DeltaOHM

○ Member of GHM GROUP

Operating manual

PM / CO_2 Transmitter
PM[B]sense

www.deltaohm.com

Keep for future reference.

TABLE OF CONTENTS

1   INTRODUCTION

PMsense is a **PM1.0**, **PM2.5** and **PM10** Particulate Matter transmitter suitable for outdoor air quality monitoring.

The dust particles concentration is measured using the laser scattering principle.

An optional CO_2 sensor can be integrated in the transmitter (**PMBsense**).

The transmitter has a digital RS485 output with MODBUS-RTU or ASCII proprietary protocol. A version with two additional 0/4…20 mA (0…10 V **on request when ordering**) analog outputs is available. The two analog outputs can be independently associated with any of the measured parameters.

The measuring circuit of the transmitter can be operated in continuous mode or, in order to extend the PM sensor lifetime, at cyclic intervals (default operating mode). The measuring cycle interval is user configurable.

The transmitter is maintenance-free and has fast response, high sensitivity, excellent stability and long operating life.

Models

| Model	Measurement		Output	
	PM	**CO₂**	**RS485**	**Analog** [*]
PMsense-M	√		√	
PMsense-A	√		√	√
PMBsense-M	√	√	√	
PMBsense-A	√	√	√	√

[*] Two analog outputs, standard 0/4…20 mA, on request 0…10 V.

2   TECHNICAL SPECIFICATIONS

| Particulate Matter	
Measuring principle	Laser scattering
Measured pollutants	PM1.0, PM2.5 and PM10
Measuring range	0…1000 µg/m^3 (for each pollutant)
Particle size detection range	$\varnothing$ 0.3…10 µm
Linearity error	< 5%
Repeatability	< 3%
Sensor warm up time	15 s
Sensor lifetime	5 years approx. in 5 minutes cyclic operating mode (default) > 10,000 hours in continuous operating mode (1 meas./s)
Temperature drift	< 0.01 µg/m^3/°C
CO$_2$ (only PMBsense…)	
Measuring principle	Double wavelength NDIR
Measuring range	0…5000 ppm
Accuracy	$\pm$(50 ppm+3% of measurement) @ 25 °C and 1013 hPa
Response time	< 120 s (air speed= 2 m/s)
Long-term stability	5% of measurement / 5 years
Temperature drift	1 ppm/°C
General specifications	
Output	RS485 with Modbus-RTU or ASCII proprietary protocol Only **PMsense-A**: 2 x analog 4…20 mA (R_{Lmax} = 500 Ω); on request 2 x 0…10 V (R_{Lmin} = 10 kΩ)
Power supply	7…30 Vdc (15…30 Vdc for 0…10 V analog outputs)
Power consumption	25 mA @ 24 Vdc during measurement 4 mA in stand-by (only for cyclic operating mode) The indicated consumption does not include the consumption due to the analog outputs
Connection	M12 8-pole circular connector
Operating conditions	-20…+70 °C / 0…95 %RH / 500…1500 hPa
Housing material	Polycarbonate
Protection degree	Housing equipped with a rain-proof and UV resistant inlet air filter – IP 53
Dimensions	120 x 94 x 71 (excluding M12 connector)
Weight	330 g

3 INSTALLATION

The transmitter is equipped with a bracket with U-bolt for the fixing to a Ø40…50 mm mast. It can be fixed to a wall using the bracket only, by removing the U-bolt.
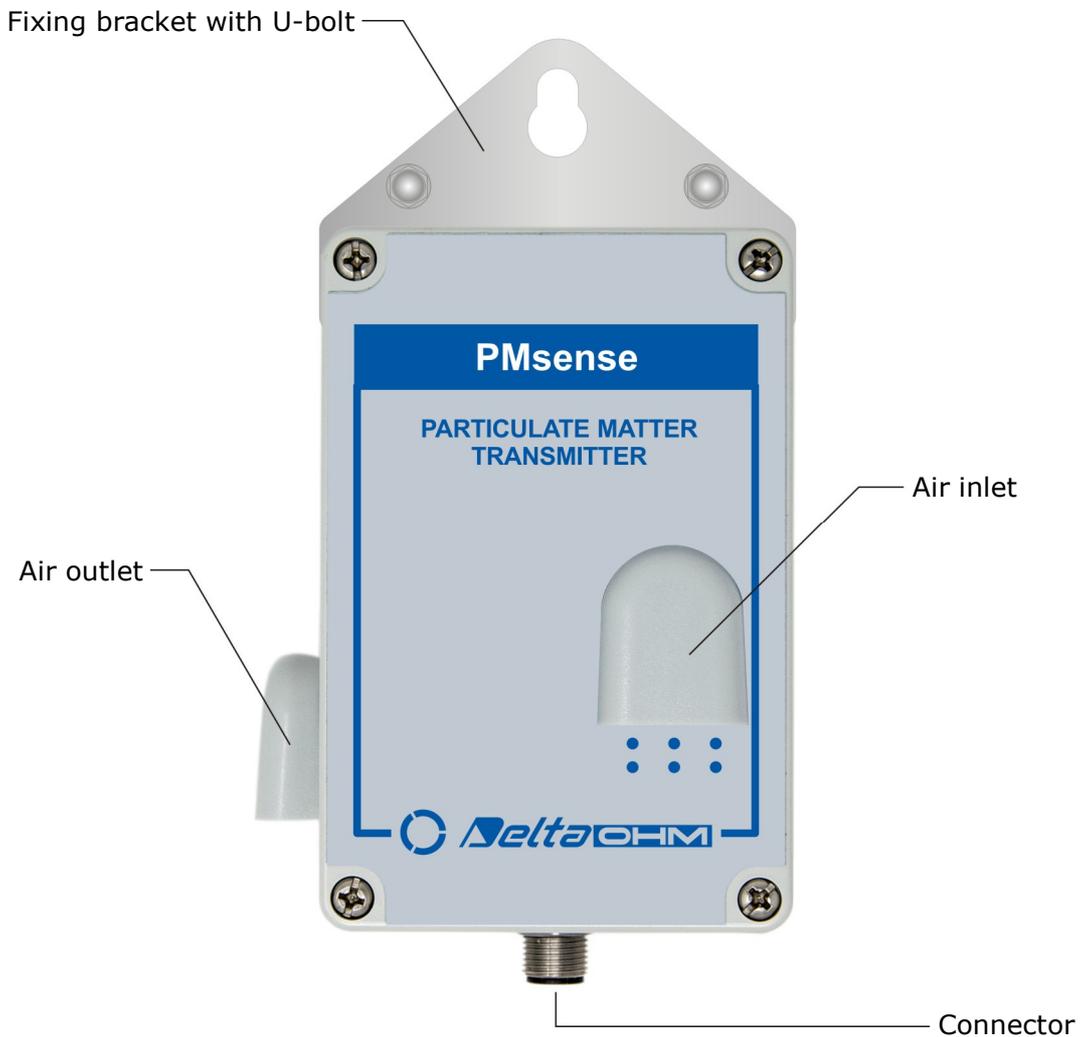
Fig. 3.1: transmitter description

3.1 ELECTRICAL CONNECTIONS

The transmitter has a M12 8-pole circular connector and uses the **CPM12-8PM... optional** cables, with M12 8-pole connector on one side and open wires on the other side.
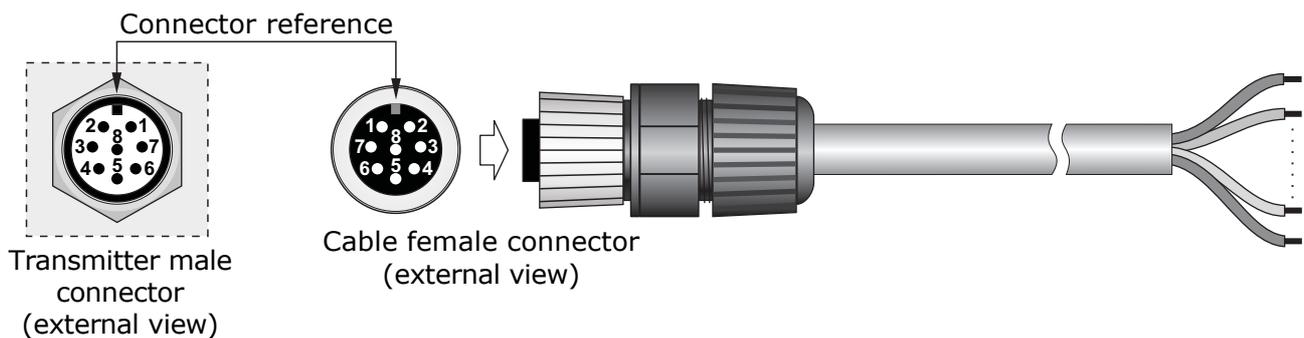
Fig. 3.2: connectors pinout

Connector pin N°	Function	CPM12-8PM... wire color
1	Power supply negative (GND)	Blue
2	Power supply positive (+Vdc)	Red
3	Not used	---
4	RS485 A/-	Brown
5	RS485 B/+	White
6	Digital and analog outputs ground (SGND)*	Grey
7	Analog output 1 positve (AOUT1, **only PM[B]sense-A**)	Yellow
8	Analog output 2 positve (AOUT2, **only PM[B]sense-A**)	Green
	Cable shield **	Black (thick wire)

* The output ground (SGND) and the negative of the power supply (GND) are short-circuited inside the transmitter.

* The cable shield is not connected to the M12 connector.

To ensure a good noise immunity, it is recommended to connect the cable shield to ground (GND).

RS485 connection:

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.
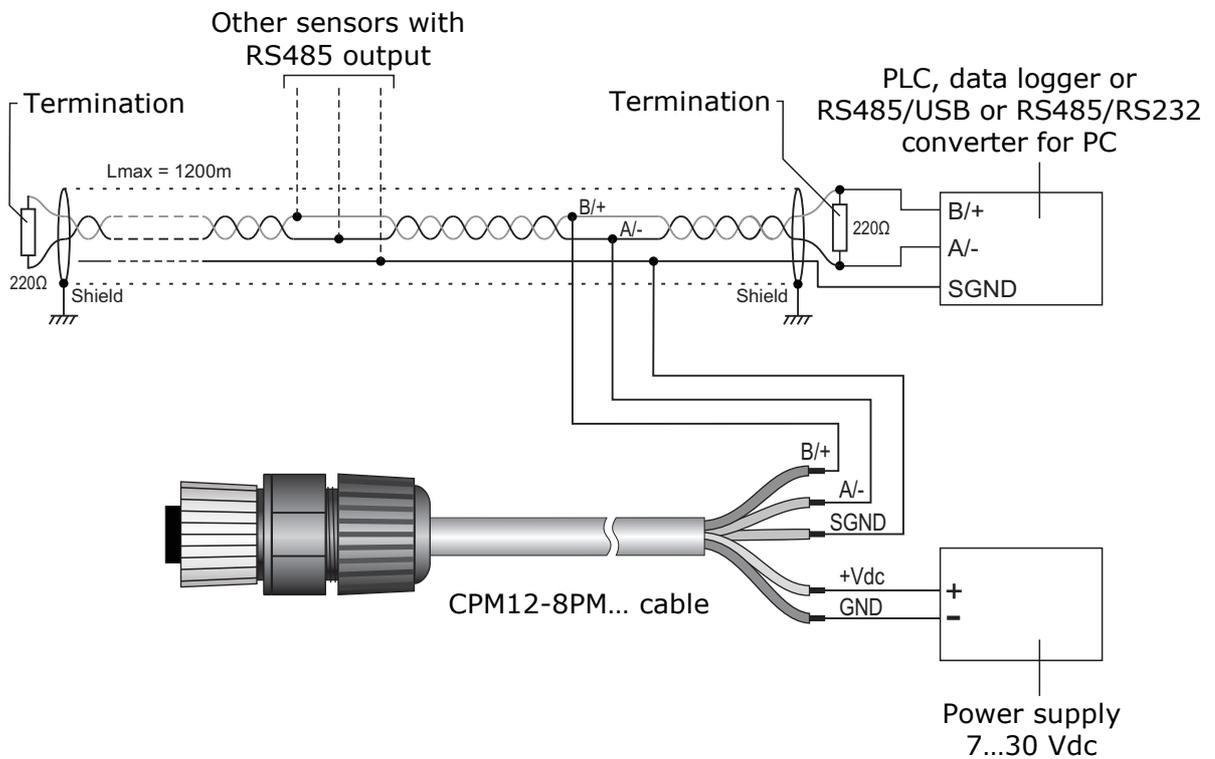
Fig. 3.3: RS485 connection

Current analog output (only PM[B]sense-A):
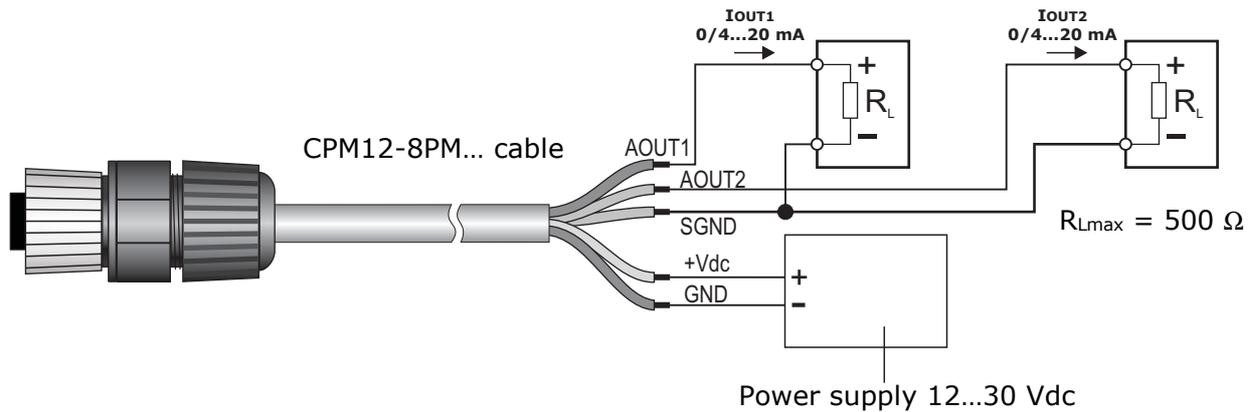
By default, the current analog outputs are 4…20 mA, with:

$4\ mA = 0\ \mu g/m^3$
$20\ mA = 1000\ \mu g/m^3$

The analog output 1 is associated by default to PM2.5. The analog output 2 is associated by default to PM10.

With the commands of the proprietary protocol it is possible to associate the analog outputs to different parameters, set the range 0…20 mA for the output 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 22 mA.

Fig. 3.4: current analog outputs connection

Voltage analog output (optional, only PM[B]sense-A):

By default, the voltage analog outputs are 0…10 V, with:

$0\ V = 0\ \mu g/m^3$
$10\ V = 1000\ \mu g/m^3$

The analog output 1 is associated by default to PM2.5. The analog output 2 is associated by default to PM10.

With the commands of the proprietary protocol it is possible to associate the analog outputs to different parameters, set the range 2…10 V for the output 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 11 V.
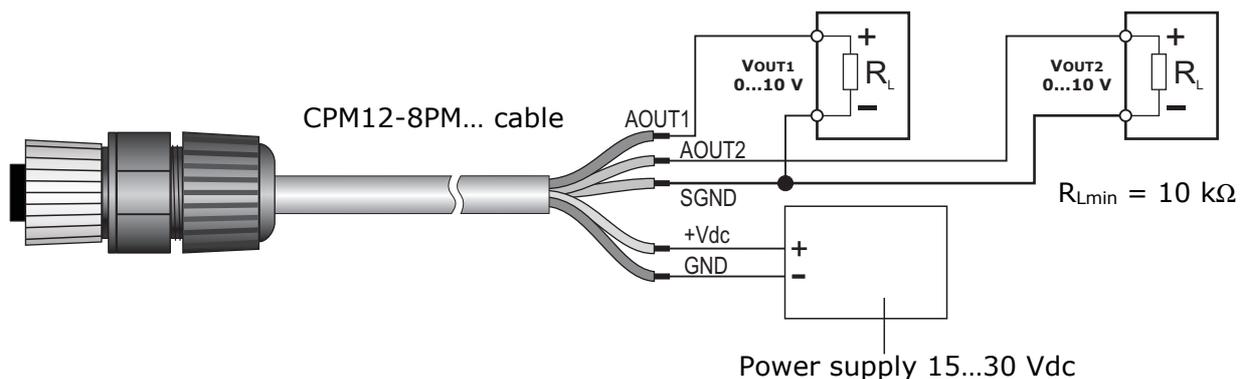
Fig. 3.5: voltage analog outputs connection

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.

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

Particulate Matter measurement modes:

The transmitter can perform the PM measurement in continuous mode, or, in order to extend the sensor lifetime, at cyclic intervals.

By default, the transmitter is configured to measure at cyclic intervals with an interval of 5 minutes. The measurement mode and the interval can be configured respectively by using the CPLS and CPLP commands of the proprietary protocol or the holding registers with address 15 and 16 of the MODBUS-RTU protocol.

In the measurement mode at cyclic intervals, the PM sensor is activated periodically for about a minute, at the end of which the measurement is made available and "frozen" (the sensor is deactivated) until the set cyclic measurement interval expires. The measurement provided is a value averaged during the minute of sensor activation.

In continuous measurement mode the sensor is always active, and the measurement provided is an averaged value chosen from the following possibilities:

- average over a 10 seconds interval, updated every second;
- average over a 60 seconds interval, updated every 10 seconds (default);
- average over a 15 min interval, updated every minute.

The type of average can be configured by using the CPS command of the proprietary protocol or the holding registers with address 19 of the MODBUS-RTU protocol.

Status of the transmitter:

There are two LEDs on the internal electronic board of the transmitter: 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 at least one of the measured parameters is in error).

5 PROPRIETARY PROTOCOL

To use the proprietary protocol, it is necessary to connect the instrument to the PC via a RS485/USB (e.g. RS51K) 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	*Model*	Instrument model
G1	&*Revision*|	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 User.Calib.Date= yyyy/mm/dd Cal.Mode=*Factory* or *User*	Date of factory calibration Date of user calibration (CO_2 only) Type of calibration active (CO_2 only)

Protocol:

Command	Reply	Description
@	&|	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	&|	Sets the operating protocol: ▪ Proprietary if n=0 ▪ MODBUS-RTU if n=1 *Default* : MODBUS-RTU (n=1)
GP	& n|	Reads the operating protocol set in the instrument.
SM	&|	Activates the MODBUS-RTU protocol immediately.
CMAn	&|	Sets the instrument address for the MODBUS-RTU protocol to n. The address should range within 1 and 247. *Default* : 1
RMA	& n|	Reads the instrument address for the MODBUS-RTU protocol.

Note: 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: ▪ 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 *Default* : 19200 (n=4)
RMB	& n|	Reads Baud Rate setting
CMPn	&|	Sets parity and stop bits: ▪ 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. *Default* : 8E1 (n=2)
RMP	& n|	Reads the setting of parity and stop bits.
CMWn	&|	Sets waiting time after transmission with MODBUS-RTU protocol: ▪ Immediate reception if n=0 (violates protocol) ▪ Waiting 3.5 characters if n=1 (respects protocol) *Default* : Immediate reception (n=0)
RMW	& n|	Reads the setting of waiting time after transmission with MODBUS-RTU protocol.

PM measurement settings:

Command	Reply	Description
CPLSn	&|	Sets the PM measurement mode: ▪ Continuous if n=0 ▪ At cyclic intervals if n=1 *Default* : At cyclic intervals (n=1)
RPLS	& n|	Reads the setting of the PM measurement mode.
CPLPn	&|	Sets the cycle interval for the measurement mode at cyclic intervals. The number of seconds must be greater than 70, in order to allow the sensor to take the measurement. *Default* : 300 (=5 min)
RPLP	& n|	Reads the setting of the cycle interval for the measurement mode at cyclic intervals.

Command	Reply	Description
CPSn	&|	Sets the type of measurement averaging for the continuous measurement mode: ▪ Average over a 10 seconds interval, updated every second if n=0 ▪ Average over a 60 seconds interval, updated every 10 seconds if n=1 ▪ Average over a 15 minutes interval, updated every minute if n=2 *Default* : Average over a 60 seconds interval, updated every 10 seconds (n=1)
RPS	& n|	Reads the type of measurement averaging for the continuous measurement mode.

Analog outputs (only PM[B]sense-A):

Command	Reply	Description
CA1On	&|	Enable/disable the offset of the analog output 1: ▪ Offset disabled if n=0 (0…20 mA or 0…10 V) ▪ Offset enabled if n=1 (4…20 mA or 2…10 V) *Default* : Offset enabled (n=1) if the output is current, offset disabled (n=0) if the output is voltage (optional)
RA1O	& n|	Reads the setting of the offset for the analog output 1.
CA1SOn	&|	Sets the direct or inverse correspondence between analog output 1 and associated physical quantity: ▪ 4 mA/0 V $\Rightarrow$ Min. quantity, 20 mA/10 V $\Rightarrow$ Max. quantity if n=0 ▪ 20 mA/10 V $\Rightarrow$ Min. quantity, 4 mA/0 V $\Rightarrow$ Max. quantity if n=1 *Default* : Direct correspondence (n=0)
RA1SO	& n|	Reads the type of correspondace (direct or inverse) between analog output 1 and associated physical quantity.
CA1Tn	&|	Associates the analog output 1 to: ▪ PM1.0 if n=0 ▪ PM2.5 if n=1 ▪ PM10 if n=2 ▪ CO_2 if n=12 (only PMBsense-A) *Default* : PM2.5 (n=1) *Note: the PM measurement is updated according to the operating mode set with the CPLS, CPLP and CPS commands.*
RA1T	& n|	Reads the physical quantity associated to analog output 1.
CA1Ln	&|	Sets n as the minimum value of the measuring range of the physical quantity associated to the analog output 1. If the output is associated to PM, the value must be expressed as a number of tenths (e.g. n=5 to indicate 0.5 µg/m^3). If the output is associated to CO_2, the value must be expressed as a number of units (e.g. n=200 to indicate 200 ppm). *Default* : 0
RA1L	& n|	Reads the minimum value of the measuring range of the physical quantity associated to the analog output 1.

Command	Reply	Description
CA1Hn	&|	Sets n as the maximum value of the measuring range of the physical quantity associated to the analog output 1.
		If the output is associated to PM, the value must be expressed as a number of tenths (e.g. n=50 to indicate 5.0 $\mu g/m^3$). If the output is associated to CO_2, the value must be expressed as a number of units (e.g. n=800 to indicate 800 ppm).
		Default : 10000 (=1000.0 $\mu g/m^3$ of PM)
RA1H	& n|	Reads the maximum value of the measuring range of the physical quantity associated to the analog output 1.
RA1F	& *Quantity Minimum value Maximum value*	Simultaneously provides the information obtainable with the RA1T, RA1L e RA1H commands.
CA2On	&|	Enable/disable the offset of the analog output 2:
		▪ Offset disabled if n=0 (0…20 mA or 0…10 V)
		▪ Offset enabled if n=1 (4…20 mA or 2…10 V)
		Default : Offset enabled (n=1) if the output is current, offset disabled (n=0) if the output is voltage (optional)
RA2O	& n|	Reads the setting of the offset for the analog output 2.
CA2SOn	&|	Sets the direct or inverse correspondence between analog output 2 and associated physical quantity:
		▪ 4 mA/0 V $\Rightarrow$ Min. quantity, 20 mA/10 V $\Rightarrow$ Max. quantity if n=0
		▪ 20 mA/10 V $\Rightarrow$ Min. quantity, 4 mA/0 V $\Rightarrow$ Max. quantity if n=1
		Default : Direct correspondence (n=0)
RA2SO	& n|	Reads the type of correspondace (direct or inverse) between analog output 2 and associated physical quantity.
CA2Tn	&|	Associates the analog output 2 to:
		▪ PM1.0 if n=0
		▪ PM2.5 if n=1
		▪ PM10 if n=2
		▪ CO_2 if n=12 (only PMBsense-A)
		Default : PM10 (n=2)
		Note: the PM measurement is updated according to the operating mode set with the CPLS, CPLP and CPS commands.
RA2T	& n|	Reads the physical quantity associated to analog output 2.
CA2Ln	&|	Sets n as the minimum value of the measuring range of the physical quantity associated to the analog output 2.
		If the output is associated to PM, the value must be expressed as a number of tenths (e.g. n=5 to indicate 0.5 $\mu g/m^3$). If the output is associated to CO_2, the value must be expressed as a number of units (e.g. n=200 to indicate 200 ppm).
		Default : 0
RA2L	& n|	Reads the minimum value of the measuring range of the physical quantity associated to the analog output 2.

Command	Reply	Description
CA2Hn	&|	Sets n as the maximum value of the measuring range of the physical quantity associated to the analog output 2. If the output is associated to PM, the value must be expressed as a number of tenths (e.g. n=50 to indicate 5.0 $\mu g/m^3$). If the output is associated to CO_2, the value must be expressed as a number of units (e.g. n=800 to indicate 800 ppm). *Default* : 10000 (=1000 $\mu g/m^3$ of PM)
RA2H	& n|	Reads the maximum value of the measuring range of the physical quantity associated to the analog output 2.
RA2F	& *Quantity* *Minimum value* *Maximum value*	Simultaneously provides the information obtainable with the RA2T, RA2L e RA2H commands.

Reading of the measurement information:

Command	Reply	Description
P0	&|	Disable the sending of the measurement enabled with P1.
P1	&|	Enable the sending of the PM measurement every second, in the sequence described in command P5.
P5	& *Measurements*	Prints the PM measurements in the following sequence: ▪ PM measurement error (0=no, 1=yes) ▪ PM1.0 in N° of particles/ml ▪ PM2.5 in N° of particles/ml ▪ PM10 in N° of particles/ml ▪ PM1.0 in $\mu g/m^3$ ▪ PM2.5 in $\mu g/m^3$ ▪ PM10 in $\mu g/m^3$ *Note: the PM measurement is updated according the operating mode set with the CPLS, CPLP and CPS commands.*
S0	&|	Disable the sending of the measurement enabled with S1.
S1	&|	Enable the sending of the measurement every second, in the sequence described in command S5.
S5	& *Measurements*	Prints the measurements in the following sequence: ▪ PM measurement error (0=no, 1=yes) ▪ PM1.0 in $\mu g/m^3$ ▪ PM2.5 in $\mu g/m^3$ ▪ PM10 in $\mu g/m^3$ ▪ CO_2 in ppm ▪ Atmospheric pressure in hPa (internal sensor for CO_2 measurement compensation) ▪ *Field not used* ▪ *Field not used* ▪ *Field not used* ▪ Power supply voltage ▪ Internal board temperature *Note: the PM measurement is updated according the operating mode set with the CPLS, CPLP and CPS commands.*

CO₂ calibration (only PMBsense...):

A 2-point (CO21 and CO22 commands) or 1-point calibration (CO2O command) can be performed. The points are chosen by the user. To perform the calibration, the transmitter must be placed in an environment with a known CO_2 concentration.

While the 2-point calibration allows moving the two calibration points independently, and therefore also to adjust the slope of the sensor response curve, the 1-point calibration simply adds an offset to the measurement (the two calibration points are shifted of the same amount) and is typically accomplished by placing the transmitter in clean air.

Before performing the calibration, the type of calibration to be used must be set to "user" with the CC command.

The transmitter allows manually setting, with the DA command, a string that is saved as the date and time of the calibration. The string must be set before performing the calibration.

Command	Reply	Description
CO21n	& t|	CO_2 calibration in the first point at n ppm.
		The transmitter must first be placed in an environment with a known CO_2 concentration (the value n entered in the command).
		The value t in the reply to the command indicates the number of seconds required for the transmitter to complete the calibration operation. During this time, the transmitter sends strings notifying the progress of the operation; for example:
		"CO2 calib. Status:IN PROGRESS 8% Avg:1096ppm Dev:0ppm"
		At the end, the OK 100% notification indicates that the operation was successful; for example:
		"CO2 calib. Status:OK 100% Avg:1100ppm Dev:7ppm"
CO22n	& t|	CO_2 calibration in the second point at n ppm.
		Operation similar to the CO21command.
CO2On	& t|	CO_2 calibration at n ppm (1-point calibration – offset adjustment).
		Operation similar to the CO21command.
DAyyyy/mm/dd hh:mm:ss	&|	Saves the string "aaaa/mm/gg hh:mm:ss" as the date and time when calibration is performed.
		The command must be sent before performing the calibration.
GA	& yyyy/mm/dd hh:mm:ss	Reads the date and time saved with the DA command.
CCn	&|	Sets the type of calibration to be used:
		▪ User if n=0
		▪ Factory if n=1
		Default : Factory (n=1)
CO2D	&|	Reset of user calibration.

Restoring the factory configuration:

Command	Reply	Description
DFLT	&|	Restores the factory configuration.

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* number 2 (address 1).

Below is the list of registers (the tables show both the number and the address of the registers, with the address of the register equal to the number of the register decreased by 1, as defined in the MODBUS standard).

Input Registers:

Number	Address	Description	Format
1	0	PM1.0 in N° of particles/ml. *Measurement updated according the operating mode set with the CPLS, CPLP and CPS commands.*	16-bit Integer
2	1	PM2.5 in N° of particles/ml. *Measurement updated according the operating mode set with the CPLS, CPLP and CPS commands.*	16-bit Integer
3	2	PM10 in N° of particles/ml. *Measurement updated according the operating mode set with the CPLS, CPLP and CPS commands.*	16-bit Integer
4	3	PM1.0 in $\mu g/m^3$ (x10). *Measurement updated according the operating mode set with the CPLS, CPLP and CPS commands.*	16-bit Integer
5	4	PM2.5 in $\mu g/m^3$ (x10). *Measurement updated according the operating mode set with the CPLS, CPLP and CPS commands.*	16-bit Integer
6	5	PM10 in $\mu g/m^3$ (x10). *Measurement updated according the operating mode set with the CPLS, CPLP and CPS commands.*	16-bit Integer
7	6	PM1.0 in N° of particles/ml. *Measurement averaged over 10 s and updated every second. Available in continuous measurement mode.*	16-bit Integer
8	7	PM2.5 in N° of particles/ml. *Measurement averaged over 10 s and updated every second. Available in continuous measurement mode.*	16-bit Integer
9	8	PM10 in N° of particles/ml. *Measurement averaged over 10 s and updated every second. Available in continuous measurement mode.*	16-bit Integer
10	9	PM1.0 in $\mu g/m^3$ (x10). *Measurement averaged over 10 s and updated every second. Available in continuous measurement mode.*	16-bit Integer

11	10	PM2.5 in µg/m^3 (x10). *Measurement averaged over 10 s and updated every second. Available in continuous measurement mode.*	16-bit Integer
12	11	PM10 in µg/m^3 (x10). *Measurement averaged over 10 s and updated every second. Available in continuous measurement mode.*	16-bit Integer
13	12	PM1.0 in N° of particles/ml. *Measurement averaged over 60 s and updated every 10 s. Available in continuous measurement mode.*	16-bit Integer
14	13	PM2.5 in N° of particles/ml. *Measurement averaged over 60 s and updated every 10 s. Available in continuous measurement mode.*	16-bit Integer
15	14	PM10 in N° of particles/ml. *Measurement averaged over 60 s and updated every 10 s. Available in continuous measurement mode.*	16-bit Integer
16	15	PM1.0 in µg/m^3 (x10). *Measurement averaged over 60 s and updated every 10 s. Available in continuous measurement mode.*	16-bit Integer
17	16	PM2.5 in µg/m^3 (x10). *Measurement averaged over 60 s and updated every 10 s. Available in continuous measurement mode.*	16-bit Integer
18	17	PM10 in µg/m^3 (x10). *Measurement averaged over 60 s and updated every 10 s. Available in continuous measurement mode.*	16-bit Integer
19	18	PM1.0 in N° of particles/ml. *Measurement averaged over 15 min and updated every minute. Available in continuous measurement mode.*	16-bit Integer
20	19	PM2.5 in N° of particles/ml. *Measurement averaged over 15 min and updated every minute. Available in continuous measurement mode.*	16-bit Integer
21	20	PM10 in N° of particles/ml. *Measurement averaged over 15 min and updated every minute. Available in continuous measurement mode.*	16-bit Integer
22	21	PM1.0 in µg/m^3 (x10). *Measurement averaged over 15 min and updated every minute. Available in continuous measurement mode.*	16-bit Integer
23	22	PM2.5 in µg/m^3 (x10). *Measurement averaged over 15 min and updated every minute. Available in continuous measurement mode.*	16-bit Integer
24	23	PM10 in µg/m^3 (x10). *Measurement averaged over 15 min and updated every minute. Available in continuous measurement mode.*	16-bit Integer
27	26	PM measurement error: 0=no, 1=yes.	Intero 16 bit
29	28	CO_2 in ppm.	Intero 16 bit
34,35	33,34	Atmospheric pressure in Pa $^{(*)}$ *Internal sensor for CO_2 measurement compensation*	Intero 16 bit
36	35	Atmospheric pressure in hPa (x10) *Internal sensor for CO_2 measurement compensation*	Intero 16 bit
38	37	Power supply voltage in Volt (x10).	16-bit Integer

		Internal board temperature (x10).	16-bit Integer
39	38	Internal board temperature (x10).	16-bit Integer
41	40	Instrument firmware revision. The most significant byte indicates the major revision; the less significant byte indicates the minor revision.	16-bit Integer
42	41	Number of MODBUS communication error.	16-bit Integer

$^{(*)}$ The measure is a 32-bit integer value. Two consecutive registers must be accessed to read the value. The register with lower address contains the most significant bits.

Coils:

Number	Address	Description	Format
1	0	Set 1 to restore the factory configuration. Bit zeroing is automatic.	Bit
2	1	Enable configuration change: 0=no (default), 1=yes. The changes to *Coils* and *Holding Registers* will be accepted only if this register is set to 1.	Bit
3	2	Sets waiting time after transmission with MODBUS-RTU protocol: 0=immediate reception (default); 1=waiting 3.5 characters.	Bit
4	3	Enable/disable the offset of the analog output 1: 0=offset disabled (0…20 mA or 0…10 V, default if the output is voltage); 1=offset enabled (4…20 mA or 2…10 V, default if the output is current).	Bit
5	4	Sets the direct or inverse correspondence between analog output 1 and associated physical quantity: 0=4 mA/0 V $\Rightarrow$ Min. quantity, 20 mA/10 V $\Rightarrow$ Max. quantity (default); 1=20 mA/10 V $\Rightarrow$ Min. quantity, 4 mA/0 V $\Rightarrow$ Max. quantity.	Bit
6	5	Enable/disable the offset of the analog output 2: 0=offset disabled (0…20 mA or 0…10 V, default if the output is voltage); 1=offset enabled (4…20 mA or 2…10 V, default if the output is current).	Bit
7	6	Sets the direct or inverse correspondence between analog output 2 and associated physical quantity: 0=4 mA/0 V $\Rightarrow$ Min. quantity, 20 mA/10 V $\Rightarrow$ Max. quantity (default); 1=20 mA/10 V $\Rightarrow$ Min. quantity, 4 mA/0 V $\Rightarrow$ Max. quantity.	Bit

Holding Registers:

Number	Address	Description	Format
1	0	RS485 Baud Rate: 0=1200; 1=2400; 2=4800; 3=9600; 4=19200 (default); 5=38400; 6=57600; 7=115200.	16-bit Integer
2	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
3	2	Instrument address for the MODBUS-RTU protocol (1…247, default=1).	16-bit Integer
4	3	Association of a physical quantity to the analog output 1: 0=PM1.0; 1=PM2.5 (default); 2=PM10; 12=CO_2 (only PMBsense-A). *Note: the PM measurement is updated according to the set operating mode.*	16-bit Integer
7,8	6,7	Setting of the minimum value of the measuring range of the physical quantity associated to the analog output 1. [*] If the output is associated to PM, the value is expressed as a number of tenths (e.g. 5 = 0.5 µg/m^3). If the output is associated to CO_2, the value is expressed as a number of units (e.g. 200 = 200 ppm). The default value is 0.	16-bit Integer
9,10	8,9	Setting of the maximum value of the measuring range of the physical quantity associated to the analog output 1. [*] If the output is associated to PM, the value is expressed as a number of tenths (e.g. 50 = 5.0 µg/m^3). If the output is associated to CO_2, the value is expressed as a number of units (e.g. 800 = 800 ppm). The default value is 10000 (=1000.0 µg/m^3 of PM).	16-bit Integer
11	10	Association of a physical quantity to the analog output 2: 0=PM1.0; 1=PM2.5; 2=PM10 (default); 12=CO_2 (only PMBsense-A). *Note: the PM measurement is updated according to the set operating mode.*	16-bit Integer

Number	Address	Description	Format
12,13	11,12	Setting of the minimum value of the measuring range of the physical quantity associated to the analog output 2. [*] If the output is associated to PM, the value is expressed as a number of tenths (e.g. 5 = 0.5 µg/m^3). If the output is associated to CO_2, the value is expressed as a number of units (e.g. 200 = 200 ppm). The default value is 0.	16-bit Integer
14,15	13,14	Setting of the maximum value of the measuring range of the physical quantity associated to the analog output 2. [*] If the output is associated to PM, the value is expressed as a number of tenths (e.g. 50 = 5.0 µg/m^3). If the output is associated to CO_2, the value is expressed as a number of units (e.g. 800 = 800 ppm). The default value is 10000 (=1000.0 µg/m^3 of PM).	16-bit Integer
16	15	Setting of the PM measurement mode: 0=continuous; 1=at cyclic intervals (default).	16-bit Integer
17	16	Setting of the cycle interval, in seconds, for the PM measurement mode at cyclic intervals. The number of seconds must be greater than 70, in order to allow the sensor to take the measurement. The default value is 300 (=5 min).	16-bit Integer Unsigned
20	19	Setting of the type of measurement averaging for the continuous PM measurement mode: 0=average over a 10 seconds interval, updated every second; 1=average over a 60 seconds interval, updated every 10 seconds (default); 2=average over a 15 minutes interval, updated every minute.	16-bit Integer
21	20	Setting of the type of CO_2 calibration to be used: 0=user; 1=factory (default).	16-bit Integer

[*] The datum is a 32-bit integer value. Two consecutive registers must be accessed to read/write the value. The register with lower address contains the most significant bits.

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 ACCESSORIES ORDERING CODES

CPM12-8PM.x   Cable with 8-pole M12 connector on one end, open wires on the other end. Length 2 m (CPM12-8PM.2), 5 m (CPM12-8PM.5) or 10 m (CPM12-8PM.10) standard, other lengths on request.

RS51K   Kit for connecting the transmitter RS485 output to a PC. It includes the SWD10 power supply and the RS485/USB adapter with:
- o screw terminals for the connection to the CPM12-8PM.x cable (not included);
- o USB connector for the connection to the PC;
- o jack connector for connecting the SWD10 power supply.

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:
Document-No. / Month.Year : **5161 / 10.2020**

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:
Product identifier :

PMsense-M / PMBsense-M
PMsense-A / PMBsense-A

Descrizione prodotto:
Product description :

Trasmettitori di Particolato (PM) e CO$_2$
Particulate Matter (PM) and CO$_2$ transmitters

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, 30/10/2020

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.

V1.2
01/06/2021