Native BACnet MS/TP for CUE

Functional profile and user manual

GRUNDFOS

Native BACnet MS/TP for CUE

English (GB)
Functional profile and user manual 4

Original functional profile and user manual

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1. General information

Read this document before you install the product. Installation and operation must comply with local regulations and accepted codes of good practice.

1.1 Hazard statements

The symbols and hazard statements below may appear in Grundfos installation and operating instructions, safety instructions and service instructions.

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

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

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

The hazard statements are structured in the following way:

SIGNAL WORD
Description of the hazard
Consequence of ignoring the warning
- Action to avoid the hazard.

1.2 Notes

The symbols and notes below may appear in Grundfos installation and operating instructions, safety instructions and service instructions.

Observe these instructions for explosion-proof products.

A blue or grey circle with a white graphical symbol indicates that an action must be taken.

A red or grey circle with a diagonal bar, possibly with a black graphical symbol, indicates that an action must not be taken or must be stopped.

If these instructions are not observed, it may result in malfunction or damage to the equipment.

Tips and advice that make the work easier.

2. Introduction

2.1 Technical overview

BACnet (Building Automation and Control Network) is an open data communications protocol, American National Standard (ANSI/ASHRAE 135-1995). BACnet provides a means by which computer-based control equipment from different manufacturers can work together. BACnet is designed to handle many types of building controls, including HVAC, lighting, security, fire, access control, maintenance and waste management. BACnet permits flexibility for expansion and different equipment combinations.

Conformance Classes, Function Groups and the PICS: Evaluating the capabilities of a BACnet device is potentially a formidable task, given the great choice of Objects, Properties and Services, which can be implemented, as well as the fact that it is not necessary for every BACnet device to have a full BACnet implementation in order to carry out its task. ASHRAE's BACnet Committee recognized this problem and responded with aids to evaluation in the form of Conformance Classes, Function Groups and the Protocol Implementation Conformance Statement (PICS).

The BACnet protocol defines six levels of Conformance Classes, each of which specifies the minimum subset of Services implemented on the device. The lowest level, Conformance Class 1, requires only that the BACnet device contain a Device Object and that it can execute (respond to) a ReadProperty Service request. Each successive Conformance Class level adds Service Requests that must be executable by the device, as well as the Service Requests it must be able to initiate. Conformance Class 6 requires 21 types of Service Requests (of the 32 overall) to be implemented, of which 20 must be initiable and 17 executable. Conformance Class thus provides a measure of the device's ability to communicate.

Function Groups specify a combination of Objects and Services necessary to carry out certain building automation functions. They are specified independently of Conformance Class, though the implementation of some of the Function Groups automatically confers some Conformance Class higher than 1.

Background information	
Protocol name	BACnet
Technology developer	ASHRAE
Year introduced	1995

Background information	
Governing standards	ANSI/ASHRAE Standard 135-2008 version 4, ISO 16484-5
Openness	Open specification
Physical characteristics	
Network topology	Bus
Physical media	Shielded twisted pair
Max. distance at low speed	1200 m
Transport mechanism	
Communication methods	Master/slave
Baud Rates Supported	9600, 19200, 38400, 76800
Termination	120 ohm

2.2 Assumptions

This manual assumes you are using the BACnet Protocol with a CUE series frequency converter. It is also assumed that your system is equipped with a firmware supporting the BACnet communication services required by your application and that all requirements stipulated in the BACnet standard are strictly observed as well as all limitations therein fully respected.

2.3 Background knowledge

The BACnet Protocol is designed to communicate with any system complying with the BACnet MS/TP standard. Familiarity with the PC, BMS or PLC used as a master in the system is assumed. Issues regarding hardware or software produced by other manufacturers are beyond the scope of this manual and are not the responsibility of Grundfos.

2.4 Abbreviations

ACI	Acyclical Control Interval
AOC	Application Orientated Controller
AV	Analog Variable
BMS	Building Management System
BV	Binary Variable
CTW	Control Word
EEPROM	Electrical Erasable Programmable Read Only Memory
EIA	Electronic Industries Association: Specifies of the EIA Standard RS 485-A
EMC	Electromagnetic Compatibility
I/O	Input/Output
ISO	International Standards Organization
LCP	Local Control Panel
LED	Light Emitting Diode
MAV	Main Actual Value
MRV	Main Reference Value
PC	Personal Computer
PDU	Protocol Data Unit
PELV	Protected Extra Low Voltage
PLC	Programmable Logic Control
PNU	Parameter Number
STW	Status Word

3. The BACnet Interface

3.1 Cabling

Cable lengths and number of nodes

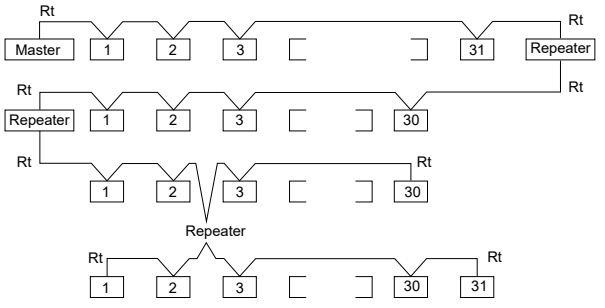
For the correct function of a BACnet MS/TP system, it is mandatory to fulfill installation of the communication cables given in this manual. Under correct installation it is possible to have up to 250 nodes (125 masters and 125 slaves) on 1200 meter (4000 feet) cable.

The use of drop cable connection (i.e. T-connection) is not allowed in a BACnet MS/TP system. Drop cables will lead to reflection and malfunction of the system. In location where the cabling will demand a T-connection the use of repeaters is recommended.

Note that a repeater is a node in both of the two segments it connects. The number of frequency converters is based on a single master system. If there are two or more devices (e.g. PC tools, Routers), the number of frequency converters must be reduced correspondingly.

- Maximum length of an MS/TP segment: 1200 meters (4000 feet)
- Characteristic impedance: 100 to 130Ω
- Resistance: <110Ω/km
- Distributed capacitance: <100pF/m, between conductors
- Cross section: 0.82mm2 conductor area, corresponding to AWG 18
- Cable type: twisted in pairs, 1 x 2, or 2 x 2 wires
- Screening: Copper-braided screen or braided screen and foil screen

Use of the same cable type throughout the entire segment is recommended to avoid impedance mismatch.



3.2 Network connection

Connect the frequency converter to the RS-485 network as follows (see also diagram):

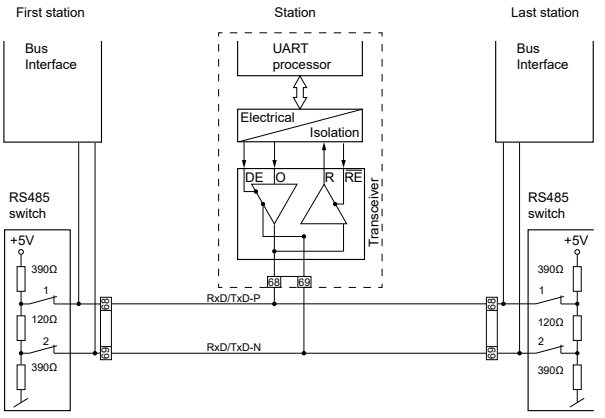
1. Connect signal wires to terminal 68 (P+) and terminal 69 (N-) on the main control board of the frequency converter.
2. Connect the cable screen as described under chapter Bus Cabling.

Screened, twisted-pair cables are recommended to reduce noise between conductors.

3.3 Network termination

Maximum cable lengths

Maximum total bus cable length: 4000 feet ~ 1200m



3.4 Switches S201, S202, and S801

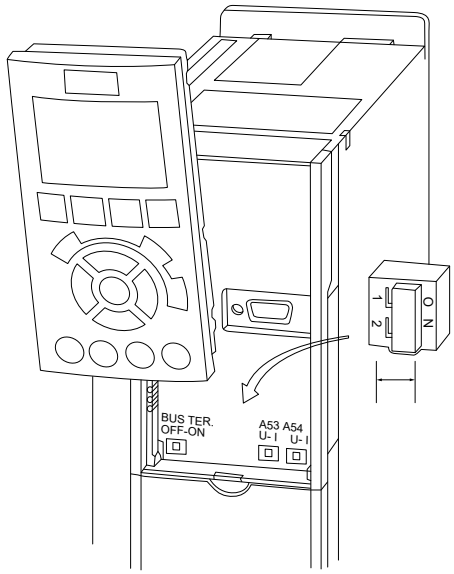
Switches S201 (A53) and S202 (A54) are used to select a current (0-20mA) or a voltage (-10 to 10V) configuration of the analog input terminals 53 and 54 respectively.

Switch S801 (BUS TER.) can be used to enable termination on the RS-485 port (terminals 68 and 69).

Default setting:

- S201 (A53) = OFF (voltage input)
- S202 (A54) = OFF (voltage input)
- S801 (Bus termination) = OFF

When changing the function of S201, S202 or S801 be careful not to use force for the switch over. It is recommended to remove the LCP fixture (cradle) when operating the switches. The switches must not be operated with power on the frequency converter.



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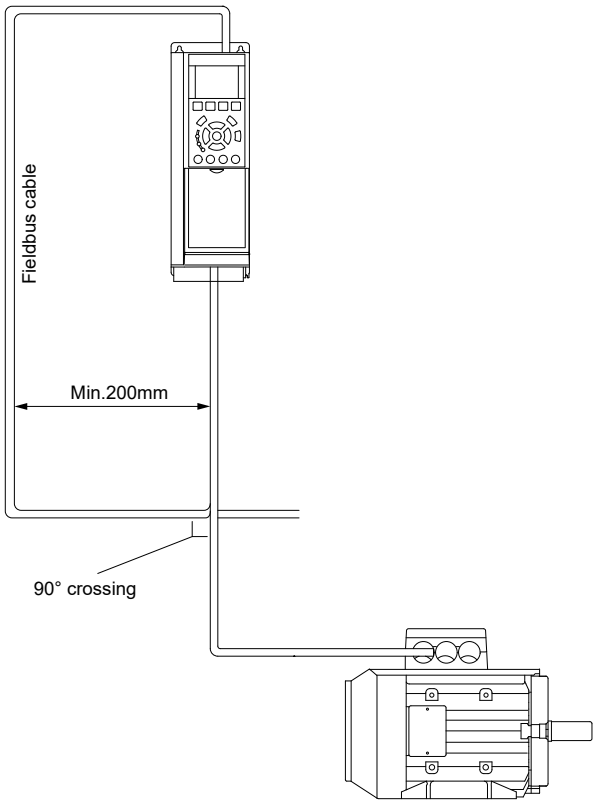
3.5 Cable routing

The BACnet communication cable must be kept away from motor cables to avoid coupling of high frequency noise from one cable to the other. Normally a distance of 200 mm is sufficient, but maintaining the greatest possible distance between cables is generally recommended, especially where cables run in parallel over long distances.

When crossing is unavoidable, the BACnet cable must cross motor cable at an angle of 90°.



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4. Bus cabling

4.1 EMC precautions

The following EMC precautions are recommended to achieve interference-free operation of the BACnet network.

Ensure compliance with relevant national and local regulations, for example in protective earth connection.

4.2 Single ground shielding

For installing the bus cable on MS/TP, two different strategies can be followed, Single ground of shield and multiple ground of shield. Each strategy has both advantages and disadvantages. The following chapter explains the different between the two strategies.

The single ground shield is specified in the ANSI/ASRAHE 135-2004 standard. The solution benefits by having only one ground connection of the shield, by doing so the possibility for ground loop of equalizing current is heavily reduced.

In these systems the shield of the MS/TP cables has to be isolated from ground at all stations, except one. At each station the shield from the two cables has to be connected with each other, and isolated from ground. The best solution for this has been proven to be the use of shrink tubes.

The single ground shielding is a good approach where the system uses long bus cables. If two buildings have to be connected over the same MS/TP bus cable, the use of fibre optic has to be considered. This will prevent that a lightning stroke will be carried from one building to another, and problem with difference in earth potential can be neglected.

4.3 Multiple ground shielding

If the distance between the individual drives is limited (e.g. inside a cabinet or in one control room) Grundfos recommends connecting the screen to ground at both ends of the bus cable. This ensures the maximum protection from EMC noise.

Connecting the screen at each end will require that each BACnet device has the same earth potential or an equalizing current will flow in the screen of the cable and cause disturbance and poor performance of the system.

Low impedance to ground connection of the screen can be achieved by connecting the surface of the screen to ground, by means of a cable clamp or a conductive cable gland.

5. System configuration

5.1 Configuring BACnet

Initialization procedure
General settings

Parameter	Default value	Setting for BACnet
8-01 Control Site	Digital and control word	Digital and control word
8-02 Control Source	FC port	FC port
8-03 Control Timeout Time	60 sec	Depending on your application.
8-04 Control Timeout Function	Off	Depending on your application.
8-05 End-of-Timeout Function	Resume setup	Depending on your application.
8-06 Reset Control Timeout	Do not reset	Depending on your application.
8-07 Diagnosis Trigger	Disable	N/A
8-09 Communication Charset	ANSI X3.4	-
8-10 Control Profile	FC Profile	Depending on the BMS system

FC port settings

Parameter	Default value	Setting for BACnet
8-30 Protocol	FC	BACnet
8-31 Address	1	1 [1)]
8-32 Baud Rate	9600	9600 baud
8-35 Minimum Response Delay	10 ms	10 ms
8-36 Maximum Response Delay	5000 ms	5000 ms

1) The address setting is depending on the system and each device connected to the BACnet MS/TP must have a unique address on this MS/TP network.

Digital/Bus Settings

Parameter	Default value	Setting for BACnet
8-50 Coasting Select	Logic-or	Logic-or
8-52 DC Brake Select	Logic-or	Logic-or
8-53 Start Select	Logic-or	Logic-or
8-54 Reversing Select	Logic-or	Logic-or
8-55 Set-up Select	Logic-or	Logic-or
8-56 Preset Reference Select	Logic-or	Logic-or

BACnet Settings

Name	Default value	Setting for BACnet
8-70 BACnet Device Instance	1	1 [2)]
8-72 MS/TP Max Masters	127	Dependent on the Number of Masters in the system
8-74 I-Am Service	At power up	At power up
8-75 Initialisation Password	admin	admin

2) The device instance setting is depending on the system, and each device connected to the BACnet MS/TP must have a unique device instance in the complete system.

Related information

7.1 Parameter list

5.2 Control word time-out function

8-03 Control Timeout Time and 8-04 Control Timeout Function are not enabled in this version of the BACnet option.

5.3 Example of a simple setup of BACnet

This example shows the necessary steps to set up the CUE BACnet interface with the following system requirements:

- MS/TP running at 38,400 Baud
- MAC address 20 for the CUE on the MS/TP network
- Device Instance number 1025 for the CUE
- Highest number of a Master device is 35
- Start/stop of FC from BACnet only
- Reference from BACnet
- Read status of FC (Actual speed)

Set the following parameters:

Parameter	Value
8-30 Protocol	BACnet [5]
8-31 Address	20
8-32 Baud Rate	38.400 Baud [4]
8-50 Coasting Select	Bus [1]
8-70 BACnet Device Instance	1025
8-72 MS/TP Max Masters	35

After the parameters have been set according the table above, the drive has to be unpowered and repowered before the changes take effect. When the frequency converter is detected by the BMS, the drive can be controlled by BV:1, which will start the motor if set to [1]. Setting AV:1 will set the speed reference of the drive. The actual speed can be monitored via AV:3.

Related information

6.1 Analog input and output objects

6.1.1 Fault codes

6. BACnet objects

6.1 Analog input and output objects

Control the frequency converter from the BACnet network using objects. The various types of objects and their descriptions are shown in the following tables. In the following tables all available objects are shown. The availability of objects depends on the mounting of the B and/or C options.

Analog inputs object map

ID	Object name	Present value		
	Default name	Parameter	Unit	Option
AI:0	Analog Input 53	1662	%	-
AI:1	Analog Input 54	1664	%	-

Analog outputs

ID	Object name	Present value					
	Default name	Parameter	Unit	Writeable	Commandable	Timeout	Option
AO:0	Terminal 42 Output Bus Control	653	%	x	x	x	-

Analog values

ID	Object name			Present value					
	Default name	Writeable	EEPROM	Parameter	Unit	Writeable	Commandable	Timeout	Option
AV:0	Reserved for VFD profile								
AV:1	Input reference 1	x	x	Note [3]	%	x	x	x	-
AV:2	Input reference 2	-	-	Note [3]	%	x	x	x	-
AV:3	Output speed	x	x	Note [4]	%	-	-	-	-
AV:4	PID feedback	-	-	Note [5]	%	-	-	-	-
AV:5	Motor current	x	x	1614	Amps	-	-	-	-
AV:6	Power	x	x	1610	kW	-	-	-	-
AV:7	Reserved for VFD profile								
AV:8									
AV:9									
AV:10									
AV:11									
AV:12									
AV:13									
AV:14									
AV:15	Motor thermal	-	-	1618	%	-	-	-	-
AV:16	Reserved for VFD profile								
AV:17									
AV:18									
AV:19									
AV:20									
AV:21	Operating hours	-	-	1500	Hours	-	-	-	-
AV:22	Running hours	-	-	1501	Hours	-	-	-	-
AV:23	kWh counter	-	-	1502	kWh	-	-	-	-
AV:24	Motor voltage	-	-	1612	V	-	-	-	-
AV:25	Frequency	-	-	1613	Hz	-	-	-	-
AV:26	Torque	-	-	1622	%	-	-	-	-
AV:27	DC Link voltage	-	-	1630	V	-	-	-	-
AV:28	Heatsink temperature	-	-	1634	Deg.	-	-	-	-
AV:29	Inverter thermal	-	-	1635	%	-	-	-	-
AV:30	Setpoint 1	-	-	2021	%	x	-	-	-
AV:31	Bus feedback 1	-	-	894	%	x	-	-	-
AV:32	Reserved for P, I, D								
AV:33									

ID	Object name			Present value					
	Default name	Writeable	EEPROM	Parameter	Unit	Writeable	Commandable	Timeout	Option
AV:34									
AV:35	Setpoint 2	-	-	2022	%	x	-	-	-
AV:36	Bus feedback 2	-	-	895	%	x	-	-	-
AV:37									
AV:38	Reserved for P, I, D								
AV:39									
AV:40	Setpoint 3	-	-	2023	%	x	-	-	-
AV:41	Bus feedback 3	-	-	896	%	x	-	-	-
AV:42									
AV:43	Reserved for P, I, D								
AV:44									
AV:45	Running bypass	-	-	3111	Hours	-	-	-	MCO 104
AV:46	-	-	-	-	-	-	-	-	-
AV:47	-	-	-	-	-	-	-	-	-
AV:48	-	-	-	-	-	-	-	-	-
AV:49	-	-	-	-	-	-	-	-	-
AV:50	Alarm Log: Error Code	-	-	1530	NONE	-	-	-	-
AV:51	Fault code	-	-	Note [6]	NONE	-	-	-	-
AV:52	PID Start speed	-	-	2083	Hz	x	-	-	-
AV:53	On reference bandwidth	-	-	2084	%	x	-	-	-
AV:54	PID proportional gain	-	-	2093	NONE	x	-	-	-
AV:55	PID Integral time	-	-	2094	Sec	x	-	-	-
AV:56	PID Differentiation time	-	-	2095	Sec	x	-	-	-
AV:57	PID Differentiation gain limit	-	-	2096	NONE	x	-	-	-

3) Either AV:1 or AV:2 controls the drive reference. Only one of them can control the frequency converter at a time and BV:2 decides which one.

4) This value is not directly available in the frequency converter. The value must be calculated as follows: $AV\ \#3 = \frac{Par.\ 16-17}{Par.\ 4-13} \times 100\ \%$

5) This value is not directly available in the frequency converter. The value must be calculated as follows: $AV\ \#4 = \frac{Par.\ 16-52}{Par.\ 20-14} \times 100\ \%$

6) CUE fault codes are transmitted as an analog value in AV:51. The fault codes are mapped and the CUE alarm codes are shown as well for comparison.

Related information

6.1.1 Fault codes

8.2 Alarm words

6.1.1 Fault codes

The following table shows the mapping of the CUE alarm codes and their mapping to the BACnet's fault codes.

Mapping of fault codes

Fault	Fault codes	CUE Alarms	Fault descriptions
Communication error	1	17, 34	Loss of communication with the network
Over current	2	13, 40, 41, 42, 59	Instantaneous Output Current has exceeded inverter rated or programmed value
Over temperature	3	11, 29, 65, 69, 74, 244, 245, 247	Heat sink Temperature Limit has been reached
Over speed deviation	4	49, 62	Inverter has exceeded maximum or programmed limit
Over voltage	5	5, 7, 64	DC Bus Voltage has exceeded inverter limit
Under voltage	6	1, 6, 8	DC Bus Voltage is lower than required inverter limit

Fault	Fault codes	CUE Alarms	Fault descriptions
Short circuit	7	16	Inverter Output has shorted Phase to Phase
Ground fault	8	14	Inverter Output Grounding Current has exceeded manufacturer
Motor overload	9	10, 50-58, 222	Motor is overloaded
Inverter overload	10	9	Timed over current fault
Over torque detection	11	12	Programmed limit for torque has been exceeded
External fault	12	142	External fault has been activated in the inverter. This is a hard fault that must be reset
Operator interface error	13	-	Inverter programming or operational interface malfunction
Load loss	14	3, 95, 229	Load on the Motor is less than programmed limit of system. An Example is a broken belt or coupling
Configuration error	15	70, 76, 79, 81, 82, 91	Errors exist in the programmed or operational configuration of the inverter
Feedback failure	16	60, 90, 192	Required system operational feedback (signal or sensor) is not responding as expected for correct system operation
Output phase loss	17	30, 31, 32	One or more of the output phases from the inverter to the motor are open
Motor stall	18	99	Motor is operating in stall region and not able to accelerate
Power unit error	19	4, 33, 36, 37, 46, 228, 246	Error sensed on the power section of the inverter
Input phase	20	-	Input single phase or low line voltage condition
Internal drive failure	21	23, 27, 38, 39, 47, 48, 73, 85, 86	CUE specific fault

6.2 Binary input and output objects

Binary inputs

ID	Object name	Present value		
	Default name	Parameter	Bit number	Option
BI:0	Digital input Term 33	1660	0	-
BI:1	Digital input Term 32	1660	1	-
BI:2	Digital input Term 29	1660	2	-
BI:3	Digital input Term 27	1660	3	-
BI:4	Digital input Term 19	1660	4	-
BI:5	Digital input Term 18	1660	5	-
BI:6	Digital input Term 37	1660	6	-
BI:10 - BI:15	Reserved for P1660/x (MCB 115)			

Binary outputs

ID	Object name	Present value					
	Default name	Parameter	Bit number	Writeable	Commandable	Timeout	Option
BO:0	Digital Output Term 27	590	0	x	x	x	-
BO:1	Digital Output Term 29	590	1	x	x	x	-
BO:4	Relay 1	590	4	x	x	x	-
BO:5	Relay 2	590	5	x	x	x	-
BO:9 - BO:39	Reserved for Output P590/x (MCB 115)						

Binary values

ID	Object name			Present value						
	Default name	Writeable	EEPROM	Parameter	Bit number	Writeable	Commandable	EEPROM	Timeout	Option
BV:0	Reserved for VFD profile									
BV:1	RUN/STOP Command	x	x	CTW=047c + Reversing	6 reverse	x	x	-	x	-
				bit 15	15					

ID	Object name					Present value				
	Default name	Writeable	EEPROM	Parameter	Bit number	Writeable	Commandable	EEPROM	Timeout	Option
BV:2	REF 1 / REF 2 Select	x	x	Note 1	n/a	x	x	x	x	
BV:3	Fault Reset Command	x	x	CTW	7	x	-	-	-	-
BV:4	RUN / STOP Monitor	x	x	STW	1	-	-	-	-	-
BV:5	OK / FAULT Monitor	x	x	STW	3, 6, 7	-	-	-	-	-
BV:6	HAND / AUTO Reference	x	x	16-95	1	-	-	-	-	-
BV:7	Reserved for VFD profile									
BV:8										
BV:9										
BV:10										
BV:11										
BV:12										
BV:13										
BV:14										
BV:15										
BV:16										
BV:17										
BV:18										
BV:19										
BV:20										
BV:21	Warning	x	x	STW	7	-	-	-	-	-
BV:22	Trip	x	x	STW	3	-	-	-	-	-
BV:23	Trip lock	-	-	STW	6	-	-	-	-	-
BV:24	Coasting	-	-	CTW	3	x	x	-	x	-
BV:25	CW/CCW	-	-	CTW	15	x	x	-	x	-
BV:26	Jog	-	-	CTW	8	x	x	-	x	-
BV:27	Reset	-	-	CTW	7	x	x	-	x	-
BV:28	Reset KWh Counter	-	-	1506	n/a	x	-	-	-	-
BV:29	Reset Running hours counter	-	-	1507	n/a	x	-	-	-	-
BV:30	Reverse	-	-	STW	1	-	-	-	-	-
BV:31	Speed = reference	-	-	STW	8	-	-	-	-	-
BV:32	Bus control	-	-	STW	9	-	-	-	-	-
BV:33	Running	x	x	STW	11	-	-	-	-	-
BV:34	Ramp 1/ Ramp 2	-	-	CTW	9	x	x	-	-	-
BV:35	ECB Test mode	-	-	3110	0	-	-	-	-	MCO 104
BV:36	ECB Drive mode	-	-	3110	1	-	-	-	-	MCO 104
BV:37	ECB auto. Bypass enable	-	-	3110	2	-	-	-	-	MCO 104
BV:38	ECB Bypass mode	-	-	3110	3	-	-	-	-	MCO 104
BV:39	Reserved for ECB (MCO 104) - 3110 bit 4-10									
BV:40										
BV:41										
BV:42										
BV:43										
BV:44										
BV:45										

6.3 Multistate value objects

ID	Object name	Present value				Timeout
	Default name	Parameter	Bit number	Writeable	Cmd.able	
MSV:0	Smart logic controller state	1638	n/a	-	-	-
MSV:1	Active Setup	CTW	13 and 14	x	x	x

6.4 Real time clock variable

The frequency converter has a built-in real-time clock. The standard real-time clock has no battery backup function, which will lead to a loss of time if the drive is un-powered.

Some BACnet Masters can be programmed to send out the date and time as a Broadcast Telegram on a regular basis. The BACnet Interface will update the real-time clock of the drive if it receives the time synchronization telegram.

6.5 Feedback to network

The BACnet option provides several output variables (nvo's) objects to the network, containing important -, motor- and I/O feedback data. The BACnet option transmits bound network variables only and sends feedback data when the value changes.

Influence of the digital input terminals upon the Control Mode, 8-50 Coasting Select to 8-56 Preset Reference Select The influence of the digital input terminals upon control of the frequency converter can be programmed in 8-50 Coasting Select to 8-56 Preset Reference Select.

8-01 Control Site overrules the settings in parameters 8-50 to 8-56 and Terminal 37, Safe Stop overrules any parameter.

Each of the digital input signals can be programmed to logic AND, logic OR, or to have no relation to the corresponding bit in the control word. In this way a specific control command such as Stop or Coast, can be initiated by the fieldbus only, fieldbus AND Digital Input, or Fieldbus OR Digital input terminal.

In order to control the frequency converter via BACnet, 8-50 Coasting Select must be set to either Bus [1], or to Logic AND [2] and 8-01 Control Site must be set to Digital and ctrl. word [0] or Control word only [2].

6.6 BIBBs

ReadProperty	Execute
WriteProperty	Execute
DeviceCommunicationControl	Execute
ReinitializeDevice	Execute
I-Am	Initiate
I-Have	Initiate
TimeSynchronization	Execute
Who-Has	Execute
Who-Is	Execute

6.7 Object/property support matrix

Object types and properties

Property	Device	Binary input	Binary output	Binary value	Analog input	Analog output	Analog value	Multistage value
Object identifier	x	x	x	x	x	x	x	x
Object name	x	x	x	x	x	x	x	x
Object type	x	x	x	x	x	x	x	x
System status	x	-	-	-	-	-	-	-
Vendor name	x	-	-	-	-	-	-	-
Vendor identifier	x	-	-	-	-	-	-	-
Model name	x	-	-	-	-	-	-	-
Firmware revision	x	-	-	-	-	-	-	-
Application software revision	x	-	-	-	-	-	-	-
Location	x	-	-	-	-	-	-	-
Description	x	-	-	-	-	-	-	-
Protocol version	x	-	-	-	-	-	-	-
Protocol revision	x	-	-	-	-	-	-	-
Services supported	x	-	-	-	-	-	-	-
Object list	x	-	-	-	-	-	-	-
Max. APDU length	x	-	-	-	-	-	-	-
Segmentation support	x	-	-	-	-	-	-	-
Local time	x	-	-	-	-	-	-	-
Local date	x	-	-	-	-	-	-	-
APDU timeout	x	-	-	-	-	-	-	-
Number APDU retries	x	-	-	-	-	-	-	-
Max Master	x	-	-	-	-	-	-	-
Max info frames	x	-	-	-	-	-	-	-
Device address binding	x	-	-	-	-	-	-	-

Property	Device	Binary input	Binary output	Binary value	Analog input	Analog output	Analog value	Multistage value
Database revision	x	-	-	-	-	-	-	-
Present value	-	x	x	x	x	x	x	x
Status flags	-	x	x	x	x	x	x	x
Event state	-	x	x	x	x	x	x	x
Reliability	-	x	x	x	x	x	x	x
Out-of-service	-	x	x	x	x	x	x	x
Number of states	-	-	-	-	-	-	-	x
State text	-	-	-	-	-	-	-	x
Units	-	-	-	-	x	x	x	-
Priority array	-	-	x	x[7)]	-	x	x[7)]	x[7)]
Relinquish default	-	-	x	x[7)]	-	x	x[7)]	x[7)]
Polarity	-	x	x		-	-	-	-
Active text	-	x	x	x	-	-	-	-
Inactive text	-	x	x	x	-	-	-	-

7) For commandable values only

7. Parameters

7.1 Parameter list

BACnet specific parameter list

Parameter	Default value	Range	Conversion index	Data type
8-01 Control site	Dig. and ctrl. word [0]	[0 - 2]	-	5
8-02 Control source	Option A	[0 - 4]	-	5
8-03 Control timeout time	1 s	0.1 - 18000	1	7
8-04 Control timeout function	Off [0]	[0 - 10]	-	5
8-05 End-of-timeout function	Hold set-up [0]	[0 - 1]	-	5
8-06 Reset control timeout	Do not reset [0]	[0 - 1]	-	5
8-07 Diagnosis trigger	Disable [0]	[0 - 3]	-	5
8-10 Control profile	FC [0]	[0 - x]	-	5
8-30 Protocol	FC	-	-	-
8-31 Address	1	[0 – 255]	-	-
8-32 Baud rate	9600	[0 – 7]	-	-
8-33 Parity / Stop bits	No parity, 1 Stop bit	-	-	-
8-35 Minimum response delay	10 mS	-	-	-
8-36 Maximum response delay	5000 mS	-	-	-
8-37 Maximum inter-char delay	25.00 mS	-	-	-
8-50 Coasting select	Logic OR [3]	[0 - 3]	-	5
8-52 DC Brake select	Logic OR [3]	[0 - 3]	-	5
8-53 Start select	Logic OR [3]	[0 - 3]	-	5
8-54 Reversing select	Logic OR [3]	[0 - 3]	-	5
8-55 Set-up select	Logic OR [3]	[0 - 3]	-	5
8-56 Preset reference select	Logic OR [3]	[0 - 3]	-	5
8-70 BACnet Device instance	1	[1-4194304]	-	-
8-72 MS/TP Max masters	127	[1-127]	-	-
8-73 MS/TP Max info frames	-	-	-	-
8-74 "I-Am" service	Once at powerup [0]	[0-1]	-	-
8-75 Initialisation password	admin	String [19]	-	-

The conversion index refers to a conversion figure used when writing or reading to and from the frequency converter.

Conversion index

Conversion index	100	67	6	5	4	3	2	1	0	-1	-2	-3	-4	-5	-6
Conversion factor	1	1/60	1000000	100000	10000	1000	100	10	1	0.1	0.01	0.001	0.0001	0.00001	0.000001

Data type	Description	Type
2	Integer 8	Int8
3	Integer 16	Int16
4	Integer 32	Int32
5	Unsigned 8	Uint8
6	Unsigned 16	Uint16
7	Unsigned 32	Uint32
9	Visible string	VisStr
33	Normalized value 2 bytes	N2
35	Bit sequence of 16 boolean variables	V2
54	Time difference w/o date	TimD

7.2 Parameter description

8-xx commands and options

8-01 Control site

Option		Function
		The setting in this parameter overrides the settings in 8-50 Coasting select to 8-56 Preset reference select.
[0]	Digital and control word	Control by using both digital input and control word.
[1]	Digital only	Control by using digital inputs only.
[2]	Control word only	Control by using control word only.

8-02 Control source

Option		Function
		Select the source of the control word: one of two serial interfaces or four installed options. During initial power-up, the frequency converter automatically sets this parameter to Option A [3] if it detects a valid fieldbus option installed in slot A. If the option is removed, the frequency converter detects a change in the configuration, sets 8-02 Control Source back to default setting FC Port, and the frequency converter then trips. If an option is installed after initial power-up, the setting of 8-02 Control Source will not change but the frequency converter will trip and display: Alarm 67 Option changed.
[0]	None	
[1]	FC Port	
[2]	USB Port	
[3]	Option A	
[4]	Option B	

This parameter cannot be adjusted while the motor is running.

8-03 Control timeout time

Range		Function
0 s	[0.1 - 18000 s]	Enter the maximum time expected to pass between the reception of two consecutive telegrams. If this time is exceeded, it indicates that the serial communication has stopped. The function selected in 8-04 Control timeout function will then be carried out.

Range	Function
	In BACnet the following variables will trigger the Control word time parameter: Analog outputs Binary outputs AV0 AV1 AV2 AV4 BV1 BV2 BV3 BV4 BV5 Multistate outputs

8-04 Control timeout function

Option		Function
		Select the time-out function. The timeout function is activated when the control word fails to be updated within the time period specified in 8-03 Control timeout time. Choice [20] only appears after setting the Metasys N2 protocol.
[0]	Off	
[1]	Freeze output	
[2]	Stop	
[3]	Jogging	
[4]	Max. speed	
[5]	Stop and trip	
[7]	Select setup 1	
[8]	Select setup 2	
[9]	Select setup 3	
[10]	Select setup 4	
[20]	N2 override release	

8-05 End-of-timeout function

Option		Function
		Select the action after receiving a valid control word following a time-out. This parameter is active only when 8-04 Control timeout function is set to [Set-up 1-4].
[0]	Hold set-up	Retains the set-up selected in 8-04 Control timeout function and displays a warning, until 8-06 Reset control timeout toggles. Then the frequency converter resumes its original set-up.
[1]	Resume setup	Resumes the set-up active prior to the timeout.

8-06 Reset control timeout

Option		Function
		This parameter is active only when the choice Hold set-up [0] has been selected in 8-05 End-of-timeout function .
[0]	Do not reset	Retains the set-up specified in 8-04 Control timeout function, [Select setup 1-4] following a control time-out.
[1]	Do reset	Returns the frequency converter to the original set-up following a control word time-out. When the value is set to Do reset [1], the frequency converter performs the reset and then immediately reverts to the Do not reset [0] setting.

8-07 Diagnosis trigger

Option		Function
		This parameter has no function for BACnet.
[0]	Disable	
[1]	Trigger on alarms	
[2]	Trigger alarm or warning	

8-09 Communication charset

Option		Function
[0]	ISO 8859-1	-
[1]	ANSI X3.4	-

8-30 Protocol

Option		Function
[5]	BACnet	The BACnet protocol is an international protocol that efficiently integrates all parts of building automation equipment from the actuator level to the building management system.

8-32 Baud rate

Option		Function
		Baud rate selection depends on Protocol selection in 8-30 Protocol.
[2]	9600 Baud	
[3]	19200 Baud	
[4]	38400 Baud	
[6]	76800 Baud	

Default refers to the FC Protocol.

8-33 Parity / Stop bits

Option		Function
		Parity and Stop bits for the protocol 8-30 Protocol using the FC Port. For some of the protocols, not all options will be visible. Default depends on the protocol selected.
[0]	Even parity, 1 Stop bit	
[1]	Odd parity, 1 Stop bit	
[2]	No parity, 1 Stop bit	
[3]	No parity, 2 Stop bits	

8-35 Minimum response delay

Range		Function
Size related	[5 - 10000 ms]	Specify the minimum delay time between receiving a request and transmitting a response. This is used for overcoming modem turnaround delays.

8-36 Maximum response delay

Range		Function
Size related	[11 - 10001 ms]	Specify the maximum permissible delay time between transmitting a request and receiving a response. Exceeding this delay time will cause control word time-out.

8-37 Maximum inter-char delay

Range		Function
Size related	[0.00 - 35.00 ms]	Specify the maximum permissible time interval between receipt of two bytes. This parameter activates timeout if transmission is interrupted.

8-50 Coasting select

Option		Function
		Select control of the coasting function via the terminals (digital input) and/or via the bus.
[0]	Digital input	Activates Start command via a digital input.
[1]	Bus	Activates Start command via the serial communication port or fieldbus option.
[2]	Logic AND	Activates Start command via the fieldbus/serial communication port, AND additionally via one of the digital inputs.
[3]	Logic OR	Activates Start command via the fieldbus/serial communication port OR via one of the digital inputs.

8-52 DC Brake select

Option		Function
		Select control of the DC brake via the terminals (digital input) and/or via the fieldbus.
[0]	Digital input	Activates Start command via a digital input.
[1]	Bus	Activates Start command via the serial communication port or fieldbus option.
[2]	Logic AND	Activates Start command via the fieldbus/serial communication port, AND additionally via one of the digital inputs.
[3]	Logic OR	Activates Start command via the fieldbus/serial communication port OR via one of the digital inputs.

8-53 Start select

Option		Function
		Select control of the frequency converter start function via the terminals (digital input) and/or via the fieldbus.
[0]	Digital input	Activates Start command via a digital input.
[1]	Bus	Activates Start command via the serial communication port or fieldbus option.
[2]	Logic AND	Activates Start command via the fieldbus/serial communication port, AND additionally via one of the digital inputs.
[3]	Logic OR	Activates Start command via the fieldbus/serial communication port OR via one of the digital inputs.

8-54 Reversing select

Option		Function
		Select control of the frequency converter reverse function via the terminals (digital input) and/or via the fieldbus.
[0]	Digital input	Activates Reverse command via a digital input.
[1]	Bus	Activates Reverse command via the serial communication port or fieldbus option.
[2]	Logic AND	Activates Reverse command via the fieldbus/ serial communication port, AND additionally via one of the digital inputs.
[3]	Logic OR	Activates Reverse command via the fieldbus/ serial communication port OR via one of the digital inputs.

This parameter is active only when 8-01 Control site is set to [0] Digital and control word.

8-55 Set-up select

Option		Function
		Select control of the frequency converter set-up selection via the terminals (digital input) and/or via the fieldbus.
[0]	Digital input	Activates the set-up selection via a digital input.
[1]	Bus	Activates the set-up selection via the serial communication port or fieldbus option.
[2]	Logic AND	Activates the set-up selection via the fieldbus/ serial communication port, AND additionally via one of the digital inputs.
[3]	Logic OR	Activate the set-up selection via the fieldbus/ serial communication port OR via one of the digital inputs.

8-56 Preset reference select

Option		Function
		Select control of the frequency converter Preset reference selection via the terminals (digital input) and/or via the fieldbus.
[0]	Digital input	Activates Preset reference selection via a digital input.
[1]	Bus	Activates Preset reference selection via the serial communication port or fieldbus option.
[2]	Logic AND	Activates Preset reference selection via the fieldbus/serial communication port, AND additionally via one of the digital inputs.
[3]	Logic OR	Activates the Preset reference selection via the fieldbus/serial communication port OR via one of the digital inputs.

8-70 BACnet device instance

Range		Function
		The Device Instance number must be unique for the complete BACnet, not only for this MS/TP Branch.
[1]	[0 - 4194302]	Enter a unique ID number for the BACnet device.

8-72 MS/TP Max masters

Option	Function
[0 - 127]	Define the address of the master which holds the highest address in this network. Decreasing this value optimises polling for the token.

8-73 MS/TP Max info frames

Range		Function
[1]	[1 - 65534]	Define how many info/ data frames the device is allowed to send while holding the token.

8-74 I-Am service

Option		Function
[0]	Send at power-up	
[1]	Continuously	Choose whether the device should send the I-Am service message only at power-up or continuously with an interval of approx. 1 min.

8-75 Initialisation password

Range		Function
[Size related]		
[0]	[0 - 0]	Enter the password needed for execution of Drive re-initialisation from BACnet.

8. Troubleshooting

8.1 Alarm, warning and extended status

Alarm and warning messages

General

There is a clear distinction between alarms and warnings. In the event of an alarm, the frequency converter will enter a fault condition. After the cause for the alarm has been cleared, the master must acknowledge the alarm message in order to start operation of the frequency converter again. A warning, on the other hand, may appear when a warning condition arises, then disappear when conditions return to normal without interfering with the process.

Alarm word and Warning word are shown on the display in Hex format. If there is more than one warning or alarm, a sum of all warnings or alarms will be shown. Warning word and Alarm word are displayed in par. 16-90 to 16-95.

For more information on the individual alarms and warnings, please refer to the CUE Service Instructions.

Alarms

Following an alarm message the frequency converter will enter a fault condition. Only after the fault has been rectified and the master has acknowledged the alarm message by setting bit 3 in the Control word, can the FC resume operation. All alarms within the FC are represented by a single bit within an Alarm word. An Alarm word is always an action parameter. Bit status FALSE [0] means no alarm, while bit status TRUE [1] means alarm.

Warnings

All warnings within the frequency converter are represented by a single bit within a Warning word. A Warning word is always an action parameter. Bit status FALSE [0] means no warning, while bit status TRUE [1] means warning. Each bit status has a corresponding text string message. In addition to the Warning word message the master will also be notified via a change to bit 7 in the status word.

8.2 Alarm words

Alarm words, 16-90

Bit (Hex)	Alarm words
00000001	Brake check
00000002	Power card over temperature
00000004	Earth fault
00000008	Control card over temperature
00000010	Control word timeout
00000020	Over current
00000040	Torque limit
00000080	Motor thermistor over temperature
00000100	Motor ETR over temperature
00000200	Inverter overloaded
00000400	DC link under voltage
00000800	DC link over voltage
00001000	Short circuit
00002000	Inrush fault
00004000	Mains phase loss
00008000	AMA not OK
00010000	Live zero error
00020000	Internal fault
00040000	Brake overload
00080000	Motor phase U is missing
00100000	Motor phase V is missing
00200000	Motor phase W is missing
00400000	Fieldbus fault
00800000	24 V supply fault
01000000	Mains failure
02000000	1.8 V supply fault
04000000	Brake resistor short circuit
08000000	Brake chopper fault
10000000	Option change
20000000	Drive initialised
40000000	Safe Stop
80000000	Not used

Alarm words, 16-91

Bit (Hex)	Alarm words
00000001	Service Trip, read / write
00000002	Reserved
00000004	Service Trip, type code / spare part
00000008	Reserved
00000010	Reserved
00000020	No flow
00000040	Dry pump
00000080	End of curve
00000100	Broken belt
00000200	Not used
00000400	Not used
00000800	Reserved
00001000	Reserved
00002000	Reserved
00004000	Reserved
00008000	Reserved
00010000	Reserved
00020000	Not used
00040000	Fans error
00080000	ECB error
00100000	Reserved
00200000	Reserved
00400000	Reserved
00800000	Reserved
01000000	Reserved
02000000	Reserved
04000000	Reserved
08000000	Reserved
10000000	Reserved
20000000	Reserved
40000000	Reserved
80000000	Reserved

8.3 Warning words

Warning words, 16-92

Bit (Hex)	Warning words
00000001	Brake check
00000002	Power card over temperature
00000004	Earth fault
00000008	Control card over temperature
00000010	Control word timeout
00000020	Over current
00000040	Torque limit
00000080	Motor thermistor over temperature
00000100	Motor ETR over temperature
00000200	Inverter overloaded

Bit (Hex)	Warning words
00000400	DC link under voltage
00000800	DC link over voltage
00001000	DC link voltage low
00002000	DC link voltage high
00004000	Mains phase loss
00008000	No motor
00010000	Live zero error
00020000	10 V low
00040000	Brake resistor power limit
00080000	Brake resistor short circuit
00100000	Brake chopper fault
00200000	Speed limit
00400000	Fieldbus communication fault
00800000	24 V supply fault
01000000	Mains failure
02000000	Current limit
04000000	Low temperature
08000000	Voltage limit
10000000	Encoder loss
20000000	Output frequency limit
40000000	Not used
80000000	Not used

Warning words, 16-93

Bit (Hex)	Warning words
00000001	Start delayed
00000002	Stop delayed
00000004	Clock failure
00000008	Reserved
00000010	Reserved
00000020	No flow
00000040	Dry pump
00000080	End of curve
00000100	Broken belt
00000200	Not used
00000400	Reserved
00000800	Reserved
00001000	Reserved
00002000	Reserved
00004000	Reserved
00008000	Reserved
00010000	Reserved
00020000	Not used
00040000	Fans warning
00080000	ECB warning
00100000	Reserved
00200000	Reserved
00400000	Reserved
00800000	Reserved
01000000	Reserved
02000000	Reserved
04000000	Reserved
08000000	Reserved
10000000	Reserved
20000000	Reserved
40000000	Reserved
80000000	Reserved

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