INSTALLATION AN OPERATING GUIDE

METEODATA-4000

Weather System

EN

V1.0

senseca

Contents

1 Introduction

This document describes the steps for correct installation and commissioning of a complete weather system based on Senseca's MTD-4000 model (METEODATA-4000).

The use of this document is strongly recommended during installation, commissioning, maintenance, etc., to save time and to avoid common mistakes during this process.

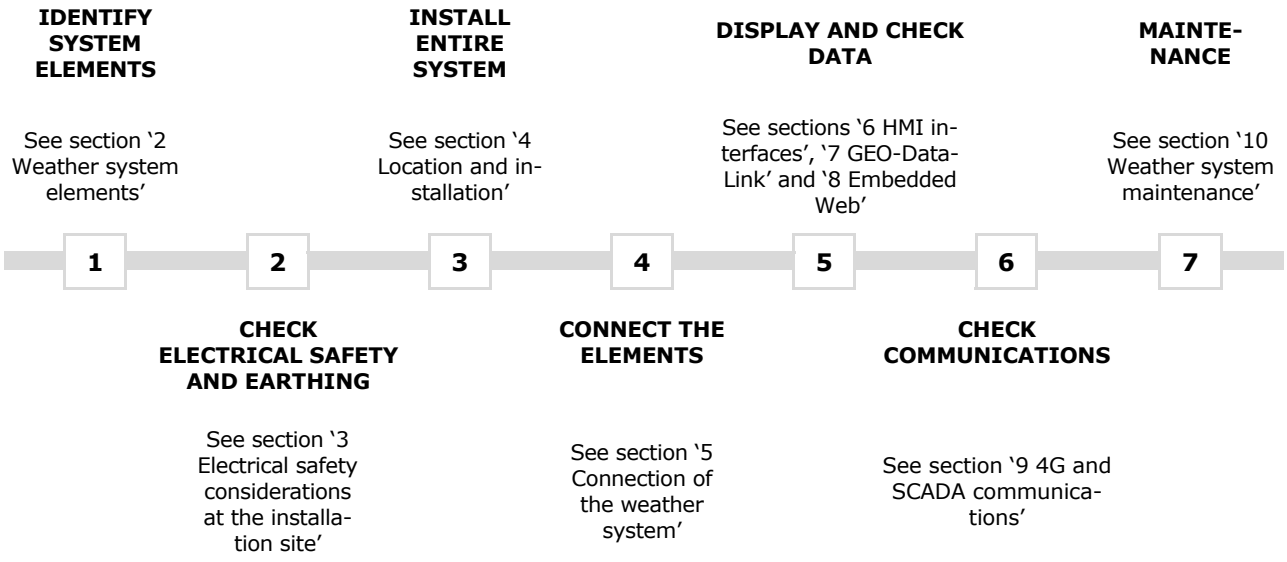


Fig. 1.1: Steps

2 Weather system elements

The weather systems are supplied packed on independent pallets, so that each pallet contains a complete system that is fully adapted to the project requirements and to the specific location: fully configured MTD-4000 stations, types and quantity of sensors, specifically calibrated solar radiation sensors, prearranged cable lengths, specific fixing elements, etc.

Considering the above, the recommended steps are: unpacking, classifying, and subsequently identifying the elements of each weather system after the reception of the materials. This will avoid mixing elements that belong to another system, and therefore the need to uninstall or disassemble them once they are deployed in the field.

The main elements that make up the weather system are detailed below:

2.1 MTD-4000 station:

The MTD-4000 station is responsible for powering the sensors, reading the signals they send and storing the instantaneous readings and/or statistics in its internal memory, for subsequent transmission to a data reception center or a local SCADA system. The MTD-4000 station can store up to 2 years of data in its internal memory. The data will always be available to be automatically transmitted in real time, through each of the integrated communication interfaces: Ethernet, 4G Modem, Wi-Fi, etc.

Attention!

The stations supplied are fully configured for the kit of sensors, power supply and communication interfaces requested by the customer in each project and site. It is therefore very important not to mix or swap elements of one station with those of similar systems.

2.2 Sensors

MTD-4000 weather stations can include sensors for measuring any type of variable, for example: Wind Speed and Direction, Temperature and Relative Humidity, Barometric Pressure, Solar Radiation (Global, Diffuse Direct, Inclined, Reflected, etc.), Precipitation, Soil or Surface Temperature (for solar panels), etc.

These meteorological sensors are classified according to the supplied output:

- **Analogue**: They provide an output signal in voltage, current or resistance, which is proportional to the measured weather variable.
- **Digital**: The output is provided as a status (logic 0 or 1) or a digital train of pulses that changes in frequency or amplitude proportionally to the measured weather variable.
- **Smart**: These sensors have an internal microcontroller that processes the source signal and delivers it through a specific communications protocol: SDI-12, Modbus RTU, ASCII NMEA, Binary, etc.
- **Virtual**: These signals are generated by the station itself based on a specific algorithm or internal function. This type of channel is commonly used for Sun position calculations as solar elevation or solar azimuth, which are obtained by executing an astronomical algorithm in real time.

2.3 Cables

Senseca weather systems include three main types of cables: signal, power, and communications cables. Regardless of their function, all the cables should have a robust outer sheath for protection against moisture and UV rays, as well as to withstand gnawing by rodents in underground conduits.

- **Signal cables**: Responsible for supplying power from the station to the sensors and for routing analogue, digital, etc. signals back to the station for their measurement and processing. This type of cable has a smaller cross-section and a shield to ensure the integrity of the signal against the electrical noise at the site.
- **Power cables**: With a larger cross-section, they are used to supply energy to the entire weather system, either from a solar panel, external battery or from mains electricity at the site.

In these cases, shielding is not usually necessary, but a larger section to minimize energy loss is strongly recommended.

- **Communication cables**: Responsible for channeling the flow of information between the smart sensors, the station and the SCADA system or data retrieval software. The most commonly used communication cables in weather systems are:
    - UTP Ethernet cables: Like those used in LAN data networks, they permit bandwidths from 10 MBit/s to 1 GBit/s. They have a robust sheath compatible with outdoor use. They are commonly used to connect the weather system to the site data network at distances of less than 50m.
    - Fiber optic cables: They do not contain copper conductors but instead feature a pair of fiber filaments. Depending on the distance to be covered and the bandwidth required, from 10MBit/s to 1GBit/s, fibers with Multimode technology will be used to cover distances from 1 to 2 km and Single mode fibers for distances of up to 40 km. Fiber optic cables have a limited curvature radius, which must be considered when designing the layout of the conduits, elbows, and branches they run through. They are commonly used for the connection of the weather system to the site data network. The galvanic isolation capacity, intrinsic to this technology, allows protecting the active elements located at both ends of the line from power surges, discharges, or noise in the communication lines.
    - RS232, RS422 and RS485 serial cables: These cables have a more limited bandwidth, less than 100Kbit/s for distances of up to 200m. They incorporate a certain number of copper pairs, usually 1 or 2 twisted pairs, protected by a shield to strengthen the immunity to noise. Some of these cables also include power wires, usually low cross-section, to provide power to the smart sensors to which they are connected. They are commonly used to connect smart sensors and the datalogger or weather station.

2.4 Fastening equipment

Their main function is to secure all the elements of the system. They are made of highly corrosion resistant materials with sufficient capacity to withstand the stresses they are subjected to.

The most common fastening elements are: Weather tower, guy wire rings, antenna and/or lightning rod masts, specific supports for sensors, MTD-4000 station attachments, etc.

The following sections describe the main fastening tools together with their main characteristics and the function they perform within the system.

2.5 Communication systems

Some of the communication interfaces are already integrated in the MTD-4000 station (Ethernet, Wi-Fi and 4G Modem). However, additional interfaces are sometimes required to ensure interconnection with other devices or data networks.

- **Fiber Optic Converters**

These allow the weather system to be connected to a long-distance LAN. The fiber connection offers great advantages such as electrical isolation and high bandwidth in both SINGLE-MODE and MULTI-MODE versions.

- **4G routers**

Some projects require connecting devices such as video surveillance cameras, alarm systems, satellite transmitters, etc. to the weather system. The use of 4G routers makes it possible to interconnect all these elements, simplifying their integration into a single data network at a lower cost.

2.6 Documentation package

Senseca supplies a complete dossier of technical documentation in digital format with each weather station accessed by a QR code or a link. This documentation package includes the following documents:

- Recommendations and warnings
- Datasheets
- Manuals
- Installation recommendations
- Wiring connections for sensors
- Modbus maps of variables
- Quality certificates
- Sensor certificates
- Shipping
- Installation reports

Some of this documentation (wiring diagrams, list of sensor connections, quick start-up guides and Modbus maps) is also supplied in physical format, inside the station cabinet, to be used during the system installation and start-up tasks.

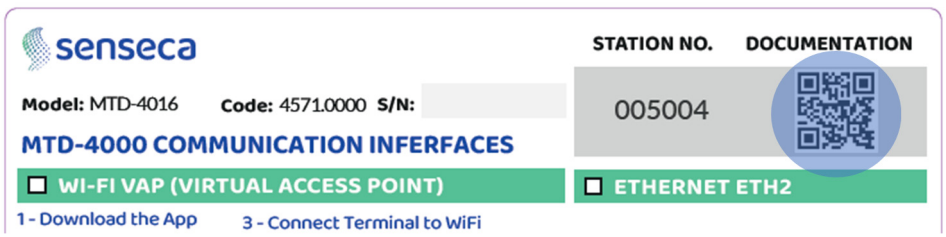


Fig. 2.1: QR for project documentation.

3 Electrical safety considerations at the installation site

With technological progress of VLSI chips (very large scale integration), component deterioration caused by ESD discharges increases exponentially. The state of the art is constantly evolving in order to provide efficient protection against ESD, which always requires a correct earthing connection. Read article.

The MTD-4000 stations include a complete set of protections against atmospheric discharges, already integrated on their motherboard: gas dischargers, varistors, transzorbs, etc. For proper operation, these protections need to be connected to the site's earthing system. Correct installation of the earthing network, as well as connection of the system to it, are essential to guarantee the optimum operation of these protection devices, which will extend the useful life of all the instrumentation.

To ensure proper earthing, rules listed below should be observed:

For installations in buildings, the earthing conductor must be connected to the earthing system of the building where the equipment is located. In isolated installations, a local or dedicated earth connection should be used, if the existing one is not available or if it does not comply with the necessary safety requirements (see following sections).

Under no circumstances should the weather station's earthing system be connected to the main lightning arrester. Ensure the system's earthing conductors are always connected right at the earthing connection point (see 6 at Fig. 3.1 and see 9 at Fig. 3.2).

The earth line impedance should be as low as possible to maximize protection against atmospheric discharges or transient currents. Impedance of less than 5 ohms, measured from the station side is recommended.

In case of noise problems in the sensor signals induced by the earth line, check that other systems are not sharing the same earthing conductor particularly if they carry large amounts of power (motors, cooling systems, uninterrupted power supplies, etc.). If this occurs, an independent earthing conductor must be wired from the equipotential bonding strip to the weather system.

The sections of the earthing conductor connected to the MTD-4000 station should be sized according to the following table:

Cable length - L (m)	**Conductor cross section – S (mm^2)**
L > 25	S > 16
10 < L < 25	S > 10
L < 10	S > 6

Warning!

In installations where the earth connection does not meet the specifications described in this section, the sensors, power supply, communications, etc., must be disconnected from the station and it will turned off using the main switch. The station will be left in that status (disabled) until the earth connection is reconnected in accordance with these instructions..

3.1 Installation of the lightning arrester

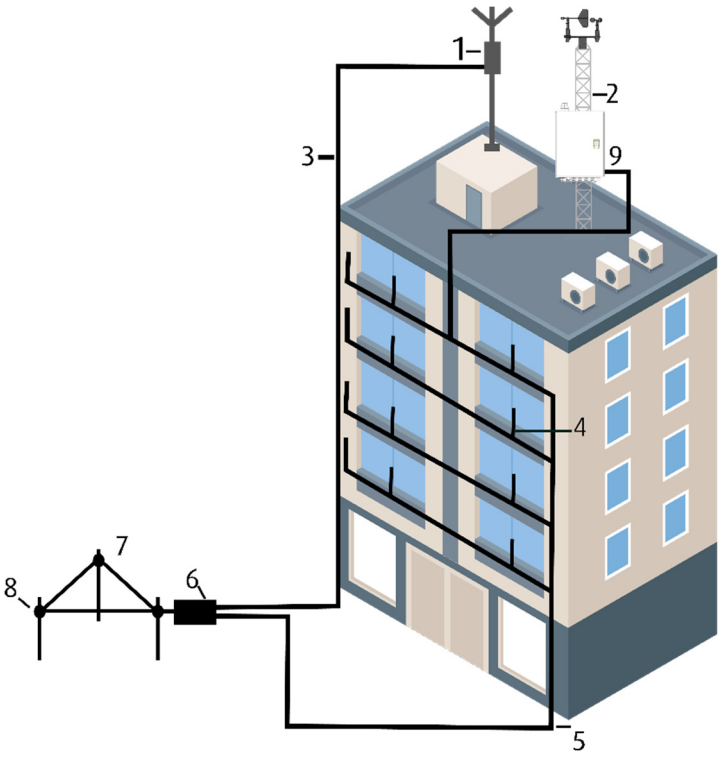
To maximize the level of protection, installation of a lightning arrester at an enough height to ensure coverage of the entire weather system within its protection cone is recommended. See technical specifications for each lightning arrester.

The lightning arrester must be installed in accordance with the current regulations of the country where the installation is located. A deficient lightning arrester installation can have the opposite effect to that expected and can cause damage to the equipment due to a lack of insulation or capacity to direct the energy to earth.

3.2 Installation on buildings

This classification includes buildings of a certain size or concentration of buildings. In these cases, the following recommendations should be followed:

- The building must have an earthing network joining all the structural metallic elements of the building, becoming an earthing equipotential network.
- The earthing of the weather system shall be connected to this earthing network of the building.
- The installation of the lightning arrester and downward earthing conductor must be performed according to each country's / region's standards.
- The installation of the lightning arrester (discharge conductor, poles, metallic flanges, etc.) must not share assembly elements with the installation of the measuring equipment and instrumentation, especially if they are metallic.



1 Lightning arrester

2 Weather system

3 Lightning arrester earthing conductor

4 Internal earthing network

5 General earthing conductor

6 Equipotential bonding strip

7 Grid of earth electrodes

8 Equipotential bonding of earth electrodes

9 Weather system earthing conductor

Fig. 3.1: Installation on buildings

3.3 General installation in remote areas

In this case, the weather system is located away from populated areas, normally isolated from buildings or other electrical, control or instrumentation installations. In this type of location, the use of lightning conductors considerably increases the level of protection, especially when the weather tower is high and/or located on mountaintops or in very exposed areas.

In these cases, the following recommendations should be followed:

- A single earth grid with an impedance as low as possible (< 5 ohm) should be provided. The lower the earthing impedance the greater the effectiveness of the ESD protection. It is a key element to have a single earth grid at these sites to avoid undesired differential voltages.
- The earthing system must be constructed using fixings, supports and connections made from corrosion-proof materials.
- The lightning arrester should be installed on an adjacent tower (don't use the same tower as the weather system). All of the elements to be protected: data acquisition systems, computers, electronics, sensors, solar panels, etc. must be placed under the protection cone.
- An electrolytic copper conductor with a recommended cross section of 50 mm2 shall be used for the connection between the ESE lightning arrester and the equipotential bonding strip. Along the path down to the equipotential bonding strip, the conductor must be galvanically bonded to the tower at regular intervals (every 50 cm is recommended as a minimum). This recommendation aims at achieving equipotentiality between the tower and the earthing conductor during any discharge current impulse.
- All the metallic elements of the installation (towers, fastenings, etc.) must be connected to equipotential connection strips by means of a dedicated independent conductor other than the lightning arrester earthing conductor.
- The instrumentation and electronics must also be connected to the equipotential bonding strip using an independent conductor.
- The lightning arrester conductor should never run too close to other cables (signal, power supply, sensors, etc.). The high current peaks produced in the discharge conductor could induce dangerous voltage levels in the cables connected to delicate instrumentation.
- When it is not possible to avoid running the cables in parallel, it is advisable to follow the considerations listed below:
    - The signal cables must be separated as far possible from the lightning arrester’s discharge conductor.
    - Protecting these conductors using a metallic corrugated pipe.
    - Use shielded cables.
    - Connect the earthed shield at only one end of the cable, always on the side closest to the electronic equipment or sensors to be protected.

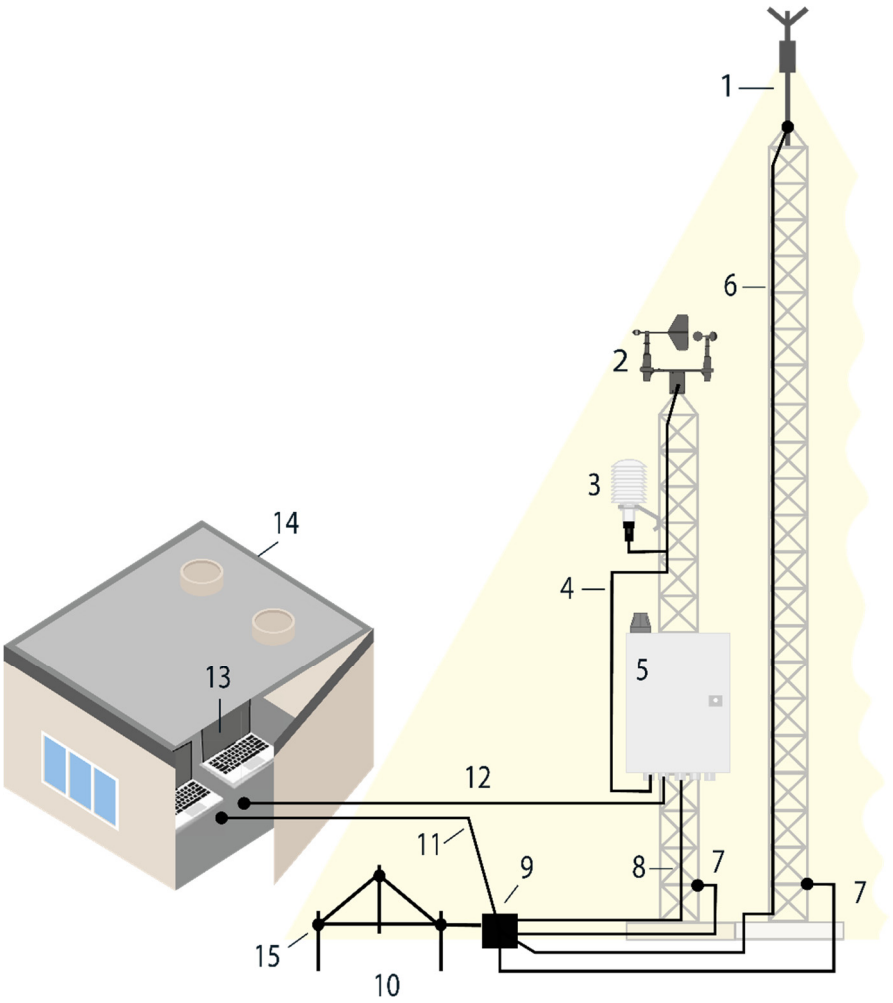


Fig. 3.2: General installation in remote areas

1 Lightning arrester covering the station and sensors
2 Wind sensor
3 Temperature and relative humidity sensor
4 Signal cable (shielded, away from line 6)
5 Data acquisition system MTD-4000
6 Lightning arrester earth discharge conductor line (50mm²)
7 Tower earth conductor
8 Weather system earth conductor
9 Equipotential bonding strip
10 Grid of earth electrodes
11 Control house earth conductor
12 Data transmission cable
13 Computer equipment
14 Control house/SCADA, etc.
15 Equipotential bonding of earth electrodes

3.4 Specific installation on photovoltaic solar plants

All the recommendations described in section 3.3 can be applied to installation in solar plants. In this type of facility, the following points must also be taken into account:

- An independent local ground must be installed for the meteorological system (**'Instrumentation' ground**) with the lowest possible resistance (< 5 Ohm) at a maximum distance of 5 meters from the tower.
- The meteorological system cabinet will be connected to the 'Instrumentation' ground via the terminal provided for this purpose located inside it.
- The tower must be connected to the same 'Instrumentation' ground point as the station cabinet. If the tower is painted, it must be stripped to ensure good contact.
- If a lightning conductor (optional) is installed, connect to the 'Instrumentation' ground diversion point. See point 7 in Fig. 3.3.
- The plant must have its own ground network (**'Power' ground**). The panel arrays (the piles and panel structures - see point 24 of Fig. 3.3) must be properly connected to the ground, along with the inverter, communications, power, etc. cabinets.
- Any communications element of the plant (switch, router, etc.) that is connected to the meteorological system via Ethernet must be correctly grounded (plant ground network). These elements are usually grounded via their housing, which must be connected to the cabinet's ground bar, which in turn must be connected to the plant ground.
- The 'Instrumentation' ground must be connected to the plant ground ('Power' ground) by direct bonding to ensure the equipotential. See point 22 in Fig. 3.3.
- Cables from sensors must be routed away from inverters, panel cables and any other high-energy plant element.
- For tracker-mounted pyranometers (Plane Of Array (POA)), consult the connection/isolation recommendations described in the connections list created specifically for each meteorological system. In general, Tracker-mounted pyranometers must be isolated from the structure by means of POM-C plastic insulation. They are grounded via the 'Instrumentation' ground.

Protections required in power supply and communications cabinets

In solar power plant installations, especially during the commissioning phase, power disconnections and electrical transients are common and can potentially damage electronic equipment. To ensure the protection of the meteorological system, the installation of the following protection devices in the plant cabinets is recommended:

- **ESP-100-POE**: A surge protection device for transient failures at Ethernet lines.
- **GEO-COMBI-PRO:** Protector against transient mains failures and permanent failures typically caused by neutral disconnection (undervoltage/overvoltage), with automatic reconnection. It must be installed in the plant cabinet supplying VAC to the weather system.

The meteorological system's need to use the 'Instrumentation' ground

- Meteorological sensors, especially solar radiation sensors, deliver a very weak signal (few microvolts) at their output. This low signal level requires the complete removal of the noise coupled to both sensor cables and station electronics.

- The 'Instrumentation' ground is installed under the meteorological tower at a short distance from the station (< 5 m) and has a resistance of less than 5 Ohm.
- The characteristics of the 'Instrumentation' ground allow the noise coupled to the sensor signal cables to be effectively removed thanks to the existing EMI filters in the sensor and station electronics. EMI filters work optimally provided that the ground is of a good quality and does not have a high level of coupled noise.
- The 'Instrumentation' ground undergoes periodic maintenance every 6 months, which coincides with the periodic revisions of the meteorological system, sensors, etc. This means that its low ohmic resistance and low noise levels are maintained optimally and periodically.

The meteorological system's need to avoid the 'Power' ground

- The 'Power' ground usually has higher resistive values, longer maintenance periods and coupled electrical noise from POA inverters, electrical network, etc.
- EMI filters cannot remove the signal noise from the sensors if the 'Power' ground has coupled electrical noise.
- If the intrinsic noise of the 'Power' ground is very high, it is coupled to the station's electronics and the sensor cables, which further degrades the quality of the measurements.
- One of the main causes of malfunctions in tracker-mounted pyranometers is the lack of a quality ground connection.
- Sometimes the tracker piles are grounded, but in many cases the hoses that connect the mobile structure to the piles are missing, leaving the metal parts that support the solar panels floating, where the pyranometers are fixed, and exposed to ESD and EMI.

Need to connect both grounds

- The communications and power cabinets are connected to the 'Power' ground of the plant, on one side, and to the meteorological station, on the other, which in turn is connected to the 'Instrumentation' ground.
- All interconnected elements of the solar plant must have an equipotential ground reference. For this reason, both grounds must be connected at point 'A' of Fig. 3.3.
- In the event that the 'Power' ground is not maintained, the meteorological system will always have a quality 'Instrumentation' ground, as a back-up, which is well maintained and with a very low ohmic value.
- The noises inherent to the 'Power' ground are greatly attenuated thanks to the low resistance of the 'Instrumentation' ground located next to the meteorological instrumentation.

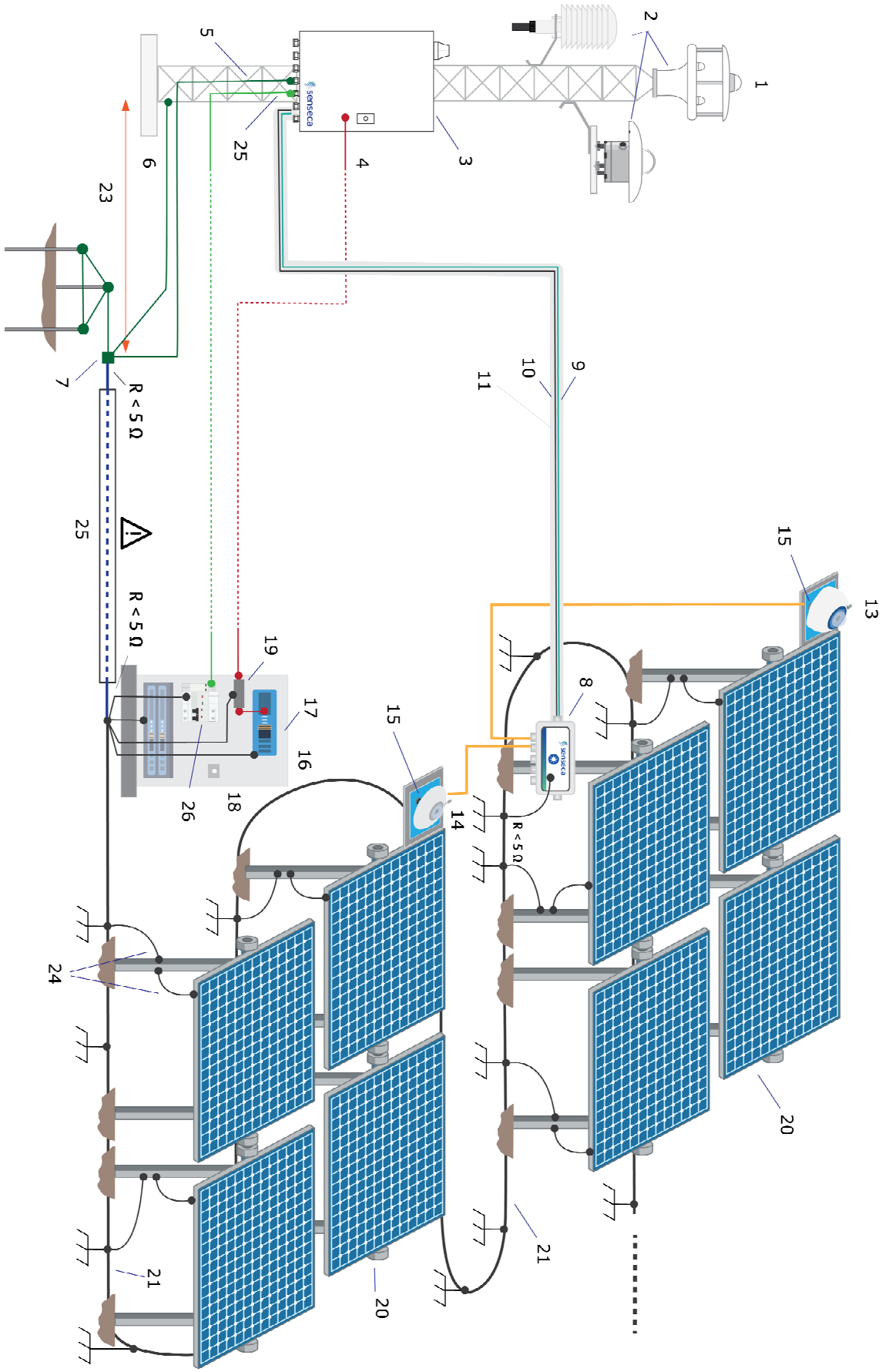


Fig. 3.3: Installation in photovoltaic solar plants

1 Meteorological system

2 Tower sensors

3 Meteorological system cabinet

4 Meteorological system Ethernet

5 Station grounding (instrumentation ground)

6 Tower grounding (instrumentation ground)

7 Instrumentation ground diversion point (optional met. sys. lightning conductor connection point)

8 SmartBox-8CH

9 Signal line

10 Ground line

11 Shielding

12 SmartBox-8CH connected to ground

13 Pyranometer

14 Pyranometer

15 POM-C insulation

16 Inverter, communications, power cabinet

17 Plant switch

18 Switch housing connected to ground (cabinet and plant)

19 ESP-100-POE Ethernet protection

20 Tracker-mounted panel arrays

21 Plant ground network (power ground)

22 Bridge between instrumentation ground network and power ground network

23 Tower to ground distance (must be less than 5 meters)

24 Ground connection of piles and panel structures

25 Mains power supply 100-240 VAC

26 Mains protection against transient failures and permanent failures due to neutral disconnection (overvoltage and undervoltage), etc.

4 Location and installation

MTD-4000 stations allow the connection of practically any sensor available on the market. The advantage of such versatile compatibility makes it difficult to describe a generic definition of the optimum site, since the characteristics of the site will depend on the meteorological variables to be measured and therefore on the number and type of sensors integrated in each system.

The following is a description of the requirements that the location of the weather system must meet, considering only the most common sensors. In all other cases, users should carefully review the installation recommendations in the specific manual of each sensor. In case of doubt, contact **technicalsupport.madrid@senseca.com**.

4.1 Weather tower

For the location of the tower, as the main element of the weather system, the following recommendations should be followed:

- Choose a location in an open area, away from trees, buildings, fences or nearby structures.
- The vegetation cover at the selected site should be representative of the surroundings of the area to be measured. In this way, the measurements obtained by the system will reflect the actual climatic conditions of the area or region to be monitored.
- The tower shall be located on flat ground. The type of ground must be capable of supporting the foundations of the tower itself and the associated wind line anchors. Avoid sandy or unstable soils.
- For towers supplied by Senseca, the customized foundation and civil works plans for each system must be consulted. Special attention should be paid to the orientation of the tower with respect to the north-south axis, always following the indications on the plans.

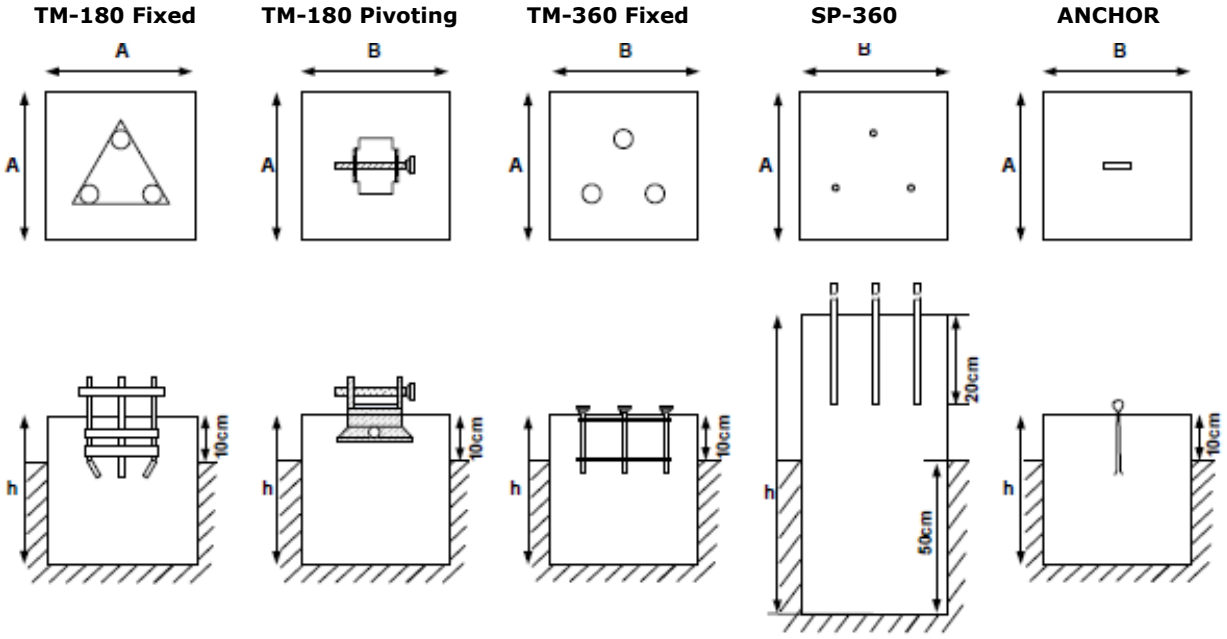


Fig. 4.1: Foundations.

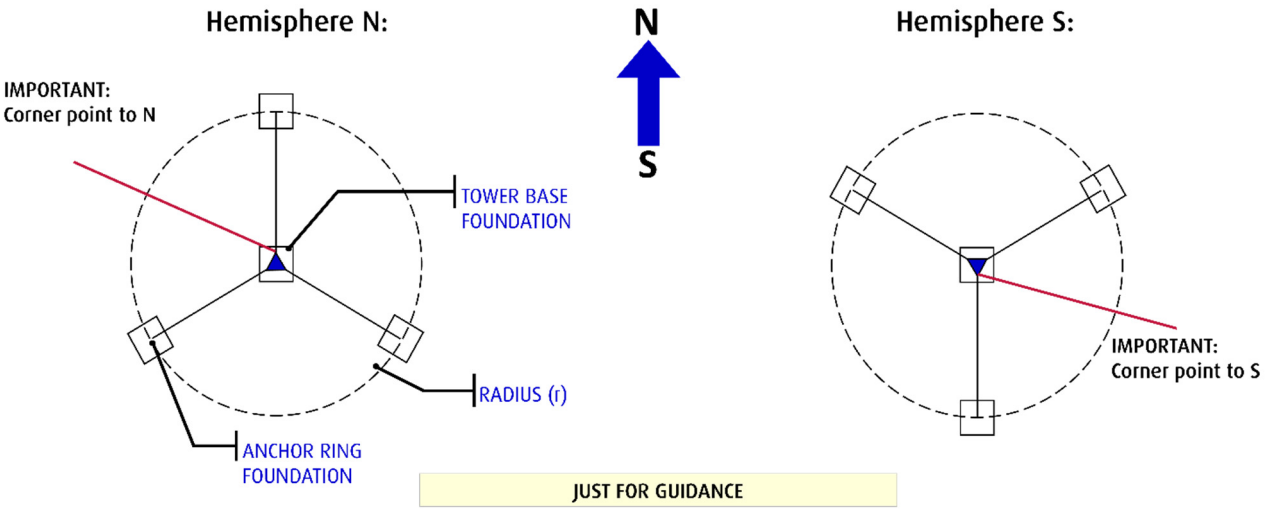


Fig. 4.2: Tower orientation.

(*) Typical values	Tower base foundation (cm)			Anchor ring foundation (cm)			
	A	**B**	**h**	**A**	**B**	**h**	**r**
TM-180-03 (3 meters tall, 180mm wide) fixed	60	60	50	-	-	-	-
TM-180-06 (6 meters tall, 180mm wide) fixed	40	40	50	80	80	60	200
TM-180-09 (9 meters tall, 180mm wide) pivoting	40	40	50	90	90	60	300
TM-180-12 (12 meters tall, 180mm wide) pivoting	40	40	50	100	100	70	400
TM-360-03 (3 meters tall, 360mm wide) fixed	80	80	60	-	-	-	-
SPL-4100 / SPL-5200 Pluviometer Supports	40	40	50	-	-	-	-
SP-360 Sun Tracker Support	50	50	100(*)	-	-	-	

4.2 MTD-4000 Data Acquisition System (DAS)

The MTD-4000 station can be installed in locations with extreme temperatures, high humidity, desert regions, etc., thanks to the exceptional qualities of the station's protection cabinet:

- IP66 weather protection
- UV Resistance
- Anti-corrosion paint with C3 type certification (optional C4).

The following are the considerations to be taken into account for correct installation of the station:

- The station cabinet shall be anchored to the tower at a height that makes operation and maintenance of the system as convenient as possible. It is recommended that the graphic display or front label is located at the operator's eye level.
- Installation on the tower, next to the solar panel, minimizes energy losses by reducing the length of the power cable.

The MTD-4000 can be optionally supplied as independent as OEM unit with an aluminum IP40 enclosure.

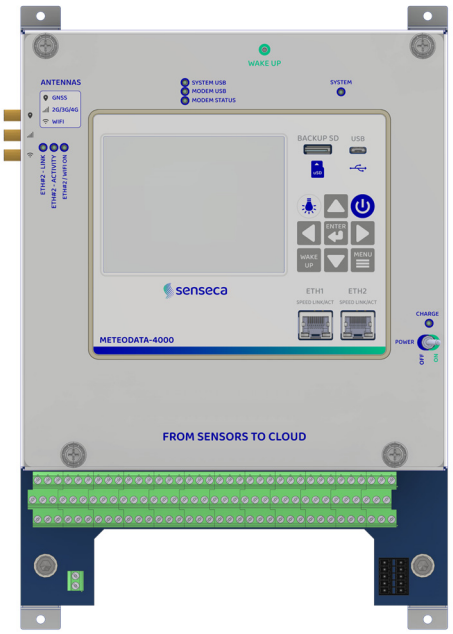


Fig. 4.1: MTD-4000-P

4.3 Recommended tightening torque

The following table represents the recommended torque for the fastening of each steel bolt involved in the installation, considering a friction coefficient of μ = 0.14.

Size (steel)	Torque MA (Nm)		
	Grade 8.8	Grade 10.9	Grade 12.9
M4	3.2	4.6	5.5
M6	11	16	19
M8	27	40	46
M10	54	79	93

4.4 Wind speed and wind direction sensor

The following considerations are recommended:

- Whenever possible the wind sensor should be installed at a standard height of 10 m (WMO & EPA) above the ground. Installation at specific heights may be required for certain projects.
- Any obstacles that may affect the behavior or stability of the wind in the sensor's measurement environment should be avoided.
- If there are any obstacles, the sensors should be placed at a distance greater than or equal to 10 times their height (WMO & EPA).
- The wind direction sensor or wind vane should be oriented in the direction of GEOGRAPHICAL north.

- Avoid confusing GEOGRAPHICAL north with that obtained using compasses or MAGNETIC north. Make use of specific cartography or software to identify GEOGRAPHICAL north at the site. The following table represents the recommended torque for the fastening of each steel bolt involved in the installation, considering a friction coefficient of μ = 0.14.

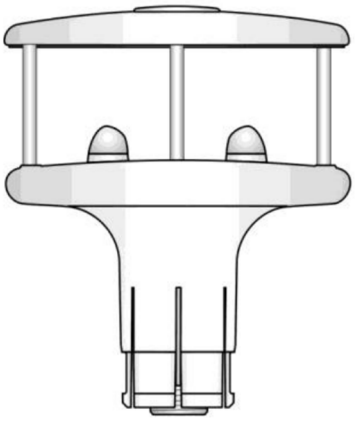


Fig. 4.3: Wind sensor

4.5 Temperature, relative humidity and dew point sensor

The following considerations are recommended:

- This type of sensor is accompanied by a solar radiation shield, natural or forced ventilation, to prevent direct sunlight from entering and affecting the measurement.
- It shall be installed in an area that allows free circulation of air, at a height between 1.25 and 2.0 m (WMO) from the ground and at a distance from the tower greater than or equal to its span.
- In general, it is extremely important to locate the sensor as far away as possible from objects that emit infrared (IR) radiation because they are at higher temperatures than the surrounding environment.

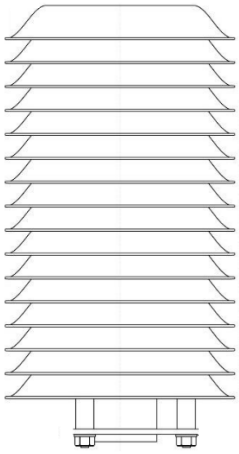


Fig. 4.4: Temperature and humidity sensor

4.6 Solar radiation sensor

The following considerations are recommended:

Solar radiation sensors should be installed in open areas where sunlight falls during the day, both in winter and summer.

- They shall be located away from objects or structures that can cause considerable reflection of sunlight.
- Avoid installation close to objects or structures that may emit IR radiation due to their high temperature at any time of the day.
- Avoid installation close to artificial light points that may switch on during the night.
- For most applications it is enough to place the sensor at a height of more than 3m above ground level. In any case, the required height dimensions for each project must be considered.
- For measurements on a horizontal plane, pay special attention to correct levelling, using the spirit level integrated in the sensor.
- For measurements on a tilted plane, level the sensor on its support previously adjusted to 0º and then adjust the support to the angle required in the project.
- When the location is in the northern hemisphere, the sensor should be oriented towards the south and vice versa in the southern hemisphere. This will make it more difficult for any objects in the environment to cast shadows and interfere with the measurement.

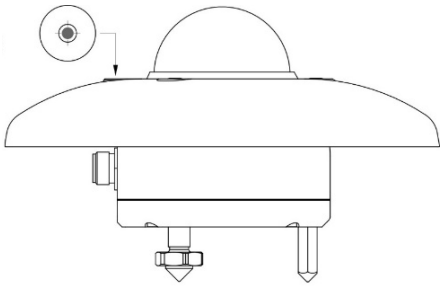


Fig. 4.5: Solar sensor

4.7 Rainfall sensor

The following considerations are recommended:

- A site as open and flat as possible should be chosen, with vegetation not exceeding the height of the top of the sensor's collecting cone.
- For locations with low winter temperatures, the sensor should include a heater and therefore, a connection to the mains will be required.
- If the location receives heavy winter snowfall, install the sensor so that its drainage outlet, located at the bottom, is above the maximum expected snow level.
- The rainfall sensor should never be located lower than 0.3m above the ground (WMO).

- Avoid locations close to trees. Falling leaves, as both leaves and pollen can block the collection hole located in the sensor's collecting cone.
- In locations exposed to wind, use the SPL-4100 brackets, supplied by Senseca. These brackets have been designed to provide maximum stability against vibrations caused by wind.
- In locations with extremely strong winds, it may be necessary to install a wind screen specifically for rainfall applications.

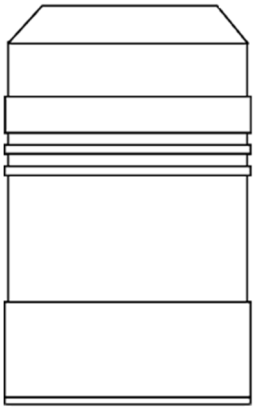


Fig. 4.6: Rainfall sensor

4.8 Solar panel

The following considerations are recommended:

- Preferably attach it to the structure of the weather tower, making use of the support kit supplied.
- Ensure that it is attached at a height from the ground that maximizes exposure to sunlight.
- It should be oriented towards the South in locations located in the Northern hemisphere and vice versa in the Southern hemisphereto minimize the projection of shadows from other nearby objects.
- The mounting bracket supplied allows the panel tilt to be adjusted in order to optimize its performance at different times of the year. For intertropical latitudes, a tilt from 60º in winter to 30º in summeris recommended. If you do not wish to change the tilt throughout the year, adjust to an angle adequate for the winter, to maximize energy collection during the time of year when sunlight is most critical. For installations in other latitudes please contact technical team.

4.9 Soiling measurement sensor, MDFS2

Windblown dirt, deposited on the surface of solar panels, significantly reduces their performance and consequently the energy generation in solar power plants. Due to this, the operators of these facilities invest large amounts of financial resources in keeping their panels clean.

The MDFS2 sensor allows cleaning processes to be optimized by ensuring that cleaning only takes place when the attenuation measurement, provided by the sensor, exceeds the thresholds established by the plant managers.

For correct installation of this sensor, the following considerations should be taken into account:

- The sensor shall be placed as close as possible to the panels whose attenuation is to be monitored.
- In solar plants with fixed-tilt panel STRINGS, the sensor can be placed on the tower of the weather system (if it is in a nearby area) or fixed on the panels structure. In these cases, the tilt of the MDFS2 sensor will be adjusted according to the tilt set by the solar plant manager.
- In solar plants with variable tilt panel STRINGS, fix the sensor to the STRING structure so that it is aligned with the automated tracking plane.
- The MDFS2 sensor provides both solar radiation and SOILING readings.

After installation and subsequent connection to the weather system, only the solar radiation measurements provided by the sensor will be available. For attenuation readings to be available, the sensor will need to be paired according to the solar elevation and solar radiation threshold criteria reflected in the manual.

5 Connection of the weather system

After installing the sensors and the station in their final location, it is time to begin with the tasks of connecting the sensors, power supply lines and communications networks that make up the weather system. To carry out this task, the following recommendations must be considered.

Sensors Connection List

For MTD-4000 stations, a document containing a "Sensors Connection List", which is exclusive to each system, is supplied. This document describes the connection details only between the sensors and the station by automatically adding a reference (for example: REFERENCE: 80292-1) at the beginning the connection description for each sensor, which will match the one that appears on the label attached to the sensor cable supplied. The last digit of the reference '-1, -2, etc.' is used to identify those sensors of the same type that share the same sensor side wiring.

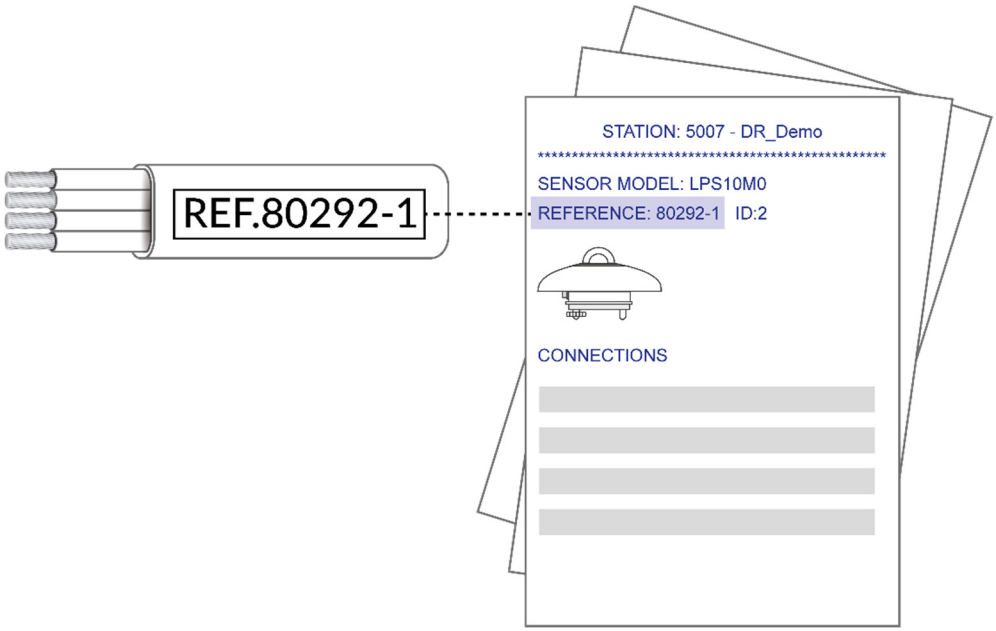


Fig. 5.1: Cable reference on the "Sensors Connection List"

General wiring diagram and essential earthing recommendations

The connection list includes a page of essential earthing recommendations and a general wiring diagram, common to all MTD-4000 stations. The general wiring diagram contains wiring instructions for:

- The mains power supply lines: solar panel, battery or external power supply.
- Communication subsystems: Ethernet, fiber optics, satellite transmitters, field buses, etc.

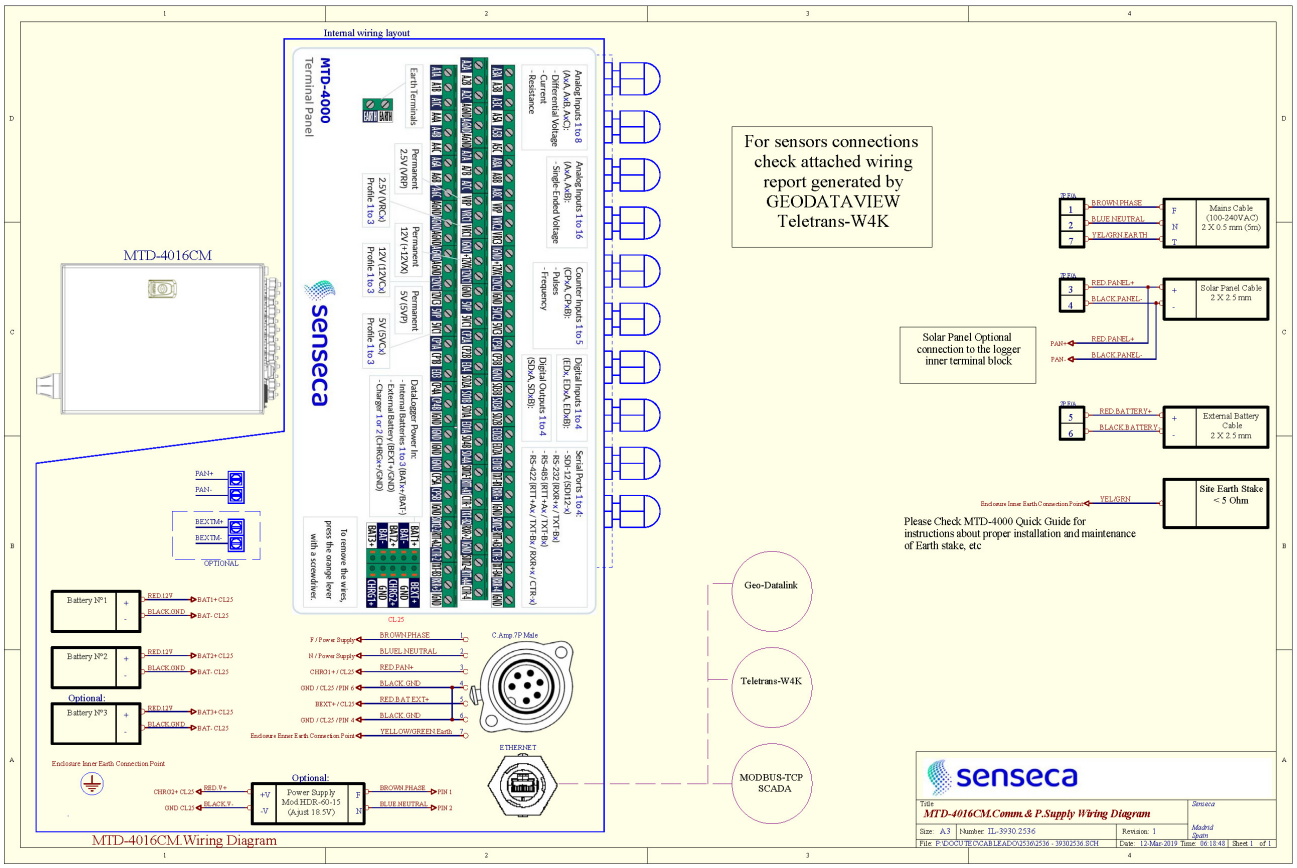


Fig. 5.2: General wiring diagram.

Cable ducts and laying

If the sensor cables are fitted in ducts, make sure that they are correctly sealed with rodent-proof polyurethane foam or similar. Otherwise, the equipment may be damaged.

Main power switch SW1

During wiring tasks, the station's SW1 switch, located on the electronic motherboard, must remain in the OFF position. Once the sensors, power lines, etc., have been individually connected, it must be turned to the ON position to check operation before proceeding to the next item. See section: SENSOR CHECK, SYSTEM DIAGNOSTICS, GNSS and GEODATALINK. Keep mains power supply lines, solar panel or external batteries disconnected until the last step to avoid possible discharges during connection tasks.

Station Power Cable

The MTD-4000 station power cable allows the connection of the station to mains power (100 to 240 VAC), solar panel (24 VDC maximum VOC) and external battery (15 VDC maximum). For each project, a customized power cable is supplied, specifically adapted to the connection lines used in each case.

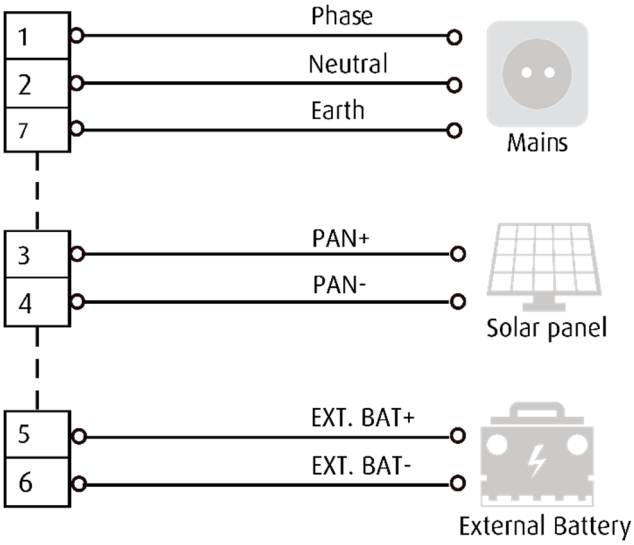


Fig. 5.1: Amphenol Connector 7P H/A IP 66 Ecomate C01630D00611012

Warning!

Safety recommendations: It is strongly recommended not performing any connections or maintenance work on the system in rainy conditions or when there are high levels of relative humidity. If necessary, ensure that the station cabinet and its internal electronics are properly protected. Such protection will prevent energy discharges or leaks that could endanger the physical integrity of the maintenance personnel or the weather system itself.

Warning!

Electrical recommendations for operation: To ensure maximum durability of the system internal batteries, it is necessary that the MTD-4000 datalogger is always connected to the electricity network or to a solar system dimensioned for permanent autonomous operation. If the solar system has been dimensioned to operate as back-up and there is no available electricity network during equipment installation, switch the equipment to non-operating status by turning the main switch SW1 to the OFF position.

Warning!

Internal batteries recommendations: The MTD-4000 system includes internal SLA batteries. This technology requires the batteries to be recharged at least once every 6 months, by connecting the datalogger to a solar panel or mains. During manufacturing, the date of last charge is recorded on the cabinet labels. If during the commissioning you observe that the last recharge was done more than 6 months ago, switch on the equipment (mains or panel powered). If the equipment does not turn on or does not charge the internal batteries, they must be replaced. For more details on the battery replacement process contact **technicalsupport.madrid@senseca.com**.

6 HMI interfaces

The various HMI interfaces included in the MTD-4000 stations are described below. They will help to simplify the operation, maintenance, testing and diagnosis of the weather system.

MTD-4000 stations optionally include either an advanced data display unit called 'Display & Keyboard' module or a basic 'Dummy Board' which does not have a visual interface.

Display & Keyboard Unit

Displays information on channels, sensors, etc. in both numerical and graphical format. Additionally, it has a slot for an microSD card for redundant data storage. This unit also has a USB port for direct connection to a PC via GEODATAVIEW PRO and two additional Ethernet ports.

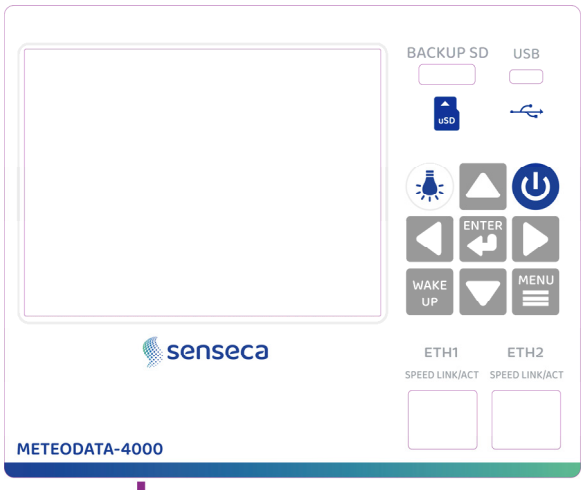


Fig. 6.1: Display & keyboard for MTD-4000

Dummy Module

This also incorporates the slot for the microSD card and the USB port along with the two Ethernet ports. In this case, there is no interface for querying or displaying the data.

Fig. 6.2: Dummy module for MTD-4000

7 GEO-DataLink app: system start-up at the station site

Whether the customer has purchased the 'Display & Keyboard' module or the 'Dummy Board', the user can always use the GEODATALINK mobile application with advanced functions.

Read the GEO-DataLink guide. A video-tutorial, which fully describes the operation of the application, is also available. This video is accessible from a link at the bottom of the main screen of the app and is accessible if the mobile terminal has an Internet connection.

Fig. 7.1: GEO-DataLink app

7.1 GDL key features

- Connection to the MTD-4000 station through any of its communication ports: TCP/IP and BLE.
- Real-time instantaneous readings and statistics calculations of all the sensors integrated in the system.
- Download and analysis of historical data from all integrated sensors.
- Immediate access to the remote technical assistance services offered by Senseca.
- Basic configuration of sensors and communication interfaces, both in the field and remotely.
- System diagnosis process management, both locally and remotely.

7.2 Start-up tasks with GDL

The basic steps to be followed using the GDL App during installation and start-up tasks of the weather system are described below:

GDL installation (Android and iOS)

Follow these links or scan these QR codes (also included on station labels). Then, follow the instructions displayed on the screen of the mobile device.

Download on the App Store

Get it on Google Play

Connecting GDL to the station

Connect the mobile terminal to the station via the station's Wi-Fi access point. Please note that the station's Wi-Fi access point automatically switches to power saving mode 1 hour after it is enabled. To enable the Wi-Fi access point again, press the WAKE-UP button located on the station's electronic board, as described on the warning label. Follow the instructions included in "Communications" label to connect the smartphone to the Wi-Fi. Then, open the app: Connect – New Station – TCP/IP and enter the IP address and port displayed in the label.

After connecting, access the GDL MONITORING, DIAGNOSTICS and CONFIGURATION screens to verify the points described below.

- **MONITORING screen**:

  This screen allows checking the values of each channel configured in the station in real time, as well as accessing the statistical data of the last period and the historical data of the current and previous day. At this point, the user must check that the readings of all the sensors connected to the station are correct.

- **DIAGNOSTIC screen**

  It shows the current operating status of the station: active communications, status of power supply lines, data storage units, etc. At this point, the user must check that no alarms are displayed, in red; if any alarm is displayed, check that it is due to expected normal operation:

  - Alarm on EXT_BATT: In many cases the station will be connected only to the mains or the solar panel at the site and, therefore, this indication will be displayed because no external battery connection is available.

  - Battery Charge Status: No internal battery charge indication appears when the weather station is not connected to the mains or solar panel.

If the weather station is not connected to the mains, this status is also shown at night, when the solar panel is not charging the battery. In all other cases, make sure that the 'Battery charge status' reads: 'Battery charging'.

- GPS/GNSS status - no FIX: This message commonly appears inside buildings, in areas with low GNSS signal or when the weather system goes into low power consumption mode (see modem on/off times in the GDL CONFIGURATION screen). In all other cases, wait 5 minutes after the weather system is activated or after the WAKE-UP button on the motherboard is pressed, until GDL displays 'Enabled (Fix available)', the 'No. Satellites', which will usually be more than 6 and the type of 'FIX', usually '2D'.

- microSD Card Status - not available: The microSD card is optional as the equipment uses it to store data backup. Check that it is inserted in its housing inside the 'Display&Keyboard' or 'Dummy Board'.

- **SETUP screen**

  Date and Time: the correct date and time of the station should be verified. The GNSS reception or the Internet connection, through ETH1, allows automatic date and time synchronization with the universal UTC reference. To set the proper date and time in the weather station, simply set the time zone of the site (Offset UTC Hours) using the GDL SETUP screen (SYSTEM RTC menu).

  It is always recommended setting the physical time zone (solar time) instead of the political time zone of the country where the weather system site is located.

  To calculate the physical time zone, apply the following criteria:

  HHF= Round off to the nearest integer (LONGITUDE (º decimal places) / 15').

  For example, if the location is in Qatar (LONGITUDE = 51.1E) the time zone will be: 51.1 / 15 = 3.40, therefore, the weather station must be configured with UTC +3.

  In the case of Bogotá: Longitude = 74ºW, the time zone will be UTC - 5.

  Geographical Coordinates: Finally, it is also necessary to configure the geographical coordinates of the site: Longitude, Latitude and Altitude. These data must be entered in the BASIC DATA section of the GDL SETUP screen. This step is very important because, although the station has a GNSS receiver and can obtain the coordinates automatically from the satellite network, sometimes sites have no or poor signal either because of nearby objects or because they are installed inside a building, etc.

  The geographical coordinates of the location can be easily obtained on the Internet or through various applications available on mobile platforms. If the consulted source provides the coordinates in degrees, minutes and seconds format, e.g., (4º, 15' and 38''), these should be converted to 'decimal degrees', e.g., (4.260556º), before being entered into the station via GDL. South latitudes and West longitudes correspond to negative decimal degrees.

Attention!

VERIFY that the latitude and longitude values are entered correctly, each in its corresponding field, without being interchanged.

8 Embedded Web

The model MTD-4000 includes an embedded Web accessible from any Web browser, designed for being used during commissioning, servicing and maintenance tasks.

Attention!

The embedded Web is available in version v01.0A82 or later. The version of each unit is visible from the DIAGNOSTIC screen of the GDL app.

To access this website, connect the Ethernet port of a PC directly to the Ethernet port labeled as ETH1 in the station. Open an Internet browser and enter the IP address of the station (192.168.1.70 by default) in the address bar. To access, the Web prompts for login credentials (default user: "admin" and empty password).

Attention!

For correct access to the Web, the PC must be in the same IP address range as the station.

Fig. 8.1: Embedded Web - Home

Real-Time data

Instantaneous values collected for each channel of the station. Enable 'Refresh every second' to automatically update the displayed values.

Diagnostic

Monitoring of internal voltages, power supply, alarms, 4G connection, etc. Press 'Refresh' to update the values on the screen.

Network

Configuration of the IP address and other network options of the ETH1 Ethernet interface. Click 'Apply changes' to make the changes effective. The station will be restarted.

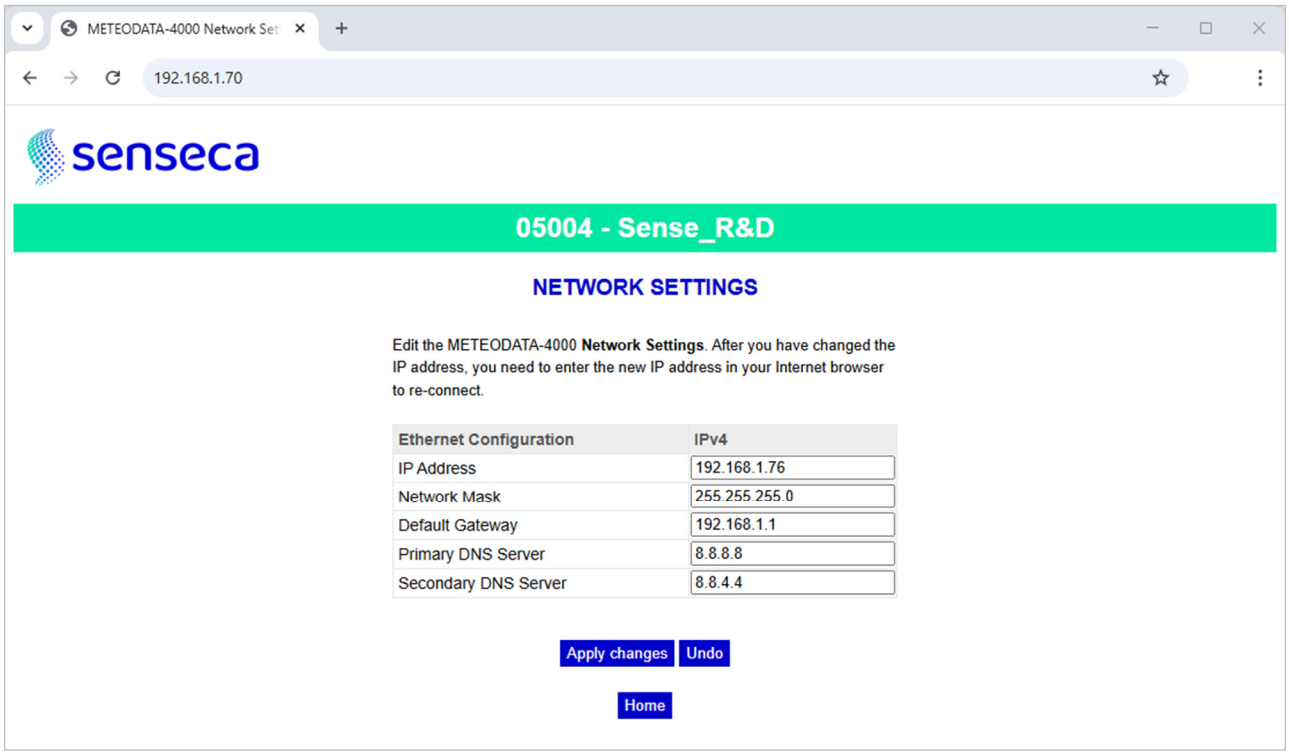


Fig. 8.1: Embedded Web - Home

FTP

The MTD-4000 station is capable of uploading data to an FTP server through its ETH1 Ethernet interface if an Internet connection is available. This page lets you configure the remote FTP server where the data will be uploaded. A microSD card must be inserted in the station to use this function.

Password

Edit the access password for the “admin” user. By default this password is empty.

9 4G and SCADA communications

9.1 SCADA Communications

The steps to be followed in order to ensure communication of the weather system with SCADA, through the local site network, and also with other systems, through the 4G link integrated in the MTD-4000 station, are detailed below.

Delivery of SCADA configuration documents

- **Modbus – Map of Variables** As previously described, along with MTD-4000 unit, a package of printed documentation is supplied inside the station cabinet. This package includes the document: 'Modbus – Map of Variables', which must be delivered to the SCADA manager.
- **Modbus Quick Guide**: Document No.: 9012.0148. It is strongly recommended that both the installer and the SCADA personnel carefully review the contents of this document before integrating the two systems.

IP Address and Modbus TCP Port Configuration

The IP address of the station ETH1 interface (and the rest of the network settings), must be assigned in coordination with the site data network manager. Once defined, edit the factory default network settings using the embedded Web or accessing the SETUP screen in GDL app. After changing the ETH1 port configuration, recording the new IP address in the user configuration section on the communication label on the cabinet door is recommended. The default TCP connection port is set to TCP:502.

Attention!

> Make sure that the terminal does not enter non-visible (space, etc.) OR non-alphanumeric characters in the network fields. If so, the port will be turned off. In this case, reconfigure with GDL.

MODBUS Node Configuration

This is the factory default set to '01' for all MTD-4000 stations. Although it is not usually necessary, due to the majority use of the Modbus TCP protocol, users can edit this MODBUS node by accessing the SETUP screen of GDL and then, BASIC DATA submenu.

9.1 4G Communications

Verify communication with 4G Modem

All the MTD-4000 stations are supplied with an integrated 4G modem on the mother-board. If the customer has contracted the automatic data upload cloud service, GEO-DataView PREMIUM option, this modem will include a SIM card with a preset data down-load volume.

Users can access the automatically downloaded data through this service using the ac-cess credentials provided along with the service agreement.

GEO-DataView PREMIUM is available at the URL: **http://webtrans4k.senseca.com**

Where users can confidentially query and download data via the GEODATAVIEW Webtrans-4K Web application. For correct use of the Web platform, read the document: Webtrans-4K Operation Quick Guide, with reference 9012.0139.

The use of the customer's own SIM cards is optionally allowed. If there are any doubts about this option, please contact **info.madrid@senseca.com**.

Attention!

> The GDL application also allows remote access to the station through the interface URL specified on the communication label (station cabinet door), 4G MODEM section. When using this 4G interface, consider the bandwidth contracted with the mobile operator to avoid exceeding it. In any case, make reasonable use of this service interface.

Finally, bear in mind that the 4G interface is factory default configured for part-time activation, by means of two operation control windows every 24 hours. This methodology is commonly used to minimize energy consumption of the 4G link, especially in remote, unattended systems without connection to the mains power supply where the autonomy of batteries is factory default set with very restrictive energy consumption criteria.

To consult the 4G modem activation / deactivation windows, use GDL, access the SETUP screen and then, MODEM section. If you want to activate the 4G link without having to wait for the next activation window, simply press the WAKE-UP button on the 'Display & Keyboard' module or the WAKE-UP button located on the upper part of the electronic motherboard. The warning label, attached to the station cabinet door, shows the location of this button.

10 Weather station system maintenance

The weather system maintenance tasks should be performed by installation and maintenance team.

The frequency of the maintenance tasks, as well as the specific tasks to be carried out for each system will depend on:

- Type of sensors included in the weather system.
- Environmental conditions, humidity, dust, sand, etc., of the site.
- Specific customer requirements.

The most common maintenance tasks are listed below, as well as the typically recommended frequency:

NO.	UNIT TO BE MAINTEINED	DETAILS OF WORK TO BE CARRIED OUT	RECOMMENDED PERIODICITY
1	Location	Cleaning and/or clearing of the equipment installation area, etc.	6 months
2	Solar radiation sensor	Dome cleaning, levelling check and calibration check.	3 months and after haze
3	Rainfall sensor	Cleaning of the collecting cone and its drain hole/filter. Checking of levelling and calibration.	6 months and after haze, leaf fall, etc.
4	Solar panel	Surface cleaning and fixing to tower.	6 months and after haze
5	Earthing point	Moisten, check corrosion, check impedance.	12 months
6	Anemometer	Cleaning, check bearings and calibration.	12 months
7	Wind Vane	Cleaning, check bearings, potentiometer and calibration.	12 months
8	Air temperature	Calibration review.	12 months
9	Relative humidity	Air filter check/replacement and calibration check.	12 months
10	SOILING sensor	Check fixing, tilting, cleaning, and pairing.	3 months or after solar plant cleaning
11	Batteries (station internal batteries or photovoltaic system external batteries)	Replacement. In case of batteries deep discharge, it is recommended to replace them if they present issues when charging from the solar panel or mains.	From 4 to 6 years
12	Station or weather system cabinet	Check corrosion and watertightness.	6 months
13	Meteorological turret and other metallic elements	Check corrosion and structural integrity.	12 months
14	Wiring and ducting	Check watertightness, structural integrity, and insulation. Check that the cables are not damaged and there are no rodents in the ducting. Seal any open ducts with rodentproof polyurethane foam.	6 months
15	Earth and earthing	Check the earth connection from the station cabinet. Check, measure using a tellurometer (<5 ohm), wetting and maintenance of the installation earth connection.	6 months

11 Operation with a microSD card

The MTD-4000 weather station allows microSD cards to be used to save CSV files containing instantaneous values (data collected for each channel at the sampling rate, e.g. 1 second). This function is enabled or disabled during the manufacturing process (request before ordering), or it can also be enabled or disabled using Geo-DataView Pro (Teletrans), remotely, under the supervision of the technical team, if necessary.

To be compatible with the MTD-4000, the microSD card must be:

- 4 / 8 / 16 / 32 GB -SDHC
- IG (Industrial Grade) for a wide operating temperature range.

Procedure for using the microSD card functionality in the MTD-4000

The steps to be followed when using a microSD card in the MTD-4000 weather station are:

A. Format the microSD card to FAT32 using a PC.
B. Insert the microSD card (see next section).
C. The microSD card records up to 128 CSV files containing data collected during one day, so it must be periodically removed or replaced to recover all of the instantaneous data collected by the station. The use of two microSD cards is recommended to make the data recovery process more efficient:
   First, follow the steps described in the following sections to safely remove the microSD card currently inserted in the station slot.
   Then, insert the second microSD card. For proper and continuous data recording, the new microSD must be inserted within 30 seconds after removing the old one. Insert an empty microSD, otherwise the station will overwrite some of the files saved on it (mixing old and new CSV files).
   These steps require a timewait = 0 for getting the instantaneous data files at the remote installation site.

Attention!

> The microSD card must be formatted into FAT32 using a PC before being inserted into the MTD-4000 station.

Insert the microSD card in the MTD-4000 station

As described in section 6.1, the MTD-4000 has two front panel options: Dummy Module and HMI-4000 Module (Display & Keyboard). In both models, there is a dedicated slot for inserting the microSD card.

Safely removing the microSD card

As with any Flash Drive, to safely remove the microSD card from the MTD-4000 datalogger, the drive must be unmounted following the steps described in one of the three available safe removal procedures:

A. Safely removing the microSD card from the station mainboard button

Press PULS1 button (see Fig. 12.1) for 2 seconds.

The status of the LED (D37 SD card removal LED), near the button, will switch to permanently OFF. The station unmounts the microSD card for 5 seconds so that it can be safely removed during this time. After this timeout, for security reasons, the station mounts the microSD card drive again to avoid any data loss if this button has been pressed by mistake.

B. Safely removing the microSD card from the GEO-DataLink App

Connect the App to the station as described in section 7.

Then, go to the App's 'DIAGNOSTIC' module. If the microSD card is properly inserted, the option 'Extract microSD' will appear on the screen. Press this button to safely remove the card.

C. Safely removing the microSD card from the HMI-4000 (Display Unit)

Press the 'MENU' button on the keyboard.

Then, use the 'Up/Down' buttons to select 'SD Card Safe Removal' option and press 'Enter'.

12 LEDs and buttons on the MTD-4000 motherboard

WiFi / Ethernet2 communication

Id	LED	Operating modes	
D19	xPICO LINK/STATUS LED	Permanent OFF	Ethernet2 (ETH2) disabled or disconnected
		Permanent ON	Link established via Ethernet2 (ETH2)
D20	xPICO ACT. LED	Permanent OFF	Ethernet2 (ETH2) disabled or disconnected
		Flicker	Activity on Ethernet2 (ETH2)
D21	SYSTEM LED	Permanent OFF	Wi-Fi / Ethernet2 (ETH2) powered
		Permanent ON	Wi-Fi / Ethernet2 (ETH2) without power supply

MTD-4000 USB and 2G/3G/4G modem communication

Id	LED	Operating modes	
D36	USB/Main	Permanent OFF	USB cable connected to station (HMI interface)
		Permanent ON	USB cable disconnected from station (HMI interface)
D15	USB/Modem	Permanent OFF	USB cable for modem connected (Reserved use)
		Permanent ON	USB cable for modem disconnected (Reserved use)
D16	Modem STATUS	Permanent OFF	Modem off
		Flicker Slowly1 (200 ms ON / 1800 ms OFF)	Modem in network searching status
		Flicker Slowly2 (1800 ms ON / 200 ms OFF)	Modem in idle and registered status
		Flicker Quickly (125 ms ON / 125 ms OFF)	Ongoing data transfer on modem
		Permanent ON	Voice calling on modem

General

Id	LED	Operating modes	
D37	SYSTEM/ SD CARD REMOVABLE LED	Permanent OFF	Station off / low power / no power supply
		Permanent OFF (during 5 seconds)	MicroSD is unmounted (it can be safely removed) or microSD / memory format in process
		Permanent ON	Awaiting confirmation microSD unmounted
		Flicker Slowly (200 ms ON / 800 ms OFF)	Station operating in normal mode
		Flicker Quickly (50 ms ON / 50 ms OFF)	Station upgrading its internal firmware

Internal batteries charge

Id	LED	Operating modes	
D14	STAT1 LED	Permanent ON	Station charging internal batteries
		Permanent OFF	Charging of internal batteries stopped
		Flicker	Internal batteries deeply discharged. Turn off SW1 and wait several hours or replace batteries
D13	STAT2 LED	Permanent ON	Not Applicable. Reserved
		Permanent OFF	Not Applicable. Reserved

ETHERNET1 Communication

Id	LED	Operating modes	
D14	STAT1 LED	Permanent ON	Station charging internal batteries
		Permanent OFF	Charging of internal batteries stopped
		Flicker	Internal batteries deeply discharged. Turn off SW1 and wait several hours or replace batteries
D13	STAT2 LED	Permanent ON	Not Applicable. Reserved
		Permanent OFF	Not Applicable. Reserved

ETHERNET2 Communication (optional)

Id	LED	Operating modes	
J4	ETH2 RJ45 - ACTIVITY (GREEN)	Permanent OFF	No link on Ethernet2 (ETH2) / Disconnected
		Flicker	Activity on Ethernet2 (ETH2)
J4	ETH2 RJ45 - LINK (AMBER)	Permanent OFF	No link on Ethernet2 (ETH2) / Disconnected
		Permanent ON	Link established via Ethernet2 (ETH2)

Buttons

Id	LED	Operating modes	
	WAKE_UP	Press	Wi-Fi activation for 1 hour
PULS3	Modem Pwrkey	Reserved	Reserved
PULS2	Reset Button	Press	Reset in station
PULS1	microSD Safe Removal	Press and hold for less than 4 seconds	Safe removal of microSD
		Press and hold for 10 seconds	Station switches to low power mode

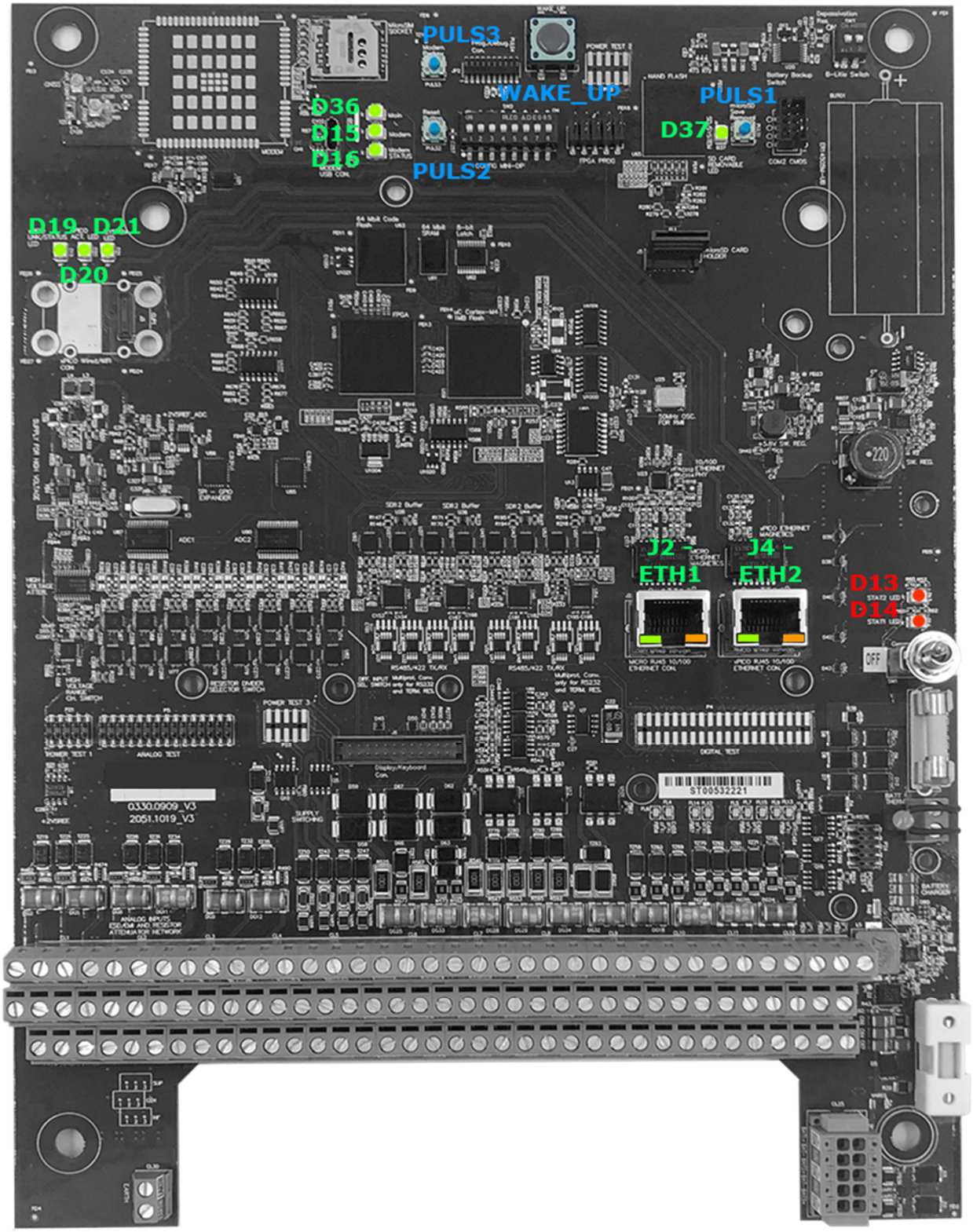


Fig. 12.1: Dummy module for MTD-4000

NOTES

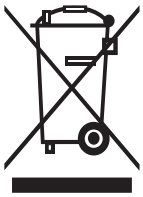
WARRANTY

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.

CE RoHS

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