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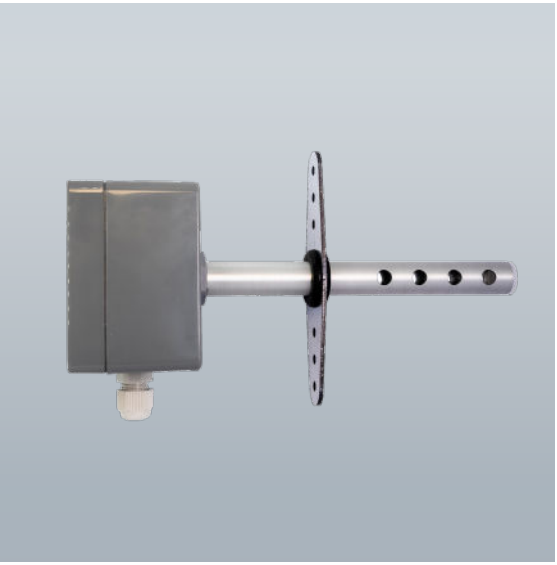

SCD/SQD series

Air quality sensors

APPLICATION MANUAL

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1. APPLICATION

SCD and SQD air quality sensors are designed for air quality measurement and maintain. Simultaneous measurement of 3 air parameters is provided through relay, analog or digital interfaces.

PID control, if enabled, will maintain user set air quality, humidity or temperature level in the premises by directly controlling air damper position, fan intensity or air heater level by the relay or analog signal.

2. SENSOR TYPES

There are 2 sensor types depending on air quality sensor. List of the sensor types described in the table below:

Sensor type	CO_2	VOC	%RH	°C
SCD	+		+	+
SQD		+	+	+

3. MECHANICAL INSTALLATION

Duct conditions, where sensor is installed, must ensure environmental requirements:

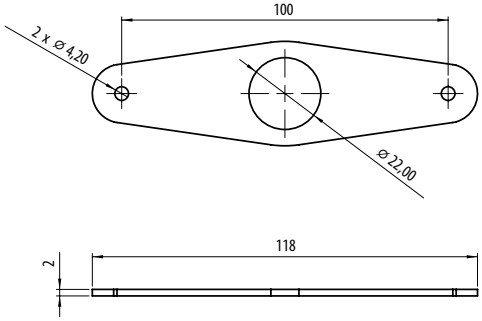
- ambient temperature: 0 °C ... 50 °C;
- relative humidity: 0 % ... 90 %, non-condensing;
- protection against vertically dripping water;
- no excessive vibrations.

The sensor is installed in the ventilation duct using the accompanying bracket, which must be attached to a firm, level surface by means of two screws. Sensor has to be mounted in such a way that the airflow passes 4 holes in the sensors tube.

Cable connection is provided through a cable gland at the bottom of the housing.

Cable diameter: 3-6,5 mm.

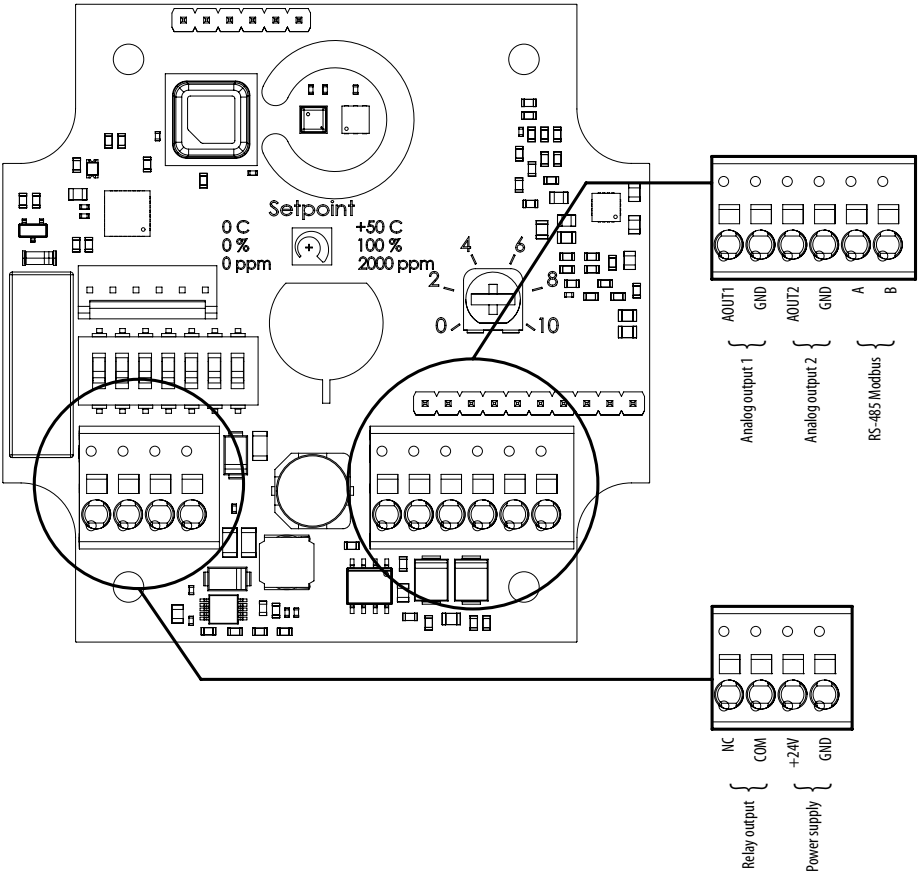
Sensor mounting diagram showed below:



For sensor mounting use 2xM4 diameter screw or another fastening element.

4. ELECTRICAL INSTALLATION

Wire in accordance with connection diagram and local requirements on electrical installations. Power supply for the sensor is 24Vac or +24Vdc.



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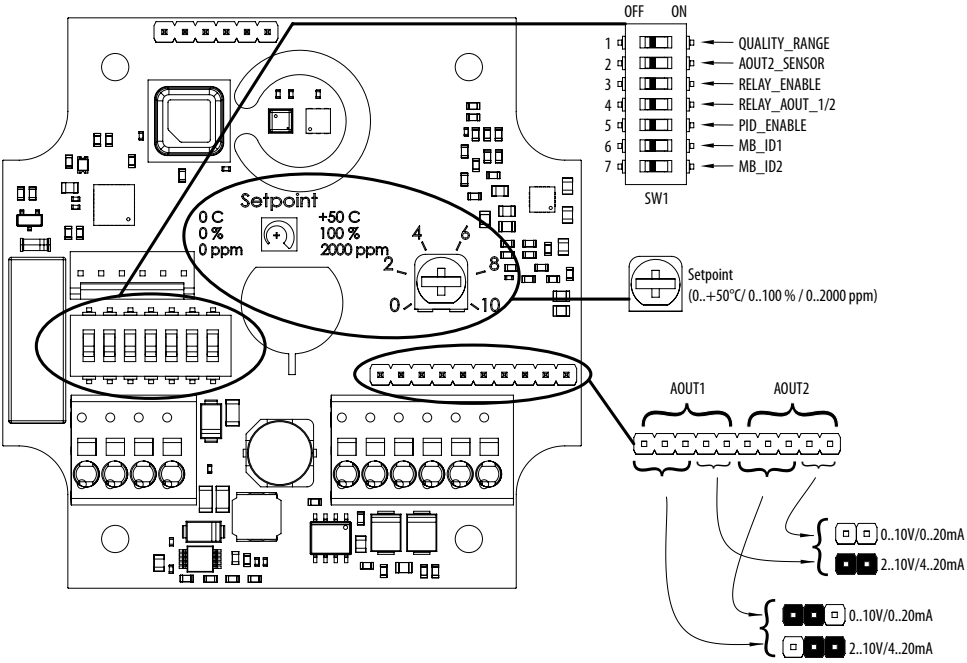
5. CONFIGURATION



Switch **SW1_1 (QUALITY_RANGE)** selects range of the air quality measurement:

Range	**SW1 (QUALITY_RANGE)**
SCD type: 0..2000 ppm SQD type: Normal	OFF
SCD type: 0..5000 ppm SQD type: Wide (2 times less sensitive)	ON

Switch **SW1_2 (AOUT2_SENSOR)** selects sensor to use for the Analog output 2 signal:

Sensor	**SW2 (AOUT2_SENSOR)**
Relative humidity, %RH	OFF
Air temperature, °C	ON

Switch **SW1_3 (RELAY_ENABLE)** allows internal relay to operate:

Relay	**SW3 (RELAY_ENABLE)**
Disabled	OFF
Enabled	ON

Switch **SW1_4 (RELAY_AOUT_1/2)** selects Analog output signal to control the relay:

Analog output	**SW4 (RELAY_AOUT_1/2)**
AOUT1	OFF
AOUT2	ON

Switch **SW1_5 (PID_ENABLE)** selects all output signals type:

Signals type	**SW5 (PID_ENABLE)**
Normal measurement	OFF
PID control	ON

Switches **SW1_6 (MB_ID1)** and **SW1_7 (MB_ID2)** selects Modbus ID slave address:

Modbus ID	**SW6 (MB_ID1)**	**SW7 (MB_ID2)**
80	OFF	OFF
81	ON	OFF
82	OFF	ON
83	ON	ON

Changes to configuration switches will apply after sensor power supply restart.

Configuration set by switches can be overridden by using RS-485 Modbus configuration. Sensor will use settings set via Modbus interface if configuration switches will not be changed after that. Changing to configuration switches settings will override corresponding value in Modbus register.

Analog outputs type selection

Configuration jumpers for AOUT1 and AOUT2 are identical and selects analog signal types.

3 position AOUT1 and AOUT2 jumpers selects voltage or current signal types:

Signal types	**Jumper position**
Voltage: 0..10 V or 2..10 V	"V"
Current: 0..20 mA or 4..20 mA	"mA"

2 position AOUT1 and AOUT2 jumpers selects offset for the signals:

Offset	**Jumper**
No offset: 0..10 V or 0..20 mA	Opened
With offset: 2..10 V or 4..20 mA	Shorted

Typical configurations are:
- For 0..10V signals – "V" with no offset
- For 4..20mA signals – "mA" with offset enabled

Setpoint setting

Potentiometer on the board selects setting point for the PID control to maintain. At the same time this setting defines relay on/off switching point.

6. OPERATION

Simultaneously, sensor is providing 3 types of reading which can be monitored using different types of interfaces:
- Analog outputs – 0..10V or 4..20mA
- Relay output
- RS-485 Modbus

VOC value reading is available 5 minutes after device power on. During start-up, low fixed value will present – 10 % for Normal and 5 % for Wide air quality range.

6.1. Analog outputs

Analog output sensor type:

Sensor	Analog output
SCD type: CO_2 SQD type: VOC	AOUT1
Relative humidity, %RH	AOUT2 [1]
Air temperature, °C	

Sensors for the analog outputs can be defined differently using Modbus configuration. For example, AOUT1 can be set for relative humidity and AOUT2 for the air temperature.

[1] Depends on the switch SW2 (AOUT2_SENSOR)

Output levels are in range from lowest to highest values (which depends on configuration), where actual sensor range described in the table below:

Sensor	Lowest value	Highest value
CO_2 Normal	0 ppm	2000 ppm
CO_2 Wide	0 ppm	5000 ppm
VOC Normal	0 %	100 %
VOC Wide	0 %	100 %
%RH	0 %RH	100 %RH
°C	0 °C	+50.0 °C

6.2. Relay output

Relay control is tied to one of the analog outputs, which control relay to switch on and off. Analog output level to trigger relay switch is selected using setpoint potentiometer on the board.

By default, and not inverted control configuration, depending on the sensor, relay contacts are closing when:

- CO_2 or VOC – higher reading than setpoint (requesting more fresh air)
- %RH – higher reading than setpoint (requesting more fresh air)
- °C – lower reading than setpoint (requesting more heating)

Hysteresis is provided to not let the relay rapid switching on and off near the setting point.

Modbus interface allows to configure the relay for inverted signal control type.

Relay will not be controlled if it is disabled by configuration. Activate relay control by configuration switch SW3 (RELAY_ENABLE) or Modbus interface.

6.3. Modbus interface

The sensor is Modbus RTU (RS-485) slave device. Modbus RTU interface allows user to read and write sensor data using the following three function codes:

- Read holding registers (0x03)
- Write single register (0x06)
- Write multiple registers (0x10)

RS-485 interface communication options

Baud rate	Data bits	Parity check	Stop bits
1200..115200, 19200 [1]	8 [1]	Even [1], Odd, None	2,1 [1]

[1] Default values

Control and operating data registers

Register	Access	Values	Default	Function	Description
1	R/W	0, 9	9	Control type	0 – Modbus 9 – Analog
2	R/W	0..10'000	0	AOUT1 Modbus setpoint	Setting point in 0.01 % steps of the configured range
3	R/W	0..10'000	0	AOUT2 Modbus setpoint	Setting point in 0.01 % steps of the configured range
4	R/W	0..2	0	Relay control	0 – Auto 1 – Open 2 – Short
10	R			Firmware version	Sensor's firmware version
11	R	-32768; 0..5'000		CO_2 level	Level in 1ppm steps (-32768 sensor fault)
12	R	-32768; 0..10'000		VOC level	Level in 0.01 % steps (-32768 sensor fault)
13	R	-32768; 0..10'000		Relative humidity	Level in 0.01 %RH steps (-32768 sensor fault)
14	R	-32768; 0..500		Air temperature	Air temperature in 0.1°C steps (-32768 sensor fault)
15	R	0..10'000		AOUT1 actual value	Value in 0.01 % steps of the configured range
16	R	0..10'000		AOUT2 actual value	Value in 0.01 % steps of the configured range
17	R	0..10'000		Potentiometer setpoint	Setting point in 0.01 % steps of the configured range
18	R	0..1		Relay status	0 – Open 1 – Short

Configuration registers

Register	Access	Values	Default	Function	Description
300	R/W	1..247	80	Modbus ID	Configuration switch change will overwrite setting
301	R/W	1..8	5	Modbus baud rate	1 – 1200 baud 2 – 2400 baud 3 – 4800 baud 4 – 9600 baud 5 – 19200 baud 6 – 38400 baud 7 – 57600 baud 8 – 115200 baud Changes will apply after power supply restart
302	R/W	1..6	2	Modbus data format	1 – 8N1 (8 data bits, Parity: none, 1 stop bit) 2 – 8E1 3 – 8O1 4 – 8N2 5 – 8E2 6 – 8O2 Changes will apply after power supply restart
303	R/W	0..1	0	Air quality range	0 – Normal (0..2000ppm, 0..100 % VOC) 1 – Wide (0..5000ppm, 0..200 % VOC)
304	R/W	0..3	By type	AOUT1 sensor	0 – CO_2 (if available by type) 1 – VOC (if available by type) 2 – Relative humidity 3 – Air temperature
305	R/W	0..3	2	AOUT2 sensor	0 – CO_2 (if available by type) 1 – VOC (if available by type) 2 – Relative humidity 3 – Air temperature
306	R/W	0..1	0	Relay control	0 – Disabled 1 – Enabled
307	R/W	0..1	0	Relay control output	0 – AOUT1 controls the relay 1 – AOUT2 controls the relay
308	R/W	0..1	0	Relay control type	0 – Normal 1 – Inverted
309	R/W	0..1	0	PID control	0b – aout1 1b – aout2 Where bit values meaning: 0 – Disabled 1 – Enabled
310	R/W	0..15 (binary)	bit0=0 bit1=0 bit2=0 bit3=1	PID sensors signal type	Each bit is the setting for the sensor: bit 0 – CO_2 bit 1 – VOC bit 2 – Relative humidity bit 3 – Air temperature Where bit values meaning: "0" – Normal (increasing output on worse/ wet/hot) "1" – Inverted
311	R/W	0..65535	1'000	PID AOUT1 Kp	PID control Kp factor
312	R/W	0..65535	300	PID AOUT1 Ki	PID control Ki factor

Register	Access	Values	Default	Function	Description
313	R/W	0..65535	1'000	PID AOUT2 Kp	PID control Kp factor
314	R/W	0..65535	300	PID AOUT2 Ki	PID control Ki factor
318	R/W	13..60	20	Temperature, humidity filter multiplier	Slow 13 <..> 60 Fast 13: slow response time, small measurement error 60: fast response time, greater measurement error
390	R/W		0	Reset to default settings	Write 0x64DF value to reset

6.4. PID control

PID functionality will change sensor outputs from real-time readings to direct control signals for the external devices to achieve Variable Air Volume (VAV) operation or heating control in the premises. Depending on control requirements, modulating analog signal or on/off relay control can be used with PID control.

Possible, but not limited to, devices list for direct control:

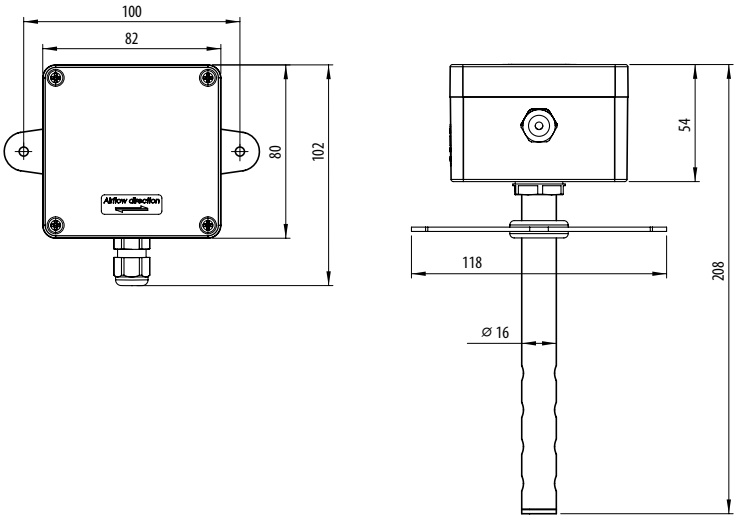
- Air damper actuator – requesting more fresh air on higher CO_2, VOC or %RH reading
- Air fan – requesting more fresh air on higher CO_2, VOC or %RH reading
- Heater – requesting more heating level on lower °C reading

Common for all sensor reading values (CO_2, VOC, %RH, °C) potentiometer with scale marks is provided on the board for setting point selection. Same point is used for analog and relay control signals.

Modbus interface allows to change default Kp and Ki factors, and invert control signals. Inverting temperature control signal, for example, can be used for cooling level control.

7. TECHNICAL DATA

Dimensions



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Case and environment data

Material	Housing - ABS plastic; Tube - AW 6085 aluminum
Protection class	IP65
Dimensions	82x80x54 mm
Weight	230 g
Ambient operating temp.	0..+50 °C
Storage temperature	-30..+70 °C
Ambient humidity	0..90 %RH, non-condensing

Electrical data

Supply voltage	24 Vac / 24 Vdc ±20 %
Power consumption	<0.4 W (<20 mA)

Outputs

Connectors	3,5 mm^2 terminal blocks
Analog outputs	2x 0..10V / 2..10V / 0..20mA / 4..20mA with up to 20mA output current
Relay output	1x 230Vac 1A
Accuracy	CO_2: ±5 % typical VOC: ±15 % %RH: ±3 %RH °C: ±1.0 °C

CE SCD and SQD sensors conforms to the requirements of the EMC directive through standard EN 61326-1.

Recycling of equipment and packaging should be taken into consideration and disposed in accordance with local and national regulations.

SERVICE AND SUPPORT

LITHUANIA
UAB KOMFOVENT
Phone: +370 5 200 8000
service@komfovent.com
www.komfovent.com

SWEDEN
Komfovent AB
Ögärdesvägen 12A
433 30 Partille, Sverige
Phone: +46 31 487 752
info_se@komfovent.com
www.komfovent.se

FINLAND
Komfovent Oy
Muuntotie 1 C1
FI-01 510 Vantaa, Finland
Phone: +358 20 730 6190
toimisto@komfovent.com
www.komfovent.com

GERMANY
Komfovent GmbH
Konrad-Zuse-Str. 2a,
42551 Velbert, Deutschland
Phone: +49 0 2051 6051180
info@komfovent.de
www.komfovent.de

LATVIA
SIA Komfovent
Bukaišu iela 1, LV-1004 Riga, Latvia
Phone: +371 24 66 4433
info.lv@komfovent.com
www.komfovent.com

Vidzemes filiāle
Alejas iela 12A, LV-4219 Valmiermuiža,
Valmieras pagasts, Burtnieku novads
Phone: +371 29 358 145
kristaps.zaicevs@komfovent.com
www.komfovent.com

UNITED KINGDOM
Komfovent Ltd
Unit C1 The Waterfront
Newburn Riverside
Newcastle upon Tyne NE15 8NZ, UK
Phone: +447983 299 165
steve.mulholland@komfovent.com
www.komfovent.com

PARTNERS

AT	J. PICHLER Gesellschaft m. b. H.	www.pichlerluft.at
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VORTVENT
Buitendijks 63, 3356 LX Papendrecht
Tel: +31(0)85-782 64 00
Email: info@vortvent.nl