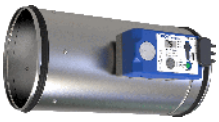
Control components

XS0

Bus interface Modbus RTU

qv / Stat.

Volume flow controller – static transducer



Control component for type TVE

Control component for type TVE-Q

Control component with static transducer and Modbus RTU interface

Compact unit for VAV control unit TVE and TVE-Q

- Regulator, static differential pressure transducer and actuator in one housing
- Use in ventilation and air-conditioning systems, for clean and polluted air
- Simple terminal connection, no connection box required
- Volume flow rates q_{vmin} and q_{vmax} factory preset and stored in the controller as changeable parameters
- High data transparency through standardised bus communication Modbus RTU, RS485
- Setpoint presets, override controls, parameter adjustment via Modbus registers
- Integrated display for volume flow rate display, operating status display and setting of operating parameters
- Service access for manual adjustment devices and PC configuration software

General information	2	Variants	6
Function	3	Technical data	7
Specification text	4	Product details	16
Order code	5	Explanation	25

General information

Application
- Complete control units for VAV control units types TVE and TVE-Q
- Static differential pressure transducer, electronic controller, and actuator are fitted together in one casing
- Static pressure transmitter for extended application range with clean and polluted air, e.g. in exhaust air areas with dust, lint, sticky, moist or slightly aggressive components
- Choice of various control options based on setpoint value default setting
- Volume flow rate control is based on setpoint values received from room temperature controller, central BMS, air quality controller or other devices as an analogue signal or via communication interface
- Override controls for activating q_{vmin}, q_{vmax}, shut-off, open position via Modbus register or switch or relay possible (depending on interface configuration)
- The actual volume flow rate is available as a network data point or as a linear voltage signal
- Damper blade position is available as a network data point

Control strategy
- The volume flow controller works independently 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.
- Flow rate range is set in the controller at 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

Operating modes
- Modbus (M): Setpoint specification via Modbus registers
- Analogue - variable operation (V): Setpoint input via analogue interface, signal voltage range corresponds to q_{vmin} – q_{vmax}
- Analogue - fixed value operation (F): no setpoint signal required, setpoint corresponds to q_{vmin}

Interface
Communication interface
- Modbus RTU, RS485
- Data points see Modbus register list

Analogue interface with adjustable signal voltage range
- Analogue signal for volume flow rate setpoint value
- Analogue signal for actual volume flow rate (factory setting)
- Alternatively: analogue signal for damper position (on-site conversion required)

Note
- Interface type preset at the factory according to operating mode
- Can be adapted on site via communication interface (Modbus register) or display operation

Signal voltage ranges
When using the analogue interface
- 0 – 10 V DC
- 2 – 10 V DC

Parts and characteristics
- Transducer for static pressure measurements
- Overload protection
- Terminals with cover
- Display and operating elements for simple menu guidance
- Menu guidance for adjusting operating parameters and communication interface
- Service interface

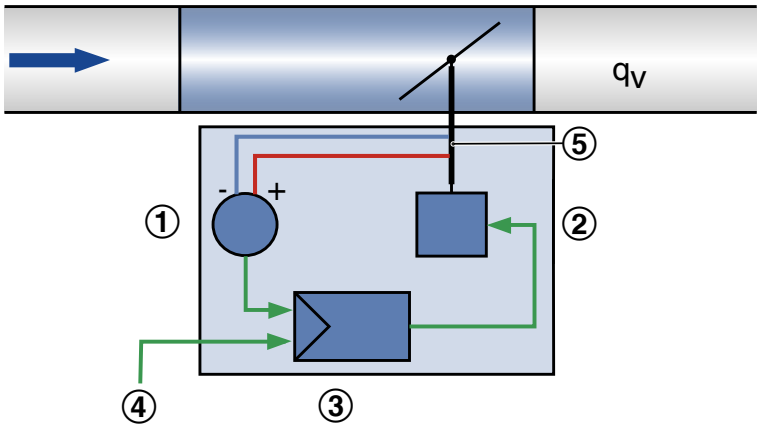
Construction
- TR0VM-024T-05I-DS10-MB
- Can only be used for TVE and TVE-Q

Commissioning
- Due to the volume flow rates set in the factory, always ensure that the control units are only installed in the specified locations
- Analogue interface: ready for use after installation and wiring
- Modbus interface: additional commissioning steps required
- Operating parameters can be adjusted by the customer (using the display, adjustment device or Modbus register)
- Zero point correction not required

Useful additions
Adjustment device type GUIV3-M (order code AT-VAV-G3)

Function

VAV terminal units control the volume flow in a closed loop, i.e. measurement - comparison - correction. This is done via a differential pressure sensor. An integral differential pressure transducer converts the effective pressure into a voltage signal. The factory setting is such that 10 V DC correspond to the nominal volume flow rate (q_{vnom}). The volume flow rate setpoint value defaults from 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, 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 integral actuator accordingly.



① Differential pressure transducer
② Actuator
③ Volume flow controller
④ Setpoint via Modbus or analogue signal
⑤ Shaft with effective pressure channel

Specification text

This specification text describes the general properties of the product.

Category
- Compact controller for volume flow rate
- Control according to a constant or variable volume flow rate setpoint
- Electronic controller for applying a reference value and capturing an actual value for integration in the central building management system
- The actual value is based on the nominal volume flow rate such that commissioning and subsequent adjustment are simplified
- Stand-alone operation or integration in central building management system

Application
- Static transducer for contaminated air in ventilation and air conditioning systems
- Modbus commands (Modbus operating mode)
- External switch contacts/wiring (with analogue interface)

Supply voltage
- 24 V AC / DC

Actuator
Integral; slow-running (running time 100 s for 90°)

Installation orientation
- Not critical

Interface/signalling
- Modbus RTU (RS-485) or alternatively analogue signals (0 – 10V or 2 – 10V DC) can be used
- Interface type set in the factory on the basis of the order code

Connection
- Terminals with rubber cap, therefore no additional terminal box required
- Double terminal for supply voltage for easy further wiring of up to 3 controllers

Interface information
- Modbus: including volume flow rate setpoint value and actual value signal, damper blade position, override control
- Alternatively: volume flow rate setpoint value and actual value signal as analogue signal

Special functions
- Clearly visible external indicator light for indicating the functions: Set, not set, and power failure
- Display for actual values, parameter setting and for test functions
- Activation q_{vmin}, q_{vmax}, closed, open by: Modbus (with Modbus control), external switch contacts (with analogue control)

Parameter setting
- Parameters specific to VAV terminal unit are set at the factory
- Operating values: q_{vmin}, q_{vmax} and interface type are set in the factory
- Subsequent adjustment via display and control element directly on the device or with optional tools: adjustment device, PC software (cable connection in each case), in Modbus mode also via Modbus register access

Factory condition
- Electronic controller factory-mounted on the terminal unit
- Factory set parameters
- Functional test under air; certified with sticker

Order code

TVE – D / 200 / D2 / XS0 / V 0 / qvmin – qvmax m³/h
1 2 5 6 7 8 9 10 11

1 Type
TVE VAV terminal unit

2 Acoustic cladding
No entry required: none
D with acoustic cladding

3 Material
Galvanised sheet steel (Standard construction)
P1 Powder-coated RAL 7001, silver grey
A2 Stainless steel construction

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

6 Accessories
No entry required: none
D2 Double lip seal both sides
G2 Matching flanges for both ends

7 Attachments (control component)
XS0 Compact controller with static transducer, Modbus RTU, display

8 Operating mode
F Constant value (a setpoint value)
V variable (setpoint value range)
M Modbus RTU

9 Signal voltage range (only with operating mode F, V)
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, M)
q_{vmax} (only with operating mode V, M)

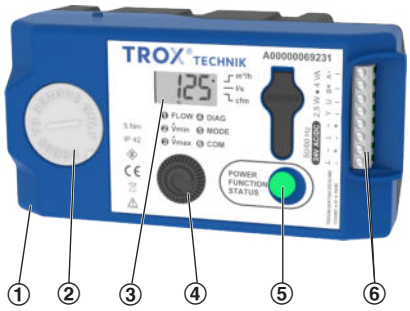
11 Volume flow unit
m³/h
l/s

Order example: TVE/100/D2/XS0/M/20-350 m³/h

Acoustic cladding	Without
Material	Galvanised sheet steel
Nominal size	100 mm
Accessories	Double lip seal both sides
Attachment	Compact controller Modbus, static transducer
Operating mode	Modbus RTU
Volume flow rate	20 – 350 m³/h

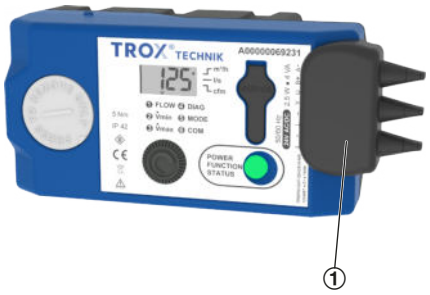
Variants

Compact controller XS0 for TVE



① Compact controller
② Damper blade position indicator and release button
③ Display
④ Rotary selector switch - Selection Options/Setting values
⑤ LED button - Selection Menu entry
⑥ Terminal

Compact controller XS0 for TVE (with attached terminal cover)



① Terminal cover (part of the supply package)

Technical data

Compact controller for VAV terminal units

Part number	Type of installation component	VAV terminal units
A00000069231	TR0VM-024T-05I-DS10-MB	TVE, TVE-Q

Compact controller XS0 for TVE and TVE-Q

Compact controller TR0VM-024T-05I-DS10-MB

Type of measurement/installation orientation	static measuring principle, position-independent
Supply voltage (AC)	24 V AC, ± 20 %, 50/60 Hz
Supply voltage (DC)	24 V DC ± 20 %
Power rating (AC)	TVE NW 100 - 160: maximum 4 VA TVE NW 200 - 400: maximum 7 VA TVE-Q up to height 200: maximum 4 VA TVE-Q from height 300: maximum 7 VA
Power rating (DC)	TVE-Q up to height 200: maximum 2.5 W TVE-Q from height 300: maximum 4 W TVE NW 100 - 160: maximum 2.5 W TVE NW 200 - 400: maximum 4 W
Power consumption (when running/when idle)	1 W
Run time for 90°	100 s
Setpoint value signal input (analogue optional)	0 - 10 V DC, input resistance > 100 kΩ or 2 - 10V DC Ra> 50 kΩ
Actual value signal output	0 - 10 V DC or 2 - 10 V DC; maximum 5 mA
IEC protection class	III (Protective extra-low voltage)
Protection level	IP 42 (with attached terminal cover)
EC conformity	EMC to 2014/30/EU
Bus connection	Modbus RTU, RS485
Number of nodes	128
Adjustable communication parameters	1200 – 115,200 Bd Start bit: 1 Data bits: 8 Stop bits: 1 or 2 Parity: None, Even, Odd
Setpoint / actual value interface (Modbus)	via Modbus register list
Cable termination	externally required

Interface configuration of the control component

Depending on the setting, the Modbus communication interface or the analogue interface for the setpoint value specification of volume flows are available here. The so-called interface mode is preset at the factory according to the order key and can be adjusted on site by setting via the menu navigation or the Modbus registers.

Typical interface configuration

XS0	Setpoint value default setting via:	Actual values via:	corresponds to order key option	Menu configuration (Mode)
Analogue operation	analogue 0 - 10 V	analogue 0 - 10 V	V or F	CA0
Analogue operation	analogue 2 - 10 V	analogue 2 - 10 V	V or F	CA2
Modbus operation	Modbus register setpoint	Modbus register actual value or analogue 2 - 10 V	M	CB

Through special configuration of the Modbus register Interface-Mode, mixed operations of Modbus and analogue operation can be configured. See the description of the interface mode in Modbus register 122.

Supplementary use of the Modbus interface in analogue mode

In analogue mode, only the setpoints at the analogue input are evaluated by the controller. A setpoint specification via the Modbus interface (register 0) is not possible. Any write attempts are acknowledged with an error response. Regardless of the selected interface configuration, however, the other Modbus registers can be used. In this way, the operating values of the actual volume flow rate and damper position can be read out from a higher-level building management system (BMS) with local control using an analogue signal via a connected Modbus, or central override controls can also be triggered.

Communication interface Modbus RTU (operating mode M)

Register	Meaning	Access right	Storage
0	Volume flow setpoint [%] Reference: Vmin – Vmax (qvmin – qvmax) Resolution: 0 – 10000 Volume flow setpoint: 0.00 - 100.00%	R, W	RAM
1	Activation of an override control; 0 = none; 1 = Open; 2 = Close; 3 = Vmin; 4 = Vmax	R, W	RAM
2	Command triggering 0 = none; 1 = adaptation; 2 = test run; 4 = controller reset	R, W	RAM
4	Current damper blade position [%] Resolution: 0 – 10000 Damper blade position: 0.00 – 100.00%	R	RAM
5	Current damper blade position [°] Reference: without decimal places	R	RAM
6	Current actual volume flow [%] Resolution: Vnom Resolution: 0 – 10000 Actual volume flow rate: 0.00 - 100.00%		RAM
7	Actual volume flow rate in volume flow rate unit [m³/h], [l/s], [cfm] according to register 201	R	RAM
8	Voltage at analogue input Y [mV]	R	RAM
20	Volume flow setpoint in volume flow unit [m³/h], [l/s], [cfm] acc. to register 201	R, W	RAM
103	Firmware version	R	Flash
104	Status information (Bit = 1 active; Bit = 0 inactive) Bit 5 mechanical overload Bit 8 internal activity e.g. test run, adaptation Bit 10 bus timeout monitoring triggered	R	RAM
105	Operating range limitation: Operating parameter Vmin (qvmin) [%] Resolution: Vnom Resolution: 0 – 10000 Vmin: 0.00 – 100.00%	R, W	EEPROM
106	Operating range limitation: Operating parameter Vmax (qvmax) [%] Resolution: Vnom Resolution: 0 – 10000 Vmax: 0.00 – 100.00%	R, W	EEPROM
108	Behaviour on bus failure (bus time-out); 0 = nothing; 1 = closed; 2 = open; 3 = qvmin; 5 = qvmax	R, W	EEPROM

109	Setting bus time-out [s]	R, W	EEPROM
120	Definition of operating range: operating parameters Vmin (qvmin) in volume flow rate unit [m³/h], [l/s], [cfm] according to register 201	R, W	EEPROM
121	Definition of operating range: operating parameters Vmax (qvmax) in volume flow rate unit [m³/h], [l/s], [cfm] according to register 201	R, W	EEPROM
122	Interface definition (Interface mode) For assignment see separate table	R, W	EEPROM
130 *	Modbus address (device address)	R, W	EEPROM
201	Volume flow rate unit 0 = l/s; 1 = m³/h; 6 = cfm	R, W	EEPROM
231	Setting of mode: Bit 0 defines the characteristic of the analogue interface. Bit 0 = 0 characteristic: 0 – 10 V Bit 0 = 1 characteristic: 2 – 10 V Bit 4 defines the actual value signal as actual volume flow rate or damper position. Bit 4 = 0 Actual volume flow rate Bit 4 = 1 Damper blade position All other bits must not be changed.	R, W	EEPROM
233	Nominal flow rate [m^3 /h] (Vnom): Displays the parameterised nominal volume flow rate	R	EEPROM
568	Modbus parameter kit communication settings: baud rate, parity, stop bits, assignment see separate table	R, W	EEPROM
569	Modbus communication settings: Modbus Response Time = 10 ms + delay; with delay= 3 ms × register value 0 - 255	R, W	EEPROM
572	Setting of switching threshold for override control CLOSE via control signal for signal voltage range 2 – 10 V: Setting range 0.5 V – 1.8 V Default value 0.8V (register value = 20) Resolution: 1 setting unit = 40mV	R, W	EEPROM

* Factory setting: Modbus address 1
R = register readable
R,W = register readable and writable
RAM = register value volatile
EEPROM = register value not volatile, but permanently stored (maximum 1 million write operations)

Note:
All registers from register number 100 onwards with storage in the EEPROM are not designed for cyclical write access, e.g. by the building management system. Cyclic write operations are only permitted on registers with storage in RAM.

Detailed information on register 122 (communication interface setpoint/actual value - interface mode)

Register value	Signal input	Feedback signal
0	analogue (0) 2 - 10 V	(0)2 – 10 V
1	Modbus via Register 0	(0)2 – 10 V
2	Modbus via Register 0	Register 10
3	q_v	Modbus-RTU-Schnittstelle

Detailed information on register 568 (Modbus communication parameters)

Register value	Display setting value	Baud rate	Parity	Stop bits
0	1	1200	None	2
1	2	1200	straight	1
2	3	1200	odd	1
3	4	2400	None	2
4	5	2400	straight	1
5	6	2400	odd	1
6	7	4800	None	2
7	8	4800	straight	1
8	9	4800	odd	1
9	10	9600	None	2
10	11	9600	straight	1
11	12	9600	odd	1
12	13	19200	None	2
13	14	19200	straight	1
14	15	19200	odd	1
15 **	**16**	**38400**	**None**	**2**
16	17	38400	straight	1
17	18	38400	odd	1
18	19	1200	None	1
19	20	2400	None	1
20	21	4800	None	1
21	22	9600	None	1
22	23	19200	None	1
23	24	38400	None	1
24	25	76800	None	1
25	26	115200	None	1
26	27	76800	None	2
27	28	76800	straight	1
28	29	76800	odd	1
29	30	115200	None	2
30	31	115200	straight	1
31	32	115200	odd	1

** Factory setting: Modbus communication parameters

Commissioning

Note on the type of static transmitter used

- Mounting position any
- Zero point adjustment not required

After installation, wiring and connection of the supply voltage

- When using the Modbus interface: Set Modbus communication parameters via the integrated menu, then the air terminal unit is ready for operation
- Setpoint value default setting via Modbus register
- When using the analogue interface: air terminal unit is immediately ready for use
- Only briefly remove the protective cap of the control component during wiring

Observe volume flow control ranges

- TVE: 4 - 100 % of q_{vnom}
- TVE-Q: 10 - 100 % of q_{vnom}
- In particular, do not fall below the values for the minimum volume flow of the control unit

Range of display functions

Display functions

- Actual volume flow rate (unit optionally m³/h, l/s, cfm)
- 3-character display with positional notation
- Status and error display for various operating states, including display of activated override control and diagnosis function

Parameter setting

- Adjustment option for the unit of the volume flow rate display m³/h, l/s, cfm
- Adjustment option for the operating range q_{vmin}, q_{vmax}
- Selection of the interface configuration Modbus or analogue including signal voltage range 0 – 10 V or 2 – 10 V DC
- Adjustment option for Modbus communication settings (address, baud rate, stop bits, parity)

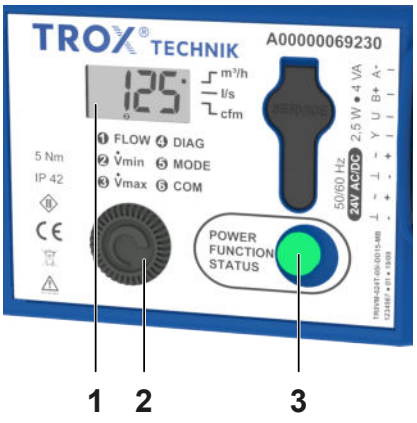
Diagnosis functions

- Activation of a test run
- Activation of override controls Open, Closed, q_{vmin}, q_{vmax}, motor stop (observe prioritisation)
- Display of the voltage value on the analogue input

Use and description of the display

Pressing the LED button (< 3 s) selects the next menu item (1) - (6). The selected menu item can be changed by pressing the LED push button for more than 3 s. Changing is done with the rotary selector switch. Pressing the LED push button again (< 3 s) confirms the selected value. If no entry is made for ≥ 60 s, the system returns to menu item 1.

Section of the controls



1: Display
2: Rotary selector switch
3: LED push button

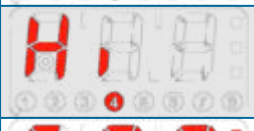
Table 1: Description of the menu items

① Flow	Display of actual values or operating states. Setting of the volume flow unit m³/h, l/s, cfm.
② Vmin	Setting qvmin
③ Vmax	Setting qvmax
④ DIAG	Display of control signal and feedback signal alternately in [V], Activation of override controls for test and diagnostic purposes: tst = test drive oP = damper open cL = damper closed Lo = q_{vmin} Hi = q_{vmax} St = motor stop oFF = override control off 000 = Display firmware version
⑤ MODE	Selection of the operating mode: CA0 = Setpoint input and actual value return via analogue interface (0 - 10 V) CA2 = Setpoint input and actual value return via analogue interface (2 - 10 V) CB2 = Setpoint input and actual value return via Modbus - optional actual value return via (2 - 10 V)
⑥ COM	Setting the Modbus address: 1 - 247 and the baud rate, parity, stop bits: 1 (b1) - 32 (b32)

Note on MODE setting:

For the control component XM0-J6 or XS0-J6, only the mode setting CB2 is useful, as setpoint input and actual value return as analogue signal are not available on the RJ12 connection socket of these control components.

Description of status LEDs and error messages

LED flashing signal	Status	Display
	no power supply connected	
	Service tool plugged in. On-site network connection deactivated. Forced controls from the service tool have priority	
	Undervoltage detected. Supply voltage outside the tolerance range. Control function not guaranteed	
	TROX service technicians provide information. Incomplete parameterisation was detected during power-on/reset *	
	Drive overload detected (block) *	
	Synchronisation drive after Power Up *	
	Test mode enabled *	
	Overpressure sensor (Overpressure) *	
	Setpoint or forced control position not yet reached (display changes between e.g. Hi = high and actual value) *	
	Forced control position reached (display changes between e.g. Hi = High and actual value) *	
	Offset: Is signalled as long as the drive does not rotate to readjust the setpoint value *	

Notes:

1. The signal spans 2 seconds. 1 = LED is illuminated, 0 = LED is not illuminated
2. For service tool plugged in (display: Pc) and undervoltage detected (display: Lou), no special flashing signal appears on the LED button. Instead, one of the operating states marked with an asterisk (*) is displayed.

Product details

Modbus operation (order code operation mode M)

For smooth data exchange in the on-site Modbus RTU network, it is necessary to set the communication parameters and the participant address for the Modbus interface.
The interface offers standardised Modbus register access to the available data points by means of the ReadHoldingRegister (3) and WriteSingleRegister (6) functions.

Setpoint value setting

- In operating mode M, the setpoint is only specified by entering the volume flow setpoint [%] in Modbus register 0
- The percentage value refers to the volume flow rate range specified by q_{vmin} – q_{vmax} defined volume flow rate range
- Volume flow rate range q_{vmin} - q_{vmax} set at the factory according to the order code details
- Subsequent adjustment of q_{vmin} or q_{vmax} possible in the setting menu on the display, with setting device or via Modbus interface

Note:

Cyclic writing to registers with storage in the EEPROM is not permitted.
This applies in particular to the basic setting parameters for the working range q_{vmin} (register 105 or 120), q_{vmax} (register 106 or 121), the definition of the interface type (register 122) as well as all other registers from number 100.
See also notes on writeability at the end of the Modbus register description.

Actual value as feedback for monitoring or tracking control

- In Modbus register 7, the current actual volume flow can be called up in the set volumetric flow unit (register 201)
- In addition to the actual volume flow rate, further information can be read out via other Modbus registers
- Overview see register list
- For diagnostic purposes, the actual volume flow rate can be tapped at terminal U in Modbus mode
- The volume flow rate range 0 – q_{vnom} always corresponds to the signal voltage range of 2 - 10 V DC

Override control

For specific operating situations, the volume flow controller can be set to a special operating state (override control). The following modes are possible: control q_{vmin}, control q_{vmax}, control damper in open position (OPEN) or control damper closed (CLOSED).

Override control via the Modbus

Specifications are made via Modbus register 1.

Override control through bus failure monitoring

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

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

Override controls for diagnosis

Activation via the diagnostic menu on the controller display or via the service tools (setting device, PC software).

Prioritisation of different override control options

Specifications for override controls via service tools are prioritised over Modbus specifications.

- Highest priority: Defaults coming from a service tool (service connector), e.g. adjustment device or PC software, for test purposes
- Lowest priority: Defaults coming from Modbus 1 or the diagnosis menu on the controller

Analogue operation 0 - 10 V DC or 2 - 10 V DC (order code operation mode V, F)

The analogue interface can be set for the signal voltage range 0 - 10 V DC or 2 - 10 V DC.
The assignment of volume flow setpoint or actual value to voltage signals is shown in the characteristic diagrams.

- The set signal voltage range applies to both setpoint value and actual value signals.
- The signal voltage range is set in the factory according to the order code
- Signal voltage range can be adjusted on site in the setting menu on the display or with the setting device

Setpoint value setting

- In operating mode V (variable operation), the setpoint is only specified with an analogue signal at terminal Y
  - Setpoint specifications via Modbus register 0 are rejected
- The selected signal voltage range 0 – 10V or 2 – 10V DC is mapped to the volume flow rate range q_{vmin} – q_{vmax} assigned to
- Volume flow rate range q_{vmin} – q_{vmax} set at the factory according to the order code details
- Subsequent adjustment of q_{vmin} or q_{vmax} possible in the setting menu on the display or with the setting device

In operating mode F (fixed value operation), no analogue signal is required at terminal Y

- The value given by q_{vmin} is controlled through the fixed volume flow rate value
- Volume flow q_{vmin} is set at the factory according to the order code specification
- Subsequent adjustment of q_{vmin} possible in the setting menu on the display or with the setting device

Actual value as feedback for monitoring or tracking control

- The actual volume flow rate measured by the controller can be captured as a voltage signal at terminal U
- The selected signal voltage range 0 – 10 V DC or 2 – 10 V DC is mapped to the volume flow rate range 0 – q_{vnom} shown
- In analogue mode (operating mode V, F), there is the parallel option of querying operating data via the Modbus interface

Override control

For special operating situations, the volume flow controller can be set to a special operating state (override control). The following modes are possible: control q_{vmin}, control q_{vmax}, control damper in open position (OPEN) or control damper closed (CLOSED).

Override controls via signal input Y

With suitable wiring at signal input Y, the override controls can be activated according to the wiring diagrams by wiring with external switching contacts/relays (see wiring examples). OPEN and CLOSE are only available if the controller is supplied with alternating current (AC).

Override control CLOSE using signal input Y

- With signal voltage range 0 - 10 V DC and q_{vmin} = 0: CLOSE is activated when command signal Y < 0.3 V DC
- With signal voltage range 0 - 10 V DC and q_{vmin} > 0: No shut-off possible
- With signal voltage range 2 - 10 V DC and q_{vmin} = 0: CLOSE is activated when command signal Y < 2.3 V DC
- With signal voltage range 2 - 10 V DC and q_{vmin} > 0: CLOSE is activated when command signal Y < 0.8 V DC; between 0.9 V and 2 V q_{vmin} regulated

Override controls in analogue mode via Modbus interface

If the Modbus interface is also connected in analogue mode, override control can also be specified via Modbus register 1.

Override control for diagnosis

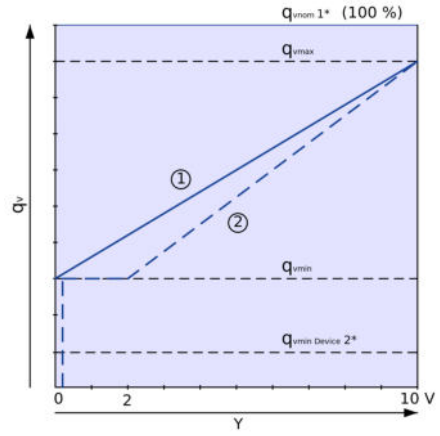
Activation via the diagnostic menu on the controller display or the service tools (setting device, PC software).

Prioritisation of different override control options

Various override options are prioritised by the controller as follows:

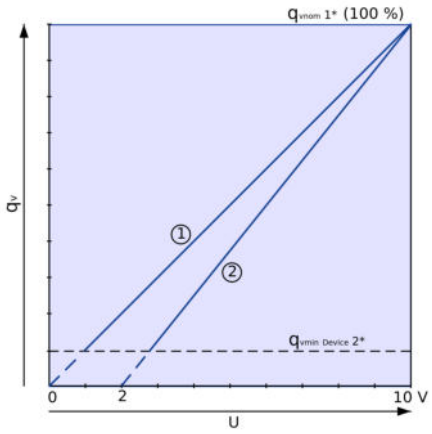
- Highest priority: Defaults coming from a service tool (service connector), e.g. adjustment device or PC software, for test purposes
- Medium priority: Specifications via Modbus register 1 or the diagnostics menu on the controller
- Lowest priority: Specifications via wiring at the Y-signal input of the controller

Characteristic of the setpoint value signal



① Signal voltage range 0 – 10 V
② Signal voltage range 2 – 10 V
1* = q_{vnom} Nominal volume flow rate
2* = $q_{vmin\ unit}$ Acceptable minimum volume flow rate

Characteristic of the actual value signal



① Signal voltage range 0 – 10 V
② Signal voltage range 2 – 10 V
1* = q_{vnom} Nominal volume flow rate
2* = $q_{vmin\ unit}$ Acceptable minimum volume flow rate

Calculation of volume flow rate setpoint value at 0 – 10 V

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

Calculation of actual volume flow rate at 0 – 10 V

$$q_{vact} = \frac{U}{10\ V} \times q_{vnom}$$

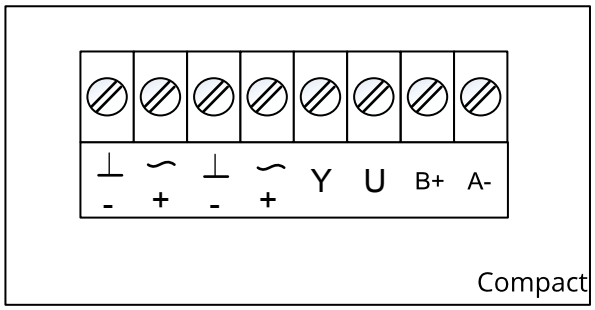
Calculation of volume flow rate setpoint value at 2 – 10 V

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

Calculation of actual volume flow rate at 2 – 10 V

$$q_{vact} = \frac{U - 2}{10\ V - 2\ V} \times q_{vnom}$$

Terminal assignment for Modbus operation

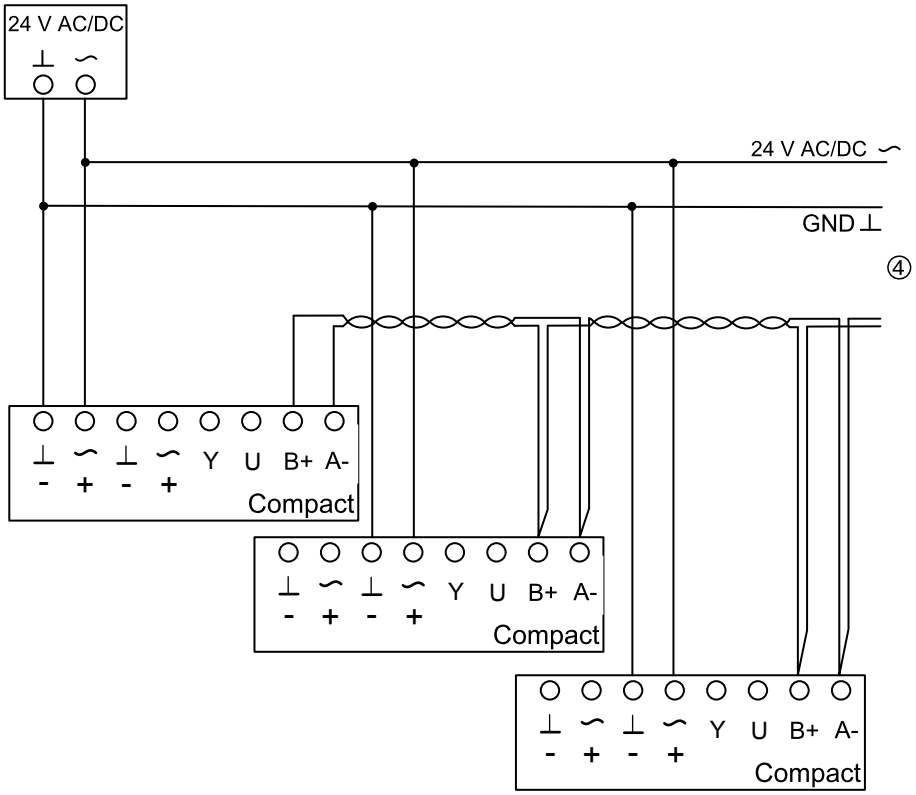


⊥, – = Ground, neutral
~, + = Supply voltage 24 V AC/DC
Y = Analogue input
U = Actual value signal
B+ = RS-485 bus (Modbus RTU)
A- = RS-485 bus (Modbus RTU)

Notes

- Analogue input Y is ignored with factory-ordered operating mode M (pure Modbus operation).
  For on-site alternative configuration, see description for interface configuration and register 122
- Actual value signal in bus mode 2 - 10 V DC (signal voltage range preset at the factory)
- Utilities and bus connections are **not** galvanically isolated

Modbus RTU connections, one voltage source

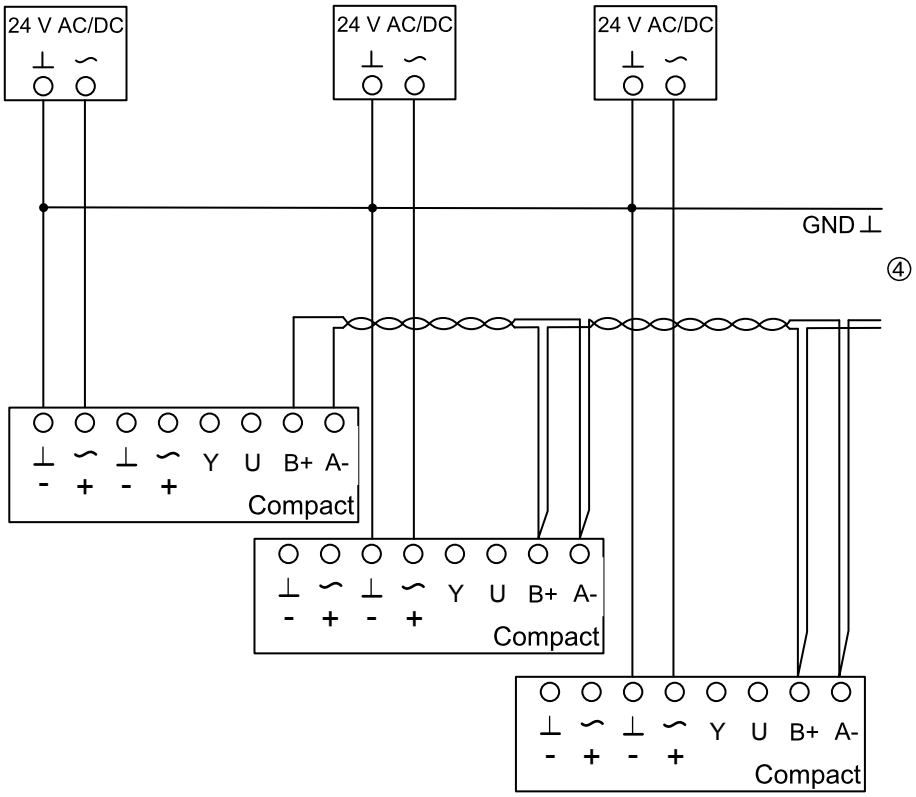


⊥, – = Ground, neutral
~, + = Supply voltage 24 V AC/DC
B+ = RS-485 bus (Modbus RTU)
A- = RS-485 bus (Modbus RTU)
④ Other network devices

Note:

- Electrical connection only with safety transformer
- Modbus wiring only according to the relevant RS485 guidelines
- Supply and bus connections are **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

Modbus RTU connection diagram - with multiple power supplies

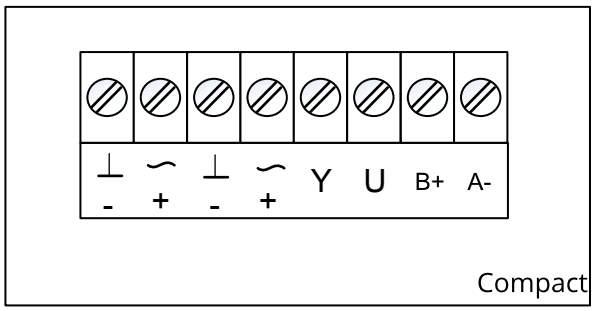


⊥, – = Ground, neutral
~, + = Supply voltage 24 V AC/DC
B+ = RS-485 bus (Modbus RTU)
A- = RS-485 bus (Modbus RTU)
④ Other network devices

Note:

- Electrical connection only with safety transformer
- Modbus wiring only according to the relevant RS485 guidelines
- Utilities and bus connections are **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

Terminal assignment for analogue operation 0 - 10 V DC or 2 - 10 V DC

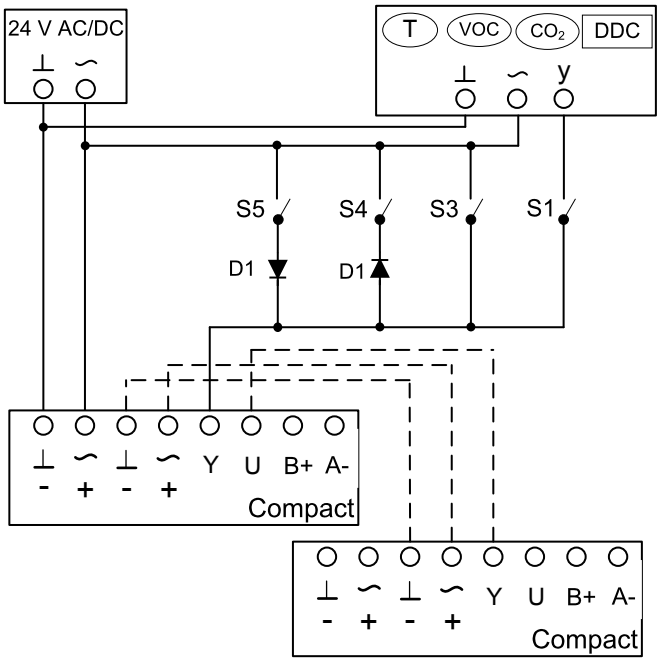


⊥, – = Ground, neutral
~, + = Supply voltage 24 V AC/DC
Y = Setpoint signal and local override
U = Actual value signal
B+ = RS-485 bus (Modbus RTU)
A- = RS-485 bus (Modbus RTU)

Notes

- Setpoint and actual value signal depending on selected signal voltage range 0 - 10 V DC or 2 - 10 V DC
- Setpoint specification via the Modbus is ignored with factory-ordered operating mode F or V (pure analogue operation). For on-site alternative configuration, see description for interface configuration and register 122
- Operating value query possible via Modbus
- Utilities and bus connections are **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

XM0, analogue control and override control, voltage signal 0 - 10 V DC



When combining several override controls, the switches must be interlocked to prevent short-circuits. Diode: e.g. 1N 4007

Notes

- T, VOC, CO_2, DDC = Setpoint value default setting q_v
- D1 = Diode for forced connection, e.g. 1N4007
- If several override controls are combined, lock the switches against each other to avoid short circuits
- Setpoint and actual value signal depending on selected signal voltage range 0 - 10 V DC or 2 - 10 V DC

Switch settings

Regular operation q_{vmin} – q_{vmax}

- E.g. for room temperature control
- Only S1 has to be closed

Override control q_{vmin}

- All switches open, only supply voltage connected

Override control q_{vmax}

- Only S3 has to be closed

Override control, damper blade OPEN

- Only S5 has to be closed
- Only with AC voltage supply

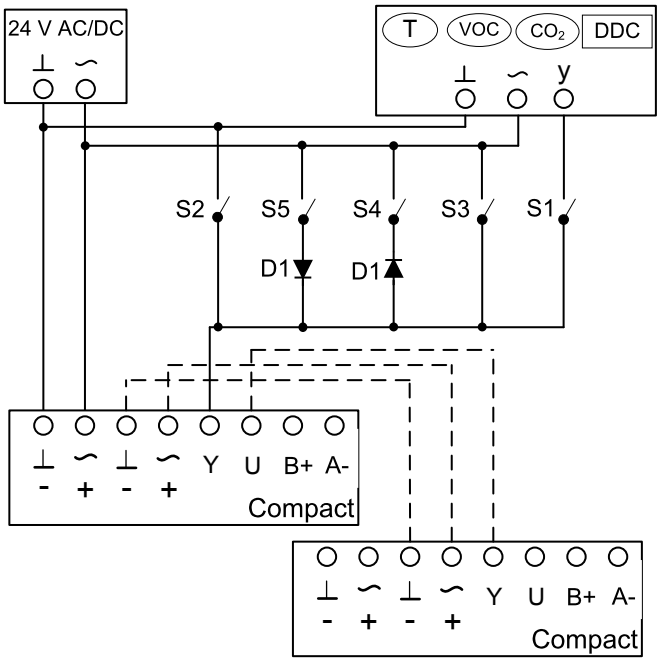
Override control, damper blade CLOSED

- Only S4 has to be closed
- Only with AC voltage supply

Control damper closed per setpoint signal CLOSED

- Only S1 has to be closed
- Further boundary conditions such as signal voltage range, q_{vmin}-For setting and shut-off voltage, see description Product details Analogue operation

XM0, analogue control and override control, voltage signal 2 - 10 V DC



When combining several override controls, the switches must be interlocked to prevent short-circuits. Diode: e.g. 1N 4007

Notes

- T, VOC, CO_2, DDC = Setpoint value default setting q_v
- D1 = Diode for forced connection, e.g. 1N4007
- If several override controls are combined, lock the switches against each other to avoid short circuits
- Setpoint and actual value signal depending on selected signal voltage range 0 - 10 V DC or 2 - 10 V DC

Switch settings

Regular operation $q_{vmin} – q_{vmax}$

- E.g. for room temperature control
- Only S1 has to be closed

Override control q_{vmin}

- All switches open, only supply voltage connected

Override control q_{vmax}

- Only S3 has to be closed

Override control, damper blade OPEN

- Only S5 has to be closed
- Only with AC voltage supply

Override control, damper blade CLOSED

- Only S2 has to be closed

Or:

- Only switch (connection) S4 may be closed; works only with AC voltage supply

Control damper closed per setpoint signal CLOSED

- Only S1 has to be closed
- Further boundary conditions such as signal voltage range, q_{vmin}-For setting and shut-off voltage, see description Product details Analogue operation

Explanation

q_{vNom} [m3/h]; [l/s]; [CFM]
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 defined in the Easy Product Finder design programme. 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.

$q_{vmin\ Unit}$ [m3/h]; [l/s]; [CFM]
Technical minimum volume flow: The value depends on product type, nominal size and control component (attachment). Values are defined in the Easy Product Finder design programme 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} [m3/h]; [l/s]; [CFM]
Client-adjustable upper limit of the operating range for the VAV terminal unit: $q_{vmax.}$ can be set to less than or equal to q_{vNom} on the terminal unit. In case of analogue control of volume flow controllers (typically used), the maximum value of the setpoint signal (10 V) is assigned to the set maximum value ($q_{vmax.}$, see characteristics.

q_{vmin} [m3/h]; [l/s]; [CFM]
Client-adjustable lower limit of the operating range of the VAV terminal unit: q_{vmin} should be set to less than or equal to $q_{vmax.}$ q_{vmin} must not be set 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 control of volume flow controllers (typically used), the minimum value of the setpoint signal (0 or 2 V) is assigned to the set minimum value (q_{vmin}, see characteristics.

q_v [m3/h]; [l/s]; [CFM]
Volume flow rate

Volume flow controller
Consists of a basic unit with an attached control component.

Basic unit
Unit for controlling volume flow rates without an attached control component. The main components include the casing with sensor(s) to measure the differential pressure and the damper blade to restrict the volume flow. The basic unit is also referred to as a VAV terminal unit. Important distinguishing features: Geometry or unit shape, material and connection variants, acoustic characteristics (e.g. optional acoustic cladding or integrated silencers), range of volume flow.

Control component
Electronic unit(s) mounted on the basic unit to control the volume flow rate, or the duct pressure, or the room pressure by adjusting the damper blade position. The electronic unit mainly consists of a controller with differential pressure transducer (integrated or external), and an integrated actuator (Easy and Compact controllers) or external actuator (Universal or LABCONTROL controller). Important distinguishing features: Transducer: dynamic transducer for clean air, or static transducer for polluted air. Actuator: Standard actuator (slow-running), spring return actuator for fail-safe position, or fast-running actuator. Interface technology: analogue interface or digital bus interface for connecting and recording signals and data.