



# ExReg-V Volume flow controller 0...1000 Pa

Electrical, explosion-proof volume flow controller (CAV / VAV)

for use exclusively in connection with ExMax-...-CY... actuators

24 VAC/DC power supply, adaptive PID controller, alarm contact

EC type-approved in acc. with ATEX directive 2014/34/EU for zone 1, 2, 21, 22

ExReg - V- ... - A
ExReg - V- ... - CT
ExReg - V- ... - OCT
ExReg - V- ... - VA
ExReg - V- ... - OVA

Subject to change!

## Compact. Easy installation. Universal. Cost effective. Safe.

Type	Sensor	Supply	Sensor range	Connection / Interface (analogue)	Alarm contact	Wiring diagram
ExReg-V- 100 - A	Diff. pressure	24 VAC/DC	0... 100 Pa	1 × actuator, 1 × setpoint, 1 × actual value, 1 × position actuator	Relay contact 30 V / 0.1 A	SB 1.0, 1.1
ExReg-V- 300 - A	Diff. pressure	24 VAC/DC	0... 300 Pa	1 × actuator, 1 × setpoint, 1 × actual value, 1 × position actuator	Relay contact 30 V / 0.1 A	SB 1.0, 1.1
ExReg-V-1000 - A	Diff. pressure	24 VAC/DC	0...1000 Pa	1 × actuator, 1 × setpoint, 1 × actual value, 1 × position actuator	Relay contact 30 V / 0.1 A	SB 1.0, 1.1
ExReg-V- ... - CT	Types as above with aluminium housing and seawater resistant coating (cable glands M16 brass nickel-plated, screws in stainless steel)					
ExReg-V- ... - OCT	Types as above, offshore versions with aluminium housing and seawater resistant coating (tubes for clamping ring connection and screws in stainless steel, cable glands M20 brass nickel-plated)					
ExReg-V- ... - VA	Types as above with stainless steel housing for aggressive ambient (cable glands M20 brass nickel-plated, screws in stainless steel)					
ExReg-V- ... - OVA	Types as above, offshore version with stainless steel housing for aggressive ambient (tubes for clamping ring connection and screws in stainless steel, cable glands M20 brass nickel-plated)					

### Product views and applications



### Description

The ExReg-V... flow controller is an essential component of technical building services, chemistry, pharmacy, industry and in onshore and offshore plants, for use in hazardous areas in zones 1, 2 (gas) and 21, 22 (dust).

Highest protection class (ATEX) and IP66 protection, small dimensions and universal functions and technical specifications ensure safe operation, even in harsh ambient conditions.

ExReg-V... is for direct use in hazardous areas, for flow control of air in ventilation systems. For technical implementation, an ExMax-...-CY or ExMax-...-CYF damper actuator (with Fail Safe spring return) and a ventilation damper with measuring orifice and a known shield factor (also called k-factor) are required.

All controllers can be parametered on-site using menu navigation, without any additional electronic aids. The internal PID control structure is easy to use and can be configured fully automatically for standard applications. The display indicates the current status for actual value, setpoint value and control variable during operation (can be switched off as required). ...Reg-V...-OCT and ...-OVA offshore versions are equipped with stainless steel tubing Ø 6 mm.

### Highlights

- ▶ For all type of gas, mists, vapours and dust for use in zone 1, 2, 21 and 22
- ▶ Power supply 24 VAC/DC
- ▶ Sensor and controller in a single housing
- ▶ Direct connection of actuator to the controller's integrated Ex-e terminal box
- ▶ No additional Ex-i module in panel required
- ▶ No intrinsically safe wiring/installation between sensor and panel required
- ▶ No intrinsically safe wiring/installation and no space in the panel required
- ▶ Relay output with adjustable alarm monitoring
- ▶ Scalable analogue input and output (selectable für setpoint, actual value, et al.)
- ▶ Optional analogue output for controller feedback
- ▶ Adjustable k-factor, universally applicable for any dampers
- ▶ Display with backlight, can be switched off
- ▶ Password locking
- ▶ Down to -20 °C ambient temperature applicable
- ▶ Compact design and small dimension
- ▶ Robust aluminium housing (optional with seawater resistant coating) or in stainless steel
- ▶ IP66 protection
- ▶ Offshore versions with pressure tube connection for clamping ring Ø 6 mm

**ExMax-...-CY... – see additional data sheet**



### Technical data

Supply voltage, frequency	24 VAC/DC +15 % (24,0...27,6 VAC/DC), 50/60 Hz
Current, power consumption	150 mA, ~ 3 W, internal fuse 350 mA, without bracket, not removable
Galvanic isolation	Supply to analogue inputs and outputs min. 1,5 kV, supply to relay output min. 1,5 kV
Electrical connection	Terminals 0,14...2,5 mm <sup>2</sup> in integrated Ex-e terminal box, wire stripping length 9 mm, tightening torque 0,4...0,5 Nm, equipotential bonding 4 mm <sup>2</sup>
Cable glands	2 × M16 × 1,5 mm, Ex-e approved, for cable diameter ~ Ø 5...9 mm
Cable glands ...-CT	2 × M16 × 1,5 mm, Ex-e approved, brass nickel-plated, for cable diameter ~ Ø 6...10 mm
...-VA, ...-OCT, ...-OVA	2 × M20 × 1,5 mm, Ex-e approved, brass nickel-plated, for cable diameter ~ Ø 6...13 mm
Protection class	Class III (grounded)
Display	LCD display backlit, for configuration, user guidance, parameter setting and actual value display. Status display via LEDs.
Control elements	3 buttons for configuration
Housing material	Aluminium die-cast housing, coated. Optional with seawater resistant coating (...-CT/...-OCT) or stainless steel housing, № 1.4581 / UNS-J92900 / similar AISI 316Nb (...-VA/...-OVA)
Dimensions (L × W × H)	Aluminium housing ~ 180 × 107 × 66 mm, stainless steel housing ~ 195 × 127 × 70 mm (each without connectors)
Weight	~ 950 g aluminium housing, stainless steel version ~ 2,5 kg
Ambient temperature	-20...+50 °C, storage temperature -35...+70 °C
Ambient humidity	0...95 % rH, non condensing
Sensor circuit	Internal intrinsically safe circuit
Sensor	Piezo pressure transmitter
Pressure connection	P+ / P- sleeves Ø 4...6 mm. OCT and OVA versions have 2 stainless steel (316L) tube connections for clamp ring fittings Ø 6 mm
Measuring range	0...300 Pa, minimum measuring range is 2 % of full scale
Sensor damping (filter)	1...50 seconds, adjustable
Precision of pressure measurement	± 2,5 % full scale ± 1 Pa
Zero point setting	Via menu. Both tube connections P+ / P- must be mechanically short-circuited for the time of zero point setting
Volume flow	Calculation via k-factor ("shield factor"); adjustable parameters: V <sub>max</sub> , V <sub>min</sub> , V <sub>Nom</sub> , k-factor
Control	Adaptive PID controller (automatic or manual mode selectable)
Control tolerance	1...5 % adjustable
Delay time	3 s
Alarm monitoring	Volume flow monitoring; adjustable functions: tolerance limit (fixed value and variable value), alarm delay
Alarm contact (terminal 3)	Relay; max. values: 0.1 A (30 VAC/DC), min. values: 10 mW / 0.1 V / 1 mA
Life time mechanically	10 × 10 <sup>6</sup>
electrically (nominal load)	100 × 10 <sup>3</sup>
Current output (terminal 6)	Range 4...20 mA, invertible, basic accuracy ± 1.0 % of full scale, load impedance < 500 Ω, influence < 0.1 %, open circuit voltage 24 V
Voltage input (terminal 8)	Range 0...10 V, invertible, basic accuracy ± 1.0 % of full scale, surge-protected up to 30 V
Voltage input (terminal 9)	Range 0...10 V, adjustable, basic accuracy ± 1.0 % of full scale, surge-protected up to 30 V
Voltage output (terminal 11)	Range 0...10 V, adjustable, basic accuracy ± 1.0 % of full scale, load > 10 kΩ, influence < 0.1 %, short circuit-proof
Voltage input (terminal 13)	Range 0...10 V, adjustable, basic accuracy ± 1.0 % of full scale, surge-protected up to 30 V
Wiring diagram	SB 1.0 / 1.1
Scope of delivery	Sensor, 3 self-tapping screws 4,2 × 13 mm resp. in stainless steel (with ...CT and ...VA versions), short circuit tube

### Approbations

ATEX directive	2014/34/EU
EC type-approved	EPS 11 ATEX 1 380
IECEX certified	IECEX EPS 12.0028
Approval for gas	II 2 (1) G Ex e mb ib [ia Ga] IIC T6 Gb
Types ...-CT, ...-OCT	II 2 (1) G Ex e mb ib [ia Ga] IIB T6 Gb
Approval for dust	II 2 (1) D Ex tb ib [ia Da] IIIC T80°C Db IP66
CE marking	CE № 0158
EMC directive	2014/34/EU
Enclosure protection	IP66 in acc. with EN 60529

### Special solutions and accessories

...-CT	Types in aluminium housing with seawater resistant coating, parts nickel-plated
...-OCT	Offshore version in aluminium housing with seawater resistant coating, parts nickel-plated
...-VA	Types in stainless steel housing, parts nickel-plated
...-OVA	Offshore version in stainless steel housing, parts nickel-plated
ExMax-...-CY	Control actuator, 4...20 mA Input, 0...10 V output
ExMax-...-CYF	Control actuator, 4...20 mA Input, 0...10 V output with spring return
ExBox-Y/S	Ex-e terminal box
MKR	Mounting bracket for round ducts up to Ø 600 mm
Kit-S8-CBR	2 cable glands M16 × 1,5 mm, Ex-e, brass nickel-plated, for cable Ø 5...10 mm
Kit 2	Flexible pressure tube, 2 m, inner Ø 6 mm, 2 connection nipples
Kit-PTC-CBR	2 connecting tubes for tube fittings Ø 6 mm, stainless steel 316 L



Important information for installation and operation

A. Installation, commissioning, maintenance

All national and international standards, rules and regulations must be complied with. For electrical installations design, selection and erection, EN/IEC 60079-14 can be used.



Attention: Apply all Ex rules and regulation before opening the internal terminal box. Do not open cover when circuits are live!

Draw the wiring cables through the cable glands. For connection use the internal Ex-e approved terminal box and connect equipotential bonding.

After connection install the cables in a fixed position and protect them against mechanical and thermal damage. Close all openings and ensure IP protection (min. IP66).

Avoid temperature transfer and ensure not to exceed max. ambient temperature! For outdoor installation a protective shield against sun, rain and snow should be applied.

After mounting and installation a zero point compensation must be done to ensure correct measurement results (see description).

Sensors are maintenance free. An annual inspection is recommended. For electrical installations inspection and maintenance, EN/IEC 60079-17 can be used.

Ex sensors must not be opened and repaired by the end user. Clean with damp cloth only.

B. Long cabling

We recommend using shielded signal wires and to connect one end of the shield to the ...Reg-... terminal box.

C. Separate ground wires

For supply and signal wires use separate grounds.

D. Impedance of MCR system

To ensure the proper function of the built-in wire break detection (CAV mode), the

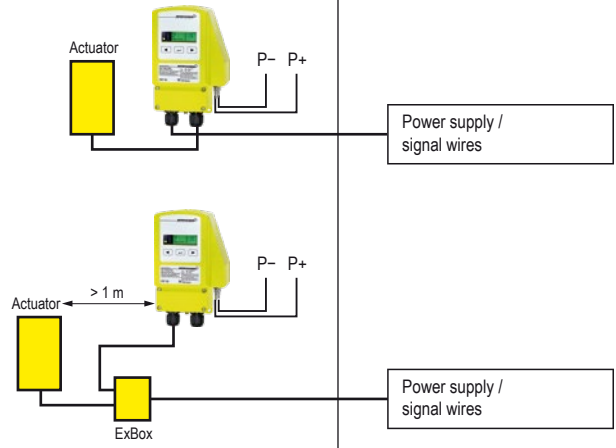
impedance of the voltage source from which the setpoint signal for terminal 13 is generated must be less than or equal to 10k ohms. With higher impedances, a malfunction of the wire break detection is possible.

Installation

Hazardous area – Zone 1, 2, 21, 22



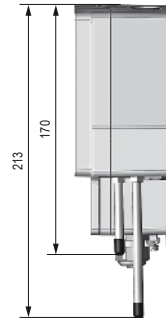
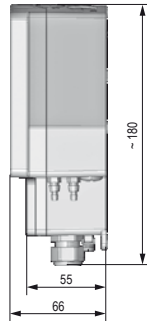
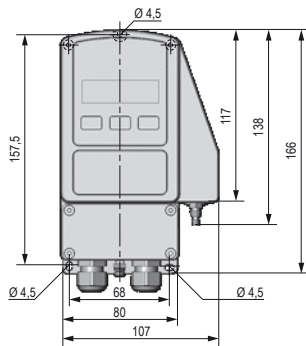
Safe area



Dimensions [mm]

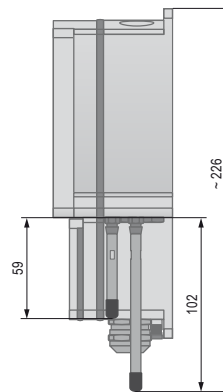
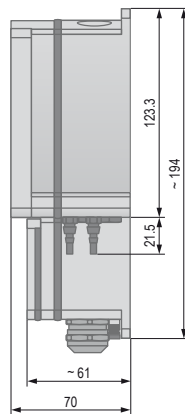
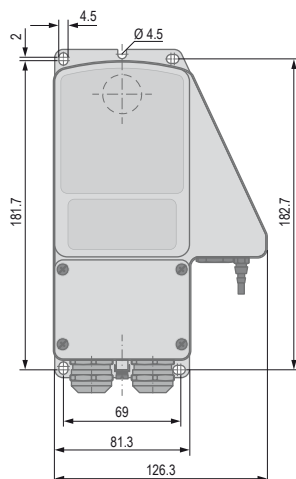
Aluminium housing

...Reg-V...-OCT

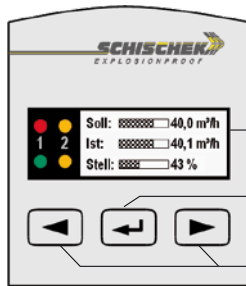


Stainless steel housing

...Reg-V...-OVA



**Display, control elements and parameter setting**



Display for programming and indication

Push button ENTER

Push button for selection

**Display in operating mode**

The current setpoint value, the actual value and the actuating value are displayed in operating mode. The red or green LEDs indicate the current operating status.

If the system is in the adjusted state, the green LED lights continuously and signals fault-free operation. The red LED lights if the control variable limits are reached or if an internal error is detected.

A flashing red LED indicates that the setpoint value cannot be achieved. In this case, the alarm function is active.

The yellow LEDs show the actuator's direction of motion during the adjustment phase. If the upper yellow LED is flashing, the actuator is opening. If the lower yellow LED is flashing, the actuator is closing. The yellow LEDs are switched off when the system is within the defined control tolerance (see Menu 8.6).

**Switchover from operation mode to parametrisation mode**

The switchover from operating mode to parameters mode switches the operating function to the parameters function. The switchover is performed by pressing once on the ENTER button (↵) for at least 6 seconds. Return to operating mode via "Leave menu".

**Selection of access level**

The access level, which allows access to a selection of menu items only, depending on the user group, must be selected immediately after switching to parametrisation mode. Password protection can also be applied to the individual access levels. The password must then be entered.

**User groups**

There are three access levels available for user groups, which can be protected with different passwords:

- Group/Level 1: User
- Group/Level 2: Service
- Group/Level 3: Manufacturer

Only a few menu items can be parametered in the user level, which is intended for users without specialist knowledge. Almost all menus are available in the service level, so that initial start-up may be performed on-site. The calibration values for the volume flow unit (k-factor, nominal value) can also be defined in the manufacturer level. Hence, this level is intended for damper manufacturers.

**Password protection**

Parametering can be protected with various passwords, depending on the user group. The appropriate, password-protected access level must be selected before the main menu is displayed. The password can be set and changed in Menu 12. Access is unrestricted if no password is set ("0" value).

Note: If a password is no longer known, menu access can be unblocked using a master password.

The master password varies from one device to the next, and can be obtained from our sales service.

If you have obtained a complete unit from a damper manufacturer, please contact their service department.

**Applications Menu 2**

As a first step in setting parameters for the volume flow controller, the corresponding application must be selected in Menu 2.

The "VAV controller" option must be selected for volume flow control. This configures the ...Reg-V as a volume flow controller.

The ...Reg-V can be used for various applications, which are set as follows in Menu 2:

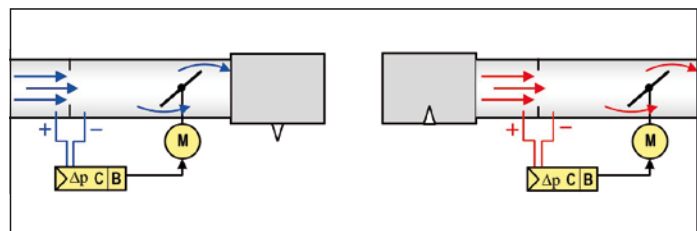
Menu	Wiring diagram	Menu structure
2.1 Volume flow control	SB 1.0	Table 1.0
2.2 Volume flow sensor	SB 2.0	Table 1.1
2.3 Pressure control	SB 1.0	Table 1.2
2.4 Pressure sensor	SB 2.0	Table 1.3

These settings are the same as the factory settings for the corresponding application. Hence, beginning parametering of the ...Reg-V with this menu is recommended.

**Example: VAV/CAV volume flow control**

The volume flow control is used for ventilation of areas intended to have a specific exchange of air. A volume flow unit normally consists of a damper with an actuating drive, a measurement orifice and the volume flow controller. These units can be used both at the input side (supply air) as well as the output side (exhaust air). Ill. 1 shows a typical use case for ventilation of an area with supply air and exhaust air control.

Electrical connection is established in accordance with SB 1.0; the menu structure is illustrated in table 1.0.



Ill. 1: Ventilation of an area with supply air and exhaust air control


**Application Volume flow controlling (VAV/CAV)**

Menu 2.1

The main application for the ...Reg-V is the control of variable (VAV) or constant (CAV) volume flows in ventilation technology. The differential pressure is measured by means of a suitable measurement orifice and is converted into the corresponding volume flow within the device. The setpoint value is set in VAV operation by the control system, or in CAV operation by the device via the menu settings (see Menu 7.2). In normal operation, the internal control structure constantly compares the current volume flow (actual value) with the set volume flow (setpoint value) and reconciles them by correcting the control variable (e.g. damper actuator).

	Function	User	Service	Manufacturer
Menu 1	Language	✓	✓	✓
Menu 2	Application		✓	✓
Menu 3	Sensor		✓	✓
Menu 4	Actuator		✓	✓
Menu 5	Air volume	✓	✓	✓
Menu 5.1	Unit			✓
Menu 5.2	k-factor			✓
Menu 5.3	Nominal value			✓
Menu 5.4	Maximum value	✓	✓	✓
Menu 5.5	Minimum value	✓	✓	✓
Menu 6	Actual value		✓	✓
Menu 7	Nominal value		✓	✓
Menu 8	Controller		✓	✓
Menu 9	Switch	✓	✓	✓
Menu 11	Diagnostics		✓	✓
Menu 12	Password	✓	✓	✓
Menu 12.1	Level 1	✓	✓	✓
Menu 12.2	Level 2		✓	✓
Menu 12.3	Level 3			✓
Menu 13	Indication	✓	✓	✓
Menu 14	Parameter		✓	✓
Menu 15	Leave menu	✓	✓	✓

Table 1.0

**Application Volume flow sensor**

Menu 2.2

The ...Reg-V can be used purely as a volume flow sensor in Menu 2.2. The control function is deactivated in this operating mode. A measurement orifice is also required for the application and must be calibrated to the required volume rate. Parameters for the volume flow's electrical output can be set using the menu.

Electrical connection is established in accordance with SB 1.1; the menu structure is illustrated in table 1.1.

	Function	User	Service	Manufacturer
Menu 1	Language	✓	✓	✓
Menu 2	Application		✓	✓
Menu 3	Sensor		✓	✓
Menu 4	[ no function ]			
Menu 5	Air volume	✓	✓	✓
Menu 5.1	Unit			✓
Menu 5.2	k-factor			✓
Menu 5.3	[ no function ]			
Menu 5.4	Maximum value	✓	✓	✓
Menu 5.5	Minimum value	✓	✓	✓
Menu 6	Actual value		✓	✓
Menu 7	[ no function ]			
Menu 8	[ no function ]			
Menu 9	Switch	✓	✓	✓
Menu 11	Diagnostics		✓	✓
Menu 12	Password	✓	✓	✓
Menu 12.1	Level 1	✓	✓	✓
Menu 12.2	Level 2		✓	✓
Menu 12.3	Level 3			✓
Menu 13	Indication	✓	✓	✓
Menu 14	Parameter		✓	✓
Menu 15	Leave menu	✓	✓	✓

Table 1.1

**Application Pressure controller**

Menu 2.3

The ...Reg-V can be configured as a pressure controller for overpressure and negative pressure applications in Menu 2.3. Parameters are set in the same way as for the "volume flow control" application. The difference is that the menu items for calculating the volume flow are omitted, and all values are applied in Pascal.

Electrical connection is established in accordance with SB 1.0; the menu structure is illustrated in table 1.2.

	Function	User	Service	Manufacturer
Menu 1	Language	✓	✓	✓
Menu 2	Application		✓	✓
Menu 3	Sensor		✓	✓
Menu 4	Actuator		✓	✓
Menu 5	Pressure	✓	✓	✓
Menu 5.4	Maximum value	✓	✓	✓
Menu 5.5	Minimum value	✓	✓	✓
Menu 6	Actual value		✓	✓
Menu 7	Nominal value		✓	✓
Menu 8	Controller		✓	✓
Menu 9	Switch	✓	✓	✓
Menu 10	[ no function ]			
Menu 11	Diagnostics		✓	✓
Menu 12	Password	✓	✓	✓
Menu 12.1	Level 1	✓	✓	✓
Menu 12.2	Level 2		✓	✓
Menu 12.3	Level 3			✓
Menu 13	Indication	✓	✓	✓
Menu 14	Parameter		✓	✓
Menu 15	Leave menu	✓	✓	✓

Table 1.2

**Application Pressure sensor**

Menu 2.4

The ...Reg-V can be used as a pressure sensor in Menu 2.4. The control function is deactivated in this operating mode. The measurement signal is indicated both as a 4...20 mA signal at terminals 6 and 7 and as a 0...10 V signal at terminals 11 and 12. In addition, an alarm contact can be used via terminal 3 in the event of a value exceeding or falling below a set value range. Parameters for the volume flow's electrical output can be set using the menu. Electrical connection is established in accordance with SB 2.0; the menu structure is illustrated in table 1.3.

	Function	User	Service	Manufacturer
Menu 1	Language	✓	✓	✓
Menu 2	Application		✓	✓
Menu 3	Sensor		✓	✓
Menu 4	[ no function ]			
Menu 5	Pressure	✓	✓	✓
Menu 5.4	Maximum value	✓	✓	✓
Menu 5.5	Minimum value	✓	✓	✓
Menu 6	Actual value		✓	✓
Menu 7	[ no function ]			
Menu 8	[ no function ]			
Menu 9	Switch	✓	✓	✓
Menu 10	[ no function ]			
Menu 11	Diagnostics		✓	✓
Menu 12	Password	✓	✓	✓
Menu 12.1	Level 1	✓	✓	✓
Menu 12.2	Level 2		✓	✓
Menu 12.3	Level 3			✓
Menu 13	Indication	✓	✓	✓
Menu 14	Parameter		✓	✓
Menu 15	Leave menu	✓	✓	✓

Table 1.3

**Electrical connection**

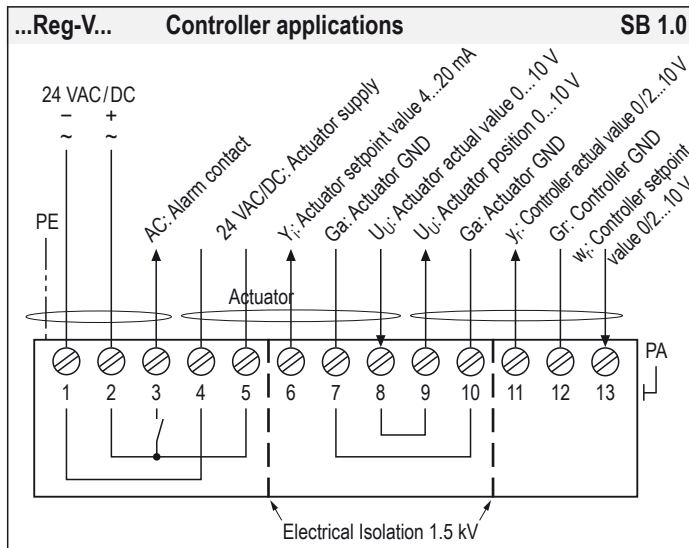
The controller is operated using a 24 VAC/DC power supply terminal 1 (-/-) and 2 (+/+). Terminals 1 and 2 are connected internally to terminals 4 and 5 and function as power supply for the actuator. The actuator's electrical connectors are directly connected to the controller via terminals 4 – 8. An additional terminal box to the actuator's connection can be omitted, as long as the actuator is assembled less than 1 metre from the controller. Otherwise, an additional terminal box should be used.

The actuator needs approx. 2 A starting current for max. 1 s in order to initialise.

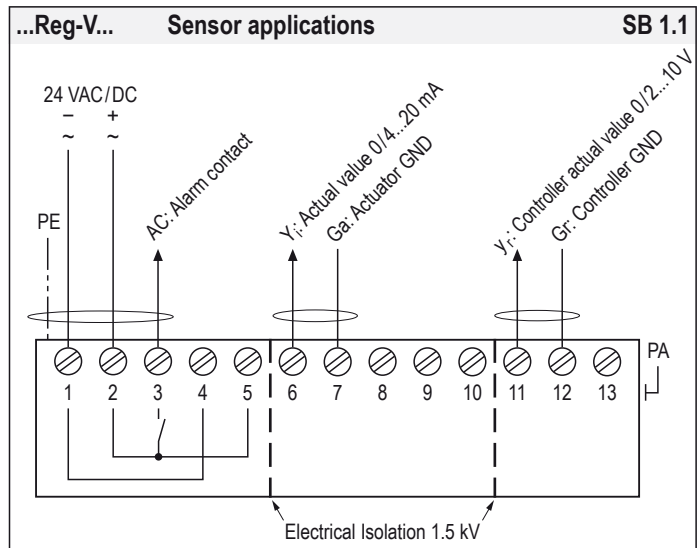
**Attention:** The sensor must be disconnected from voltage before opening the cover of the terminal box!

The alarm contact (terminal 3) acts as acknowledgement of normal operation. The device also has an analog output (terminal 11) which outputs the current setpoint value as a constant signal, and an analog feedback signal for the damper position (terminal 9). This function is predominantly used to save energy.

The setpoint value is set via terminal 13. The voltage range for minimum and maximum volume flow is defined either from 0...10 V or from 2...10 V. Depending on the "setpoint value" (Menu 6) setting used, the positive control function can also be used. If the voltage level of approx. 12 V is exceeded, the damper opens; if the level falls below 0.2 V, the damper is completely closed. The controller is out of service during these positive control functions (Damper Open/Closed). A switch to CAV mode occurs if the input is unwired. The setpoint value is set by the device in this operating mode, and can be adjusted in Menu 7.2 (setpoint value setting).



Electrical connection for the "volume flow control" and "pressure control" applications.



Electrical connection for the "volume flow sensor" and "pressure sensor" applications.

Note:  
The current output and voltage output can be used simultaneously.

**Differential pressure sensor**

Menu 3

The...Reg-V... integrated precision pressure controller is suitable for measuring both differential pressure and volume flow. Hence, the controller can be used both as a volume flow sensor or as a differential pressure sensor.

**Sensor filter**

Menu 3.1

The ...Reg-V... has an electronic filter, which can be used to moderate the sensor signal in the event of pressure fluctuations.

The filter value entered sets the interval between 1 and 50 seconds, in which the sliding average value is calculated. If 20 s is set, for example, the measured values of the previous 20 seconds are used consecutively to determine the average value.

**Zero point compensation**

Menu 3.2

For...Reg-V... a zero point offset must be performed for controllers at initial start-up in order to correct measured value deviations relating to the installation position. To do this, pressure connectors P+ and P- must be short-circuited mechanically, and the offset is carried out using the parameter setting menu navigation (Menu 18).

The sensor should be connected to the supply voltage for approx. 15 minutes prior to the zero point offset in order to achieve a balanced operating temperature!

**Volumen flow**

Menu 5

The ...Reg-V... has a precision pressure controller which is suitable for measuring both differential pressure and volume flow. Volume flow cannot be directly measured with the differential pressure procedure; it requires a suitable measurement orifice in order to do so, and volume flow rate must be calculated in accordance with the design of the measurement orifice and of the duct.

Volume flow for the ...Reg-V... is calculated according to equation 1.0. The design of the volume flow unit is summarised with the k-factor (often also referred to as c-factor). I.e. this characteristic must be known, or it must be possible to measure it in situ, for operation to take place.

$$\dot{V} = k \cdot \sqrt{\Delta p} \quad (\text{Equation 1.0})$$

$$k = \frac{\dot{V}}{\sqrt{\Delta p}} \quad (\text{Equation 1.1})$$

The volume flow is calculated using the differential pressure (see equation 1.0). A maximum volume flow  $V_1$ , is calculated based on the internal pressure sensor and the set k-factor, and cannot be exceeded.

$$V_1 = k \cdot \sqrt{\Delta p_{max}} \quad (\text{Equation 2.0})$$

Example:  
...Reg-V-300-A

The measurement range between 0 and  $V_{nom}$  and the control range between  $V_{min}$  and  $V_{max}$  can be defined as desired between 0 and  $V_1$ .

**k-factor**

Menu 5 continued

**1. Determination of the k-factor**

If the k-factor is unknown, it can be calculated either using the volume flow unit manufacturer's information, or determined experimentally on-site.

**Method 1:** Use of manufacturer's instructions

Some manufacturers of volume flow units indicate typical values, e.g. 1000 m<sup>3</sup>/h at 100 Pa, in datasheets or on the VAV unit's identification plate. The k-factor can be calculated on the basis of this data as per equation 1.1.

This method is relatively inexact, however, as the values specified relate to typical values; hence, production tolerances are not taken into account.

**Method 2:** Experimental determination

As with the first method, a pressure value in Pa and an associated volume flow value in m<sup>3</sup>/h are required for experimental determination. To carry it out, a reference instrument for volume flow is required and must be attached to the ventilation duct.

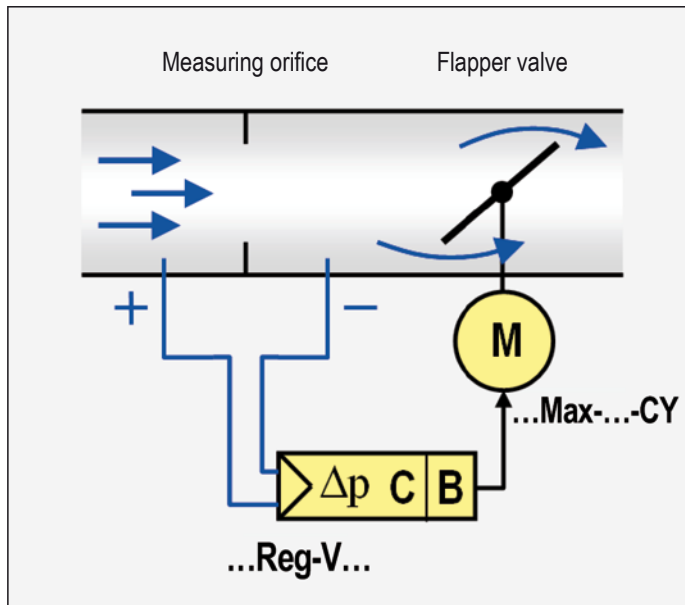
The actuator can be moved into a suitable position in Menu 4.2 "Test" (typically 70...100 %) and the measurement value in Pa can then be read from Menu 3.3 "Sensor status", and the volume flow can be read in m<sup>3</sup>/h on the reference instrument.

The k-factor is also calculated according to equation 1.1.

**2. Verification of the k-factor**

In order to verify the k-factor identified, it should be entered in Menu 5.2 "Volume flow rate k-factor" and the volume flow measured should then be read in m<sup>3</sup>/h in "Actual value status", Menu 6.3. This display and the reference instrument's measurement value should be identical. Several other measurement points should also be verified in this way. Another damper position can then be put into operation in Menu 4.2 "Test", so that another volume flow is set which can, in turn, be verified in Menu 6.3.

**Example: Volume flow measurement**

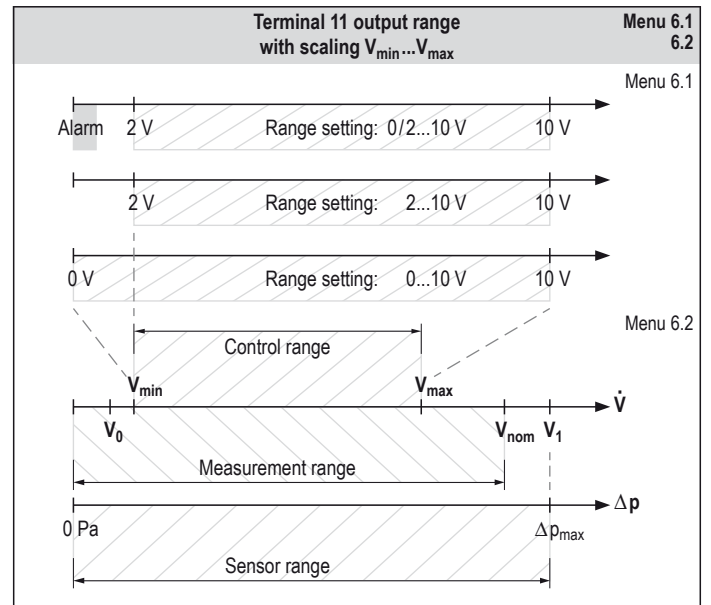
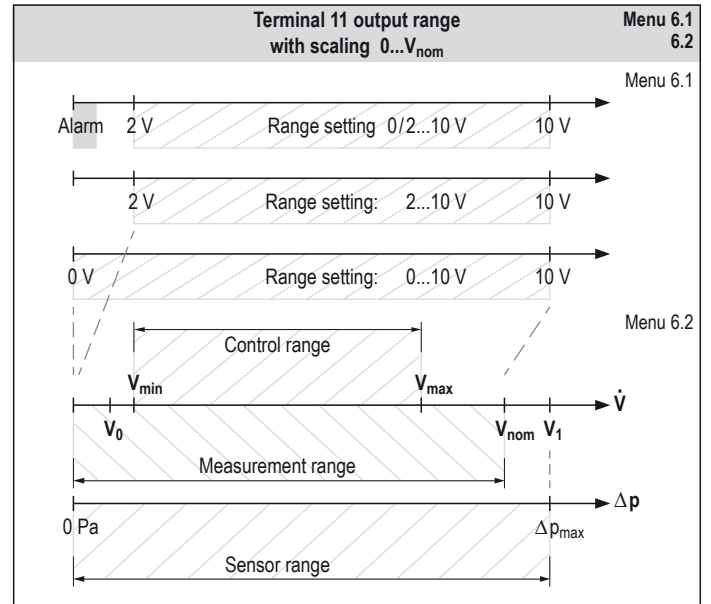


III. 2: Block diagram of CAV/VAV volume flow control consisting of a measurement orifice, damper and controller/actuator combination (...Reg-V... + ...Max-...-CY).

**Actual value "Control" application**

Menu 6

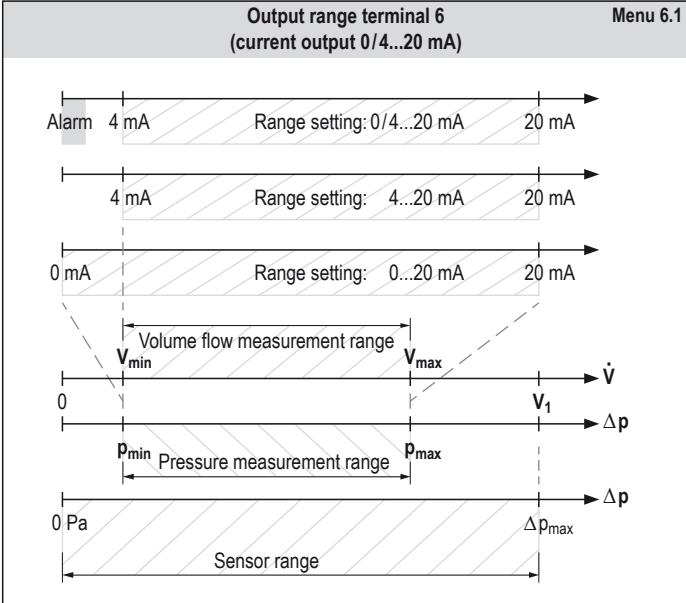
These settings are for use in the "VAV controller" and "pressure controller" applications. The basic value ranges for the control variables defined here have a direct influence on scaling of the analog output signal for the actual value. The measurement range is usually output for the actual value. Alternatively, the control range can also be used as scaling (see Menu 6.2).





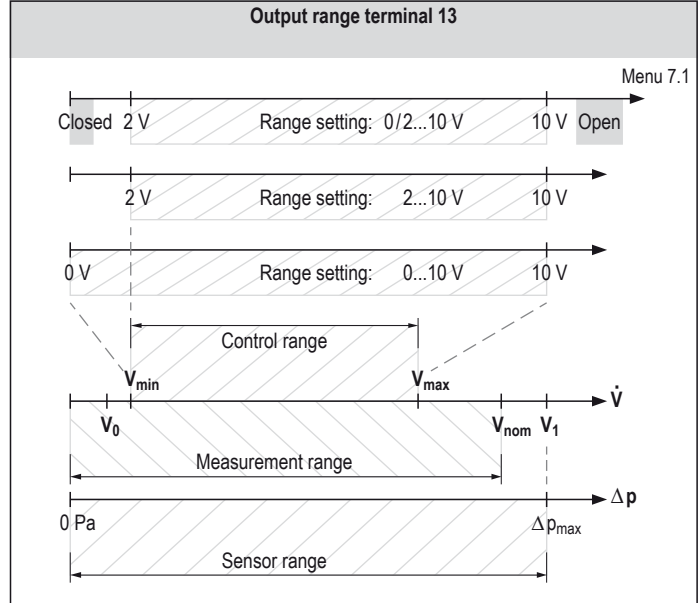
Actual value "Sensor" application Menu 6

These settings are for use in the "VAV sensor" and "pressure sensor" applications. The basic value ranges for the measured variables defined here have a direct influence on scaling of the analog output signal for the actual value. The measurement range is usually output for the actual value. Alternatively, the control range can also be used as scaling (see Menu 6.2).

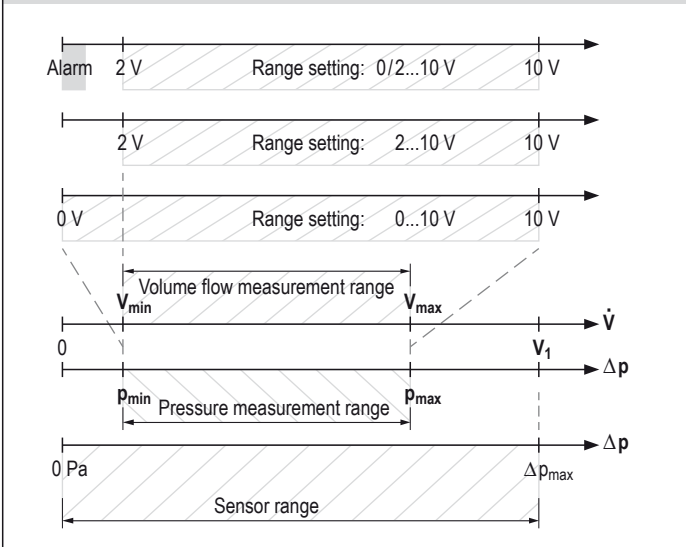


Setpoint value Menu 7

The control range between minimum and maximum value (V\_min and V\_max) is always used for the setpoint value.



Output range terminal 11 (voltage output 0/2...10 V) Menu 6.2



Control (general) Menu 8

There are a range of processes in nature, technology and economics that act as controls. Product pricing is controlled by supply and demand in economics, for example. Or, an individual controls his/her personal circumstances, i.e. in each of these cases, a system (in technology, the term "controlled system" is used) is brought out of balance by certain or unknown circumstances (disturbance variables). The controller, which can be a person, a device or a system in general, attempts to restore the desired state (setpoint value, reference variables, etc.) by means of an intervention (control variable).

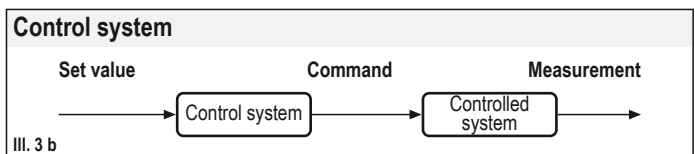
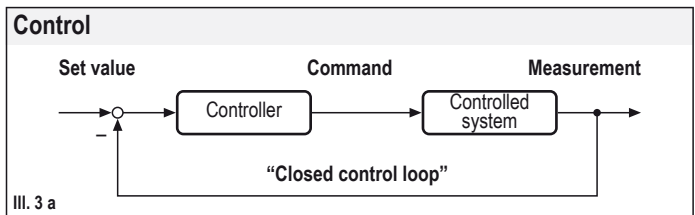
Hence, in technology, a control is always used where disturbances may influence the actual value (measurement value) and are largely known.

The objective of a control is to bring a physical variable to a defined value, and to keep it constant. The preset value (reference variable/setpoint value) is continuously compared with the measurement value (actual value) for this purpose. A controller corrects the control variable according to the deviation in order to bring the actual value to the setpoint value and to keep it there. A closed functional chain (closed-loop system) is characteristic of a control (see III. 3 a).

In contrast to a control, an open-loop control has only an open-loop system (see III. 3 b) i.e. a certain actual value (measurement value) is set using the set value via the open-loop control; however, verification does not take place.

The terminology and definitions of control technology are defined in the DIN IEC 60050-351 series of standards. A control is described as follows:

"A control is a procedure in which a variable's set value is continuously produced and maintained by means of interventions on account of measurements".







### Control configuration

Menu 8 continued

...Reg-V... are designed for volume flow control. The control action can be set in Menu 8 "Controller". Fully automatic calculation of control parameters ("Auto" selection) is sufficient in normal operation. In addition, an adaptive PID controller (P component is calculated automatically) and a standard PID controller can be selected. These settings should only be applied by trained specialists.

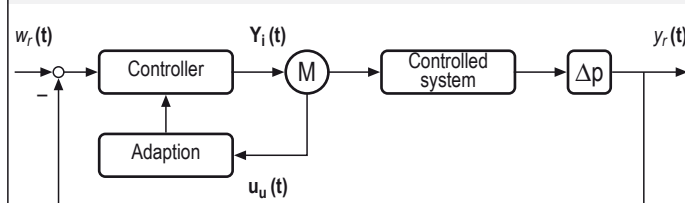
Under certain circumstances – particularly during major pressure fluctuations in the air duct – the control circuit gain (Menu 8.2) and control tolerance (Menu 8.6) should be adjusted.

#### Controller types

The ...Reg-V... has three different PID control structures, which differ from each other in respect of their levels of automation. The controller type can be selected in Menu 8.1. The following settings are available for selection:

Option	Type	automatic setting
1.) „Auto“	fully automatic controller	P, I and D component
2.) „PID adaptiv“	semi-automatic controller	P component
3.) „PID norm“	manual controller	none

### Control ...Reg-V...



#### Explanations:

$w_r(t)$ = setpoint value controller	R = Controller (...Reg-V internal control structure)
$y_r(t)$ = actual value controller	M = Actuator (e.g. ...Max actuating drive)
$Y_i(t)$ = setpoint value control variable	S = Controlled system (consisting of duct piece with measuring orifice and valve)
$u_u(t)$ = actual value control variable	$\Delta p$ = differential pressure
	A = Adaption (automatic internal controller adjustment of ...Reg-V)

III. 4

### Control rate

The control speed can be specified directly via the actuator's run time. The control parameter does not need to be modified in this case. The controller automatically factors in the change to runtime via the actuator's feedback cable (terminal 7). This applies to all controller settings. Thus, the control speed depends only on the actuator runtime used.

Please refer to the actuator's datasheet for further information.

### Actual value monitoring (alarm function)

Menu 9

The adjustable alarm function can be used to monitor the actual value. An activated alarm is signalled both visually and electrically (see "Alarm function signalling").

Both a fixed limit and a percentage limit relating to the setpoint value can be set as alarm limits. If both values are set, they are added together.

#### Example 1: Volume flow application

Limit (%) = 4 %; setpoint value = 500 m<sup>3</sup>/h; fixed limit = 10 m<sup>3</sup>/h

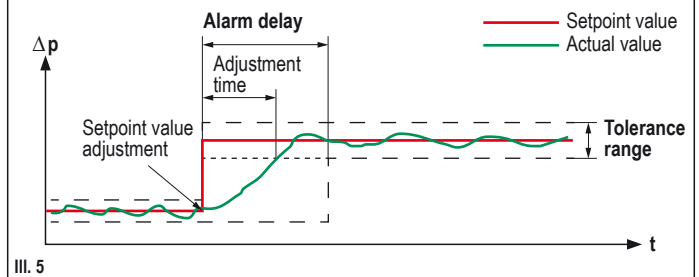
Tolerance limit:  $\pm (0.04 \times 500 \text{ m}^3/\text{h} + 10 \text{ m}^3/\text{h}) = \pm 30 \text{ m}^3/\text{h}$

#### Example 2: Pressure application

Limit (%) = 5 %; setpoint value = 100 Pa; fixed limit = 2 Pa

Tolerance limit:  $\pm (0.05 \times 100 \text{ Pa} + 2 \text{ Pa}) = \pm 7 \text{ Pa}$

### Alarm limits



III. 5

The alarm function can be set with a delay (Menu 9.4). An alarm is not triggered after a change to the setpoint value during an adjustment procedure.

The adjustment time (see III. 5) is based primarily on the actuator's set runtime. **Please refer to the actuator's datasheet for information on setting runtime.**

The actuator's run time can also be set (Menu 4.4 and 4.5). The alarm delay should always be set so that it corresponds to the actuator's runtime as a minimum.

Example: The ...Max-CY used is configured with switch setting 2 (30 s runtime). Hence, the alarm delay should be at least 30 s.

#### Alarm function signalling

The red status LED flashes when the alarm function is active.

If the LED continuously lights RED, this indicates a critical state – however, the alarm signal is not active.

The alarm is also emitted via the relay at terminal 3. In addition, the "0/2...10 V" option can be activated via Menu 6.1 "Range".

In the event of an alarm, the actual value signal is switched to 0 V (error); a signal between 2...10 V would be output during normal operation, depending on the current actual value. The optional display and the electrical signal (terminal 3 alarm relay and actual value signal at terminal 11) are always activated simultaneously.



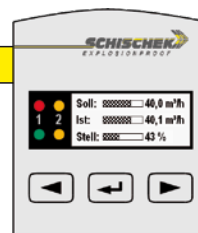
### Parameter setting and commissioning

The switchover from operating mode to parameters mode is performed by pressing once on the ENTER key (↵) for at least 6 seconds.

If password-protected, enter password and press (↵).

Return to operating mode via "Leave menu".

Operation → Parameter setting  
Press (↵) for at least 6 s



Menu	Function	ENTER	Indication	Select	ENTER	Description
<b>Menu 1</b>	<b>Language</b> Language selection	↵	1: Language english deutsch, english, français, italiano, español, back	⏪ ⏩	↵	The following languages are available for selection: German, English, French, Italian, Spanish
<b>Menu 2</b>	<b>Application</b> Application selection	↵	2: Application VAV controller VAV controller, VAV sensor, Pressure controller, Pressure sensor, back	⏪ ⏩	↵	Default and factory settings for the respective application.
2.1	<b>VAV controller</b> Select standard CAV/VAV control	↵	Device'll be reconfigurated. Continue?	⏪ ⏩	no yes	
2.2	<b>VAV sensor</b> Select standard VAV sensor	↵	Device'll be reconfigurated. Continue?	⏪ ⏩	no yes	
2.3	<b>Pressure controller</b> Select standard pressure control	↵	Device'll be reconfigurated. Continue?	⏪ ⏩	no yes	
2.4	<b>Pressure sensor</b> Select standard pressure sensor	↵	Device'll be reconfigurated. Continue?	⏪ ⏩	no yes	
<b>Menu 3</b>	<b>Sensor</b> Configuration menu for sensor setting	↵	3: Sensor Filter Filter, 0-point comp., Status, back	⏪ ⏩	↵	Settings selection for the internal pressure sensor.
3.1	<b>Filter</b> Select Filter/Damping Sensor Measurement Value	↵	3.1: Filter 20 s 0...50 s	⏪ ⏩	↵	The input filter for the internal sensor can be adjusted in the range of 1...50 s in order to reduce pressure fluctuations.
3.2	<b>Zero point compensation</b> Calibrate the sensor in its installation position after mechanical short-circuit of P+ and P-	↵	Start 0-point compensation?	⏪ ⏩	no yes	The internal sensor can indicate measurement deviations according to the ...Reg-V's installation position. These can be compensated with the zero point compensation.
3.3	<b>Status</b> Display of the current measured value	↵	3.3: Status 87 Pa 5...300 Pa		↵	Test and status display of measurement value for the internal sensor in Pa. This function is usually used for diagnostics.
<b>Menu 4</b>	<b>Actuator</b> Configuration menu for actuator	↵	4: Actuator Inverse Inverse, Test, Status, Runtime open/close, Range, back	⏪ ⏩	↵	Settings for selection for installation, test run and commissioning of the actuator.
4.1	<b>Invers</b> Set inverse operation	↵	4.1: Inverse Off Off, On, back	⏪ ⏩	↵	For spring return actuators in particular, it can be necessary, for the actuator to be actuated inversely, depending on the safety position.
4.2	<b>Test</b> Perform actuator test run	↵	4.2: Test 20 % 0...100 %	⏪ ⏩	↵	The actuator is put into operation towards a defined position as a test. It must be at position 0 % when closed and at 100 % when open.
4.3	<b>Status</b> Display of actuator's current position	↵	4.3: Status 20 % 0...100 %		↵	Test and status display of the actuator position. This function is usually used for diagnostics.
4.4	<b>Runtime "Open"</b> Set runtime limit	↵	4.4: Runtime open 10 s 0...120 s	⏪ ⏩	↵	If the runtime is limited to 10 s, for example, it amounts to at least 10 s. This function can be deactivated with the setting "0 s".
4.5	<b>Runtime "Closed"</b> Set runtime limit	↵	4.5: Runtime close 10 s 0...120 s	⏪ ⏩	↵	If the runtime is limited to 10 s, for example, it amounts to at least 10 s. This function can be deactivated with the setting "0 s".
4.6	<b>Range</b> Set actuator control signal (mA)	↵	4.6: Range mA 4...20 mA 0...20 mA, 4...20 mA	⏪ ⏩	↵	The setting 4...20 mA should be used for Schischek standard actuators.
<b>Menu 5</b>	<b>Air volume</b> Configuration menu for volume flow	↵	5: Air volume k-factor Unit, k-factor, Vnominal, Vmaximum, Vminimum, back	⏪ ⏩	↵	The relevant control variables can be adjusted according to configuration.
5.1	<b>Unit</b> Enter unit	↵	5.1: Unit m³/h m³/h, m³/min, m³/s, l/min, l/s, ft³/h, ft³/min, ft³/s, m/s, back	⏪ ⏩	↵	
5.2	<b>k-factor</b> Enter k-factor	↵	5.2: k-factor 50 1...1800	⏪ ⏩	↵	The shield factor is used to calibrate the ...Reg-V to a volume flow unit.
5.3	<b>Nominal value</b> Enter volume flow nominal value	↵	5.3: Vnom 1000 m³/h	⏪ ⏩	↵	The upper limit of the measurement range is set.


**Parameter setting and commissioning (continued)**

Menu	Function	ENTER	Indication	Select	ENTER	Description
5.4	<b>Maximum value</b> Enter volume flow maximum value		5.4: Vmax 800 m³/h			The upper limit of the control range is set.
5.5	<b>Minimum value</b> Enter volume flow minimum value		5.5: Vmin 200 m³/h			The lower limit of the control range is set.
<b>Menü 6</b>	<b>Actual value</b> Configuration menu for actual value		6: Actual value Range Range, Scaling, Status, back			Settings selection for the actual value. The actual value is output either in Pa or in m³/h, depending on the application.
6.1	<b>Range</b> Output range settings		6.1: Range 0...10 V 0...10 V, 2...10 V, 0/2...10 V, back			Electrical output range options 0...10 V or 2...10 V. Additional option: output status of alarm monitoring from 0/2...10 V.
6.2	<b>Scaling</b> Set output range (control or measurement range)		6.2: Scaling 0...Vnom 0...Vnom, Vmin...Vmax, back			The actual value output can be set either to the control range (Vmin...Vmax) or to the measurement range (0...Vnom).
6.3	<b>Status</b> Display of the current actual value		6.3: Status 100 m³/h m³/h			Test and status display of actual value (in m³/h for applications for CAV/VAV, in Pa for pressure). This function is usually used for diagnostics.
<b>Menü 7</b>	<b>Nominal value</b> Configuration menu for setpoint value		7: Nominal value Range Range, Value, Status, back			Settings selection for the setpoint value. The actual value is output either in Pa or in m³/h, depending on the application.
7.1	<b>Range</b> Output range settings		7.1: Range 0...10 V 0...10 V, 2...10 V, 0/2...10/12+ V, back			Electrical output range options 0...10 V or 2...10 V. Additional option: activate positive control with 0/2...10/12+ V.
7.2	<b>Set value</b> Setpoint value setting in CAV operation		7.2: Value 500 m³/h 300...1000 m³/h			CAV mode is activated automatically if the electrical terminal for the setpoint value is unwired.
7.3	<b>Status</b> Display of the current setpoint value		7.3: Status 100 m³/h m³/h			Test and status display of setpoint value (in m³/h for applications for CAV/VAV, in Pa for pressure). This function is usually used for diagnostics.
<b>Menu 8</b>	<b>Controller</b> Configuration menu for controller		8: Controller Type Type, gain, P-, I-, D-ratio, tolerance			Settings selection for the internal PID controller. Adjustments should not be made for standard CAV/VAV applications.
8.1	<b>Controller type</b> Set controller type		8.1: Type Auto Auto, PID adaptive, PID norm, back			
8.2	<b>Gain factor</b> Set control circuit gain		8.2: Gain 100 % 1...100			Control circuit gain can be adjusted in automatic mode.
8.3	<b>P component</b> Set proportional component		8.3: P-ratio 10 0...1000			The PID controller's proportional component is indicated with KP in control technology.
8.4	<b>I component</b> Set integral component (derivative action time)		8.4: I-ratio 2.0 s 0...1000			The PID controller's integral component (derivative action time) is indicated with TI or TV in control technology.
8.5	<b>D component</b> Set damping component (reset time)		8.5: D-ratio 1.0 s 0...1000			The PID controller's damping component (reset time) is indicated with TD or TN in control technology.
8.6	<b>Tolerance</b> Set controller tolerance		8.6: Tolerance 2.0 % 1.0...5.0			With automatic controllers, the gain is greatly reduced within the tolerance limits, so that the actuator remains in an idle state as much as possible.
<b>Menu 9</b>	<b>Switching contact</b> Configuration menu for the alarm function		9: Switch contact Alarm function Alarm function, Limit %, Limit abs., Delay time			Settings selection for current actual value monitoring.
9.1	<b>Alarm function</b> Switch alarm function on / off		9.1: Alarm function auto/nc auto/nc, auto/no, hand/nc, hand/no, on/nc, on/no, off, back			Activation of the alarm function. Additional switching characteristics for alarm contact (terminal 3) with "normally closed" (nc) or "normally open" (no).
9.2	<b>Limit (%)</b> Set alarm limit in %		9.2: Limit (%) 2.0 % 0...10.0			
9.3	<b>Limit (absolute)</b> Set fixed value in m³/h as alarm limit		9.3: Limit abs. 20 m³/h 0...240			
9.4	<b>Delay</b> Set delay for the alarm		9.4: Delay time 20.0 s 10...200			
<b>Menu 10</b>	<b>No function</b> (Menu item is skipped)					


**Parameter setting and commissioning (continued)**

Menu	Function	ENTER	Indication	Select	ENTER	Description
<b>Menu 11</b>	<b>Diagnostics</b> for testing all electrical inputs and outputs		11: Diagnostics Input 1 Input 1, 2, 3, Output 1, 2, switch, back			Inspection and testing of electrical connections. The electrical level can be displayed or output according to type.
11.1	<b>Input 1</b> Status display terminal 8		11.1: Input 1 10.0 V			If the input is unwired, "input open" appears in the display.
11.2	<b>Input 2</b> Status display terminal 9		11.2: Input 2 10.0 V			If the input is unwired, "input open" appears in the display.
11.3	<b>Input 3</b> Status display terminal 13		11.3: Input 3 10.0 V			If the input is unwired, "input open" appears in the display.
11.4	<b>Output 1</b> Test output terminal 6		11.4: Output 1 20.0 mA			Testing of the electrical input level.
11.5	<b>Output 2</b> Test output terminal 11		11.5: Output 2 10.0 V			Testing of the electrical input level.
11.6	<b>Contact</b> Switching contact test functions terminal 3		11.6: Switch Function: open Status: opened			Testing of the alarm contact's electrical properties. The contact can be configured and tested as an input or output.
<b>Menü 12</b>	<b>Password</b> Configuration menu for passwords		12: Password Level 1 Level 1, Level 2, Level 3, back			Up to three passwords can be assigned, according to access authorisation levels, in order to prevent unauthorised access and so that certain menus can no longer be selected.
12.1	<b>Level 1</b> Password for user level		12.1: Password E1 0000			
12.2	<b>Level 2</b> Password for installation level		12.2: Password E2 0000			
12.3	<b>Level 3</b> Password for manufacturer level		12.3: Password E3 0000			
<b>Menu 13</b>	<b>Indication</b> Configuration menu for display		13: Indication Display Display, Contrast, Brightness, Short menu, Device info, back			Settings selection for the display.
13.1	<b>Display</b> Set display functions		13.1: Display on, lighted On lighted, On, Off			The display mode can be set during standard operation mode. In this mode, the status LEDs remain switched on at all times.
13.2	<b>Contrast</b> Set display contrast		13.2: Contrast 60.0 %			
13.3	<b>Brightness</b> Set brightness of background lighting		13.3: Brightness 100 %			
13.4	<b>Short menu</b> Use short menu		13.4: Short menu off On, Off, back			Frequently-used functions can be called up during control operation. Press the  key for more than 2 seconds and less than 10 seconds in order to do this.
13.5	<b>Device info</b> Serial number and firmware		SN <Serial number> Firmware <0.0>			
<b>Menü 14</b>	<b>Parameters</b> Menu for parameter management		14: Parameter save save, use, activate, erase, back			The parameter menu can be used to manage up to three different configurations.
14.1	<b>Save</b> Save parameters		14.1: Save P1 (active) P1 (active), P2 (used), P3 (empty), back			
14.2	<b>Use</b> Edit parameters		14.2: Use P1 (active) P1 (active), P2 (used), P3 (empty), back			
14.3	<b>Activate</b> Set active parameters		14.3: Activate P2 (used) P1 (active), P2 (used), P3 (empty), back			
14.4	<b>Erase</b> Delete parameters		14.4: Erase P2 (used) P1 (active), P2 (used), P3 (empty), back			
<b>Menu 15</b>	<b>Leave menu</b> Leave menu and confirm active parameters		15: Leave menu			