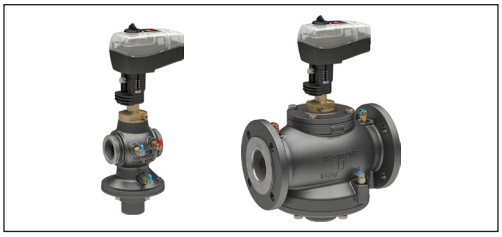
ENGINEERING
TOMORROW

Data sheet

NovoCon® M digital actuator & AB-QM NovoCon® DN 40-100 valves

Description



NovoCon® M is a high accuracy multi-functional fieldbus actuator, specifically designed for use in combination with the Pressure Independent Control Valve type AB-QM NovoCon® in sizes from DN 40-100 used in air handling units AHU, chillers and distribution station applications. The high position accuracy of the actuator, together with the pressure independent and linear characteristic of the AB-QM valve, allow NovoCon® M to be used as a flow indicator. Setup of the actuator and valve parameters are made via fieldbus. Control is achieved via fieldbus or via analog inputs to NovoCon® M.

General features:

- Remote commissioning/Pre-set/Flush features
- Flow, power emission and energy indication
- High position resolution and accuracy
- Energy management algorithms
- Inputs/Outputs
  - 3x Resistance Inputs (PT1000, PT500, PT100, NTC 10k Type 2 & 3)
  - 1x Analog Input (0-10V or 0/4-20mA),
  - 1x Analog Output (0-10V)
- LED displaying status and alarms
- No tools required for mounting on valve
- Maintenance-free lifetime
- Low-noise operation
- Auto MAC addressing for BACnet
- Auto baud rate detection
- Intrinsic alarm reporting for BACnet
- Valve blockage alarm
- Choice of BACnet MS/TP or Modbus RTU in the same product

Ordering

Actuator

Type	Supply voltage	Code No.
NovoCon® M	24V ac/dc	**003Z8540**

Temperature sensors

Type	Code No.
ESMB-12, universal temp. sensor, PT1000, 2.5m cable	**087B1184**

Accessories

Designation	Code No.
Immersion brass pockets, 40 mm, Ø6.0 mm, pair. For pipes DN40/50/65.	**087G6061**
Immersion brass pockets, 85 mm, Ø6.0 mm, pair. For pipes DN80/100.	**087G6062**

Valves

Type	Code No.
AB-QM NovoCon DN40 PN16 3TP	**003Z1770**
AB-QM NovoCon DN50 PN16 3TP	**003Z1771**
AB-QM NovoCon DN50 PN16 - Flange 3TP	**003Z1772**
AB-QM NovoCon DN65 PN16 3TP	**003Z1773**
AB-QM NovoCon DN65 PN16 3TP HF	**003Z1793**
AB-QM NovoCon DN80 PN16 3TP	**003Z1774**
AB-QM NovoCon DN80 PN16 3TP HF	**003Z1794**
AB-QM NovoCon DN100 PN16 3TP	**003Z1775**
AB-QM NovoCon DN100 PN16 3TP HF	**003Z1795**

Note: The above AB-QM NovoCon valves must be used with NovoCon® M.

NovoCon® Configuration Tool

Type	Length	Connections	Cable material	Code No.
NovoCon® Configuration Tool cable	5 m	USB / actuator	Halogen free. USB Converter, PVC	**003Z8620**

Software available on www.novocon.com

Technical data

NovoCon® M

Power supply		V	24 ±25% ac/dc
Power consumption	running	VA	<3.5@24Vac / <2.0@24Vdc
	standby	W	2.0 ac / 0.9 dc
Frequency		Hz	50/60±10%
Control signal		VDC	BACnet MS/TP, Modbus RTU, 0-10, 0-5, 2-10, 5-10, 2-6, 6-10
		mA	0-20, 4-20
Impedance			Rin 90kΩ (V). 500 Ω (mA)
			Rout 250Ω
Closing force		N	550
Max. stroke		mm	20
Position accuracy		mm	± 0.2
Actuator speed selections (open to close)		s/mm	3, 6, 12, 24, Constant Time
Max. medium temperature		°C	120
Ambient temperature			–10 … 50
Storage and transport temperature			–40 … 70
Ambient humidity			5-95% r.h., non-condensing (according to EN 60730-1)
Protection class			III
Grade of enclosure			IP 54
Weight		kg	0.5

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Technical data *(continued)*

AB-QM NovoCon® DN 40-100

Nominal diameter		**DN**	**40**	**50**	**50**	**65**	**65 HF**	**80**	**80 HF**	**100**	**100 HF**
Flow range	Q_{nom} (100 %) [1]	l/h	7,500	12,500	12,500	20,000	25,000	28,000	40,000	38,000	59,000
Design Flow setting range [1, 2]		%	40-100								
Diff. pressure [3]	Δp_{min}	kPa	30				60	30	60	30	60
	Δp_{max}		600								
Pressure stage		PN	16								
Control range			Acc. to standard IEC 534 control range is high as Cv characteristic is linear. (1:1000)								
Control valve's characteristic			Linear (could be converted by actuator to equal percentage)								
Leakage rate with recommended actuators			max. 0.05 % of Q_{nom}								
Flow medium			Water and water mixture for closed heating and cooling systems according to plant type I for DIN EN 14868. When used in plant Type II for DIN EN 14868 appropriate protective measures are taken. The requirements of VDI 2035, part 1 + 2 are observed.								
Medium temperature		°C	–10 ... +120								
Storage and transport temp.			–40 … 70								
Stroke		mm	10			15					
Connection	ext. thread (ISO 228/1)		G 2 A	G 2½ A							
	Flange		-	-	PN 16						
	Actuator		Danfoss standard								
Materials in the water											
Valve bodies			Grey iron EN-GJL-250 (GG25)								
Membranes/ Bellow			EPDM								
O-rings			EPDM								
Springs			W.Nr. 1.4568, W.Nr. 1.4310								
Cone (Pc)			CuZn40Pb3 - CW 614N, W.Nr. 1.4305								
Seat (Pc)			W.Nr. 1.4305								
Cone (Cv)			CuZn40Pb3 - CW 614N								
Seat (Cv)			W.Nr. 1.4305								
Screw			Stainless Steel (A2)								
Flat gasket			NBR								

Note:
Min temperature 2°C without stem heater. Min temperature -10°C with a stem heater.
Water for heating systems according to VDI 2035, Oxygen free systems, 7 < pH < 10, Ammonia / Sulphides free water.

[1] Factory setting of the valve is done at nominal setting range.
[2] Controlled by the actuator setting. Regardless of the setting, the valve can modulate below 1% of set flow.
[3] At min differential pressure valve reaches at least 90% of nominal flow. Declaration of performance is available upon request.

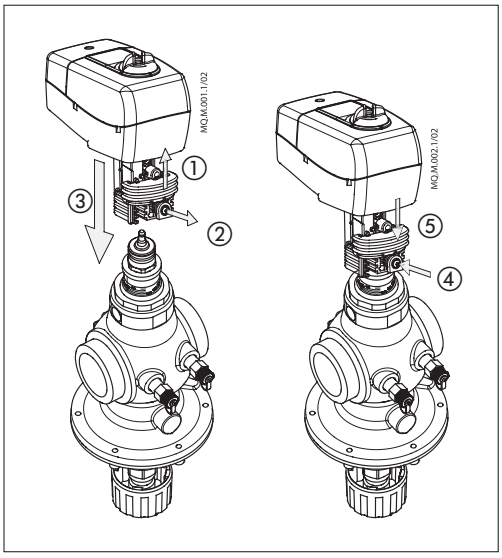
According suitability and usage especially in not oxygen tight systems please mind the instructions given by the coolant producer.
Pc -pressure controller part
Cv -Control valve part

Installation

No tool is required to mount the actuator on the valve. Installation of the valve with the actuator is allowed in the horizontal position or upwards. Installation downwards is not allowed.
The actuator must not be installed in an explosive atmosphere, at ambient temperature lower than 0 °C or at ambient temperature higher than 50 °C. It must not be subject to steam jets, water jets or dripping liquid.

Note: The actuator may be rotated up to 360° with respect to the valve stem by loosening the retaining fixture. Once the actuator is in place, retighten the retaining fixture.

Note: The cable and cable gland/grommet used, must not compromise the actuator's IP rating. There must be no strain on the connectors. The rubber cable grommet delivered from factory do not compromise the IP rating but do not provide full strain relief according to the LVD directive.
Please observe local rules and regulations.



Firmware update

Get the most out of your NovoCon® digital actuators and keep the firmware up to date with the most recent firmware version, which can be downloaded at www.novocon.com by selecting the tab: Support files.

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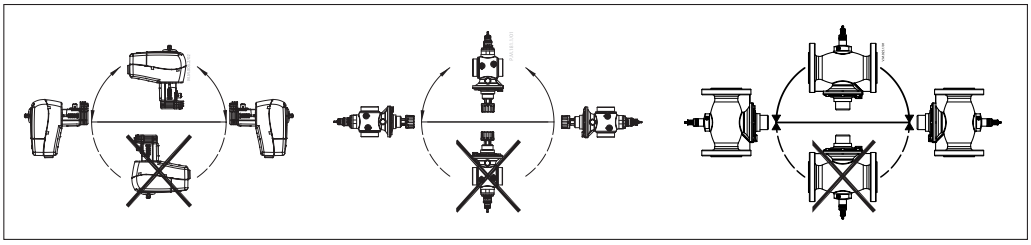
Installation *(continued)*



BACnet data

Type	Description
BACnet device profile	BACnet Application Specific Controller (B-ASC)
BACnet protocol	BACnet Master Slave / Token Passing (MS/TP)
BACnet baud rates supported	Auto baud rate detection* / 9600 bps / 19200 bps / 38400 bps / 56700 bps / 76800 bps / 115200bps

Modbus RTU data

Type	Description
Supported baud rates	Auto baud rate detection* / 9600 bps / 19200 bps / 38400 bps / 56700 bps / 76800 bps / 115200bps
Supported transmission modes	Parity: None (1-8-N-2) / Odd (1-8-O-1) / Even (1-8-E-1) / None (1-8-N-1) / Auto parity* Data format: Parity (Start bit - Data bits - Parity - Stop bits)

** Default*

Dip switches

The DIP switches located under the housing cover are for manual addressing.
The jumper next to the connectors is used for terminal resistor setting.

DIP Switch Settings

BACnet: Auto MAC addressing is default. For manual MAC addressing, use DIP switches
Modbus: Manual MAC addressing is default. Automatic addressing is not available for Modbus. However, if an address has been assigned in BACnet before switching to Modbus, the address will also be used in Modbus if the DIP switches are left in the default positions.

DIP Switch	Configuration name	OFF state (default)	ON state
1. 1 2 3 4 5 6 7 8 R ON OFF	BACnet address / Modbus unit ID bit 0	Logic '0'	Logic '1'
2. 1 2 3 4 5 6 7 8 R ON OFF	BACnet address / Modbus unit ID bit 1	Logic '0'	Logic '1'
3. 1 2 3 4 5 6 7 8 R ON OFF	BACnet address / Modbus unit ID bit 2	Logic '0'	Logic '1'
4. 1 2 3 4 5 6 7 8 R ON OFF	BACnet address / Modbus unit ID bit 3	Logic '0'	Logic '1'
5. 1 2 3 4 5 6 7 8 R ON OFF	BACnet address / Modbus unit ID bit 4	Logic '0'	Logic '1'
6. 1 2 3 4 5 6 7 8 R ON OFF	BACnet address / Modbus unit ID bit 5	Logic '0'	Logic '1'
7. 1 2 3 4 5 6 7 8 R ON OFF	BACnet address / Modbus unit ID bit 6	Logic '0'	Logic '1'
8. 1 2 3 4 5 6 7 8 R ON OFF	-	BACnet MS/TP [2]	Modbus RTU [2]

R. 1 2 3 4 5 6 7 8 R ON OFF	Termination resistor (120Ω)	*No termination*	Termination resistor enabled [1]

[1] The actuator possesses a resistor, located between the connectors, DIP switch no. 9 R on/off, that can be activated in the last actuator on the bus for correct termination of the bus.
[2] When the protocol is changed on DIP switch no. 8, a power cycle is required to make the actuator adopt the newly selected protocol.

DIP Switch Settings - Manual Addressing

BACnet MAC address/Modbus Slave ID is set by DIP switch 1 to 7.
0 = OFF, 1 = ON

DIP switch 1, 2, 3, 4																DIP switch 5,6,7
0000	1000	0100	1100	0010	1010	0110	1110	0001	1001	0101	1101	0011	1011	0111	1111	
0*	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	**000**
16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	**100**
32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	**010**
48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	**110**
64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	**001**
80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	**101**
96	97	98	99	100	101	102	103	104	105	106	107	108	109	110	111	**011**
112	113	114	115	116	117	118	119	120	121	122	123	124	125	126	127*	**111**

** Addresses no. 0 and 127 must not be used.*

Example

Setting MAC address to 37:

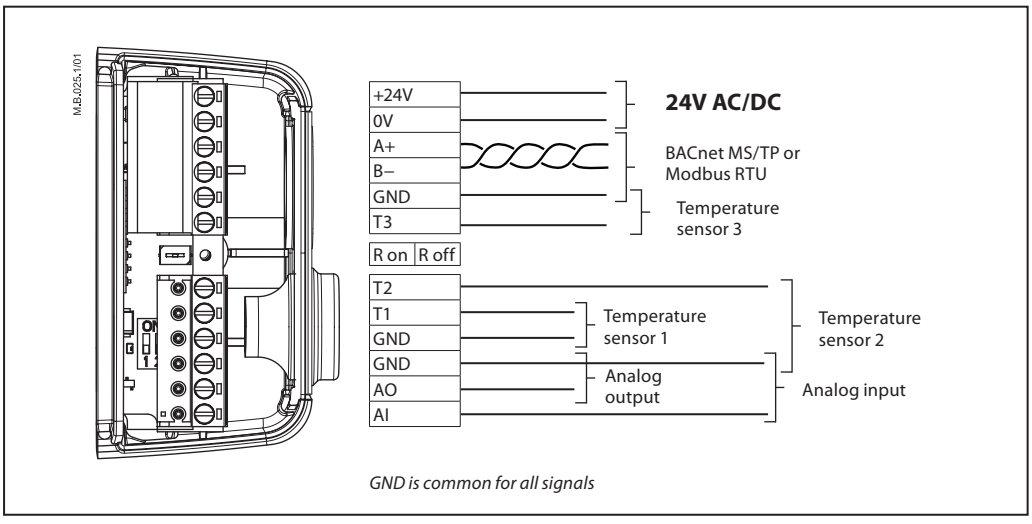
DIP 1	DIP 2	DIP 3	DIP 4	DIP 5	DIP 6	DIP 7
ON	OFF	ON	OFF	OFF	ON	OFF

Wiring

The wiring of BACnet MS/TP or Modbus RTU (RS485) must be carried out in accordance with applicable standard ANSI/TIA/EIA-485-A-1998. Galvanic separation shall be provided for segments crossing buildings. The bus connection 'A+' is the non-inverting signal and 'B-' is the inverting signal wire.

Common ground shall be used for all devices on the same network including routers gateways etc. The recommended cable type is AWG22/0.32 mm^2 twisted pair. If used for longer distances, please use a AWG20/0.5mm^2 or AWG18/0.75 mm^2 cable. The cable's impedance characteristic shall be between 100-130 Ω. The capacitance between conductors shall be less than 100 pf per meter. The length of the cables influence the communication speed. Longer cable lengths should result in lower baud rates. The total maximum cable length allowed per network is 1200 m.

Use a minimum 20 cm separation distance between 110V/230V/400V power line cables and bus cables. NovoCon® M has mis-wiring protection up to 30V AC/DC on all wires but be aware that if 30V AC are connected to the Analog input, the external power supply will see this as a short circuit and blow the fuse in the external power supply.



Danfoss recommends that NovoCon® M should be used on its own sub-network for optimal performance.

General requirements and recommendations:

- Use the termination resistor (between the 2 connectors) at the end of each daisy chain.
- Generally, one power supply is preferred.
- If two power supplies are used, they must have the same polarity and the same common ground.
- A common ground must be used for all devices on the same sub-network, including routers and gateways.
- Galvanic separation shall be provided for segments crossing buildings.
- Total maximum sub-network cable length is 1200m.

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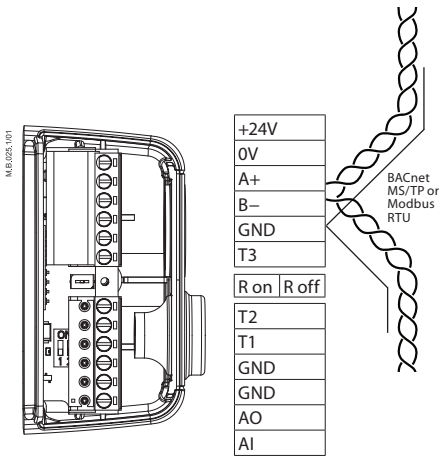
Daisy chain & Power booster

DC Power supply (recommended)
When daisy chaining with 10m AWG20/0,5 mm² twisted pair cable and using a 24V DC power supply, additional voltage boosters/power supply is needed when 12 NovoCons in series is exceeded.

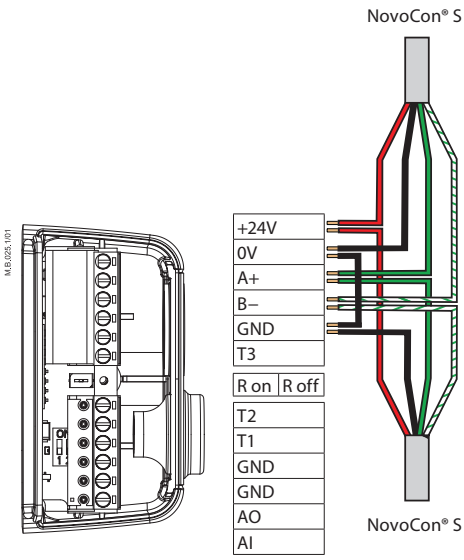
AC Power supply
When daisy chaining with AWG20/0,5 mm² twisted pair cable and using a 24V AC power supply, additional voltage boosters/power supply is needed when 7 NovoCons in series is exceeded.
Important: The power supply used must be able to deliver 60% more power than the nominal rating of NovoCon® M.

Please secure:
- Common ground
- 24VDC power supply is recommended
- In case more 24VAC power supplies are used always separate the 24VAC power supplies if different types of power supplies are used and / or different phases are used.

NovoCon® M in daisy chain



NovoCon® M in daisy chain with NovoCon® S



GND is common for all signals

If the NovoCon® M network is supplied with two or more AC power boosters, caution must be observed when disconnecting one of the transformers from the high voltage power line. As the NovoCons are connected in a daisy chain, there may be high voltage on the primary side of the disconnected power supply. Disconnect always both the primary and secondary side of the transformer.
The power boosters must be protected against overload, otherwise the power booster may be damage if one of the other power boosters in the network is disconnected.

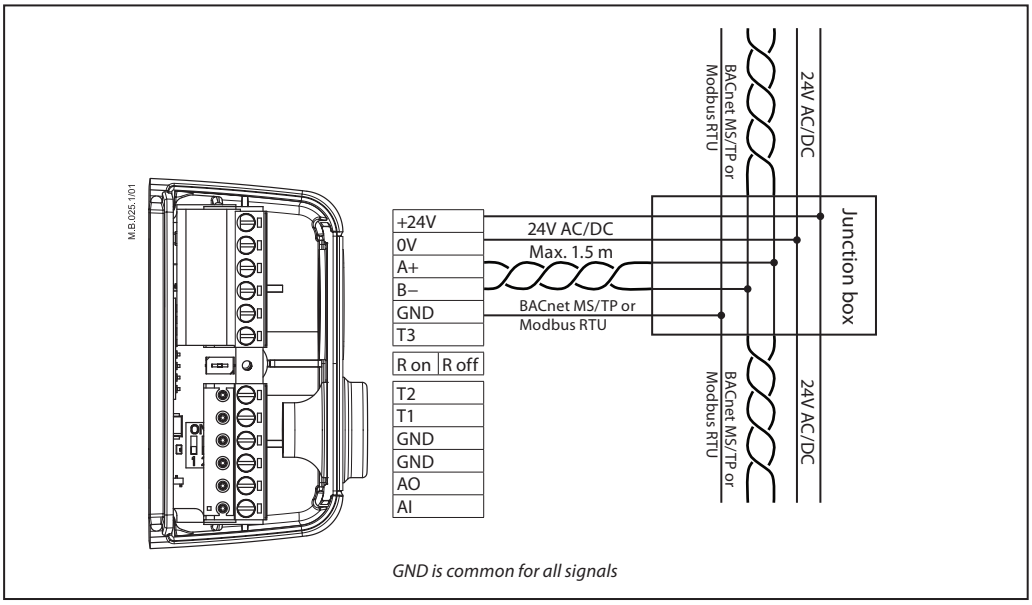
T-junctions

General requirements and recommendations:

T-junction connections (stub lines) :

- max T-junction cable length 1.5m (shortest standard digital cable)
- total length of Network max 640m (+ 100m stub length)
- max baud rate 76 kb/s [1)]
- max number of devices on network 64 [1)]
- main cable should be standard RS485 bus, twisted pair, min thickness AWG22 / 0.32mm2.

[1)] When using less than 32 devices you may attempt to raise the speed to 115 kb/s.



GND is common for all signals

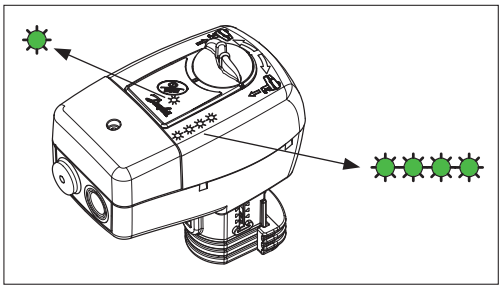
Star topology

Star topology is not according to the RS485 standard and should not be used with NovoCon® M.

LED

Options

- Normal use: LED's shows position and alarms if any.
- Only Alarms: LED's will only light up if alarms are present
- No light: No LED's are ON during normal operation and when alarms are present.



Note: The left LED in the information below is the LED closest to the wire connectors.

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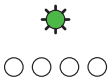
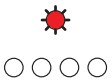
LED Display

BACnet/Modbus (RS485) activity



BACnet/Modbus (RS485) activity
No light from LED: Actuator sees no activity on the network.
LED turn on and off quickly, 10x/second:
Normal operation on the network communication is OK.
LED turn on and off slowly with green light, 3x/second: Normal operation on the network - communication over longer time directly with this actuator.



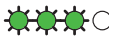
BACnet/Modbus (RS485) activity with ERRORS
LED turns on and off slowly, 3x/second, with RED color: Actuator sees activity, but with errors.
LED turn on and off quickly, 10x/second, with RED color: Communication is OK, EXCEPT that another device may be using the same MAC address.

Position of valve/actuator

AB-QM valve is **fully closed.**

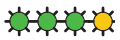
AB-QM is open 1-24% of Design Flow.

AB-QM is open 25-49% of Design Flow.



AB-QM is open 50-74% of Design Flow.

AB-QM is open 75-99% of Design Flow.



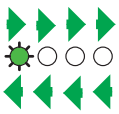
AB-QM valve is **open 100% of Design Flow.**

Flush is active
All LEDs turns on/off with specific period.

Movement of valve/actuator

NovoCon® is closing the valve
All green LEDs are turned ON, then turned OFF one at the time (repeatedly).

NovoCon® is opening the valve
All green LEDs are turned OFF, then turned ON one at the time (repeatedly).

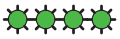
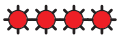


NovoCon® is calibrating
Green light moves forward and backwards, one by one.

De-air is active
Yellow LEDs are turned ON one by one, then turned OFF one by one (repeatedly).

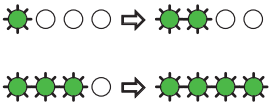
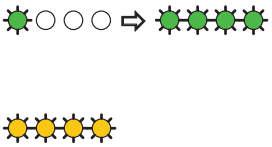
LED Display *(continued)*

Information from actuator

	**Blinking function**, all green LEDs turns on/off. Used to physically identify individual actuator on the bus.
	Error during closing Debris might be trapped under the AB-QM valve cone. Flushing may solve the problem.
	Temperature inside NovoCon® is out of the recommended range LEDs change between showing the alarms and showing normal operation. Ambient temperature has likely exceeded 60°C.
	Internal NovoCon® error LEDs change between showing the alarms and showing normal between operation. Try: A: Re-calibrate. B: Turn power off and on. C: If the error does not disappear actuator replacement can be necessary.
	**Error during NovoCon® calibration** LEDs change between showing the alarms and showing normal operation. Verify if the NovoCon® M is correctly attached to the valve and recalibrate.
	Power supply is outside limits LEDs change between showing the alarms and showing normal operation.
	No Control Signal In analog control mode a broken control wire is detected.

LEDs change between showing the alarms and showing normal operation.

Pressing the reset button during normal operation

	**Calibration/Reset/Flush** Press reset button. All LED's are turned off. Keep pressing the reset button for 1 second: 1 LED ON 2 seconds: 2 LEDs ON = Start calibration (Reset). 3 seconds: 3 LEDs ON 4 seconds: 4 LEDs ON = Start flushing. 5 seconds or more = Return to normal operation.
	**Factory reset - reset to default settings** Press and hold the reset button and then power up the actuator, all LED's are initially turned off. Keep pressing the reset button until 4 LED's are turned on = Reset to default settings. **When factory reset is performed it is shown by:** 1 short flash with all yellow position LED's. Note that after factory reset a calibration will be automatically be performed and all settings are reverted to factory settings.

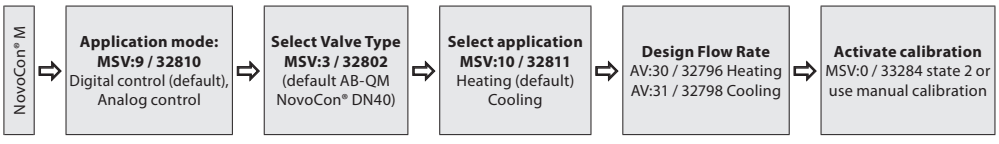
BACnet objects and Modbus registers usage

- Design flow rate setting

General

There are simple BACnet and Modbus settings that are essential to the basic setup configuration of NovoCon® M in order to communicate and control. These are contained in the BACnet objects or in decimal format Modbus registers.

Initial configuration



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BACnet objects and Modbus registers usage

- Advanced configuration and features

If the default setup of the actuator isn't suitable, special attention has to be payed to the following objects:

MSV:9 / 32810	Application mode
MSV:3 / 32802	Selected Valve Type
MSV:10 / 32811	Application command & status
AV:30 / 32796	Design Flow Rate Heating
AV:31 / 32798	Design Flow Rate Cooling
MSV:0 / 33284	Actuator Mode and special features
AI:1 / 33218	Temperature T1 or resistance input
AI:2 / 33220	Temperature T2 or resistance input
AI:3 / 33222	Temperature T3 or resistance input
AV:32 / 33288	Power emission
MSV:13 / 32815	Energy management

Application mode:
The default Application mode is Digital Control. In this mode the NovoCon® M is controlled via fieldbus and the voltage inputs and outputs are available to connect other devices. Alternatively, in Analog Control mode the NovoCon is expecting an analog control signal.

Selection of AB-QM valve type:
After selecting Application mode (see above), it is then necessary to select the AB-QM valve type that the actuator is mounted on. This is done with the object MSV:3 / 32802 Selected Valve Type. The present value of MSV:3 / 32802 may be set to values between 1 and 9. Each number represents a specific AB-QM valve type, which can be found in the table: Valve type selection. The default value for MSV:3 / 32802 is 1 i.e. ABQM ISO DN40 valve.

Selection and setting of engineering units:
If there is a need to change the default engineering units, this is done in BACnet via the object's engineering units property or in separate objects, and in Modbus via separate registers. See the BACnet and Modbus tables for more details.

Setting the Design Flow Rate:
The designed maximum flow rate of the controlled system should be set if the nominal flow of the valve does not correspond to the designed maximum flow rate. The Design Flow Rate is set by changing the present value of:
- MSV:30 / 32796 Design Flow Rate for Heating applications
- MSV:31 / 32798 Design Flow Rate for Cooling applications

Temperature measurements:
AI:1 / 33218 Temperature T1 or resistance input, AI:2 / 33220 Temperature T2 or resistance input and AI:3 / 33222 Temperature T3 or resistance input are used to measure the temperature with temperature sensors. The resistance value may also be shown directly if selected, allowing these inputs to be used for other purposes than measuring temperature e.g. window contacts or other potential free contacts. Closed circuit <900Ω, open circuit 100kΩ.

Power emission:
AV:32 / 33288 Power emission is used to show the present hydronic power emission of the terminal unit, based on calculations from water flow rate and the temperature difference between supply and return pipes.

Energy Counter:
Either the Cooling or Heating hydronic energy used is counted and logged under AV:33 / 33290 or AV:34 / 33292. This function is enabled and disabled with MSV:12 / 32814.

Flushing a system:
Actuator Mode and Special Features MSV:0 / 33284 has an option which allows the user to flush the system via the fieldbus. To start flushing the system, set MSV:0 / 33284 to 3, Flush. The actuator will then open up the AB-QM valve completely. Flush will end when:
- MSV:0 / 33284 is set back to 1 = Normal operation
- Or the power is cycled.
- Or the flush function times-out after 1 hour.

When flushing ends, the actuator returns to normal operation.

De-Airing of a system:
With MSV:0 / 33284, is it also possible to start the De-Air function in the actuator. This function will open and close the AB-QM valve a number times, helping getting rid of trapped air in the hydronic system. Start De-Air by setting MSV:0 / 33284 to 4. De-air will run undisturbed until it ends. The state of the actuator will then go back to normal operation i.e. MSV:0 / 33284 = 1, Normal.

Controlling the actuator:
Under normal operation (Digital Control) of the actuator, where the flow through the AB-QM valve is to be controlled, the object Flow Rate Setpoint AV:1 / 33280 is used. The default setting for the Flow Rate Setpoint engineering unit is %.

This is the most suitable setting as the controller does not need to know anything about the Design Flow Rate setting of the actuator. The output signal from the controller needs only to be set up so it regulates from 0 to 100% of the Heating Design Flow Rate AV:30 / 32796 or Cooling Design Flow Rate AV:31 /32798. Alternative Design Flow Rate AV:0 / 32768 can be used.
To change the flow rate through the valve, the present value of AV:1 / 33280 is written-to, in the range 0 – 100%.

If the engineering unit selected for AV:1 / 33280 must be l/h, the Flow Rate Setpoint through the valve must be written-to in integers representing l/h. An example of this could be a controller writing values to the actuator in the range 0 to 7500 l/h for a DN40 valve.

Alarms and warnings:
System issues can be detected by using BACnet object values BV:10 to BV:24 or Modbus register 33536, see BACnet and Modbus tables for more details.

Optimize BACnet network speed

Reducing Unnecessary PollforMaster Traffic
The MAX_MASTER setting in NovoCon® M can be set above the number of the highest used MAC address in the MS/TP sub network. The MAX_MASTER property is found in the Device object and has a default value of 127. If used, it should be noted that the MAX_MASTER property value should be adjusted accordingly at a later stage prior to adding more devices to the network when the highest MAC address exceeds the MAX_MASTER property value.
Important: Before MAX_MASTER can be set, ensure **ALL** network device MAC addresses are below the intended MAX_MASTER property value. Failure to do this may result in network communication problems.

Allocating Correct INFO_FRAMES
Setting for Controller:
Network Routers and Controller devices that transport traffic in the MS/TP network require a higher number of INFO_FRAMES than NovoCon® M. Therefore, these devices should have a higher value than NovoCon® M. A general rule of thumb for the sub network router's MAX_INFO_FRAMES property value is equal to the amount of MS/TP devices in the router's sub network. The MAX_INFO_FRAMES property is found in the Device object of MS/TP devices. NovoCon's default MAX_INFO_FRAMES value is 1.

Energy management MSV:13 / 32815

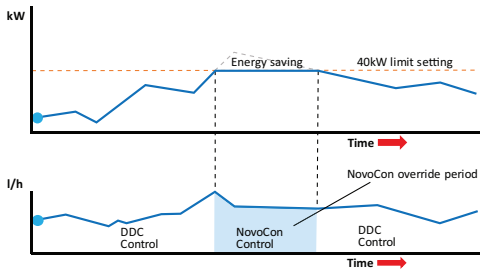
General Information - Energy Limitation States:
For all 'limitation' states within MSV:13/32815, a warning will be activated and made visible on the bus to inform the user that NovoCon® has taken control of the flow rate through the AB-QM valve. Whilst under NovoCon® control, the valve will not be closed at any time i.e. closing % constraints are contained within its algorithms, although an external device's control signal will always be able to close the valve. If the energy limitation settings are unobtainable without NovoCon® closing itself, a warning will be activated to inform the user that the set-point value is 'out of range'. Please note that NovoCon® will not automatically relinquish control of the flow rate as soon as the set-point is achieved if the external device e.g. DDC differs greatly with that of NovoCon's® calculated flow rate/ opening %. TIP: This information may be used by the user to improve the external control device's PID.

General Information - Energy Control States:
For all 'control' states, except Power control, within MSV:13/32815, NovoCon® takes full control over the flow rate through the AB-QM valve and will not accept a control signal from an external device. Whilst under NovoCon® control, the valve will not be fully closed at any time i.e. closing % constraints are contained within its algorithms. If the energy control settings are unobtainable without NovoCon® closing or opening itself fully, a warning will be activated to inform the user that the set-point value is 'out of range'.

Power Manager

State 1: Not active
Energy management applications are disabled.

State 2: Power limitation (chilled water example)
NovoCon® M calculates the instantaneous hydronic power used and will then, when required, override the DDC control signal and limit the flow rate / hydronic power according to the user defined values in object / register AV:35 or 36 / 32832 or 32834. The hydronic power is limited by closing the valve until the kW value measured, once again, falls below the defined limit. There are user defined limits for both Cooling Power and Heating Power. When this limitation is active, the warning object BV:23 / bit 23 in register 33536 will be set to 'on'.
Application example: When the "Power" is limited in this way we are able to prevent over consumption (during peak load) and save energy.



Object/ Register	Write/read value	Description
MSV:9 / 32810	Digital	NovoCon/AB-QM opening degree command via BUS
MSV:3 / 32802	Selected Valve Type	ISO valve selected = l/h, °C , kW and kg/m^3. ANSI valve selected = g/min, °F and kBTU.
AV:31 / 32798	7500	Design flow setting of Cooling e.g. 7500 l/h
MSV:13 / 32815	Power Limitation	The Cooling max hydronic power value that NovoCon will not exceed e.g. 40kW
AV:36 / 32834	Cooling max. power value	The value that NovoCon will ensure the calculated emission will not exceed e.g. 40kW
AV:46 / 32862	10%	Energy management minimum valve opening in percentage of Design flow Rate.

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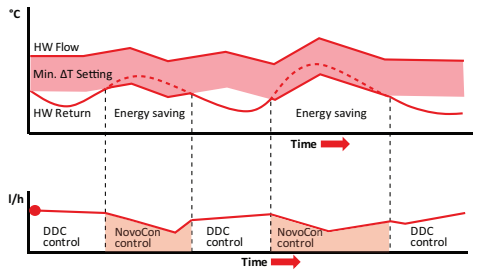
Energy management
MSV:13 / 32815 *(continued)*

Power Manager

State 3: Power control
Power emission is controlled directly in kW, kBTU or % and not l/hr / GPM. The flowrate through the valve is controlled by the Flow Rate setpoint AV:1 in kW or kBTU/h (selected in MSV:21 / 32788) and is based on the flowrate and temperature inputs which are used to calculate the power consumption.
Application example: Tempering a space (e.g. in storage hall).

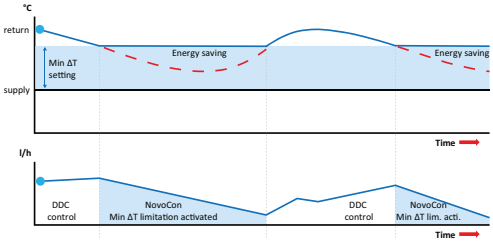
Delta T Manager

State 4: Min. Delta T limitation (heating water example)
NovoCon® M, when required, overrides the DDC control signal and maintains a minimum temperature difference between the flow and return temperatures by starting to close the valve when the user defined minimum delta T is not achieved. As the flow temperature increases/decreases, so will the calculated minimum set-point for the return temperature. This always ensures a minimum energy transfer to the Terminal Unit irrespective of the flow temperature.
For heating, the delta T value is set in object / register AV:37 / 32836. When conditions allow for this limitation to be activated, the warning object BV:23 / bit 23 in register 33536 will be set to 'on'.
Application example: When we would like to improve the efficiency of boiler/chiller we can define the Minimum Delta T in the system with respect to outside temperatures.



Object/ Register	Write/ read value	Description
MSV:9 / 32810	Digital	NovoCon/AB-QM opening degree command via BUS
MSV:3 / 32802	Selected Valve Type	ISO valve selected = l/h, °C and kW. ANSI valve selected = GPM, °F and kBTU.
MSV:10 / 32811	Heating	Any control algorithms used are with AI:1>AI:2 in mind
AV:30 / 32796	7500	Design flow setting of Heating e.g. 7500 l/h
MSV:13 / 32815	Min. Delta T limitation	Constantly ensures the flow and return temperature difference do not fall below a specified value
AV:37 / 32836	Heating Delta T value	The delta T value that NovoCon will not fall below e.g. 20°C
AV:46 / 32862	10%	Energy management minimum valve opening in percentage of Design flow Rate.

State 4: Min. Delta T limitation (Chilled water example)
Application example: When we would like to improve the efficiency in the system we can define the Minimum Delta T in the terminal units.

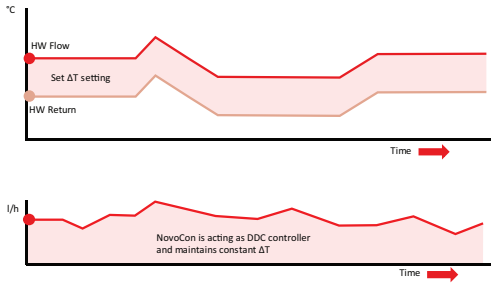


Object/ Register	Write/read value	Description
MSV:9 / 32810	Digital	NovoCon/AB-QM opening degree command via BUS
MSV:3 / 32802	Selected Valve Type	ISO valve selected = l/h, °C , kW and kg/m^3. ANSI valve selected = g/min, °F, kBTU and lb/ft3
MSV:10 / 32811	Cooling	Any control algorithms used are with AI:1<AI:2 in mind
AV:31 / 32798	7500	Design flow setting of Cooling e.g. 7500 l/h
MSV:13 / 32815	Min. delta T limitation	Constantly ensures the flow and return temperature difference do not fall below a specified value
AV:38 / 32838	Cooling Delta T value	The delta T value over the terminal unit will not fall below e.g. 5°C
AV:46 / 32862	10%	Energy management minimum valve opening in percentage of Design flow Rate.

Energy management
MSV:13 / 32815 *(continued)*

State 5: Set Delta T control (heating water example)

NovoCon® M maintains a constant temperature difference between the flow and return temperatures by opening and closing the valve. When the flow temperature increases/decreases, so will the calculated delta T set-point for the return temperature. This always ensures a constant delta T across the terminal unit irrespective of the flow temperature.
The constant delta T for Heating is set in object / register AV:37 / 32836 and for Cooling AV:38 / 32838.
Application example: Tempering a space (e.g. in storage hall) where we can set and keep a constant Delta T. Preheat coil on an AHU.

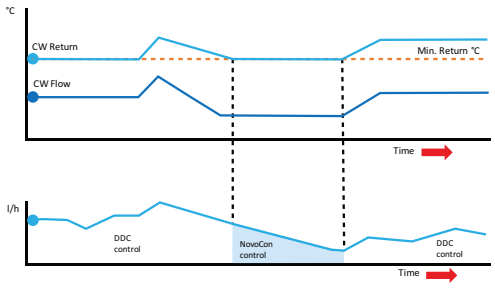


Object/ Register	Write/read value	Description
MSV:9 / 32810	Digital	NovoCon/AB-QM opening degree command via BUS
MSV:3 / 32802	Selected Valve Type	ISO valve selected = l/h, °C and kW. ANSI valve selected = GPM, °F and kBTU.
MSV:10 / 32811	Heating	Any control algorithms used are with AI:1>AI:2 in mind
AV:30 / 32796	7500	Design flow setting of Heating e.g. 7500 l/h
MSV:13 / 32815	Set Delta T control	Constantly ensures the flow and return temperature difference do not deviate from a specified value
AV:37 / 32836	Heating Delta T value	The delta T value that NovoCon will use as setpoint e.g. 10°C
AV:46 / 32862	10%	Energy management minimum valve opening in percentage of Design flow Rate.

When this limitation is active, the warning object BV:23 / bit 23 in register 33536 will be set to 'on'.

State 6: Return T limitation (chilled water example)

NovoCon® M ensures the min. return temp. which is set in register / object AV:40 / 32842.
This function will mainly be used for a Cooling application where the return temperature is higher than the flow temperature. NovoCon® M overrides the DDC control signal when activated and maintains a minimum return temperature by starting to close the valve when the user defined minimum return temperature is not achieved. When conditions allow for this limitation to be active, the warning object BV:23 / bit 23 in register 33536 will be set to 'on'.
Application example:
To improve chiller efficiency and ensure proper flow temperature for cooling systems, we can prescribe minimum return temperature to avoid COP reduction as well as low Delta T syndrome.



Object/ Register	Write/read value	Description
MSV:9 / 32810	Digital	NovoCon/AB-QM opening degree command via BUS
MSV:3 / 32802	Selected Valve Type	ISO valve selected = l/h, °C and kW. ANSI valve selected = GPM, °F and kBTU.
MSV:10 / 32811	Cooling	Any control algorithms used are with AI:1<AI:2 in mind
AV:31 / 32798	7500	Design flow setting of Cooling e.g. 7500 l/h
MSV:13 / 32815	Return T limitation	Ensures the return temperature does not fall below a specified value
AV:40 / 32842	Cooling T2 value	The value that NovoCon will ensure T2 will not fall below e.g. 13°C
AV:46 / 32862	10%	Energy management minimum valve opening in percentage of Design flow Rate.

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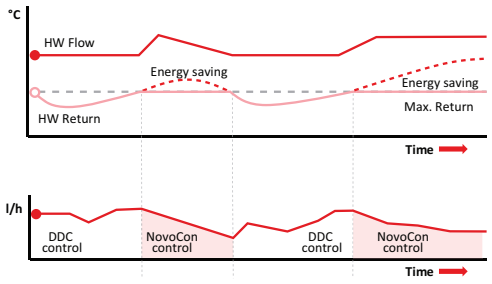
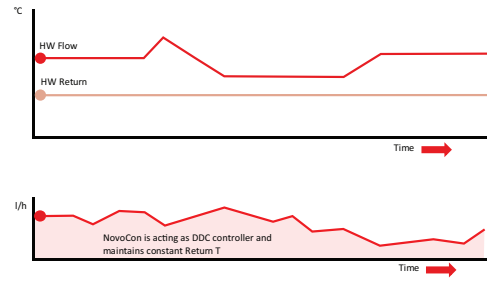
Energy management
MSV:13 / 32815 *(continued)*

State 6: Return T limitation (heating water example)
NovoCon® M ensures the max. return temp. set in register / object AV:39 / 32840.
This function will mainly be used for a Heating application where the return temperature is lower than the flow temperature. NovoCon® M overrides the DDC control signal when activated and maintains a maximum return temperature by starting to close the valve when the user defined maximum return temperature is not achieved. When conditions allow for this limitation to be active, the warning object BV:23 / bit 23 in register 33536 will be set to 'on' .
Application example: Heating systems that require a maximum return temperature for efficient heat source generation e.g. condensing boilers and heat pumps.



Object/ Register	Write/read value	Description
MSV:9 / 32810	Digital	NovoCon/AB-QM opening degree command via BUS
MSV:3 / 32802	Selected Valve Type	ISO valve selected = l/h, °C and kW. ANSI valve selected = GPM, °F and kBTU.
MSV:10 / 32811	Heating	Any control algorithms used are with AI:1>AI:2 in mind
AV:30 / 32796	7500	Design flow setting of Heating e.g. 7500 l/h
MSV:13 / 32815	Return T limitation	Ensures the return temperature does not rise above a specified value
AV:39 / 32840	Heating T2 value	The value that NovoCon will ensure T2 will not rise above e.g. 60°C
AV:46 / 32862	10%	Energy management minimum valve opening in percentage of Design flow Rate.

State 7: Set Return T control (heating water example)
A constant return temperature T2 value is set in object / register AV:37 / 32836 and/or AV:38 / 32838.
NovoCon® M constantly maintains a constant return temperature by opening and starting to close the valve when the user defined Return T is exceeded or not achieved. When the flow temperature increases/decreases, the Return T set-point remains the same. This will ensure a constant return temperature back to the energy source.
Application example: When we intend to use the return water for secondary usage e.g. pre-heat on a AHU or a standalone terminal unit in which the T2 value is used as the temperature set-point to be maintained.



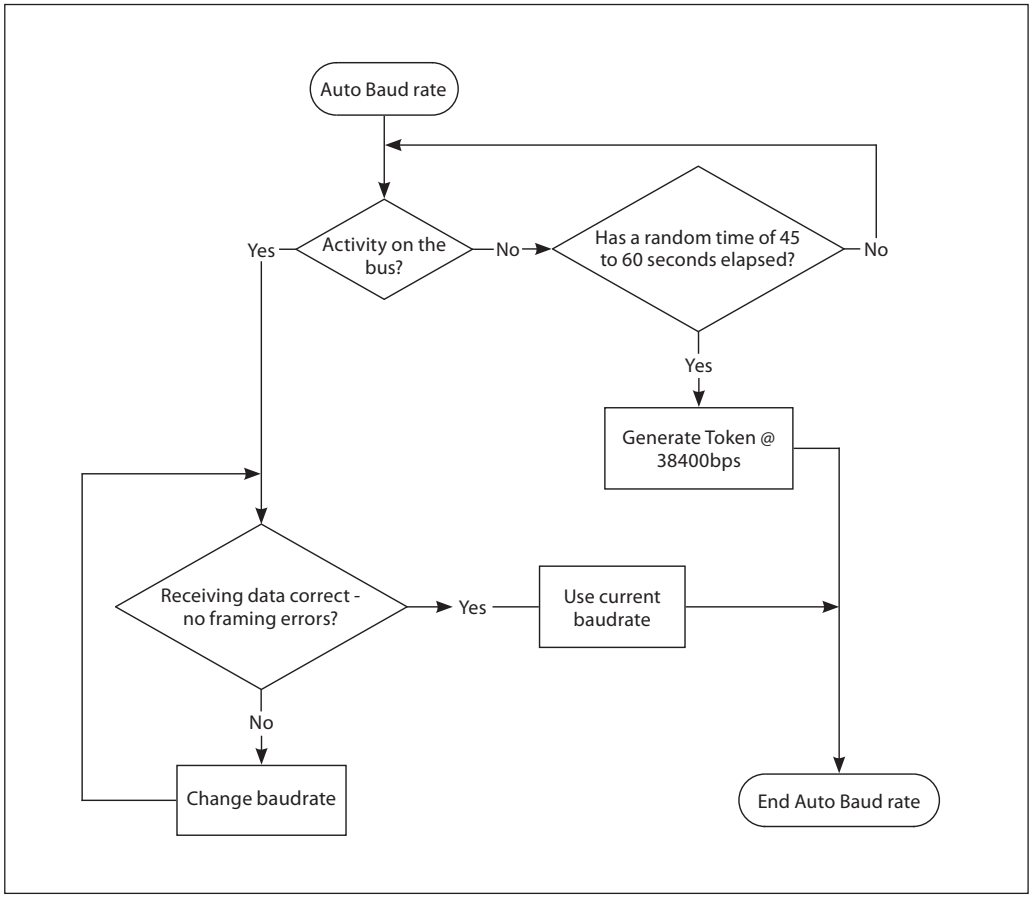
Object/ Register	Write/read value	Description
MSV:9 / 32810	Digital	NovoCon/AB-QM opening degree command via BUS
MSV:3 / 32802	Selected Valve Type	ISO valve selected = l/h, °C and kW. ANSI valve selected = GPM, °F and kBTU.
MSV:10 / 32811	Heating	Any control algorithms used are with AI:1>AI:2 in mind
AV:30 / 32796	7500	Design flow setting of Heating e.g. 7500 l/h
MSV:13 / 32815	Set Return T control	Constantly ensures the return temperature does not deviate from a specified value
AV:37 / 32836	Heating T2 value	The return T value that NovoCon will use as setpoint e.g. 40°C
AV:46 / 32862	10%	Energy management minimum valve opening in percentage of Design flow Rate.

Auto baud rate

NovoCon® M should be connected after, or at the same time as, other BACnet devices. NovoCon® M will then adapt to it's network's baud rate automatically.

Baud rate MSV:6 / 32804 must be set to 1 (default).

If the NovoCon® M observes activity on the bus within 45 seconds after powering up, then it adopts the baud rate presently used on the network by other BACnet devices. If the actuator does not see activity on the network within this time, it generates a token and sends the token out at the default baud rate of 38400bps.



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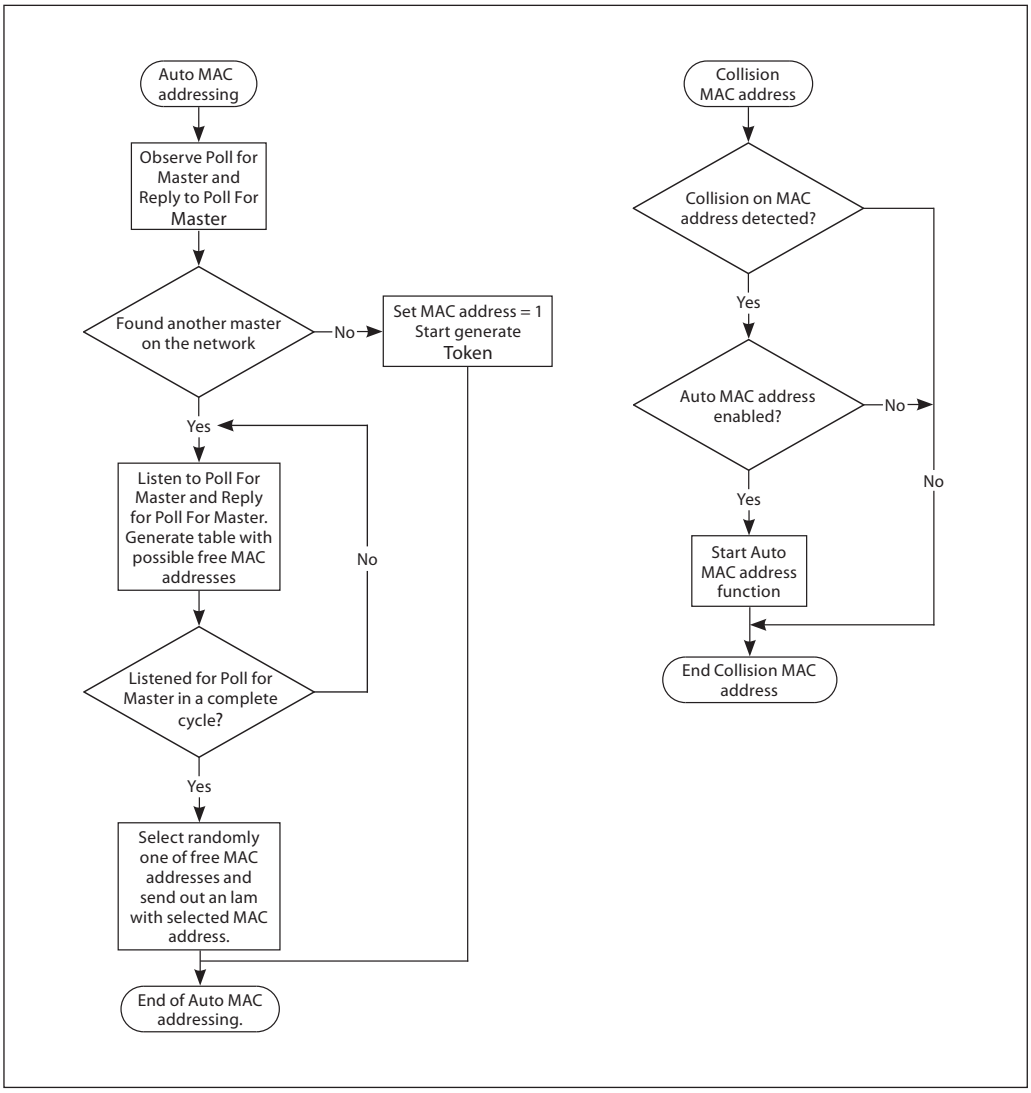
Auto MAC Addressing - BACnet only

MAC address assignment method MSV:5 must be set to 1 (default).
The NovoCon® M actuator observes for occupied MAC addresses on the sub-network and then automatically assigns an available MAC address to the actuator only on first Power up. Assuming the address has not already been manually selected by DIP Switches. If a MAC address collision arises an Auto MAC addressing is enabled. This function will start the search for an available MAC address again. When an available MAC address is found, an "I-Am" notification will be sent out via BACnet.
Please note that consecutive MAC addresses may not always be assigned.



BACnet Objects - Analog Value

Ident	Object / Parameter name	Unit	Read/ Write	Min	Max	Default	Resolution	Description	Persistent Yes/No
AV:0	**Design Flow Rate**	98: % 136: L/h 89: GPM	R/W	Recommended 40% of nominal flow	Setting Range Maximum from Valve table	Nominal value from the Valve table in L/h	0.1	Recommended to use AV:30 for Heating and/or AV:31 for cooling. Pre-set value for the Design Flow Rate when control signal is at 100%. Units can be changed via the object's engineering units property and/or MSV:20. The units L/h (ISO valves) or GPM (ANSI valves) comes from the object MSV:3 Selected Valve type.	Yes
AV:1	**Flow Rate Setpoint**	98: % 136: L/h 89: GPM 48: kW 157: kBTU/h	R/W	0	100% or Design Flow value	100%	0.01	The Flow Rate Setpoint (max. flow rate) through the AB-QM valve. Units can be changed via the object's engineering units property and/or MSV: 21. In case the Energy management functions are active the Flow Rate Setpoint will follow the actual setting controlled by the Energy Management function. NOTE: For kW or kBTU/h to become active, MSV:13 Power Controller (state:3) must be chosen.	No
AV:2	**Flow Rate feedback**	%, L/h, GPM	R	0	If L/h (GPM) is selected then the valve flow rate is set to the selected valve's (MSV:3) maximum value. Otherwise 100%	L/h or GPM depending on the selected valve	0.001	Flow rate indication based on the position of the Actuator stem. Units can be changed via the object's engineering units property and/or MSV:22. This object is supported by COV.	No
AV:3	Control Fallback Time	72: Minutes	R/W	0	60	10	1	Time before actuator reacts to a missing analog control signal. i.e. when MSV:9=1 Analog control and not receiving an analog control signal.	Yes
AV:4	Alpha Value	95: No units	R/W	0.05	1.0	1.0	0.01	Value used for shaping the curve in Manual Defined Function (MDF) mode to fit the characteristic curve of a heat exchanger. Linear setting: MDF=1. See curve below table. If AV:1 is in L/h in Digital mode, the alpha setting is ignored. See Alpha value diagram.	Yes
AV:5	Valve closing or opening time	73: Seconds	R/W	30	700	na	1	The time the actuator needs to move from 0% to 100% of Design Flow Rate. Use with MSV:4.	Yes
AV:6	Rectified voltage measured by the actuator	Volts	R	12	50	na	0.01	Not used	No
AV:7	MAC Address	95: No units	R/W	1	126	na	1	MAC Address used for BACnet communication.	Yes
AV:8	Temperature in the Actuator	°C, °F	R	-20	100	°C	0.5	Temperature measured inside the actuator. Units can be changed via the object's engineering units property.	No
AV:9	Total Operating Hours	Hours	R	0	MAX	na	1	Total Operating Hours of the actuator.	Yes
AV:10	Minutes since last power-up	Minutes	R	0	MAX	na	1	Minutes since the last power-up of the actuator.	No
AV:11	Minutes since last calibration	Minutes	R	0	MAX	na	1	Minutes since the last time the actuator was calibrated to an AB-QM valve.	Yes
AV:12	Minutes since fully closed	Minutes	R	0	MAX	na	1	Minutes since the last time the AB-QM valve was fully closed.	Yes
AV:13	Minutes Since fully Opened	Minutes	R	0	MAX	na	1	Minutes since the last time the AB-QM valve was fully opened.	Yes
AV:14	Lifetime estimate	na	R	0	MAX	na	0.01	Calculated percentage of expended lifetime. At 100% the valve and actuator have reached the estimated minimum lifetime. Replacement of valve and actuator is recommended.	Yes
AV:15	Server Message Count	na	R	0	MAX	na	1	Server Message Count	No
AV:16	Server Message Received	na	R	0	MAX	na	1	Server Message Received	No
AV:17	Server Error Count	na	R	0	MAX	na	1	Server Error Count	No
AV:18	Server Message sent	na	R	0	MAX	na	1	Server Message sent	No
AV:19	Server Timeout Error	na	R	0	MAX	na	1	Server Timeout Error	No
AV:20	Serial Number of the actuator	na	R	na	na	na	1	Description of this object holds the serial number of the actuator - programmed at the time of production.	na
AV:21	The name of the Selected valve is shown here	L/h or GPM, Unit type comes from MSV:3 Selected Valve Type	R	na	na	na	1	Nominal flow of the selected AB-QM valve is shown in the present value	na
AV:22	Valve position at nominal flow	Millimetre	R	na	na	na	1	Position in mm for nominal flow of the selected AB-QM valve.	na
AV:23	Maximum value for the Design Flow Rate	%	R	na	Setting Range Maximum from Valve table	%	1	Maximum level the Design Flow Rate can be increased to for the selected AB-QM valve.	na
AV:24	The name of the User Defined Valve is shown here	136: L/h or 89: GPM. Unit type written here is copied to the Valve Table. Default: L/h	R/W	1	90000	7500	0.1	Name and Nominal Flow for the User Defined Valve. This Object is used only if NovoCon® is not used with an AB-QM valve. Plase contact your Danfoss representative to verify if the desired connection is possible.	Yes
AV:25	Valve position at nominal flow for User Defined Valve	30: Millimetre	R/W	5	20	10	0.01	Position in mm for nominal flow of the User Defined Valve. This Object is used only if NovoCon® M is not used with an AB-QM valve. Please contact your Danfoss representative to verify if the desired connection is possible.	Yes
AV:26	Maximum value for the Design Flow in the User Defined Valve	98: %	R/W	100	150	120	1	Maximum level the Design Flow can be increased to for the User Defined Valve. This Object is used normally only if NovoCon® M is not used with an AB-QM valve. Please contact your Danfoss representative to verify if the desired connection is possible.	Yes
AV:27	Alarm summary count	95: No units	R	na	na	0	na	Numerical overview about pending errors detected. Coding for AV:27 Alarm summary count is: If BV:10 is active then AV:27 is 1.0. If BV:11 is active then AV:27 is 2.0. If BV:12 is active then AV:27 is 4.0. If BV:13 is active then AV:27 is 8.0. If BV:14 is active then AV:27 is 16.0. If BV:15 is active then AV:27 is 32.0. If BV:16 is active then AV:27 is 64.0. If BV:17 is active then AV:27 is 128.0. If BV:18 is active then AV:27 is 256.0. If BV:19 is active then AV:27 is 512.0. If BV:20 is active then AV:27 is 1024.0. If BV:21 is active then AV:27 is 2048.0. If BV:22 is active then AV:27 is 4096.0. If BV:23 is active then AV:27 is 8192.0. If BV:24 is active then AV:27 is 16384.0. e.g. if both BV:11 & BV:12 are active then AV:27 is 6.0. This object is supported by COV.	No
AV:30	Heating Design Flow Rate	98: % 136: L/h 89: GPM	R/W	Recommended 40% of nominal flow	Setting Range Maximum from Valve table	Nominal value from the Valve table in L/h	0.1	Pre-set value for the Design Flow Rate in heating mode, when the control signal is at 100%. MSV:10 must be set to Heating. The units L/h (ISO valves) or GPM (ANSI valves) comes from the object MSV:3 Selected Valve type.	Yes
AV:31	Cooling Design Flow Rate	98: % 136: L/h 89: GPM	R/W	Recommended 40% of nominal flow	Setting Range Maximum from Valve table	Nominal value from the Valve table in L/h	0.1	Pre-set value for the Design Flow Rate in cooling mode, when the control signal is at 100%. MSV:10 must be set to Cooling. The units L/h (ISO valves) or GPM (ANSI valves) comes from the object MSV:3 Selected Valve type.	Yes
AV:32	**Power emission**	48: kW 157: kBTU/h	R	0	na	na	0.01	The hydronic power emission of the terminal unit, based on calculations from water flow rate and the temperature difference between supply (AI:1) and return (AI:2) pipes. If AV:41 Glycol correction is used, Power emission will be adjusted accordingly. Units can be changed via the object's engineering units property.	No

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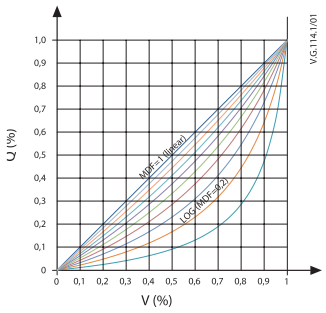
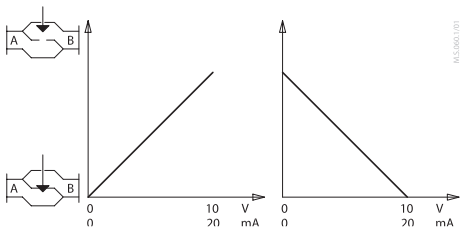
BACnet Objects - Analog Value *(continued)*

Ident	Object / Parameter name	Unit	Read/ Write	Min	Max	Default	Description	Information	Persistent Yes/No
AV:33	Heating Energy counter	19: kWh 126: MJ 147: kBTU	R/W	0	na	na	Accumulative Energy counter for heating.	Activated/Deactivated via MSV:12. Units set via MSV:27. MSV:10 must be set to Heating If AV:41 Glycol correction is used, Heating Energy counter will be adjusted accordingly.	Yes
AV:34	Cooling Energy counter	19: kWh 126: MJ 147: kBTU	R/W	0	na	na	Accumulative Energy counter for cooling.	Activated/Deactivated via MSV:12. Units set via MSV:27. MSV:10 must be set to Cooling If AV:41 Glycol correction is used, Cooling Energy counter will be adjusted accordingly.	Yes
AV:35	Heating max. Power	48: kW 157: kBTU/h	R/W	0	na	0	Pre-set value for the design flow rate, in heating mode.	When using MSV:13 state Power limiter this is the maximum allowed hydronic energy output. This value is intended to limit the heating power through the terminal unit.	Yes
AV:36	Cooling max. power	48: kW 157: kBTU/h	R/W	0	na	0	Pre-set value for the design flow rate, in cooling mode.	When using MSV:13 state Power limiter this is the maximum allowed hydronic energy output. This value is intended to limit the cooling power through the terminal unit.	Yes
AV:37	Heating Delta T	62: °C 64 °F	R/W	na	na	15	Set-point value for the temperature difference between the flow and return pipes	For MSV:13 state Min. delta T management and Set Delta T control, this is the value the control is based on for heating.	Yes
AV:38	Cooling Delta T	62: °C 64 °F	R/W	na	na	5	Set-point value for the temperature difference between the flow and return pipes	For MSV:13 state Min. delta T management and Set Delta T control, this is the value the control is based on for cooling.	Yes
AV:39	Heating T2	62: °C 64 °F	R/W	na	na	35	Set-point value for Heating T2 (Heating return pipe temperature)	For MSV:13 state Max. Return T management and Set return T control, this is the value the control is based on for heating.	Yes
AV:40	Cooling T2	62: °C 64 °F	R/W	na	na	13	Set-point value for Cooling T2 (Cooling return pipe temperature)	For MSV:13 state Min. Return T management and Set return T control, this is the value the control is based on for cooling.	Yes
AV:41	Glycol Factor	na	R/W	0.5	2	1	Glycol correction factor	Select appropriate factor from 0.5-2 if a glycol mixture is used.	Yes
AV:42	Position feedback	98: %	R	0	100	na	Position of the Actuator stem in percentage	Flow rate indication in percentage based on the position of the Actuator stem.	No
AV:46	Energy management min flow	98: %	R/W	0	100	10	Energy management minimum flow in percentage of AV:30 or AV:31 Design flow rate.	Minimum allowed flow while the Energy management function MSV:13 is active. Exceptions, the object has no effect if: The energy limitation is inactive or the Power control energy mgmt. function is selected. In this case, the min. flow limit is set to 2% of the Design flow rate.	Yes
AV:47	Control-Gain P	95: No units	R/W	na	na	7	Set proportional part for control	Sets the proportional part for control of the object MSV:13 Energy Management functions.	Yes
AV:48	Control-Gain I	95: No units	R/W	na	na	0.35	Set integral part for control	Sets the integral part for control of the object MSV:13 Energy management functions. I parameter in sec. = (Pgain / Igain) * 2 sec. Default: 7/0.35 * 2sec. = 40 sec.	Yes

AV:4 / 32772 Alpha Value Curve



BV:2 / 32786 Direct or Inverse operation mode



BACnet Objects - Multi State Value

Ident	Object / Parameter name	Read/ Write	State Text	Default State	Description	Persistent Yes/No
MSV:0	**Actuator Mode and special features**	R/W	1: Normal 2: Calibration 3: Flush [1] 4: De-Air [2] 5: Alarm	1: Normal	Shows present mode of actuator. Calibration, flushing and de-air may be started from here.	Yes, except state 3,4 & 5
MSV:1	Analog Control signal type and range	R/W	1: 0-5 VDC 2: 0-10 VDC 3: 2-10 VDC 4: 5-10 VDC 5: 2-6 VDC 6: 6-10 VDC 7: 0-20 mA 8: 4-20 mA	2: 0-10 VDC	Used to select the analog control signal input type and range.	Yes
MSV:2	Missing Control Signal Fallback Action	R/W	1: No action 2: CLOSE 3: OPEN 4: 50% of Design Flow	1: No action	The action that the actuator will commence upon a missing analog control signal when MSV:9=1.	Yes
MSV:3	**Selected Valve Type**	R/W	See table "Valve Type Selection"	4: AB-QM DN 40	This is the AB-QM valve type that the actuator is set-up to control.	Yes
MSV:4	Actuator Speed	R/W	1: 3 sec/mm 2: 6 sec/mm 3: 12 sec/mm 4: 24 sec/mm 5: Constant Time	3: 12 sec/mm	The amount of time the actuator takes to move 1mm or alternatively, a specified constant time function (see AV:5). The Constant Time value range is 18-700 seconds.	Yes
MSV:5	MAC Address assignment method	R/W	1: DIP Switch Settings or Auto Addressing 2: User configuration over BACnet or Auto Addressing	1: DIP Switch Settings or Auto Addressing	Method used to set the BACnet MAC address. If the MAC address is not set by DIP Switch, the actuator will automatically assign itself an available MAC address.	Yes
MSV:6	Baud Rate	R/W	1: Auto Baud Rate Detection 2: 9600 bps 3: 19200 bps 4: 38400 bps 5: 57600 bps 6: 76800 bps 7: 115200 bps	1: Auto Baud Rate Detection	Baud Rate used for BACnet communication.	Yes
MSV:7	LED Control	R/W	1: Normal LED mode 2: Show alarms only 3: All LED's OFF 4: Blink	1: Normal LED mode	Used to select the LED display required.	Yes
MSV:8	Select fieldbus protocol	R/W	1: DIP switch 2: BACnet 3: Modbus	1: DIP switch	Selection of fieldbus protocol. See also the DIP Switch Settings section of the data sheet. When the protocol is changed, a power cycle is required to make the actuator adopt the newly selected protocol.	Yes

[1] Opens the valve fully for one hour or until a new state is selected
[2] Opens and closes the valve 5 times at maximum speed

BACnet Objects - Multi State Value *(continued)*

Ident	Object / Parameter name	Read/ Write	State Textw	Default State	Description	Persistent Yes/No
MSV:9	**Application mode**	R/W	1: Analog control 2: Digital control	2: Digital control	Select the actuator application mode. **State 1:** Analog Control. Flow is controlled with an analog signal e.g. 0-10V. Design Flow Rate set via AV:30 Heating or AV:31 Cooling. Alternative AV:0 can be used. **State 2:** Digital Control. AV:1 is used to control the flow. Design Flow Rate set via AV:30 Heating or AV:31 Cooling. Alternative AV:0 can be used.	Yes
MSV:10	Application	R/W	1: Heating 2: Cooling	1: Heating	Select if the application is Heating or Cooling. All temperature sensor related kW/h readings and energy functions are affected by this choice.	Yes
MSV:12	Energy counter activation	R/W	1: Off 2: On	1: Off	Enable or disable energy counter	Yes
MSV:13	Energy management	R/W	1: Not active **Power Manager:** 2: Power limitation 3: Power control **Delta T Manager:** 4: Min. Delta T limitation 5: Set Delta T Control 6: Return T limitation 7: Set Return T control	1: Not active	Activate functions to optimise system performance. The calculated flow from the activated energy functions is limited to AV:46 Energy management min flow, except the function Power control that has a limitation at min. 2% of the Design Flow Rate. If needed the PI values can be fine tuned in objects AV:47 and AV:48. **State 1:** Not active **State 2:** If power is above the set value in AV:35/36, NovoCon will regulate to the specified limit AV:35 and/or AV:36. When this limitation is active, the warning BV:23 will be set to 'on'. Sensors T1 and T2 used. **State 3:** The flowrate through the valve is controlled by AV:1 in %, kW or kBTU/h (selected in MSV:26) and is based on the flowrate and temperature inputs. Sensors T1 and T2 used. **State 4:** If delta T value in AV:37 and/or AV:38 is exceeded, NovoCon will begin to close the valve until the AV:37 and/or AV:38 values are reached. When this limitation is active, the warning BV:23 will be set to 'on'. Sensors T1 and T2 used. **State 5:** The constant delta T is set in AV:37 and/or AV:38 and NovoCon will regulate within these limits. When this control is active, the warning BV:23 will be set to 'on'. Sensors T1 and T2 used. **State 6:** NovoCon ensures the min. or max. return temp. T2 set in AV:39 & AV:40. In MSV:10 / 32811 Heating/cooling application must be selected. When this limitation is active, the warning BV:23 will be set to 'on'. **State 7:** A constant T2 value is set in AV:39 and/or AV:40. NovoCon will regulate to maintain these values constant.	Yes
MSV:14	Temperature Sensor type	R/W	1: NTC10k Type 2 2: NTC10k Type 3 3: PT1000 4: PT500 5: PT100	3: PT1000	Select the type of Temperature sensor connected.	Yes
MSV:20	Units used to set Design Flow Rate	R/W	1: L/h 2: % 3: GPM	1: L/h	Engineering Units used for the Design Flow AV:0, AV:30 and AV:31	Yes
MSV:21	Units used to set Flow Rate Setpoint	R/W	1: L/h 2: % 3: GPM 4: kW 5: kBTU/h	2: %	Engineering Units used for the desired Flow AV:1. NOTE: If kW or kBTU/h chosen then MSV:13 Power Controller (state:3) also becomes active	Yes
MSV:22	Units used to set Actual Flow feedback	R/W	1: L/h 2: % 3: GPM	1: L/h	Engineering Units used for AV:2	Yes
MSV:23	Units used to set Temperature	R/W	1: °C 2: °F	1: °C	Engineering Units used for AV:8, AV:37-40	Yes
MSV:24	Units used to set T1	R/W	1: °C 2: °F 3: Ohm	1: °C	Engineering Units used for AI:1	Yes
MSV:25	Units used to set T2	R/W	1: °C 2: °F 3: Ohm	1: °C	Engineering Units used for AI:2	Yes
MSV:26	Units used to set Power	R/W	1: kW 2: kBTU/h	1: kW	Engineering Units used for AV:32	Yes
MSV:27	Units used to set Energy counter	R/W	1: kWh 2: MJ 3: kBTU	1: kWh	Engineering Units used for AV:33 and AV:34	Yes
MSV:28	Units to set T3	R/W	1: °C 2: °F 3: Ohm	1: °C	Engineering Units used for AI:3	Yes

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BACnet Objects - Binary Value

Ident	Object / Parameter name	Read/ Write	Active Text (1)	Inactive Text (0)	Default	Description	Persistent Yes/No
BV:2	Direct or Inverse operation Mode	R/W	Inverse	Direct	Direct	Selection between Direct and Inverse operation mode. See Direct/Inverse diagram.	Yes
BV:3	Analog feedback signal	R/W	Active	Inactive	Inactive	By activating this feature, the analog output signal (AO:0) and the position of the valve opening become linked. The voltage output type and range is linked to the MSV:1 present value. If BV:3 is active and the analog output signal (AO:0) is written to manually it must be relinquished i.e. write "NULL" to return to the original setting of BV:3.	Yes
BV:10	Warning: Temperature of the actuator is out of recommended range	R	ON	OFF	na	The Temperature inside the Actuator is out of the recommended range.	No
BV:11	Alarm: No Control Signal	R	ON	OFF	na	The actuator has detected that it has no analog control signal.	No
BV:12	Alarm: Error during Closing	R	ON	OFF	na	The actuator is unable to reach it's intended closing position. Check for valve blockages.	No
BV:13	Warning: Pre-set Conflict	R	ON	OFF	na	The warning will also be activated if the Selected Valve Type has different stroke than the actually valve used validated during calibration.	No
BV:14	Warning: Voltage of power supply is too high	R	ON	OFF	na	Not used	No
BV:15	Warning: Voltage of power supply is too low	R	ON	OFF	na	Not used	No
BV:16	Alarm: Error during Calibration	R	ON	OFF	na	There was an error during calibration of the actuator. E.g. the NovoCon® M actuator is not mounted on the valve or the valve is stuck.	No
BV:17	Warning: BACnet MAC-address Conflict was Detected	R	ON	OFF	na	Two or more devices on the same BACnet sub-network have the same MAC-address.	No
BV:18	Warning: Faults on the BACnet was detected	R	ON	OFF	na	Problems with communication on the network are detected.	No
BV:19	Alarm: An internal Error has been detected	R	ON	OFF	na	Re-calibrate or power cycle actuator to reset - actuator replacement may be necessary	No
BV:22	Warning: Temp. sensors are missing or interchanged	R	ON	OFF	na	Temp. sensors for T1 and/or T2 are missing or interchanged	No
BV:23	Warning: Energy limitation is active	R	ON	OFF	na	Limitation is active. E.g. Power limitation, min. delta T or min/max return T management limitation.	No
BV:24	Warning: Energy management controller out of range	R	ON	OFF	na	Power, delta T or return T setpoint out of range or the setpoint can't be achieved. Action: Check that setpoint is achievable with the given flow rates and temperatures. T1 and T2.	No

BACnet Objects - Device Object

List with some selected important Device Object properties.

Property	Value	Read / Write	Description	Persistent Yes/No
Object ID	Instance Range: 0 to 4194302	R/W	This property is normally called Device Instance number or Unique ID.	Yes
Object-Name	Combination of "NovoCon M" + Type and Object ID	R/W	Product name. Max. 25 characters.	Yes
Firmware revision	Current firmware version	R	BACnet software revision.	Yes
Application S/W version	Current Application SW version	R	Actuator Application Software version.	Yes
Location	This string is empty when actuator is new.	R/W	Free text can be used to describe location etc. Max. 50 characters.	Yes
Description	Danfoss NovoCon actuator with BACnet MS/TP	R/W	Product description. Max. 50 characters.	Yes
Segmentation-supported	SEGMENTATION	R	Able to transmit and receive segmented messages.	Yes
Max-master	Default: 127 Range: 0-127	R/W	The MAX_master setting in NovoCon® M can be set above the highest used MAC address in the MS/TP sub network.	Yes
Max ADPU length	480	R	Maximum allowed ADPU length.	Yes
Max segments accepted	5	R	Max segments accepted	Yes

BACnet Objects - Analog Input

Ident	Object / Parameter name	Unit	Read / Write	Min	Max	Default units	Description	Persistent Yes/No
AI:0	Voltage or Current on analog input	5: Volts 2: mA	R	0	10V 20mA	Volts	Voltage(V) or Current(mA) level on the analog control input, measured by the actuator. Units comes from MSV:1 Analog Control signal type and range. This object is supported by COV.	No
AI:1	T1 or resistance input	62: °C 64: °F, 4: Ohms	R	-10°C 10°F 900Ω	120°C 250°F 10kΩ	°C	Temperature/resistance measured from connected sensors. For Power emission AV:32, AI:1 is temperature on the flow pipe and AI:2 is temperature on the return pipe. When used as potential free contacts: Closed circuit <900Ω, open circuit 100kΩ. Recommended max. cable length 2m. Units can be changed via the object's engineering units property. This object is supported by COV.	No
AI:2	T2 or resistance input							
AI:3	T3 or resistance input							

BACnet Objects - Analog Output

Ident	Object / Parameter name	Unit	Read / Write	Min	Max	Default units	Description	Persistent Yes/No
AO:0	Voltage on analog output	Volts	R/W	0	10	Volt	Output Voltage value	No

BACnet Objects - Notification class

Ident	Object / Parameter name	Description
NC:0	Alarm Notifier, Subscribe here for alarms	Subscribe devices for receiving alarms

NC:0 is an object where other BACnet devices can subscribe to be informed directly from this device if an alarm or warning is activated or cleared. A maximum of 4 devices can subscribe to this service. Subscribers of this object will be informed if any of the Warning or Alarms BV:10 to BV:24 is activated or cleared.

When the notification class NC:0 is going to be used to notify about changes with status of Warnings and Alarms (BV:10 – BV24), is it necessary to subscribe for notifications for the entire day and week: From 00:00:00:00 to 23:59:59:99 and all 7 days of the week. This is because the actuator does not have a clock built in and will therefore not be able to handle notifications with respect to time.

BACnet Objects - Averaging

Ident	Object / Parameter name	Min. Value	Average value	Max. Value	Window Interval	Window Sample	Description	Persistent Yes/No
AVO:0	Average rectified voltage measured by the actuator	Updated according to actual measurements			1 Day	24	Not used.	No

Valve Type Selection

Values for flow are valid for water applications. For glycol mixtures, please use correction factor.

Index	Name	Nominal Flow	Units	Valve position for nominal flow [mm]	Setting Range Maximum [%]
1[1)]	AB-QM NovoCon DN40 PN16 3TP	7,500	L/h	10	100
2	AB-QM NovoCon DN50 PN16 3TP	12,500	L/h	10	100
3	AB-QM NovoCon DN65 PN16 3TP	20,000	L/h	15	100
4	AB-QM NovoCon DN65 PN16 3TP HF	25,000	L/h	15	100
5	AB-QM NovoCon DN80 PN16 3TP	28,000	L/h	15	100
6	AB-QM NovoCon DN80 PN16 3TP HF	40,000	L/h	15	100
7	AB-QM NovoCon DN100 PN16 3TP	38,000	L/h	15	100
8	AB-QM NovoCon DN100 PN16 3TP HF	59,000	L/h	15	100
9[2)]	User Defined Valve	NF	UF	VPNF	SRMax

[1)] Default

[2)] The "User Defined Valve" is used only if NovoCon® M is not used with an AB-QM NovoCon® valve. Please contact your Danfoss representative to verify if the desired connection is possible.

BACnet BIBBs services

Service	BIBBs	Init/Exe
ReadProperty	DS-RP-B	exe
WriteProperty	DS-WP-B	exe
Who-Is	DM-DDB-A	init
Who-Is	DM-DDB-B	exe
I-Am	DM-DDB-B	init
I-Am	DM-DDB-A	exe
Who-Has	DM-DOB-B	exe
I-Have	DM-DOB-B	init
DeviceCommunicationControl	DM-DCC-B	exe
ReinitializeDevice[1)]	DM-RD-B	exe
ConfirmedEventNotification	AE-N-I-B	init
UnconfirmedEventNotification	AE-N-I-B	init
AcknowledgeAlarm	AE-ACK-B	exe
GetEventInformation	AE-INFO-B	exe

Service	BIBBs	Init/Exe
GetAlarmSummary	AE-ASUM-B	exe
GetEnrollmentSummary	AE-ESUM-B	exe
AddListElement	DM-LM-B	exe
RemoveListElement	DM-LM-B	exe
ReadPropertyMultiple	DS-RPM-B	exe
WritePropertyMultiple	DS-WPM-B	exe
SubscribeCOV [2)]	DS-COV-B	exe
Restart	DM-R-B	exe
AtomicWriteFile	na	exe

[1)] NovoCon® M supports BACnet warm reset (power cycle) and Cold reset (factory reset). Note that after Cold/factory reset a calibration will be automatically performed and all settings will be reverted to factory settings.

[2)] COV is implemented for the following: Analog Inputs AI:0, AI:1 and AI:2, and for the following Analog Values AV:2 and AV:27.

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Modbus registers - Configuration

Modbus register	Read/ Write	Modbus function	Modbus Data Type	Object / Parameter name	Description	Default	Unit	Description of usage	Persistent Yes/No
0x8000 32768	R/W	3,4 & 16	FLOAT	**Design Flow Rate**	Recommended to use 32796 for Heating and 32798 for cooling Design Flow rate. Pre-set value for the Design Flow Rate when control signal is at 100%. Unit follows 32787.	Nominal value from the Valve table in L/h	%, L/h, GPM	Design Flow Rate in Liters per hour i.e. 150 ..450 correspond to 150 …450 L/h or in percent, i.e. 40 … 100 correspond to 40 … 100%. The maximum setting range is depending on the selected valve. See Valve Type Selection.	Yes
0x8002 32770	R/W	3,4 & 6	WORD	Control Fallback Time	Time before actuator reacts to a missing analog control signal	10	Minutes	Control Fallback Time in minutes, i.e.. 0 … 60 correspond to 0 … 60 minutes	Yes
0x8004 32772	R/W	3,4 & 16	FLOAT	Alpha Value	Value used for shaping the curve in Manual Defined Function (MDF) mode to fit the characteristics curve of a heat exchanger. If 33280 is in L/h in Digital mode, the alpha setting is ignored.	1.0	na	Alpha Value curve, i.e. 0.05 … 1.00 correspond to 0.05 … 1.00. Alpha = 1.00 is liniar. Alpha = 0.2 is equal to the LOG function. See Alpha value diagram.	Yes
0x8006 32774	R/W	3,4 & 16	WORD	Valve closing or opening time	The time the actuator needs to move from 0% to 100% of Design Flow Rate. Use with 32803.	na	Seconds	Valve closing or opening time in seconds i.e.. 30 … 700 correspond to 30 … 700 seconds	Yes
0x8008 32776	R	3,4 & 6	FLOAT	Nominal Flow of the user defined valve	The Nominal flow of the user defined valve is shown here. This Object is used only if NovoCon® M is not used with an AB-QM valve. Please contact your Danfoss representative to verify if the desired connection is possible.	na	L/h or GPM, Unit type comes from Valve Table	Nominal flow e.g. in Liters per hour i.e. 0 ... 7500 correspond to 0 … 7500 L/h	Yes
0x800A 32778	R	3 & 4	FLOAT	Valve position at nominal flow for User Defined Valve	Position in mm for nominal flow of the User Defined Valve. This Object is used only if NovoCon® M is not used with an AB-QM valve. Please contact your Danfoss representative to verify if the desired connection is possible.	10	Millimetre	Valve position for nominal flow in millimetre, i.e. 5 … 20 correspond to 5 … 20 millimetre	Yes
0x800C 32780	R/W	3,4 & 6	FLOAT	Maximum value for the Design Flow in the User Defined Valve	Maximum level the Design Flow Rate can be increased to for the User Defined Valve. This Object is only used only if NovoCon® M is not used with an AB-QM valve. Please contact your Danfoss representative to verify if the desired connection is possible.	120	Unit type follows 32787 selection: % or (L/h or GPM)	i.e. 0 ..150 correspond to 0 …150 %	Yes
0x8012 32786	R/W	3,4 & 6	WORD	Direct or Inverse operation Mode	Selection between Direct and Inverse operation mode. See Direct/Inverse diagram.	0: Direct	0: Direct 1: Inverse	Selection between Direct and Inverse operation mode. See Direct/Inverse diagram.	Yes
0x8013 32787	R/W	3,4 & 6	WORD	Units used to set and display the Design Flow Rate	Units used to set and display the Design Flow Rate. Units for L/h & GPM comes from Selected Valve Type.	0: L/h	0: L/h 1: % 2: GPM	Engineering Units used for the Design Flow Rate.	Yes
0x8014 32788	R/W	3,4 & 6	WORD	Units used to set and display Flow Rate Setpoint	Units used to set and display Flow Rate Setpoint	1: %	0: L/h 1: % 2: GPM 3: kW 4: kBTU/h	Engineering Units used for the desired Flow 33280. Note: If kW or kBTU/h chosen then 32815 Power Controller (state 3) also becomes active.	Yes
0x8015 32789	R/W	3,4 & 6	WORD	Units used to set and display the Flow Rate feedback	Units used to set and display the Flow Rate feedback	0: L/h	0: L/h 1: % 2: GPM	Engineering Units used for 33282.	Yes
0x8016 32790	R/W	3,4 & 6	WORD	Units used to set temperature	Select between °C or °F to set and display temperature	0: °C	0: °C 1: °F	Engineering Units for 33796, 32836. 32838, 32840 & 32842.	Yes
0x8017 32791	R/W	3,4 & 6	WORD	Units used to set and display T1	Units used to read the temperature or resistance value.	0: °C	0: °C 1: °F 2: Ohms	Engineering Units used for 33218.	Yes
0x8018 32792	R/W	3,4 & 6	WORD	Units used to set and display T2				Engineering Units used for 33220.	
0x8032 32818	R/W	3,4 & 6	WORD	Units used to set and display T3				Engineering Units used for 33222.	
0x8019 32793	R/W	3,4 & 6	WORD	Units used to set Power	Units used to read the power usage.	0: kW	0: kW, 1: kBTU/h	Engineering Units used for 33288.	Yes
0x801A 32794	R/W	3,4 & 6	WORD	Endian type	Word ordering for LONG and FLOAT types	0: Big	0: Big 1: Little	Used endian type for float and long registers	Yes
0x801C 32796	R/W	3,4 & 16	FLOAT	Heating Design Flow Rate	Pre-set value for the Design Flow Rate when the control signal is at 100%. 32810 must be set to Heating or Cooling. Unit follows 32787	Nominal value from the Valve table in L/h	%, L/h, GPM	Design Flow Rate in Liters per hour i.e. 750 ... 79000 correspond to 750 ... 79000 L/h or in percent, i.e. 40 … 100 correspond to 40 … 100%. The maximum setting range is depending on the selected valve. See Valve Type Selection.	Yes
0x801E 32798	R/W	3,4 & 16	FLOAT	Cooling Design Flow Rate					

Modbus registers - Configuration *(continued)*

Modbus register	Read/ Write	Modbus function	Modbus Data Type	Object / Parameter name	Description	Default	Description of usage	Persistent Yes/No
0x802A 32810	R/W	3,4 & 6	WORD	**Application mode**	1: Analog control 2: Digital control	2: Digital	Select the actuator application mode. All temperature sensor related kW/h readings and energy functions are affected by this choice. **State 1:** Analog Control. Flow is controlled with an analog signal e.g. 0-10V. Design Flow Rate set via register 32796 Heating or 32798 Cooling. Alternative 32738 can be used. **State 2:** Digital Control. Register 33280 is used to control the flow. Design Flow Rate set via register 32796 Heating or 32798 Cooling. Alternative 32738 can be used.	Yes
0x802B 32811	R/W	3,4 & 6	WORD	Application	1: Heating 2: Cooling	1: Heating	Select the actuator application mode.	Yes
0x802E 32814	R/W	3,4 & 6	WORD	Energy counter activation	1: Off 2: On	1: Off	Enable or disable energy counter	Yes
0x802F 32815	R/W	3,4 & 6	WORD	Energy management	1: Not active **Power Manager:** 2: Power limitation 3: Power control **Delta T Manager:** 4: Min. Delta T limitation 5: Set Delta T control 6: Return T limitation 7: Set Return T control	1: Not active	Activate functions to optimise system performance. The calculated flow from the activated energy functions is limited to register 32862 Energy management min flow, except the function Power control that has a limitation at min. 2% of the Design Flow Rate. If needed the PI values can be fine tuned in register 32856 and 32858. **State 1:** Not active. **State 2:** If power is above the set value in register 32832 or register 32834, NovoCon will regulate to the specified limit register 32832 and/or 32834. When this limitation is active, the warning bit 23 in register 33536 will be set to 'on'. **State 3:** The flowrate through the valve is controlled by register 33280 in %, kW or kBTU/h (selected in 32793) and is based on the flowrate and temperature inputs. Sensors T1 and T2 used. **State 4:** If delta T value in register 32836 and/or 32838 is exceeded, NovoCon will begin to close the valve until the register 32836 and/or 32838 values are reached. When this limitation is active, the warning bit 23 in register 33536 will be set to 'on'. Sensors T1 and T2 used. **State 5:** The constant delta T is set in register 32836 and/or 32838 and NovoCon will regulate within these limits. When this control is active, the warning bit 23 in register 33536 will be set to on'. Sensors T1 and T2 used. **State 6:** NovoCon ensures the min. or max. return temp. T2 set in 32840 & 32842. In register 32811 Heating/cooling application must be selected. When this limitation is active, the warning bit 23 in register 33536 will be set to 'on'. **State 7:** A constant T2 value is set in 32840 and/or 32842. NovoCon will regulate to maintain these values constant.	Yes
0x8020 32800	R/W	3,4 & 6	WORD	Analog Control signal type and range	Used to select the analog control signal input type and range	2: 0-10 VDC	Select 1, 2 or… based on the table below: 1: 0-5 VDC 2: 0-10 VDC 3: 2-10 VDC 4: 5-10 VDC 5: 2-6 VDC 6: 6-10 VDC 7: 0-20 mA 8: 4-20 mA	Yes
0x8021 32801	R/W	3,4 & 6	WORD	Missing Control Signal Fallback Action	The action that the actuator will commence upon a missing analog control signal.	1: No action	Select 1, 2 or… based on the table below: 1: No action 2: CLOSE 3: OPEN 4: Go to 50% of Design Flow Rate	Yes

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Modbus registers - Configuration *(continued)*

Modbus register	Read/ Write	Modbus function	Modbus Data Type	Object / Parameter name	Description	Default	Unit	Description of usage	Persistent Yes/No
0x8022 32802	R/W	3,4 & 6	WORD	**Selected Valve Type**	This is the AB-QM valve type that the actuator is set-up to control	1: AB-QM NovoCon DN40	na	See table "Valve Type Selection 1-9"	Yes
0x8023 32803	R/W	3,4 & 6	WORD	Actuator Speed	The amount of time the actuator takes to move 1mm or alternatively, a specified constant time function (see 32774). The Constant Time value range is 30-700 seconds.	3: 12 sec/mm	na	Select 1, 2 or… based on the table below: 1: 3 sec/mm 2: 6 sec/mm 3: 12 sec/mm 4: 24 sec/mm 5: Constant Time (set by register 0x8006)	Yes
0x8024 32804	R/W	3,4 & 6	WORD	Baud Rate	Baud Rate used for bus communication	1: Auto Baud Rate Detection	na	Select 1, 2 or… based on the table below: 1: Auto Baud Rate Detection 2: 9600 bps 3: 19200 bps 4: 38400 bps 5: 57600 bps 6: 76800 bps 7: 115200 bps	Yes
0x8025 32805	R/W	3,4 & 6	WORD	Select UART mode	Supported transmission modes	5: Auto parity	na	Select 1, 2, 3 or 4 based on the table below: 1: 1-8-N-2 2: 1-8-O-1 3: 1-8-E-1 4: 1-8-N-1 5: Auto parity Data format: (Start bit-Data bits-Parity-Stop bits)	Yes
0x8026 32806	R/W	3,4 & 6	WORD	Slave ID	Slave ID used for communication.	na	na	Slave ID used for communication	Yes
0x8027 32807	R/W	3,4 & 6	WORD	Slave ID asignment method	The Slave ID address selection method.	1: DIP Switch Settings	na	1: DIP Switch Settings 2: User configuration over Modbus If DIP Switches are in an invalid position the actuator will automatically check if a Slave ID is present in the User Configuration.	Yes
0x8028 32808	R/W	3,4 & 6	WORD	BUS protocol	Select fieldbus protocol to be used. See also the DIP Switch Settings section of the data sheet. When the protocol is changed, a power cycle is required to make the actuator adopt the newly selected protocol.	1: DIP switch	na	Select 1, 2 or 3 based on the table below: 1: DIP switch 2: BACnet 3: Modbus	Yes
0x8029 32809	R/W	3,4 & 6	WORD	LED Control	Used to select the LED display required.	1: Normal LED mode	na	Select 1, 2 or… based on the table below: 1: Normal LED mode 2: Show alarms only 3: All LED's OFF 4: Blink (can be used to locate the actuator)	Yes
0x8030 32816	R/W	3,4 & 6	WORD	Units used to set Energy counter	Units used to set energy counter	0: kWh	0: kWh 1: MJ 2: kBTU	Engineering Units used for 33290 & 33292.	Yes
0x8031 32817	R/W	3,4 & 6	WORD	Analog feedback signal	Set analog output according to valve position	0: Inactive	na	0: Inactive 1: Active By activating this feature, the analog output signal (33286) and the position of the valve opening become linked. The voltage output type and range is linked to the 32800 present value. If 32817 is active and the analog output signal (33286) must be written to manually, it is necessary to change the setting of 32817 to inactive.	Yes
0x8033 32819	R/W	3,4 & 6	WORD	Temperature sensor type	Select the type of Temperature sensor connected.	3: PT1000	na	Select temperature sensor type: 1: NTC10k Type 2 2: NTC10k Type 3 3: PT1000 4: PT500 5: PT100	Yes
0x804C 32844	R/W	3, 4 & 16	FLOAT	Glycol Factor	Glycol correction factor	1	na	Select appropriate factor from 0.5-2 if a glycol mixture is used.	Yes
0x8058 32856	R/W	3,4 & 16	FLOAT	Control-Gain P	Set proportional part for control	7	na	Sets the proportional part for control of register 32815 Energy Mangement functions.	Yes
0x805A 32858	R/W	3,4 & 16	FLOAT	Control-Gain I	Set integral part for control	0.35	na	Sets the integral part for control of register 38215 Energy management functions. I parameter in sec. = (Pgain / Igain) * 2 sec. Default: 7/0.35 * 2sec. = 40 sec.	Yes
0x805E 32862	R/W	3, 4 & 6	FLOAT	Energy management min flow	Energy management minimum flow in percentage of register 32796 or 32798 Design flow Rate.	10	%	Minimum allowed flow while the Energy management function register 32815 is active. Exceptions, the object has no effect if: The energy limitation is inactive or the Power control energy mgmt. function is selected. In this case, the min. flow limit is set to 2% of the Design flow rate. 0 …100 correspond to 0 … 100%.	Yes
0x8500 34048	W	6	WORD	Reset	Warm reset = Power cycle. Cold reset = Factory reset. Note that after factory reset a calibration will be automatically be performed and all settings will be reverted to factory settings.	na	na	0x5741 / 22337: Warm reset 0x434F / 17231: Cold reset.	na

Modbus registers - Operating

Modbus register	Read/ Write	Modbus function	Modbus Data Type	Object / Parameter name	Description	Default	Unit	Description of usage	Persistent Yes/No
0x8200 33280	R/W	3,4 & 16	FLOAT	Flow Rate Setpoint	The Flow Rate Setpoint through the AB-QM valve. Unit follows 32788. In case the Energy management functions are active the Flow Rate Setpoint will follow the actual setting controlled by the Energy Management function.	100%	%, L/h, GPM, kW, kBTU/h	Flow Rate Setpoint in percent, i.e.0 … 100 correspond to 0 … 100%	No
0x8202 33282	R	3 & 4	FLOAT	Flow Rate feedback	Flow Rate Indication based on the position of the Actuator stem. Unit follows 32789	na	%, L/h, GPM	Flow Rate feedback in percent, i.e. 0 … 100 correspond to 0 … 100%. If L/h (GPM) is selected in 32787 then the valve flow rate is set to the selected valve's 32776 maximum value. Otherwise 100%	No
0x8204 33284	R/W	3,4 & 6	WORD	Actuator Mode and special features	Shows present mode of actuator. Calibration, Flush and de-air may be started from here	1: Normal	na	Select 1, 2 or… based on the table below: 1: Normal 2: Calibration 3: Flush 4: De-Air 5: Alarm	Yes, except state 3,4 & 5
0x8206 33286	R/W	3,4 & 16	FLOAT	Voltage on analog output	Output Voltage value	na	Volts	Voltage level i.e. 0.00 … 10.00 correspond to 0.00 … 10.00 V	No
0x8208 33288	R/W	3,4 & 16	FLOAT	Power emission	The hydronic power emission of the terminal unit, based on calculations from water flow rate and the temperature difference between supply (33218) and return (33220) pipes. Positive values reflect heating power emission. Negative values reflect cooling power emission. Units can be changed via the object's engineering units property.	na	kW, kBTU/h	Power in kW or kBTU/h. If register 32844 Glycol correction is used, Power emission will be adjusted accordingly. i.e. -1000.00 … 1000.00 correspond to -1000.00 … 1000.00 kW or in kBTU/h, i.e. -1000.00 … 1000.00 correspond to -1000.00 … 1000.00 kBTU/h	No
0x820A 33290	R/W	3,4 & 16	FLOAT	Heating Energy counter	Energy counter for heating	na	kWh, MJ, kBTU	Accumulative Energy counter for heating. i.e. 0.00 … 1000.00 correspond to 0.00 … 1000.00 kWh. If register 32844 Glycol correction is used, Heating Energy Counter emission will be adjusted accordingly.	Yes
0x820C 33292	R/W	3,4 & 16	FLOAT	Cooling Energy counter	Energy counter for cooling	na	kWh, MJ, kBTU	Accumulative Energy counter for cooling. i.e. 0.00 … 1000.00 correspond to 0.00 … 1000.00 kWh. If register 32844 Glycol correction is used, Cooling Energy Counter emission will be adjusted accordingly.	Yes
0x820E 33294	R	3 & 4	FLOAT	Position feedback	Position of the Actuator stem in percentage	na	%	Design Flow Rate feedback in percent, 0 … 100 correspond to 0 … 100%.	No
0x8040 32832	R/W	3,4 & 16	FLOAT	Heating max. Power	Pre-set value for the design power, in heating mode, when control signal is at 100%	0	kW, kBTU/h	When using register 32815 state Power limiter this is the maximum allowed hydronic energy output. This value is intended to limit the heating power through the terminal unit. i.e. 0.00 … 10.00 correspond to 0.00 … 10.00 kW	Yes
0x8042 32834	R/W	3,4 & 16	FLOAT	Cooling max. power	Pre-set value for the design power, in cooling mode, when control signal is at 100%	0	kW, kBTU/h	When using register 32815 state Power limiter this is the maximum allowed hydronic energy output. This value is intended to limit the cooling power through the terminal unit. i.e. 0.00 … 10.00 correspond to 0.00 … 10.00 kW	Yes
0x8044 32836	R/W	3,4 & 16	FLOAT	Heating Delta T	Set-point value for the temperature difference between the flow and return pipes	15	°C or °F	For register 32815 state Minimum Delta T management and Set Delta T control, this is the value the control is based on for heating. i.e. 5 … 50 correspond to 5°C … 50°C	Yes
0x8046 32838	R/W	3,4 & 16	FLOAT	Cooling Delta T	Set-point value for the temperature difference between the flow and return pipes	5	°C or °F	For register 32815 state Minimum Delta T management and Set Delta T control, this is the value the control is based on for cooling. i.e. 5 … 50 correspond to 5°C … 50°	Yes
0x8048 32840	R/W	3,4 & 16	FLOAT	Heating T2	Set-point value for Heating T2 (Heating return pipe temperature)	35	°C or °F	For register 32815 state Max. Return T management and Set return T control, this is the value the control is based on for heating. i.e. 5 … 50 correspond to 5°C … 50°	Yes
0x804A 32842	R/W	3,4 & 16	FLOAT	Cooling T2	Set-point value for Cooling T2 (Cooling return pipe temperature)	13	°C or °F	For register 32815 state Min. Return T management and Set return T control, this is the value the control is based on for cooling. i.e. 5 … 50 correspond to 5°C … 50°	Yes

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Modbus registers - Information

Modbus register	Read/ Write	Modbus function	Modbus Data Type	Object / Parameter name	Description	Default	Unit	Description of usage	Persistent Yes/No
0x8100 33024	R	3 & 4	FLOAT	Nominal flow of the selected valve type	Nominal flow of the selected valve is shown in the present value	7500	L/h or GPM, Unit type comes from Valve Table	Nominal flow e.g. in Litres per hour i.e. 0 ..7500 correspond to 0 …7500 L/h.	na
0x8102 33026	R	3 & 4	FLOAT	Valve position at nominal flow	Position in mm for nominal flow of the selected valve	na	Millimetre	Valve position for nominal flow in millimetre, i.e.. 0.5 … 5.8 correspond to 0.5 … 5.8 millimetre.	na
0x8104 33028	R	3 & 4	FLOAT	Maximum value of the Design Flow Rate	Maximum level the Design Flow Rate can be increased to for the selected valve	Setting Range Maximum from Valve table	%	Maximum level of the Design Flow Rate in percent, i.e. 20 … 100 correspond to 20 … 100%.	na
0x8120 33056	R/W	3 & 4	STRING	Device name	Product name	NovoCon M	na	ASCII coded STRING	Yes
0x8140 33088	R	3 & 4	STRING	Model name	Type of the actuator	Medium	na	ASCII coded STRING	Yes
0x8160 33120	R	3 & 4	STRING	Vendor name	Name of the Manufacture	Danfoss A/S	na	ASCII coded STRING	Yes
0x8180 33152	R/W	3, 4 & 16	STRING	Location description	Free text can be used to describe location etc. E.g. Room 1	na	na	ASCII coded STRING. Max. 50 characters.	Yes
0x81A0 33184	R	3, 4	STRING	Serial number	Serial number of the actuator	na	1	Description of this object holds the serial number of the actuator, programmed at the production time.	Yes
0x8108 33032	R	3, 4	LONG	Product ID	Serial number of the actuator	na	1	Unique Product id. The last part of the serial number.	Yes
0x810A 33034	R	3 & 4	WORD	SW version	Software version of the actuator	na	na	ASCII coded WORD	Yes
0x810B 33035	R	3 & 4	WORD	HW version	Hardware version of the actuator	na	na	ASCII coded WORD	Yes
0x81C0 33216	R	3 & 4	FLOAT	Voltage or Current on analog input	Voltage(V) or Current(mA) level on the analog control input, measured by the actuator. In CO6 modes mA cannot be selected.	na	Volts / mA	Voltage level measured i.e. 0.00 … 10.00 correspond to 1.00 … 10.00 V or in mA, i.e. 0.00 … 20.00 correspond to 0.00 … 20.00 mA	No
0x81C2 33218	R	3 & 4	FLOAT	T1 or resistance input	Temperature/resistance measured from connected PT1000 sensors. For Power emission 33288, register 33218 is temperature on the flow pipe and 33220 is temperature on the return pipe.	°C	°C, °F, Ohms	Temperature/resistance measured from connected sensors. For Power emission AV:32, AI:1 is temperature on the flow pipe and AI:2 is temperature on the return pipe. When used as potential free contacts: Closed circuit <900Ω, open circuit 100kΩ. Recommended max. cable length 2m. Units can be changed via the object's engineering units property. This object is supported by COV.	No
0x81C4 33220				T2 or resistance input					No
0x81C6 33222				T3 or resistance input	Temperature/resistance measured from connected sensors.				No
0x8402 33794	R	3 & 4	FLOAT	Rectified voltage measured by the actuator	Measured rectified voltage which powers the actuator	na	Volts	Not used.	No
0x8404 33796	R	3 & 4	FLOAT	Temperature in the actuator	Temperature measured inside the Actuator	na	na	Temperature measured inside the actuator. Unit is decided by 32790.	No
0x8406 33798	R	3 & 4	LONG	Total Operating Hours	Total Operating Hours of the actuator	Hours	Hours	Total Operating Hours of the actuator	Yes
0x8408 33800	R	3 & 4	LONG	Lifetime estimate	Calculated percentage of expended lifetime	%	na	At 100% the valve and actuator have reached the estimated minimum lifetime. Replacement of valve and actuator is recommended.	Yes
0x8410 33808	R	3 & 4	LONG	Minutes since last power-up	Minutes since the last power-up of the actuator	Minutes	Minutes	Minutes since the last power-up of the actuator	No
0x8412 33810	R	3 & 4	LONG	Minutes since last calibration	Minutes since the last time the actuator was calibrated to an AB-QM valve	Minutes	Minutes	Minutes since the last time the actuator was calibrated to a valve	Yes
0x8414 33812	R	3 & 4	LONG	Minutes since fully closed	Minutes since the last time the AB-QM valve was fully closed	Minutes	Minutes	Minutes since the last time the valve was fully closed	Yes
0x8416 33814	R	3 & 4	LONG	Minutes Since Fully Opened	Minutes since the last time the AB-QM valve was fully opened	Minutes	Minutes	Minutes since the last time the valve was fully opened	Yes

Alarms & warning

Modbus register	Read/ Write	Modbus function	Modbus Data Type	Object / Parameter name	Description	Default	Description of usage	Persistent Yes/No
0x8300 33536	R	3&4	LONG	Alarm: No Control Signal	The actuator has detected that is has no analog control signal	0: OFF	Bit 0: 0:OFF; 1:ON	No
				Alarm: Error during Closing	The actuator is unable to reach it's intended closing position. Check for valve blockages.	0: OFF	Bit 1: 0:OFF; 1:ON	No
				Alarm: Error during Calibration	There was an error during calibration of the actuator. E.g. the NovoCon® M actuator is not mounted on the valve or the valve is stuck	0: OFF	Bit 2: 0:OFF; 1:ON	No
				Alarm: An internal Error has been detected	Re-calibrate or power cycle actuator to reset - actuator replacement may be necessary	0: OFF	Bit 3: 0:OFF; 1:ON	No
				Alarm: Temp. sensors are missing or interchanged	Temp. sensors for T1 and/or T2 are missing or interchanged	0: OFF	Bit 6: 0: OFF; 1:ON	No
				Warning: Temperature of the actuator is out of recommended range	The Temperature inside the Actuator is out of the recommended range	0: OFF	Bit 16: 0:OFF; 1:ON	No
				Warning: Pre-set Conflict	Warning: Conflict between the Mechanical AB-QM valve setting and the NovoCon® M. The mechanical valve setting must be 100% or above. The warning will also be activated if the Selected Valve Type has different stroke than the actually valve used validated during calibration.	0: OFF	Bit 17: 0: OFF; 1:ON	No
				Warning: Voltage of power supply is too high	Not used	0: OFF	Bit 18: 0: OFF; 1:ON	No
				Warning: Voltage of power supply is too low	Not used	0: OFF	Bit 19: 0: OFF; 1:ON	No
				Warning: Faults on communication was detected	Problems with Communication on the network are detected	0: OFF	Bit 21: 0:OFF; 1:ON	No
				Warning: Invalid Slave ID setting	Slave ID assignment was done incorrectly to either 0 or 127	0: OFF	Bit 22: 0:OFF; 1:ON	No
				Warning: Energy limitation is active	Limitation is active. E.g. Power limitation, min. delta T or min/max return T management limitation.	0: OFF	Bit 23: 0: OFF; 1:ON	No
				Warning: Energy management controller out of range	Power, delta T or return T setpoint is out of range or the setpoint cannot be achieved. Action: Check that setpoint is achievable with the given flow rates and temperatures.	0: OFF	Bit 24: 0: OFF; 1:ON	No

Firmware update

Manual update

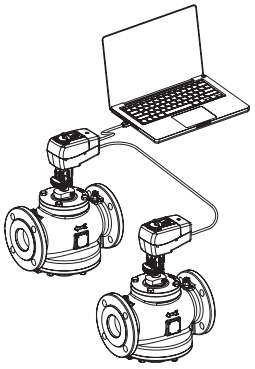
Using BACnet MS/TP

Ident	Object / Parameter name	Read/Write	State Text	Default State	Description
MSV:19	Firmware update	R/W	1: Normal 2: Prepare 3: Ready 4: Error 5: Received 6: Update	1: Normal	Commands & status for firmware update. Method used to update the firmware: • Send 'Prepare' command to MSV:19. NovoCon ® M will prepare for the firmware update and change status to 'Ready'. • Send file to FIL:0. If successful, status should be 'Received'. • Send 'Update' command. NovoCon ® M will reboot and update the firmware. The status should be 'Normal' after a successful firmware update.

Ident	Object / Parameter name	Read/Write	State Text	Default State	Description
FIL:0	File	W	File used to update the firmware	na	Used to transfer the new firmware to NovoCon ® M.

Using Modbus RTU

Modbus register	Read/ Write	Modbus function	Modbus Data Type	Object / Parameter name	Description	Default	Description of usage
0x8501 34049	R/W	3, 4 & 6	WORD	Firmware update	1: Normal 2: Prepare 3: Ready 4: Error 5: Received 6: Update	1: Normal	Commands & status for Firmware update. Method used to update the Firmware: • Send 'Prepare' command to 34049. NovoCon ® M will prepare for the firmware update and change status to 'Ready'. • Send file using Modbus function 21. If successful, status should be 'Received'. • Send 'Update' command. NovoCon ® M will reboot and update the software. The status should be 'Normal' after a successful software update



When using modbus function 21 (0x15) to update the firmware in NovoCon® M it is necessary to perform the upload in smaller sections due to modbus limitations in file size, please see the modbus standard for more details.

Broadcast, update multiple NovoCon® M by sending the firmware to Slave Id 0, is supported in modbus. However each NovoCon® M must be Prepared before the firmware upload is performed.

Danfoss NovoCon® Configuration tool

Easy configuration, commissioning and firmware updates can be performed with the Danfoss configuration tool. Please see separate operating manual.

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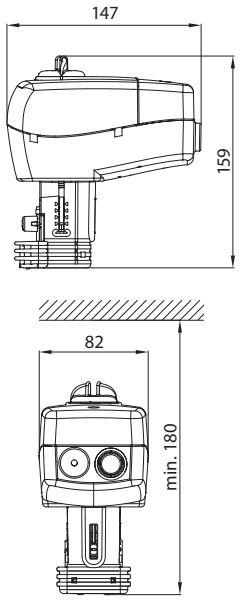
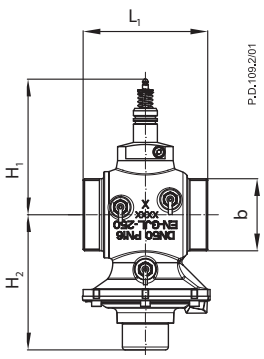
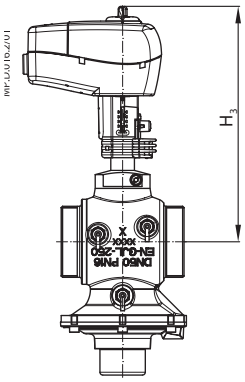
Dimensions



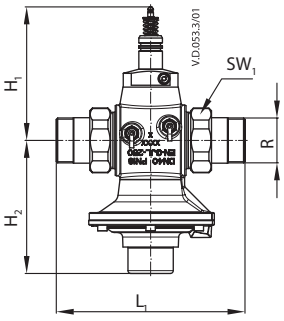


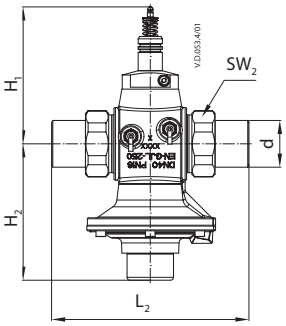
DN 40, 50



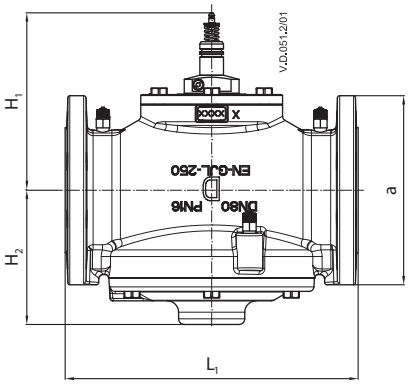
NovoCon® M + AB-QM NovoCon®

DN	L_1	H_1	H_2	H_3	b
	mm				ISO 228/1
40	110	141.5	141	247.5	G 2
50	130	141.5	141	247.5	G 2½

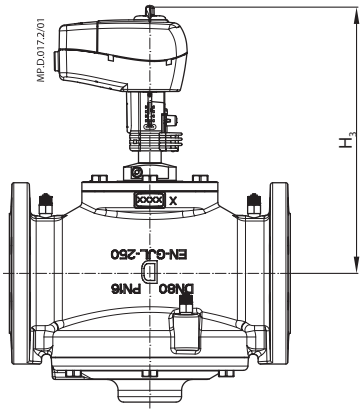




DN		40	50
R		1½	2
SW_1	mm	64	80
SW_2		70	82
d		48.3	60.3
L_1		200	244
L_2		204	234
H_1		141.5	141
H_2		141.5	141



DN 50-100



NovoCon® M + AB-QM NovoCon®

DN	L_1	H_1	H_2	H_3	a
	mm				(EN 1092-2)
50	230	141.5	141	247.5	165
65	290	187	132	293	185
80	310	190	139.5	296	200
100	350	202	152	308	220

Data sheet **NovoCon® M digital actuator & AB-QM NovoCon® DN 40-100 valves**

Tender text NovoCon® M

Modulating, high accuracy, geared actuator with bus connectivity used to control pressure independent control valves type AB-QM NovoCon® DN 40-100.

Control signal digital: BACnet MS/TP, Modbus RTU. Control signal analog: 0-10V/2-10V, 0-20mA/4-20mA
Actuator functionality is remotely accessible via the fieldbus:

- design flow pre-setting
- flushing the valve and terminal unit
- error during closing/opening/calibration alarm
- LIN/LOG/a-setting characteristics setting
- selectable speed
- opening/closing time selection
- auto MAC addressing (BACnet)
- auto Parity detection (Modbus)
- auto Baud rate detection
- Flow and energy indication

Supply Voltage 24V ac/dc
64 actuators can be connected to the same network
IP Class: 54
Stroke: 20mm
Manual override function
Click on mounting
LED status indication
BACnet Testing Laboratories (BTL) listed BACnet MS/TP fieldbus device

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