PMsense
Particulate Matter (PM) Transmitter
RS485 Modbus-RTU output

Member of GHM GROUP

PMsense is a **PM1.0**, **PM2.5** and **PM10** Particulate Matter transmitter with RS485 Modbus-RTU output, suitable for outdoor air quality monitoring.

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

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

On request, an optional CO_2 sensor can be integrated in the trasmitter.

The transmitter can be supplied with up to 2 optional configurable 4…20 mA, 0…5 V or 0…10 V analog outputs.

On request, optional cable.

Applications:

- Smart city
- Environmental monitoring
- Mobility
- Distributed monitoring of PM pollutants

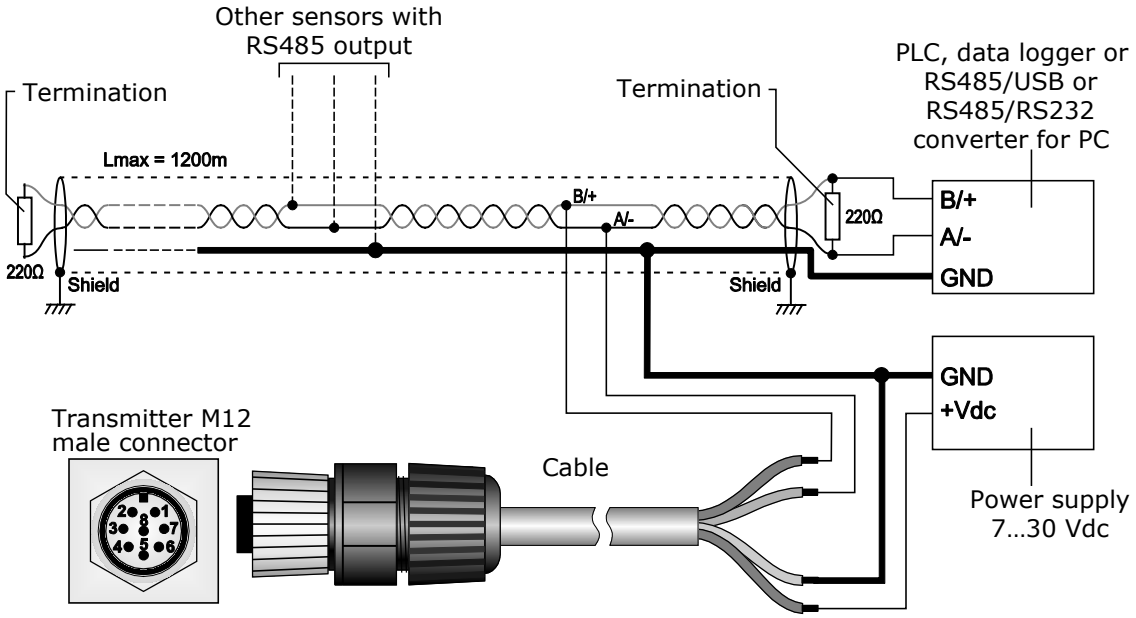
TECHNICAL SPECIFICATIONS

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	Ø 0.3…10 µm
Linearity error	< 5%
Repeatability	< 3%
Warm up time	15 s
Sensor operating mode	- Discontinuous (default): 5 mins interval ≈ 5 years lifetime - Continuous : 1 sec interval ≈10.000 h lifetime
Temperature drift	< 0.01 µg/m^3 /°C
CO_2 (optional)	
Measuring principle	Double wavelength NDIR
Measuring range	0…5000 ppm
Accuracy	±(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
Power supply	7….30 Vdc

Power consumption	- Discontinuous (default): 25 mA @ 24Vdc during measure, 4 mA stand-by - Continuous : 25 mA @ 24Vdc
Connection	M12 8-pole circular connector
Operating conditions	-20…+70 °C / 500…1500 hPa
Housing material	Polycarbonate
Protection Degree	Housing equipped with a sensor inlet air filter rain-proof and UV resistant - IP53 protection rating
Dimensions	120 x 94 x 71 (excluding M12 connector)
Weight	330 g

CONNECTIONS

Connector	Function	Wire number
1	Power supply negative (GND)	12
2	Power supply positive (+Vdc)	1
3	Not connected	
4	RS485 A/-	9
5	RS485 B/+	5
6	Not connected	
7	Analog output 1 positve	10
8	Analog output 2 positve	11



1 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.

The status of the transmitter can be monitored with 2 leds:
- GREEN led blinks every 1 sec with duty cycle 50% (power led)
- RED led blinks every 0.5 sec with duty cycle 50% if at least 1 measure is in error, otherwise it stays off.

Sensor operating mode

The PM sensor can be operated in two ways:

- **Continuous operating mode**
  The sensor is always active and measurements are continuously taken. In this mode at least 10,000 hours of PM sensor life are guaranteed.

- **Discontinuous operating mode** (default)
  The sensor is activated at regular intervals, when measurements has to be taken. This mode increases the PM sensor life.

See PM settings section for configuration details.

2 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=mode	Date of factory and user calibration and indication of calibration mode (Factory or user)

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 settings:

Command	Reply	Description
CPLSn	&|	Set PM sensor operating mode: Continuous operating mode if n=0 (sensor life >= 10000 hours guaranteed) Discontinuous operating mode if n=1 (sensor life is increased according to operating cycle and current consumption of PMSense transmitter is reduced) *Default:* n=1
RPLS	& n|	Get PM sensor operating mode n = {0,1}
CPLPn	&|	Set PM power up period in seconds when discontinuous operating mode is active *Default* : n=300 (=300s)
RPLP	& n|	Get PM power up period when discontinuous operating mode is active.
CPLWn	&|	Set PM warm up interval in seconds when discontinuous operating mode is active. *Default* : n=70 (=70s)
RPLW	& n|	Get PM warm up interval when discontinuous operating mode is active.
CPLOn	&|	Set PM sensor ON time interval in seconds when discontinuous operating mode is active. *Default* : n=71 (=71s)

Command	Reply	Description
RPLO	& n|	Get PM sensor ON time interval when discontinuous operating mode is active.
CPSn	&|	Set PM measure update and average policy for default PM measures notifications: PM measures with 10 sec average and 1 sec update with n=0 PM measures with 60 sec average and 10 sec update with n=1 PM measures with 900 sec average and 60 sec update with n=2 *Default* : n=1
RPS	& n|	Get PM measure update and average policy for default PM measures notifications.

Reading of the measurement information:

Command	Reply	Description
S0	&|	Disable the sending of the measurement information.
S1	&|	Enable the sending of the measurement information every 1 sec using for PM measures the update and average policy defined with CPS and all other PM settings commands. For the meaning of the information sent by the instrument, see the command S5.
S2	&|	Enable the sending of the measurement information every 1 sec using for PM measures the 10 sec average and 1 sec update policy. This command is significant when the sensor is in continuous operating mode. For the meaning of the information sent by the instrument, see the command S6.
S3	&|	Enable the sending of the measurement information every 1 sec using for PM measures the 60 sec average and 10 sec update policy. This command is significant when the sensor is in continuous operating mode. For the meaning of the information sent by the instrument, see the command S7.
S4	&|	Enable the sending of the measurement information at regular intervals using for PM measures the 900 sec average and 60 sec update policy. This command is significant when the sensor is in continuous operating mode. For the meaning of the information sent by the instrument, see the command S8.

Command	Reply	Description
S5	& PM_ERROR PM1_0 PM2_5 PM10 CO2 PRESS_ATM AMB_TEMP RH DEW_POINT VOLTAGE BOARD_TEMP|	Print the list of the measurement information sent by the instrument using for PM measures the update and average policy defined with CPS command: PM_ERROR = error status for PM measures PM1_0 = PM1.0 in µg/m^3 PM2_5 = PM2.5 in µg/m^3 PM10 = PM10 in µg/m^3 CO2 = carbon dioxide in ppm PRESS_ATM = atmospheric pressure in hPa AMB_TEMP = ambient temperature RH = relative humidity DEW_POINT = dew point VOLTAGE = power supply voltage BOARD_TEMP = board temperature
S6	& PM_ERROR PM1_0 PM2_5 PM10 CO2 PRESS_ATM AMB_TEMP RH DEW_POINT VOLTAGE BOARD_TEMP|	Print the list of the measurement information sent by the instrument using for PM measures the 10 sec average and 1 sec update policy. This command is significant when the sensor is in continuous operating mode. For the meaning of fields provided in reply see command S5.
S7	& PM_ERROR PM1_0 PM2_5 PM10 CO2 PRESS_ATM AMB_TEMP RH DEW_POINT VOLTAGE BOARD_TEMP|	Print the list of the measurement information sent by the instrument using for PM measures the 60 sec average and 10 sec update policy. This command is significant when the sensor is in continuous operating mode. For the meaning of fields provided in reply see command S5.
S8	& PM_ERROR PM1_0 PM2_5 PM10 CO2 PRESS_ATM AMB_TEMP RH DEW_POINT VOLTAGE BOARD_TEMP|	Print the list of the measurement information sent by the instrument using for PM measures the 900 sec average and 60 sec update policy. This command is significant when the sensor is in continuous operating mode. For the meaning of fields provided in reply see command S5.
P0	&|	Disable sending of PM concentrations.
P1	&|	Enable the sending of PM concentrations at regular intervals using the update and average policy defined with CPS and all other PM settings commands. For the meaning of the information sent by the instrument, see the command P5. The notification interval is 1 sec in case of continuous operating mode and varies with PM settings in case of discontinuous operating mode.
P2	&|	Enable the sending of PM concentrations at regular intervals using 10 sec average and 1 sec update policy. This command is significant when the sensor is in continuous operating mode. For the meaning of the information sent by the instrument, see the command P6.

Command	Reply	Description
P3	&|	Enable the sending of PM concentrations at regular intervals using 60 sec average and 10 sec update policy. This command is significant when the sensor is in continuous operating mode. For the meaning of the information sent by the instrument, see the command P7.
P4	&|	Enable the sending of PM concentrations at regular intervals using 900 sec average and 60 sec update policy. This command is significant when the sensor is in continuous operating mode. For the meaning of the information sent by the instrument, see the command P8.
P5	& PM_ERROR PM1_0_RAW PM2_5_RAW PM10_RAW PM1_5 PM2_5 PM10|	Print PM concentrations using for PM measures the update and average policy defined with CPS command: PM_ERROR = error status for PM measures PM1_0_RAW = PM1.0 concentration in pcs/mL PM2_5_RAW = PM2.5 concentration in pcs/mL PM10_RAW = PM10 concentration in pcs/mL PM1_0 = PM1.0 concentration in µg/m^3 PM2_5 = PM2.5 concentration in µg/m^3 PM10 = PM10 concentration in µg/m^3
P6	& PM_ERROR PM1_0_RAW PM2_5_RAW PM10_RAW PM1_5 PM2_5 PM10|	Print PM concentrations using for PM measures 10 sec average and 1 sec update policy. This command is significant when the sensor is in continuous operating mode. For the meaning of fields provided in reply see command P5.
P7	& PM_ERROR PM1_0_RAW PM2_5_RAW PM10_RAW PM1_5 PM2_5 PM10|	Print PM concentrations using for PM measures 60 sec average and 10 sec update policy. This command is significant when the sensor is in continuous operating mode. For the meaning of fields provided in reply see command P5.
P8	& PM_ERROR PM1_0_RAW PM2_5_RAW PM10_RAW PM1_5 PM2_5 PM10|	Print PM concentrations using for PM measures 900 sec average and 60 sec update policy. This command is significant when the sensor is in continuous operating mode. For the meaning of fields provided in reply see command P5.
P9	& State:PM_ERROR Fiw:PM_FIW PM_TEMP PM_RH|	Print additional information relative to PM sensor: PM_ERROR = error status for PM measures PM_FIW = Firmware version of PM sensor PM_TEMP = Internal temperature of PM sensor PM_RH = Internal relative humidity of PM sensor
B0	&|	Disable sending of CO2 measures.
B1	&|	Enable the sending of CO2 measures every 1 sec. For the meaning of the information sent by the instrument, see the command B2.

Command	Reply	Description
B2	& CO2_NOT_AVG_RAW CO2_NOT_AVG_CAL CO2_RAW CO2_CAL|	Print CO2 measures: CO2_NOT_AVG_RAW = Instantaneous (not averaged) raw CO2 measures CO2_NOT_AVG_CAL = Instantaneous (not averaged) calibrated CO2 measures CO2_RAW = Averaged raw CO2 measures CO2_CAL = Averaged calibrated CO2 measures
R0	&|	Disable sending of ambient temperature and relative humidity measures.
R1	&|	Enable the sending of ambient temperature and relative humidity measures every 1 sec. For the meaning of the information sent by the instrument, see the command R2.
R2	& AMB_TEMP RH DEW_POINT|	Print ambient temperature and relative humidity measures: AMB_TEMP = ambient temperature RH = Relative Humidity DEW_POINT = dew point
A0	&|	Disable sending of atmospheric pressure measures.
A1	&|	Enable sending of atmospheric pressure measures every 1 sec. For the meaning of the information sent by the instrument, see the command A2.
A2	& ATM_PRESS SENSOR_TEMP|	Print measures relative to atmospheric pressure sensor: ATM_PRESS = atmospheric pressure SENSOR_TEMP = internal temperature of atmospheric pressure sensor.

Analog outputs:

Command	Reply	Description
CA1On	&|	Enable (n=1) / disable (n=0) the offset to analog output 1: 4…20 mA or 2…10 V.
RA1O	& n|	Reads the setting of the offset for the analog output 1: Without offset if n=0 (*default for voltage output*) With offset if n=1 (*default for current output*)
CA1SOn	&|	Set the correspondence between electrical output limits and associated physical quantity for the analog output 1: If n=0 4 mA / 0 V ⇒ minimum value of the associated physical quantity 20 mA / 10 V ⇒ maximum value of the associated physical quantity If n=1 (switched output) 4 mA / 0 V ⇒ maximum value of the associated physical quantity 20 mA / 10 V ⇒ minimum value of the associated physical quantity *Default:* n=0

Command	Reply	Description
RA1SO	& n|	Read the setting of switched output for analogue output 1
CA1Tn	&|	Set measure type for analogue output 1: - PM1.0 with default average and update policy if n=0 - PM2.5 with default average and update policy if n=1 - PM10 with default average and update policy if n=2 - PM1.0 with 10 sec average and 1 sec update policy if n=3 (significant in continuous operating mode) - PM2.5 with 10 sec average and 1 sec update policy if n=4 (significant in continuous operating mode) - PM10 with 10 sec average and 1 sec update policy if n=5 (significant in continuous operating mode) - PM1.0 with 60 sec average and 10 sec update policy if n=6 (significant in continuous operating mode) - PM2.5 with 60 sec average and 10 sec update policy if n=7 (significant in continuous operating mode) - PM10 with 60 sec average and 10 sec update policy if n=8 (significant in continuous operating mode) - PM1.0 with 900 sec average and 60 sec update policy if n=9 (significant in continuous operating mode) - PM2.5 with 900 sec average and 60 sec update policy if n=10 (significant in continuous operating mode) - PM10 with 900 sec average and 60 sec update policy if n=11 (significant in continuous operating mode) - CO2 if n=12 - Atmospheric pressure if n=13 - Ambient temperature if n=14 - Ambient relative humidity if n=15 - Ambient dew point if n=16 *Default* : n=1 (PM2.5 with default average and update policy)
RA1T	& n|	Read measure type for analogue output 1
CA1Ln	&|	Set minimum value of measure selected for analogue output 1 to be mapped to 4mA / 0V output (assuming not swiched output). The value n is multiple of 0.1 for all physical quantities except for CO2 for which resolution is 1 ppm *Default* : n=0 (PM2.5 0 µg/m^3)
RA1L	& n|	Read minimum value of measure selected for analogue output 1 to be mapped to 4mA / 0V output
CA1Hn	&|	Set maximum value of measure selected for analogue output 1 to be mapped to 20mA / 10V output (assuming not swiched output). The value n is multiple of 0.1 for all physical quantities except for CO2 for which resolution is 1 ppm *Default* : n=10000 (PM2.5 1000.0 µg/m^3)
RA1H	& n|	Read maximum value of measure selected for analogue output 1 to be mapped to 20mA / 10V output

Command	Reply	Description
RA1F	& MEAS_TYPE LOW_LIMIT HIGH_LIMIT|	Read all mapping parameters for analogue output 1: MEAS_TYPE = source measure type (as described in command CAIT) LOW_LIMIT = minimum value of measure to be mapped to 4mA / 0V output (as described in command CA1L) HIGH_LIMIT = maximum value of measure to be mapped to 20mA / 10V output (as described in command CA1H)
CA2On	&|	Enable (n=1) / disable (n=0) the offset to analog output 2: 4…20 mA or 2…10 V.
RA2O	& n|	Reads the setting of the offset for the analog output 2: Without offset if n=0 (*default for voltage output*) With offset if n=1 (*default for current output*)
CA2SOn	&|	Set the correspondence between electrical output limits and associated physical quantity for the analog output 2: If n=0 4 mA / 0 V ⇒ minimum value of the associated physical quantity 20 mA / 10 V ⇒ maximum value of the associated physical quantity If n=1 (switched output) 4 mA / 0 V ⇒ maximum value of the associated physical quantity 20 mA / 10 V ⇒ minimum value of the associated physical quantity *Default:* n=0
RA2SO	& n|	Read the setting of switched output for analogue output 2
CA2Tn	&|	Set measure type for analogue output 2. Refer to CA1T command for the set of values available for n *Default* : n=2 (PM10 with default average and update policy)
RA2T	& n|	Read measure type for analogue output 2
CA2Ln	&|	Set minimum value of measure selected for analogue output 2 to be mapped to 4mA / 0V output (assuming not swiched output). The value n is multiple of 0.1 for all physical quantities except for CO2 for which resolution is 1 ppm *Default* : n=0 (PM10 0 µg/m^3)
RA2L	& n|	Read minimum value of measure selected for analogue output 1 to be mapped to 4mA / 0V output
CA2Hn	&|	Set maximum value of measure selected for analogue output 2 to be mapped to 20mA / 10V output (assuming not swiched output). The value n is multiple of 0.1 for all physical quantities except for CO2 for which resolution is 1 ppm *Default* : n=10000 (PM10 1000.0 µg/m^3)
RA2H	& n|	Read maximum value of measure selected for analogue output 2 to be mapped to 20mA / 10V output

Command	Reply	Description
RA2F	& MEAS_TYPE LOW_LIMIT HIGH_LIMIT|	Read all mapping parameters for analogue output 2: MEAS_TYPE = source measure type (as described in command CA2T) LOW_LIMIT = minimum value of measure to be mapped to 4mA / 0V output (as described in command CA2L) HIGH_LIMIT = maximum value of measure to be mapped to 20mA / 10V output (as described in command CA2H)

Calibration setup

Command	Reply	Description
DAyyyy/mm/dd hh:mm:ss	&|	Set date and time. Command necessary to execute before calibration because calibration date is saved in flash
GA	& yyyy/mm/dd hh:mm:ss|	Get date/time
CCn	&|	Set calibration type with n={0: factory, 1 User}. User calibration for some physical quantities is available (e.g. CO2, RH). User must first set calibration type as "User" before performing user calibration

Instrument update and restore of factory settings

Command	Reply	Description
UPDATE	&|	Perform firmware update via XMODEM. Command enabled with CAL USER ON
DFLT	&|	Restore all factory settings. Command enabled with CAL USER ON

Units of measurement:

Command	Reply	Description
TTn	&|	Sets the temperature unit of measurement: °C if n=0 °F if n=1 *Default* : °C (n=0)
HT	& n|	Reads the setting of the temperature unit of measurement.

RH calibration

Command	Reply	Description
CRH1n	&|	Perform 33% RH calibration (n expressed as multiple of 0.1%)
CRH2n	&|	Perform 75% RH calibration (n expressed as multiple of 0.1%)
CRHD	&|	Reset RH user calibration linear mapping (Maybe we can skip this command)

CO2 calibration

Command	Reply	Description
CO21n	& t|	Perform CO2 first point calibration. Put sensor in know gas concentration and input as n the current CO2 value expressed in ppm. This command starts a procedure in which instrument monitors for a time interval the CO2 value, takes an average of all accumulated measures and performs the calibration using value input by user. The estimated time for this process is t in seconds. Asynch notifications are provided to monitor CO2 calibration process CO2 calib. Status:IN PROGRESS 8% Avg:1096ppm Dev:0ppm … CO2 calib. Status:OK 100% Avg:1100ppm Dev:7ppm Procedure is completed when 100% is reached. The result of the procedure is notified. If CO2 concentration is not stable during procedure the calibration is not accepted. List of possible results: - IN PROGRESS - OK - DEVIATION ERR - PEAK ERR - ERR 1 - ERR 2 - MAX RETRY ERR
CO22n	& t|	Perform CO2 second point calibration. Please refer to explanation givent in command CO21n
CO2On	& t|	Apply CO2 offset calibration where n is expressed in ppm. For details about calibration procedure please refer to command CO21n

Command	Reply	Description
CO2D	&|	Reset user calibration.
CO2An	&|	Apply pressure compensation to CO2 measure with n={0: not active, 1 active}. Default n=1
RO2A	& n|	Get pressure compensation in CO2 measure configuration with n={0,1}

3 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 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).

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 (1) / disable (0) the offset to analog output 1: 4…20 mA or 2…10 V. *Default:* 1 for current output and 0 for voltage output	Bit
5	4	Enable (1) / disable (0) switched output configuration for analogue output 1. *Default:* 0. Refer to command CA1SO for additional details	Bit
6	5	Enable (1) / disable (0) the offset to analog output 2: 4…20 mA or 2…10 V. *Default:* 1 for current output and 0 for voltage output	Bit
7	6	Enable (1) / disable (0) switched output configuration for analogue output 2. *Default:* 0. Refer to command CA2SO for additional details	Bit
8	7	Apply pressure compensation on CO2 measure. *Default:* 1	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

Number	Address	Description	Format
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
5	4	Temperature unit of measurement: 0=°C, 1=°F.	16-bit Integer
6	5	Measure type for analogue output 1. Refer to CA1T command for register value range	16-bit Integer
7	6,7	Minimum value of measure selected for analogue output 1 to be mapped to 4mA / 0V output (assuming not swiched output). Refer to CA1L command for additional details	32-bit Integer
9	8,9	Maximum value of measure selected for analogue output 1 to be mapped to 20mA / 10V output (assuming not swiched output). Refer to CA1H command for additional details	32-bit Integer
11	10	Measure type for analogue output 2. Refer to CA2T command for register value range	16-bit Integer
12	11,12	Minimum value of measure selected for analogue output 2 to be mapped to 4mA / 0V output (assuming not swiched output). Refer to CA2L command for additional details	32-bit Integer
14	13,14	Maximum value of measure selected for analogue output 2 to be mapped to 20mA / 10V output (assuming not swiched output). Refer to CA2H command for additional details	32-bit Integer
16	15	PM sensor operating mode: - Continuous operating mode if 0 (sensor life >= 10000 hours guaranteed) - Discontinuous operating mode if 1 (sensor life is increased according to operating cycle and current consumption of PMSense transmitter is reduced) *Default:* 1	16-bit Integer
17	16	PM power up period in seconds when discontinuous operating mode is active *Default* : 300 (=300s)	16-bit Unsigned integer
18	17	PM warm up interval in seconds when discontinuous operating mode is active. *Default* : 70 (=70s)	16-bit Unsigned integer
19	18	PM sensor ON time interval in seconds when discontinuous operating mode is active. *Default* : 71 (=71s)	16-bit Unsigned integer
20	19	PM measure update and average policy for default PM measures notifications: - 0: 10 sec average and 1 sec update - 1: 60 sec average and 10 sec update - 2: 900 sec average and 60 sec update *Default* : 1	16-bit Integer
21	20	Calibration type: 0 (factory) / 1 (user)	16-bit Integer

Input Registers:

Number	Address	Quantity	Format
1	0	PM1.0 concentration in pcs/mL (default average and update policy)	16-bit Integer
2	1	PM2.5 concentration in pcs/mL (default average and update policy)	16-bit Integer
3	2	PM10 concentration in pcs/mL (default average and update policy)	16-bit Integer
4	3	PM1.0 concentration (x10) in µg/m^3 (default average and update policy)	16-bit Integer
5	4	PM2.5 concentration (x10) in µg/m^3 (default average and update policy)	16-bit Integer
6	5	PM10 concentration (x10) in µg/m^3 (default average and update policy)	16-bit Integer
7	6	PM1.0 concentration in pcs/mL (refresh every 1s with 10s of average). To be used in continuous operating mode	16-bit Integer
8	7	PM2.5 concentration in pcs/mL (refresh every 1s with 10s of average). To be used in continuous operating mode	16-bit Integer
9	8	PM10 concentration in pcs/mL (refresh every 1s with 10s of average). To be used in continuous operating mode	16-bit Integer
10	9	PM1.0 concentration (x10) in µg/m^3 (refresh every 1s with 10s of average). To be used in continuous operating mode	16-bit Integer
11	10	PM2.5 concentration (x10) in µg/m^3 (refresh every 1s with 10s of average). To be used in continuous operating mode	16-bit Integer
12	11	PM10 concentration (x10) in µg/m^3 (refresh every 1s with 10s of average). To be used in continuous operating mode	16-bit Integer
13	12	PM1.0 concentration in pcs/mL (refresh every 10s with 60s of average). To be used in continuous operating mode	16-bit Integer
14	13	PM2.5 concentration in pcs/mL (refresh every 10s with 60s of average). To be used in continuous operating mode	16-bit Integer
15	14	PM10 concentration in pcs/mL (refresh every 10s with 60s of average). To be used in continuous operating mode	16-bit Integer
16	15	PM1.0 concentration (x10) in µg/m^3 (refresh every 10s with 60s of average). To be used in continuous operating mode	16-bit Integer
17	16	PM2.5 concentration (x10) in µg/m^3 (refresh every 10s with 60s of average). To be used in continuous operating mode	16-bit Integer
18	17	PM10 concentration (x10) in µg/m^3 (refresh every 10s with 60s of average). To be used in continuous operating mode	16-bit Integer
19	18	PM1.0 concentration in pcs/mL (refresh every 60s with 900s of average). To be used in continuous operating mode	16-bit Integer

Number	Address	Quantity	Format
20	19	PM2.5 concentration in pcs/mL (refresh every 60s with 900s of average). To be used in continuous operating mode	16-bit Integer
21	20	PM10 concentration in pcs/mL (refresh every 60s with 900s of average). To be used in continuous operating mode	16-bit Integer
22	21	PM1.0 concentration (x10) in µg/m^3 (refresh every 60s with 900s of average). To be used in continuous operating mode	16-bit Integer
23	22	PM2.5 concentration (x10) in µg/m^3 (refresh every 60s with 900s of average). To be used in continuous operating mode	16-bit Integer
24	23	PM10 concentration (x10) in µg/m^3 (refresh every 60s with 900s of average). To be used in continuous operating mode	16-bit Integer
27	26	PM sensor status	16-bit Integer
29	28	CO2 in ppm	16-bit Integer
30	29	Ambient temperature (x10)	16-bit Integer
31	30	Relative humidity (x10)	16-bit Integer
32	31	Dew point (x10)	16-bit Integer
34	33,34	Atmospheric pressure (x100) in hPa	32-bit Integer
36	35	Atmospheric pressure (x10) in hPa	16-bit Integer
38	37	Power supply voltage (x10) in V	16-bit Integer
39	38	Board temperature (x10)	16-bit Integer
41	40	Instrument firmware version	16-bit Integer
42	41	Modbus communication error counter	16-bit Integer

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