move
SOLUTIONS

# Tiltmeter

## Instruction Manual

**Quick installation guide and system operation**

Important safety, compliance and warranty information

**Move S.p.A.**

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**MOVE SOLUTIONS CUSTOMER ASSISTANCE SERVICE**

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# Tiltmeter

## Instruction Manual

## English

Read manual before using the product



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**NOTICE OF PUBLICATION**

The information contained in this manual may be subject to change without notification. For further instructions, more detailed information, product specifications and to download up-to-date manuals, visit our website at www.movesolutions.it

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## *Annex A*

# Warnings

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For the correct and safe operation of the product, it is recommended to read and follow the instructions in this manual.

Great attention should be paid to the following warnings. Move Solutions shall not be held responsible for inconveniences, damage or malfunctions due to lack of compliance to the prescriptions and suggested use in this manual.

- The declared IP rating is to be intended with both the cable gland tightened around a cable and the lid of the product correctly screwed in place. Do not expose the product to humidity or dust in any other condition.
- Before use, make sure that the product conforms to the description in this manual and that no damage is present.
- Do not use batteries other than those specified by Move Solutions without express approval from a Move Solutions representative.
- Before any operation on the product, disconnect the batteries.
- The product is not intended for use in applications where safety is extremely critical, such as medical-related applications or life-security systems.
- On top of the prescriptions in this manual, the user should operate in compliance with local standards for security and health, and according to the best engineering practices for a safe installation.
- The product must be kept clear of children, animals, and any unauthorized personnel.
- Do not disassemble the product except when explicitly instructed in this manual, as this could cause malfunctions and damage the product.
- Do not attempt to repair or modify the product.
- If the product releases smoke or heat during operation, immediately disconnect the batteries.
- Do not expose the product to high temperatures outside the specified range or heat sources.
- Do not expose the product to liquids of any kind and do not operate on it with wet hands. The product can only be exposed to water when the conditions to guarantee the IP rating are satisfied.

- Do not operate on the product in extreme weather conditions that may damage the device or the user, such as thunderstorms or snowstorms.
- Do not disperse the product or part of it in the environment.
- Correct functioning of the product in environments with high radio activity is not guaranteed.
- The product is compliant to all regulations concerning the fair use of ISM radio bands. However, given the free nature of these bands, occasional conflict with nearby devices operating on the same bands cannot be fully prevented.

This product contains electronic components and batteries that must be disposed of separately from common household waste, according to local regulations. To ensure correct disposal of the product at the end of its lifecycle, please refer to your local authority. Failure to comply to the regulations could lead to penalties.

**NOTE**

- In case of deterioration or loss of this manual, a compliant copy may be requested by the customer from the manufacturer. For increased security, we suggest that you keep a copy of this manual in a place where it cannot be damaged or lost.

# FCC Compliance

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions:

- This device may not cause harmful interference
- This device must accept any interference received, including interference that may cause undesired operation.

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

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

# ISED Compliance

This device complies with Industry Canada licence-exempt RSS standard(s). Operation is subject to the following two conditions:

(1) this device may not cause interference, and

(2) this device must accept any interference, including interference that may cause undesired operation of the device.

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes:

(1) l'appareil ne doit pas produire de brouillage, e

(2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

This equipment complies with Industry Canada radiation exposure limits set forth for an uncontrolled environment.

Cet équipement est conforme à l'exposition aux rayonnements Industry Canada limites établies pour un environnement non contrôlé.

# Symbols and provisions used in the documentation

The following symbols and conventions are used throughout the documentation. Please follow all warnings and instructions marked on the product.

## WARNING

**WARNING** indicates a potentially hazardous situation which, if not avoided, can result in minor or moderate injury.

## IMPORTANT

**IMPORTANT** indicates a potentially hazardous situation which, if not avoided, can result in property damage or loss of product functionality.

## NOTE

**NOTE** specifies the operating environment, installation conditions, or special conditions of use.

**Bold**
Bold text highlights an important point or keywords for understanding the context.

***Italic***
Text in italics is used for specific names for sensors, options of the Move Cloud Platform, or chapters of this manual.

Fire Danger icons warn of the possibility of fire.

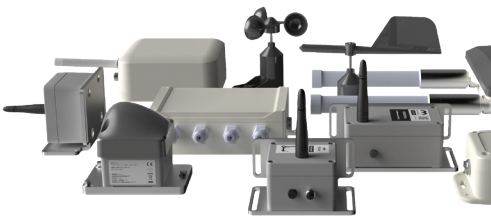
Electrical Danger icons warn of the risk of electric shock.

Prohibition icons indicate actions that must not be performed.

# General description

2

The tiltmeter measures variations in the static tilt angle relative to the horizontal plane and offers different working modes to suit user needs. In addition to tilt angles, it also measures temperature and vibrations for data correlation and analysis. Part of the Move Solutions' sensor family, it integrates seamlessly with the MyMove IoT Platform.



The Tiltmeter is thus suitable for use in geo-environmental, hydrogeological, geotechnical, and structural monitoring.

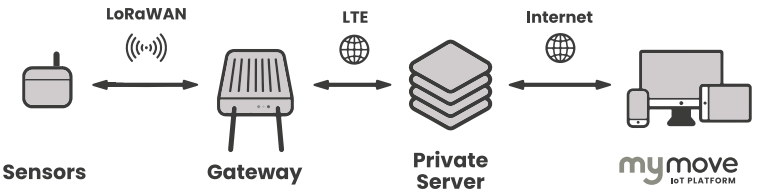
The Tiltmeter can log the acquired events to the internal memory. This allow the user to retrieve data even in case the LoRaWAN connection is lost for a certain amount of time. Access to data saved locally is possible through the serial connector.

Moreover, the user can also access the streaming mode for a live view of the data flow.

A specific software and serial cable are required to access both the storage memory and the streaming mode.

A specific software and serial cable are required.

The Tiltmeter is part of the Move Solutions range of LoRaWAN products for monitoring purposes; as such, it needs a LoRaWAN gateway in its range (such as the Move Solutions Gateway Pro) to connect to the MyMove IoT Platform. When the sensor is connected to the platform, the settings and data can be personalized to fit the user's needs.




# Technical Data

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| Measurement performances | |
|---|---|
| Angle sensing technology | MEMS accelerometer (3 axes) |
| Accelerometer sampling frequency | 125 Hz (4kHz downsampled) |
| Accelerometer full scale range | Customizable, available values:<br>• ± 2g<br>• ± 8g (default) |
| Acceleration data buffer size<br>(used for both angle and vibrational acceleration measurement) | Customizable, available values:<br>• 125 samples / 1 second<br>• 250 samples/ 2 seconds<br>• 500 samples / 4 seconds<br>• 1000 samples / 8 seconds<br>• 2000 samples / 16 seconds |
| Operating modes | • Programmed acquisition<br>• Programmed acquisition + acceleration trigger<br>• Programmed acquisition + angle trigger<br>• Programmed acquisition + angular velocity trigger |
| Angle resolution | 0,0000001° |
| Angle repeatability[1,2,3] | ±0,0008° |

| | | |
|---|---|---|
| Angle accuracy[1,2] | Value | Validity range |
| | ± 0.002° | ± 0.5° |
| | ± 0.003° | ± 2° |
| | ± 0.01° | ± 5° |
| | ± 0.05° | ± 20° |
| | ± 0.25° | ± 90° |
| Angle full scale range | ± 180° | |
| Absolute synchronization accuracy | ± 1 s | |
| Vibrational acceleration resolution | 0.125 mg | |
| Vibrational acceleration RMS noise | Range | Value |
| | ± 2g | 126 µg |
| | ± 8g | 140 µg |
| Vibrational acceleration full scale | Same as accelerometer range | |
| Vibrational acceleration bandwidth | 0.1 – 31.25 Hz | |
| Temperature resolution | 0.05 °C | |
| Temperature accuracy | 0.2 °C | |
| Internal storage memory | 10000 acquisitions | |

[1] Referred to absolute, non-compensated angles.

[2] Measurement conditions: ± 2g accelerometer range, buffer depth of 2000 samples, room temperature 20°C, 45%rh.

[3] Applies to consecutive readings within 30 minutes with constant tilt angle. Provided at 95% confidence level.

| General data | |
|---|---|
| Wireless connection technology | Sub-GHz LoRaWAN protocol[1] (Gateway required) |
| Supported LoRaWAN regions | EU868, US915, AU915 |
| Wireless coverage[2] | 1 km line of sight from the nearest gateway |
| Cable connection | Move Solutions 8-pole connector. For compatible accessories visit Move Solutions' website or contact us directly. |
| IP rating[3] | IP67 |
| Power supply | 1x 19Ah 3.6V replaceable lithium battery (D-type $LiSOCl_2$ with JST EHR-2 connector). Battery charge level measured remotely and available in MyMove IoT Platform. |
| Operating temperature range | From -40 °C to +85 °C |
| Dimensions[4] | 97.5 x 80.5 x 66 mm |
| Weight[4] | 0.5 kg |
| Package weight | 1.2 kg |
| Case material | GD-AlSi12 alloy |
| Installation options | Wall, floor, or ceiling mount.<br>Two-points attachment using screw anchors (Ø6mm max) |
| Software version | v4 |

[1] The sensor's LoRaWAN connection operates on a best-effort basis, which means that while most data packets are delivered, there is a slight possibility of occasional packet loss.

[2] Wireless coverage may vary based on the actual deployment scenario.

[3] Guaranteed only when the antenna is installed, and the connector is protected by the provided protection cap or connected to external cables and/or accessories.

[4] Refers to the sensor unit itself. External accessories, such as mounting plate, antenna and protection cover for the antenna are not considered since they are optional and/or can be replaced with alternative parts to fit specific applications.

| Battery life | |
|---|---|
| Configuration[1] | Expected battery life[2] |
| Programmed acquisition with:<br>30 minutes period<br>Data buffer depth: any | 11 years |
| Programmed acquisition with:<br>2 minutes period<br>Data buffer depth: 125 samples | 8.2 years |
| Programmed acquisition with:<br>2 minutes period<br>Data buffer depth: 2000 samples | 5 years |
| Programmed acquisitions with:<br>30 minutes period<br>Data buffer depth: any<br>Acceleration trigger [3] | 2.7 years |
| Programmed acquisitions with:<br>30 minutes period<br>Data buffer depth: any<br>Angle trigger [3] | 2.3 years |
| Programmed acquisitions with:<br>30 minutes period<br>Data buffer depth: 2000 samples<br>Angular velocity trigger [3] | 2.3 years |

[1] Configuration parameters that are not specified are to be considered in their default configuration.

[2] The estimation refers to a sensor in a typical working environment with average quality of the radio connection between the sensor and the gateway. Actual battery life may be worse in case the product is used under extreme conditions, such as prolonged working in high or low temperatures, bad quality of the radio connection between the sensor and the gateway, etc.

[3] The consumption of trigger acquisitions depends on the actual input signal of the sensor and its configuration, so it may differ from the stated. The estimation refers to an average of 240 trigger events per day.

# What's in the box

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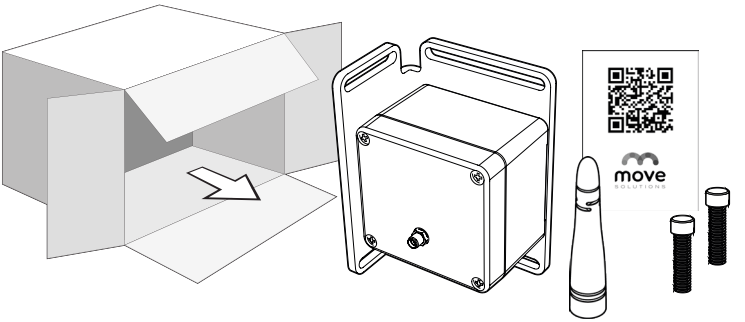
The Tiltmeter is shipped inside a cardboard box. On the side of the box, a label is affixed with the EUI and Serial Number of the product. The EUI is very important as it identifies the sensor on the MyMove IoT Platform.




Inside the package you should find:

| Number of pieces | Components |
|---|---|
| 1 pc. | Tiltmeter |
| 1 pcs. | Antenna |
| 2 pcs. | Anchors |
| 1 pc. | Move Solutions flyer with a QR code linking to the most up-to-date documentation |

Carefully examine what's inside the package and check that everything is present and in excellent condition.

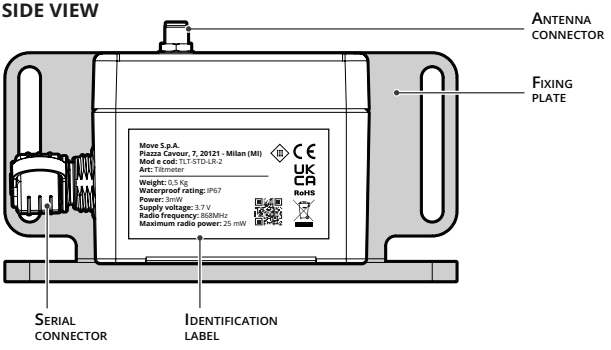
**WARNING**

- **DO NOT** use the Tiltmeter if any of the components looks broken or tampered with.

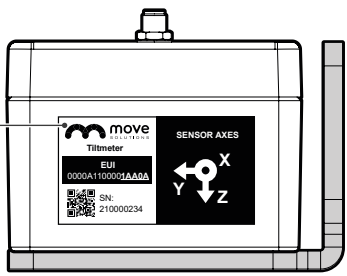
Two labels bearing the same information as the one on the packaging is affixed on the side of the Tiltmeter.

From the outside you'll see:

**SIDE VIEW**




**UP VIEW**




Axes label

The arrows' direction on the label are to be intended as the positive direction of the sensor's axes (+Z, +Y).

The X axis is positive (+X) when the label side is on top.

**IMPORTANT**

- **DO NOT** unbox the Tiltmeter in a dusty and/or humid environment. The IP rating of the product is guaranteed only after the antenna is screwed tightly on and the serial connector has a cable connected or the supplied lid on.
- **DO NOT** loosen or tighten the screws of the Tiltmeter as this could alter the product's IP rating.

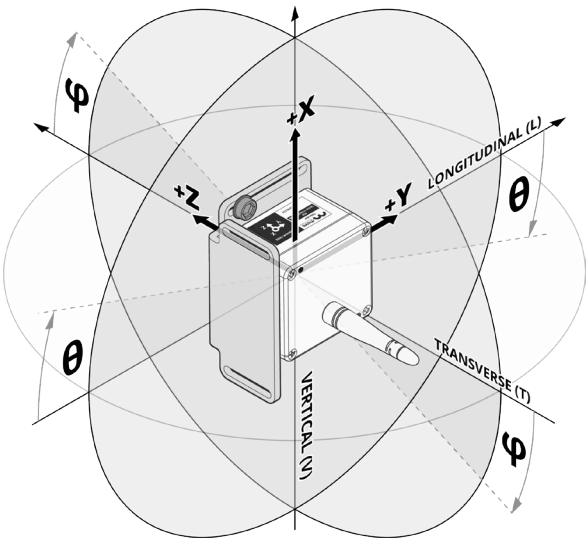
# 5 Quick guide to installation

## 5.1 Axis configuration

Each Tiltmeter provides two angular measurements:

- **φ (PHI) angle:** represents the rotation around the sensor's LONGITUDINAL axis.
- **θ (THETA) angle:** represents the rotation around the sensor's TRANSVERSAL axis.

By default, the sensor's LONGITUDINAL axis (L) is set to be +Y and the TRANSVERSAL axis (T) is +Z, with the VERTICAL axis (V) being +X.

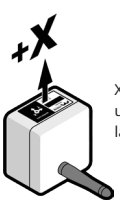



The association between (X, Y, Z) and (L, T, V) axis system can be modified on *myMove IoT Platform*, so that the user can decide the orientation of the two angles detected.

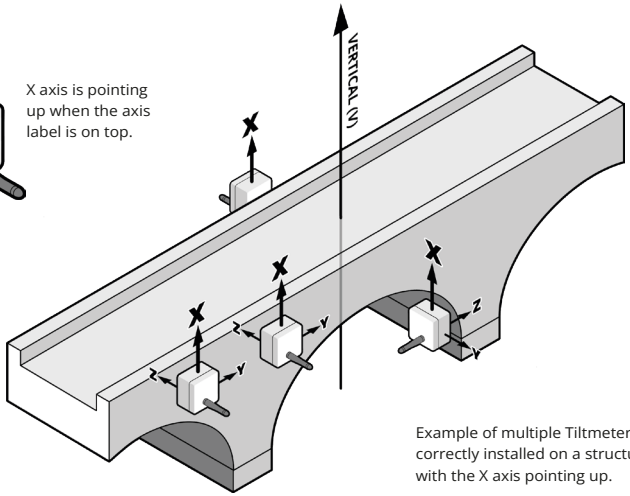
## VERTICAL AXIS CONFIGURATION

It's important to be aware, during installation, which one of the three axes of the sensor (out of X, Y and Z) is VERTICAL and in which direction (point up or pointing down). The proper configuration of this parameter is crucial for the sensor's correct functioning.

By default, the sensor is set to have **+X as VERTICAL (V)** (X axis, pointing up). Installing the sensor in that position is preferable, in order to avoid a configuration step (setting a different VERTICAL axis on *myMove IoT Platform*).




X axis is pointing up when the axis label is on top.




Example of multiple Tiltmeters correctly installed on a structure with the X axis pointing up.

**IMPORTANT**

- In case it was not possible to install the sensor with the X axis pointing up, the user will have the possibility to configure, from *myMove IoT Platform*, the axis of the sensor associated with VERTICAL.

The sensor is now ready to measure, and the angles **φ** (PHI) and **θ** (THETA) are detected as shown in the previous page figure, in case of installation according to the default.

**LONGITUDINAL AXIS CONFIGURATION (OPTIONAL)**

Once the VERTICAL axis is properly configured, changing the axis associated to LONGITUDINAL is not a required configuration step.

This step is needed in two occasions:

- **VERTICAL axis is different from default (+X)**
- **Unifying angles detection on a structure**

Check the chapter ***5.2 Why changing the longitudinal axis?*** for more details.

---

**NOTE**

- When associating the axis of the sensor to LONGITUDINAL and TRANSVERSAL, for every axis the two options + and – are available (example: +Y and -Y). If +Y is set as LONGITUDINAL it means that the positive direction of Y is associated with LONGITUDINAL. If -Y is set as LONGITUDINAL it means that the negative direction of Y axis is associated with LONGITUDINAL.

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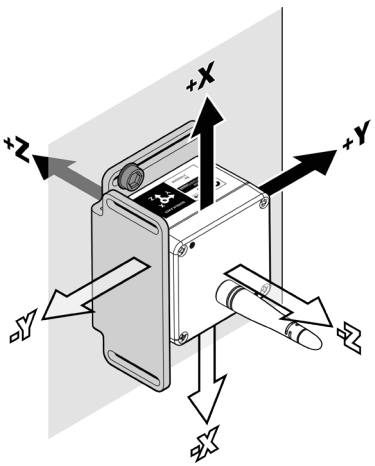
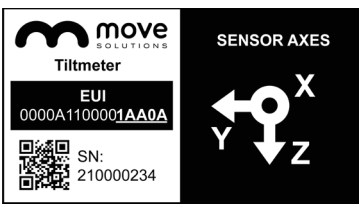



Refer to the axes label on the top side of the Tiltmeter to identify the axes positions and directions. The arrows direction indicate the positive side of its axis (+X, +Y, +Z).

Consequently the directions opposite to the arrows can be identified as the negative side of the axes (-X, -Y, -Z).

The Sensor offers the possibility to modify the axis set as LONGITUDINAL and TRANSVERSAL and consequently the orientation of **φ** (PHI) and **θ** (THETA).

### Default configuration

By default, the axes configuration is **FIG.1**:

- LONGITUDINAL (L) associated with +Y
- TRANSVERSAL (T) associated with +Z

**φ** (PHI) is always the rotation around LONGITUDINAL and **θ** (THETA) around TRANSVERSAL.

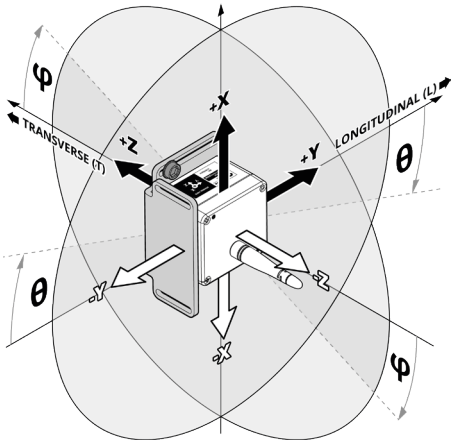



FIG.1
DEFAULT CONFIGURATION

| Structure axis | L | T | V |
|---|---|---|---|
| Sensor axis | +Y | +Z | +X |

### Alternative configuration

Modifying the LONGITUDINAL and TRANSVERSAL axes configuration means associating different axes to them. An example of an alternative configuration would be **FIG.2**:

- LONGITUDINAL (L) associated with +Z
- TRANSVERSAL (T) associated with -Y

**φ** (PHI) and **θ** (THETA) are still rotations around LONGITUDINAL and TRANSVERSAL axes, which now correspond to different axes of the sensor, with respect to the configuration of the Tiltmeter in **FIG.1.**

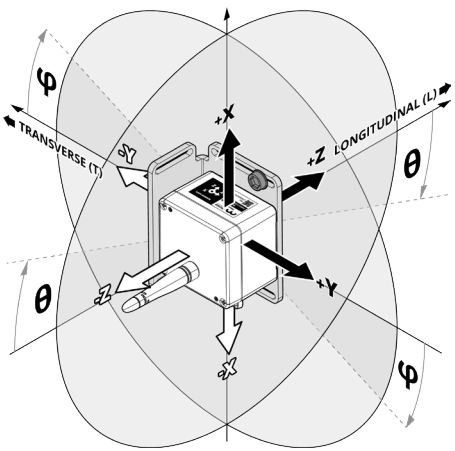



FIG.2
ALTERNATIVE CONFIGURATION

| Structure axis | L | T | V |
|---|---|---|---|
| Sensor axis | +Z | -Y | +X |

## 5.2 Why changing the longitudinal axis?

The two situations that make it necessary to modify that parameter are:

1. **VERTICAL axis is different from default (+X):** in this scenario it's necessary to identify new LONGITUDINAL and TRANSVERSAL axes to detect **φ** (PHI) and **θ** (THETA).
2. **Unifying angles detection on a structure:** in case multiple sensors were installed on a structure with different axes orientation between each other, you may want to change, on some of the sensors, the axes associated with LONGITUDINAL and TRANSVERSAL to be able to measure **φ** (PHI) and **θ** (THETA) in the same way, all over the structure (regardless of how every individual device is installed). In this scenario, the LONGITUDINAL and TRANSVERSAL axes of every sensor installed become LONGITUDINAL and TRANSVERSAL axes of the entire structure with **φ** (PHI) and **θ** (THETA) being the rotation of every sensor around them.

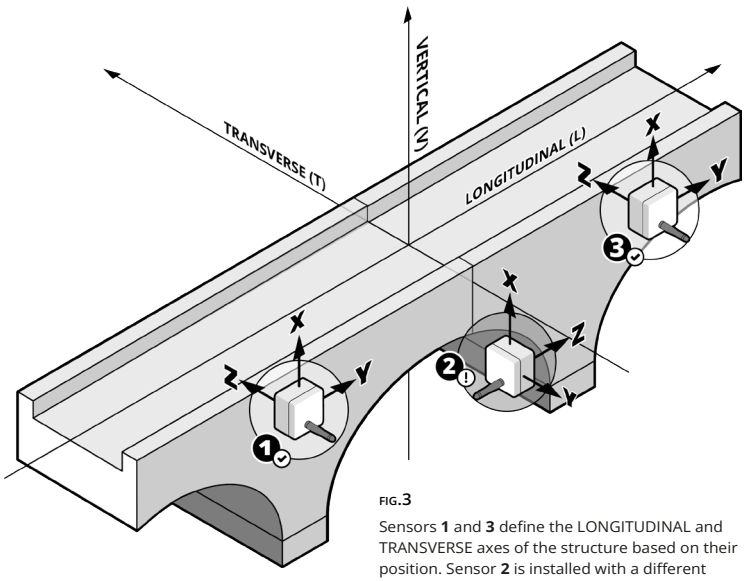



FIG.3

Sensors **1** and **3** define the LONGITUDINAL and TRANSVERSE axes of the structure based on their position. Sensor **2** is installed with a different orientation compared to Sensors **1** and **3**. You can adjust the axes assignment of Sensor **2** on *MyMove IoT Platform*, to align with the other sensors.

In **FIG.3**, Tiltmeters **1** and **3** are installed in the same orientation. Tiltmeter **2**, however, is installed with a 90° degree clockwise rotation compared to the other two. In this case it makes sense to set the +Z axis as LONGITUDINAL and the -Y axis as TRANSVERSAL for sensor **2**. Now, for all three sensors, you have rotations around the structure's LONGITUDINAL and TRANSVERSAL axes as you can see in **FIG.4**.

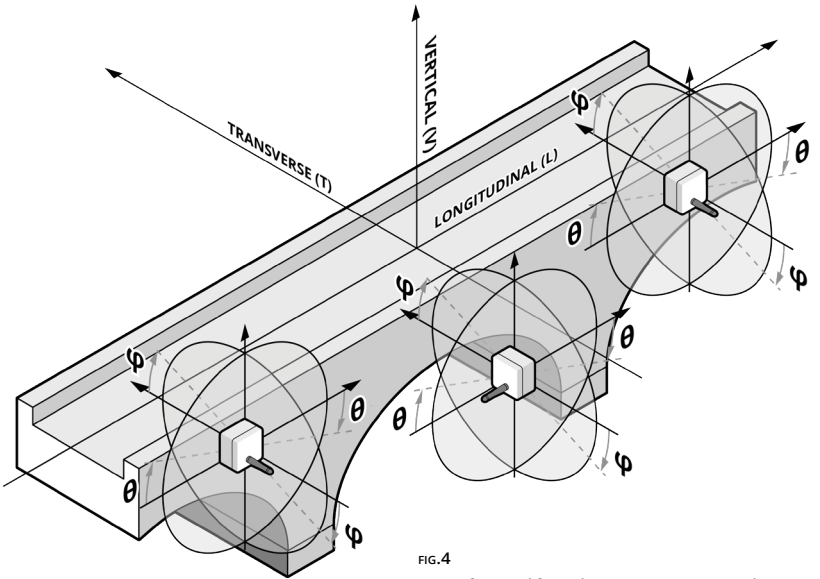



FIG.4

Now, after modifying the axis assignment on the *MyMove IoT Platform*, all sensors measure the **φ** (PHI) and **θ** (THETA) angles according to the same direction of the LONGITUDINAL and TRANSVERSE axes.

**IMPORTANT**

- To ensure unified angle detection on a structure, record the orientation of each sensor's axes during installation by checking the sensor labels. This is crucial because adjusting the sensor axes correctly via MyMove remotely could be challenging without this information.

# 5.3 Installation on site

**BEFORE THE INSTALLATION**

Check that you have the right tools for the operation.

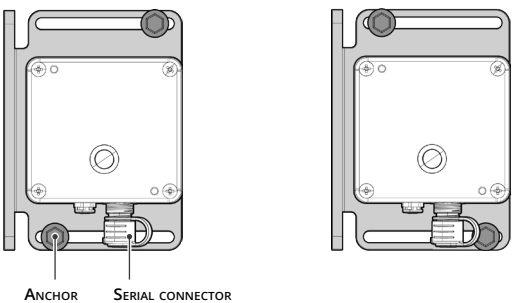
1. A drill of suitable size
2. An electric screwdriver of suitable size
3. A level




**ANCHORS POSITIONING**

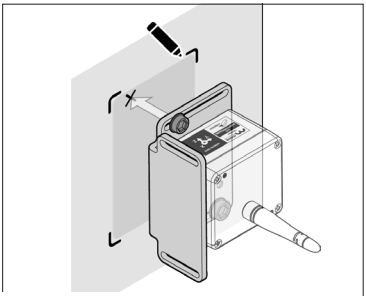
Pay close attention to the positioning of the anchors on the plate: given the location of the serial connector, the ideal placement of the anchors is at the ends of the plate's holes and not in the middle.

For this reason, It is recommended that the anchors are positioned **opposite to each other** to ensure greater stability of the sensor, as shown in the figure.

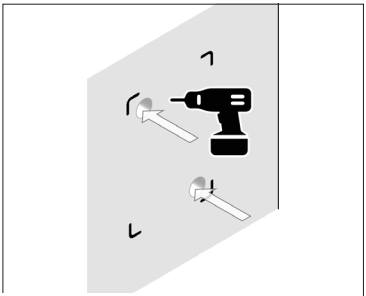



**IMPORTANT**

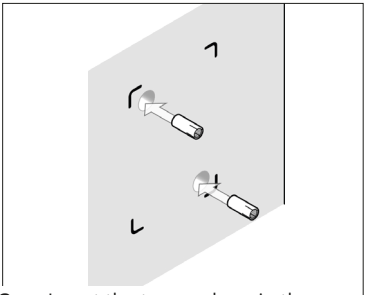
Make sure the surface where the Tiltmeter is going to be installed does not have asperities and protrusions. Close, stable and tight contact of the device with the surface is crucial to detecting accurate data.



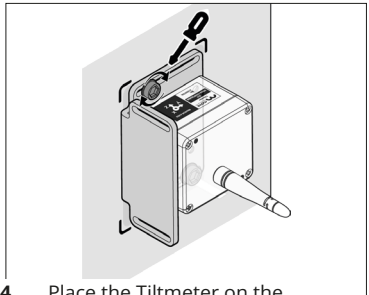
**1.** Using the installation plate as reference, mark the chosen spot.



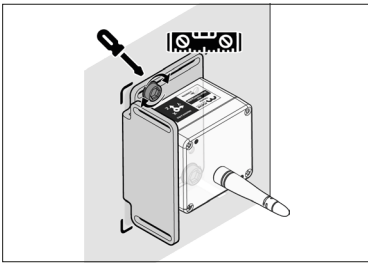
**2.** Drill two holes in the mounting surface.



**3.** Insert the two anchors in the holes.



**4.** Place the Tiltmeter on the structure and loosely tighten the two screws.



**5.** Using a level, make sure that the sensor is as horizontal as possible. The plate allows for slight corrections in inclination. Tighten the screws to lock in place.

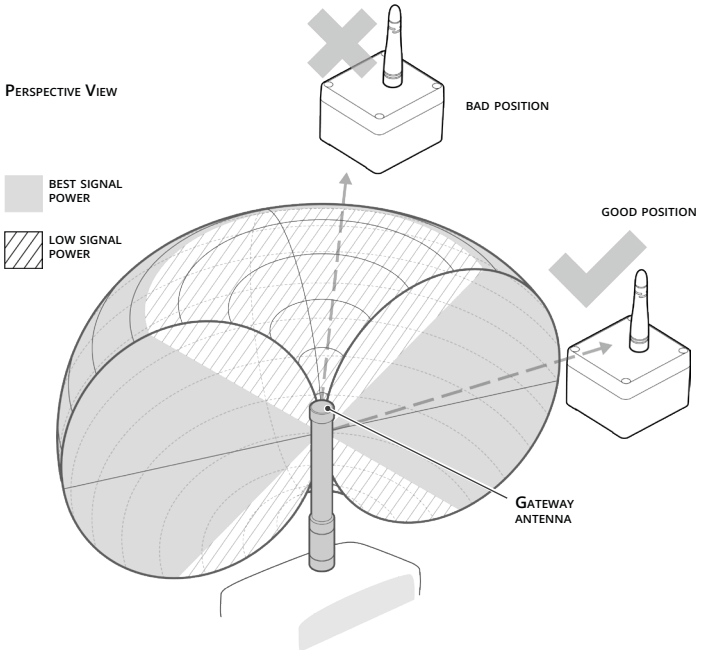
If the gateway is already running, you can start checking your data on *MyMove IoT Platform* within a few minutes. Otherwise, a maximum time of 30 minutes after the installation of the gateway is required before the sensor can be viewed on the platform.

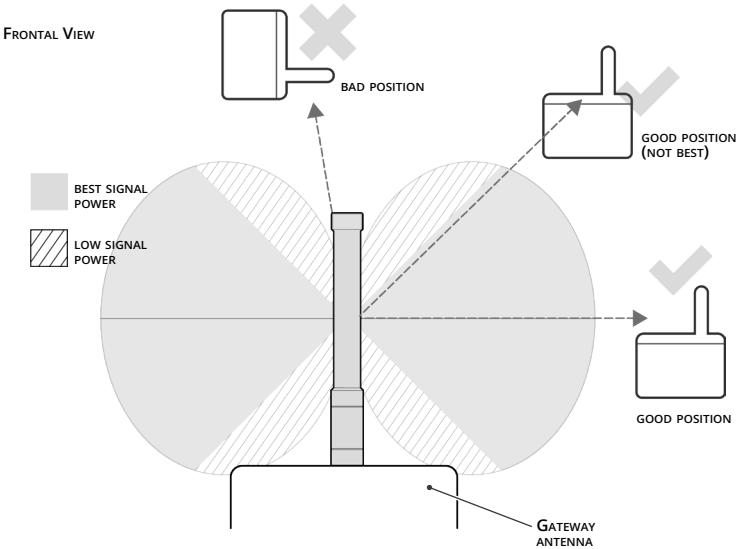
# 6 Maximizing radio performance

When installing the Tiltmeter, it is important to follow some basic prescriptions to ensure the correct operation of the product.

Avoid, if possible, to locate the gateway vertically above or under the Tiltmeter. If this cannot be avoided, it is best to keep the two antennas perpendicular to one another. Keep the Tiltmeter and the gateway in line of sight as much as possible, as obstacles along the path of the signal could have a negative impact on the radio link.

Additional information on optimal positioning can be found on the gateway manual.






Try to keep the antenna as far as possible from metallic materials that could alter its radiative performance. Similarly, keep as clear as possible of high voltage power cables, radio and tv antennas and any other source of unwanted electromagnetic disturbance.

Use the hardware supplied with the Tiltmeter to fix it to the wall, floor, or ceiling.

**WARNING**

- Remember to install the TIltmeter away from busy areas where it could be damaged by or cause damage to animals or people. For example, don't install the Vibrometer on the floor unless it's in a completely secluded area.

# MyMove IoT Platform 7

## 8.1 General settings

To access *MyMove IoT Platform*, connect to the URL that you have been supplied with by Move Solutions and log in with your credentials.

Through the *MyMove IoT Platform* you'll be able to:

- check the data of the last 24 hours and the current state of all your devices
- explore all the data that has been gathered by your sensors since day one
- set alarms and email notifications for each sensor
- manage settings for each sensor
- ...and more!

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**NOTES**

- *MyMove IoT Platform* is frequently updated with new features, fixes, and reviews. Refer to its documentation for more detailed information.
- Settings that alter the Tiltmeter behavior (settings that don't concern email alarms and sensor naming) can require up to 1 hour to be synchronized with the sensor.

---

# Output data

8

The sensor provides a comprehensive understanding of the 3D rotation of the structure in which it is installed by measuring two rotational angles of the structure:

- **φ (PHI) angle**: Rotation around LONGITUDINAL axis
- **θ (THETA) angle**: Rotation around the TRANSVERSE axis

The sensor measures the gravity acceleration vector to compute the rotation of the structure relative to it. To enhance accuracy, the input acceleration data is sampled over time and saved into the internal data buffer. The collected data is then averaged and used to compute the tilt angles. At the same time, the collected acceleration data is used to determine the RMS and peak values of the structure's vibration to provide the vibration intensity at the time of acquisition. The sensor also records the temperature at measurement time.

The adjustable accelerometer full scale range and the size of the data buffer makes possible to optimize the instrument for different needs, such as improved accuracy, better battery life, and reliable operation under strong vibrations of the monitored structure.

**WORKING PRINCIPLE**

The sensor periodically collects data points at specific times and programmed intervals. This enables multiple sensors to synchronize their data collection with high precision. The time-correlated data points from these acquisitions are useful for several purposes, such as:

- Monitoring trends in tilt angles and their correlation with temperature and vibrations
- Reconstruct the static deflection of structures, such as during static load tests of bridges
- Monitoring cant/twist angles of railways

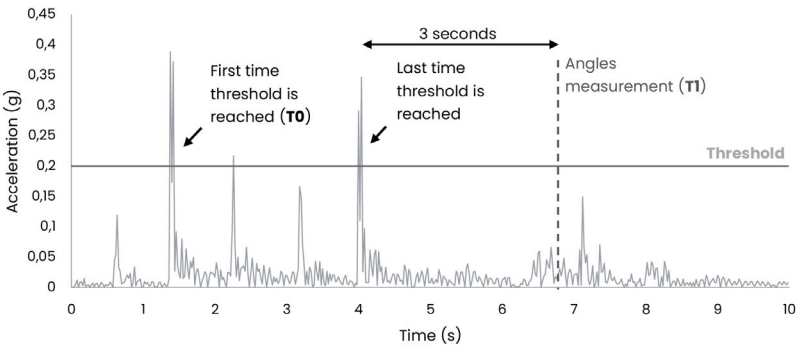
This synchronization and correlation capability, combined with the algorithms provided by the MyMove IoT Platform, allows for detailed and accurate analysis of structural behavior over time. Programmed data acquisition is always enabled.

Triggered acquisitions can be enabled alongside the programmed mode to collect additional data points. The transmission of these triggered acquisitions to the MyMove IoT Platform is optimized for very low latency, ensuring responsive notification of significant events. Users have the option to enable and configure triggered acquisitions based on their application's specific needs. Note that only one among the following types of triggers can be enabled at any given time. Available trigger sources are now described.

# 8.1 Trigger on acceleration

The trigger source is a vibrational event whose amplitude exceeds the programmed acceleration threshold. Vibration amplitude is defined as the magnitude of the three-dimensional acceleration vector. The sensor processes an acceleration-triggered event as follows:

- The sensor continuously monitors the three-dimensional acceleration, computing its magnitude and comparing it to the specified threshold.
- If the threshold is exceeded (time T0), the sensor processes the subsequent 3 seconds of data to compute the RMS and peak values of the triggering vibrational event.
- It then waits until the threshold is not exceeded for at least 3 seconds, then samples the tilt angles (time T1). This delay prevents the sensor from sampling tilt angles during intense vibrations, thereby improving measurement accuracy. A 2-minute timeout from T0 is implemented to prevent excessive waiting times
- The sensor transmits the acquired data, marked with timestamp T1, to the MyMove IoT Platform. The peak and RMS values of the vibrational event are measured at time T0, tilt angles and temperature at time T1.




Example of acceleration-triggered acquisition.

## 8.2 Trigger on angular velocity

The trigger source is the fast variation in one of the structure's tilt angles. The sensor triggers an acquisition when the angular velocity exceeds the programmed threshold. The sensor processes this type of event as follows:

- The sensor acquires the tilt angles every 30 seconds and calculates the angular velocity.
- Angular velocities are computed and compared to the programmed threshold. It is possible to enable the trigger on just a single angle or both.
- If the threshold is exceeded, the sensor acquires and transmits the event.
- The sensor sends the data to the MyMove IoT Platform, including which angle triggered the acquisition.

## 8.3 Trigger on angle value

The trigger source is an out of bounds value for one of structure's tilt angles, i.e. when a measured angle is not within the low and high thresholds programmed by the user. The sensor processes this type of event as follows:

- The sensor samples the tilt angles with the cadence programmed by the user
- It compares the measured tilt angles with their respective high and low thresholds
- If the value of an angle is lower than the low threshold or higher than the higher threshold, the sensor triggers the acquisition of an event.

In case the measured angle is constantly out of bounds, the sensor continuously acquires and transmits events with the programmed faster cadence. Acquired events are sent to the MyMove IoT Platform, including which angle triggered the acquisition.

# Maintenance 9

**IMPORTANT**

- Opening the Tiltmeter and breaking the seal voids the warranty. Only change the battery independently when the warranty has already expired. For issues on devices still covered by warranty always consult Move Solutions before resolving to opening the product.

Depending on the sensor's working settings and its environmental conditions, a battery change may be necessary every few months to every few years. In this event, only use the prescribed batteries.

For information on how to provision said batteries, please contact a Move Solutions representative. If the prescribed batteries are unavailable, or provisioning is not possible, consult a Move Solutions representative to find a viable alternative.

**IMPORTANT**

- Move Solutions is not responsible for malfunctions and damage caused by batteries supplied by other companies and/or utilization of batteries different from the specified part number.

To change the batteries:

1. Arrange the necessary tools to work safely where the Tiltmeter is installed.
2. make sure to work with dry hands and in a dry environment. It's advised not to change the batteries in humid, rainy, foggy, or snowy weather.
3. Open the lid. This voids the product's warranty (if still valid).
4. Disconnect the battery.
5. Insert the new battery.
6. Connect the new battery.
7. Properly close the lid tightening the screws. To tighten the screws, proceed in cross sequence and first tighten the screws gently, then tighten all screws to a torque of 1.7 Nm, still in cross sequence.
8. Properly close the lid tightening the screws.

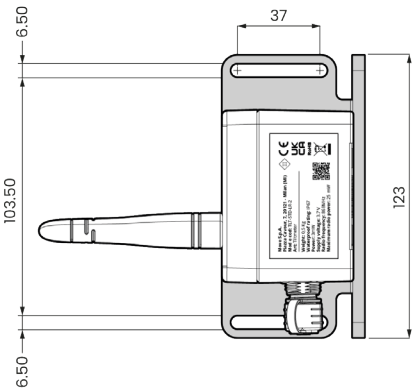
# Overall dimensions 10

Please note that the drawings provided in this manual are not drawn to scale.

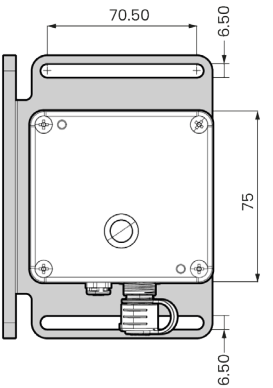
The purpose of these illustrations is to assist you in understanding the various components and their relative positions. Therefore, it is essential to rely on the numerical measurements provided alongside the drawings for accurate dimensions.

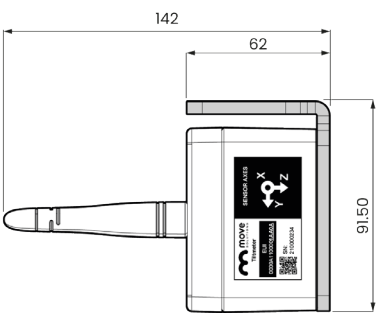
The following measurements are expressed in millimeters (**mm**).

**Side view**




**Front view**



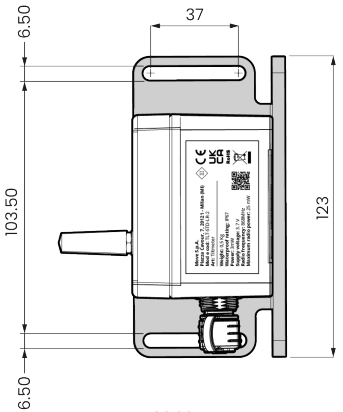




**Top view**

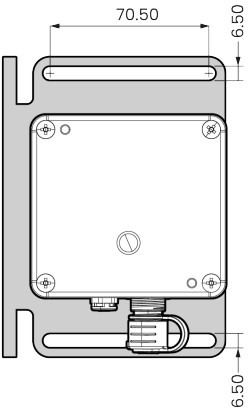
# Short antenna (optional)

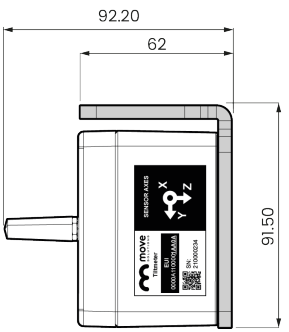
The following measurements are expressed in millimeters (**mm**).

**Side view**




**Front view**



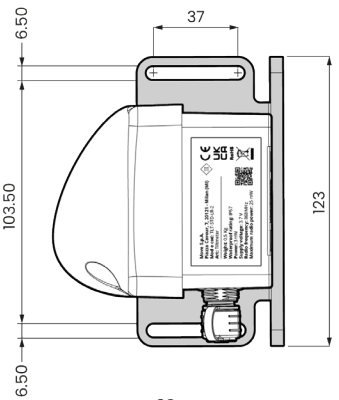




**Top view**

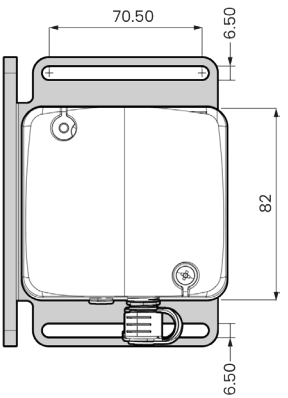
# Short antenna + dome (optional)

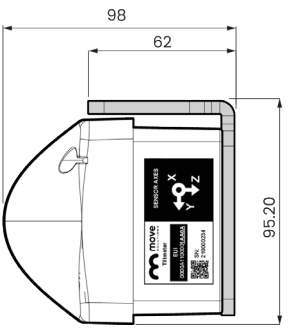
The following measurements are expressed in millimeters (**mm**).

**Side view**




**Front view**




**Top view**

# *Annex A*
# Troubleshooting

A

Here we seek to give a few pointers to the most common misfunctions and suggested countermeasures.

**WARNING**

- Remember to always disconnect the batteries before physically operating on the Tiltmeter.

**THE TILTMETER IS OFFLINE**

Check that a gateway is installed nearby, and that it is online. If the gateway is offline, refer to its manual or to the customer service to solve the problem. If the gateway has no issues, the problem can be ascribed to the sensor itself, so follow these steps to tighten the circle:

- Wait a few hours: the Tiltmeter might be functioning correctly, but the data may not arrive due to high traffic on the radio channel. This might be the case in installations with a high density of LoRaWAN devices, or when the radio environ- ment abruptly changed. The device automatically adapts its radio parameters to the environment, but in some cases up to one day might be required to reach stability.
- Examine the surroundings of the Tiltmeter and check that no disturbance is present. Disturbances might come from industrial appliances, machinery, or metal objects in general. If the device has stopped working after regularly working for a while, investigate on environmental conditions that might have appeared (drastic changes in atmospheric conditions, such as fog or snow, or new obstacles that might have been installed). Changes in the device's environment could cause the device to go offline for several hours, for example if a large metal object is placed close to the sensor, behaving as a radio shield.
- Dismount the Tiltmeter and move it in a location closer to the gateway and wait up to one day. If the Tiltmeter goes back online, it probably means that the radio path between it and the gateway is suboptimal, and action needs to be taken.

If all these tests fail, refer to the customer support for assistance.

### THE TILTMETER IS ONLINE, BUT NO DATA IS SHOWING ON MYMOVE IOT PLATFORM

The Tiltmeter might be configured in Threshold triggering mode, but the measured data never reach the threshold. Check that the tiltmeter's mechanical coupling to the structure is correct. If the mechanical coupling is correct, then the measured data might actually be unable to reach the selected threshold: in this case, you can set a lower threshold to collect more data points. In case the instrument is using programmed acquisition based on a defined cadence, you can increase the cadence to collect more data points for the same time interval.

### UNEXPECTED BEHAVIOR AFTER CHANGING THE SETTINGS

Changes made in the platform's setup menu might require up to 1 hour to be synchronized to the sensor. Moreover, if the setup is changed on more than one sensor, there might be a difference on when different sensors receive the new setting. For the best results, please allow some time for the system to stabilize after changing any settings.

**MOVE SOLUTIONS CUSTOMER ASSISTANCE SERVICE**
Visit the website at www.movesolutions.it for contact information relating to office addresses and telephone numbers.

**PUBBLICATION**
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