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

<table>
<thead>
<tr>
<th>Type</th>
<th>Code No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>NovoCon® S Digital &amp; Hybrid</td>
<td>003Z8502</td>
</tr>
</tbody>
</table>

Accessories

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

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

Service kit - combination with old AB-QM

<table>
<thead>
<tr>
<th>Type</th>
<th>Code No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>NovoCon® adapter for AB-QM, DN 10-32 (5 pcs.)</td>
<td>003Z20239</td>
</tr>
</tbody>
</table>

Approvals

RoHS Directive 2011/65/EU
**Technical data**

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

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

**BACnet data**

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

**Modbus RTU data**

<table>
<thead>
<tr>
<th>Supported baud rates</th>
<th>Auto baud rate detection* / 9600 bps / 19200 bps / 38400 bps / 56700 bps / 76800 bps / 115200bps</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supported transmission modes</td>
<td>Parity: None (1-8-N-2) / Odd (1-8-O-1) / Even (1-8-E-1) / None (1-8-N-1) / Auto parity*</td>
</tr>
<tr>
<td>Data format: Parity (Start bit - Data bits - Parity - Stop bits)</td>
<td></td>
</tr>
</tbody>
</table>

* Default

**Dimensions**

![Dimensions Diagram]
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

**LED Display**

**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)

<table>
<thead>
<tr>
<th>Movement of valve/actuator</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1" alt="Diagram" /> → <img src="image2" alt="Diagram" /></td>
<td>NovoCon® S is closing the valve. All green LEDs are turned ON, then turned OFF one at the time (repeatedly).</td>
</tr>
<tr>
<td><img src="image3" alt="Diagram" /> → <img src="image4" alt="Diagram" /></td>
<td>NovoCon® S is opening the valve. All green LEDs are turned OFF, then turned ON one at the time (repeatedly).</td>
</tr>
<tr>
<td><img src="image5" alt="Diagram" /> → <img src="image6" alt="Diagram" /></td>
<td>NovoCon® S is calibrating. Green light moves forward and backwards, one by one.</td>
</tr>
<tr>
<td><img src="image7" alt="Diagram" /> → <img src="image8" alt="Diagram" /></td>
<td>De-air is active. Yellow LEDs are turned ON one by one, then turned OFF one by one (repeatedly).</td>
</tr>
</tbody>
</table>

### Information from actuator

- **Blinking function**: All green LEDs turn 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.
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.

Initial configuration

- BV:0 / 32784 Digital control (default) or Analog control
- MSV:3 / 32802 Select Valve Type
  (default AB-QM DN 15)
- AV:0 / 32768 Design Flow Rate

BACnet objects and Modbus registers usage
- Advance configuration

If the default setup of the actuator isn’t suitable, special attention has to be payed 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:
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 / 3282 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 is it also possible to start the De-Air function in the actuator. This function will open an close the valve a number 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.

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Auto MAC Addressing

*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

<table>
<thead>
<tr>
<th>Ident</th>
<th>Parameter Name</th>
<th>Read/Write</th>
<th>Min</th>
<th>Max</th>
<th>Resolution</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AV:0</td>
<td>Design Flow Rate</td>
<td>R/W</td>
<td>98: %</td>
<td>89: L/hr</td>
<td>0.1</td>
<td>Nominal value from valve table</td>
</tr>
<tr>
<td>AV:1</td>
<td>Flow Rate Setpoint</td>
<td>R/W</td>
<td>98: %</td>
<td>89: L/hr</td>
<td>0.01</td>
<td>The Flow Rate Setpoint through the valve</td>
</tr>
<tr>
<td>AV:2</td>
<td>Actual Flow Rate Feedback</td>
<td>%, L/hr, GPM</td>
<td>0</td>
<td>100%</td>
<td>0.001</td>
<td>Flow rate indication based on the position of the actuator</td>
</tr>
<tr>
<td>AV:3</td>
<td>Control Fallback Time</td>
<td>R/W</td>
<td>72: Minutes</td>
<td>60</td>
<td>10</td>
<td>1</td>
</tr>
<tr>
<td>AV:4</td>
<td>Valve Value</td>
<td>R/W</td>
<td>95: No units</td>
<td>1.0</td>
<td>1.0</td>
<td>0.01</td>
</tr>
<tr>
<td>AV:5</td>
<td>Valve closing or opening time</td>
<td>R/W</td>
<td>73: Seconds</td>
<td>700</td>
<td>na</td>
<td>1</td>
</tr>
<tr>
<td>AV:6</td>
<td>Rectified voltage measured</td>
<td>Volts</td>
<td>0</td>
<td>50</td>
<td>0.01</td>
<td>Rectified voltage which powers the actuator</td>
</tr>
<tr>
<td>AV:7</td>
<td>MAC Address</td>
<td>R/W</td>
<td>95: No units</td>
<td>128</td>
<td>na</td>
<td>1</td>
</tr>
<tr>
<td>AV:8</td>
<td>Temperature in the Actuator</td>
<td>R</td>
<td>-20</td>
<td>100</td>
<td>0.5</td>
<td>Temperature measured inside the actuator</td>
</tr>
<tr>
<td>AV:9</td>
<td>Total Operating Hours</td>
<td>R</td>
<td>0</td>
<td>MAX</td>
<td>na</td>
<td>1</td>
</tr>
<tr>
<td>AV:10</td>
<td>Minutes since last power-up</td>
<td>R</td>
<td>0</td>
<td>MAX</td>
<td>na</td>
<td>1</td>
</tr>
<tr>
<td>AV:11</td>
<td>Minutes since last calibration</td>
<td>R</td>
<td>0</td>
<td>MAX</td>
<td>na</td>
<td>1</td>
</tr>
<tr>
<td>AV:12</td>
<td>Minutes since fully closed</td>
<td>R</td>
<td>0</td>
<td>MAX</td>
<td>na</td>
<td>1</td>
</tr>
<tr>
<td>AV:13</td>
<td>Minutes since fully opened</td>
<td>R</td>
<td>0</td>
<td>MAX</td>
<td>na</td>
<td>1</td>
</tr>
<tr>
<td>AV:14</td>
<td>Total steps taken by the actuator</td>
<td>na</td>
<td>R</td>
<td>0</td>
<td>MAX</td>
<td>na</td>
</tr>
<tr>
<td>AV:15</td>
<td>Server Message Count</td>
<td>na</td>
<td>R</td>
<td>0</td>
<td>MAX</td>
<td>na</td>
</tr>
<tr>
<td>AV:16</td>
<td>Server Message sent</td>
<td>na</td>
<td>R</td>
<td>0</td>
<td>MAX</td>
<td>na</td>
</tr>
<tr>
<td>AV:17</td>
<td>Server Message sent</td>
<td>na</td>
<td>R</td>
<td>0</td>
<td>MAX</td>
<td>na</td>
</tr>
<tr>
<td>AV:20</td>
<td>Serial Number of the actuator</td>
<td>na</td>
<td>R</td>
<td>na</td>
<td>na</td>
<td>na</td>
</tr>
</tbody>
</table>

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

**AV:4 / 32772 Alpha Value Curve**

![Curve](image)

**Note:** Units L/hr (ISO) and GPM (ANSI) are decided by the valve selection.
### BACnet Objects - Binary Value

<table>
<thead>
<tr>
<th>Ident</th>
<th>Parameter name</th>
<th>Read/Write</th>
<th>Active Text (1)</th>
<th>Inactive Text (0)</th>
<th>Default</th>
<th>Description</th>
<th>Persistent</th>
</tr>
</thead>
<tbody>
<tr>
<td>BV/0</td>
<td>Analog or Digital control</td>
<td>R/W</td>
<td>Digital</td>
<td>Analog</td>
<td>Digital</td>
<td>Selects between analog or digital control of the flow.</td>
<td>Yes</td>
</tr>
<tr>
<td>BV/1</td>
<td>Detection of LOG or Manual Defined Function (MDF)</td>
<td>R/W</td>
<td>Digital</td>
<td>LOG</td>
<td>MDF</td>
<td>Selection of LOG or MDF (controlled by Alpha Value mode).</td>
<td>Yes</td>
</tr>
<tr>
<td>BV/2</td>
<td>Detection of inverse operation mode</td>
<td>R/W</td>
<td>Direct</td>
<td>Direct</td>
<td>Direct</td>
<td>Select here between Direct and Inverse operation mode.</td>
<td>Yes</td>
</tr>
<tr>
<td>BV/3</td>
<td>LED control</td>
<td>R/W</td>
<td>%</td>
<td>%</td>
<td>%</td>
<td>Units used to set and display the Design Flow.</td>
<td>Yes</td>
</tr>
<tr>
<td>BV/4</td>
<td>Units used to set and display the Flow Rate Setpoint</td>
<td>R/W</td>
<td>%</td>
<td>%</td>
<td>%</td>
<td>Units used to set and display the Flow Rate Setpoint.</td>
<td>Yes</td>
</tr>
</tbody>
</table>

### BACnet Objects - Multi State Value

<table>
<thead>
<tr>
<th>Ident</th>
<th>Parameter name</th>
<th>Read/Write</th>
<th>State Text</th>
<th>Default State</th>
<th>Description</th>
<th>Persistent</th>
</tr>
</thead>
<tbody>
<tr>
<td>MSV/0</td>
<td>Actuator Mode and special features</td>
<td>R/W</td>
<td>1: Normal, 2: Calibration, 3: Flush, 4: De-Air, 5: Alarm</td>
<td>1: Normal</td>
<td>Shows present mode of actuator. Calibration, flushing and de-air can be started from here.</td>
<td>Yes</td>
</tr>
<tr>
<td>MSV/1</td>
<td>Analog Control signal type and range</td>
<td>R/W</td>
<td>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</td>
<td>2: 0-10 VDC</td>
<td>Used to select the analog control input type and range.</td>
<td>Yes</td>
</tr>
<tr>
<td>MSV/2</td>
<td>Missing Control Signal Fallback Action</td>
<td>R/W</td>
<td>1: No action, 2: CLOSE, 3: OPEN, 4: Go to 50% of Design Flow</td>
<td>1: No action</td>
<td>What the actuator shall do if control signal is lost.</td>
<td>Yes</td>
</tr>
<tr>
<td>MSV/3</td>
<td>Selected Valve Type</td>
<td>R/W</td>
<td>See table &quot;Valve Type Selection&quot;</td>
<td>4: AB-QM DN 15</td>
<td>This is the valve type. The actuator is set-up to control.</td>
<td>Yes</td>
</tr>
<tr>
<td>MSV/4</td>
<td>Actuator Speed</td>
<td>R/W</td>
<td>1: 3 sec/mm, 2: 6 sec/mm, 3: 12 sec/mm, 4: 24 sec/mm, 5: Constant Time</td>
<td>4: 24 sec/mm</td>
<td>Amount of time for actuator to move 1mm or alternatively selection of a constant time.</td>
<td>Yes</td>
</tr>
<tr>
<td>MSV/5</td>
<td>MAC Address assignment method</td>
<td>R/W</td>
<td>1: DIP Switch Settings or Auto Addressing, 2: User configuration over BACnet or Auto Addressing</td>
<td>1: DIP Switch Settings or Auto Addressing</td>
<td>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.</td>
<td>Yes</td>
</tr>
<tr>
<td>MSV/6</td>
<td>Baud Rate</td>
<td>R/W</td>
<td>1: Auto Baud Rate Detection, 2: 9600 bps, 3: 19200 bps, 4: 38400 bps, 5: 57600 bps, 6: 76800 bps, 7: 115200 bps</td>
<td>1: Auto Baud Rate Detection</td>
<td>Baud Rate used for BACnet communication.</td>
<td>Yes</td>
</tr>
<tr>
<td>MSV/7</td>
<td>LED Control</td>
<td>R/W</td>
<td>1: Normal LED mode, 2: Show only alarms, 3: All LED's off, 4: Blink, 5: Alarm, 6: Blink</td>
<td>1: Normal LED mode</td>
<td>Select here the usage of the LED's for example Normal or Blink or all OFF.</td>
<td>Yes</td>
</tr>
<tr>
<td>MSV/8</td>
<td>Select field bus protocol</td>
<td>R/W</td>
<td>1: DIP switch, 2: BACnet, 3: ModBus</td>
<td>1: DIP switch</td>
<td>Selection of field bus protocol.</td>
<td>Yes</td>
</tr>
</tbody>
</table>
Data sheet NovoCon® S Digital & Hybrid - High Accuracy Actuator

**BAcnet Objects - Device Object**

List with some selected important Device Object properties.

<table>
<thead>
<tr>
<th>Property</th>
<th>Value</th>
<th>Read / Write</th>
<th>Description</th>
<th>Persistent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Object ID</td>
<td>Instance Range: 0 to 4194302</td>
<td>R/W</td>
<td>This property is normally called Device Instance number or Unique ID.</td>
<td>Yes</td>
</tr>
<tr>
<td>Object Name</td>
<td>Combination of &quot;NovoCon 5&quot; + Type and Object ID</td>
<td>R/W</td>
<td>Product name. Type and Object ID.</td>
<td>Yes</td>
</tr>
<tr>
<td>Firmware revision</td>
<td>Current firmware version</td>
<td>R</td>
<td>BACnet software revision.</td>
<td>Yes</td>
</tr>
<tr>
<td>Application S/W version</td>
<td>Current Application S/W version</td>
<td>R</td>
<td>Actuator Application Software version.</td>
<td>Yes</td>
</tr>
<tr>
<td>Location</td>
<td>This string is empty when actuator is new.</td>
<td>R/W</td>
<td>Free text can be used to describe location etc.</td>
<td>Yes</td>
</tr>
<tr>
<td>Description</td>
<td>Danfoss NovoCon actuator with BAcnet MS/TP</td>
<td>R/W</td>
<td>Product description. Max. 30 characters.</td>
<td>Yes</td>
</tr>
<tr>
<td>Segmentation-supported</td>
<td>NO SEGMENTATION</td>
<td>R</td>
<td>Actuator does not support segmentation.</td>
<td>Yes</td>
</tr>
<tr>
<td>Max-master</td>
<td>Default: 127 Range: 0-127</td>
<td>R/W</td>
<td>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.</td>
<td>Yes</td>
</tr>
</tbody>
</table>

**BAcnet Objects - Analog Input**

<table>
<thead>
<tr>
<th>Ident</th>
<th>Object / Parameter name</th>
<th>Unit</th>
<th>Resolution</th>
<th>Description</th>
<th>Persistent</th>
</tr>
</thead>
<tbody>
<tr>
<td>AI:0</td>
<td>Voltage(V) or Current(mA)</td>
<td>Volt</td>
<td>0.001</td>
<td>Voltage or Current control signal measured by the actuator</td>
<td>No</td>
</tr>
</tbody>
</table>

**BAcnet Objects - Notification class**

<table>
<thead>
<tr>
<th>Ident</th>
<th>Object / Parameter name</th>
<th>Description</th>
<th>Persistent</th>
</tr>
</thead>
<tbody>
<tr>
<td>NC:0</td>
<td>Alarm Notifier, Subscribe here for alarms</td>
<td>Subscribe here devices for receiving alarms</td>
<td>Yes</td>
</tr>
</tbody>
</table>

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 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**

<table>
<thead>
<tr>
<th>Ident</th>
<th>Object / Parameter name</th>
<th>Min. Value</th>
<th>Average Value</th>
<th>Max. Value</th>
<th>Window Interval</th>
<th>Window Sample</th>
<th>Description</th>
<th>Persistent</th>
</tr>
</thead>
<tbody>
<tr>
<td>AVO:0</td>
<td>Average rectified voltage measured by the actuator</td>
<td>Updated according to actual measurements</td>
<td>1 Day</td>
<td>24</td>
<td>Average of the rectified voltage which powers the actuator</td>
<td>No</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Valve Type Selection**

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

<table>
<thead>
<tr>
<th>Index</th>
<th>Name</th>
<th>Nominal Flow</th>
<th>Units</th>
<th>Valve position for nominal flow [mm]</th>
<th>Setting Range Maximum [%]</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>AB-QM ISO DN 10LF</td>
<td>150</td>
<td>L/hr</td>
<td>2.25</td>
<td>120</td>
</tr>
<tr>
<td>2</td>
<td>AB-QM ISO DN 10</td>
<td>275</td>
<td>L/hr</td>
<td>2.25</td>
<td>120</td>
</tr>
<tr>
<td>3</td>
<td>AB-QM ISO DN 15LF</td>
<td>275</td>
<td>L/hr</td>
<td>2.25</td>
<td>120</td>
</tr>
<tr>
<td>4†</td>
<td>AB-QM ISO DN 15</td>
<td>450</td>
<td>L/hr</td>
<td>2.25</td>
<td>120</td>
</tr>
<tr>
<td>5</td>
<td>AB-QM ISO DN 20</td>
<td>900</td>
<td>L/hr</td>
<td>2.25</td>
<td>120</td>
</tr>
<tr>
<td>6</td>
<td>AB-QM ISO DN 25</td>
<td>1700</td>
<td>L/hr</td>
<td>4.5</td>
<td>110</td>
</tr>
<tr>
<td>7</td>
<td>AB-QM ISO DN 32</td>
<td>3200</td>
<td>L/hr</td>
<td>4.5</td>
<td>110</td>
</tr>
<tr>
<td>8</td>
<td>AB-QM ANSI DN ½&quot; LF</td>
<td>1.2</td>
<td>GPM</td>
<td>2.25</td>
<td>100</td>
</tr>
<tr>
<td>9</td>
<td>AB-QM ANSI DN ½&quot;</td>
<td>2</td>
<td>GPM</td>
<td>2.25</td>
<td>100</td>
</tr>
<tr>
<td>10</td>
<td>AB-QM ANSI DN ¾&quot;</td>
<td>5</td>
<td>GPM</td>
<td>4</td>
<td>100</td>
</tr>
<tr>
<td>11</td>
<td>AB-QM ANSI DN ¾&quot;</td>
<td>4</td>
<td>GPM</td>
<td>2.25</td>
<td>100</td>
</tr>
<tr>
<td>12</td>
<td>AB-QM ANSI DN ¾&quot;</td>
<td>7.5</td>
<td>GPM</td>
<td>4</td>
<td>100</td>
</tr>
<tr>
<td>13</td>
<td>AB-QM ANSI DN 1&quot;</td>
<td>7.5</td>
<td>GPM</td>
<td>4.5</td>
<td>100</td>
</tr>
<tr>
<td>14</td>
<td>AB-QM ANSI DN 1½&quot;</td>
<td>12</td>
<td>GPM</td>
<td>4.5</td>
<td>100</td>
</tr>
<tr>
<td>15</td>
<td>AB-QM ANSI DN 1½&quot;</td>
<td>14.1</td>
<td>GPM</td>
<td>4.5</td>
<td>100</td>
</tr>
<tr>
<td>16</td>
<td>AB-QM ANSI DN 1¾&quot;</td>
<td>17.5</td>
<td>GPM</td>
<td>4.5</td>
<td>100</td>
</tr>
<tr>
<td>17†</td>
<td>&quot;User Defined Valve&quot;</td>
<td>NF</td>
<td>UF</td>
<td>VFNF</td>
<td>SRM</td>
</tr>
</tbody>
</table>

† Default

*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.
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 Switches are left in the default positions.

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

\(^1\) 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.
\(^2\) 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

<table>
<thead>
<tr>
<th>Modbus register</th>
<th>Modbus Data Type</th>
<th>Object / Parameter name</th>
<th>Description</th>
<th>Default</th>
<th>Unit</th>
<th>Description of usage</th>
<th>Persistent Yes/No</th>
</tr>
</thead>
<tbody>
<tr>
<td>0x8000 32768</td>
<td>R/W</td>
<td>3,4 &amp; 16 FLOAT</td>
<td>Design Flow Rate</td>
<td>Preset value for the design flow when control signal is at 100% Unit follows 0x8013</td>
<td>Nominal value from the Valve table in L/hr</td>
<td>Design Flow Rate in Liters per hour i.e. 0.150…450 corresponds to L/hr 0.150…450 or in percent, i.e. 20…100 corresponds to 20…100% Yes</td>
<td></td>
</tr>
<tr>
<td>0x8002 32770</td>
<td>R/W</td>
<td>3,4 &amp; 6 WORD</td>
<td>Control Fallback Time</td>
<td>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 32780 is in L/hr in Digital mode the alpha setting is ignored.</td>
<td>10 Minutes</td>
<td>Control Fallback Time in minutes, i.e. 0…60 correspond to 0…60 minutes Yes</td>
<td></td>
</tr>
<tr>
<td>0x8004 32772</td>
<td>R/W</td>
<td>3,4 &amp; 16 FLOAT</td>
<td>Alpha Value</td>
<td>Position used for shaping the curve of a heat exchanger. If 32780 is in L/hr in Digital mode the alpha setting is ignored.</td>
<td>1.0</td>
<td>na</td>
<td>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</td>
</tr>
<tr>
<td>0x8006 32774</td>
<td>R/W</td>
<td>3,4 &amp; 6 WORD</td>
<td>Valve closing or opening time</td>
<td>The time the actuator needs to move from 0% to 100% of Design Flow.</td>
<td>na</td>
<td>Seconds</td>
<td>Valve closing or opening time in seconds i.e. 18…700 corresponds to 18…700 seconds Yes</td>
</tr>
<tr>
<td>0x8008 32776</td>
<td>R</td>
<td>3 &amp; 4 FLOAT</td>
<td>Nominal Flow of the user defined valve</td>
<td>The Nominal flow of the User Defined Valve</td>
<td>na</td>
<td>L/hr or GPM, Unit type comes from Valve Table</td>
<td>Nominal flow e.g. in Liters per hour i.e. 0…450 corresponds to 0…450 L/hr Yes</td>
</tr>
<tr>
<td>0x800A 32778</td>
<td>R</td>
<td>3 &amp; 6 FLOAT</td>
<td>Valve position at nominal flow for User Defined Valve</td>
<td>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.</td>
<td>2.25</td>
<td>Millimetre</td>
<td>Valve position for nominal flow in millimetres, i.e. 0.5…5.8 correspond to 0.5…5.8 millimetre Yes</td>
</tr>
<tr>
<td>0x800C 32780</td>
<td>R/W</td>
<td>3,4 &amp; 6 FLOAT</td>
<td>Maximum value for the Design Flow Rate in the User Defined Valve</td>
<td>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.</td>
<td>120</td>
<td>Unit type follows 32783 selection: % or L/hr or GPM</td>
<td>i.e. 0…150 corresponds to 0…150% Yes</td>
</tr>
<tr>
<td>0x8010 32784</td>
<td>R/W</td>
<td>3,4 &amp; 6 WORD</td>
<td>Analog or Digital control</td>
<td>Selects between analog or digital control of the flow.</td>
<td>1: Digital</td>
<td>na</td>
<td>Selects between 0: Analog or 1: Digital control of the flow. Yes</td>
</tr>
<tr>
<td>0x8011 32785</td>
<td>R/W</td>
<td>3,4 &amp; 6 WORD</td>
<td>LOG or Manual Defined Function (MDF) mode</td>
<td>Selection of LOG or MDF (controlled by Alpha value) mode*</td>
<td>1: MDF</td>
<td>na</td>
<td>Selection of 0: LOG or 1: MDF (controlled by Alpha Value) mode Yes</td>
</tr>
<tr>
<td>0x8012 32786</td>
<td>R/W</td>
<td>3,4 &amp; 6 WORD</td>
<td>Direct or Inverse operation mode</td>
<td>Select here between Direct and Inverse operation mode</td>
<td>0: Direct</td>
<td>na</td>
<td>Select between Direct and Inverse operation mode. See Direct/Inverse diagram Yes</td>
</tr>
<tr>
<td>0x8013 32787</td>
<td>R/W</td>
<td>3,4 &amp; 6 WORD</td>
<td>Units used to set and display the Design Flow</td>
<td>Units used to set and display the Design Flow.</td>
<td>na</td>
<td>L/hr or GPM, Unit type follows 32783</td>
<td>Units used to set and display the Design Flow. Select between L/hr and % for European versions or GPM and % for ANSI versions Yes</td>
</tr>
<tr>
<td>0x8014 32788</td>
<td>R/W</td>
<td>3,4 &amp; 6 WORD</td>
<td>Units used to set and get the Flow Rate Setpoint</td>
<td>Units used to set and get the Flow Rate Setpoint</td>
<td>1: %</td>
<td>0: L/hr / GPM</td>
<td>Units used to set and display the Flow Rate Setpoint. See between % and L/hr or GPM for ANSI versions Yes</td>
</tr>
<tr>
<td>0x8016 32790</td>
<td>R/W</td>
<td>3,4 &amp; 6 WORD</td>
<td>Units used to set and display temperature inside the actuator</td>
<td>Select between °C or °F to set and display temperature inside the actuator.</td>
<td>0: °C</td>
<td>0: °F</td>
<td>Units used to set and display temperature inside the actuator. Yes</td>
</tr>
<tr>
<td>0x801A 32794</td>
<td>R/W</td>
<td>3,4 &amp; 6 WORD</td>
<td>Endian type</td>
<td>Byte ordering for LOG and FLOAT types</td>
<td>0: Big</td>
<td>0: Big</td>
<td>Little</td>
</tr>
<tr>
<td>0x8020 32800</td>
<td>R/W</td>
<td>3,4 &amp; 6 WORD</td>
<td>Analog Control signal type and range</td>
<td>Used to select the analog control input type and range</td>
<td>2: 0-10 VDC</td>
<td>V / mA</td>
<td>Select 1, 2 or based on the table below: Yes</td>
</tr>
</tbody>
</table>
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 |
| 0x8022 32802    | R/W        | 3,4 & 6         | WORD             | Selected Valve Type | This is the valve type the actuator is set up to control | 4: AB/OM 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: 1.3 sec/mm 2: 2.6 sec/mm 3: 3.2 sec/mm 4: 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, 3 or 4 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 3 based on the table below: 1: Normal LED mode 2: Show only alarms 3: All LEDs OFF 4: Blink (can be used to locate the actuator) | Yes |

Operating

| Modbus register | Read/Write | Modbus Function | Modbus Data Type | Object / Parameter name | Description | Default | Description of usage | Persistent Yes/No |
|-----------------|------------|-----------------|------------------|------------------------|-------------|---------------------|------------------|
| 0x8020 33280    | R/W        | 3,4 & 16        | FLOAT            | Flow Rate Setpoint | 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 |
| 0x8020 33282    | R          | 3 & 4           | FLOAT            | Actual Flow Rate feedback | 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% | No |
| 0x8024 33284    | R/W        | 3,4 & 6         | WORD             | Actuator Mode and special features | Shows present mode of actuator. Calibration, Flush and de-air can be started from here | 1: Normal | 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 |
|-----------------|------------|-----------------|------------------|------------------------|-------------|-------|---------------------|------------------|
| 0x8000 34048    | W          | 6               | WORD             | Reset | Warm reset = Power cycle. Cold reset = Factory reset. Note that after factory reset a calibration will be automatically performed and all setting will be reverted to factory setting | na | 0x5741 / 22337: Warm reset. 0x434F / 17231: Cold reset. | Yes |
## Information

| Modbus register | Read/Write | Modbus function | Modbus Data Type | Object / Parameter name | Description | Default | Unit | Description of usage | Persistent | Yes/No |
|-----------------|------------|-----------------|------------------|-------------------------|-------------|---------|---------------------|------------|--------|
| 0x4100 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       |        |
| 0x4102 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 millimetres, i.e.: 0.5 ... 5.8 millimetres | na       |        |
| 0x4104 33028    | R          | 3 & 4           | FLOAT            | Maximum valve for the Design Flow Rate | Maximum level the Design Flow can be increased to for the selected valve | %       | Maximum of the Design Flow in percent, i.e. 20 ... 100 correspond to 20 ... 100% | Maximum level of the Design Flow in percent, i.e. 20 ... 100% | na       |        |
| 0x4120 33056    | R/W        | 3, 4, 16 & 43   | STRING           | Device name | Product name | Danfoss S/5 | na | Ascii coded STRING | Yes |
| 0x4140 33088    | R          | 3, 4 & 43       | STRING           | Model name | Type of the actuator | Digital or Hybrid | na | wAscii coded STRING | Yes |
| 0x4160 33120    | R          | 3, 4 & 43       | STRING           | Vendor name | Name of the manufacture | Danfoss A/S | na | Ascii coded STRING | Yes |
| 0x4180 33152    | R/W        | 3, 4 & 43       | STRING           | Location description | Free text can be used to describe the location etc. e.g. Room 1 | na | na | Ascii coded STRING, Max. 50 characters | Yes |
| 0x4180 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 |
| 0x4180 33034    | R          | 3 & 4           | WORD             | SW version | Software version of the actuator | na | na | Ascii coded WORD | Yes |
| 0x4180 33035    | R          | 3 & 4           | WORD             | HW version | Hardware version of the actuator | na | na | Ascii coded WORD | Yes |
| 0x4400 33170    | 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 |
| 0x4402 33174    | 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 |
| 0x4404 33176    | R          | 3 & 4           | FLOAT            | Temperature in the actuator | Temperature measured inside the actuator. Unit is decided by 32790. | na | na | Temperature measured inside the actuator. Unit is decided by 32790. | No |
| 0x4404 33178    | R          | 3 & 4           | LONG             | Total Operating Hours | Total Operating Hours of the actuator | na | Hours | Total Operating Hours of the actuator | Yes |
| 0x4408 33000    | 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 |
| 0x4410 33080    | R          | 3 & 4           | LONG             | Minutes since last power-up | Minutes since last the power-up of the actuator | Minutes | Minutes | Minutes since the last power-up of the actuator | Yes |
| 0x4412 33082    | 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 |
| 0x4414 33084    | 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 |
| 0x4416 33086    | 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 AWG22/0.32mm². 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 mm². If used for longer distances please use a AWG20/0.5mm² or AWG18/0.75mm² cable. The cables characteristic impedance shall be between 100-1300 Ω. 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.

The digital daisy chain cable is used to connect power and BACnet/Modbus between two NovoCon® S devices.
Wiring (continuous)

NovoCon® digital cable

The digital cable is used to connect NovoCon® to other BACnet/Modbus devices.

- **Red**: Power
- **Black**: Common ground for power and bus signal wire
- **Green**: ‘+’ non-inverting signal wire
- **Green/White**: ‘-’ inverting signal wire

![Digital cable diagram](image)

NovoCon® analog cable

The analog cable is used to connect power and analog control signal. The analog cable can also be used as a voltage booster for NovoCon® S on the network. The “Power ground” and “Analog input ground” should be connected to the same ground on the Controller.

- **Red**: Power
- **Black**: Power Ground
- **Grey**: Analog input
- **Blue**: Analog input ground

![Analog cable diagram](image)

To avoid electrical short-circuiting, ensure that loose cable-ends have been connected or isolated before inserting the plug-in connector to the NovoCon® S actuator.

Daisy chain

**DC Power supply (recommended)**

When daisy chaining with 10m NovoCon® cables and using a 24V DC power supply, additional voltage boosters/power supply is needed when 11 NovoCons in series is exceeded. See table below.

**AC Power supply**

When daisy chaining with 10m NovoCon® cables and using a 24V AC power supply, additional voltage boosters/power supply is needed when 7 NovoCons in series is exceeded. See table below.

Important: The power supply used must be able to deliver 60% more power than the nominal rating of NovoCon® S.

- **Controller and 24 Volt AC or DC Power supply**
- **Voltage booster / Power supply.**

![Daisy chain diagram](image)

In case all BACnet devices are NovoCon® S, please see some examples for usage of voltage booster cable.

![Voltage booster examples](image)
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 Poll for Master 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 considerations

The important factors here are:
- Common ground
- 24VDC power supply is recommended
- In case 24VAC power supply is used always separate the 24VAC power supply’s if different power supply’s are used and / or different phases are used.

Wiring with DC power supply: *(recommended solution)*

![Diagram of wiring with DC power supply](chart1)

**Digital application – 24V DC – PSU with power sharing capability.**

Wiring with DC or AC power supply:

![Diagram of wiring with DC or AC power supply](chart2)

**Digital application - One transformer**

**Hybrid application - One transformer**

- Connect Power ground and Analog input ground on the Controller.
- 24V power can also be connected to NovoCon® through the analog cable, but is not required.

Turn DIP switch no. 8 ON for bus termination of the last unit on the bus.
Wiring with AC power supply:

Digital application - Identical transformers, same phase

230/110V AC
L1 L2 L3 0 GND

24V AC
Ground

Room 1

24V AC
PSU

DDC

Room controller

Thermostat

Bus

Daisy chain cables between NovoCon S

Cable NovoCon Digital

Room 2

110V AC

24V AC

Ground

Thermostat

Room controller

Daisy chain cables between NovoCon S

Cable NovoCon Digital

XX Cable NovoCon Analog

Turn DIP switch no. 8 ON for bus termination of the last unit on the bus.

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.

Digital application - Identical or different transformers with different phases

230/110V AC
L1 L2 L3 0 GND

24V AC
Ground

Room 1

DDC

Room controller

Thermostat

Bus

Daisy chain cables between NovoCon S

Cable NovoCon Digital

Room 2

24V AC

Ground

Thermostat

DDC

Room controller

Daisy chain cables between NovoCon S

Cable NovoCon Digital

XX Cable NovoCon Analog

Turn DIP switch no. 8 ON for bus termination of the last unit on the bus.

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.
Trouble shooting

BAConet 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 BAConet 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 / 33794 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 / 33794 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.

<table>
<thead>
<tr>
<th>Voltage (Present value of AV:6 / 33794)</th>
<th>Reaction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Voltage below 16.5V</td>
<td>Start alarm indication with LED. Initiate and alarm BV:15 / 33536 Bit 19 via BAConet (if subscribed to) and that the supply voltage is too low.</td>
</tr>
<tr>
<td>Voltage below 16.1V</td>
<td>Motor is stopped. The LEDs indicating alarm and BAConet still initiating alarm BV:15 / 33536 Bit 19 (if subscribed to) if the voltage hasn’t dropped too low.</td>
</tr>
<tr>
<td>When voltage rises above 17.5V again</td>
<td>Motor can run again. LED alarm indication stops and returns to normal operation. BAConet alarm BV:15 / 33536 Bit 19 returns to normal operation.</td>
</tr>
<tr>
<td>When voltage rises above 43.4V</td>
<td>Start alarm indication with LED. Initiate and alarm BV:14 / 33536 Bit 18 via BAConet (if subscribed to).</td>
</tr>
<tr>
<td>When voltage drops below 38.3V again</td>
<td>LED alarm indication stops and returns to normal operation. BAConet alarm BV:14 / 33536 Bit 18 returns to normal operation.</td>
</tr>
</tbody>
</table>

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 / 33794 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 / 33794. 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 BAConet alarm is initiated, or a value less than 18V is observed, then cabling should be reviewed.
- Check the values of AVO:0. This BAConet 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.