure to wait the specified time after power has been removed before performing service or repair work can result in death or serious injury.

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

⚠ WARNING

LEAKAGE CURRENT HAZARD

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

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

⚠ WARNING

EQUIPMENT HAZARD

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

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

⚠ CAUTION

INTERNAL FAILURE HAZARD

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

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

1.6 Abbreviations

Table 1: Abbreviations

Abbreviation	Definition
AI	Analog input
AO	Analog output
AV	Analog value
B-ASC	BACnet Application-Specific Controller
BI	Binary input
BMS	Building management system

Table 1: Abbreviations - (continued)

Abbreviation	Definition
BO	Binary output
BV	Binary value
CTW	Control word
EMC	Electromagnetic compatibility
I/O	Input/output
IP	Internet protocol
LED	Light-emitting diode
MRV	Main reference value
N/A	Not applicable
NC	Notification class
PLC	Programmable logic controller
REF	Reference (=MRV)
RTC	Real-time clock
STW	Status word
UTC	Universal time coordinated

1.7 Trademarks

BACnet™ is a registered trademark of American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE).

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
AQ528743911395, version 0101	First release.

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2 Overview

2.1 BACnet MSTP Features and Technical Data

BACnet (Building Automation and Control Networks) is a communication protocol standard designed for building automation and control systems that enable the seamless integration of products from different manufacturers. One of its specific data link layer protocols is MSTP (Multidrop Serial Bus/Token Passing), where 1 master node controls the communication by passing a token, granting permission to other devices (followers or other masters) to transmit data and preventing collisions on the shared RS-485 network.

BACnet facilitates the integration of diverse building systems from various manufacturers, leading to enhanced energy efficiency, improved performance, and greater occupant comfort. Its scalable and reliable protocol makes it a user-friendly and economical choice for building automation. The primary application for BACnet is in Building Management Systems (BMS) to control and monitor a wide range of HVAC and other building automation devices, allowing facility managers and building owners to manage their systems efficiently from a unified platform.

Table 3: BACnet MSTP Features

Feature	Technical data
Protocol name	BACnet
Governing standards	ANSI/ASHRAE Standard 135-2024
Openness	Open specification
Network topology	Line
Physical media	Shielded twisted pair
Maximum distance at low speed	1200 m
Supported node	Master
Supported baud rates	9600, 19200, 38400, 76800, 115200 bps
Termination	560 Ω

Table 4: BACnet Model Codes

Model code	Description
+BABN	BACnet MSTP OS7BN

When selecting a different communication protocol as a multi-license option, BACnet MSTP is included as a secondary protocol.

2.2 BACnet Interoperability Building Blocks

2.2.1 Overview

BACnet Interoperability Building Blocks (BIBBs) are collections of 1 or more BACnet services and fall into 5 principal areas:

- Data sharing
- Alarms and events
- Scheduling
- Trending
- Device management

Each of these areas has several interoperable functions, which are prescribed in terms of an A and a B device. Both devices are nodes on a BACnet internetwork. Usually, the A device acts as the user of data (client), and the B device is the provider of this data (server). iC7 drives support type B devices and the ASC profile.

2.2.2 Supported BACnet Interoperability Building Blocks

Table 5: Supported Data Sharing BIBBs

BIBB	Abbreviation	Description
Data Sharing Read Property	DS-RP-B	Retrieve the value of a property from a device.
Data Sharing Read Property Multiple	DS-RPM-B	Retrieve the value of multiple properties from a device with in 1 request.
Data Sharing Write Property	DS-WP-B	Writes the value of a property to a device.
Data Sharing Write Property Multiple	DS-WPM-B	Write the value to multiple properties from a device with in 1 request.

Table 6: Supported Device Management BIBBs

BIBB	Abbreviation	Description
Device Management - Dynamic Device Binding B	DM-DDB-B	Responds to Who-Is with I-am. Based on the setting in the ***BacnetIAmService***parameter, during the power-up or every 60 s with I-am.
Device Management Dynamic Object Binding B	DM-DOB-B	Respond to Who-Have with I-Have.
Device Management Device Communication Control	DM-DCC-B	Supports Disable initialization and Enable with an optional password.
Device Management UTC Time Synchronization	DM-UTC-B	Supports UTC time synchronization with time offset and daylight saving with an optional password.
Device Management Reinitialize Device	DM-RD-B	Supports cold start, warm start, and Activate Changes with an optional password.

2.2.3 MSTP Frame

In BACnet MSTP, communication is conducted through frames, which are sequences of bytes exchanged between devices. iC7 series drives support the following frame types:

- Token
- Poll For Manager
- Reply To Poll For Manager
- BACnet Data Expecting Reply
- Reply Postponed

2.3 BACnet Segmentation

To provide for messages that are longer than the maximum length supported by a communications network, or the sending or receiving device, BACnet provides a method to perform application layer segmentation. In BACnet, only Confirmed-Request and Complex ACK messages can be segmented.

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Table 7: BACnet Message Specifications

Data	Value	Description
Maximum APDU length	480 bytes	Specifies the maximum length for application protocol data units.
Maximum segments accepted	16	Specifies the maximum number of segments transmitted in a Confirmed-Request or Complex ACK message.
Proposed window size	8	Specifies the maximum segmentation window size acceptable to a requester sending a segmented BACnet-Confirmed-Request-PDU.

2.4 BACnet Services

2.4.1 UTC Time Synchronization

The UTC Time Synchronization service is used by a requesting BACnet user to notify 1 or more remote devices of the correct Universal Time Coordinated (UTC). Its purpose is to notify recipients of the correct UTC so that devices synchronize their internal clocks with each other.

A device receiving a UTC Time Synchronization service indication updates its local representation of time and date by subtracting the value of the ***UTC Offset*** property of the Device Object from the ***Time*** parameter and taking the ***Daylight Savings Status*** property of the Device Object into account as appropriate to the locality. This change is reflected in the Local Time and Local Date properties of the Device Object.

The time zones to the west of the 0° meridian are positive values, and time zones to the east are negative values. The value of the UTC Offset property is subtracted from the UTC received in UTC Time Synchronization service requests to calculate the correct local standard time. UTC Offset is configurable and accepts any multiples of 15 minutes across the full range.

2.4.2 Reinitialize Device

2.4.2.1 Overview

The Reinitialize Device service is used by a client BACnet user to instruct a remote device to reboot itself (cold start), reset itself to a predefined initial state (warm start), to activate network port object changes, or to control the backup or restore procedure.

Resetting or rebooting a device is primarily initiated by a human operator for diagnostic purposes. Use of this service during the backup or restore procedure is initiated on behalf of the user by the device controlling the backup or restore.

iC7 drives support the following options:

- 2.4.2.2 Warm Start
- 2.4.2.3 Cold Start
- 2.4.2.4 Activate Changes
- 2.4.2.5 Discard Changes

2.4.2.2 Warm Start

Warm start performs the power cycle operation on the device without affecting the drive parameters. The warm start should reinitialize the device only when the device is in ready state (Drive Not Running) and irrespective of the device communication control.

When the BACnet client attempts a warm start on a device when the device is not ready state, the device does not execute a warm start and reports an error in the BACnet service.

2.4.2.3 Cold Start

Cold start applies the restore operation to all settings (all application parameters and log history) to factory set default values except the communication parameters followed by a power cycle. Warm start should reinitialize the device only when the device is in ready state (Drive Not Running) and irrespective of the device communication control.

When the BACnet client attempts a cold start for a device when the device is not ready state, the device does not execute the cold start and reports an error in the BACnet service.

The BACnet parameters which are excluded from the restore operation are listed in Table 8.

Table 8: Excluded Parameters in BACnet MSTP

Parameter index number	Parameter name
10.3.7.2.1	***BACnet Device instance***
10.3.7.2.2	***BACnet Max Manager***
10.3.7.2.3	***BACnet Max Info Frames***
10.2.8	***X4Address***
10.2.8	***Baud Rate***
10.2.8	***Data Format – Data bits, Parity and Stop bits***

2.4.2.4 Activate Changes

The Activate Changes service involves applying the new configuration via the device user interface or software, and often restarting the device for the settings to take effect. For more information, see 2.5.9 Network Port Object.

2.4.2.5 Discard Changes

If the device supports the Discard changes command, the object reverts to the set of property values that were contained in the object when Changes_Pending was last equal to FALSE.

2.4.3 Device Communication Control

The Device Communication Control (DCC) service is used by a client BACnet user to instruct a remote device to stop initiating BACnet services on the communication network or internetwork for a specified duration of time. This service is primarily used by a human operator for diagnostic purposes. A password may be required from the client BACnet user before executing the service.

The behavior of the Device Communication Control service varies:

- On power cycle: During power-up, the DCC is configured to the ***Enable*** state, allowing the device to initiate the I-Am service. On device startup, the DCC is automatically set to the ***Enable*** state, irrespective of the DCC state before the reboot.
- On warm start or cold start: According to the specification, whenever the device undergoes a warm start or a cold start, the DCC is set to the ***Enable*** state.

2.5 BACnet Objects

2.5.1 Overview

The following objects are supported in iC7 drives with BACnet:

- 2.5.8 Device Objects
- 2.5.5 Binary Input Object
- 2.5.6 Binary Output Object
- 2.5.7 Binary Value Object
- 2.5.2 Analog Input Object
- 2.5.3 Analog Output Object
- 2.5.4 Analog Value Object
- 2.5.9 Network Port Object

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Temperature Measurement OC7T0 option is not supported in BACnet.

2.5.2 Analog Input Object

Table 9: Analog Input Object

ID	Object name	Unit	Custom unit	R/W	Parameter	Index	Available from
AI:20	Analog Input (T33)	%	Y	R	1611	9.3.4 [101]	Integrated I/O
AI:21	Analog Input (T34)	%	Y	R	1612	9.3.5 [101]	Integrated I/O
AI:22	Analog Input (T2)	%	Y	R	1620	9.3.3 [201]	General Purpose I/O
AI:23	Analog Input (T3)	%	Y	R	1621	9.3.4 [201]	General Purpose I/O
AI:24	Temperature Input (T34)	°C	Y	R	1616	9.3.6 [101]	Integrated I/O
AI:25	Temperature Input 1 (T2)	°C	Y	R	4966	9.3.6 [201]	General Purpose I/O or Temperature Measurement OC7T0
AI:26	Temperature Input 2 (T3)	°C	Y	R	4967	9.3.7 [201]	General Purpose I/O or Temperature Measurement OC7T0

2.5.3 Analog Output Object

Table 10: Analog Output Object

ID	Object name	Unit	Custom Unit	R/W	Parameter	Index	Remarks
AO:0	Analog Output 1 (T31)	%	-	R/W	1613	9.3.3 [101]	Integrated I/O
AO:3	Analog Output (T4)	%	-	R/W	1622	9.3.5 [201]	General Purpose I/O

2.5.4 Analog Value Object

NOTE:

- Properties *Reliability*, *Fault High Limit*, *Fault Low Limit*, and *Reliability Evaluation Inhibit* are not available for Analog Value instances AV 5, 6, 16, 17, 18, 19, 20, 21, 22, 23, 25, 51, 71, 76, and 77.
- Supported reliability values are NO_FAULT_DETECTED, UNDER_RANGE, and OVER_RANGE.
- The *Event State* property always shows the value as ***Normal***.

Table 11: Analog Value Object

ID	Object name	Unit	Custom Unit	R/W	Parameter	Index	Remarks
AV:1	Fieldbus Speed Reference 1 (Input Reference 1)	%	-	R/W	1611	9.3.4 [101]	Integrated I/O
AV:3	Motor Speed (Motor Actual Speed)	%	-	R/W	1612	9.3.5 [101]	Integrated I/O
AV:5	Motor Current	A	-	R	1620	9.3.3 [201]	General Purpose I/O

Table 11: Analog Value Object - (continued)

ID	Object name	Unit	Custom Unit	R/W	Parameter	Index	Remarks
AV:6	Output Power	kW	-	R	1621	9.3.4 [201]	General Purpose I/O
AV:7	Fieldbus Process Reference	%	-	R	1616	9.3.6 [101]	Integrated I/O
AV:15	Motor Thermal Overload (ETR)	%	-	R	2951	4.1.16	–
AV:16	Line-To-Line Voltage (RMS)	V	-	R	9040	1.1.2	–
AV:17	L1-L2 Line Voltage (RMS)	V	-	R	9048	1.1.3	–
AV:18	L2-L3 Line Voltage (RMS)	V	-	R	9049	1.1.4	–
AV:19	L3-L1 Line Voltage (RMS)	V	-	R	9050	1.1.5	–
AV:20	Control Unit On Time	h	-	R	2000	6.5.1	–
AV:21	Power Unit On Time	h	-	R	2001	6.5.2	–
AV:22	Active Running Hours	h	-	R	2009	6.5.9	–
AV:23	Energy Consumption	kWh	-	R	2002	6.5.3	–
AV:24	Motor Voltage	V	-	R	9005	4.1.6	–
AV:25	Output Frequency	Hz	-	R	9015	5.8.1.3	–
AV:26	Torque	%	-	R	1708	4.1.12	–
AV:27	DC Link Voltage	V	-	R	9044	2.1.3	–
AV:28	Heat Sink Temperature	°C	-	R	2950	2.1.15	–
AV:30	Multi Zone Reference 1 (Setpoint 1)	%	-	R/W	6383	5.10.8.1	–
AV:32	Feedback 1	%	-	R	6080	5.10.1.6	–
AV:35	Multi Zone Reference 2 (Setpoint 2)	%	-	R/W	6384	5.10.8.2	–
AV:37	Feedback 2	%	-	R	6085	5.10.1.7	–
AV:40	Multi Zone Reference 3 (Setpoint 3)	%	-	R/W	6285	5.10.8.3	–
AV:42	Feedback 3	%	-	R	6104	5.10.1.8	–
AV:47	Control Unit Temperature	°C	-	R	2952	6.1.1.3	–
AV:49	Control Place Selection	#	-	R/W	114	5.5.2.1	–

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Table 11: Analog Value Object - (continued)

ID	Object name	Unit	Custom Unit	R/W	Parame-ter	Index	Remarks
AV:51	Occurrence Number	#	-	R	1610	6.1.1.1	Refer to the drive and profile.
AV:52	PID Start Speed	Hz	-	R/W	6056	5.10.3.24	–
AV:53	On Reference Band-width	%	-	R/W	6050	5.10.2.1	–
AV:54	PID Proportional Gain	#	-	R/W	6065	5.10.5.1	–
AV:55	PID Integral Time	s	-	R/W	6058	5.10.5.2	–
AV:56	PID Derivative Time	s	-	R/W	6068	5.10.5.5	–
AV:57	PID Derivative Gain	#	-	R/W	6069	5.10.5.6	–
AV:59	Process Controller out-put (PID Output)	%	-	R/W	6075	5.10.1.2	–
AV:60	Reserved		-	R	6092	5.10.1.3	–
AV:61	Fault Status Word 1		-	R	6203	5.1.5	–
AV:66	Warning Word		-	R	6205	5.1.8	–
AV:70	Feedback	%	Y	R	6090	5.10.1.4	–
AV:71	Converted Signal 1	m^3/h	Y	R	6700	–	–
AV:72	Converted Signal	m^3/h	Y	R/W	6701	–	–
AV:77	Converted Signal 3	m^3/h	Y	R	6702	–	–
AV:153	MPC Status		-	R	5367	5.31.2.1.1	–
AV:154	Number of Fixed-Speed Pumps Running	-	-	R	5331	5.31.2.1.2	–
AV:155	Fixed-Speed Pump 1 Status	-	-	R	5340	5.31.2.1.3	–
AV:156	Fixed-Speed Pump 2 Status	-	-	R	5341	5.31.2.1.4	–
AV:157	Fixed-Speed Pump 3 Status	-	-	R	5342	5.31.2.1.5	–
AV:158	Fixed-Speed Pump 4 Status	-	-	R	5343	5.31.2.1.6	–
AV:159	Fixed-Speed Pump 5 Status	-	-	R	5344	5.31.2.1.7	–
AV:163	Fixed-Speed Pump 1 Running Hours	h	-	R/W	5350	5.31.2.1.8	–
AV:164	Fixed-Speed Pump 2 Running Hours	h	-	R/W	5351	5.31.2.1.9	–
AV:165	Fixed-Speed Pump 3 Running Hours	h	-	R/W	5352	5.31.2.1.10	–

Table 11: Analog Value Object - (continued)

ID	Object name	Unit	Custom Unit	R/W	Parame-ter	Index	Remarks
AV:166	Fixed-Speed Pump 4 Running Hours	h	-	R/W	5353	5.31.2.1.11	–
AV:167	Fixed-Speed Pump 5 Running Hours	h	-	R/W	5354	5.31.2.1.12	–
AV:171	Fixed-Speed Pump 1 Number of Starts	-	-	R	5357	5.31.2.1.13	–
AV:172	Fixed-Speed Pump 2 Number of Starts	-	-	R	5358	5.31.2.1.14	–
AV:173	Fixed-Speed Pump 3 Number of Starts	-	-	R	5359	5.31.2.1.15	–
AV:174	Fixed-Speed Pump 4 Number of Starts	-	-	R	5360	5.31.2.1.16	–
AV:175	Fixed-Speed Pump 5 Number of Starts	-	-	R	5361	5.31.2.1.17	–

2.5.5 Binary Input Object

Table 12: Binary Input Object

ID	Object name	R/W	Parameter	Index	Remarks
BI:0	Digital input Term 13	R	1614	9.3.1 [101]	Integrated I/O
BI:1	Digital input Term 14	R	1614	9.3.1 [101]	Integrated I/O
BI:2	Digital input Term 15	R	1614	9.3.1 [101]	Integrated I/O
BI:3	Digital input Term 16	R	1614	9.3.1 [101]	Integrated I/O
BI:4	Digital input Term 17	R	1614	9.3.1 [101]	Integrated I/O
BI:5	Digital input Term 18	R	1614	9.3.1 [101]	Integrated I/O
BI:7	Digital input 1 (T11)	R	1614	9.3.1 [201]	General Purpose I/O
BI:8	Digital input 1 (T12)	R	1614	9.3.1 [201]	General Purpose I/O
BI:9	Digital input 1 (T13)	R	1614	9.3.1 [201]	General Purpose I/O

2.5.6 Binary Output Object

Table 13: Binary Output Object

ID	Object name	R/W	Parameter	Index	Available from
BO:0	Digital Output Term 15	R/W	1615	9.3.2 [101]	Integrated I/O
BO:1	Digital Output Term 15	R/W	1615	9.3.2 [101]	Integrated I/O
BO:2	Digital Output 1 (T7)	R/W	1615	9.3.2 [201]	General Purpose I/O
BO:3	Digital Output 2 (T8)	R/W	1615	9.3.2 [201]	General Purpose I/O
BO:4	Relay Output 1 (T5)	R/W	1615	9.3.2 [101]	Integrated I/O
BO:5	Relay Output 2 (T6)	R/W	1615	9.3.2 [101]	Integrated I/O
BO:6	Relay Output 1 X101	R/W	4909	9.3.1 [201]	Relay Option

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Table 13: Binary Output Object - (continued)

ID	Object name	R/W	Parameter	Index	Available from
BO:7	Relay Output 2 X102	R/W	4909	9.3.1 [201]	Relay Option
BO:8	Relay Output 3 X103	R/W	4909	9.3.1 [201]	Relay Option

2.5.7 Binary Value Object

Table 14: Binary Value Object

ID	Object name	R/W	Parameter	Index	Available from
BV:1	RUN/STOP Command	R/W	1335	5.27.1.42	–
BV:3	Fault Reset	R	1307	5.27.1.50	–
BV:5	READY/FAULT Monitor	R	1307	5.27.1.50	–
BV:6	LOCAL/REMOTE	R	1307	5.27.1.50	–
BV:21	Warning	R	1307	5.27.1.50	–
BV:22	Trip	R	1307	5.27.1.50	–
BV:24	Coasting	R/W	1335	5.27.1.42	–
BV:25	Reversing (CW/CCW)	R/W	1335	5.27.1.42	–
BV:31	Speed = reference	R	1307	5.27.1.50	–
BV:32	Bus control	R	1307	5.27.1.50	–
BV:33	Running	R	1307	5.27.1.50	–
BV:34	Ramp 1/Ramp 2	R/W	1335	5.27.1.42	–
BV:41	Sleep Mode Status	–	–	–	–
BV:44	Interlock Status	–	–	–	–
BV:47	End of Curve	–	–	–	–
BV:49	No Flow	–	–	–	–
BV:50	Dry Run	–	–	–	–
BV:62	Fieldbus Status word 1, bit 14	R	1307	5.27.1.50	–
BV:63	Fieldbus Status word 1, bit 15	R	1307	5.27.1.50	–
BV:64	Fieldbus Status word 2, bit 0	R	1344	5.27.1.90	–
BV:65	Fieldbus Status word 2, bit 1	R	1344	5.27.1.90	–
BV:66	Fieldbus Status word 2, bit 2	R	1344	5.27.1.90	–
BV:67	Fieldbus Status word 2, bit 3	R	1344	5.27.1.90	–
BV:68	Fieldbus Status word 2, bit 4	R	1344	5.27.1.90	–
BV:69	Fieldbus Status word 2, bit 5	R	1344	5.27.1.90	–
BV:70	Fieldbus Status word 2, bit 6	R	1344	5.27.1.90	–
BV:71	Fieldbus Status word 2, bit 7	R	1344	5.27.1.90	–
BV:72	Fieldbus Status word 2, bit 8	R	1344	5.27.1.90	–
BV:73	Fieldbus Status word 2, bit 9	R	1344	5.27.1.90	–

Table 14: Binary Value Object - (continued)

ID	Object name	R/W	Parameter	Index	Available from
BV:74	Fieldbus Status word 2, bit 10	R	1344	5.27.1.90	–
BV:75	Fieldbus Status word 2, bit 11	R	1344	5.27.1.90	–
BV:76	Fieldbus Status word 2, bit 12	R	1344	5.27.1.90	–
BV:77	Fieldbus Status word 2, bit 13	R	1344	5.27.1.90	–
BV:78	Fieldbus Status word 2, bit 14	R	1344	5.27.1.90	–
BV:79	Fieldbus Status word 2, bit 15	R	1344	5.27.1.90	–
BV:80	Fieldbus Control Word 1, bit 12	R/W	1335	5.27.1.42	–
BV:81	Fieldbus Control Word 1, bit 13	R/W	1335	5.27.1.42	–
BV:82	Fieldbus Control Word 1, bit 14	R/W	1335	5.27.1.42	–
BV:83	Fieldbus Control Word 1, bit 15	R/W	1335	5.27.1.42	–
BV:84	Fieldbus Control Word 2, bit 0	R/W	1347	5.27.1.89	–
BV:85	Fieldbus Control Word 2, bit 1	R/W	1347	5.27.1.89	–
BV:86	Fieldbus Control Word 2, bit 2	R/W	1347	5.27.1.89	–
BV:87	Fieldbus Control Word 2, bit 3	R/W	1347	5.27.1.89	–
BV:88	Fieldbus Control Word 2, bit 4	R/W	1347	5.27.1.89	–
BV:89	Fieldbus Control Word 2, bit 5	R/W	1347	5.27.1.89	–
BV:90	Fieldbus Control Word 2, bit 6	R/W	1347	5.27.1.89	–
BV:91	Fieldbus Control Word 2, bit 7	R/W	1347	5.27.1.89	–
BV:92	Fieldbus Control Word 2, bit 8	R/W	1347	5.27.1.89	–
BV:93	Fieldbus Control Word 2, bit 9	R/W	1347	5.27.1.89	–
BV:94	Fieldbus Control Word 2, bit 10	R/W	1347	5.27.1.89	–

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Table 14: Binary Value Object - (continued)

ID	Object name	R/W	Parameter	Index	Available from
BV:95	Fieldbus Control Word 2, bit 11	R/W	1347	5.27.1.89	–
BV:96	Fieldbus Control Word 2, bit 12	R/W	1347	5.27.1.89	–
BV:97	Fieldbus Control Word 2, bit 13	R/W	1347	5.27.1.89	–
BV:98	Fieldbus Control Word 2, bit 14	R/W	1347	5.27.1.89	–
BV:99	Fieldbus Control Word 2, bit 15	R/W	1347	5.27.1.89	–

2.5.8 Device Objects

The Device Object provides information about the device and its capabilities available to other devices on the networks. Before a BACnet device starts control-related communication with another device, it needs to obtain some of the information presented by the Device Object of the other device.

Table 15: Device Objects

Number	Property identifier	Property datatype	R/W status
1	Object_Identifier	BACnetObjectIdentifier	R
2	Object_Name	CharacterString	W
3	Object_Type	BACnetObjectType	R
4	System_Status	BACnetDeviceStatus	R
5	Vendor_Name	CharacterString	R
6	Vendor_Identifier	Unsigned16	R
7	Model_Name	CharacterString	R
8	Firmware_Revision	CharacterString	R
9	Application_Software_Version	CharacterString	R
10	Location	CharacterString	W
11	Description	CharacterString	W
12	Protocol_Version	Unsigned	R
13	Protocol_Revision	Unsigned	R
14	Protocol_Services_Supported	BACnetServicesSupported	R
15	Protocol_Object_Types_Supported	BACnetObjectTypesSupported	R
16	Object_List	BACnetARRAY[N] of BACnetObjectIdentifier	R
17	Max_APDU_Length_Accepted	Unsigned	R
18	Segmentation_Supported	BACnetSegmentation	R
19	Max_Segments_Accepted	Unsigned	R
20	Local_Time	Time	R
21	Local_Date	Date	R

Table 15: Device Objects - (continued)

Number	Property identifier	Property datatype	R/W status
22	UTC_Offset	INTEGER	W
23	Daylight_Savings_Status	BOOLEAN	R
24	APDU_Segment_Timeout	Unsigned	W
25	APDU_Timeout	Unsigned	W
26	Number_Of_APDU_Retries	Unsigned	W
27	Max_Manager	Unsigned(0..127)	W
28	Max_Info_Frames	Unsigned	W
29	Last_Restart_Reason	BACnetRestartReason	R
30	Database revision	Unsigned	R
31	Time_Of_Device_Restart	BACnetTimeStamp	R
32	Serial_Number	CharacterString	R
33	Property_List	BACnetARRAY[N] of BACnetPropertyIdentifier	R
34	Device Address Binding	BACnetLIST of BACnetAddressBinding	R

2.5.9 Network Port Object

A BACnet network port object (NPO) represents a physical or logical network port on a BACnet device and provides access to its configuration and properties. It is used to manage communication settings for each port, including addressing, data rates, and other parameters specific to the network type.

The properties of NPO objects are writable through the BACnet MSTP master and through MyDrive® Insight.

In MyDrive® Insight, it is possible to write parameters on the fly and the changes are updated instantly. However, modifying the properties through BACnet requires additional steps to activate the changes.

After a successful write to the NPO properties, the event sets the Changes_Pending property to TRUE. A value written to the property becomes effective when the device receives a Reinitialize Device service request with a reinitialized device state ACTIVATE_CHANGES or WARMSTART.

1. When NPO updates happen through the Activate Changes service, it is not required to be updated in the last restart reason in the Device object property.
2. When executing a power cycle or the Discard changes service when the Changes_Pending property is TRUE, the changes are discarded.
3. NPO supports a single non-hierarchical network port object for the BACnet MS/TP port.
4. NPO Object Reliability property supports only the value NO_FAULT_DETECTED.

Table 16: Network Port Object

Property	Access	Default
Object_Identifier	R	{NETWORK_PORT.1}
Object_Name	W	Network Port Object
Object_Type	R	NETWORK_PORT (56)
Description	W	MSTP Port for BACnet Communication
Status_Flags	R	Operational
Reliability	R	no_fault_detected

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Table 16: Network Port Object - (continued)

Property	Access	Default
Out_Of_Service	R	False
Network_Type	R	MSTP
Protocol_Level	R	BACNET APPLICATION
Network_Number	R	0
Network_Number_Quality	R	False
Changes_Pending	R	False
MAC_Address	R	0
APDU_Length	R	480
Max_Manager	W	32
Max_Info_Frames	W	1
Property_List	R	Object Collection
Link Speed	W	38400
Link Speeds	R	9600,19200,38400,57600,76800,115200

2.6 Engineering Units

2.6.1 Standard Engineering Units

BACnet uses a standardized set of engineering units to represent physical quantities. These units are defined in the BACnet standard and are used to ensure consistent data exchange between different devices and systems.

In iC7 drives with BACnet, it is possible to change the units to compatible units through the BACnet client.

Unit group	Unit	Enum.
Rotational speed and frequency	RPM	104
	Hz	27
Electric current	mA	2
	A (default)	3
Electric potential or voltage	V (default)	5
	kV	6
	mV	124
Energy	Wh	18
	kWh (default)	19
	MWh	146
Power	W	47
	kW (default)	48
	MW	49
	hp	51
	mW	132

Unit group	Unit	Enum.
Pressure	Pa (default)	53
	kPa	54
	bar	55
	psi	56
	hPa	133
	mbar	134
Temperature	°C (default)	62
	°F	64
Time	h (default)	71
	s	72
Volumetric flow rate	m^3/s (default)	85
	l/s	87
	m^3/h	135
Fraction of 100	%	98
No unit	-	95

NOTE: The assigned engineering unit must retain its latest value when a power cycle or a warm start occurs in the drive. The cold start service resets the engineering unit to the default value. For more information, see 2.4.2.2 Warm Start and 2.4.2.3 Cold Start.

2.6.2 Custom Units

In certain applications, BACnet objects handle different engineering units where the actual value should not change but the engineering units should be modified with compatible engineering conversions.

iC7 drives have custom units to handle this functionality. For more information on custom objects, see BACnet Objects.

2.7 BACnet Control Word and Status Word

2.7.1 Control Word

Table 17: Control Word Bits in BACnet

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 (should be kept 0)	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	0 = Causes the frequency converter immediately to coast the motor. 1 = No function.

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Table 17: Control Word Bits in BACnet - (continued)

Bit number	Name	Description
4	Reserved (should be kept 0)	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.
5	Reserved (should be kept 0)	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.
6	Start/No Start	0 = Stops the frequency converter and the motor speed ramps down to stop via the selected ramp-down parameter. 1 = Allows the frequency converter to start the motor if the other starting conditions have been fulfilled.
7	Fault Acknowledge	0 = No function. 0 → 1 = Acknowledge faults. Acknowledge is triggered by the edge when changing from logic 0 to logic 1. Faults can only be acknowledged if the trigger condition has been removed and any required acknowledge has been done.
8	Reserved (should be kept 0)	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.
9	Ramp select	0 = Ramp 1 is active. 1 = Ramp 2 is active.
10	Reserved (should be kept 0)	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.
11	Reverse	0 = Normal running. 1 = Reversing.
12	User-defined	These bits enable mapping the application functionality of the drive to the control word. Mapping is done through parameters. For details, refer to the application guide.
13		
14		
15		

2.7.2 Status Word

Table 18: Status Word Bits in BACnet

Bit number	Name	Description
0	Control ready/Control not ready	0 = The device controls are not ready and do not react to process data. 1 = The device controls are ready and reacts to process data.
1	Frequency converter ready/Frequency converter not ready	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. 1 = The frequency converter is ready for operation.

Table 18: Status Word Bits in BACnet - (continued)

Bit number	Name	Description
2	Coasting/No Coast	0 = The frequency converter has an active Coast signal and has released the motor. 1 = There are no active coast signals. (can start when the start signal is given).
3	Fault/No Fault	0 = The frequency converter is not in fault mode. 1 = The frequency converter is faulted, and an acknowledge signal is required to re-establish operation.
4	Reserved	Reserved.
5	Reserved	Reserved.
6	Reserved	Reserved.
7	Warning/No warning	0 = There are no warnings. 1 = A warning has occurred.
8	Speed=reference/Speed<>reference	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. 1 = The present motor speed matches the present speed reference within a given tolerance. The tolerance is product specific.
9	Bus control/Local operation	0 = The HMI has taken over the control and the device is right now not reacting to control requests coming from the process data and/or I/Os. 1 = The device is controlled and reacting to I/O and process data.
10	SpeedMonitorActive	0 = The speed monitor is not active (for example, the motor speed is within the defined warning limits). 1 = The speed monitor is active (for example, the motor speed exceeds the defined warning limits).
11	In operation/No operation	0 = There are no active start requests and the process does not run. The motor is in a coasted state and the motor is not started. 1 = The process is running and the motor could be running or starting at any time.
12	Reserved	Reserved for intermittent problem.
13	Reserved	Reserved.
14	Vendor-specific 2.	Vendor-specific 2.
15	Vendor-specific 1.	Vendor-specific 1.

2.8 Network Topology

Communication interface X4 is used for the RS-485 fieldbus connection.

RS-485 is a 2-wire bus interface compatible with multi-drop network topology, that is, nodes can be connected as a bus, or via drop cables from a common trunk line.

A total of 32 nodes can be connected to 1 network segment. Repeaters divide network segments.

> **!** IMPORTANT: Each repeater functions as a node within the segment in which it is installed. Each node connected within a given network must have a unique node address across all segments.

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NOTICE

Installing drives or power converters of different current ratings in line topology may result in unwanted fieldbus timeout messages in the event log.

- 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.

3 Fieldbus Cable Connections

3.1 Prerequisites for Installation

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

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

3.2 Installation

One or more frequency converters can be connected to a control (or master) using the RS-485 interface. X4 Terminal 65 is connected to the A+ signal, while terminal 67 is connected to the B- signal. If more than 1 frequency converter is connected to a master, use parallel connections.

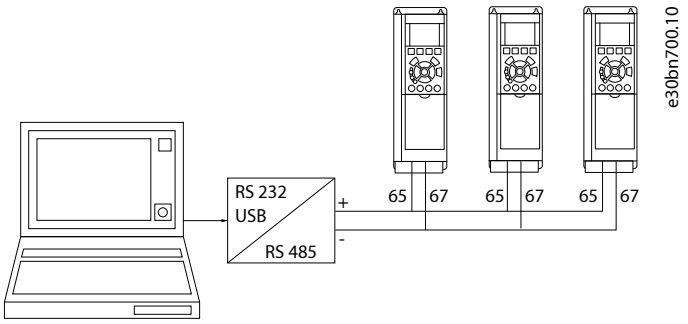


Figure 1: RS-485 Network Connection

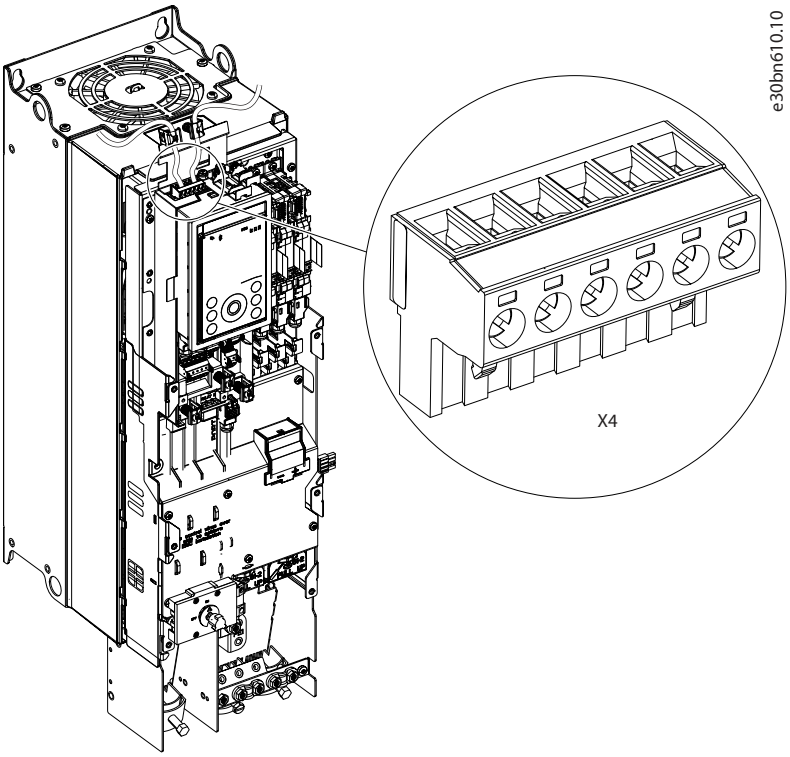


Figure 2: Location of the X4 Terminal in Frames FA02–FA12

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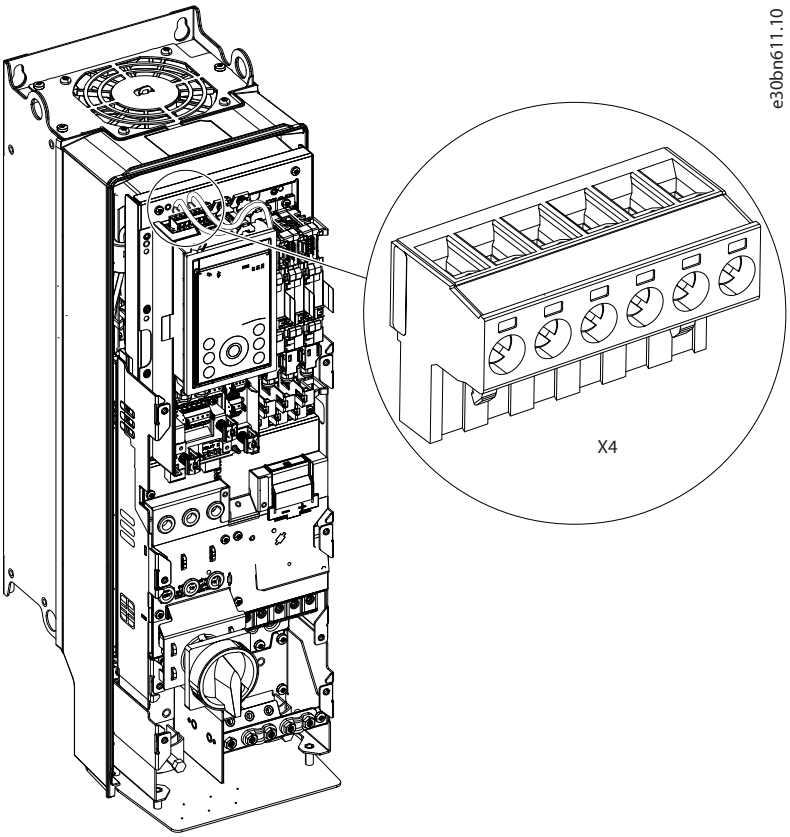


Figure 3: Location of the X4 Terminal in Frames FK03, FK05–FK12, FB03, and FB05–FB12

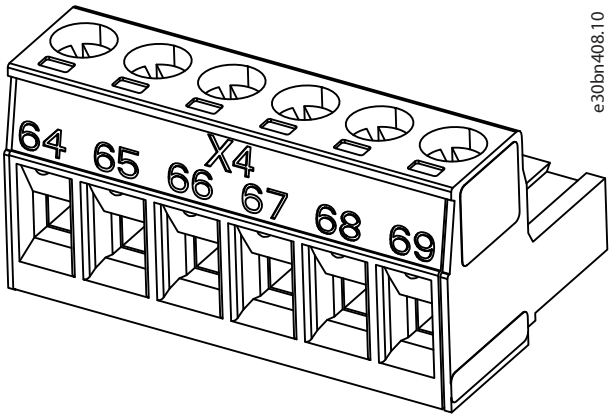


Figure 4: X4 Connector

Table 19: X4 Terminal Functions

Terminal number	Name	Function
64	GND	The GND terminal is the isolated ground. This terminal can be used, for example, for adding external bias resistors if required.
65	A+	The positive or data+ of the RS-485 bus.
66	Shield	The shield terminal has an RC network connected internally to the ground terminal.
67	B-	The negative or data- of the RS-485 bus.

Table 19: X4 Terminal Functions - (continued)

Terminal number	Name	Function
68	5 V out	5 V out is the output to the isolated 5 V fieldbus supply. This terminal can be used, for example, for adding external bias resistors if required.
69	Dir	Dir is the direction pin. It is driven to +5 V whenever data is transmitted out.

Observe the following guidelines:

- Terminate each segment at both ends, using either the termination switch (S801) of the drives or a biased termination resistor network. The termination switch is located on the top of the control unit below the X4 socket. The control panel and its cradle must be removed to access the switch.
- Always use shielded twisted pair (STP) cable for bus cabling and follow good common installation practice.
- Low-impedance ground connection of the shield at every node is important, including at high frequencies. Thus, connect a large surface of the shield to ground, for example, with a cable clamp or a conductive cable gland. Sometimes, it is necessary to apply potential-equalizing cables to maintain the same ground potential throughout the network, particularly in installations with long cables.
- To prevent impedance mismatch, use the same type of cable throughout the entire network. When connecting a motor to the drive, always use a shielded motor cable.

Table 20: Technical Specifications

Function	Data
Cable type	Shielded twisted pair Cu, 75 °C (167 °F)
Flexible/rigid wire without cable end sleeves	0.2–1.5 mm^2 (24–16 AWG)
Flexible wire without cable end sleeves	0.2–1.5 mm^2 (24–16 AWG)
Supported Baud rates	9600, 19200, 38400, 57600, 76800, 115200

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4 Configuration

4.1 Checking the License

Before starting the configuration, check that BACnet is installed in the drive.

1. Verify that BACnet MSTP (+BABN) is installed in the drive.
   - In MyDrive® Insight, go to *Device Info*.
   - In the control panel, go to *About this device*.

Table 21: BACnet MSTP License

Protocol	Model code	Description
BACnet MSTP	+BABN	Enables support for BACnet MSTP protocol over serial communication (RS-485), allowing integration with PLCs, sensors, and other field devices.

4.2 Configuring the RS-485 Interface

1. Configure the RS-485 settings.
   - In MyDrive® Insight, go to *Setup and Service* > *Interface configuration* > *RS485 Port X4* > *RS485 Settings*.
   - In the control panel, navigate to parameter group ***10.2 Communication Interfaces***.

Table 22: RS-485 Parameters

Parameter name	Value	Description
Port Address	00:247	The address of the device.
Baud Rate	9600 bps 19200 bps 38400 bps 57600 bps 76800 bps 115200 bps	Baud rate setting for the interface.
Data Frame Settings	8 data bits, no parity, 1 stop bit 8 data bits, no parity, 2 stop bits 8 data bits, odd parity, 1 stop bit 8 data bits, even parity, 2 stop bits	Select the desired frame settings, including number of data bits, parity, and number of stop bits.

4.3 Configuring BACnet MSTP Communication

1. Configure the BACnet MSTP settings.
   - In MyDrive® Insight, go to *Setup and Service* > *Parameter* > *Live* > *Connectivity* > *Protocols* > *BACnet* > *Configuration*.
   - In the control panel, navigate to parameter group ***10.3.7.2 Configuration***.

Table 23: BACnet Interface Parameters

Parameter index	Parameter name	Parameter number	Default value	Minimum value	Maximum value	Description
10.3.7.2.1	***Device Instance***	7100	1	1	4194303	Device instance for BACnet.
10.3.7.2.2	***Max Masters***	7101	32	0	127	The maximum number of masters that can be configured in the BACnet network.
10.3.7.2.3	***Max Info Frames***	7102	1	1	255	The maximum number of information frames that a BACnet device can send or receive in a single transmission.
10.3.7.2.6	***APDU Segment Timeout***	7105	5000 ms	3000 ms	10000 ms	Enter the wait time for a device to acknowledge the transmitted segment.
10.3.7.2.7	***APDU Timeout***	7106	6000 ms	5000 ms	65535 ms	Set the time to wait for a device to receive a response after a message is sent.

The device is detected by the BMS. Start Logic and Stop Logic are assigned automatically as ***Fieldbus Start*** and ***Fieldbus Stop*** if ***Fieldbus Control*** is selected as the control place.

If there is a problem in establishing the communication between the device and the BACnet MSTP Master, see Troubleshooting.

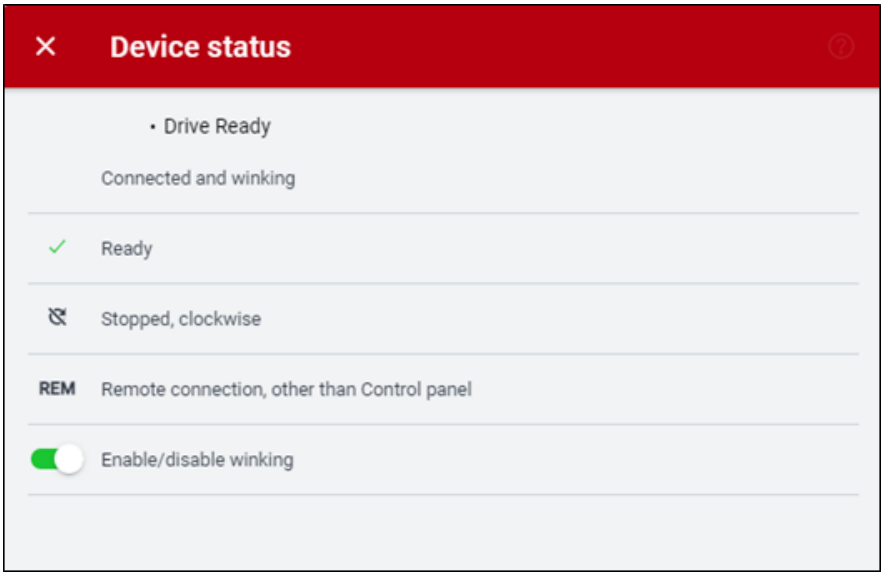
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5 Troubleshooting

5.1 Identifying a Unit

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

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

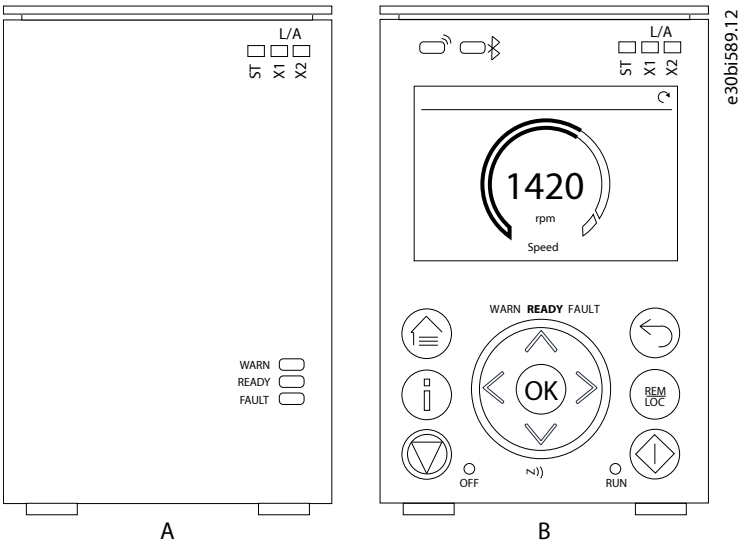


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See 5.2 Fieldbus Indicator LEDs for more information on interpreting the LED signals and where the LEDs are located.

5.2 Fieldbus Indicator LEDs

There are 3 LEDs (X1, X2, and ST) on the top right corner of the control panel. The LED labeled X1 shows the network status and the LED labeled ST shows the BACnet protocol related status.



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Figure 5: Fieldbus Indicator LEDs on Control Panel

Table 24: Fieldbus Indicator LED Functions

LED label		Description
RS-485 link status (X1)	BACnet protocol status (ST)	
Off	Off	Cable break, open circuit, short circuit, controller not in Run mode.
Red	Red	Wrong configuration due to, for example, baud rate mismatch or parity mismatch.
Green	Red	Communication integrity error due to, for example, an error in the CRC calculation.
Green	Red blink	Invalid BACnet request due to, for example, the entity does not exist or access is denied.
Green	Green blink	The master is not polling at the specified rate.
Green	Green	DUT is communicating successfully.

5.3 Occurrences

An occurrence refers to a specific event or condition detected or reported by the device that is communicated across the fieldbus network to other devices or systems. Occurrences are often associated with faults or warnings.

The active faults and warnings are shown on the control panel and in MyDrive® Insight. Warnings are reset automatically when the cause for the warning is cleared. Faults stop the motor and require a manual reset. Once the issue is fixed, use the control panel, MyDrive® Insight, fieldbus, or a digital input to reset the fault.

The occurrences for iC7 BACnet MSTP devices are listed in Table 25.

Table 25: Occurrences in iC7 drives with BACnet MSTP

Number	Occurrence	Configurable	Value
1	BACnet No Connection	No	Warning
2	BACnet Timeout	Yes	• ***No Response***: The event is ignored. • ***Info***: The event is logged in the event log. • ***Warning***: The drive issues a warning. • ***Warning - Change Control Place***: The drive issues a warning, and the control place changes to the selected alternative while the timeout warning is active. The control place changes back to the original control place when the fieldbus process data returns. • ***Warning - Change Control Place – Persistent***: The drive issues a warning, and the control place changes to the selected alternative while the timeout warning is active. The control place requires a reset command to change back to the original control place after the fieldbus process data returns. • ***Fault, ramp to coast***: The drive issues a fault, ramps down, and coasts the motor. • ***Fault***: The drive issues a fault and coasts the motor.

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Table 26: BACnet Timeout Function Parameters

Parameter index	Parameter name	Default value	Minimum value	Maximum value	Description
10.3.7.2.14	***BACnet Connection Timeout***	60.00 s	10.00 s	18000.00 s	Set the BACnet Timeout Value.
10.3.7.2.15	***BACnet Timeout Control Place***	1	1	4	Select the alternative control place to be used in case of BACnet timeout. 1. Local control 2. Fieldbus control 3. I/O control 4. Advanced control
10.3.7.2.16	***BACnet Timeout Response***	0	0	6	Select the response to a BACnet data time-out. 1. Info 2. Warning 3. Warning - Change Control Place 4. Warning - Change Control Place – Persistent 5. Fault, ramp to coast 6. Fault

5.4 Error Codes

For BACnet to function, set the MAC address, the device instance, baud rate, and data format to match the bus parameters. If there are errors in establishing communication, see 5.5 Diagnostic Counters.

Table 27 provides more information for troubleshooting the BACnet error responses.

BACnet communication also fails if bus termination is not done properly. Ensure that the ends are properly terminated.

Table 27: BACnet Error Codes

Number	BACnet error code	Error class category	Error code reason
1.	UNKNOWN_OBJECT	Object Class Error Code	Specified objects do not exist in the database.
2.	INVALID_ARRAY_INDEX	Property Class Error Code	Array index is out of range.
3.	INVALID_DATATYPE	Property Class Error Code	Property value datatype does not match the expected type.
4.	PROPERTY_IS_NOT_AN_ARRAY	Property Class Error Code	Attempt to access a property as an array, but it is not an array.
5.	UNKNOWN_PROPERTY	Property Class Error Code	Property identifier is unknown or unsupported.
6.	VALUE_OUT_OF_RANGE	Property Class Error Code	Value outside the valid range for the property.
7.	WRITE_ACCESS_DENIED	Property Class Error Code	Write access denied for the property.
8.	OUT_OF_MEMORY	Resource Class Error Code	Failed to allocate memory during internal operations.
9.	PASSWORD_FAILURE	Security Class Error Code	The operator's name and password did not match correctly.

Table 27: BACnet Error Codes - (continued)

Number	BACnet error code	Error class category	Error code reason
10.	CONFIGURATION_IN_PROGRESS	Device Class Error Code	Device is being configured; requests temporarily declined.
11.	OPTIONAL_FUNCTIONALITY_NOT_SUPPORTED	Object Class Error Code, Property Class Error Code, Service Class Error Code	Optional functionality required is not supported.
12.	NO_SPACE_TO_WRITE_PROPERTY	Resource Class Error Code	Not enough memory space to write the property.
13.	MISSING_REQUIRED_PARAMETER	Service Class Error Code, Reject Reason Error Code	Missing required parameter for the execution of the service request.
14.	PARAMETER_OUT_OF_RANGE	Service Class Error Code, Reject Reason Error Code	Parameter value is outside the allowable range for the service.
15.	ABORT_APPLICATION_EXCEEDED_REPLY_TIME	Abort Reason Error Code	Device failed to respond within the APDU Timeout period.
16.	ABORT_BUFFER_OVERFLOW	Communication Class Error Code, Abort Reason Error Code	Input buffer exceeded capacity either locally or remotely.
17.	ABORT_SEGMENTATION_NOT_SUPPORTED	Communication Class Error Code	Abort due to unsupported segmentation in PDU.
18.	ABORT_WINDOW_SIZE_OUT_OF_RANGE	Communication Class Error Code	Window size in segmented request exceeds the acceptable range.
19.	REJECT_UNDEFINED_ENUMERATION	Communication Class Error Code	Reject due to an undefined enumeration in the remote device.
20.	CHARACTER_SET_NOT_SUPPORTED	Property Class Error Code, Service Class Error Code	Unsupported character string encountered.
21.	DATATYPE_NOT_SUPPORTED	Property Class Error Code	Data contains an unsupported datatype.
22.	INVALID_TAG	Service Class Error Code, Reject Reason Error Code, Communication Class Error Code	Syntax error encountered in the service request.
23.	ABORT_INVALID_APDU_IN_THIS_STATE	Communication Class Error Code	APDU is not expected in the current transaction state.
24.	ABORT_PREEMPTED_BY_HIGHER_PRIORITY_TASK	Abort Reason Error Code	Transaction aborted to allow higher priority tasks to process.
25.	OTHER	All Class Error Code	This error code is returned for a reason other than any of those previously enumerated for this Error Class.

5.5 Diagnostic Counters

BACnet diagnostic counters are used to monitor and diagnose BACnet communication.

If the counter exceeds the limit, it restarts from 0. No information about the counter that has completed a cycle is recorded, and no notifications are sent.

The counters are reset when the drive restarts, or a warm start or a cold start is executed.

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Table 28: BACnet Diagnostic Counters

Parameter index number	Parameter name	Minimum value	Maximum value	Description
10.3.7.1.1	***Total Messages***	0	4.29E+09	Total count of all messages processed (Rx + Tx). This counter increases by 1 for every message, whether it is transmitted or received.
10.3.7.1.2	***Transmitted Messages***	0	4.29E+09	Total count of all transmitted messages. This counter increases by 1 for every transmitted message.
10.3.7.1.3	***Received Messages***	0	4.29E+09	Total count of all received messages. This counter increases by 1 for every received message.
10.3.7.1.4	***Valid Received Messages***	0	4.29E+09	Count of received messages that passed validation. This counter increases if the received message is valid.
10.3.7.1.5	***Invalid Received Messages***	0	4.29E+09	Count of received messages that failed validation. This counter increases by 1 if the received message is invalid.



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