

Data sheet

NovoCon® S CO6, Energy, I/O

Description



NovoCon® S is a high accuracy multi-functional field bus actuator, specifically designed for use in combination with the 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 boiler and/or chiller efficiency.

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.

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 a flow indicator.

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

Typical applications are:

- Radiant ceiling panels, supplied by 4 pipes (Heating supply and return and cooling supply and return).
- Fan coil units, with single coils supplied by 4 pipes (Heating supply and return and cooling supply and return).

General features:

- Remote commissioning/Pre-set/Flush features
- Flow indication
- High position accuracy
- LED bar displaying status
- No tools required for mounting
- Maintenance-free lifetime
- Self-positioning process
- Low-noise operation
- Plug-in halogen free cables
- Auto MAC addressing for BACnet
- Auto baud rate detection

- Intrinsic alarm reporting for BACnet
- Valve blockage alarm
- Broken wire detection on analog control and ground signal
- BACnet MS/TP and Modbus RTU in the same product.

Combined with the Actuator NovoCon® ChangeOver⁶, NovoCon® S offers a unique solution in controlling both the AB-QM valve and a 6-port motorised ball valve that performs a diverting function between two water circuits in 4-pipe changeover systems.

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.

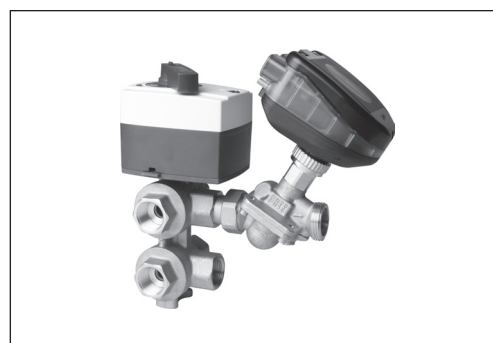
The 6-port diverting valve and actuator works in combination with an AB-QM PIBCV valve and NovoCon® S bus actuator. The AB-QM balances the flow and the NovoCon® S bus actuator controls the flow. NovoCon® S also controls the 6-port diverting valve actuator which switches between heating and cooling. This unique functionality is characterized by the following:

- There is only one single field bus and power supply connection cable to the NovoCon® S actuator. This powers both the NovoCon® S and controls the 6-port actuator. Furthermore, there is feedback from the 6-port actuator to NovoCon® S.
- The NovoCon® S actuator detects, by means of comparing 0-10V control & feedback signal, if the 6-port actuator is in manual operation mode, removed from the valve or if the 6-port valve is blocked.
- The NovoCon® S actuator has two Design Flow Rate pre-settings: one for heating and another for cooling.
- The NovoCon® S actuator indicates power emission for heating and cooling energy based on flow, supply and return pipe measurement.
- While in maintenance mode, the 6-port actuator is able to fully close the valve and prevent any leakage, thereby saving on stop valves.
- Logic contained within the NovoCon® S actuator, ensures that only one actuator in each pair (NovoCon® S and 6-port valve actuator) runs at the same time. This reduces voltage booster demands in daisy chains.
- The NovoCon® S actuator detects if the 6-port actuator cable is disconnected. If this is the case an alarm is initiated.

Description (continued)

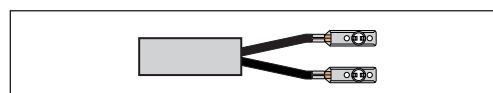
Features CO6:

- NovoCon® S CO6 + ChangeOver⁶ actuator represents only ONE device on the fieldbus network needing no physical I/O
- No cross-flow between heating and cooling
- 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 alarm
- Manual override



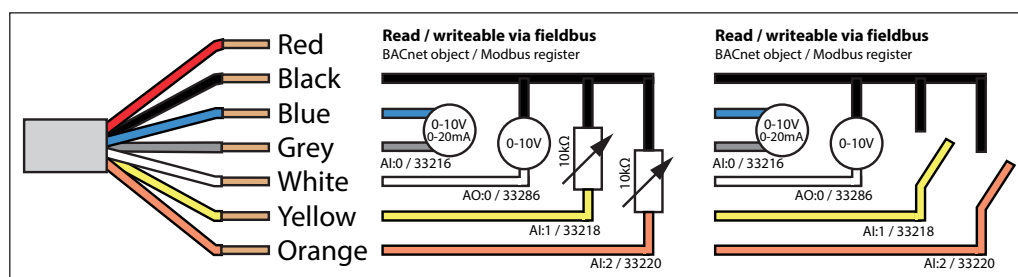
Features Energy:

- Supply and return temperature measurement
- Power/emission indication reading



Features I/O:

- Connection to other devices, e.g. room thermostat, window contact, CO2 sensor, humidity sensors, fan control, 0-10V actuator etc.
- Select temperature units, Ohms or use as potential free contacts
- Available analog output AO, analog input AI, 2xT(resistance) inputs



Ordering



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

Accessories

| Type | Length | Connections | Cable material | Code No. |
|-------------------------------------|--------|----------------------------------|----------------|----------|
| Cable NovoCon® Digital | 1.5 m | bus / power | Halogen free | 003Z8600 |
| Cable NovoCon® Digital | 5 m | bus / power | Halogen free | 003Z8601 |
| Cable NovoCon® Digital | 10 m | bus / power | Halogen free | 003Z8602 |
| Cable NovoCon® Digital, daisy chain | 0.5 m | actuator / actuator | Halogen free | 003Z8609 |
| Cable NovoCon® Digital, daisy chain | 1.5 m | actuator / actuator | Halogen free | 003Z8603 |
| Cable NovoCon® Digital, daisy chain | 5 m | actuator / actuator | Halogen free | 003Z8604 |
| Cable NovoCon® Digital, daisy chain | 10 m | actuator / actuator | Halogen free | 003Z8605 |
| Cable NovoCon® Analog | 1.5 m | 0-10 V / power / voltage booster | Halogen free | 003Z8606 |
| Cable NovoCon® Analog | 5 m | 0-10 V / power / voltage booster | Halogen free | 003Z8607 |
| Cable NovoCon® Analog | 10 m | 0-10 V / power / voltage booster | Halogen free | 003Z8608 |
| Cable NovoCon® I/O | 1.5 m | actuator / free wires | Halogen free | 003Z8612 |



| | | | | |
|-----------------------|-------|--|-----|----------|
| Cable NovoCon® Energy | 1.5 m | actuator / PT1000 surface temperature sensors | PVC | 003Z8610 |
| Cable NovoCon® Energy | 1.5 m | actuator / PT1000 Immersed / universal temperature sensors | PVC | 003Z8611 |

ChangeOver⁶ actuators

| | | | | |
|---|---------------------------|--|---------------------------|----------|
| Actuator NovoCon ChangeOver ⁶ | 1 m | Plug-in | Halogen free | 003Z8520 |
| Actuator NovoCon ChangeOver ⁶ Energy | 1 m Temp. sensors 1.5m | Plug-in incl. PT1000 surface temperature sensors | Halogen free, sensors PVC | 003Z8521 |
| Actuator NovoCon ChangeOver ⁶ Flexible | 2 m | Actuator / open wires | PVC | 003Z8522 |



Note! Cables are not included with actuator and must be ordered separately.
If separate PT1000 temperature sensors are needed, Danfoss has an array of PT1000 sensors that can be used with NovoCon® S CO6, Energy, I/O.
See Danfoss PT1000 sensors ESMT, ESM-10, ESM-11, ESMB-12, ESMC and ESMU.

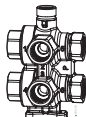
Data sheet

NovoCon® S CO6, Energy, I/O

Ordering (continued)

| Type | DN | Fire load class ¹⁾ | Code No. |
|------------------------------------|----|-------------------------------|-----------------|
| ChangeOver ⁶ insulation | 15 | B2 | 003Z3159 |

¹⁾ According to D/N 4102



| Type | DN | k _{vs} (m³/h) | Connection | Code No. |
|-------------------------------|----|---------------------------|------------|-----------------|
| ChangeOver ⁶ valve | 15 | 2,4 | Rp ½ | 003Z3150 |
| | 20 | 3,8 | Rp ¾ | 003Z3151 |

Accessories and spare parts (Cable NovoCon® Energy)

| Type | Designation | Code No. |
|--------|--|-----------------|
| Pocket | Immersion, stainless steel 100 mm, for Cable NovoCon® Energy (003Z8611) | 087B1192 |
| | Heat conducting paste, 3,5 cm² | 041E0110 |

Service kit - combination with old AB-QM

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

Approvals



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

Technical data

| | |
|---|--|
| Power supply range | 24 V AC/DC, 50 / 60 Hz * |
| Power consumption | 3.3 VA@24VAC / 1.4 W@24V DC / Standby: 0.9 W |
| Protection class | III safety extra-low voltage |
| 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

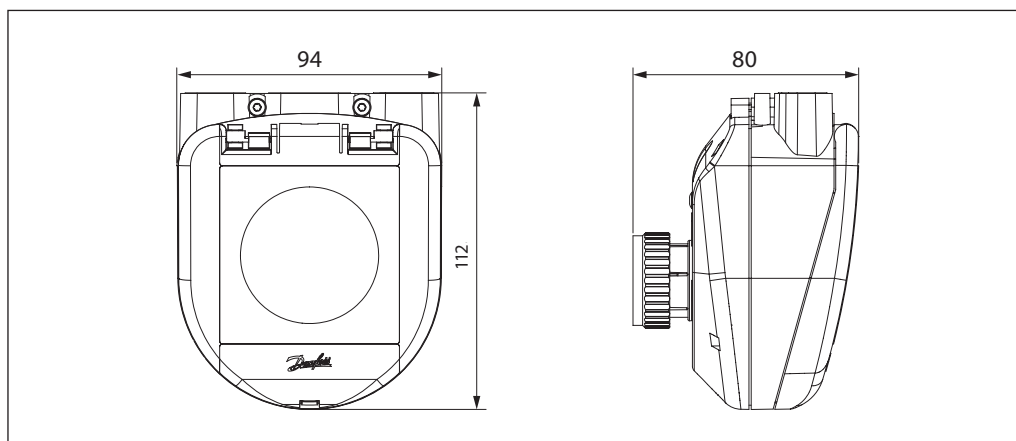
| Type | Length |
|-----------------------------|--|
| BACnet device profile | BACnet Application Specific Controller (B-ASC) |
| BACnet protocol | BACnet Master Slave / Token Passing (MS/TP) |
| BACnet baud rates supported | Auto baud rate detection* / 9600 bps / 19200 bps / 38400 bps / 56700 bps / 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) / Auto parity* Data format: Parity (Start bit - Data bits - Parity - Stop bits) |

* Default

Dimensions



Presetting

Pre-setting of flow is made electronically with the NovoCon® S actuator. The pre-set scale on the AB-QM valve is not used under normal operation.

Normal operation

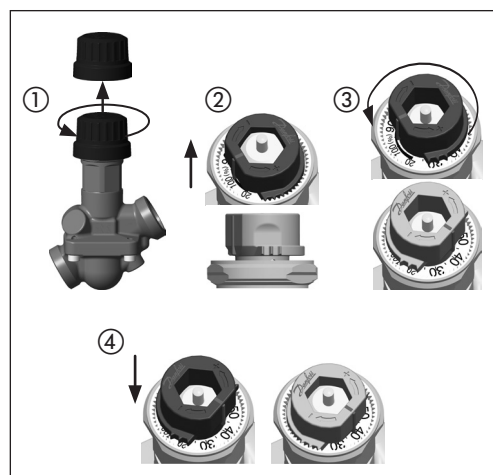
Leave valve at default factory pre-set (100 %).

High flow operation

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

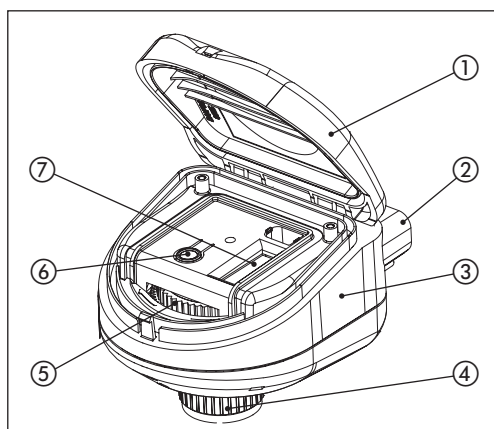
See drawing.

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

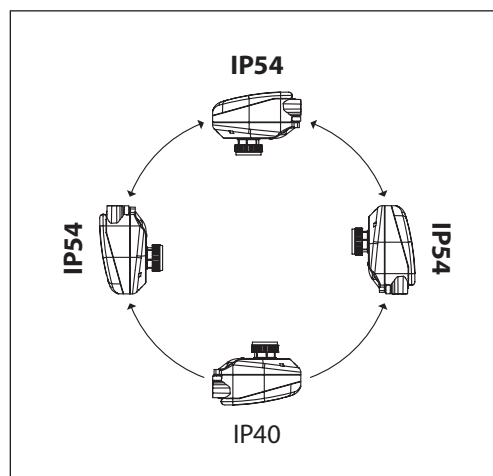


Mounting Orientation

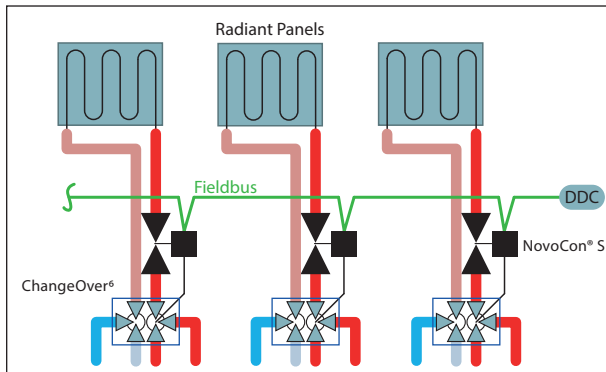
NovoCon® S can be mounted in any position. However, mounting orientation affects the IP classification. See illustration.

Note!

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



Application principles ChangeOver⁶

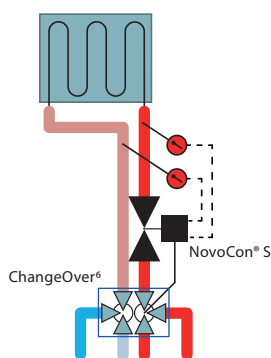


Separate maximum flow pre-setting for heating and for cooling

Setup

| Object / Register | Write/read value | Description |
|-------------------|------------------|---|
| MSV:9 / 32810 | CO6 mode | While in CO6 mode, the 0-10V input and output signals are used purely for controlling the 6-port valve actuator |
| MSV:3 / 32802 | Valve type | ISO valve selected = l/h, °C, kW and kg/m ³ , ANSI valve selected = g/min, °F, kBTU and lb/ft ³ |
| 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 ChangeOver⁶ Energy

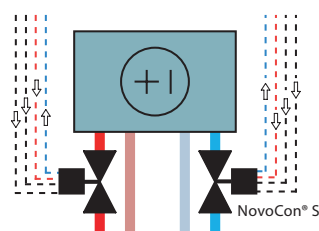


Setup

| Object / Register | Write/read value | Description |
|-------------------|------------------|---|
| MSV:9 / 32810 | CO6 mode | While in CO6 mode, the 0-10V input and output signals are used purely for controlling the 6-port valve actuator |
| 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/m ³ , ANSI valve selected = g/min, °F, kBTU and lb/ft ³ |
| AI:1 / 33218 | Temperature | Select between temperature units or ohms |
| AI:2 / 33220 | Temperature | Select between temperature units 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® S I/O

When combining the NovoCon® S and the Cable NovoCon® I/O, many options are possible



Resistance inputs can also be used as galvanic insulated digital inputs for detection of window contact, condensation sensor etc.
Connected: 850 Ohm.
Disconnected >100 kOhm.

Operation example (DDC command)

| Object / Register | Write value | Description |
|-------------------|-----------------|---|
| MSV:9 / 32810 | Digital Control | Select Digital mode to disable alarms caused by expected feedback signals while in CO6 mode |
| AV:1 / 33280 | 85 | DDC writes % opening value of the AB-QM valve |
| AO:0 / 33286 | 5.5 | DDC writes level of voltage on NovoCon® S analog output, which is send to the connected remote device |

Read on the BMS example

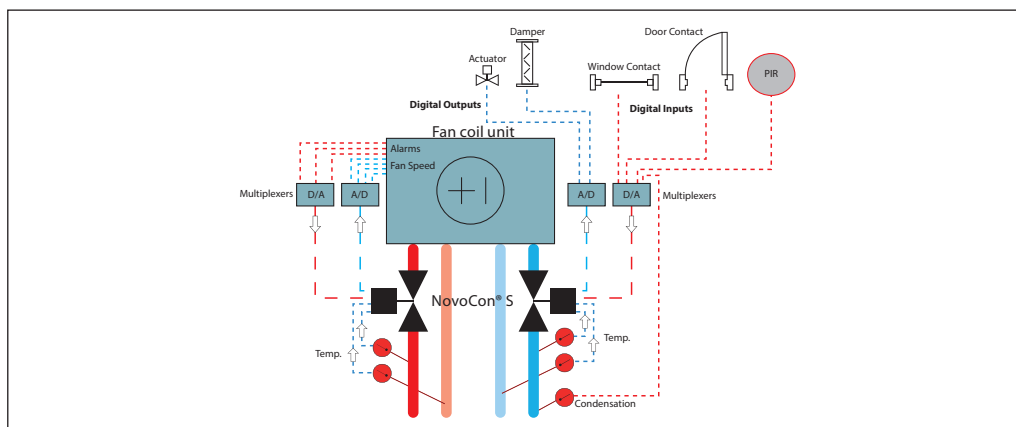
| Object / Register | Read value | Description |
|-------------------|------------|---|
| AO:0 / 33286 | 5.5 | Voltage output from NovoCon® S to remote device |
| AI:0 / 33216 | 6.5 | Voltage level on the analog control input measured by the actuator (may also be mA) |
| AI:1 / 33218 | 1160 | Resistance value (Ohm) received from remote device 1 |
| AI:2 / 33220 | 1263 | Resistance value (Ohm) received from remote device 2 |

Application principles NovoCon® I/O and Multiplexers

Multiplexers (analog-digital-analog convertors) in combination with NovoCon® S CO6, Energy, I/O, may be used to gather information on, or control on/off devices.

Using NovoCon's 0-10V output signal (AO:0 / 33286), multiplexers convert this signal in order to switch devices on or off e.g. 7V signal from NovoCon® S is converted inside the multiplexer so device1=on, device 2=on, device3=off. E.g. 4V signal from NovoCon® S is converted inside the multiplexer so the device1=on, device 2=off, device3=off.

Using NovoCon's 0-10V input signal (AI:0 / 33216) received from the multiplexers the DDC can decipher the meaning of the voltage signal e.g. 7V signal to NovoCon® S from the multiplexer is deciphered by the DDC as meaning device1=on, device 2=on, device3=off. 4V signal to NovoCon® S from the multiplexer is deciphered by the DDC as meaning device1=on, device 2=off, device3=off.



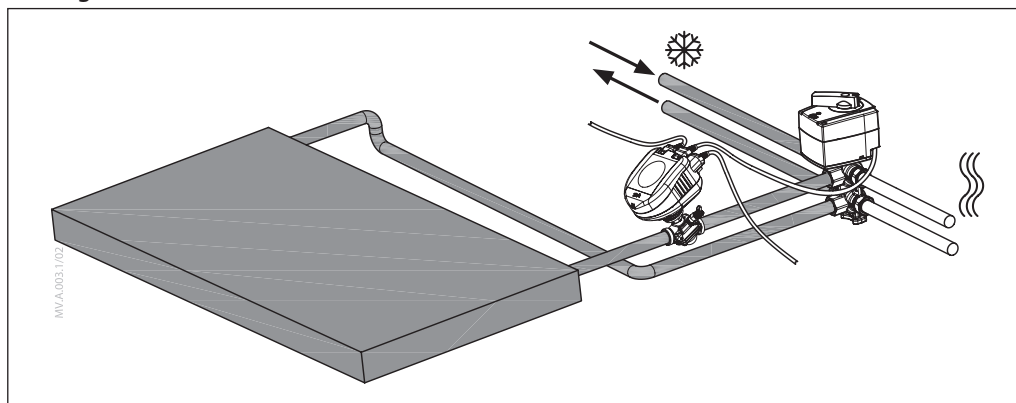
Application principles ChangeOver® (continued)

Anti-sticking requirements:

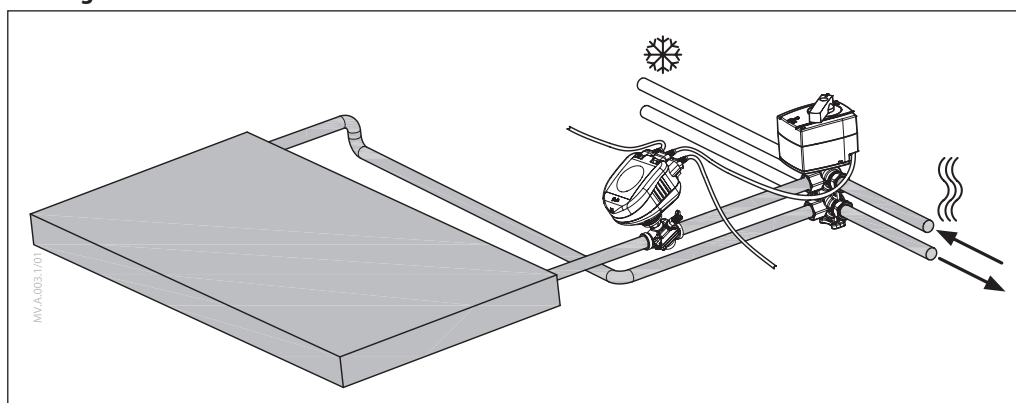
To reduce the risk of the ball valve sticking due to water quality, the valve must be partially rotated at least every 7 days. This is a factory default setting and is handled by the object MSV:11 / register 32812.

The ChangeOver® is a 6-port valve with a rotary actuator that switches the flow between heating and cooling. An AB-QM pressure independent balancing and control valve with an actuator is used to balance the system and modulate the flow. When using the NovoCon® S CO6, Energy, I/O for flow control, both NovoCon® S and the Actuator NovoCon® ChangeOver® are represented on the fieldbus network and need no physical I/O for control.

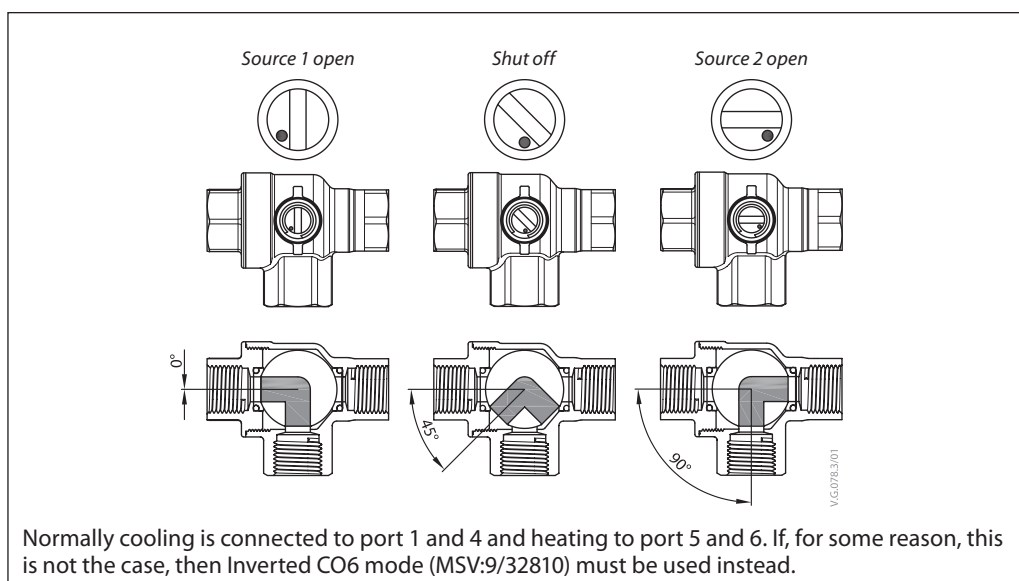
Cooling:



Heating:



No mixing and shut off



CO6, contrary to other ball valves, includes a shut off function. This function should only be used during maintenance and not during operation. This replaces the need for four ball valves.

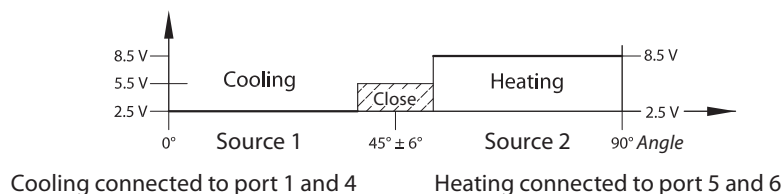
MSV:9 / 32810

3: CO6 Mode

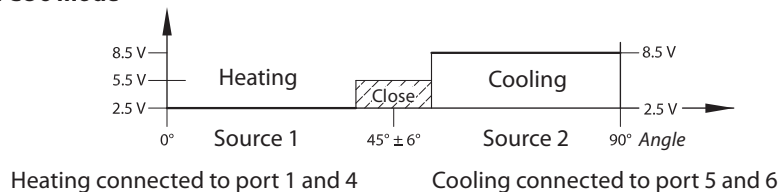
Normally cooling is connected to ports 1 and 4 and heating to ports 5 and 6. If that is not possible, then this may be switched and **4: Inverted CO6 Mode** must be selected.

NovoCon® S and the ChangeOver⁶ actuator communicate with 0-10V control and feedback signal. Whole functionality is available by using simple bus commands. For easier technical understanding, please see below detailed explanation of the communication between NovoCon® S and the ChangeOver⁶ actuator.

CO6 mode



Inverted CO6 mode



Signal from NovoCon® S to the Actuator NovoCon® ChangeOver⁶

| | Stop the motor | Cooling | Shut-off | Heating |
|-------------------|----------------|---------|----------|---------|
| CO6 mode | 1.0 V | 2.5 V | 5.5 V | 8.5 V |
| Inverted CO6 mode | 1.0 V | 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 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.**

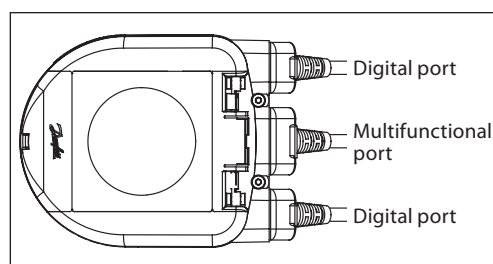
All BACnet bus connections in the cables are made with twisted wires.

The cable type used for NovoCon® analog, digital and I/O 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 100-130Ω The capacitance between conductors shall be less than 100 pf per meter. Note: the length of the cables influence on the communication speed. Longer cable lengths should mean lower baud rate. Maximum cable length allowed is 1200m.

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

NovoCon® S has mis-wiring protection on up to 30 V AC and DC on bus and power wires.

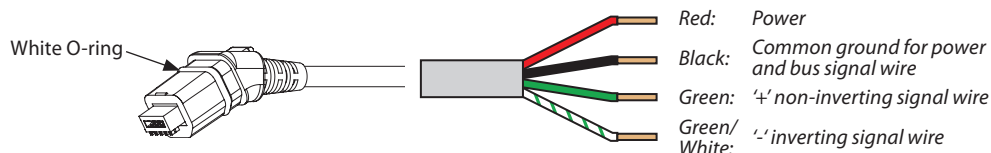


NovoCon® digital daisy chain cable



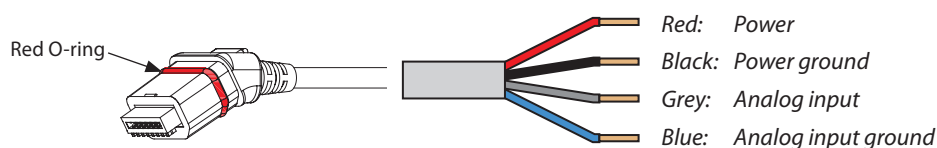
The digital daisy chain cable is used to connect power and BACnet/Modbus between two NovoCon® S devices.

NovoCon® digital cable



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

NovoCon® analog cable

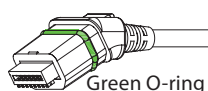


The analog cable is used to connect power and analog control signal.

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.

Cable NovoCon® Energy with PT1000 surface sensor

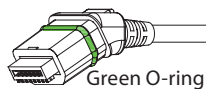


NovoCon® Energy cable - PT1000 surface sensors

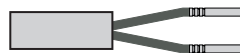


Wiring (continued)

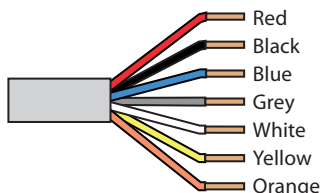
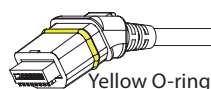
Cable NovoCon® Energy with universal PT1000 temperature sensor



NovoCon® Energy cable - PT1000 immersed sensors



Cable NovoCon® I/O



| | |
|--------|--|
| Red | Power 24V |
| Black | Power ground. T1, T2 and V output signal ground. |
| Blue | V/mA input signal ground |
| Grey | V/mA input signal |
| White | V output signal |
| Yellow | T1 or resistance input |
| Orange | T2 or resistance input |

Normally the user will connect "Power ground" and "V/mA input signal ground" to a common ground unless A) NovoCon® S is being controlled by a v/mA signal and B) if there are separate power ground and control signal ground on the controller.

If a power booster is needed on a NovoCon® S with temperature sensors, the power must be connected to the Digital port to improve accuracy.



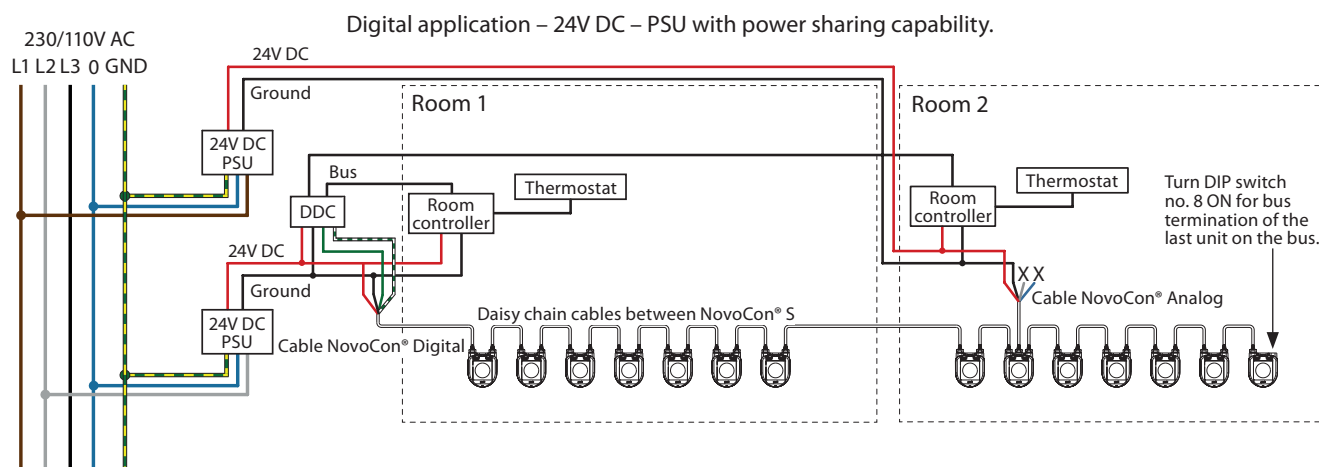
To avoid electrical short-circuiting, ensure that loose cable-ends have been connected or isolated before inserting the plug-in connector to the NovoCon® S actuator.

Wiring considerations

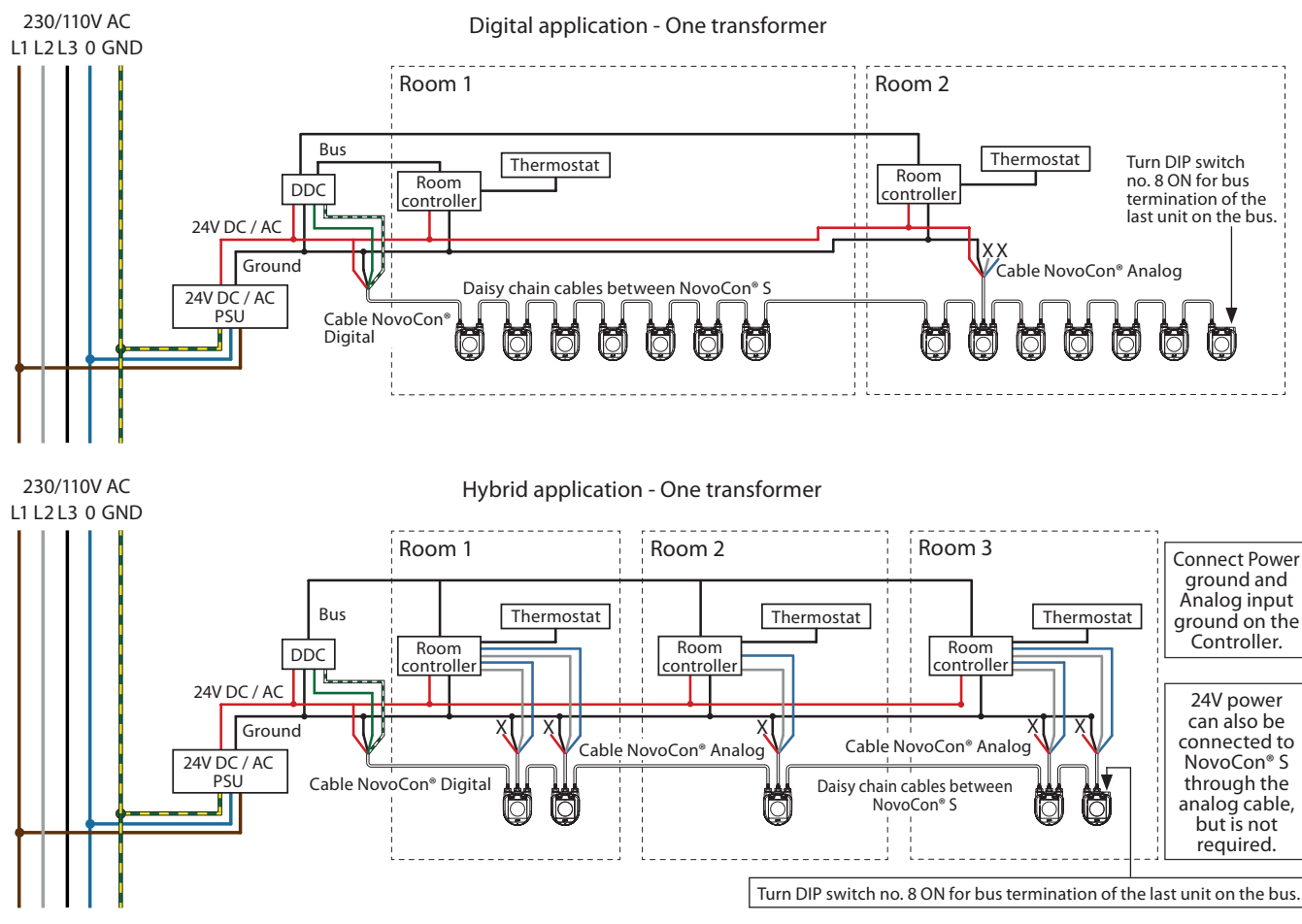
The important factors here are:

- 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.

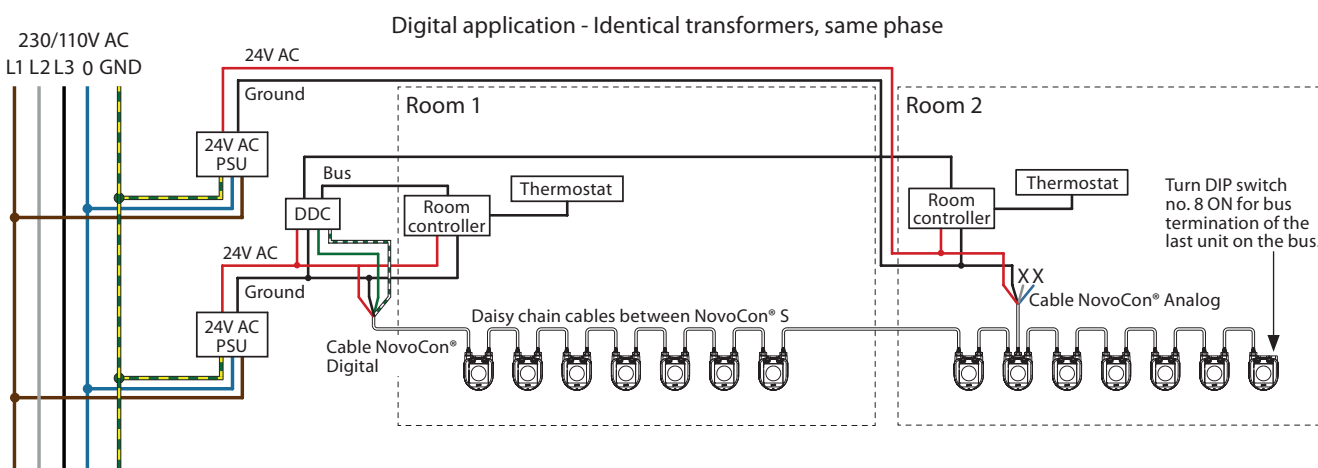
Wiring with DC power supply: (recommended solution)



Wiring with DC or AC power supply:



Wiring with AC power supplies:

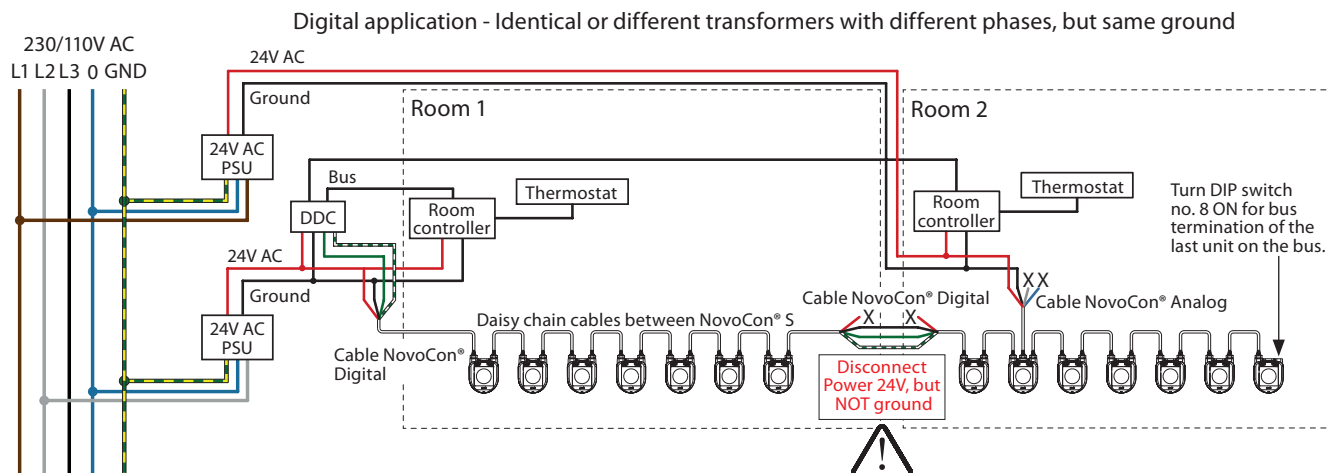


If the NovoCon® S network is supplied with two or more AC power boosters, caution must be observed when disconnecting one of the transformers from the high voltage power line. As the NovoCons are connected in a daisy chain, there may be high voltage on the primary side of the disconnected power supply. 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.

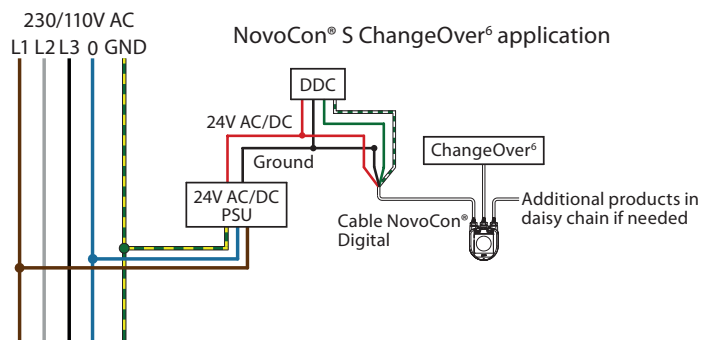
Wires that ends in an "X" must be properly terminated.

Wiring with AC power supply: (continued)

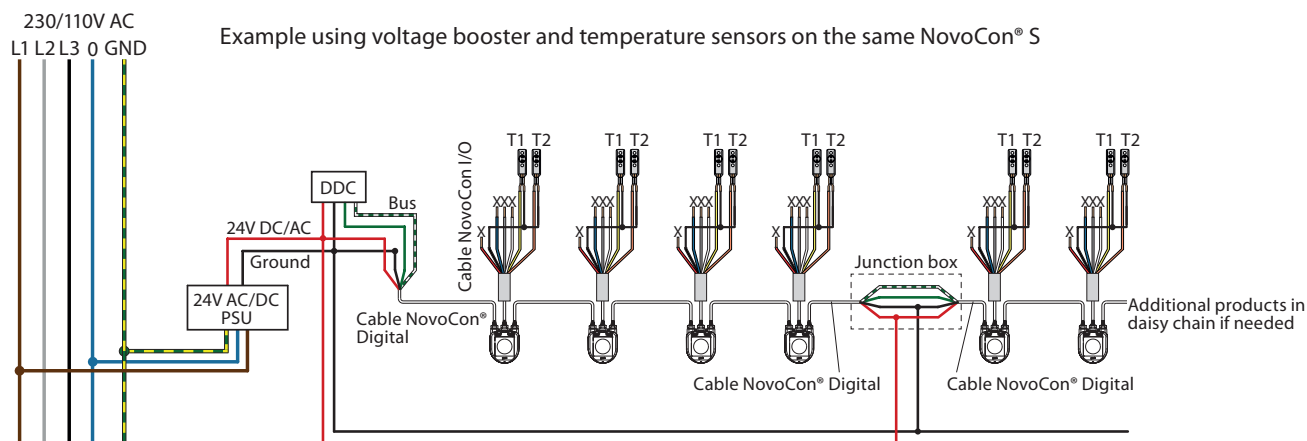


Wires that ends in an "X" must be properly terminated.

NovoCon® S ChangeOver⁶ application



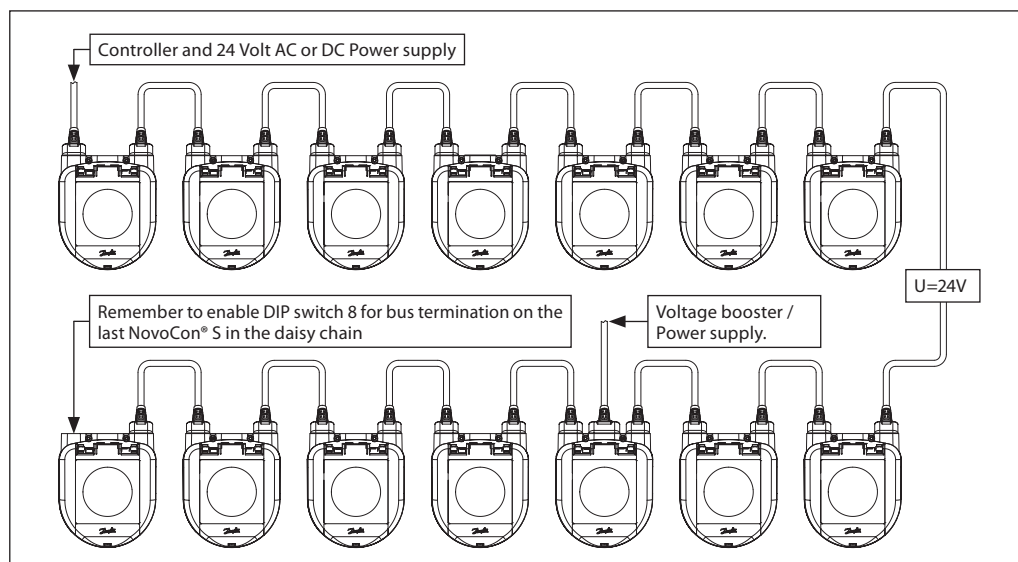
Wiring I/O application:



DC Power supply (recommended)

AC Power supply

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

Temperature sensors added directly or through the Cable NovoCon® I/O

U=24V

Remember to enable DIP switch 8 for bus termination on the last NovoCon® S in the daisy chain

Voltage booster / power supply is connected to a NovoCon® digital cable between the NovoCon® S inside a junction box.

When all devices on the sub-network are NovoCon® S, refer to the examples below for guidance.

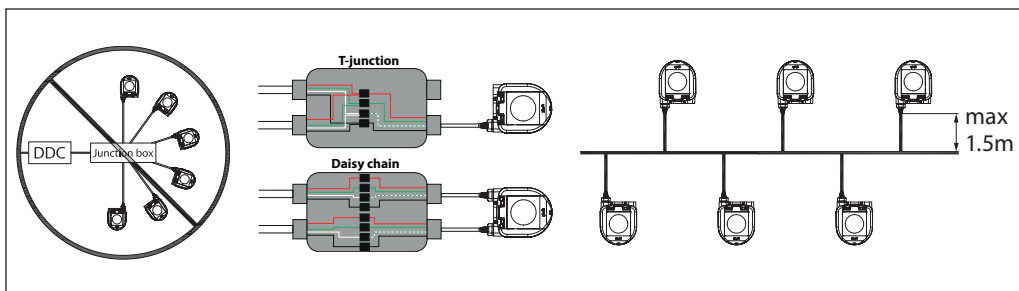
VD.HU.U3.02

Daisy chain *(continued)*

Use daisy chain connection for NovoCon® S. Danfoss recommend that star topology is NEVER used with NovoCon® S as debugging the system becomes very difficult. T-junction connections (stub lines) are not recommended. In the event of T-junction connections being used, Danfoss accepts no responsibility although it is advised that the following limitations are never exceeded:

- max T-junction cable length 1.5m (shortest standard digital cable)
- total length of Network max 640m (+ 100m stub length)
- max baud rate 76 kb/s¹⁾
- max number of devices on network 64¹⁾
- main cable should be standard RS485 bus, twisted pair, min thickness AWG22 / 0.32mm².

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



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.

The recommended maximum quantities of NovoCon® S are 64 pcs in one daisy chain connection. If other BACnet devices are added with NovoCon® S in the same daisy chain connection, Danfoss recommends a maximum of 32 pcs. to ensure sufficient network speed.

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

General requirements:

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

Optimize BACnet network speed

Reducing Unnecessary PollforMaster Traffic

Setting for the last NovoCon® in the daisy chain:

The MAX_MASTER setting in NovoCon® S 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.

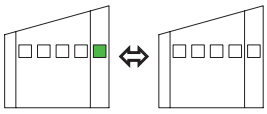
Allocating Correct INFO_FRAMES

Setting for Controller:

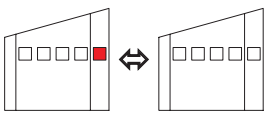
Network Routers and Controller devices that transport traffic in the MS/TP network require a higher number of INFO_FRAMES than NovoCon® S. Therefore, these devices should have a higher value than NovoCon® S e.g. A general rule of thumb for the sub network router's MAX_INFO_FRAMES property value is equal 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/Modbus (RS485) activity

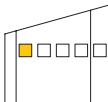


BACnet/Modbus (RS485) activity
 No light from LED: Actuator sees no activity on the network.
 LED turn on and off quickly, 10x/second:
 Normal operation on the network communication is OK.
 LED turn on and off slowly with green light, 3x/second: Normal operation on the network - communication over longer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

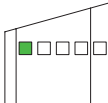


BACnet/Modbus (RS485) activity with ERRORS
 LED turns on and off slowly, 10x/second, with RED color: Actuator sees activity, but with errors.
 LED turn on and off quickly, 10x/second, with RED color: Communication is OK, EXCEPT that another device may be using the same MAC address.

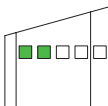
Position of valve/actuator



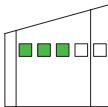
AB-QM valve is **fully closed**.



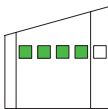
AB-QM is 1-24% open.



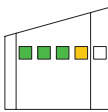
AB-QM is 25-49% open.



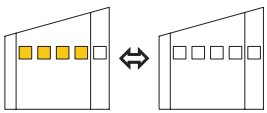
AB-QM is 50-74% open



AB-QM is 75-99% open.



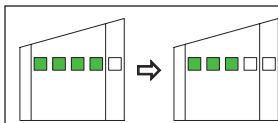
AB-QM valve is **fully open**.



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

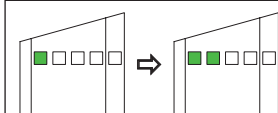
LED Display (continued)

Movement of valve/actuator



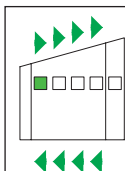
NovoCon® S is closing the valve

All green LEDs are turned ON, then turned OFF one at the time (repeatedly).



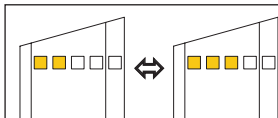
NovoCon® S is opening the valve

All green LEDs are turned OFF, then turned ON one at the time (repeatedly).



NovoCon® S is calibrating

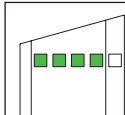
Green light moves forward and backwards, one by one.



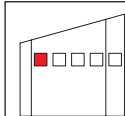
De-air is active

Yellow LEDs are turned ON one by one, then turned OFF one by one (repeatedly).

Information from actuator

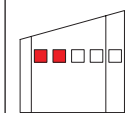


Blinking function, all green LEDs turns on/off. Used to physically identify individual actuator on the bus.



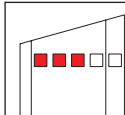
Error during closing

Debris might be trapped under the AB-QM valve cone. Flushing may solve the problem.



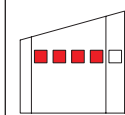
Temperature inside NovoCon® S is out of the recommended range

LEDs change between showing the alarms and showing normal operation. Ambient temperature has likely exceeded 60°C.



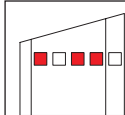
Internal NovoCon® S error

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.



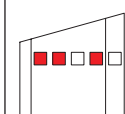
Error during NovoCon® S calibration

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



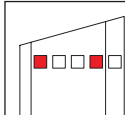
Power supply is outside limits

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.
In CO6 mode or Inverted CO6 mode the ChangeOver⁶ actuator is not connected or damaged.



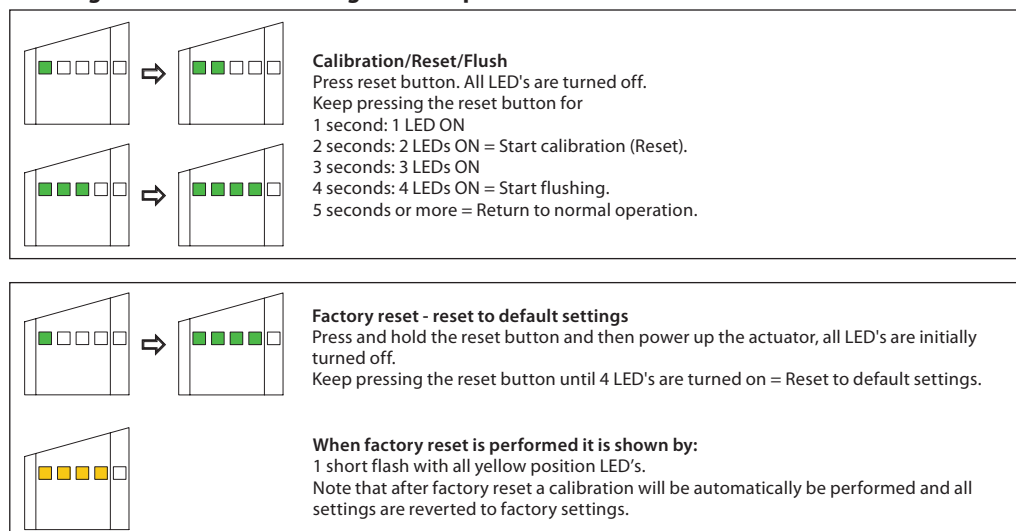
ChangeOver⁶ actuator

The ChangeOver⁶ actuator is in manual override or unable to reach position.

LEDs change between showing the alarms and showing normal operation.

LED Display (continued)

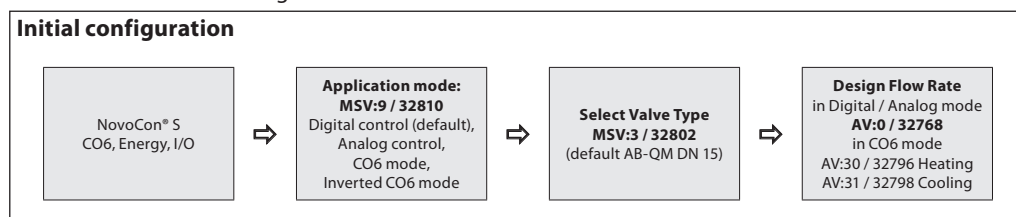
Pressing the reset button during normal operation



BACnet objects and Modbus registers usage - Design flow rate setting

General

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



BACnet objects and Modbus registers usage - Advanced configuration and features

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

| | |
|----------------|---|
| MSV:9 / 32810 | Application mode |
| MSV:3 / 32802 | Selected Valve Type |
| MSV:30 / 32796 | Design Flow Rate Heating (when MSV:9 / 32810 is in CO ₆ mode or CO ₆ inverted mode) |
| MSV:31 / 32798 | Design Flow Rate Cooling (when MSV:9 / 32810 is in CO ₆ mode or CO ₆ inverted mode) |
| AV:0 / 32768 | Design Flow Rate (when MSV:9 / 32810 is in Digital or Analog mode) |
| MSV:10 / 33811 | CO ₆ command & status |
| AI:1 / 32791 | Temperature T1 or resistance input |
| AI:2 / 32792 | Temperature T2 or resistance input |
| AV:32 / 33288 | Power Emission |

Application mode:

The default Application mode is Digital Control. Here is the NovoCon® S CO₆, Energy, I/O controlled via fieldbus and the the voltage inputs and outputs are available.

If the CO₆ functionality is needed the Application mode must be changed to CO₆ mode. This is where the NovoCon® S CO₆, Energy, I/O actuator is ready to be used with the Actuator NovoCon® ChangeOver[®]. If the heating and cooling pipes are connected inverted to that shown on the data sheet, then CO₆ Inverted mode must be selected. The object/register MSV:9 / 32810 Application mode is used to select this. Analog Control is also possible if required.

Selection of AB-QM valve type:

After selecting Application mode (see above), it is then necessary to select the AB-QM valve type that the actuator is mounted on. This is done with the object MSV:3 / 32802 Selected Valve Type. The present value of MSV:3 / 32802 may be set to values between 1 and 17. Each number represents a specific AB-QM valve type, which can be found in the table: Valve type selection. The default value for MSV:3 / 32802 is 4 i.e. ABQM ISO DN15 valve.

Selection and setting of engineering units:

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

BACnet objects and Modbus registers usage

- Advanced configuration and features *(continued)*

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 the designed maximum flow rate. The Design Flow Rate is set by changing the present value of:

- MSV:30 / 32796 Design Flow Rate Heating (when MSV:9 / 32810 is in CO6 mode or CO6 inverted mode)
- MSV:31 / 32798 Design Flow Rate Cooling (when MSV:9 / 32810 is in CO6 mode or CO6 inverted mode)
- AV:0 / 32768 Design Flow Rate (when MSV:9 / 32810 is in Digital or Analog mode)

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 must be set to maximum open (100% open is the default mechanical pre-setting from our factory).

Calibration of the Actuator to the AB-QM Valve:

After all basic settings have been made, it is now time to calibrate the actuator to the chosen AB-QM valve. In doing this, the actuator will adjust itself to the exact AB-QM valve used, and all settings will be used correctly.

A calibration is started by setting the object / register: Actuator Mode and Special Features MSV:0 / 33284 to calibration.

Changing from Heating to cooling in CO6 and Inverted CO6 mode:

The object / register MSV:10 / 32811 CO6 command & status is used to change from heating function to cooling function as well as giving feedback as to the ball position status. A more detailed description of this is found in the tables for BACnet objects / Modbus registers.

Temperature measurements:

AI:1 / 32791 Temperature T1 or resistance input and AI:2 / 32792 Temperature T2 or resistance input are used to measure the temperature with PT1000 temperature sensors. The resistance value may also be show directly if selected, allowing these inputs to be used for other purposes than measuring temperature e.g. window contacts or another potential free contacts.

Power emission:

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

Flushing a system:

Actuator Mode and Special Features MSV:0 / 33284 has an option which allows the user to flush the system via the field bus. To start flushing the system, set MSV:0 / 33284 to 3, Flush. The actuator will then open up the AB-QM valve completely. Flush will end when:

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

When flushing ends, the actuator returns to normal operation.

De-Airing of a system:

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

Controlling the actuator:

Under normal operation Digital (MSV:9 / 32810 Application mode in CO6 mode, Inverted CO6 mode and Digital mode) of the actuator, where the flow through the AB-QM valve is to be controlled, the object Flow Rate Setpoint AV:1 / 33280 is used. The default setting for the Flow Rate Setpoint engineering unit is %.

This is the most suitable setting as the controller does not need to know anything about the Design Flow Rate setting of the actuator. The output signal from the controller needs only to be set up so it regulates from 0 to 100% of the 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 engineering unit selected for AV:1 / 33280 must 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 to 450 l/hr for a DN15 valve.

Alarms and warnings:

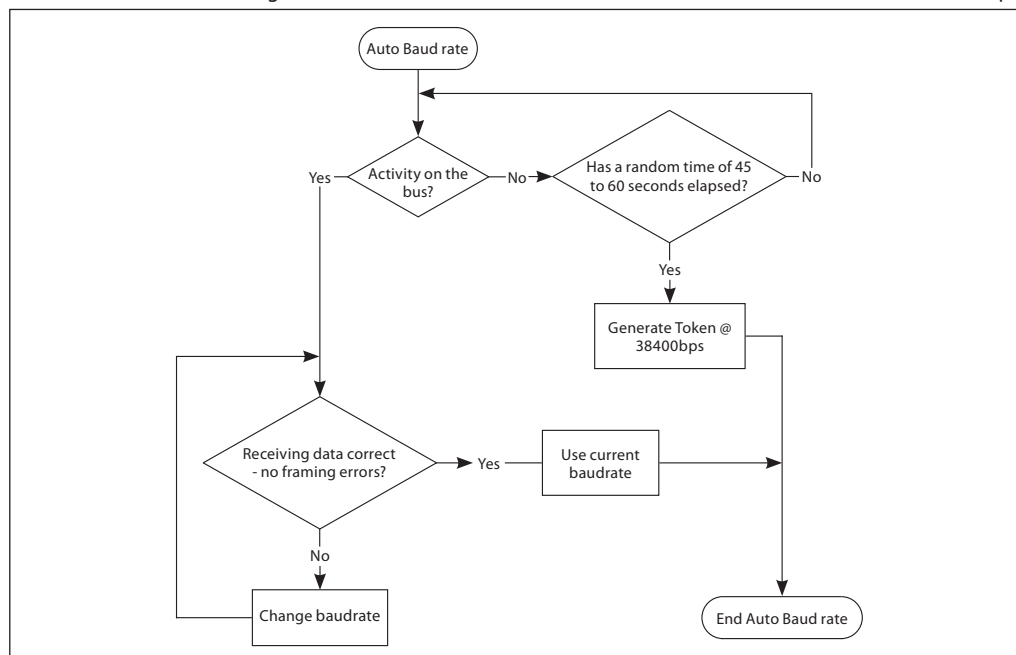
System issues can be detected by using BACnet object values BV:10 to BV:21 or Modbus register 33536, see BACnet and Modbus tables for more details.

Auto baud rate

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

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

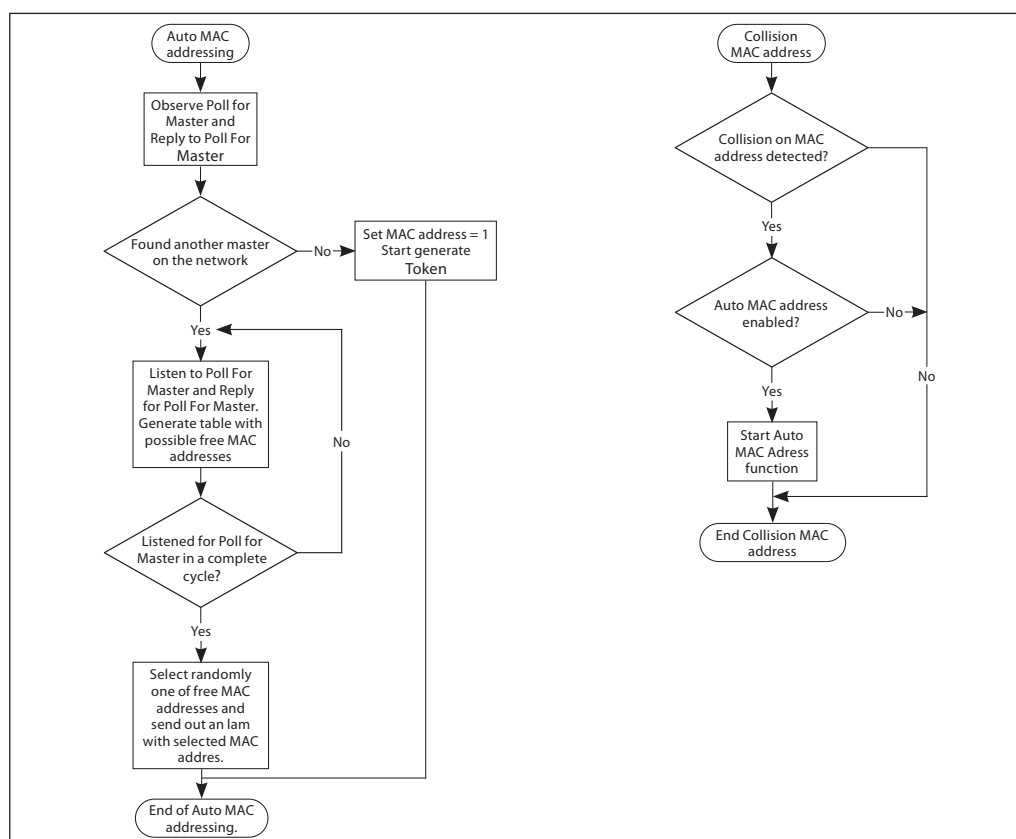
If the NovoCon® S observes activity on the bus within 45 seconds after powering up, then it adopts the baud rate presently used on the network by other BACnet devices. If the actuator does not see activity on the network within this time, it generates a token and sends the token out at the default baud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



Auto MAC Addressing - BACnet only

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

The NovoCon® S actuator observes for used which MAC addresses on the sub-network that are taken and then automatically assign an available MAC address to the actuator on first power up, if the address has not already been manually selected by DIP Switches. If a MAC address collision arises later and Auto MAC addressing is enabled, this function will start the search for an available MAC address again. When an available MAC address is found, an "I-Am" notification will be sent out via BACnet.

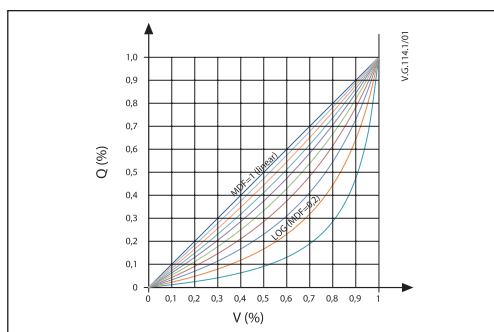


BACnet Objects - Analog Value

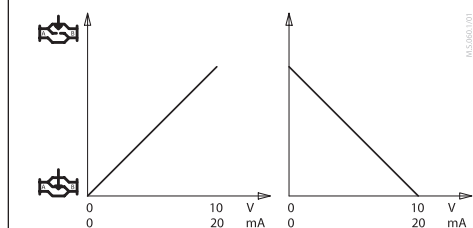
| Ident | Object / Parameter name | Unit | Read/ Write | Min | Max | Default | Resolution | Description | Persistent Yes/No |
|-------|---|--|-------------|---------------------------------|---|---|------------|---|-------------------|
| AV:0 | Design Flow Rate | 98: % 136: L/hr 89: GPM | R/W | Recommended 20% of nominal flow | Setting Range Maximum from Valve table | Nominal value from the Valve table in L/hr | 0.1 | Pre-set value for the Design Flow Rate when control signal is at 100%. If Application mode is Analog or Digital control otherwise not used. Units can be changed via the object's engineering units property. The units L/hr (European valves) or GPM (ANSI valves) comes from the object MSV:3 Selected Valve type. | Yes |
| AV:1 | Flow Rate Setpoint | 98: % 136: L/hr 89: GPM | R/W | 0 | 100% or Design Flow value | 100% | 0.01 | The Flow Rate Setpoint through the AB-QM valve. Units can be changed via the object's engineering units property. | No |
| AV:2 | Actual Flow Rate feedback | %, L/hr, GPM | R | 0 | If L/hr (GPM) is selected then the valve flow rate is set to the selected valve's (MSV:3) maximum value. Otherwise 100% | L/hr or GPM depending on the selected valve | 0.001 | Flow rate indication based on the position of the Actuator stem. Units can be changed via the object's engineering units property. This object is supported by COV. | No |
| AV:3 | Control Falback Time | 72: Minutes | R/W | 0 | 60 | 10 | 1 | Time before actuator reacts to a missing analog control signal. | Yes |
| AV:4 | Alpha Value | 95: No units | R/W | 0.05 | 1.0 | 1,0 | 0.01 | Value used for shaping the curve in Manual Defined Function (MDF) mode to fit the characteristic curve of a heat exchanger. Linear setting: MDF=1. See curve below table. If AV:1 is in L/hr in Digital mode, the alpha setting is ignored. See Alpha value diagram. | Yes |
| AV:5 | Valve closing or opening time | 73: Seconds | R/W | 18 | 700 | na | 1 | The time the actuator needs to move from 0% to 100% of Design Flow Rate. Use with MSV:4. | Yes |
| AV:6 | Rectified voltage measured by the actuator | Volts | R | 12 | 50 | 0 | 0.01 | Rectified voltage which powers the actuator. Too low voltage: 16.1-17.5V. Too high voltage: 38.3-43.4V. | No |
| AV:7 | MAC Address | 95: No units | R/W | 1 | 126 | na | 1 | MAC Address used for BACnet communication. | Yes |
| AV:8 | Temperature In the Actuator | °C, °F | R | -20 | 100 | °C | 0.5 | Temperature measured inside the actuator. Units can be changed via the object's engineering units property. | No |
| AV:9 | Total Operating Hours | Hours | R | 0 | MAX | na | 1 | Total Operating Hours of the actuator. | Yes |
| AV:10 | Minutes since last power-up | Minutes | R | 0 | MAX | na | 1 | Minutes since the last power-up of the actuator. | No |
| AV:11 | Minutes since last calibration | Minutes | R | 0 | MAX | na | 1 | Minutes since the last time the actuator was calibrated to an AB-QM valve. | Yes |
| AV:12 | Minutes since fully closed | Minutes | R | 0 | MAX | na | 1 | Minutes since the last time the AB-QM valve was fully closed. | Yes |
| AV:13 | Minutes Since Fully Opened | Minutes | R | 0 | MAX | na | 1 | Minutes since the last time the AB-QM valve was fully opened. | Yes |
| AV:14 | Total steps taken by the actuator | na | R | 0 | MAX | na | 1 | Total steps taken by the actuator since first power ON | Yes |
| AV:15 | Server Message Count | na | R | 0 | MAX | na | 1 | Server Message Count | No |
| AV:16 | Server Message Received | na | R | 0 | MAX | na | 1 | Server Message Received | No |
| AV:17 | Server Error Count | na | R | 0 | MAX | na | 1 | Server Error Count | No |
| AV:18 | Server Message sent | na | R | 0 | MAX | na | 1 | Server Message sent | No |
| AV:19 | Server Timeout Error | na | R | 0 | MAX | na | 1 | Server Timeout Error | No |
| AV:20 | Serial Number of the actuator | na | R | na | na | na | 1 | Description of this object holds the serial number of the actuator - programmed at the time of production. | na |
| AV:21 | The name of the Selected valve is shown here | L/hr or GPM, Unit type comes from MSV:3 Selected Valve Type | R | na | na | na | 1 | Nominal flow of the selected AB-QM valve type. | na |
| AV:22 | Valve position at nominal flow | Millimetre | R | na | na | na | 1 | Position in mm for nominal flow of the selected AB-QM valve. | na |
| AV:23 | Maximum value for the Design Flow Rate | % | R | na | Setting Range Maximum from Valve table | % | 1 | Maximum level the Design Flow Rate can be increased to for the selected AB-QM valve. | na |
| AV:24 | The name of the User Defined Valve is shown here | 136: L/hr or 89: GPM. Unit type written here is copied to the Valve Table. Default: L/hr | R/W | 1 | 5000 | 450 | 0.1 | Name and Nominal Flow for the User Defined Valve. This Object is used only if NovoCon® S is not used with an AB-QM valve. Please contact your Danfoss representative to verify if the desired connection is possible. | Yes |
| AV:25 | Valve position at nominal flow for User Defined Valve | 30: Millimetre | R/W | 1.5 | 5.8 | 2.25 | 0.01 | Position in mm for nominal flow of the User Defined Valve. This Object is used only if NovoCon® S is not used with an AB-QM valve. Please contact your Danfoss representative to verify if the desired connection is possible. | Yes |
| AV:26 | Maximum value for the Design Flow in the User Defined Valve | 98: % | R/W | 100 | 150 | 120 | 1 | Maximum level the Design Flow can be increased to for the User Defined Valve. This Object is used only if NovoCon® S is not used with an AB-QM valve. Please contact your Danfoss representative to verify if the desired connection is possible. | Yes |
| AV:27 | Alarm summary count | 95: No units | R | na | na | 0 | na | Coding for AV:27 Alarm summary count is: If BV:10 is active then AV:27 is 1.0. If BV:11 is active then AV:27 is 2.0. If BV:12 is active then AV:27 is 4.0. If BV:14 is active then AV:27 is 8.0. If BV:15 is active then AV:27 is 16.0. If BV:16 is active then AV:27 is 32.0. If BV:17 is active then AV:27 is 64.0. If BV:18 is active then AV:27 is 128.0. If BV:19 is active then AV:27 is 256.0. If BV:20 is active then AV:27 is 512.0. If BV:21 is active then AV:27 is 1024.0. e.g. if both BV:11 & BV:12 are active then AV:27 is 6.0. This object is supported by COV. | No |
| AV:30 | CO6 Heating Design Flow Rate | 98: % 136: L/hr 89: GPM | R/W | Recommended 20% of nominal flow | Setting Range Maximum from Valve table | Nominal value from the Valve table in L/hr | 0.1 | Pre-set value for the Design Flow Rate in heating mode, when the control signal is at 100%. When MSV:9 Application mode is in CO6 mode or Inverted CO6 mode. The units L/hr (European valves) or GPM (ANSI valves) comes from the object MSV:3 Selected Valve type | Yes |
| AV:31 | CO6 Cooling Design Flow Rate | 98: % 136: L/hr 89: GPM | R/W | Recommended 20% of nominal flow | Setting Range Maximum from Valve table | Nominal value from the Valve table in L/hr | 0.1 | Pre-set value for the Design Flow Rate in cooling mode, when the control signal is at 100%. When MSV:9 Application mode is in CO6 mode or Inverted CO6 mode. The units L/hr (European valves) or GPM (ANSI valves) comes from the object MSV:3 Selected Valve type. | Yes |
| AV:32 | Power emission | 48: kW 157: kBtu/h | R | na | na | kW | 0.01 | The hydronic power emission of the terminal unit, based on calculations from water flow rate and the temperature difference between supply (AI:1) and return (AI:2) pipes. Positive values reflect heating power emission. Negative values reflect cooling power emission. Units can be changed via the object's engineering units property. | No |

Note: In the following objects, the engineering units are linked e.g. if engineering units are changed in one object then it will be changes in all: AV:0, AV:30 and AV:31.

AV:4 / 32772 Alpha Value Curve



BV:2 / 32786 Direct or Inverse operation mode



BACnet Objects - Multi State Value

| Ident | Object / Parameter name | Read/Write | State Text | Default State | Description | Persistent Yes/No |
|--------|--|----------------------|--|---|---|-------------------|
| MSV:0 | Actuator Mode and special features | R/W | 1: Normal 2: Calibration 3: Flush ¹⁾ 4: De-Air ²⁾ 5: Alarm | 1: Normal | Shows present mode of actuator. Calibration, flushing and de-air may be started from here. | Yes |
| MSV:1 | Analog Control signal type and range | R/W | 1: 0-5 VDC 2: 0-10 VDC 3: 2-10 VDC 4: 5-10 VDC 5: 2-6 VDC 6: 6-10 VDC 7: 0-20 mA 8: 4-20 mA | 2: 0-10 VDC | Used to select the analog control signal input type and range. | Yes |
| MSV:2 | Missing Control Signal Fallback Action | R/W | 1: No action 2: CLOSE 3: OPEN 4: 50% of Design Flow | 1: No action | The action that the actuator will commence upon a missing analog control signal. | Yes |
| MSV:3 | Selected Valve Type | R/W | See table "Valve Type Selection" | 4: AB-QM DN 15 | This is the AB-QM valve type that the actuator is set-up to control. | Yes |
| MSV:4 | Actuator Speed | R/W | 1: 3 sec/mm 2: 6 sec/mm 3: 12 sec/mm 4: 24 sec/mm 5: Constant Time | 4: 24 sec/mm | The amount of time the actuator takes to move 1mm or alternatively, a specified constant time function (see AV:5). The Constant Time value range is 18-700 seconds. | Yes |
| MSV:5 | MAC Address assignment method | R/W | 1: DIP Switch Settings or Auto Addressing 2: User configuration over BACnet or Auto Addressing | 1: DIP Switch Settings or Auto Addressing | The MAC address selection method. If the MAC address is not set by DIP Switch, the actuator will automatically assign itself an available MAC address. | Yes |
| MSV:6 | Baud Rate | R/W | 1: Auto Baud Rate Detection 2: 9600 bps 3: 19200 bps 4: 38400 bps 5: 57600 bps 6: 76800 bps 7: 115200 bps | 1: Auto Baud Rate Detection | Baud Rate used for BACnet communication. | Yes |
| MSV:7 | LED Control | R/W | 1: Normal LED mode 2: Show only alarms 3: All LED's OFF 4: Blink | 1: Normal LED mode | The LED display options. | Yes |
| MSV:8 | Select field bus protocol | R/W | 1: DIP switch 2: BACnet 3: Modbus | 1: DIP switch | Selection of field bus protocol. See also the DIP Switch Settings section of the data sheet. When the protocol is changed, a power cycle is required to make the actuator adopt the newly selected protocol. | Yes |
| MSV:9 | Application mode | R/W | 1: Analog control 2: Digital control 3: CO ₆ mode 4: Inverted CO ₆ mode | 2: Digital control | Select the actuator application mode. State 1: Analog Control. Flow is controlled with an analog signal e.g. 0-10V. Design Flow Rate set via AV:0.. State 2: Digital Control. AV:1 is used to control the flow. Design Flow Rate set via AV:0. State 3: CO ₆ mode. AV:1 is used to control the flow. Design Flow Rate set via AV:30 for heating and AV:31 for cooling. Heating is connected to the CO ₆ valve to ports 5 & 6 and cooling to ports 1 & 4. State 4: Inverted CO ₆ mode. AV:1 is used to control the flow. Design Flow Rate set via AV:30 for heating and AV:31 for cooling. Ports are inverted in relation to State 3. | Yes |
| MSV:10 | CO ₆ 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: Not used | 1: Heating | States 1 to 4 are commands for the Actuator NovoCon® ChangeOver ⁴ . States 5 to 9 are feedback from the Actuator NovoCon® ChangeOver ⁴ . State 3, shut-off mode may only be used for maintenance and is only possible when the Flow Rate Setpoint is 0%. | Yes |
| MSV:11 | CO ₆ auto exercise | R/W | 1: ON 2: OFF | 1: ON | ON: The ChangeOver ⁴ 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. | Yes |

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

²⁾ Opens and closes the valve 5 times at maximum speed

³⁾ A zero Flow Rate Setpoint 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 and only when the water temperature in terminal unit is equal to ambient temperature or the terminal unit is not mounted. A water temperature change inside of a 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 | Persistent Yes/No |
|-------|--|------------|-----------------|-------------------|---------|---|-------------------|
| BV:2 | Direct or Inverse operation Mode | R/W | Inverse | Direct | Direct | Selection between Direct and Inverse operation mode. See Direct/Inverse diagram. | Yes |
| BV:10 | Warning: Temperature of the actuator is out of recommended range | R | ON | OFF | na | The Temperature inside the Actuator is out of the recommended range. | No |
| BV:11 | Alarm: No Control Signal | R | ON | OFF | na | The actuator has detected that it has no analog control signal. | No |
| BV:12 | Alarm: Error during Closing | R | ON | OFF | na | Actuator can't completely close the AB-QM valve. | No |
| 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 once more below 38.3V, the alarm will be turned OFF. | No |
| 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 once more above 17.5V, the motor will be activated again. | No |
| BV:16 | Alarm: Error during Calibration | R | ON | OFF | na | There was an error during calibration of the actuator. | No |
| BV:17 | Warning: BACnet MAC-address Conflict was Detected | R | ON | OFF | na | Two or more devices on the same BACnet sub-network have the same MAC-address. | No |
| BV:18 | Warning: Faults on the BACnet was detected | R | ON | OFF | na | Problems with communication on the network are detected. | No |
| BV:19 | Alarm: An internal Error has been detected | R | ON | OFF | na | Re-calibrate or power cycle actuator to reset - actuator replacement may be necessary | No |
| BV:20 | Alarm: CO6 in manual override or CO6 unable to move | R | ON | OFF | na | ChangeOver [®] actuator is in manual override or is unable to reach position. | No |
| BV:21 | Alarm: CO6 actuator not connected or damaged | R | ON | OFF | na | The ChangeOver [®] actuator is not connected or is damaged. | No |

BACnet Objects - Device Object

List with some selected important Device Object properties.

| Property | Value | Read / Write | Description | Persistent Yes/No |
|-------------------------|---|--------------|---|-------------------|
| Object ID | Instance Range: 0 to 4194302 | R/W | This property is normally called Device Instance number or Unique ID. | Yes |
| Object-Name | Combination of "NovoCon S" + Type and Object ID | R/W | Product name. Max. 25 characters. | Yes |
| Firmware revision | Current firmware version | R | BACnet software revision. | Yes |
| Application S/W version | Current Application SW version | R | Actuator Application Software version. | Yes |
| Location | This string is empty when actuator is new. | R/W | Free text can be used to describe location etc. Max. 50 characters. | Yes |
| Description | Danfoss NovoCon actuator with BACnet MS/TP | R/W | Product description. Max. 50 characters. | Yes |
| Segmentation-supported | NO SEGMENTATION | R | Actuator does not support segmentation. | Yes |
| Max-master | Default: 127 Range: 0-127 | R/W | The MAX_master setting in NovoCon® S should be set to the number of devices (or the highest used MAC address) in the MS/TP sub network. | Yes |

BACnet Objects - Analog Input

| Ident | Object / Parameter name | Unit | Read / Write | Min | Max | Default | Description | Persistent Yes/No |
|-------|------------------------------------|------------------------------|--------------|-----------------------|------------------------|---------|---|-------------------|
| AI:0 | Voltage or Current on analog input | 5: Volts 2: mA | R | 0 | 10V 20mA | na | Voltage(V) or Current(mA) level on the analog control input, measured by the actuator. Units comes from MSV:1 Analog Control signal type and range. This object is supported by COV. | No |
| AI:1 | T1 or resistance input | 62: °C 64: °F, 4: Ohms | R | -10°C 10°F 900Ω | 120°C 250°F 10kΩ | °C | Temperature/resistance measured from connected PT1000 sensors. For Power emission AV:32, AI:1 is temperature on the flow pipe and AI:2 is temperature on the return pipe. Max. 10m cable. Units can be changed via the object's engineering units property. This object is supported by COV. | No |
| AI:2 | T2 or resistance input | | | | | | | |

BACnet Objects - Analog Output

| Ident | Object / Parameter name | Unit | Read / Write | Min | Max | Default | Description | Persistent Yes/No |
|-------|--------------------------|-------|--------------|-----|-----|---------|---|-------------------|
| AO:0 | Voltage on analog output | Volts | R/W | 0 | 10 | Volt | Output Voltage value in Digital and Analog mode MSV:9. Note: In CO6 and Inversed CO6 mode the present value is not writeable. | No |

BACnet Objects - Notification class

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

NC:0 is an object where other BACnet devices can subscribe to be informed directly from this device if an alarm or warning is activated or cleared. A maximum of 4 devices can subscribe to this service. Subscribers of this object will be informed if any of the Warning or Alarms BV:10 to BV:21 is activated or cleared.

When the notification class NC:0 is going to be used to notify about changes with status of Warnings and Alarms (BV:10 – BV:21), 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 because the actuator does not have a clock built in and will therefore not be able to handle notifications with respect to time.

BACnet Objects - Averaging

| Ident | Object / Parameter name | Min. Value | Average value | Max. Value | Window Interval | Window Sample | Description | Persistent Yes/No |
|-------|--|------------|--|------------|-----------------|---------------|--|-------------------|
| AVO:0 | Average rectified voltage measured by the actuator | | Updated according to actual measurements | | 1 Day | 24 | Average of the rectified voltage that powers the actuator. | No |

Valve Type Selection



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

| Index | Name | Nominal Flow | Units | Valve position for nominal flow [mm] | Setting Range Maximum [%] |
|------------------|----------------------|--------------|-------|--------------------------------------|---------------------------|
| 1 | AB-QM ISO DN 10LF | 150 | L/hr | 2.25 | 120 |
| 2 | AB-QM ISO DN 10 | 275 | L/hr | 2.25 | 120 |
| 3 | AB-QM ISO DN 15LF | 275 | L/hr | 2.25 | 120 |
| 4 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 ISO DN 15HF | 1135 | L/hr | 4 | 110 |
| 9 | AB-QM ISO DN 20HF | 1700 | L/hr | 4 | 110 |
| 10 | AB-QM ISO DN 25HF | 2700 | L/hr | 4.5 | 110 |
| 11 | AB-QM ISO DN 32HF | 4000 | L/hr | 4.5 | 110 |
| 12 | AB-QM ANSI DN ½" LF | 1.2 | GPM | 2.25 | 100 |
| 13 | AB-QM ANSI DN ½" | 2 | GPM | 2.25 | 100 |
| 14 | AB-QM ANSI DN ½" HF | 5 | GPM | 4 | 100 |
| 15 | AB-QM ANSI DN ¾" | 4 | GPM | 2.25 | 100 |
| 16 | AB-QM ANSI DN ¾" HF | 7.5 | GPM | 4 | 100 |
| 17 | AB-QM ANSI DN 1" | 7.5 | GPM | 4.5 | 100 |
| 18 | AB-QM ANSI DN 1" HF | 12 | GPM | 4.5 | 100 |
| 19 | AB-QM ANSI DN 1¼" | 14.1 | GPM | 4.5 | 100 |
| 20 | AB-QM ANSI DN 1¼" HF | 17.5 | GPM | 4.5 | 100 |
| 21 ²⁾ | User Defined Valve | NF | UF | VPNF | SRM |

¹⁾ Default

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

BACnet BIBBs services

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

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

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

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

Listed by BTL

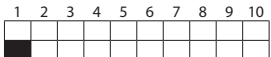

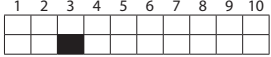
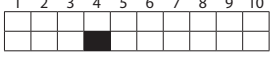



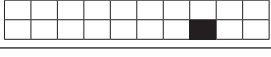
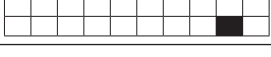
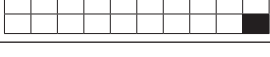
The NovoCon® S CO6, Energy, I/O solution is listed by BTL Testing Laboratories.



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

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 the 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

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 | Persistent Yes/No |
|-------------------------------|------------|-----------------|------------------|---|--|--|---|---|-------------------|
| 0x8000 32768 | R/W | 3,4 & 16 | FLOAT | Design Flow Rate | Pre-set value for the Design Flow Rate when control signal is at 100%. Unit follows 32787 | Nominal value from the Valve table in L/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%. The maximum setting range is depending on the selected valve. See Valve Type Selection. | Yes |
| 0x8002 32770 | R/W | 3,4 & 6 | WORD | Control Fallback Time | Time before actuator reacts to a missing analog control signal | 10 | Minutes | Control Fallback Time in minutes, i.e.. 0 ... 60 correspond to 0 ... 60 minutes | Yes |
| 0x8004 32772 | R/W | 3,4 & 16 | FLOAT | Alpha Value | Value used for shaping the curve in Manual Defined Function (MDF) mode to fit the characteristics curve of a heat exchanger. If 33280 is in L/hr in Digital mode, the alpha setting is ignored. | 1.0 | na | Alpha Value curve, i.e. 0.05 ... 1.00 correspond to 0.05 ... 1.00. Alpha = 1.00 is linear. Alpha = 0.2 is equal to the LOG function. See Alpha value diagram. | Yes |
| 0x8006 32774 | R/W | 3,4 & 16 | WORD | Valve closing or opening time | The time the actuator needs to move from 0% to 100% of Design Flow Rate. Use with 32803. | na | Seconds | Valve closing or opening time in seconds i.e.. 18 ... 700 correspond to 18 ... 700 seconds | Yes |
| 0x8008 32776 | R | 3,4 & 6 | FLOAT | Nominal Flow of the user defined valve | The Nominal flow of the user defined valve is shown here. This Object is used only if NovoCon® S is not used with an AB-QM valve. Please contact your Danfoss representative to verify if the desired connection is possible. | na | L/hr or GPM, Unit type comes from Valve Table | Nominal flow e.g. in Liters per hour i.e. 0 ...450 correspond to 0 ...450 L/hr | Yes |
| 0x800A 32778 | R | 3 & 4 | FLOAT | Valve position at nominal flow for User Defined Valve | Position in mm for nominal flow of the User Defined Valve. This Object is used only if NovoCon® S is not used with an AB-QM valve. Please contact your Danfoss representative to verify if the desired connection is possible. | 2.25 | Millimetre | Valve position for nominal flow in millimetre, i.e. 0.5 ... 5.8 correspond to 0.5 ... 5.8 millimetre | Yes |
| 0x800C 32780 | R/W | 3,4 & 6 | FLOAT | Maximum value for the Design Flow in the User Defined Valve | Maximum level the Design Flow Rate can be increased to for the User Defined Valve. This Object is used only if NovoCon® S is not used with an AB-QM valve. Please contact your Danfoss representative to verify if the desired connection is possible. | 120 | Unit type follows 32787 selection: % or (L/hr or GPM) | i.e. 0 ...150 correspond to 0 ...150 % | Yes |
| 0x8012 32786 | R/W | 3,4 & 6 | WORD | Direct or Inverse operation Mode | Selection between Direct and Inverse operation mode. See Direct/Inverse diagram. | 0: Direct | 0: Direct 1: Inverse | Selection between Direct and Inverse operation mode. See Direct/Inverse diagram. | Yes |
| 0x8013 32787 | R/W | 3,4 & 6 | WORD | Units used to set and display the Design Flow | Units used to set and display the Design Flow Rate. Units for L/hr & GPM comes from Selected Valve Type. | 0: L/hr or GPM for ANSI versions | 0: L/hr / GPM 1: % | Units used to set and display the Design Flow. Select between L/hr and % for European versions or GPM and % for ANSI versions | Yes |
| 0x8014 32788 | R/W | 3,4 & 6 | WORD | Units used to set and display Flow Rate Setpoint | Units used to set and display Flow Rate Setpoint | 1: % | 0: L/hr / GPM 1: % | Units used to set and display the Flow Rate Setpoint. Select between L/hr and % for European versions or GPM and % for ANSI versions | Yes |
| 0x8015 32789 | R/W | 3,4 & 6 | WORD | Units used to set and display the Actual Flow Rate feedback | Units used to set and display the Actual Flow Rate feedback | 0: L/hr or GPM | 0: L/hr / GPM 1: % | Select between L/hr and % for European versions or % and GPM for ANSI versions | Yes |
| 0x8016 32790 | R/W | 3,4 & 6 | WORD | Units used to set and display Temperature | Select between °C or °F to set and display temperature inside the actuator | 0: °C | 0: °C 1: °F | Units used to set and display temperature inside the actuator. | Yes |
| 0x8017 32791 | R/W | 3,4 & 6 | WORD | Units used to set and display T1 | Units used to read the temperature or resistance value. | 0: °C | 0: °C 1: °F 2: Ohms | Units for temperature or resistance value. | Yes |
| 0x8018 32792 | R/W | 3,4 & 6 | WORD | Units used to set and display T2 | | | | | |
| 0x8019 32793 | R/W | 3,4 & 6 | WORD | Units used to set Power | Units used to read the power usage. | 0: kW | 0: kW, 1: kBTU/h | Units for power. | Yes |
| 0x801A 32794 | R/W | 3,4 & 6 | WORD | Endian type | Byte ordering for LONG and FLOAT types | 0: Big | 0: Big 1: Little | Used endian type for float and long registers | Yes |
| 0x801C 32796 | R/W | 3,4 & 16 | FLOAT | CO6 Heating Design Flow Rate | Pre-set value for the Design Flow Rate when the control signal is at 100%. Unit follows 32787 | 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%. The maximum setting range is depending on the selected valve. See Valve Type Selection. | Yes |
| 0x801E 32798 | R/W | 3,4 & 16 | FLOAT | CO6 Cooling Design Flow Rate | | | | | |

Configuration (continued)

| Modbus register | Read/Write | Modbus function | Modbus Data Type | Object / Parameter name | Description | Default | Description of usage | Persistent Yes/No |
|-----------------|------------|-----------------|------------------|--|---|-----------------------------|---|-------------------|
| 0x802A 32810 | R/W | 3, 4 & 6 | WORD | Application mode | Select the actuator application mode. State 1: Analog Control. Flow is controlled with an analog signal e.g. 0-10V. Design Flow Rate set via 33280. State 2: Digital Control. AV:1 is used to control the flow. Design Flow Rate set via 33280. State 3: CO6 mode. 33280 is used to control the flow. Design Flow Rate set via 32796 for heating and 32798 for cooling. Heating is connected to the CO6 valve to ports 5 & 6 and cooling to ports 1 & 4. State 4: Inverted CO6 mode. AV:1 is used to control the flow. Design Flow Rate set via 32796 for heating and 32798 for cooling. Ports are inverted in relation to State 3. | 2: Digital control | 1: Analog control 2: Digital control 3: CO6 mode 4: Inverted CO6 mode | Yes |
| 0x802B 32811 | R/W | 3, 4 & 6 | WORD | CO6 command & status | Commands and status for the ChangeOver ⁶ actuator. | 1: Heating | 1: Heating 2: Cooling 3: Shut Off 4: Start exercise 5: Moving towards Cooling 6: Moving towards Heating 7: Alarm 8: Exercising 9: Not used Heating States 1 to 4 are commands for the Actuator NovoCon® ChangeOver6. States 5 to 9 are feedback from the Actuator NovoCon® ChangeOver6. State 3, shut-off mode may only be used for maintenance and is only possible when the Flow Rate Setpoint is 0%. | Yes |
| 0x802C 32812 | R/W | 3, 4 & 6 | WORD | CO6 auto exercise | ON: The ChangeOver ⁶ 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 shut off and back again once per week to prevent the valve getting stuck. | 1: ON | 1: ON 2: OFF | Yes |
| 0x8020 32800 | R/W | 3, 4 & 6 | WORD | Analog Control signal type and range | Used to select the analog control signal input type and range | 2: 0-10 VDC | Select 1, 2 or... based on the table below: 1: 0-5 VDC 2: 0-10 VDC 3: 2-10 VDC 4: 5-10 VDC 5: 2-6 VDC 6: 6-10 VDC 7: 0-20 mA 8: 4-20 mA | Yes |
| 0x8021 32801 | R/W | 3, 4 & 6 | WORD | Missing Control Signal Fallback Action | The action that the actuator will commence upon a missing analog control signal. | 1: No action | Select 1, 2 or... based on the table below: 1: No action 2: CLOSE 3: OPEN 4: Go to 50% of Design Flow Rate | Yes |
| 0x8022 32802 | R/W | 3, 4 & 6 | WORD | Selected Valve Type | This is the AB-QM valve type that the actuator is set-up to control | 4: AB-QM DN 15 | See table "Valve Type Selection 1-17" | Yes |
| 0x8023 32803 | R/W | 3, 4 & 6 | WORD | Actuator Speed | The amount of time the actuator takes to move 1mm or alternatively, a specified constant time function (see 32774). The Constant Time value range is 18-700 seconds. | 4: 24 sec/mm | Select 1, 2 or... based on the table below: 1: 3 sec/mm 2: 6 sec/mm 3: 12 sec/mm 4: 24 sec/mm 5: Constant Time (set by register 0x8006) | Yes |
| 0x8024 32804 | R/W | 3, 4 & 6 | WORD | Baud Rate | Baud Rate used for bus communication | 1: Auto Baud Rate Detection | Select 1, 2 or... based on the table below: 1: Auto Baud Rate Detection 2: 9600 bps 3: 19200 bps 4: 38400 bps 5: 57600 bps 6: 76800 bps 7: 115200 bps | Yes |
| 0x8025 32805 | R/W | 3, 4 & 6 | WORD | Select UART mode | Supported transmission modes | 5: Auto parity | Select 1, 2, 3 or 4 based on the table below: 1: 1-8-N-2 2: 1-8-O-1 3: 1-8-E-1 4: 1-8-N-1 5: Auto parity Data format: (Start bit-Data bits-Parity-Stop bits) | Yes |
| 0x8026 32806 | R/W | 3, 4 & 6 | WORD | Slave ID | Slave ID used for communication. | na | Slave ID used for communication | Yes |
| 0x8027 32807 | R/W | 3, 4 & 6 | WORD | Slave ID assignment method | The Slave ID address selection method. | 1: DIP Switch Settings | 1: DIP Switch Settings 2: User configuration over Modbus If DIP Switches are in an invalid position the actuator will automatically check if a Slave ID is present in the User Configuration. | Yes |
| 0x8028 32808 | R/W | 3, 4 & 6 | WORD | BUS protocol | Select field bus protocol to be used. See also the DIP Switch Settings section of the data sheet. When the protocol is changed, a power cycle is required to make the actuator adopt the newly selected protocol. | 1: DIP switch | 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 | The LED display options. | 1: Normal LED mode | Select 1, 2 or... based on the table below: 1: Normal LED mode 2: Show only alarms 3: All LED's OFF 4: Blink (can be used to locate the actuator) | Yes |
| 0x8500 34048 | W | 6 | WORD | Reset | Warm reset = Power cycle. Cold reset = Factory reset. Note that after factory reset a calibration will be automatically be performed and all settings will be reverted to factory settings. | na | 0x5741 / 22337: Warm reset 0x434F / 17231: Cold reset. | na |

¹⁾ A zero Flow Rate Setpoint command (33280) 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 and only when the water temperature in terminal unit is equal to ambient temperature or the terminal unit is not mounted. A water temperature change inside of a 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 | Persistent Yes/No |
|-----------------|------------|-----------------|------------------|------------------------------------|---|--------------|--------------|--|-------------------|
| 0x8200 33280 | R/W | 3, 4 & 16 | FLOAT | Flow Rate Setpoint | The Flow Rate Setpoint through the AB-QM valve. Unit follows 32788 | 100% | %, L/hr, GPM | Flow Rate Setpoint in percent, i.e. 0 ... 100 correspond to 0 ... 100% | No |
| 0x8202 33282 | R | 3 & 4 | FLOAT | Actual Flow Rate feedback | Flow Rate Indication based on the position of the Actuator stem. Unit follows 32788 | na | %, L/hr, GPM | Design Flow Rate feedback in percent, i.e. 0 ... 100 correspond to 0 ... 100%. If L/hr (GPM) is selected in 32787 then the valve flow rate is set to the selected valve's 32776 maximum value. Otherwise 100% | No |
| 0x8204 33284 | R/W | 3, 4 & 6 | WORD | Actuator Mode and special features | Shows present mode of actuator. Calibration, Flush and de-air may be started from here | 1: Normal | na | Select 1, 2 or ... based on the table below: 1: Normal 2: Calibration 3: Flush 4: De-Air 5: Alarm | No |
| 0x8206 33286 | R/W | 3, 4 & 16 | FLOAT | Voltage on analog output | Output Voltage value in Digital and Analog mode 32810. Note: In CO6 and Inversed CO6 mode the present value is not writeable | V | Volts | Voltage level i.e. 0.00 ... 10.00 correspond to 0.00 ... 10.00 V | No |
| 0x8208 33288 | R/W | 3, 4 & 16 | FLOAT | Power emission | The hydronic power emission of the terminal unit, based on calculations from water flow rate and the temperature difference between supply (33218) and return (33220) pipes. Positive values reflect heating power emission. Negative values reflect cooling power emission. Units can be changed via the object's engineering units property. | kW | kW, kBTU/h | Power in kW or kBTU/h i.e. -1000.00 ... 1000.00 correspond to -1000.00 ... 1000.00 kW or in kBTU/h, i.e. -1000.00 ... 1000.00 correspond to -1000.00 ... 1000.00 kBTU/h | No |

Modbus registers - Information

| Modbus register | Read/Write | Modbus function | Modbus Data Type | Object / Parameter name | Description | Default | Unit | Description of usage | Persistent Yes/No |
|-----------------|------------|-----------------|------------------|--|--|---|---|--|-------------------|
| 0x8100 33024 | R | 3 & 4 | FLOAT | Nominal flow of the selected valve type | Nominal flow of the selected valve type | 450 | L/hr or GPM, Unit type comes from Valve Table | Nominal flow e.g. in Litres per hour i.e. 0 ... 450 correspond to 0 ... 450 L/hr. | na |
| 0x8102 33026 | R | 3 & 4 | FLOAT | Valve position at nominal flow | Position in mm for nominal flow of the selected valve | na | Millimetre | Valve position for nominal flow in millimetre, i.e. 0.5 ... 5.8 correspond to 0.5 ... 5.8 millimetre. | na |
| 0x8104 33028 | R | 3 & 4 | FLOAT | Maximum value of the Design Flow Rate | Maximum level the Design Flow Rate can be increased to for the selected valve | Setting Range Maximum from Valve table | % | Maximum level of the Design Flow Rate in percent, i.e. 20 ... 100 correspond to 20 ... 100%. | na |
| 0x8120 33056 | R/W | 3 & 4 | STRING | Device name | Product name | NovoCon S | na | Ascii coded STRING | Yes |
| 0x8140 33088 | R | 3 & 4 | STRING | Model name | Type of the actuator | CO6 | na | Ascii coded STRING | Yes |
| 0x8160 33120 | R | 3 & 4 | STRING | Vendor name | Name of the Manufacture | Danfoss A/S | na | Ascii coded STRING | Yes |
| 0x8180 33152 | R/W | 3, 4 & 16 | STRING | Location description | Free text can be used to describe location etc. E.g. Room 1 | na | na | Ascii coded STRING. Max. 50 characters. | Yes |
| 0x81A0 33184 | R | 3, 4 | String | Serial number | Serial number of the actuator | na | 1 | Description of this object holds the serial number of the actuator, programmed at the production time. | Yes |
| 0x8108 33032 | R | 3, 4 | LONG | Product ID | Serial number of the actuator | na | 1 | Unique Product id. The last part of the serial number. | Yes |
| 0x810A 33034 | R | 3 & 4 | WORD | SW version | Software version of the actuator | na | na | Ascii coded WORD | Yes |
| 0x810B 33035 | R | 3 & 4 | WORD | HW version | Hardware version of the actuator | na | na | Ascii coded WORD | Yes |
| 0x81C0 33216 | R | 3 & 4 | FLOAT | Voltage or Current on analog input | Voltage(V) or Current(mA) level on the analog control input, measured by the actuator. | na | Volts / mA | Voltage level measured i.e. 0.00 ... 10.00 correspond to 1.00 ... 10.00 V or in mA, i.e. 0.00 ... 20.00 correspond to 0.00 ... 20.00 mA | No |
| 0x81C2 33218 | R | 3 & 4 | FLOAT | T1 or resistance input | Temperature/resistance measured from connected PT1000 sensors. For Power emission 33288, register 33218 is temperature on the flow pipe and 33220 is temperature on the return pipe. | °C | °C, °F, Ohms | Temperature measured in °C i.e. -10°C ... 120°C or resistance measured i.e. 900Ω ... 10kΩ. Max. 10m cable. | No |
| 0x81C4 33220 | R | 3 & 4 | FLOAT | T2 or resistance input | Temperature/resistance measured from connected PT1000 sensors. For Power emission 33288, register 33218 is temperature on the flow pipe and 33220 is temperature on the return pipe. | °C | °C, °F, Ohms | Temperature measured in °C i.e. -10°C ... 120°C or resistance measured i.e. 900Ω ... 10kΩ. Max. 10m cable. | No |
| 0x8402 33794 | R | 3 & 4 | FLOAT | Rectified voltage measured by the actuator | Measured rectified voltage which powers the actuator | na | Volts | Rectified voltage which powers the actuator. Too low voltage: 16.1-17.5V Too high voltage: 38.3-43.4V | No |
| 0x8404 33796 | R | 3 & 4 | FLOAT | Temperature in the actuator | Temperature measured inside the Actuator | na | na | Temperature measured inside the actuator. Unit is decided by 32790. | No |
| 0x8406 33798 | R | 3 & 4 | LONG | Total Operating Hours | Total Operating Hours of the actuator | Hours | Hours | Total Operating Hours of the actuator | Yes |
| 0x8408 33800 | R | 3 & 4 | LONG | Total steps taken by the actuator | Total steps taken by the actuator since first power ON | na | na | Total steps taken by the actuator since first power ON | Yes |
| 0x8410 33808 | R | 3 & 4 | LONG | Minutes since last power-up | Minutes since the last power-up of the actuator | Minutes | Minutes | Minutes since the last power-up of the actuator | No |
| 0x8412 33810 | R | 3 & 4 | LONG | Minutes since last calibration | Minutes since the last time the actuator was calibrated to an AB-QM valve | Minutes | Minutes | Minutes since the last time the actuator was calibrated to a valve | Yes |
| 0x8414 33812 | R | 3 & 4 | LONG | Minutes since fully closed | Minutes since the last time the AB-QM valve was fully closed | Minutes | Minutes | Minutes since the last time the valve was fully closed | Yes |
| 0x8416 33814 | R | 3 & 4 | LONG | Minutes Since Fully Opened | Minutes since the last time the AB-QM valve was fully opened | Minutes | Minutes | Minutes since the last time the valve was fully opened | Yes |

Alarms & warning

| Modbus register | Read/Write | Modbus function | Modbus Data Type | Object / Parameter name | Description | Default | Description of usage | Persistent Yes/No |
|-----------------|------------|-----------------|------------------|--|---|---------|----------------------|-------------------|
| 0x8300 33536 | R | 3&4 | LONG | Alarm: No Control Signal | The actuator has detected that it has no analog control signal | 0: OFF | Bit 0: 0:OFF; 1:ON | No |
| | | | | Alarm: Error during Closing | Actuator can't completely close the AB-QM valve | 0: OFF | Bit 1: 0:OFF; 1:ON | No |
| | | | | Alarm: Error during Calibration | There was an error during calibration of the actuator | 0: OFF | Bit 2: 0:OFF; 1:ON | No |
| | | | | Alarm: An internal Error has been detected | Re-calibrate or power cycle actuator to reset - actuator replacement may be necessary | 0: OFF | Bit 3: 0:OFF; 1:ON | No |
| | | | | Warning: Temperature of the actuator is out of recommended range | The Temperature inside the Actuator is out of the recommended range | 0: OFF | Bit 16: 0:OFF; 1:ON | No |
| | | | | Warning: 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 the alarm will be turned OFF | 0: OFF | Bit 18: 0:OFF; 1:ON | No |
| | | | | Warning: Voltage of power supply is too low | Voltage of power supply is measured to be too low. When the measured voltage level drops below 16.5V the alarm will be activated for too low voltage. When the measured voltage level drops below 16.1V the motor will also be turned off. When the measured voltage is once more above 17.5V the motor will be activated | 0: OFF | Bit 19: 0:OFF; 1:ON | No |
| | | | | Warning: Faults on communication was detected | Problems with Communication on the network are detected | 0: OFF | Bit 21: 0:OFF; 1:ON | No |
| | | | | Warning: Invalid Slave ID setting | Slave ID assignment was done incorrectly to either 0 or 127 | 0: OFF | Bit 22: 0:OFF; 1:ON | No |
| | | | | Alarm: CO6 in manual override or CO6 unable to move | ChangeOver [®] actuator is in manual override or is unable to reach position. | 0: OFF | Bit 4: 0:OFF; 1:ON | No |
| | | | | Alarm: CO6 actuator not connected or damaged | The ChangeOver [®] actuator is not connected or is damaged. | 0: OFF | Bit 5: 0:OFF; 1:ON | No |

Firmware update

Manual update

Using BACnet MS/TP

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

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

Using Modbus RTU

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

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

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

Automatic update using the Danfoss configuration tool

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



Temperature sensors

Functional description

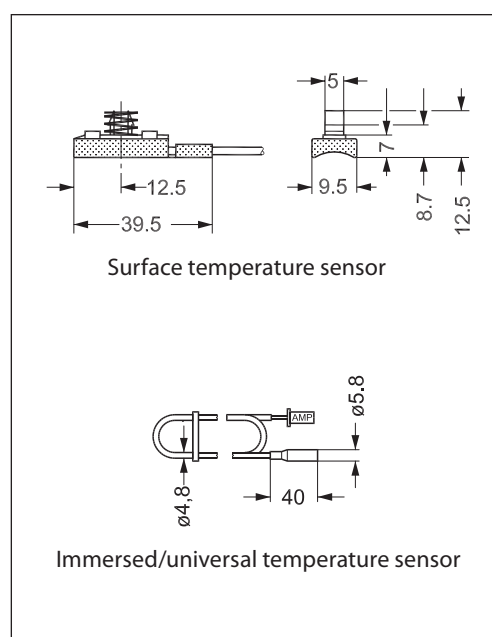
The sensor unit consists of a platinum element, the resistance value of which, changes proportionally with the temperature.

Pt 1000 ohm sensor (1000 ohm at 0°C).

The sensor is adjusted and meets the tolerance requirements of EN 60751 Class B.

The accuracy of temperature measurement is approximately 0.5° in typical operating range. It is unlikely, that during calculation of ΔT , deviation of both sensors would be summed up. Therefore, it is estimated that ΔT measurement accuracy is 0.5° when the sensors are mounted correctly.

| R (Typ.) Ohm | Temp. °C | Temp. °F | Tolerance. °C |
|-----------------|-------------|-------------|------------------|
| 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 |



Tender text

NovoCon® S CO6, Energy, I/O actuator

Modulating geared actuator with field bus (BACnet MS/TP and Modbus RTU) 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 ¹⁾

Direct connection to 2x PT1000 surface/immersed sensors and emission power indication

Direct connection I/O: 2x resistance, AO and AI ³⁾

Actuator functionality is remotely accessible via the field 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 ¹⁾
- Supply and return temperature readings, emission power indication ²⁾
- Alarm high/low deltaT and temperature sensors disconnected ²⁾
- Alpha characteristics setting
- Speed selection 3/6/12/24 s/mm
- Opening/closing time selection from 18s to 700s
- Auto MAC addressing (BACnet only)
- 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

Manual override function

Commissioning tool available for addressing, parametrization and hydronic continuous commission

¹⁾ CO6 application

²⁾ Energy application

³⁾ 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 functioning network. Some values that tell you about the quality of the network can be found in the objects AV:15 to AV:19. The most important values are AV:17 Server Error Count and AV:19 Server Timeout Error. These two values should be much lower than AV:15, AV:16 and AV:18. As a general rule, it is important that AV:17 and AV:19 are not constantly increasing their count.

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 / 33794) | Reaction |
|---|---|
| Voltage below 16.5V | Start alarm indication with LED. Initiate and alarm BV: 15 / 33536 Bit 19 and that the supply voltage is too low. |
| Voltage below 16.1V | Motor is stopped. The LEDs indicating alarm and actuator still initiating alarm BV:15 / 33535 Bit 19 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. Alarm BV:15 / 33536 Bit 19 returns to normal operation. |
| When voltage rises above 43.4V | Start alarm indication with LED. Initiate an alarm BV:14 / 33536 Bit 18. |
| When voltage drops below 38.3V again | LED alarm indication stops and returns to normal operation. Alarm BV:14 / 33536 Bit 18 returns to normal operation. |

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

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

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

The actuator's voltages are considered to be OK when all values of AV:6 / 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 BACnet/Modbus 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.

