EGOpro

Safe MOVE 4.0

Use and Installation Manual

(V01)

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1 TABLE OF REVISIONS

Date	Rev.	Notes
22/11/2019	01	Draft of new full version with modules

2 CONFORMITY

The manufacturer, Advanced Microwave Engineering Srl, hereby declares that the type of radio equipment P LX HUB SR, PLX TAGSAFETY 3T, PLX TAGSAFETY 3TH, P LX SAFEMOVE DIS, P LX SAFEMOVE CPU, PLX SAFEMOVE HUB 4, PLX SAFEMOVE HUB 4M, PLX SAFEMOVE SENS 4, PLX SAFEMOVE SENS 4M complies with the **RED directive 2014/53/EC.** The full text of the EU Declaration of Conformity is available on the following Internet address:
http://www.ameol.it/en/declaration-of-conformity/

3 SAFETY INSTRUCTIONS

3.1 DISPOSAL

Treatment of the electrical or electronic device at the end of its service life (applicable in all European Union countries and in other European Countries with waste sorting system) This symbol indicates that the product must be taken to a suitable collection point for recycling electrical and electronic equipment.
The EGOpro Safe MOVE 4.0 System is a set of electrical and electronic equipment
By making sure that this product is correctly disposed of, you will contribute to preventing potential negative consequences for the environment and for health that would otherwise be caused by its improper disposal. Recycling these materials helps to preserve natural resources. For more detailed information about how to recycle this product, contact the municipal office or the local waste disposal service. In case of unauthorised disposal of electrical and/or electronic equipment, the penalties foreseen by the applicable regulations could be applied (valid only for Italy).

3.2 LIMITATIONS FOR USE

Upon installing the system in industrial vehicles, strictly follow the instructions given by the manufacturer of the vehicle contained in the manual (electrical and mechanical connections, etc.). Only duly trained personnel must install the system. The forklift truck should not be modified in such a way as to render the Declaration of Conformity null and void.
If the installation does to comply with the instructions contained in the manufacturer's manual, AME shall not be held liable for any damage to the vehicle or its poor performance.
The EGOpro Safe MOVE 4.0 system (the Product) is a safety supporting tool to prevent man-vehicle and vehicle-vehicle collisions. This is not a personal safety system.
This system has been designed to offer an additional aid for driving. While driving, the driver's total attention is always required. The driver must always be ready to react- act on the brakes and turn the steering-wheel- in order to avoid possible collisions. The EGOpro Safe MOVE 4.0 system does not replace the driver's attention and judgement or need to slow down or brake in case of danger, and it does not exonerate the purchaser and the driver from adopting the usual safety procedures expected.
The control of the vehicle is still under the driver's responsibility, who must always assess the current conditions in which the vehicle moves, paying attention to the presence of pedestrian workers, other vehicles, and obstacles in general.

In no case shall AME be held liable for direct or indirect damage of any kind (personal injuries or damage to objects) suffered for any reason whatsoever by the Purchaser or by third persons due to the use of the Product.

The EGOpro Safe MOVE 4.0 system is a product for professional use, and it may not be used in places frequented by children.

3.3 STATEMENTS FOR THE USE IN NORTH AMERICA

This device complies with part 15 of the FCC Rules. 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.

NOTE: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:
—Reorient or relocate the receiving antenna.
—Increase the separation between the equipment and receiver.
—Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
—Consult the dealer or an experienced radio/TV technician for help.

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

3.3.1 Statements for PLXSAFEMOVESENS4 and PLXSAFEMOVESEN4M.

This product complies with FCC and ISED radiation exposure limits set forth for an uncontrolled environment. The antenna should be installed and operated with minimum distance of 20cm between the radiator and your body.

4 INTRODUCTION

4.1 INTENDED USE

The EGOpro Safe MOVE 4.0 System is a safety supporting system that is used for detecting the presence of pedestrian workers and vehicles equipped with suitable devices. When either are detected, sound and visual signals are generated, to which the I/O that are present in the system can be associated.

4.2 SYMBOLS

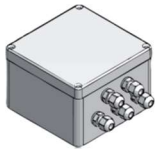
Symbol	Description
	DC or AC voltage
	DC voltage
	Symbol no. 5031 of IEC 60417 is used to indicate, on the identification plate, that the equipment may only be used with direct current.

5 BASIC KIT COMPONENTS

The EGOpro Safe MOVE 4.0 basic kit consists of:

✓ **1** **P LX SAFEMOVE DIS** - Display with cable (plate and joint included)

✓ **3** **P LX SAFEMOVE SENS4** - SAFE MOVE 4.0 multifunction sensor.



✓ **1** **P LX SAFEMOVE HUB4** - HUB SAFEMOVE 4.0.

✓ **1** **P LX SAFEMOVE CPU** - CPU for SAFE MOVE. (plate and joint included)

GENERAL CONSUMPTION VALUES

- Consumption to the Hub up to 3 sensors 20W
- Consumption of CPU with active display 15W
- Consumption of CPU with display on standby 1W

6 SYSTEM OPERATION

The solution offered by the EGOpro Safe MOVE 4.0 proximity warning & alert system minimises the potential for accidents between forklifts and operators on foot in common working areas. Through visual and sound alarms, the system warns the driver, in real time, of the presence and position of pedestrian workers wearing active PPE who enter the danger zones around the vehicle in motion.

With the system, the driver can promptly take the most appropriate safety measures to avoid hitting other pedestrian workers or other vehicles.

Thanks to a multifunction sensor, the system detects pedestrian workers wearing a TAG, in two stages:

6.1 PEDESTRIAN WORKER PRE-WARNING

PRE-WARNING| The activation range can be configured up to 50 m with the control of a relay contact.

By means of a visual and sound alarm, the system warns the driver about the presence and position of the pedestrian worker.

6.2 PEDESTRIAN WORKER WARNING

WARNING| The activation range can be configured up to 5-m with the control of a contact relay.

By means of a visual and sound alarm, the system warns the driver about the presence of the pedestrian worker with a red circle and by switching on the lateral LEDs.

6.3 VEHICLE-VEHICLE WARNING

VEHICLE-VEHICLE WARNING| When a vehicle equipped with the EGOpro Safe MOVE 4.0 system gets into the sensor activation area. The activation range can be configured up to 100 m.

By means of a visual and sound alarm, the system warns the driver about the presence and position of the other vehicle.

7 PLACING TAGS

7.1 HELMET TAG FITTING

To fit the PLX TAGSAFETY 03TH Tag, you first need to clean the helmet. Then, you have to suitably remove the grease from the surface with the napkin supplied. Now you can affix the Tag as shown in the figure.

7.2 WEARABLE TAG ACCESSORIES

The wearable Tag is supplied together with a series of accessories that guarantee a wide range of options for wearing it.

Clip for band

Use the screws supplied: 2.2 X7

Slot for strap

Use the screws supplied: 2.2 X6

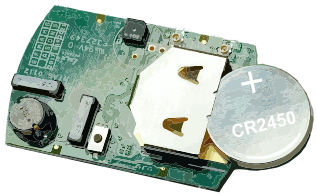
Snap fastener

Use the screws supplied: 2.2 X7

7.3 PROCEDURE FOR CHANGING THE BATTERY

The battery inside the Tag is a CR2450 button cell battery.
To replace it, remove the yellow rubber piece, and then replace the battery.

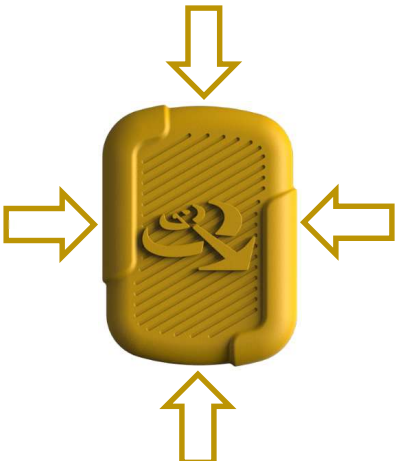
> Caution: respect the correct polarity; insert the battery with the negative pole towards the circuit.
> While replacing the battery in the helmet tag, be careful not to damage or disconnect the small coaxial cables connected to the circuit board.



Once the battery has been replaced, make sure that the Tag has turned on correctly. Depending on the version, it can emit a long initial sound followed by three short sounds, or only one long flash followed by three short flashes of the LED on the board.
If this does not happen, the device has not started correctly; contact the manufacturer.

Put the tag back into the slot at the correct position as shown in the figure opposite.

Position the soft rubber piece back into place, and then press it in all directions so that it correctly adheres to the rigid piece.



Battery life depends on the daily activations of the tag when it is near a vehicle equipped with the anti-collision system.

Typically, there are three identified scenarios; the following table summarises the battery life associated to each of them:

Type of scenario	***Estimated duration in years***
Driver use*	1.5
Pedestrian worker with high interference with vehicles	2
Pedestrian worker with low interference with vehicles	3/5

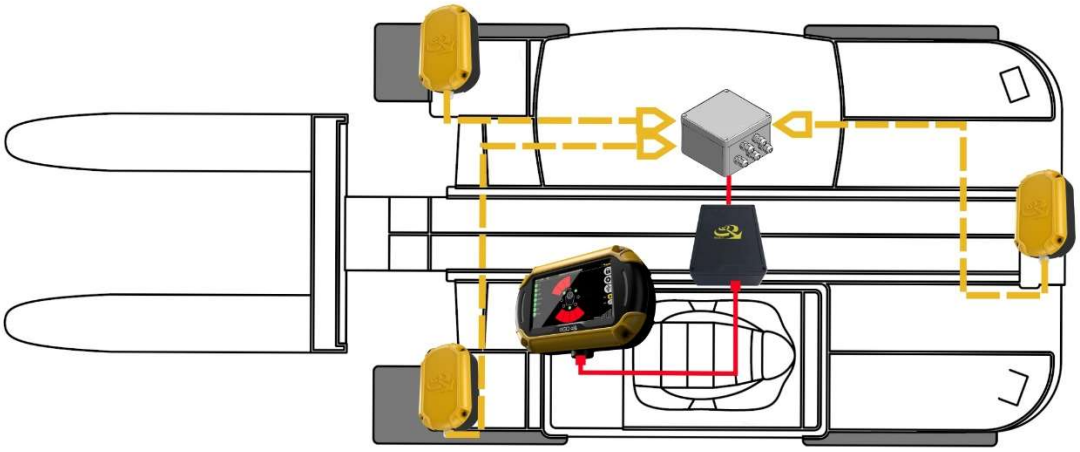
**Equipped with an inhibitor in the cabin (FILTERSENS)*

8 INSTALLATION ON THE VEHICLE

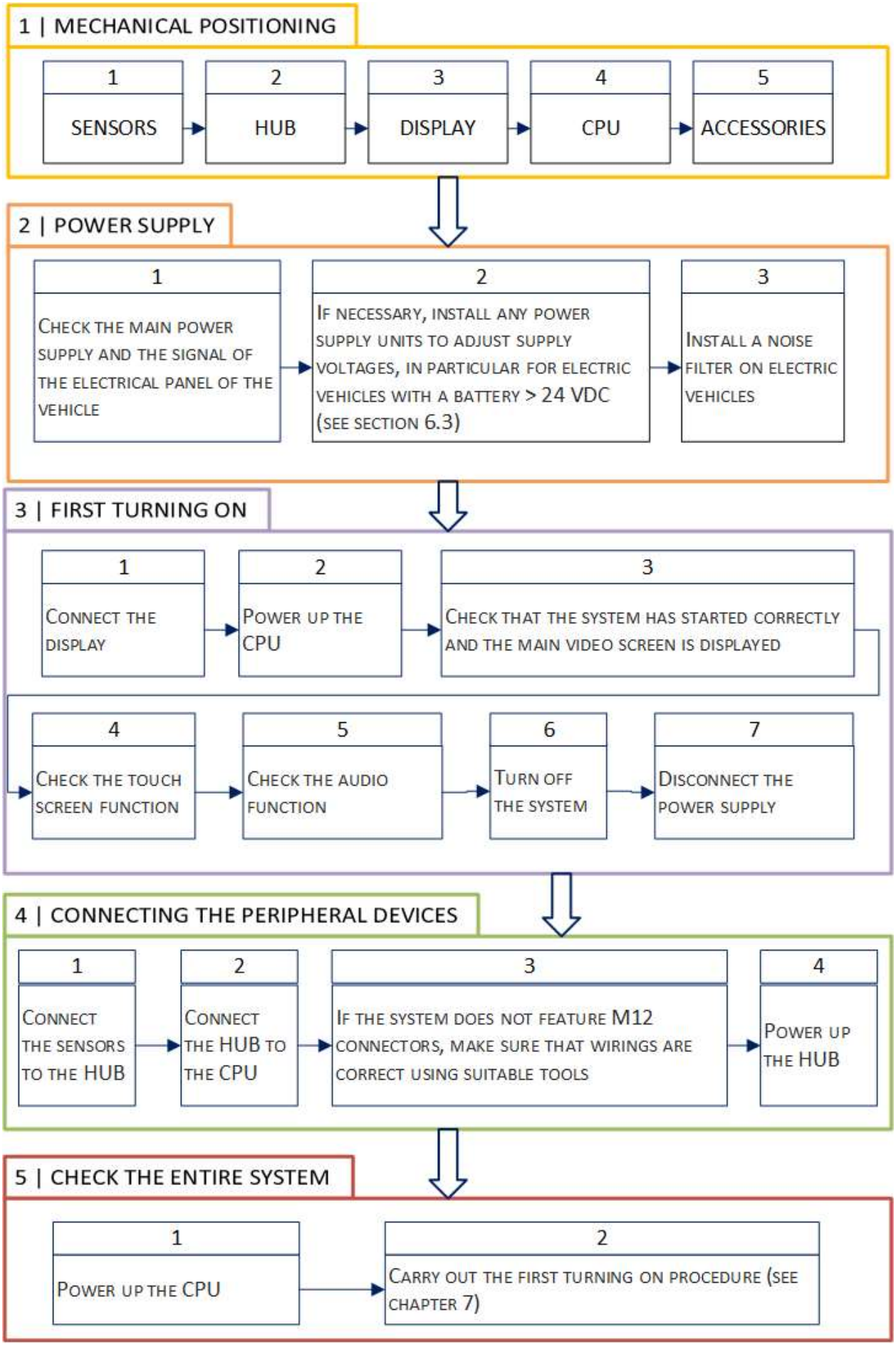
8.1 SYSTEM ARCHITECTURE AND GENERAL INSTRUCTIONS

The basic KIT of the EGOpro Safe MOVE 4.0 system that is installed on the vehicle consists of the following devices:

- ✓ **3 Sensors**
- ✓ **1 HUB**
- ✓ **1 CPU**
- ✓ **1 Display**



It is advisable to follow the workflow indicated in the following table and described in detail in the subsequent sections in order to minimise installation problems.



8.2 POSITIONING THE DEVICES

To position the devices, take into account the operation characteristics of the system, the mechanical restrictions and the IP protection degree of the devices.
For these reasons, two categories are identified:

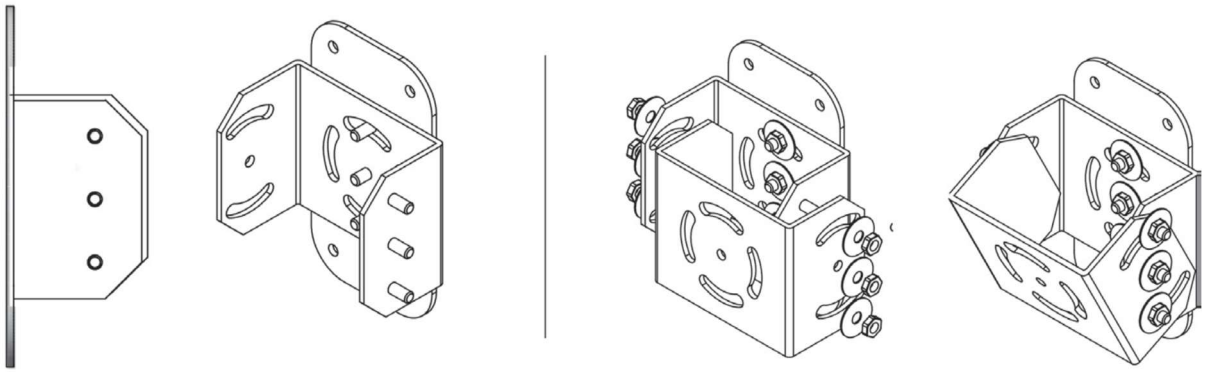
- ✓ **Devices outside the driver's cabin**
  - **Sensors** are usually positioned outside the driver's cabin, except for exceptional cases such as exposure to high temperatures.
- ✓ **Devices inside the driver's cabin**
  - **CPU** and **Display**: due to their function and the IP protection degree, they must be inside the driver's cabin or, in any case, in a protected position.

The **HUB** can be positioned either outside or inside the driver's cabin due to both its operation and its high degree of protection.

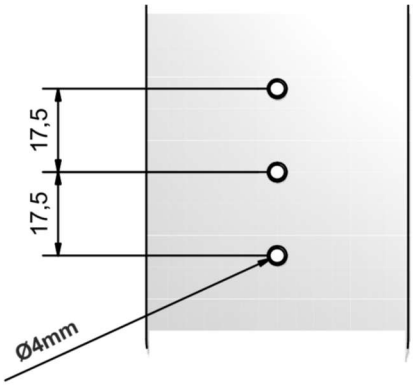
> ⚠ The 433MHz whip aerial antenna, which is present on the HUB, must be fitted outside

The **Display** and the **Sensors** must be correctly oriented: for this reason, they are supplied with a mounting plate and a mechanical joint onto which the support that is necessary for holding the device must be fitted.

The joint, which is made up of 2 U-shaped mechanical pieces, has been designed to be easily connected to the plate that is present on the devices.



Find below the heights for the possible holes to be used for fixing it to the plate.



8.2.1 Positioning the control unit (CPU)

The CPU is the basic element of the system and it can be positioned at any point inside the driver's cabin. The position of the CPU must not obstruct the driver’s and the vehicle operability, and it should be handy to connect the HUB and the Display.
To fix the CPU, use the 4 holes on the box that can be accessed by removing the device cover.

When choosing the position, keep in mind that there are usable outputs on the CPU to make it conveniently accessible and not to be obstructed during assembly. For example, the USB port can be used to download data and for servicing.

The CPU has an IP 20 protection degree, and the connection cable is 2.50 m long.

8.2.2 Positioning the Display

The Display must be positioned inside the driver's cabin in accordance with the driver's visibility requirements and taking into account the CPU position: **the connection cable between Display and CPU is 2.5 m long**.

When installing the Display and laying the connection cable, be careful so that they do not disturb the driver' movements and the driver's visibility remains unaffected.

The Display has an **IP 20** protection degree. Position it in the cabin, in an area protected from the elements.

The cable that carries the video signal from the CPU to the Display is double-shielded; therefore, handle the cable carefully and avoid bending radii of less than **5 cm** in order to avoid damaging the internal conductors, in particular the ends on the connector side and the Display housing inlet.

If the display is mounted upside down to facilitate installation, the rotation of the video can be changed from the advanced settings of the system (contact technical support for help).

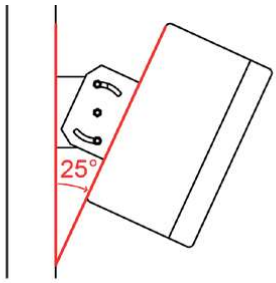
8.2.3 Positioning the sensors

The basic Kit is made up of 3 sensors that are sufficient to cover small and medium-sized vehicles. The installation must optimise coverage around the vehicle taking into account the type of mobility of the vehicle.
The most common installation includes 2 Sensors on the front/loading side, driven forward, and 1 Sensor on the rear side/driven in reverse.
NOTE: the number of sensors can be extended up to 8 by adding suitable components (see section 8.5).

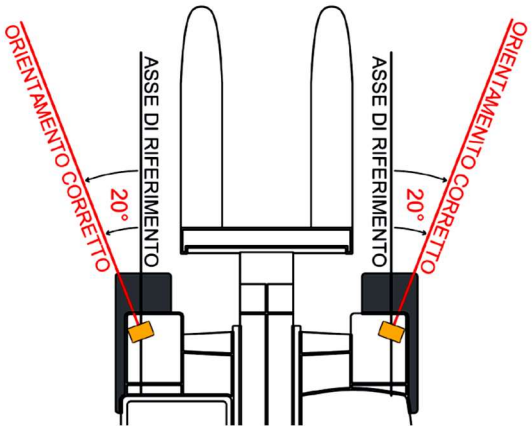
Find below the reference diagram for a counterbalanced forklift truck.



The sensors must be so positioned on the perimeter of the vehicle to have maximum visibility between Sensors and TAG. On small/medium-sized vehicles, they are usually positioned on the uprights immediately below the roof and with a 25 ° downward inclination.



NOTE: the mechanical joint supplied can be used to obtain the desired inclination.
Front sensors must have a slight orientation towards the outside. For example, for a counterbalanced vehicle, they must be positioned outside the moulding of the fork/gripper holder mounting, and they must have an orientation angle towards the outside of around 20°.



Be careful not to place the sensors behind obstacles such as the turret of the forks or the vehicle chassis.
For the best operation of the sensors, they must be installed in areas that are as free as possible.

8.2.4 Positioning the HUB

The HUB can be positioned at any point inside or outside the driver's cabin, even in a hidden area, but the external RF antenna (whip aerial antenna), connected to the HUB by means of a 1.5m-long cable, must be outside the driver's cabin in vertical position.

To position the external antenna, also refer to the HUB connections (see section 8.3.4).
The position of the HUB must not obstruct the driver's and the vehicle operability, and it should be handy to connect the Sensors and the CPU.

8.3 CONNECTIONS

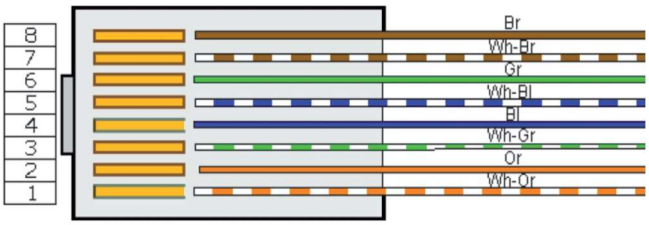
8.3.1 General instructions

The necessary connections on the systems can be summarised in two categories:

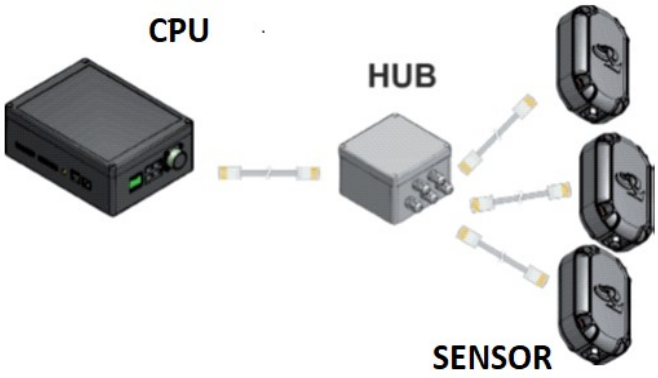
- ✓ **Data Connections**
- ✓ **Power Supply Connections**

Data Connections

The data connection between the system devices is established with a UTP cable. As a minimum requirement, it is recommended to use a UTP cable belonging to category 5E or higher. In the case of RJ45 connections, the same sequence of colours must be followed on each cable end, and it is recommended to use the sequence of colours according to Standard TIA/EIA-568-B.



The data connection is between Hub-CPU and between Sensors-Hub.

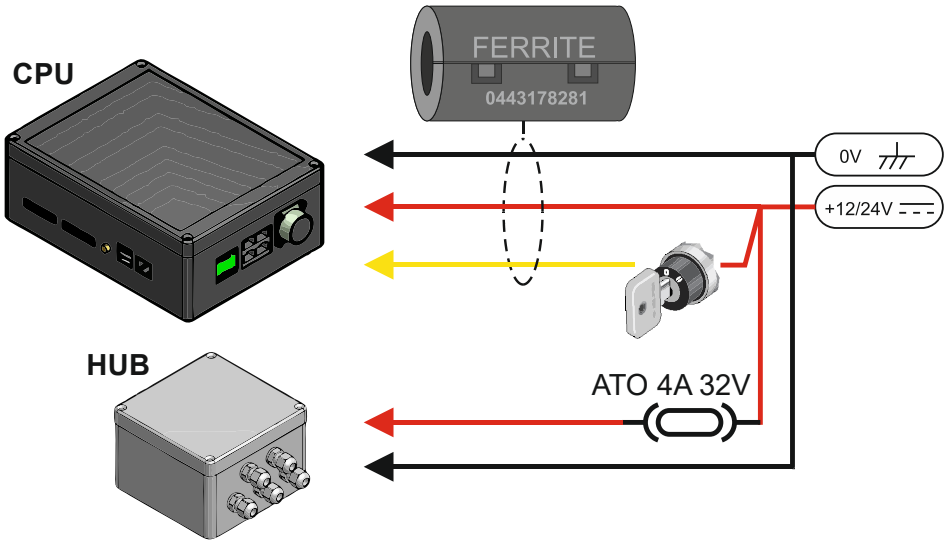


The maximum length of the connection depends on the supply voltage of the system and on the cross section of the UTP cable (AWG). For convenience purposes, the reference tables of both connections are provided.

	CPU-HUB Connection				HUB-SENSOR Connection	
VDC	**AWG 26**	**AWG 24**		**VDC**	**AWG 26**	**AWG 24**
12 V	20m	40m		**12 V**	3m	6m
24 V	50m	100m		**24 V**	25m	50m

Power Supply Connection

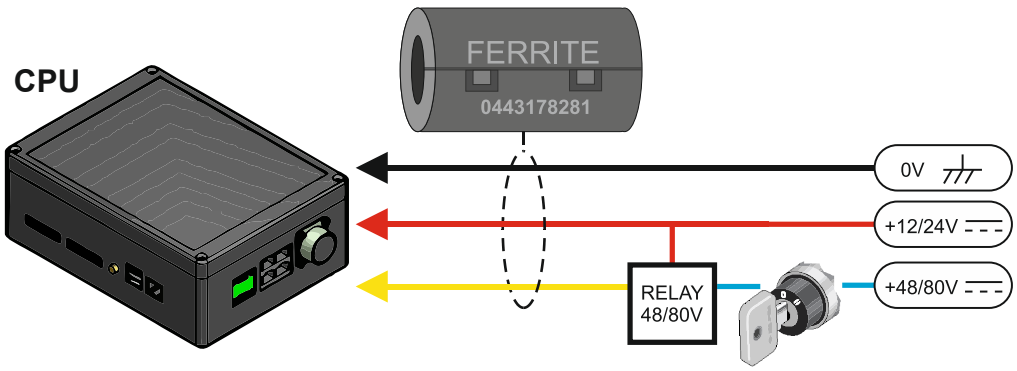
The system must be powered in direct current (VDC) ranging from 12V to 24V (±10%).
The devices to be powered are the CPU and the HUB. A direct positive wire (VIN) and a positive wire under key (VQ) must arrive to the CPU, whereas only the direct positive wire protected by an ATO fuse (4A/32V) must arrive to the Hub.
Apply the supplied Fair Rite 0443178281 ferrite on the CPU power cables.



For the power supply connections, it is recommended to use an AWG 18 /0.75mm^2 cable or a cable with a higher cross section.

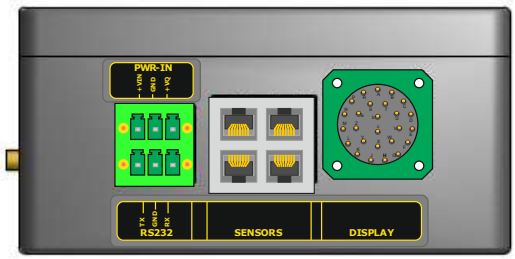
Within the 12÷24 VDC power supply range, the voltage of the direct positive wire (V_{IN}) and of the line under key (V_Q) do not have to be the same.
In some cases, the voltage present on the wire under key is not within the range foreseen by the system. In these cases, one solution would be using a relay at the same voltage available for changing over the forward voltage

For vehicles with a battery with power higher than 24V, such as electric vehicles for heavy work with 48V or 80V, follow the power supply scheme specified in chapter 24.6; use the indicated isolated power supply unit or an equivalent model whenever possible.



8.3.2 CPU Wiring

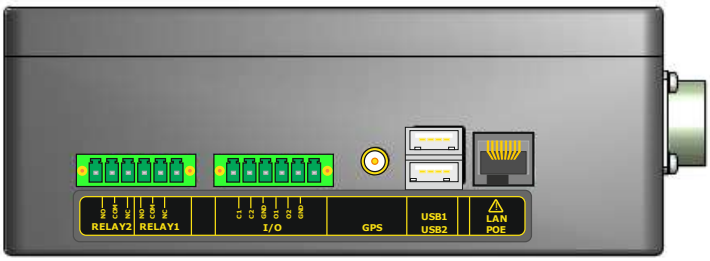
All the devices of the system must be connected to the CPU.
The available connectors are as follows:



Power supply /turning-on
RS 232

HUB Sensors (RJ45)

Display connector



Relay

I/O

GPS

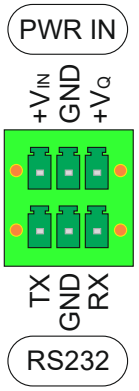
USB

LAN POE

Power supply/turning-on	To power the CPU and some of the accessories that can be installed
RS 232	To connect the BADGE module
SENSORS	To connect the HUB and other accessories of the system (FILTER SENS, INDOOR SPEED SENSOR, SHOCK SENSOR)
Display Connector	To connect the display, the touchscreen and the audio
Relay	Clean contacts to connect to the vehicle
I/O	I/O signals for managing additional functions
GPS Antenna	To connect the antenna of the GPS module (if any)
USB	To connect peripherals devices for downloading data/updates/maintenance
POE LAN	To connect the Wi-Fi Module and the cellular router

Caution: this is a POE 10/100 LAN port, mode B, "DC on spares" and therefore, it must not be used with devices that are not suitable for this type of connection (e.g., notebooks, Ethernet switch, etc.)

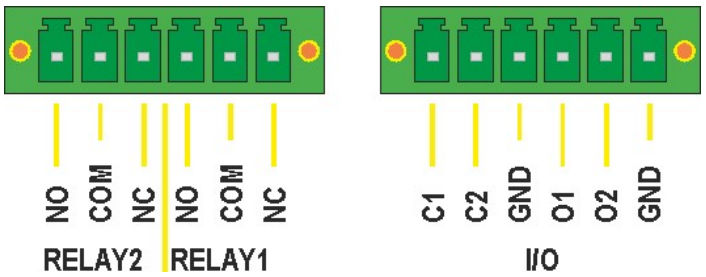
The CPU is powered at 12-24V, and it needs a specific $+V_Q$ line (under key). The CPU remains turned on even when the vehicle is off in low consumption mode (stand-by). Activation takes place when voltage is supplied to the V_Q terminal. This enables a quick turning-on of the system.



+VIN	12/24 VDC power supply
GND	Negative supply voltage
+VQ	12/24 VDC positive voltage of the turning-on signal of the board

To connect the HUB, an UTP cable belonging to Cat. 5e or higher must be connected to one of the Sensors ports.

The CPU has 2 relays that can be controlled independently. There are 3 pins for each relay:
- NO | normally open
- C | common
- NC | normally closed.



The default configuration indicates that:

- **Relay 1** (RL1) remains active until the system detects one or more TAGs in the long-range detection area, i.e. in pre-Warning.
- **Relay 2** (RL2) remains active until the system detects one or more TAGS in the short-range detection area, i.e. in Warning.

The configuration of the relays can be modified from the advanced settings of the system (contact technical support for help).

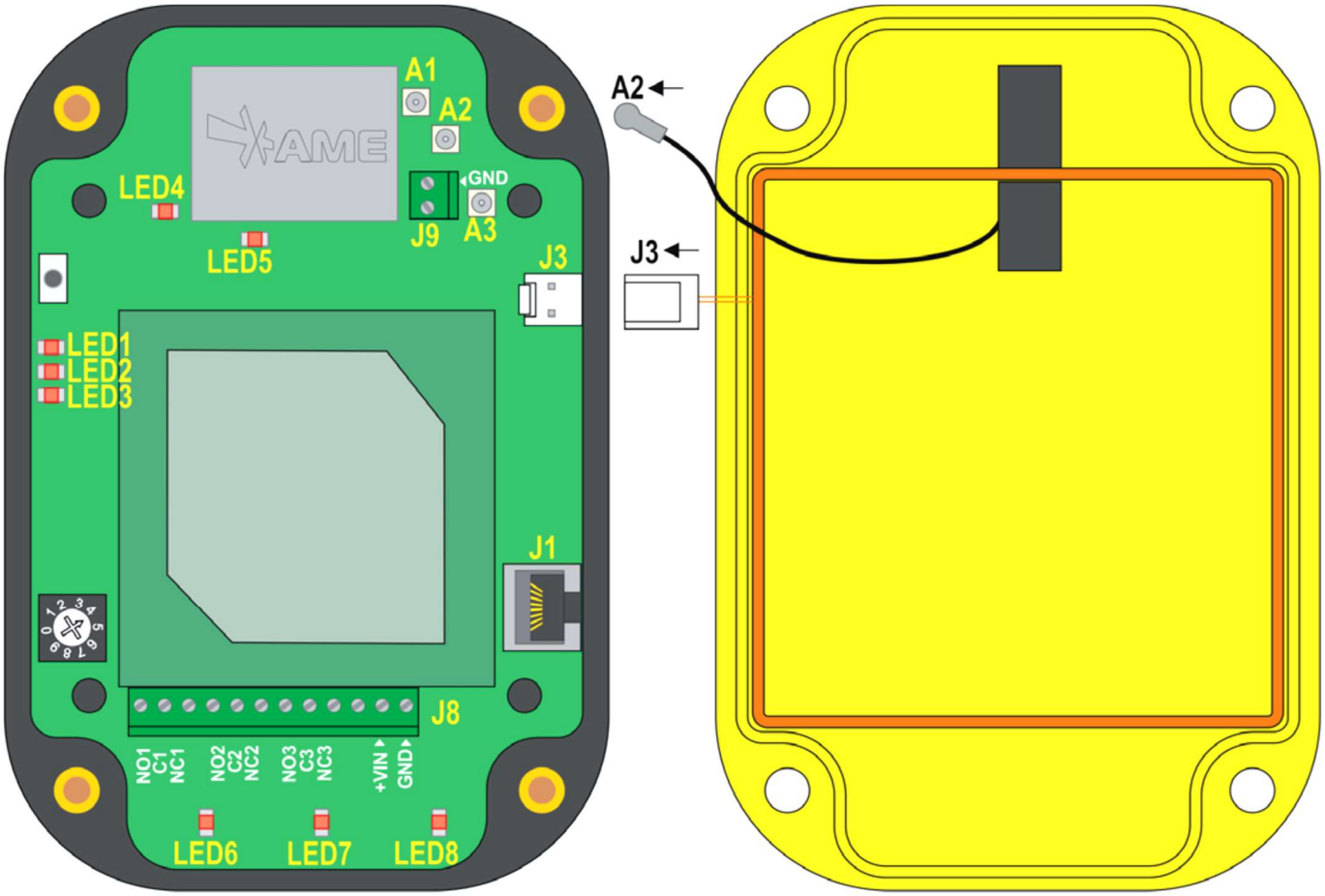
8.3.3 Connecting sensors

The sensors are connected to the HUB with 8 poles UTP cables. The maximum connection length is linked to the supply voltage and the type of cable

	AWG 26	**AWG 24**
12 V	3m	6m
24 V	25m	50m

Figure 1 Maximum length of the HUB sensor connection cables according to the type of cable and the power supply

The UTP cable must be connected to the J1 connector inside the sensor box with an RJ45 connector.



A1 – MW transmission antenna uFL connector (antenna already connected)
A2 – MW reception antenna uFL connector (antenna to be connected)
A3 – RF test uFL connector
J9 – RF antenna connector (antenna already connected)
J3 – LF antenna connector (antenna to be connected)
J1 – data BUS and power supply connector
J8 – relay terminal board and stand-alone power supply

LED1 – vehicle-vehicle reception signal (flashing)
LED2 – LF transmission (flashing) and diagnosis error (steady off)
LED3 – ON status indicator
LED4 – MW status indicator (flashing) and diagnosis error (steady off)
LED5 – RF status indicator (flashing) and diagnosis error (steady off)
LED6 – Relay 1 active/inactive (ON/OFF)
LED7 – Relay 2 active/inactive (ON/OFF)
LED8 – Relay 3 active/inactive (ON/OFF)

While the sensor is closing back, make sure that the A2 and J3 connectors are connected; prevent the cables from finishing above the patch antenna (central panel of the figure on the left). Make sure that the sealing O-ring is placed back in its housing.

Immediately after the UTP cable comes out of the box, insert a 74271132S ferrite or an equivalent type.

8.3.4 Connecting the HUB

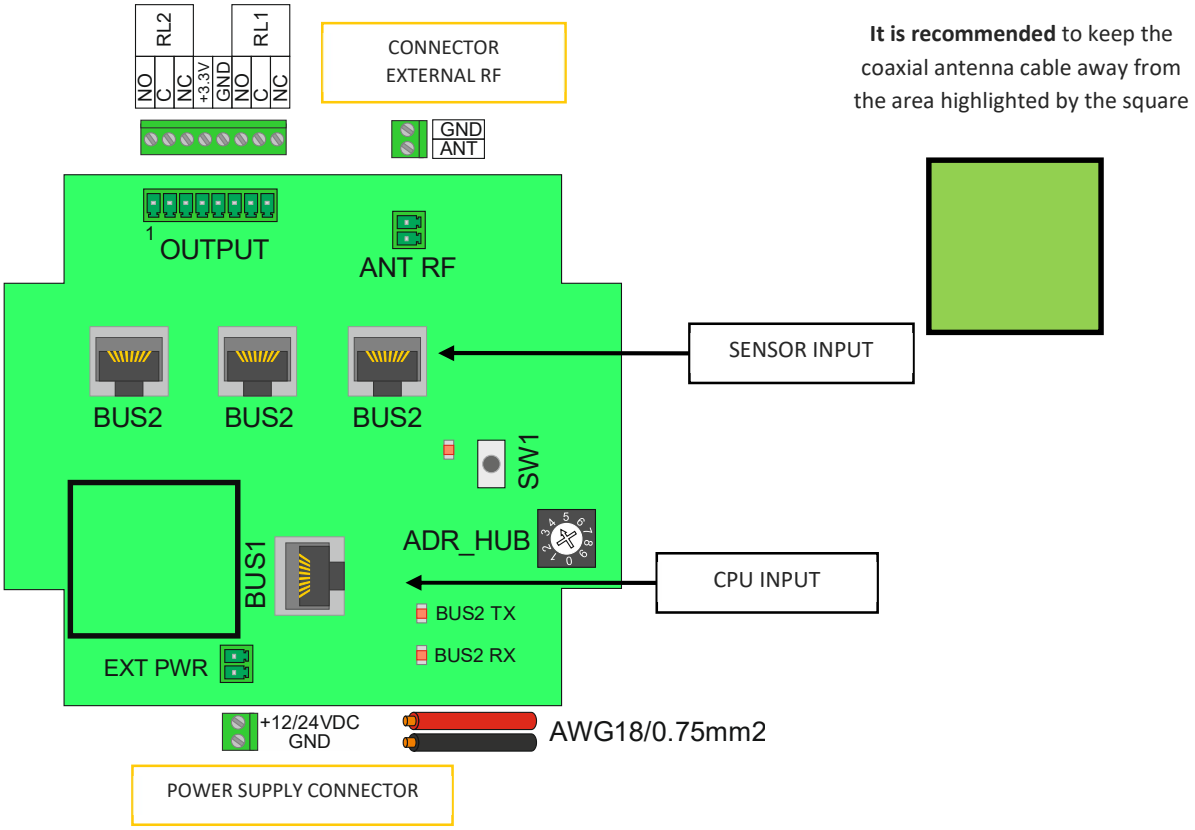
Connect the sensors to BUS 2 by means of UTP cable following the indications given in the sensor connection section. When crimping the UTP cable, follow the same sequence of colours on each cable end.

Connect the HUB to the CPU by means of the BUS 1 connector using a cable belonging to CAT. 5e or higher.

Connect the power supply to the EXT POWER connector using an AWG 18/0.75 mm^2 bipolar cable or a cable with a higher cross section.

Insert the ferrite, 74271132S type or equivalent, in the power cable

> The device is powered in direct current with a voltage between 12/24 V.
> The power supply to the device must be limited to a maximum of 4A/32V. Use a fuse directly fitted on the positive-pole conductor.



Connect the antenna supplied together with the system. Observe the polarity. The braiding should be on GND and the central conductor on 'ANT'.

> <u>The antenna support must be kept isolated from the chassis of the vehicle</u>.
> Observe the measurements shown in the figure to strip the RG58 cable of the antenna. Stripping the cable too much may impair the correct RF performance of the system.

If the device is installed on electric vehicles, add a power line filter, for instance an FN2090-3-06 Schaffner filter.

If requested, the relays present on the board can be connected following the diagram foreseen.
The default configuration indicates that:

- **Relay 1** (RL1) remains active until the system detects one or more TAGS in the short-range detection area, i.e. in Warning.
- **Relay 2** (RL2) is activated with a delay time, which can be configured once relay 1 is activated.

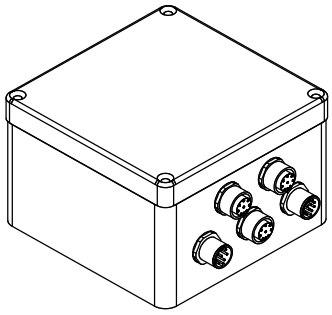
The configuration of the relays can be modified from the advanced settings of the system (contact technical support for help).

8.4 INSTALLING THE SYSTEM WITH M12 CONNECTORS

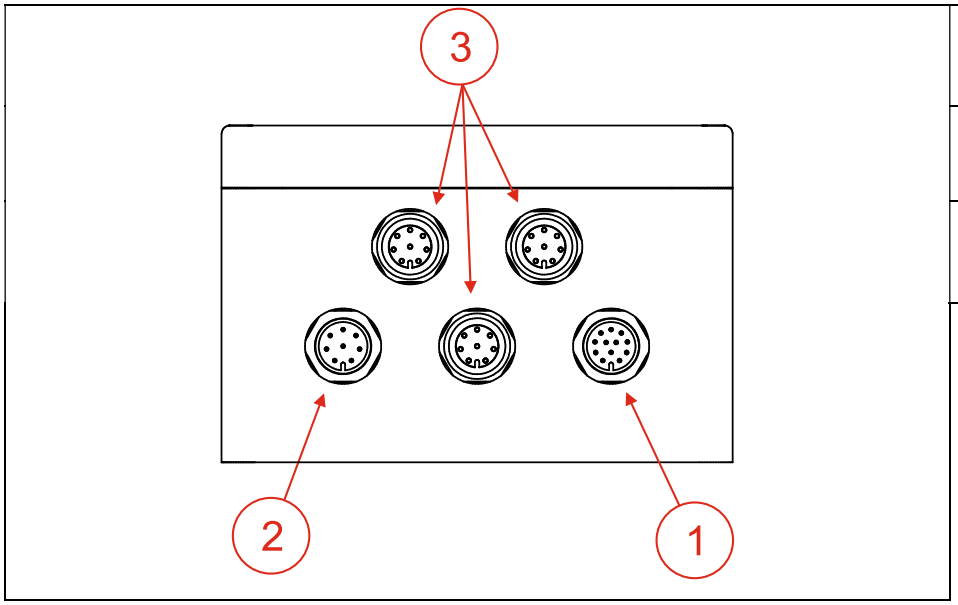
The PLX SAFEMOVE SENS 4 and PLX SAFEMOVE HUB 4 devices are available in a version fitted with M12 connectors. Such version has been designed in order to make the system installation and removal simpler and quicker.
The table below summarises the codes used in the system fitted with connectors.

DEVICE	CODE
HUB	PLX SAFEMOVE HUB 4M
SENSOR	PLX SAFEMOVE SENS 4M

CABLE	POLES	LENGTH (m)	AWG	CODE
RJ45-M12f CPU-HUB CONNECTION CABLE	8	5	24	M12AFRJ45CABLE5M
M12m-M12f HUB SENSOR CONNECTION CABLE	8	5	24	M12AMFCABLE5M
HUB POWER SUPPLY AND RELAY CONNECTION CABLE	12	5	24	M12AFPAN12P5M

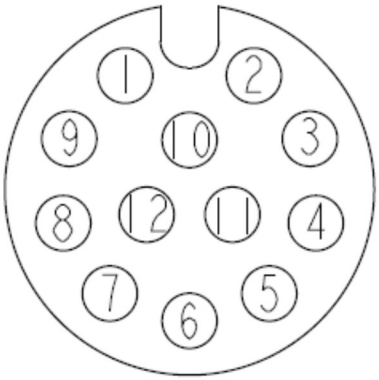


The section below indicates the functions of the different connectors and connections for the HUB power supply and relay



1	**HUB power supply and relay connector**
2	**Connector for HUB-CPU connection cable**
3	**Connection connectors towards sensors**

FEMALE (FRONT VIEW)



1 brown
2 blue
3 white
4 green
5 pink
6 yellow
7 black
8 grey
9 red
10 violet
11 grey-pink
12 red-blue

PIN	Colour	Function
1	Brown	VDC
2	Blue	VDC
3	White	GND
4	Green	GND
5	Pink	Normally Open Relay 1
6	Yellow	Common Relay 1
7	Black	Normally Closed Relay 1
8	Grey	Normally Open Relay 2
9	Red	Common Relay 2
10	Violet	Normally Closed Relay 2
11	Grey-Pink	Not Used
12	Red-Blue	Not Used

8.4.1 LENGTH OF CONNECTIONS

The cables supplied are 5-m long, and they are AWG 24. If longer connections are to be made between HUB and sensors and between HUB and CPU, M12 AMF CABLES (5M) may be used as extensions.

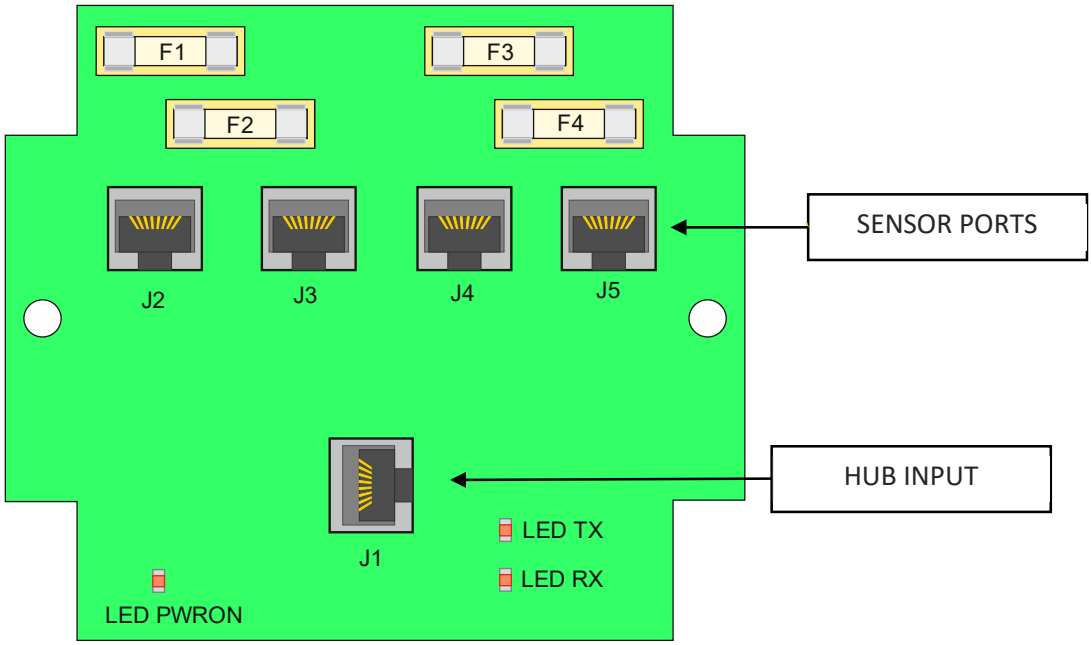
	CPU-HUB Connection				HUB-SENSOR Connection	
VDC	**AWG 26**	**AWG 24**		**VDC**	**AWG 26**	**AWG 24**
12 V	20m	40m		**12 V**	3m	6m
24 V	50m	100m		**24 V**	25m	50m

8.5 EXPANSION OF THE NUMBER OF SENSORS

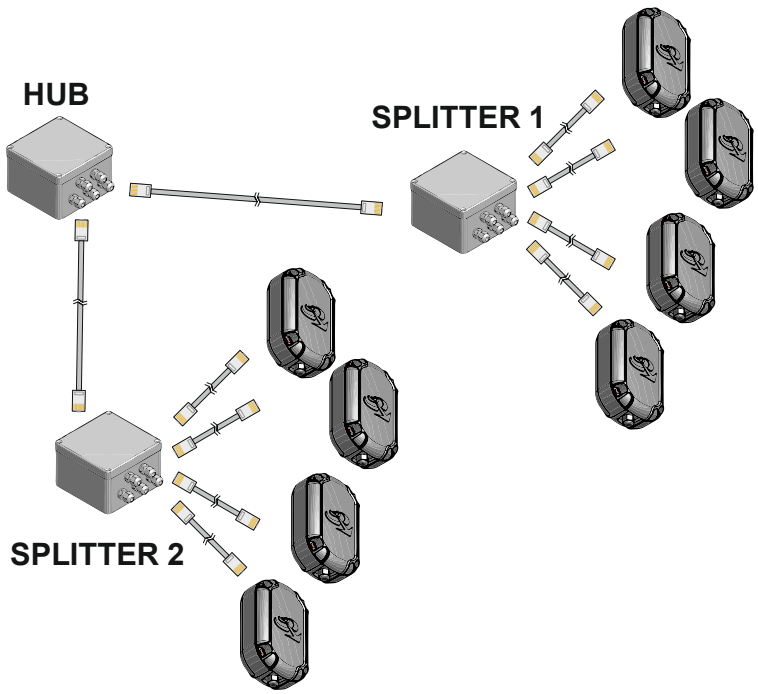
The system can manage up to a maximum of 8 sensors. To add additional sensors to the basic kit, one or more splitters must be installed, as required:

- up to 6 sensors, one splitter is needed
- for 7-8 sensors, two splitters are needed

The splitter must be connected to one of the 3 ports available in the HUB, and this makes 4 ports available for connecting just as many sensors.



Find below an example of the configuration of an EGOpro Safe Move system with 8 sensors.



8.6 STOPPING DISTANCES AND ACTIVATION DISTANCES

When installing a safety supporting system to be used for reducing the risk of man-vehicle and vehicle-vehicle collisions, it is necessary to take into account which activation distances have to be considered for the system operation. The purpose of this is to adjust the system so that a truly helpful signal can be given to the pedestrian worker.
As a matter of fact, the distance at which a pedestrian worker wearing a Tag or a vehicle has to be detected in order to give effective aid for the prevention of collisions depends on many factors such as:

- Shape and dimension of the vehicle.
- Reaction time of the detection system
- Reaction time of the driver
- Deceleration distance
- Conditions of the ground

Even though formulating an accurate mathematical model of the vehicle stop physical phenomenon is very complex, it can be schematised following a simplified model in order to draw attention to the main physical phenomena involved.

8.7 Vehicle deceleration and driver's response distances

The space/distance a vehicle needs to stop safely must be clearly assessed. Firstly, evaluate the deceleration distance- the distance the forklift truck needs to reach zero speed starting from a given speed from the instant the braking system is actuated. In turn, this space depends on the speed of the forklift truck, the maximum deceleration set in the parameters of the vehicle, and the response time of the systems of the forklift truck.
Deceleration, as well as maximum speed, can be set to different values depending on the type of load, vehicle and ground. The maximum distances for industrial vehicles are standardised by ISO 6292 that sets the maximum stopping distances from the instant when the braking system is actuated. Such values will be taken as reference. The driver's reaction distance is to be added to the acceleration distance afterwards. Such distance is associated to the time between the alert and the driver's action stop the vehicle. As a normal practice, this response time is estimated in 1 second. By way of an example, find below two charts with the values referring to deceleration space and total stopping space for two types of vehicles defined in the standard.

Chart 1 *Stopping distances as per ISO 6292 A1 (<16000 kg)*

Speed [km/h]	Deceleration distance [m] (ISO6292 A1)	Driver reaction distance @1s [m]	Total braking time [m]
3	0.8	0.8	1.6
4	1.3	1.1	2.4
5	1.8	1.4	3.2
6	2.2	1.7	3.8
7	2.5	1.9	4.5
8	2.9	2.2	5.1
9	3.3	2.5	5.8
10	3.6	2.8	6.4
11	4.0	3.1	7.0
12	4.4	3.3	7.7
13	4.7	3.6	8.3
14	5.2	3.9	9.1
15	5.8	4.2	10.0

16	6.4	4.4	10.9
17	7.1	4.7	11.8
18	7.8	5.0	12.8
19	8.5	5.3	13.8
20	9.3	5.6	14.8
21	10.1	5.8	15.9
22	10.9	6.1	17.0
23	11.8	6.4	18.2
24	12.7	6.7	19.3

Chart 2 *Calculation of stopping distance as per ISO 6292 A2 (<16000 kg)*

Speed [km/h]	Deceleration distance [m] ISO6292 A2	Driver reaction distance @1s [m]	Total braking time [m]
3	0.9	0.8	1.8
4	1.4	1.1	2.5
5	2.1	1.4	3.4
6	2.5	1.7	4.1
7	2.9	1.9	4.8
8	3.3	2.2	5.5
9	3.7	2.5	6.2
10	4.1	2.8	6.9
11	4.5	3.1	7.6
12	5.0	3.3	8.3
13	5.4	3.6	9.0
14	6.0	3.9	9.8
15	6.7	4.2	10.8
16	7.4	4.4	11.9
17	8.2	4.7	13.0
18	9.1	5.0	14.1
19	9.9	5.3	15.2
20	10.9	5.6	16.4
21	11.8	5.8	17.6
22	12.8	6.1	18.9
23	13.8	6.4	20.2
24	14.9	6.7	21.6

8.8 System activation distances. Setting the powers transmitted

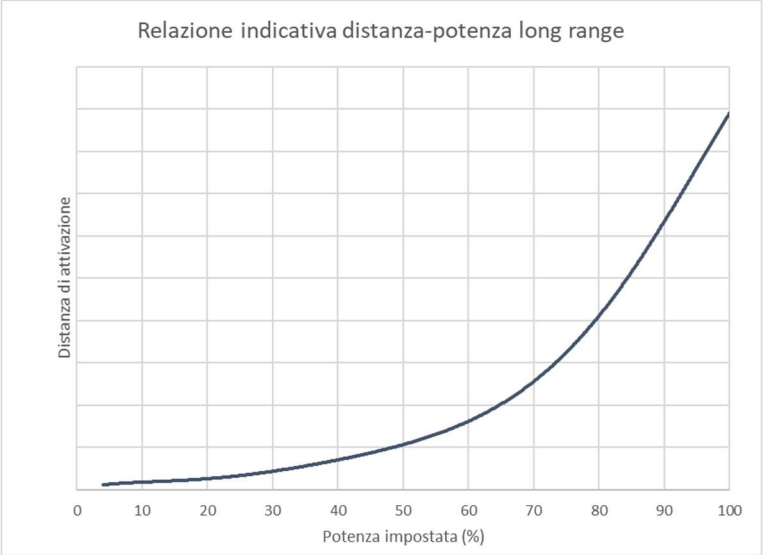
The section above dealt with how to calculate stopping distances for an industrial vehicle. When estimating the distances at which a tag potentially in danger of collision should be detected, a distance margin should be considered as well. A zero distance cannot and should not be set. Besides, the detection system has reaction times that have to be taken into account. To these distances identified, we should add a value that can be calculated according to the chart below.

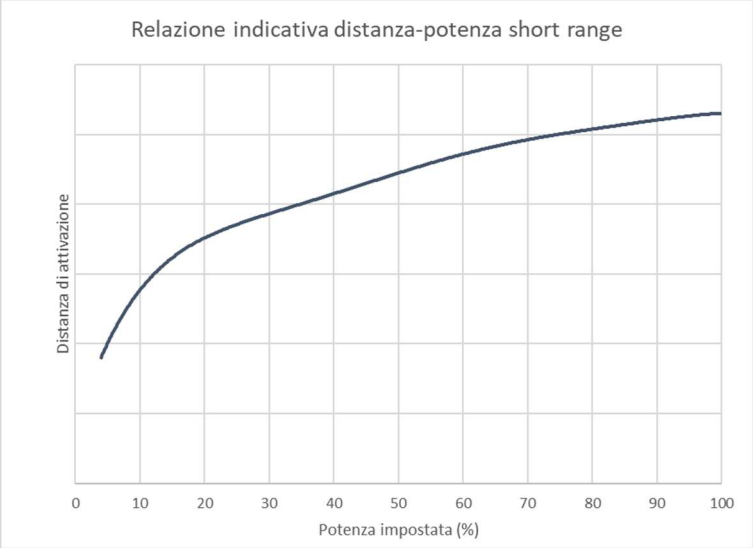
Speed [km/h]	operational margin [m]
3	0.6
4	0.8
5	1.0
6	1.2
7	1.4
8	1.6
9	1.8
10	1.9
11	2.1
12	2.3
13	2.5
14	2.7
15	2.9
16	3.1
17	3.3
18	3.5
19	3.7
20	3.9
21	4.1
22	4.3
23	4.5
24	4.7

Now the detection distance we want can be calculated. For instance, if a system is installed in a forklift truck falling within category A1, with a maximum speed of 12 km/h and manual braking, the total braking distance will be 7.7 m; some further 2.3 m should be added as margin, to a total distance of 10 meters.

Once the desired distance is defined, adjust the power of the relevant sensors until a safe coverage for the distance calculated is guaranteed. The distance previously identified is that from the interfering worker to the point of contact that is closest to the forklift truck, which in a scenario of a front impact with a forklift truck is the forks.

Since the distance between the sensors and the first point of contact is not known a priori, and since the position of the sensors may vary a lot, check the activation distance by applying control tests. Keep in mind that the low that governs the power set and the activation distance is not linear. Find below some graphs that show the progress of the ratio between these two values for both long range (pre-warning) and short range (warning).





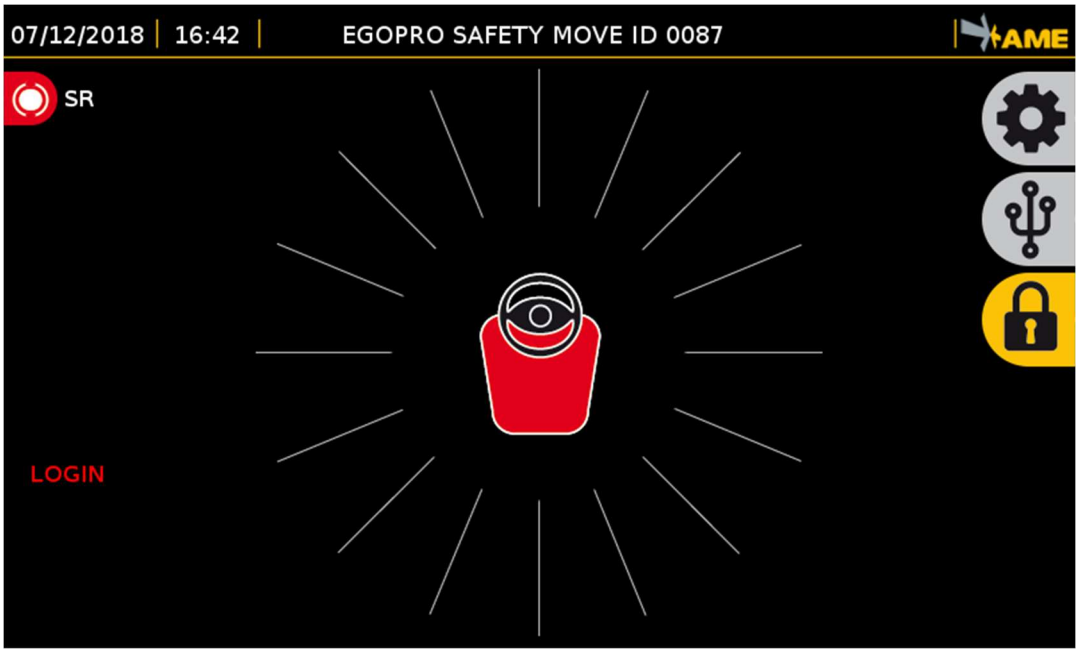
8.9 Calculating the distance in case of vehicle-vehicle collision.

In case of vehicle-vehicle collision, we can consider that the same assessments described in the sections above are applicable. The worst case to be considered is the one in which vehicles move at maximum speed against each other. In this case, the calculated distance is twice the one that was calculated before.

9 TURNING-ON AND CONFIGURATION

9.1 TURNING ON THE SYSTEM

The system turns on automatically when the power supply (12/24V$_{DC}$) is connected. While the system is turned on for the first time, the initialisation screen is displayed.
Once initialisation is completed, the following screen is showed.



The first time the system is turned on takes more time.

The sensors, even if they are correctly installed, are not displayed by the system until the search procedure is followed.

9.2 CONFIGURATION

In order for sensors to be recognised by the system, they must be configured from the configuration menu via the touchscreen.

The following procedure describes the steps to be followed in order to configure the system and make sure that the peripheral devices are correctly connected.

STEP 1	•Open the configuration menu
STEP 2	•Enter password
STEP 3	•Open the Sensors Configuration menu
STEP 4	•Open the Sensors Search menu
STEP 5	•Search sensors by ID
STEP 6	•Search sensor by position and save them to the system

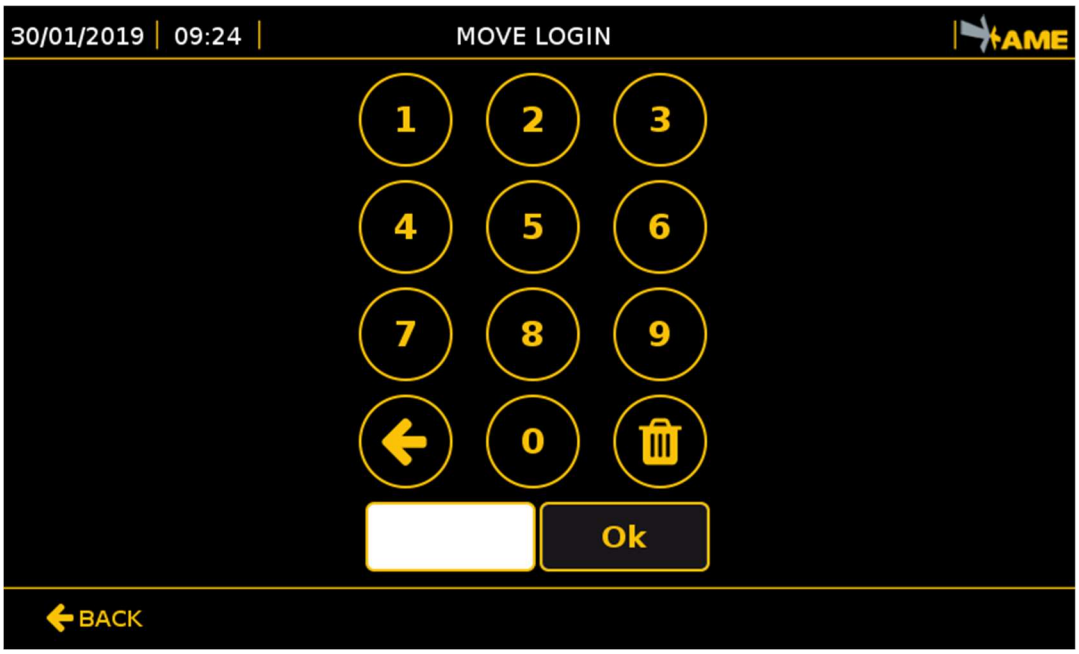
9.2.1 STEP 1 | CONFIGURATION MENU

Press the CONFIGURATION icon to access the menu

9.2.2 STEP 2 | ENTERING THE PASSWORD

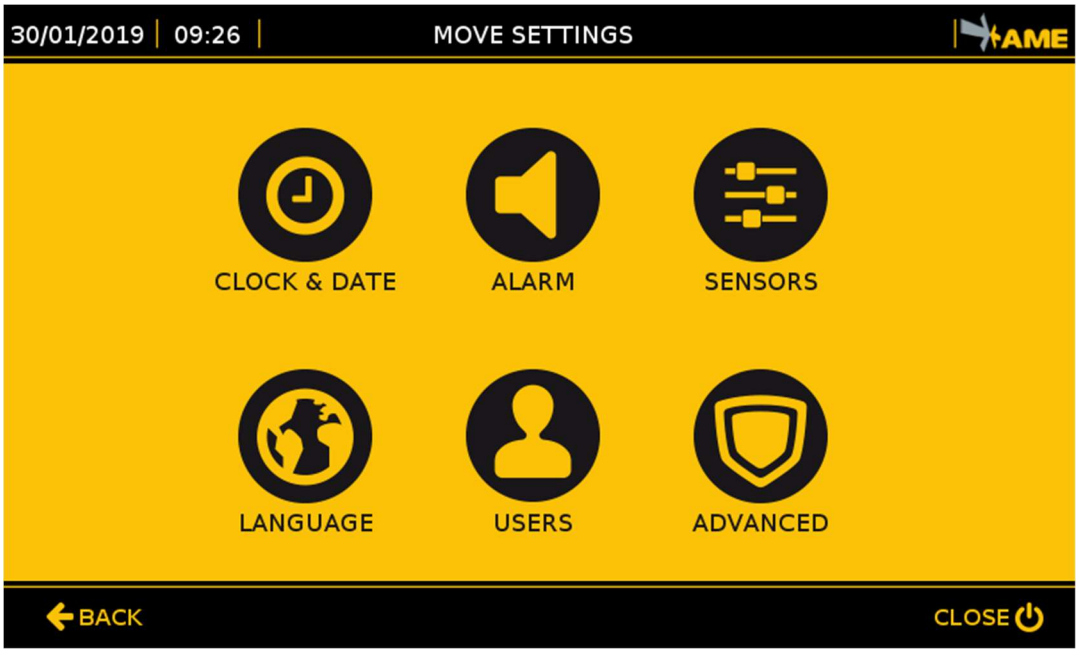
To access the system configuration section, a password must be entered so that only the enabled user can view this screen.

The default access password is **1234**. Enter the sequence and press OK.

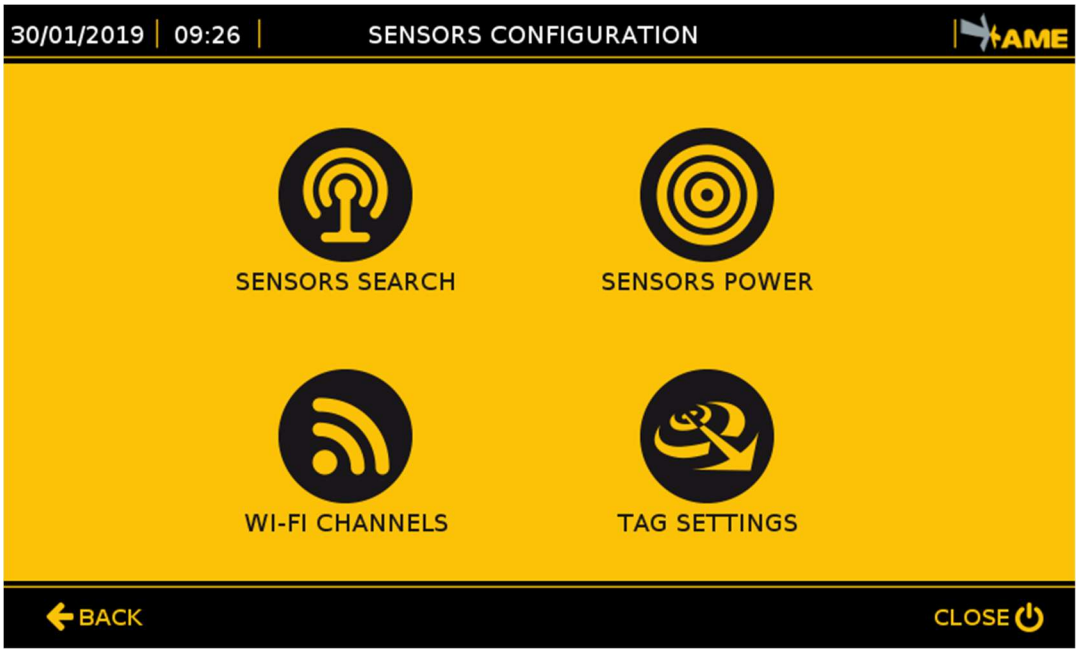


9.2.3 STEP 3 | SENSORS

The first screen when accessing the configuration menu is the following one. To configure the sensors press the *SENSORS* key.

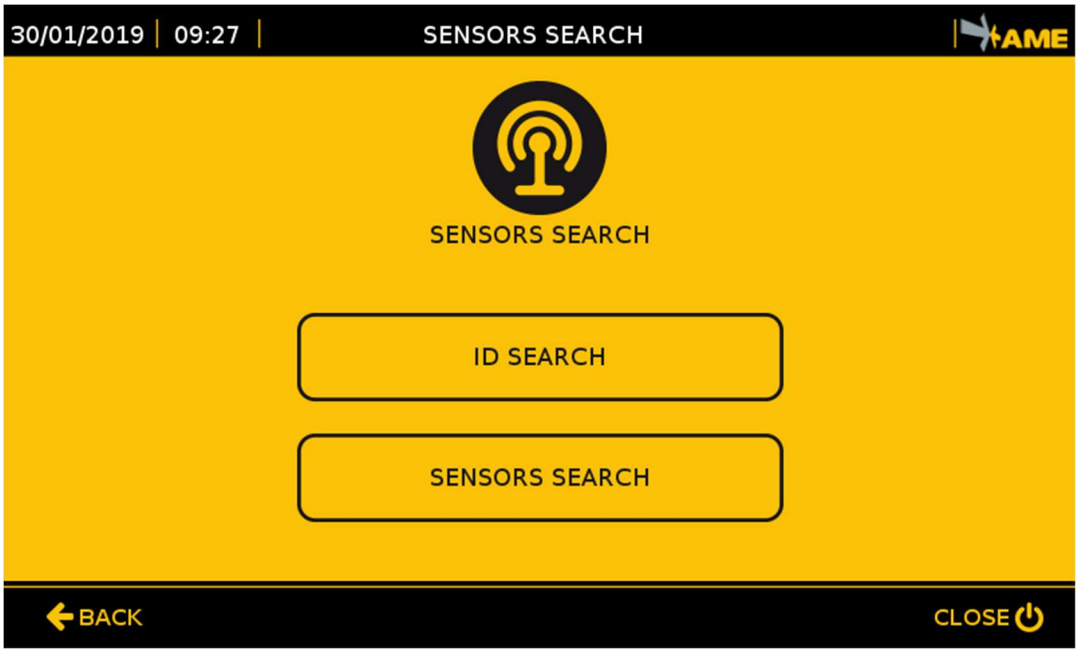


To configure the sensors press the *SENSORS SEARCH* key.



9.2.4 STEP 4 | SENSORS SEARCH

Each sensor has an unequivocal ID that must be saved to the CPU: first perform the ID SEARCH and then the SENSORS SEARCH.



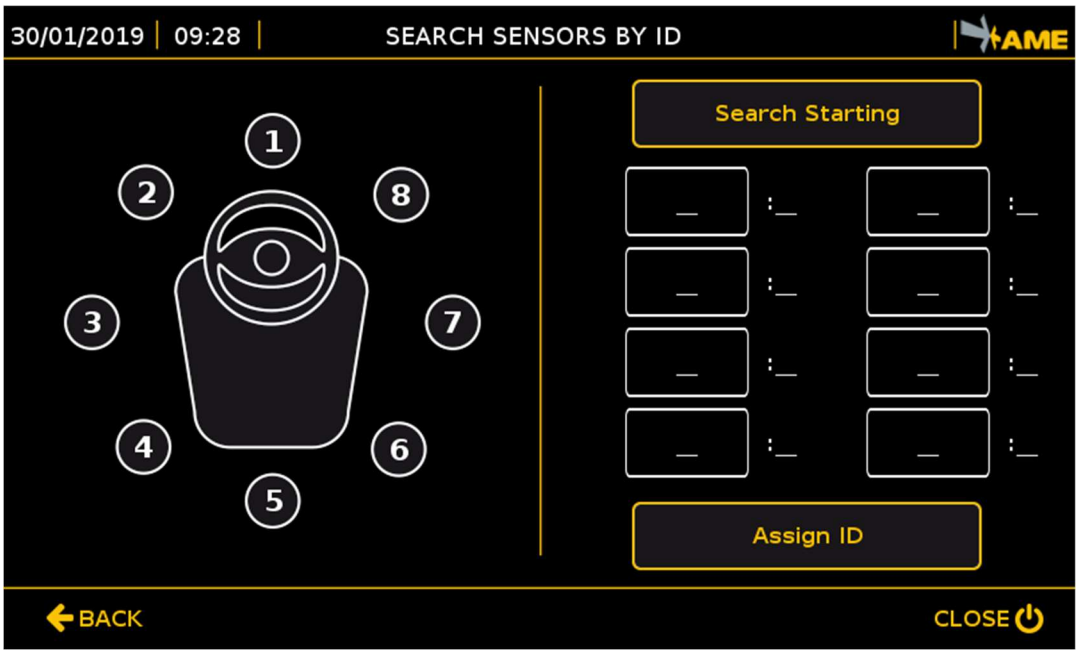
Before starting the ID SEARCH, make sure that the selectors present on the HUB and on each sensor are set to 0.

The sensors and the HUB, if they have an M12 connector, are already correctly set, and they **must not** be opened.

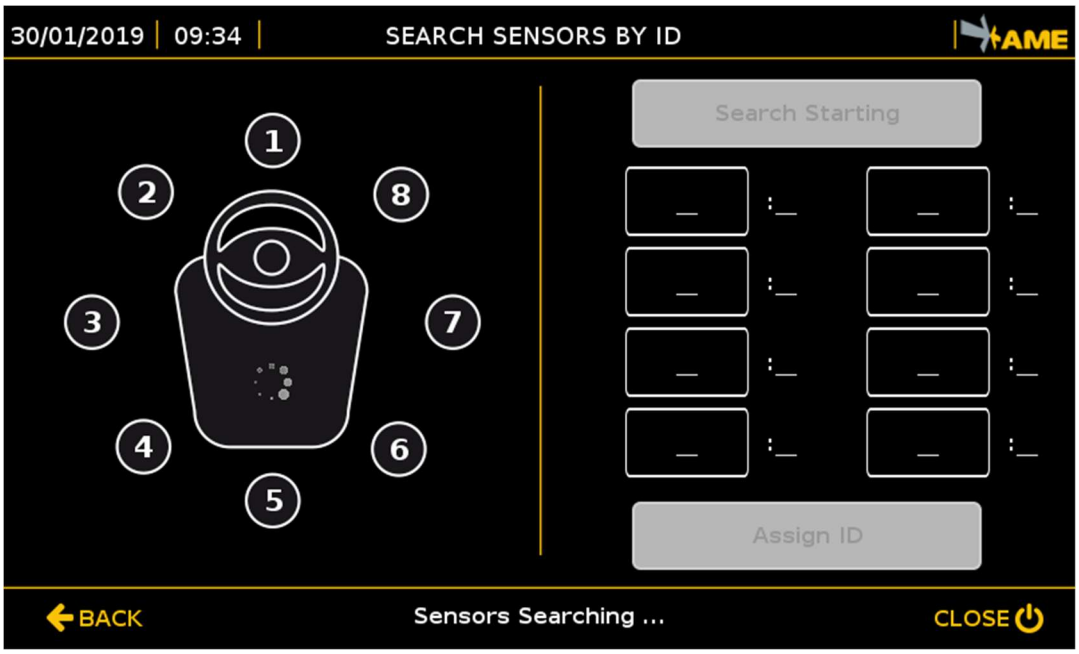
Before starting the ID SEARCH note down the code (ID) (shown as FC: XX XX XX) indicated on each sensor in order to be able to save it in the correct position.

9.2.5 STEP 5 | SEARCHING SENSORS BY ID

The search sensors by ID function is used to associate each sensor ID (Factory Code uniquely assigned by the manufacturer) with a number from 1 to 8 that identifies its position compared to the vehicle, in order to facilitate the subsequent system calibration operations.

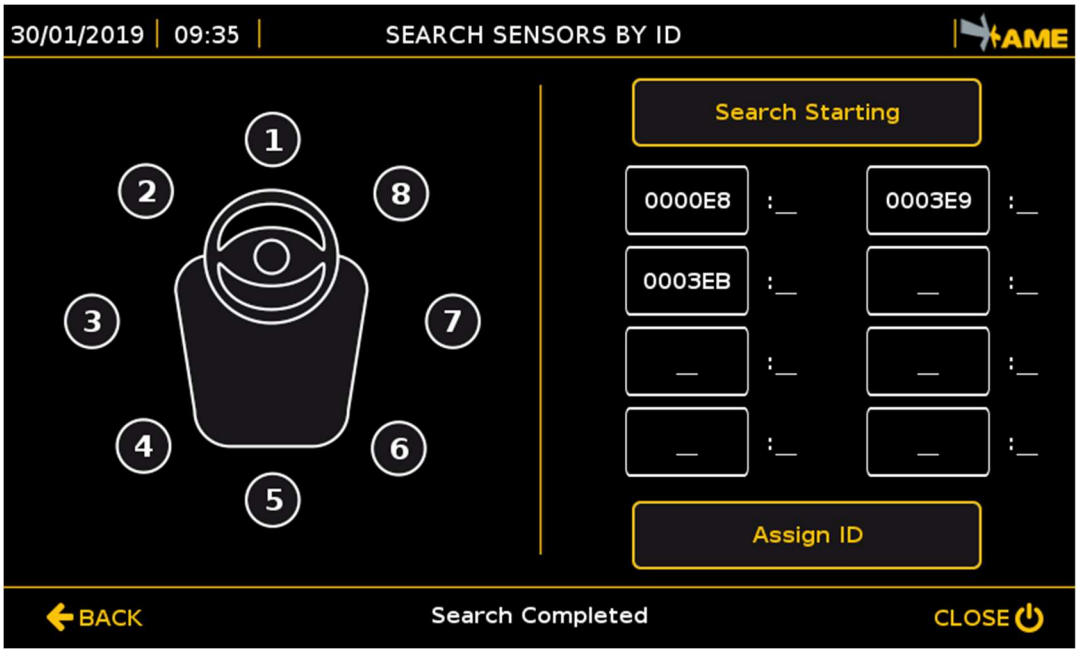


Press the SEARCH STARTING key to display all the sensors connected to the system.



This operation may take several seconds.

Once the Search Sensors by ID stage is completed, the sensors that have been identified are displayed.



If some sensors have not been identified, try repeating the search operation. If it still fails, check:

- Position of all selectors (they must be set to 0)
- Connections between sensor and HUB.

If no sensor is identified, check:

- Connections between HUB and CPU
- HUB power supply.

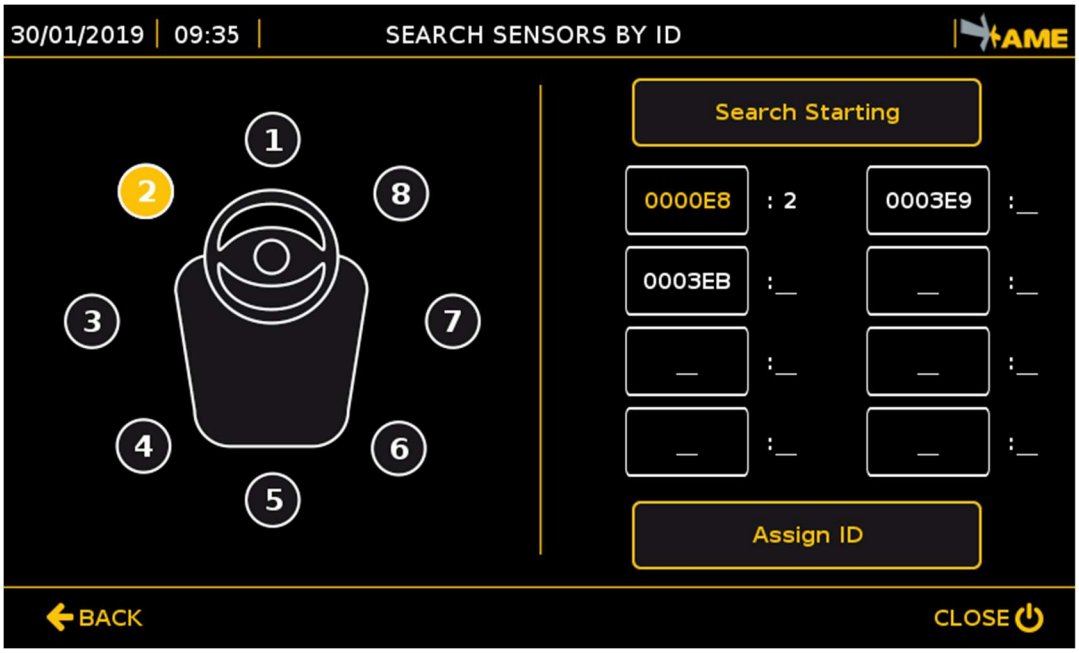
Make sure that each ID matches those that had been previously noted down, and then associate to each ID a position identified with a number from 1 to 8.
The sensors must be positioned in the following way compared to the driver's cabin:

- FRONT SENSORS: 2 - 1 - 8
- REAR SENSORS: 4 - 5 - 6
- LATERAL SENSORS: 3 - 7

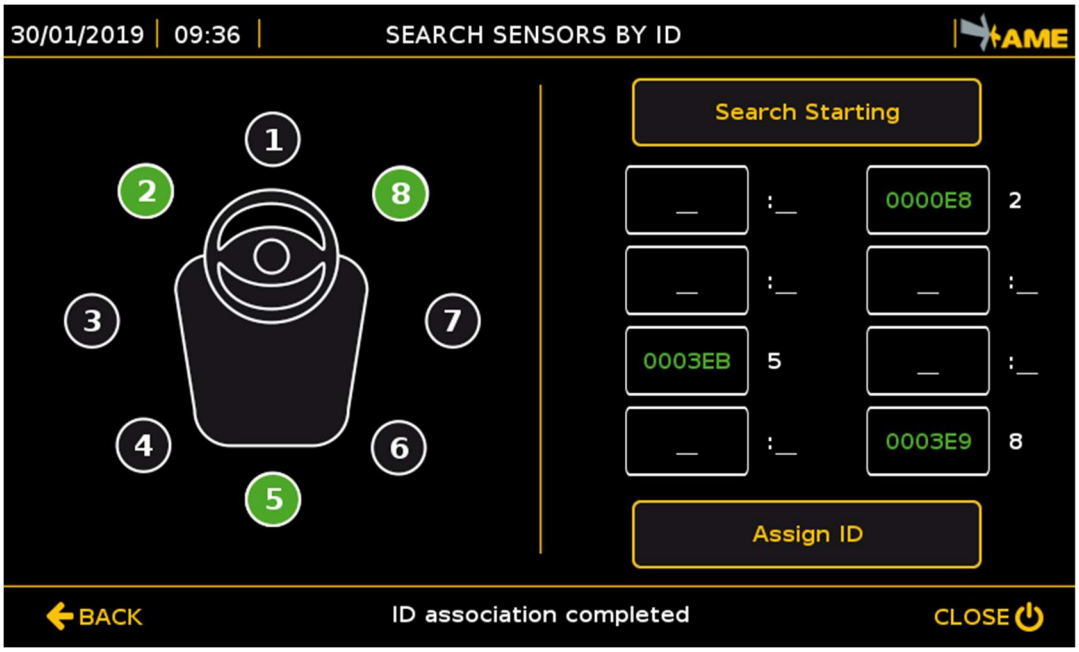
The following figures show, as an example, the case of the 3 sensors of the basic kit for a front counterbalanced vehicle which must be positioned as follows:

- FRONT LEFT: 2
- FRONT RIGHT: 8
- REAR: 5

To associate an ID to the position, press the ID to be associated (it will be highlighted in yellow, on the right side of the screen), and then press the position (it will turn yellow, on the left side). The position associated to the ID is displayed next to the selected ID. Proceed in the same way with the other sensors, and then press the ASSIGN ID key.



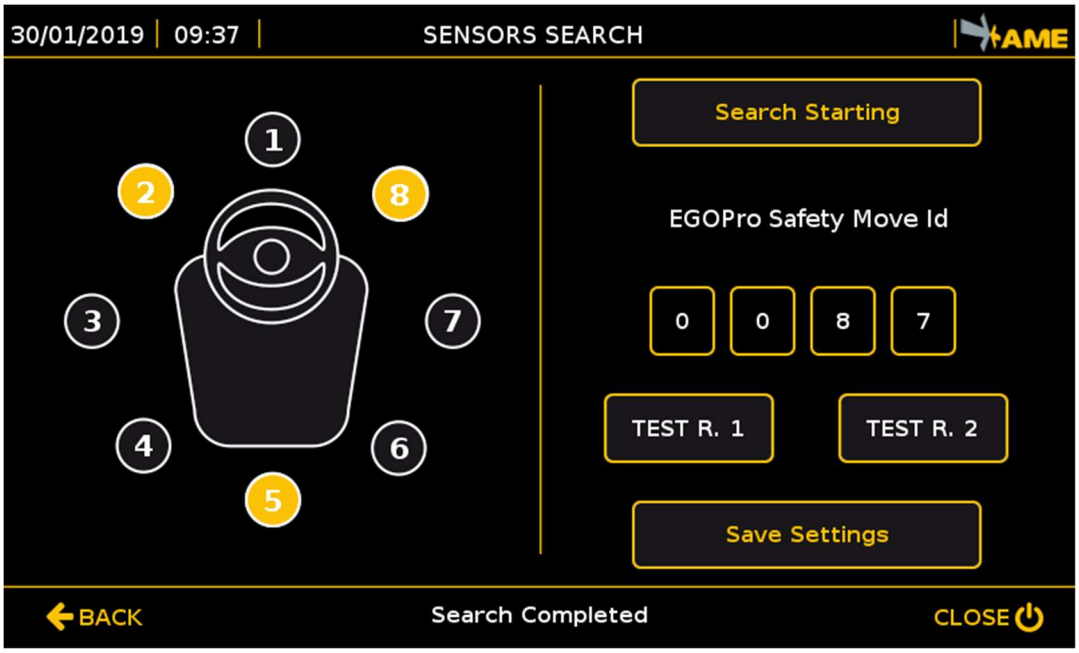
If the allocation procedure has been successful, the sensors turn green and the associated IDs move to the new positions. In case of error, try making the allocation again.



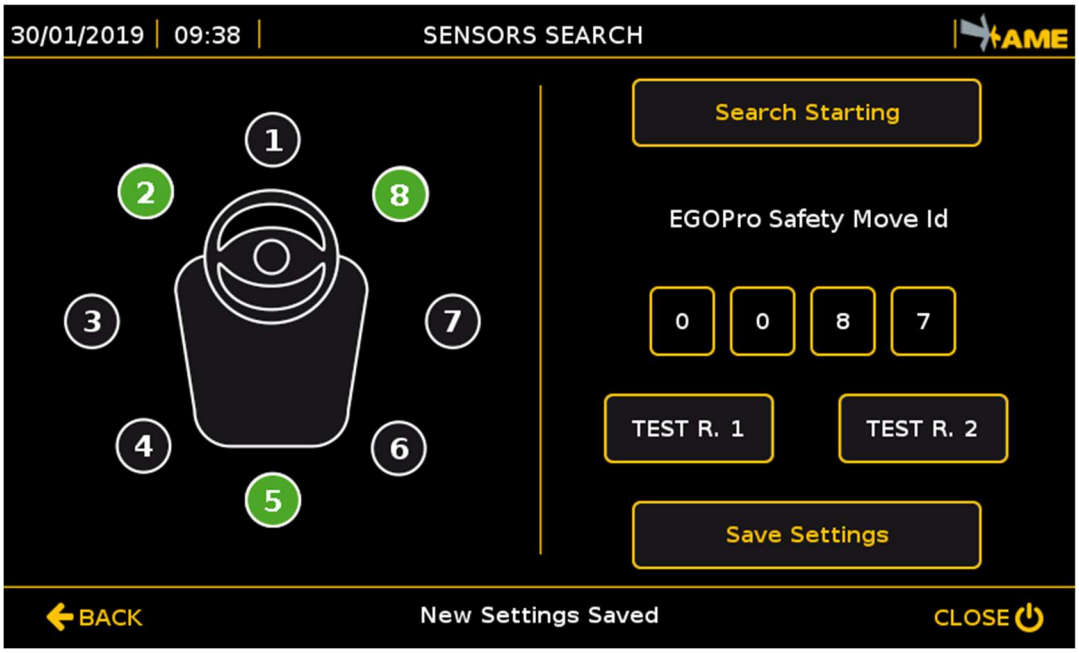
Press BACK and return to the previous screen.

9.2.6 STEP 6 | SEARCHING SENSORS BY POSITION

This step checks the correct operation of the sensors and saves them to the system. Press SENSORS SEARCH (STEP 4 screen). The search for sensors starts automatically.



If the ID search has been correctly performed, the selected sensors (e.g. 2, 5 and 8) will turn yellow.
Press the SAVE SETTINGS key: the colour of the sensors will change from *yellow* to *green*, and, as of that moment, the sensors will be associated to the vehicle.



Press the BACK key to return to the previous menu.
Press the BACK key to return to the main menu.

> ⚠ Press SEARCH STARTING to repeat the operation, for example, when the selected sensors are not highlighted in yellow, or if - once the procedure is completed - they are not green

9.2.7 SEARCHING SENSORS WITHOUT ID

A fixed position can be assigned to the sensors without making the ID search. In this case, place the selector present on each sensor in the desired position. For example, for the basic kit:

- FRONT LEFT: 2
- FRONT RIGHT: 8
- REAR: 5

The selector present on the HUB must be set to 0.

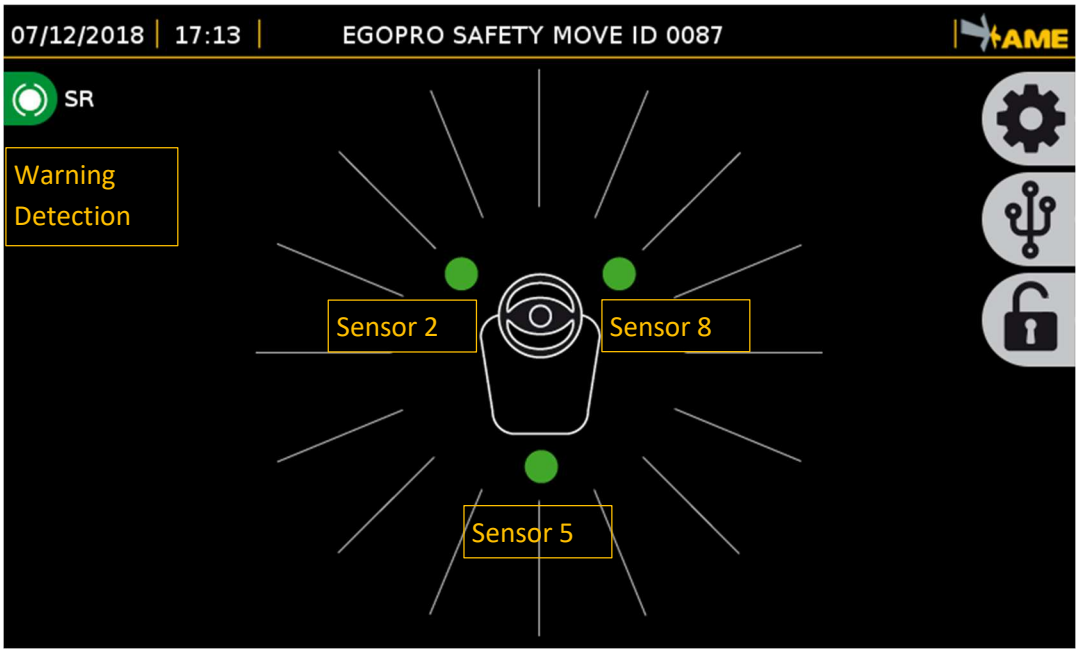
In this case, the SEARCH SENSORS BY ID procedure (STEP 5) must not be followed.

9.3 TEST

Once the sensors have been configured and saved to the system, make a test to check that it works correctly.
In general, the system is working correctly if the central part of the monitor is no longer red.

9.3.1 SENSOR CHECK

All sensors are in good working order if they are all green.
The Warning detection system (indicated with SR) is in good working order if the indicator on the top left corner on the monitor is green.



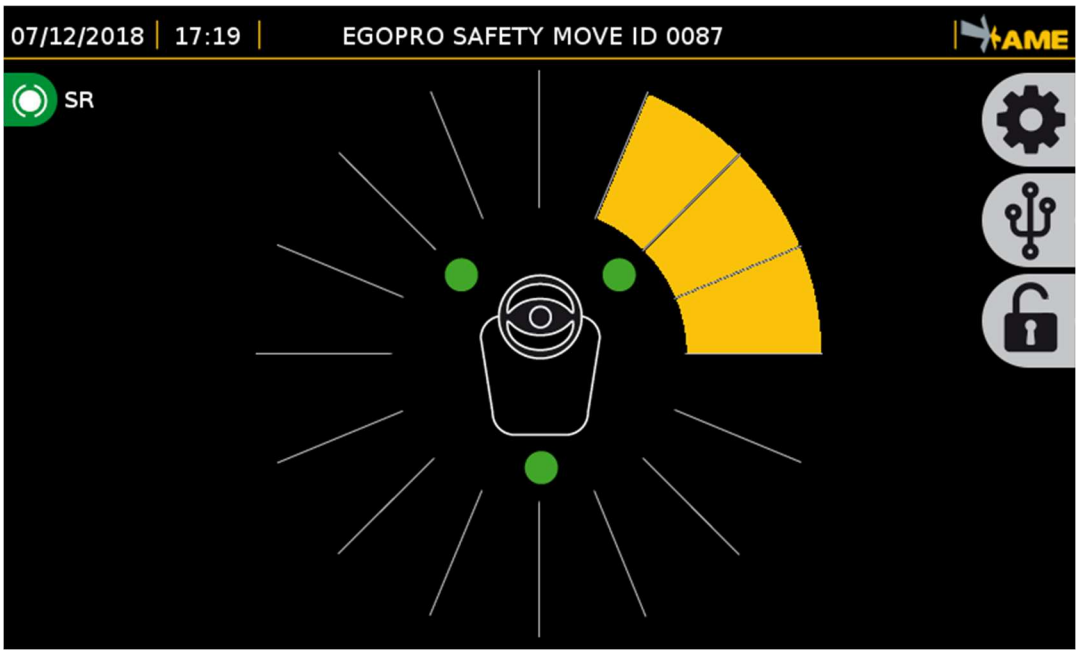
If the Vehicle-Vehicle module is active and the white sectors are displayed indicating the presence of a vehicle but there are no other vehicles with sensors installed nearby:

- Try restarting the system
- Disconnect and connect again the power supply connector on the HUB
- Repeat the sensors search procedure

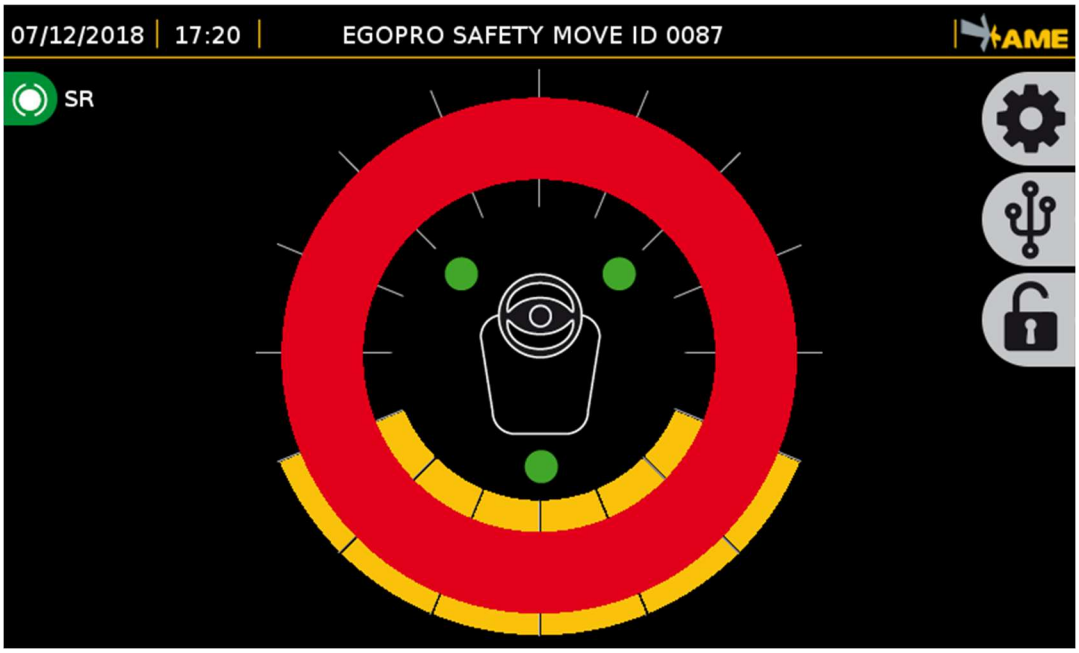
9.3.2 TAG DETECTION TEST

Move a Tag close to each of the sensors installed and check their operation.

The transponder detection in Pre-Warning is yellow. The yellow sectors correspond to the sensor that has detected the Tag and indicate the Tag position with respect to the vehicle.



The transponder detection in Warning is red. In this case, the TAG position with respect to the vehicle is not indicated: there is one single indication with a red ring.



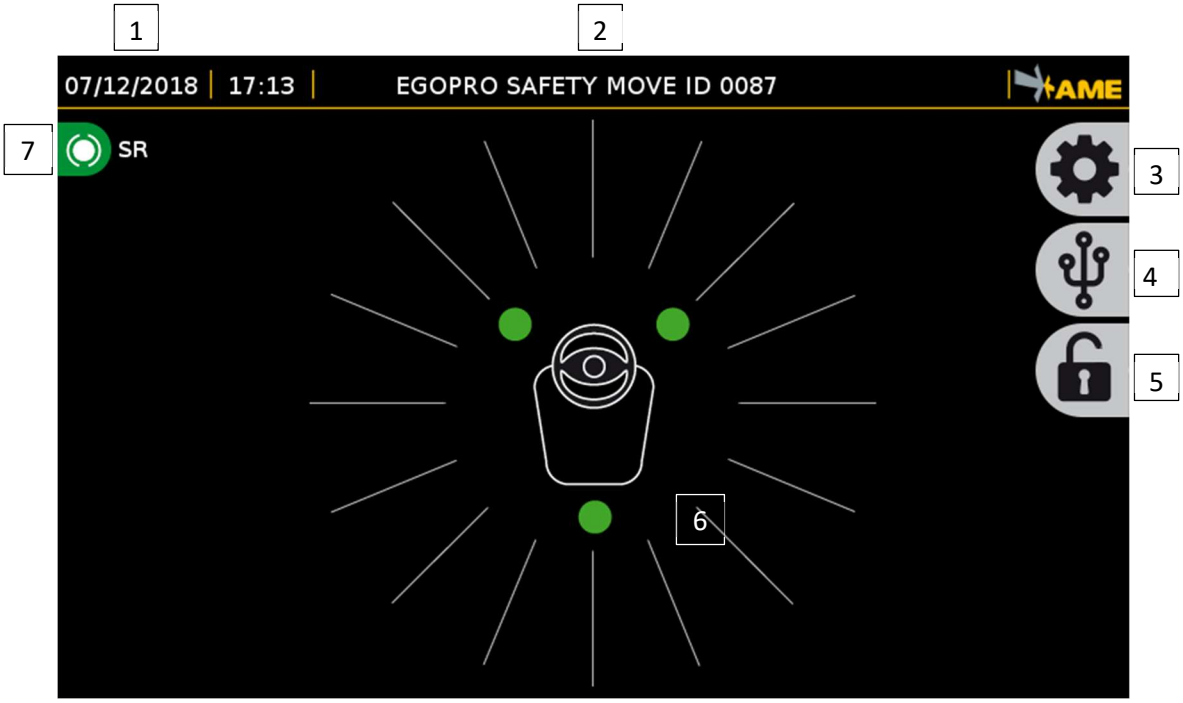
In addition to the visual alarm, there is also a sound alert.

By default, the power of sensors is set to the minimum value; therefore, the detection distances are very short.

10 OPERATION MODES

10.1 DISPLAY OVERVIEW

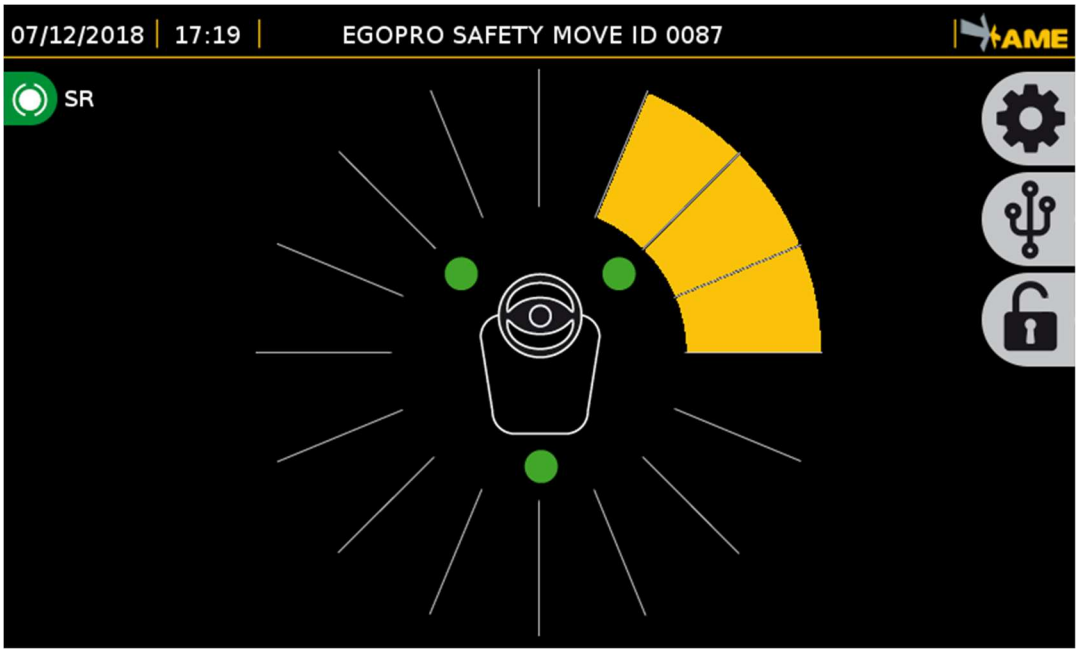
Main screen of EGOpro Safe MOVE 4.0 with 3 sensors installed without any detection of pedestrian workers or vehicles.



In addition, the following elements are also displayed on the screen:

1. Date and time
2. System Identification Code
3. Key to access configurations/settings
4. Key to access the section for data/log downloading
5. Key for the driver login
6. Position and status of the sensors installed. In this case, the three sensors, represented with a green circle, are arranged as follows: two at the front and one at the rear. The green colour indicates the correct operation of each sensor.
7. Status of the Warning detection (SR).

10.2 PEDESTRIAN WORKER'S TAG DISPLAY ALARM: PRE-WARNING



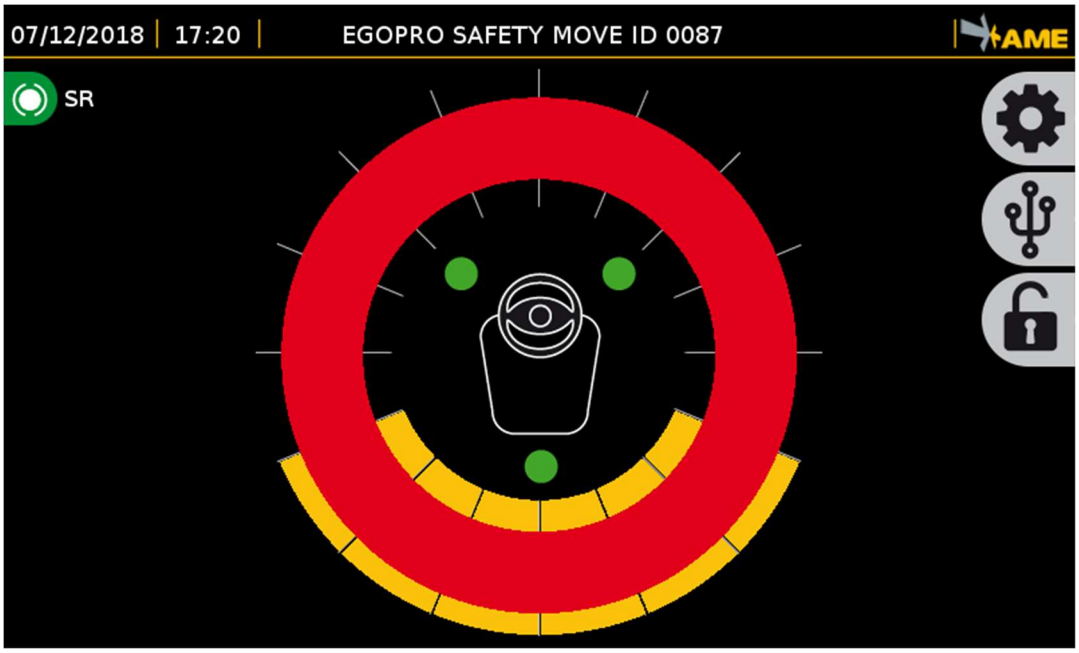
The presence of the pedestrian worker wearing an active TAG within the **PRE-WARNING** activation range is signalled to the driver via the display that shows the position of the pedestrian worker around the vehicle.

Lighted up sectors are associated to the sensor and they are coloured according to the sensor detecting the Tag, and so the pedestrian worker's position.
The sector corresponding to the pedestrian worker's position will remain YELLOW as long as the Tag is in this area.
If several pedestrian workers are found around the vehicle simultaneously at different positions, several sectors will be lighted up on the display corresponding to the pedestrian workers.

The visual alarm is accompanied by two sound alarms that draw the driver's attention. The first alarm, which is loud, is emitted when the pedestrian worker enters the PRE-WARNING area, and the second alarm, which is low, reminds that the pedestrian worker is still within the detection area.
In addition to a visual and sound alarm on the display, the system also activatesa a relay of the CPU.

All these alarms can be configured in the ALARM CONFIGURATION section.

10.3 PEDESTRIAN WORKER'S TAG DISPLAY ALARM: WARNING

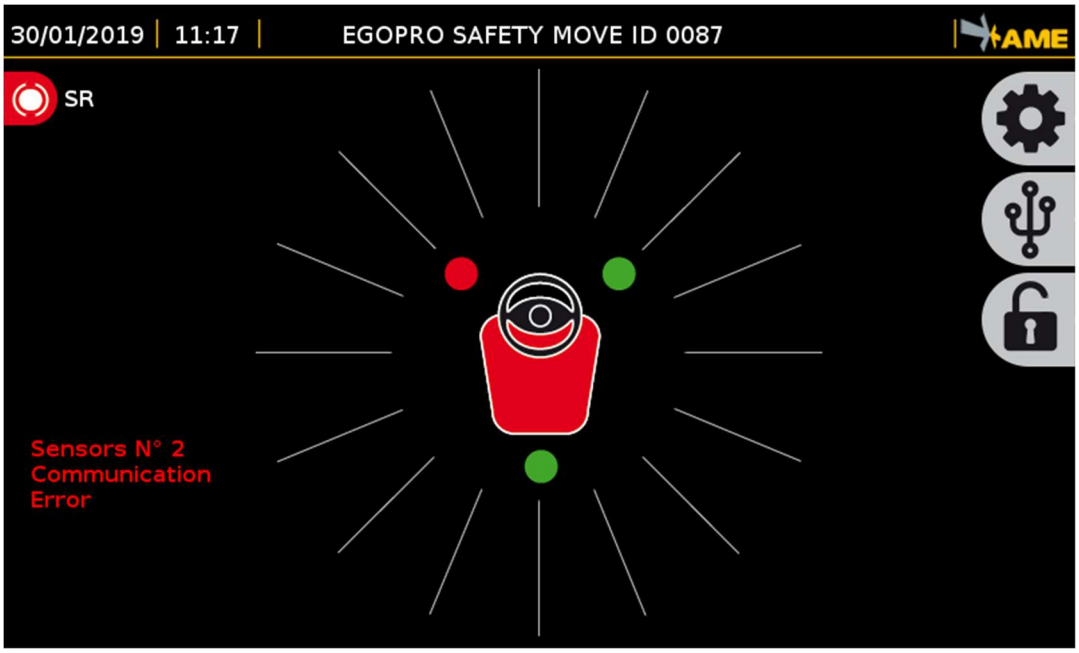


The presence of the pedestrian worker wearing an active TAG within the **WARNING** activation range is signalled to the driver via the display by means of a clearly visible red ring.
The PRE-WARNING alarm indication remains visible and helps the driver locate the personnel on foot.
The red ring will remain lit up, together with the two lateral LEDs in the display, as long as the Tag is in this area.

The visual alarm is accompanied by two sound alarms that draw the driver's attention. The first alarm, which is loud, is emitted when the pedestrian worker enters the WARNING area, and the second alarm, which is low, reminds that the pedestrian worker is still within the detection area.
In addition to a visual and sound alarm on the display, the system also activates a second relay of the CPU and two relays present on the HUB.

All these alarms can be configured in the ALARM CONFIGURATION section.

10.4 SENSORS AND HUB DIAGNOSIS



Active sensors are displayed matching their position on the vehicle. Only fitted and configured sensors are shown on the display.
The system is equipped with a self-diagnosis function that constantly checks the correct operation of the devices. If the icon of the sensor is GREEN, it means that the diagnosis system did not detect any anomalies on that specific sensor.

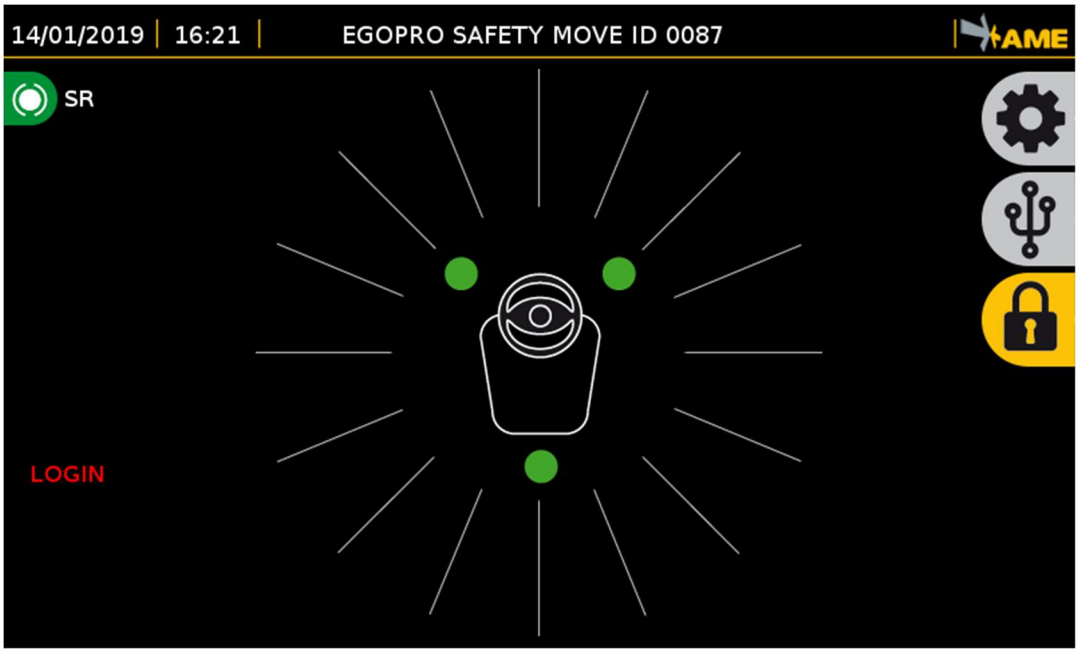
The system signals any anomalies by illuminating the seat and the icon of the sensor that is not working in red. Moreover, the type of error detected by the system is shown for 5 seconds at the bottom left-side corner.
A sound warning is reproduced together with the visual alarm.
The error message can also be subsequently displayed by pressing the red icon corresponding to the sensor in alarm.

The anomalies that can be detected during self-diagnosis are the following:

- **Communication Error:** no communication between CPU and HUB and/or HUB and sensor.
- **Microwave Error:** the sensor may not be able to activate the Tag in pre-warning mode (yellow) and be detected by other vehicles.
- **Low Frequency Error:** the sensor may not be able to activate the Tag in warning mode (red).
- **RF Sensor Error:** the sensor may not be able to detect the presence of other vehicles.
- **Radio Frequency Error**: the HUB may not be able to receive the activation of the Tags.

The self-diagnosis system does not allow identifying all the possible anomalies of the system. For example, it does not detect whether the RF antenna of the HUB and/or one or several internal antennas of a sensor are not connected, as it may happen after one of the components of the system undergoes a strong impact.
It is therefore advisable to thoroughly check the system on a regular basis following the procedure specified in the maintenance section (chapter 23).

10.5 DRIVER LOGIN

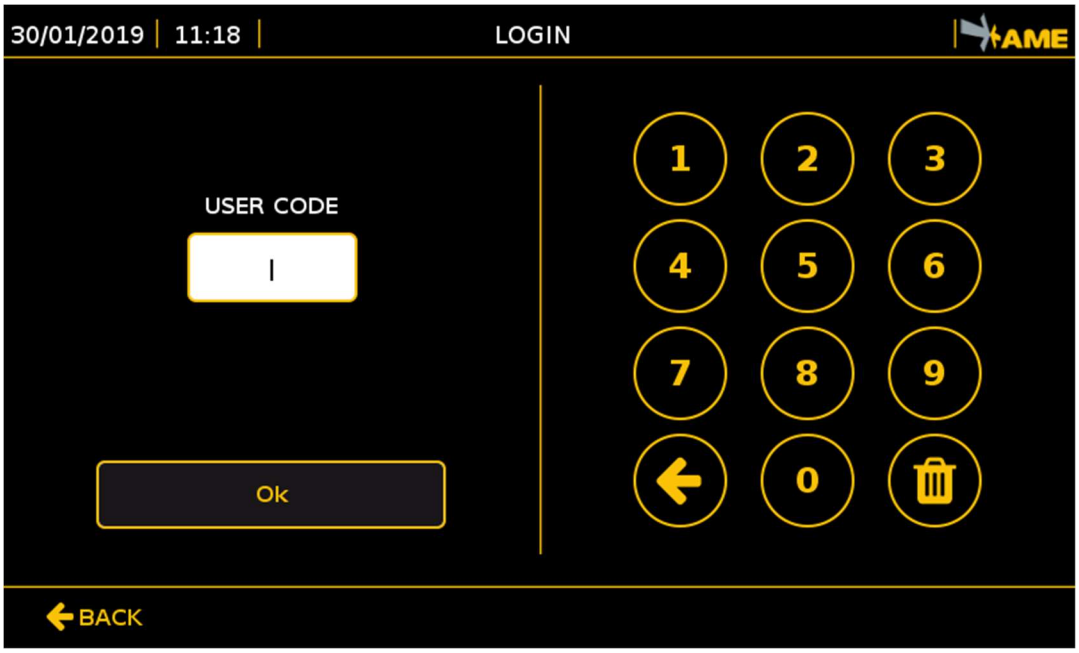


The LOGIN operation is used to check which operator is driving the vehicle at the date and time requested, and it is essential to exclude the driver's TAG from the anti-collision system.
When the system is turned on, the main interface presents a lateral red message inviting the user to LOGIN, which is signalled by a yellow icon.

Press the yellow login icon- a closed padlock- to login, and enter your driver's code/Tag code. Once the login is complete, the icon will become grey, the symbol will turn into an open padlock, and the login word in red will disappear.

For the LOGOUT operation, press again the grey icon and it will be yellow again.

⚠	The LOGOUT operation is essential to be able to make the driver's Tag visible again for the anti-collision system. When the system is turned off, the LOGOUT operation is automatically performed.



For the login operation, enter the unequivocal ID in the space:
USERCODE: unequivocal numerical code of 6 figures: the code usually coincides with the TAG own code.
Use the numerical keyboard to enter the code.

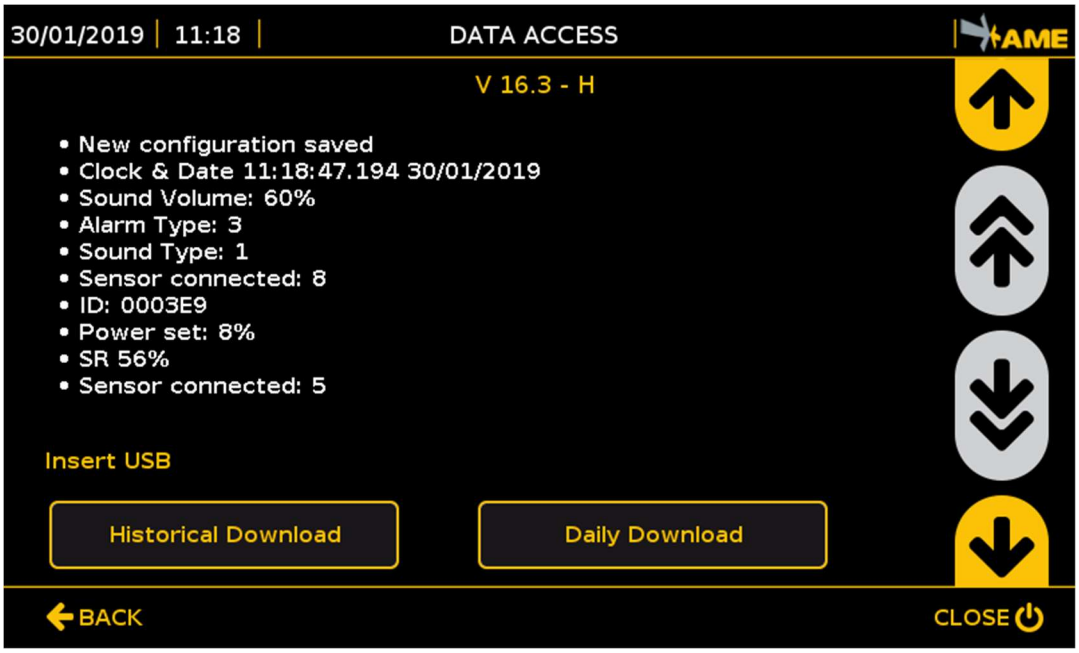
To delete only one character:

To delete all characters together:

Once the code has been entered, press OK. The system automatically returns to the main screen.

In order to log in, the list of users must have been added to the system (see section 11.8).

10.6 DATA ACCESS



Press the key with the USB icon and enter the relevant password to access the data page in which the history of events is shown.

Up to 1,000 events can be displayed, including:

- **TAGS detected** with the following information: detected TAG code - activated sensor - date and time - position (if the GPS module is enabled)
- **Configurations carried out**: type of configuration and saved data.
- **Shocks** (if the shocks module is enabled) with the following information: date and time - GPS coordinates (if the option is installed) - shock intensity.

Use the side arrows to scroll the list of information.

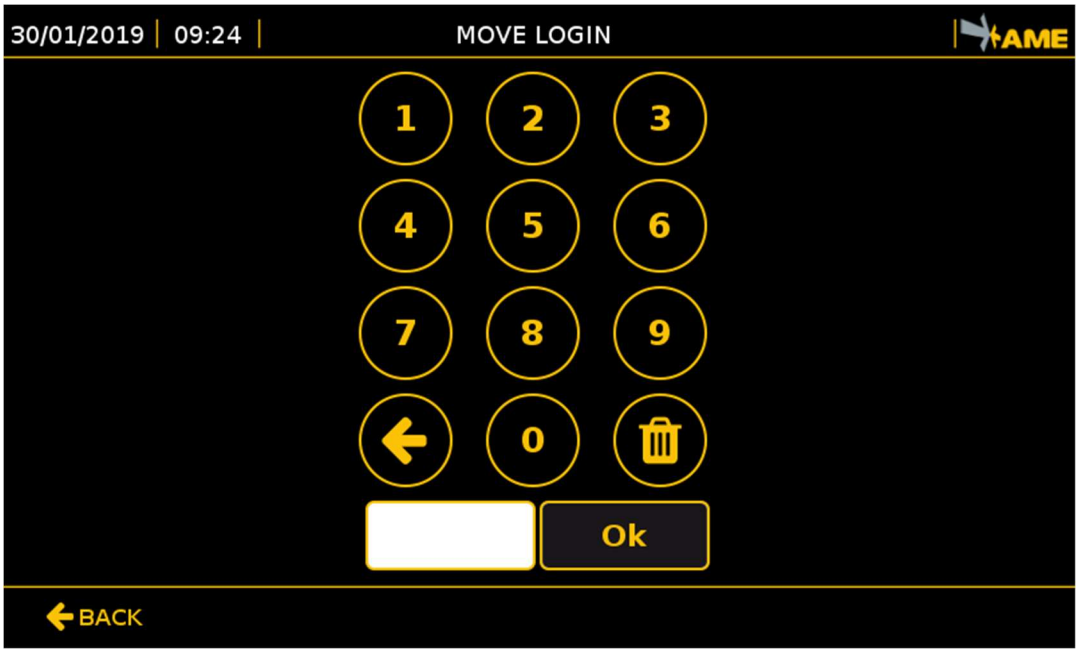
Moreover, in this section, once a USB is inserted into the specific input of the CPU, data can be downloaded by using the following keys:

Daily download: the daily events are downloaded to the USB.

Historical download: the events of the previous 60 days are downloaded to the USB. Any data older than 60 days is automatically deleted from the system.

11 BASIC CONFIGURATION

11.1 ACCESS TO MENU



Press the CONFIGURATION icon to access the menu

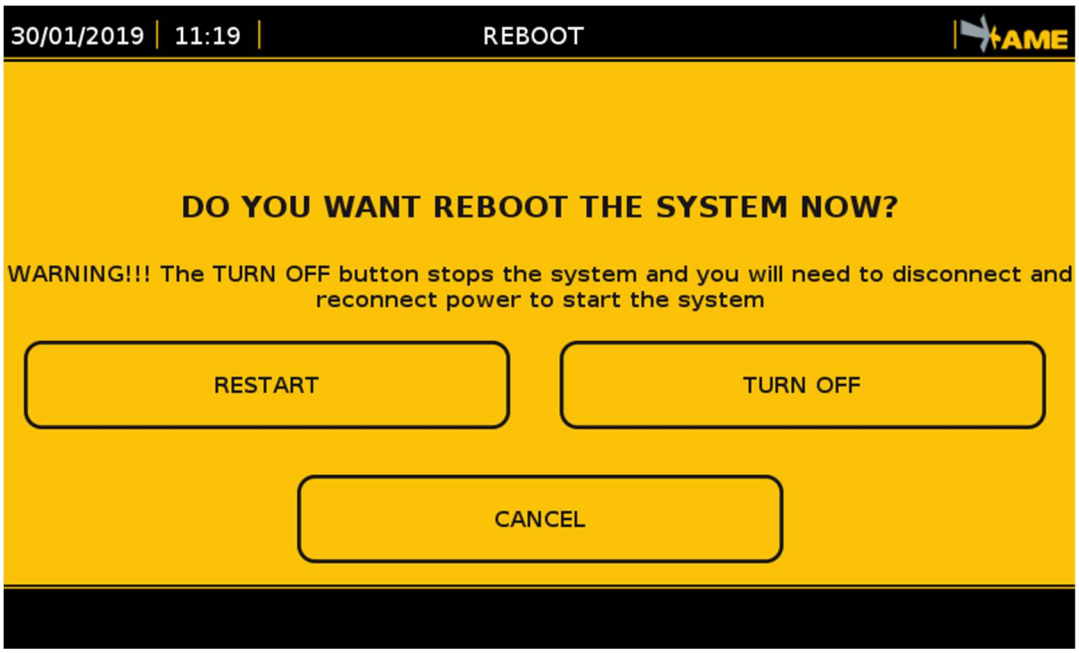
To access the system configuration section, a password must be entered so that only the enabled user can view this screen.

The default password is **1234**.

11.2 REBOOT

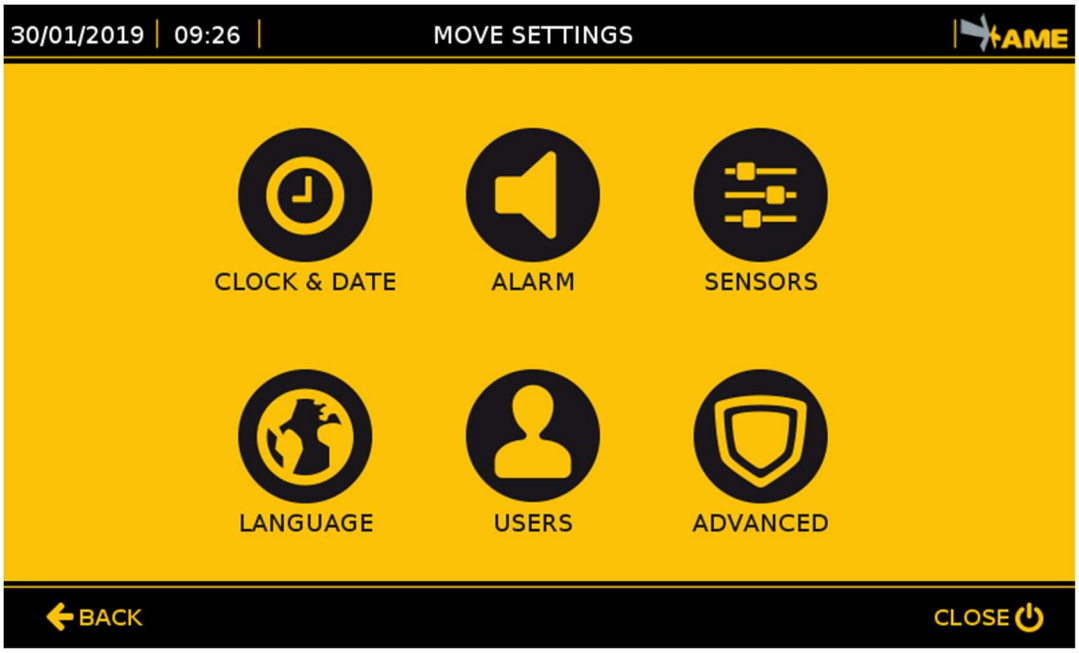
To reboot or stop the system, enter the specific password and open the configuration menu.

CLOSE key to reboot the system. If necessary, press this key to reboot the system. This key is shown in all the configuration screens



If the system is turned off, you will need to disconnect and reconnect power to restart it.

11.3 CONFIGURATION MENU



In the configuration menu, you can:

- Set the system Time and Date
- Configure the Modes of the alarms
- Configure the sensors (System Calibration)
- Select the language preferred
- Set the master data of users/drivers
- ADVANCED configurations: only authorised installers can have access to them.

Press the dedicated key to select the function.