

OPERATING MANUAL

LR35 series

LoRaWAN[®] data loggers



EN
V3.0



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1 Introduction

The data loggers of the **LR35...** series are wireless devices for **IoT** (Internet of Things) applications that use **LoRaWAN®** technology for long distance data transmission.

LoRaWAN® technology uses the unlicensed frequencies of the ISM band (for example EU868, US915, AU915, KR920, AS923, IN865) and allows a transmission range of several kilometers depending on the installation position and the urbanization condition of the place where the network infrastructure is located, with extremely limited energy consumption, allowing long operation of battery-powered devices.

A system based on LoRaWAN® technology consists of 4 stages:

A. Sensors / data loggers

They detect the physical quantities at the measuring points and send the data via RF to one or more gateways (access points) of the LoRaWAN® network.

The data loggers of the LR35 series can be integrated into any public or private LoRaWAN® network, even existing ones.

B. LoRaWAN® gateway (access point)

The gateway receives the data via RF from the sensors / data loggers and forwards them, using a TCP/IP connection via cellular (e.g. LTE) or ETHERNET/Wi-Fi network, to a network server.

Multiple gateways can be used in the system to increase RF coverage. The gateways are not associated with particular sensors but forward the data of all active sensors in their coverage area.

Senseca can provide already configured third-party gateways, or the user can use his own gateway and do the configuration himself.

C. Network server

It is the IoT platform that receives the data from the sensors / data loggers and forwarded by the gateway. The data loggers of the LR35 series are preconfigured to send the data to the free-to-use network server "**The Things Network (TTN)**", but the user can change the configuration to use other servers, for example a possible network server embedded into the gateway, or Cloud-based platforms.

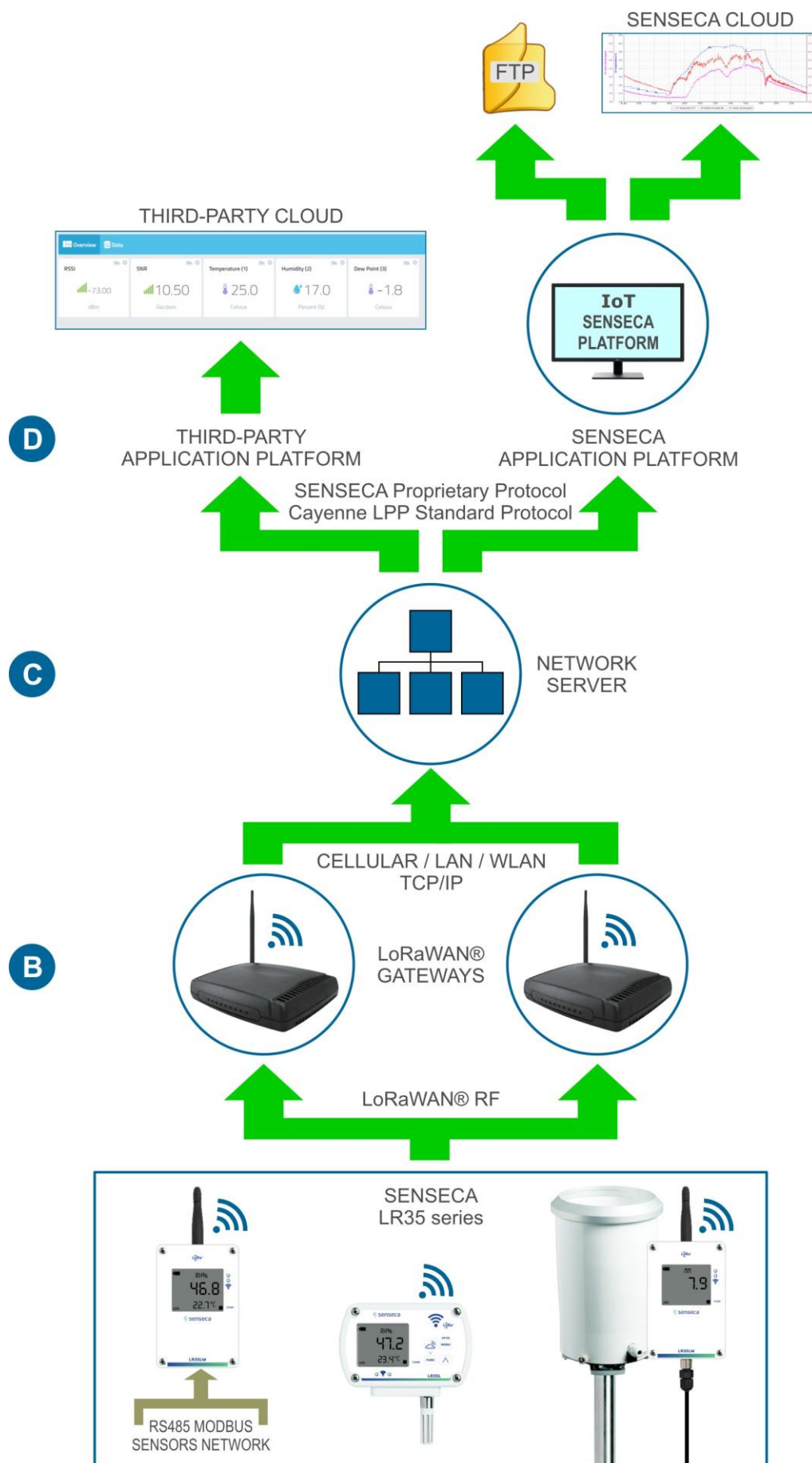
D. Web application

It is the application that allows you to view the data on the network server.

It can be the Senseca Cloud or a third-party service, both for free use (e.g. myDevices) and for a fee (e.g. ioThink®).

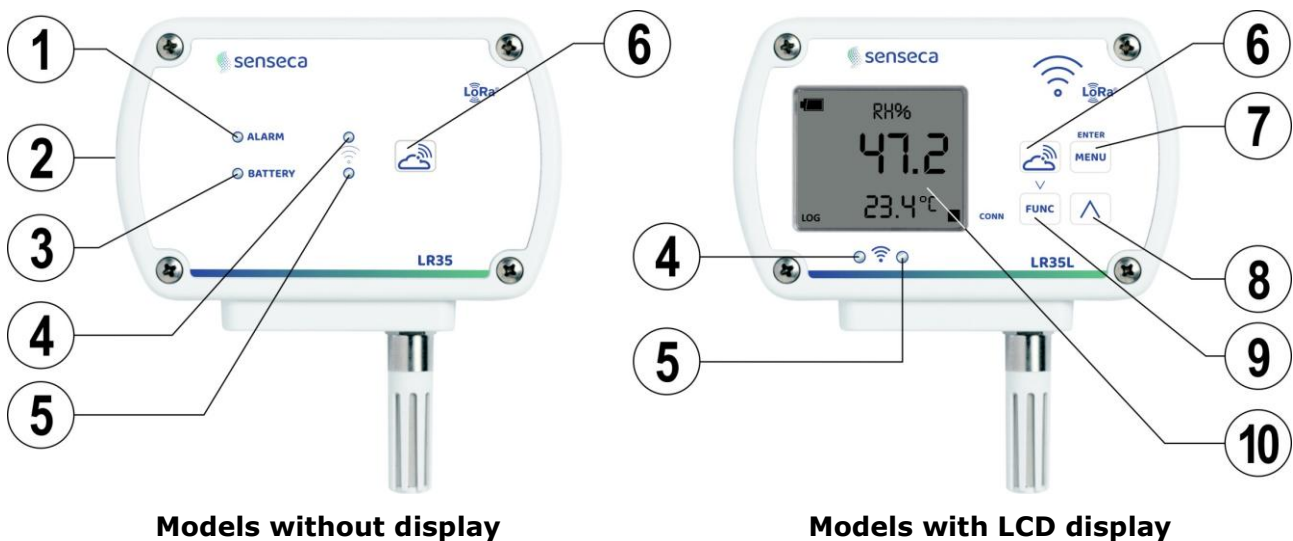
If the Senseca Cloud is used, the **iotcloud.deltaohm.com** platform automatically and transparently converts the data present on the network server (The Things Network) into the data format required by the Senseca Cloud. The Senseca IoT platform also allows sending data via **FTP**.

If instead a third-party service is used, the data are available with the standard **Cayenne LPP** data protocol (only for the most common environmental quantities, such as temperature, relative humidity, barometric pressure, ...) or with a **proprietary data protocol provided free of charge** which allows you to manage any type of measurement and the development of advanced customized applications.

**Fig. 1.1: LoRaWAN® network architecture**

2 Data loggers description

Indoor models



Outdoor models (except models that measures PM)



All outdoor models are only available with LCD display, except models that measure PM, which are only available without display.

- 1.** Red ALARM LED: it blinks when a measurement is in alarm condition.
- 2.** USB port with mini-USB connector. In the outdoor models, the USB port is internal.
- 3.** Green BATTERY LED: battery charge level; As the battery is running low, the LED blinks with a lower frequency (once every 5 s = battery is charged, once every 10 s = 50% battery charge, once every 15 s = battery is almost discharged).
- 4.** Red RF LED: it blinks to signal that data transmission has failed.

- 5.** Green RF LED: it blinks when the data transmission has been successful.
- 6.** Button for connection to the LoRaWAN® network.
- 7.** MENU/ENTER key: allows access to the configuration menu; confirm the selected option or the set value in the menu.
- 8.** ▲ key: in normal operation, it scrolls the quantities measured by the data logger; it scrolls upwards the available options or increases the set value in the menu.
- 9.** FUNC/▼key: in normal operation, it displays the maximum (MAX), the minimum (MIN) and the average (AVG) of the measurements; it scrolls downwards the available options or decreases the set value in the menu.
- 10.** LCD Display.
For the indoor models, the type of display, custom or graphic, depends on the model. For the outdoor models, the display is always custom.
- 11.** RF antenna.
In LR35W[B]PM and in the indoor models, the antenna is internal.

The green and red RF LEDs blink simultaneously if the device is in error condition.

Type of sensors / connections – Indoor models

LR35L...TV



Relative humidity and/or temperature fixed probe

LR35L...TC



In some ...TC models, the display is graphic

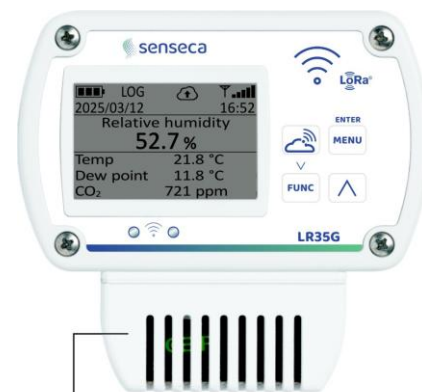
M12 connectors for external probes (the number depends on model)

LR35L4r1Z



Differential pressure inputs

LR35G1NB



Integrated sensors

LR35GH



Protective cover of the terminal inputs for standard analog sensors

Type of sensors / connections – Outdoor models

LR35LWDPTC  M12 connector for rain gauge Cable gland for level probe	LR35LWH LR35LW-MB  Cable glands
LR35LW...TC  M12 connectors for external probes (the number depends on model)	LR35WPM[B]  Fixing bracket with U-bolt Air outlet Air inlet LR35WPM[B]: 2 x M12 (power supply and mini-USB) LR35WPM[B]-USB: 1 x M12 (power supply via mini-USB)

Notes:

- The outdoor models (except LR35WPM[B]) can optionally have the solar radiations shield.
- LR35WPM[B]... models have no external LEDs and are not available with LCD.
- In models with multiple inputs for external probes, the number (in the case of multi-channel models for probes of the same type) or the type of input is indicated next to the input.
- In outdoor models with cable glands, the cable gland can be PG7 or PG9 depending on model.
- Some models can be a combination of the basic models illustrated (e.g. differential pressure inputs + fixed T/RH probe).

3 Installation and configuration

3.1 Connection of the battery

For shipments by aircraft, the battery of the device must be disconnected.

Open the instrument by unscrewing the 4 front screws, then connect the battery female connector to the male connector indicated with **BATT** on the electronic board, paying attention to the correct polarity: the connector is equipped with a polarization key that prevents the possibility of a wrong insertion of the connector.

The indoor models can be closed by fixing the 4 front screws. The outdoor models, instead, must be closed after the configuration, in order to keep the internal USB port accessible.

Note: the models LR35W[B]PM and LR35[L]W-MB have no internal battery, but require 7...30 Vdc external power supply. For the connection of these models, see the following paragraphs.

3.2 Data logger configuration

The data logger is already factory configured to send data to **TTN** network server. As soon as the data logger is powered, it automatically connects to the **TTN** server (if a LoRaWAN® gateway is present within the data logger coverage range), performs the time synchronization and starts sending data.

If you want to change the data logger settings, proceed as follows:

1. Download HD35AP-S software from the Senseca website and install it on the PC.
2. Connect the USB port of the data logger to the PC through the **CP23** cable.

Note: the USB connection does not require the installation of drivers: when the data logger is connected to the PC, the Windows® operating system uses drivers already included in the operating system.

Note: the instrument consumption increases strongly when the USB port is connected to the PC; in order to extend the battery life, it is recommended to connect the data logger to the PC only for the time strictly necessary.

3. Start the HD35AP-S software, perform the connection procedure selecting the type of connection "Serial connection (HID)" and perform the settings:
 - To change the LoRaWAN® network settings, select the "Instruments setup" > "LoRa Options" menu.
 - To set the measuring and data sending intervals, the alarms, the inputs (if configurable), press the button "Settings" with the data logger serial number.
 - To set the clock, select the "Instruments setup" > "Setting of date and time" menu.

See the software on-line help for the usage details and other features available in the software.

In the indoor models with display, the configuration can also be changed via the front keyboard (see paragraph 5.2).

3.3 Fixing the data logger

The installation of the indoor models is on the wall using the removable support provided or, alternatively, using the optional HD35.11K kit for fixed installation with lock pin for safety lock.

The outdoor models can be wall mounted using the holes on the back of the housing (accessible by opening the housing) or the HD35.24W optional flange or installed on a mast using the HD35.24C (mast Ø35...44 mm) or HD35.24C5 (mast Ø35...60 mm) optional flange. The models supplied with solar shield are already prepared for fixing to a mast (Ø35...44 mm).

If the data logger requires external probes, connect them to the inputs at the bottom of the instrument. If the data logger has several inputs, respect the indications reported near the inputs (type of probe, channel number, polarity for differential pressure).



Fig. 3.3.1: indoor models installation modes

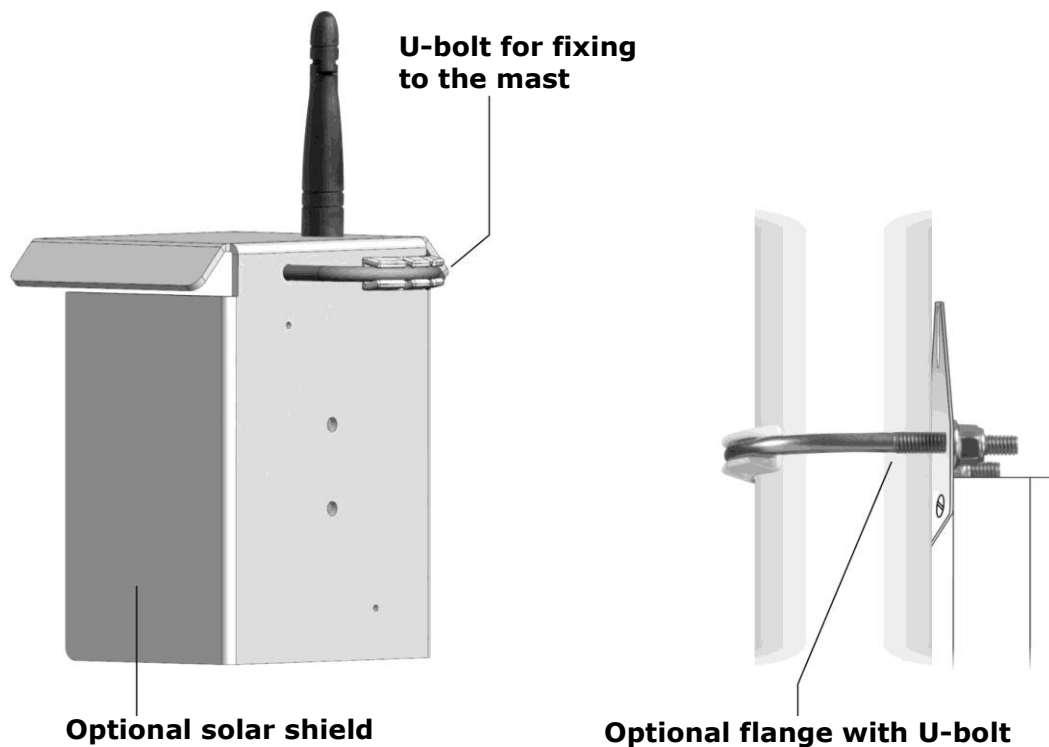


Fig. 3.3.2: outdoor models mast installation modes

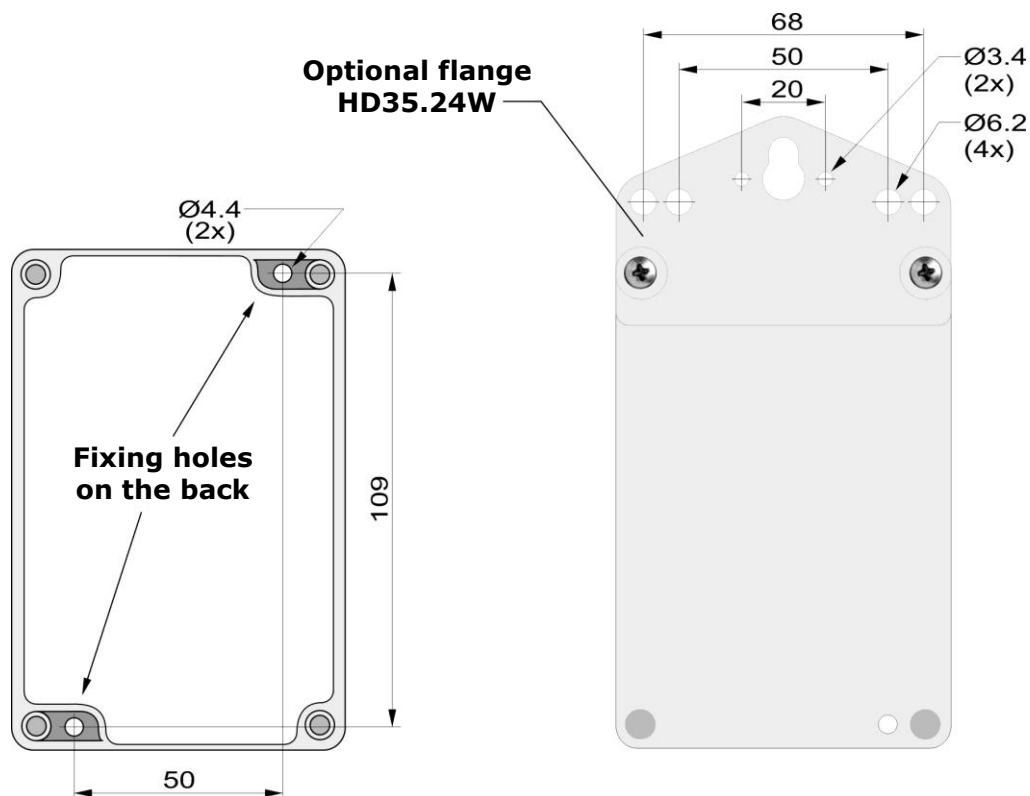


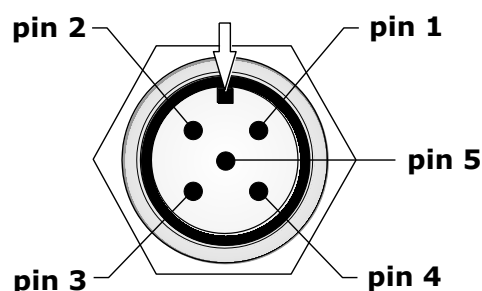
Fig. 3.3.3: outdoor models wall mount installation modes

3.4 M12 connectors pinout

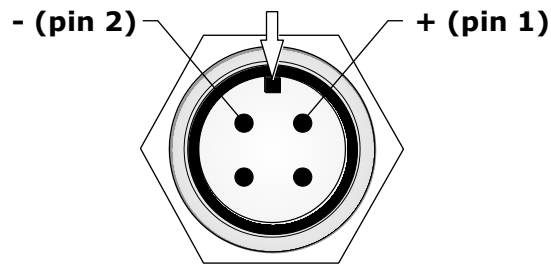
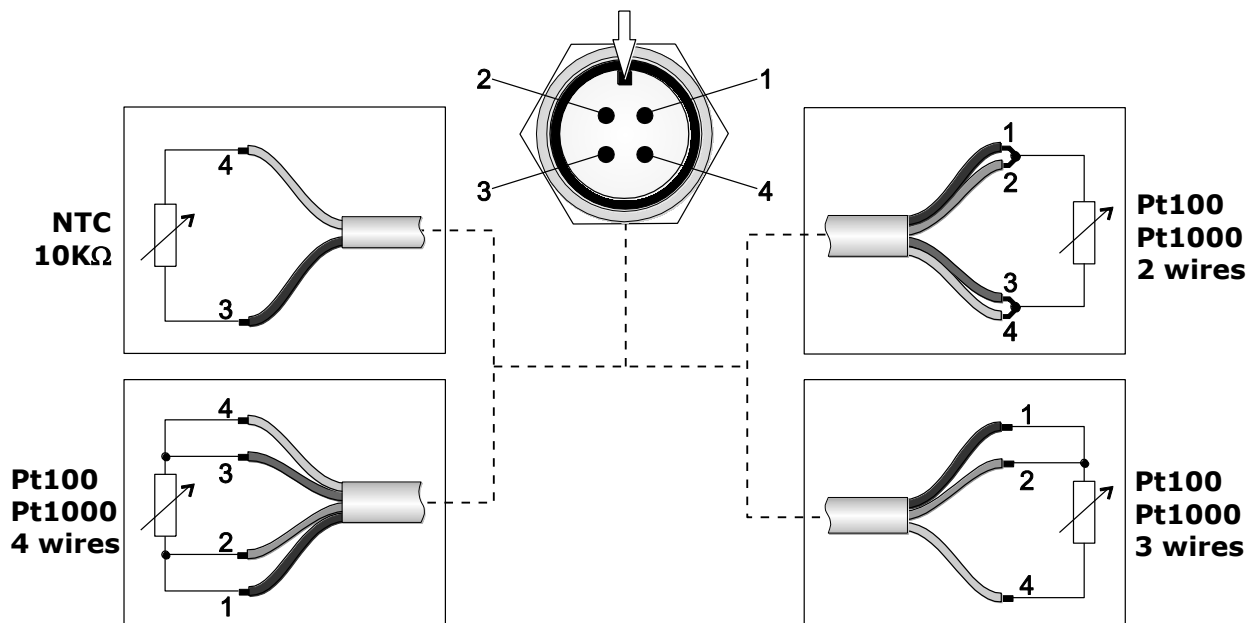
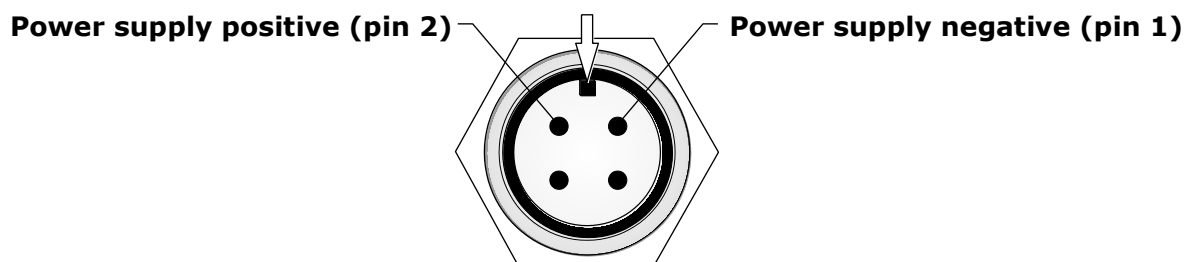
WARNING: to the data loggers using the HP3517... T/RH probe must be connected the probe with the same serial number as the data logger (if purchased together). The replacement of the probe requires recalibration of the instrument in line with the new probe.

The following figures show the external side of the data logger M12 connector. The arrow indicates the connector reference notch.

Connector for HP3510... probes:



M12 connector pin	Description
1	%VWC output positive
2	Not connected
3	GND
4	Temperature output positive
5	Power supply positive

Connector for rain gauges and pyranometers:**Connector for temperature probes:****LR35WPM[B] power supply connector:**

3.5 LR35[G]H connections

LR35[G]H has three terminal header inputs. Each input can be configured as a Pt100/Pt1000, thermocouple, 0/4...20 mA (shunt resistance is inside), 0...50 mV, 0...1 V or potentiometric input. Only input 3 can be also configured as pulse counter (count of voltage-free contact switchings).

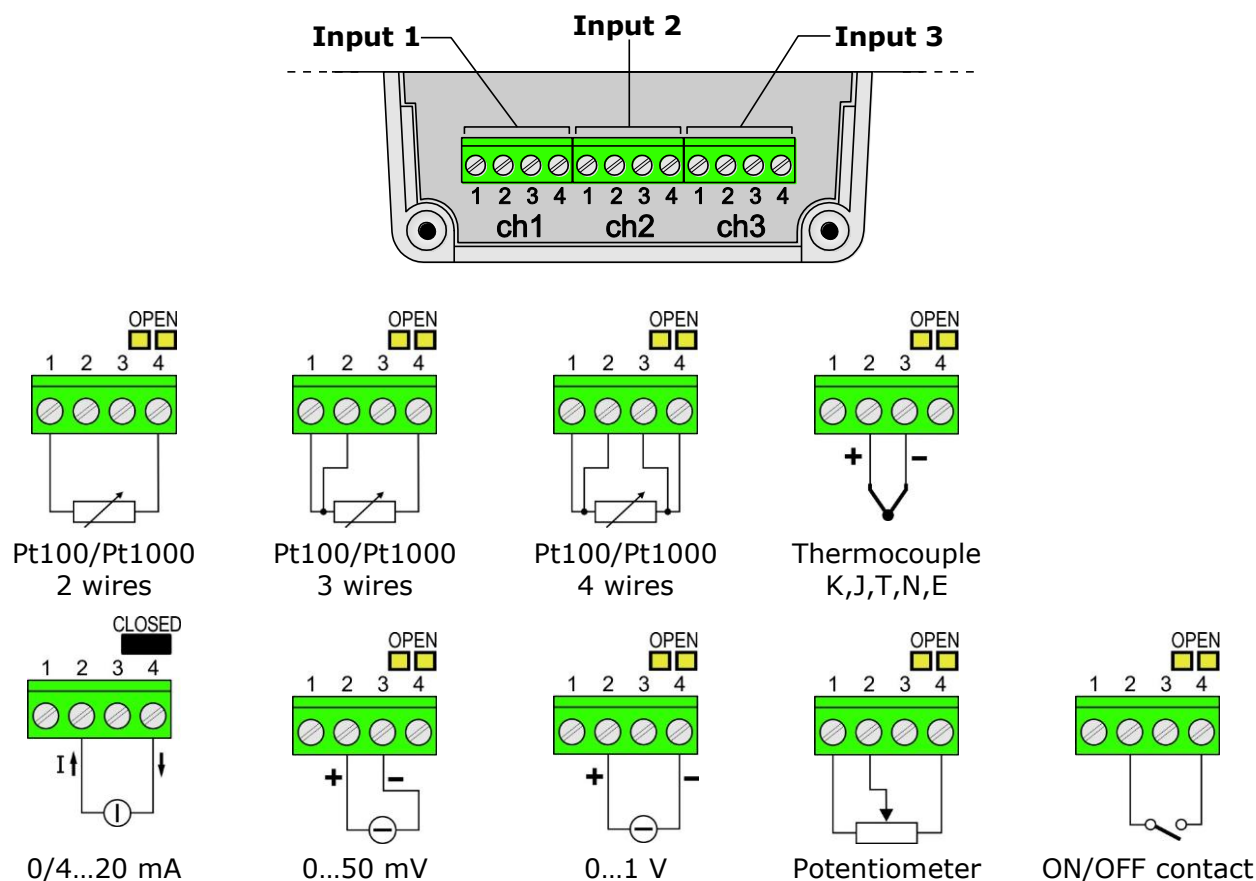


Fig. 3.5.1: sensors connection in LR35[G]H

If a channel is configured as current input, insert the 50 Ω shunt resistance closing the jumper placed above the terminals of the relevant channel. In all the other configurations, leave the jumper open. The current input accepts any value in the range 0...20 mA.

Inputs configuration

Configuration of inputs can be implemented through the HD35AP-S software (see software instructions) or, if the data logger is equipped with a display, through the front keyboard.

To configure the input channel ch x (x=1,2,3 is the number of the input) through the keyboard, access the menu and select the item *Ch x settings* $\Rightarrow$ *ch x configuration*. Set the type of input among those available:

- Pt100 2-wire, Pt100 3-wire, Pt100 4-wire, Pt1000 2-wire, Pt1000 3-wire, Pt1000 4-wire,
- TC-K, TC-J, TC-T, TC-N, TC-E,
- 0-1V, 0-50mV, 4-20mA, Potentiometer, Counter, Frequency,
- 0-1V Mapped, 0-50mV Mapped, 4-20mA Mapped, Mapped Potent., Mapped Count., Mapped Freq.

The input types *4-20mA* and *4-20mA Mapped* also work with 0-20 mA signals. The input types *Counter* and *Frequency* are only in channel Ch 3.

Set *NO MEASURE* if the channel is not used.

The indication *Mapped* means that a linear correspondence between input values (in mA, mV, V, Ω or counts) and the values of a physical quantity will be associated to the channel. For example, if *4-20mA* is selected, the data logger stores the input value in mA; if *4-20mA Mapped* is selected, the data logger doesn't store the input value in mA but the corresponding value of the physical quantity associated to the input.

By selecting a Mapped-type configuration, the guided procedure for the association between the input values (in mA, mV, V, Ω or counts) and the values of the corresponding physical quantity is started. The procedure is illustrated below:

1. After confirming the selection of a Mapped input, the procedure start message is displayed, press **ENTER** to continue.
2. Select the measurement unit of the physical quantity among those proposed by the instrument. If the desired measurement unit is not in the list, select *NOT DEF* (not defined). Select the option OK and confirm with **ENTER** to continue.
3. Select the measurement resolution of the physical quantity among those proposed by the instrument. Select the option OK and confirm with **ENTER** to continue.
4. A message will be displayed reminding that the two coordinates of the linear relation between input and physical quantity will be now required:
 x_1 =input value (in mA, mV, V, Ω or counts) in the first point,
 y_1 =value of the physical quantity corresponding to the input value x_1 ,
 x_2 =input value (in mA, mV, V, Ω or counts) in the second point,
 y_2 =value of the physical quantity corresponding to the input value x_2 ,

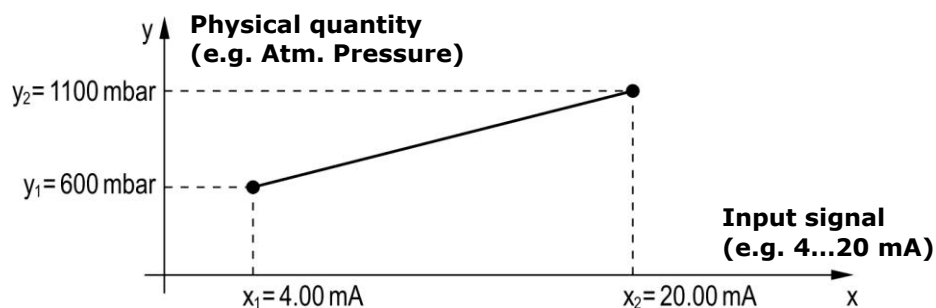


Fig. 3.5.2: association of a physical quantity to the input signal

press **ENTER** to continue.

5. Select the input value x_1 for the first point (e.g. 4.00 mA). Select the option OK and confirm with **ENTER** to continue.
6. Select the physical quantity value y_1 for the first point (e.g. 600 mbar). Select the option OK and confirm with **ENTER** to continue.
7. Select the input value x_2 for the second point (e.g. 20.00 mA). Select the option OK and confirm with **ENTER** to continue.
8. Select the physical quantity value y_2 for the second point (e.g. 1100 mbar). Select the option OK and confirm with **ENTER** to continue.
9. The message requesting confirmation of the configuration storage is displayed, press **YES** to save the settings and terminate the procedure.

The procedure can be stopped at any moment by selecting the option CANCEL and confirming with **ENTER**.

Through the HD35AP-S software, a user name can be associated to each measurement channel to remind the type of physical quantity detected.

3.6 LR35LWH connections

LR35LWH has four terminal header inputs. Each input can be configured as a Pt100/Pt1000, thermocouple, 0/4...20 mA (shunt resistance is inside), 0...50 mV, -50...50 mV, 0...1 V, 0...10 V or potentiometric input. Only input 4 can be also configured as pulse counter (count of voltage-free contact switchings).

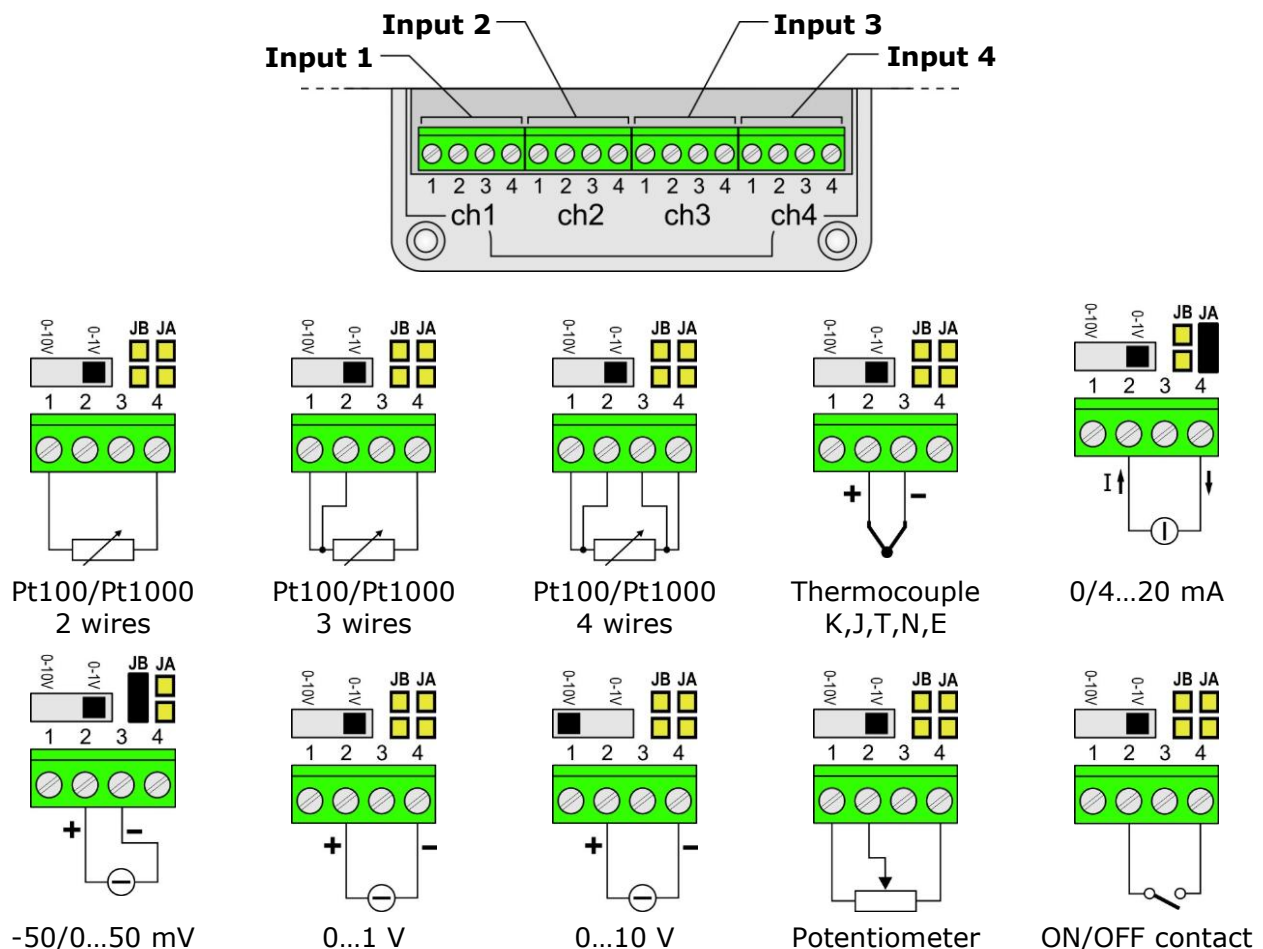


Fig. 3.6.1: sensor connection in LR35LWH

If a channel is configured as 0-10 V input, set the switch on the terminals of the channel to 0-10V. In all other cases, set the switch to 0-1V.

If a channel is configured as current input, insert the 50 Ω shunt resistance closing the jumper **JA** above the terminals of the relevant channel. In all the other configurations, leave the jumper open. The current input accepts any value in the range 0...20 mA.

If a channel is configured as -50/0...50 mV input, close the jumper **JB** above the terminals of the relevant channel. In all the other configurations, leave the jumper open.

Configuration of inputs is done with the HD35AP-S software.

3.7 LR35LW -MB connections

LR35LW-MB has:

- 7...30 Vdc power supply input (terminals 1, 2).
- Switched power supply output (terminals 3, 4). It has the same value as the power supply input, but it is **active only during the measurement acquisition phase**. The output can be used to power the sensors.
- RS485 port (terminals 5, 6, 7) with Modbus-RTU protocol for the connection of the sensors.
- Potential-free contact input (terminals 8, 9). For example, a rain gauge with contact output can be connected.

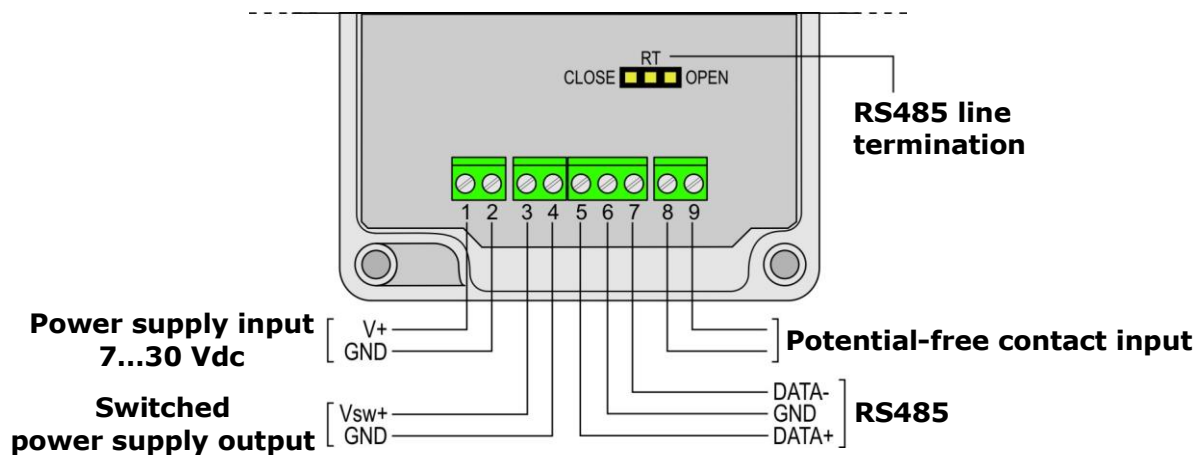


Fig. 3.7.1: LR35LW-MB connections

The jumper placed above the terminals allows inserting the termination resistance for long distance RS485 connection. Place the jumper between the **RT** and **CLOSE** indications to connect the termination resistance. Place the short jumper between the **RT** and **OPEN** indications to disconnect the resistance.

3.8 Level sensor connection (LR35LWDPTC)

The instrument accepts relative pressure sensors with 5 Vdc power supply, three-wire ratiometric (10...90% of supply voltage) voltage output and 0...1 bar measuring range (e.g., Huba Control 712.911x1...).

Terminal	Description
9	GND
10	Sensor output positive
12	Sensor power supply positive

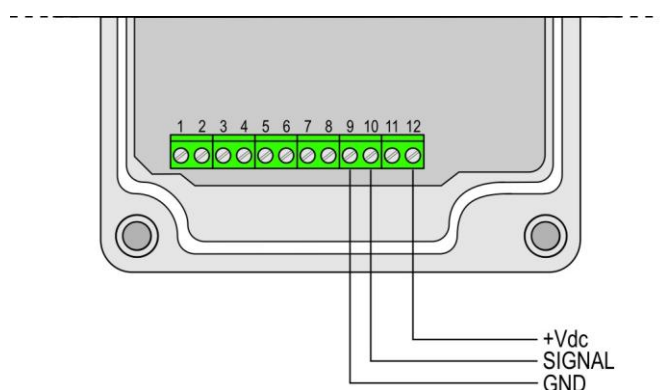


Fig. 3.8.1: connection of level sensor

4 Connection to the network

4.1 Network connection / disconnection

As soon as the data logger is powered, it automatically tries to connect to the LoRaWAN® network server.

If necessary, the data logger connection button, pressed for at least 5 seconds, allows connecting / disconnecting the data logger.

In the indoor models, the connection button is on the front panel. In the outdoor models, the connection button is internal and is indicated with CONNECT / DISCONNECT on the electronic board.

The activation of the connection procedure is signaled by the lightning-up of the green RF LED for one second and by a beep of the buzzer. Successively, the red RF LED will start blinking until the device is connected.

For the connection to the network, a LoRaWAN® gateway must be present within the data logger coverage range.

4.2 Gateway

Unless LoRaWAN® coverage is already present in your area, you need to use your own gateway.

If the gateway is supplied by Senseca, it is normally already configured for connection to the LoRaWAN® network server, and it is sufficient to insert a SIM, if the gateway has a cellular connection, or connect the gateway to your LAN/WLAN network, if the gateway has Wi-Fi or ETHERNET connection.

If the gateway is not supplied by Senseca, the user must set the gateway to connect to the desired LoRaWAN® network server.

In any case, it is recommended to carefully read the documentation supplied with the gateway.

4.3 WEB application

The data sent by the data logger can be viewed on the Senseca Cloud or on third-party Clouds.

In the case Senseca supplies an already configured gateway and the Senseca Cloud is used, the user simply has to register on the Senseca Cloud "**www.deltaohm.cloud**" and enter (during registration or later, if already registered) the data logger serial number: the data will be immediately available. For the use of the Senseca Cloud see the instructions downloadable from the "environmental.senseca.com" website in the "Support" > "Software" screen.

If a third-party Cloud is used, e.g. myDevices, ioThink®, etc., it is the user who must prepare his own data display screens according to the chosen application and the data protocol used (Cayenne LPP or proprietary). For the development of advanced customized applications that interface directly with the network server (e.g. TTN), Senseca provides a free Javascript decoder for the proprietary protocol.

5 Data loggers with LCD

According to the data logger model, the LCD display can be custom (**L** option) or graphic (**G** option) type. The display shows all quantities measured and calculated by the data logger along with the following RF quantities:

- **RSSI** (*Received Signal Strength Indication*): received signal power;
- **PER** (*Packet Error Rate*): percentage of transmission errors;

Note: the HOP1 indication in the screens showing the RF quantities simply indicates that a direct connection exists between the data logger and the gateway.

The indications of connection status, logging (in progress/deactivated), and battery charge level are displayed.

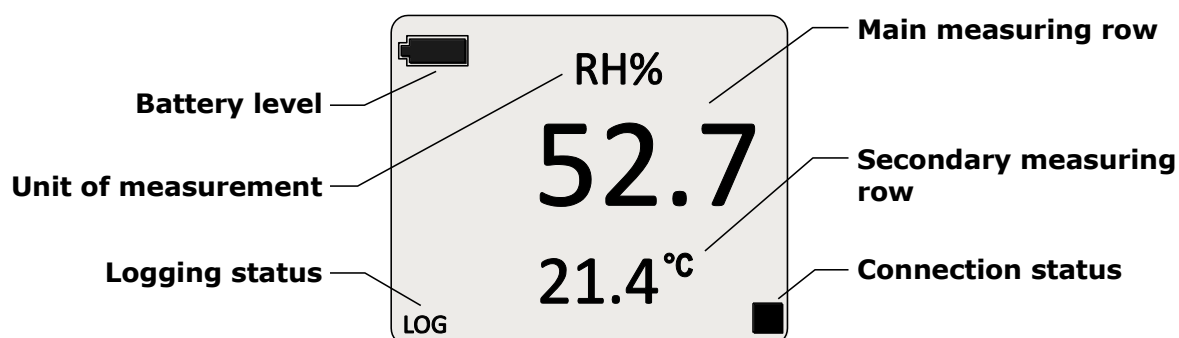


Fig. 5.1: custom LCD

In the models with custom LCD that measure several quantities, the temperature (if measured by the model) is displayed in the secondary row (except when a RF quantity appears in the main row).

The models with graphic LCD allow the simultaneous display of 3 measurements in the secondary rows. The graphic display shows in addition the RF signal level and date & time.

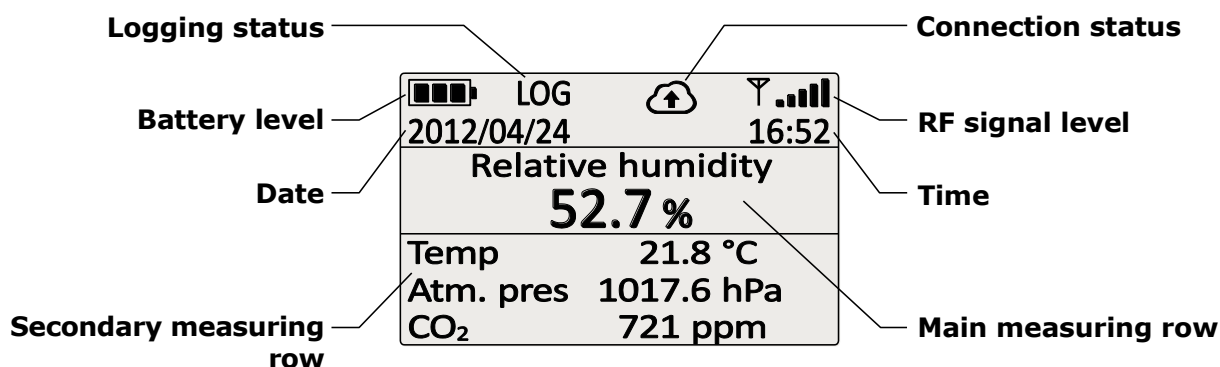


Fig. 5.2: graphic LCD

In the indoor models, use the **▲** key to scroll the quantities on the display. In the outdoor models, through HD35AP-S software you can select the measurement to be displayed on the main measuring row of the display or set the automatic alternation of the measured quantities.

The "connection status" symbol provides the following information:

- symbol steady on: data logger connected;
- symbol blinking: trying to connect;
- symbol off: data logger not connected.

5.1 Maximum, minimum and average of measurements (only indoor models)

To display the maximum value (**MAX**), the minimum value (**MIN**) and the average (**AVG**) of the acquired values, press the **FUNC** key until the desired function is shown on the display.

To reinitialize the function value and start a new measuring session, press the **FUNC** key until you read *FUNC CLR* (custom LCD) or *Function clear* (graphic LCD), use the arrow keys to select yes and confirm with **ENTER**.

5.2 Menu (only indoor models)

The menu allows displaying the data logger information and changing operation parameters. The menu is structured in levels, with main categories and submenus.

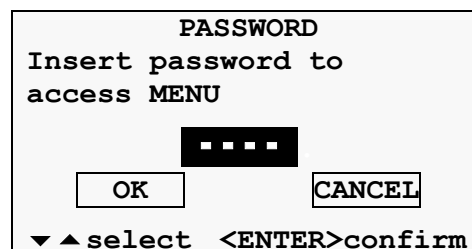
To access the menu you need to enter the **user password** (configurable through the appropriate menu item, default 0000) or the **administrator password** (supplied with the system and not editable). Entering the user password makes some settings not changeable.

The instrument exits automatically the menu if no key is pressed for 3 minutes. After exiting the menu, the password remains active for a few minutes, during which you may enter the menu again without re-entering the password. It is possible to exit the menu by disabling immediately the password by performing a password level reset in the *Password* menu.

5.2.1 The menu in data loggers with graphic LCD

To access a menu parameter, proceed as follows:

1. Press **MENU**.
2. Press ▼ to select the password field.



3. Press **ENTER**, the first digit of the password will blink.
4. Use ▼/▲ keys to set the first digit and confirm with **ENTER**, the second digit of the password will blink. Set all the password digits in the same way.
5. Press ▼ to select the option OK and confirm with **ENTER**.
6. Use ▼/▲ keys to select a main category of the menu and confirm with **ENTER**.
7. If the selected main category has a submenu, select the desired item using ▼/▲ and confirm with **ENTER**.

To exit the main menu or a submenu, select the item EXIT (last menu item).

Changing a parameter

After selecting the desired parameter, it can be changed, if allowed, in the following way:

1. Use ▼/▲ keys to highlight the current setting of the parameter.

LOG/RF TX INTERVAL
Set the interval of log
memorization and RF Tx

15 min

OK CANCEL

▼ ▲ select <ENTER>confirm

2. Press **ENTER**, the field will start blinking.
3. Use ▼/▲ keys to select the desired setting and confirm with **ENTER**. If you are setting a numeric value, you can move faster by keeping ▼ or ▲ keys depressed.
4. Press ▼ to select the option OK and confirm with **ENTER**. The instrument closes the parameter window and returns to the previous menu level.

To exit a parameter window without changes, select CANCEL and confirm with **ENTER**.

If only the option CANCEL is available in the parameter window, it means that it is not allowed to change the parameter setting.

Menu structure

The complete structure of the main window with the relevant submenus is shown below. According to the data logger model, some items could not be available if not significant for that particular model.

1) Information

It lists the general information of the instrument: model, serial number, device EUI (Extended Unique Identifier), user code, firmware version, calibration date, etc.

3) LoRaWAN parameters

- 1) **Join Network server**: enables or disables the connection to the LoRaWAN® network server. Select *Yes* to enable the connection. The connection enabling or disabling can be done also through the connection button.
- 2) **Duty cycle**: enables or disables the data transmission duty-cycle (time slot in which the data logger transmits). Select *On* to enable the duty-cycle. If enabled, the duty-cycle is automatically set by the instrument according to the regulations in force.
- 3) **Ack mode**: enables or disables the request for acknowledgement of the data sent by the data logger and received by the network. The default setting is *Off* (Ack disabled).
Note: the request for acknowledgement impacts on data transmission duty cycle; leave the option disabled if a limited number of downlink packets are allowed (as for example, for TTN server).
- 4) **Protocol type**: choice of the Cayenne LPP or proprietary (default) protocol.
- 5) **Auto data rate**: enables or disables the data rate automatic setting (Adaptive Data Rate). The default setting is *On* (Auto data rate enabled).

- 6) **Data rate**: data rate manual setting, used if the automatic setting is disabled. It is set the index (0,1,2,...) corresponding to the data rate according to the convention published in the document "LoRaWAN® Regional Parameters" (see "lora-alliance.org").
- 7) **Exit**: returns to the main menu.

4) Ch x settings (x=1, 2, 3) – Only available in the models with configurable inputs

- 1) **Ch x info**: lists all the general information of the input channel Ch x of the instrument: name of measurement, probe type, resolution. The correspondence between the input signal value and the physical quantity value is also indicated for mA, mV, V, Potentiometer and Counter inputs associated with a physical quantity.
- 2) **Ch x configuration**: sets the type of input among the available inputs (see page 13 for setting modes).
The input types indicated with **HR** (Pt100/Pt100 3W/4W), available in some models, have 0.01 °C resolution (the non-HR Pt100/Pt1000 input types have 0.1 °C resolution).
The input type can be set only with the administrator password.
- 3) **Ch x zero setting**: sets the current measurement value as zero value. Only available for mA, mV, V and Potentiometer inputs associated with a physical quantity.
- 4) **Ch x down threshold**: lower alarm threshold of channel x.
- 5) **Ch x up threshold**: higher alarm threshold of channel x.
- 6) **Ch x reset counter**: zeroes the number of counts. The item is available only if the channel is configured as counter.
- 7) **Exit**: returns to the main menu.

5) Alarm thresholds or Alarm configuration

- 1) **Quantity 1** (*) **down threshold**: lower alarm threshold of quantity 1.
- 2) **Quantity 1** (*) **up threshold**: higher alarm threshold of quantity 1.
- 3) ...
- 4) **Quantity n** (*) **down threshold**: lower alarm threshold of quantity n.
- 5) **Quantity n** (*) **up threshold**: higher alarm threshold of quantity n.
- 6) **Thres. buzzer alarm**: activates or deactivates the buzzer when measurement thresholds are exceeded.
- 7) **Exit**: returns to the main menu.

(*) The type of quantity depends on the data logger model.

Note: in the models with configurable inputs, the items down threshold and up threshold of quantities are not available in this submenu, but are included in the menus for the setting of channels Ch x.

6) Measure hysteresis

- 1) **Quantity 1** (*) **hysteresis**: hysteresis of the alarm thresholds of quantity 1.
- 2) ...
- 3) **Quantity n** (*) **hysteresis**: hysteresis of the alarm thresholds of quantity n.
- 4) **Exit**: returns to the main menu.

(*) The type of quantity depends on the data logger model.

The width of the hysteresis is a percentage (0 ... 100%) of the difference between the two alarm thresholds.

For example, if Hysteresis=2%, Lower threshold=10 °C and Upper threshold=60 °C, the hysteresis is $(60-10) \times 2/100 = 1$ °C:

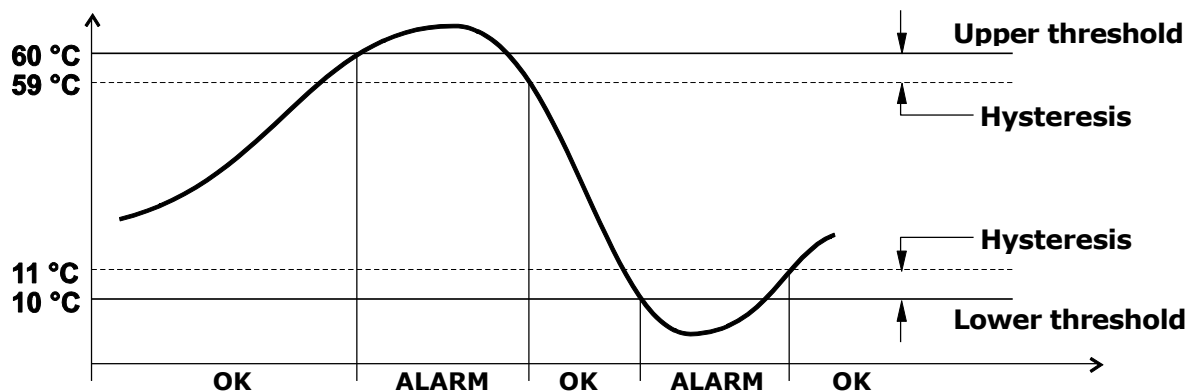


Fig. 5.3: hysteresis of the alarm thresholds

7) Alarm time delay (in seconds)

- 1) **Quantity 1** ^(*) **alarm delay**: delay for alarm activation of quantity 1.
- 2) ...
- 3) **Quantity n** ^(*) **alarm delay**: delay for alarm activation of quantity n.
- 4) **Exit**: returns to the main menu.

^(*) The type of quantity depends on the data logger model.

If the measured value drops below the lower threshold or exceeds the upper threshold, the alarm is generated after the time set. The alarm is generated immediately if 0 is set. If the alarm condition ends before the delay time is elapsed, the alarm is not generated.

8) Unit measures

- 1) **Quantity 1** ^(*): measurement unit of quantity 1.
- 2) ...
- 3) **Quantity n** ^(*): measurement unit of quantity n.
- 4) **Exit**: returns to the main menu.

^(*) The type of quantity depends on the data logger model.

Note: in the LR35H model, only the temperature measurement unit is available. The measurement units for the other quantities are defined during the inputs mapping procedure (if applied, see page 13).

9) Logging

- 1) **Start/stop log**: enables or disables logging.
- 2) **Logging mode**: choice between cyclical management (the new data overwrite the old ones when the memory is full) or non-cyclical management (logging stops when the memory is full) of the data logger memory.
- 3) **Log/RF Tx interval**: choice of logging and RF transmission interval (the two intervals coincide). If it is higher than the measuring interval, the average of the measurements acquired during the interval will be stored.

- 4) **Measure interval**: choice of the measurements acquisition interval. It is forced to the value *RF log/Tx interval* if a higher value is set.
- 5) **Log erase**: deletes all stored measurements from the data logger memory.
- 6) **Exit**: returns to the main menu.

10) Clock

- 1) **Clock Configuration**: date/time of data logger.
- 2) **Exit**: returns to the main menu.

11) Password

- 1) **Reset password level**: exits menu disabling immediately the password (the password will not remain active for some minutes like it usually happens when exiting a menu: you will have to re-enter the password even if you access the menu at once).
- 2) **User password config.**: sets the user level password.
- 3) **Exit**: returns to the main menu.

12) CO₂ auto calibration

- 1) **Start/stop auto-calib.**: enables or disables CO₂ auto-calibration.
- 2) **Auto-calib. period**: time interval between two consecutive auto-calibrations.
- 3) **Auto-cal. 1st period**: time interval after which the first auto-calibration will be performed after activation.
- 4) **Background CO₂ value**: CO₂ reference value for auto-calibration.
- 5) **Auto-cal. max change**: maximum offset that can be applied to the measurement by the auto-calibration procedure.
- 6) **Exit**: returns to the main menu.

13) Calibration – Only available with administrator password

- 1) **Calibration 1** (*)
- 2) ...
- 3) **Calibration n** (*)
- 4) **Atm. pressure config.**: manual setting of the atmospheric pressure to compensate CO₂ measurements if the data logger has no pressure sensor.
- 5) **Calibration Type**: choice between user calibration and factory calibration.
- 6) **Exit**: returns to the main menu.

(*) The calibrations available in the *Calibration* submenu depend on the data logger model; e.g., the *RH 75% calibration* and *RH 33% calibration* items appear in the models measuring relative humidity.

14) Language

- 1) **Language config.**: choice of the language to be used for the display.
- 2) **Exit**: returns to the main menu.

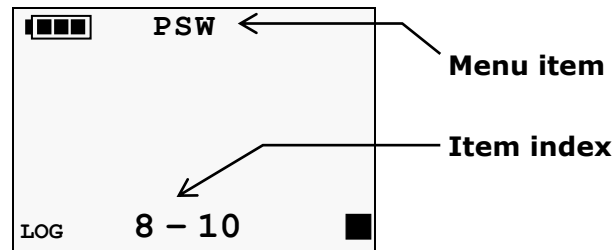
15) Exit

Returns to the measurement mode.

5.2.2 The menu in data loggers with custom LCD

To access a menu parameter, proceed as follows:

1. Press **MENU**, the first digit of the password will blink.
2. Using ▼/▲ keys, set the first digit and confirm with **ENTER**, the second digit of the password will blink. Set all the password digits in the same way.
3. Using ▼/▲ keys, select a main category in the menu and confirm with **ENTER**. Menu items appear one at a time in the upper part of the display; the lower part of the display shows the position of the item in the menu and the total number of items in the menu (for ex. "8 – 10" means the eighth item in a menu of 10 items).



4. If the selected main category has a submenu, select the desired item using ▼/▲ keys and confirm with **ENTER**. Scrolling the submenus displays also the parameter current setting.
5. To change the selected parameter, if allowed, use ▼/▲ keys to select the desired setting and confirm with **ENTER**. If you are setting a numeric value, you can fast forward by keeping ▼ or ▲ keys depressed.

To exit the main menu or a sub menu, select EXIT item (last menu item).

If it is not allowed to change a parameter, the notice N/A (Not Available) will appear when pressing ENTER to select it.

Menu structure

The complete structure of the main menu with the relevant submenus is shown below. According to the data logger model, some items could be not available if not significant for that particular model.

1) DEV_INFO (information)

It lists the general information of the instrument: model, serial number, device EUI (Extended Unique Identifier), user code, firmware version, calibration date, etc. Information is shown in the upper part of the display.

2) LORA_WAN_MENU (LoRaWAN® parameters)

- 1) **JOIN_NET**: enables or disables the connection to the LoRaWAN® network server. Select **YES** to enable the connection. The connection enabling or disabling can be done also through the connection button.
- 2) **DUTY_CYCL**: enables or disables the data transmission duty-cycle (time slot in which the data logger transmits). Select **On** to enable the duty-cycle. If enabled, the duty-cycle is automatically set by the instrument according to the regulations in force.
- 3) **ACK_MODE**: enables or disables the request for acknowledgement of the data sent by the data logger and received by the network. The default setting is **OFF** (Ack disabled).

Note: the request for acknowledgement impacts on data transmission duty

cycle; leave the option disabled if a limited number of downlink packets are allowed (as for example, for TTN server).

- 4) **PROT_TYPE**: choice of the protocol. Select "0" for the Cayenne LPP standard protocol. Select "1" for the proprietary protocol (default).
- 5) **AUTO_DATA_RATE**: enables or disables the data rate automatic setting (Adaptive Data Rate). The default setting is *On* (Auto data rate enabled).
- 6) **DATA_RATE**: data rate manual setting, used if the automatic setting is disabled. It is set the index (0,1,2,...) corresponding to the data rate according to the convention published in the document "LoRaWAN® Regional Parameters" (see "lora-alliance.org").
- 7) **EXIT**: returns to the main menu.

3) THLD_MENU (alarm thresholds)

- 1) **Quantity 1** (*) **_DOWN_THLD**: lower alarm threshold of quantity 1.
- 2) **Quantity 1** (*) **_UP_THLD**: higher alarm threshold of quantity 1.
- 3) ...
- 4) **Quantity n** (*) **_DOWN_THLD**: lower alarm threshold of quantity n.
- 5) **Quantity n** (*) **_UP_THLD**: higher alarm threshold of quantity n.
- 6) **THLD_ALARM**: enables or disables the buzzer when measurement thresholds are exceeded.
- 7) **EXIT**: returns to the main menu.

(*) The type of quantity depends on the data logger model.

4) HYST_MENU (hysteresis of the alarm thresholds)

- 1) **Quantity 1** (*) **_HYST%**: hysteresis of the alarm thresholds of quantity 1.
- 2) ...
- 3) **Quantity n** (*) **_HYST%**: hysteresis of the alarm thresholds of quantity n.
- 4) **EXIT**: returns to the main menu.

(*) The type of quantity depends on the data logger model.

The width of the hysteresis is a percentage (0 ... 100%) of the difference between the two alarm thresholds.

For example, if Hysteresis=2%, Lower threshold=10 °C and Upper threshold=60 °C, the hysteresis is $(60-10) \times 2 / 100 = 1$ °C (see the example graph on page 23).

5) ALRM_DELY_MENU (delay time in seconds for alarm activation)

- 1) **Quantity 1** (*) **_ALRM_DELY**: delay for alarm activation of quantity 1.
- 2) ...
- 3) **Quantity n** (*) **_ALRM_DELY**: delay for alarm activation of quantity n.
- 4) **EXIT**: returns to the main menu.

(*) The type of quantity depends on the data logger model.

If the measured value drops below the lower threshold or exceeds the upper threshold, the alarm is generated after the time set. The alarm is generated immediately if 0 is set. If the alarm condition ends before the delay time is elapsed, the alarm is not generated.

6) MEAS_UNIT_MENU (measurement unit)

- 1) **Quantity 1** (*) **_UNIT_MEAS**: measurement unit of quantity 1.
- 2) ...
- 3) **Quantity n** (*) **_UNIT_MEAS**: measurement unit of quantity n.
- 4) **EXIT**: returns to the main menu.

(*) The type of quantity depends on the data logger model.

7) LOG_MENU (logging)

- 1) **LOG_STAT**: enables or disables the logging.
- 2) **LOG_CYCL**: choice between cyclical management (the new data overwrite the old ones when the memory is full) or non-cyclical management (logging stops when the memory is full) of the data logger memory. Select **YES** for the cyclical management.
- 3) **LOG/RF_TIME**: choice of logging and RF transmission interval (the two intervals coincide). If it is higher than the measuring interval, the average of the measurements acquired during the interval will be stored.
- 4) **MEAS_TIME**: choice of the measurements acquisition interval. It is forced to the value *Log/RF_TIME* if a higher value is set.
- 5) **LOG_DEL**: deletes all stored measurements from the data logger memory. Select **YES** to delete the memory.
- 6) **EXIT**: returns to the main menu.

8) CLK_MENU (clock)

- 1) **YEAR**: year.
- 2) **MON**: month.
- 3) **DAY**: day.
- 4) **HOURL**: hour.
- 5) **MIN**: minutes.
- 6) **EXIT**: returns to the main menu.

9) PSW_MENU (password)

- 1) **RST_PSW_LVL**: exits the menu and deactivates immediately the password (the password will not remain active for some minutes as it normally happens when exiting the menu: you will need to re-enter the password even if you re-access immediately the menu).
- 2) **SET_NEW_PSW**: sets user-level password.
- 3) **EXIT**: returns to the main menu.

10) CAL_MENU (calibration) – *Only available with administrator password*

- 1) **Calibration 1** (*)
- 2) ...
- 3) **Calibration n** (*)
- 4) **CAL_TYPE**: choice between user calibration (*USER*) or factory calibration (*FACT*).
- 5) **EXIT**: returns to the main menu.

(*) The calibrations available in the *CAL_MENU* submenu depend on the data logger model; e.g., the *RH_75%_CAL* and *RH_33%_CAL* items appear in the models

measuring relative humidity, while *DIFF_PRES_AUTO_ZERO_CAL* (enables/disables the automatic zero calibration) and *DIFF_PRES_AUTO_ZERO_INT_min* (setting of the periodic interval of the automatic zero calibration) items appear in the models measuring differential pressure with auto-zero.

12) EXIT

Returns to measurement mode.

6 Calibration

The data logger is factory-calibrated and does not normally require further interventions of the user. Anyway, a new sensor calibration can be performed for:

- CO₂ at any reference value within the measurement range
- Differential pressure at zero
- R.H. at 75% and 33%

For a correct calibration of the probes, it is crucial to know and respect the physical phenomena which underlie measurements: for this reason, it is recommended to thoroughly follow the following instructions and to perform new calibrations only if in possession of adequate technical knowledge and instruments.

To access calibration, the data logger must have the user-calibration option set:

- In the indoor models with graphic LCD, select the menu item *Calibration* ⇒ *Calibration Type* and set the *User* option.
- In the indoor models with custom LCD, select the menu item *CAL_MENU* ⇒ *CAL_TYPE* and set the *User* option.

The calibration procedure deletes the data of the previous user calibration. In case of failed procedure, you can always return the instrument to factory calibration by selecting:

- in the indoor models with graphic LCD, the menu item *Calibration* ⇒ *Calibration Type* and setting the *Factory* option;
- in the indoor models with custom LCD, the menu item *CAL_MENU* ⇒ *CAL_TYPE* and setting the *FACT* (factory) option.

Calibration can be performed with HD35AP-S software (see software instructions) or, if the data logger has display and keyboard, through the front keyboard.

6.1 CO₂ calibration

The CO₂ sensor can be calibrated to any reference value within the measurement range.

Calibration procedure:

1. Place the instrument in an environment with known CO₂ concentration (for ex. in clean air).
2. Wait for at least 15 minutes for the measurement to become stable, with the instrument on.
3. Access the menu with the administrator password and select the item *Calibration* ⇒ *CO₂ calibration*. Press **ENTER** to confirm.
4. The value measured by the instrument appears on the left, and the calibration point on the right. The instrument initially proposes the same measurement value as calibration point.
5. Enter the calibration value, select the option OK and confirm with **ENTER**.

CO ₂ CALIBRATION	
Put sensor in known gas concentration	
Meas. [ppm]	Cal. [ppm]
472	450
OK	CANCEL
▼▲select <ENTER>confirm	

6. The instrument tests the measurement stability. Wait for a few minutes for measurement completion. In the meantime, don't stay too close to the instrument to avoid altering the measurement.

WAIT FOR STABILIZATION OF CO ₂ CONCENTRATION...	
Please stay away to not alter measures	
Meas. [ppm]	Avg [ppm]
472	----

7. At the end, a message is shown indicating the calibration success or failure. Press any key to return to the calibration submenu.

If a message appears declaring that calibration has failed, it means that the value measured by the instrument during the procedure differs too much from the set reference value. In that case repeat calibration checking the CO₂ reference value in the environment and making sure to operate in a stable environment.

6.1.1 CO₂ sensor auto-calibration

The instrument can be set so as CO₂ calibration is automatically performed at predetermined intervals.

In order for auto calibration to be effective, the CO₂ concentration in the environment where the instrument is installed must assume a known value (referred to as environment **background value**). For example, we can have that an instrument installed inside a public place performs a weekly auto calibration when people are not present and CO₂ concentration is close to the outdoor air value (if there is an adequate air change).

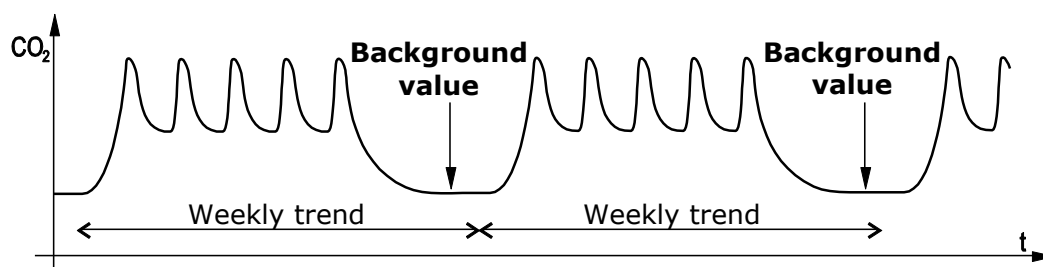


Fig. 6.1.3: example of background value for CO₂ auto calibration

The offset applied to the measurement by the auto calibration procedure can be limited to a maximum value, so as to avoid erroneous calibrations when the measured value differs too much from the estimated background value. The auto calibration procedure acts therefore in the following way:

- If the difference between the measured value and the background value is lower than the maximum offset, an offset is applied to the measurement so that the measured value coincides with the background value.
- If the difference between the measured value and the background value is higher than the maximum offset, only the maximum offset is added or subtracted so as to approach the background value.

To set the auto calibration interval and the maximum offset and to activate auto calibration, see the menu item *CO₂ autocalibration*.

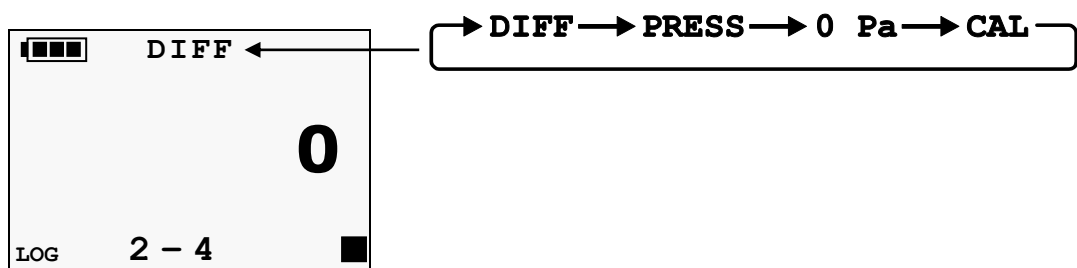
6.2 Differential pressure calibration

Differential pressure sensors may show a slight difference between the two inputs, consequently the instrument, with an equal pressure applied to the two inputs, doesn't show a zero value.

If the data logger is equipped with the auto-zero function, zeroing is automatic (with a configurable period, item DIFF_PRES_AUTO_ZERO_INT_min of the calibration submenu). To carry out the manual zeroing instead, proceed as follows.

Calibration procedure:

1. Leave the instrument pressure input open.
2. Access menu with the administrator password and select the item *CAL_MENU* ⇒ *DIFF_PRES_0 Pa_CAL*. Press **ENTER** to confirm.
3. The zero value blinks on the display.



4. Press **ENTER**, the instrument stores the calibration and returns to the calibration submenu.

6.3 Relative humidity calibration

The sensor can be calibrated in the two points 75%RH and 33%RH. Before starting the calibration procedure, it's better to **check** if a new calibration is necessary, with the aid of 75.4%RH and 33%RH saturated solutions (except LR35[G]1NB, that requires a climatic chamber): a calibration will be performed only if an error of a few humidity points in one of the two calibration points is detected.

The sensor can be calibrated in both points or in one point only.

Preliminary operations before calibration:

Check that the chamber with the saturated saline solutions contains at the same time:

- solid state salt,
- liquid solution or wet salt, in particular for the 75%RH solution.

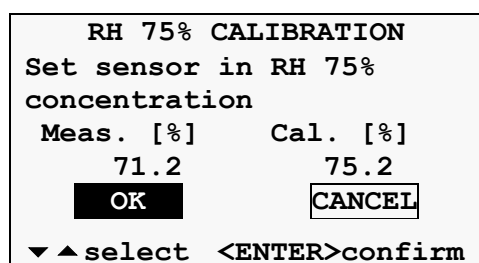
The instrument and the saturated solutions to be used for this operation must be placed

in a stable temperature environment for the whole calibration period. Wait for at least a couple of hours with a stable temperature so that the instrument and the saturated solutions reach a thermal balance with the environment before starting the calibration procedure. In order to obtain a good calibration, it is crucial that the probe and the solution have the same temperature. Bear in mind that plastic material is a bad heat conductor.

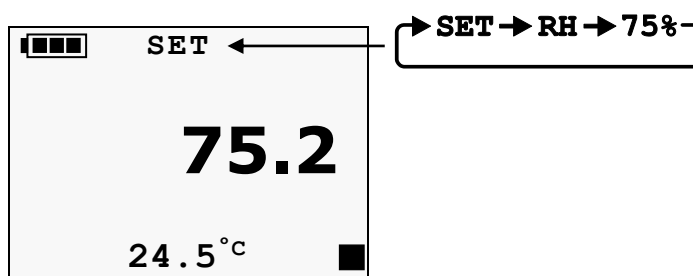
Calibration should be performed at a temperature ranging within 15 and 30°C.

Calibration procedure:

1. Unscrew the probe protection grid and screw the M12×1 threaded ring.
Avoid any contact of the sensitive element with your hands or other objects or liquids. **If some liquid has formed inside the measuring chamber, dry it with a clean absorbent paper towel.**
2. Unscrew the cap of the saturated solution. Screw the threaded ring with the probe on the saturated solution container and wait for at least 30 minutes.
3. Access the menu with the administrator password and select the item *CAL_MENU* (custom LCD) or *Calibration* (graphic LCD). Press **ENTER** to confirm.
4. Select the item *RH_75%_CAL* (custom LCD) or *RH 75% calibration* (graphic LCD) to calibrate the point 75%RH; select the item *RH_33%_CAL* (custom LCD) or *RH 33% calibration* (graphic LCD) to calibrate the point 33%RH. Press **ENTER** to confirm.
5. In the models with custom LCD, the blinking value of the saturated solution at the temperature measured by the probe is displayed. In the models with graphic LCD, the value measured by the instrument (on the left) and the calibration point (on the right) appear.



Graphic LCD



Custom LCD

Note: the suggested calibration value is not updated if the measured temperature changes after starting calibration. If necessary, set manually the calibration value to the value of the saturated solution at the measured temperature using ▼/▲ keys (see the table on the saturated solution container).

6. In the models with custom LCD, press **ENTER** to confirm the value; in the models with graphic LCD, select the option OK and confirm with **ENTER**. The instrument stores the calibration and returns to the calibration submenu.
7. Remove the threaded ring with the probe from the container of the saturated solution and close the container with the solution.
8. To calibrate the second point, repeat the procedure from step 2 to step 7 with the second saturated solution.
9. Unscrew the M12X1 threaded ring from the probe and place again the sensor protection grid.

7 Technical specifications

General characteristics

RF band	EU868, US915, AU915, AS923 depending on model Other frequencies on request
Antenna	Internal in indoor models and in LR35WPM... External in outdoor models (except LR35WPM...)
RF power	+14 dBm
LoRaWAN Class	A
Activation methods	OTAA (Over-The-Air-Activation) ABP (Activation-by-Personalization)
Data encryption	AES128
Measuring interval	1(*), 2, 5, 10, 15, 30 s / 1, 2, 5, 10, 15, 30, 60 min
Data transmitting interval	2, 5, 10, 15, 30, 60 min
Alarm	Acoustic by means of the internal buzzer
Power supply	Li-SOCl ₂ not rechargeable battery, except: LR35[L]4r1Z and LR35[L]1N4r1ZTV: 3 x AA alkaline batteries LR35LW-MB: 7...30 Vdc (< 10 mA) external power supply LR35WPM[B]: 7...30 Vdc (25 mA @ 24 Vdc) external power supply LR35WPM[B]-USB: external power supply via USB
Battery life (**)	2 years typical, with 2 min measuring and data transmitting interval
Display	Indoor models: optional, custom or graphic depending on model Outdoor models: custom LR35WPM... is not available with display
Operating conditions	-20...+70 °C (-10...+70 °C for LR35[G]1NB) 0...85 %RH not condensing for indoor models 0...100 %RH for outdoor models (0...95 %RH for LR35WPM...)
Protection Degree	Indoor models: IP 50 (except LR35[G]1NB) LR35[G]1NB: IP 30 Outdoor models: IP 67 (except LR35WPM...) LR35WPM is equipped with a rain-proof and UV resistant inlet air filter – IP 53
Weight	Indoor models: 200 g approx. Outdoor models: 250 g approx.
Housing	Indoor models: ABS Outdoor models: Polycarbonate

(*) Models measuring several quantities may have a minimum interval exceeding 1 second.

(**) Battery life is greatly reduced if the USB port is left connected to the PC for a long time.

Memory capacity and stored quantities

Model	Number of samples	Stored quantities
Indoor models		
LR35[L]NTV	68,000	T
LR35[G]7P/1TC	68,000	T
LR35[G]7P/3TC	from 42,000 to 68,000	T
LR35[L]1NTC	from 24,000 to 60,000	T, RH, T _D , T _W , AH, MR, PVP
LR35[L]1NTV	from 24,000 to 60,000	T, RH, T _D , T _W , AH, MR, PVP
LR35[L]14bNTV	from 22,000 to 60,000	T, RH, T _D , T _W , AH, MR, PVP, P _{ATM}
LR35[G]1NB	from 44,000 to 120,000	T, RH, T _D , T _W , AH, MR, PVP, CO ₂
LR35[L]4r1Z	68,000	ΔP
LR35[L]1N4r1ZTV	from 22,000 to 60,000	T, RH, T _D , T _W , AH, MR, PVP, ΔP
LR35[G]H	from 36,000 to 68,000	
Outdoor models		
LR35LW1NTC	from 24,000 to 60,000	T, RH, T _D , T _W , AH, MR, PVP
LR35WPM	from 34,000 to 60,000	PM1.0, PM2.5, PM10
LR35WPMB	from 26,000 to 60,000	PM1.0, PM2.5, PM10, CO ₂ , P _{ATM}
LR35LWRTC	from 42,000 to 68,000	R, D _R , mV
LR35LWPTC	from 26,000 to 58,000	P, D _P , I _P , CNT, FRQ
LR35LWDPTC	from 24,000 to 52,000	F _L , P _{REL} , P, D _P , I _P
LR35LWS/1TC	from 42,000 to 68,000	T, VWC
LR35LWS/3TC	from 18,000 to 52,000	T, VWC
LR35LWH	from 28,000 to 58,000	
LR35LW-MB	from 14,000 to 52,000	

Symbols of the quantities:

AH: absolute humidity
CNT: number of detected pulses
CO₂: carbon dioxide
D_P: daily rainfall quantity
D_R: daily solar radiation (Wh/m²)
F_L: fluid level
FRQ: frequency of detected pulses
I_P: rainfall rate (mm/h)
MR: mixing ratio
mV: pyranometer output in mV
P: rainfall quantity

ΔP: differential pressure
P_{ATM}: atmospheric pressure
P_{REL}: relative pressure
PM...: particulate matter
PVP: partial vapour pressure
R: solar radiation (pyranometer)
RH: relative humidity
T: temperature
T_D: dew point
VWC: soil volumetric water content

The number of samples depends on the number of stored quantities. A sample consists of all the quantities measured and/or calculated enabled for storing.

Measurement characteristics (except LR35...H) - Instrument in line with sensor

Temperature - NTC Sensor LR35[L]1NTC, LR35[L][1]NTV, LR35[L]1N4r1ZTV, LR35LW1NTC, LR35LWS/xTC	
Sensor	NTC 10 kΩ @ 25 °C
Measuring range	-40...+105 °C (except LR35LWS/xTC) -40...+60 °C (only LR35LWS/xTC)
Resolution	0.1 °C
Accuracy	±0.3 °C @ T=0...+70 °C (except LR35LWS/xTC) ±0.4 °C @ T<0 °C and T>+70 °C (except LR35LWS/xTC) ±0.5 °C (only LR35LWS/xTC)
Stability	0.1 °C/year
Temperature - Pt100/Pt1000 Sensor LR35[G]7P/xTC	
Sensor	Pt100 / Pt1000
Measuring range	-200...+650 °C
Resolution	Configurable 0.1/0.01 °C
Accuracy	±0.1 °C plus the error of the connected probe
Stability	0.1 °C/year
Temperature – Sensor integrated in RH module LR35[G]1NB	
Sensor	PTAT integrated in humidity module
Measuring range	-40...+105 °C
Resolution	0.1 °C
Accuracy	±0.2 °C @ T=0...+60 °C ±(0.2 – 0.05 * T) °C @ T=-40...0 °C ±[0.2 + 0.032 * (T-60)] °C @ T=+60...+105 °C
Stability	0.05 °C/year
Relative Humidity (RH) LR35[L]1[4b]NTC, LR35[L]1NTV, LR35[L]1N4r1ZTV	
Sensor	Capacitive
Measuring range	0...100%
Resolution	0.1%
Accuracy @ T=15...35 °C @ T= remaining range	±1.8% (0...85%) / ±2.5% (85...100%) ±(2 + 1.5% of the measure)%
Sensor operating temperature	-20...+80 °C (LR35...TV) / -40...+150 °C (LR35...TC)
Response time	T ₆₃ <10 s (10→80% @T const., air speed 2 m/s, with filter)
Stability	1%/year (in the whole temperature and RH range)

Relative humidity (RH) LR35[G]1NB	
Sensor	Capacitive
Measuring range	0...100%
Resolution	0.1%
Accuracy @ T=23 °C	±2.5% (0..85%) / ±3.5% (85...100%)
Temperature drift	0.05%RH/K (0...60 °C)
Sensor operating temperature	-40...+105 °C (R.H. max=[100-2*(T-80)] @ T=80...105 °C)
Response time	T ₆₃ <6 s (10→80% @T const., air speed 2 m/s, with filter)
Stability	<1%/year (@ 23 °C and 30...70% RH)
Atmospheric Pressure LR35[L]14bNTV	
Sensor	Piezoresistive
Measuring range	300...1100 hPa
Resolution	0.1 hPa
Accuracy @T=20 °C @T=0...60 °C	±0.5 hPa (700...1100 hPa) ±1 hPa (500...1100 hPa) / ± 1.5 hPa (300...500 hPa)
Stability	±1 hPa/year
Differential Pressure LR35[L]4r1Z, LR35[L]1N4r1ZTV	
Sensor	Piezoresistive
Measuring range	±100 Pa
Resolution	0.1 hPa
Accuracy	±(0.8% measure + 0.5) Pa @ 0...50 °C
Stability	±0.2 Pa with zero self-calibration
Overpressure limit	50 kPa
Compatible media	Only air and non-aggressive dry gases
Pressure inputs	Ø 5.5 mm
Carbon Dioxide (CO₂) LR35[G]1NB, LR35WPMB	
Sensor	Non-dispersive infrared rays (NDIR)
Measuring range	0...5.000 ppm
Resolution	1 ppm
Accuracy	±(50 ppm + 3% of meas.) @ 25 °C and 1013 hPa
Sensor operating conditions	LR35...1NB: 0...50 °C / 0...95%RH non condensing / 950...1100 hPa LR35WPMB: -20...60 °C / 0...95%RH non condensing / 700...1100 hPa
Response time	T ₉₀ <120 s (air speed=2 m/s)
Calibration interval	>5 years (under normal operating conditions)

Particulate Matter (PM) LR35WPM...	
Measuring principle	Laser scattering
Pollutants detected	PM1.0, PM2.5, PM10
Measuring range	0...1000 µg/m ³ (for each pollutant)
Resolution	0.1 µg/m ³
Linearity error	<5%
Repeatability	<3%
Warm up time	<15 s
Temperature drift	<0.01 µg/m ³ /°C
Rainfall quantity (*) LR35LWPTC, LR35LWDPTC	
Sensor	Tipping bucket with NC or NO configurable contact
Resolution	Configurable 0.1 – 0.2 – 0.5 mm/tipping
Solar radiation (*) LR35LWRTC	
Sensor	Thermopile
Measuring range	0...2000 W/m ²
Resolution	1 W/m ²
Sensitivity	Configurable in mV/(kW m ⁻²)
Soil volumetric water content LR35LWS/xTC	
Measuring principle	Capacitive
Measuring range	0...60% VWC (Volumetric Water Content)
Resolution	0.1%
Accuracy	±3 % between 0 and 50% VWC (standard mineral soil up to 5 mS/cm)
Measuring volume	Ø=100 mm x H=150 mm (HP3510.1...) Ø=80 mm x H=110 mm (HP3510.2...)
Sensor working temperature	-40...+60 °C
Level LR35LWDPTC	
Sensor	Sensor of pressure relative to the atmosphere
Pressure measuring range	0...1 bar
Level measuring range	Depends on the fluid density (configurable via software) For water: 0...10 m approx.
Resolution	1 hPa / 0,01 m (for water)
Accuracy	±0.8% f.s. @ 25 °C

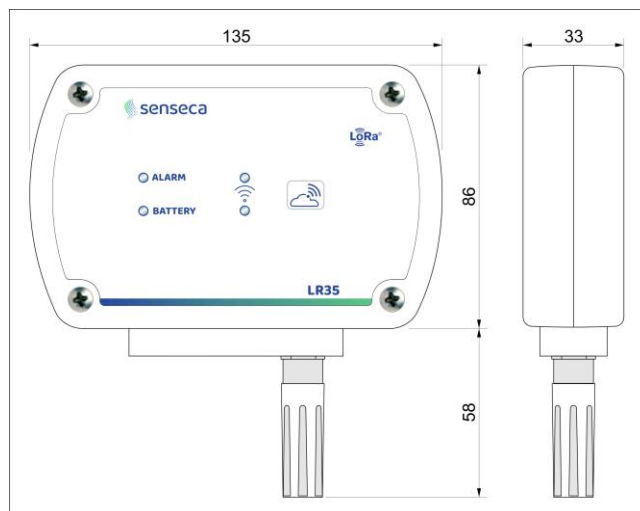
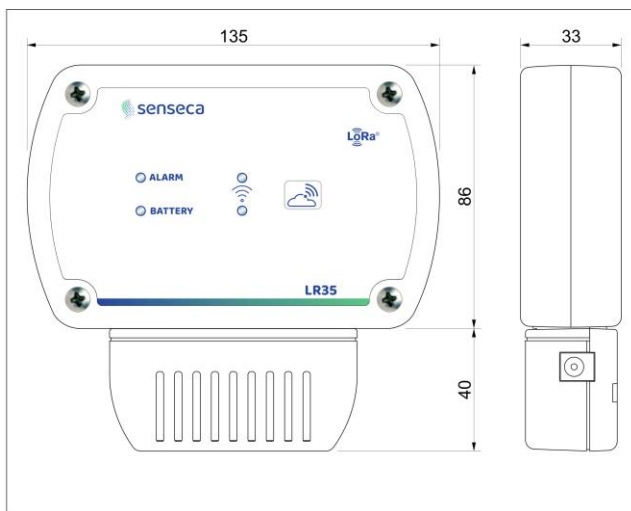
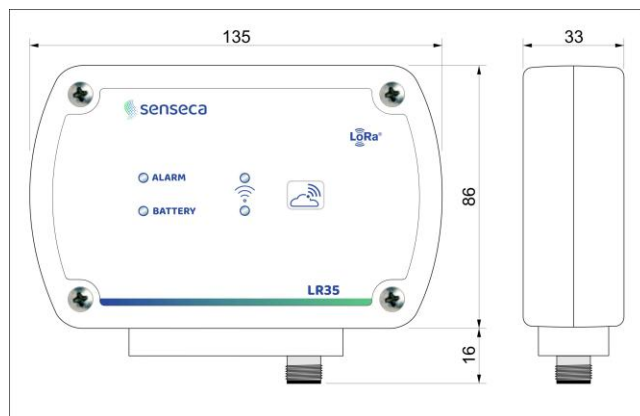
(*) Other characteristics depend on the sensor connected; please refer to the data sheet of the sensor.

LR35...H measurement characteristics

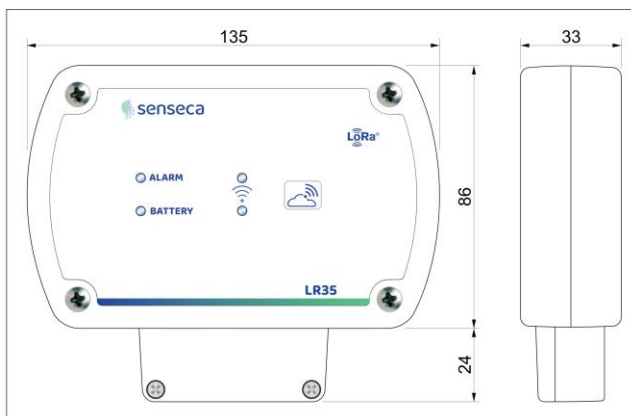
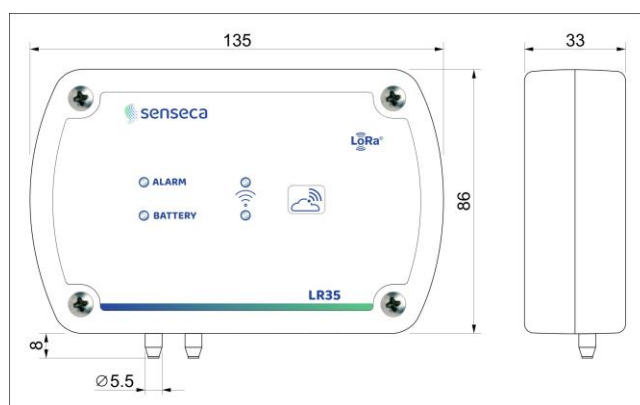
Pt100 / Pt1000	
Measuring range	-200...+650 °C
Resolution	0.1 °C
Accuracy	±0.1 °C (excluding probe error)
Sensor coefficient	$\alpha=0.00385\text{ }^{\circ}\text{C}^{-1}$
Connection	2, 3 or 4 wires
Thermocouple	
Thermocouple type	K, J, T, N, E. The inputs are not isolated, use thermocouples with isolated hot junction.
Measuring range	Type K: -200...+1370 °C Type J: -100...+750 °C Type T: -200...+400 °C Type N: -200...+1300 °C Type E: -200...+750 °C
Resolution	0.1 °C
Accuracy (excluding probe error)	Type K: ±0.1 °C (< 600 °C) Type J: ±0.1 °C ±0.2 °C (> 600 °C) Type T: ±0.1 °C Type N: ±0.1 °C (< 600 °C) ±0.2 °C (> 600 °C) Type E: ±0.1 °C (< 300 °C) ±0.2 °C (> 300 °C)
Current input	
Input range	0...20 mA or 4...20 mA
Shunt resistance	Internal (50 Ω)
Resolution	16 bit
Accuracy	±2 µA
Voltage input	
Input range	0...50 mV, -50...50 mV (only LR35WH), 0...1 V, 0...10 V (only LR35WH)
Input Resistance	100 MΩ
Resolution	16 bit
Accuracy	±0.01% f.s.
Inputs for counting the switchings of a voltage-free contact	
Switching frequency	50 Hz max.
Hold Time	10 ms min.
Potentiometer input	
Potentiometer	Typically 10 kΩ
Resolution	16 bit
Accuracy	±0.01% f.s.

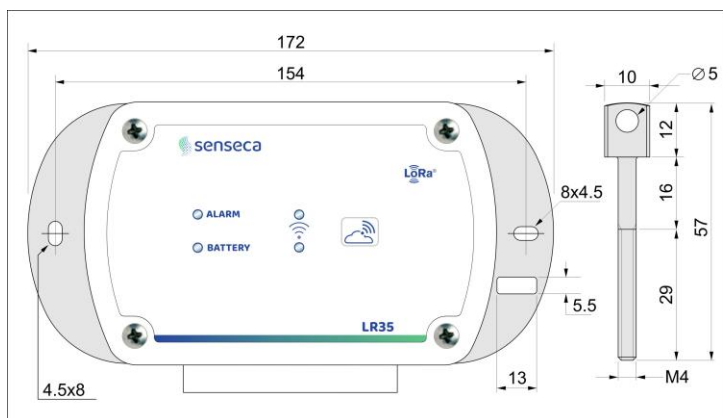
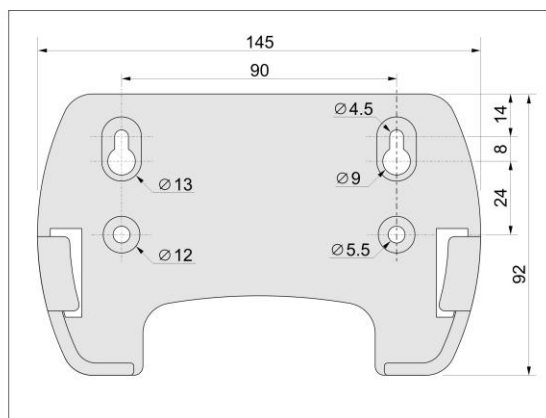
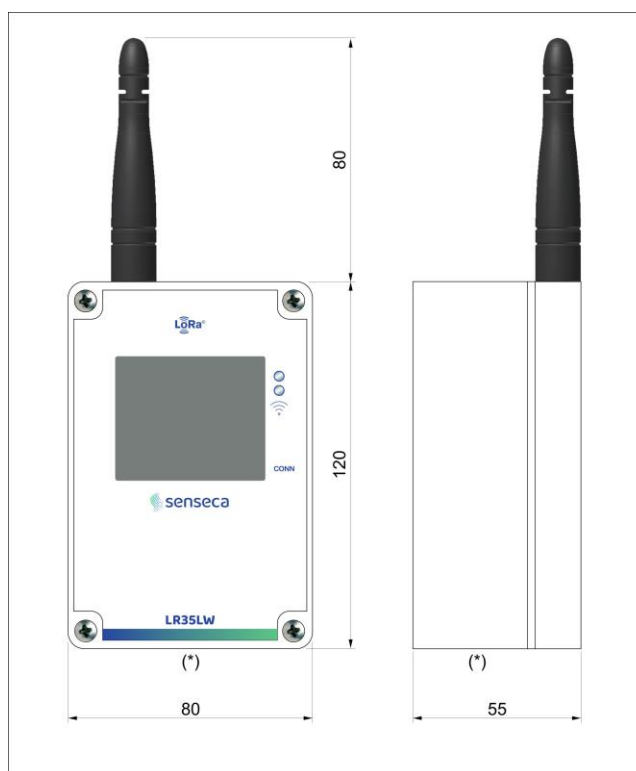
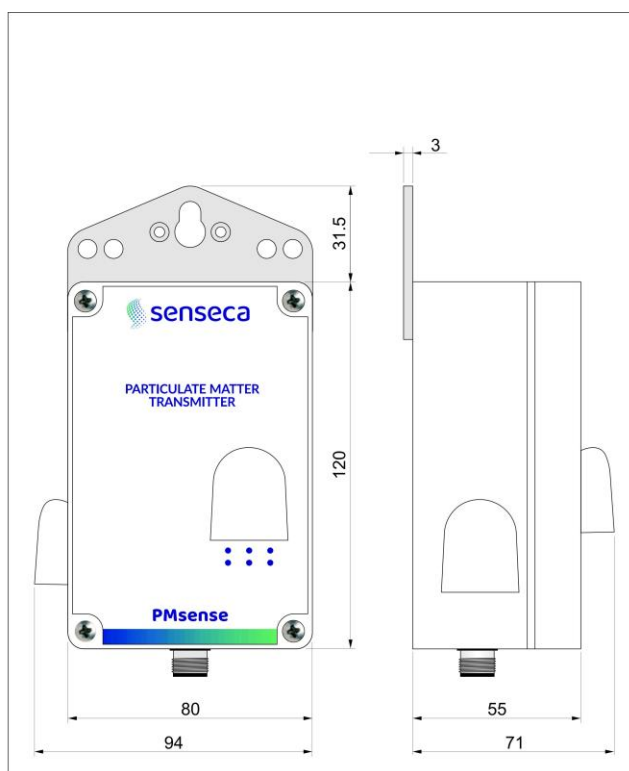
Dimensions (mm)

Indoor models

**LR35...TV****LR351NB****LR35...TC**

The number of connectors depends on model

**LR35H****LR354r...**

**Flanges for fixed installation (HD35.11K)****Support for removable installation****Outdoor models****LR35LW...***(*) Connectors or cable glands depending on model***LR35WPM...**

8 Maintenance

In order to grant measurements high accuracy, it is necessary to clean the external sensor filters periodically. To clean the filter of T/RH sensors, unscrew it and wash it under running water with the help of a brush. Dry the filter and screw it back.

Warning: after removing the filter, be careful not to touch the RH sensor with your hands, so as not to damage it irreparably.

If the RH filter is too dirty to be able to clean, it can be replaced with a new one.

For radiometric probes, keep the sensitive area clean.

Do not use aggressive cleaning agents or incompatible with the materials indicated in the technical specifications. For cleaning the instrument, use a soft dry cloth or slightly dampened with clean water.

9 Safety instructions

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

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:

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

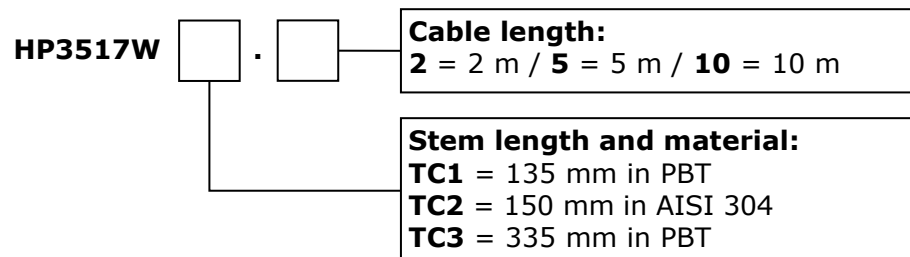
10 Probes and accessories ordering codes

The devices are supplied with battery (if required by the model), HD52.03 wall mount support (only indoor models) and HD35AP-S software (downloadable from website).

External probes, connection cables, external power supplies, other fixing accessories and HD35AP-CFR21 software (for system management in accordance with FDA 21 CFR part 11 recommendations) have to be ordered separately.

Temperature and relative humidity combined probes

HP3517W... Temperature and relative humidity combined probe. NTC Temperature sensor. Ø14 mm. Filter in PBT and stainless steel grid. 4-pole M12 connector.



The outdoor installation of the probe requires HD9007A-1 or HD9007A-2 protection against solar radiations.

The replacement of the probe requires recalibration of the instrument in line with the new probe.

Temperature probes

TP35N1... **NTC** temperature probe. Range -40...+105 °C. Ø5x40 mm AISI 316 tube. 4-pole M12 connector. Cable length 3 m (TP35N1.3/C), 5 m (TP35N1.5/C) or 10 m (TP35N1.10/C).

TP35.1... 4-wire 1/3 DIN **Pt1000** temperature probe. Range -50...+105 °C. Ø5x40 mm AISI 316 tube. Cable ending with free wires (TP35.1.x) or 4-pole M12 connector (TP35.1.x/C). Cable length 3 m (TP35.1.3[/C]), 5 m (TP35.1.5[/C]) or 10 m (TP35.1.10[/C]).

TP35.2... 4-wire 1/3 DIN **Pt1000** temperature probe. Range -40...+105 °C. Ø5x20 mm thermoplastic rubber tube. Suitable for use with chemically aggressive solutions as well. Cable ending with free wires (TP35.2.x) or 4-pole M12 connector (TP35.2.x/C). Cable length 3 m (TP35.2.3[/C]) or 5 m (TP35.2.5[/C]).

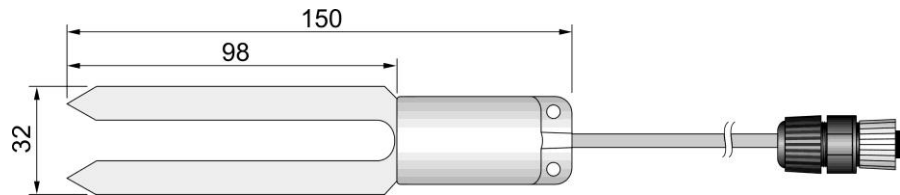
TP35.4... 4-wire 1/3 DIN **Pt100** temperature probe. Range -50...+105 °C. Ø6x50 mm AISI 316 tube. Cable ending with free wires (TP35.4.x) or 4-pole M12 connector (TP35.4.x/C). Cable length 3 m (TP35.4.3[/C]) or 5 m (TP35.4.5[/C]).

TP35878ISS... 4-wire 1/3 DIN **Pt100** contact temperature probe for solar panel. Range -40...+85 °C. Aluminum disk Ø30 x 7.5 mm. Cable length 5 m (TP35878ISS.5) or 10 m (TP35878ISS.10). Cable ending with 4-pole M12 connector.

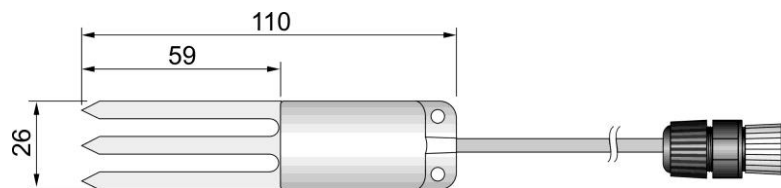
TP35K6.5 **K-thermocouple** temperature probe. Isolated junction. Class 1 according to IEC 60584-1. Range -50...+750 °C. Ø3x150 mm AISI 316 tube. Cable length 5 m. Cable ending with free wires.

Soil volumetric water content sensors

HP3510.1... 2-electrode probe for measuring the soil volumetric water content. With integrated NTC temperature sensor. IP 67. 5 m (HP3510.1.5) or 10 m (HP3510.1.10) cable with 5-pole M12 connector.



HP3510.2... 3-electrode probe for measuring the soil volumetric water content in restricted volumes. With integrated NTC temperature sensor. IP 67. 5 m (HP3510.2.5) or 10 m (HP3510.2.10) cable with 5-pole M12 connector.



Other sensors

For rain gauges, anemometers, pyranometers and other radiometric sensors, please visit [Senseca website](http://Senseca.com).

Accessories

CP23	Direct USB connection cable with mini-USB male connector on the instrument side and A-type USB male connector on the PC side.
HD35.11K	Pair of flanges in anodized aluminum alloy with lock pin for padlock, for fixed installation of indoor models.
HD35.24W	Flange in anodized aluminum alloy for fixing to the wall the outdoor models.
HD35.24C	HD35.24W flange with U-bolt for fixing to a Ø35...44 mm mast.
HD35.24C5	HD35.24W flange with U-bolt for fixing to a Ø35...60 mm mast.
HD9007A-1	12-ring protection against solar radiations, with support bracket.
HD9007A-2	16-ring protection against solar radiations, with support bracket.
HD75	Saturated solution to check Relative Humidity probes at 75% RH, includes ring adapter for Ø14 mm probes, thread M12×1.
HD33	Saturated solution to check Relative Humidity probes at 33% RH, includes ring adapter for Ø14 mm probes, thread M12×1.
HD11	Saturated solution to check Relative Humidity probes at 11% RH, includes ring adapter for Ø14 mm probes, thread M12×1.

Spare parts

HD35-BAT2	3.6 V size A Li-SOCl ₂ non rechargeable battery, Molex 5264 2-pole connector. For all models powered by Li-SOCl ₂ battery except LR35LWDPTC, LR35LWPTC, LR35LWRTC, LR35LWS/xTC, LR35LWH.
BAT-2013DB	3.6 V size C Li-SOCl ₂ non rechargeable battery, 2-pole Molex 5264 connector. For LR35LWDPTC, LR35LWPTC, LR35LWRTC, LR35LWS/xTC, LR35LWH.
HD35.03	Plastic wall support for indoor models.

Approvals

Sub-GHz certifications:

Models LR35....**U/.AU** contain transmitter module FCC ID: VPYCMABZ
IC ID: 772C-CMABZ
ANATEL: 05650-18-08488

Models LR35....**AS** contain TELEC certified RF module: [R] 001-P01026



FCC and IC notices

Caution: changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

Notice: This device complies with Part 15 of the FCC Rules and with Industry Canada (IC) licence-exempt RSS standard(s). Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

Avis: Cet appareil est conforme avec Part 15 des règlements FCC et Industrie Canada (IC) RSS standard exempts de licence(s). Son fonctionnement est soumis aux deux conditions suivantes: (1) cet appareil ne peut pas provoquer d'interférence et (2) cet appareil doit accepter toute interférence, y compris les interférences qui peuvent causer un mauvais fonctionnement du dispositif.

Notice: To satisfy FCC/IC RF exposure requirements for mobile and base station transmission devices, a separation distance of 20 cm or more should be maintained between the antenna of this device and persons during operation. To ensure compliance, operation at closer than this distance is not recommended. The antenna(s) used for this transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.

Avis: Pour répondre aux exigences d'exposition RF FCC/IC pour les dispositifs de transmission mobiles et les stations de base, une distance de séparation de 20 cm ou plus doit être maintenue entre l'antenne de l'appareil et des personnes en cours de fonctionnement. Pour assurer la conformité, l'exploitation de plus près à cette distance n'est pas recommandée. L'antenne(s) utilisé pour cet émetteur ne doit pas être co-localisés ou fonctionner conjointement avec une autre antenne ou transmetteur.

Notice: Under Industry Canada regulations, this radio transmitter may only operate using an antenna of a type and maximum (or lesser) gain approved for the transmitter by Industry Canada. To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropically radiated power (e.i.r.p.) is not more than that necessary for successful communication.

Avis: Conformément à la réglementation d'Industrie Canada, le présent émetteur radio peut fonctionner avec une antenne d'un type et d'un gain maximal (ou inférieur) approuvé pour l'émetteur par Industrie Canada. Dans le but de réduire les risques de brouillage radioélectrique à l'intention des autres utilisateurs, il faut choisir le type d'antenne et son gain de sorte que la puissance isotrope rayonnée équivalente (p.i.r.e.) ne dépasse pas l'intensité nécessaire à l'établissement d'une communication satisfaisante.

NOTES

WARRANTY

The manufacturer 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.

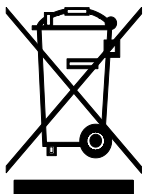
The manufacturer repairs the products that show defects of construction in accordance with the terms and conditions of warranty included in the manual of the product. For any dispute, the competent court is the Court of Padua. The Italian law and the "Convention on Contracts for the International Sales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

We reserve 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.



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