

Operating manual

Barometric transmitter

BAROsense



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1 INTRODUCTION

BAROsense is a barometric transmitter equipped with a precision piezo-resistive pressure sensor with integrated temperature sensor. The pressure and temperature measurements are digitally processed to obtain a pressure output value compensated over the whole transmitter temperature operating range.

The sensor is factory calibrated in multiple points and has excellent time stability and repeatability.

The instrument has a digital **RS485** output with **MODBUS-RTU** or proprietary protocol. As option, it can be supplied with an analog additional output to be chosen from:

- **0/4...20 mA**
- **0...5 V**
- **0...10 V**

The transmitter digital output enables the transmission of the measurements over long distances and connects the transmitter to sensors networks.

The pressure can be expressed in different user-selectable units of measurement.

Optional **LCD** display.

Optional input for combined temperature and relative humidity probe.

Also available with optional **static port** and support bracket to minimize the effect of dynamic pressure due to the wind in open field measurements.

2 TECHNICAL SPECIFICATIONS

Barometric pressure	
Sensor	Piezoresistive
Measuring range	300...1100 hPa
Resolution	See table below
Accuracy	± 0.5 hPa (700...1100 hPa) @ 20 °C ± 1 hPa (500...1100 hPa) / ± 1.5 hPa (300...500 hPa) @ T=(0...60 °C)
Long-term stability	< ± 1 hPa/year
Relative humidity (with optional external T/RH probe)	
Sensor	Capacitive
Measuring range	0...100%
Resolution	0.1%
Accuracy	$\pm 2.5\%$ (0..85%) / $\pm 3.5\%$ (85...100%) @ T=23 °C
Temperature drift	0.05%/K (0...60 °C)
Sensor operating temp.	-40...+105 °C (R.H. max=[100-2*(T-80)] @ T=80...105 °C)
Response time	T ₆₃ < 4 s (air speed = 2 m/s, without filter)
Long-term stability	< 1%/year (@ 23 °C and 30...70%)
Temperature (with optional external T/RH probe)	
Sensor	PTAT integrated in humidity module
Measuring range	-40...+105 °C
Resolution	0.1 °C
Accuracy	± 0.2 °C in the range 0...+60 °C $\pm (0.2 - 0.05 * T)$ °C in the range T=-40...0 °C $\pm [0.2 + 0.032 * (T-60)]$ °C in the range T=+60...+105 °C
Long-term stability	0.05 °C/year
General specifications	
Output	RS485 with Modbus-RTU or ASCII proprietary protocol 0/4...20 mA or 0...5/10 V optional analog output
Power supply	7...30 Vdc for the Modbus-RTU output 15...30 Vdc for the 0...10 V analog output
Consumption	4 mA @ 24 Vdc
Connection	Internal screw terminal header / PG7 cable gland for power supply and output. Optional M12 connector for the T/RH external probe.
Operating conditions	-40...+60 °C (-20...+60 °C con LCD) / 0...100%RH
Compatible media	Air and dry gases
Materials	Transmitter: Polycarbonate, pressure input in nickel-plated brass Static port (optional): ASA Support bracket: Aluminium alloy
Housing dimensions	120 x 80 x 55

Weight	250 g approx. 570 g approx. the static port with support bracket
Protection degree	IP65

Units of measurement available and corresponding resolution

With the MODBUS-RTU protocol, two different input registers are available for the pressure measurement, with different resolution: IR 0 (32-bit) and IR 2 (16-bit).

With the ASCII proprietary protocol, the resolution is unique.

Unit of measurement	Resolution	
	ASCII proprietary protocol Modbus protocol IR 0 (32-bit)	Display Modbus protocol IR 2 (16-bit)
Pa	1 Pa	10 Pa
hPa	0.01 hPa	0.1 hPa
kPa	0.001 kPa	0.01 kPa
mbar	0.01 mbar	0.1 mbar
bar	0.00001 bar	0.0001 bar
atm	0.00001 atm	0.0001 atm
psi	0.0001 psi	0.001 psi
mmHg	0.01 mmHg	0.1 mmHg
inHg	0.001 inHg	0.01 inHg
mmH ₂ O	0.1 mmH ₂ O	1 mmH ₂ O
inH ₂ O	0.01 inH ₂ O	0.1 inH ₂ O
kg/cm ²	0.00001 kg/cm ²	0.0001 kg/cm ²
Torr	0.01 Torr	0.1 Torr

3 INSTALLATION

The transmitter is wall mounted using the two holes on the back (open the cover to access the holes and the terminal header for electrical connections).

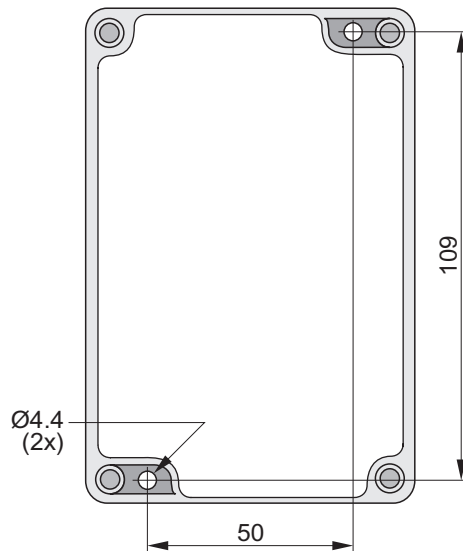


Fig. 3.1: fixing holes

It is advisable to mount the transmitter so that the pressure input is facing downwards, in order to reduce the accumulation of dust and dirt on the input.

For outdoor installation, the use of the transmitter version with static pressure port (**BAROsense...K**) is recommended, in order to minimize the measurement error caused by the wind flow on the pressure input (the measurement deviation due to wind is less than 0.3 hPa @ 20 m/s if the static port is used). The transmitter version with static port includes a support bracket suitable for fixing to a Ø30...50 mm mast.

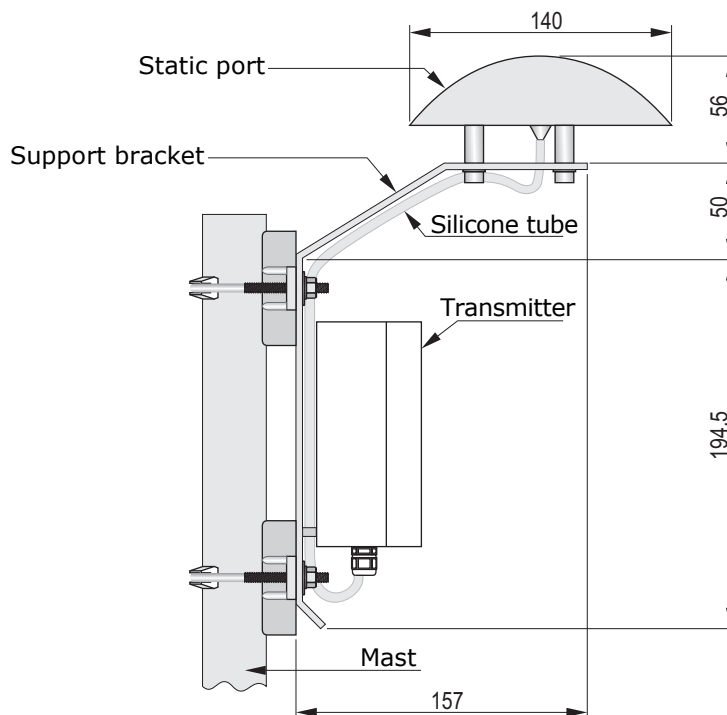


Fig. 3.2: transmitter with static pressure port

3.1 ELECTRICAL CONNECTIONS

The transmitter has an internal screw terminal header.

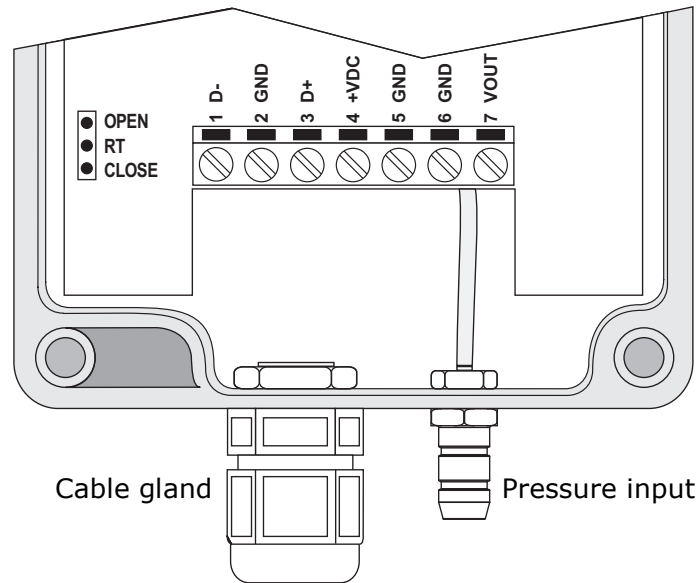


Fig. 3.3: internal terminal header

Terminal N°	Function
1	RS485 D-
2	GND
3	RS485 D+
4	Power supply positive (+Vdc)
5	GND
6	GND
7	Analog output

To the left of the terminal header there is a built-in line termination that can be connected or removed through a short jumper. To connect the termination, place the short jumper between the "RT" and "CLOSE" indications. To remove the termination, place the short jumper between the "RT" and "OPEN" indications.

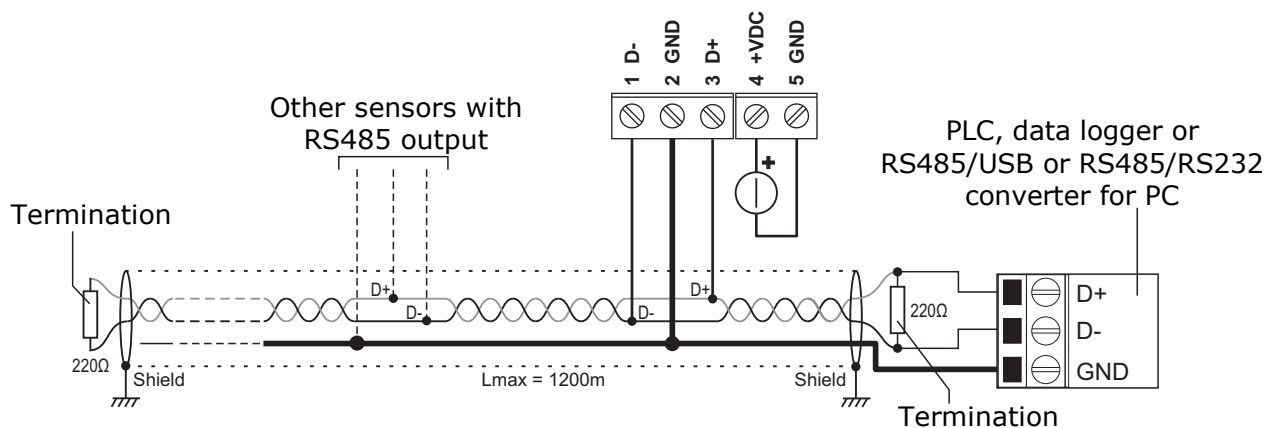


Fig. 3.4: RS485 connection

4 CONFIGURATION AND MEASUREMENT

The configuration of the instrument and the reading of the measurements can be done via the RS485 serial output, both with the proprietary protocol and with the MODBUS-RTU protocol.

In the first 10 seconds after the instrument power on, it is always active the proprietary protocol. After 10 seconds from power on, the operating protocol is activated, which by default is the MODBUS-RTU protocol.

It is possible to keep the proprietary protocol active even after 10 seconds from power on by sending, before the 10 seconds expire, the command @ of the proprietary protocol. The proprietary protocol can be set as operating protocol by means of the DP0 command.

By default, the instrument has MODBUS address **1** and communication parameters 19200, 8E1. Different parameters can be set using the proprietary protocol or the MODBUS-RTU protocol.

The commands of the proprietary protocol and the registers of the MODBUS-RTU protocol are described in detail in the following chapters.

Voltage analog output:

By default, the voltage analog output (0...5 V or 0...10 V depending on the model) corresponds to the pressure range 600...1100 hPa.

Using the proprietary protocol or the MODBUS-RTU protocol it is possible to associate the analog output to different values, add an offset to the output minimum voltage value (1...5 V or 2...10 V depending on the model) and reverse the direction of the output, so that the output decreases as the measurement increases.

In case of measurement error, the output goes to 5.5 V (if F.S.=5 V) or 11 V (if F.S.=10 V).

Status of the transmitter:

The transmitter version with LCD option has two front LEDs: the **green** LED indicates the presence of the external power supply (blinks once per second), the **red** LED indicates the presence of any measurement errors (normally off, it blinks twice per second if in error).

5 ASCII PROPRIETARY PROTOCOL

To use the ASCII proprietary protocol, it is necessary to connect the instrument to the PC via a RS485/USB or RS485/RS232 converter and use a standard serial communication program. In the serial communication program, set the COM port number to which the instrument is connected and the communication parameters as follows:

- If the MODBUS-RTU protocol is set as the operating protocol in the instrument (default), set the Baud Rate 57600 and the parameters 8N2 in the serial communication program, then power cycle the instrument and send the command @ within 10 seconds from the instrument power on.
- If the proprietary protocol is already set as the operating protocol in the instrument, it is possible to operate with Baud Rate 57600 and parameters 8N2 by sending the command @ within 10 seconds from the instrument power on, or you can let the 10 seconds pass without sending the command @ and operate with the communication parameters set in the instrument (default 19200, 8E1).

To change the instrument configuration, the serial command **CAL USER ON** must be sent first (the instrument replies with USER CAL MODE ON). The command CAL USER ON is automatically disabled after a few minutes of inactivity. If the settings should be only read, the command CAL USER ON is not required.

Below is the list of the serial commands.

Instrument information:

Command	Reply	Description
G0	<i>Model</i>	Instrument model
G1	<i>&Revision </i>	Instrument hardware revision
G2	SN=nnnnnnnn	Instrument serial number
G3	Firm.Ver.=x.y	Instrument firmware revision
G4	Firm.Date=yyyy/mm/dd	Date of firmware revision
GC	Fact.Calib.Date= yyyy/mm/dd	Date of factory calibration

Protocol:

Command	Reply	Description
@	<i>& </i>	Keeps the proprietary protocol operational even after 10 seconds from instrument power on. It must be sent within 10 seconds from instrument power on.
DPn	<i>& </i>	Sets the operating protocol: <ul style="list-style-type: none">▪ Proprietary if n=0▪ MODBUS-RTU if n=1 <i>Default : MODBUS-RTU (n=1)</i>
GP	<i>& n </i>	Reads the operating protocol set in the instrument.
SM	<i>& </i>	Activates the MODBUS-RTU protocol immediately.
CMA n	<i>& </i>	Sets the MODBUS-RTU address (1...247) to n. <i>Default : 1</i>
RMA	<i>& n </i>	Reads the MODBUS-RTU address.

Warning: after sending the DP1 command, the instrument remains with the proprietary protocol. Send the command SM to activate the MODBUS-RTU protocol immediately, or power cycle the instrument.

RS485 communication parameters:

Command	Reply	Description
CMBn	&	Sets the Baud Rate: <ul style="list-style-type: none"> ▪ 1200 if n=0 ▪ 2400 if n=1 ▪ 4800 if n=2 ▪ 9600 if n=3 ▪ 19200 if n=4 ▪ 38400 if n=5 ▪ 57600 if n=6 ▪ 115200 if n=7 <i>Default</i> : 19200 (n=4)
RMB	& n	Reads Baud Rate setting
CMpN	&	Sets parity and stop bits: <ul style="list-style-type: none"> ▪ 8N1 if n=0 [No parity, 1 stop bit] ▪ 8N2 if n=1 [No parity, 2 stop bits] ▪ 8E1 if n=2 [Even parity, 1 stop bit] ▪ 8E2 if n=3 [Even parity, 2 stop bits] ▪ 8O1 if n=4 [Odd parity, 1 stop bit] ▪ 8O2 if n=5 [Odd parity, 2 stop bits] The number of data bits is fixed to 8. <i>Default</i> : 8E1 (n=2)
RMP	& n	Reads the setting of parity and stop bits.
CMWn	&	Sets waiting time after transmission with MODBUS-RTU protocol: <ul style="list-style-type: none"> ▪ Immediate reception if n=0 (violates protocol) ▪ Waiting 3.5 characters if n=1 (respects protocol) <i>Default</i> : Immediate reception (n=0)
RMW	& n	Reads the setting of waiting time after transmission with MODBUS-RTU protocol.

Measurements reading:

Command	Reply	Description
S0	&	Disables the sending of the measurements enabled with S1.
S1	&	Enables the sending of the measurements at regular intervals. To set the sending interval, use the command MT.
S2	& <i>Measurements</i>	Prints the measurements in the following sequence: <ul style="list-style-type: none"> ▪ Pressure ▪ Power supply voltage ▪ Internal temperature ▪ Measurement error: <ul style="list-style-type: none"> 0 = no error 1 = pressure error 2 = internal temperature error 3 = pressure and internal temperature error The measurements are expressed in the set units of measurement.
MTn	&	Sets the measurement interval to n seconds (1...30 s). <i>Default</i> : 1
NT	& n	Reads the measurements sending interval.

Units of measurement:

Command	Reply	Description
CUn	&	Sets the pressure unit of measurement of index n: <ul style="list-style-type: none"> ▪ Torr if n=0 ▪ Pa if n=1 ▪ hPa if n=2 ▪ kPa if n=3 ▪ mbar if n=4 ▪ psi if n=5 ▪ kg/cm² if n=6 ▪ mmH₂O if n=7 ▪ mmHg if n=8 ▪ inH₂O if n=9 ▪ inHg if n=10 ▪ atm if n=11 ▪ bar if n=12 <i>Default: 2 ⇒ hPa</i>
RU	& n	Reads the pressure unit of measurement.
TTn	&	Sets the temperature unit of measurement of index n: <ul style="list-style-type: none"> ▪ °C if n=0 ▪ °F if n=1 <i>Default: 0 ⇒ °C</i>
HT	& n	Reads the temperature unit of measurement.

Pressure measurement offset:

Command	Reply	Description
COn	&	Adds the offset n to the measured pressure value. For the value n to be entered, see Note 1 below. The offset must be within the ±10 hPa range or equivalent range in the set unit of measurement, if different from hPa. <i>Default: 0</i>
RO	& n	Reads the pressure measurement offset (see Note 1 below).

Restoring the factory configuration:

Command	Reply	Description
DFLT	&	Restores the factory configuration.

Analog output:

Command	Reply	Description
CVOn	&	Enable/disable the offset of the voltage analog output: <ul style="list-style-type: none"> ▪ Offset disabled if n=0 (0...5 V / 0...10 V) ▪ Offset enabled if n=1 (1...5 V / 2...10 V) <i>Default</i> : Offset disabled (n=0)
RVO	& n	Reads the setting of the offset for the voltage analog output.
CVSON	&	Sets the direct or reversed correspondence between voltage analog output and pressure: <ul style="list-style-type: none"> ▪ 0 V \Rightarrow Min. pressure, F.S. \Rightarrow Max. pressure if n=0 ▪ F.S. \Rightarrow Min. pressure, 0 V \Rightarrow Max. pressure if n=1 <i>Default</i> : Direct correspondence (n=0)
RVSO	& n	Reads the type of correspondence (direct or reversed) between voltage analog output and pressure.
CVLn	&	Sets n as the minimum pressure value for the voltage analog output. For the value n to be entered, see Note 1 below. <i>Default</i> : 60000 (=600.00 hPa)
RVL	& n	Reads the minimum pressure value for the voltage analog output (see Note 1 below).
CVHn	&	Sets n as the maximum pressure value for the voltage analog output. For the value n to be entered, see Note 1 below. <i>Default</i> : 110000 (=1100.00 hPa)
RVH	& n	Reads the maximum pressure value for the voltage analog output (see Note 1 below).
RVF	& 0 <i>Minimum value</i> <i>Maximum value</i>	Simultaneously provides the information obtainable with the RVL e RVH commands.

Note 1: The value is an integer, expressed in the set unit of measurement and must take into account the resolution corresponding to the set unit of measurement (see the column "ASCII proprietary protocol" of the table on page 5). For example, if the set unit of measurement is hPa, the value is in hundredths of hPa (60000 equals 600.00 hPa). The number is automatically converted if the unit of measurement is changed (which must therefore be set first).

6 MODBUS-RTU PROTOCOL

By default, the instrument has MODBUS address **1** and communication parameters 19200, 8E1. The address and the communication parameters can be changed by using the appropriate serial commands of the proprietary protocol or, alternatively, directly with MODBUS commands by changing the value of the Coils and Holding Registers described later.

The MODBUS-RTU protocol, if set as the operating protocol (default), is active after 10 seconds from the instrument power on.

In order to change the instrument configuration using the MODBUS-RTU protocol, the value 1 must be written first in the *Coil* with address 1.

Below is the list of registers.

Input Registers:

Address	Description	Format
0	Pressure in the set unit of measurement (<i>see table on page 5 for the resolution</i>).	32-bit Integer ⁽²⁾
2	Pressure in the set unit of measurement (<i>see table on page 5 for the resolution</i>).	16-bit Integer
3	Power supply voltage in Volt [x10]	16-bit Integer
4	Internal temperature in the set unit of measurement [x10]	16-bit Integer
5	Error register: 0 = no error 1 = pressure error 2 = internal temperature error 3 = pressure and internal temperature error	16-bit Integer

Coils:

Address	Description	Format
0	Set 1 to restore the factory configuration. Bit zeroing is automatic.	Bit
1	Enable configuration change: 0=no (default), 1=yes. The changes to <i>Coils</i> and <i>Holding Registers</i> will be accepted only if this register is set to 1.	Bit
2	Sets waiting time after transmission with MODBUS-RTU protocol: 0=immediate reception (default); 1=waiting 3.5 characters.	Bit
6	Enable/disable the offset of the voltage analog output: 0=offset disabled (default, 0...5 V / 0...10 V) 1=offset enabled (1...5 V / 2...10 V)	Bit
7	Sets the direct or reversed correspondence between voltage analog output and pressure: 0=direct (default, 0 V \Rightarrow Min. press., F.S. \Rightarrow Max. press.) 1=reversed (F.S. \Rightarrow Min. press., 0 V \Rightarrow Max. press.)	Bit

Holding Registers:

Address	Description	Format
0	RS485 Baud Rate: 0=1200; 1=2400; 2=4800; 3=9600; 4=19200 (default); 5=38400; 6=57600; 7=115200.	16-bit Integer
1	RS485 parity and stop bits: 0=8N1; 1=8N2; 2=8E1 (default); 3=8E2; 4=8O1; 5=8O2. [N=no parity, E=even parity, O=odd parity]	16-bit Integer
2	Instrument address for the MODBUS-RTU protocol (1...247, default=1).	16-bit Integer
3	Pressure unit of measurement: 0 ⇒ Torr, 1 ⇒ Pa, 2 ⇒ hPa, 3 ⇒ kPa, 4 ⇒ mbar, 5 ⇒ psi, 6 ⇒ kg/cm ² , 7 ⇒ mmH ₂ O, 8 ⇒ mmHg, 9 ⇒ mmHg, 10 ⇒ inHg, 11 ⇒ atm, 12 ⇒ bar Default: 2 ⇒ hPa	16-bit Integer
4	Offset added to the measured pressure value. For the value, see Note 3 below. The offset must be within the ±10 hPa range or equivalent range in the set unit of measurement, if different from hPa. Default: 0.	16-bit Integer
5	Temperature unit of measurement: 0 ⇒ °C, 1 ⇒ °F Default: 0 ⇒ °C	16-bit Integer
6	Measurement interval in seconds (1...30, default=1).	16-bit Integer
13	Minimum pressure value for the voltage analog output. For the value, see Note 3 below. Default : 60000 (=600.00 hPa)	32-bit Integer ⁽²⁾
15	Maximum pressure value for the voltage analog output. For the value, see Note 3 below. Default : 110000 (=1100.00 hPa)	32-bit Integer ⁽²⁾

Note 2: The value is a 32-bit integer; two consecutive registers starting from the one indicated must be accessed to read it. The register with lower address contains the least significant bits.

Note 3: The value is an integer, expressed in the set unit of measurement and must take into account the resolution corresponding to the set unit of measurement (*see the column "Modbus protocol IR 0" of the table on page 5*). For example, if the set unit of measurement is hPa, the value indicates hundredths of hPa (60000 equals 600.00 hPa. The number is automatically converted if the unit of measurement is changed (which must therefore be set first).

7 SAFETY INSTRUCTIONS

General safety instructions

The instrument has been manufactured and tested in accordance with the safety standard EN61010-1:2010 "Safety requirements for electrical equipment for measurement, control and laboratory use" and has left the factory in perfect safety technical conditions.

The instrument proper operation and operating safety can be ensured only if all standard safety measures as well as the specific measures described in this manual are followed.

The instrument proper operation and operating safety can be ensured only in the climatic conditions specified in this manual.

Do not use the instruments in places where there are:

- Corrosive or flammable gases.
- Direct vibrations or shocks to the instrument.
- High-intensity electromagnetic fields, static electricity.

User obligations

The instrument operator shall follow the directives and regulations below that refer to the treatment of dangerous materials:

- EEC directives on workplace safety.
- National law regulations on workplace safety.
- Accident prevention regulations.

8 ORDERING CODES

BAROsense

ACCESSORIES

SWD10F

100...240 Vac / 12 Vdc – 1A power supply. Includes adapter cable with jack connector on the power supply side and free wires on the instrument side.

NOTES

NOTES

**DICHIARAZIONE DI CONFORMITÀ UE**
EU DECLARATION OF CONFORMITY**Delta Ohm S.r.L. a socio unico – Via Marconi 5 – 35030 Caselle di Selvazzano – Padova – ITALY**Documento Nr. / Mese.Anno: **5181 / 07.2022**
Document-No. / Month.Year :

Si dichiara con la presente, in qualità di produttore e sotto la propria responsabilità esclusiva, che i seguenti prodotti sono conformi ai requisiti di protezione definiti nelle direttive del Consiglio Europeo:
We declare as manufacturer herewith under our sole responsibility that the following products are in compliance with the protection requirements defined in the European Council directives:

Codice prodotto: **BAROsense**
Product identifier :Descrizione prodotto: **Trasmittitore barometrico**
Product description : **Barometric transmitter**I prodotti sono conformi alle seguenti Direttive Europee:
The products conform to following European Directives:

Direttive / Directives	
2014/30/EU	Direttiva EMC / EMC Directive
2014/35/EU	Direttiva bassa tensione / Low Voltage Directive
2011/65/EU - 2015/863/EU	RoHS / RoHS

Norme armonizzate applicate o riferimento a specifiche tecniche:
Applied harmonized standards or mentioned technical specifications:

Norme armonizzate / Harmonized standards	
EN 61010-1:2010	Requisiti di sicurezza elettrica / Electrical safety requirements
EN 61326-1:2013	Requisiti EMC / EMC requirements
EN 50581:2012	RoHS / RoHS

Il produttore è responsabile per la dichiarazione rilasciata da:
*The manufacturer is responsible for the declaration released by:***Alessandro Perego**Amministratore delegato
Chief Executive Officer

Caselle di Selvazzano, 21/07/2022

Questa dichiarazione certifica l'accordo con la legislazione armonizzata menzionata, non costituisce tuttavia garanzia delle caratteristiche.
This declaration certifies the agreement with the harmonization legislation mentioned, contained however no warranty of characteristics.

WARRANTY

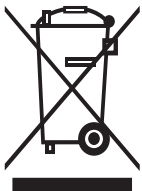
Delta OHM is required to respond to the "factory warranty" only in those cases provided by Legislative Decree 6 September 2005 - n. 206. Each instrument is sold after rigorous inspections; if any manufacturing defect is found, it is necessary to contact the distributor where the instrument was purchased from. During the warranty period (24 months from the date of invoice) any manufacturing defects found will be repaired free of charge. Misuse, wear, neglect, lack or inefficient maintenance as well as theft and damage during transport are excluded. Warranty does not apply if changes, tampering or unauthorized repairs are made on the product. Solutions, probes, electrodes and microphones are not guaranteed as the improper use, even for a few minutes, may cause irreparable damages.

Delta OHM repairs the products that show defects of construction in accordance with the terms and conditions of warranty included in the manual of the product. For any dispute, the competent court is the Court of Padua. The Italian law and the "Convention on Contracts for the International Sales of Goods" apply.

TECHNICAL INFORMATION

The quality level of our instruments is the result of the continuous product development. This may lead to differences between the information reported in the manual and the instrument you have purchased. In case of discrepancies and/or inconsistencies, please write to sales@deltaohm.com. Delta OHM reserves the right to change technical specifications and dimensions to fit the product requirements without prior notice.

DISPOSAL INFORMATION



Electrical and electronic equipment marked with specific symbol in compliance with 2012/19/EU Directive must be disposed of separately from household waste. European users can hand them over to the dealer or to the manufacturer when purchasing a new electrical and electronic equipment, or to a WEEE collection point designated by local authorities. Illegal disposal is punished by law.

Disposing of electrical and electronic equipment separately from normal waste helps to preserve natural resources and allows materials to be recycled in an environmentally friendly way without risks to human health.



V1.1
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