BACnet for MIXIT

Functional profile and user manual

GRUNDFOS

BACnet for MIXIT

English (GB)

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Original functional profile and user manual

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1. General information

This functional profile describes Grundfos BACnet MIXIT.

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

1.1 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.

1.2 Target group

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

1.3 Further information

In the following guide: *MIXIT integration guide* more detailed information about the application specific functionality can be found. Especially how use MIXIT in connection with air handling units See MIXIT quick guide, Mini quick guide & I&O

2. Introduction

2.1 About MIXIT functional profile

The functional profile describes the following modules and units.

- MIXIT BACnet MS/TP
- MIXIT Ethernet for BACnet IP

Grundfos cannot be held responsible for any problems caused directly or indirectly by using information in the functional profile.

2.2 Definitions and abbreviations

APDU	Application Protocol Data Unit
ARP	Address Resolution Protocol. translate IP addresses into MAC addresses.
CRC	Cyclic Redundancy Check. A data error detection method.
Device	A BACnet device is typically a controller, gateway, or user interface. Every BACnet device contains a device object that defines certain device information
DHCP	Dynamic Host Configuration Protocol. Used to configure network devices so that they can communicate on an IP network.
Grundfos GO Remote	Grundfos GO Remote is an app for setting up, controlling and monitoring Grundfos products. The app can be downloaded for free in your preferred app store for both Android and iOS.
MAC	Unique network address for a piece of hardware.
MS/TP	Master-Slave / Token-Passing. A data protocol used for BACnet RS-485.
Transmission speed	Bits transferred per second, bits/s.
Parity	An error checking method. When a message is transmitted, the parity bit is calculated and applied to the 8 bit data frame of each character transmitted. The receiving device checks the validity of each 8 bit characters frame if an error occurs the complete telegram is discarded.
Line termination resistors	Line termination must be connected at each of the two ends of the wire. The MIXIT unit is fitted with a built-in optional line termination resistor. RS485 network only (MS/TP).
AI (Analog input)	Analog inputs, Analog objects with measured values and status information from the product.
AO (Analog output)	Analog output, Analog object for setting a new setpoint in the product.
AV (Analog Value)	Analog value, Analog objects for configuration of the product.
BI (Binary Input)	Binary input, Binary objects that provide information from product.
BO (Binary output)	Binary output, Binary objects for control of the product.
BV (Binary Value)	Binary value, Binary objects for configuration of the product
MI (Multistate Input)	Multistate inputs, Multistate objects that represent the result from an algorithmic process within a BACnet device as an enumeration (Enum)
MO (Multistate Output)	Multistate outputs, Multistate objects that set an enumeration (Enum) value in the product.
MV (Multistate Value)	Multistate values, multistate objects for configuration of the product.

2.3 Specifications for BACnet MS/TP

BACnet MS/TP	**Description**	**Comments**
BACnet connector	Screw-type terminal	3 pins. AYB
BACnet connection type	RS-485	
BACnet wire configuration	Two wire + Ground	Conductors: Plus, Minus and Ground.
Maximum cable length	1200 m	Equals 4000 ft.
Recommended cross-section of BACnet cable	0.20 - 0.25 mm^2	AWG24 or AWG23.
MAC address	0-127	Set via Grundfos GO ("Fieldbus address").
Line termination	On or Off	Set via DIP switch in the product.
Supported transmission speeds [bits/s]	9600, 19200, 38400, 76800	Set via Grundfos GO.
Data bits	8	Fixed value.
Stop bits	1	Fixed value.
Parity	None	Fixed value.
Maximum number of BACnet devices	32	This number can be increased using repeaters.
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 MIXIT unit is a BACnet MS/TP master device.

BACnet MS/TP	Description	Comments
Manual slave address binding	No	
BACnet protocol revision	15	
Max. master range	1-127	

2.4 Specifications for BACnet IP

BACnet IP	Description	comments
Application layer	HTTP, BACnet IP	
Transport layer	UDP	
Internet layer	Internet protocol V4 (IPv4)	
Link layer	ARP, media access control	
Ethernet cable	CAT5, CAT 5e, CAT6	
Max. cable length	100 metres at 10/100 Mbit/s	
Transmission speed detected	10/100 Mbit/s auto-detected	
BACnet protocol revision	15	
Max. APDU length	1496 (fixed)	
Default UDP port	47808	

2.5 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 inter-network. 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 MIXIT unit is a BACnet Application-Specific Controller (BASC) with a few additional services

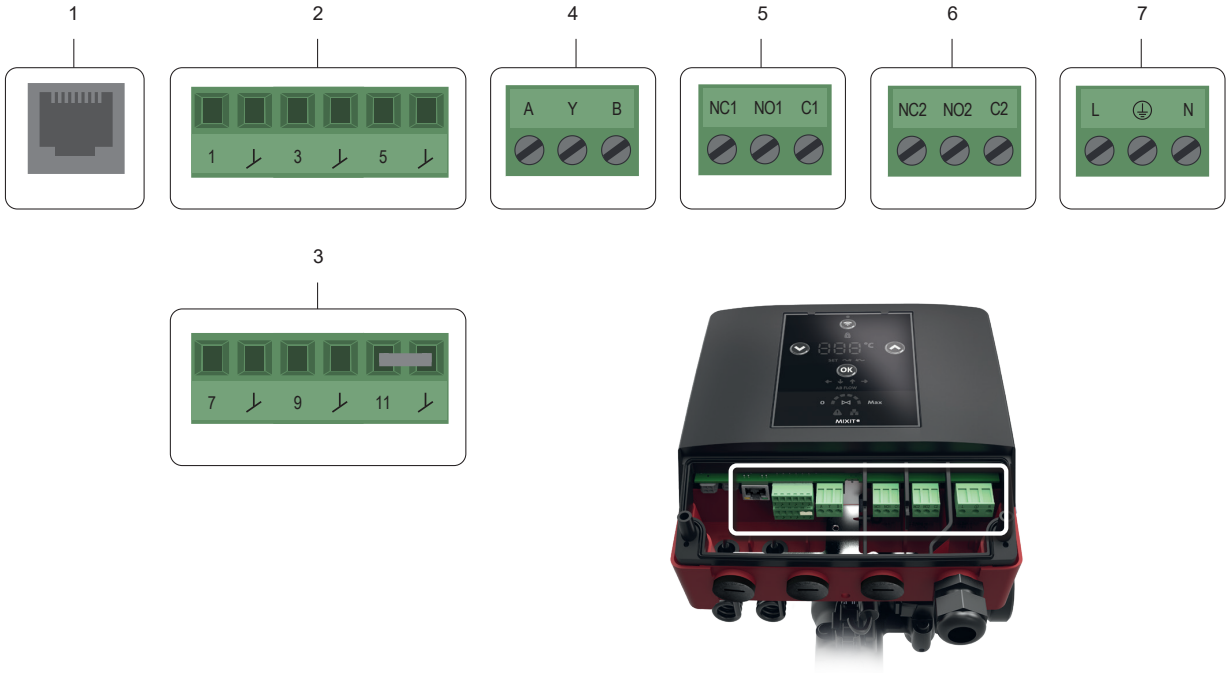
2.5.1 Data sharing services

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

2.5.2 Data management services

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

2.6 Terminal connections overview



Pos.	Description
1	Ethernet RJ45 (BACnet IP, Modbus TCP, Grundfos BuildingConnect)
2	Configurable I/O
3	Configurable I/O
4	RS-485 transceiver (BACnet MS/TP, Modbus RTU)
5	Relay 1
6	Relay 2
7	Mains supply. Carry out the electrical connection and protection according to local regulations.

The terminals are coded in such a way that the relay terminal plugs cannot be used in the RS-485 input and the configurable inputs and outputs cannot be switched around.

2.7 BACnet device Instance Number

The term "Device ID" is short for Device Identifier, and is shorthand for the Instance Number portion of the BACnet Device object Object_Identifier property. The Device ID is a non-volatile value that is chosen and configured by someone at the site where the BACnet product is installed. The Device ID is used for resolution of network layer addresses into application layer addresses, commonly referred to as "binding".

Each BACnet device object at a site must have a unique instance number and name. The BACnet device object instance number and name are assigned in the field as part of the installation configuration. When assigning instance numbers and names to device objects at a site, we recommend maintaining a list of devices and their assigned BACnet device object unique instance numbers and names. A useful naming convention can be made like this:

Building # (2 digits) – Floor # (2 digits) – Device Marker (1 digit) – Device Index (2 digits)

Keep in mind that the maximum instance number is 4,194,302.

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

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

2.7.1 Default Device Object Instance Number

The Default Device Object Instance Number for the MIXIT unit is 227005. You can change the number via Grundfos GO Remote.

2.7.2 Custom Device Object Instance Number

The custom device instance number can be activated using Grundfos GO Remote and change it via AV,0.

ID	Object name	Access
AV,0	Config Custom Device Object Instance Number	R/W

2.8 Best Practices

Make initial configuration of MIXIT with Grundfos GO before trying to connect from fieldbus

Before connecting and communicating with MIXIT, MIXIT shall be configured for the correct application and the communication protocol shall be set up.

Ensure safe default values

Ensure to set the local setpoint AV,6 [°C] to a safe value, so heat/cooling is not lost if communication error. If in Combined (H/C), Setting of fallback temperature must be made individually for Heating and Cooling mode respectively. AV,6 [°C] is always setting/displaying the default setpoint. Use MO,4 to change between Heating and Cooling in case both defaults should be set.

Perform a continuous poll of a MIXIT BACnet register to maintain connectivity by reading :

Read from, for example, status register BI,0 (Status Control Source, 0: Local control 1: Bus control) **every 30 sec** to maintain communication between Building Management System and MIXIT. If communication is lost, MIXIT will reverse back to local setpoint.

Only write to persistence data when needed

Ensure **NOT** to write in persistence area when making the iterative read of MIXIT to keep MIXIT in bus control. Instead **read** from the unit and **don’t write** every 30 sec.

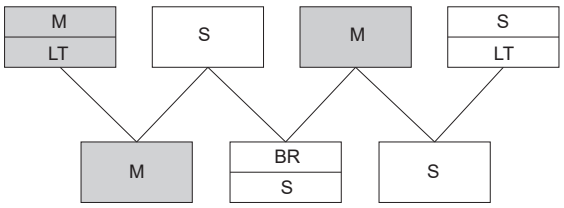
Ensure correct handling of power failures

If power failure occurs, MIXIT will start up in local when the power is re-established. To get MIXIT in remote, sent the complete set of initial commands again.

3. BACnet MS/TP Setup

3.1 BACnet bus topology

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.



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Pos.	Description
M	Master
S	Slave
BR	Bias resistor
LT	Line termination

3.1.1 Line termination resistors

Line termination must be connected at each of the two ends of the segment medium. The MIXIT unit is fitted with built-in optional line termination resistor.

Enable the termination resistor for line termination if the unit is set as the last station on the network. Set the DIP switch to "ON" to activate. The termination resistor is fitted inside the MIXIT unit and has a value of 120 Ω.

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Related information

3.3 Configuring BACnet MS/TP

3.1.2 Bias resistors

The BACnet system integrator must specify if and where a bias resistor is needed. A bias resistor ensures 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 MIXIT unit has no bias resistors.

3.2 Cables for BACnet MS/TP

We recommend that the maximum cable length within a BACnet MS/TP segment is 1200 meters (4000 ft) with a 0.82 mm^2 (AWG 18) cable.

Connection between the BACnet modules must be made by using a screened, twisted-pair cable with a characteristic impedance between 100 and 130 Ω.

Use a screened, twisted-pair cable and connect the 3 wires according to below table:

Terminal	Recommended color	Data signal
A	Red	Positive
B	Green	Negative
Y	Grey	Ground

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

3.3 Configuring BACnet MS/TP

The configuration of the BACnet interface is done with Grundfos GO Remote. Please follow the below steps

1. Turn on MIXIT and connect it to the pump. See separate installation and operating instructions for MIXIT.
   - If it is the first time MIXIT is connected to Grundfos GO Remote, please run the initial setup wizard
2. Make sure the CONNECT upgrade is installed and select the communication protocol
   - When the Dashboard is displayed on the screen, press Upgrades and control the green check mark in the CONNECT upgrade
   - Upgrade MIXIT with the CONNECT upgrade, if unavailable
3. Select the communication protocol - if it is not selected in the initial setup use one of the following entries.
   - **Settings** menu: **other Settings** > **Connectivity settings** > **Fieldbus connection settings** > **BACnet MS/TP**,
   - **Settings** menu: **Settings** > **Setpoint** > **Reconfigure setpoint input** > **Setpoint from fieldbus connection**. Press **Next**, select **BACnet MS/TP** and press **Next** again.
   - **Upgrades** menu: **Upgrades** > **CONNECT upgrade** > **Reconfigure** > **Fieldbus connectivity** > **BACnet MS/TP**.
4. Set up protocol settings
   a. Baud rate (transmission speed)

      The transmission speed must be set correctly before the MIXIT unit is ready to communicate on the BACnet MS/TP network. Use Grundfos GO Remote to set the transmission speed. All devices on the BACnet MS/TP network must communicate at the same transmission speed.

   b. Range (MAC address)

      The MAC address must be within the range of 0 to 127 and must be unique on the BACnet MS/ TP segment. By default, the MAC address on our controllers is set to 5. An illegal value will result in a MAC address of 0. Max. master must be within the range of 1 and 127.

   c. Range (Max master)

      Max. master must be within the range of 1 and 127.

      To increase network efficiency, we recommend configuring the Max Master of the highest MAC device when there are less than 127 devices on the network. The Max Master prevents the Poll From Master (PFM) from exceeding the current value set. For example, 32 devices with MAC addresses ranging from 1 to 32 and a Max Master of 33 ensures that the PFM are not done for addresses higher than 33. If a new device is entered outside the set value of the MAX Master, the network will not see the device until the MAX Master has been changed to include the new device

   d. Device Object Instance Number

      The MIXIT unit offers two different approaches to setting the BACnet Device Object Instance Number: default and custom. The default BACnet Device Object Instance Number is 227005. The use of custom can be enabled in Grundfos GO Remote and customised via AV,0

4. BACnet IP Setup

4.1 Cables for BACnet IP

Use RJ45 plug and Ethernet cable. If available, connect the cable shield to protective earth at both ends.
The standard cable length is max. 100 meters.

4.2 DATA and Link LED's

Check the data and link LED’s to ensure communication is established:

Status	Description
Green on	Ethernet Link on the RJ45 connector is OK
Green off	No Ethernet Link on the RJ45 connector
Yellow on	Link OK, no traffic
Yellow flashing	Data communication ongoing on the RJ45 connector

4.3 Configuring BACnet IP

The configuration of the BACnet interface is done with Grundfos GO Remote. Please follow the below steps:

1. Turn on MIXIT and connect it to the pump. See separate installation and operating instructions for MIXIT.
   - If it is the first time MIXIT is connected to Grundfos GO Remote, please run the initial setup wizard
2. Make sure the CONNECT upgrade is installed and select the communication protocol
   - When the Dashboard is displayed on the screen, press Upgrades and control the green check mark in the CONNECT upgrade
   - Upgrade MIXIT with the CONNECT upgrade, if unavailable
3. Select the communication protocol - if it is not selected in the initial setup use one of the following entries.
   - **Settings** menu: **other Settings** > **Connectivity settings** > **Fieldbus connection settings** > **BACnet IP**,
   - **Settings** menu: **Settings** > **Setpoint** > **Reconfigure setpoint input** > **Setpoint from fieldbus connection**. Press **Next**, select **BACnet IP** and press **Next** again.
   - **Upgrades** menu: **Upgrades** > **CONNECT upgrade** > **Reconfigure** > **Fieldbus connectivity** > **BACnet IP**.
4. Setup IP settings
   - IP addresses can either be static or assigned via DHCP. If you want to use DHCP, then DHCP should be enabled. If DHCP is selected, wait for 1 minute before checking the IP address given to MIXIT.
   - For static settings please follow the flow in the Grundfos GO Remote.
5. Setup other protocol settings
   - UDP port number, Device Name, Device Location.
   - Custom Device object instance number: The MIXIT unit offers two different approaches to setting the BACnet Device Object Instance Number: default and custom. The use of custom can be enabled in Grundfos GO Remote and customised via AV,0
   - Foreign Device setting – if the MIXIT unit should be configured as a foreign device: IP address, UDP port, reregister time

5. Setting up MIXIT and communicating using BACnet

Having successfully completed the setup in the previous sections, it is now possible to start communicating with the MIXIT unit.

5.1 Hello world - starting communication with MIXIT

Perform the operations stated in the below table to establish the first initial communication with MIXIT.

ID	Object Name	Description	Value
BO,0	Set Control Source	0: Local control (power-on default) 1: Bus control	**1**
MV,0	Config Temperature Setpoint Source [Enum]	1: default_setpoint 2: ana_temp_setpoint 3: temp_setpoint_remote 4: outdoor_temp 5: outdoor_temp_remote	**3**
AO,0	Set Temperature Setpoint Remote [°C*]	Temperature setpoint set via fieldbus	45 = 45 °C
BO,1	Set Start Stop	0: Stop system (OFF) (default) 1: Start system (ON)	**1**

***Remember all temperature in BACnet is written in 1°C**

5.1.1 Ensure safe default values

- Ensure to set the local setpoint AV,6 [°C] to a safe value, so heat/cooling not is lost if communication error. If in Combined (H/C), Setting of fallback temperature must be made individually for Heating and Cooling mode respectively. AV,6 [°C] is always setting/displaying the default setpoint. Use MO,4 to change between Heating and Cooling if both defaults should be set. Please refer *2.8 Best Practices* .

5.2 Maintaining communication with the MIXIT unit

Perform a continuous poll of a MIXIT BACnet register to maintain connectivity:

Read from, for example, status register BI,0 (Status Control Source, 0: Local control 1: Bus control) **every 30 sec** to maintain communication between Building Management System and MIXIT. If communication is lost, MIXIT will reverse back to local setpoint.

Only write to persistence data when needed

Ensure **NOT** to write in persistence area when making the iterative read of MIXIT to keep MIXIT in bus control. Instead **read** from the unit and **don't write** every 30 sec.

6. Object overview

6.1 BACnet device object

The following properties are supported in the device object.

Property identifier	Data type	Description	Access
Object_identifier	BACnetObjectIdentifier	Device Object Instance Number	R
Object_name	Character string	Device Object Name	R/W
Object_Type	BACnetObjectType	Device	R
System_Status	BACnetDeviceStatus	Operational	R
Vendor_Name	Character string	Grundfos	R
Vendor_Identifier	Unsigned16	227	R
Model_Name_Family	Character string	Grundfos product family. This will show the Grundfos pump model to which the MIXIT unit is connected to.	R
Model_Name_type	GrundfosUnitType	Grundfos product type number.	R
Model_Name_version	GrundfosUnitVersion	Grundfos product version number.	R
Firmware_Revision	Character string	Revision number of the BACnet firmware in the MIXIT unit.	R
Application_Software_Version	Character string	Software build date, DD-MM-YYYY.	R
Location	Character string	The user can enter a location here (maximum 200 characters).	R/W
Description	Character string	The user can enter a description here (maximum 200 characters).	R/W
Protocol_Version	Unsigned	Actual revision of the BACnet protocol.	R
Protocol_Revision	Unsigned	Actual revision of the BACnet protocol.	R
Protocol_Services_Supported	BACnetServicesSupported	This indicates which standardised protocol services are supported.	R
Protocol_Object_Types_Supported	ProtocolObjectTypesSupported	This indicates which standardised protocol object types are supported.	R
Object_List	BACnetARRAY[N]ofBACnetObjectIdentifier	An array of objects available.	R
Max_APDU_length_Accepted	Unsigned	The maximum number of bytes that may be contained in a single APDU.	R
Segmentation_Supported	BACnetSegmentation	This indicates if segmentation of messages is possible. It will always read NO_SEGMENTATION to indicate that segmentation is not possible.	R
APDU_Timeout	Unsigned	This indicates the amount of time in ms before timeout.	R
Number_Of_APDU_Retries	Unsigned	This indicates the maximum number of times an APDU is to be retransmitted.	R
Max_Master	Unsigned	This 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.	R/W
Max_Info_Frames	Unsigned	This specifies the maximum number of information frames that are sent before the token is passed on.	R
Device_Address_Binding	List of BACnetAdressBindings	This holds address bindings to other devices, if any.	R
Database_Revision	Unsigned	Logical revision number for the device database.	R

6.2 Binary inputs

ID	Object name	Access	Description
BI,0	Status Control Source	R	0: Local control (default) 1: Bus control Is 1 if the bus control is activated. Activation of bus control is done via BO, 0.
BI,1	Status Fan and Dampers	R	0: Disabled 1: Enabled When the coil has been preheated the air temperature after the coil is controlled according to the setpoint. MIXIT signals this at the fieldbus by setting BI,1=1. Only for Heating Coil application.
BI,2	Status Actual Run State Pump	R	0: Stopped 1: Started This status shows the actual pump run status.
BI,3	Status Ready	R	0: Not ready 1: Ready Indicates if the system is ready for operation or not.
BI,4	Status Fault	R	0: No fault 1: Fault If 1, the system is stopped due to an alarm.
BI,5	Status Alarm Simulation	R	0: Inactive 1: Active Status of alarm/warning simulation.
BI,6	Notification Flow Temp High	R	0: Not detected 1: Detected. If detected: • the mixing temperature is above the configured value, • external overheat signal is set, or • overheat protection is forced by setting BO,3 to 1. The notification is not resettable. The internal detection function is configured with Grundfos GO Remote. The function is associated with the underfloor heating application.
BI,7	Notification Frost Risk Detected	R	0: Not detected 1: Detected. If 1, frost risk is detected. The notification is not resettable. The internal detection function is configured with Grundfos GO Remote.
BI,8*	Notification Supply Flow High	R	0: Not above 1: Above. If 1, the supply flow is above the limit in AV,10 for an extended time (3600 s). The notification is not resettable, but it will reset itself. The supply flow limit function is enabled and disabled with Grundfos GO Remote or BV,0(Heating) or BV,4 (Cooling).
BI,9*	Notification Thermal Power High	R	0: Not above 1: Above. If 1, the thermal power is above the limit in AV,11 for an extended time (3600s). The notification is not resettable, but it will reset itself. The supply flow limiter function is enabled and disabled with Grundfos GO Remote or BV,1(Heating) or BV,5 (Cooling).
BI,10*	Notification Return Temperature Threshold	R	0: Not above (heating), not below (cooling) 1: Above (heating), below (cooling). If 1, the return temperature exceeds the limit in AV,12 for an extended time (3600 s). The notification is not resettable, but it will reset itself. The supply flow limit function is enabled and disabled with Grundfos GO Remote or BV,2(Heating) or BV,6 (Cooling).
BI,11*	Notification Differential Temperature High	R	0: Not above (heating), not below (cooling) 1: Above (heating), below (cooling). If 1, the primary differential temperature exceeds the limit in AV,13 for an extended time (3600 s). The notification is not resettable, but it will reset itself. The supply flow limiter function is enabled and disabled with Grundfos GO Remote or BV,3(Heating) or BV,7 (Cooling).
BI,12	Bus Feedback Enabled	R	0: False 1: True Indicate if the air temperature feedback in heating coil and cooling applications is provided by the fieldbus.
BI,13	Heat Curve Slope Factor Enabled	R	0: False 1: True Used to indicate whether base curve is linear or non-linear.
BI,14	Heat Curve Offset Range Exceeded	R	0: Exceeded 1: Not exceeded Used to indicate that weather curve offset value is out of range [-15 ; 15].
BI,15	Heat Curve Slope Factor Range Exceeded	R	0: Exceeded 1: Not exceeded Used to indicate that weather curve slope factor value is out of range [0.4 ; 2.0].

Note: Objects marked with * are only available for DYNAMIC variants

6.3 Binary outputs

ID	Object name	Access	Description
BO,0	Set Control Source	W	0: Local control (default) 1: Bus control Set to 1 to enable control via BACnet. See BI,0 for actual state.
BO,1	Set Start Stop	W	0: Stop (Off). 1: Start (ON) If set to 0: • The pump stops • The valve closes The value of MI,2 will be 3 if there is no system fault.
BO,2	Reset fault	W	Resets pending alarms and warnings. The data point is rising edge triggered.
BO,3	Enable Overheat Protection	W	0: Disable overheat indication (default) 1: Set overheat indication When set, the valve is closed, and the pump is stopped when the limit is exceeded. Can be used to simulate the overheat protection function during test. This function is only active for underfloor heating application. Actual status is read via BI,6.
BO,4	Enable Frost Protection, heating	W	0: Disable frost protection (default) 1: Enable frost protection When enabled, the valve opens fully when the limit is exceeded. The function is only active for heating coil application. Actual status is read via BI,7.
BO,5	Set Fault Simulation	W	Activate (rising edge) or deactivate (falling edge) the alarm/warning simulation.
BO,7	Enable Bus Feedback	W	0: Disable air temperature feedback from bus 1: Enable air temperature feedback from bus.
BO,8	Enable Frost Protection Cooling Mode	W	0: Disable frost protection (default) 1: Enable frost protection.

6.4 Binary values

ID	Object name	Access	Description
BV,0*	Config Supply Flow Limiting, Heating	R/W	0: Disabled (default) 1: Enabled. Enabling of supply flow limit. When enabled, the consumed primary flow is limited below the configuration in AV,10.
BV,1*	Config Thermal Power Limiting, Heating	R/W	0: Disabled (default) 1: Enabled. Enabling of thermal power limiter. When enabled, the delivered thermal power is limited below the configuration in AV,11.
BV,2*	Config Return Temp Limiting, Heating	R/W	0: Disabled (default) 1: Enabled. Enabling of return temperature limiter. When enabled, the return temperature is limited below (above for cooling applications) the configuration in AV,12.
BV,3*	Config Primary DeltaT Limiting, Heating	R/W	0: Disabled (default) 1: Enabled. Enabling of primary differential temperature limiter. When enabled, the differential temperature on the primary side is limited below the configuration in AV,13.
BV,4*	Config Supply Flow Limiting Cooling	R/W	0: disabled 1: Enabled. Enabling of supply flow limit. When enabled, the consumed primary flow is limited below the configuration in AV,17.
BV,5*	Config Thermal Power Limiting Cooling	R/W	0: disabled 1: Enabled. Enabling of thermal power limiter. When enabled, the delivered thermal power is limited below the configuration in AV,18.
BV,6*	Config Return Temp Limiting Cooling	R/W	0: disabled 1: Enabled. Enabling of return temperature limiter. When enabled, the return temperature is limited below (above for cooling applications) the configuration in AV,10).
BV,7*	Config Primary Delta T Limiting Cooling	R/W	0: disabled 1: Enabled. Enabling of primary differential temperature limiter. When enabled, the differential temperature on the primary side is limited below the configuration in AV,20.

Note: Objects marked with * are only available for DYNAMIC variants

6.5 Multistate inputs

ID	Object name	Access	Description
MI,0	Status Pump Control Mode, Heating and Cooling	R	1: Constant speed 2: Constant pressure 3: Proportional pressure 4: AUTO$_{ADAPT}$ 5: Constant flow Shows the current pump control mode.
MI,1	Data Application Type Heating	R	1: Radiator heating 2: Underfloor heating 3: Heating coil The registered application type via MO,2.
MI,2	Status System State	R	1: Powering up (~30 s) 2: Fault (fault relay activated) 3: Ready 4: Preheating heating coil 5: Temperature control state (ready relay activated) 6: Frost protection 7: Underfloor overheat protection 8: Shut down due to removal of start signal 10: Valve 100 % open (for backup) 11: Return temperature control.
MI,3	Status Thermal selection	R	1: Heating 2: Cooling.
MI,4	Data Application type Cooling		1: General Cooling The registered application type via MO,5.
MI,5	Data Valve Mode	R	1: Injection 2 way 2: Mixing 3 way 3: Injection 3 way.

6.6 Multistate outputs

ID	Object name	Access	Description
MO,0	Config Pump Control Mode, Heating	W	1: Constant speed 2: Constant pressure 3: Proportional pressure 4: AUTO$_{ADAPT}$ 5: Constant flow Sets the pump control mode for heating mode
MO,1	Set Manual Valve Function	W	1: Off (default) 2: 100% open 3: 50% open 4: 25% open 5: 0% (closed) Function for manual setting of the valve opening, e.g. for degassing use or other service purposes.
MO,2	Set Application Type Heating	W	1: Radiator heating 2: Underfloor heating 3: Heating coil This sets the application type for Heating.
MO,3	Config Pump Control Mode Cooling	W	1: Constant speed 2: Constant pressure 3: Proportional pressure 4: AUTO$_{ADAPT}$ 5: Constant flow Sets the pump control mode for cooling mode.
MO,4	Config Thermal selection	W	1: Heating 2: Cooling Used for change-over between Heating and Cooling in Combined Heating/Cooling applications.**Configuration of Thermal Application Mode must happen via MO,7 Config Heating Cooling Selection.**
MO,5	Set Application Type Cooling	W	1: General Cooling This sets the application type for Cooling.
MO,6	Config Valve Mode	W	1: Injection 2 way 2: Mixing 3 way 3: Injection 3 way
MO,7	Config Heating Cooling Selection	W	1: Heating 2: Cooling 3: Combined

6.7 Multistate value

ID	Object name	Access	Description
MV,0	Config Temp Setpoint Source	R/W	This selects the source of the temperature setpoint. 1: default_setpoint 2: ana_temp_setpoint 3: temp_setpoint_remote 4: outdoor_temp 5: outdoor_temp_remote • 1: Default • 2: Relates to setpoint from analog input terminals. • 3: Relates to AO,0. • 4: Utilizing weather curve in MIXIT with input from outdoor temperature sensor connected to MIXIT. Associated with the following objects: - AV,4 - AV,5 - BI,13 - BI,14 - BI,15 • 5: Utilizing weather curve in MIXIT with outdoor temperature input from fieldbus AO,1. Associated with objects: - AV,4 - AV,5 - BI,13 - BI14 - BI,15 For all options, the actual temperature setpoint used by the algorithm can be read at AI,2. **Configuration of analogue input must happen via Grundfos GO Remote.**

6.8 Analog inputs

ID	Object name	Access	Description
AI,0	Data Temp Setpoint Remote [°C]	R	Actual value of remote temperature setpoint.
AI,1	Data Outdoor Temp Remote [°C]	R	Actual value of remote outdoor temperature.
AI,2	Data Act Temp Setpoint [°C]	R	Actual temperature setpoint used in temperature controller. If the limiter function is set to off, it is the same as the actual reference temperature derived from the set reference temperature mode via MV,0.
AI,5	Status Pump Warning Code [Enum]	R	Actual pump warning code.
AI,6	Status Pump Alarm Code [Enum]	R	Actual pump alarm code.
AI,7*	Data Heating Energy [kWh]	R	Accumulated heating energy in total lifetime.
AI,8*	Data Heating Power [kW]	R	Current thermal power for product running in heating mode.
AI,9*	Data Cooling Energy [kWh]	R	Accumulated cooling energy in total lifetime. Reset by BO,6.
AI,10*	Data Cooling Power [kW]	R	Current thermal power for product running in cooling mode.
AI,11*	Data Heat Temp Difference [°C]	R	Numerical value of forward and return pipe differential temp. Used for heat transfer calculation.
AI,12	Data Pump Power [W]	R	Current electrical power consumption of pump.
AI,13	Data percentage Speed [%]	R	Percentage of maximum pump speed.
AI,14	Data Pump Operating Hours [h]	R	Counter for pump operating hours.
AI,15	Data Pump Energy [kWh]	R	Accumulated pump energy.
AI,16	Data Flow Temp [°C]	R	Flow temperature measured in the secondary side via the connected pump.
AI,17	Data Supply Temp [°C]	R	Supply temperature measured at the valve.
AI,19	Data Logical Valve Opening [%]	R	Valve opening request, linear from algorithm.
AI,20*	Data Valve Supply Flow [m^3/h]	R	Flow rate at primary side measured at the A-port.
AI,21	Data Return Temperature [°C]	R	Return temperature measured at the valve.
AI,22	Data Controlled Temp [°C]	R	Actual controlled temperature: zone air, flow temperature.
AI,23	Data Supply Source Setpoint [°C]	R	Supply source temperature reference derived from setpoint and thermal mode of the mixing loop. Cooling: requested setpoint - 2°C, Heating: requested setpoint + 5°C.
AI,24	Data Pump Flow [m^3/h]	R	Actual pump flow.
AI,25	Data Pump Head [m]	R	Actual pump head.
AI,26	Data Outdoor Temp [°C]	R	Outdoor temperature measured at analog input. The outdoor temperature sensor configuration is done via Grundfos GO Remote.
AI,27	Data Zone Air Temp [°C]	R	Air temperature measured at analog input. The air temperature sensor configuration is done via Grundfos GO Remote.
AI,28	Data Bus Temperature Feedback [°C]	R	Get air temperature feedback measured by bus.

ID	Object name	Access	Description
AI,35	Status System Warning Code [Enum]	R	Warning codes for the MIXIT unit: 84: Memory storage media faulty 91: Secondary flow temperature sensor fault(pump) 97: Missing analog input 125: Outdoor sensor fault 126: Remote air temperature sensor fault 157: Real time clock battery fault 161: 5 V/12 V internal supply fault 162: 24 V internal supply fault 169: Flow sensor fault 175: Supply (forward) temp. sensor fault 176: Return temperature sensor fault 236: Multi-pump alarm for pump 1 237: Multi-pump alarm for pump .
AI,36	Status System Sub Warning Code [Enum]	R	Sub codes for warnings – detailing the cause of the warning. See MIXIT I&O for details.
AI,37	Status System Alarm Code [Enum]	R	Alarm codes for the MIXIT code: 10: Pump communication fault 25: Wrong configuration 39: Valve fault 72: Internal hardware fault 91: Flow temperature sensor fault 132: Missing GSC file configuration 203: Pump alarm 230: MAC address not configured 236: Pump faulty
AI,38	Status System Sub Alarm Code [Enum]	R	Sub codes for alarms– detailing the cause of the alarm. See MIXIT I&O for details.
AI,39*	Data HeatingVolume [m3]	R	Totally pumped heating volume
AI,40*	Data CoolingVolume [m3]	R	Totally pumped cooling volume
AI,41*	Data VolWeightAvgT1Heat [°C m3]	R	Totally volume weighted average for T1, Heating (Inlet)
AI,42*	Data VolWeightAvgT2Heat [°C m3]	R	Totally volume weighted average for T2, Heating (Outlet)
AI,43*	Data VolWeightAvgT1Cool [°C m3]	R	Totally volume weighted average for T1, Cooling (Inlet)
AI,44*	Data VolWeightAvgT2Cool [°C m3]	R	Totally volume weighted average for T2, Cooling (Outlet)
AI,45	Data MIXIT Operating Hours [s]	R	Operating (running) hours for MIXIT.

Objects marked with * are only available for DYNAMIC variants

6.9 Analog Output

ID	Object name	Access	Description
AO,0	Set Temperature Setpoint Remote [°C]	W	Temperature setpoint via fieldbus. Enabling: • Set BO,0 (Set Control Source) to 1. • Set MV,0 (Config Temp Setpoint Source) to 3
AO,1	Set Outdoor Temperature Remote [°C]	W	Temperature setpoint via fieldbus. Enabling: • Set BO,0 (Set Control Source) to 1. • Set MV,0 (Config Temp Setpoint Source) to 5
AO,2	Set Bus Temperature Feedback [°C]	W	Set air temperature feedback via fieldbus. Enabling: • Set BO,7 (Enable Bus Feedback) to 1.

6.10 Analog Valve

ID	Object name	Access	Description
AV,0	Config Custom Device Object Instance Number	R/W	Value for Custom Device Object Instance Number. Used in conjunction with Grundfos GO setup Present_Value range: 0-0x3FFFFE.(4194302) Default Present_Value: 0xE7.
AV,1	Config Product time and date	R/W	Product time and date in UNIX format (seconds since 00:00 01-01-1970) for the MIXIT unit Range: 1577836800 to 4070908799 (1/1/2020 – 31/12/2098)
AV,2	Set Simulation Event Code [Enum]	R/W	Set alarm/warning code to simulate.

ID	Object name	Access	Description
AV,3	Set Simulation Event Sub Code [Enum]	R/W	Set sub error code to simulate.
AV,4	Config Heat curve offset (+/-) [°C]	R/W	Adjusts the weather curve offset in degrees Celsius (+/- 15) [°C]. It is used when MV,0 = 4 or MV,0 = 5.
AV,5	Config Heat curve slope (+/-) [-]	R/W	Adjusts the slope of the configured weather curve (Min: 0.4, Max: 2). 1 equals the configured weather curve and 1.5 equals the configured slope multiplied by 1.5.
AV,6	Config Default Temp Setpoint [°C]	R/W	Fall back temperature setpoint in case setpoint signal from bus or sensor is lost. Default: 40 °C (Heating), 15 °C (Cooling). Setting of fallback temperature must be made individually for Heating and Cooling mode respectively.
AV, 7	Config Pump Head Duty Point, Heating [m]	R/W	Desired pressure duty point for constant or proportional pressure control modes.
AV, 8	Config Pump Flow Duty Point, Heating [m^3/h]	R/W	Desired flow duty point for proportional pressure and flow control.
AV,9	Config Pump Speed DutyPoint, Heating [%]	R/W	Desired speed in control mode constant speed. Depending on pump model, the minimum speed may be larger than minimum accepted at data point (larger than 30%).
AV,10*	Config Supply Flow Limit Heating [m^3/h]	R/W	Primary flow limit for hydronic balancing. The primary flow limit is enabled BV,0.
AV,11*	Config Thermal Power Limit Heating [kW]	R/W	Thermal power limit for the hydronic balancing. The thermal power limit is enabled by BV,1.
AV,12*	Config Return Temp Limit Heating [°C]	R/W	Return temperature limit for hydronic balancing. The return temperature limit is enabled by BV,2. For heating applications, the value works as an upper threshold.
AV,13*	Config Primary DeltaT Limit Heating [°C]	R/W	Differential temperature limit for hydronic balancing. The differential temperature limit is enabled by BV,3. The value is positive for both heating and cooling applications.
AV,14*	Config Pump Head Duty Point Cooling [m]	R/W	Desired pressure duty point for constant or proportional pressure.
AV,15*	Config Pump Flow Duty Point Cooling [m^3/h]	R/W	Desired flow duty point for proportional pressure and flow control.
AV,16*	Config Pump Speed Duty Point Cooling [%]	R/W	Desired speed in control mode constant speed.
AV,17*	Config Supply Flow Limit Cooling [m^3/h]	R/W	Primary flow limit for hydronic balancing in cooling mode. The primary flow limit is enabled by BV,4.
AV,18*	Config Thermal Power Limit Cooling [kW]	R/W	Thermal power limit for hydronic balancing in cooling mode. The thermal power limit is enabled by BV,5.
AV,19*	Config Return Temp Limit Cooling [°C]	R/W	Return temperature limit for hydronic balancing in cooling mode. The return temperature limit is enabled by BV,6. For cooling applications, the value works as a lower threshold.
AV,20*	Config Primary Delta T Limit Cooling [°C]	R/W	Differential temperature limit for hydronic balancing in cooling mode. The differential temperature limit is enabled by BV,7. The value is used as an absolute value (always positive) for both heating and cooling applications.
AV,21	Config Kp	R/W	Proportional gain of the temperature controller (min: 0.1, max: 20). Setting must be done individually for Heating and Cooling mode respectively.
AV,22	Config Ti	R/W	Integral action of the temperature controller (min: 0, max: 3600). Setting must be done individually for Heating and Cooling mode respectively.
AV,23	Config Kvs	R/W	Limitation of valve capacity (min: 0.1 Kvs, max: Kvs).
AV,24	Config Outdoor Temperature X1	R/W	Weather curve outdoor temperature point 1.
AV,25	Config Setpoint Y1	R/W	Weather curve setpoint 1.
AV,26	Config Outdoor Temperature X2	R/W	Weather curve outdoor temperature point 2.
AV,27	Config Setpoint Y2	R/W	Weather curve setpoint 2.
AV,28	Config Outdoor Temperature X3	R/W	Weather curve outdoor temperature point 3.
AV,29	Config Setpoint Y3	R/W	Weather curve setpoint 3.
AV,30	Config Outdoor Temperature X4	R/W	Weather curve outdoor temperature point 4.
AV,31	Config Setpoint Y4	R/W	Weather curve setpoint 4.
AV,32	Config Outdoor Temperature X5	R/W	Weather curve outdoor temperature point 5.
AV,33	Config Setpoint Y5	R/W	Weather curve setpoint 5.

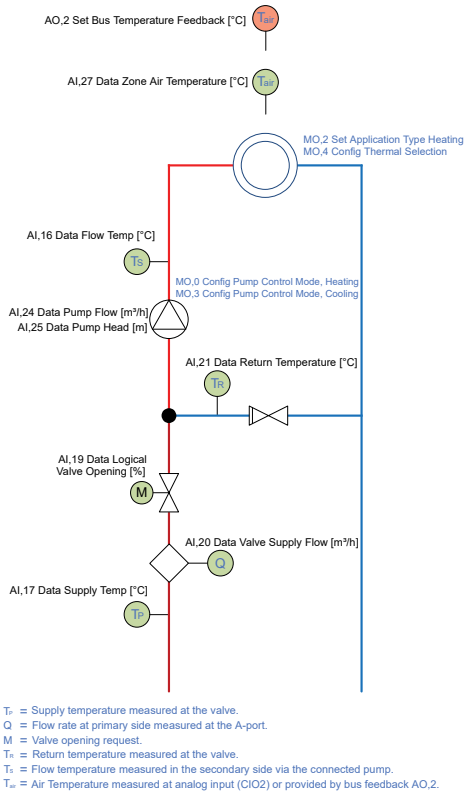
Objects marked with * are only available for DYNAMIC variants

7. MIXIT overview

MIXIT has a built-in temperature controller that is used to control either the flow temperature or according to the feedback of an external sensor (typical air temperature) when in heating coil application. The following can be configured:

- Application type
- Limiter functions
- Protection functions
- Setpoint chain
- Pump configuration

The below figure shows the most used data points in MIXIT.



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7.1 Setpoint chain

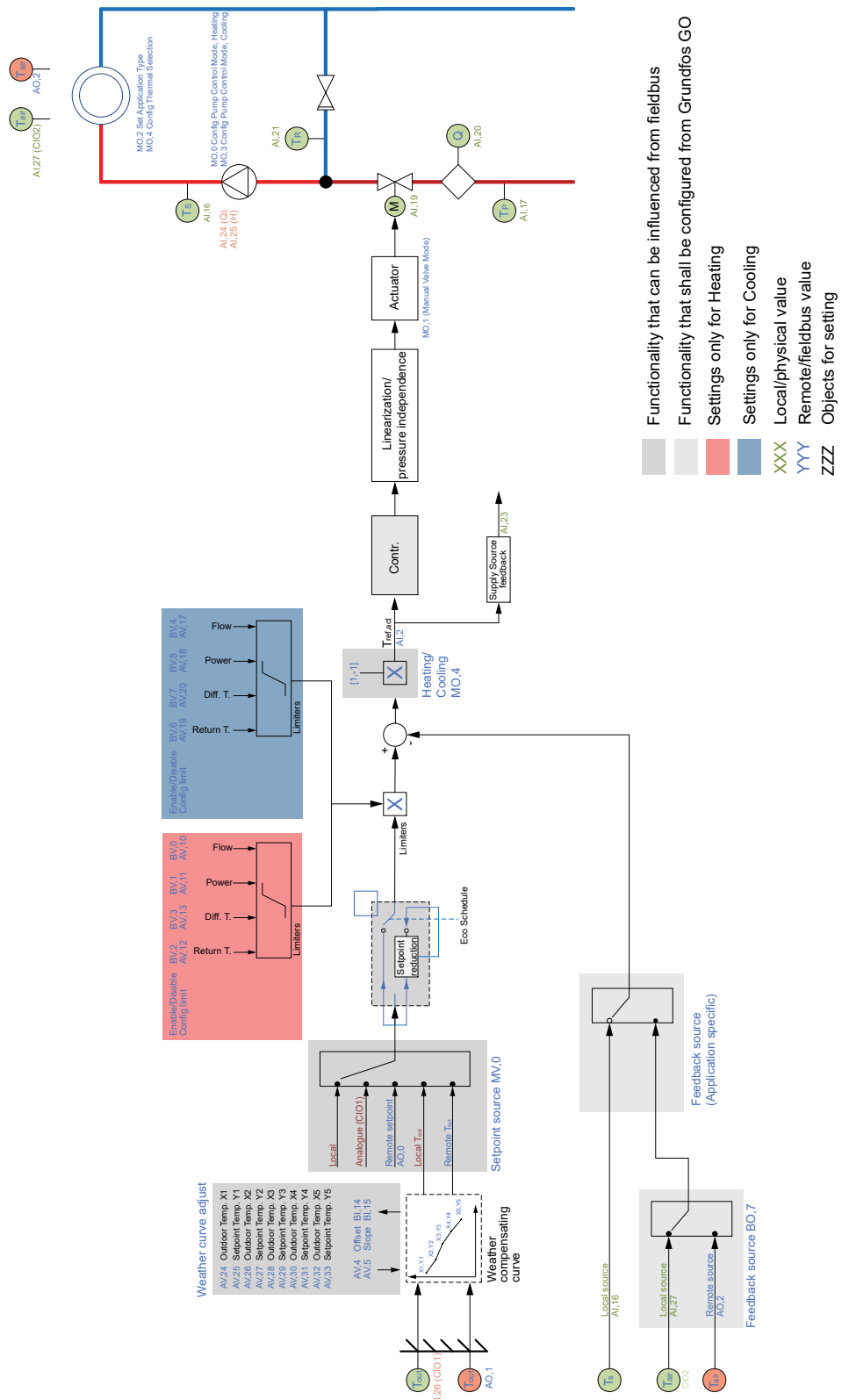
MIXIT can use different setpoint sources (Refer to figure on the next page) as indicated by the multiplexer controlled by MV,0. Setpoint can come from local(1- default), analog input(2), remote setpoint(3), weather curve with outdoor temperature sensor connected to the MIXIT unit(4), weather curve with the outdoor temperature coming from fieldbus(5). The limiters can influence the actual setpoint, which always can be read in AI,2. In the case where is configured as combined Heating and Cooling change over between Heating and Cooling can be made by changing the value of MO,4. When in in Cooling mode the controller operates in inverse mode. A supply source setpoint (AI,23) is derived from the requested setpoint by adding + 5°C and subtracting -1.5°C in Heating and Cooling respectively. During the preheat state when the application is configured to Heating coil + 40°C is added to the return temperature to derive the supply source setpoint.

7.2 Thermal mode and application setup

MIXIT can operate in three different thermal application modes as shown in below table – Heating, Cooling and Combined Heating & Cooling. In Cooling and when Cooling is the active mode in combined Heating & Cooling the controller is operating in inverse mode – a positive difference between setpoint and feedback will result in a decreasing output of the controller

Configuring the Application Type sets up some application specific functionalities. In the current version of MIXIT it is only possible to configure different application types for Heating via MO,2.

Thermal Mode	Heating	Cooling	Combined (H/C)
Application type Setup in GO	Radiator Floor heating Heating coil	General load	General Load
Fieldbus operation	Set point source Setpoints Limiters Alarm	Set point source Setpoints Limiters Alarm	Set point source Setpoints Limiters Alarm Change over


Functionality that can be influenced from fieldbus
Functionality that shall be configured from Grundfos GO
Settings only for Heating
Settings only for Cooling
XXX Local/physical value
YYY Remote/fieldbus value
ZZZ Objects for setting
Actuator
Linearization/ pressure independence
Contr.
Supply Source feedback
Heating/ Cooling MO.4
Limiters
Eco Schedule
Setpoint source MV.0
Feedback source (Application specific)
Feedback source BO.7
Weather curve adjust
Weather compensating curve
Flow
Power
Diff. T.
Return T.
Enable/Disable Config limit

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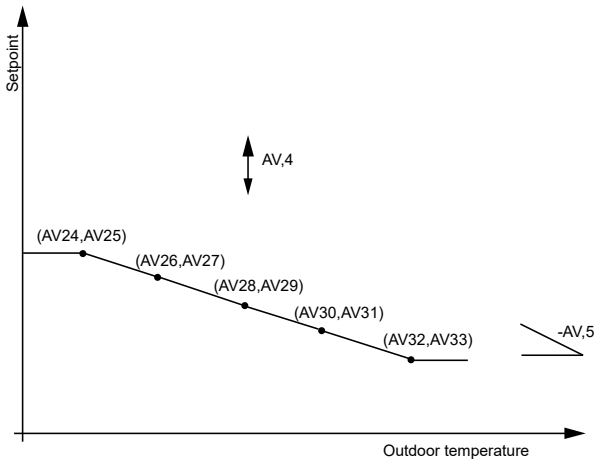
7.3 Weather curve

With the outdoor temperature compensation function activated, the product automatically adjusts the mixed flow temperature according to the outdoor temperature. Outdoor temperature compensation is set by the means of a five-point temperature curve. The five data pairs (T_{out}, T_{flow},) defining the weather curve can be accessed by using AV,24-33. The outdoor temperature points can be configured in the range from -60 °C to 60 °C and the setpoints can be configured in the range from 0 °C to 90 °C.

The fieldbus provides data points for offsetting (AV,4) and changing the slope (AV,5) of the weather curve. These can be used to make fine tuning from remote. See the below figure. The slope is input as positive value, even though strictly speaking mathematically, the slope is negative.



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Five-point temperature curve. Y axis: Setpoint [°C]. X axis: Outdoor temperature [°C].

The setpoint source in MV,0 shall be configured to either 4 or 5, where the former assumes the outdoor temperature is coming from a sensor connected to MIXIT, whereas the latter assumes the outdoor temperature is a data point in the fieldbus system written to AO,1 in MIXIT. In both cases the initial configuration has to be made in MIXIT. Status is read in BI,13 , BI,14 and BI,15

For heating-coil applications, the curve defines the air temperature.

7.4 Default settings

The below table summarise the default (factory) settings for MIXIT.

Application / Default Settings	Readiator heating	Underfloor heating	Heating coil	Cooling	Combined
Pump control mode	Prop. pressure	Constant pressure	Constant flow	Constant flow	Constant flow
Setpoint	Local 40 °C	Local 40 °C	Local 40 °C	Local 15 °C	Local 40 °C / 15 °C
Temperature Feedback	Flow temp. sensor	Flow temp. sensor	Air temp. sensor	Flow temp. sensor	Flow temp. sensor
Kv value	Kvs of valve	Kvs of valve	Kvs of valve	Kvs of valve	Kvs of valve
Limiters	Off	Off	Off	Off	Off
Coil preheat	NA	NA	On (20 °C)	NA	NA
Frost protection	NA	NA	On (8 °C)	On (8 °C)	On (8 °C)
Overheat protection	NA	On (50 °C)	NA	NA	NA

7.5 Configuring the pump

During initial setup of the MIXIT unit, MIXIT and the pump are paired with a radio link.
Twin pumps or two single pumps operating as twins have to be paired before the master is paired with MIXIT. It is possible to configure the control mode and the duty point of the pump.

7.5.1 Objects for configuration of pump

The control mode is set by MO,0 and MO,3 for Heating and Cooling respectively. The status can be read in MI,0. MI,0 always returns the status of the current selected Thermal mode (Heating or Cooling). Set points for the pump is set in AV,7, AV,8, AV,9, AV,14, AV,15 and AV,16.

	ID	Object name	Description
Heating	MO,0	Config Pump Control Mode Heating	This sets the pump control mode: 1: Constant speed 2: Constant pressure 3: Proportional pressure 4: AUTOADAPT 5: Constant flow
	MI,0	Status Pump control mode Heating and Cooling	The current pump control mode: 1: Constant speed 2: Constant pressure 3: Proportional pressure 4: AUTOADAPT 5: Constant flow.
	AV,7	Config Pump Head Duty Point Heating	Desired pressure duty point for constant or proportional pressure control modes.
	AV,8	Config Pump Flow Duty Point Heating	Desired flow duty point for proportional pressure and flow control modes.
	AV,9	Config Pump Speed Duty Point Heating	Desired speed for constant speed control mode.
Cooling	MO,3	Config Pump Control Mode Cooling	This sets the pump control mode: 1: Constant speed 2: Constant pressure 3: Proportional pressure 4: AUTOADAPT 5: Constant flow
	MI,0	Status Pump control mode Heating and Cooling	The current pump control mode: 1: Constant speed 2: Constant pressure 3: Proportional pressure 4: AUTOADAPT 5: Constant flow.
	AV,14	Config Pump Head Duty Point Cooling	Desired pressure duty point for constant or proportional pressure control modes.
	AV,15	Config Pump Flow Duty Point Cooling	Desired flow duty point for proportional pressure and flow control modes.
	AV,16	Config Pump Speed Duty Point Cooling	Desired speed for constant speed control mode.

7.6 Limiters

For these functions to be unlocked, the DYNAMIC upgrade must be activated on the MIXIT unit or the unit must be a MIXIT DYNAMIC.

MIXIT has four different limiting functions

- Supply flow limit
- Thermal power limit
- Return temperature limit
- Differential temperature limit

that can be individually setup for Heating and Cooling Mode respectively. The limiters are implemented as PI-controllers that tries to keep each limited value within the limit. This means that the actual temperature set point read in AI,2 can differ from the set point set in AO,0. All limiters can run simultaneously.

The limiters are setup by the following sequence

1. Enable the limit by setting BV,X to 1.
2. Configure the limit via AV,X

Notification for exceeding threshold(X) can be read in BI,X

The objects relating to the different limiters can be found in the below table

		Enable limit	Config limit	Notification threshold exceeded
Heating	Supply flow limit	BV,0	AV,10	BI,8
	Thermal power limit	BV,1	AV,11	BI,9
	Return temperature limit	BV,2	AV,12	BI,10
	Differential temperature limit	BV,3	AV,13	BI,11
Cooling	Supply flow limit	BV,4	AV,17	BI,8
	Thermal power limit	BV,5	AV,18	BI,9
	Return temperature limit	BV,6	AV,19	BI,10
	Differential temperature limit	BV,7	AV,20	BI,11

Notifications for threshold exceed for Supply flow limit (BI,8) and Thermal power limit (BI,9) is set when the actual value is above the limits for more than 3600s. Notifications for Return temperature limit (BI,10) and Differential temperature limit (BI,11) is set when actual value is above for more than 3600s (Heating) or when the actual value is below for more than 3600s (Cooling).

7.7 Application specific functionality

MIXIT is equipped with application specific functions mainly for protection. The current state of operation of MIXIT can be read in MI,2, see *7.8 Sequence of operation and state machines* for details.

7.7.1 Underfloor overheat protection

When choosing the application type **Underfloor heating**, you automatically activate the **Underfloor overheat protection** function.

By defining a maximum forward-flow temperature, you ensure that the temperature will never exceed the given value. The overheat protection consists of two parts: one using the temperature sensor in the pump and the other using an external temperature switch connected to DI4. If the limit is exceeded, the valve will close and the pump stops.

Any temperature setpoint will be limited to a maximum of 5 °C below the configured **Max. flow temperature**. This ensures a leeway to control the mixing temperature.

Configuration of the maximum flow temperature in Grundfos GO Remote:

Main menu > **Settings** > **Application settings** > **Underfloor overheat protection**

The default maximum flow temperature is 50°C.

1. To change the limit, press **Max. flow temperature** and make your adjustment. Press **OK**.
2. To deactivate or reactivate **Underfloor overheat protection**, press the corresponding slide-button.

Fieldbus behaviour

BO,3 can be used to force or simulate that an overheat situation has occurred. BI,6 indicates if overheat is detected. This can happen due to three different reasons a) temperature exceeds limit, b) External temperature switch connected to DI4 indicates overheat, c) BO,3 has been set to 1.

7.7.2 Preheat and frost protection, heating coil

When choosing the application type **Heating coil**, you can activate the coil preheat and frost protection functions.

Coil preheat

With MIXIT you can preheat the coil before allowing the fan to start. Preheat is activated if the return temperature is below a certain limit that can be configured in Grundfos GO. The function is default enabled.

Configuration via Grundfos GO Remote:

Main menu > **Settings** > **Application settings** > **Coil preheat and frost protection**

Fieldbus behaviour

When MIXIT is in the preheat state, MI,2 is set to 4.

Frost protection

You can protect the coil from freezing by defining an air and return flow temperature. If the temperature falls below one of the two temperature limits, MIXIT will react by fully opening the valve to circulate hot water in the system.

The return flow temperature is measured by the sensor in port B of MIXIT. To measure the air temperature, you will need to install a temperature sensor in the coil. The two limits can be configured in Grundfos as well as being enabled or disabled.

Configuration via Grundfos GO Remote:

Main menu > **Settings** > **Application settings** > **Coil preheat and frost protection**

Fieldbus behaviour

BO,4 enables the function, BI,7 indicates that a frost risk is detected either from one of the two sources.

7.7.3 Frost protection, Cooling and Combined Heating/Cooling

You can protect the coil from freezing by defining a return flow temperature. If the temperature falls below the configured temperature limit, MIXIT will react by fully opening the valve to circulate hot water in the system. In Combined H/C the limit and behaviour is identical in Heating and Cooling Mode

Configuration via Grundfos GO Remote:

Main menu > **Settings** > **Application settings** > **Frost protection**

Fieldbus behaviour

The frost protection is enabled by setting BO,8 to 1. If the frost on the cooling system is detected, a notification is given via BI,7 to 1.

7.8 Sequence of operation and state machines

MIXIT has an internal state machine that governs the logic behavior of MIXIT during operation. The current state can be read via MI,2, where the state enum has the following description.

1: PowerUp: Powering up, initializing the software, and calibrating the valve. After approx. 60 seconds it will go to Ready state. Pump is stopped. *Run relay is deactivated*

.**2: Fault:** Fault state, valve is closed, and pump is stopped. *Fault relay activated. Run relay is deactivated.*

3: Ready: Waiting for start signal - all initializations are done and no faults. Temperature control is ready to start. Valve is closed and pump is stopped. *Run relay is deactivated*.

4: Preheating heat coil: Only for heating coil application and this state is only entered after startup (when the start signal is given). Will warm up the coil by opening the valve, run the pump and wait for the return temperature to be above a user determined threshold. *Run relay is activated.*

5: Temperature Control: Normal temperature control where the valve will open or close accordingly to maintain the temperature at the user defined setpoint. *Run relay is activated.*

6: Frost protection: Frost protection state where the valve is opened fully, and the pump is running. MIXIT will enter this state if internal from protection is detected (return temperature or air temperature is too low) or if the external frost protection has been triggered on the digital input. *Run relay is activated.*

7: Underfloor heat protection: Only for floor heating application. Pump is running and the valve is closed. MIXIT will enter this state if the mixed temperature is too high or if the external overheat protection has been triggered on the digital input. *Run relay is activated.*

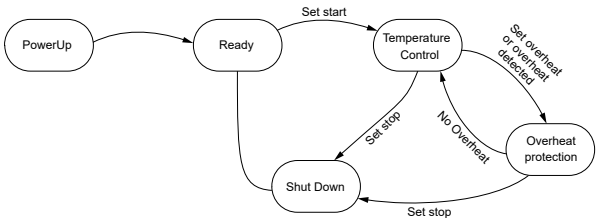
8: Shut down: MIXIT will go to this state if start signal on digital input is removed or if stop commands is sent. Immediately after MIXIT will go to ready state. Pump is stopped and the valve is closed. *Run relay is deactivated.*

10: Backup Control 1: The Pump is running, and the valve is fully open to ensure heating or cooling in the system. *Run relay is activated.*

11: Backup Control 2: Not for floor heating application. If the mixed temperature sensor is faulty, MIXIT will switch to return temperature control where the valve will open and close accordingly to maintain the return temperature at a predefined setpoint (heating coil = 23°C, general cooling= requested setpoint + 5°C and radiator heating = 35°C). *Run relay is activated.*

The following figures gives a brief overview regarding the sequence of operation for different applications.

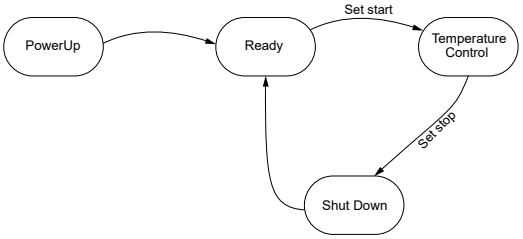
Floor heating states



TM086130

Floor heating states

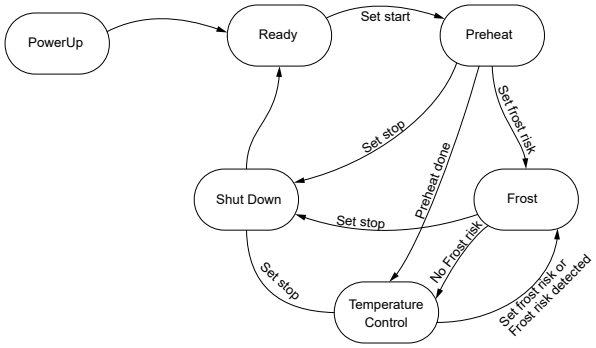
Radiator heating states



TM086129

Radiator heating states

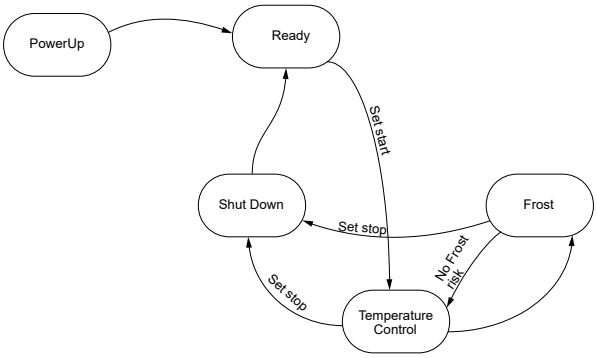
Heating coil states



TM086131

Heating coil states

General cooling states



TM086132

General cooling states

7.8.1 Fallback operation and fault handling

The built controller has MIXIT built-in default actions in the case of errors that can't recovered and fallback modes if sensors are lost. See below table.

Application / Fault type	Radiator heating	Underfloor heating	Heating coil
Pump alarm	VC, SP	VC, SP	VC, SP
Pump communication	VC, SP	VC, SP	VC, SP
Valve blocked	VC, SP	VC, SP	VC, SP
Air temperature sensor	NA	NA	DSP(FTS)
Flow temperature sensor	RTC	VC, SP	RTC(RTS)
Return temperature sensor	VO	VC, SP	VC,SP
Outdoor temperature sensor	DSP	DSP	DSP
Temperature reference	NA	DSP	NA

Abbreviations: VC: Valve Close; VO: Valve Open; RTC: Return temperature control; ATC: Air temperature control; SP: Stop pump; RP: Attempt to Run Pump (may not be possible); DSP: Default setpoint; SP: Stop Pump; FTS: Flow Temperature Sensor; RTS: Return Temperature Sensor; NA: Not Applicable. Arrows indicates fallback control when a sensor is lost.

7.9 Energy monitoring

The energy monitoring function makes it possible to monitor the energy consumption in individual zones. This function does not require any additional sensors or additional settings to the system.

The calculated value cannot be used for billing purposes. However, it is perfect for optimization purposes to prevent excessive energy costs caused by system imbalances.

Energy monitoring register

Registers are available for cloud, in Grundfos GO Remote and via fieldbus.

- Life time, last year and year to date counters are available in Grundfos GO Remote
- Life time counters are available via fieldbus

Grundfos GO Remote menu:

Main menu > **Monitoring** > **Energy monitoring**

7.9.1 Energy monitoring register

Lifetime counters for Energy, Volume and Volume Weighted Temperatures are available via fieldbus in the registers AI,7, AI,9, AI,39, AI,40, AI,41, AI42, AI,43, AI,44. See below table. Furthermore, instantaneous values for power and temperature difference are available in the registers AI,8, AI,10, AI,11.

ID	Object name	Access	Description
AI,7*	Data Heating Energy [kWh]	R	Accumulated heating energy in total lifetime. Reset via BO,6 (Reset Accumulated Counters).
AI,8*	Data Heating Power [kW]	R	Current thermal power for product running in heating mode.
AI,9*	Data VolWeightAvgT1Heat [°C m^3]	R	Accumulated cooling energy in total lifetime. Reset by BO,6 (Reset Accumulated Counters).
AI,10*	Data VolWeightAvgT2Heat [°C m^3]	R	Current thermal power for product running in cooling mode.
AI,11*	Data VolWeightAvgT1Cool [°C m^3]	R	Numerical value of forward pipe and return pipe differential temp. Used for heat transfer calculation.
AI,39*	Data HeatingVolume [m^3]	R	Totally pumped heating volume
AI,40*	Data CoolingVolume [m^3]	R	Totally pumped cooling volume
AI,41*	Data VolWeightAvgT1Heat [°C m^3]	R	Totally volume weighted average for T1, Heating (Inlet)
AI,42*	Data VolWeightAvgT2Heat [°C m^3]	R	Totally volume weighted average for T2, Heating (Outlet)
AI,43*	Data VolWeightAvgT1Cool [°C m^3]	R	Totally volume weighted average for T1, Cooling (Inlet)
AI,44*	Data VolWeightAvgT2Cool [°C m^3]	R	Totally volume weighted average for T2, Cooling (Outlet)

7.10 Functionality not available on fieldbus

7.10.1 Basic setup of valve

The valve orientation can only be changed on the local HMI or in Grundfos GO. The configuration is fundamental to the operation of MIXIT and therefore it is important to be present at the product when this configuration is made.

7.10.2 Summer mode

Summer mode is not supposed to be used in system controlled by fieldbus. Here it is assumed that the overall control is handled by the automation system. Hence summer mode should be disabled(default setting). Otherwise there is a risk that MIXIT will act autonomous and stop unintentionally.

7.10.3 Calendar functionality

The calendar functionality in MIXIT is supposed to be used in standalone installations or installations monitored by Grundfos BuildingConnect. In an installation connected to fieldbus scheduling is handled by the automation system

8. Fault finding the product

This is a complete list of alarm and warning codes for the MIXIT fieldbus connection. For more information about fault finding of MIXIT and MAGNA3/TPE3, see the installation and operating instructions of the products

8.1 The external control icon is not switched on

Cause	Remedy
Wrong configuration	• Check the BACnet interface configuration via Grundfos GO Remote. • Try switching wires A and B terminals (MS/TP) • Ensure Ethernet is connected correctly (IP) When a fieldbus connection is established and data is transferred, the external control icon on the MIXIT operating panel will light up. The light will switch off 30 seconds after data communication via the fieldbus has stopped.
The data line is disconnected	• he light will switch off 30 seconds after data communication via the fieldbus has stopped.

8.2 Data is read from the MIXIT unit but it is not reacting on a setpoint change

Cause	Remedy
The product is in local control instead of remote control.	• Check that MIXIT is in remote control. The actual state is read at BI,0. The status is changed via BO,0. Note that local control is the default setting. • Check that MV,0 is configured correctly. - MV,0 = 3: temp_setpoint_remote - MV,0 = 5: outdoor_temp_remote

8.3 The controlled temperature is much different than the requested temperature for more than 10-20 minutes

Cause	Remedy
The setpoint source is configured wrong.	1. If the controlled temperature at AI,22 is much different than the setpoint at AI,0, after several minutes, check if the setpoint in AI,0 is the same as requested in AO,0. 2. Check that MV,0 is configured for remote setpoint.
The limit functions may be enabled which reduces the setpoint.	1. Check that the actual setpoint in AI,2 is the same as the registered remote setpoint in AI,0. 2. Check if one or more limit functions are active. Check if BV,0, BV,1, BV,2, BV,3, BV,4, BV,5, BV,6 and BV,7 are set to 1. If one or more limit functions are active and the MIXIT unit is running at or above the threshold associated with the active limit function, the remote setpoint in AI,0 is reduced until the threshold is reached.
The gain of the closed-loop controller is too low.	1. Increase the proportional gain with Grundfos GO Remote with 10 % of the actual gain at a time until the response is satisfactory. Wait for several minutes between each increase. 2. If necessary, adjust the integral time with Grundfos GO Remote.

8.4 The MIXIT unit was put into bus control, but it is now in local control again

Cause	Remedy
The MIXIT unit starts in local control. The actual status is not kept during a power cycle.	• Ensure to keep MIXIT in remote if a power cycle occurs • Check the status in BI,0. • If it is set to 0, set BO,0 to 1 again.

8.5 The MIXIT unit was stopped from BACnet command, but it has started again

Cause	Remedy
The MIXIT unit is starting again. The actual start/stop status is not kept during a power cycle.	• Ensure to keep MIXIT in Remote • Check the status in BI,2. • If it is set to 1, set BO,0 to 1 and then set BO,1 to 0.

8.6 The MIXIT unit does not start the pump when a start signal is given in BO,1

Cause	Remedy
The pump state is incorrect.	• Ensure the requested pump run state in BI,2 is set to 1 in order to start the pump. • Check if the pump is stopped locally via the pump interface.

Cause	Remedy
	At the pump, local stop has priority over bus control. • Pump error • not paired

8.7 The MIXIT unit does not stop the pump when a stop signal is given in BO,1

Cause	Remedy
The pump state is incorrect.	• Ensure the requested pump run state in BI,2 is set to 0 in order to stop the pump. • Check if the pump is running at maximum speed. At the MAGNA3/TPE3 pump, local max curve has priority over bus control. • Pump error • Not paired

8.8 Reading and resetting warnings and alarms

- Read out system warnings via AI,35. For Warnings with subcodes, read AI36 to get the specific warning
- Read out system alarms via AI,37. For alarms with subcodes, read AI,38 to get the specific alarm.
- Pump warnings codes are read via AI,5. Pump alarm codes are read via AI,6.
- Reset alarms and warnings via BO,2.

See MIXIT I&O for details about alarms and warnings.

9. BACnet telegrams

9.1 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	Pa
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. 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.

9.2 Telegram types

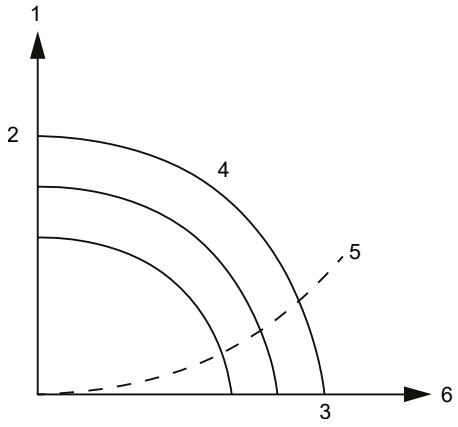
The available telegram types are listed below:

Type	Name	Description
00	Token	Used to pass network mastership to the destination device.
01	Poll for master	Used to discover 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 loop-back 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.

10. Appendix: overview of pump control mode settings

10.1 Setting the duty point for constant-speed control mode

This duty point is set via AV,9 (speed duty point). The duty point is a percentage of the maximum speed. In this control mode, the pump speed will be constant at the configured speed duty point.



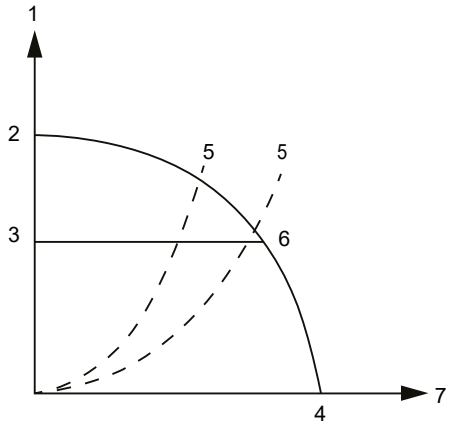
TM069265

Constant-speed control curve

Pos.	Description
1	Head [m]
2	$H_{max.}$
3	$Q_{max.}$
4	Constant speed curves
5	System curve
6	Flow [m^3/h]

10.2 Setting the duty point for constant-pressure control mode

The duty point is set via AV,7 (speed duty point). The duty point is the pressure in meters. In this control mode, the pump speed will have a constant pressure at the configured duty point.



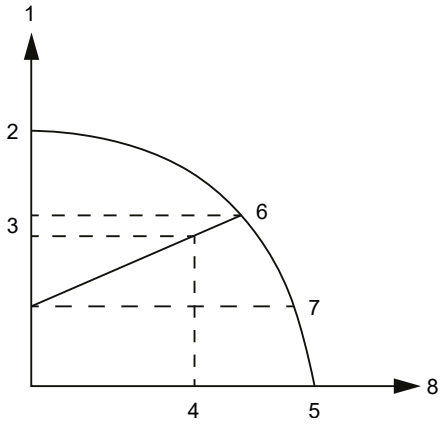
TM069264

Constant-pressure control curve

Pos.	Description
1	Head [m]
2	$H_{max.}$
3	AV,7
4	$Q_{max.}$
5	System curves
6	Control curve
7	Flow [m^3/h]

10.3 Setting the duty point for proportional-pressure control mode

The duty point is set via AV,7 (head duty point) and AV,8 (flow duty point). The control curve will be a straight sloped line through the configured duty point.



TM069263

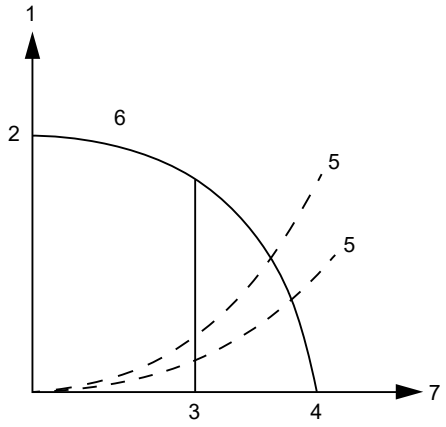
Proportional-pressure control curve

Pos.	Description
1	Head [m]
2	$H_{max.}$
3	AV,7
4	AV,8
5	$Q_{max.}$
6	H_0
7	$H_0/2$
8	Flow [m^3/h]

The foot point of the proportional-pressure curve at zero flow is always half of the head where the proportional-pressure curve crosses the pump curve for maximum speed.

10.4 Setting the duty point for constant-flow control mode

The duty point is set via AV,8 (flow duty point). In this control mode, the pump flow will be constant. This control mode is recommended for heating coils. For pumps without a dedicated flow control function, the auxiliary control function flow limit is activated. For hydraulic circuits with a low hydraulic resistance, such as heating coils, this is effectively flow control mode.



TM069262

Pos.	Description
1	Head [m]
2	$H_{max.}$
3	AV,8
4	$Q_{max.}$
5	System curves
6	Control curve
7	Flow [m^3/h]

Argentina
Bombas GRUNDFOS de Argentina S.A.
Ruta Panamericana km. 37.500industin
1619 - Garín Pcia. de B.A.
Tel.: +54-3327 414 444
Fax: +54-3327 45 3190

Australia
GRUNDFOS Pumps Pty. Ltd.
P.O. Box 2040
Regency Park
South Australia 5942
Tel.: +61-8-8461-4611
Fax: +61-8-8340-0155

Austria
GRUNDFOS Pumpen Vertrieb Ges.m.b.H.
Grundfosstraße 2
A-5082 Grödig/Salzburg
Tel.: +43-6246-883-0
Fax: +43-6246-883-30

Belgium
N.V. GRUNDFOS Bellux S.A.
Boomsesteenweg 81-83
B-2630 Aartselaar
Tel.: +32-3-870 7300
Fax: +32-3-870 7301

Bosnia and Herzegovina
GRUNDFOS Sarajevo
Zmaja od Bosne 7-7A
BiH-71000 Sarajevo
Tel.: +387 33 592 480
Fax: +387 33 590 465
www.ba.grundfos.com
E-mail: grundfos@bih.net.ba

Brazil
BOMBAS GRUNDFOS DO BRASIL
Av. Humberto de Alencar Castelo Branco, 630
CEP 09850 - 300
São Bernardo do Campo - SP
Tel.: +55-11 4393 5533
Fax: +55-11 4343 5015

Bulgaria
Grundfos Bulgaria EOOD
Slatina District
Iztochna Tangenta street no. 100
BG - 1592 Sofia
Tel.: +359 2 49 22 200
Fax: +359 2 49 22 201
E-mail: bulgaria@grundfos.bg

Canada
GRUNDFOS Canada inc.
2941 Brighton Road
Oakville, Ontario
L6H 6C9
Tel.: +1-905 829 9533
Fax: +1-905 829 9512

China
GRUNDFOS Pumps (Shanghai) Co. Ltd.
10F The Hub, No. 33 Suhong Road
Minhang District
Shanghai 201106 PRC
Tel.: +86 21 612 252 22
Fax: +86 21 612 253 33

Colombia
GRUNDFOS Colombia S.A.S.
Km 1.5 vía Siberia-Cota Conj. Potrero Chico,
Parque Empresarial Arcos de Cota Bod. 1A.
Cota, Cundinamarca
Tel.: +57(1)-2913444
Fax: +57(1)-8764586

Croatia
GRUNDFOS CROATIA d.o.o.
Buzinski prilaz 38, Buzin
HR-10010 Zagreb
Tel.: +385 1 6595 400
Fax: +385 1 6595 499
www.hr.grundfos.com

Czech Republic
GRUNDFOS Sales Czechia and Slovakia s.r.o.
Čajkovského 21
779 00 Olomouc
Tel.: +420-585-716 111

Denmark
GRUNDFOS DK A/S
Martin Bachs Vej 3
DK-8850 Bjerringbro
Tel.: +45-87 50 50 50
Fax: +45-87 50 51 51
E-mail: info_GDK@grundfos.com
www.grundfos.com/DK

Estonia
GRUNDFOS Pumps Eesti OÜ
Peterburi tee 92G
11415 Tallinn
Tel.: + 372 606 1690
Fax: + 372 606 1691

Finland
OY GRUNDFOS Pumput AB
Trukkikuja 1
FI-01360 Vantaa
Tel.: +358-(0) 207 889 500

France
Pompes GRUNDFOS Distribution S.A.
Parc d'Activités de Chesnes
57, rue de Malacombe
F-38290 St. Quentin Fallavier (Lyon)
Tel.: +33-4 74 82 15 15
Fax: +33-4 74 94 10 51

Germany
GRUNDFOS GMBH
Schlüterstr. 33
40699 Erkrath
Tel.: +49-(0) 211 929 69-0
Fax: +49-(0) 211 929 69-3799
E-mail: infoservice@grundfos.de
Service in Deutschland:
kundendienst@grundfos.de

Greece
GRUNDFOS Hellas A.E.B.E.
20th km. Athinon-Markopoulou Av.
P.O. Box 71
GR-19002 Peania
Tel.: +0030-210-66 83 400
Fax: +0030-210-66 46 273

Hong Kong
GRUNDFOS Pumps (Hong Kong) Ltd.
Unit 1, Ground floor, Siu Wai industrial Centre
29-33 Wing Hong Street & 68 King Lam Street, Cheung Sha Wan
Kowloon
Tel.: +852-27861706 / 27861741
Fax: +852-27858664

Hungary
GRUNDFOS South East Europe Kft.
Tópark u. 8
H-2045 Törökbálint
Tel.: +36-23 511 110
Fax: +36-23 511 111

India
GRUNDFOS Pumps India Private Limited
118 Old Mahabalipuram Road
Thoraipakkam
Chennai 600 097
Tel.: +91-44 2496 6800

Indonesia
PT GRUNDFOS Pompa
Graha intirub Lt. 2 & 3
Jln. Cililitan Besar No.454. Makasar,
Jakarta Timur
ID-Jakarta 13650
Tel.: +62 21-469-51900
Fax: +62 21-460 6910 / 460 6901

Ireland
GRUNDFOS (Ireland) Ltd.
Unit A, Merrywell Business Park
Ballymount Road Lower
Dublin 12
Tel.: +353-1-4089 800
Fax: +353-1-4089 830

Italy
GRUNDFOS Pompe Italia S.r.l.
Via Gran Sasso 4
I-20060 Truccazzano (Milano)
Tel.: +39-02-95838112
Fax: +39-02-95309290 / 95838461

Japan
GRUNDFOS Pumps K.K.
1-2-3, Shin-Miyakoda, Kita-ku
Hamamatsu
431-2103 Japan
Tel.: +81 53 428 4760
Fax: +81 53 428 5005

Kazakhstan
Grundfos Kazakhstan LLP
7' Kyz-Zhibek Str., Kok-Tobe micr.
KZ-050020 Almaty Kazakhstan
Tel.: +7 (727) 227-98-55/56

Korea
GRUNDFOS Pumps Korea Ltd.
6th Floor, Aju Building 679-5
Yeoksam-dong, Kangnam-ku, 135-916
Seoul, Korea
Tel.: +82-2-5317 600
Fax: +82-2-5633 725

Latvia
SIA GRUNDFOS Pumps Latvia
Deglava biznesa centrs
Augusta Deglava ielā 60
LV-1035, Rīga,
Tel.: + 371 714 9640, 7 149 641
Fax: + 371 914 9646

Lithuania
GRUNDFOS Pumps UAB
Smolensko g. 6
LT-03201 Vilnius
Tel.: + 370 52 395 430
Fax: + 370 52 395 431

Malaysia
GRUNDFOS Pumps Sdn. Bhd.
7 Jalan Peguam U1/25
Glenmarie industrial Park
40150 Shah Alam, Selangor
Tel.: +60-3-5569 2922
Fax: +60-3-5569 2866

Mexico
Bombas GRUNDFOS de México
S.A. de C.V.
Boulevard TLC No. 15
Parque industrial Stiva Aeropuerto
Apodaca, N.L. 66600
Tel.: +52-81-8144 4000
Fax: +52-81-8144 4010

Netherlands
GRUNDFOS Netherlands
Veluwezoom 35
1326 AE Almere
Postbus 22015
1302 CA ALMERE
Tel.: +31-88-478 6336
Fax: +31-88-478 6332
E-mail: info_gnl@grundfos.com

New Zealand
GRUNDFOS Pumps NZ Ltd.
17 Beatrice Tinsley Crescent
North Harbour Industrial Estate
Albany, Auckland
Tel.: +64-9-415 3240
Fax: +64-9-415 3250

Norway
GRUNDFOS Pumper A/S
Strømsveien 344
Postboks 235, Leirdal
N-1011 Oslo
Tel.: +47-22 90 47 00
Fax: +47-22 32 21 50

Poland
GRUNDFOS Pompy Sp. z o.o.
ul. Klonowa 23
Baranowo k. Poznania
PL-62-081 Przeźmierowo
Tel.: (+48-61) 650 13 00
Fax: (+48-61) 650 13 50

Portugal
Bombas GRUNDFOS Portugal, S.A.
Rua Calvet de Magalhães, 241
Apartado 1079
P-2770-153 Paço de Arcos
Tel.: +351-21-440 76 00
Fax: +351-21-440 76 90

Romania
GRUNDFOS Pompe România SRL
S-PARK BUSINESS CENTER, Clădirea A2, etaj 2
Str. Tipografilor, Nr. 11-15, Sector 1, Cod 013714
Bucuresti, Romania
Tel.: 004 021 2004 100
E-mail: romania@grundfos.ro

Serbia
Grundfos Srbija d.o.o.
Omladinskih brigada 90b
11070 Novi Beograd
Tel.: +381 11 2258 740
Fax: +381 11 2281 769
www.rs.grundfos.com

Singapore
GRUNDFOS (Singapore) Pte. Ltd.
25 Jalan Tukang
Singapore 619264
Tel.: +65-6681 9688
Faxax: +65-6681 9689

Slovakia
GRUNDFOS s.r.o.
Prievozská 4D 821 09 BRATISLAVA
Tel.: +421 2 5020 1426
sk.grundfos.com

Slovenia
GRUNDFOS LJUBLJANA, d.o.o.
Leskoškova 9e, 1122 Ljubljana
Tel.: +386 (0) 1 568 06 10
Fax: +386 (0)1 568 06 19
E-mail: tehnika-si@grundfos.com

South Africa
GRUNDFOS (PTY) LTD
16 Lascelles Drive, Meadowbrook Estate
1609 Germiston, Johannesburg
Tel.: (+27) 10 248 6000
Fax: (+27) 10 248 6002
E-mail: lgradidge@grundfos.com

Spain
Bombas GRUNDFOS España S.A.
Camino de la Fuentecilla, s/n
E-28110 Algete (Madrid)
Tel.: +34-91-848 8800
Fax: +34-91-628 0465

Sweden
GRUNDFOS AB
Box 333 (Lunnagårdsgatan 6)
431 24 Mölndal
Tel.: +46 31 332 23 000
Fax: +46 31 331 94 60

Switzerland
GRUNDFOS Pumpen AG
Bruggacherstrasse 10
CH-8117 Fällanden/ZH
Tel.: +41-44-806 8111
Fax: +41-44-806 8115

Taiwan
GRUNDFOS Pumps (Taiwan) Ltd.
7 Floor, 219 Min-Chuan Road
Taichung, Taiwan, R.O.C.
Tel.: +886-4-2305 0868
Fax: +886-4-2305 0878

Thailand
GRUNDFOS (Thailand) Ltd.
92 Chaloem Phrakiat Rama 9 Road
Dokmai, Pravej, Bangkok 10250
Tel.: +66-2-725 8999
Fax: +66-2-725 8998

Turkey
GRUNDFOS POMPA San. ve Tic. Ltd. Sti.
Gebze Organize Sanayi Bölgesi
Ihsan dede Caddesi
2. yol 200. Sokak No. 204
41490 Gebze/ Kocaeli
Tel.: +90 - 262-679 7979
Fax: +90 - 262-679 7905
E-mail: satis@grundfos.com

Ukraine
ТОВ "ГРУНДФОС УКРАЇНА"
Бізнес Центр Європа
Столичне шосе, 103
м. Київ, 03131, Україна
Tel.: (+38 044) 237 04 00
Fax: (+38 044) 237 04 01
E-mail: ukraine@grundfos.com

United Arab Emirates
GRUNDFOS Gulf Distribution
P.O. Box 16768
Jebel Ali Free Zone, Dubai
Tel.: +971 4 8815 166
Fax: +971 4 8815 136

United Kingdom
GRUNDFOS Pumps Ltd.
Grovebury Road
Leighton Buzzard/Beds. LU7 4TL
Tel.: +44-1525-850000
Fax: +44-1525-850011

U.S.A.
Global Headquarters for WU
856 Koomey Road
Brookshire, Texas 77423 USA
Phone: +1-630-236-5500

Uzbekistan
Grundfos Tashkent, Uzbekistan
The Representative Office of Grundfos Kazakhstan in Uzbekistan
38a, Oybek street, Tashkent
Tel.: (+998) 71 150 3290 / 71 150 3291
Fax: (+998) 71 150 3292

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ECM: 1410596

www.grundfos.com

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