# Control component

## BUPNF

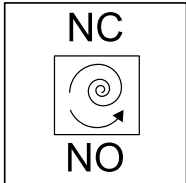**Duct pressure control - static transducer**

**Safe position - spring return**

## Control component with static transducer and separate spring return actuator for VAV terminal units for duct pressure control

Universal device for use with VAV terminal units

- Controller and static differential pressure transducer are fitted together in one casing
- Separate actuator with spring return for safe position
- Use in ventilation and air conditioning systems, with clean and contaminated air
- Duct pressure control up to 450 Pa, e.g. line pressure control
- Constant value control $\Delta p_{min}$ or variable control $\Delta p_{min} – \Delta p_{max}$
- Operating parameter $\Delta p_{min}$ and $\Delta p_{max}$ are set in the factory and saved in the controller
- Activation of override controls via external wiring
- Modification of operating parameters by PC software as well as the smartphone and tablet app (TROX FlowCheck app)
- Service access for PC configuration software
- Access with a smartphone thanks to NFC interface and Bluetooth
- Setpoint value settings, override controls and parameter adjustment via analogue interface or bus communication
- High data transparency through standardised bus communication Modbus RTU, BACnet MS/TP or MP-Bus

# General information

## Application

- All-in-one control device for VAV terminal units for duct pressure control up to 450 Pa in ventilation and air conditioning systems
- Static differential pressure transducer and controller electronics combined in one casing
- Separate actuator with spring return
- Safe position can be defined upon failure of the supply voltage or wire breakage in the order code: NC = damper closed, NO = damper in OPEN position
- For use with clean and contaminated air
- Variable duct pressure control by specifying setpoint values via communication interfaces or analogue signal e.g. from the central building management system
- Duct pressure control with constant value by set operating value
- Override controls for activating $\Delta p_{max}$, $\Delta p_{min}$, shut-off, control stop, OPEN position via Modbus/BACnet register or partly with switch or relay possible
- Duct pressure actual value is available as a network data point or linear voltage signal
- The damper blade position is available as a network data point
- Use the TROX FlowCheck app and PC tool to configure the controller and the communication parameters

## Control strategy

- Duct pressure fluctuations are controlled, e.g. by changing volume flow requirements
- To prevent the control from becoming unstable, a dead band is allowed within which the damper blade does not move
- $\Delta p_{min}$: selected operating value of minimum duct pressure or constant value
- $\Delta p_{max}$: selected operating value of maximum duct pressure
- Operating parameters are set in the factory according to the order code

## Interface

Analogue interface
- Analogue interface with adjustable signal voltage range
- Analogue signal for pressure setpoint value
- Analogue signal for actual pressure value

Digital communication interface (bus)
- Modbus RTU, RS-485
- BACnet MS/TP, RS-485
- MP bus
- Data points, see bus lists

Hybrid mode
- Mixed mode of analogue and digital interface

Factory setting
- Setpoint value default setting via analogue interface
- Actual value output via analogue interface and Modbus communication interface

## Operating modes

Variable operation (V)
- Setpoint value setting via analogue signal, Modbus, BACnet or MP-Bus: operating range corresponds to $\Delta p_{min}$ – $\Delta p_{max}$

Constant value mode (F)
- A setpoint signal is not required, setpoint value corresponds to $\Delta p_{min}$

## Operating parameters

- Nominal pressure $\Delta p_{Nominal}$ = 500 Pa
- The flow rate range for the controller is set in the factory; $\Delta p_{min}$: minimum pressure, 0 – 100 % of $\Delta p_{Nominal}$ adjustable; $\Delta p_{max}$: maximum pressure, 20 – 100 % of $\Delta p_{Nominal}$ adjustable
- Reference point for the output signal: $\Delta p_{Nominal}$
- $\Delta p_{min}$ and $\Delta p_{max}$ can be factory-set to 90 % of $\Delta p_{Nominal}$ so that adjustment behaviour is fully visible in the output signal
- Observe the variable duct pressure range from 25 – 450 Pa

## Signal voltage ranges

- 0 – 10 V DC
- 2 – 10 V DC

## Parts and characteristics

- Transducer for static measurement principle
- Separate overload protection
- Plug-in terminals for power and bus cables, with cover
- Socket for the actuator
- NFC and service interfaces
- Crank handle for manual winding of the spring return actuator
- Release button to allow for manual operation
- Indicator lights for displaying the operating mode
- Addressing button to confirm the addressing request of an MP master (only in MP-Bus mode)
- Controller casing prepared with 4 openings for threaded connections, 2 cable glands M16 x 1.5 for connecting cable in the supply package
- Duct pressure testing set with duct pressure test plug and measuring tube included in supply package
- Controller casing can be opened without tools

## Construction

BUPNF with actuator LF24-VST for:
- TVR, TVZ, TVA, TVRK up to NW 250

BUPNF with actuator NF24A-VST for:
- TVJ, TZ-Silenzio, TA-Silenzio all dimensions
- TVR, TVZ, TVA, TVRK for NW 315 – 400
- TVT up to dimension 1000 × 300 or 800 × 400

## Commissioning

- Due to the factory set operating values of the duct pressure, it must always be ensured that the control units are only installed at the intended locations
- Modbus/BACnet/MP bus interface: additional commissioning steps required
- Operating parameters can be adjusted using the TROX FlowCheck app

**Useful additions**

- TROX FlowCheck app for Android and iOS
- Bluetooth-to-NFC converter ZIP-BT-NFC
- Type ZTH-EU adjustment device (limited use)
- Belimo PC-Tool software

# Function

**Duct pressure controller (line pressure controller) area of application**

Ventilation planning for a larger building often requires a widely branched duct network, with individual building sections being supplied via branch lines of the main duct. Here, a sufficient air supply from the various branch lines must be ensured in all (use-dependent) operating situations, so that the planned ventilation of the respective zones or rooms is guaranteed by the volume flow controllers being used.

In the simplest implementation scenario, (high) volume flow rates are throttled exclusively by terminal volume flow controllers in the zones or rooms. In this way, high differential pressures close to the room can be reduced, but this leads to disadvantages in terms of acoustics and control engineering.

A practical alternative is to regulate the air requirements of the branch line on the basis of demand with an additional control instance – and thus only apply as much differential pressure in the line as is actually required to supply the volume flow controller in this line. This means that only very low differential pressures have to be regulated at the terminal volume flow controllers, which has benefits in terms of accuracy and acoustic performance.

Volume flow controllers cannot be used for this purpose. When volume flow controllers are connected in series in the line and zone or in the room, only one of the controllers assumes the volume flow control (limiting variable) – all others are in the OPEN position. Only a volume flow limiter can be implemented in this way.

Duct pressure controllers should always be used where parallel lines have different static pressure requirements. The static pressure in the individual duct sections/lines should be regulated so that there is always sufficient, demand-based pressure available and unnecessary throttling processes are avoided. The duct pressure controller is parameterised in such a way that it regulates the line pressure only to the point where the volume flow controller can function and the outlet resistances in the zones behind it are overcome. Overall, the use of a duct pressure controller in the line and the use of a terminal volume flow controller for the zone or room result in a system performance that is more stable with better acoustic and energy efficiency properties.

**Functioning of a duct pressure controller**

A static differential pressure transducer converts the duct pressure into a voltage signal. The differential pressure actual value is available as a voltage signal. The factory setting is such that 10 V DC always corresponds to the nominal differential pressure ($\Delta p_{Nominal}$). The differential pressure setpoint value is either a constant value or it comes from a setpoint adjuster or from switch contacts. The controller compares the differential pressure setpoint value to the actual value and controls the actuator according to the deviation. Differential pressure parameters and signal voltage range are stored in the control component. Changes made by the customer can easily be made with the TROX FlowCheck App, adjustment device or a notebook. If the supply voltage is interrupted or there is a wire breakage, the spring return actuator moves to the OPEN (NO) or CLOSED (NC) safe position that was set at the factory via the order code.

**Principle of operation Universal controller for duct pressure control: TVR, TVJ, TVT, TZ-/TA-Silenzio, TVZ, TVA, TVRK**
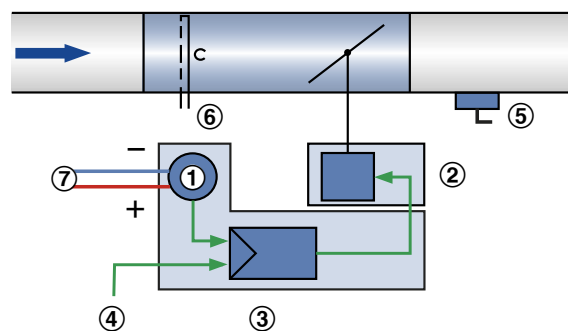


① Differential pressure transducer

② Actuator

③ Differential pressure controller

④ Setpoint value signal or programmed fixed constant value

⑤ Duct pressure tapping point

⑥ Differential pressure sensor of the VAV terminal unit (unused, depending on types and variant possibly not accessible or not available)

⑦ Differential pressure connection at the transducer of the control component, depending on the installation situation (supply air/ exhaust air):

▪ One connection side for duct pressure measurement - see ⑤

▪ Other connection side open as reference value

## Specification text

This specification text describes the general properties of the product.

### Category
- Universal controller for duct pressure with safe position

### Application
- Control of a constant or variable duct pressure setpoint
- Electronic controller for applying a reference value and capturing an actual value signal
- The actual value signal relates to the nominal pressure such that commissioning and subsequent adjustment are simplified
- Stand-alone operation or integration with a central BMS

### Area of application
- Duct pressure control for ventilation and air conditioning systems in the range of 25-450 Pa (static transducer integrated)

### Actuator
- Spring return actuator for defined safe position of the damper blade in case of power failure
- Run time 120 s for 90°; run time spring return < 20 s for 90°

### Installation orientation
- Either direction

### Connection
- Pluggable connection terminals; no additional terminal box required

### Supply voltage
- 24 V AC/DC

### Interface/signalling
Analogue signal:
- 0 – 10 V DC or 2 – 10 V DC,

Bus interface:
- Modbus RTU
- BACnet MS/TP
- MP bus

### Interface information
Analogue signal:
- Duct pressure setpoint and actual value

Bus interface:
- Duct pressure setpoint and actual value
- Damper blade position
- Fault status

### System connections
MP-Bus for optional extensions
- Gateways for Modbus, BACnet, KNX, e.g. Belimo UK24xxx
- Fan optimiser, e.g. Belimo COU24-A-MP

### Special functions
- Activation of $\Delta p_{min}$, $\Delta p_{max}$, Closed, Open, Control Stop by means of external switch contacts/wiring or bus communication

### Parameter setting
Parameters specific to the VAV terminal unit are factory set
- Nominal pressure factory set
- Operating values $\Delta p_{min}$, $\Delta p_{max}$ are factory set
- Signal characteristic is factory-set

Subsequent adaptation possible with
- TROX FlowCheck app (NFC or Bluetooth with optional adapter)
- PC software

### Factory condition
- Electronic controller factory mounted on the control unit
- Factory set, certified with sticker
- Controller in OPEN position
- Duct pressure testing set with duct pressure test plug and measuring tube included in supply package

# Order code

**Control component BUPNF (shown together with TVR as an example)**

TVR – D – P1 – / 200 / D2 / BUPNF / PDS / V 0 / 50 – 350 [Pa] / NO
| | | | | | | | | | | |
1  2  3  4  5  6  7  8 9 10  11  12

**1 Type**

**TVR** VAV terminal unit

**2 Acoustic cladding**

No entry: none
**D** With acoustic cladding

**3 Material**

No entry: galvanised sheet steel
**P1** Powder-coated RAL 7001 (silver grey)
**A2** Stainless steel construction

**4 Duct connection**

No entry: push-fit, suitable for ducts according to EN 1506; with groove for optional lip seal
**FL** Flanges both ends (not with TVR-D-P1)

**5 Nominal size [mm]**
**100, 125, 160, 200, 250, 315, 400**

**6 accessories**

No entry: without accessories
**D2** Double lip seal both ends (push-fit only)
**G2** Matching flanges for both ends (only with FL)

**7 Attachments (control component)**

**BUPNF** Universal controller with static transducer and separate

spring return actuator for duct pressure control

**8 Equipment function/Installation location**
**PDS** Duct pressure control, supply air (Pressure Duct Supply)
**PDE** Duct pressure controller – extract air (Pressure Duct Extract)

**9 Operating mode**
**F** Constant value mode (one setpoint value, no external switch contact)
**V** Variable operation (adjustable setpoint value range)

**10 Signal voltage range**
**0** 0 – 10 V DC
**2** 2 – 10 V DC

**11 Operating values for factory setting**
Duct pressure [Pa]

Depending on operating mode
F: $\Delta p_{const}$
V: $\Delta p_{min} - \Delta p_{max}$

**12 Damper blade position**
**NO** Power off to open (Normally Open)
**NC** Power off to close (Normally Closed)

**Order example: TVR-D-P1/200/D2/BUPNF/PDS/V0/50-350[Pa]/NO**

| Type | TVR |
|---|---|
| Acoustic cladding | With acoustic cladding |
| Material | Powder-coated RAL 7001 (silver grey) |
| Duct connection | Push-fit, suitable for ducts according to EN 1506; with groove for optional lip seal |
| Nominal size | 200 |
| Accessories | Double lip seal both ends |
| Attachments (control component) | BUPNF – Universal controller with static transducer and separate spring return actuator for duct pressure control |
| Equipment function/installation location | Duct pressure control, supply air (Pressure Duct Supply) |
| Operating mode | Variable operation |
| Signal voltage range | 0 – 10 V DC |
| Operating values for factory setting | 50 – 350 [Pa] |
| Damper blade position | Power off to open (Normally Open) |

# Variants

**Universal controller, Type VRU-M1-M/B TR**



① Adaptation key
② Actuator connection socket
③ NFC interface
④ Dummy cover (not in use)
⑤ Cable glands (separate supply and control)
⑥ Fixing holes
⑦ Differential pressure connection

**Universal controller, type VRU-***-M/B TR (terminal cover opened)**
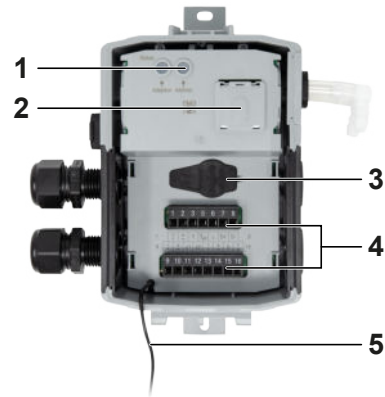


① Yellow status LED; address confirmation (only with MP-Bus operation)
② Magnetic holder for ZIP-BT-NFC
③ Service socket
④ Pluggable terminal strips
⑤ Cover fixing (safety cable)

**Actuator with spring return LF24-VST TR**



① Axle support
② Actuator total
③ Plug connection for the controller
④ Mechanical end stop for rotation angle
⑤ Direction of rotation of spring return (clockwise here)
⑥ Holder for crank handle for manual winding (locking via abrupt change of direction of rotation)
⑦ Connecting cable

**Actuator with spring return NF24A-VST TR**



① Axle support
② Actuator total
③ Position lock spring return (e.g. after manual winding using crank handle)
④ Socket for the crank handle
⑤ Connecting cable
⑥ Plug connection for the controller
⑦ No function
⑧ Mechanical end stop for rotation angle

# Technical data

**Universal controller for VAV terminal units**

| – | Controller | | Actuator | | – |
|---|---|---|---|---|---|
| **Order code detail** | Part number | Type | Part number | Type | **VAV terminal units** |
| BUPNF | A00000073652 | VRU-M1-M/B TR | A00000076097 | LF24-VST TR | ② |
| BUPNF | A00000073652 | VRU-M1-M/B TR | A00000073648 | NF24A-VST TR | ① |

① 
TVR, TVZ, TVA, TVRK up to NW 250

② 
TVR, TVZ, TVA, TVRK from NW 315

TVJ

TVT up to dimension 1000 × 300 or 800 × 400

## Universal controller, type VRU-M1-M/B TR



### Universal controller, type VRU-M1-M/B TR

| | |
|---|---|
| Type of measurement/installation orientation | static measuring principle, position-independent |
| Nominal pressure | 500 Pa |
| Pressure regulation range | 25 – 450 Pa |
| Nominal voltage | AC/DC 24 V |
| Rated voltage frequency | 50/60 Hz |
| Functional range | 19.2 - 28.8 V AC or 21.6 - 28.8 V DC |
| Power consumption (when running/when idle) | 1.5 W |
| Power requirement dimensioning | 2 VA plus connected VST drive |
| Power consumption dimensioning note | $I_{max}$ 20 A @ 5 ms |
| Drive connection | AC/DC supply through controller, PP-Link VST drive |
| Bus connection | **Modbus RTU\*,** BACnet MS/TP, MP-Bus |
| Modbus RTU communication parameters to be set | Baud rate: 9600, 19200, **38400\***, 76800, 115200; Address: **1\***,2.3 – 247; Parity: **1-8-N-2\***, 1-8-N-1, 1-8-E-1, 1-8-O-1; Number of nodes: maximum 32 (without repeater) Terminating resistor: 120 Ω; integrated, switchable |
| BACnet MS/TP communication parameters to be set | Baud rate: 9600, 19200, **38400\***, 76800, 115200; Address: **1\***,2.3 – 127; Number of nodes: maximum 32 (without repeater) Terminating resistor: 120 Ω; integrated, switchable |
| Addressing | Required on site: by smartphone app |
| Setpoint value signal input (analogue optional) | 0 - 10 V DC, 2 - 10 V DC Input resistance 100 kΩ |
| Actual value signal output | 0 - 10 V, 2 - 10 V, maximum 0.5 mA |
| Protection class IEC/EN | III (Protective extra-low voltage) |
| Protection level | IP 42 |
| EMC | CE according to 2014/30/EU |
| Weight | 0.3 kg |

* Factory setting.

**Actuator with spring return LF24A-VST TR**



**Actuator with spring return LF24A-VST TR**

| | |
|---|---|
| Power supply | from the controller |
| Power consumption – when running | 2.5 W |
| Power requirement dimensioning | 5 VA |
| Self-consumption (idle state) | 1 W |
| Torque | 4 Nm |
| Run time for 90° | 120 s/90° |
| Running time emergency control function | < 20 s/90° |
| Setpoint value signal input | from the controller |
| IEC protection class | III (Protective extra-low voltage) |
| Protection level | IP 54 |
| EMC | EMC to 2014/30/EU |
| Weight | 1.8 kg |
| Manual adjustment | by hand crank; locking by counter-rotation |

**Actuator with spring return NF24A-VST TR**



**Actuator with spring return NF24A-VST TR**

| Power supply | from the controller |
|---|---|
| Power consumption – when running | 5 W |
| Power requirement dimensioning | 8 VA |
| Self-consumption (idle state) | 2.5 W |
| Torque | 10 Nm |
| Run time for 90° | 120 s/90° |
| Running time emergency control function | < 20 s/90° |
| Setpoint value signal input | from the controller |
| IEC protection class | III (Protective extra-low voltage) |
| Protection level | IP 54 |
| EMC | EMC to 2014/30/EU |
| Weight | 2.3 kg |
| Manual adjustment | by hand crank and locking switch |

**Meaning of the green status LED/push button (applies to all VRU control components)**

| LED/push button (green) | Meaning |
|---|---|
| ON | Power supply ok - Normal operation |
| blinking | in operation - status message pending* |
| at the press of the button | Trigger rotation angle adaptation, then normal operation |

**\* Status message pending:** signals a pending status message, whereby the type of fault is not specified. For a concrete evaluation of this collective fault message, a query must be made using service tools or the bus interface:
- Belimo Assistant app, TROX FlowCheck app or Belimo PC-Tool software
- MP-Bus command, Modbus register, BACnet object

**Meaning of the yellow status LED/push button (applies to all VRU control components)**

| LED/push button (yellow) | Meaning |
|---|---|
| blinking | MP-Addressing |
| at the press of the button | Confirmation of addressing |

**Commissioning**
- Due to the factory-set operating values, it must always be ensured that the control units are only installed in the intended locations
- Install control unit in the duct section to be controlled
- Set up a pressure measurement point

For supply air:
- Connect the positive connection point of the controller to the duct to be controlled
- Leave the negative connection of the controller open

For extract air:
- Leave the positive connection point of the controller open
- Connect the negative connection of the controller to the channel to be controlled
- The duct connection has to be on the side facing away from the fan
  - Observe the duct pressure control range according to the technical data
  - Establish electrical wiring connection
  - The controller is then ready for use
- Only briefly remove the protective cap of the control component during wiring

For bus operation, further commissioning steps are required depending on the required integration of the control component into the local network:

**For operation with Modubus interface**
- Switching the setpoint to bus with the service tool
- Bus protocol is already set in the factory from Modbus RTU; no adjustment required
- Adjust Modbus participant address and communication settings

**For operation with BACnet interface**
- Switching the setpoint to bus with the service tool
- Switch bus protocol to bus with service tool
- Adjust BACnet subscriber address and communication settings

**For operation with MP-BUS interface**
- Switching the setpoint to bus with the service tool
- Switch bus protocol to MP-Bus with service tool
- For operation with MP-Bus interface in existing systems as a replacement for VRP-M controllers:
  Activation of VRP-M compatity mode required

**Functional scope of service tools**

| Function/parameter setting | Smartphone app | PC-Tool [1] | ZTH-EU |
|---|---|---|---|
| Setting $\Delta p_{min}$, $\Delta p_{max}$ | R, W [2] | R, W | R, W |
| Setting signal voltage range for Analogue interface 0 - 10 V, 2 - 10 V DC | R, W [2] | R, W | – |
| Setpoint value default setting via analogue connection or bus (Modbus, BACnet or MP bus) | R, W [2] | R, W | – |
| Modbus, BACnet settings (address, communication parameters) | R, W [2] | R, W | – |
| MP-Bus settings (address) | R, W [2] | R, W | – |
| Execute override controls (test function) | R, W [3] | – | – |
| Trend display | R, W [3] | yes | – |

R, W = function is readable and writable

- = Function is not available for the service tool

[1] Requires interface converter, e.g. setting devices ZTH-EU

[2] Function/parameterisation is possible without connecting the controller to supply voltage

Function/parameterisation only in conjunction with ZIP-BT-NFC **and** connected power supply to the controller

For the proper use of the service tools, they should always be kept up to date with the latest software version.

Information on current versions/updates for PC-Tool software and setting device ZTH-EU on the Belimo homepage www.belimo.com.

Minimum versions for ZTH-EU firmware: V 2.09.0004

## Modbus RTU communication interface

| Number | Register Address | Description | Range Enumeration | Unit | Scaling | Access |
|---|---|---|---|---|---|---|
| 1 | 0 | Setpoint value between $q_{vmin}/\Delta p_{min}$ (reg. address 105) and $q_{vmax}/\Delta p_{max}$ (reg. address 106)<br><br>(*1) (*2) (*3) (*4) | 0 – 10,000<br>Factory setting: 0 | % | 0.01 | [R / W] |
| 2 | 1 | Override control<br><br>Overwrites the setpoint value with override control | 0: None<br>1: OPEN<br>2: CLOSED<br>3: $q_{vmin}/\Delta p_{min}$<br>5: $q_{vmax}/\Delta p_{max}$<br>Factory setting: None | – | – | [R / W] |
| 3 | 2 | Command triggering<br><br>Triggering of functions for service and test purposes. Command ends automatically with 0 | 0: None<br>1: Adapting<br>3: Synchronisation<br>Factory setting: None | – | – | [R / W] |
| 4 | 3 | Type of actuator<br><br>(*5) | 0: Actuator not connected/not known<br>1: Actuator Air/Water with/without safety function<br>2: Volume flow controller VAV/EPIV<br>3: Fire damper<br>4: Energy Valve<br>5: 6way EPIV | – | – | [R] |
| 5 | 4 | Current damper blade position acc. to mechanical limits<br><br>(*5) | 0 – 10,000 | % | 0.01 | [R] |
| 6 | 5 | Blade angle acc. to angle range<br><br>(*5) | 0 – 9,600 | ° | 0.01 | [R] |
| 7 | 6 | Relative volume flow rate related to $q_{vnom}$ (reg. address 110)<br><br>(*6) | 0 – 15,000 | % | 0.01 | [R] |
| 8 | 7 | Absolute volume flow rate<br><br>(*6) | 0 – $q_{vnom}$ | m³/h | 1 | [R] |
| 9 | 8 | Sensor value (voltage, resistance, switch)<br>Value dependent on the setting of the sensor type (reg. address 107) | 0 – 65,535 | mV, Ω, 0/1 | 0.1 | [R] |
| 10 | 9 | – | – | – | - | [–] |
| 11 | 10 | Absolute volume flow rate in selected volume flow unit acc. to (reg. address 117)<br><br>(Low word) < 16 of 32 bit<br><br>(*6) | 0 – 500,000,000 | UnitSel | 0.001 | [R] |
| 12 | 11 | Absolute volume flow rate in selected volume flow unit acc. to (reg. address 117)<br><br>(High word) > 16 of 32 bit<br><br>(*6) | 0 – 500,000,000 | UnitSel | 0.001 | [R] |
| 13 | 12 | Analogue setpoint value | 0 – 10,000 | % | 0.01 | [R] |

| Number | Register Address | Description | Range Enumeration | Unit | Scaling | Access |
|---|---|---|---|---|---|---|
| | | Shows the setpoint value in % with analogue control input signal. Active if reg. address 118 = 0 (analogue) | | | | |
| 51 | | Relative differential pressure<br><br>According to application case as per (reg. address 128) | 0 – 20,000 | % | 0.01 | [R] |
| 52 | | Absolute differential pressure | -1,000 – 15,000 | [Pa] | 0.1 | [R] |
| 53 | | – | – | – | – | [–] |
| 54 | | Absolute differential pressure in selected unit (reg. address 145) (Low word) < 16 of 32 bit | -10,000,000 – 100,000,000 | UnitSel | 0.001 | [R] |
| 55 | | Absolute differential pressure in selected unit as per (reg. address 145)<br><br>(High word) > 16 of 32 bit | -10,000,000 – 100,000,000 | UnitSel | 0.001 | [R] |
| 100 | 99 | Bus terminal resistor<br><br>Indicates whether the terminal resistor (120 Ω) is active or deactivated. Can only be set using service tools. | 0: Not active<br>1: Active<br>Factory setting: Not active | – | – | [R] |
| 101 | 100 | Serial number, part 1<br>Example: 00839-31324-064-008<br>1st part: 00839<br>2st part: 31324<br>3st part: 008 | – | – | – | [R] |
| 102 | 101 | Serial number, part 2 | – | – | – | [R] |
| 103 | 102 | Serial number, part 3 | – | – | – | [R] |
| 104 | 103 | Firmware version<br>Example: 101, version 01.01. | – | – | – | [R] |
| 105 | 104 | Malfunctions and service information – automatic reset if status has ceased | Bit 0: –<br>Bit 1: Mechanical travel too high<br>Bit2: Actuator cannot be moved (e.g. mechanical overload)<br>Bit 3: –<br>Bit 4: Error of dP sensor<br>Bit 5: Return air flow detected<br>Bit 6: Volume flow rate too low<br>Bit 7: Flow rate in closed position<br>Bit 8: Internal activity (e.g. test run, adaptation)<br>Bit9: Gear release active<br>Bit10: Bus monitoring triggered<br>Bit 11: Actuator not suitable for application<br>Bit 12: Pressure sensor incorrectly connected<br>Bit 13: Pressure sensor not reached<br>Bit 14: Error in dP sensor outside of measuring range | – | – | [R] |
| 106 | 105 | Setting work areas $q_{vmin}/\Delta p_{min}$<br><br>Requirements: $q_{vmin}/\Delta p_{min} < q_{vmax}/\Delta p_{max}$ Vmax in the area 0 – 100 % of $q_{vnom}/\Delta p_{nominal}$ | 0 – $q_{vmax}/\Delta p_{max}$ | % | 0.01 | [R / W*] |
| 107 | 106 | Setting work areas $q_{vmax}/\Delta p_{max}$<br><br>Requirements: $q_{vmax}/\Delta p_{max} < q_{vmin}/\Delta p_{min}$ | 2,000 – 10,000 | % | 0.01 | [R / W*] |

| Number | Register Address | Description | Range Enumeration | Unit | Scaling | Access |
|---|---|---|---|---|---|---|
| | | Vmax in the area 20 – 100 % of $q_{vnom}$/$\Delta p_{nominal}$ | | | | |
| 108 | 107 | Type of sensor<br><br>If reg. address 118 = 0 (analogue), then reg. address 107 = 1 (active) for mV | 0: None<br>1: Active<br>2: Passive<br>3: –<br>4: Switch<br><br>Factory setting: None | – | – | [R / W*] |
| 109 | 108 | Bus timeout monitoring<br><br>If there is a bus timeout, the actuator moves into a position specified here. The position is mech. limited, $q_{vmin}$/$\Delta p_{min}$ and $q_{vmax}$/$\Delta p_{max}$ have no impact. Release if no change takes place in reg. address 1 or reg. address 2 in the specified time for reg. address 109.<br>Display of release in reg. address 104.<br>In hybrid mode, bus timeout activation is deactivated.<br><br><br>Bus timeout time: acc. to reg. address 109 | 0 – 10,000<br>Factory setting: 0 | % | 0.01 | [R / W*] |
| 110 | 109 | Time until release bus timeout monitoring<br><br>If reg. 108 ≠ 0, then the initial automatic status is reg. 108 = 120 s. | 0 – 3,600<br>0: Inactive<br>Factory setting: Deactivated | s | 1 | [R / W*] |
| 113 | 112 | Nominal volume flow rate in selected volume flow unit acc. (reg. address 117)<br><br>(Low word) < 16 of 32 bit | 0 – 60,000,000 | UnitSel | 0.001 | [R] |
| 114 | 113 | Nominal volume flow rate in selected volume flow unit acc. (reg. address 117)<br><br>(High word) > 16 of 32 bit | 0 – 60,000,000 | UnitSel | 0.001 | [R] |
| 115 | 114 | – | – | – | – | [–] |
| 116 | 115 | – | – | – | – | [–] |
| 117 | 116 | Control mode | 0: Position control (open loop)<br>1: Volume flow control<br>Factory setting: Volume flow control | – | – | [R] |
| 118 | 117 | Unit selection –<br><br>Unit selection for reg. address 11 and 12 | 0: –<br>1: m³/h<br>2: l/s<br>3: –<br>4: –<br>5: –<br>6: cfm | - | – | [R / W*] |
| 119 | 118 | Setpoint value setting<br><br>If reg. address 118 = 0 (analogue), then reg. address 12 = active.<br>If reg. address 118 = 1 (Bus), then reg. address 1 = active. | 0: Analogue (0 – 10 V, 2 – 10 V)<br>1: Bus (Modbus, BACnet, MP-Bus)<br>Factory setting: Analogue | – | – | [R / W*] |

| Number | Register Address | Description | Range Enumeration | Unit | Scaling | Access |
|---|---|---|---|---|---|---|
| | | | | | | |
| 120 | | Pressure operating mode

Only for VRU-M1R-M/B TR. | 0: Negative pressure
1: Positive pressure | – | – | [R / W*] |
| 121 | | – | – | – | – | [–] |
| 122 | | – | – | – | – | [–] |
| 123 | | – | – | – | – | [–] |
| 124 | | Room pressure cascade release

Only available if reg. address 124 = 0 (volume flow control) or 2 (room pressure control). | 0: Inactive
1: Active
2: Active fast (only for VRU-M1R-M/B TR) | – | – | [R] |
| 125 | | Applications | 0: Volume flow control
1: Pressure control
2: Room pressure control
3: Flow measurement | – | – | [R] |
| 126 | | Unit height | 0 – 3,000
Factory setting: 0 | m | 1 | [R / W*] |
| 127 | | Nominal differential pressure in the selected unit as per (reg. address 145)

More info in (reg. address 128) | D3: 0 – 50000
M1: 0 – 60000
M1R: 0 – 60000 | UnitSel | – | [R] |
| 128 | | – | – | – | – | [–] |
| 129 | | Nominal differential pressure in Pa

If reg. address 124 = 0 (volume flow control), then reg. address 110 as $q_{vnom}$.
If reg. address 124 = 1 (differential pressure control) or 2 (room pressure control), then the maximum is defined by the diff. pressure. | D3: 0 – 500
M1: 0 – 600
M1R: 0 – 750 | Pa | 0.1 | [R] |
| 146 | | Selection of the pressure unit

The selected unit is displayed in (reg. address 126). | 0: Pascal
1: –
2: Water column
Factory setting: Pascal | – | – | [R / W*] |

[R] = Read-only access to register
[R/W] = Register readable and writable
[R/W*] = Register readable and writeable with restrictions; all writeable registers from 100 are persistent (stored in the EEPROM), regular or cyclical writing must be avoided.

(*1) If reg. addr. 118 = 1 (bus), then reg. addr. 0 = active
(*2) If reg. addr. 124 = 0 (flow rate control), then reg. addr. 0 = flow rate
(*3) If reg. addr. 124 = 0 (volume flow control) and reg. addr. 116 = 0 (position control), then reg. addr. = damper blade position
(*4) If reg. addr. 124 = 1 (differential pressure control) or 2 (room pressure control), then reg. addr. = pressure
(*5) If reg. addr. 124 = 2 (room pressure control) or 3 (volume flow measurement), then reg. addr. = deactivate 65.535
(*6) If reg. addr. 124 = 1 (differential pressure control) or 2 (room pressure control), then reg. addr. = deactivate 65.535

**BACnet MS/TP - Protocol Implementation Conformance Statement - PICS (General information)**

| | |
|---|---|
| Date | 2020-06-11 |
| Vendor Name | TROX GmbH |
| Vendor ID | 329 |
| Product Name | VRU-D3-BAC, VRU-M1-BAC, VRU-M1R-BAC |
| Product Model Number | VRU - BAC |
| Applications Software Version | 01.02.0001 |
| Firmware revision | 10.02.0000 |
| BACnet Protocol Revision | 12 |
| Product Description | Controller for VAV/CAV and pressure applications |
| BACnet Standard Device Profile | BACnet Application Specific Controller (B-ASC) |
| BACnet Interoperability Building Blocks supported | Data Sharing – ReadProperty-B (DS-RP-B) <br> Data Sharing – ReadPropertyMultiple-B (DS-RPM-B) <br> Data Sharing – WriteProperty-B (DS-WP-B) <br> Data Sharing – WritePropertyMultiple-B (DS-WPM-B) <br> Data Sharing – COV-B (DS-COV-B) <br> Device Management – DynamicDeviceBinding-B (DM-DDB-B) <br> Device Management – DynamicObjectBinding-B (DM-DOB-B) <br> Device Management – DeviceCommunicationControl-B (DM-DCC-B) |
| Segmentation Capability | No |
| Data Link Layer Options | MS/TP master, baud rates: 9600, 19200, 38400, 76800, 115200 |
| Device Address Binding | No static device binding supported |
| Networking Options | None |
| Character Sets Supported | ISO 10646 (UTF-8) |
| Gateway Options | None |
| Network Security Options | Non-secure device |

**Communication interface BACnet MS/TP - Object processing**

| Object type | Optional properties | Writeable properties |
|---|---|---|
| Analog Input [AI] | Description<br>COV Increment | COV Increment |
| Analog Output [AO] | Description<br>COV Increment | Present Value<br>COV Increment<br>Relinquish Default |
| Analog Value [AV] | Description<br>COV Increment | Present Value<br>COV Increment |
| Binary Input [BI] | Description<br>Active Text<br>Inactive Text | |
| Device | Description<br>Location<br>Active COV Subscriptions<br>Max Master<br>Max Info Frames<br>Profile Name | Object identifier<br>Object Name<br>Location<br>Description<br>APDU Timeout (1000 – 60000)<br>Number Of APDU Retries (0 – 10)<br>Max Master (1 – 127)<br>Max Info Frames (1 – 255) |
| Multi-state Input [MI] | Description<br>State Text | |
| Multi-state Output [MO] | Description<br>State Text | Present Value<br>Relinquish Default |
| Multi-state Value [MV] | Description<br>State Text | Present Value (if marked) |

**Editing of services**

▪ The unit does not support the services "Create object" and "Delete object".

▪ The specified maximum length of writable strings is based on single-byte characters.

1. Object name 32 characters
2. Location 64 characters
3. Description 64 characters

▪ The unit supports DeviceCommunicationControl services, no password required.

▪ A maximum of 6 active COV subscriptions with a runtime of 1 - 28800 s (maximum 8 h) are supported.

## Communication interface BACnet MS/TP - BACnet objects

| Object Name | Object Type | Description | Values | COV Increment | Access |
|---|---|---|---|---|---|
| Device | Device [Inst.No] | | 0 – 4,194,302 Factory setting: 1 | – | WR |
| RelPos | AI[1] | Damper blade position in % Status flags: (*1), (*2) | 0 – 100 | 0.01 – 100 Factory setting: 1 | RD |
| AbsPos | AI[2] | Absolute position in ° Angular position corresponding to the entire rotation range. Status flags: (*1), (*2) | 0 – max. angle | 0.01 – 90 Factory setting: 1 | RD |
| SpAnalogue | AI[6] | Analogue setpoint value in % Shows the analogue setpoint value according to the selected application flow rate, pressure, damper blade position as per ApplicationSel MV[2]. If setpoint value setting in SpSource MV[122] = 1 (analogue), then SpAnalog AI[6] = active. The analogue setpoint value is limited by Min AV[97] and Max AV[98]. Status flags: (*1), (*3) | 0 – 100 | 0.01 – 100 Factory setting: 1 | RD |
| RelDeltaP | AI[9] | Relative differential pressure in % with respect to DeltaPnom_Pa AV[122] | 0 – 150 | 0.01 – 150 Factory setting: 1 | RD |
| RelFlow | AI[10] | Relative volume flow rate in % related to Vnom_m3h AV[112] Status flags: (*4) | 0 – 150 | 0.01 – 150 Factory setting: 1 | RD |
| AbsFlow_m3h | AI[12] | Absolute volume flow rate in m³/h Status flags: (*4) | 0 – 60,000 | 1 – 60,000 Factory setting: 10 | RD |
| DeltaP_UnitSel | AI[18] | Absolute differential pressure in selected unit as per UnitSelPressure MV[127] | -10,000 – 100,000 | 0.001 – 100,000 Factory setting: 1 | RD |
| AbsFlow_UnitSel | AI[19] | Absolute volume flow rate in selected unit as per UnitSelAirFlow MV[121] Status flags: (*4) | 0 – 500,000 | 0.01 – 500,000 Factory setting: 1 | RD |
| Sens1Analogue | AI[20] | Sensor 1 as analogue value If Sensor1Type MV[220] = 2 (active), then display = analogue value in 0 – 10 V. If Sensor1Type MV[220] = 3 (passive), then display = resistance value. If RmPCascade MV[10] = 2 (enabled) or 3 (quickly enabled), then the sensor input is not | 0 – 65535 | 0.01 – 1000 Factory setting: 1 | RD |

| Object Name | Object Type | Description | Values | COV Increment | Access |
|---|---|---|---|---|---|
| | | available.<br><br>Status flags: (*5) | | | |
| DeltaP_Pa | AI[29] | Absolute differential pressure in Pa | 0 – 600 | 0.01 – 600<br>Factory setting: 10 | RD |
| SpRel | AO[1] | Relative setpoint value in %<br><br>The rel. setpoint value depends on the application (flow rate/pressure/damper blade position).<br>If SpSource MV[122] = 2 (bus), then SpRel AO[1] = active.<br>The analogue setpoint value is limited by Min AV[97] and Max AV[98].<br><br>Status flags: (*1), (*2) | 0 – 100<br>Factory setting: 0 | 0.01 – 100<br>Factory setting: 1 | C |
| Min | AV[97] | Minimum setpoint value in % ($q_{vmin}$/$P_{min}$)<br><br>Requirement:<br>$q_{vmin}/\Delta p_{min} < q_{vmax}/\Delta p_{max}$<br>$q_{vmin}/\Delta p_{min}$ in the range 0 - 100 & $q_{vnom}/\Delta p_{nom}$ | $0 - q_{vmax}/\Delta p_{max}$ | 0.01 – 100<br>Factory setting: 1 | WR |
| Max | AV[98] | Maximum setpoint value in % ($q_{vmax}$/$P_{max}$)<br><br>Requirement:<br>$q_{vmax}/\Delta p_{max} > q_{vmin}/\Delta p_{min}$<br>$q_{vmax}/P_{max}$ in the range 20 - 100 % of $q_{vnom}/P_{nom}$ | $q_{vmin}/\Delta p - 100$ | 0.01 – 100<br>Factory setting: 1 | WR |
| Vnom_m3h | AV[112] | Nominal volume flow rate in m³/h | 0 – 50,000 | 0.01 – 50,000<br>Factory setting: 1 | RD |
| Vnom_UnitSel | AV[119] | Nominal volume flow rate in selected unit as per UnitSel MV[121] | 0 – 250,000 | 0.01 – 1,000:<br>Factory setting: 1 | RD |
| SystemAltitude | AV[120] | System altitude in metres above sea level | 0 – 3,000 | 1 – 3,000<br>Factory setting: 10 | WR |
| DeltaPnom_Pa | AV[122] | Nominal differential pressure in Pa<br><br>The nominal differential pressure depends on the selected pressure sensor (D3, M1, M1R).<br>Depending on the selected application, the nominal differential pressure serves as dp@Vnom or as the maximum pressure limitation<br>If ApplicationSel MV[2] = 1 (flow control), then display = nominal differential pressure<br>If ApplicationSel MV[2] = 2 (pressure control) or 3 (room pressure control), then display = max. pressure limitation | D3: 0 – 500<br>M1: 0 – 600<br>M1R: 0 – 75 | 1 – 600<br>Factory setting: 1 | RD |

| Object Name | Object Type | Description | Values | COV Increment | Access |
|---|---|---|---|---|---|
| DeltaPnom_UnitSel | AV[129] | Nominal differential pressure in selected unit as per UnitSelPressure MV[127]<br><br>More infos: see AV[122]. | | 0.01 – 1000<br>Factory setting: 1 | RD |
| BusWatchdog | AV[130] | Time until the release bus timeout monitoring in s<br><br>If BusWatchdog AV[130] ≠ 0, then monitoring of SpRel AO[1] and override MO[1] for change.<br>If changes in SpRel AO[1] and override MO[1], then reset the bus timeout monitoring.<br>If SpSource MV[122] = 1 (analogue), then BusWatchdog AV[130] only takes account of override MO[1]. | 0 – 3600 s<br>Factory setting: 0 (bus timeout monitoring deactivated) | 0.01 – 1000<br>Factory setting: 1 | WR |
| Sens1Switch | BI[20] | Switch status of the switch at the sensor input<br><br>If SenType MV[220] = 5 (switch), then Sens1Switch BI[20] = active.<br><br>Status flags: (*6) | 0: Inactive<br>1: Active | – | RD |
| BusTermination | BI[99] | Terminal resistor<br><br>Shows whether the terminal resistor (120 Ω) has been activated via the service tools. | 0: Deactivated<br>1: Activated | – | RD |
| SummaryStatus | BI[101] | Condensed status<br><br>Groups together the status of the objects:<br><br>"StatusSensor" MI[103]<br>"StatusFlow" MI[104]<br>"StatusActuator" MI[106]<br>"StatusPressure" MI[109]<br>"StatusDevice" MI[110] | Not equal to 1: OK<br>1: Not OK | – | RD |
| RmPCasacade | MV [10] | Room pressure cascade<br><br>If RmPCascade MV[10] = 2 (active) or 3 (active fast), then sensor1 is the input for the room cascade (0 – 10 V).<br>If ApplicationSel MV[2] =1 (volume flow control) or 3 (room pressure control), then RmPCascade MV [10] = active.<br><br>Status flags: (*7) | 1: Inactive<br>2: Active<br>3: Active fast (for M1R only) | – | RD |
| InternalActivity | MI[100] | Internal status | 1: None<br>2: –<br>3: Adaption<br>4: Synchronisation | – | RD |

| Object Name | Object Type | Description | Values | COV Increment | Access |
|---|---|---|---|---|---|
| StatusSensor | MI[103] | Status of the differential pressure sensor<br><br>If status end = automatic reset | 1: OK<br>2: dP sensor not OK<br>3: dP sensor outside of measuring range<br>4: dP sensor incorrectly connected | – | RD |
| StatusFlow | MI[104] | Volume flow rate status<br><br>If there is no volume flow rate within 600 s, then StatusFlow MI[104] = 3. | 1: OK<br>2: –<br>3: No airflow detected | – | RD |
| StatusActuator | MI[106] | Status of the actuator<br><br>Status flags: (*2) | 1: OK<br>2: Actuator cannot be moved<br>3: Gear release active<br>4: Mechanical travel exceeded<br>5: Actuator not suitable for application | – | RD |
| StatusPressure | MI[109] | Differential pressure status<br><br>If the differential pressure is not reached within 180 s, then StatusPressure MI[109] = 3. | 1: OK<br>2: –<br>3: Pressure not reached | – | RD |
| StatusDevice | MI[110] | Status of the device during bus monitoring<br><br>According to BusWatchdog AV[130]. | 1: OK<br>2: Bus timeout monitoring activated | – | RD |
| Override | MO[1] | Override control<br><br>Overwrites the setpoint value with a forced command.<br><br>Status flags: (*8) | 1: None<br>2: OPEN<br>3: CLOSED<br>4: $q_{vmin}$/Δpmin<br>5: –<br>6: $q_{vmax}$/Δpmax<br>Factory setting: None (1) | – | C |
| ApplicationSel | MV[2] | Display of application<br><br>VRU-D3-M/B TR, VRU-M1-M/B TR<br>- Flow control<br>- Pressure control<br>- Flow measurement<br><br>VRU-M1R-M/B TR<br>- Room pressure control | 1: Flow control<br>2: Pressure control<br>3: Room pressure control<br>4: Flow measurement | – | RD |
| ControlMode | MV[100] | Control mode<br><br>Status flags: (*9) | 1: PosCtrl<br>2: FlowCtrl<br>Factory setting: FlowCtrl | – | RD |
| OperationMode | MV[102] | Operating mode<br><br>Only relevant for VRU-M1R-BAC.<br><br>Status flags: (*10) | 1: Negative pressure<br>2: Positive pressure | – | WR |
| Command | MV[120] | Release test functions<br><br>Status flags: (*2) | 1: None<br>2: Adaption<br>3: –<br>4: Reset<br>Factory setting: None | – | WR |
| UnitSelAirFlow | MV[121] | Selection of the volume flow unit | 1: –<br>2: m³/h<br>3: l/s | – | WR |

| Object Name | Object Type | Description | Values | COV Increment | Access |
|---|---|---|---|---|---|
| | | The selected unit is indicated in AI[19] and AV[104] | 4: –<br>5: –<br>6: –<br>7: cfm | | |
| SpSource | MV[122] | Selection of the setpoint value setting<br><br>If SpSource MV[122] = 1 (analogue), then SpAnalog AI[6] = active.<br>If SpSource MV[122] = 2 (bus), then SpRel AO [1] = active. | 1: Analogue (0 – 10 V, 2 – 10 V)<br>2: Bus (Modbus, BACnet, MP-Bus)<br>Factory setting: Analogue | – | WR |
| UnitSelPressure | MV[127] | Selection of the pressure unit<br><br>The selected unit is indicated in DeltaP_UnitSel AI[18] and DeltaPnom_UnitSel AV[129]. | 1: Pascal<br>3: Water column<br>Factory setting: pascal | – | WR |
| UnitSelTemp | MV[128] | Selection of temperature unit<br>The selected unit is located in AI[20]. | 1: K<br>2: °C<br>3: °F<br>Factory setting: °C (2) | – | W |
| Sens1Type | MV[220] | Definition of the sensor type<br><br>If Sens1Type MV[220] = 2 (active) or 3 (passive), then Sens1Analog AI[20] active.<br>If Sens1Type MV [220] = 5 (switch), then Sens1Schalter BI[20] active. | 1: None<br>2: Active sensor (in hybrid mode)<br>3: Passive sensor<br>4: –<br>5: Switch<br>Factory setting: None | – | WR |

RD = Read-only access

WR = Read/write access

C = Commendable with priority array

Status flags:

(*1) If gear disengagement pressed, then Overridden = 1

(*2) If ApplicationSel MV[2] = 3 (room pressure control) or 4 (flow measurement), then Out of Service = 1

(*3) If SpSource MV[122] = 2 (bus), then Out of Service = 1

(*4) If ApplicationSel MV[2] = 2 (pressure control) or 3 (room pressure control), then Out of Service = 1

(*5) If Sens1Type MV[220] = 1 (none), then Out of Service = 1

(*6) If Sens1Type MV[220] ≠ 5, then Out of Service = 1

(*7) If ApplicationSel MV[2] = 2 (pressure control) or 4 (flow measurement), then Out of Service = 1

(*8) If ApplicationSel MV[2] = 4 (flow measurement), then Out of Service = 1

(*9) If ApplicationSel MV[2] ≠ 1 (flow rate control), then Out of Service = 1

(*10) If ApplicationSel MV[2] ≠ 3 (room pressure control), then Out of Service = 1

## Product details

### Analogue interface 0 – 10 V DC or 2 – 10 V DC
In the delivery state, the setpoint must be specified via the analogue interface. If the setpoint value is specified via a digital communication interface, this can be changed to Modbus, BACnet or MP-Bus at any time via the TROX FlowCheck App. The analogue interface can be set for the signal voltage range 0 - 10 V DC or 2 - 10 V DC through the TROX FlowCheck App. The assignment of the channel pressure setpoint or actual value to the voltage signal is shown in the characteristic diagrams.

### Setpoint value setting
Variable operation
- In the variable operating mode, the setpoint is specified with an analogue signal at terminal 3. Setpoint specifications via the respective bus system are rejected
- Selected signal voltage range 0 - 10 V or 2 - 10 V DC is assigned to the set pressure range $\Delta p_{min}$ – $\Delta p_{max}$ assigned to
- Pressure range $\Delta p_{min}$ – $\Delta p_{max}$ set at the factory according to the order code details
- Subsequent adjustment of $\Delta p_{min}$ or $\Delta p_{max}$ possible via adjustment device, TROX FlowCheck app or PC tool

Constant value mode
- In the operating mode fixed value operation, no analogue signal is required at terminal 3
- The value determined by $\Delta p_{min}$ the set fixed duct pressure value is controlled
- Pressure value $\Delta p_{min}$ set at the factory according to the order code details
- Subsequent adjustment of $\Delta p_{min}$ possible via adjustment device, TROX FlowCheck app or PC tool

### Override control
For special operating situations, the duct pressure regulator can be set to a special operating state (override control). Possible are: Regulation $\Delta p_{min}$, regulation $\Delta p_{max}$, damper blade open (OPEN), damper blade closed (CLOSED) or control stop.

### Override controls via signal input Y or override control inputs z1, z2
Through suitable wiring of the inputs Y, z1, z2, the override controls can be activated according to the wiring diagrams via wiring with external switching contacts/relays (see wiring examples).

### Override controls via command signal at signal input Y
For signal voltage range 0 - 10 V DC
- $P_{min}$ – $P_{max}$: 0 - 10 V DC
- No shut-off: Damper CLOSED via signal input Y

For signal voltage range 2 - 10 V DC
- Flap CLOSED: Y < 0.3 V DC
- $P_{min}$: Y > 0.4 V DC
- $P_{min}$ – $P_{max}$: 2 - 10 V DC

### Actual value as feedback for monitoring or tracking control
- The actual pressure measured by the controller can be tapped as a voltage signal at terminal 5
- Selected signal voltage range 0 - 10 V DC or 2 - 10 V DC is applied to the pressure range 0 - $\Delta p_{Nominal}$ Pa depicted
- Reference point $\Delta p_{Nominal}$ = 500 Pa
- In analogue mode, there is the parallel option of querying operating data via the Modbus interface (hybrid mode)

**Override controls in analogue mode via Modbus or BACnet interface**

If the bus interface is also connected in analogue mode, override control can also be specified via Modbus register 1 or BACnet Object MO[1].

**Override control for diagnosis**

Activation via TROX FlowCheck App.

**Prioritisation of different default options**

- Specifications for override controls via analogue are prioritised over Modbus/BACnet specifications
- Highest priority: Preset via analogue override control
- Medium priority: Specifications via the service plug (setting device, PC software) for test purposes
- Lowest priority: Default via Modbus/BACnet/MP-BUS

**Analogue hybrid operation**

- With analogue setpoint input via terminal 3 and analogue feedback via terminal 5, feedback via BACnet MS/TP or Modbus RTU is still possible
- The factory default setting for the bus interface is Modbus RTU; however, this can be changed via TROX FlowCheck App or PC-Tool
- Various operating parameters can be called up according to the bus interface list via Modbus RTU or BACnet MS/TP
- Forced controls $\Delta p_{min}$, $\Delta p_{max}$, control damper in open position (OPEN) or control damper closed (CLOSED) possible via bus interface

## Digital communication interface

For a setpoint value specification via the bus interface, an on-site conversion with the TROX FlowCheck App is necessary. The bus interface can be set to Modbus, BACnet and MP-Bus. For smooth data exchange in the on-site bus network, it is necessary to set the communication parameters and the participant address for the bus interface. The communication parameters of the bus systems (address, baud rate, etc.) can be set using the TROX FlowCheck app. The interface provides standardised bus register/object access to the available data points.

## Setpoint value setting

- In Modbus RTU operating mode (factory setting), the setpoint is specified by entering the pressure setpoint [%] in Modbus register 0
- In the BACnet MS/TP operating mode, the setpoint is specified by specifying the pressure setpoint [%] in the BACnet object AI[1]
- The transferred percentage value relates to the value given by $\Delta p_{min} - \Delta p_{max}$ defined pressure range
- Pressure ranges $\Delta p_{min} - \Delta p_{max}$ set at the factory according to the order code details
- Subsequent adjustment of $\Delta p_{min}$ or $\Delta p_{max}$ possible via setting device, TROX FlowCheck App, PC tool or via Modbus/BACnet interface

## Actual value as feedback for monitoring or tracking control

- Both in Modbus and in BACnet, the actual values can be read in Pa (factory setting)
- In addition to the pressure value, further information can be read out via other Modbus registers/BACnet objects
- Overview of the registers/objects in the communication tables
- For diagnostic purposes, the actual pressure value can be tapped at terminal 5 during bus operation
- The pressure range 0 - $\Delta p_{Nominal}$ always corresponds to the signal voltage range (0)2 – 10 V DC
- Reference point $\Delta p_{Nominal}$ = 500 Pa

## Override control

For special operating situations, the duct pressure controller can be put in a special operating mode (override control). Possible are: Regulation $\Delta p_{min}$, regulation $\Delta p_{max}$ the control damper is in open position (OPEN), control damper closed (CLOSED) or control stop.

## Priority control via the bus

Specifications are made via Modbus register 1 or via BACnet Object Type MO[1].

## Override control by bus failure monitoring (Modbus)

In case of failure of the Modbus communication for a defined period of time, a predefined operating state $\Delta p_{min}$, $\Delta p_{max}$, OPEN or CLOSED can be activated.

- The override to be activated in case of bus failure is defined via Modbus register 108 or 109
- The determination after which bus failure time the override control is activated is made via Modbus register 109 or 110
- Any Modbus communication resets the bus failure monitoring timeout

## Override control by bus failure monitoring (BACnet)

If BACnet communication fails for a specified period of time, a predefined operating state can be activated.

- The setpoint to be activated in the event of bus failure is determined via the Reliquish_Default of SpRel (Object AO1)
- Bus failure time is defined via BusWatchdog (object type AV [130])
- Communication on the data points SpRel (Object AO[1]) and Override (Object MO[1]) resets the timeout of bus failure monitoring

## Override controls for diagnosis

Activation via bus systems, external/on-site switching contacts (bridges) and TROX FlowCheck App.

## Prioritisation of different default options

Specifications for override controls via switching contacts are prioritised over Modbus/BACnet specifications.

- Highest priority: Preset via override control by external wiring (switching contact, relay)
- Medium priority: Specifications via the service plug (TROX FlowCheck App) for test purposes
- Lowest priority: Default via Modbus/BACnet/MP bus
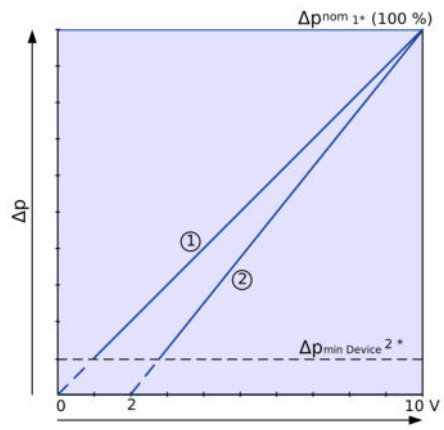
## Characteristic of the setpoint value signal
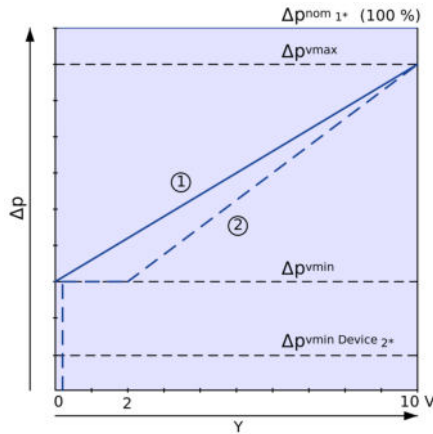


① Signal voltage range 0 – 10 V
② Signal voltage range 2 – 10 V
1* = $\Delta p_{Nominal}$ Nominal pressure difference
2* = $\Delta p_{minUnit}$ minimum adjustable pressure difference

### Calculation of differential pressure setpoint at 0 - 10 V

$$\Delta p_{set} = \frac{w}{10}\left(\Delta p_{max} - \Delta p_{min}\right) + \Delta p_{min}$$

### Calculation of differential pressure setpoint at 2 - 10 V

$$\Delta p_{Set} = \frac{w-2}{8}\left(\Delta p_{max} - \Delta p_{min}\right) + \Delta p_{min}$$

## Characteristic of the actual value signal



① Signal voltage range 0 – 10 V
② Signal voltage range 2 – 10 V
1* = $\Delta p_{Nominal}$ Nominal pressure difference
2* = $\Delta p_{min\ device}$ minimum adjustable pressure difference

### Calculation of differential pressure actual value at 0 - 10 V

$$\Delta p_{act} = \frac{U5}{10} \times \Delta p_{nom}$$

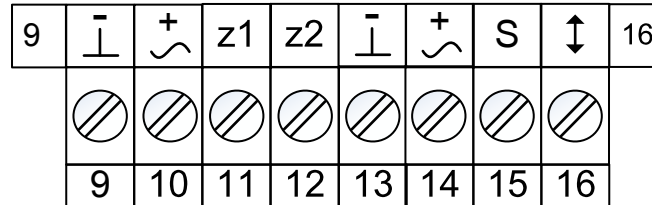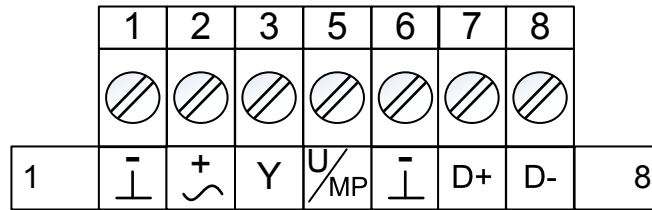### Calculation of actual differential pressure at 2 - 10 V

$$\Delta p_{act} = \frac{U5-2}{8} \times \Delta p_{nom}$$

**View of plug-in terminal strips at the VRU**

| 1 | 2 | 3 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|
| ⊘ | ⊘ | ⊘ | ⊘ | ⊘ | ⊘ | ⊘ |

| 1 | $\overset{-}{\perp}$ | $\overset{+}{\sim}$ | Y | U/MP | $\overset{-}{\perp}$ | D+ | D- | 8 |

| 9 | $\overset{-}{\perp}$ | $\overset{+}{\sim}$ | z1 | z2 | $\overset{-}{\perp}$ | $\overset{+}{\sim}$ | S | ↕ | 16 |

| ⊘ | ⊘ | ⊘ | ⊘ | ⊘ | ⊘ | ⊘ | ⊘ |
|---|---|---|---|---|---|---|---|
| 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 |

## Universal

**Nomenclature**

1, 6, 9, 13: $\perp$, – = Ground, neutral

2, 10, 14: ~, + = Supply voltage 24 V

3: Y = Setpoint signal Y and override controls

5: U/MP = Actual value signal or MP-Bus or service tool connection

7: D+ = B = C2 = RS-485 bus (BACnet MS/TP or Modbus RTU)

8: D- = A = C1 = RS-485 bus (BACnet MS/TP or Modbus RTU)

11, 12: z1, z2 = Forced control inputs

15: Extension for external sensor
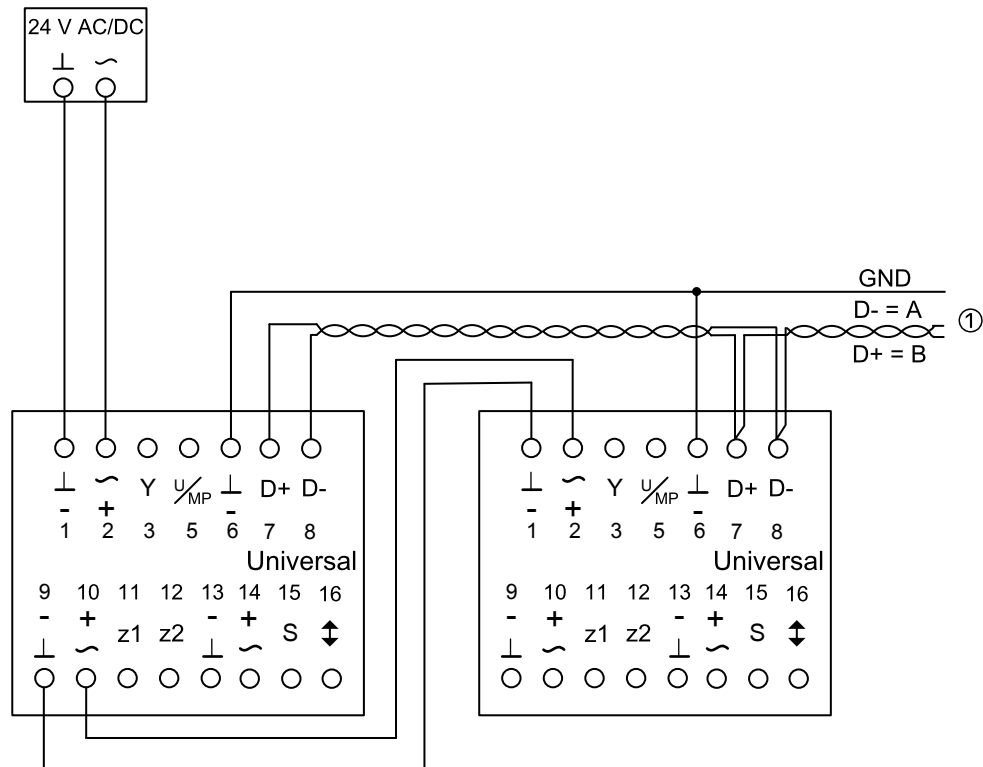
16: Not used

**Wiring diagram analogue control**
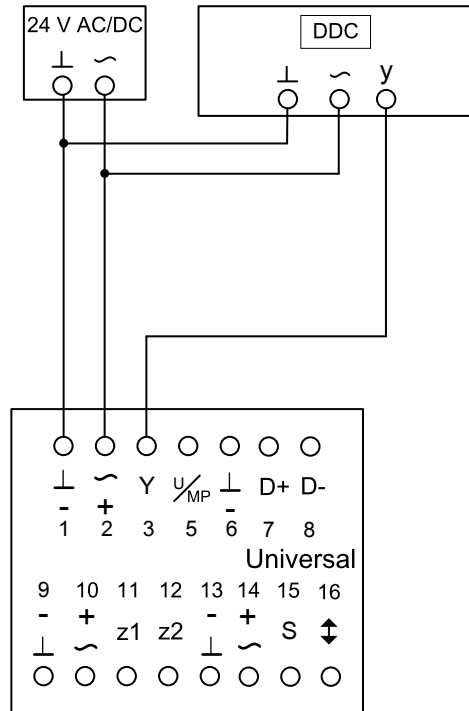


**Nomenclature**

1: ⊥, – = Ground, neutral

2: ~, + = Supply voltage 24 V AC/DC

3: Y = setpoint input and override control

5: U/MP = Actual value signal

**Note:**

▪ DDC = Setpoint value setting

▪ Setpoint value and actual value signals depend on the signal voltage range, either 0 – 10 V DC or 2 – 10 V DC
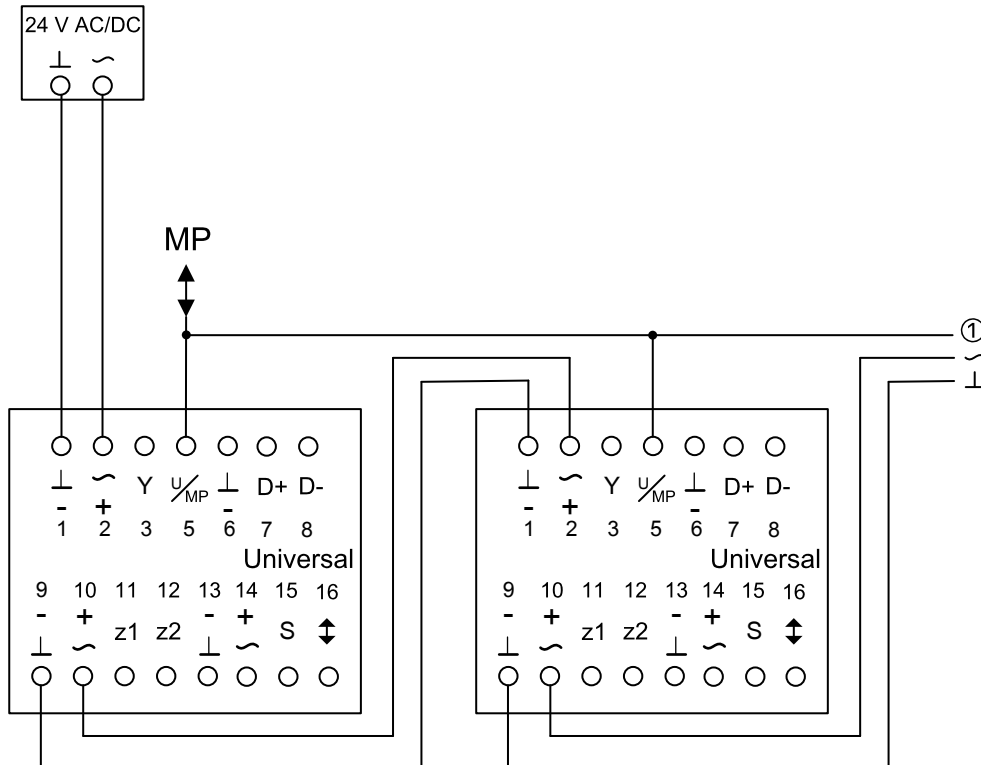
**Wiring diagram Modbus, BACnet operation**



**Nomenclature**

1: ⊥, – = Ground, neutral

2: ~, + = Supply voltage 24 V AC/DC

6: GND = Common ground potential

7: D+ = Modbus/BACnet B, C2

8: D- = Modbus/BACnet A, C1

## Note

- ① Additional network participants for Modbus/BACnet (maximum 32)
- Supply voltage and communication not galvanically isolated
- Voltage supply: Make sure that all devices on the bus have the same GND reference point
- Use terminal resistors on both ends of the bus. Bus terminating resistors integrated in the VRU can be activated with the service tool

**MP-Bus connection diagram**



**Nomenclature**

1: $\perp$, – = Ground, neutral

2: ~, + = Supply voltage 24 V AC/DC

5: U/MP = MP-Bus connection

Note

- ① Number of MP-Bus participants depends on the type of MP-Bus devices; maximum 16 participants
- Of which max. 8 MP participants (e.g. volume flow controller)
- Plus a maximum of 8 MPL participants (e.g. valve drives)
- Supply voltage and communication not galvanically isolated
- Voltage supply: Make sure that all devices on the bus have the same GND reference point.

**Wiring diagram hybrid operation**
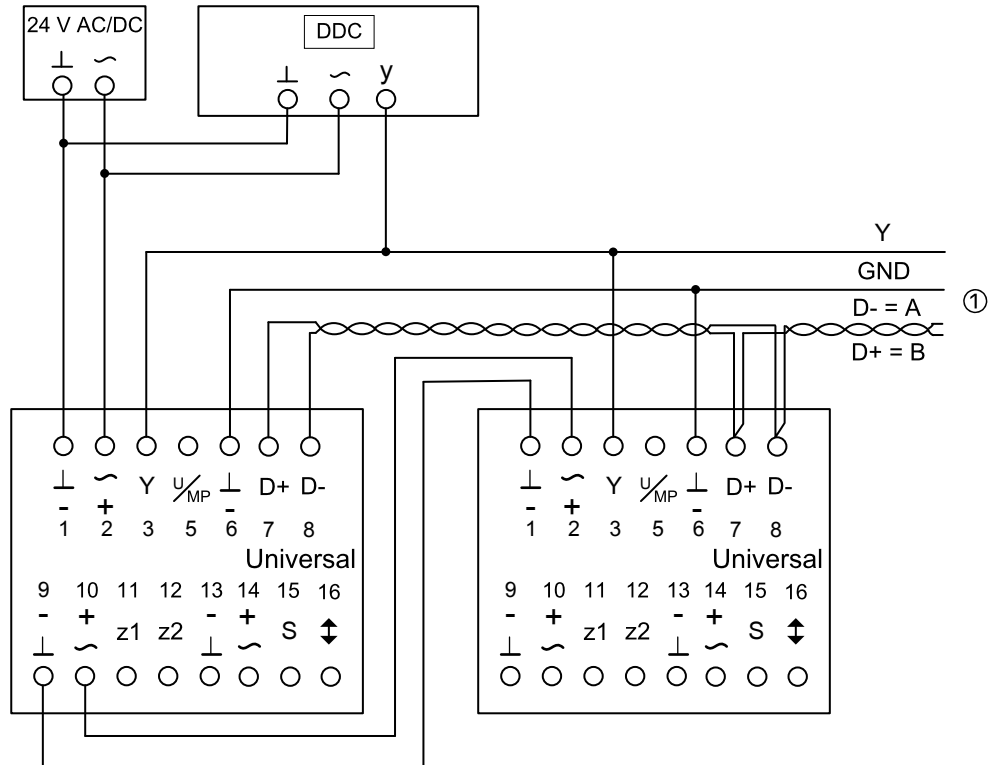


**Nomenclature**

1: ⊥, – = Ground, neutral
2: ~, + = Supply voltage 24 V AC/DC
6: GND = Common ground potential
7: D+ = Modbus/BACnet B, C2
8: D- = Modbus/BACnet A, C1

Notes

· DDC = setpoint setting Δp
· ① Additional network participants for Modbus/BACnet (maximum 32)
· Supply voltage and communication not galvanically isolated
· Voltage supply: Make sure that all devices on the bus have the same GND reference point
· Use bus terminating resistors at the ends of the bus line
· Bus terminating resistors integrated in the VRU can be activated with the service tool

**Connection diagram for override controls,**
**Alternative 1: Y-input**
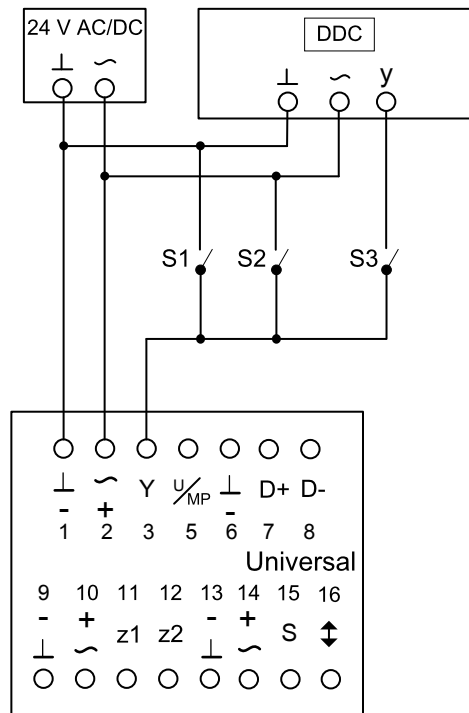


### Nomenclature

1: $\perp$, – = Ground, neutral

2: ~, + = Supply voltage 24 V AC/DC

3: Y = Setpoint signal and override controls

5: U/MP = Actual value signal or MP-Bus or service tool connection

### Notes

- DDC = Setpoint for $\Delta p$
- When combining several override controls, the switches must be interlocked to prevent short-circuits
- Setpoint value and actual value signals depend on the signal voltage range, either 0 – 10 V DC or 2 – 10 V DC

### Wiring variants Y-signal

### Constant mode $\Delta p_{min}$ (override control $\Delta p_{min}$)

- Only switch (connection) S1 may be closed
- Only works with signal voltage range 0 - 10 V DC

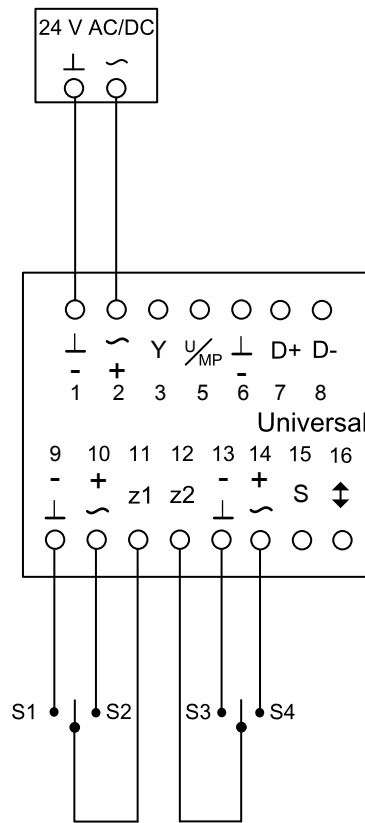### Priority $\Delta_{pmax}$

- Only S2 has to be closed

### Control operation $\Delta_{pmin} - \Delta_{pmax}$

- Analogue setpoint for $\Delta p$
- Only S3 has to be closed

### Override control, damper blade CLOSED

- Only S1 has to be closed
- Only works with signal voltage range 2 - 10 V DC

**Connection diagram for override controls,**
**Alternative 2: z1/z2 input**



**Nomenclature**

9: $\perp$, – = Ground, neutral

10: ~, + = Supply voltage 24 V AC/DC

11: Priority z1

12: Priority z2

13: $\perp$, – = Ground, neutral

14: ~, + = Supply voltage 24 V AC/DC

**Notes**

▪ When combining several override controls, the switches must be interlocked to prevent short-circuits

**Wiring variants z1/z2 input**

**Control stop (e.g. door contact)**

▪ Only S1 has to be closed

**Override control, damper blade OPEN**

▪ Only S2 has to be closed

**Override control, damper blade CLOSED**

▪ Only S3 has to be closed

**Priority $\Delta_{pmax}$**

▪ Only S4 has to be closed

**Further override controls possible at the Y input.**

# Explanation

**$\Delta_{pNom}$ [Pa]**
Nominal pressure (100 %): Maximum differential pressure that can be detected by the pressure transducer and converted into an electrical signal. Please note that the adjustable differential pressure range is only a range of the nominal pressure and cannot be fully utilised (see technical data). $\Delta p_{Nominal}$ is the reference value for defining $\Delta p_{min}$ and $\Delta p_{max}$.

**$\Delta_{pmax}$ [Pa]**
Upper limit of the operating range of the duct pressure controller adjustable by the customer (note usable control range, see technical data). In case of analogue signalling to duct pressure controllers (which are typically used), the maximum value of the setpoint signal (10 V) is assigned the set maximum value ($\Delta p_{max}$ (see characteristic).

**$\Delta_{pmin}$ [Pa]**
Customer-adjustable lower limit of the operating range of the duct pressure controller: $\Delta p_{min}$ should be set to less than or equal to $\Delta p_{max}$ . $\Delta p_{min}$ should not be set lower than the lower control range, otherwise the control is unstable. With analogue control, the minimum value of the setpoint signal (0 or 2 V) is assigned the set minimum value $\Delta p_{min}$ (see characteristic).

**$\Delta_{p}$ [Pa]**
Differential pressure

**Duct pressure controller**
Consists of a basic unit and an attached control component for duct pressure control

**Basic unit** (for duct pressure controller)
Control unit without attached control component. The main components are the casing and the damper blade to control the differential pressure in the relevant section of the air duct.

Important distinguishing features:
Geometry or unit shape, material and types of connection, acoustic characteristics (e.g. acoustic cladding option or integral silencers).
For manufacturing reasons, the basic unit is based on the basic units for volume flow control and is therefore also referred to as a VAV terminal unit. Sensor elements of the VAV terminal unit are therefore usually present, but are not accessible in all construction variants, e.g. acoustic cladding.
The pressure measurement point is typically placed in the air duct downstream of the terminal unit.

**Control component** (for duct pressure controller)
Electronic unit(s) mounted on the basic unit to control the pressure in an air duct section (e.g. branch) by adjusting the control damper position.
The electronic unit essentially consists of a controller with differential pressure transducer (integral or external) and an actuator, which is an integral part of compact controllers and separately supplied for universal controllers, e.g. to define additional functions such as a safe position.
Important distinguishing features:
- Transducers: Measuring and control range
- Actuator variants VARYCONTROL universal controller:
  - Standard actuator, slow-running
  - Spring return actuator for damper blade safety function
- Actuator variants TROX UNIVERSAL:
  - Standard actuator, slow-running
  - Spring return actuator for damper blade safety function
  - Fast-running actuator
- Interface technology:
  Analogue interface or digital bus interface for the capturing and transmission of signals and information only with TROX UNIVERSAL: various expansion modules can be used, e.g. for simultaneous volume flow rate measurement.