move
SOLUTIONS

Dynamic Displacement Sensor

Instruction Manual

Quick installation guide and system operation

Important safety, compliance and warranty information

Move S.p.A.

Piazza Cavour 7, 20121 Milan - Italy

Via Guglielmo Lippi Francesconi 1256/J, 55100 Lucca - Italy

P.IVA: 09887990969

MOVE SOLUTIONS CUSTOMER ASSISTANCE SERVICE

Visit the website at www.movesolutions.it for contact information relating to office addresses and telephone numbers.

Dynamic Displacement Sensor

Instruction Manual

English

Read manual before using the product

PUBLICATION

Printed in Italy
October 2023

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 .

Index

1. **Warnings** 5

FCC Compliance 7

ISED Compliance 8

Symbols and provisions used in the documentation 9

2. **General description** 10

3. **Technical Data** 12

4. **What's in the box** 14

5. **Quick guide to installation** 16

5.1 Positioning and orientation 16

5.2 Installation 19

6. **Maximizing radio performance** 21

7. **Move Solutions IoT Platform™** 23

7.1 General settings 23

7.2 Data visualization 24

8. **Acquired data** 25

8.1 Event acquisition mode 25

9. **Maintenance** 26

10. **Overall dimensions** 27

Annex A. Troubleshooting 28

Annex B. Optimizing battery life 29

Warnings

1

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 the lid of the product correctly screwed in place, the antenna screwed on the lid and the circular connector covered by the protective lid or connected to a suitable IP cable. Do not expose the product to humidity or dust in any other condition. The product is not intended to be opened.
- 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 Solutions IoT 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.

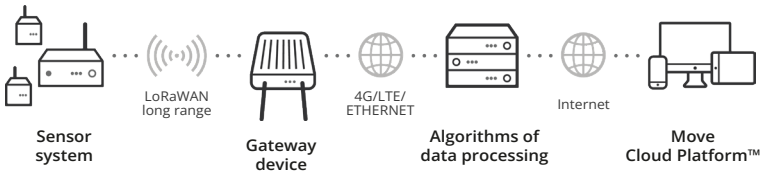
General description

2

The Dynamic Displacement Sensor is a wireless sensor specifically designed to measure the uniaxial oscillations of the structure providing dynamic displacement values in mm. The Dynamic Displacement Sensor samples dynamic oscillations of the structure at 50 Hz and transmits relevant events to the Move Solutions IoT Platform via LoRaWAN for the user to view and interact with the data.

When the displacement threshold set by the user is exceeded, an “event” occurs. The occurrence of an event triggers the Dynamic Displacement Sensor to send the relative data to the Move Solutions IoT Platform. For each event the data that is transmitted starts from 12 seconds prior to the event and stops 20 seconds after.

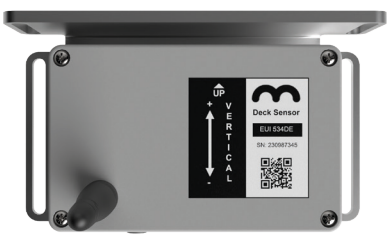
The Dynamic Displacement Sensor is part of the Move Solutions range of LoRaWAN products for monitoring purposes; as such, it needs a LoRaWAN gateway in its range (such as the Move Solutions Gateway Pro) to connect to the Move Solutions IoT Platform. When the sensor is connected to the platform, the settings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



The Dynamic Displacement Sensor is available in two versions:

- Vertical (DECK002-V)
- Horizontal (DECK002-H)

Allowing it to be used in a variety of settings. The Vertical version is made to measure displacements parallel to the axis of gravity, while the Horizontal version measures displacements parallel to the ground. The two versions are not interchangeable (See "Quick Guide to Installation" for more details).



VERTICAL (DECK002-V)

HORIZONTAL (DECK002-H)

Technical Data

3

Operation	
Operating temperature range	-40°C to +80°C
IP rating	IP67
Batteries	2 LiSOCl2 battery (suggested: EVE ER34615PHR4)
Battery connector	JST PHR-4
Radio coverage	1 km in line of sight with gateway[1]
Maximum radiated power	< +16 dBm
Transmission Frequency	868 MHz in EU and UK, 902 MHZ in US and Canada

Operation parameters	
Orientation	Horizontal (code DECK002-H) or Vertical (code DECK002-V)
Displacement range	± 1.5 mm, ± 3mm
Displacement resolution	0.012 mm (range ± 1.5 mm), 0.024 mm (range ± 3mm)
Sampling frequency	50 Hz
Number of samples for each acquisition	1600
Acquisition duration	32 seconds per event (12 seconds before trigger and 20 seconds after trigger)

Bandwidth (-3dB)	0.7 – 15 Hz
Temperature accuracy	0.5 °C
Temperature resolution	0.125 °C
Battery life	2 years with 5 events acquired every hour[2]

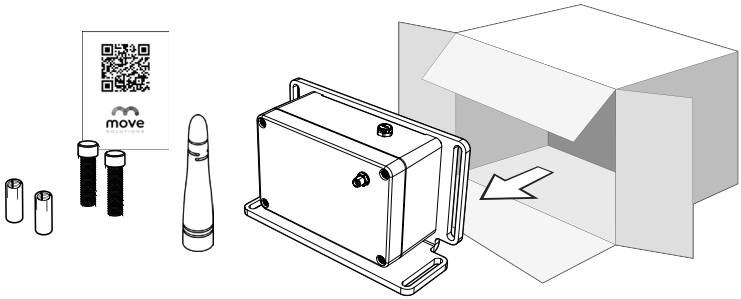
Mechanical	
Installation options	Wall mount, ceiling mount, floor mount
Installation mode	2x mounting screw and anchors
Dimensions (with plate and antenna)	165 x 97 x 145 mm
Weight	1.7 Kg

[1, 2] This information is strictly dependent on environmental parameters such as humidity, presence of other radio devices, presence of obstacles and others.

What's in the box

4

The Dynamic Displacement Sensor 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 Move Solutions IoT Platform.



Inside the package you should find:

Number of pieces	Components
1 pc.	Dynamic Displacement Sensor
1 pc.	Antenna
2 pcs.	Anchors (M6x25mm, fixing hole 8mm)
2 pcs.	Socket cap screws (M6x30mm)
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.

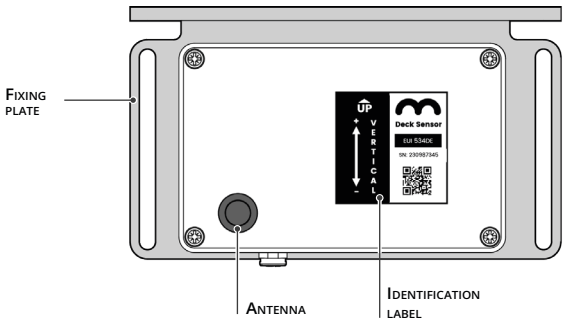
WARNING

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

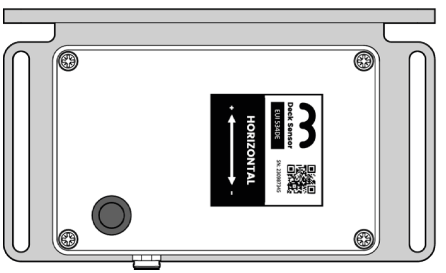
A label bearing the same information as the one on the packaging is affixed on the top lid of the Dynamic Displacement Sensor.

From the outside you'll see:

VERTICAL
(DECK002-V)



HORIZONTAL
(DECK002-H)



IMPORTANT

- **DO NOT** unbox the Dynamic Displacement Sensor 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 Dynamic Displacement Sensor as this could alter the product's IP rating.

Quick guide to installation

5

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

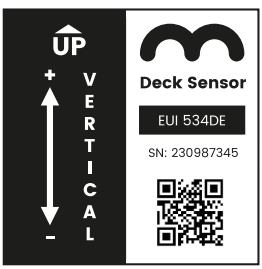
5.1 Positioning and orientation

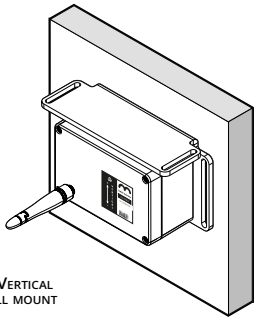
Before installing the Dynamic Displacement Sensor, make sure you have the right version (vertical or horizontal). The ones described below are the **ONLY** allowed orientations, installing the device in any other way may compromise its effectiveness.

VERTICAL

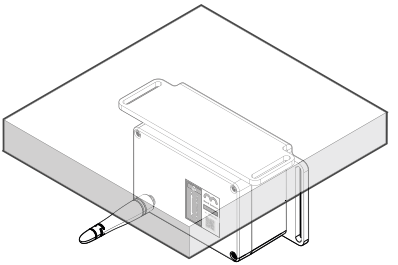
IMPORTANT

the vertical version of the Dynamic Displacement Sensor must **ALWAYS** be installed with the positive side facing upwards, as reminded by the word "UP" surmounted in an arrow pictured on the label.

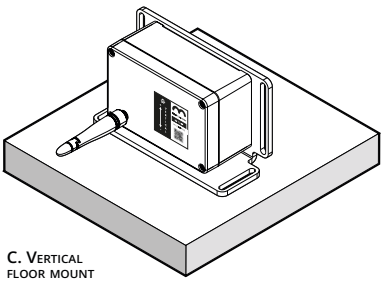




A. Vertical
wall mount

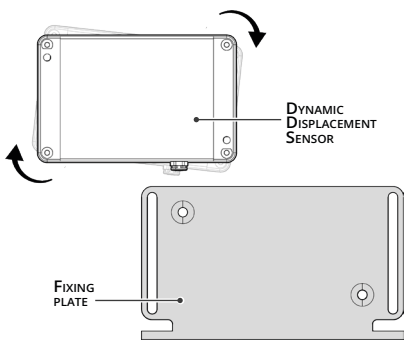


B. Vertical
ceiling mount



C. Vertical
floor mount

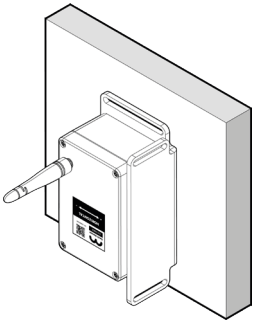
To mount a vertical Dynamic Displacement Sensor on the floor (**C.**) the user must rotate the mounting plate so that the "UP" sign on the label is correctly pointing upwards.



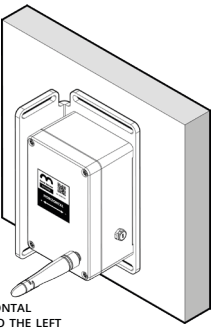
To rotate the mounting plate:

1. Unscrew the two screws under the Dynamic Displacement Sensor.
2. Place the sensor so that the antenna is closer to the shorter part of the plate.
3. Tighten the screws under the Dynamic Displacement Sensor to secure it to the mounting plate.

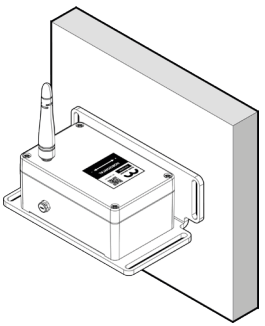
HORIZONTAL



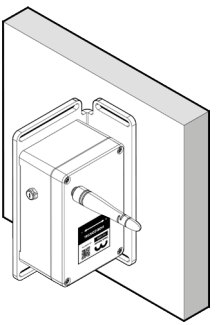
D. Horizontal
positive to the right
wall mount



E. Horizontal
positive to the left
wall mount



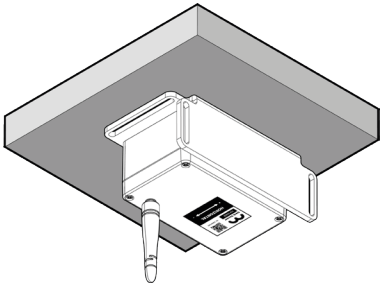
F. Horizontal
positive towards the wall (preferred)
wall mount



G.Horizontal
positive towards the wall (suboptimal)
wall mount

NOTE

positions **F.** and **G.** should yield the same measurements, however having the antenna facing upwards (i.e. parallel to the antenna of the Gateway) results in better radio coverage and should thus be preferred when possible.

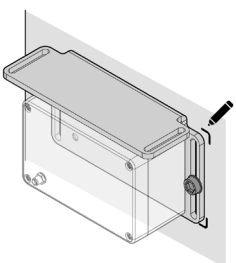


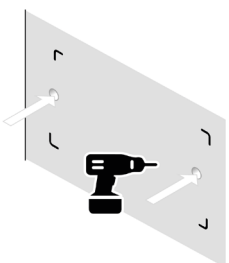
H. Horizontal ceiling mount

5.2 Installation

IMPORTANT

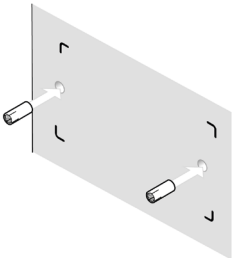
Make sure the surface where the Dynamic Displacement Sensor is going to be installed does not have asperities and protrusions. Close, stable and tight contact of the device with the surface is crucial to detecting accurate data.



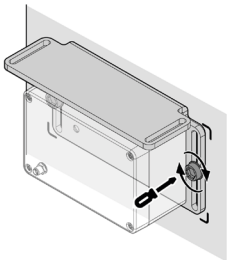


1. Using the installation plate as reference, mark the chosen spot.

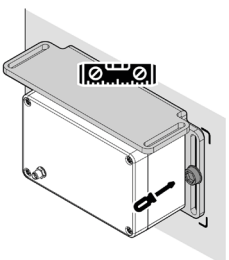
2. Drill two holes in the mounting surface.



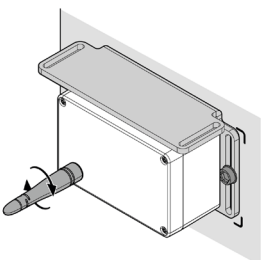
3. Insert the two brass anchors in the holes.



4. Place the Dynamic Displacement Sensor 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.



6. If the antenna was not already installed (advised to protect the sensor from humidity), tightly screw on the antenna.

If the Gateway is already running, you can start checking your data on the Move Solutions 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.

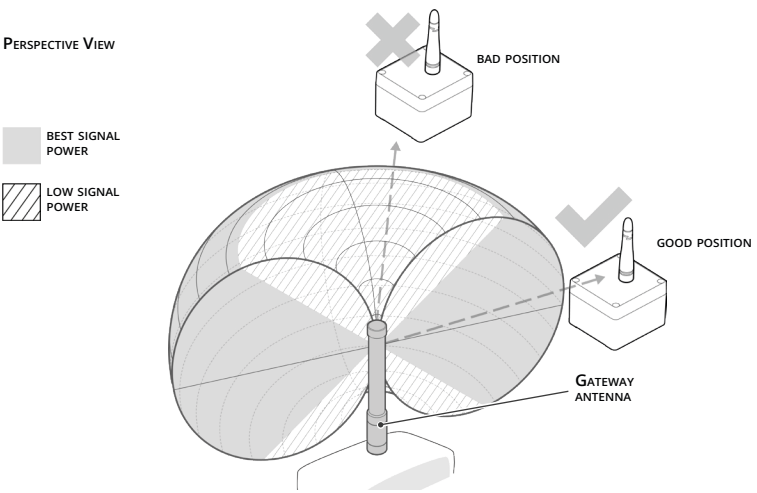
Maximizing radio performance

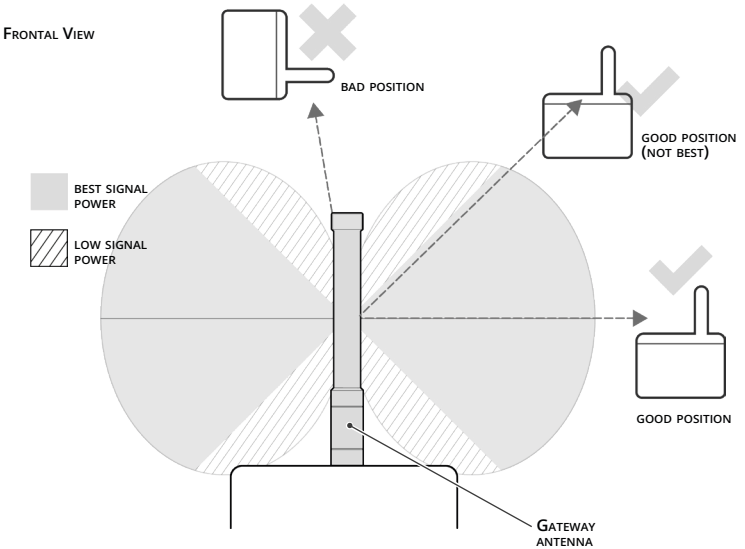
6

When installing the Dynamic Displacement Sensor, it is important to follow some basic prescriptions to ensure the correct operation of the product. For optimal radio performance, the antenna should be oriented the same way as the gateway antenna, and the gateway should be on the side of the device.

Avoid, if possible, to locate the gateway vertically above or under the Dynamic Displacement Sensor. If this cannot be avoided, it is best to keep the two antennas perpendicular to one another.

Keep the Dynamic Displacement Sensor 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. The radio link quality affects the battery life of the Dynamic Displacement Sensor: the better the link quality and stability, the higher is the battery life. For this reason it is strongly suggested to optimize the link quality as much as possible. 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 Dynamic Displacement Sensor to fix it to the wall, floor, or ceiling.

WARNING

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

Move Solutions IoT Platform™

7

7.1 General settings

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

Through the Move Solutions 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!

NOTES

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

To access the settings of your Dynamic Displacement Sensor, go to Settings in the side navigation menu. Select the Dynamic Displacement Sensor in the side bar, and a list of all the Dynamic Displacement Sensors on your structure will appear.

From this page you will have various tabs available.

- In the **Management** tab, you can add labels to your Dynamic Displacement Sensors, for example, to assign a mnemonic reference to each sensor.
- In the **Alarm** tab, you can manage the alarm threshold for each Dynamic Displacement Sensor: this threshold is applied to events once they reach the Move Cloud Platform. If the threshold is exceeded and email alarms are configured an email notification is sent.

NOTE

Alarms are only applied to events that reach the platform, so it is advisable to set an activation threshold below the alarm level to make sure that no alarms go undetected.

- In the **Resolution** tab, you can choose the resolution of the Dynamic Displacement Sensor: a lower value means that the sensor can measure the displacement with finer resolution at cost of a lower maximum displacement before reaching saturation; a higher value, on the other hand, means that the sensor measures the variations less finely, but allows for higher maximum displacement before reaching saturation.
- In the **Activation threshold** tab, you can manage the activation threshold: when this threshold is exceeded, an event is transmitted by the sensor.

7.2 Data visualization

The data collected by the sensor is shown on the Move Solutions IoT Platform™ in different ways.

- In **Dashboard**, the data from the last 24 hours is shown as sequence of peak-to-peak values.
- In the **Events** page the user can select a custom date range to visualize the data from the sensor. The events and temperature are listed in chronological order. By selecting a specific event it is possible to see:
    - The displacement in the time domain from 12 seconds before to 20 seconds after the trigger event
    - The FFT of the displacement data

Please check the Move Solutions IoT Platform™ documentation for more information and for a full list of the features provided by the cloud platform.

Acquired data

8

The Dynamic Displacement Sensor samples data with a sampling frequency of 50 Hz, and has a -3dB bandwidth of 0.7 to 15 Hz. Sample resolution and full scale can be selected by the user based on the use case. Each event is made of 1600 samples or 32 seconds.

8.1 Event acquisition mode

Events are acquired using a threshold trigger policy: the sensor continuously reads the input signal and waits for it to exceed the activation threshold. Once the threshold is passed, the sensor acquires for 20 more seconds after the trigger time. Once the acquisition is complete the sensor starts to transmit the data via LoRaWAN connection.

Activation threshold shall be properly set by the user based on their specific use case. In general, given the same use case:

- A lower threshold implies more collected events for the same amount of time, and lower battery life.
- A higher threshold implies less collected events for the same amount of time, and higher battery life.

Maintenance 9

IMPORTANT

- Opening the Dynamic Displacement Sensor 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 Dynamic Displacement Sensor 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 batteries.
5. Insert the new batteries.
6. Connect the new batteries.
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.

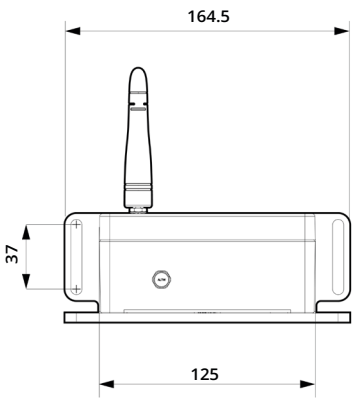
Overall dimensions 10

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

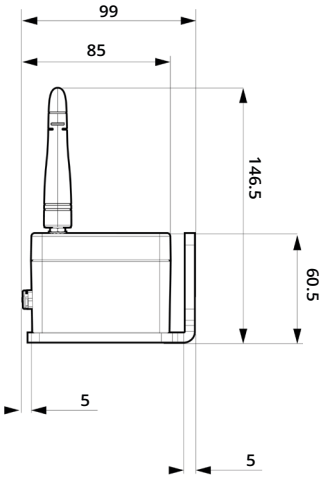
The purpose of these illustrations is to assist you in understanding the various components and their relative positions. Therefore, it is essential to rely on the numerical measurements provided alongside the drawings for accurate dimensions.

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

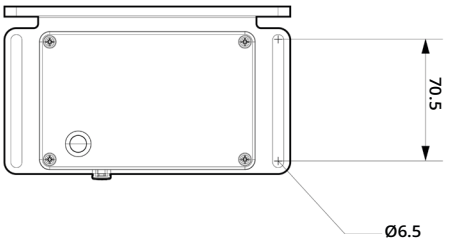
Front view



Right view



Upper view



Annex A
Troubleshooting

A

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

THE DYNAMIC DISPLACEMENT SENSOR 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 Dynamic Displacement Sensor 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 environment 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 Dynamic Displacement Sensor 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 Dynamic Displacement Sensor and move it in a location closer to the gateway and wait up to one day. If it 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 DYNAMIC DISPLACEMENT SENSOR IS ONLINE, BUT NO DATA IS SHOWING ON THE MOVE SOLUTIONS IOT PLATFORM

The Dynamic Displacement Sensor might be configured with a working threshold that's too high for the sensed data. Check that the sensor's mechanical coupling to the structure is correct. If the mechanical coupling is correct the displacement data might be too low compared to the selected working threshold: in this case, you can set a lower threshold to collect more data points.

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.

Annex B
Optimizing battery life

B

The life of DECK's batteries depends on its setup and the environment as follows:

- a low threshold has more chances to be exceeded, so more events are acquired. This translates to more data transmissions and lower battery life.
- the stronger are the vibrations of the structure (and thus the bigger the events) the lower is the battery life.
- The quality of the radio link between the sensor and the gateway: a better signal quality translates to longer battery life.

Moreover, environmental conditions such as prolonged exposure to extreme temperatures may affect the battery life of the sensor.

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

PUBBLICATION
Made in Italy
10/2023

www.movesolutions.it

Move S.p.A.
Piazza Cavour 7, 20121 Milan - Italy
Via Guglielmo Lippi Francesconi 1256/J, 55100 Lucca - Italy
P.IVA: 09887990969