

## Data sheet

# NovoCon® S Digital & Hybrid with BACnet MS/TP and Modbus High Accuracy Actuator

## Description



NovoCon® S is a high accuracy multi-function field bus actuator, specifically designed for use in combination with Pressure Independent Balancing Control Valve type AB-QM in sizes from DN 10-32.

The high position accuracy of the actuator, together with the pressure independent and linear characteristic of the AB-QM valve, allow NovoCon® S Digital & Hybrid to be used as flow indicator.

Setup of the actuator and valve parameters is made via fieldbus. Control is made via field bus or via analog inputs for NovoCon® S.

The actuator with AB-QM is used to control water supply to fan coil units, chilled beams, induction units, small re-heaters, re-coolers, AHU's and other terminal units for zone control, in which hot/cold water is the controlled medium. Due to its accuracy, remote functionality and flow indication features, this product facilitates an accelerated commissioning process, allows easy maintenance, improves indoor comfort, increases energy savings and allows for fair cost allocation of heat/cool energy.

**Main features:**

- Remote commissioning/Reset/Flush features
- Flow indication
- High position accuracy
- LED bar displaying status
- No tools required for mounting
- Maintenance-free during lifetime
- Self-positioning process
- Low-noise operation
- Plug-in halogen free cables
- Auto MAC addressing for BACnet
- Auto baud rate detection
- Intrinsic alarm reporting
- Valve blockage alarm
- Broken wire detection on analog control and ground signal

## Ordering

Type	Code No.
NovoCon® S Digital & Hybrid	003Z8502

**Accessories**

Type	Length	Connections	Code No.
Cable NovoCon® Digital	1.5 m	bus / power	003Z8600
Cable NovoCon® Digital	5 m	bus / power	003Z8601
Cable NovoCon® Digital	10 m	bus / power	003Z8602
Cable NovoCon® Digital, daisy chain	0.5 m	actuator / actuator	003Z8609
Cable NovoCon® Digital, daisy chain	1.5 m	actuator / actuator	003Z8603
Cable NovoCon® Digital, daisy chain	5 m	actuator / actuator	003Z8604
Cable NovoCon® Digital, daisy chain	10 m	actuator / actuator	003Z8605
Cable NovoCon® Analog	1.5 m	0-10 V / power / voltage booster	003Z8606
Cable NovoCon® Analog	5 m	0-10 V / power / voltage booster	003Z8607
Cable NovoCon® Analog	10 m	0-10 V / power / voltage booster	003Z8608

*Note! Cables are not included with actuator and must be ordered separately.*

**Service kit - combination with old AB-QM**

Type	Code No.
NovoCon® adapter for AB-QM, DN 10-32 (5 pcs.)	003Z0239

## Approvals



EMC Directive 2014/30/EU, EN 60730-2-14:1997, EN 60730-2-14/A1:2001, EN60730-1:2011  
RoHS Directive 2011/65/EU

**Technical data**

Power supply range	24 V AC/DC, 50 / 60 Hz *
Power consumption	Running: 3.9 VA@24VAC / 1.7 W@24V DC / Standby: 0.9 W
Protection class	III safety extra-low voltage
Electrical connection	Halogen free cable
Control signal NovoCon® S	BACnet MS/TP, Modbus RTU 0-10 VDC, 0-5 VDC, 2-10 VDC, 5-10 VDC, 2-6 VDC, 6-10 VDC, 0-20 mA, 4-20 mA
Actuator speed selections ( <i>open to close</i> )	3 sec/mm, 6 sec/mm, 12 sec/mm, 24 sec/mm, Constant Time
Stroke	7 mm
Force	90 N
Position accuracy	± 0.05 mm
Ambient temp. range	-10° C to 50° C
Ambient humidity	98% r.h., non-condensing (according to EN 60730-1)
Max. medium temp.	120° C
Storage temp. range	-40 to 70° C
Grade of enclosure	IP 54 (IP 40 upside down)
Weight	0.4 kg

\* NovoCon® S is designed to operate at power deviations up to ±25%.

**BACnet data**

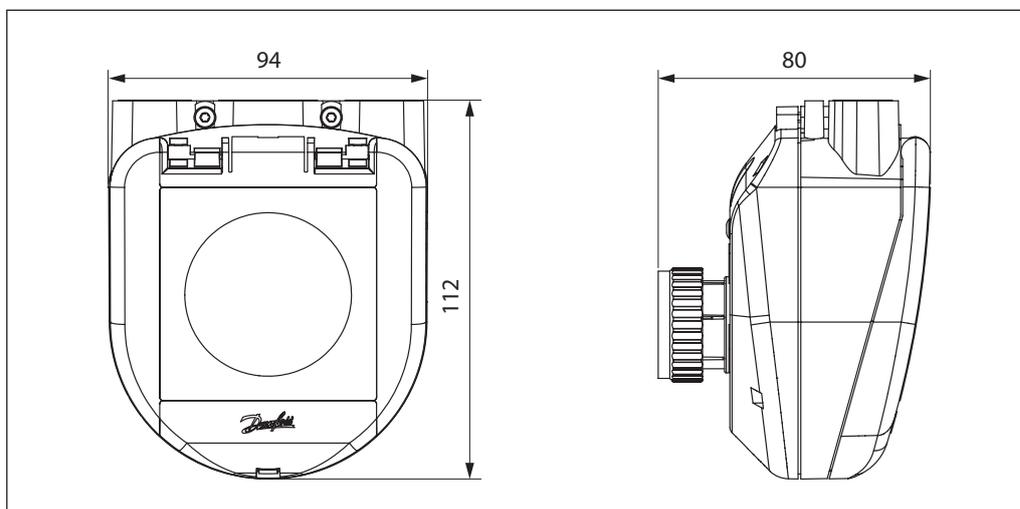
Type	Length
BACnet device profile	BACnet Application Specific Controller (B-ASC)
BACnet protocol	BACnet Master Slave / Token Passing (MS/TP)
BACnet baud rates supported	Auto baud rate detection* / 9600 bps / 19200 bps / 38400 bps / 56700 bps / 76800 bps / 115200bps

**Modbus RTU data**

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

**Dimensions**



**Presetting**

Preset of flow is made electronically with the NovoCon® S Digital & Hybrid actuator. Preset on the AB-QM valve is not used under normal operation.

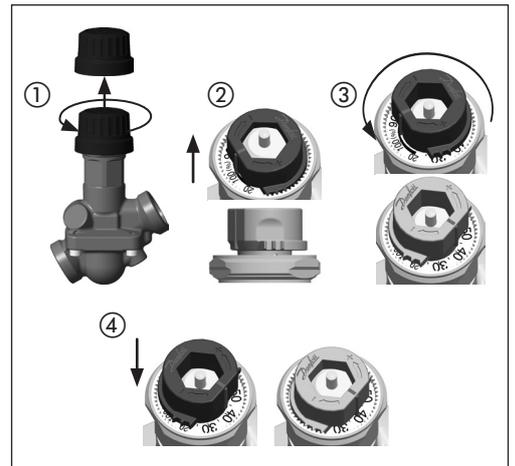
**Normal operation**

Leave valve at default factory preset (100 %).

**High flow operation**

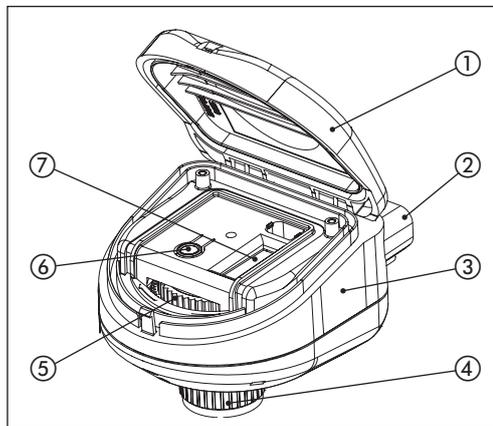
In order to achieve a more efficient flush and enable presetting of valve of more than 100% it is recommended to manually preset AB-QM valve to maximum flow. This is done by turning the preset scale counter-clockwise until it stops. See drawing.

Details about AB-QM pre-setting can be found in the AB-QM data sheet.



**Design**

- ① Removable lid
- ② Bus and power connections
- ③ LED window
- ④ Locking ring
- ⑤ Manual override
- ⑥ Reset button
- ⑦ DIP switches

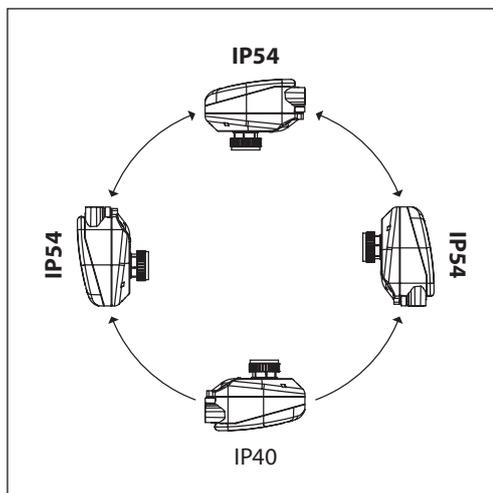


**Mounting Orientation**

NovoCon® S Digital & Hybrid can be mounted in any position, however mounting orientation affects the IP classification, see illustration.

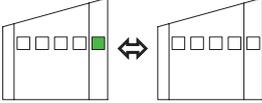
**Note!**

IP classification is only valid when cable or plugs are present in all connections.

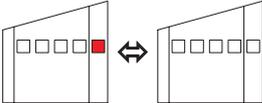


**LED Display**

**(RS485) activity**

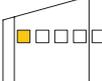


**BACnet/Modbus (RS485) activity**  
 No light from LED: Actuator sees no activity on the network.  
 LED turn on and off quickly, 10x/second: Normal operation on the network communication is OK.  
 LED turn on and off slowly with green light, 3x/second: Normal operation on the network - communication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

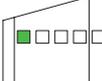


**BACnet/Modbus (RS485) activity with ERRORS**  
 LED turns on and off slowly with RED color: Actuator sees activity, but with errors.  
 LED turn on and off quickly with RED color: Communication is OK, EXCEPT that another device may be using the same MAC address

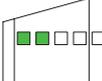
**Position of valve/actuator**



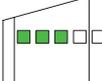
AB-QM valve is **fully closed**.



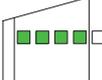
AB-QM is 1-24% open.



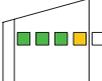
AB-QM is 25-49% open.



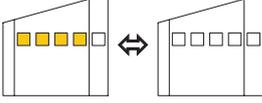
AB-QM is 50-74% open



AB-QM is 75-99% open.



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



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

**LED Display** *(continuous)*

**Movement of valve/actuator**

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

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

**NovoCon® S 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).

**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 valve cone. Flushing might solve the problem.

**Temperature inside NovoCon® S is out of the recommended range**  
LEDs change between showing the alarms and showing normal operation. Ambient temperature has likely exceeded 60°C.

**Internal 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® S calibration**  
LEDs change between showing the alarms and showing normal operation. Verify if the NovoCon® S is correctly attached to the valve and recalibrate.

**Power supply is outside limits**  
LEDs change between showing the alarms and showing normal operation. Use analog cables as voltage booster.

**No Control Signal**  
In analog mode the broken control wire is detected.

*LEDs change between showing the alarms and showing normal operation.*

**LED Display** *(continuous)*

**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.

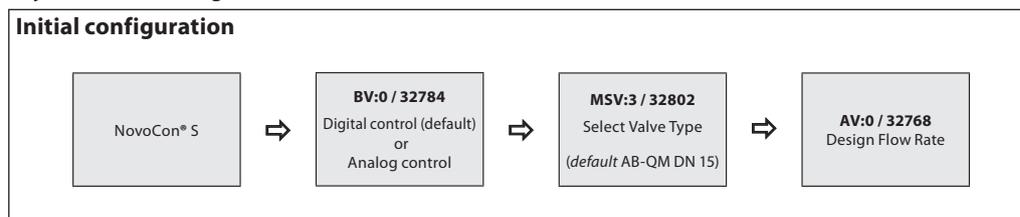
**Factory reset - reset to default settings**  
 Press and hold the reset button and then power up the actuator, all LED's are initially turned off.  
 Keep pressing the reset button until 4 LED's are turned on = Reset to default settings.

**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 and Modbus**  
**- Design flow rate setting**

**General**

There are simple BACnet and Modbus settings there are essential to the basic setup configuration of NovoCon® S Digital & Hybrid in order to communicate and control. These are contained in the BACnet objects / Modbus registers in decimal format.



**BACnet objects and Modbus registers usage**  
**- Advance configuration**

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

- |               |  |
|---------------|--|
| BV:0 / 32784  | Digital or analog control  |
| MSV:3 / 32802 | Selected Valve Type  |
| AV:0 / 32768  | Design Flow Rate   |
| BV:4 / 32787  | Units for setting Design Flow (and unit for Flow Feedback in AV:2 / 33282) |
| BV:5 / 32788  | Unit for setting the Flow Rate Setpoint in AV:1 / 33280                    |

**Digital or Analog Control:**

Digital control is default and if Analog control is required it is necessary to change the present value of BV:0 / 32784.

- The default value of BV:0 / 32784 is set to 1 = Digital Control, the position of the actuator (including all other functions) are controlled over the digital field bus.
- By setting BV:0 / 32784 to 0 = Analog Control the position of the actuator is controlled by the analog voltage on the input (middle cable port).

**Selection of valve type:**

After selecting Digital or Analog control, it is necessary to select the 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 17. Each number represents a specific valve type, which can be found in the table: Valve type selection. The default value is 4 (ABQM ISO DN15 valve).

**Selection of units of flow rate:**

After selecting the valve type to be controlled by the actuator, it is important to determine if the default unit of flow rate settings for AV:0 / 32768 Design Flow and AV:1 / 33280 Flow Rate Setpoint are suitable. The default settings are:

- For AV:0 / 32768 Design Flow, the default setting is L/hr (GPM if an ANSI valve is selected)
- For AV:1 / 33280 Flow Rate Setpoint, the default setting is %.

**Setting the units:**

**BACnet objects and Modbus registers usage - Advance configuration (continuous)**

If the default units value (l/h) for the object Design Flow Rate AV:0 / 32768 are not as desired, then the units may be changed by changing the present value of the object BV:4 / 32802. Note that the value for the object Actual Flow Rate Feedback AV:2 / 33282 will also change.

- BV:4 / 32802 = 0 sets the units to L/hr
- BV:4 / 32802 = 1 sets the units to %

If the default units value (%) for the object Flow Rate Setpoint Rate Input AV:1 / 33280 are not as desired, then the units may be changed by changing the present value of the object BV:5 / 32788.

- BV:5 / 32788 = 0 sets the unit to L/hr
- BV:5 / 32788 = 1 sets the unit to %

**Setting the Design Flow Rate:**

Now we come to the point where the designed maximum flow rate of the controlled system should be set if the nominal flow of the valve does not correspond to this. The Design Flow Rate is set by changing the present value of AV:0 / 32768.

Note: If the Design Flow Rate is set to more than the nominal flow value of the valve, the mechanical pre-setting on the valve should be set to maximum open (100% open is the default mechanical pre-setting from our factory).

**Calibration of Actuator to the Valve:**

After all basic settings have been set, it is now time to calibrate the actuator to the valve. By this, the actuator will adjust itself to the exact valve used, and all settings will be used correctly.

A calibration is started by setting Actuator Mode and Special Features MSV:0 / 33284 to calibration. Possible settings of present value of MSV:0 / 33284 are:

- 1. Normal (Operation)
- 2. Calibration
- 3. Flush
- 4. De-Air
- 5. Alarm (Actuator will only go into this alarm state if it cannot control the motor or some major internal errors are present)

If, and when calibration has finished successfully, MSV:0 / 33284 will change to the value 1 = Normal. This means the actuator is now ready to run in normal mode and is ready to control the flow through the valve.

**Flushing a System:**

Actuator Mode and Special Features MSV:0 / 33284 has an option, which allows the user to flush the system from a terminal. To start flush of the system set MSV:0 / 33284 to 3. This will make the actuator open up the valve completely. Flush will end when:

- MSV:0 / 33284 is set back to 1 = Normal operation
- Power is cycled.
- Or flush function times out after 1 hour.

When flush ends, it will under normal conditions, return to normal operation.

**De-Air of a system:**

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

**Controlling the actuator:**

Under normal operation of the actuator, where the flow through a valve is to be controlled, the object Flow Rate Setpoint Rate Input AV:1 / 33280 is used. The default setting for the Flow Rate Setpoint 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 from the controller only has to be set up so it regulates from 0 to 100% of the Design Flow Rate AV:1 / 33280.

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 unit selected for AV:1 / 33280 has to be l/hr, the Flow Rate Setpoint through the valve must be written to in integers representing l/hr. An example of this could be a controller writing values to the actuator in the range 0 til 450 l/hr for a DN15 valve.

**Alarms and warnings:**

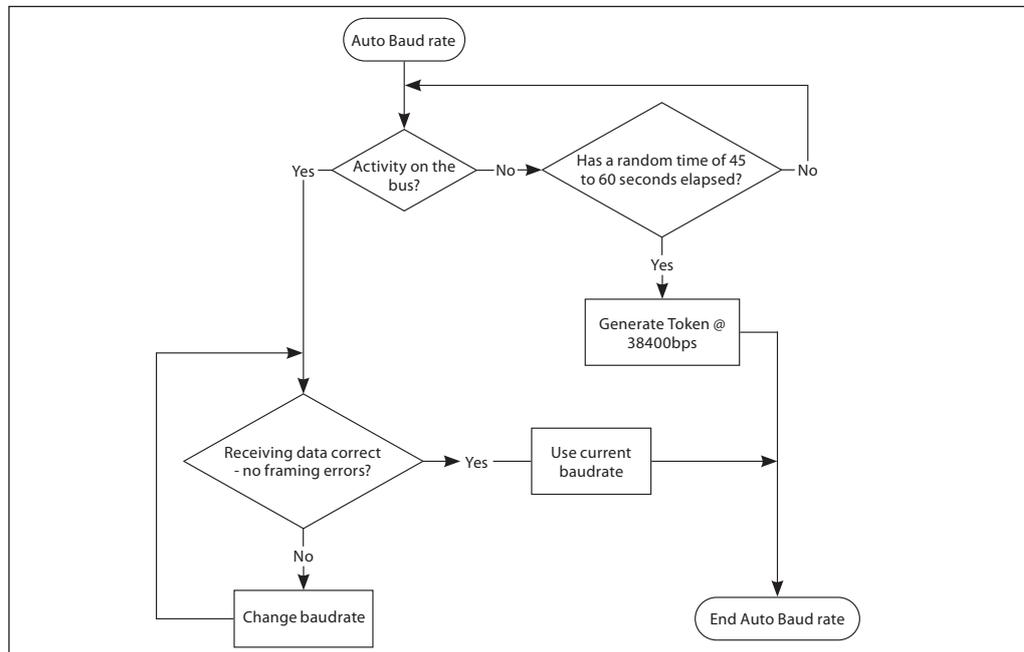
System issues can be detected by using BACnet object values BV:10 to BV:19 or Modbus register 33536, see Modbus registers for more details.

**Auto baud rate**

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

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

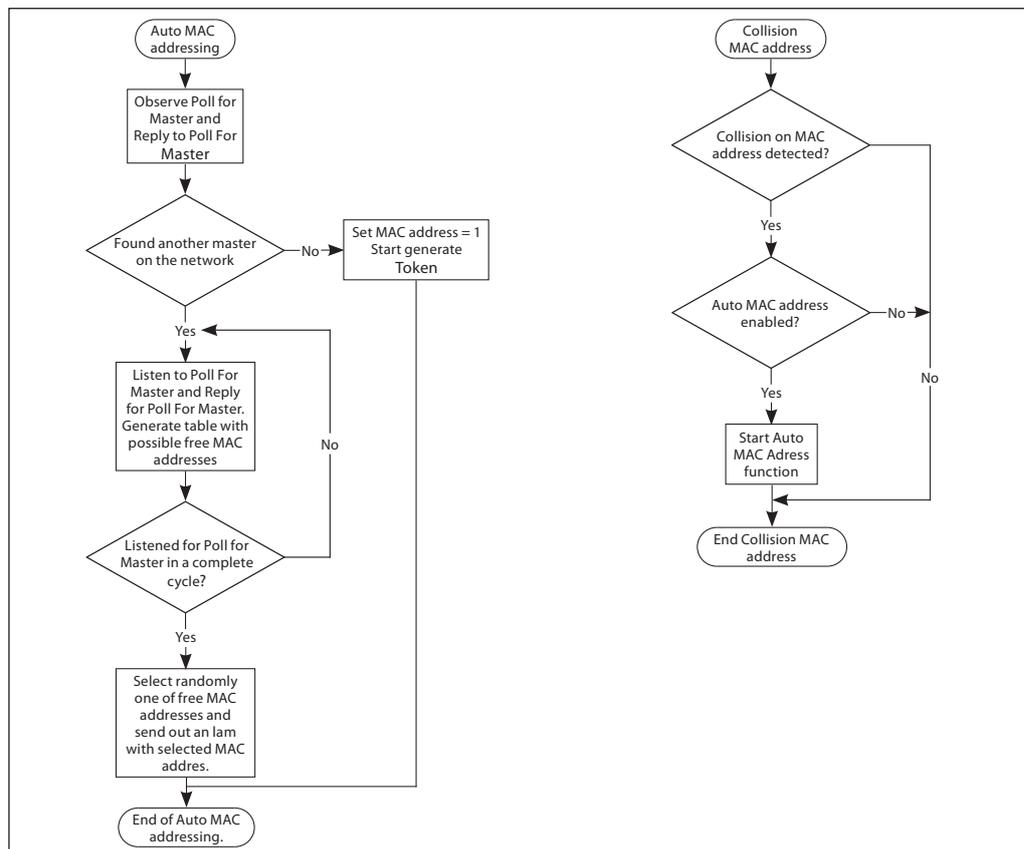
If the NovoCon® S observes activity on the bus within 45 seconds after powering up, then it adapts to the baud rate presently used on the network by other BACnet devices. If the actuator does not see activity on the network within this time, it generates a token and sends this out at the default baud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



**Auto MAC Addressing  
- BACnet only**

**MAC address assignment method MSV:5 must be set to 1 (default).**

The NovoCon® S actuator observes for used MAC addresses on the network and automatically assign an available MAC address to the actuator at first power up. If a MAC address collision appears later and Auto MAC addressing is enabled this function will start the search for a free MAC addresses again. When a free MAC address is found an "I-Am" notification will be sent out via BACnet.

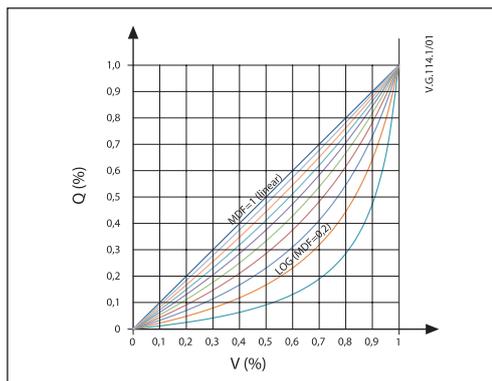


BACnet Objects - Analog Value

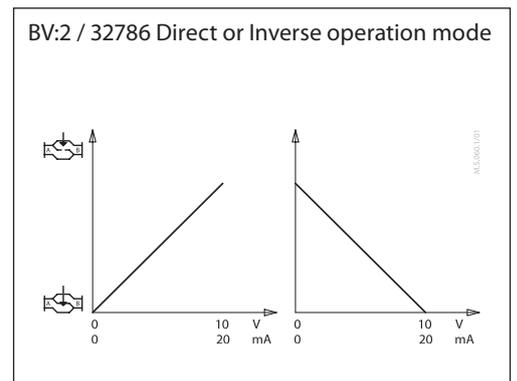
Ident	Object / Parameter name	Unit	Read/Write	Min	Max	Default	Resolution	Description	Persistent Yes/No
AV:0	Design Flow Rate	98: % 136: L/hr 89: GPM	R/W	Recommended 20% of nominal flow	Setting Range Maximum from Valve table	Nominal value from the Valve table in L/hr	0.1	Preset value for the design flow when control signal is at 100%. Unit follows BV:4	Yes
AV:1	Flow Rate Setpoint	98: % 136: L/hr 89: GPM	R/W	0	100% or Design Flow value	100%	0.01	The Flow Rate Setpoint through the valve. Unit follows BV:5	No
AV:2	Actual Flow Rate feedback	% , L/hr, GPM	R	0	If L/hr (GPM) is selected in BV:4 then the valve flow rate is set to the selected valve's (MSV:3) maximum value. Otherwise 100%	na	0.001	Flow rate indication based on the position of the Actuator stem. Unit follows BV:4	No
AV:3	Control Fallback Time	72: Minutes	R/W	0	60	10	1	Time before actuator reacts to a missing 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 (select in BV:1) to fit the characteristic curve of a heat exchanger. Linear setting: MDF=1. See curve below table. If AV:1 is in L/hr in Digital mode, the alpha setting is ignored.	Yes
AV:5	Valve closing or opening time	73: Seconds	R/W	18	700	na	1	The time the actuator needs to move from 0% to 100% of Design Flow.	Yes
AV:6	Rectified voltage measured by the actuator	Volts	R	12	50	0	0.01	Rectified voltage which powers the actuator. Too low voltage: 16,1-17,5V. Too high voltage: 38,3-43,4V.	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.	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 a valve.	Yes
AV:12	Minutes since fully closed	Minutes	R	0	MAX	na	1	Minutes since the last time the valve was fully closed.	Yes
AV:13	Minutes Since Fully Opened	Minutes	R	0	MAX	na	1	Minutes since the last time the valve was fully opened.	Yes
AV:14	Total steps taken by the actuator	na	R	0	MAX	na	1	Total steps taken by the actuator since first power ON	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 production time.	na
AV:21	The name of the Selected valve is shown here	L/hr or GPM, Unit type comes from Valve Table	R	na	na	na	1	Nominal flow of the selected valve type.	na
AV:22	Valve position at nominal flow	Millimetre	R	na	na	na	1	Position in mm for nominal flow of the selected 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 valve.	na
AV:24	The name of the User Defined Valve is shown here	136: L/hr or 89: GPM. Unit type written here is copied to the Valve Table. Default: L/hr	R/W	1	5000	450	0.1	Name and Nominal Flow for the User Defined Valve. This Object is used only if NovoCon® S is not used with an AB-QM valve. Please 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	1.5	5.8	2.25	0.01	Position in mm for nominal flow of the User Defined Valve. This Object is used only if NovoCon® S 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 only if NovoCon® S is not used with an AB-QM valve. Please contact your Danfoss representative to verify if the desired connection is possible.	Yes

Note! Units L/hr (ISO) and GPM (ANSI) are decided by the valve selection.

AV:4 / 32772 Alpha Value Curve



BV:2 / 32786 Direct or Inverse operation mode



**BACnet Objects  
- Binary Value**

Ident	Object / Parameter name	Read/Write	Active Text (1)	Inactive Text (0)	Default	Description	Persistent Yes/No
BV:0	<b>Analog or Digital control</b>	R/W	Digital	Analog	Digital	Selects between analog or digital control of the flow.	Yes
BV:1	LOG or Manual Defined Function (MDF) mode	R/W	MDF (controlled by Alpha Value)	LOG	MDF	Selection of LOG or MDF (controlled by Alpha Value) mode.	Yes
BV:2	Direct or Inverse operation Mode	R/W	Inverse	Direct	Direct	Select here between Direct and Inverse operation mode.	Yes
BV:4	Units used to set and display the Design Flow	R/W	%	L/hr or GPM for ANSI version	L/hr or GPM for ANSI version	Units used to set and display the Design Flow.	Yes
BV:5	Units used to set and display the Flow Rate Setpoint	R/W	%	L/hr or GPM for ANSI version	%	Units used to set and display the Flow Rate Setpoint.	Yes

Ident	Object / Parameter name	Read/Write	Active Text (1)	Inactive Text (0)	Description	Persistent Yes/No
BV:10	Warning: Temperature of the actuator is out of recommended range	R	ON	OFF	The Temperature inside the Actuator is out of the recommended range.	No
BV:11	Alarm: No Control Signal	R	ON	OFF	The actuator has detected that it has no control signal in.	No
BV:12	Alarm: Error during Closing	R	ON	OFF	Actuator can't close the valve completely.	No
BV:14	Warning: Voltage of power supply is too high	R	ON	OFF	Voltage of power supply is measured to be too high. When the measured voltage exceeds 43,4V the alarm will be turned ON for too high voltage. When the measured voltage is below 38,3V again the alarm will be turned OFF.	No
BV:15	Warning: Voltage of power supply is too low	R	ON	OFF	Voltage of power supply is measured to be too low. When the measured voltage level drops below 16,5V the alarm will be activated for too low voltage. When the measured voltage level drops below 16,1V the motor will also be turned off. When the measured voltage is above 17,5V again the motor will be activated again.	No
BV:16	Alarm: Error during Calibration	R	ON	OFF	There was an error during calibration of actuator.	No
BV:17	Warning: BACnet MAC-address Conflict was Detected	R	ON	OFF	Two or more devices on the BACnet have the same MAC-address.	No
BV:18	Warning: Faults on the BACnet was detected	R	ON	OFF	Problems with communication on the network are detected.	No
BV:19	Alarm: An internal Error has been detected	R	ON	OFF	Re-calibrate or power cycle actuator to reset - actuator replacement can be necessary	No

**BACnet Objects  
- Multi State Value**

Ident	Object / Parameter name	Read/Write	State Text	Default State	Description	Persistent Yes/No
MSV:0	<b>Actuator Mode and special features</b>	R/W	1: Normal 2: Calibration 3: Flush <sup>1)</sup> 4: De-Air <sup>2)</sup> 5: Alarm	1: Normal	Shows present mode of actuator. Calibration, flushing and de-air can be started from here.	Yes
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 input type and range.	Yes
MSV:2	Missing Control Signal Fallback Action	R/W	1: No action 2: CLOSE 3: OPEN 4: Go to 50% of Design Flow	1: No action	What the actuator shall do if control signal is lost.	Yes
MSV:3	<b>Selected Valve Type</b>	R/W	See table "Valve Type Selection"	4: AB-QM DN 15	This is the valve type. 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	4: 24 sec/mm	Amount of time for actuator to move 1mm or alternatively selection of a constant time.	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	The MAC address selection method. 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 only alarms 3: All LED's OFF 4: Blink	1: Normal LED mode	Select here the usage of the LED's for example Normal or Blink or all OFF.	Yes
MSV:8	Select field bus protocol	R/W	1: DIP switch 2: BACnet 3: Modbus	1: DIP switch	Selection of field bus protocol.	Yes

<sup>1)</sup> Opens the valve fully for one hour or until a new state is selected

<sup>2)</sup> Opens and closes the valve 5 times at maximum speed

**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 S" + 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	NO SEGMENTATION	R	Actuator does not support segmentation.	Yes
Max-master	Default: 127 Range: 0-127	R/W	The MAX_master setting in NovoCon shall be set to the number of devices (or the highest used MAC address) in the MS/TP sub network.	Yes

**BACnet Objects  
- Analog Input**

Ident	Object / Parameter name	Unit	Resolution	Description	Persistent Yes/No
AI:0	Voltage(V) or Current(mA) level measured on the analog control input	Volt / mA	0.001	Voltage or Current control signal measured by the actuator	No

**BACnet Objects  
- Notification class**

Ident	Object / Parameter name	Description	Persistent Yes/No
NC:0	Alarm Notifier, Subscribe here for alarms	Subscribe here devices for receiving alarms	Yes

NC:0 is an object where other BACnet devices can subscribe to be informed directly from this device if an alarm or warning is set or cleared. A maximum of 4 devices can subscribe to this service. Subscribers of this object will be informed if one of the Warning or Alarms BV:10 to BV:20 is set 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 – BV20), it is 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 due to that 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	Average of the rectified voltage which powers the actuator.	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	AB-QM ISO DN 10LF	150	L/hr	2.25	120
2	AB-QM ISO DN 10	275	L/hr	2.25	120
3	AB-QM ISO DN 15LF	275	L/hr	2.25	120
4 <sup>1)</sup>	AB-QM ISO DN 15	450	L/hr	2.25	120
5	AB-QM ISO DN 20	900	L/hr	2.25	120
6	AB-QM ISO DN 25	1700	L/hr	4.5	110
7	AB-QM ISO DN 32	3200	L/hr	4.5	110
8	AB-QM ANSI DN ½" LF	1.2	GPM	2.25	100
9	AB-QM ANSI DN ½"	2	GPM	2.25	100
10	AB-QM ANSI DN ½" HF	5	GPM	4	100
11	AB-QM ANSI DN ¾"	4	GPM	2.25	100
12	AB-QM ANSI DN ¾" HF	7.5	GPM	4	100
13	AB-QM ANSI DN 1"	7.5	GPM	4.5	100
14	AB-QM ANSI DN 1" HF	12	GPM	4.5	100
15	AB-QM ANSI DN 1¼"	14.1	GPM	4.5	100
16	AB-QM ANSI DN 1¼" HF	17.5	GPM	4.5	100
17 <sup>2)</sup>	"User Defined Valve"	NF	UF	VPNF	SRM

<sup>1)</sup> Default

<sup>2)</sup> The "User Defined Valve" is used only if NovoCon® S is not used with an AB-QM 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	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
GetAlarmSummary	AE-ASUM-B	exe
AddListElement	DM-LM-B	exe
RemoveListElement	DM-LM-B	exe

**DIP Switch Settings**

**BACnet:**

Auto MAC addressing is default. For manual MAC addressing using DIP Switches, MSV:5 must be set to: DIP Switch Settings.

**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 Switched are left in the default positions.

DIP Switch	Configuration name	OFF state (default)	ON state
1.	BACnet address / Modbus unit ID bit 0	Logic '0'	Logic '1'
2.	BACnet address / Modbus unit ID bit 1	Logic '0'	Logic '1'
3.	BACnet address / Modbus unit ID bit 2	Logic '0'	Logic '1'
4.	BACnet address / Modbus unit ID bit 3	Logic '0'	Logic '1'
5.	BACnet address / Modbus unit ID bit 4	Logic '0'	Logic '1'
6.	BACnet address / Modbus unit ID bit 5	Logic '0'	Logic '1'
7.	BACnet address / Modbus unit ID bit 6	Logic '0'	Logic '1'
8.	Termination resistor (120Ω)	No termination	Termination resistor enabled <sup>1)</sup>
9.	Not used		
10.	-	BACnet MS/TP <sup>2)</sup>	Modbus RTU <sup>2)</sup>

<sup>1)</sup> The actuator possesses a resistor, DIP Switch no. 8, that can be activated in the last actuator on the bus for correct termination of the bus.

<sup>2)</sup> When protocol is changed on DIP Switch no. 10, a power cycle is required to make the actuator adopt the newly selected protocol.

**DIP Switch Settings  
- Manual Addressing**

MAC address 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

**Modbus registers - Configuration**

Modbus register	Read/Write	Modbus function	Modbus Data Type	Object / Parameter name	Description	Default	Unit	Description of usage	Persistent Yes/No
<b>0x8000</b> <b>32768</b>	R/W	3,4 & 16	FLOAT	<b>Design Flow Rate</b>	Preset value for the design flow when control signal is at 100%. Unit follows 0x8013	Nominal value from the Valve table in L/hr	%, L/hr, GPM	Design Flow Rate in Liters per hour i.e. 150...450 correspond to L/hr 150...450 L/hr or in percent, i.e. 20... 100 correspond to 20... 100%	Yes
0x8002 32770	R/W	3,4 & 6	WORD	Control Fallback Time	Time before actuator reacts to a missing 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, select in 32785, to fit the characteristics curve of a heat exchanger. If 33280 is in L/hr 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 linear. Alpha = 0.2 is equal to the LOG function	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	na	Seconds	Valve closing or opening time in seconds i.e. 18... 700 correspond to 18... 700 seconds	Yes
0x8008 32776	R	3 & 4	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® S is not used with an AB-QM valve. Please contact your Danfoss representative to verify if the desired connection is possible.	na	L/hr or GPM, Unit type comes from Valve Table	Nominal flow e.g. in Liters per hour i.e. 0...450 correspond to 0...450 L/hr	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® S is not used with an AB-QM valve. Please contact your Danfoss representative to verify if the desired connection is possible.	2.25	Millimetre	Valve position for nominal flow in millimetre, i.e. 0.5... 5.8 correspond to 0.5... 5.8 millimetre	Yes
0x800C 32780	R/W	3,4 & 6	FLOAT	Maximum value for the Design Flow Rate in the User Defined Valve	Maximum level the Design Flow Rate can be increased to for the User Defined Valve. This Object is used only if NovoCon® S 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/hr or GPM)	i.e. 0...150 correspond to 0...150 %	Yes
<b>0x8010</b> <b>32784</b>	R/W	3,4 & 6	WORD	<b>Analog or Digital control</b>	Selects between analog or digital control of the flow	1: Digital	na	Selects between 0: Analog or 1: Digital control of the flow	Yes
0x8011 32785	R/W	3,4 & 6	WORD	LOG or Manual Defined Function (MDF) mode	Selection of LOG or MDF (controlled by Alpha value) mode"	1: MDF	na	Selection of 0:LOG or 1: MDF (controlled by Alpha Value) mode	Yes
0x8012 32786	R/W	3,4 & 6	WORD	Direct or Inverse operation Mode	Select here between Direct and Inverse operation mode	0: Direct	0: Direct 1: Inverse	Select 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	Units used to set and display the Design Flow	0: L/hr or GPM for ANSI versions	0: L/hr / GPM 1: %	Units used to set and display the Design Flow. Select between L/hr and % for European versions or GPM and % for ANSI versions	Yes
0x8014 32788	R/W	3,4 & 6	WORD	Units used to set and display Flow Rate Setpoint	Units used to set and get the Flow Rate Setpoint	1: %	0: L/hr / GPM 1: %	Units used to set and display the Flow Rate Setpoint Select between % and L/hr or GPM for ANSI versions	Yes
0x8016 32790	R/W	3,4 & 6	WORD	Units used to set and display Temperature	Select between °C or °F to set and display temperature inside the actuator	0: °C	0: °C 1: °F	Units used to set and display temperature inside the actuator.	Yes
0x801A 32794	R/W	3,4 & 6	WORD	Endian type	Byte ordering for LONG and FLOAT types	0: Big	0: Big 1: Little	Used endian type for float and long registers	Yes
0x8020 32800	R/W	3,4 & 6	WORD	Analog Control signal type and range	Used to select the analog control input type and range	2: 0-10 VDC	V / mA	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

**Configuration (continuous)**

Modbus register	Read/Write	Modbus function	Modbus Data Type	Object / Parameter name	Description	Default	Description of usage	Persistent Yes/No
0x8021 32801	R/W	3,4 & 6	WORD	Missing Control Signal Fallback Action	What the actuator shall do if control signal is lost	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
<b>0x8022</b> <b>32802</b>	R/W	3,4 & 6	WORD	<b>Selected Valve Type</b>	This is the valve type the actuator is set-up to control	4: AB-QM DN 15	See table "Valve Type Selection 1-17"	Yes
0x8023 32803	R/W	3,4 & 6	WORD	Actuator Speed	Amount of time for actuator to move 1 mm or alternatively selection of a constant time	4: 24 sec/mm	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	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	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	Slave ID used for communication	Yes
0x8027 32807	R/W	3,4 & 6	WORD	Slave ID assignment method	The Slave ID address selection method	1: DIP Switch Settings	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 field bus protocol. See DIP Switch Setting section of the data sheet	1: DIP switch	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	Select here the usage of the LEDs for example Normal or Blink or all OFF	1: Normal LED mode	Select 1, 2 or ... based on the table below: 1: Normal LED mode 2: Show only alarms 3: All LED's OFF 4: Blink (can be used to locate the actuator)	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 setting will be reverted to factory setting.	na	0x5741 / 22337: Warm reset. 0x434F / 17231: Cold reset.	Yes

**Operating**

Modbus register	Read/Write	Modbus function	Modbus Data Type	Object / Parameter name	Description	Default	Unit	Description of usage	Persistent Yes/No
<b>0x8200</b> <b>33280</b>	R/W	3,4 & 16	FLOAT	<b>Flow Rate Setpoint</b>	The Flow Rate Setpoint through the valve. Unit follows 32788	100%	% , L/hr, GPM	Flow Rate Setpoint input in percent, i.e.0 ... 100 correspond to 0 ... 100%	No
<b>0x8202</b> <b>33282</b>	R	3 & 4	FLOAT	<b>Actual Flow Rate feedback</b>	Flow Rate Indication based on the position of the Actuator stem. Unit follows 32787	na	% , L/hr, GPM	Design Flow Rate feedback in percent, i.e.0 ... 100 correspond to 0 ... 100%. If L/hr (GPM) is selected in 32787 then the valve flow rate is set to the selected valve's 32776 maximum value. Otherwise 100%	No
<b>0x8204</b> <b>33284</b>	R/W	3,4 & 6	WORD	<b>Actuator Mode and special features</b>	Shows present mode of actuator. Calibration, Flush and de-air can 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

**Alarms & warning**

Modbus register	Read/Write	Modbus function	Modbus Data Type	Object / Parameter name	Description	Default	Unit	Description of usage	Persistent Yes/No
0x8300 33536	R	3&4	LONG	Alarm: No Control Signal	The actuator has detected that is has no control signal in	0: OFF	na	Bit 0: 0:OFF; 1:ON	No
				Alarm: Error during Closing	Actuator cannot close the valve completely	0: OFF	na	Bit 1: 0:OFF; 1:ON	No
				Alarm: Error during Calibration	There was an error during calibration of actuator	0: OFF	na	Bit 2: 0:OFF; 1:ON	No
				Alarm: An internal Error has been detected	Re-calibrate or power cycle actuator to reset - actuator replacement can be necessary	0: OFF	na	Bit 3: 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	na	Bit 16: 0:OFF; 1:ON	No
				Warning: Voltage of power supply is too high	Voltage of power supply is measured to be too high. When the measured voltage exceeds 43,4V the alarm will be turned ON for too high voltage. When the measured voltage is below 38,3V again the alarm will be turned OFF	0: OFF	na	Bit 18: 0:OFF; 1:ON	No
				Warning: Voltage of power supply is too low	Voltage of power supply is measured to be too low. When the measured voltage level drops below 16,5V the alarm will be activated for too low voltage. When the measured voltage level drops below 16,1V the motor will also be turned off. When the measured voltage is above 17,5V again the motor will be activated again	0: OFF	na	Bit 19: 0:OFF; 1:ON	No
				Warning: Faults on communication was detected	Problems with Communication on the network are detected	0: OFF	na	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	na	Bit 22: 0:OFF; 1:ON	No				

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 type	450	L/hr or GPM, Unit type comes from Valve Table	Nominal flow e.g. in Litres per hour i.e. 0 ..450 correspond to 0 ... 450 L/hr.	na
0x8102 33026	R	3 & 4	FLOAT	Valve position at nominal flow	Position in mm for nominal flow of the selected valve	na	L/hr or GPM, Unit type comes from Valve Table	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 for the Design Flow Rate	Maximum level the Design Flow can be increased to for the selected valve	Setting Range Maximum from Valve table	%	Maximum level of the Design Flow in percent, i.e..20 ... 100 correspond to 20 ... 100%.	na
0x8120 33056	R/W	3, 4, 16 & 43	STRING	Device name	Product name	NovoCon S	na	Ascii coded STRING	Yes
0x8140 33088	R	3, 4 & 43	STRING	Model name	Type of the actuator	Digital or Hybrid	na	wAscii coded STRING	Yes
0x8160 33120	R	3, 4 & 43	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
0x8400 33792	R	3 & 4	FLOAT	Voltage(V) or Current(mA) level measured on the analog control input	Voltage or Current control signal measured by the actuator	na	Volt / mA	Voltage or Current control signal measured by the actuator.	No
0x8402 33794	R	3 & 4	FLOAT	Rectified voltage measured by the actuator	Measured rectified voltage which powers the actuator	na	Volt	Rectified voltage which powers the actuator. Too low voltage: 16,1-17,5V. Too high voltage: 38,3-43,4V.	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	Total steps taken by the actuator	Total steps taken by the actuator since first power ON	na	na	Total steps taken by the actuator since first power ON	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	Yes
0x8412 33810	R	3 & 4	LONG	Minutes since last calibration	Minutes since the last time the actuator was calibrated to a 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 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 valve was fully opened	Minutes	Minutes	Minutes since the last time the valve was fully opened	Yes

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. Common ground shall be used for all devices on the same network inclusive router, gateways etc.**

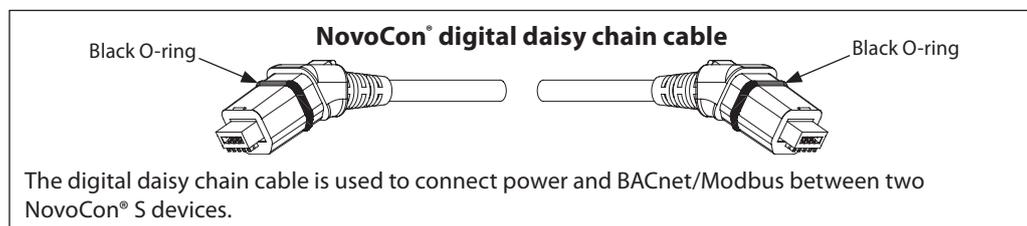
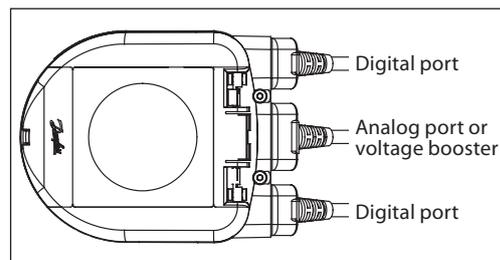
All BACnet bus connections in the cables are made with twisted wires.

The cable type used for all NovoCon® cables is AWG22/0.32mm<sup>2</sup>.

If other cables are used to extend the length, always use twisted pair wire for bus signal and include ground for the bus signal. The recommended cable type for this is AWG22/0.32 mm<sup>2</sup>. If used for longer distances please use a AWG20/0.5mm<sup>2</sup> or AWG18/0.75mm<sup>2</sup> cable. The cables characteristic impedance shall be between 100-130Ω The capacitance between conductors shall be less than 100 pf per meter. Note: the length of the cables influence on the communication speed. Longer cable lengths should mean lower baud rate. Maximum cable length allowed is 1200m.

Use a minimum 20 cm distance between 110V/230V/400V power line cables and bus cables.

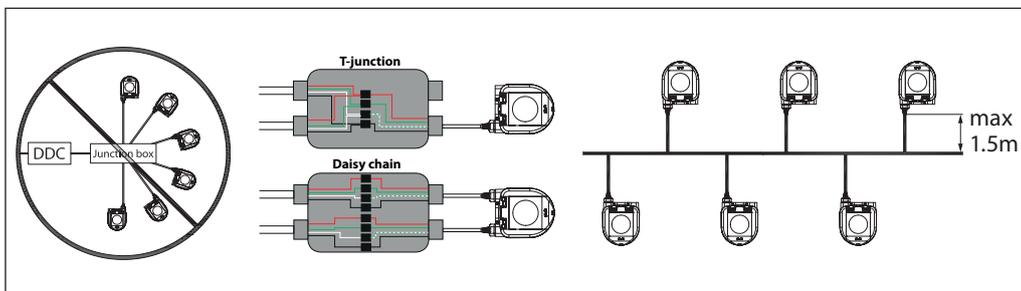
NovoCon® S has mis-wiring protection on any wire up to 30 V AC and DC, however the external power supply may be damaged if connecting AC power to the Analog input through the NovoCon® analog cable.





**Daisy chain** *(continued)*

Use daisy chain connection for NovoCon® S. T-junction/bus configuration shall not be used. Danfoss recommend that star topology is NEVER used with NovoCon® as debugging the system becomes very difficult. In special cases, where a T-junction has to be used, Danfoss recommends a maximum T-junction length of 0.3 m length with limited amount of T-junctions. Be aware that making these type of connections to the RS485 terminal i.e. drops instead of connections, may give the electrical signals complicated paths which may lead to reflections and harmonics. Twisted pair cables must always be used.



- Rules for Daisy chain and additional voltage booster.
- 24 Volt AC: Maximum 7 NovoCon® S from a voltage (booster) point to an actuator.
- 24 Volt DC: Maximum 11 NovoCon® S from a voltage (booster) point to an actuator.

Using this distribution of voltage boosters will assure enough power supply voltage to all NovoCon® S on network and limit max current to permissible level. You can use NovoCon® object AV:6 / 33794 in order to verify power supply voltage.

If the supply voltage to the first device in the daisy chain is lower than 24V AC/DC, or long thin cables other than NovoCon® cables are used, then the quantity of devices in the daisy chain may have to be reduced.

Recommended maximum quantities of NovoCon® S Digital & Hybrid are 64 pcs in one daisy chain connection. If other BACnet devices are added with NovoCon® S in the same daisy chain connection we recommend a maximum of 32 pcs. in order to assure appropriate network speed.

We recommend NovoCon® S to be used on its own sub-network for optimal performance.

General requirements:

- Use Danfoss daisy chain cable to connect two NovoCon® S.
- Use Danfoss digital cable to connect NovoCon® S and another BACnet device.
- Current in cables should not exceed 3Arms at 30°C.
- Use termination resistor (DIP switch 8) on the end of daisy chain.
- Use Danfoss analog cable as voltage booster to increase voltage.
- Same power supply is preferred.
- If two power supplies are used they must have same polarity and common ground.
- Common ground shall be used for all devices on the same network including routers and gateways.
- Galvanic separation shall be provided for segments crossing buildings.
- Connect Power ground and Analog input ground on the Controller.
- Maximum cable length 1200m.

**Optimize BACnet network speed**

**Reducing Unnecessary PollforMaster Traffic**

Setting for the last NovoCon® in the daisy chain:

The MAX\_MASTER setting in NovoCon® shall be set to the number of devices (or 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. It should be noted that the MAX\_MASTER property value should be adjusted accordingly at a later stage if more devices are added to the network and/or the highest MAC address exceeds the MAX\_MASTER property value.

Before MAX\_MASTER can be set it is needed to ensure all devices are within the MAX\_MASTER value. If MAX:MASTER is set to 20 communication will not work with a device, which uses MAC address 22, even though e.g. MAC address 15 is not used.

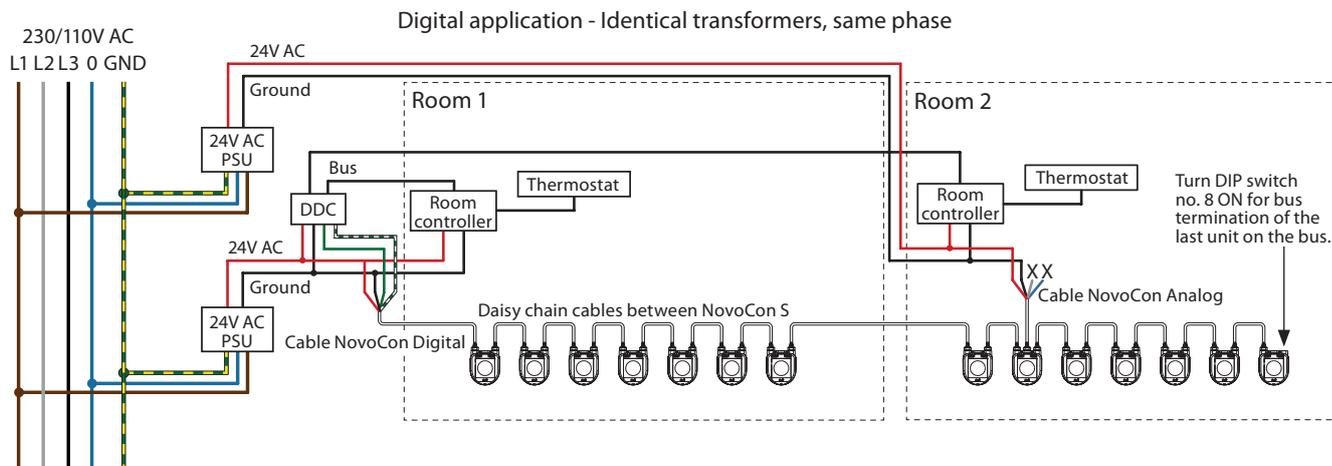
**Allocating Correct INFO\_FRAMES**

Setting for Controller:

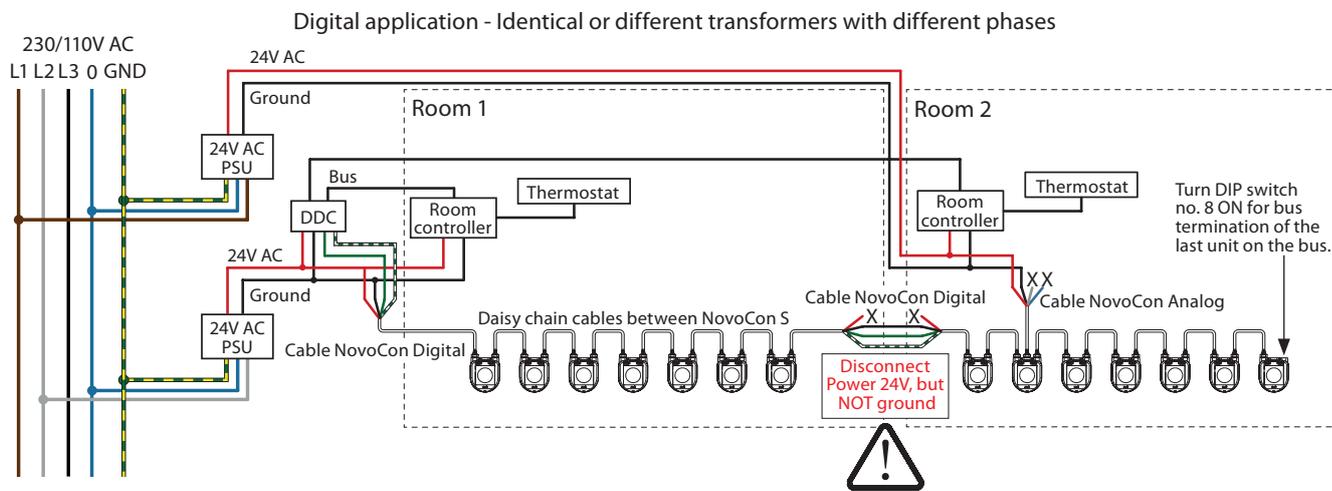
Network Routers and Controller devices that transport traffic in the MS/TP network require a higher number of INFO\_FRAMES than NovoCon®. Therefore, these devices should have a higher value than NovoCon® e.g. A general rule of thumb for the sub network router's MAX\_INFO\_FRAMES property value is equal 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.



**Wiring with AC power supply:**



**If the NovoCon S 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 damaged if one of the other power boosters in the network is disconnected.**



Wires that ends in an "X" must be properly terminated.

## Tender text

**NovoCon® S Digital & Hybrid actuator with BACnet MS/TP and Modbus RTU**

Modulating geared actuator with bus connectivity used to control pressure independent balancing and control valves DN10-32.

Control signal: BACnet MS/TP, Modbus RTU, 0-10V/2-10V, 0-20/4-20mA

Actuator functions remotely accessible via the bus:

- design flow pre-setting
- flushing the valve and terminal unit
- error during closing intrinsic alarm reporting
- LIN/LOG/ $\alpha$ -setting characteristics setting

- speed selection 3/6/12/24 s/mm
  - opening/closing time selection from 18s to 700s
  - auto BACnet addressing
  - auto Baud rate detection
  - flow indication based on measured stroke in l/h
- Supply Voltage: 24V AC/DC  
Spindle position accuracy:  $\pm 0.05$ mm  
Cables: Halogen free plug-in available in 1.5m, 5m and 10m length  
IP Class: 54  
Stroke: 7mm  
Manual operation

## Trouble shooting

**BACnet Fieldbus check:**

It is possible to check the fieldbus state by examining error messaging related to the actuator, in order to verify communication and detect early potential fieldbus related problems. This is done by the object values AV:15 to AV:19.

**Quality of the BACnet network:**

An important thing for good operation of the actuator is a well working network. Some values that tell you about the quality of the network can be found in the objects AV:15 to AV:19. The important values are AV:17 Server Error Count and AV:19 Server Timeout Error. These two values shall be much lower than AV:15, AV:16 and AV:18. If in doubt, then it is important that AV:17 and AV:19 are not increasing their count all the time.

**Quality of power supply:**

The object / register AV:6 / 32794 may be used to check if the power supply and cabling used to supply the actuator with power, is according to specification requirements. The present value of AV:6 / 32794 represents the current voltage measured inside the actuator. This is the voltage that the actuator monitors at all times and subsequently reacts on if outside the recommended range. See in the table below how the actuator reacts at different voltage levels.

Voltage (Present value of AV:6 / 32794)	Reaction
Voltage below 16.5V	Start alarm indication with LED. Initiate and alarm BV:15 / 33536 Bit 19 via BACnet (if subscribed to) and that the supply voltage is too low.
Voltage below 16.1V	Motor is stopped. The LEDs indicating alarm and BACnet still initiating alarm BV:15 / 33536 Bit 19 (if subscribed to) if the voltage hasn't dropped too low.
When voltage rises above 17.5V again	Motor can run again. LED alarm indication stops and returns to normal operation. BACnet alarm BV:15 / 33536 Bit 19 returns to normal operation.
When voltage rises above 43.4V	Start alarm indication with LED. Initiate and alarm BV:14 / 33536 Bit 18 via BACnet (if subscribed to).
When voltage drops below 38.3V again	LED alarm indication stops and returns to normal operation. BACnet alarm BV:14 / 33536 Bit 18 returns to normal operation.

**NB:** the voltage level will be constantly changing depending on the operational activity of the entire group of actuators and other devices connected. The supply voltage will go up and down in value if:

- Power supply is not strong and stable
- If long cables are used in a daisy chain setup

A higher number of actuators running at the same time will reduce the supply voltage (for the last devices on a daisy chain cable, in particular).

The actuator's voltages are considered to be OK when all values of AV:6 / 32794 are above 18V, when all actuators are moving the motor/running. To ensure voltage in each device is OK under worst case operational conditions, the following is recommended:

- Run all the actuators on the daisy chain cable at the same time. While all are running, check each value of AV:6 / 32794. These values should still be above 18V and no previously mentioned voltage level alarms should be initiated or indicated. If LEDs indicate an alarm state or a BACnet alarm is initiated, or a value less than 18V is observed, then cabling should be reviewed.
- Check the values of AVO:0. This BACnet object holds 3 values: Average measured voltage, Maximum measured voltage and Minimum measured voltage. The most important value here is the Minimum measured voltage. It can tell you the lowest voltage that has been measured during operation of the actuator.