BACnet for Grundfos pumps

CIM/CIU 300 BACnet MS/TP

Functional profile and user manual

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Original functional profile and user manual.

CONTENTS

1. Symbol used in this document

Note ***Notes or instructions that make the job easier and ensure safe operation.***

2. Introduction

2.1 About this functional profile

This functional profile describes the CIM/CIU 300 (BACnet Communication Interface Unit 300) for the following Grundfos pumps:

- Grundfos MAGNA (with add-on GENIbus module)
- Grundfos MAGNA3 (with add-on CIM 300 module)
- Grundfos UPE Series 2000 (UPE 80-120 and 100-120)
- Grundfos CRE, CRNE, CRIE, MTRE, CME
  Grundfos TPE, TPE Series 2000, NBE, NKE
  Grundfos CUE frequency converter.

The data in this document are subject to change without prior notice. Grundfos cannot be held responsible for any problems caused directly or indirectly by using information in this functional profile.

2.2 Assumptions

This functional profile assumes that the reader is familiar with commissioning and programming BACnet devices. The reader should have some basic knowledge of the BACnet protocol and technical specifications. It is also assumed that an existing BACnet MS/TP network is present.

2.3 Definitions and abbreviations

CIM	Communication Interface Module. A Grundfos add-on module.
CIU	Communication Interface Unit. A Grundfos box for CIM modules.
CRC	Cyclic Redundancy Check. A data error detection method.
Device	A node on the BACnet MS/TP network
GENIbus	Proprietary Grundfos fieldbus standard based on RS-485
Inter-network	A set of two or more BACnet networks interconnected by routers
LED	Light Emitting Diode
MAC	Media Access Control. A sublayer of the data communication protocol.
MS/TP	Master-Slave / Token-Passing. A data protocol used for BACnet RS-485.
Router	A device that connects two or more networks at the network layer.
Transmission speed	Bits transferred per second
Trunk cable	Main RS-485 cable on a BACnet MS/TP network

2.4 System diagrams

The system diagrams give an overview of how to connect the CIM/CIU 300 to the Grundfos pump that is to be connected to a BACnet network.

CIM 300

The CIM 300 is an add-on communication module to be installed internally in a Grundfos pump, using a 10-pin connection. In this setup, the pump will supply power to the CIM 300. See fig. 1.
This installation option is currently available for Grundfos E-pumps (11-22 kW), MGE model H-based E-pumps and Grundfos MAGNA3 pumps.

Pump with built-in CIM 300

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Fig. 1 CIM 300 solution

CIU 300

The CIU 300 solution is a box with a power supply module and a CIM 300 BACnet module. It can either be mounted on a DIN rail or on a wall. See fig. 2.
It is used in conjunction with Grundfos E-pumps that do not support an internal, add-on communication module (CIM 300).

Pump connected to CIU 300 via GENIbus

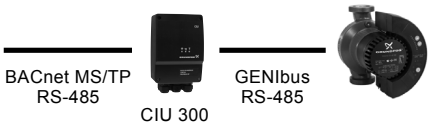

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Fig. 2 CIU 300 solution

2.5 Specifications

General data	Description	Comments
GENIbus visual diagnostics	LED2	Red/green status LED. See section *4.2 LED2, internal communication*.
Communication Interface Unit (CIU 300)		
Power supply	24-240 V AC/DC	Located in the CIU 300.
GENIbus connection type	RS-485	
GENIbus wire configuration	Three-wire + screen	Conductors: A, B and Y.
Recommended cable cross sectional cobber area for GENIbus cable	0.20 - 0.25 mm^2	AWG24 or AWG23
BACnet		
Data protocol	BACnet MS/TP	
BACnet connector	Screw-type terminal	3 pins. See section *3.2 CIM 300 BACnet module*.
BACnet connection type	RS-485	
BACnet wire configuration	Two-wire + ground	Conductors: Plus, Minus and Ground. See section *3.3 Connecting to the BACnet network*.
Maximum cable length	1200 m	Equals 4000 ft.
Recommended cable cross sectional cobber area for BACnet cable	0.20 - 0.25 mm^2	AWG24 or AWG23
MAC address	0-127	Set via rotary switches SW6 and SW7. See section *3.7 Selecting the BACnet MAC address*.
Line termination	On or Off	Set via DIP switches SW1 and SW2. See section *3.8 Termination resistor*.
Supported transmission speeds [bits/s]	9600, 19200, 38400, 76800	Set via DIP switches SW4 and SW5. See section *3.4 Setting the BACnet transmission speed*.
Data bits	8	Fixed value.
Stop bits	1	Fixed value.
Parity	None	Fixed value.
BACnet visual diagnostics	LED1	Red/green status LED. See section *4.1 LED1, BACnet MS/TP communication*.
Maximum number of BACnet devices	32	Using repeaters, this number can be increased.
Grundfos BACnet vendor ID	227	
BACnet segmentation support	No	
Character set support	ANSI X3.4	Base definition for the widely used character code known as ASCII.
BACnet device profile	B-ASC	BACnet Application-Specific Controller.
BACnet MS/TP master	Yes	The CIM/CIU 300 is a BACnet MS/TP master device.
Manual slave address binding	No	

3. BACnet interface

3.1 BACnet bus topology

The Grundfos CIM/CIU 300 is connected as a BACnet MS/TP master directly to the BACnet MS/TP network.

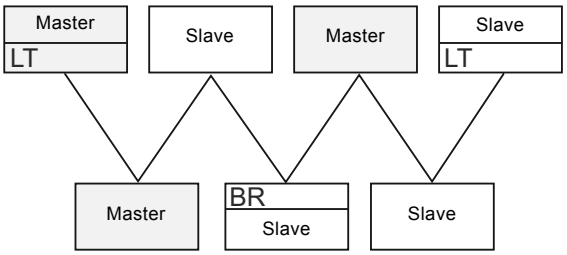

Fig. 3 Example of BACnet MS/TP network

BACnet MS/TP is a multi-master system, meaning that there can be more than one master on the network. It uses a token to control access to the bus network. A master node may initiate the transmission of a data telegram when it holds the token.
Both master and slave nodes may transmit data telegrams in response to requests from master nodes, but slaves never hold the token. Master nodes pass the token between them.

A BACnet MS/TP segment is a single contiguous medium to which BACnet nodes are attached. Segments can be connected by use of repeaters or bridges, thus forming networks.

Multiple networks may be interconnected by BACnet routers to form a BACnet inter-network.

3.1.1 Line termination resistors

Line termination must be connected at each of the two ends of the segment medium. The CIM/CIU 300 has optional line termination resistor on board.

3.1.2 Bias resistors

At least one set, and no more than two sets, of network bias resistors must exist for each segment so that an undriven communications line will be held in a guaranteed logical one state. The bias provides a reliable way for stations to detect the presence or absence of signals on the line. An unbiased line will take an indeterminate state in the absence of any driving node.

The CIM/CIU 300 has no bias resistors.

3.2 CIM 300 BACnet module

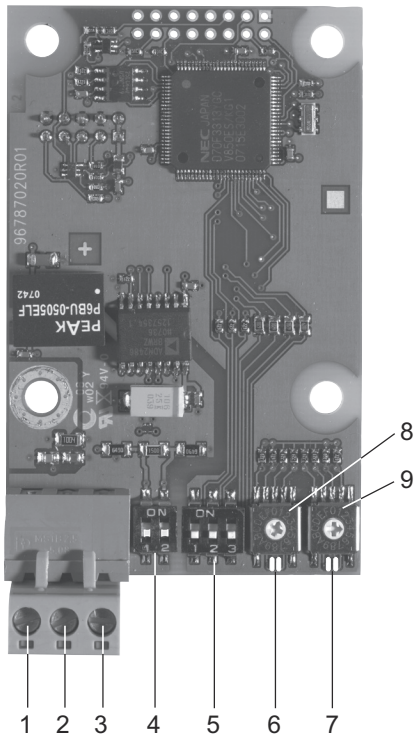

Fig. 4 CIM 300 BACnet module

Pos.	Designation	Description
1	Plus	BACnet Plus terminal (RS-485 positive data signal)
2	Minus	BACnet Minus terminal (RS-485 negative data signal)
3	Ground	BACnet Ground terminal
4	SW1/SW2	On/off switches for termination resistor
5	SW3/SW4/SW5	Switches for selecting the BACnet transmission speed and the default or custom Device Object Instance Number.
6	LED1	Red/green status LED for BACnet communication
7	LED2	Red/green status LED for internal communication between the CIM 300 and the Grundfos pump
8	SW6	Hexadecimal rotary switch for setting the BACnet MAC address (four most significant bits)
9	SW7	Hexadecimal rotary switch for setting the BACnet MAC address (four least significant bits)

3.3 Connecting to the BACnet network

A screened, twisted-pair cable must be used.

BACnet terminal	Recommended colour	Data signal
Plus	Red	Positive
Minus	Green	Negative
Ground	Grey	Ground

The ANSI/ASHRAE BACnet standard states that the cable screen must only be earthed at one end of the segment to prevent earth fault currents.

3.4 Setting the BACnet transmission speed

The transmission speed must be set correctly before the CIM 300 is ready to communicate on the BACnet MS/TP network.
DIP switches SW4 and SW5 are used to set the transmission speed. The default transmission speed is 9600 bits/s, but higher speeds are recommended for better data throughput. All devices on the BACnet MS/TP network must communicate at the same transmission speed.

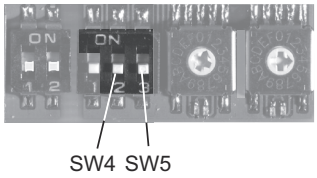

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Fig. 5 BACnet transmission speed settings

3.4.1 DIP switch settings

Available transmission speeds in bits/s: 9600, 19200, 38400 and 76800.

Use DIP switches SW4 and SW5 to select the desired speed.

Transmission speed [bits/s]	SW4	SW5
9600	OFF	OFF
19200	OFF	ON
38400	ON	OFF
76800	ON	ON

The default transmission speed is 9600 bit/s, as per the BACnet MS/TP standard. The transmission speed will be effective immediately after setting the values of the DIP switch.

3.5 Selecting the Device Object Instance Number

The Device Object Identifier value consists of two components:

- a 10-bit Object Type (bits 22 to 31)
- a 22-bit Instance Number (bits 0 to 21).

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Fig. 6 Bit numbers

The Object Type is fixed and determines that it is a Device Object. The Instance Number is a numeric code that is used to identify the device. It must be unique inter-network-wide, i.e. on all interconnected networks.

The CIM 300 offers two different approaches to setting the BACnet Device Object Instance Number: default and custom, both described in the following subsections.

3.5.1 Default Instance Number

By default, the CIM 300 uses a predefined Device Object Instance Number, which is 227XXX where XXX is the BACnet MAC address. This gives an Instance Number range of 227000 to 227127. See section *3.7 Selecting the BACnet MAC address* for more information on MAC addresses.

Example

The BACnet MAC address is set to 20 via the hexadecimal rotary switches, so the Device Object Instance Number is 227020.

3.5.2 Custom Instance Number

To use the complete Instance Number range, set the new Instance Number with the BACnet object Custom Device Object Instance Number (AV, 0), and set SW3 to ON. This will immediately set the new Device Object Instance Number.
See fig. 7 for DIP switch location.

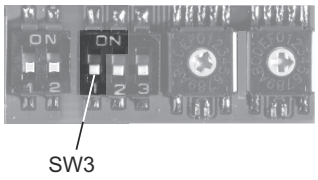

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Fig. 7 Device Object Instance Number

Device Object Instance Number	SW3
Default (227000 + BACnet MAC address)	OFF
Custom, set with object (AV, 0)	ON

The default Present_Value of the Custom Device Object Instance Number is 231.

Example

The Present_Value of Custom Device Object Instance Number (AV, 0) is 231, so the Device Object Instance Number is 231.

Note ***The Present_Value of Custom Device Object Instance Number cannot be 4194303, as this is a reserved value.***

3.6 Selecting the Device Object Name

The property Device_Name is a character string that must be unique inter-network-wide. By default, the name will be constructed as "Grundfos - XXXXXX" where XXXXXX is the current Device Object Instance Number as described in section *3.5 Selecting the Device Object Instance Number*.

Example

The Device Object Instance Number is 227001, so the Device Object Name is "Grundfos - 227001".

If a new name is selected, it will be stored in the device and replace the default naming scheme.

3.7 Selecting the BACnet MAC address

To set the BACnet MAC address, use the two hexadecimal rotary switches (SW6 and SW7).

The value must be within the range of 0 to 127. An illegal value will result in a MAC address of 0.

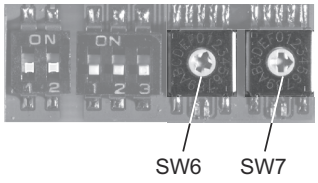

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Fig. 8 Setting the BACnet MAC address

For a complete overview of BACnet addresses, see section *12. BACnet MAC address*.

Note

The BACnet MAC address must be set decimally from 0 to 127 and must be unique on the BACnet MS/TP segment.

3.8 Termination resistor

A termination resistor for line termination is fitted on the CIM 300 and has a value of 120 Ω. It should be cut in if the CIM 300 is set as the last station on the network.

The CIM 300 has two DIP switches (SW1 and SW2) for cutting the termination resistor in and out. Figure 8 shows the DIP switches in cut-out state.

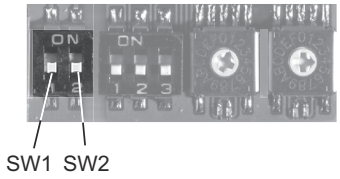

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Fig. 9 Cutting the termination resistor in and out

Status	SW1	SW2
Cut-in	ON	ON
Cut-out	OFF	OFF
	ON	OFF
	OFF	ON

Default setting: Termination resistor cut-out.

3.9 Cable length

The maximum recommended cable length within a BACnet MS/TP segment is 1200 metres (4000 ft) with 0.82 mm^2 (AWG 18) cable.

The connection between the BACnet modules must be made by use of a screened, twisted-pair cable with a characteristic impedance between 100 and 130 Ω.

4. LEDs

The CIM 300 BACnet module has two LEDs.

- Red/green status LED (LED1) for BACnet MS/TP communication
- Red/green status LED (LED2) for internal communication between the CIM 300 and the Grundfos pump.

4.1 LED1, BACnet MS/TP communication

Status	Description
Off	No communication.
Flashing green	Communication active.
Flashing red	Fault in the BACnet communication.
Permanently red	Fault in the CIM 300 BACnet configuration.

4.2 LED2, internal communication

Status	Description
Off	The CIM 300 has been switched off or is starting up.
Flashing red	No internal communication between the CIM 300 and the pump.
Permanently red	The CIM 300 does not support the specific pump version.
Permanently green	Internal communication between the CIM 300 and the pump is OK.

Note ***During start-up, there may be a delay of up to 5 seconds before the LED status is updated.***

5. Supported services

BACnet Interoperability Building Blocks (BIBBs) are collections of one or more BACnet services. These are described in terms of an "A" and a "B" device. Both devices are nodes on a BACnet internetwork. In most cases, the "A" device will act as the user of data (client), and the "B" device will be the provider of this data (server).

The CIM/CIU 300 is a BACnet Application-Specific Controller (B-ASC) with a few additional services.

5.1 Data sharing services

Name	BACnet BIBB code	Notes	Initiate	Execute
ReadProperty	DS-RP-B	The CIM/CIU 300 can be a provider of data.	-	●
ReadPropertyMultiple	DS-RPM-B	The CIM/CIU 300 can be a provider of data and return multiple values at one time.	-	●
WriteProperty	DS-WP-B	The CIM/CIU 300 allows a value to be changed over the network.	-	●
WritePropertyMultiple	DS-WPM-B	The CIM/CIU 300 allows multiple values to be changed over the network.	-	●
SubscribeCOV	DS-COV-B	The CIM/CIU 300 can be a provider of "Change Of Value" data. It supports up to 10 simultaneous COV subscriptions. Subscription lifetime can be limited or unlimited.	-	●
ConfirmedCOVNotification			●	-
UnconfirmedCOVNotification			●	-

5.2 Device management services

Name	BACnet BIBB code	Notes	Initiate	Execute
Who-Is	DM-DDB-A	The CIM/CIU 300 can seek information about device attributes of other devices and interpret device announcements.	●	-
I-Am			-	●
Who-Is	DM-DDB-B	The CIM/CIU 300 can provide information about its device attributes and responds to requests to identify itself.	-	●
I-Am			●	-
Who-Has	DM-DOB-B	The CIM/CIU 300 can provide address information about its objects upon request.	-	●
I-Have			●	-
DeviceCommunicationControl	DM-DCC-B	The CIM/CIU 300 can respond to communication control requests. It supports both limited and unlimited duration. Password (where required) is Grundfos.	-	●

6. Object overview

6.1 Device Object

The following properties are supported in the Device Object (available for all pump types).

Property identifier	Data type	Notes	Access
Object_Identifier	BACnetObjectIdentifier	See section *3.5 Selecting the Device Object Instance Number*.	R
Object_Name	CharacterString	See section *3.6 Selecting the Device Object Name* for details on Object Name.	W
Object_Type	BACnetObjectType	DEVICE.	R
System_Status	BACnetDeviceStatus	OPERATIONAL.	R
Vendor_Name	CharacterString	Grundfos.	R
Vendor_Identifier	Unsigned16	227.	R
Model_Name	CharacterString	Will show the Grundfos pump model to which the CIM/CIU 300 is connected.	R
Firmware_Revision	CharacterString	Revision of the firmware in the CIM/CIU 300.	R
Application_Software_Version	CharacterString	Software build date, DD-MM-YYYY.	R
Location	CharacterString	The user can enter a location here (maximum 200 characters).	W
Description	CharacterString	The user can enter a description here (maximum 200 characters).	W
Protocol_Version	Unsigned	Actual version of the BACnet protocol.	R
Protocol_Revision	Unsigned	Actual revision of the BACnet protocol.	R
Protocol_Services_Supported	BACnetServicesSupported	Indicates which standardised protocol services are supported.	R
Protocol_Object_Types_Supported	BACnetObjectTypesSupported	Indicates which standardised protocol object types are supported.	R
Object_List	BACnetARRAY[N]of BACnetObjectIdentifier	An array of objects available.	R
Max_APDU_Length_Accepted	Unsigned	The maximum number of bytes that may be contained in a single APDU. Fixed to 480.	R
Segmentation_Supported	BACnetSegmentation	Indicates if segmentation of messages is possible. Will always read NO_SEGMENTATION to indicate that segmentation is not possible.	R
APDU_Timeout	Unsigned	Indicates the amount of time in ms before timeout.	R
Number_Of_APDU_Retries	Unsigned	Maximum number of times an APDU is to be retransmitted.	R
Max_Master	Unsigned	Specifies the highest possible address for master nodes and must be between 1 and 127. The default value is 127, but this value can be lowered by the user to reduce transmission overhead.	W
Max_Info_Frames	Unsigned	Specifies the maximum number of information frames that are sent before the token is passed on. Fixed to 1.	R
Device_Address_Binding	List of BACnetAddressBindings	Holds address bindings to other devices, if any.	R
Database_Revision	Unsigned	Logical revision number for the device database.	R

6.2 Binary inputs

Binary objects that provide information from the Grundfos pump.

ID	Object Name	R/W	Notes	MAGNA/ UPE Series	E-pumps 0.25 - 7.5 kW	CUE/ E-pumps 11 - 22 kW
BI, 0	Control source status	R	Status of the actual control source. 0: Local control 1: Bus control.	●	●	●
BI, 1	Actual direction	R	Rotational direction of the pump impeller. 0: Clockwise 1: Counter-clockwise.	3	●	●
BI, 2	Rotation status	R	Rotation status. 0: No rotation 1: Rotation (pump running).	●	●	●
BI, 3	At minimum speed	R	0: Not running at minimum speed 1: Running at minimum speed.	●	●	●
BI, 4	At maximum speed	R	0: Not running at maximum speed 1: Running at maximum speed.	●	●	●
BI, 11	Digital input 1 status	R	0: Not active 1: Active.	3	●	●
BI, 12	Digital input 2 status	R	0: Not active 1: Active.	3	●	●
BI, 13	Digital input 3 status	R	0: Not active 1: Active.	-	●	●
BI, 14	Digital output 1 status	R	0: Not active 1: Active.	3	●	●
BI, 15	Digital output 2 status	R	0: Not active 1: Active.	3	●	●
BI, 28	Fault simulation status	R	Fault simulation status. 0: Fault simulation not active 1: Fault simulation active.	●	●	●
BI, 31	At power limit	R	0: Not running at power limit 1: Running at power limit.	3	H	-
BI, 38	Setpoint influence	R	0: Not active 1: Active.	●	H	-
BI, 39	Max. flow limit	R	0: Not active 1: Active.	3	H	-

3: Only available on MAGNA3.

H: Only available on version H and later.

6.3 Binary outputs

Binary objects for control of the Grundfos pump.

ID	Object Name	R/W	Notes	MAGNA/ UPE Series	E-pumps 0.25 - 7.5 kW	CUE/ E-pumps 11 - 22 kW
BO, 0	Set control source	W	Sets the control source. Set to 1 to enable pump control via BACnet. 0: Local control (default) 1: Bus control.	•	•	•
BO, 1	Relay 1 control	W	Controls relay 1 if bus control is enabled and relay 1 is set to be controlled via bus. 0: Closed (default) 1: Open.	-	•	•
BO, 2	Relay 2 control	W	Controls relay 2 if bus control is enabled and relay 2 is set to be controlled via bus. 0: Closed (default) 1: Open.	-	H	•
BO, 4	Reset fault	W	Resets fault if bus control is enabled. (Triggered on rising edge). 0: No resetting (default) 1: Resetting.	•	•	•
BO, 5	Fault simulation	W	Enables simulated fault if bus control is enabled. 0: Disabled (default) 1: Enabled.	•	•	•
BO, 6	Copy settings to local	W	Copies remote settings to local pump settings. 0: Disabled 1: Enabled.	3	H	-
BO, 9	Enable max. flow limit	W	0: Disabled 1: Enabled.	3	H	-

3: Only available on MAGNA3.

H: Only available on version H and later.

6.4 Multistate inputs

Objects that contain an enumeration value from the pump.

ID	Object Name	R/W	Notes	MAGNA/ UPE Series	E-pumps 0.25 - 7.5 kW	CUE/ E-pumps 11 - 22 kW
MI, 0	Actual control mode	R	Reads the current control mode. 1: Constant speed 2: Constant pressure 3: Proportional pressure 4: Automatic / $AUTO_{ADAPT}$ 5: Constant flow 6: Constant temperature 7: Constant level 8: Constant percentage 9: Auto flow 10: Closed-loop sensor control 11: Constant diff. pressure 12: Constant diff. temperature. See section *7.1 Control modes* for details on the control modes.	•	•	•
MI, 1	Actual operating mode	R	Reads the current operating mode. 1: Start (normal) 2: Stop 3: Minimum 4: Maximum.	•	•	•
MI, 2	Next bearing-service type	R	Type of next bearing service. 1: Service type unknown 2: Lubricate bearings 3: Change bearings.	-	H	•
MI, 3	CIM status	R	Reads the status of the CIM module, useful for fault finding. 1: OK 2: EEPROM fault 3: Memory fault.	•	•	•
MI, 11	Feedback sensor unit	R	Unit of the feedback sensor. 1: Unknown 2: bar 3: mbar 4: m 5: kPa 6: psi 7: ft 8: m^3/h 9: m^3/s 10: l/s 11: gpm 12: °C 13: °F 14: % 15: K 16: W.	•	•	•

H: Only available on version H and later.

6.5 Multistate outputs

Objects that set an enumeration value in the pump.

ID	Object Name	R/W	Notes	MAGNA/ UPE Series	E-pumps 0.25 - 7.5 kW	CUE/ E-pumps 11 - 22 kW
MO, 0	Set control mode	W	Sets the control mode if bus control is enabled. 1: Constant speed 2: Constant pressure 3: Proportional pressure 4: Automatic / $AUTO_{ADAPT}$ 5: Constant flow 6: Constant temperature 7: Constant level 8: Constant percentage 9: Auto flow 10: Closed-loop sensor control 11: Constant diff. pressure 12: Constant diff. temperature. See section *7.1 Control modes* for details on the control modes.	•	•	•
MO, 1	Set operating mode	W	Sets the operating mode if bus control is enabled. 1: Start (normal) 2: Stop 3: Minimum 4: Maximum.	•	•	•
MO, 2	Product simulation	W	Enables product simulation (for commissioning and testing purposes, can only be enabled when no physical pump is present). 1: Disabled (default) 2: MAGNA 3: E-pumps 0.25 - 7.5 kW 4: E-pumps 11 - 22 kW / CUE 8: MAGNA3. 9: E-Pumps based on MGE model H See section *7.6 Product simulation* for details.	•	•	•

H: Only available on version H and later.

6.6 Analog inputs

Objects with measured values and status information from the pump.

ID	Object Name	R/W	Notes	Unit	MAGNA /UPE Series	E-pumps 0.25 - 7.5 kW	CUE/ E-pumps 11 - 22 kW
AI, 0	Fault code	R	Grundfos fault code. See section *11. Grundfos alarm and warning codes.*	-	●	●	●
AI, 1	Warning code	R		-	3	●	●
AI, 2	Time to bearing service	R	Time to bearing service in months. A value of 24 means "24 or more".	month	-	H	●
AI, 3	Capacity	R	Actual capacity value (process feedback).	%	●	●	●
AI, 4	Head	R	Actual system head/pressure.	bar	S	S	S
AI, 5	Flow	R	Actual system flow.	m^3/h	S*	S*	S*
AI, 6	Relative performance	R	Performance relative to maximum performance.	%	●	●	●
AI, 7	Speed	R	Motor speed.	rpm	●	●	●
AI, 8	Frequency	R	Actual control signal applied to motor.	Hz	●	●	●
AI, 9	Actual setpoint	R	Actual setpoint.	%	●	●	●
AI, 10	Motor current	R	Actual motor current.	A	3	●	●
AI, 11	DC link voltage	R	Frequency converter DC Link voltage.	V	●	●	●
AI, 12	Motor voltage	R	Motor voltage.	V	-	●	●
AI, 13	Power	R	Total power consumption of the pump.	W	●	●	●
AI, 14	Remote flow	R	Measured flow at external sensor.	m^3/h	-	G+S	S
AI, 15	Inlet pressure	R	System inlet pressure.	bar	-	G+S	S
AI, 16	Remote pressure	R	Measured pressure at external sensor.	bar	3	G+S	S
AI, 17	Level	R	Tank level.	m	-	S	S
AI, 18	Power electronic temp.	R	Temperature in frequency converter.	°C	3	●	●
AI, 19	Motor temperature	R	Motor winding temperature.	°C	-	G	●
AI, 20	Remote temperature	R	Temperature at external sensor.	°C	-	S	S
AI, 21	Electronic temperature	R	Pump electronics temperature.	°C	-	H+S	S
AI, 22	Fluid temperature	R	Pumped-liquid temperature.	°C	●	G	S
AI, 23	Bearing temperature DE	R	Bearing temperature, drive end.	°C	-	H+S	S
AI, 24	Bearing temp. NDE	R	Bearing temperature, non-drive end.	°C	-	H+S	S
AI, 25	Auxiliary sensor input	R	Auxiliary sensor input.	%	-	S	S
AI, 26	Specific energy	R	Specific energy consumption.	kWh/m^3	3	H+S	CUE
AI, 27	Runtime	R	Total operating time of the pump.	h	●	●	●
AI, 28	Total ontime	R	Total power-on time of the pump.	h	●	●	●
AI, 29	Torque	R	Motor torque.	Nm	-	3ph	●
AI, 30	Energy consumption	R	Total energy consumption of the pump.	kWh	●	●	●
AI, 31	Number of starts	R	Number of times the pump has started.	-	3	●	●
AI, 32	Volume	R	Total pumped volume.	m^3	3	H+S	CUE
AI, 57	Remote temperature 2	R	Temperature at external temperature sensor 2.	°C	3	H+S	-
AI, 58	User setpoint	R	User-selected setpoint.	%	●	●	●
AI, 85	Min. of feedback sensor	R	Minimum value of feedback sensor.	-	●	●	●
AI, 86	Max.of feedback sensor	R	Maximum value of feedback sensor.	-	●	●	●
AI, 92	Load percent	R	Motor current in percent of rated motor current.	%	3	H	-
AI, 93	Differential pressure	R	Pressure between pump flanges.	bar	3	H+S	-
AI, 95	Actual flow limit	R	Actual maximum flow limit.	m^3/h	3	H	-
AI, 114	Remote diff. temperature	R	Differential temperature at remote sensor	°C	-	H + S	-
AI, 115	Inlet diff. pressure	R	Differential pressure at the inlet pipe	bar	-	H + S	-
AI, 116	Outlet diff. pressure	R	Differential pressure at the outlet pipe	bar	-	H + S	-
AI, 117	Remote diff. pressure	R	Differential pressure at remote sensor	bar	-	H + S	-
AI, 118	Storage tank Level	R	Water level in the storage tank	m	-	H + S	-
AI, 119	Heat energy counter	R	Accumulated heat energy in pump life	1 kWh	3 + S	H + S	-
AI, 120	Heat power	R	Actual heat power	1 W	3 + S	H + S	-
AI, 121	Heat diff. temperature	R	Differential temperature (heat)	0.01 K	3 + S	H + S	-

3 Only available on MAGNA3.

G Only available on model G and later versions.

● Always available.

S Sensor required.

H Only available on version H and later.

S* On TPE Series 2000 and MAGNA/UPE, the flow is estimated and is only to be used for monitoring, not for control purposes. On all other pump types, a flow sensor is required.

CUE Only available on CUE (with sensor).

3ph Only available on three-phase E-pumps.

6.7 Analog outputs

Object for setting a new setpoint in the pump.

ID	Object Name	R/W	Notes	Unit	MAGNA /UPE Series	E-pumps 0.25 - 7.5 kW	CUE/ E-pumps 11 - 22 kW
AO, 0	Set setpoint	W	Sets the pump setpoint if bus control is enabled. A value of 0 does not imply a stop. See section *7.2 Setpoint*.	%	•	•	•
AO, 5	Set max. flow limit	W	Sets the maximum flow limit value.	m^3/h	3	H	-

3: Only available on MAGNA3.

H: Only available on version H and later.

6.8 Analog values

Objects for configuration of the CIM/CIU 300 and/or the pump.

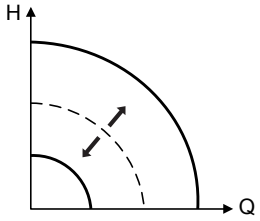
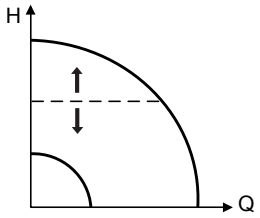
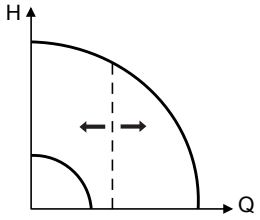
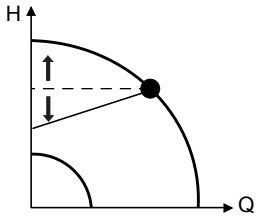
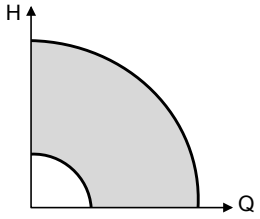
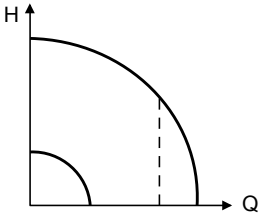
ID	Object Name	R/W	Notes	Unit	MAGNA/ UPE Series	E-pumps 0.25 - 7.5 kW	CUE/ E-pumps 11 - 22 kW
AV, 0	Custom Device Object Instance Number	R/W	Value for Custom Device Object Instance Number. Used in conjunction with DIP switch SW3. See section *3.5 Selecting the Device Object Instance Number*. Present_Value range: 0-0x3FFFFE. Default Present_Value: 0xE7.	-	•	•	•
AV, 1	BACnet watchdog	R/W	Time in seconds before BACnet communication watchdog times out, and sets the pump to local control mode. See section *7.3 BACnet communication watchdog*. 0: Disabled (default). Set to a value between 5 and 3600 to enable.	s	•	•	•
AV, 2	Simulation fault code	R/W	Fault code to simulate. See section *11. Grundfos alarm and warning codes*. Can be cleared by writing a value of 0.	-	•	•	•
AV, 3	Simulation warning code	R/W	Warning code to simulate. See section *11. Grundfos alarm and warning codes*. Can be cleared by writing a value of 0.	-	3	•	•
AV, 9	Product time and date	R/W	Pump time and date in UNIX format (seconds since 00:00 01-01-1970).	s	3	H	-

3: Only available on MAGNA3.

H: Only available on version H and later.

7. Detailed descriptions

7.1 Control modes

Control modes	Description	Illustration
Constant speed	**Open loop** The setpoint of the pump will be interpreted as setpoint for the pump speed in %. The setpoint value is a percentage of the maximum speed of the pump. No sensor is required.	 TM04 2289 2208
Constant pressure Constant diff. pressure	**Closed loop** The setpoint of the pump will be interpreted as setpoint for the pressure. The controller inside the pump will adapt the pump speed so that the pressure is constant, regardless of the flow. A pressure sensor is required.	 TM04 2290 2208
Constant flow Constant level Constant temperature Constant diff. temperature Constant percentage Closed loop sensor control	**Closed loop** Constant flow, constant level, constant temperature or constant percentage can be obtained by replacing the main pressure sensor with another sensor, e.g. a flow sensor is needed for flow control, a level sensor is needed for level control and a temperature sensor is needed for temperature control. Closed loop sensor control is not available for current pump. Constant flow is illustrated to the right.	 TM04 2288 2208
Proportional pressure	**Closed loop** The setpoint of the pump will be interpreted as basic setpoint for the proportional-pressure mode (the black dot in the illustration). This control mode is only available on GRUNDFOS MAGNA series and TPE Series 2000 pumps.	 TM04 2291 2208
AUTO$_{ADAPT}$	**AUTO$_{ADAPT}$** For this control mode, the optimum setpoint is automatically estimated and used. This also means that any setpoint value will be ignored. Only available on GRUNDFOS MAGNA Series and some three-phase motors of 0.55 to 7.5 kW. A pressure sensor is required.	 TM04 2287 2208
FLOW$_{ADAPT}$	**AUTO$_{ADAPT}$ with flow limitation** For this control mode, the optimum setpoint is automatically estimated and used, but the flow is limited by the maximum flow limit value which is set by the user. Set the value with AO, 5.	 TM05 2950 0712

H: Pressure (Head)

Q: Flow

Important notes to control modes

Only valid control modes will be accepted.

Example: If the pump is a TPE Series 2000 (with an MGE motor model G), and the control mode is changed to Constant temperature, the pump will not change its control mode because it is not possible for a TPE Series 2000 to run in this mode. The mode will then be the last valid control mode.

7.2 Setpoint

This object accepts values ranging from 0 to 100 (0 % to 100 %). This is illustrated in fig. 10.

Note ***The setpoint is a percentage of the maximum setpoint or sensor maximum (max. = 100 %).***

The setpoint value can represent speed, pressure, flow, etc., depending on the selected control mode.

A setpoint of 0 does not imply a stop.

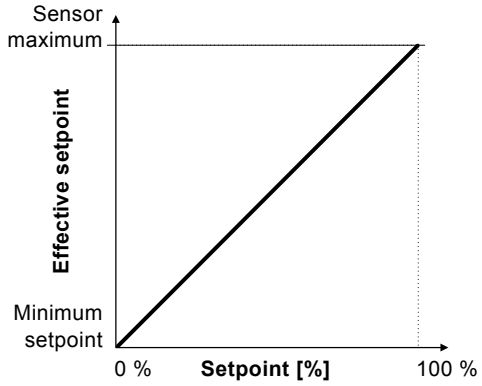


Fig. 10 Setpoint

7.2.1 Setpoint examples

Closed loop

If the control mode is set to Constant pressure (closed loop) and the pressure sensor is in the range of 0 to 10 bar, a setpoint of 80 % will result in an effective setpoint of 8 bar.

If the sensor range was 0 to 16 bar, a 50 % setpoint would be 8 bar, a 25 % setpoint would be 4 bar, and so on.

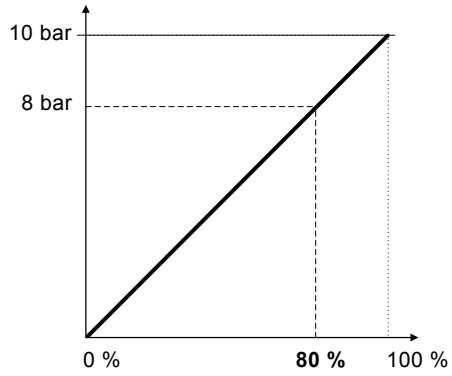


Fig. 11 Constant pressure

Open loop

If the control mode is set to Constant speed (open loop), the setpoint is interpreted as setpoint for the pump performance.

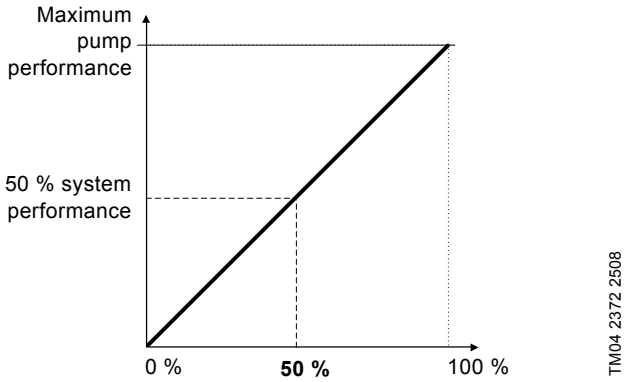


Fig. 12 Constant speed

7.3 BACnet communication watchdog

A BACnet communication watchdog is implemented in the CIM/CIU 300. If no BACnet communication is detected for the time period defined by the BACnet watchdog object (AV, 1) and the pump is set to Bus control mode (BO, 0), the pump is automatically switched to local control mode, and its local settings will be used.

This functionality can be used to define the pump behaviour in case of a BACnet communication breakdown. Before enabling the watchdog, the local pump settings should be made with either a Grundfos PC Tool or the Grundfos R100 remote control. This ensures that the pump behaves as expected if the BACnet communication breaks down.

When BACnet communication is re-established after a watchdog timeout, the user must manually set the pump back to Bus control mode (BO, 0).

When the Present_Value of the AV, 1 object is set to 0, the watchdog is disabled (default). To enable the watchdog, set the Present_Value to [5-3600] seconds.

7.4 Fault monitoring and resetting

This example shows how to monitor faults or warnings in the Grundfos pump and how to manually reset a fault.

The Fault code object (AV, 0) and the Warning code object (AV, 1) can both hold a Grundfos-specific fault code. See section *11. Grundfos alarm and warning codes* for code interpretation.

Warnings are notifications only and will not stop the pump, whereas faults will stop the pump. Most pumps can be configured to either automatically reset the fault when the fault condition disappears or to require manual resetting.

If a fault is to be manually reset, use the Reset fault object (BO, 4). When the Present_Value of this object is set to 1, a Reset fault command is sent to the device.

7.5 Pump control via BACnet

This example shows how to set a GRUNDFOS MAGNA to 50 % setpoint, in proportional-pressure mode.

- Before enabling pump control via BACnet, values for setpoint, control mode and operating mode should be set.
- Set operating mode with Multistate output 1. In this example, the value for operating mode should be 1 (Start).
- Set control mode with Multistate output 0. A value of 3 corresponds to Proportional pressure.
- Set the setpoint to a value of 50 % in Analog output 0. See section *7.2 Setpoint* for details on setpoint.
- To enable bus control, set Binary output 0 to a value of 1.

Now the GRUNDFOS MAGNA pump should be running at 50 % in proportional-pressure mode, with bus control enabled.

7.6 Product simulation

Product profile simulation (pump simulation) can be useful for testing and pre-commissioning purposes. It is possible to simulate a pump profile when using a CIU 300 that is not connected to a pump. The CIU 300 will behave as if a pump was connected on the GENIbus, even if that is not the case.
The objects supported by the simulated product will be available, although the data will only be dummy values that do not simulate real pump behaviour.

Product simulation is enabled by setting the Multistate output object "Product simulation" (MO, 2):

Product to simulate	Value
Disabled (no simulation)	1
MAGNA/UPE	2
E-pumps 0.25 - 7.5 kW	3
E-pumps 11 - 22 kW / CUE	4
MAGNA3	8
E-pumps based on MGE model H	9

Note ***Product simulation will always be disabled on power-up.***

Note ***If a physical pump is detected on GENIbus during power-up, it will not be possible to enable product simulation.***

8. Commissioning

8.1 Step-by-step guide to hardware setup (CIU 300)

Step	Action
1	Complete the pump configuration, e.g. sensor configuration.
2	Select the BACnet MAC address (0-127) on the CIM 300. See section *3.7 Selecting the BACnet MAC address*.
3	Select the transmission speed of the CIM 300. See section *3.4 Setting the BACnet transmission speed*.
4	Select Device Object Instance Number. See section *3.5 Selecting the Device Object Instance Number*.
5	If necessary, set line termination. See section *3.8 Termination resistor*.
6	Connect the GENIbus cable from the CIU 300 to the pump.
7	Connect the necessary cables from the CIU 300 to the BACnet network. See section *3.3 Connecting to the BACnet network*.
8	Connect the power supply cable to the CIU 300, and switch it on.
9	Confirm that the GENIbus LED is constantly green and that the BACnet LED is either off or flashing green (indicating communication). See section *4. LEDs*.
The CIU 300 is now configured and ready.	

8.2 Step-by-step guide to hardware setup (CIM 300)

Step	Action
1	Complete the pump configuration, e.g. sensor configuration.
2	Select the BACnet MAC address (0-127) on the CIM 300. See section *3.7 Selecting the BACnet MAC address*.
3	Select the transmission speed of the CIM 300. See section *3.4 Setting the BACnet transmission speed*.
4	Select Device Object Instance Number. See section *3.5 Selecting the Device Object Instance Number*.
5	If necessary, set line termination. See section *3.8 Termination resistor*.
6	Connect the necessary cables from the CIM 300 to the BACnet network. See section *3.3 Connecting to the BACnet network*.
7	Confirm that the GENIbus LED is constantly green and that the BACnet LED is either off or flashing green (indicating communication). See section *4. LEDs*.
The CIM 300 is now configured and ready.	

9. Fault finding

9.1 LED status

Faults in a CIM/CIU 300 can be detected by observing the status of the two communication LEDs. See the table below.

Fault (LED status)	Possible cause	Remedy
1. Both LEDs (LED1 and LED2) remain off when the power supply is connected, and 5 seconds have passed.	a) The CIM 300 is defective.	Replace the CIM 300.
2. The LED for internal communication (LED2) is flashing red.	a) No internal communication between the CIM/CIU 300 and the Grundfos pump.	• Check the cable connection between the pump and the CIU 300. • Check that the individual conductors have been fitted correctly. • Check the power supply to the pump.
3. The LED for internal communication (LED2) is constantly red.	a) The CIM/CIU 300 does not support the connected pump.	Contact the nearest Grundfos company.
4. The BACnet LED (LED1) is constantly red.	a) Fault in the CIM 300 BACnet configuration.	• Ensure that the BACnet MAC address has a valid setting. See section *3.7 Selecting the BACnet MAC address*. • Ensure that the Device Object Instance Number is within the allowed range. See section *3.5 Selecting the Device Object Instance Number*.
5. The BACnet LED (LED1) is flashing red.	a) Fault in the BACnet communication (cyclic redundancy check).	• Check the transmission speed (switches SW4 and SW5). See section *3.4 Setting the BACnet transmission speed*. • Check the cable connection between the CIM 300 and the BACnet network. • Check the termination resistor settings (switches SW1 and SW2). See section *3.8 Termination resistor*.

9.2 BACnet faults

Fault	Possible cause	Remedy
1. The CIM/CIU 300 does not communicate on the BACnet MS/TP network.	a) Configuration or wiring fault.	Ensure that the cable between the BACnet MS/TP devices is connected correctly. See section *3.3 Connecting to the BACnet network* for wiring recommendations.
		Ensure that the BACnet MAC address and Device Object Instance Number are configured correctly and are unique on the network. See section *3.7 Selecting the BACnet MAC address* and *3.5 Selecting the Device Object Instance Number* for address selections.
		Ensure that the transmission speed is configured correctly. See section *3.4 Setting the BACnet transmission speed*.
		Ensure that each end of the BACnet MS/TP trunk cable is terminated, if necessary. See section *3.8 Termination resistor* for line termination of the Grundfos CIM/CIU 300.
		Ensure that the bus topology for a BACnet MS/TP network is correct.
	b) The CIM/CIU 300 is instructed to not communicate on the BACnet network via the DeviceCommunicationControl service.	Use the Device Communication Control service to enable communication from the device.
2. The pump does not react to control commands from the bus.	a) The pump is running in local mode.	Set the pump to bus control by setting the Present_Value of BO, 0 to 1.
3. There are only a few BACnet objects available, and the GENIbus LED flashes red.	a) There is no communication between the CIM 300 and the pump.	Ensure that the GENIbus cable between the CIM 300 and the pump is connected correctly. Ensure that the pump is switched on and able to communicate on GENIbus.

10. BACnet telegrams

10.1 BACnet MS/TP telegram overview

All BACnet MS/TP telegrams have the following format:

Preamble	Telegram type	Destination	Source	Length	Header CRC	Data	Data CRC	(Pad)
2 bytes: 0x55 0xFF	1 byte	1 byte	1 byte	2 bytes, MSB first	1 byte	Variable, [0-501] bytes	2 bytes, LSB first	At most 1 byte 0xFF

For BACnet MS/TP, the destination address and source address are MAC addresses. See section *3.7 Selecting the BACnet MAC address*. A destination address of 255 (0xFF) denotes broadcast. The length field specifies the length in bytes of the data field which must be between 0 and 501 bytes long.

10.2 Telegram types

The available telegram types are listed below.

Type	Name	Description
00	Token	Used to pass network mastership to the destination device.
01	Poll for master	Discovers the presence of other master devices on the network.
02	Reply to poll for master	Used by a master to indicate a wish to enter the token ring.
03	Test request	Used to initiate a loopback test.
04	Test response	A reply to a test request telegram.
05	BACnet data, expecting reply	Used for data transmission where a reply is expected.
06	BACnet data, not expecting reply	Used for data transmission where no reply is expected.
07	Reply postponed	Used by master devices to defer sending a BACnet data reply.

11. Grundfos alarm and warning codes

This is a general Grundfos alarm and warning code list.

Code	Description	Code	Description	Code	Description
1	Leakage current	32	Overvoltage	72	Hardware fault, type 1
2	Missing phase	33	Soon time for service (general service information)	73	Hardware shutdown (HSD)
3	External fault signal	35	Gas in pump head, deaerating problem	74	Internal supply voltage too high
4	Too many restarts	36	Discharge valve leakage	75	Internal supply voltage too low
5	Regenerative braking	37	Suction valve leakage	76	Internal communication fault
6	Mains fault	38	Vent valve defective	77	Communication fault, twin-head pump
7	Too many hardware shutdowns	40	Undervoltage	78	Fault, speed plug
8	PWM switching frequency reduced	41	Undervoltage transient	79	Functional fault, add-on module
9	Phase sequence reversal	42	Cut-in fault (dV/dt)	80	Hardware fault, type 2
10	Communication fault, pump	45	Voltage asymmetry	81	Verification error, data area (RAM)
11	Water-in-oil fault (motor oil)	48	Overload	82	Verification error, code area (ROM, FLASH)
12	Time for service (general service information)	49	Overcurrent (i_line, i_dc, i_mo)	83	Verification error, FE parameter area (EEPROM)
13	Moisture alarm, analog	50	Motor protection function, general shutdown (MPF)	84	Memory access error
14	Electronic DC-link protection activated (ERP)	51	Blocked motor/pump	85	Verification error, BE parameter area (EEPROM)
15	Communication fault, main system (SCADA)	52	Motor slip high	88	Sensor fault
16	Other	53	Kipped motor	89	Signal fault, (feedback) sensor 1
17	Performance requirement cannot be met	54	Motor protection function, 3 sec. limit	90	Signal fault, speed sensor
18	Commanded alarm standby (trip)	55	Motor current protection activated (MCP)	91	Signal fault, temperature 1 sensor
19	Diaphragm break (dosing pump)	56	Underload	92	Calibration fault, (feedback) sensor
20	Insulation resistance low	57	Dry running	93	Signal fault, sensor 2
21	Too many starts per hour	58	Low flow	94	Limit exceeded, sensor 1
22	Moisture switch alarm, digital	59	No flow	95	Limit exceeded, sensor 2
23	Smart trim gap alarm	60	Low input power	96	Setpoint signal outside range
24	Vibration	64	Overtemperature	97	Signal fault, setpoint input
25	Setup conflict	65	Motor temperature 1 (t_m or t_mo or t_mo1)	98	Signal fault, input for setpoint influence
26	Load continues even if the motor has been switched off	66	Temperature, control electronics (t_e)	99	Signal fault, input for analog setpoint
27	External motor protector activated (e.g. MP 204)	67	Temperature too high, internal frequency converter module (t_m)	104	Software shutdown
28	Battery low	68	External temperature/ water temperature (t_w)	105	Electronic rectifier protection activated (ERP)
29	Turbine operation (impellers forced backwards)	69	Thermal relay 1 in motor (e.g. Klixon)	106	Electronic inverter protection activated (EIP)
30	Change bearings (specific service information)	70	Thermal relay 2 in motor (e.g. thermistor)	110	Skew load, electrical asymmetry
31	Change varistor(s) (specific service information)	71	Motor temperature 2 (Pt100, t_mo2)	111	Current asymmetry

Code	Description	Code	Description	Code	Description
112	Cos φ too high	167	Signal fault, analog input 3	195	Limit exceeded, sensor 6
113	Cos φ too low	168	Signal fault, pressure sensor	196	Operation with reduced efficiency
120	Auxiliary winding fault (single-phase motors)	169	Signal fault, flow sensor	197	Operation with reduced pressure
121	Auxiliary winding current too high (single-phase motors)	170	Signal fault, water-in-oil (WIO) sensor	198	Operation with increased power consumption
122	Auxiliary winding current too low (single-phase motors)	171	Signal fault, moisture sensor	199	Process out of range (monitoring/ estimation/calculation/control)
123	Start capacitor, low (single-phase motors)	172	Signal fault, atmospheric pressure sensor	200	Application alarm
124	Run capacitor, low (single-phase motors)	173	Signal fault, rotor position sensor (Hall sensor)	201	External sensor input high
144	Motor temperature 3 (Pt100, t_mo3)	174	Signal fault, rotor origo sensor	202	External sensor input low
145	Bearing temperature high (Pt100), in general or top bearing	175	Signal fault, temperature 2 sensor (t_mo2)	203	Alarm on all pumps
146	Bearing temperature high (Pt100), middle bearing	176	Signal fault, temperature 3 sensor (t_mo3)	204	Inconsistency between sensors
147	Bearing temperature high (Pt100), bottom bearing	177	Signal fault, Smart trim gap sensor	205	Level float switch sequence inconsistency
148	Motor bearing temperature high (Pt100) in drive end (DE)	178	Signal fault, vibration sensor	206	Water shortage, level 1
149	Motor bearing temperature high (Pt100) in non-drive end (NDE)	179	Signal fault, bearing temperature sensor (Pt100), general or top bearing	207	Water leakage
152	Communication fault, add-on module	180	Signal fault, bearing temperature sensor (Pt100), middle bearing	208	Cavitation
153	Fault, analog output	181	Signal fault, PTC sensor (short-circuited)	209	Non-return valve fault
154	Communication fault, display	182	Signal fault, bearing temperature sensor (Pt100), bottom bearing	210	High pressure
155	Inrush fault	183	Signal fault, extra temperature sensor	211	Low pressure
156	Communication fault, internal frequency converter module	184	Signal fault, general-purpose sensor	212	Diaphragm tank precharge pressure out of range
157	Real-time clock out of order	185	Unknown sensor type	213	VFD not ready
158	Hardware circuit measurement fault	186	Signal fault, power meter sensor	214	Water shortage, level 2
159	CIM fault (Communication Interface Module)	187	Signal fault, energy meter	215	Soft pressure build-up timeout
160	GSM modem, SIM card fault	188	Signal fault, user-defined sensor	216	Pilot pump alarm
161	Sensor supply fault, 5 V	189	Signal fault, level sensor	217	Alarm, general-purpose sensor high
162	Sensor supply fault, 24 V	190	Limit exceeded, sensor 1 (e.g. alarm level in WW application)	218	Alarm, general-purpose sensor low
163	Measurement fault, motor protection	191	Limit exceeded, sensor 2 (e.g. high level in WW application)	219	Pressure relief not adequate
164	Signal fault, LiqTec sensor	192	Limit exceeded, sensor 3 (e.g. overflow level in WW application)	220	Fault, motor contactor feedback
165	Signal fault, analog input 1	193	Limit exceeded, sensor 4 (e.g. low level in WW/tank filling application	221	Fault, mixer contactor feedback
166	Signal fault, analog input 2	194	Limit exceeded, sensor 5	222	Time for service, mixer

Code	Description	Code	Description	Code	Description
223	Maximum number of mixer starts per hour exceeded	232	Ethernet: Auto-disabled due to misuse	241	Motor phase failure
224	Pump fault (due to auxiliary component or general fault)	233	Ethernet: IP address conflict	242	Automatic motor model recognition failed
225	Communication fault, pump module	234	Back-up pump alarm	243	Motor relay has been forced (manually operated/commanded)
226	Communication fault, I/O module	235	Gas detected	244	Fault, On/Off/Auto switch
227	Combi event	236	Pump 1 fault	245	Pump continuous runtime too long
228	User-defined event	237	Pump 2 fault	246	User-defined relay has been forced (manually operated/ commanded)
229	Water on floor	238	Pump 3 fault	247	Power-on notice (device/system has been switched off)
230	Network alarm	239	Pump 4 fault	248	Fault, battery/UPS
231	Ethernet: No IP address from DHCP server	240	Lubricate bearings (specific service information)		

12. BACnet MAC address

BACnet address	SW6	SW7
0	0	0
1	0	1
2	0	2
3	0	3
4	0	4
5	0	5
6	0	6
7	0	7
8	0	8
9	0	9
10	0	A
11	0	B
12	0	C
13	0	D
14	0	E
15	0	F
16	1	0
17	1	1
18	1	2
19	1	3
20	1	4
21	1	5
22	1	6
23	1	7
24	1	8
25	1	9
26	1	A
27	1	B
28	1	C
29	1	D
30	1	E
31	1	F
32	2	0
33	2	1
34	2	2
35	2	3
36	2	4
37	2	5
38	2	6
39	2	7
40	2	8
41	2	9
42	2	A
43	2	B
44	2	C
45	2	D
46	2	E
47	2	F
48	3	0
49	3	1
50	3	2

BACnet address	SW6	SW7
51	3	3
52	3	4
53	3	5
54	3	6
55	3	7
56	3	8
57	3	9
58	3	A
59	3	B
60	3	C
61	3	D
62	3	E
63	3	F
64	4	0
65	4	1
66	4	2
67	4	3
68	4	4
69	4	5
70	4	6
71	4	7
72	4	8
73	4	9
74	4	A
75	4	B
76	4	C
77	4	D
78	4	E
79	4	F
80	5	0
81	5	1
82	5	2
83	5	3
84	5	4
85	5	5
86	5	6
87	5	7
88	5	8
89	5	9
90	5	A
91	5	B
92	5	C
93	5	D
94	5	E
95	5	F
96	6	0
97	6	1
98	6	2
99	6	3
100	6	4
101	6	5

BACnet address	SW6	SW7
102	6	6
103	6	7
104	6	8
105	6	9
106	6	A
107	6	B
108	6	C
109	6	D
110	6	E
111	6	F
112	7	0
113	7	1
114	7	2
115	7	3
116	7	4
117	7	5
118	7	6
119	7	7
120	7	8
121	7	9
122	7	A
123	7	B
124	7	C
125	7	D
126	7	E
127	7	F

If the MAC address switches are set to an invalid MAC address value, a MAC address of 0 will be used.

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