# Control engineering information

## VARYCONTROL VAV Units
## Electronic controller VRD3

**B1. · B27**


TROX® TECHNIK
The art of handling air

# Contents



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# 1 General information

### Correct use

The electronic controller VRD3 is part of the air terminal unit and provides a control loop for flow rate control. The controller is delivered ready to operate. Parameters are factory set.

The air terminal units are suitable for use in ventilation and air conditioning systems. Particular conditions can restrict the functioning capacity and must be taken into account during the design stage:

- Installation should only be carried out by specialists. The normal local rules of site working, in particular the health and safety regulations must be complied with.
- For air with aggressive media, only air terminal units made of plastic materials should be used and then only after extensive tests for suitability.
- Galvanised sheet steel units must not be installed in contaminated environments (e.g. acetic acid).

For the electronic controller VRD3 the following must be noted:

- Use in aircraft is not allowed.
- Safety transformers must be used.
- The user should not exchange or repair any parts of the controller.
- The controller consists of electronic components therefore must be separated from domestic waste. When disposed of, local up to date regulations must be complied with.
- For hazardous areas, only use units with explosion proof electrical components.
- If there is a risk of fire due to flammable solids, the electric equipment must be rated IP 4X (see VdS 2033 fire safety guidelines or appropriate regulations).

Standard filtration in air conditioning systems is suitable for the use of the controller in the supply air without additional dust protection filters.
Since only a small volume flow is passed through the transducer in order to monitor the flow rate, the following must be noted:

- With heavy dust in the room, suitable extract air filters must be provided.
- If the air is contaminated with fluff or sticky particles or contains aggressive media, the VRD3 should not be used.

### Materials

Please note that in critical cases, material compatibility testing should be carried out on the air terminal unit and the diaphragm pressure transducer, taking into consideration the harmful substances involved and the concentrations in which they occur.

### Maintenance

The mechanical components are maintenance-free.

| Air terminal units with VRD3 controller, M546GA4 | | | |
|---|---|---|---|
| **Order code**[1] | **Air terminal unit** | **Actuator** | |
| | | Type | TROX part No. |
| **B11** | TVT | SM24A-V | B028PJ7 |
| **B13** | TVR · TVJ · TVZ · TVA | NM24A-V | B028PJ9 |
| **B1B** | TVR · TVZ · TVA · TVJ · TVT | LF24-V[2] | M466CA8 |
| | | AF24-V[2] | M466DS0 |
| **B27** | TVM | 2 x NM24A-V | B028PJ9 |

[1] Control components according to order code
[2] Actuator type depends on size of the unit

# 2 Field of application, Technical data

### Field of application

The electronic controller VRD3 is designed for use in VAV systems for flow rate control. A dynamic differential pressure transducer and electronic controller are combined in one casing.

For variable control, a signal is provided by, for example, a room temperature controller or a DDC outstation. The output signal of this controller controls the VRD3.

For constant control switches or relays are used.

The actual value of the flow rate is monitored as a standard linear, electrical signal. This signal can be used to control a slave unit, for example in the extract air duct and/or for monitoring.

Control signals can be in two ranges:

- 0 to 10 V DC
- 2 to 10 V DC

Using the adjustment tool ZTH-VAV, the customer can change the voltage range.

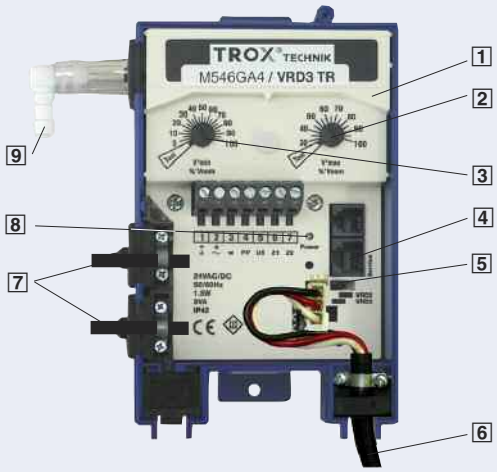
The flow rate is microprocessor-controlled on a digital basis. The VRD3 has adjustment knobs for setting $\dot{V}_{min}$ and $\dot{V}_{max}$. Additionally the $\dot{V}_{min}$ and $\dot{V}_{max}$ values are stored in memory. These values are active with adjustment knobs set to “Tool”.

The controller is supplied with all the parameters set. The flow rate can be changed by the customer at the adjustment knobs or easily and reliably using an adjustment tool ZTH-VAV or a notebook with service tool and certain parameters are read only.

Several controllers may be connected in parallel to one room temperature controller.

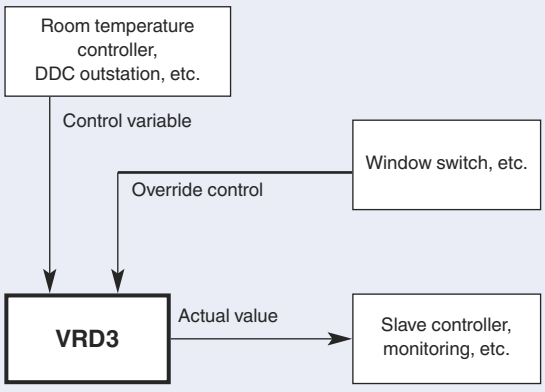
Supply - extract tracking control is possible.

### VRD3




1 Controller VRD3
2 $\dot{V}_{max}$-adjustment knob
3 $\dot{V}_{min}$-adjustment knob
4 Connection for adjustment tool
5 Jumper for control signal input w
6 Connecting cable with plug for actuator
7 Connecting cables for supply voltage, control signal and actual value signal
8 Indicator light power
9 Tube connection

### VAV control




| Technical data | | | |
|---|---|---|---|
| Supply voltage | 24 V AC, 50/60 Hz, ± 20 %<br>24 V DC -10 / + 20 % | Override control | Terminal 6, terminal 7,<br>input resistance ~ 100kΩ |
| Power rating (without actuator) | max. 3.5 VA (for AC voltage)<br>max. 2 W (for DC voltage) | IEC protection class | III (Safe voltage) |
| Control signal | 0 (2) to 10 V DC, Ri ~ 100 kΩ | Protection level | IP 40 |
| Flow rate actual value signal | 0 to 10 V DC / 2 to 10 V DC<br>max. 0.5 mA | EMC | CE marking according to 2004/108/EG |

# 3 Adjustment using the ZTH-VAV

### Flow rate adjustment on site

If site adjustments to the factory set flow rate values are required, $\dot{V}_{min}$ and $\dot{V}_{max}$, new values can be calculated as described on page 7 and set, or the adjustment tool ZTH-VAV is used for setting.

### Adjustment tool ZTH-VAV

Actual values can be read and parameters can be changed using the adjustment tool ZTH-VAV ($\dot{V}_{min}$ and $\dot{V}_{max}$ set to "Tool"). The adjustment tool is connected directly to the VRD3 or in the switch cabinet as shown in the wiring diagram.

Start-up window

```
VRD3
```

### Operation and changing of display

Use the arrow keys "↓" and "↑" to change the displays. The flow rates are displayed in l/s.

**Attention: $\dot{V}_{Nom}$ must not be changed!**

### Setting of parameters

Select parameter using arrow keys. The actual value is shown. To calculate the values use formula shown on page 7.

Use "+" and "–" keys to set required value. Save value with "ok".

Example for $\dot{V}_{max}$:

```
Vmax          110l/s
Setpoint       90l/s
```

Repeat procedure with $\dot{V}_{min}$.

Change of mode of operation

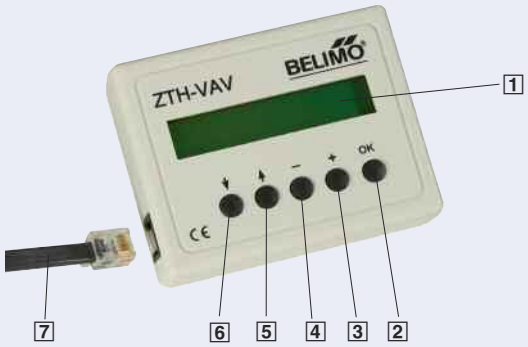
The mode (0 to 10 or 2 to 10 V) can only be changed, when the ZTH-VAV is in "Expert mode".

To enable the expert mode:

- Keep "ok" button pressed and connect the cable 7. The "Configuration menu" is shown.
- Use one of the arrow keys until "Expert mode" is shown.
- Set expert mode using "+" key to value 1 and save value with "ok".
- Use one of the arrow keys until "Leave expert mode" is shown.
- Confirm with "ok".

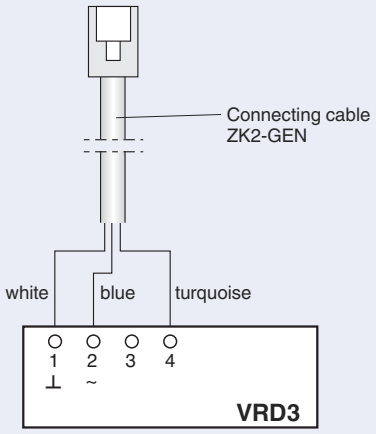
The expert mode remains enabled when the adjustment tool is disconnected, but can be disabled from the "Configuration menu".

**ZTH-VAV**




1 Display
2 OK key
3 Plus key
4 Minus key
5 Arrow key "back"
6 Arrow key"forward"
7 Connecting cable with plug

**Connection of ZTH-VAV to VRD3**




Example:

```
Mode          0.0-10.0V
-new            2-10V
```

Use "+" and "–" keys to set required value. Save value with "ok".

For further information about wiring and operation, see separate manual, No. M/ZTHVAV/EN/..

| Values and parameters of VRD3 | | | | | |
|---|---|---|---|---|---|
| **Display** | **Actual values** | | **Parameters** | | **Mode**[1] |
| | Flow rate | Damper position | Vmin | Vmax | |
| Flow rate control | $\dot{V}_{actual}$ in l/s | $Y_{actual}$ in % | $\dot{V}_{min}$ | $\dot{V}_{max}$ | 0 to 10 V DC or 2 to 10V DC |

[1] Can only be changed when "expert mode" is active

# 4 Functional description

### Functional description

The flow rate is measured using the dynamic differential pressure principle. The effective pressure $\Delta p_w$ of the differential pressure sensor in the air terminal unit enables a partial volume flow passing through the transducer to be detected and measured. Two temperature-dependent resistors are used to measure this partial flow rate, which is, with temperature compensation, proportional to the total flow rate, this is then available, as a voltage signal. The linearisation of the flow rate signal is carried out in the controller.

The actual flow rate can be monitored as the voltage signal U5. The flow rate range is factory adjusted depending on the size of the unit so that 10 V DC corresponds to the unit nominal flow rate ($\dot{V}_{Nom}$).

The required flow rate is set by the room temperature controller or by switch contacts. The controller determines the required flow rate in accordance with the characteristic shown and compares this with the actual value. The damper actuator is controlled based on the deviation. The electronic controllers VRD3 allow for a specific range of actuators, the dynamic behaviour and control voltage of which are matched to the controller and thus a stable flow rate control can be achieved.

The factory set parameters $\dot{V}_{min}$ and $\dot{V}_{max}$ can be altered by the customer.

### 2 to 10 V DC mode (characteristic B)

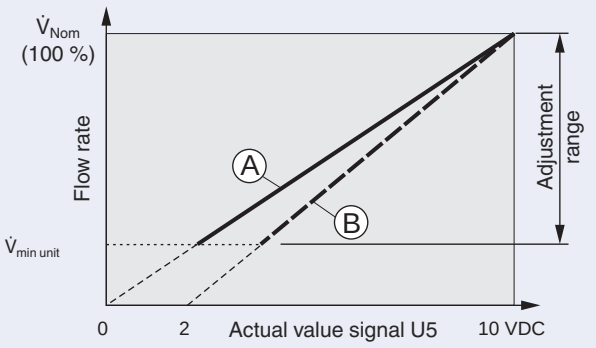
With a control signal below 0.1 VDC, the control damper closes.

### Compatibility to VRD2

Shut-off with a control signal < 0.1 V DC in mode 2 to 10 V DC was not possible with the previous type VRD. The function of the VRD2 is set with a jumper. Therefore the VRD3 can be used to replace VRD2.

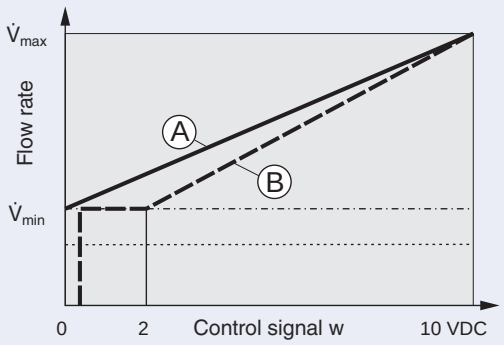
- VRD3 (factory setting)
  Control signal w compatible to VAV Compact
- VRD2
  Control signal w compatible to VRD2

### Characteristic of actual value signal




| Ⓐ 0 – 10 V DC | Ⓑ 2 – 10 V DC |
|---|---|
| $\dot{V}_{actual} = \dot{V}_{Nom} \frac{U5}{10}$ | $\dot{V}_{actual} = \dot{V}_{Nom} \frac{U5-2}{8}$ |

### Characteristics of the control signal




| Ⓐ 0 – 10 V DC | Ⓑ 2 – 10 V DC |
|---|---|
| $\dot{V}_{Set} = \frac{w}{10} (\dot{V}_{max} - \dot{V}_{min}) + \dot{V}_{min}$ | $\dot{V}_{Set} = \frac{w-2}{8} (\dot{V}_{max} - \dot{V}_{min}) + \dot{V}_{min}$ |

| Override control “Closed” for voltage range 2 to 10 V DC | | |
|---|---|---|
| **U3** | **Flow rate** | **Control** |
| **< 0.1 V DC** | 0 | Damper blade closed, Inactive control |
| **0.2 to 2 V DC** | $\dot{V}_{min}$ | Controlling $\dot{V}_{min}$ |
| **2 to 10 V DC** | $\dot{V}_{min} - \dot{V}_{max}$ | Variable volume flow control |

# 5 Flow rate control

### Flow rate control

The flow rate controller operates independently of duct pressure, i.e. pressure fluctuations cause no changes to flow rate. To prevent the flow rate control becoming unstable, a band is provided within which the damper does not move. This dead band and the accuracy of the differential pressure sensor lead to a flow rate deviation $\Delta\dot{V}$ as shown in the figure opposite.

If the conditions given in the technical leaflet (e.g. minimum total pressure differential, upstream conditions) are not complied with, greater deviations must be expected.

### $\dot{V}_{min}$-setting

The $\dot{V}_{min}$-value corresponds to the flow rate which is set with a 0 or 2 V DC control signal or $\dot{V}_{min}$-override control. $\dot{V}_{min}$ may be set between 0 and 100 % of $\dot{V}_{Nom}$. The percentage figures relate to $\dot{V}_{Nom}$.

At setpoint values lower than $\dot{V}_{min\ unit}$ the damper blade closes.

### $\dot{V}_{max}$-setting

The $\dot{V}_{max}$-value corresponds to the flow rate which is set with a 10 V DC control signal or $\dot{V}_{max}$-override control. The setting range is from 30 to 100 %.
The percentage figures relate to $\dot{V}_{Nom}$.

### Tracking control

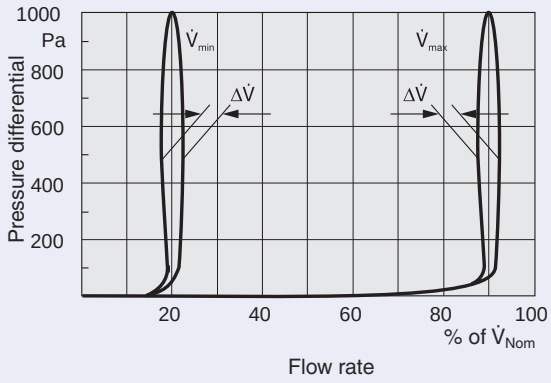
The VRD3 only provides for ratio control, i.e. the supply (M) and extract (S) air must be in the same ratio under all operating conditions.

The flow rate ratio is set using the $\dot{V}_{max}$-parameter on the slave controller. The setting range is from 30 to 100 %.

Where the flow rates are the same and the units of equal size, the setting will be 100 %. If units are of different sizes then $\dot{V}_{max\ S}$-setpoint value is calculated with the formula opposite. If $\dot{V}_{max\ S}$-setpoint value > 100 %, the master and slave functions must be reversed.

As a rule, the $V_{min}$-setpoint value on the slave is set to 0 %.

**Pressure independent control characteristics**




$$\dot{V}_{min}\text{-setpoint value} = \frac{\dot{V}_{min}}{\dot{V}_{Nom}} \times 100\ \%$$

$$\dot{V}_{max}\text{-setpoint value} = \frac{\dot{V}_{max}}{\dot{V}_{Nom}} \times 100\ \%$$

$$\frac{\dot{V}_{max\ M}}{\dot{V}_{min\ M}} = \frac{\dot{V}_{max\ S}}{\dot{V}_{min\ S}}$$

$$\dot{V}_{max\ S}\text{-setpoint value} = \frac{\dot{V}_{max\ S}}{\dot{V}_{max\ M}} \times \frac{\dot{V}_{Nom\ M}}{\dot{V}_{Nom\ S}} \times 100\ \%$$

# 6 Flow rate ranges

| Flow rate ranges | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | in l/s | | | | in m³/h | | | |
| | | $\dot{V}_{min}$ | | $\dot{V}_{max}$ | | $\dot{V}_{min}$ | | $\dot{V}_{max}$ | |
| | | $\dot{V}_{min\ unit}$ [1] | up to | from | up to $\dot{V}_{Nom}$ | $\dot{V}_{min\ unit}$ [1] | up to | from | up to $\dot{V}_{Nom}$ |
| **Nominal size** | | **TVZ · TVA · TVR · TVRK** | | | | | | | |
| **100** [2] | | 10 | 95 | 30 | **95** | 36 | 342 | 108 | **342** |
| **125** | | 15 | 150 | 45 | **150** | 54 | 540 | 162 | **540** |
| **160** | | 25 | 250 | 75 | **250** | 90 | 900 | 270 | **900** |
| **200** | | 40 | 405 | 120 | **405** | 144 | 1458 | 432 | **1458** |
| **250** | | 60 | 615 | 185 | **615** | 216 | 2214 | 666 | **2214** |
| **315** | | 105 | 1025 | 310 | **1025** | 378 | 3690 | 1116 | **3690** |
| **400** | | 170 | 1680 | 505 | **1680** | 612 | 6048 | 1818 | **6048** |
| **B x H in mm** | | **TVJ · TVT** | | | | | | | |
| **200** | **100** | 45 | 215 | 65 | **215** | 162 | 774 | 234 | **774** |
| **300** | | 65 | 320 | 95 | **320** | 234 | 1152 | 342 | **1152** |
| **400** | | 85 | 425 | 130 | **425** | 306 | 1530 | 468 | **1530** |
| **500** | | 105 | 535 | 160 | **535** | 378 | 1926 | 576 | **1926** |
| **600** | | 130 | 650 | 95 | **650** | 468 | 2340 | 702 | **2340** |
| **200** | **200** | 85 | 415 | 125 | **415** | 306 | 1494 | 450 | **1494** |
| **300** | | 125 | 620 | 185 | **620** | 450 | 2232 | 666 | **2232** |
| **400** | | 165 | 825 | 250 | **825** | 594 | 2970 | 900 | **2970** |
| **500** | | 205 | 1035 | 310 | **1035** | 738 | 3726 | 1116 | **3726** |
| **600** | | 250 | 1250 | 375 | **1250** | 900 | 4500 | 1350 | **4500** |
| **700** | | 290 | 1450 | 435 | **1450** | 1044 | 5220 | 1566 | **5220** |
| **800** | | 330 | 1650 | 495 | **1650** | 1188 | 5940 | 1782 | **5940** |
| **300** | **300** | 185 | 920 | 275 | **920** | 666 | 3312 | 990 | **3312** |
| **400** | | 245 | 1230 | 370 | **1230** | 882 | 4428 | 1332 | **4428** |
| **500** | | 305 | 1535 | 460 | **1535** | 1098 | 5526 | 1656 | **5526** |
| **600** | | 370 | 1850 | 555 | **1850** | 1332 | 6660 | 1998 | **6660** |
| **700** | | 430 | 2150 | 645 | **2150** | 1548 | 7740 | 2322 | **7740** |
| **800** | | 490 | 2450 | 735 | **2450** | 1764 | 8820 | 2646 | **8820** |
| **900** | | 555 | 2770 | 830 | **2770** | 1998 | 9972 | 2988 | **9972** |
| **1000** | | 620 | 3100 | 930 | **3100** | 2232 | 11160 | 3348 | **11160** |
| **400** | **400** | 325 | 1630 | 490 | **1630** | 1170 | 5868 | 1764 | **5868** |
| **500** | | 410 | 2040 | 610 | **2040** | 1476 | 7344 | 2196 | **7344** |
| **600** | | 490 | 2450 | 735 | **2450** | 1764 | 8820 | 2646 | **8820** |
| **700** | | 570 | 2850 | 855 | **2850** | 2052 | 10260 | 3078 | **10260** |
| **800** | | 650 | 3250 | 975 | **3250** | 2340 | 11700 | 3510 | **11700** |
| **900** | | 735 | 3670 | 1100 | **3670** | 2646 | 13212 | 3960 | **13212** |
| **1000** | | 820 | 4100 | 1230 | **4100** | 2952 | 14760 | 4428 | **14760** |
| **500** | **500** | 510 | 2540 | 760 | **2540** | 1836 | 9144 | 2736 | **9144** |
| **600** | | 610 | 3050 | 915 | **3050** | 2196 | 10980 | 3294 | **10980** |
| **700** | | 710 | 3550 | 1065 | **3550** | 2556 | 12780 | 3834 | **12780** |
| **800** | | 810 | 4050 | 1215 | **4050** | 2916 | 14580 | 4374 | **14580** |
| **900** | | 915 | 4570 | 1370 | **4570** | 3294 | 16452 | 4932 | **16452** |
| **1000** | | 1020 | 5100 | 1530 | **5100** | 3672 | 18360 | 5508 | **18360** |
| **600** | **600** | 730 | 3650 | 1095 | **3650** | 2628 | 13140 | 3942 | **13140** |
| **700** | | 850 | 4250 | 1275 | **4250** | 3060 | 15300 | 4590 | **15300** |
| **800** | | 970 | 4850 | 1455 | **4850** | 3492 | 17460 | 5238 | **17460** |
| **900** | | 1100 | 5500 | 1650 | **5500** | 3960 | 19800 | 5940 | **19800** |
| **1000** | | 1220 | 6100 | 1830 | **6100** | 4392 | 21960 | 6588 | **21960** |
| **700** | **700** | 990 | 4950 | 1485 | **4950** | 3564 | 17820 | 5346 | **17820** |
| **800** | | 1140 | 5700 | 1710 | **5700** | 4104 | 20520 | 6156 | **20520** |
| **900** | | 1280 | 6400 | 1920 | **6400** | 4608 | 23040 | 6912 | **23040** |
| **1000** | | 1420 | 7100 | 2130 | **7100** | 5112 | 25560 | 7668 | **25560** |
| **800** | **800** | 1300 | 6500 | 1950 | **6500** | 4680 | 23400 | 7020 | **23400** |
| **900** | | 1460 | 7300 | 2190 | **7300** | 5256 | 26280 | 7884 | **26280** |
| **1000** | | 1620 | 8100 | 2430 | **8100** | 5832 | 29160 | 8748 | **29160** |
| **900** | **900** | 1640 | 8200 | 2460 | **8200** | 5904 | 29520 | 8856 | **29520** |
| **1000** | | 1820 | 9100 | 2730 | **9100** | 6552 | 32760 | 9828 | **32760** |
| **1000** | **1000** | 2020 | 10100 | 3030 | **10100** | 7272 | 36360 | 10908 | **36360** |

[1] $\dot{V}_{min}$ = 0 is also possible

[2] TVR only

| Flow rate control tolerances[1] | | |
|---|---|---|
| Flow rate in % of $\dot{V}_{Nom}$ | $\Delta\dot{V}$ in ± % | |
| | TVZ, TVA, TVR, TVRK | TVJ, TVT |
| 100 | 5 | 5 |
| 80 | 5 | 5 |
| 60 | 7 | 7 |
| 40 | 7 | 8 |
| 20 | 9 | 14 |
| 10 | 20 | >14 |

[1] Percentages relative to $\dot{V}_{Act}$

## Single duct units

### Order code, order example

The available options are given in the current price list.

**TVZ / 160 / 00 / B13 / E2 - 150 – 400 l/s**

**TVR / 160 / 00 / B13 / M2 - 50 – 240 l/s**

**TVA / 160 / 00 / B13 / S2 - 50 – 240 l/s**

| Control mode | |
|---|---|
| E | Single |
| M | Master |
| S | Slave |
| F | Constant value |

| Voltage range | |
|---|---|
| 0 | 0 to 10 V DC |
| 2 | 2 to 10 V DC |

| Flow rate parameter | |
|---|---|
| Control mode | Factory settings[2] |
| E2, E0<br>M2, M0 | $\dot{V}_{min}$ and $\dot{V}_{max}$ set at required value |
| S2, S0 | $\dot{V}_{min}$ set at 0 %<br>$\dot{V}_{max}$ set at flow rate ratio to the master controller |
| F2, F0 | $\dot{V}_{min}$ set at required value<br>$\dot{V}_{max}$ set at 100 % |

[2] Adjustment knobs set to “Tool”

# 8 Dual duct units

| TVM flow rate ranges | | | | |
|---|---|---|---|---|
| Nominal size | l/s | | m³/h | |
| | $\dot{V}_{min\ unit}$ | $\dot{V}_{Nom}$ | $\dot{V}_{min\ unit}$ | $\dot{V}_{Nom}$ |
| **125** | 45 | **150** | 162 | **540** |
| **160** | 75 | **250** | 270 | **900** |
| **200** | 120 | **405** | 432 | **1458** |
| **250** | 185 | **615** | 666 | **2214** |
| **315** | 310 | **1025** | 1116 | **3690** |
| **400** | 505 | **1680** | 1818 | **6048** |

**Dual duct units**

**Order code, order example**

The available options are given in the current price list.

**TVM** / **160** / **00** / **B27** / **E2** - **150 - 400 l/s**

| Control mode | |
|---|---|
| E | Single |
| M | Master |
| F | Constant value |

| Voltage range | |
|---|---|
| 0 | 0 to 10 V DC |
| 2 | 2 to 10 V DC |

| Flow rate control tolerances[1] | | |
|---|---|---|
| Flow rate in % of $\dot{V}_{Nom}$ | $\Delta\dot{V}$ in ± % | |
| | $TVM_{cold}$ | $TVM_{total}$ |
| **100** | 5 | 7 |
| **80** | 5 | 10 |
| **60** | 5 | 12 |
| **40** | 7 | 15 |
| **30** | 8 | 20 |
| **20** | 9 | |
| **10** | 20 | |

[1] Percentages relative to $\dot{V}_{Act}$

| Flow rate parameter | | |
|---|---|---|
| Control mode | Factory settings[2] | |
| | Cold controller | Warm controller |
| **E2, E0 M2, M0 F2, F0** | $\dot{V}_{min}$ set at 0 %<br>$\dot{V}_{max}$ set at required flow rate ($\dot{V}_{cold}$) | $\dot{V}_{min}$ set at required flow rate ($\dot{V}_{warm}$)<br>$\dot{V}_{max}$ set at 100 % |

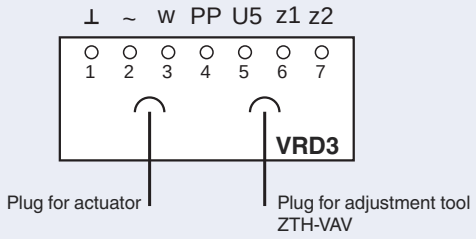
[2] Adjustment knobs set to “Tool”

# 9 Electrical wiring

### Wiring

The actuator and flow rate controller are factory wired. The 24 V supply voltage must be wired by the customer. Safety transformers must be used (EN 60742). If several flow rate controllers are connected to one 24 V network, it is important to ensure that a common neutral or ground wire is used and that this is not connected to any other wiring.

### Terminal allocation




### IMPORTANT

The examples illustrated show the most common arrangements for flow rate control. The generally recognised codes of practice must be observed in the overall control system design, selection of other control components and wire sizing.

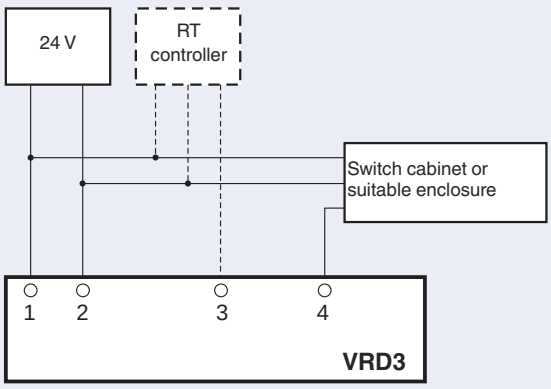
### Nomenclature

| | |
|---|---|
| ⊥ | Ground |
| ~ | Supply voltage 24 V AC (24 V DC) |
| w | Control signal input (0/2 to 10 V DC) |
| PP | PP bus interface for ZTH-VAV |
| U5 | Actual value signal output (0/2 to 10 V DC) |
| z1 | Override control input 1 (OPEN) |
| z2 | Override control input 2 (CLOSED, $\dot{V}_{min}$, $\dot{V}_{max}$) |

### Commissioning connections

It is advisable that the signal line for the adjustment tool ZTH-VAV is linked up in an easily accessible location. This would mean that ceiling panels do not need to be removed for service. Suitable locations include: spare terminals in room temperture controller, wall mounted enclosure or switch cabinet. It is important that the ground/earth (and 24 V) is also available. Therefore, a 3-wire connection is recommended for the commissioning connection.

### Service signal



# 9 Electrical wiring

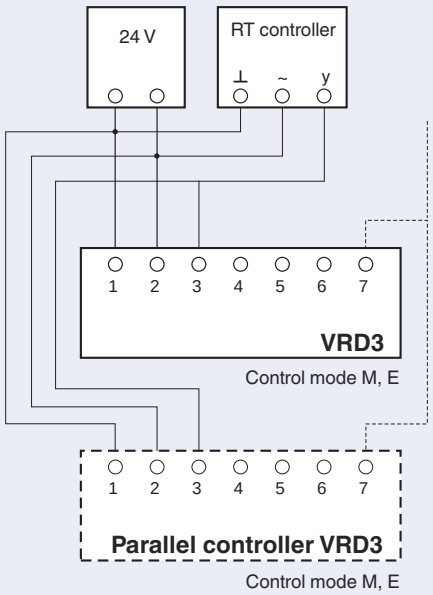
**Room temperature control**

A dedicated room temperature controller or a DDC outstation with 0/2 to 10 V DC output is connected with at least two wires (terminals 1 and 3) as shown opposite. If the controllers are on the same mains (24 V) make sure that terminal 1 of the VRD3 is identical to the ground of the control signal.

**Parallel control**

Several flow rate controllers (supply or extract air) are run in parallel by one controller. If the air terminal units are of the same size and the $\dot{V}_{min}$ and $\dot{V}_{max}$-values are set the same, all units will control to the same flow rate. If there are different settings, then the controls will maintain a constant percentage between the flow rates.

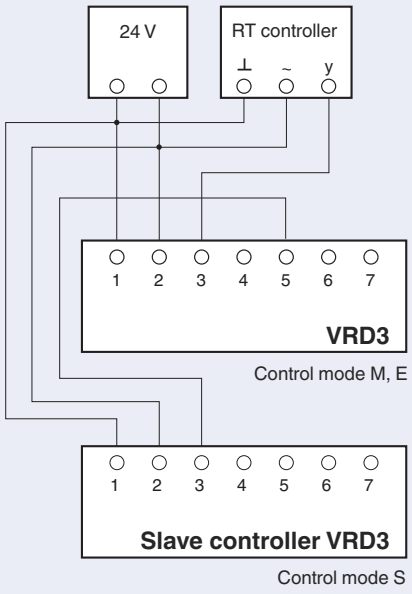
**Room temperature control and parallel control**




**Supply - extract tracking control (Master/Slave)**

If the units are controlled in parallel and if the pressure in one duct section is too low there may be an undesirable difference in flow rate between supply and extract air. It is therefore more beneficial to use the actual value signal, usually that of the supply air, as the control signal for the slave flow rate (extract) controller.

**Tracking control**



# 9 Electrical wiring

### Override controls

External switches (potential-free contacts) provided by the customer can override the variable flow rate control. These overrides can be applied separately for each controller or centrally as shown in the wiring diagram opposite.

### Switch functions

S1, S2, S3 and S4 open : variable flow rate control

S1 closed : Damper blade CLOSED

S2 closed : $\dot{V}_{max}$

S3 closed : $\dot{V}_{min}$*

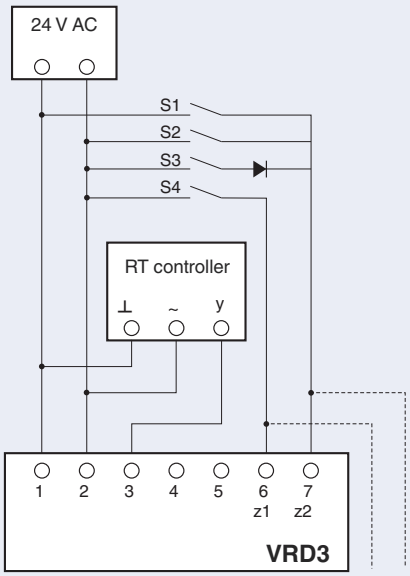
S4 closed : Damper blade OPEN
(Priority to other override controls)

* Only for 24 V AC

### IMPORTANT

When combining several override controls, the switches must be interlocked such that no short-circuit occur. Connection of z1 (Terminal 6) with the terminal 6 of a VRD2 is not allowed.

**Override controls z1 and z2**



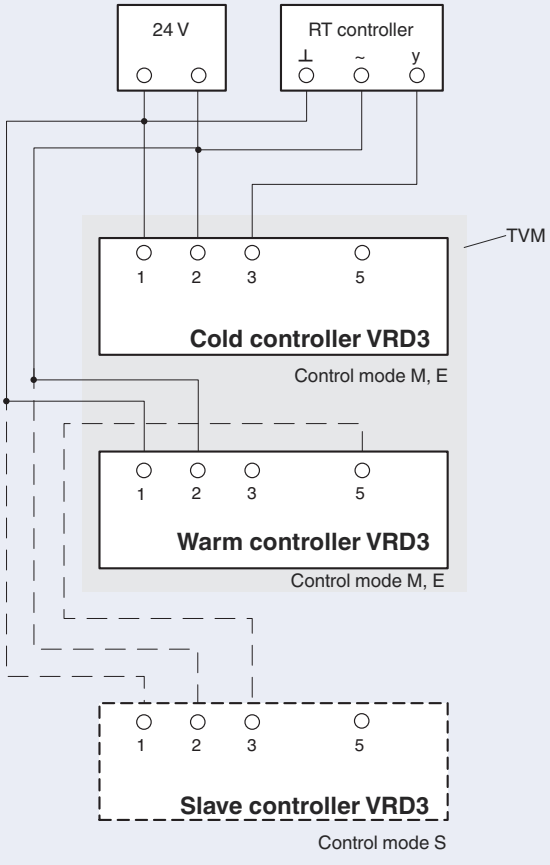

### Flow rate control of TVM units

Two VRD3 are necessary in order to control a dual duct terminal unit type TVM.

The room temperature controller controls the cold duct flow rate controller. In most cases, the proportion of warm air is increased in the heating cycle from 0 to the required $\dot{V}_{min}$. The warm duct controller ($\dot{V}_{total}$ is measured) is therefore set as a constant flow rate controller and does not require a control signal.

If there is a tracking controller, e.g. for extract air, this controller operates as a slave controller with control mode S, and receives the actual value output signal of the warm flow rate controller as control signal.

**Dual duct terminal units type TVM**



# 10 Commissioning

### Commissioning

With the indicator lights a functional test can easily be carried out. If the commissioning procedure is to include verification of the flow rate setpoint values $\dot{V}_{min}$ and $\dot{V}_{max}$, these must be set as described below. The actual value signal U5 is measured in each operating mode and the flow rate is then calculated.

In many cases, incorrect wiring can be the reason for malfunctions. To find faults:

- Disconnect wiring from terminals 3 to 7 and remove the actuator plug
- Disengage actuator drive and open damper blade manually, the voltage U5 must increase
- Connect actuator plug, link terminals 1 and 7: actuator must close
- Change link to 2 to 6: actuator must open
- Remove the link: The controller must control to $\dot{V}_{min}$
- Change link to 2 to 7: The controller must control to $\dot{V}_{max}$
- Remove link. Apply control signal w. Calculate the set flow rate and compare it with the actual flow rate
- Apply override controls z1 and z2, to test the required functions in sequence

The functional check can be simplified using the adjustment tool ZTH-VAV, see page 5. The set flow rate values $\dot{V}_{min}$ and $\dot{V}_{max}$ can be read. Furthermore, the adjustment tool indicates whether the monitored value agrees with the set value.

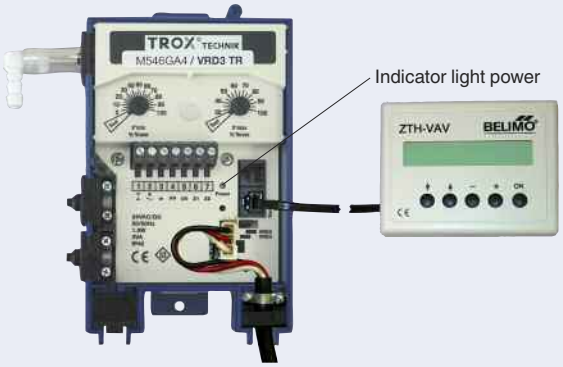
### Replacement controller

When replacing faulty controllers, calibrated controllers set for the air terminal unit type and size must be used. Uncalibrated controllers can only be used as a temporary solution.

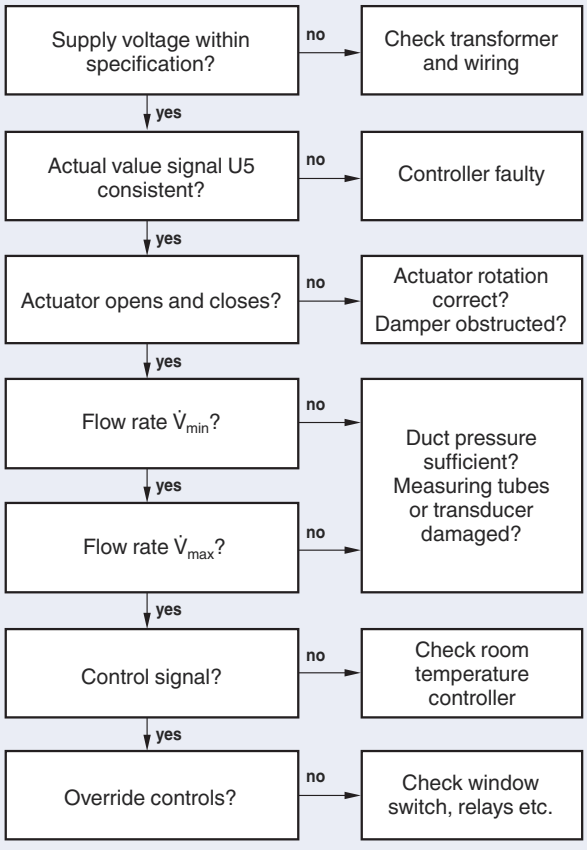
The following must be specified when ordering replacement controllers. This information can be found on the unit label and on the adjustment label of the unit.

- Terminal unit type and size, and in case of TVM units, warm or cold duct controller
- Operating mode
- $\dot{V}_{min}$ and $\dot{V}_{max}$
- Voltage range
- Delivery date of the faulty controller

### Functional testing




### Fault finding check




### Order example spare controller

Spare controller VRD3 (B08PC1) for TVZ/125/00/B13/E0-15 - 150 l/s