Oppermann® Regelgeräte

Volume flow indicator / monitor / transmitter
SENSO-X® VPX

- Large LCD display
- Volume flow up to 99,999 displayed in numerals or as an indicator bar in any of the following units: m^3/h, l/s, ft^3/min
- Limit displayed up to max. volume flow
- Working range displayed (Range max)
- Three-color LED: red for limit value undershoot, yellow for fault and green for overshoot
- Temperature / Absolute pressure transducer
- NFC parametrisation of limit, range max, signal range for analog output, K-factor and air density ρ
- Optional Modbus output
- Power supply: 24 V AC at 50 / 60 Hz or 24 V DC
- Available in two built-in and one surface-mounted versions

Technical data

Housing:	high impact ABS
Front panel color:	antique white
Lower housing color:	anthracite
Protection class:	surface-mounted type (AP) IP 65 built-in type IP 54 / built-in type with additional sealing (accessory) IP64
Operating temperature:	-20 °C to 65 °C
Storage temperature:	-20 °C to 70 °C
Relative humidity:	max. 95 % non-condensing
Front cover dimensions	
- square:	182 x 140 x 21 mm [L x W x H]
- round:	143 mm Ø
Dimensions of surface-mounted type:	165 x 71 mm [Ø x T]
Hose connection:	2x 6 mm Ø
Working and measuring ranges:	see table
Working range:	adjustable via keys and NFC tool
Burst pressure:	20 kPa (VPX1000) 40 kPa (VPX4000)
Protection class:	II (IEC 60536)
Error margin:	+/- 1 % of measuring range (@ -5 to 65 °C)
Power consumption:	24 V DC 41 mA 24 V AC 81 mA
Long-term stability:	≤ ± 0.5 % FS/a
Supply voltage:	13.5 – 36 V DC or 13.5 – 30 V AC at 50/60 Hz
Output analog:	linear 0 – 10 V (max. 0.1 mA) or 4 – 20 mA (max. load 600 Ω).
Output digital:	relay (250 V AC 6 A, 30 V DC 5 A), changeover switch, closed-circuit principle, freely selectable limit value. Modbus optional.
Cable gland:	M16
Cable connection:	Spring terminals 0.2 – 1.5 mm^2

Types

Type	Measuring range	Working range (output signal)	Units of measure / output*	Limit value monitoring
VPX1000	0 – 1,000 Pa	0 – 99,999 m^3/h freely adjustable in 1 m^3/h-increments	m^3/h, l/s, ft^3/min	Freely selectable. LED/bar -indicator + switching output for **undershoot**
VPX4000	0 – 4,000 Pa	0 – 99,999 m^3/h freely adjustable in 1 m^3/h-increments	m^3/h, l/s, ft^3/min	Freely selectable. LED/bar -indicator + switching output for **undershoot**

** analog output 0 – 10 V or 4 – 20 mA linear depending on selected working range and unit of measure.*

Installation

All work (such as installation, electrical connection, startup, operation, and maintenance) must only be performed by sufficiently qualified tradesmen. The respectively applicable local rules and regulations (e.g. national building codes, electrical/VDE regulations, etc.) must be observed. Installers and operating entities are required to sufficiently familiarize themselves before startup. Read the product description before operating the equipment. Verify that the product can be used for the relevant application without restrictions. We are not liable for printing errors and changes after printing. Appropriate use implies compliance with operating and installation instructions. We are not liable for losses due to inappropriate use. Unauthorized or inappropriate manipulations or modifications of the device render the operating permit, the product warranty and warranty claims null and void.

Built-in version
Mill a 115 mm Ø hole in the sandwich plate or cabinet door and push the functional part through the opening from the front. The mounting direction is indicated by an arrow pointing upward on the back of the device. Screw the threaded rod into the threaded sleeve with a screwdriver; slip the mounting bracket over it and secure with a wing nut. When connecting the pressure transfer hoses, care must be taken to comply with the direction of the pressure (+/-). Finally, the front panel can be snapped into place.

Surface-mounted housing
Screw the functional part onto a wall, duct or similar and then connect it to the power and pneumatic lines. Then slip the ring cover over the functional part and snap on the front cover.

Design

The **built-in version** of the **SENSO-X**®VPX consists of a round section and a square or round front cover. The instrument is optimized for installation in ventilation devices and control cabinets. The two pressure test points, marked + (positive pressure side) and - (negative pressure side), are sunk into the housing on the back. In the middle is a threaded sleeve. Attach the retaining bracket using the supplied threaded rod and wing nut. The wing nut is secured against loosening. Two cable breakthroughs are provided on the back of the housing. Two M16 x 1.5 screw joints are included in the assembly kit. An integrated O-ring serves to seal the functional part against the mounting surface. The arrow on the back of the device points upward in the correct mounting position.

The **surface-mounted version** of the **SENSO-X®** VPX consists of a round functional part with three screw-on mounting brackets, a ring cover and a snap-on front cover. The two measurement connections, marked + (positive-pressure side) and – (negative-pressure side), exit at the bottom. Exiting at the bottom are also two strain relief elements.

Built into the functional part in all versions, and visible from the front, are an LCD display, an LED to indicate when limit values are exceeded and 4 function keys.
After installation and configuration of the device, the front cover is snapped onto the functional part. Due to 3 guided notches this is only possible in the correct position. Removing the front cover is done by pulling with both hands or by using a screwdriver.

Operating principle

The measured differential pressure is transmitted via flexible hoses and connecting nipples onto the piezoelectric differential pressure sensor, electronically evaluated, converted into units of volume flow taking into account the programmed k-factor and density ρ and displayed on the LCD indicator.

This calculation is based on the following formula

$$V_h = K \times \sqrt{\frac{2 \times \Delta p}{\rho}}$$

Vh = volume flow [m³/h]
K = K-factor [m²s/h]
Δp = differential pressure [Pa]
ρ = air density [kg/m³]

Note: Many fan manufacturers use simplified basic formulas and accordingly modified K-values. State the manufacturer when entering the K-factor, and the transmitter will take this into account. Please refer to the table below for identifiers of the most common manufacturers:

Manufacturer	Manufacturer identifier „Manufactor“	Example types	Calculated K-factor K1 transmitter
ebm-pabst	A	R3G, K3K, …	K = 0,7746 * K_{ebm}
Fläkt	B	CXLF, GXLB, GPEB, …	K = 2788,5 / $K_{Fläkt}$
Nicotra Gebhardt	C	RZR, RZA, …	K = $K_{Gebhardt}$
Rosenberg	C	DKH, GKH, …	K = $K_{Rosenberg}$
Ziehl-Abegg	A	ER…C, GR…C, …	K = 0,7746 * K_{Ziehl}
Comefri	C	-	K = $K_{Comefri}$
Unassigned value / universal	D	-	K = (enter value)

Non-binding information. Please note the current data sheets of the manufacturers. Subject to change. If the manufacturer of your choice is not listed, enter the K-factor manually. Use the setting D = “Uni” for this purpose. This is also the default setting.
The additional parameter “No. of fans” allows for fan walls/fan grids. Enter the number of fans. The default setting is 1.

Activation and operation

Make all electrical connections before connecting the supply voltage. Connect the 24 V supply voltage with the correct polarity to start up the **SENSO-X®** VPX.
The device is ready for use immediately.
To set the parameters either take off the front panel and enter the desired settings via the 3 keys or use the NFC tool (Windows program for PCs: see Specification Sheet 13180; or Android App for smartphones / tablets in the Google Play Store).

Setting display unit (dimension)
A brief push of the lower key (S1) in normal operation mode swit-

ches the setting back and forth between m^3/h, l/s and ft^3/min. The volume flow is displayed in numerals and as an indicator bar. The indicator bar serves to visualize the measured volume flow in % in relation to the set working range (Range max).

Programming the SENSO-X® VPX
(valid from firmware 1.0.2.8)

While programming, the current values on the display and the analog output are frozen. Hold down the lower key (S1) to enter the programming mode. The adjustable parameter is displayed in flashing mode. Press S1 repeatedly to move through the menu in the following sequence:

- Limit (value) infinitely adjustable between 0 and the upper end of the working range
- Range max. (working range) infinitely adjustable between 0 and 99,999m^3/h, 27,777 l/s or 58,857 ft^3/min.
- Out (analog output setting): 4 – 20 mA or 0 – 10 V
- MANUFACTOR (fan manufacturer identifier): A to D
- K-factor, infinitely adjustable between 0 and 6.553,5 (default 500)
- NO OF VENT (number of fans/ventilator in the fan grid): 1 (default) – 20
- Air density ρ, infinitely adjustable between 0 and 2.0 (default 1.15 kg/m^3)
- BUS ADDR* (Bus Address): 1 – 127
- BAUD* (Baud rate): 9.6k (default), 14.4k, 19.2k, 38.4k or 56k baud)
- PAR* (Paritätseinstellung Modbus): Even, Odd or None
- TEMP GRAD CEL (temperature on the circuit board in °C)
- PRESS AMBI hPA (absolute atmospheric pressure inside the device housing, shown in hPa)
- SW VERS (Software version)
- FACTORY RESET (resets the device to factory settings)
  * for Modbus versions only

Use the keys at the top left (S2) and top right (S3) to change the parameter value shown in the flashing display area:
Short keystroke → single steps,
Long keystroke → increases rate of change
The LED changes color when the set limit value is reached: LED red on limit value undershoot and green on overshoot.
The working range extends to the value in m^3/h, l/s or ft^3/min. that corresponds to an analog output of 20 mA or 10 V. This value can be set under the menu item Range max.
For example: set working range 20,000 m^3/h
at 0 m^3/h , the AO is 4 mA or 0 V
at 20,000 m^3/h , the AO is 20 mA or 10 V

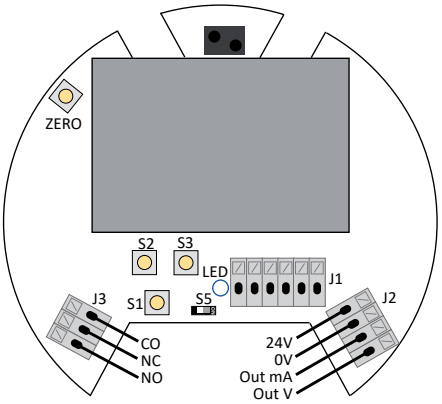
Save (OK)
After 10 s without a keystroke the set values are saved automatically and the display and the analog output return to operating mode.

Factory settings
To reset the device to its factory settings, select the menu item Factory Reset. The display flashes "ZERO". Hold down the "ZERO" key for 3 s. Then the display flashes "DONE". All previous settings of the limit value and working range as well as any bus settings return to their default values.

0-point adjustment
It is possible for volume flow readings to drift upwards or downwards by up to a few m3/h for a period of up to four weeks after initial start-up. This is no defect. To compensate for this drift you can perform a manual zero-point adjustment. Depressurize the measurement inputs (draw off both hoses). Hold down the ZERO key for ca. 3 s. The display flashes „ZERO". Briefly press the S1 key. The device recalibrates and the display flashes "DONE" for ca. 10 s.

Display of differential pressure for verification purposes
On pressing keys S2 and S3 the measured differential pressure is displayed for as long as they are held down.

Electrical connection



If the relay is de-energized (falling below the limit or voltage drop), COM and NC are connected.
For Modbus connection to terminal J1 see next page.

Caution:
Disconnect all power supplies before opening the housing. The housing may only be opened by a trained electrician. Observe supply and switching voltage ratings. Observe the following symbols on the device:

Danger – High Voltage!

Disconnect power supply before working on the device

Observe Instructions

Note:
Floating switch contacts "CO, "NC" and "NO" may only be used for 230 V AC or 24 C AC/DC .
Disconnection or electrical protection equipment must be provided by the customer. The 24V AC/DC supply voltage requires a local fuse for max. 6 A or a supply unit with a power output limit of 6 A.

Caution:
All cable installation and connection work must be left to a duly qualified electrician. Make sure that all cables are connected in accordance with the relevant electrical regulations. The cable sheath must reach as close as possible to the terminals. Braided wires longer than 10 mm must be secured near the terminal with a cable clip or similar or must be insulated in pairs using, e.g., suitable shrink tubing (see installation example).

Installation example:

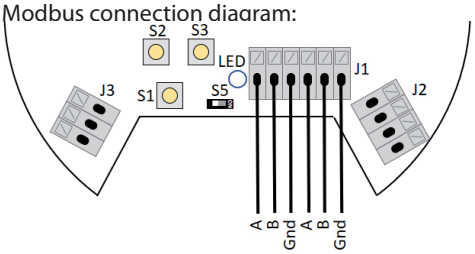
Modbus RTU

The sliding switch S5 is for inserting a 120 ohm terminal resistor.
Ex factory the switch is in off-position (OFF pos. = left).

Default (factory) Modbus settings

Baud rate:	9600
data bits:	8
start bits:	1
stop bits:	1
Modbus address:	1
parity:	even

Modbus connection diagram:



Terminal J1 only present in bus version.
For electrical connections see previous page.

The following Modbus parameter options are available via the menu or the NFC tool configuration program:

bus adresse:	1-127
baud rate:	9.6k, 14.4k, 19.2k, 56k
parity:	even (1 startbit, 8 datenbits, 1 stopbit), odd (1 startbit, 8 datenbits, 1 stopbit), none (1 startbit, 8 datenbits, 2 stopbits)

Implemented Modbus function: Read Holding Registers function 0x03

Overview of registers

Register	PWM address	Name	File type	Raw data	Description
0 (0x00)	40001	pressure	unsigned 16	0 to 1,000 or 4,000	measured differential pressure in Pa
1 (0x01)	40002	limit (low word)	unsigned 32	0 to 65,535	Set limit value in selected unit of measure, see register 7, e.g. 0 to 99,999 m^3/h
2 (0x02)	40002	limit (high word)		0 or 1	
3 (0x03)	40004	output analog	unsigned 16	0 or 1	0 = 0 – 20 mA or 0 – 10 V 1 = 4 – 20 mA or 2 – 10 V
4 (0x04)	40005	unassigned			
5 (0x05)	40006	flow (low word)	unsigned 32	0 to 65,535	calculated volume flow in m^3/h 0 to 99,999
6 (0x06)	40007	flow (high Word)		0 or 1	

7 (0x07)	40008	unit of measure	unsigned 16	4, 5 or 6	4: ft³/min 5: l/s 6: m³/h
8 (0x08)	40009	range max (low word)	unsigned 32	0 to 65,535	Set limit value in selected unit of measure, see register 7, e.g. 0 to 99,999 m³/h
9(0x09)	40010	range max (high word)		0 or 1	
10 (0x0A)	40011	ρ (Rho)	unsigned 16	0 to 200	air density in kg/m³ (default 1.15) 0 to 2.00
11 (0x0B)	40012	K-factor	unsigned 16	0 to 65.535	correction factor (default 500,0) 0 to 6.553,5
12 (0x0C)	40013	temperature	signed 16	-300 to 1,050	temperature on circuit board in 1/10°C from -30 to 105 °C
13 (0x0D)	40014	atmospheric pressure	unsigned 16	2,600 to 12,600	absolute atmospheric pressure in housing in 1/10 hPa from 260 hPa to 1,260 hPa
14 (0x0E)	40015	sensor error	unsigned 16	0 or 1	0 = no sensor error 1 = sensor error
15 (0x0F)	40016	measured limit	unsigned 16	0 to 100	0 to 100 %
16 (0x10)	40017	state of switching output	unsigned 16	0 or 1	0 = inactive 1 = active
17 (0x11)	40018	LED status	unsigned 16	0 to 3	0 = LED off 1 = green 2 = yellow 3 = red
18 (0x12)	40019	firmware version	unsigned 16	1.0.1.1 and higher	"1018" means FW version 1.0.1.8
19 (0x13)	40020	type	unsigned 16	0 bis 4	0 = PPX1000 1 = PPX4000 2 = VPX1000 3 = VPX4000
20 (0x14)	40021	Modbus Address	unsigned 16	1 to 127	1 to 127
21 (0x15)	40022	Fan manufacturer	Unsigned 16	0 to 3	0 = A (ebm-pabst, Ziehl-Abegg) 1 = B (Fläkt) 2 = C (Nicotra Gebhardt, Rosenberg) 3 = D (unassigned/universal)
22 (0x16)	40023	Number of fans	Unsigned 16	1 to 20	Number of fans in the fan grid

Example of Modbus telegram (hexadecimal notation)

Request:

Tx:[time stamp]- 01 03 00 05 00 02 D4 0A

from left to right:

"01" = Modbus address of SENSO-X, here = 1

"03" = function code "Read holding register"

"00" = high byte of start register (1st register to be read out), here = 0

"05" = low byte of start register, here register no. 5 = flow / volume flow, low word

"00 02" = number of registers read, here = 2

"D4 0A" = CRC

Response – flow / volume flow

Rx:[time stamp]- 01 03 04 0C B6 00 01 D9 45

from left to right:

"01" = responding Modbus address, here = 1

"03" = function code

"04" = number of response data bytes, here = 4

"0C" = high byte of 5th register, here = 0x0C00h = 3,072d

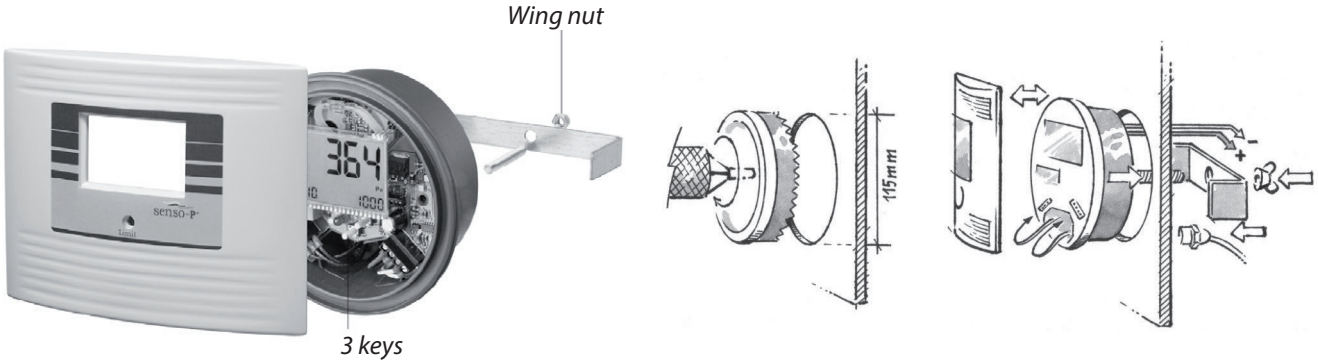
"B6" = low byte of 5th register, here = 0xB6h = 182d -> 182 + 3,072 = 3,254 m³/h

„00" = high byte of 6th register, here = 0x000000h = 0d

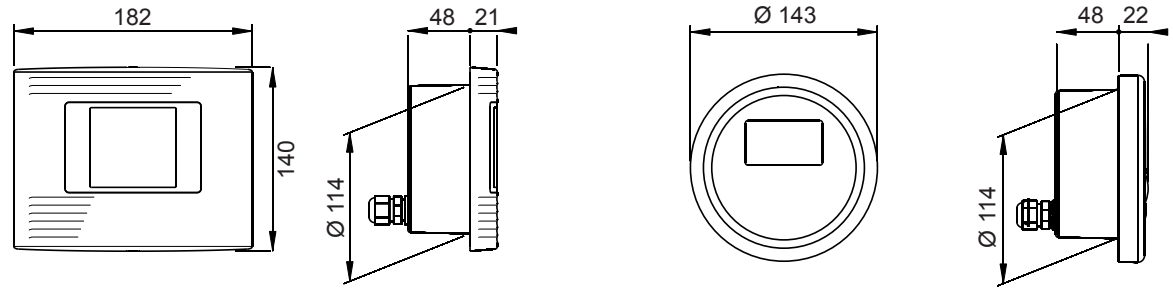
„01" = low byte of 6th register, here = 0x010000h = 65,536d -> 65,536 + 3,254 = 68,790 m³/h

"D9 45" = CRC

Overview of the **SENSO-X®** PPX in its built-in version

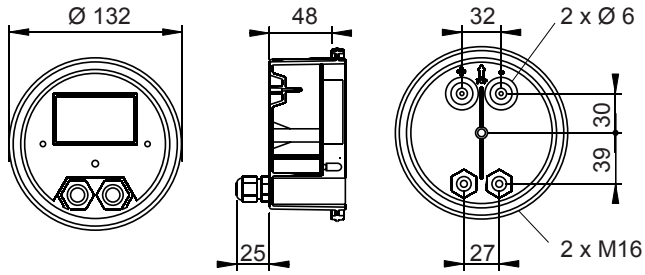


Built-in versions



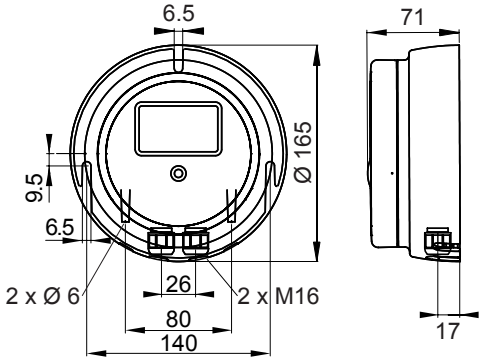
Square front type ... 00

Round front type ... 01



Housing base (Functional part in the built-in version)

Surface mounted housing



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