SX-X

Concentration transmitter for flammable / toxic gases Zone 1 / Zone 21 ATEX (Cat. 2GD)

- 12..24Vdc Power supply
- 4..20mA Output and Modbus®

seitron Innovation Technology
Via del Commercio, 9/11- 36065 Mussolente (VI)
Tel.: +39.0424.567842 - Fax.: +39.0424.567849
http://www.seitron.it - e-mail: info@seitron.it

USE AND MAINTENANCE MANUAL

OVERVIEW

The concentration gas transmitters **Series SX-X** consist of the following components:

- the gas sensor.
- the electronic conversion circuit.
- the terminals for the electrical connection of power supply and signal output.
- the metal housing and relevant sensor holder with sintered filter that ensure the ATEX protection mode for the entire device.

The gas sensors that fit inside the ATEX protective housing can be of various types, either for gas fuel or for toxic gases as well as for Oxygen.
The mounted terminals provide by standard both an analog current output (4..20mA) and a digital Modbus® output.

TRANSMITTER IDENTIFICATION

The transmitter code indicates what gas it detects and with what full-scale.
The features of the device are, anyhow, explicitly described on the product label. Sensors for other gases are made on specific request to the manufacturer.

OPERATION

This sensor is a gas concentration transmitter capable to measure the concentration of the gas for which it has been calibrated and to convert this concentration in an analog and digital electric signal.
It is composed of a metal case with Ex db protection mode which houses the electronic board and the gas sensor, properly protected with a sintered filter, assembled on the bottom side of the case itself (see the assembly instructions).
The sensing element can be catalytic or electrochemical, according to the model and the type of gas detected.

OUTPUT SIGNAL (Modbus® output)

The terminals output signal Modbus® is compatible with the physical standard RS485.

OUTPUT SIGNAL (4..20mA Output)

General example of Concentration-Current output relation for a Combustible gas transmitter with 4..20mA output and full-scale defined as FS.

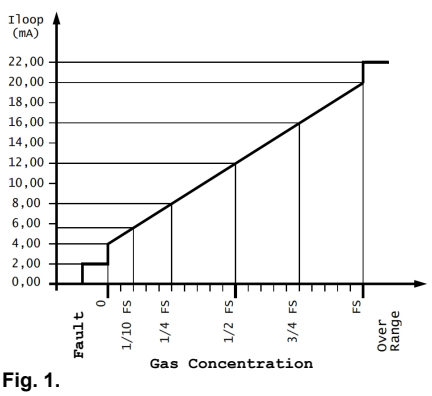


Fig. 1.

Table of correspondence between generic concentration in fractions of full scale (F.S.) and output current (mA)	
Concentration	**Output (mA)**
Fault current loop	**0.0**
Sensor end-life	**1.0**
Sensor fault	**2.0**
0	**4.0**
1/4 Full-scale	**8.0**
1/2 Full-scale	**12.0**
3/4 Full-scale	**16.0**
Full-scale	**20.0**
Over Range (>500ppm)	**22.0**

Tab. 1.

Specific example of Concentration-Current output relation for a Combustible gas transmitter with 4..20mA output and full-scale 50% L.E.L.

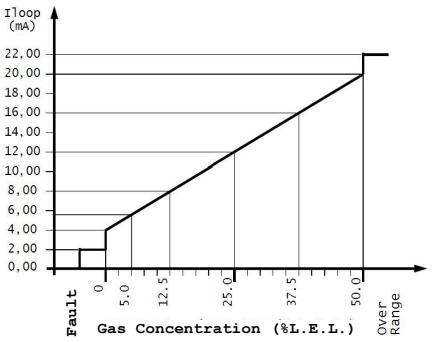


Fig. 2.

Table of relation between gas concentration (% L.E.L.) and output current (mA)				
%L.E.L.	% $^{V}/_{V}$ n-Butane (CAS 106.97.8)	% $^{V}/_{V}$ Methane (CAS 74.82.8)	% $^{V}/_{V}$ n-Octane (CAS 111.65.9)	**Output (mA)**
Detected gas	LPG	METHANE	Fuel Vapours	
Fault current Loop				**0.0**
Sensor end-life				**1.0**
Sensor fault				**2.0**
0 %	0.00 %	0.00 %	0.00 %	**4.0**
10 %	0.14 %	0.44 %	0.08 %	**7.2**
20.0 %	0.28 %	0,88 %	0.16 %	**10.4**
50.0 %	0.70 %	2.20 %	0.40 %	**20.0**
Over Range (>50% L.E.L.)				**22.0**

Tab. 2.

Specific example of Concentration-Current output relation for a Combustible gas transmitter with 4..20mA output and full-scale 100% L.E.L.

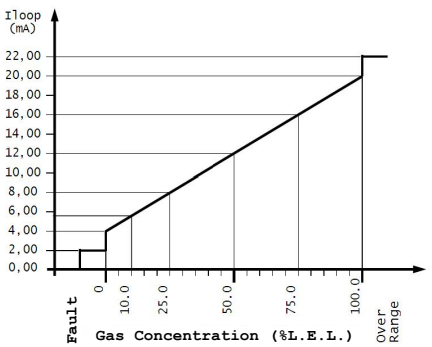


Fig. 3.

Table of relation between gas concentration (% L.E.L.) and output current (mA)				
% L.E.L.	% $^{V}/_{V}$ n-Butane (CAS 106.97.8)	% $^{V}/_{V}$ Methane (CAS 74.82.8)	% $^{V}/_{V}$ n-Octane (CAS 111.65.9)	**Output (mA)**
Detected gas	LPG	METHANE	Fuel Vapours	
Fault current loop				**0.0**
Sensor end-life				**1.0**
Sensor fault				**2.0**
0 %	0 %	0.00 %	0.00 %	**4.0**
10 %	0.14 %	0.44 %	0.08 %	**7.2**
20.0 %	0.28 %	0,88 %	0.16 %	**10.4**
100.0 %	1.40 %	4.40 %	0.80 %	**20.0**
Over Range (>100% L.E.L.)				**22.0**

Tab. 3.

Specific example of Concentration-Current output relation for toxic gases transmitter with 4..20mA and full-scale 500 ppm.

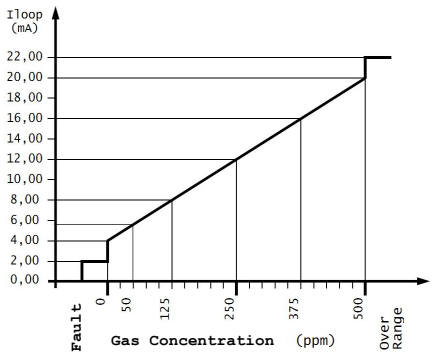


Fig. 4.

Table of relation between gas concentration (ppm) and output current (mA)	
ppm	**Output (mA)**
Fault in current Loop	**0.0**
Sensor end-life	**1.0**
Sensor fault	**2.0**
0	**4.0**
125	**8**
250	**12**
500	**20**
Over Range (>500ppm)	**22.0**

Tab. 4.

Fault status:
If the electric board or the sensor inside the transmitter fails, the system detects the error and sends the output current loop at 2.0 mA. This feature makes available an error that can be distinguished from the one due to the interruption of the current loop, which appears naturally to the unit as 0.0 mA.
In other words, this function allows a 'differential diagnosis', making it easier to resolve the problem.

Over-range status:
If the gas concentration exceeds the range limit, the current output value is fixed at 22 mA, this way allowing to detect an over-range condition through the unit to which the sensor is connected.

MECHANICAL INSTALLATION

Since the mechanical installation must comply with constraints that may affect the ATEX safety of the device and of the environment itself,

these instructions are provided in section 'Mechanical Installation' in the ATEX Safety Instructions.

FUNCTIONAL INSTALLATION

About the precautions to be taken to achieve a proper functional behavior of the device, it is important to notice that regarding the location of the sensors in the environment to be controlled, particular attention must be paid to:

- Density of the gas (heavier or lighter than air)
- Speed of release of the gas (flow)
- Possible openings in walls and ceilings and air streams
- Arrangement and shape of the environment
- Dimensions of the protected area

The response time of the sensor is strictly related to its position in the environment as well as to the type of gas to detect. For heavy gases like LPG it is advisable to install the transmitter at 20 cm above the ground, while for light gases like Methane the correct position is 20 cm below the ceiling. For other gases it is necessary to evaluate the relative density to air (available on standard EN60079-20-1) and place the device consequently.

INTERNAL DISPOSITION

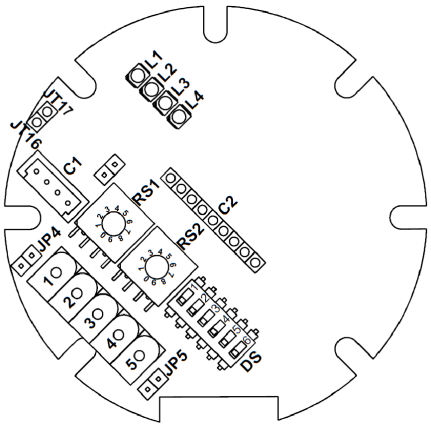


Fig. 5: Internal disposition

1: +Vin
2: 4..20mA Output
3: Gnd
4: Modbus® A
5: Modbus® B

C1: Gas sensor connector
C2: Connector for the expansion board (optional)

DS1: Not used
DS2: ON = Range Selection Hi (DO NOT alter)
OFF = Range Selection Lo (DO NOT alter)

DS3: Kind of Gas (See table - DO NOT alter)
DS4: Kind of Gas (See table - DO NOT alter)

Gas type setting table				
	CH4	***Gasoline vapours***	**CO**	**LPG**
DS3	OFF	ON	OFF	ON
DS4	OFF	OFF	ON	ON

DS5: Leave it OFF
DS6: Leave it OFF

RS1: Rotary Switch 1: Address setting (x 10)
RS2: Rotary Switch 2: Address setting (x 1)

L1: Red LED (Auxiliary)
L2: Yellow LED (Fault)
L3: Red LED (Alarm/Pre-alarm)
L4: Green LED (Supply)

JP4: Function Reset (see text)

JP5: Function Reset (see text)

JT17: Test point for calibration (see text)
JT16: Test point for calibration (see text)

⚠ WARNING

The transmitter comes by standard without any jumper inserted.

ELECTRICAL WIRINGS (4..20mA)

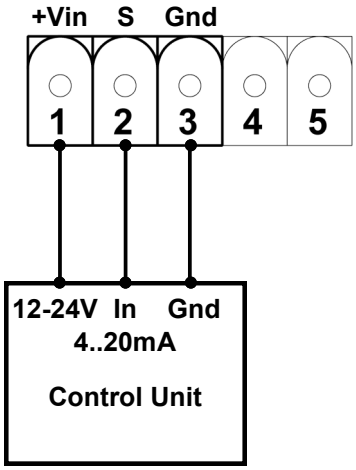


Fig. 6: Example of 4..20mA connection

The electrical connection is made with a tripolar copper wire considering the distances indicated in the table.
It is not necessary to use a shielded cable, however it is appropriate to maintain the laying of the cables for the transmitters separated from mains and/or power cables.

⚠ WARNING

Insulated electric cables resistance in braid for each km. (according to CEI 20-29 1997)	
Cable Section	Electric resistance (Ohm / km)
0.50 mm^2	36.5 (x 2)
0.75 mm^2	24.5 (x 2)
1.00 mm^2	18.1 (x 2)
1.50 mm^2	12.1 (x 2)
2.50 mm^2	7.41 (x 2)

Tab. 4: Typical resistance values of the copper wires in braid.

- ***The electrical connections must be made with a tripolar cable with an advised section of 1,5 mm^2 and with an advised length of 25 m. Although a shielded cable is not required it is strongly recommended to lay down the transmitter connection cables in different ducts other than the ones for mains or power cables.***
- ***The use of cables with a length greater than the one advised or with an inferior section can lead to malfunctions caused by the excessive drop of tension which could happen along the cable. This last could lead to cause powering tension values for the transmitter inferior to the valid ones. For example, in the following table are listed some values for the electric resistance in copper braid cables.***
- ***The maximum resistance applicable as a load on the output line (4..20 mA), when the powering is at 12V= -15%, is 250 Ohm.***
- ***If the transmitter is powered by the control unit it is necessary to verify that the latter is able to supply the correct powering to the transmitter.***
- ***It is absolutely fundamental to verify with a multimeter, once the system is installed, that the alimentation tension present at the respective terminals of the transmitter is inside the tension range valid for the correct operation.***
- ***Moreover, in order to avoid malfunctions it is necessary to make sure that, even in the worst conditions of the mains tension power to the transmitter it is maintained a sufficient tension value to allow the correct functioning.***

ELECTRICAL WIRINGS (Modbus®)

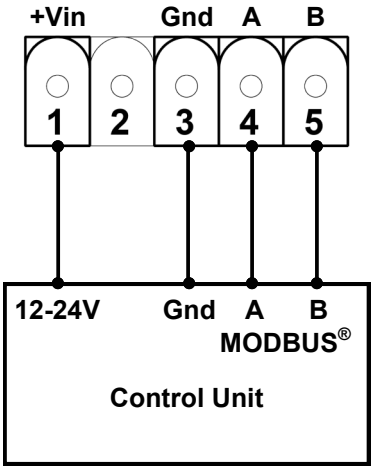


Fig. 7: Example of Modbus® connection.

OPERATION

Complete in order:
- Mechanical installation
- Electrical connections
- As soon as the power is on and after a brief ignition of all LEDs, the green LED **L4** will blink. In this phase the sensor is in pre-heating stage and it is not able to detect any gas. When this time is elapsed **L4** will be in still lit mode to indicate the normal operation.

GAS ALARM AND FAULT SIGNALS

Because this transmitter is simply a converter of a gas concentration in the respective current level, the alarm detection, fault and over-range functions are assigned to the control unit, on which the threshold limits are set, and to the Manual, to which the user is advised to refer.

The only version of the transmitter for toxic gases features, among the internal components, a microcontroller, that constantly checks in time the validity and the remaining life of the electrochemical cell.
The possible LED signals are described in the specific section.
Although the control of the sensor life is implemented in all the models, in the toxic gas sensor (CO) the remaining life is stored directly in the sensor module, while in other cases is stored on the base board of the transmitter and so it must be reset when the sensor is changed for a new one.

LED SIGNALS

Only the **L2**, **L3**, **L4** LEDs are used for the current indications: fixed lit for 2 sec when turning on the transmitter indicates the waiting for the ADC measurements to stabilize.

L4: Green LED (Powering)

Slow blinking:
It indicates that the stabilization phase is on after powering, to allow the warm-up.
The sensors, particularly for catalytic need several seconds for the output to stabilize.

Fast blinking:
When warm-up is finished, the fast blinking indicates normal functioning of the Modbus® communication (if active); the frequency depends on the polling speed of the master.

Fixed:
When the stabilization and warm-up time are over, the LED stays steadily on to indicate normal functioning of the transmitter (without Modbus® interrogation).

L2: Yellow LED (Fault)
Following, in correspondence to the number of blinks, is listed the type of fault:

1: Power out of the range
2: Sensor fault
3: Sensor fault + Power out of the range
4: Sensor end life
5: Sensor end life + Power out of the range
6: Sensor end life + Sensor fault
7: Power out of the range + Sensor end life + Sensor fault
8: Error on flash data writing
9: Error on flash data writing + Power out of the range
10: Error on flash data writing + Sensor fault
11: Error on flash data writing + Sensor end life
12: Error on flash data writing + Sensor fault + Power out of the range
13: Error on flash data writing + Sensor end life + Sensor fault
14: Error on flash data writing + Power out of the range + Sensor end life + Sensor fault

Steady on (Fault detector):
Microcontroller code memory error
Ram memory error
Flash memory error
Flash-Data memory error

Off:
No Fault

L3: Red LED (Pre-alarm/Alarm)

Blinking (Pre-alarm):
It indicates that the transmitter has detected a gas concentration higher than the set pre-alarm threshold.

Steady on (Alarm):
It indicates that the transmitter has detected a gas concentration higher than the set alarm threshold.

L1: Red LED (Auxiliary)

On for 2s:
Manual Reset of sensor life;
Manual Reset sensor parameters (default);
Manual Reset Modbus® parameters (Add.=01 and Baud Rate=9600);
Module Reset via Modbus® command;

MODBUS® INTERFACE

On the main board, both the interfaces 4..20mA and Modbus® are available: through the latter several parameters can be read and written with the commands sent via bus.

The Modbus® interface consists in two rotary switches (tens and units) for the setting of the device address, two power supply terminals for the circuit and two terminals (A and B) for the BUS RS485.
The parameters, like address and baud rate, can be modified by the user writing in the respective registers with the function 06.
The changes of the address and baud rate will be activated just after the reset board command is sent (COIL-39) or after power up.

4 .. 20 mA MODE

The device acts as a standard transmitter: the Alarm and pre-alarm LEDs show the exceeding of the respective thresholds set by factory default.
These thresholds, if required, are still editable through Modbus® command.

MODBUS® MODE

In this mode, the transmitter parameters can be read and modified by the control unit.

WARNING
Every 24 hours, the sensor life time will be updated in the non-volatile memory of the transmitter; at that moment the transmitter will interrupt the MODBUS® communication for about 300ms.

Two settings can be selected via Modbus®: outputs and LEDs.
If the COIL-41 is set to 0, the LEDs are controlled by the transmitter logic, otherwise are controlled by Modbus® according to the content of the register OutBitReg (REG-01).

This function can be useful to assign for both relays and LEDs, different transmitters activation characteristics other than those provided as standard. If the COIL 42 is set to 0 it will control the buzzer.

TRANSMITTER DATA RESET

Setting reset (except the life time of the sensor):
It is possible to reset the settings memory by default data, shorting the jumper JP5 for at least 5 seconds during the power-up time (60 sec, LED **L4** blinking green): in this way the transmitter is brought back to the initial mode (the modified records are reset by the Modbus® but not the life of the sensor).
The reset is signaled by the lighting of the auxiliary red LED **L1** (present only on the main board) for 2 sec.
The same function can be activated via Modbus® writing 1 in the COIL-36.

Sensor life Reset (except the settings):
Short-circuit the JP4 for at least 10 seconds during the power-up time (blinking green LED) to reset the life time of the sensor to the standard value written in code memory according to the kind of gas selected.
This function allows to reset the life time of a sensor/nose when it is changed with a new one.
The occurred recovery is displayed with the lighting of the auxiliary red LED.
The same function can be activated via Modbus®, writing 1 in the COIL-38.

Default transmitter data according to the installed sensor

	CH4	VB	CO	LPG
Elapsed Lifetime (gg)	0	0	0	0
Set Lifetime (gg)	1825	1825	1825	1825
Prealarm (ppm)	4400	800	16	1350
Alarm (ppm)	8800	1600	80	2700
Range Lo (ppm)	22000	4000	300	6750
Range Hi (ppm)	44000	8000	500	13500
F.S. LEL Lo (0.1%)*	500	500	0	500
F.S. LEL Hi (0.1%)*	1000	1000	0	1000

***:** The LEL values are expressed in 0.1% (1000 = 100.0% L.E.L.)

Resetting Modbus® setting (Address=1, Baud Rate = 9600):
Short-circuit JP5 for at least 5 seconds out of the power-up time (LED **L4** fixed green) to reset the default data communication, this way bringing it back to normal mode: the occurred recovery is shown with the lighting of the Red LED **L1** auxiliary for 2 sec.
If the hardware configuration is in use, the address set in flash will not be considered.
The same function can be activated via Modbus® writing 1 in COIL-33, followed by the board reset command (write 1 in COIL-39).

FUNCTIONAL MAINTENANCE

The periodical check of the transmitter aims to verify the correct efficiency both of the basic functions and the precision of the measurement (i.e. the current passing through the output in relation to the measured gas concentration).
The procedure regarding the control with titrated gas is described in a dedicated paragraph.
Besides the control of concentration value of the measured gas, it is necessary to periodically perform the following other operations:

- Carefully control the kinds and quantities of potentially contaminant substances (usually compounds based on organic solvents) which may be in the environment where the sensor is installed; the presence of these substances may alter the operational capability of the sensor or lead, generally, to a worse behavior, or yet require more frequent calibrations.
- Visually inspect each device by which the gas detection system is made. Pay special attention to dust, dirt, pollutants, solvents and accumulation of condensing, which may alter the operational capability of the sensor.
- The frequency with which the inspections and the recalibration have to be performed, is under the responsibility of the detection system manager, who must check the requirements of the eventual national legislations. For example, in the next section, there is a summary of what the Italian law CEI 31-35 requires:
  "The lapse of time between the inspections and the recalibrations must be set by the user according to the actual functioning conditions and to the instructions of the manufacturer; anyway this must be at least:
  - *<u>every three months:</u> for systems overseeing environments with first degree emissions (i.e.' can happen during the normal functioning).*
  - *<u>every six months:</u> for systems overseeing environments with second degree emissions (i.e. it is unlikely to happen during normal operation)".*
- It is necessary to clean periodically the equipment to avoid the formation of dust layers higher than 5mm.

VERIFICATION - Overall view

By the term 'Verification' is meant the check for the correct transmitter functioning through the application of a sample gas which concentration is known and certified and measuring at the same time the output signal.

In detail, the procedure is articulated in the following points:
- Use of the Zeroing gas
- Verify of the Zero output (4..20mA or Modbus®)
- Use of the Span gas
- Verify of the Span output (4..20mA or Modbus®)

Application of the zeroing gas (Combustibles Gases)
Applying the zeroing gas means to put the transmitter in certainly clean air and verify that the output signal indicates a zero concentration.
The transmitter must operate for at least 48 hours in clean air and must be placed in its normal functioning position.

Application of the Span gas (Combustibles and toxic gases)
Applying the Span gas means make the transmitter to be reached by a gas with a known and certified concentration which value is as close as possible to the center of the scale measured by the transmitter.
For the Combustible gases it is mandatory, for safety reasons, that the gas concentration is below to the 50% of L.E.L. of the applied gas.

To apply the Span gas it is necessary to convey to the transmitter sensor the certified gas from the cylinder as shown in the following figure.

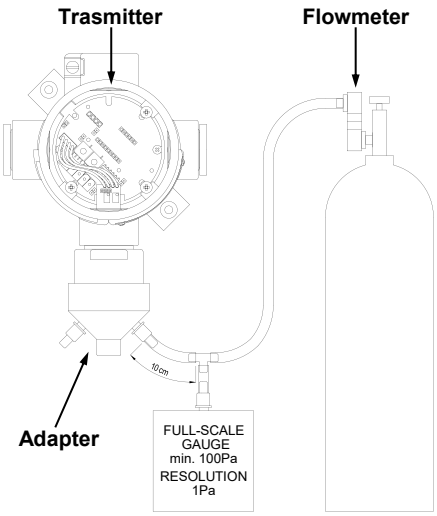


Fig. 7: How to convey the gas to the transmitter for the inspection or calibration operations.

The gauge is necessary to check that an excessive extra pressure is not created on the sensor, because this condition can lead to a wrong concentration reading.
The transmitter must have been operative for at least 48 hours in clean air and must be set in its normal functioning setting.
Regulate the gas flux towards the sensor until on the gauge is displayed the value of 10 Pa (about 0,2 l/min.) which will have to remain steady for the entire inspection.
From the moment in which the gas reaches the sensor, the drive voltage of the current loop will gradually rise up to stabilize, after about 5 minutes, around a value.
The easiest way to measure the current in the output loop, in order to perform the inspection, is to 'cut' this loop and insert a handheld multimeter in series, as shown in the following figure.

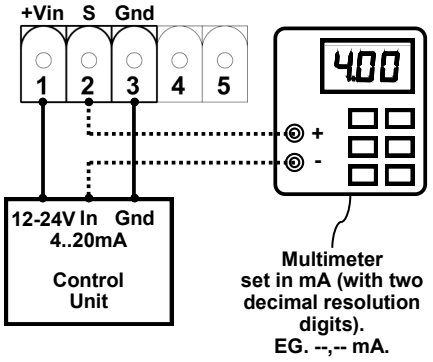


Fig. 8: Multimeter connection for current measuring during the Zero and Span check.

VERIFICATION
Combustible and toxic gases

Zero signal test (Combustible gases)
When the Zero gas is applied (clean air) the output current measured with the multimeter must be 4.0mA ±0.2mA.
If the measured value is not inside this range, a calibration is necessary to reset the correct value (see further). For versions with digital output on the bus, the concentration value read by the unit must be zero.

Span signal test (Combustible and toxic gases)
When the Span gas reaches the sensor the output current will rise gradually until stabilizing around a value (after about 5 minutes).
If the 4..20mA current output is used, at this point it is necessary to note the measured current value on the multimeter and, referring to the table or to the concentration-current graph of Fig. 2, 3 and 4 (depending on the full-scale and on the gas classification, toxic or combustible) convert in a correspondent concentration value.

Instead, if the Modbus® output is used, it is necessary to note the value (directly in ppm or % of L.E.L.) displayed on the unit connected to the transmitter. In case the measured value is not correct it is necessary to calibrate the Span as described in the next section.

If the result of the previous checks is positive then it is not necessary to proceed with the calibration.

CALIBRATION - Overview

By the term 'calibration' it is meant the procedure that must be performed on the transmitter, possibly with the help of a tool, aimed to bring back the output signal inside the precision declared every time it is necessary.
A certain output current signal shifting is to be considered inevitable, this being caused by small drifts of the sensor itself, both for Zero and Span. The calibration of the transmitter is made applying on the transmitter a sample gas which concentration is known and certified and regulating, through the appropriate controls placed inside the transmitter, the output signals.
In detail, the procedure is articulated in the following points:

- Applying the Zero gas
- Calibration of the Zero signal
- Applying the Span gas
- Calibration of the Span signal

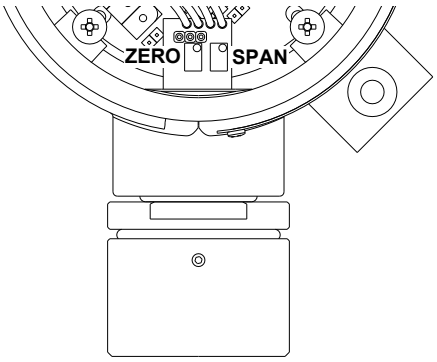
Application of the Zero gas (Combustible Gases)
Proceed as described in the "VERIFICATION" paragraph.

Application of the Span gas (Combustible and toxic gases)
Proceed as described in the "VERIFICATION" paragraph.

⚠ WARNING

- ***The complete calibration necessarily implies the calibration of both of the parameters (first 'Zero' and then 'Span') exactly in this order.***
- ***The transmitter must be operative for at least 48 hours in clean air and must be placed in its normal position and operational standard.***

CALIBRATION - Combustible gases



To perform this procedure, a multimeter in current mode is needed and it has to have at least 2 decimal resolution digits to guarantee the appropriate precision on the measure, see figure 8.

Fig. 9a: Position of Zero and Span controls on the sensor for combustibles gases.

Calibration of the Zero signal (Combustible gases):

- With the transmitter in clean air, rotate the 'ZERO' trimmer (see **Fig. 9a**) in anti-clockwise direction, until the current stops at a minimum value (about 4.00mA), then turn the trimmer in clockwise direction until the value rises up a little bit (eg: 4.10mA), then turn slowly the trimmer in anti-clockwise direction until bringing the current as close as possible to the minimum value (eg: 4.00mA) without exceeding this value.
- This operation is the same for any version of the transmitter, independently from the type of output (analog or digital).

⚠ WARNING

The regulation compels to have a precise tuning for the minimum value (eg.: 4.00mA) otherwise there will be an offset error.

Calibration of the Span gas (Combustible gases):

- Apply the Span gas as suggested in paragraph '***Application of the Span gas (Combustibles and toxic gases)***' respecting the stabilization time of at least 5 minutes.
- Calculate, according to the following formula, the calibration Span current:

$$Ispan\ (mA) = \left[16 * \frac{100}{F.S.} * \frac{\text{Bottle concentration (\% v/v)}}{\text{Target gas L.E.L. (\% v/v)}}\right] + 4$$

Or:

$$Ispan\ (mA) = \left[0{,}16 * \frac{100}{F.S.} * \text{Bottle Concentration (\% L.E.L.)}\right] + 4$$

Where:

F.S.:
Full-scale of the transmitter in % L.I.E.

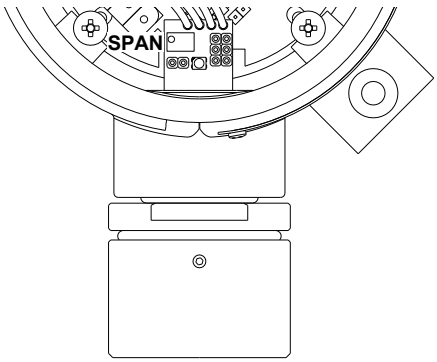
Bottle concentration (%$^{V}/_{V}$):
Concentration of the sample gas applied to the detector (in %$^{V}/_{V}$). This data can be found on the certificate of the cylinder.

Target gas L.E.L. (%$^{V}/_{V}$):
Lower explosion limit of the gas test. This data can be found on the EN60079-20-1 standard.

Bottle concentration (% L.E.L.):
Value of the sample gas applied to the detector expressed in % of L.E.L. This data can be found on the certificate of the cylinder.

- Regulate the 'SPAN' value until the multimeter shows a current equal to the one calculated with the formulas. If the operation is not successful at the first try, repeat the procedure again, putting the sensor in clean air and powered for at least 10 minutes.
- Verify that on the unit the concentration value (in % L.E.L.) measured by the related transmitter, is equal to the value of the gas used for the inspection with en error margin equal to ±2 %.
- Place back the cover and screw it, checking the tightness of the closure.

CALIBRATION - Toxic gases



To perform this procedure, a multimeter in

current mode is needed and it has to have at least 2 decimal resolution digits to guarantee the appropriate precision on the measure, see figure 8.

Fig. 9b: Position of the Span control on the sensor for toxic gases.

Zero signal calibration (Toxic gases):
With this kind of transmitters it is not necessary to regulate the 'ZERO' signal.

Span signal calibration (Toxic gases):

- Apply the Span gas as suggested in the '***Application of the Span gas (Combustibles and toxic gases)***' paragraph respecting the stabilization time of at least 5 minutes.

Calculate, according to the following formula, the calibration Span current:

$$Ispan\ (mA) = \left[16 * \frac{Bottle\ Concentration\ (ppm)}{F.S.\ (ppm)}\right] + 4$$

Where:

Bottle Concentration (ppm):
Concentration in ppm of the sample gas applied to the detector (in ppm). This data can be found on the certificate of the cylinder.

F.S. (ppm):
Value in ppm of the transmitter full-scale that is being calibrated. This data can be found on the label of the product itself.

- Regulate the 'SPAN' trimmer (shown in **Fig. 9b**) until the multimeter shows a current equal to the one calculated with the formulas. If the operation is not successful at the first try, repeat the procedure again, putting the sensor in clean air and powered for at least 10 minutes.
- Make sure that on the unit the concentration value (in ppm) measured by the related transmitter is equal to the value of the gas used for the test with an error margin equal to ±2% of the full-scale (e.g.: FS = 500 ppm, error = 500 * 2 / 100 = ±10 ppm.
- Place back the cover and screw it, checking the tightness of the closure.

⚠ WARNING

- ***It is possible to repeat this step as often as necessary, before completing the calibration procedure.***
- ***It is strongly recommended to make a verification after the calibration in order to check for the correct setting.***
- ***In case the current values of Zero or Span and/or the concentration value measured do not fall within the expected values even after the calibration, and subsequent verification, the transmitter is to be considered faulty, thus it must be returned to an authorized center for servicing or replacement.***
- ***Verification and calibration procedures cannot be performed using pure gases; the complement to the certified gas must be air (possibly synthetic) because, for example, catalytic sensors need oxygen to work properly. Never use the gas contained in the lighters.***
- ***The gas flow applied to the transmitter sensor must remain constant during the entire test in the range of 0.2 .. 0.4 l / min.***
- ***For the calibration procedure it is necessary to open the explosion proof housing; therefore it is necessary to follow all the safety directions explained below.***
- ***When, in order to carry out the maintenance procedure, the detection devices must be disabled, even temporarily, special care must be taken in order to activate an alternative detection system which could in turn give continuity to the safety against gas leakages. As an alternative countermeasure during the maintenance operations, either the gas leakage and ignition sources removal or an increased ventilation can be adopted.***
- ***Since for the verification and calibration procedures it is necessary to open the housing of the device, losing in this way the ATEX protection, it is absolutely mandatory to proceed as follows:***
  - ***a. Remove the explosion risk by cutting the flow from any possible source of gas.***
  - ***b. After double checking that atmosphere is safe, open the case.***
  - ***c. Perform the verification and/or calibration procedures.***
  - ***d. Once the correct functionality of the detection system has been checked close the case.***
  - ***e. The area is now protected again.***
- ***Maintenance operations must never jeopardize the safety of the area under protection. In case of doubts contact the distributor or the manufacturer before proceeding.***
- ***It is the system manager responsibility to adopt all countermeasures which might grant an acceptable safety level for people involved as well as for the environment itself.***
- ***Never open the case unless the explosion risk has been previously removed and no residual risk is present.***
- ***It is strongly recommended to log the results of the maintenance operations in a specific register, according to the standard and current national regulations.***
- ***All operations described in the User Manual and Safety Instructions must be performed by qualified and properly trained personnel.***
- ***The installation and maintenance of the transmitter must be performed in accordance with EN 60079-14 (installation) and EN60079-17 (maintenance), and be limited to what is expressly stated in the instructions of use and safety of the manufacturer.***

TRAINING INSTRUCTIONS

It is necessary to verify, both when operating for the first time and periodically, that the personnel who uses this device have understood the meaning of this user manual and therefore comply with its content.

MODBUS ® COMMUNICATION

- Interface: RS485
- Communication speed: 9600, 8, N, 1
- Protocol: Modbus ®
- Minimum polling time at 9600 baud = 200 ms for 56 byte reading.
- Minimum polling time at 38400 baud = 60 ms for 56 byte reading.
- About the detail of the registers allocation and the implemented functions, see the table at the end of this manual.
- Writing some register implies the communication stop for about 200 ms. See the table at the end of this manual on the column "Description".
- For any other detail related to Modbus® communication refer to the official site www.modbus.org.

FEATURES AND LIMITATIONS

This transmitter must be used to measure the gas for which it has been calibrated (see the marking on the device for the kind and range of the gas).

Response time T_{90}:	<60 s (CH4).
Functioning temp. range:	See product label.
Humidity functioning range:	20% .. 90% RH (non-condensing)
Pressure functioning range:	800 .. 1100 hPa
Supply voltage:	12V= -10% .. 24V=+10%
Power consumption:	2.3 W max.
Activation time:	60 s.
Stabilization time:	48 h.
Output (4..20mA):	
4 .. 20mA:	measure
0 mA:	loop interruption
1 mA:	sensor end-life
2 mA:	fault (*)
22 mA:	over range
(Modbus®):	See Modbus® table
Protection degree:	IP6X
Dimension:	98x98x54 mm
Weight:	380 g. ca.

Long term stability: In normal functioning conditions and without potential toxic substances in the environment, which may alter the operation, the catalytic sensor has a good long term stability of 5 years starting from the installation and when put in operation for the first time.

STORAGE

Temperature:	-20°C .. +55°C.
Humidity:	20% .. 90% RH (non-condensing)
Pressure:	800 .. 1100 hPa.
Long term drift in air:	tip.-5% of the signal / year

SPECIAL EMPLOYMENT CONDITIONS

This paragraph shows all the special conditions that may correspond to an improper use and must be carefully avoided in order not to use the device in an improper or unsafe way.

- It is extremely important to underline that all the catalytic sensors are able to work correctly only if Oxygen (O2) is present; for this reason and to obtain correct indications from the device, the installer must be absolutely sure that, in the environment in which the sensor is installed, a sufficient Oxygen concentration is present, equal to the normal concentration in the atmosphere (20.9 $^{v}/_{v}$).
- Both during the normal operations and during the maintenance, the presence of other gases in the atmosphere, different from those that are being detected, may alter the precision of the measurement or the operations. Please consider that all the catalytic sensors have a crossed sensibility that changes in relation to several other gases. In case of doubts please contact the dealer.
- As the sensor can detect different kind of hydrocarbons (HC) at the same time, is crucial for the user to consider the resulting cumulative effect and also to evaluate the crossed sensibility to the different gases of the sensor.
- As soon as the power supply is connected a pre-heating phase starts during which the sensor cannot detect any gas.
- The response of the sensor might be temporarily compromised when it is detecting some substances so called 'inhibitors': among these, can be found the halogenated gases, Sulphur Dioxide, Chlorine, Chlorinated Hydrocarbons (Trichlorethylene and Carbon

Tetrachloride). Ask the dealer in case of doubts.
- The response of the sensor might, instead, be definitively damaged in case it detects some substances so called 'contaminants': among these can be found several Silicone compounds, Tetraethyl Lead and Phosphate esters.

CONVERSION FROM % L.E.L. TO % v/v

The value of L.E.L (Lower Explosion Level) varies for each individual detected gas. These values can be found in the harmonized standard EN60079-20-1 and are shown in the next table for reference.

SENSIBILITY TO OTHER GASES

The crossed sensibility (K in the following table) of the catalytic sensor (COMBUSTIBLE gases version) to the most common gases is reported in the following table related to the METHANE (CH4=1).

	CAS Number	K*	L.E.L. (% v/v)
CH4 (Methane)	74.82.8	1.00	4.4
GPL (n-Butane)	106.97.8	1.94	1.4
CO (Carbon Oxide)	630.08.0	1.79	10.9
n-Octane	111.65.9	2.89	0.8
C_3H_8 (Propane)	74.98.6	1.79	1.7
H_2 (Hydrogen)	1333.74.0	1.21	4.0
NH_3 (Ammonia)	7664.41.7	n.a.	15.0
SO_2 (Sulfur Dioxide)	7446.09.5	n.a.	n.a.

Tab. 5: Indicative values of cross sensibility to different gases for catalytic sensors.

⚠ WARNING

: The K value shown in the table is to be considered purely indicative. K values for other gases can be requested to the manufacturer.

SPARE PARTS

This transmitter has no user-replaceable parts. When the sensor reaches the end of life the entire transmitter must be replaced by a new device.

ACCESSORIES

The only accessory available is the field calibration kit, that allows to correctly convey the test gas to the sensor.
Contact the dealer in case of necessity.

COMPLIANCE WITH STANDARDS

The transmitter complies with the standards described in the relevant ATEX Certificate provided with each package of this product.

WARRANTY

In the view of a constant development of their products, the manufacturer reserves the right to amend technical data and features without prior

CONVERSION %L.E.L. ⇆ ppm

Following, are reported the formulas which allows to calculate the %L.E.L. ($\%^{V}/_{V}$) knowing the gas concentration to measure in ppm and vice versa.

$$\%L.E.L. = \frac{\text{Gas Conc. (ppm)}}{\text{L.E.L. used gas x 100}}$$

Gas Conc. (ppm)= L.E.L. used gas x %L.E.L. x 100

Eg. For CH4: $10\%(L.I.E.) = \frac{4400\ (ppm)}{4.4 \times 100}$

4400 (ppm)= [4.4] x [10%(L.I.E.)] x 100

Where:

Gas Conc. (ppm): gas concentration to be detected (in ppm).

L.E.L. used gas: % of the gas volume lower explosive limit to detect; data to find on the standard EN60079-20-1.

Gas Concentration (%L.E.L.): gas concentration to be detected (% of L.E.L.).

TROUBLESHOOTING

- **Problem.**
  The control unit reads a null value of current from the transmitter.
  Possible cause:
  The connection between the transmitter and the control unit is faulty.
  Remedy:
  Check for integrity of electrical wirings between transmitter and central unit. Check for correct insertion of terminal block inside its socket. Check with a multimeter for presence of power supply on terminals '+' and '-' of the sensor.

- **Problem.**
  The concentration of gas measured from the transmitter is incorrect.
  Possible cause:
  The transmitter requires recalibration.
  Remedy:
  Proceed with the calibration and verification as described in the relevant paragraphs. If this doesn't resolve the problem, contact the distributor.
  Possible cause:
  The sensor filter is dirty or wet.
  Remedy:
  Remove dirt and/or condensate. If this does not solve the issue please contact the distributor.

MODBUS® FUNCTION TABLES - Registers addressment (By the user)

Modbus - Registers access (reading-3, writing-6)								
Addr. (dec)	**Description**	**Unit**	**Rng Lo (Write)**	**Rng Hi (Write)**	**Byte**	**Reg.**	**R/ W**	**Modbus Function**
0 (0)	ModbusAddr (Waiting time 200ms)	*Address = 1-247* **[Default: 1]**	1	247	1	1	RW	3,6
1 (0x01)	ModbusResponseDelay (Response delay in ms) (Waiting time 200ms)	0 … 255 (10ms multiples) **[Default: 10]**	10	255	1	1	RW	3.6
2 (0x02)	ModbusBaudRate (Waiting time 200ms)	*0 = 4800,* *1 = 9600,* *2 = 19200,* *3 = 38400* **[Default: 1]**	0	3	1	1	RW	3,6
3 (0x03)	ModbusCfg	Bit 0 (RW) 0=7bit, 1=8bit Bit 1 (RW) 0=ASCII, 1=RTU Bit 2,3 (RW) 0=--, 1=even, 2=odd, 3=none Bit 4-15 (R) not used **[Default: 0x000F]**	0	15	1	1	R	1,3
4 (0x04)	FaultBits	Bit 0 (R) 1=Memory code error Bit 1 (R) 1=Ram memory error Bit 2 (R) 1=Flash data error Bit 3 (R) 1=Flash memory error Bit 4 (R) 1=Flash ID error Bit 5 (R) 1=Sensor life error Bit 6 (R) 1=Sensor fault Bit 7 (R) 1=Power tension error Bit 8-15 (R) not used	0	0x00FF	2	1	R	1,3
5 (0x05)	Valim	[mV]	0	65535	2	1	R	3
6 - 32 (0x06 – 0x20)	Reserved	Reserved	0	65535	1	27	R	3
33 (0x21)	BoardStatusReg	Bit 0 (R) 1=On-going Warm-up Bit 1 (R) 1=Stable measurements Bit 2 (R) 1=End of initialization Bit 3-7 (R) not used	0	7	1	1	R	1,3
34 (0x22)	BoardResetReg	Bit 0 (RW) 1=Reset Board Bit 1 (RW) 1=Reset Cfg modbus Bit 2 (RW) 1=Reset Life sensor 1 Bit 3 (R) 1=not used Bit 4 (RW) 1=Reset Cfg sensor (no sensor life) Bit 5-7 (R) not used	0	0x17	1	1	RW	1,3,5
35 (0x23)	BoardOutCtrl	Bit 0 (R) 1=Relays controlled by board, 0=by modbus* Bit 1 (R) 1=Led controlled by board, 0=by modbus Bit 2 (R) 1=Buzzer controlled by board, 0=by modbus Bit 3-15 (R) not used **[Default: 0x0007]**	0	0x0007	2	1	RW	1,3,5,6
36,37 (0x24, 0x25)	BoardHw	**WORD LOW** Bit 0 (R) 1=Sensor 1 type analog Bit 1 (R) 1=not used Bit 2 (R) 1=Sensor 1 replaceable Bit 3 (R) 1=not used Bit 4 (R) 1=Sensor 1 type digital Bit 5 (R) 1=not used Bit 6-15 (R) not used **WORD HIGH** Bit 16 (R) 1=4-20mA output present Bit 17 (R) 1=0-10V output present Bit 18 (R) 1=Output expansion module present Bit 19 (R) 1=Input expansion module present Bit 20 (R) 1=I/O expansion module present Bit 21 (R) 1=Temperature sensor present Bit 22 (R) 1=Humidity sensor present Bit 23-31 (R) not used	0	0xFFF F FFFF	4	2	R	1,3
38 (0x26)	InputLogicReg	Not used	0	65535	2	1	R	3
39 (0x27)	InputStatusReg	Not used	0	65535	2	1	R	3
40 (0x28)	OutReleCtrl	Bit 0 (RW) 1=Alarm relay ON Bit 1 (RW) 1=Pre-alarm relay ON Bit 2-15 (R) not used **[Default: 0x0000]**	0	0x0003	2	1	RW	1,3,5,6
41 (0x29)	OutAuxBlink [f=2Hz, 0,5s]	Bit 0 (RW) 1=Intermittent Buzzer Bit 1-15 (R) not used **[Default: 0x0000]**	0	0x0001	2	1	RW	1,3,5,6
42 (0x2A)	OutAuxCtrl	Bit 0 (RW) 1=Buzzer ON Bit 1-15 (R) not used **[Default: 0x0000]**	0	0x0001	2	1	RW	1,3,5,6
43 (0x2B)	LedBlink [f=2Hz, 0,5s]	Bit 0 (RW) 1=Led power blink Bit 1 (RW) 1=Led alarm blink Bit 2 (RW) 1=Led fault blink Bit 3 (RW) 1=Led aux blink Bit 4-15 (R) not used **[Default: 0x0000]**	0	0x000F	2	1	RW	1,3,5,6
44 (0x2C)	LedCtrl	Bit 0 (RW) 1=Led power ON Bit 1 (RW) 1=Led alarm ON Bit 2 (RW) 1=Led fault ON Bit 3 (RW) 1=Led aux ON Bit 4-15 (R) not used **[Default: 0x0000]**	0	0x000F	2	1	RW	1,3,5,6
45 (0x2D)	SensorStatusBit	Bit 0 (R) 1=Fault Bit 1 (R) 1=Sensor end life Bit 2 (R) 1=Overange Bit 3 (R) 1=Pre-alarm Bit 4 (R) 1=Alarm Bit 5 (R) 1= - - - - Bit 6 (R) 1=Sensor fault Bit 7 (R) 1=Supply voltage error **[Default: 0x0000]**	0	0x001F	2	1	R	1,3

MODBUS® FUNCTION TABLES - Registers addressment (By the user)

Modbus - Registers access (reading-3, writing-6)								
Addr. (dec)	**Description**	**Unit**	**Range Low**	**Range High**	**Byte N°**	**Register N°**	**R/W**	**Modbus Function**
46 (0x2E)	SensorGasBit (Waiting time 200ms)	Bit 0-4 (R) **Detected Gas** 0 =CH4, 1=VaporF., 2=CO, 3=LPG Bit 5-7 (R) Not used Bit 8 (R) **Gas category** 0=Explosives, 1=toxic Bit 9 (R) **Gas Range** 0=Low, 1=High Bit 10 (RW) Activates sensor end life signal Bit 11-15 (R) Not used	0	0x0400	2	1	R/W	1,3,5
47 (0x2F)	Spent sensor life	(In days)	0	65535	2	1	R	3
48 (0x30)	Planned sensor life	(In days)	0	65535	2	1	R	3
49 (0x31)	Range Gas 1	[ppm]	0	65535	2	1	R	3
50 (0x32)	Pre-alarm threshold (Waiting time 200ms)	[ppm]	0	65535	2	1	R/W	3,6
51 (0x33)	Alarm 1 threshold (Waiting time 200ms)	[ppm]	0	65535	2	1	R/W	3,6
52 (0x34)	Not used		0	65535	2	1	R	3
53 (0x35)	L.E.L. Gas range 1 (X*10) (valid for explosives gases)	Resolution 0,1%, (1000 = 100.0%)	0	1000	2	1	R	3
54 (0x36)	Measure Gas 1	[ppm]	0	65535	2	1	R	3
55 (0x37)	L.E.L. Measure Gas 1 (X*10) (valid for explosives gases)	Resolution 0,1%, (1000 = 100.0%)	0	1000	2	1	R	3
56-66 (0x38 - 0x42)	Not used		0	65535	2	1	-	-
67 (0x43)	Temperature	Resolution 0,1°C, (100 = 10.0 °C)	0	65535	2	1	-	-
68-76 (0x44 - 0x4C)	Reserved	Reserved	0	65535	2	8	-	-

ID Area addressing (By the user)

Addr. (hex)	**Description**	**Unit**	**Range Low**	**Range High**	**Byte N°**	**Register N°**	**R/W**	**Modbus Function**
65280-65287 (0xFF00 – 0xFF07)	Client's product code		0	65535	16 char	8	R	3
65288-65295 (0xFF08 – 0xFF0F)	OEM distributor name		0	65535	16 char	8	R	3
65296-65303 (0xFF10 – 0xFF17)	Brand name		0	65535	16 char	8	R	3
65304-65305 (0xFF18 – 0xFF19)	Firmware protocol number		0	65535	4	2	R	3
65306-65307 (0xFF1A – 0xFF1B)	Serial number		0	65535	4	2	R	3
65308-65309 (0xFF1C – 0xFF1D)	Batch number		0	65535	4	2	R	3
65310-65317 (0xFF1E – 0xFF25)	SVN number		0	65535	16 char	8	R	3
65318-65325 (0xFF26 – 0xFF2D)	Notes		0	65535	16 char	8	R	3
65326 (0xFF2E)	Product family	**BYTE LOW** 1 = GAS Family **BYTE HIGH** 0-255 = Revision of modbus register map inherent to the selected family.	0	65535	2	1	R	3

MODBUS® FUNCTION TABLES - Registers addressment (By the user)

Addr. (hex)	Description	Unit	Range Low	Range High	Byte N°	Register N°	R/W	Modbus Function
65327 (0xFF2F)	Product sub-family	**BYTE LOW** 1 = CENTRAL UNIT 2 = TRANSMITTER 3 = DETECTOR 4 = BOARD INPUT 5 = BOARD OUTPUT 6 = BOARD I/O **BYTE HIGH** 0-255 = Revision of modbus register map inherent to the selected sub-family.	0	65535	2	1	R	3
65328 (0xFF30)	Modbus registers map revision, common part to all the families		0	65535	2	1	R	3
65329 (0xFF31)	Device HW revision		0	65535	2	1	R	3

Bit addressing (By the user)

Addr. Bit (hex)	Description	Value (Hex) Range Low	Value (Hex) Range High	Bit	R/W	Modbus Function
00 (0x00)	Uart bit number	0=7bit	1=8bit	1	R	1
01 (0x01)	Kind of modbus	0= ASCII	1= RTU	1	R	1
02,03 (0x02, 0x03)	Parity	0=--, 1=even, 2=odd, 3=none	0=--, 1=even, 2=odd, 3=none	2	R	1
04-07 (0x04 – 0x07)	---	---	---	4	R	1
08 (0x08)	Memory code error	0=ok	1=err	1	R	1
09 (0x09)	Ram memory error	0=ok	1=err	1	R	1
10 (0x0A)	Flash Data error	0=ok	1=err	1	R	1
11 (0x0B)	Flash Memory error	0=ok	1=err	1	R	1
12 (0x0C)	Flash ID error	0=ok	1=err	1	R	1
13 (0x0D)	Sensor life error	0=ok	1=err	1	R	1
14 (0x0E)	Sensor fault	0=ok	1=err	1	R	1
15 (0x0F)	Power tension error	0=ok	1=err	1	R	1
16-23 (0x10 – 0x17)	---	---	---	8	R	1
24 (0x18)	On-going Power-up	0=no	1=Yes	1	R	1
25 (0x19)	Stable measurements	0=no	1=Yes	1	R	1
26 (0x1A)	End of initialization	0=no	1=Yes	1	R	1
27-31 (0x1B - 0x1F)	---	---	---	5	R	1
32 (0x20)	Reset Board	0=--	1=Reset	1	R/W	1,5
33 (0x21)	Reset Cfg modbus	0=--	1=Reset	1	R/W	1,5
34 (0x22)	Reset Life sensor 1	0=--	1=Reset	1	R/W	1,5
35 (0x23)	Not used	---	---	1	R	1
36 (0x24)	Reset Cfg sensor (no sensor life)	0=--	1=Reset	1	R/W	1,5
37-39 (0x25 – 0x27)	Not used	---	---	3	R	1
40 (0x28)*	Realy control*	0 = Modbus*	1 = Board*	1*	R/W*	1,5*
41 (0x29)	Led control	0 = Modbus	1 = Board	1	R/W	1,5
42 (0x2A)	Buzzer control	0 = Modbus	1 = Board	1	R/W	1,5
43-55 (0x2B – 0x37)	Not used	---	---	13	R	1
56 (0x38)	Sensor 1 type analogic	0=No	1=Yes	1	R	1
57 (0x39)	Not used	---	---	1	R	1

MODBUS® FUNCTION TABLES - Registers addressing (By the user)

Addr. Bit (hex)	Description	Value (Hex) Range Low	Value (Hex) Range High	Bit	R/W	Modbus Function
58 (0x3A)	Sensor 1 replaceable	0=No	1=Yes	1	R	1
59 (0x3B)	Not used	---	---	1	R	1
60 (0x3C)	Sensore 1 type digital	0=No	1=Yes	1	R	1
61-71 (0x3D – 0x47)	Not used	---	---	11	R	1
72 (0x48)	4-20mA output present	0=No	1=Yes	1	R	1
73 (0x49)	0-10V output present	0=No	1=Yes	1	R	1
74 (0x4A)	Output expansion module present	0=No	1=Yes	1	R	1
75 (0x4B)	Input expansion module present	0=No	1=Yes	1	R	1
76 (0x4C)	I/O expansion module present	0=No	1=Yes	1	R	1
77 (0x4D)	Temperature sensor present	0=No	1=Yes	1	R	1
78 (0x4E)	Humidity sensor present	0=No	1=Yes	1	R	1
79-87 (0x4F – 0x57)	Not used	---	---	9	R	1
88 (0x58)*	Alarm relay ON*	0=OFF*	1=ON*	1*	R/W*	1,5*
89 (0x59)*	Pre-alarm relay ON*	0=OFF*	1=ON*	1*	R/W*	1,5*
90-103 (0x5A – 0x67)	Not used	---	---	14	R	1
104 (0x68)	Intermittent Buzzer	0=OFF	1=ON	1	R/W	1,5
105-119 (0x69 – 0x77)	Not used	---	---	15	R	1
120 (0x78)	Buzzer ON	0=OFF	1=ON	1	R/W	1,5
121-135 (0x79 – 0x87)	Not used	---	---	15	R	1
136 (0x88)	Led power blink	0=OFF	1=ON	1	R/W	1,5
137 (0x89)	Led alarm blink	0=OFF	1=ON	1	R/W	1,5
138 (0x8A)	Led fault blink	0=OFF	1=ON	1	R/W	1,5
139 (0x8B)	Led aux blink	0=OFF	1=ON	1	R/W	1,5
140-151 (0x8C – 0x97)	Not used	---	---	12	R	1
152 (0x98)	Led power ON	0=OFF	1=ON	1	R/W	1,5
153 (0x99)	Led alarm ON	0=OFF	1=ON	1	R/W	1,5
154 (0x9A)	Led fault ON	0=OFF	1=ON	1	R/W	1,5
155 (0x9B)	Led aux ON	0=OFF	1=ON	1	R/W	1,5
156-167 (0x9C – 0xA7)	Not used	---	---	12	R	1
168 (0xA8)	Fault	0=No	1=Yes	1	R	1
169 (0xA9)	Sensor end life	0=No	1=Yes	1	R	1
170 (0xAA)	Overange	0=No	1=Yes	1	R	1
171 (0xAB)	Pre-alarm	0=No	1=Yes	1	R	1
172 (0xAC)	Alarm	0=No	1=Yes	1	R	1
173-175 (0xAD – 0xAF)	Not used	---	---	3	R	1
176-180 (0xB0 – 0xB4)	Gas 1 detected	0 =CH4, 1=VaporB., 2=CO, 3=LPG	0 =CH4, 1=VaporB., 2=CO, 3=LPG	5	R	1
181-183 (0xB5 – 0xB7)	Not used	---	---	3	R	1
184 (0xB8)	Gas Category	0=Explosives	1=Toxic	1	R	1
185 (0xB9)	Gas Range	0=Low	1=High	1	R	1
186 (0xBA)	Activate sensor end life signal (If OFF, no led reports and 4-20mA)	0=OFF	1=ON	1	R/W	1,5
187-191 (0xBB – 0xBF)	Not used	---	---	5	R	1

* The relay module is not available on this version of the product.