ENGINEERING
TOMORROW

Data sheet

NovoCon® S ChangeOver[6], Energy, Remote I/O

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 flow is modulated by the AB-QM pressure independent control valve to avoid overflow and reduced efficiency of boiler or chiller.

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, product adds to an accelerated commissioning process, easy maintenance, improved indoor comfort, energy saving and fair allocation of heat/cool energy.

The high position accuracy of the actuator, together with the pressure independent and linear characteristic of the AB-QM valve, allow NovoCon® S 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.

Typical applications are:
- Radiant ceiling panel, supplied by 4 pipes (Heating supply and return and cooling supply and return).
- Fan coil unit, with single coil supplied by 4 pipes (Heating supply and return and cooling supply and return).

General 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
- Mis-wiring protection on any wire up to 30 V
- BACnet MS/TP and Modbus RTU in the same product.

The NovoCon ChangeOver[6] offers furthermore a unique solution with the NovoCon S actuator and AB-QM valve controlling the flow and a 6-port motorised ball valve solution, which is controlled directly from NovoCon® S and performs a diverting function between two water circuits in 4-pipe changeover system.

This diverting function allows the cooling and heating capacity of a fan coil unit to be increased for the same compact size compared to a double coil model where the heating and cooling water circuits each have their own coil.

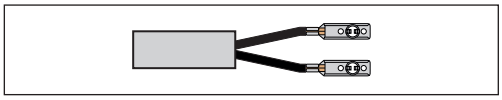
6-port diverting valve and actuator in combination with AB-QM PIBCV valve and NovoCon® S bus actuator, where AB-QM balances the flow and the NovoCon® S bus actuator controls the flow and 6-port diverting valve, with actuator switches between heating and cooling, characterized by that:

- There is only a single bus connection and power supply to the NovoCon® S actuator, powering up and controlling also the 6-port actuator via 0-10V control, including feedback signal and power connection between NovoCon® S and 6-port actuator.
- The NovoCon® S PIBCV actuator detects by means of comparing 0-10V control & feedback signal if 6-port actuator is in manual operation mode (feedback signal does not follow control signal) , removed from the valve (feedback signal indicates actuator has driven wider angle as valve operational angle), valve is blocked (feedback signal does not follow control signal).
- The NovoCon® S PIBCV actuator has two Design Flow Rate pre-setting's, one for heating and another for cooling.
- Bus actuator indicates separate for heating and cooling indication of flow (current flow and flow counter) based on PIBCV valve stem position.
- Bus actuator indicates separate for heating and cooling information of energy (power and energy counter) based on flow, supply and return measurement.
- 6-port actuator is in maintenance mode able to fully close the valve to prevent any leakage.
- The NovoCon® S actuator has logic that only one actuator in each pair runs at the same time. This reduces voltage booster demands in daisy chaining.
- The NovoCon® S actuator detects if CO6 actuator cable is disconnected and initiates an alarm.

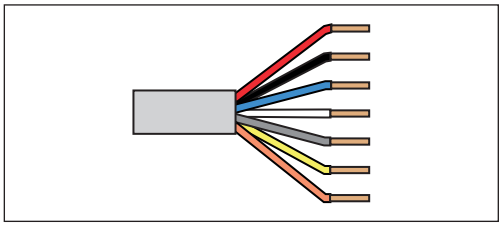
Description *(continuous)*

Features CO6:
- Only one bus device on network (NovoCon + CO6 actuator)
- No cross-flow between supply circuits
- Simple connection and control
- Feedback for position status and alarms
- Silent and reliable operation
- Maintenance free
- Teflon seal and polished chrome valve ball to prevent valve sticking
- Blocked valve indication
- Manual override

Features Energy:
- Temperature measurement
- Energy counter



Features I/O:
- Connection to other devices, e.g. room controller
- Select temperature or Ohm input



Ordering

Type	Code No.
NovoCon® S CO6, Energy, I/O	**003Z8503**

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	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**
Cable NovoCon® Digital, daisy chain	0.5 m	actuator / actuator	**003Z8609**
Cable NovoCon® Energy	1.5 m	actuator / PT1000 surface temperature sensors	**003Z8610**
Cable NovoCon® Energy	1.5 m	actuator / PT1000 Immersed temperature sensors	**003Z8611**
Cable NovoCon® I/O	1.5 m	actuator / free wires	**003Z8612**
Actuator NovoCon ChangeOver⁶	1 m	Plug-in	**003Z8520**
Actuator NovoCon ChangeOver⁶ Energy	1 m Temp. sensors 1.5m	Plug-in	**003Z8521**
Actuator NovoCon ChangeOver⁶ Flexible	2 m	free wires	**003Z8522**

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

Type	DN	k_{vs} (m^3/h)	Connection	Code No.
ChangeOver⁶ valve	15	2,4	Rp ½	**003Z3150**
	20	3,8	Rp ¾	**003Z3151**

Type	DN	Fire load class[1)]	Code No.
ChangeOver⁶ insulation	15	B2	**003Z3159**

[1)] *According to D/N 4102*

Accessories and spare parts *(for temp. sensor)*

Type	Designation	Code No.
Pocket	Immersion, stainless steel 100 mm, for ESMB (**087B1184**)	**084N1082**
Pocket	Immersion, stainless steel 250 mm, for ESMB (**087B1184**)	**084N1083**
Heat conducting paste, 3.5 cm^2		**041E0110**

Service kit - combination with old AB-QM

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

Approvals

CE 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 / 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 (*open to close*)	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

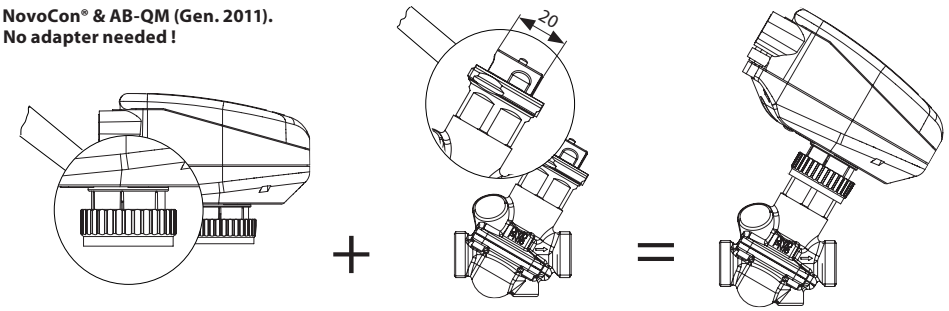
Modbus RTU data

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) Data format: Parity (Start bit - Data bits - Parity - Stop bits)

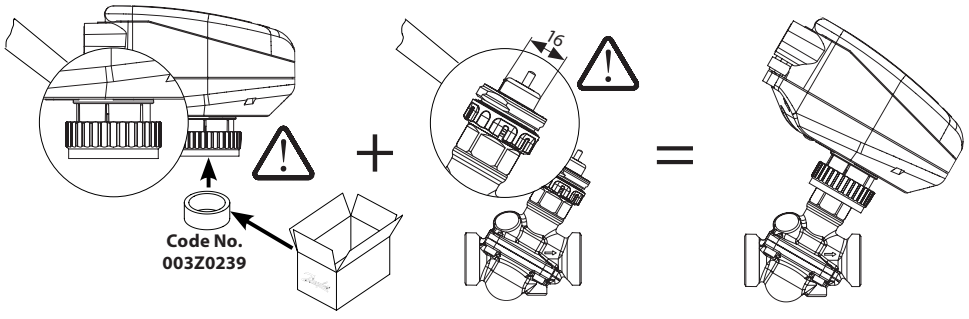
** Default*

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

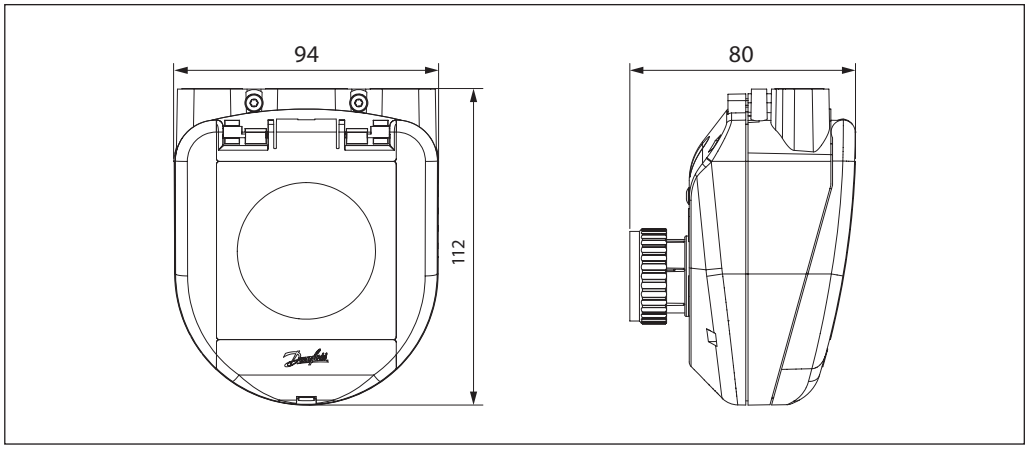
❶ **NovoCon® & AB-QM (Gen. 2011). No adapter needed !**



❷ **NovoCon® & AB-QM (version made before year 2011).**



Dimensions



Presetting

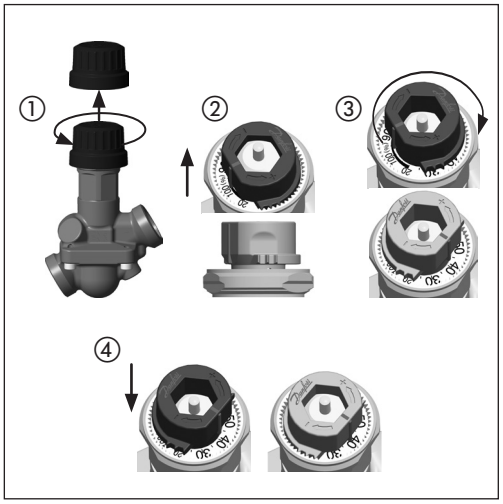
Preset of flow is made electronically with the NovoCon® S Digital & Hybrid actuator. Preset on the AB-QM valve is not used under normal operation.

Normal operation

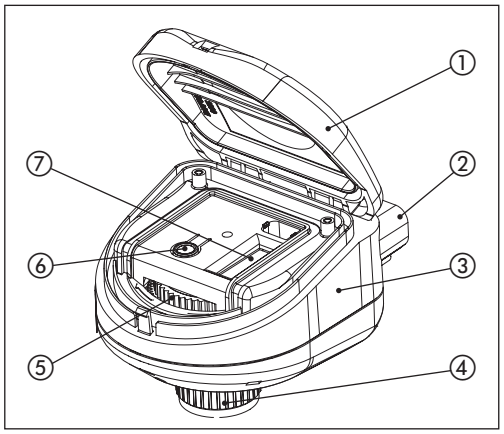
Leave valve at default factory preset (100 %).

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.*
NovoCon® S Digital & Hybrid in high flow operation enables presetting of AB-QM DN 10-20 up to 120% and DN 25-32 up to 110%.



Design

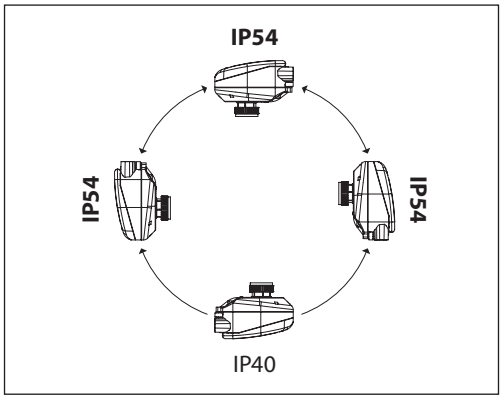


① Removable lid
② Bus and power connections
③ LED window
④ Locking ring
⑤ Manual override
⑥ Reset button
⑦ DIP switches

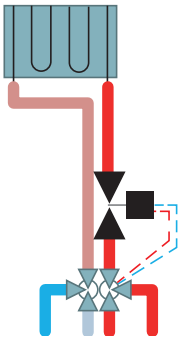
Mounting Orientation

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.



Application principles ChangeOver⁶

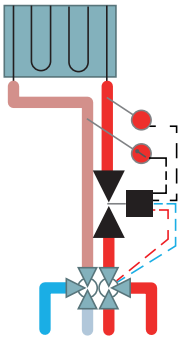


Separate maximum flow presetting for cooling and heating

Setup

Object /Register	Write Object / Property valve	Description
MSV:9 / 33810	CO6 mode	CO6 mode may or may not be used to connect other device but is not used for changeover mode
MSV:3 / 32802	Valve type	ISO valve selected = l/h, °C , kW and kg/m³ ANSI valve selected = g/min, °F, BTU and lb/ft³
AV:30 / 32796	400	Design flow setting of Heating e.g. 400 l/h
AV:31 / 32798	250	Design flow setting of Cooling e.g. 250 l/h

Application principles Energy

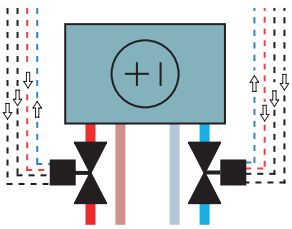


Setup

Object /Register	Write Object / Property valve	Description
MSV:9 / 33810	CO6 mode	CO6 mode may or may not be used to connect other device but is not used for changeover mode
AV:32 / 33288	Power emission	Calculates energy based on values from flow feedback (AV:2) and temperature (AI:1 and AI:2)
MSV:3 / 32802	Valve type	ISO valve selected = l/h, °C , kW and kg/m³ ANSI valve selected = g/min, °F, BTU and lb/ft³
AI:1 / 33218	Temperature	Select between temperature or ohms
AI:2 / 32796	Temperature	Select between temperature or ohms
AV:30 / 32796	400	Design flow setting of Heating e.g. 400 l/h
AV:31 / 32798	250	Design flow setting of Cooling e.g. 250 l/h

Application principles NovoCon I/O

Combining the NovoCon® S and the Cable NovoCon I/O a variety of options is possible.



Operation (DDC command)

Object /Register	Write Object / Property valve	Description
AV:1 / 33280	85%	DDC writes opening value of AB-QM
AO:0 / 33286	5,5V	DDC writes voltage output NC is to send to connected remote device

Read on the BMS

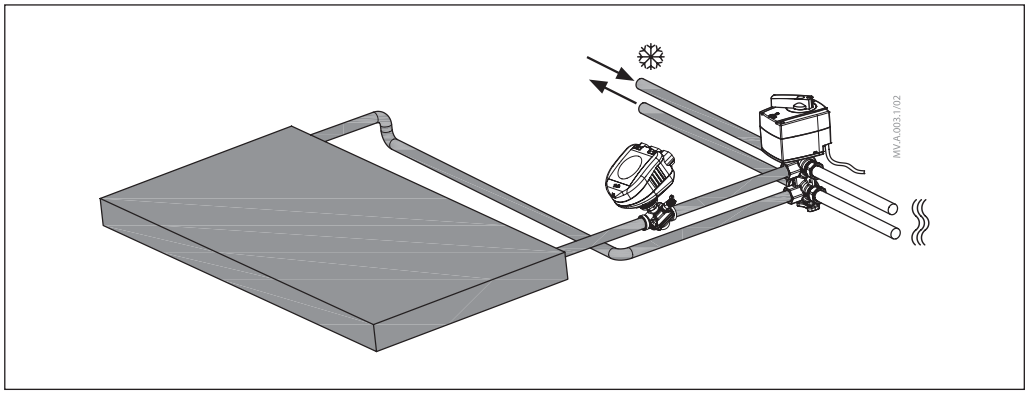
Object /Register	Write Object / Property valve	Description
AO:0 / 33286	5,5V	Analog value sent to remote device
AI:1 / 33218	1160 ohms	Resistance value received from remote device 1
AI:2 / 33220	1263 ohms	Resistance value received from remote device 2

Application principles ChangeOver6 *(continuous)*

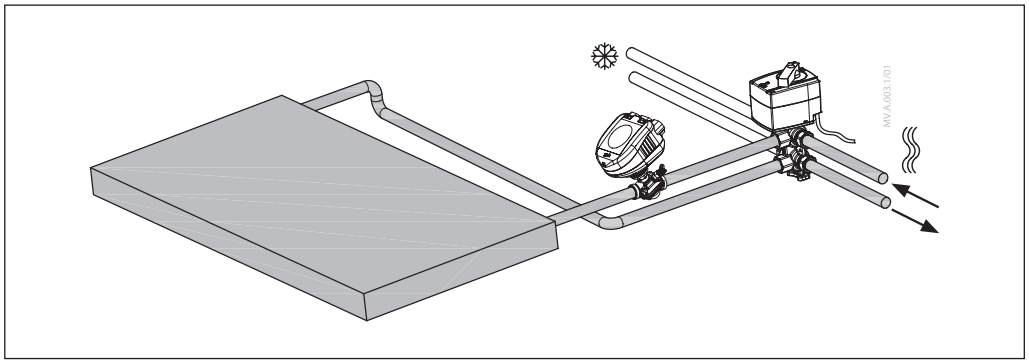
The ChangeOver[6] is a 6-port valve with rotary actuator that switches the flow between heating and cooling. An AB-QM pressure independent balancing and control valve with actuator is used to balance the system and modulate the flow. For modulating control, the AME 110NL actuator should be used. For fieldbus conrol (BACnet, Modbus) NovoCon® S (Hybrid or Digital) should be used.

Anti-sticking requirements:
To reduce the risk of the ball valve sticking due to water quality, the valve must be partially rotated at least every 7 days. By default this is handled by the object MSV:11 / register 33812

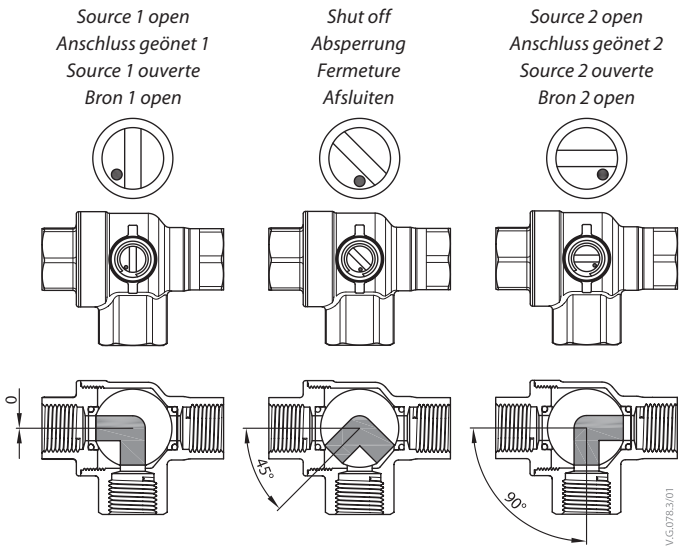
Cooling:



Heating:



No mixing

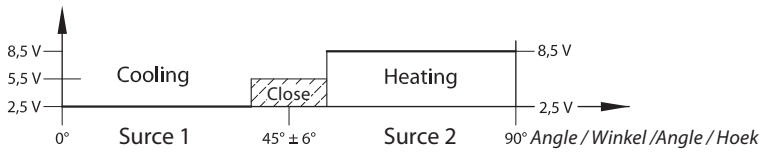


Normally cooling is connected to port 1 and 4 and heating to port 5 and 6. If not that is possible the can be switched and Inverted CO6 Mode must must be selected in BACnet/Modbus.

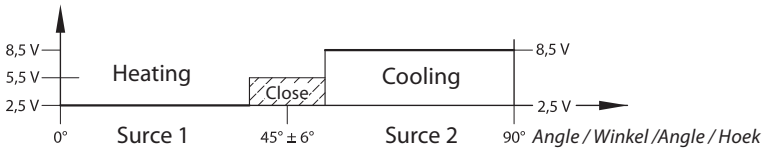
MSV:9 / 33810

3: CO6 Mode

Normally cooling is connected to ports 1 and 4 and heating to ports 5 and 6.
If not that is possible this can be switched and **4: Inverted CO6 Mode** must be selected.



Cooling connected to port 1 and 4 Heating connected to port 5 and 6



Heating connected to port 1 and 4 Cooling connected to port 5 and 6

Signal from NovoCon S to the Actuator NovoCon ChangeOver6

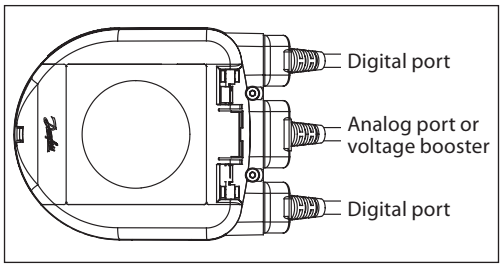
	Cooling	Shut-off	Heating
CO6 mode	2.5 V	5.5 V	8.5 V
Inverted CO6 mode	8.5 V	5.5 V	2.5 V

Feedback signal from the Actuator NovoCon ChangeOver6

Unable to move	Cooling	Moving direction: Cooling to Heating	Shut-off	Moving direction: Heating to Cooling	Heating
1.0 V	2.5 V	4.0	5.5 V	7.0 V	8.5 V

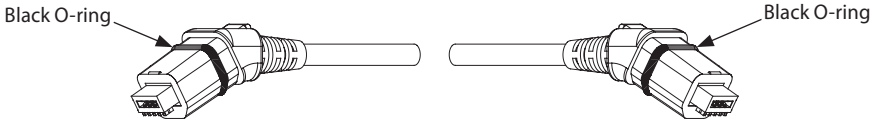
Wiring

The wiring of BACnet MS/TP (*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^2.
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^2. If used for longer distances please use a AWG20/0.5mm^2 or AWG18/0.75mm^2 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.

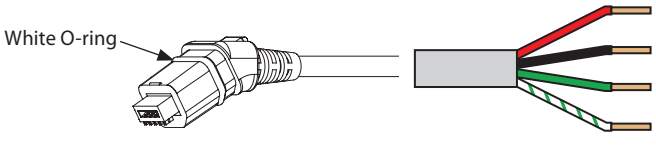
NovoCon® digital daisy chain cable



The digital daisy chain cable is used to connect power and BACnet between two NovoCon® S devices.

Wiring *(continuous)*

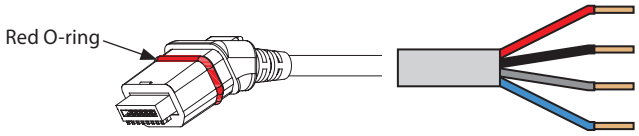
NovoCon® digital cable



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

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

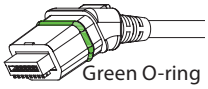
NovoCon® analog cable



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

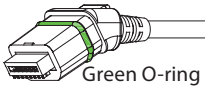
The analog cable is used to connect power and analog control signal.
Optional the analog cable can be used as a voltage booster for NovoCon® S in daisy chain connections.
Connect Power ground and Analog input ground on the Controller.

Cable NovoCon® Energy with PT1000 surface sensor

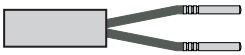


NovoCon® Energy cable - PT1000 surface sensors

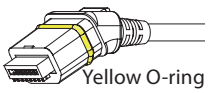
Cable NovoCon® Energy with universal PT1000 temperature sensor



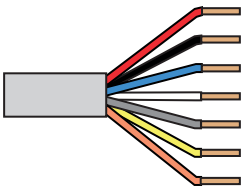
NovoCon® Energy cable - PT1000 immersed sensors



Cable I/O



NovoCon® I/O cable



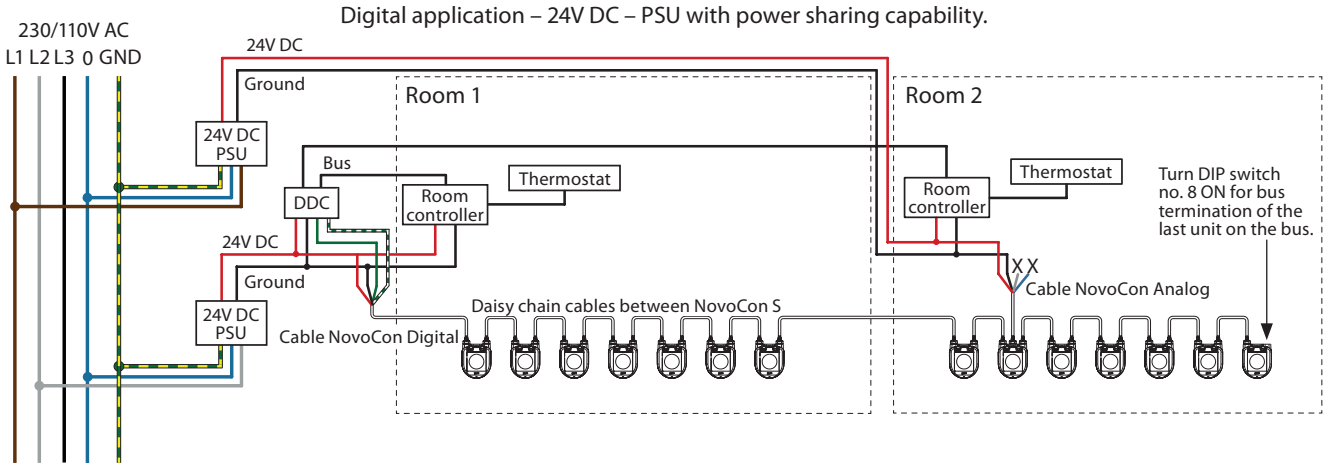
Red	Power 24V
Black	GND
Blue	Analog GND
White	Control signal
Grey	Feedback signal
Yellow	T1 or resistance input
Orange	T2 or resistance input

Analog ground is for the Control Signal. If the wires are cut, GND and Analog GND can be connected together if not separate ground for power and control signal exists.

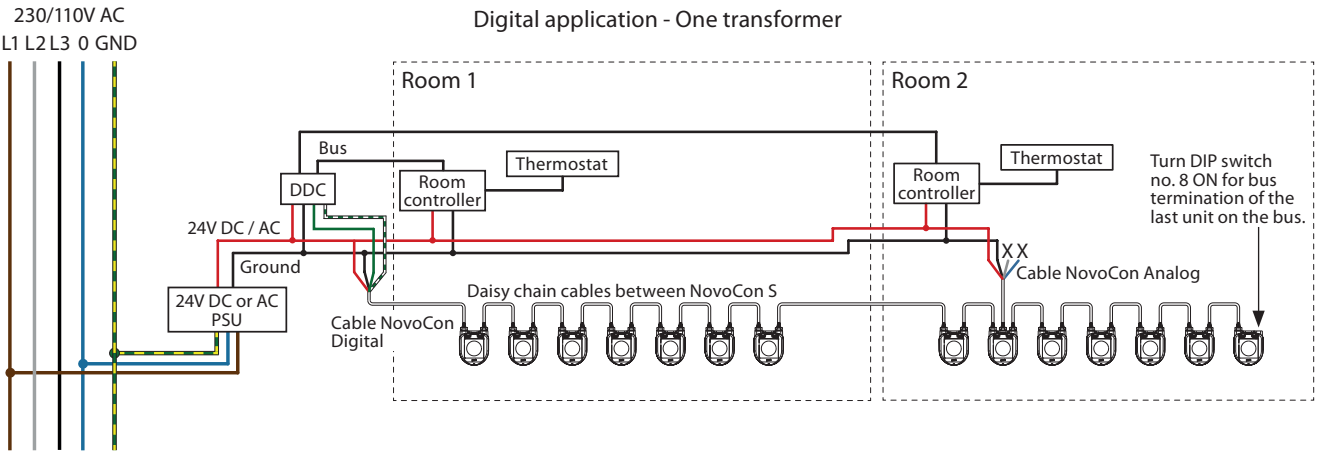
Wiring considerations

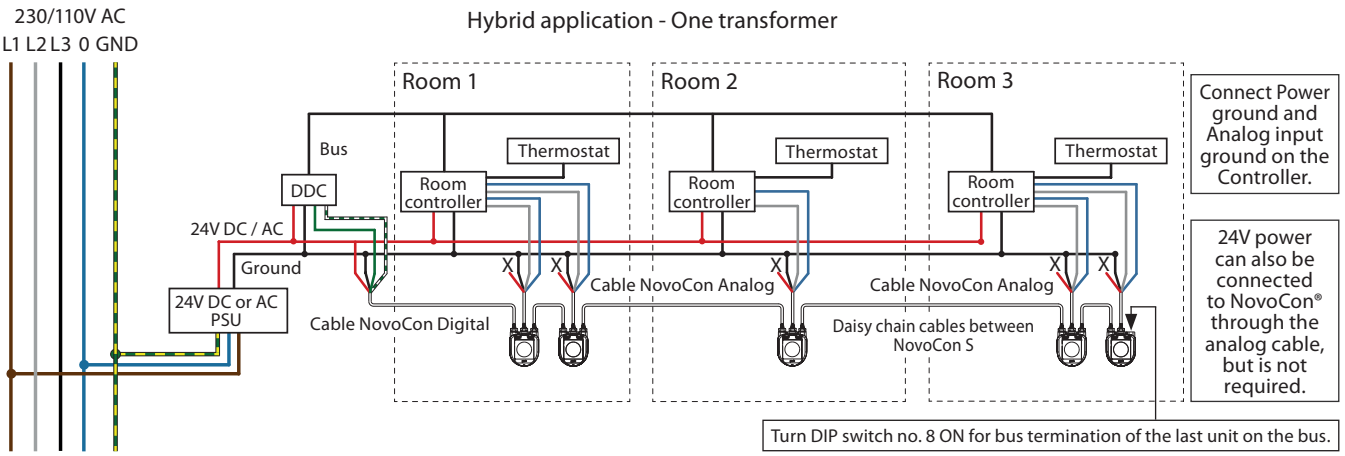
The important factors here are:
- Common ground
- 24VDC power supply is recommended
- In case 24VAC power supply is used always separate the 24VAC power supply's if different power supply's are used and / or different phases are used.

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



Wiring with DC or AC power supply:





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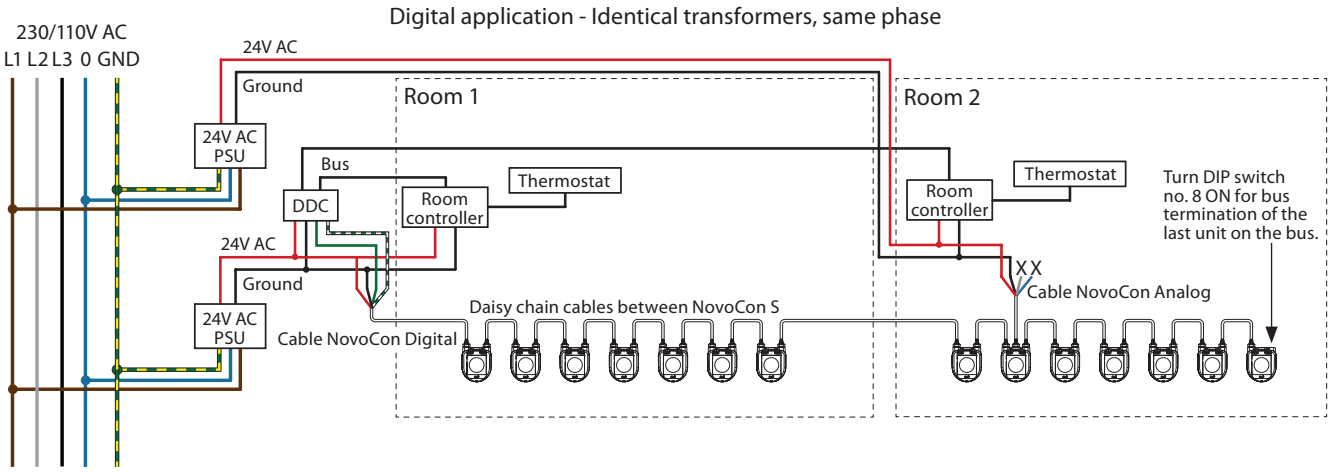
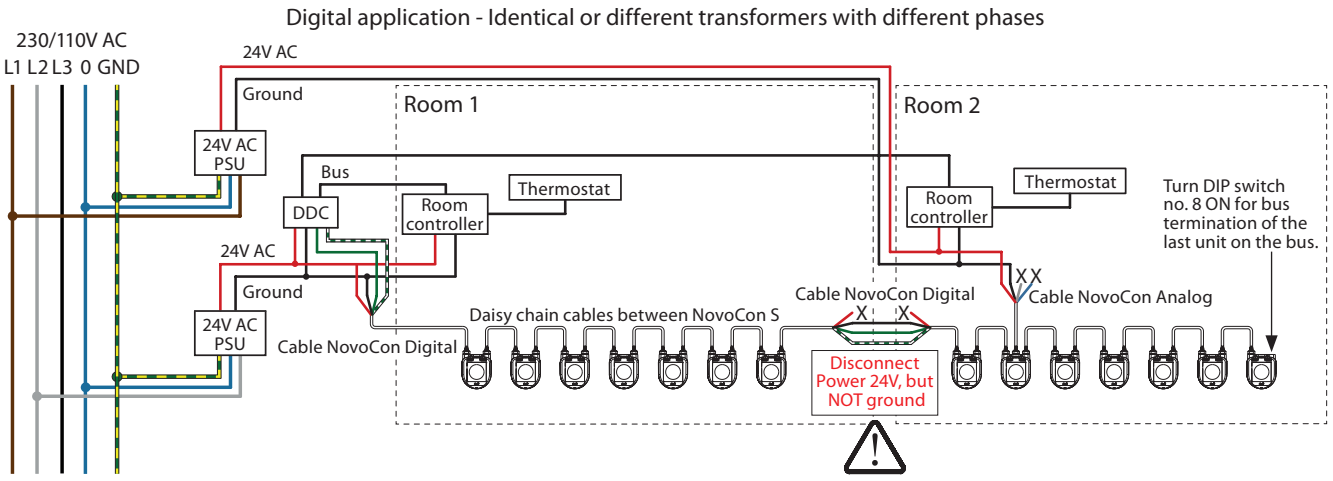
Wiring with AC power supply:



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

Wiring with AC power supply: *(continuous)*

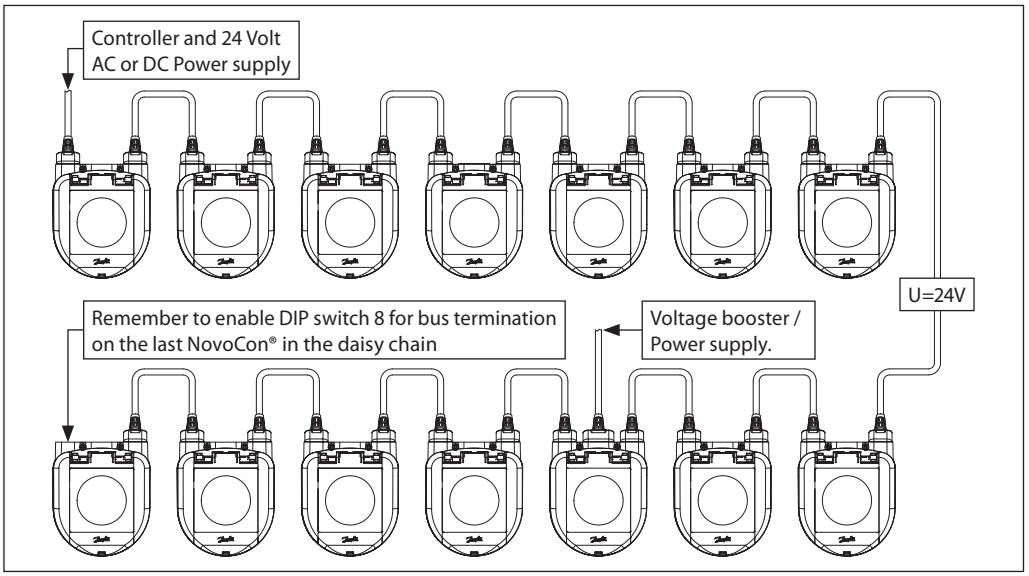


Wires that ends in an "X" must be properly terminated.

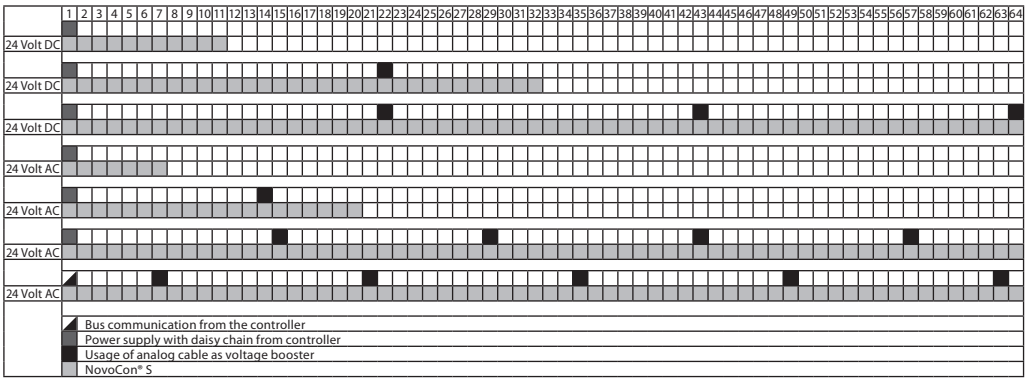
Daisy chain

DC Power supply (recommended)
If the quantity of NovoCon® S Digital & Hybrid in daisy chain with NovoCon 10m cables in connection with a 24V DC power supply, exceeds 11 pcs. then additional power supply/voltage booster is needed.

AC Power supply
If the quantity of NovoCon® S Digital & Hybrid in daisy chain with NovoCon 10m cables in connection with a 24V AC power supply, exceeds 7 pcs. then additional power supply/ voltage booster is needed.
Important: The used power supply must be able to deliver 60% more power than the nominal rating of NovoCon® S.

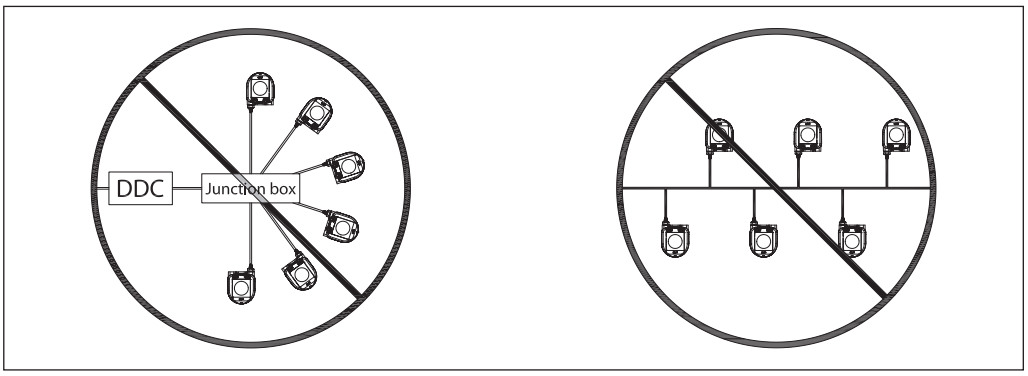


In case all BACnet devices are NovoCon® S, please see some examples for usage of voltage booster cable.



Daisy chain *(continuous)*

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 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.

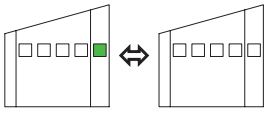
Allocating Correct INFO_FRAMES

Setting for Controller:

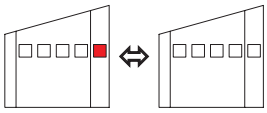
Network Routers and Controller devices that transport traffic in the MS/TP network require a higher number of INFO_FRAMES than NovoCon. Therefore, these devices should have a higher value than NovoCon e.g. A general rule of thumb for the sub network router's MAX_INFO_FRAMES property value is equal to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

LED Display

BACnet(RS485) activity

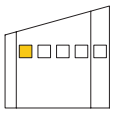


BACnet(RS485) activity
No light from LED: Actuator sees no activity on the network
LED turn on and off quickly, 10x/second:
Normal operation on the network communication is OK.
LED turn on and off slowly with green light, 3x/second: Normal operation on the network - communication over longer time directly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

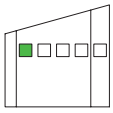


BACnet(RS485) activity with ERRORS
LED turns on and off slowly, 10x/second, with RED color: Actuator sees activity, but with errors.
LED turn on and off quickly, 10x/second, with RED color: Communication is OK, EXCEPT that another device may be using the same MAC address

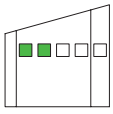
Position of valve/actuator



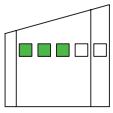
AB-QM valve is **fully closed.**



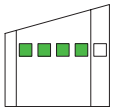
AB-QM is 1-24% open.



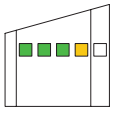
AB-QM is 25-49% open.



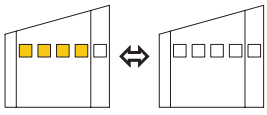
AB-QM is 50-74% open



AB-QM is 75-99% open.



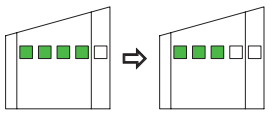
AB-QM valve is **fully open**.



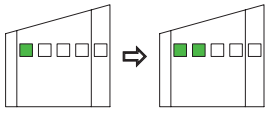
Flush is active
All LEDs turns on/off with specific period.

LED Display *(continuous)*

Movement of valve/actuator

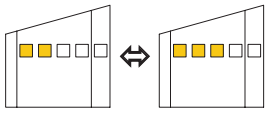


NovoCon® S closes the valve
All green LEDs are turned ON, then turned OFF one at the time (repeatedly).



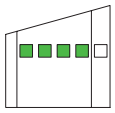
NovoCon® S opens the valve
All green LEDs are turned OFF, then turned ON one at the time (repeatedly).

Calibrating
Green light moves forward and backwards, one by one.

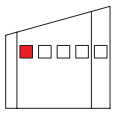


De-air is active
Yellow LEDs are turned ON one by one, then turned OFF one by one (repeatedly).

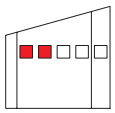
Information from actuator



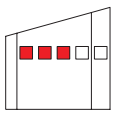
Blinking function, all green LEDs turns on/off. Used to physically identify individual actuator on the bus.



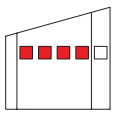
Error during closing
Debris might be trapped under the valve cone. Flushing might solve the problem.



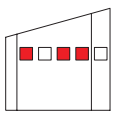
Temperature inside actuator is out of the recommended range
LEDs change between showing the alarms and showing normal operation. Ambient temperature has likely exceeded 60°C.



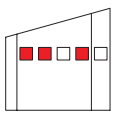
Internal error
LEDs change between showing the alarms and showing normal between operation. Try:
A: Re-calibrate.
B: Turn power off and on.
C: If the error does not disappear actuator replacement can be necessary.



Error during 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.

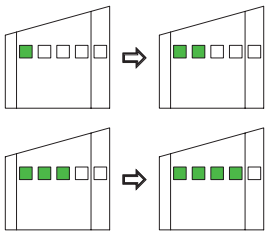


No Control Signal
In analog mode is it detected that the control wire is broken.
In digital mode is it detected that there has been no update of the Flow Rate Setpoint for more than the specified time in AV:3 (Control fall back timeout).

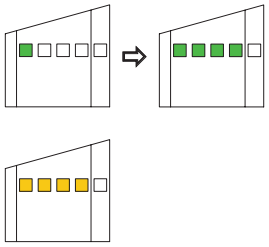
LEDs change between showing the alarms and showing normal operation.

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 objects and Modbus registers usage - 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

NovoCon® S CO6, Energy, I/O ⇨ **Application mode: MSV:9 / 33810** Analog control, Digital control, CO6 mode (default), Inverted CO6 mode ⇨ **Select Valve Type MSV:3 / 33802** (default AB-QM DN 15) ⇨ **Design Flow Rate** CO6 mode (default) AV:30 / 32796 Heating AV:31 / 32798 Cooling Digital/Analog Control AV:0 / 32768

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 then 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 %.

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

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 / 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 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.

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 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 Flow Rate Setpoint 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 desired flow 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.

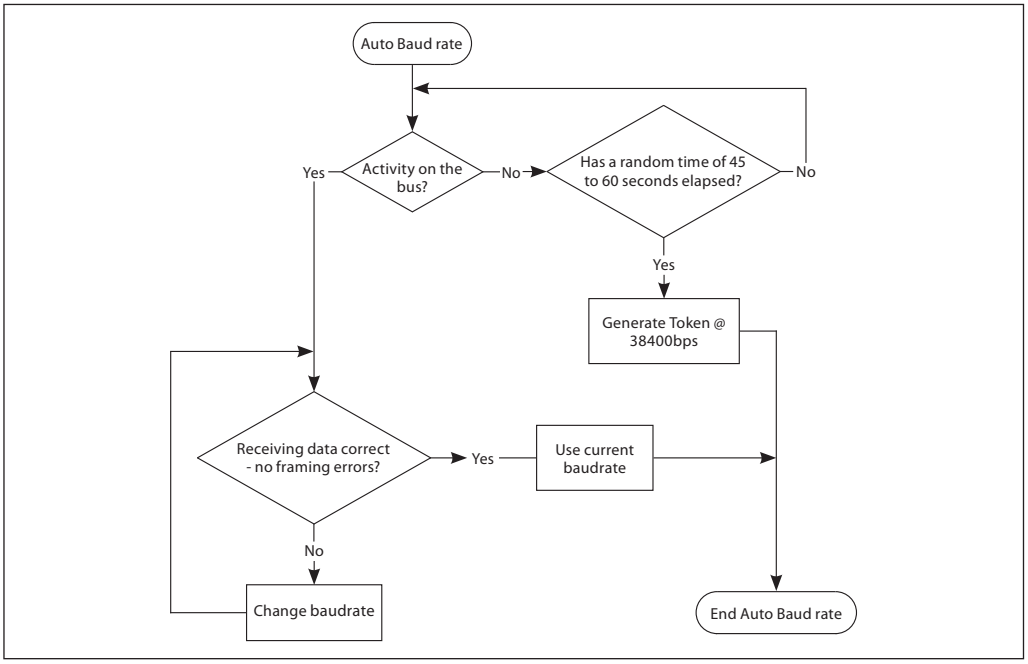
Alarms and warnings:
System issues can be detected by using BACnet object values BV:10 to BV:22 or Modbus register 33536, see Modbus registers for more details.

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).

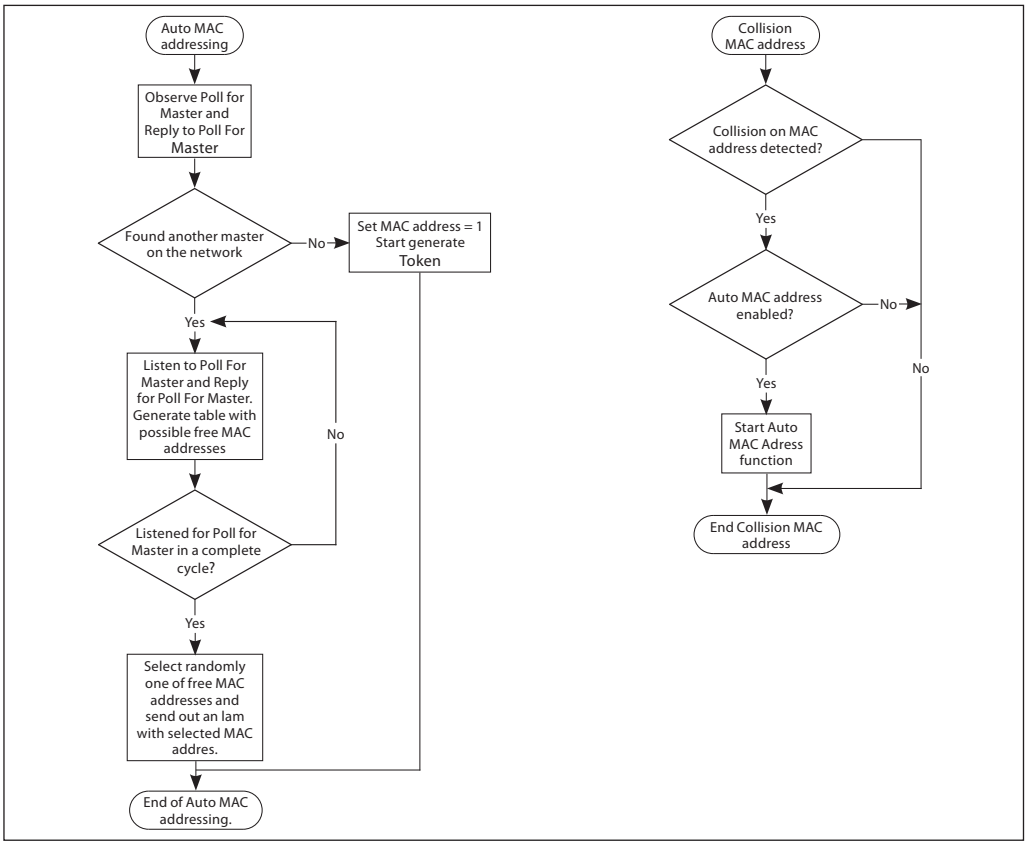
If the NovoCon® S observes activity on the bus within 45 seconds after powering up, then it adapts to the baud rate presently used on the network by other BACnet devices. If the actuator does not see activity on the network within this time, it generates a token and sends this out at the default baud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

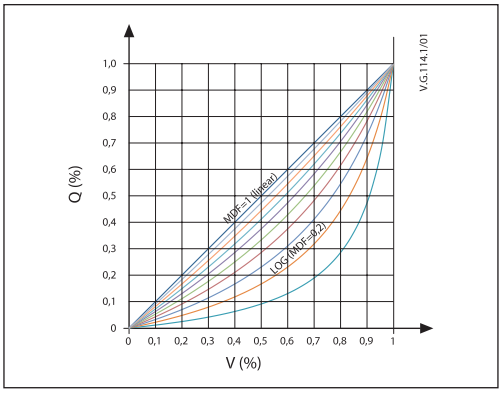


BACnet Objects
- Analog Value

Ident	Object / Parameter name	Unit	Read/ Write	Min	Max	Default	Resolution	Description
AV:0	**Design Flow Rate**	%, L/hr, 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
AV:1	**Flow Rate Setpoint**	%, L/hr, GPM	R/W	0	100% or Design Flow value	100%	0.01	The Flow Rate Setpoint through the valve. Unit follows BV:5
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
AV:3	Control Fallback Time	Minutes	R/W	0	60	10	1	Time before actuator reacts to a missing control signal.
AV:4	Alpha Value	na	R/W	0.05	1.0	1.0	0.01	Value used for shaping the curve in Manual Defined Function (MDF) mode to fit the characteristic curve of a heat exchanger. Linear setting: MDF=1.See curve below table. If AV:1 is in L/hr in Digital mode, the alpha setting is ignored.
AV:5	Valve closing or opening time	Seconds	R/W	18	700	na	1	The time the actuator needs to move from 0% to 100% of Design Flow.
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.
AV:7	MAC Address	na	R/W	1	126	na	1	MAC Address used for BACnet communication.
AV:8	Temperature In the Actuator	°C, °F	R	-20	100	°C	0.5	Temperature measured inside the actuator.
AV:9	Total Operating Hours	Hours	R	0	MAX	na	1	Total Operating Hours of the actuator.
AV:10	Minutes since last power-up	Minutes	R	0	MAX	na	1	Minutes since the last power-up of the actuator.
AV:11	Minutes since last calibration	Minutes	R	0	MAX	na	1	Minutes since the last time the actuator was calibrated to a valve.
AV:12	Minutes since fully closed	Minutes	R	0	MAX	na	1	Minutes since the last time the valve was fully closed.
AV:13	Minutes Since Fully Opened	Minutes	R	0	MAX	na	1	Minutes since the last time the valve was fully opened.
AV:14	Total steps taken by the actuator	na	R	0	MAX	na	1	Total steps taken by the actuator since first power ON
AV:15	Server Message Count	na	R	0	MAX	na	1	Server Message Count
AV:16	Server Message Received	na	R	0	MAX	na	1	Server Message Received
AV:17	Server Error Count	na	R	0	MAX	na	1	Server Error Count
AV:18	Server Message sent	na	R	0	MAX	na	1	Server Message sent
AV:19	Server Timeout Error	na	R	0	MAX	na	1	Server Timeout Error
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.
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.
AV:22	Valve position at nominal flow	Millimetre	R	na	na	na	1	Position in mm for nominal flow of the selected valve.
AV:23	Maximum value for the Design Flow Rate	Unit type follows BV:4 selection: % or (L/hr or GPM)	R	na	na	na	1	Maximum level the Design Flow can be increased to for the selected valve.
AV:24	The name of the User Defined Valve is shown here	L/hr or 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.
AV:25	Valve position at nominal flow for User Defined Valve	Millimetre	R/W	1.5	5.8	2.25	0.01	Position in mm for nominal flow of the User Defined Valve.
AV:26	Maximum value for the Design Flow in the User Defined Valve	%	R/W	100	150	120	1	Maximum level the Design Flow can be increased to for the User Defined Valve.
AV:27	Alarm summary count	na	R	na	na	0	na	Coding for AV:27 Alarm summary count is 2n. If BV:10 is active then AV:27 is 1.0. If BV:11 is active then AV:27 is 2.0. If BV:12 is active then AV:27 is 4.0. If BV:14 is active then AV:27 is 8.0. If BV:15 is active then AV:27 is 10.0. If BV:16 is active then AV:27 is 12.0. If BV:17 is active then AV:27 is 14.0. If BV:18 is active then AV:27 is 16.0. If BV:19 is active then AV:27 is 18.0. If BV:20 is active then AV:27 is 20.0. If BV:21 is active then AV:27 is 22.0. e.g. of both BV:11 & BV:12 are active then AV:27 is 6.0.
AV:30	CO6 Heating Design Flow Rate	%, L/hr, 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, in heating mode, when the control signal is at 100%.
AV:31	CO6 Cooling Design Flow Rate	%, L/hr, 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, in cooling mode, when the control signal is at 100%.
AV:32	Power emission	kW, BTU/h	R	na	na	kW	na	Power from calculated flow and temperature difference between supply and return.

Note: Units are linked e.g. if unit are changed in one of the following objects it will be changed for them all: AV:0, AV:30 and AV:31…

AV:4 Alpha Value Curve



BACnet Objects - Multi State Value

Ident	Object / Parameter name	Read/ Write	State Text	Default State	Description
MSV:0	**Actuator Mode and special features**	R/W	1: Normal 2: Calibration 3: Flush [1] 4: De-Air [2] 5: Alarm	1: Normal	Shows present mode of actuator. Calibration, flushing and de-air can be started from here.
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.
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.
MSV:3	**Selected Valve Type**	R/W	See table "Valve Type Selection"	4: AB-QM DN 15	This is the valve type. The actuator is set-up to control.
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. Range for constant time is 18-700 seconds for one stroke length.
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	Selection of method to set MAC Address for BACnet communication. If not the address is set by DIP Switch the actuator will be automatically be assigned an available MAC address.
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.
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.
MSV:8	Select field bus protocol	R/W	1: DIP switch 2: BACnet 3: Modbus	1: DIP switch	Selection of field bus protocol.
MSV:9	Application mode	R/W	1: Analog control 2: Digital control 3: CO6 mode 4: Inverted CO6 mode	3: CO6 mode	Select the actuator application mode. State 1: Analog Control. State 2: Digital Control. AV:1 is used to control the flow. State 3: CO6 mode AV:30 and AV:31 is used to control the flow. Heating is connected to the CO6 valve to ports 5 & 6 and cooling to ports 1 & 4. State 4: State 3 inverted ports.
MSV:10	CO6 command & status	R/W (1-4) R (5-9)	1: Heating 2: Cooling 3: Shut Off [3] 4: Start exercise 5: Moving towards Cooling 6: Moving towards Heating 7: Alarm 8: Exercising 9: CO6 function not active	1: Heating	State 1-4 are commands and feedback for the actuator NovoCon ChangeOver⁶. State 5-9 are feedback from the actuator NovoCon ChangeOver⁶. State 3, shut-off mode may only be used for maintenance. Do not use shut-off function during operation.
MSV:11	CO6 auto exercise	R/W	1: ON 2: OFF	1: ON	ON: The ChangeOver⁶ valve will be moved from current position to shut off and back again once per week to maintain free movement. OFF: Exercising the valve should be handled by BMS.

[1] Opens the valve fully for one hour or until a new state is selected
[2] Opens and closes the valve 5 times at maximum speed
[3] A zero desired flow command (AV:1) closes the AB-QM, so that there is neither heating nor cooling, do not use the CO6 maintenance shut-off function for this purpose.

The CO6 valve shut-off function should only be used for maintenance, when the water temperature in terminal unit is equal to ambient temperature or the terminal unit is not mounted. Water temperature change inside of closed coil could result in rising pressure and possible damage of to the terminal unit.

BACnet Objects - Binary Value

Ident	Object / Parameter name	Read/ Write	Active Text (1)	Inactive Text (0)	Default	Description
BV:0	**Analog or Digital control**	R/W	Digital	Analog	Digital	Selects between analog or digital control of the flow.
BV:2	Direct or Inverse operation Mode	R/W	Inverse	Direct	Direct	Select here between Direct and Inverse operation mode.
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.
BV:5	Units used to set and display Flow Rate Setpoint	R/W	%	L/hr or GPM for ANSI version	%	Units used to set and display the Flow Rate Setpoint.
BV:10	Warning: Temperature of the actuator is out of recommended range	R	ON	OFF	na	The Temperature inside the Actuator is out of the recommended range.
BV:11	Alarm: No Control Signal	R	ON	OFF	na	The actuator has detected that it has no control signal in.
BV:12	Alarm: Error during Closing	R	ON	OFF	na	Actuator can't close the valve completely.
BV:14	Warning: Voltage of power supply is too high	R	ON	OFF	na	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.
BV:15	Warning: Voltage of power supply is too low	R	ON	OFF	na	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.
BV:16	Alarm: Error during Calibration	R	ON	OFF	na	There was an error during calibration of actuator.
BV:17	Warning: BACnet MAC-address Conflict was Detected	R	ON	OFF	na	Two or more devices on the BACnet have the same MAC-address.
BV:18	Warning: Faults on the BACnet was detected	R	ON	OFF	na	Problems with communication on the network are detected.
BV:19	Alarm: An internal Error has been detected	R	ON	OFF	na	Re-calibrate or power cycle actuator to reset - actuator replacement can be necessary
BV:20	Alarm: CO6 in manual override or CO6 unable to move	R	ON	OFF	na	ChangeOver⁶ actuator is in manual override or unable to reach position.
BV:21	Alarm: CO6 actuator not connected or damaged	R	ON	OFF	na	The ChangeOver⁶ actuator is not connected or is damaged.

BACnet Objects - Device Object

List with some selected important Device Object properties.

Property	Value	Read / Write	Description
Object ID	Instance Range: 0 to 4194302	R/W	This property is normally called Device Instance number or Unique ID.
Object-Name	Combination of "NovoCon S" + Type and Object ID	R/W	Product name. Max. 25 characters.
Firmware revision	Current firmware version	R	BACnet software revision.
Application S/W version	Current Application SW version	R	Actuator Application Software version.
Location	This string is emty when actuator is new.	R/W	Free text can be used to describe location etc. Max. 50 characters.
Description	Danfoss NovoCon actuator with BACnet MS/TP	R/W	Product description. Max. 50 characters.
Segmentation-supported	NO SEGMENTATION	R	Actuator does not support segmentation.
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.

BACnet Objects - Analog Input

Ident	Object / Parameter name	Unit	Read / Write	Min	Max	Default	Description
AI:0	Voltage or Current on analog input	Volt / mA	R	na	na	na	Voltage(V) or Current(mA) level on the analog control input measured by the actuator. Units follows MSV:1
AI:1	T1 or resistance input	°C, °F, Ohm	R	-10°C 900Ω	120°C 100Ω	°C	Temperature measured on the return pipe or measured resistance value. Max. 10m cable.Max. 10m cable.
AI:2	T2 or resistance input						

BACnet Objects - Analog Output

Ident	Object / Parameter name	Unit	Read / Write	Min	Max	Default	Description
AO:0	Voltage on analog output	Volt	R/W	na	na	Volt	Voltage(V) on analog output (Remote I/O). Note: In CO6 mode the preset value is not writeable.

BACnet Objects - Notification class

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

NC:0 is an object where other BACnet devices can subscribe to be informed directly from this device if an alarm or warning is 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), is it necessary to subscribe for notifications for the entire day and week: From 00:00:00:00 to 23:59:59:99 and all 7 days of the week. This is 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
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.

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 [1)]	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 [2)]	"User Defined Valve"	NF	UF	VPNF	SRM

[1)] Default
[2)] Default values are identical to AB-QM ISO DN 15. This setting may be used, if other valves are used.

BACnet BIBBs services

Service	BIBBs	Init/Exe
ReadProperty	DS-RP-B	exe
WriteProperty	DS-WP-B	exe
Who-Is	DM-DDB-A	init
Who-Is	DM-DDB-B	exe
I-Am	DM-DDB-B	init
I-Am	DM-DDB-A	exe
Who-Has	DM-DOB-B	exe
I-Have	DM-DOB-B	init
DeviceCommunicationControl	DM-DCC-B	exe
ReinitializeDevice[1)]	DM-RD-B	exe
ConfirmedEventNotification	AE-N-I-B	init
UnconfirmedEventNotification	AE-N-I-B	init
AcknowledgeAlarm	AE-ACK-B	exe
GetEventInformation	AE-INFO-B	exe
GetAlarmSummary	AE-ASUM-B	exe
GetEnrollmentSummary	AE-ESUM-B	exe
AddListElement	DM-LM-B	exe
RemoveListElement	DM-LM-B	exe
ReadPropertyMultiple	DS-RPM-B	exe
WritePropertyMultiple	DS-WPM-B	exe
ChangeOfValue	DS-COV-B	exe
Restart	DM-R-B	exe

[1)] NovoCon S CO6, Energy, I/O support BACnet warm reset (power cycle) and Cold reset (factory reset). Note that after Cold/factory reset a calibration will be automatically be performed and all settings are reverted to factory settings.

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. 1 2 3 4 5 6 7 8 9 10 ON OFF	BACnet address / Modbus unit ID bit 0	Logic '0'	Logic '1'
2. 1 2 3 4 5 6 7 8 9 10 ON OFF	BACnet address / Modbus unit ID bit 1	Logic '0'	Logic '1'
3. 1 2 3 4 5 6 7 8 9 10 ON OFF	BACnet address / Modbus unit ID bit 2	Logic '0'	Logic '1'
4. 1 2 3 4 5 6 7 8 9 10 ON OFF	BACnet address / Modbus unit ID bit 3	Logic '0'	Logic '1'
5. 1 2 3 4 5 6 7 8 9 10 ON OFF	BACnet address / Modbus unit ID bit 4	Logic '0'	Logic '1'
6. 1 2 3 4 5 6 7 8 9 10 ON OFF	BACnet address / Modbus unit ID bit 5	Logic '0'	Logic '1'
7. 1 2 3 4 5 6 7 8 9 10 ON OFF	BACnet address / Modbus unit ID bit 6	Logic '0'	Logic '1'
8. 1 2 3 4 5 6 7 8 9 10 ON OFF	Termination resistor (120Ω)	No termination	Termination resistor enabled [1)]
9. 1 2 3 4 5 6 7 8 9 10 ON OFF	Not used		
10. 1 2 3 4 5 6 7 8 9 10 ON OFF	-	BACnet MS/TP [2)]	Modbus RTU [2)]

[1)] The actuator possesses resistors which can be switched on 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 use the newly selected protocol.

DIP Switch Settings - Manual Addressing

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

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

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

Example

Setting MAC address to 37:

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

Modbus registers - Configuration

Modbus / register	Read/ Write	Modbus function	Modbus Data Type	Object / Parameter name	Description	Default	Unit	Description of usage
0x8000 32768	R/W	3,4 & 16	FLOAT	**Design Flow Rate**	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 150 …450 L/hr or in percent, i.e. 20 … 100 correspond to 20 … 100%
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
0x8004 32772	R/W	3,4 & 16	FLOAT	Alpha Value	Value used for shaping the curve in Manual Defined Function (MDF) mode to fit the characteristics curve of a heat exchanger. If 33280 is in L/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 liniar. Alpha = 0.2 is equal to the LOG function
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
0x8008 32776	R	3 & 4	FLOAT	Nominal Flow of the user defined valve	The Nominal flow of the user defined valve is shown here	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
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	2.25	Millimetre	Valve position for nominal flow in millimetre, i.e. 0.5 … 5.8 correspond to 0.5 … 5.8 millimetre
0x800C 32780	R/W	3,4 & 16	FLOAT	Maximum value for the Design Flow in the User Defined Valve	Maximum level the Design Flow can be increased to for the User Defined Valve	120	Unit type follows 0x8013 selection: % or (L/hr or GPM)	i.e. 0 ..150 correspond to 0 …150 %
0x8010 32784	R/W	3,4 & 6	WORD	**Analog or Digital control**	Selects between analog or digital control of the flow	Digital	na	Selects between analog or digital control of the flow
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"	LOG	na	Selection of LOG or MDF (controlled by Alpha Value) mode
0x8012 32786	R/W	3,4 & 6	WORD	Direct or Inverse operation Mode	Select here between Direct and Inverse operation mode	Direct	na	Select here between Direct and Inverse operation mode
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	L/hr or GPM for ANSI versions	na	Units used to set and display the Design Flow. Select between L/hr and % for European versions or GPM and % for ANSI versions
0x8014 32788	R/W	3,4 & 6	WORD	Units used to set and display Flow Rate Setpoint	Units used to set and get the desired Flow	1: %	1: % 2: L/hr / GPM	Units used to set and display the desired Flow. Select between % and L/hr or GPM for ANSI versions
0x8016 32790	R/W	3,4 & 7	WORD	Units used to set and display Temperature	Select between °C or °F to set and display temperature inside the actuator	1: °C	1: °C 2: °F	Units used to set and display temperature inside the actuator.
0x8017 32791	R/W	3,4 & 6	WORD	Units used to set and display T1	Units used to read the temperature or resistance value.	1: °C	1: °C 2: °F 3: Ohm	Temperature or resistance value can be selected.
0x8018 32792	R/W	3,4 & 6	WORD					
0x8019 32793	R/W	3,4 & 7	WORD	Units used to set Power	Units used to read the power usage.	1: kW	1: kW, 2: BTU/h	Units for power.
0x801A 32794	R/W	3,4 & 6	WORD	Endian type	Byte ordering for LONG and FLOAT types	1: Big	1: Big 2: Little	Used endian type for float and long registers
0x801C 32796	R/W	3,4 & 6	FLOAT	CO6 Heating Design Flow Rate	Preset value for the design flow, when the control signal is at 100%.	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 150 …450 L/hr or in percent, i.e. 20 … 100 correspond to 20 … 100%
0x801E 32798	R/W	3,4 & 6	FLOAT	CO6 Cooling Design Flow Rate				

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Configuration *(continuous)*

Modbus / register	Read/ Write	Modbus function	Modbus Data Type	Object / Parameter name	Description	Default	Unit	Description of usage
0x802A 33810	R/W	3,4 & 6	WORD	Application mode	Select the actuator application mode. State 1: Analog Control. State 2: Digital Control. AV:1 is used to control the flow. State 3: CO6 mode AV:30 and AV:31 is used to control the flow. Heating is connected to the CO6 valve to port 5 & 6 and cooling to port 1 & 4. State 4: State 3 inverted ports.	3: CO6 mode	na	1: Analog control 2: Digital control 3: CO6 mode 4: Inverted CO6 mode
0x802B 33811	R/W	3,4 & 6	WORD	CO6 command & status	Commands for the ChangeOver6 actuator.	1: Heating	na	1: Heating 2: Cooling 3: Shut-off* 4: Start exercise 5: Moving towards Cooling 6: Moving towards Heating 7: Alarm 8: Exercising 9: CO6 function not active State 1-4 are commands and feedback for the actuator NovoCon ChangeOver6. State 5-9 are feedback from the actuator NovoCon ChangeOver6. State 3, shut-off mode may only be used for maintenance. Do not use shut-off function during operation.
0x802C 33812	R/W	3,4 & 6	WORD	CO6 auto exercise	ON: The ChangeOver6 valve will be moved from current position to shut off and back again once per week to maintain free movement. OFF: Exercising the valve should be handled by BMS.moved from current position to shutt off and back again once per week to prevent the valve getting stucked.	1: ON	na	1: ON 2: OFF
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	na	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
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	na	Select 1, 2 or… based on the table below: 1: No action 2: CLOSE 3: OPEN 4: Go to 50% of Design Flow Rate
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-QM DN 15	na	See table "Valve Type Selection 1-17"
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	na	Select 1, 2 or… based on the table below: 1: 3 sec/mm 2: 6 sec/mm 3: 12 sec/mm 4: 24 sec/mm 5: Constant Time (set by register 0x8006)
0x8024 32804	R/W	3,4 & 6	WORD	Baud Rate	Baud Rate used for bus communication	1: Auto Baud Rate Detection	na	Select 1, 2 or… based on the table below: 1: Auto Baud Rate Detection 2: 9600 bps 3: 19200 bps 4: 38400 bps 5: 57600 bps 6: 76800 bps 7: 115200 bps
0x8025 32805	R/W	3,4 & 6	WORD	Select UART mode	Supported transmission modes	3: 1-8-E-1	na	Select 1, 2, 3 or 4 based on the table below: 1: 1-8-N-2 2: 1-8-O-1 3: 1-8-E-1 4: 1-8-N-1 Data format: (Start bit-Data bits-Parity-Stop bits)
0x8026 32806	R/W	3,4 & 6	WORD	Slave ID	Slave ID used for communication.	na	na	Slave ID used for communication
0x8027 32807	R/W	3,4 & 6	WORD	Slave ID asignment method	Selection of method to set Slave ID for Modbus communication.	1: DIP Switch Settings	na	Select 1 or 3 based on the table below: 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.
0x8028 32808	R/W	3,4 & 6	WORD	BUS protocol	Select field bus protocol	1: DIP switch	na	Select 1, 2 or 3 based on the table below: 1: DIP switch 2: BACnet 3: Modbus
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	na	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)
0x8500 34048	W	6	WORD	Reset	Warm reset = Power cycle. Cold reset = Factory reset. Note that after factory reset a calibration will be automatically be performed and all settings are reverted to factory settings.	na	na	0x5741 / 22337: Warm reset 0x434F / 17231: Cold reset.

[1] A zero desired flow command (AV:1) closes the AB-QM, so that there is neither heating nor cooling, do not use the CO6 maintenance shut-off function for this purpose. The CO6 valve shut-off function should only be used for maintenance, when the water temperature in terminal unit is equal to ambient temperature or the terminal unit is not mounted. Water temperature change inside of closed coil could result in rising pressure and possible damage of to the terminal unit.

Modbus registers - Operating

Modbus / register	Read/ Write	Modbus function	Modbus Data Type	Object / Parameter name	Description	Default	Unit	Description of usage
0x8200 33280	R/W	3,4 & 16	FLOAT	**Flow Rate Setpoint**	The Flow Rate Setpoint through the valve. Unit follows 0x8014	100%	%, L/hr, GPM	Flow Rate Setpoint in percent, i.e.0 … 100 correspond to 0 … 100%
0x8202 33282	R	3 & 4	FLOAT	**Actual Flow Rate feedback**	Flow Rate Indication based on the position of the Actuator stem. Unit follows 0x8013	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 0x8013 then the valve flow rate is set to the selected valve's (0x8008) maximum value. Otherwise 100%
0x8204 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	na	Select 1, 2 or… based on the table below: 1: Normal 2: Calibration 3: Flush 4: De-Air 5: Alarm
0x8206 33286	R/W	3,4 & 16	FLOAT	**Voltage on analog output**	Voltage(V) on analog output (Remote I/O). Note: In CO6 mode the preset value is not writeable.	V	Volt / mA	Voltage level measures i.e. 0.00 … 10.00 correspond to 1.00 … 10.00 V or in mA, i.e. 0.00 … 20.00 correspond to 0.00 … 20.00 mA
0x8208 33288	R/W	3,4 & 16	WORD	**Power emission**	Power from calculated flow and temperature difference between supply and return.	kW	kW, BTU/h	Power in kW or BTU/h i.e. 0 … 1000 correspond to 0 … 1000 kW or in BTU/h, i.e. 0 … 1000 correspond to 0 … 1000 BTU/h

Modbus registers - Information

Modbus / register	Read/ Write	Modbus function	Modbus Data Type	Object / Parameter name	Description	Default	Unit	Description of usage
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.
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.
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	na	Unit type follows 0x8013 selection: % or (L/hr or GPM)	Maximum level of the Design Flow e.g. in Litres per hour i.e. 0 ..450 correspond to 0 …450 L/hr.
0x8120 33056	R/W	3, 4, 16 & 43	STRING	Device name	Product name	NovoCon S	na	Ascii coded STRING
0x8140 33088	R	3, 4 & 43	STRING	Model name	Type of the actuator	Digital or Hybrid	na	Ascii coded STRING
0x8160 33120	R	3, 4 & 43	STRING	Vendor name	Name of the Manufacture	Danfoss A/S	na	Ascii coded STRING
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.
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.
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.
0x810A 33034	R	3 & 4	WORD	SW version	Software version of the actuator	na	na	Ascii coded WORD
0x810B 33035	R	3 & 4	WORD	HW version	Hardware version of the actuator	na	na	Ascii coded WORD
0x81C0 33216	R	3 & 4	FLOAT	Voltage or Current on analog input	Voltage(V) or Current(mA) level on the analog control input measured by the actuator.	na	Volt / mA	Voltage level measured i.e. 0.00 … 10.00 correspond to 1.00 … 10.00 V or in mA, i.e. 0.00 … 20.00 correspond to 0.00 … 20.00 mA
0x81C2 33218	R	3 & 4	FLOAT	T1 or resistance input	Temperature measured on the supply pipe or measured resistance value.	°C	°C, °F, Ohm	Temperature measured in °C i.e. -10°C … . 120°C or resistance measured i.e. 900Ω … 100kΩ. Max. 10m cable.
0x81C4 33220	R	3 & 4	FLOAT	T2 or resistance input	Temperature measured on the return pipe or measured resistance value.	°C	°C, °F, Ohm	Temperature measured in °C i.e. -10°C … . 120°C or resistance measured i.e. 900Ω … 100kΩ. Max. 10m cable.
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.
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.
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 0x8015.
0x8406 33798	R	3 & 4	LONG	Total Operating Hours	Total Operating Hours of the actuator	Hours	Hours	Total Operating Hours of the actuator
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
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
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
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
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

Alarms & warning

Modbus / register	Read/ Write	Modbus function	Modbus Data Type	Object / Parameter name	Description	Default	Unit	Description of usage
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
				Alarm: Error during Closing	Actuator cannot close the valve completely	0: OFF	na	Bit 1: 0:OFF; 1:ON
				Alarm: Error during Calibration	There was an error during calibration of actuator	0: OFF	na	Bit 2: 0:OFF; 1:ON
				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
				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
				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
				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
				Warning: Faults on communication was detected	Problems with Communication on the network are detected	0: OFF	na	Bit 21: 0:OFF; 1:ON
				Warning: Invalid DIP switch setting	Slave ID assignment was done incorrectly to either 0 or 127	0: OFF	na	Bit 22: 0:OFF; 1:ON
0x8300 33536	R	3&4	LONG	Alarm: CO6 in manual override or CO6 unable to move	ChangeOver6 actuator is in manual override or unable to reach position.	0: OFF	na	Bit 23: 0:OFF; 1:ON
0x8300 33536	R	3&4	LONG	Alarm: CO6 actuator not connected or damaged	The ChangeOver6 actuator is not connected or is damaged.	0: OFF	na	Bit 24: 0:OFF; 1:ON

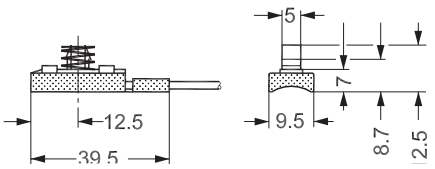
Temperature sensors

Functional description

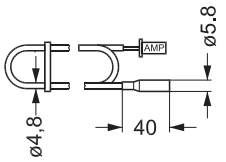
The sensor unit consists of a platinum element the resistance value of wich changes proportionally with the temperature.

Pt 1000 ohm sensor (1000 ohm at 0°C).
The sensor are adjusted and meet the tolerance requirements of EN 60751 Class B.
Accuracy of temperature measurement is approximately 0.5° in typical operating range.
It is unlikely that during calculation of ΔT deviation of booth sensors would be summed up.
Therefore it is estimated of ΔT measurement accuracy is 0.5° in case sensors are mounted correctly.

R (Typ.) Ohm	Temp. °C	Temp. °F	Tolerance
1117	30	86	0.45
1078	20	68	0.40
1039	10	50	0.35
1000	0	32	0.30
961	–10	14	0.35
922	–20	–4	0.40
882	–30	–22	0.45



Surface temperature sensor



Immersed/universal temperature sensor

Tender text

NovoCon® S CO6, Energy, Remote I/O actuator

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
Direct connection to 6-port ball valve actuator with position feedback signal [2)]
Direct connection to 2x PT1000 surface/immersed sensors and emission power indication
Direct connection I/O: 2x resistance, AO and AI [4)]
Actuator functions remotely accessible via the bus:
design flow pre-setting
flushing the valve and terminal unit
error during closing intrinsic alarm reporting
Alarm if CO6 6-port ball valve actuator is blocked, in manual override or disconnected [2)]
Supply and return temperature readings, emission power indication [3)]
Energy counter (kWh) [3)]
Alarm high/low deltaT and temperature sensors disconnected [3)]
alpha characteristics setting
speed selection 3/6/12/24 s/mm
opening/closing time selection from 18s to 700s
auto MAC addressing (BACnet)
auto Baud rate detection
flow indication based on measured stroke in l/h
Eu.bac interchangeability approved in combination with PIBCV valve
Supply Voltage: 24V DC/AC 50/60Hz
Spindle position accuracy: ±0.05mm
Cables: Halogen free plug-in available in 1.5m, 5m and 10m length
Temperature sensors: plug-in 2x PT1000 surface or immersed 1.5m length
64 actuators can be connected to the same network
IP Class: 54
Stroke: 7mm
BACnet Testing Laboratories (BTL) listed BACnet MS/TP fieldbus device [1)]
Manual override function
Commissioning tool available for addressing, parametrization and hydronic continuous commission

[1)] BACnet certification in progress and will be available in Q1.2017
[2)] CO6 application
[3)] Energy application
[4)] Remote I/O application

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 / 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.

Voltage (Present value of AV:6 / 32794)	Reaction
Voltage below 16,5V	Start alarm indication with LED. Initiate and alarm BV: 15 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 (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 returns to normal operation.
When voltage rises above 43,4V	Start alarm indication with LED. Initiate and alarm BV:14 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 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 / 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 / 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.

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