

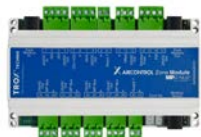
# Control component BUSN



## Control component with static transducer and separate actuator for VAV terminal units

Universal device for use with VAV terminal units

- Controller and static differential pressure transducer in one casing
- Separate actuator with simple plug connection
- Use in ventilation and air conditioning systems, with clean and contaminated air
- Suitable for constant and variable volume flow rates
- Activation of override controls via external wiring
- Volume flow rates  $q_{vmin}$  and  $q_{vmax}$  are set in the factory and saved in the controller
- Modification of operating parameters by PC software as well as smartphone and tablet app (TROX FlowCheck app)
- Service access for PC configuration software
- Smartphone access via 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 MP-Bus, Modbus RTU or BACnet MS/TP



X-AIRCONTROL zone  
module MP-bus

General information	2	Variants	7
Function	4	Technical data	9
Specification text	5	Product details	28
Order code	6	Explanation	39

## General information

### Application

- All-in-one control engineering device for VAV terminal units
- Static differential pressure transducer and control electronics in one casing
- Separate actuator with prefabricated connection plug
- For use with clean and contaminated air
- Suitable for different control tasks depending on the specification of the setpoint value
- The room temperature controller, central BMS, air quality controller or similar units control the variable volume flow control by specifying the setpoint values via a communication interface or analogue signal
- Override controls for activating  $q_{vmin}$ ,  $q_{vmax}$ , shut-off, OPEN position via MP-Bus data points or Modbus/BACnet register or switch/relay possible
- Volume flow rate actual value is available as a network data point or linear voltage signal
- Damper blade position is available as a network data point
- Use TROX FlowCheck app and PC tool to configure the controller and the communication parameters

### Control concept

- The volume flow controller works independent of the duct pressure
- Differential pressure fluctuations do not result in permanent volume flow rate changes
- To prevent the control from becoming unstable, a dead band is allowed within which the damper blade does not move.
- Volume flow rate range in the controller set in the factory
- $q_{vmin}$ : minimum volume flow rate
- $q_{vmax}$ : maximum volume flow rate
- Operating parameters are specified via the order code and set in the factory

### Interface

#### Analogue interface

- Analogue interface with adjustable signal voltage range
- Analogue signal for volume flow rate setpoint
- Analogue signal for actual volume flow rate

#### Digital communication interface (Bus)

- MP bus
- Modbus RTU, RS485
- BACnet MS/TP, RS485
- Data points, see bus lists

#### Hybrid mode

- Mixed mode of analogue and digital interface

#### Factory setting

- Setpoint value 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  
Work area corresponds to  $q_{vmin} - q_{vmax}$

#### Constant value mode (F)

- A setpoint signal is not required, setpoint value corresponds to  $q_{vmin}$

### Operating parameters

- Volume flow rate range in the controller set in the factory
- $q_{vmin}$ : minimum volume flow rate
- $q_{vmax}$ : maximum volume flow rate
- $q_{vmin} = 0 - 100\%$  of the nominal volume flow rate  $q_{vnom}$  adjustable
- $q_{vmax} = 20 - 100\%$  of the nominal volume flow rate  $q_{vnom}$  adjustable

### Signal voltage ranges

- 0 – 10 V DC
- 2 – 10 V DC

### Parts and characteristics

- Transducer for static measurement principle
- Separate overload protection
- Plug-in terminal for supply line and controls including cover
- Socket for the actuator
- NFC and service interface
- Release button to allow for manual operation
- Indicator lights for displaying the operating mode
- Addressing key for setting user addresses in bus mode
- Controller casing prepared with 4 openings for threaded connections, 2 cable glands M16x1.5 for connecting cable in the supply package
- Duct pressure tapping set with duct pressure tapping nipple and measuring hose included in supply package

### Construction

BUSN with actuator LM24A-VST for:

- TVR, TZ-Silenzio, TA-Silenzio, TVZ, TVA
- TVRK nominal size 125 - 250

BUSN with actuator NM24A-VST for:

- TVJ
- TVT up to dimensions 1000 × 300 or 800 × 400
- TVRK nominal size 315 - 400

BUSN with actuator SM24A-VST for:

- TVT from dimensions from 800 × 500 to 1000 × 600

### Commissioning

- Due to the volume flow rates set in the factory, always ensure that the control units are only installed in the specified 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
- Adjustment device type ZTH-EU (order code AT-VAV-B)
- Belimo PC-Tool
- NFC Bluetooth converter ZIP-BT-NF
- X-AIRCONTROL zone modules for room control

## Function

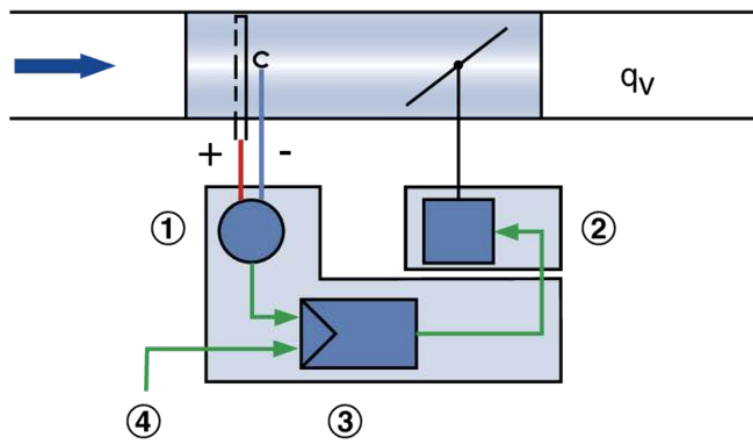
A closed control circuit for regulation of the volume flow rate, i.e. measuring - comparing - adjusting, is characteristic of air terminal units.

The volume flow rate is recorded by measuring a differential pressure (effective pressure). This is done via a differential pressure sensor. An integrated differential pressure transducer converts the effective pressure into a voltage signal. The volume flow rate actual value is available as a voltage signal. The factory setting is such that an actual output signal of 10 V DC always corresponds to the nominal volume flow rate ( $q_{vnom}$ ).

The volume flow rate setpoint value is specified by a higher-level controller (e.g. room temperature controller, air quality controller, central BMS). Variable volume flow control results in a value between  $q_{vmin}$  and  $q_{vmax}$ . It is possible to override the room temperature control by override control, e.g. by a complete shut-off of the duct.

The controller compares the volume flow rate setpoint value to the actual value and controls the external actuator accordingly to the system deviation.

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



① Differential pressure transducer  
② Actuator

③ Volume flow controller  
④ Setpoint value signal

## Specification text

This specification text describes the general properties of the product.

### Category

- Universal controller for volume flow rate

### Application

- Regulation of a constant or variable volume flow rate setpoint.
- Electronic controller for connecting a controlled variable and tapping an actual value signal
- The actual value signal relates to the nominal volume flow rate such that commissioning and subsequent adjustment are simplified
- Stand-alone operation or integration in central building management system

### Area of application

- Static transmitter for polluted air in ventilation and air conditioning systems

### Actuator

- Actuator slow-running; Running time 120 s for 90°

### Installation orientation

- Either direction

### Connection

- Pluggable connection terminals; no additional terminal box required

### Supply voltage

- 24 V AC/DC

### Interface/Control

Analogue signal:

- 0 – 10 V DC or 2 – 10 V DC

Bus interface:

- MP bus
- Modbus RTU
- BACnet MS/TP

### Interface information

Analogue signal:

- Volume flow rate setpoint and actual values

Bus interface:

- Volume flow rate setpoint and actual values
- Damper blade position
- Fault status

### System connections

MP-Bus for optional extensions

- Suitable for TROX X-AIRCONTROL zone module X-AIR-ZMO-MP
- Gateways for LonWorks, Modbus, BACnet, KNX, e.g. Belimo UK24EIB
- Fan optimiser, e.g. Belimo COU24-A-MP

Modbus RTU for optional extensions

- Suitable for TROX X-AIRCONTROL zone module X-AIR-ZMO-MOD, e.g. in conjunction with X-SENS-SPLITTER

### Special functions

- Activation  $q_{vmin}$ ,  $q_{vmax}$ , Closed, Open, Control Stop by means of external switching contacts/wiring or bus communication

### Parameter settings

Parameters specific to VAV terminal unit set at the factory

- Operating values  $q_{vmin}$ ,  $q_{vmax}$  factory set
- Signal characteristic factory set

Subsequent adjustment

- Via TROX FlowCheck app (NFC or Bluetooth with optional adapter)
- Via PC software

### Factory settings

- Electronic controller factory-mounted on the terminal unit
- Factory parameter settings
- Functional test under air; certified with sticker
- Controller in OPEN position

## Order code

**TVR – D / 200 / D2 / BUSN / V 0 / qvmin – qvmax m³/h**  
 |     |     |     |     |     |     |     |     |     |  
 1    2    5    6    7    8 9    10    11

**1 Type**
**TVR** VAV terminal unit

**2 Acoustic cladding**

No entry: none

**D** with acoustic cladding

**3 Material**

Galvanised sheet steel (Standard construction)

**P1** Powder-coated RAL 7001, silver grey

**A2** Stainless steel construction

**4 Duct connection**
**5 Nominal size [mm]**
**100, 125, 160, 200, 250, 315, 400**
**6 Accessories**

No entry: none

**D2** Double lip seal both sides

**G2** Matching flanges for both ends

**Order example: TVR/100/D2/BUSN/V0/50-354 m³/h**
**Acoustic cladding**
**Material**
**Nominal size**
**Accessories**
**Attachment**
**Signal voltage range**
**Operating values**
**7 Attachments (control component)**
**BUSN** Universal controller with static transducer

**8 Operating mode**
**F** Constant value (a setpoint value)

**V** variable (setpoint value range)

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

**2** 2 – 10 V DC

**10 Operating values for factory setting**

Volume flow rates in m³/h or l/s

 $q_{vconst}$  (only with operating mode F)

 $q_{vmin}$  (only with operating mode V)

 $q_{vmax}$  (only with operating mode V)

**11 Volume flow unit**

m³/h

l/s

None

galvanised sheet steel

100 mm

Double lip seal both sides

VARYCONTROL Universal controller, static transducer

0 – 10 V DC

 $q_{vmin} = 50 \text{ m}^3/\text{h}$ 
 $q_{vmax} = 354 \text{ m}^3/\text{h}$

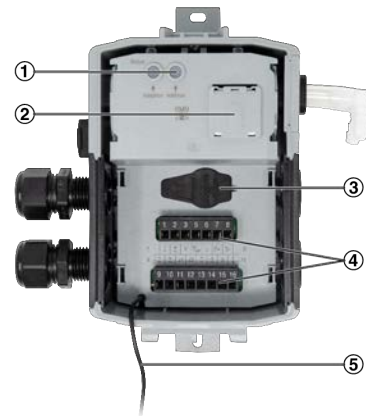
## Variants

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 Connection for effective pressure

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



- ① Addressing key including yellow status LED
- ② Magnetic holder for ZIP-BT-NFC
- ③ Service socket
- ④ Pluggable terminal strips
- ⑤ Cover fixing (safety cable)

Actuator LM24A-VST TR, 5 Nm



- ① Clamping device (spindle)
- ② Casing actuator
- ③ Gear release button
- ④ Connecting cable
- ⑤ Plug connection controller

Actuator NM24A-VST TR, 10 Nm



- ① Clamping device (spindle)
- ② Casing actuator
- ③ Gear release button
- ④ Connecting cable
- ⑤ Plug connection controller

## Actuator SM24A-VST TR, 20 Nm



- ① Clamping device (spindle)
- ② Casing actuator
- ③ Gear release button
- ④ Connecting cable
- ⑤ Plug connection controller



## Technical data

### Universal controller for VAV terminal units

–	Controllers		Actuator		–
Order code detail	Part number	Type	Part number	Type	VAV terminal units
BUSN	A00000073652	VRU-M1-M/B TR	A00000076423	LM24A-VST TR	①
BUSN	A00000073652	VRU-M1-M/B TR	A00000073640	NM24A-VST TR	②
BUSN	A00000073652	VRU-M1-M/B TR	A00000073642	SM24A-VST TR	③

①

- TVR, TZ-Silenzio, TA-Silenzio, TVZ, TVA
- TVRK nominal size 125 - 250

②

- TVJ, TVT up to dimensions of 1000 × 300 or 800 × 400
- TVRK nominal size 315 - 400

③ TVT dimensions from 800 × 500 to 1000 × 600

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

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

Measurement principle	static transducer type, independent of position
Nominal voltage	AC/DC 24 V
Nominal voltage frequency	50/60 Hz
Functional range	AC 19.2 – 28.8 V/DC 21.6 – 28.8 V
Power requirement (operation/resting state)	1.5 W
Power requirement rating	2 VA plus connected VST drive
Power consumption rating note	$I_{\max}$ 20 A @ 5 ms
Actuator connection	AC/DC supply from controller, PP link VST drive
bus connection	<b>Modbus RTU*</b> , BACnet MS/TP, MP-Bus
Adjustable communication parameters Modbus RTU	Baud rate: 9600, 19200, <b>38400*</b> , 76800, 115200; Address: <b>1*</b> , 2.3 – 247; Parity: <b>1-8-N-2*</b> , 1-8-N-1, 1-8-E-1, 1-8-O-1; Number of nodes: max. 32 (without repeater) Terminal resistor: 120 $\Omega$ ;
Adjustable communication parameters BACnet MS/TP	Baud rate: 9600, 19200, <b>38400*</b> , 76800, 115200; Address: <b>1*</b> , 2.3 – 127; Number of nodes: max. 32 (without repeater) Terminal resistor: 120 $\Omega$ ;
Addressing	Required on-site: through TROX FlowCheck app
Setpoint value signal input (analogue optional)	0 – 10 V, 2 – 10 V Input resistance 100 k $\Omega$
Actual value signal output	



	0 – 10 V, 2 – 10 V, max. 0.5 mA
IEC/EN protection class	III (protective extra-low voltage)
Protection level	IP 42
EMC	CE according to 2014/30/EU

\* Factory setting.

**Actuator LM24A-VST TR**

**Actuator LM24A-VST TR**

Supply voltage	from the controller
Power requirement (operation)	1 W
Power requirement rating	2 VA
Self-consumption (idle state)	0.4 W
Torque	5 Nm
Running time for 90°	120 s/90°
Setpoint value signal input	from the controller
IEC protection class	III (protective extra-low voltage)
Protection level	IP54
EMC	EMC to 2014/30/EU
Weight	0.56 kg

**Actuator NM24A-VST TR**

**Actuator NM24A-VST TR**

Supply voltage	from the controller
Power requirement (operation)	2 W
Power requirement rating	4 VA
Self-consumption (idle state)	0.4 W
Torque	10 Nm
Running time for 90°	120 s/90°
Setpoint value signal input	from the controller
IEC protection class	III (protective extra-low voltage)
Protection level	IP54
EMC	EMC to 2014/30/EU
Weight	0.78 kg

**Actuator SM24A-VST TR**

**Actuator SM24A-VST TR**

Supply voltage	from the controller
Power requirement (operation)	2 W
Power requirement rating	4 VA
Self-consumption (idle state)	0.4 W
Torque	20 Nm
Running time for 90°	120 s/90°
Setpoint value signal input	from the controller
IEC protection class	III (protective extra-low voltage)
Protection level	IP54
EMC	EMC to 2014/30/EU
Weight	0.98 kg

**Commissioning**

- On-site adjustment is not required
- Due to the volume flow rates set in the factory, always ensure that the control units are only installed in the specified locations
- After successful installation and wiring the controller is ready for use
- Comply with the volume flow rate control ranges of the VAV terminal units, do not set a volume flow rate which is below the minimum flow rate
- Only briefly remove the protective cap of the control component during wiring
- For operation with the Modbus/BACnet/MP-Bus interface: additional commissioning steps such as user addressing and setting of the communication parameters are required
- For operation with the MP-Bus interface in existing systems as a replacement for the VRP-M controller: activation of the VRP-M compatibility mode is required

**Functional scope of service tools**

Function/parameterisation	TROX FlowCheck app	PC-Tool	ZTH-EU
Setting qvmin, qvmax	R, W	R, W	R, W
Mode, control signals 0 – 10 V, 2 – 10 V DC	R, W	R, W	-
Setpoint value setting analogue, Bus	R, W	-	-
Modbus, BACnet	R, W	-	-
MP bus	R, W	R, W	-
Setting bus parameters	R, W	-	-
carry out override controls	No	No	No
Trend display	Yes	Yes	-

R,W = Function can be read and written.

- = Function is not available for the service tool.

## Communication interface Modbus RTU

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



Number	Register Address	Description	Range Enumeration	Unit	Scaling	Access
		(High word) > 16 of 32 bit. (*6)				
13	12	Analogue setpoint value  Shows the setpoint value in % with analogue control input signal. Active if reg. address 118 = 0 (analogue)	0 – 10,000	%	0.01	RD
51	50	Relative differential pressure  According to application case as per (reg. address 128).	0 – 20,000	%	0.01	RD
52	51	Absolute differential pressure	-1,000 – 15,000	[Pa]	0.1	RD
53	52	–	–	–	–	[-]
54	53	Absolute differential pressure in selected unit (reg. address 145) (Low word) < 16 of 32 bit.	-10,000,000 – 100,000,000	UnitSel	0.001	RD
55	54	Absolute differential pressure in selected unit as per (reg. address 145)  (High word) > 16 of 32 bit.	-10,000,000 – 100,000,000	UnitSel	0.001	RD
100	99	Bus terminal resistor  Indicates whether the terminal resistor (120 Ω) is active or deactivated.  Can only be set using service tools.	0: Not active 1: active Factory setting: Not active	–	–	RD
101	100	Serial number, part 1 Example: 00839-31324-064-008. 1 <sup>st</sup> part: 00839 2 <sup>st</sup> part: 31324 3 <sup>st</sup> part: 008	–	–	–	RD
102	101	Serial number, part 2	–	–	–	RD
103	102	Serial number, part 3	–	–	–	RD
104	103	Firmware version Example: 101, version 01.01.	–	–	–	RD
105	104	Malfunctions and service information – automatic reset if status has ceased.	Bit 0: – Bit 1: Mechanical travel too high Bit2: Actuator cannot be moved (e.g. mechanical overload) Bit 3: – Bit 4: Error of dP sensor Bit 5: Return air flow detected Bit 6: Volume flow rate too low Bit 7: Flow rate in closed position Bit 8: Internal activity (e.g. test run, adaptation) Bit9: Gear release active Bit10: Bus monitoring triggered Bit 11: Actuator not suitable for application Bit 12: Pressure sensor incorrectly connected Bit 13: Pressure sensor not reached	–	–	RD

Number	Register Address	Description	Range Enumeration	Unit	Scaling	Access
			Bit 14: Error in dP sensor outside of measuring range			
106	105	Setting work areas $q_{vmin}/\Delta p_{min}$ 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	WR
107	106	Setting work areas $q_{vmax}/\Delta p_{max}$ Requirements: $q_{vmax}/\Delta p_{max} < q_{vmin}/\Delta p_{min}$ Vmax in the area 20 – 100 % of $q_{vnom}/\Delta p_{nominal}$	2,000–10,000	%	0.01	WR
108	107	Type of sensor If reg. address 118 = 0 (analogue), then reg. address 107 = 1 (active) for mV.	0: None 1: active 2: Passive 3: – 4: Switch  Factory setting: None	–	–	WR
109	108	Bus timeout monitoring 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. Display of release in reg. address 104. In hybrid mode, bus timeout activation is deactivated.  Bus timeout time: acc. to reg. address 109	0 – 10,000 Factory setting: 0	%	0.01	WR
110	109	Time until release bus timeout monitoring If reg. 108 $\neq$ 0, then the initial automatic status is reg. 108 = 120 s.	0 – 3,600 0: inactive Factory setting: deactivated	s	1	WR
113	112	Nominal volume flow rate in selected volume flow unit acc. (reg. address 117)  (Low word) < 16 of 32 bit.	0 – 60,000,000	UnitSel	0.001	RD
114	113	Nominal volume flow rate in selected volume flow unit acc. (reg. address 117)  (High word) > 16 of 32 bit.	0 – 60,000,000	UnitSel	0.001	RD
115	114	–	–	–	–	[–]

Number	Register Address	Description	Range Enumeration	Unit	Scaling	Access
116	115	–	–	–	–	[–]
117	116	Control mode	0: Position control (open loop) 1: Volume flow control Factory setting: Volume flow control	–	–	[R]
118	117	Unit selection –  Unit selection for reg. address 11 and 12.	0: – 1: m³/h 2: l/s 3: – 4: – 5: – 6: cfm	–	–	WR
119	118	Setpoint value setting  If reg. address 118 = 0 (analogue), then reg. address 12 = active. If reg. address 118 = 1 (Bus), then reg. address 1 = active.	0: Analogue (0 – 10 V, 2 – 10 V) 1: Bus (Modbus, BACnet, MP-Bus) Factory setting: Analogue	–	–	WR
120	119	Pressure operating mode  Only for VRU-M1R-M/B TR.	0: Negative pressure 1: Positive pressure	–	–	WR
121	120	–	–	–	–	[–]
122	121	–	–	–	–	[–]
123	122	–	–	–	–	[–]
124	123	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)	–	–	RD
125	124	Applications	0: Volume flow control 1: Pressure control 2: Room pressure control 3: Flow measurement	–	–	RD
126	125	Unit height	0 – 3,000 Factory setting: 0	m	1	WR
127	126	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	–	RD
128	127	–	–	–	–	[–]
129	128	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	RD

Number	Register Address	Description	Range Enumeration	Unit	Scaling	Access
146	145	Selection of the pressure unit The selected unit is displayed in (reg. address 126).	0: pascal 1: – 2: water column Factory setting: pascal	–	–	[–]
147	146	Selection of temperature unit	0: K 1: °C 2: °F Factory setting: °C (2)	–	–	WR

RD = Register can only be read

WR = Register can be read and written

(\*1) If reg. address 118 = 1 (Bus), then reg. address 0 = active.

(\*2) If reg. address 124 = 0 (volume flow control), then reg. address 0 = volume flow rate.

(\*3) If reg. address 124 = 0 (volume flow control) and reg. address 116 = 0 (position control), then reg. address = damper blade position.

(\*4) If reg. address 124 = 1 (differential pressure control) or 2 (room pressure control), then reg. address = pressure.

(\*5) If reg. address 124 = 2 (room pressure control) or 3 (volume flow rate measurement), then reg. address = deactivated 65.535.

(\*6) If reg. address 124 = 1 (differential pressure control) or 2 (room pressure control), then reg. address = deactivated 65.535.

**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
Application 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) Data Sharing – ReadPropertyMultiple-B (DS-RPM-B) Data Sharing – WriteProperty-B (DS-WP-B) Data Sharing – WritePropertyMultiple-B (DS-WPM-B) Data Sharing – COV-B (DS-COV-B) Device Management – DynamicDeviceBinding-B (DM-DDB-B) Device Management – DynamicObjectBinding-B (DM-DOB-B) 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

**Object processing**

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

**Processing of services**

- The device does not support the services "Create object" and "Delete object"
- The specified maximum length of the writable character strings is based on single-byte characters
  1. Object name 32 characters
  2. Location 64 characters
  3. Description 64 characters
- The device supports the DeviceCommunicationControl Services, no password necessary
- A maximum of 6 active COV subscriptions with a run time of 1 – 28800 s (maximum of 8 h) is supported

**Communication interface BACnet MS/TP**

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 %  <u>Status flags:</u> (*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.  <u>Status flags:</u> (*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].  <u>Status flags:</u> (*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]  <u>Status flags:</u> (*4)	0 – 150	0.01 – 150 Factory setting: 1	RD
AbsFlow_m3h	AI[12]	Absolute volume flow rate in m³/h  <u>Status flags:</u> (*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]  <u>Status flags:</u> (*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 available.  <u>Status flags:</u> (*5)	0 – 65535	0.01 – 1000 Factory setting: 1	RD

Object Name	Object Type	Description	Values	COV Increment	Access
DeltaP_Pa	AI[29]	Absolute differential pressure in Pa	0 – 600	0.01 – 600 Factory setting: 10	RD
SpRel	AO[1]	Relative setpoint value in %  The rel. setpoint value depends on the application (flow rate/pressure/damper blade position). If SpSource MV[122] = 2 (bus), then SpRel AO[1] = active. The analogue setpoint value is limited by Min AV[97] and Max AV[98].  <u>Status flags: (*1), (*2)</u>	0 – 100 Factory setting: 0	0.01 – 100 Factory setting: 1	C
Min	AV[97]	Minimum setpoint value in % ( $q_{vmin}/P_{min}$ )  Requirement: $q_{vmin}/\Delta p_{min} < q_{vmax}/\Delta p_{max}$ $q_{vmin}/\Delta p_{min}$ in the range 0 - 100 & $q_{vnom}/\Delta p_{nom}$	$0 - q_{vmax}/\Delta p_{max}$	0.01 – 100 Factory setting: 1	WR
Max	AV[98]	Maximum setpoint value in % ( $q_{vmax}/P_{max}$ )  Requirement: $q_{vmax}/\Delta p_{max} > q_{vmin}/\Delta p_{min}$ $q_{vmax}/P_{max}$ in the range 20 - 100 % of $q_{vnom}/P_{nom}$	$q_{vmin}/\Delta p - 100$	0.01 – 100 Factory setting: 1	WR
Vnom_m3h	AV[112]	Nominal volume flow rate in m <sup>3</sup> /h	0 – 50,000	0.01 – 50,000 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: Factory setting: 1	RD
SystemAltitude	AV[120]	System altitude in metres above sea level	0 – 3,000	1 – 3,000 Factory setting: 10	WR
DeltaPnom_Pa	AV[122]	Nominal differential pressure in Pa  The nominal differential pressure depends on the selected pressure sensor (D3, M1, M1R). Depending on the selected application, the nominal differential pressure serves as dp@Vnom or as the maximum pressure limitation If ApplicationSel MV[2] = 1 (flow control), then display = nominal differential pressure If ApplicationSel MV[2] = 2 (pressure control) or 3 (room pressure control), then display = max. pressure limitation	D3: 0 – 500 M1: 0 – 600 M1R: 0 – 75	1 – 600 Factory setting: 1	RD
DeltaPnom_UnitSel	AV[129]	Nominal differential pressure in selected unit as per UnitSelPressure MV[127]  More infos: see AV[122].		0.01 – 1000 Factory setting: 1	RD



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

Object Name	Object Type	Description	Values	COV Increment	Access
		If there is no volume flow rate within 600 s, then StatusFlow MI[104] = 3.	2: – 3: No airflow detected		
StatusActuator	MI[106]	Status of the actuator  <u>Status flags:</u> (*2)	1: OK 2: Actuator cannot be moved 3: Gear release active 4: Mechanical travel exceeded 5: Actuator not suitable for application	–	RD
StatusPressure	MI[109]	Differential pressure status  If the differential pressure is not reached within 180 s, then StatusPressure MI[109] = 3.	1: OK 2: – 3: Pressure not reached	–	RD
StatusDevice	MI[110]	Status of the device during bus monitoring  According to BusWatchdog AV[130].	1: OK 2: Bus timeout monitoring activated	–	RD
Override	MO[1]	Override control  Overwrites the setpoint value with a forced command.  <u>Status flags:</u> (*8)	1: None 2: OPEN 3: CLOSED 4: $q_{vmin}/\Delta p_{min}$ 5: – 6: $q_{vmax}/\Delta p_{max}$ Factory setting: None (1)	–	C
ApplicationSel	MV[2]	Display of application  VRU-D3-M/B TR, VRU-M1-M/B TR - Flow control - Pressure control - Flow measurement  VRU-M1R-M/B TR - Room pressure control	1: Flow control 2: Pressure control 3: Room pressure control 4: Flow measurement	–	RD
ControlMode	MV[100]	Control mode  <u>Status flags:</u> (*9)	1: PosCtrl 2: FlowCtrl Factory setting: FlowCtrl	–	RD
OperationMode	MV[102]	Operating mode  Only relevant for VRU-M1R-BAC.  <u>Status flags:</u> (*10)	1: Negative pressure 2: Positive pressure	–	WR
Command	MV[120]	Release test functions  <u>Status flags:</u> (*2)	1: None 2: Adaption 3: – 4: Reset Factory setting: None	–	WR
UnitSelAirFlow	MV[121]	Selection of the volume flow unit  The selected unit is indicated in AI[19] and AV[104]	1: – 2: m <sup>3</sup> /h 3: l/s 4: – 5: – 6: – 7: cfm	–	WR

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

RD = Register can only be read

WR = Register can be read and written

C = Commendable with priority array.

Status flags:

(\*1) If the gear latch is 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 (volume flow 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 delivered state, the setpoint value must be set via the analogue interface. If the setpoint value is to be set via a digital communication interface, this can be changed at any time to Modbus, BACnet or MP Bus using the TROX FlowCheck app. The analogue interface can be set for the signal voltage range of 0 – 10 V DC or 2 – 10 V DC by means of the TROX FlowCheck app. The assignment of the setpoint value or actual value of the volume flow rate to the voltage signal is shown in the characteristic line displays.

### Setpoint value setting

#### Variable operation

- In the variable operating mode, setpoint values are set using an analogue signal at terminal 3. Setpoint value settings via the respective bus system are rejected.
- The selected signal voltage range 0 – 10 V or 2 – 10 V DC is assigned to the set volume flow rate range  $q_{vmin} - q_{vmax}$  a change packet.
- Volume flow rate range  $q_{vmin} - q_{vmax}$  preset at the factory as per the order key data
- Subsequent adjustment of  $q_{vmin}$  or  $q_{vmax}$  is possible using an adjustment device, the TROX FlowCheck app or PC-Tool

#### Constant value mode

- In the constant value operating mode, no analogue signal is required at terminal 3
- The volume flow rate constant value set by  $q_{vmin}$  is controlled
- Volume flow rate  $q_{vmin}$  preset at the factory as per the order key data
- Subsequent adjustment of  $q_{vmin}$  is possible using an adjustment device, the TROX FlowCheck app or PC tool

### Actual value as feedback for monitoring or tracking control

- The actual volume flow rate measured by the controller can be picked up as a voltage signal at terminal 5.
- The selected signal voltage range 0 – 10 V DC or 2 – 10 V DC is mapped on the volume flow rate range 0 –  $q_{vnom}$  shown.
- In analogue mode, the operating data can be picked up from the Modbus interface (hybrid mode) in parallel.

### Override control

For special operating situations, the volume flow controller can be put in a special operating mode (override control). The following are possible: control  $q_{vmin}$ , control  $q_{vmax}$ , control valve open (OPEN), control valve closed (CLOSED) or control stop.

### Override controls via signal input Y or override control inputs Z1, Z2

By means of a suitable connection of the inputs Y, Z1, Z2, the override controls can be activated as per the connection diagrams through connection with external switching contacts/relays (see wiring examples).

### Override control CLOSED via control signal on control signal Y

With signal voltage range 0 - 10 V DC and setting value  $q_{vmin} = 0$

- Damper CLOSED =  $Y < 0.45$  V DC
- Damper OPEN =  $Y > 0.55$  V DC

For signal voltage range 0 - 10 V DC and  $q_{vmin} > 0$

- If no override control CLOSED is possible via the control signal. The control process takes place over the entire signal voltage range

With signal voltage range 2 - 10 V DC and setting value  $q_{vmin} = 0$

- Damper CLOSED =  $Y < 2.36$  V DC
- Damper OPEN =  $Y > 2.44$  V DC

With signal voltage range 2 - 10 V DC and setting value  $q_{vmin} > 0$

- Damper CLOSED =  $Y < 0.3$  V DC
- Damper OPEN =  $Y > 0.3$  V DC

### Override controls in analogue mode via the Modbus or BACnet interface

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

### Override control for diagnostic purposes

Activation via the TROX FlowCheck app

### Prioritisation of various setting options

- Settings for override controls via analogue have priority over Modbus/BACnet settings
- Highest priority: setting via an analogue override control
- Medium priority: settings via the service connector (adjustment device, PC software) for test purposes
- Lowest priority: setting via Modbus/BACnet/MP-Bus

### Analogue hybrid mode

- Even if the analogue setpoint value is set via terminal 3 and the analogue feedback is available on terminal 5, a feedback via BACnet MS/TP or Modbus RTU is still possible
- The bus interface Modbus RTU is preset at the factory; this setting can be changed via the TROX FlowCheck app or PC-Tool
- Various operating parameters as per the bus interface list can be called up via Modbus RTU or BACnet MS/TP
- Override controls  $q_{vmin}$ ,  $q_{vmax}$ , control valve open (OPEN) or control valve closed (CLOSED) via bus interface are possible

### Digital communication interface

To output a setpoint value setting via the bus interface, an on-site change using the TROX FlowCheck app is necessary. The bus interface can be set to Modbus, BACnet or MP-Bus. For a smooth exchange of data in the on-site bus network, the communication parameters and the user address for the bus interface are required. The communication parameters of the bus systems (address, baud rate, etc.) can be set using the TROX FlowCheck app. The interface offers standardised bus register/object accesses to the available data points.

### Setpoint value setting

- In the operating mode Modbus RTU (factory setting), the setpoint value setting is made by setting the volume flow setpoint value [%] in the Modbus register 0
- In the operating mode BACnet MS/TP, the setpoint value setting is made by setting the volume flow setpoint [%] in BACnet object AI[1]
- The transferred percentage value refers to the volume flow rate range specified by  $q_{vmin} - q_{vmax}$
- Volume flow rate range  $q_{vmin} - q_{vmax}$  preset at the factory as per the order key data
- Subsequent adjustment of  $q_{vmin}$  or  $q_{vmax}$  is possible using an adjustment device, the TROX FlowCheck app, PC-Tool or via the Modbus/BACnet interface

### Actual value as feedback for monitoring or tracking control

- The actual values can be read out in  $m^3/h$  in both the Modbus and BACnet (factory setting). Other units such as l/s and cfm are possible
- In addition to the actual value of the volume flow rate, further information on the other Modbus registers/BACnet objects can be read out as well.
- Overview of the registers/objects in the communication tables
- For diagnostic purposes, the actual value of the volume flow rate can be picked up at terminal 5 in bus mode.
- The volume flow rate range  $0 - q_{vnom}$  always corresponds to the signal voltage range of (0)2 – 10 V DC

### Override control

For special operating situations, the volume flow controller can be put in a special operating mode (override control). The following are possible: control  $q_{vmin}$ , control  $q_{vmax}$ , control valve open (OPEN), control valve closed (CLOSED) or control stop.

### Override control via the bus

Settings are made via the Modbus register 1 or via BACnet object type MO[1].

### Override control via bus timeout monitoring (Modbus)

If the Modbus communication fails for a specified time period, a predefined operating state  $q_{vmin}$ ,  $q_{vmax}$ , OPEN or CLOSED can be activated.

- The override control that is to be activated in the event of a bus timeout is defined in Modbus register 108 or 109.
- The bus timeout period after which the override control is activated is defined in Modbus register 109 and 110.
- Every Modbus communication resets the timeout of the bus timeout monitoring

### Override control via bus timeout monitoring (BACnet)

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

- The setpoint value to be activated upon bus timeout is specified via Relinquish\_Default from SpRel (object AO1)
- Bus timeout period 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 the bus timeout monitoring

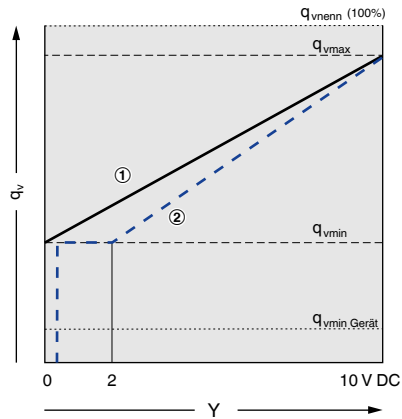
### Override controls for diagnostic purposes

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

### Prioritisation of various setting options

Settings for override controls via switching contacts have a higher priority than Modbus/BACnet settings.

- Highest priority: setting via an analogue override control
- Medium priority: settings via the service plug (TROX FlowCheck app) for test purposes
- Lowest priority: setting via Modbus/BACnet/MP-Bus

**Characteristic curve of the setpoint signal**


- ① Signal voltage range 0 - 10 V
- ② Signal voltage range 2 - 10 V

**Characteristic of the actual value signal**


- ① Signal voltage range 0 – 10 V
- ② Signal voltage range 2 – 10 V

**Calculation of nominal volume flow at 0 – 10 V**

$$q_{vsoll} = \frac{Y}{10 \text{ V}} \times (q_{vmax} - q_{vmin}) + q_{vmin}$$

**Calculation of actual volume flow at 0 – 10 V**

$$q_{vist} = \frac{U}{10 \text{ V}} \times q_{vnenn}$$

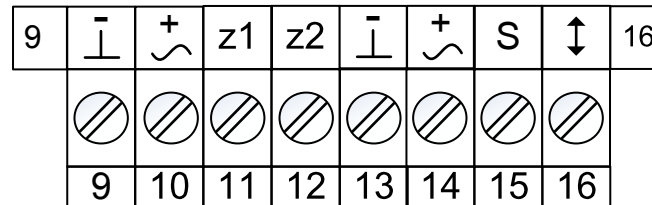
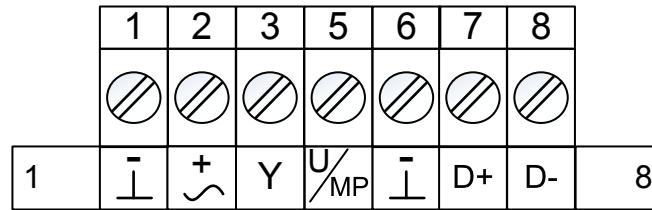
**Calculation of nominal volume flow at 2 – 10 V**

$$q_{vsoll} = \frac{Y - 2 \text{ V}}{(10 \text{ V} - 2 \text{ V})} \times (q_{vmax} - q_{vmin}) + q_{vmin}$$

**Calculation of actual volume flow at 2 – 10 V**

$$q_{vist} = \frac{U - 2}{10 \text{ V} - 2 \text{ V}} \times q_{vnenn}$$

## View of pluggable terminal strips on the VRU

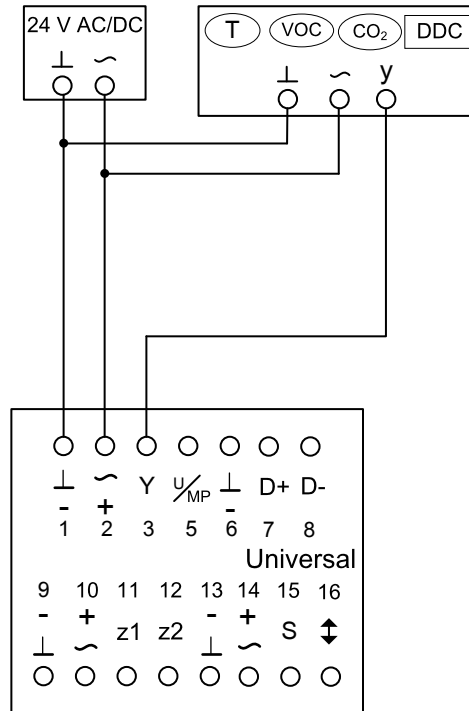


## Universal

- 1, 6, 9, 13:  $\perp$ , - = Ground, neutral
- 2, 10, 14:  $\sim$ , + = Supply voltage 24 V
- 3: Y = Setpoint value signal Y and override controls
- 5: U/MP = Actual value signal U or MP-bus
- 7: D- = Modbus/BACnet A, C1
- 8: D+ = Modbus/BACnet B, C2
- 11, 12: Override controls
- 15: Expansion for external sensor
- 16: Not used



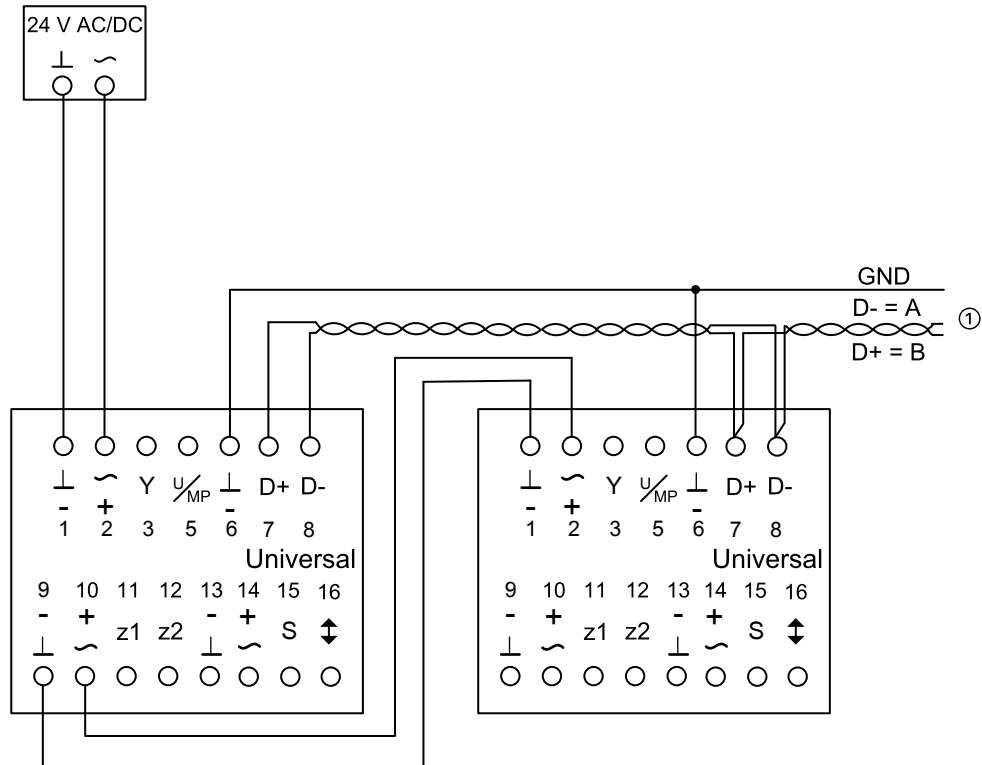
Connection diagram analogue control input signal



- 1: ⊥, - = Ground, neutral
- 2: ~, + = Supply voltage 24 V AC/DC
- 3: Y = Analogue input 0 – 10 V DC or 2 – 10 V DC
- 5: U: Actual value signal 0 – 10 V DC or 2 – 10 V DC

**Note:**  
 T, VOC, CO<sub>2</sub>, DDC = Setpoint value defaults

Connection diagram Modbus, BACnet operation

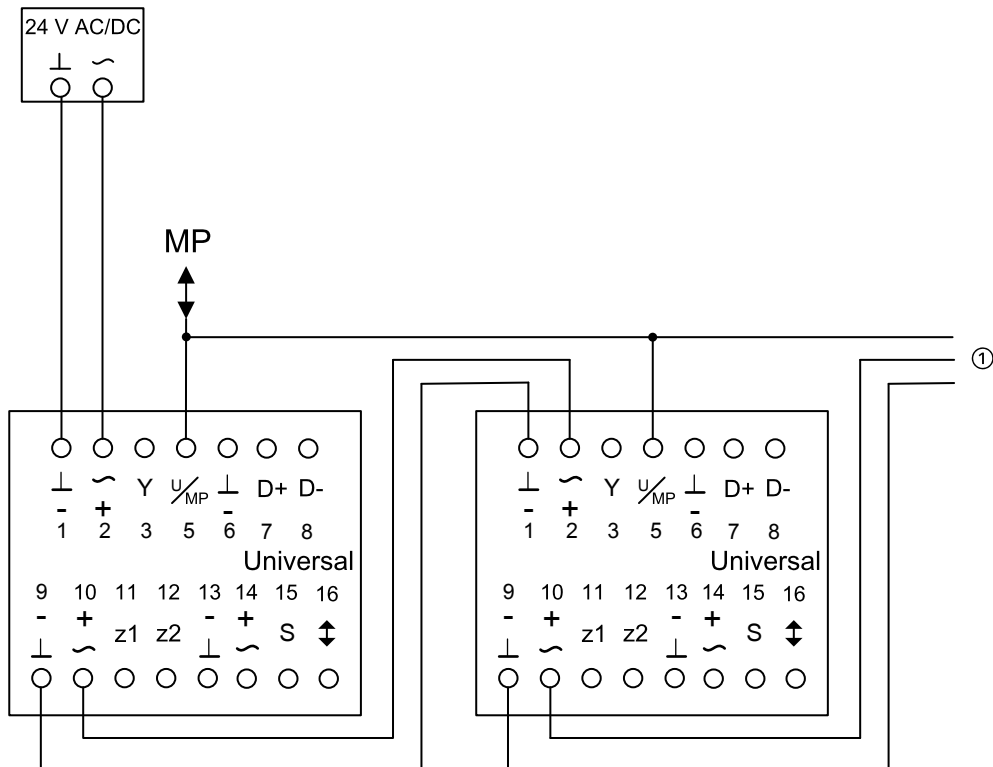


- 1: ⊥, - = Ground, neutral
- 2: ~, + = Supply voltage 24 V AC/DC
- 7: D- = Modbus/BACnet A, C1
- 8: D+ = Modbus/BACnet B, C2
- 6: GND = Common ground potential

Note:

① Other Modbus or BACnet network devices (up to 32)

MP bus wiring diagram

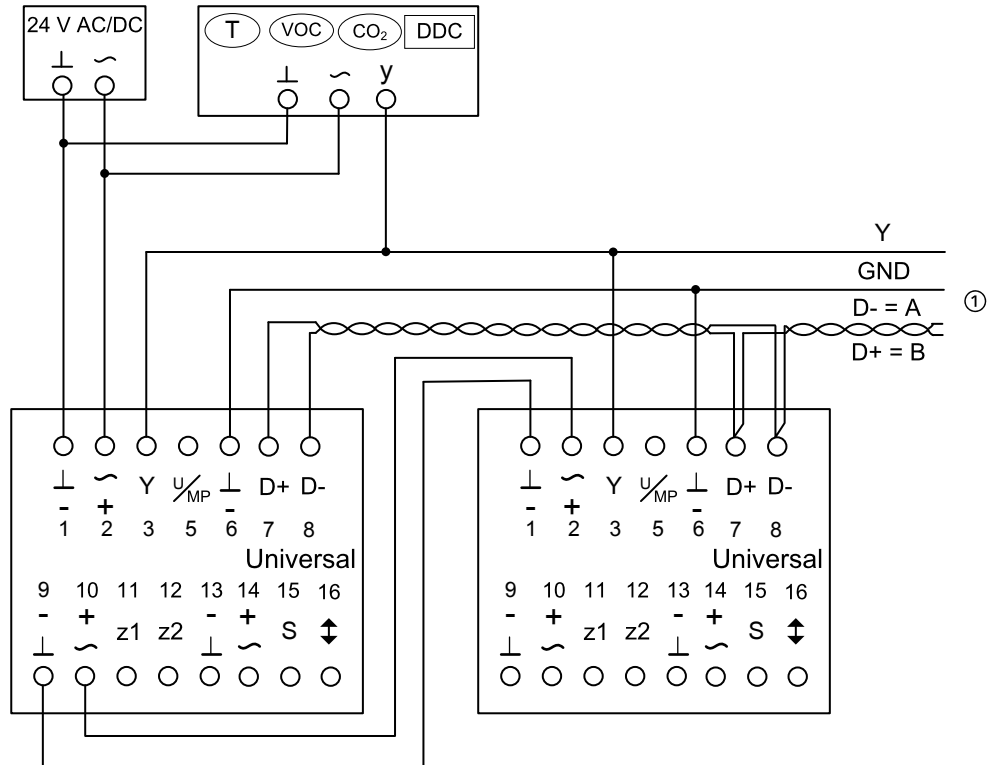


- 1: ⊥, - = Ground, neutral
- 2: ~, + = Supply voltage 24 V AC/DC
- 5: U/MP = MP-bus integration

Note:

① Other devices on an MP bus (up to 16, including up to 8 MP devices such as volume flow controllers and another 8 MPL actuators such as valve actuators)

Connection diagram hybrid mode



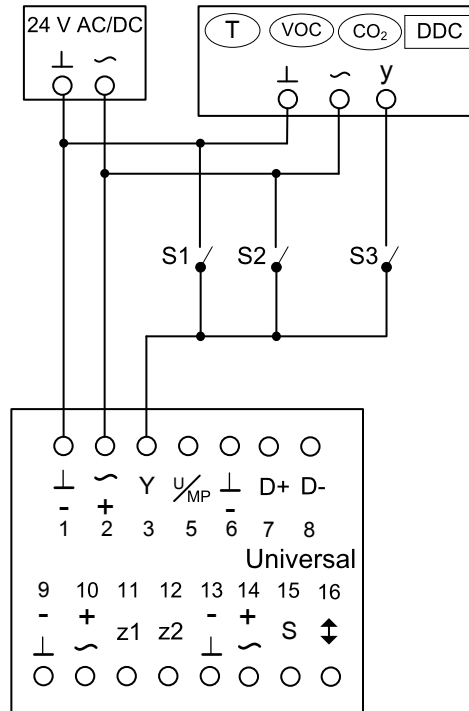
- 1: ⊥, - = Ground, neutral
- 2: ~, + = Supply voltage 24V AC/DC
- 7: D- = Modbus/BACnet A, C1
- 8: D+ = Modbus/BACnet B, C2
- 6: GND = Common ground potential

**Note:**

T, VOC, CO<sub>2</sub>, DDC = Setpoint value defaults

① Other Modbus or BACnet network devices (up to 32)

Connection diagram override controls



- 1: ⊥, - = Ground, neutral
- 2: ~, + = Supply voltage 24 V AC/DC
- 3: Y = Analogue input 0 – 10 V DC or 2 – 10 V DC and override control
- 5: U: Actual value signal 0 – 10 V DC or 2 – 10 V DC

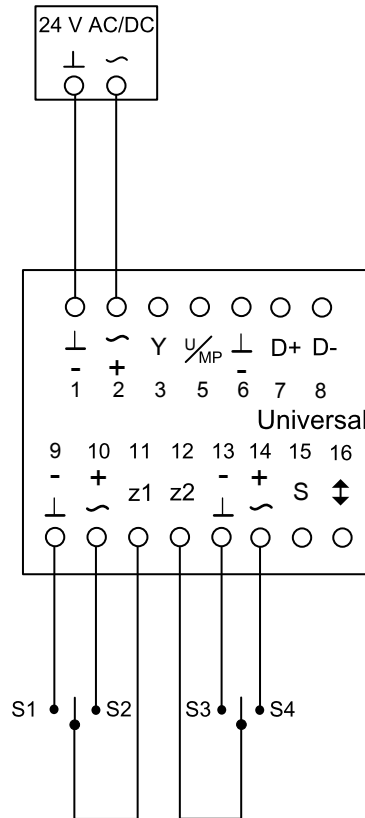
Switching functions (S1 – S3 closed)

- S1:
  - At 2 – 10 V: CLOSE damper
  - At 0 – 10 V: V min
- S2: V max
- S3: Analogue specification of the setpoint value (room temperature controller)

**Note:**  
 T, VOC, CO 2 , DDC = Setpoint value defaults

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

Connection diagram z1/z2 alternative override controls



- 9: ⊥, - = Ground, neutral
- 10: ~, + = Supply voltage 24 V AC/DC
- 11: Override control z1
- 12: Override control z2
- 13: ⊥, - = Ground, neutral
- 14: ~, + = Supply voltage 24 V AC/DC

Switching functions (with connected switch S1 – S4)

- S1: Stop control
- S2: OPEN damper
- S3: CLOSE damper
- S4: V max

Note:

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

## Explanation

$q_{vnom}$  [m<sup>3</sup>/h]; [l/s]

Nominal flow rate (100 %): The value depends on product type, nominal size and control component (attachment). Values are published on the internet and in technical leaflets and stored in the Easy Product Finder design software. Reference value for calculating percentages (e.g.  $q_{vmax}$ ). Upper limit of the setting range and maximum volume flow rate setpoint value for the VAV terminal unit.

$q_{vmin Unit}$  [m<sup>3</sup>/h]; [l/s]

Technically possible minimum volume flow rate: The value depends on product type, nominal size and control component (attachment). Values are stored in the Easy Product Finder design software. Lower limit of the setting range and minimum volume flow rate setpoint value for the VAV terminal unit. Setpoint values below  $q_{vmin unit}$  (if  $q_{vmin}$  equals zero) may result in unstable control or shut-off.

$q_{vmax}$  [m<sup>3</sup>/h]; [l/s]

Upper limit of the operating range for the VAV terminal unit that can be set by customers:  $q_{vmax}$  can be set to less than or equal to  $q_{vnom}$ . In case of analogue signalling to volume flow controllers (which are typically used), the set maximum value ( $q_{vmax}$ ) is allocated to the maximum setpoint signal (10 V) (see characteristic).

$q_{vmin}$  [m<sup>3</sup>/h]; [l/s]

Lower limit of the operating range for the VAV terminal unit that can be set by customers:  $q_{vmin}$  should be set to less than or equal to  $q_{vmax}$ . Do not set  $q_{vmin}$  to less than  $q_{vmin unit}$  as the control may become unstable or the damper blade may close.  $q_{vmin}$  may equal zero. In case of analogue signalling to volume flow controllers

(which are typically used), the set minimum value ( $q_{vmin}$ ) is allocated to the minimum setpoint signal (0 or 2 V) (see characteristic).

$q_v$  [m<sup>3</sup>/h]; [l/s]

Volume flow rate

### Volume flow controller

Consisting of a basic device and an attached control component.

#### Basic unit

Device for controlling a volume flow rate without an attached control component. The main components are the casing with sensor element(s) to measure the effective pressure and the damper blade to throttle the volume flow rate. The basic unit is also referred to as a VAV terminal unit. Important distinguishing features: Geometry or unit shape, material and types of connection, acoustic characteristics (e.g. acoustic cladding option or integrated sound attenuator), volume flow rate range

#### Control component

Electronic unit(s) mounted on the basic device to control the volume flow rate or the duct pressure or the room pressure by adjusting the control damper position. The electronic unit essentially consists of a controller with differential pressure transducer (integrated or external) and an integrated actuator (Easy and Compact controller) or separate actuator (Universal or LABCONTROL controller). Important differences: Transducer: dynamic transducer for clean air or static transducer for polluted air. Actuator: standard actuator slow-running, spring return actuator for safe position or fast-running actuator. Interface technology: analogue interface or digital bus interface for connection and tapping of signals and information.