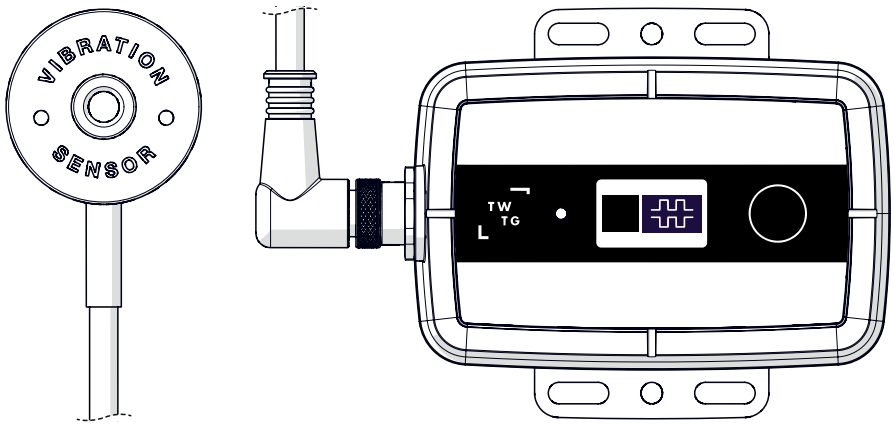
Vibration Sensor

Product Manual

This document applies to products of batch **AB** and onwards (LD 01 20 **AB** 00001). See chapter 2.



Contents

1 TWTG NEON

1.1 NEON Product Introduction

NEON stands for a standardised approach to collecting data points from the operational environment and in doing so, creates a general approach to integrated solutions within existing IT ecosystems.

The TWTG NEON product range supports all industrial customers moving towards LoRaWAN as the Industrial IoT network of the future.

The LoRaWAN network gives industrial operations a secure solution, which scales-up to tens of thousands of sensors, covers complete sites with only a small amount of gateways and best of all – the low-power approach means that the lifetime of the NEON products can be extended dramatically.

1.2 Related Documents

Document Name	Document Number
NEON Data Sheet	6016_P20-002_Data-Sheet-NEON-Vibration-Sensor
NEON Communication Protocol	6013_P20-002_Communication-Protocol-NEON-Vibration-Sensor
3M Scotch Weld Epoxy Datasheet	DP8405NS Green

Table 1: Related Documents

2 Getting Started

2.1 Compatibility of this manual

This manual is meant to be used with products of from a specific production batch. See Product Type Identification for an explanation on how to retrieve the production batch code from the serial number.

This manual is applicable to:

- Production Batch: **AB** and onwards
  - Example serial number: LD0120**AB**00001

2.2 What you will need

In order to deploy the NEON Transmitter, a compatible and operational LoRa-WAN network architecture is required. This manual does not contain any instructions of how-to set-up and install LoRa-WAN networks.
TWTG offers radio network planning and IT architecture design services to fully integrate the products in the NEON product line.

2.3 What is in the box

When the product is delivered check the components for damage and if all box items mentioned below are included.

Box Items	
NEON Transmitter	2 batteries, included in the product 1 mounting bracket, mounted on the product M12 connector O-ring, mounted on the product
NEON Vibration Sensor	M6 Bolt
Declaration of Conformity	Declaration of Conformity, containing a link to the latest version of this product manual and other relevant product documentation

Table 2: Box Items

2.4 Product Specifications

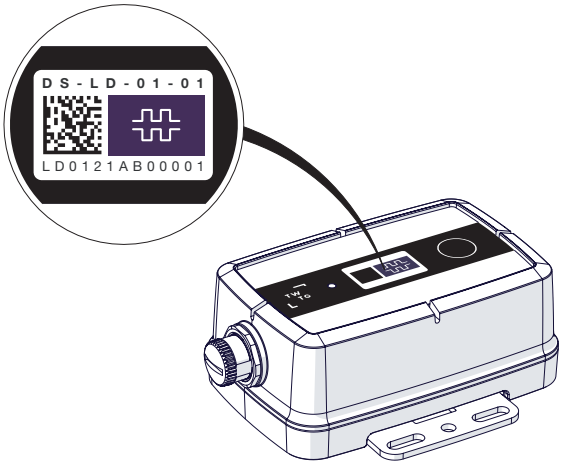
Product	
Product name	TWTG NEON Vibration Sensor
Type identification Transmitter	DS-LD-01-XX
Type identification Sensor	DS-VB-01-XX
Environmental conditions	
Ambient temperature range	-40℃ - 80℃
Storage temperature range	10℃ - 30℃
Water & dust resistance	IP65
Mechanical (Transmitter)	
Material	Molded plastic
Weight (including mounting bracket)	245 g
Dimensions	100x70x45 mm
Mechanical (Sensor)	
Material	Stainless steel and polyurethane
Weight	560 g
Dimensions	⌀40x21 mm
Cable length	3 m
Installation	
Transmitter	Band clamp or bolts (not included)
Sensor	Bolt
	Chemically bonded adapter (not included)
	Magnet for curved surfaces (not included)
	Magnet for flat surfaces (not included)
Certifications	
ATEX certificate number	DEKRA 20ATEX0098 X
IECEx certificate number	IECEx DEK 20.0056X
Ex marking	Ex II 2G Ex ib IIC T4 Gb
Applicable ATEX/IECEx standards	EN 60079-0
	EN 60079-11
IMDA Dealer License	DA108442
CE	EN 300 220-1
	EN 300 220-2
	EN 300 330
Safety	EN 62368-1
	EN 62311
	EN 60529
EMC	EN 301 489-1
	EN 301 489-3
UKCA	Radio Regulation 2017

Table 3: Product specifications. See also "NEON datasheet" in Related Documents for a detailed overview of specifications.

Connectivity	
Protocol	LoRa-WAN
Frequency band	863-870 MHz
	902-928 MHz (compatible)
Maximum RF output power	+13 dBm
Provisioning	
Data matrix code / Serial number	Serial number (read only)
NFC	Serial number (read only)

Table 4: Product specifications. See also "NEON datasheet" in Related Documents for a detailed overview of specifications.

2.5 Product Type Identification



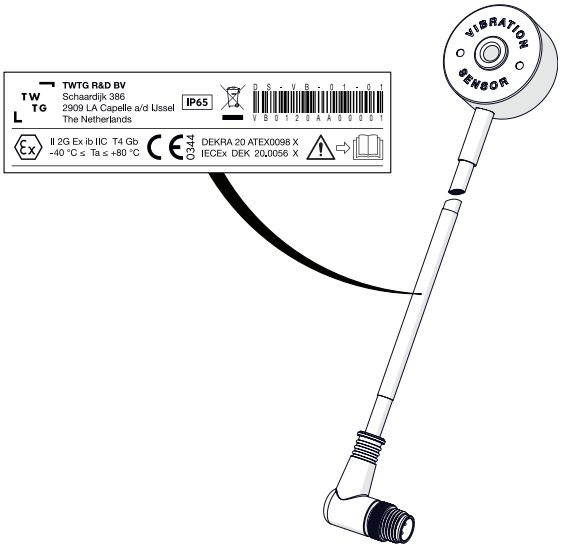
AA-BB-CC-DD	
AA - Product Family	DS
BB - Product Variant	LD = Transmitter
CC - Main Revision	Eg. 01
DD - Region	01 = Europe, 868 03 = Singapore, 923

Product Nomenclature

AA-BB-CC-DD-EEEEE	
AA - Product Variant	LD = Transmitter
BB - Product Revision	Eg. 01
CC - Production Year	Eg. 21 = 2021
DD - Production Batch	Eg. AA
EEEEE - Serial Number	Eg. 00001

Serial Number

Figure 1: Transmitter product identification



AA-BB-CC-DD	
AA - Product Family	DS
BB - Product Variant	VB = Vibration Sensor
CC - Main Revision	Eg. 01
DD - Region	01 = Europe, 868 03 = Singapore, 923

Product Nomenclature

AA-BB-CC-DD-EEEEE	
AA - Product Variant	VB = Vibration Sensor
BB - Product Revision	Eg. 01
CC - Production Year	Eg. 20 = 2020
DD - Production Batch	Eg. AA
EEEEE - Serial Number	Eg. 00001

Serial Number

Figure 2: Vibration Sensor product identification

2.6 Component Names

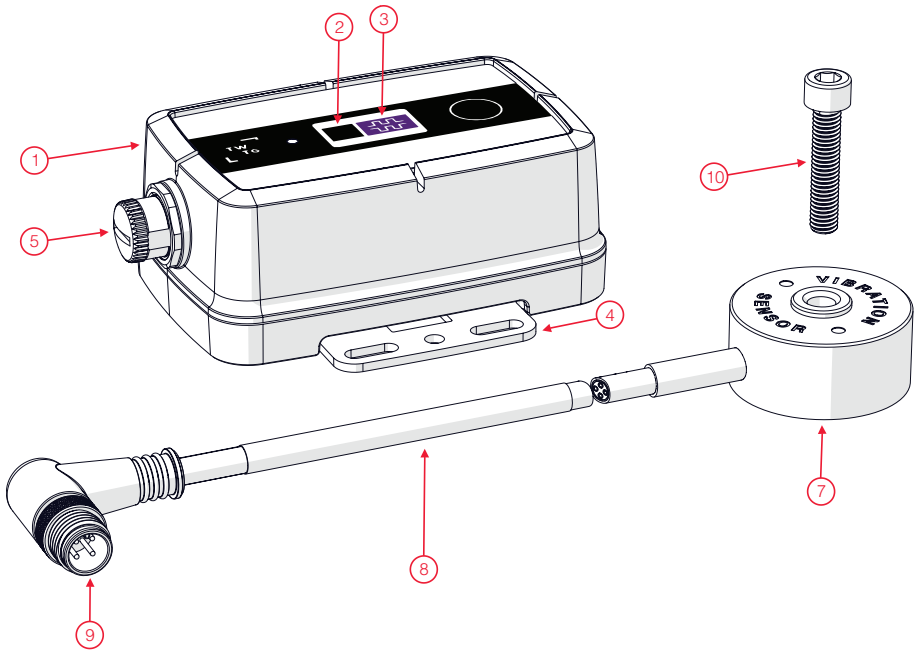


Figure 3: Component Names

Number	Description
1	Neon Transmitter
2	Data Matrix Code
3	NFC Tag
4	Mounting Bracket
5	M12 Connector Dust Cap
7	Vibration Sensor
8	Sensor Label
9	Sensor (M12) Connector
10	M6 Bolt

Table 5: Component Names

2.7 Product Dimensions

2.7.1 Transmitter

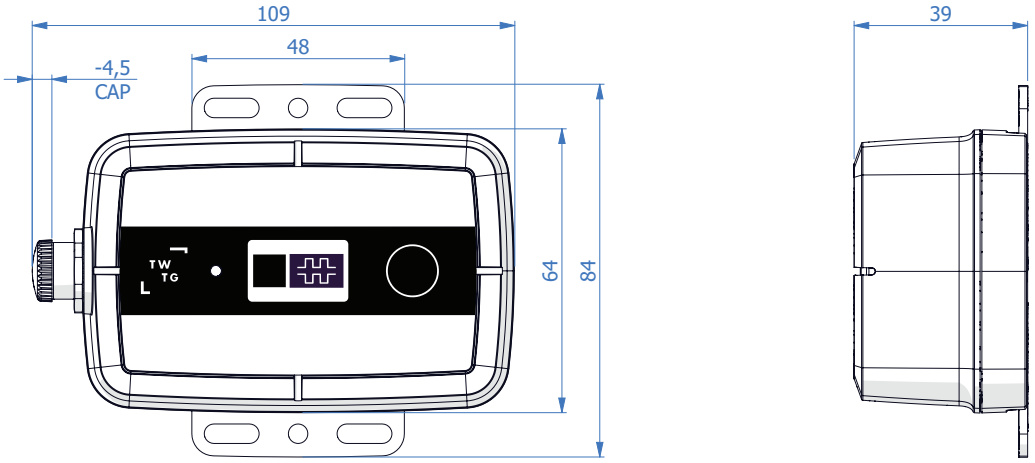


Figure 4: Neon Transmitter Dimensions (mm)

2.7.2 Sensor

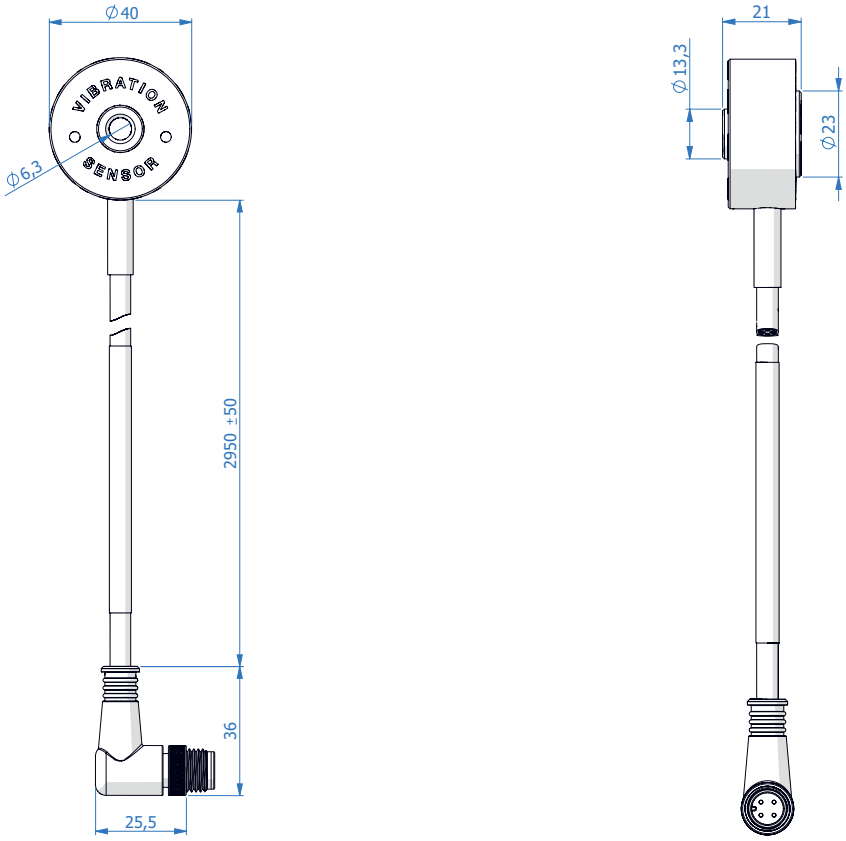


Figure 5: Neon Vibration Sensor Dimensions (mm)

3 Warnings

3.1 ATEX / IECEx

3.1.1 Specific Conditions of Use

WARNING - POTENTIAL ELECTROSTATIC CHARGING HAZARD

- The product shall be installed in such a way that the risk for electrostatic discharges is minimised;
- When the equipment is used in hazardous locations, avoid any actions which generate electrostatic discharge;
  - Cleaning: The equipment shall only be cleaned using a wet cloth;
  - Installation: Touch non-metallic parts with an insulating object;
  - Environment: Do not use the product in environments with powerful charge generating processes.

3.1.2 Installation

- This equipment shall be installed according to NEN-EN-IEC 60079-14 and the installation instructions;
- This equipment is intended for fixed installations only;
- This equipment is intended for use in restricted access areas only .

WARNING - DO NOT OPEN WHEN AN EXPLOSIVE ATHMOSPHERE IS PRESENT

- Under no circumstances shall the equipment enclosure be opened within a hazardous area

3.1.3 Operation

The connector of this equipment may only be used with external equipment as listed in the “Product Matrix”;

- The connector of this equipment shall not be connected when an explosive atmosphere is present;
- This equipment shall only be used in environments where electromagnetic field strength is limited according to EN 60079-14;
- This equipment is only intended for use in combination with NFC Forum Tag 2 Type technical specification compatible readers;
- This equipment shall only be used within ambient temperatures between -40 ℃ and 80 ℃.

3.1.4 Service

- This equipment shall only be opened by TWTG or by a competent instructed person;
  - The battery is serviceable by said persons;
  - Only replace the battery in a non-hazardous location;
  - Only use SAFT LS17500 batteries;
- If damage to the enclosure is evident, a trained and competent person shall be immediately informed, who shall remove the device from service as soon as possible;
- If the equipment is or has been in contact with chemical materials, clean it appropriately.

3.2 General

3.2.1 Transport and Storage

- The product must be kept in its original packaging until it reaches the installation site to prevent damage while in transit;
- The storage location must be dry;
- The product must not be exposed to vibrations or impact during transit and storage.

3.2.2 Warranty

- The warranty covers the period noted on the quotation;
- If the device doesn't function as documented, the customer should contact TWTG and provide the following information:
  - Model specification;
  - Serial number;
  - Circumstances under which the problems developed;
  - Any previously generated data;
- The party responsible for the costs of solving the problem shall be determined by TWTG on the basis of an investigation conducted by TWTG.

3.2.3 Warranty will be void in case of

- Malfunction due to ignoring the design specifications;
- Malfunction due to modification of the product carried out by the user;
- Deferred maintenance of the product or the installation location.

4 Provisioning

4.1 User Interface

The product contains one Light Emitting Diode (LED) to communicate with the user. In order to interact with the device a button is present on the right side of the NFC label.

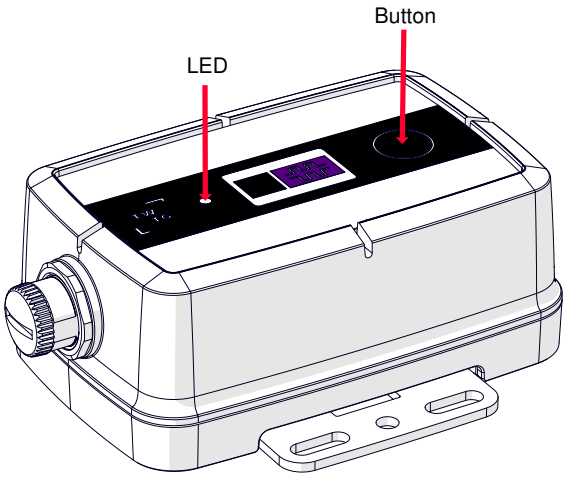


Figure 6: NEON Transmitter Interface

4.2 Operating the Device

Press and Release | **Press and Hold** | **Release**

Red (Blink 2x)
Deactivated

Red (Illuminated)
Failed

Green (Blink 2x)
Activated

Green (Illuminated)
Passed

White (Blinking)
Connecting

White (Illuminated)
Calibrating

Blue (Illuminated)
Action / Handling Required

Blue (Flashing each second)
Button is being hold

4.2.1 Read device status

1. Press & release the button and the device will immediately show its status:

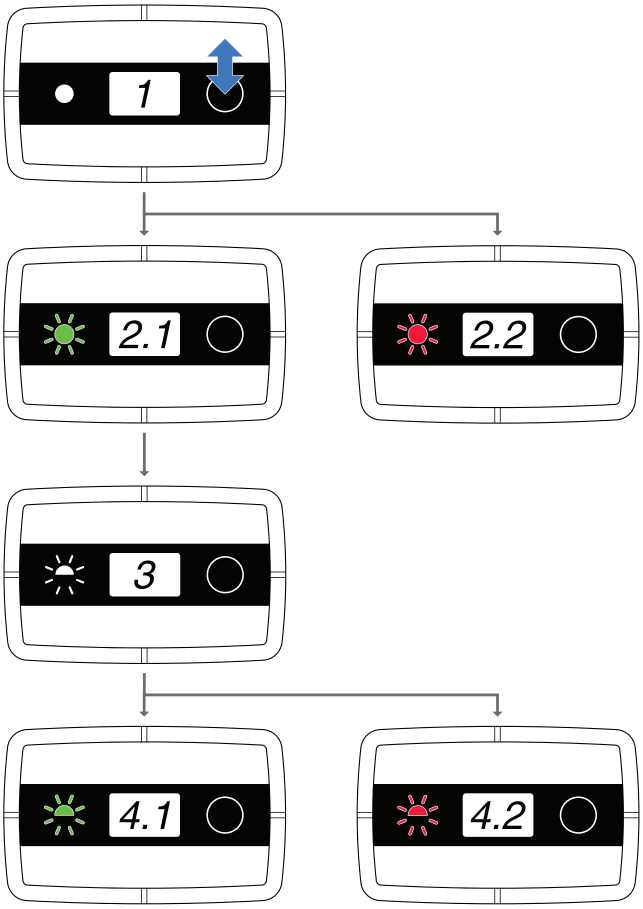
- **2.1 Green (Illuminated):** Device is activated
- **2.2 Red (Illuminated):** Device is deactivated

If the device is activated it will try to send the Device Status message over LoRa (using default configuration):

- **3. White (Blinking):** Connecting to network

Within a typical maximum of 3 minutes*, the device will show:

- **4.1 Green (Blink 2x):** Message sent, or
- **4.2 Red (Blink 2x):** Failed to connect to send message / connect to network



Notes:

- *The NEON Transmitter can be configured to send a Sensor Data message upon a button press. In this configuration the Sensor Data message will be sent after the Sensor Event message;*
- **All timeout and retry values are valid for the default configuration, the maximum timeout might be longer when process is performed repeatedly due to RF duty cycle limitations.*

4.2.2 Device Activation

1. Press & hold the button for 5 seconds
During the button hold the LED will blink Blue each second.

2. After holding the button for 5 seconds the device will first check the LoRa network:

- **3.1 White (Blinking):** Checking LoRa network

4. Within a typical maximum of 3 minutes* the device will show:

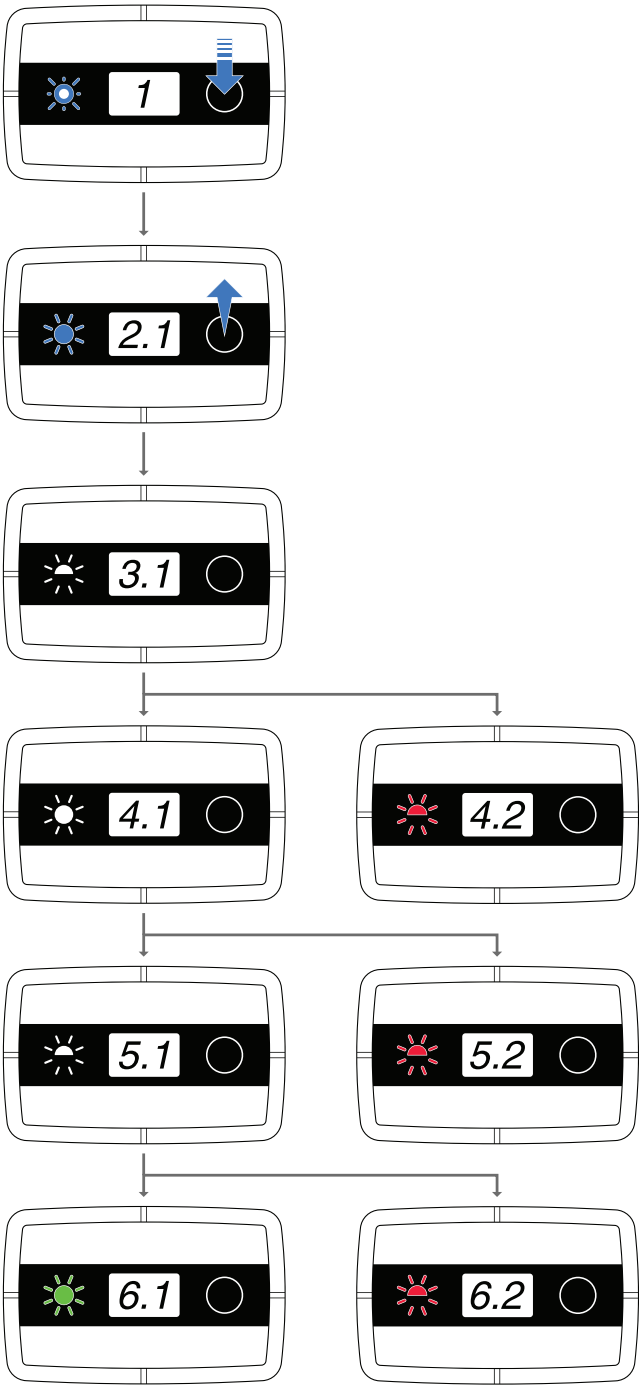
- **4.1 White (Illuminated):** Checking sensor communication
- **4.2 Red (Blink 2x):** Check network

5. Within 30 seconds max. the device will show:

- **5.1 White (Blinking):** Sending activation over LoRa
- **5.2 Red (Blink 2x):** Check sensor

6. After communicating over LoRa, within a typical maximum of 3 minutes*, the device will show:

- **6.1 Green (Illuminated):** Activated, or
- **6.2 Red (Blink 2x):** Check network



Notes:

- **All timeout and retry values are valid for the default configuration, the maximum timeout might be longer when process is performed repeatedly due to RF duty cycle limitations.*

4.2.3 Device Deactivation

1. Normal Configuration
During the button hold the LED will blink Blue each second.

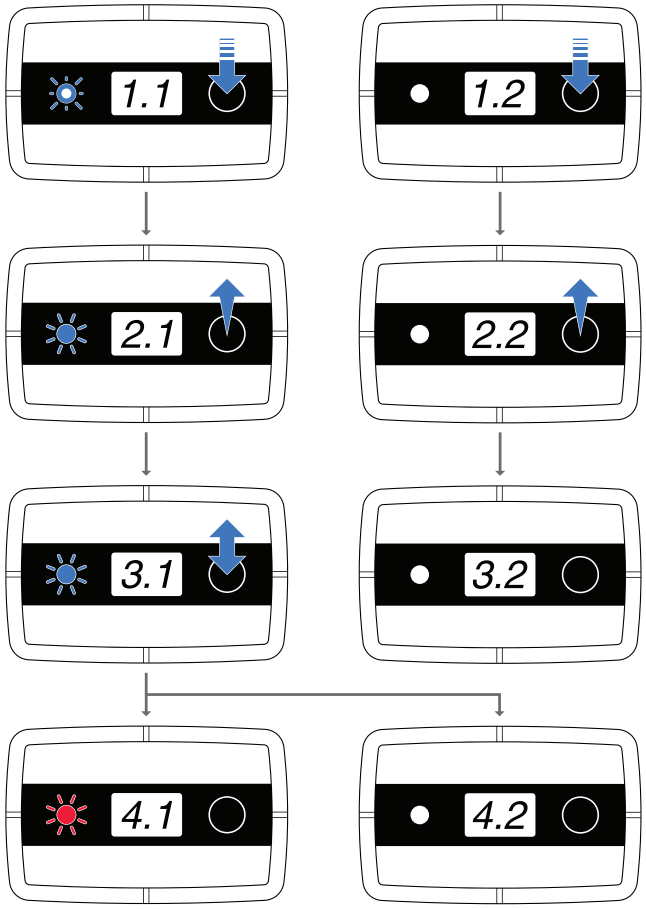
2. After holding the button for 5 seconds the device will show:

- **2.1 Blue (Illuminated):** Action required

3. The user can now release the button and press and release within 5 seconds:

4. If the button isn't pressed & released within these 5 seconds:

- **Red (Illuminated):** Deactivated
- **No LED:** Deactivation canceled



Notes:

- *Secured Configuration*
  - *If the device is in Secured Configuration it is not possible to deactivate the device using the button. The device will not react to a press and hold of the button and the LED will stay off. See diagram 1.2, 2.2 and 3.2 and "Communication Protocol" in Related Documents.*

4.3 Product Identification

4.3.1 NFC

The NFC label is located in the identification sticker and programmed with the serial number of the device. The serial number read from the NFC can be used as unique identifyer for provisioning and registration.

4.3.2 Data Matrix Code

The Data Matrix Code label also represents the serial number of the device. The serial number read from the Data Matrix Code code can be used as unique identifyer for provisioning and registration. See Product Type Identification for the a detailed label description.

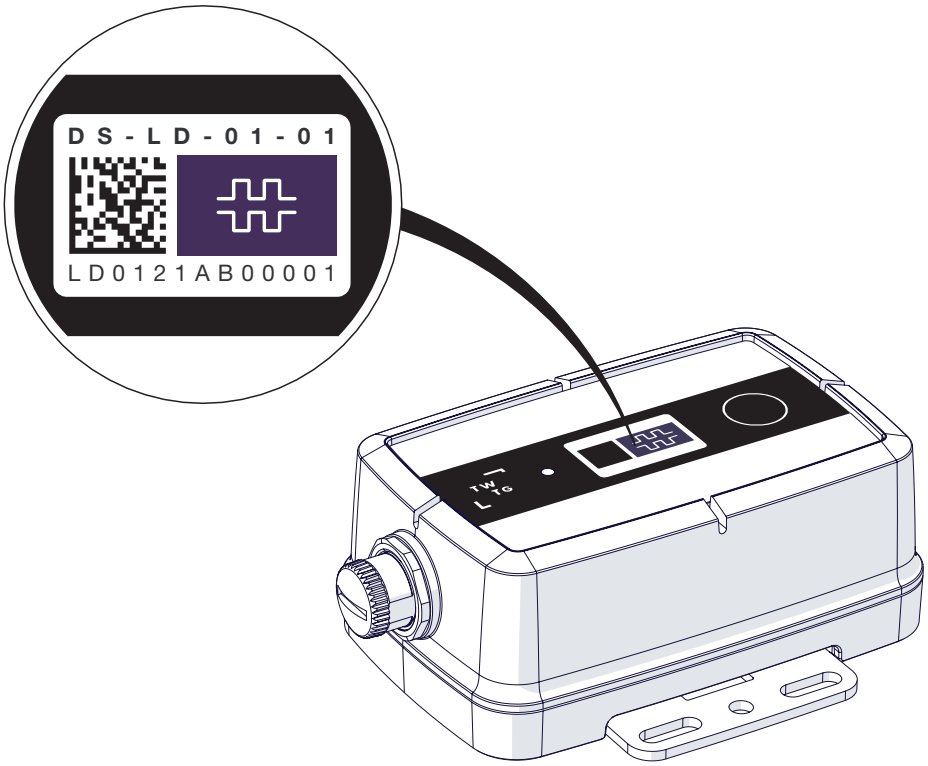


Figure 7: NFC and Data Matrix Code code Location

5 Installation of the Transmitter

5.1 Precautions

WARNING

- Avoid placing wiring close to noise sources such as large motors or power supplies;
- Only connect the M12 connector to the Transmitter when there is no explosive atmosphere present;
- The equipment must be installed in accordance with EN 60079-14.

5.2 Mounting Bracket Dimensions

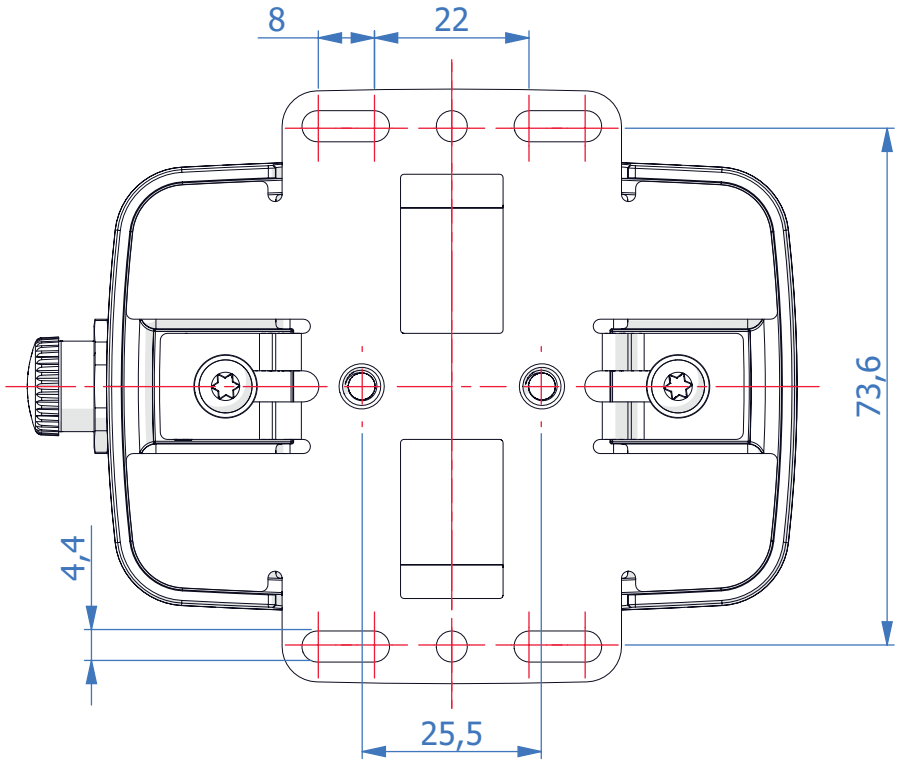


Figure 8: Mounting Bracket Dimensions (in mm)

5.3 Installation Methods

5.3.1 Installation using mounting holes

Place the bracket against the (flat) desired surface and use the screw holes or slots to fix in place.
Note: Slots and screw holes are designed for M4 fasteners.

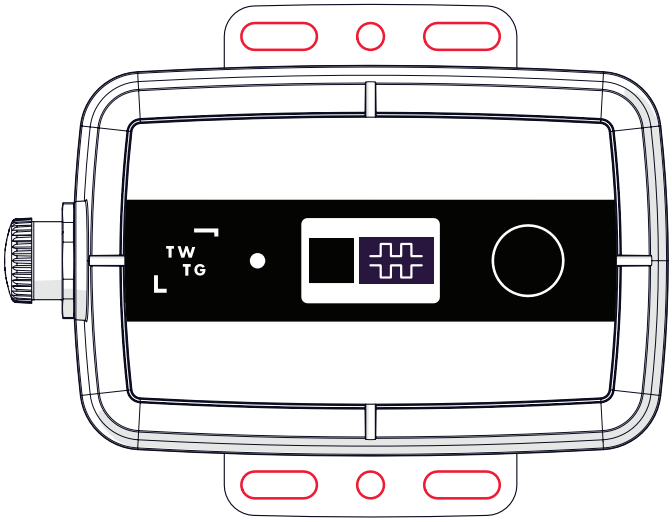


Figure 9: Product Mounting Holes

5.3.2 Installation using threaded holes

Note: Threaded hole accepts M5 bolts.

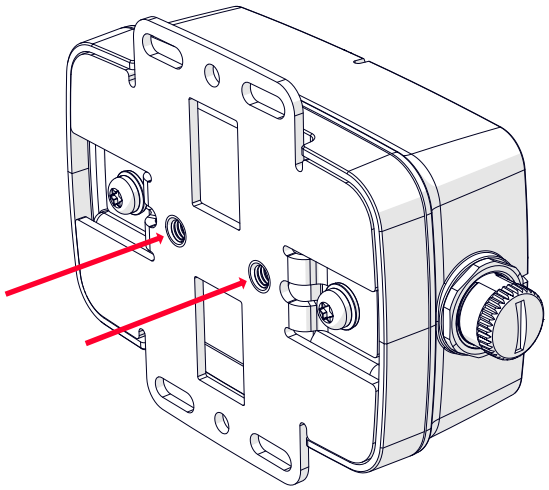


Figure 10: Product Threaded Mounting Holes

5.3.3 Installation using bandclamp

The Neon Transmitter can be mounted to a pole using a 14 mm wide band clamp, other sizes are not recommended.

Procedure:

1. Place the band clamp through the bracket;
2. Place the band clamp around the pole and cut to size;
3. Place the band clamp through the adjustable tightener and fold around the bottom with a plier;
4. Place the band clamp around the pole with the (adjustable) tightener and fix it in place.

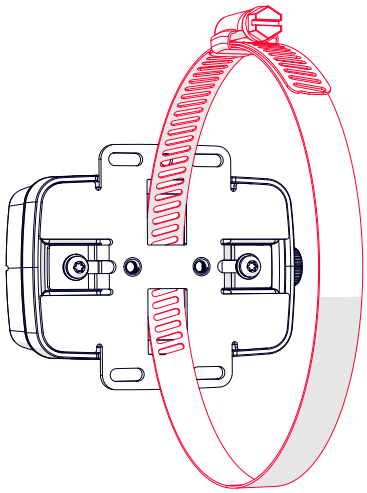


Figure 11: Installation using Bandclamp

6 Installation of the Vibration Sensor

6.1 General installation requirements

IMPORTANT

- Always use a torque wrench set to the listed torque to tighten the mounting screw;
- The mounting surface should be flat and always be cleaned before mounting the sensor;
  - Failure to do so may affect measurements;
- Install according to EN 60079-14.

6.2 Vibration Sensor Orientation

For correct operation the Vibration Sensor needs to be mounted in the correct orientation. Use the cable as a reference for the Y-axis direction.

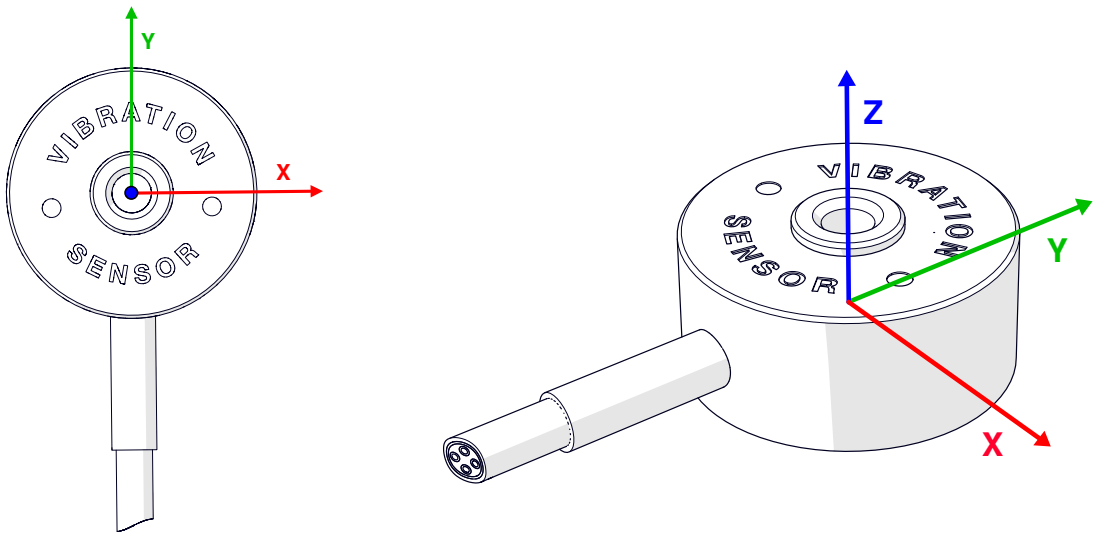


Figure 12: Mounting Orientation

6.3 Direct installation using the mounting hole

Procedure:

1. Find a flat surface of at least 40 mm in diameter;
2. The surface should be flat, undamaged and clean;
3. Create a threaded hole, size M6 with a thread depth of at least 8 mm;
4. Attach the Vibration Sensor using the supplied M6 bolt, according to Direct Mounting Assembly;
5. Ensure proper orientation according to Vibration Sensor Orientation;
6. Tighten the screw using a torque wrench:
   - Minimum torque: 14 Nm;
   - Maximum torque: 16,3 Nm.

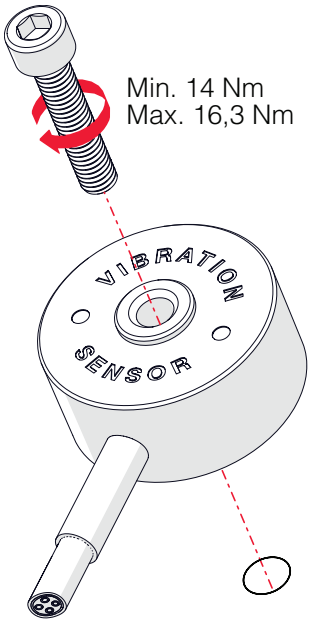


Figure 13: Direct Mounting Assembly

6.3.1 Dimensions

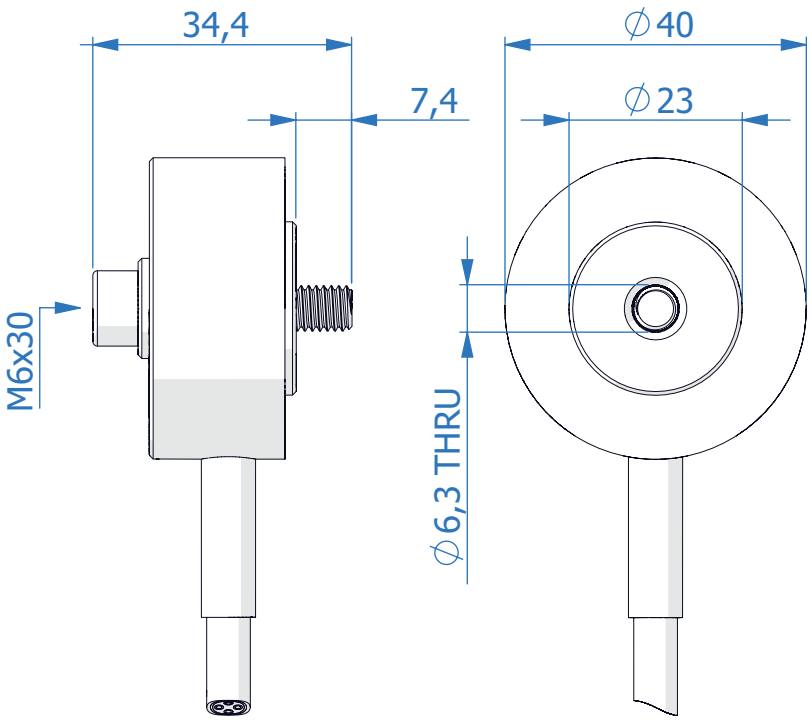


Figure 14: Direct Mounting Dimensions (mm)

6.4 Using Chemically Bonded Adapter

Procedure:

1. Find a flat and surface of at least 40 mm in diameter;
2. See "3M Scotch Weld Epoxy Datasheet" in Related Documents on how to prepare the surface;
3. Use "3M DP8405 Green" Acrylic Adhesive and compatible dispenser products. Attach adapter to the surface according to "3M Scotch Weld Epoxy Datasheet" in Related Documents. Make sure the adapter is parallel to the mounted surface;
4. Let the adhesive cure for the time as stated in the "3M Scotch Weld Epoxy Datasheet";
5. Attach the Vibration Sensor to the adapter using the supplied M6 bolt, according to Chemically Bonded Adapter Assembly;
6. Ensure proper orientation according to Vibration Sensor Orientation;
7. Tighten the screw using a torque wrench:
   - Minimum torque: 14 Nm;
   - Maximum torque: 16,3 Nm.

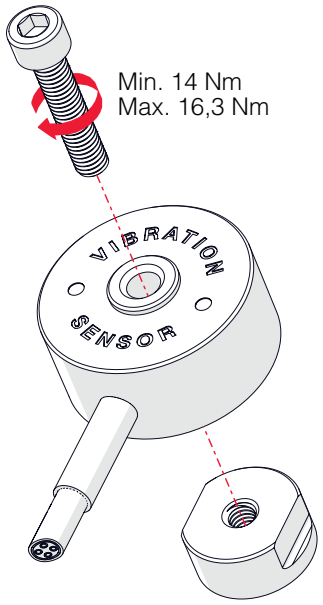


Figure 15: Chemically Bonded Adapter Assembly

6.4.1 Dimensions

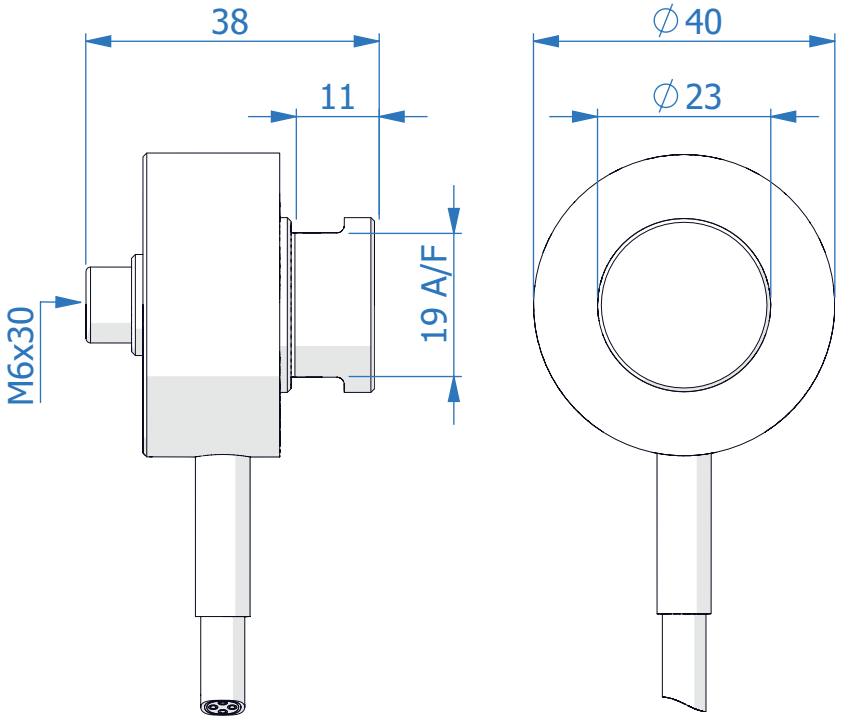


Figure 16: Chemically Bonded Adapter Dimensions (mm)

6.5 Using Magnet Adapter (Flat)

Procedure:

1. Hold the Magnet Adapter in position, using the proper tool;
2. Attach the Vibration Sensor using the supplied M6 bolt, according to Curved Magnet Adapter Assembly;
3. Tighten the screw using a torque wrench:
   - Minimum torque: 14 Nm;
   - Maximum torque: 16,3 Nm;
4. Find a flat and surface of at least 40 mm in diameter;
5. The surface should be flat, undamaged, and clean;
6. Attach the Vibration Sensor using the magnet;
7. Ensure proper orientation according to Vibration Sensor Orientation.

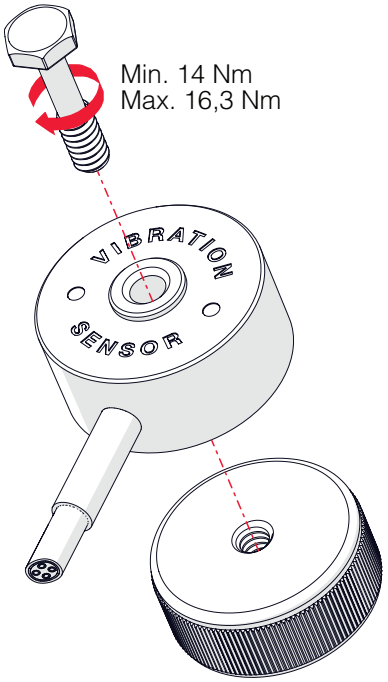


Figure 17: Flat Magnet Adapter Assembly

6.5.1 Dimensions

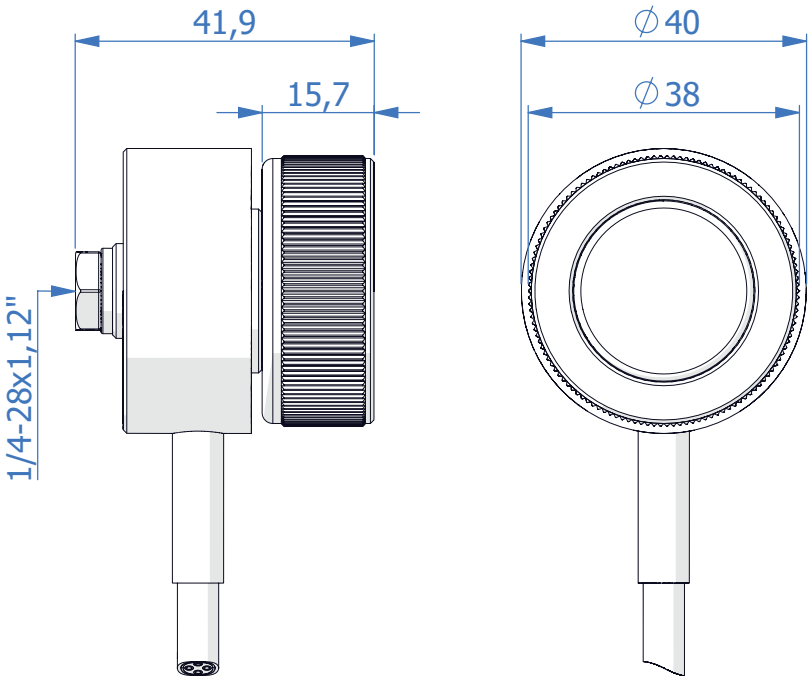


Figure 18: Flat Magnet Adapter Dimensions (mm)

6.6 Using Magnet Adapter (Curved)

Procedure:

1. Hold the Magnet Adapter in position;
2. Attach the Vibration Sensor using the supplied M6 bolt, according to Curved Magnet Adapter Assembly;
3. Tighten the screw using a torque wrench:
   - Minimum torque: 14 Nm;
   - Maximum torque: 16,3 Nm;
4. The surface should be undamaged and clean;
5. Attach the Vibration Sensor using the magnet;
6. Ensure proper orientation according to Vibration Sensor Orientation.

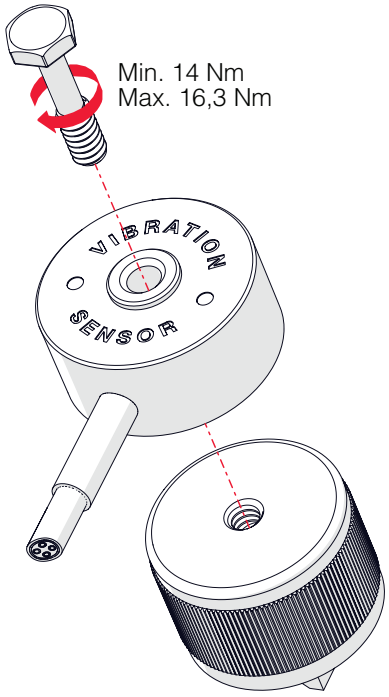


Figure 19: Curved Magnet Adapter Assembly

6.6.1 Dimensions

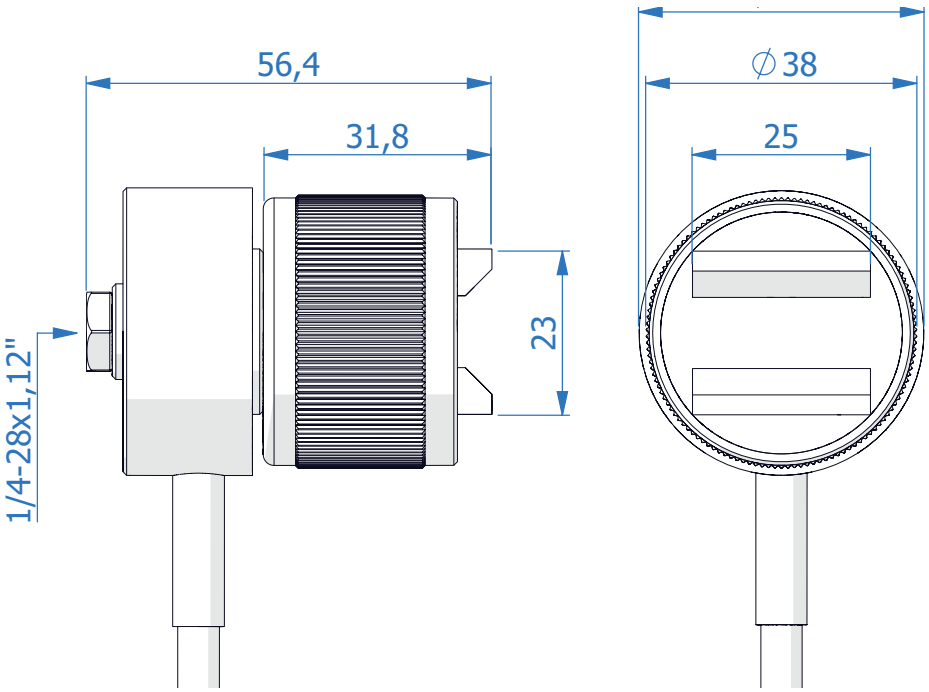


Figure 20: Curved Magnet Adapter Dimensions (mm)

6.7 Connecting the Vibration Sensor to the Transmitter

1. Unscrew the dust cap from the product. Check inside the M12 connector for correct placement of the O-Ring (marked in red). Without this O-Ring, the water and dust resistance rating of the product cannot be guaranteed.

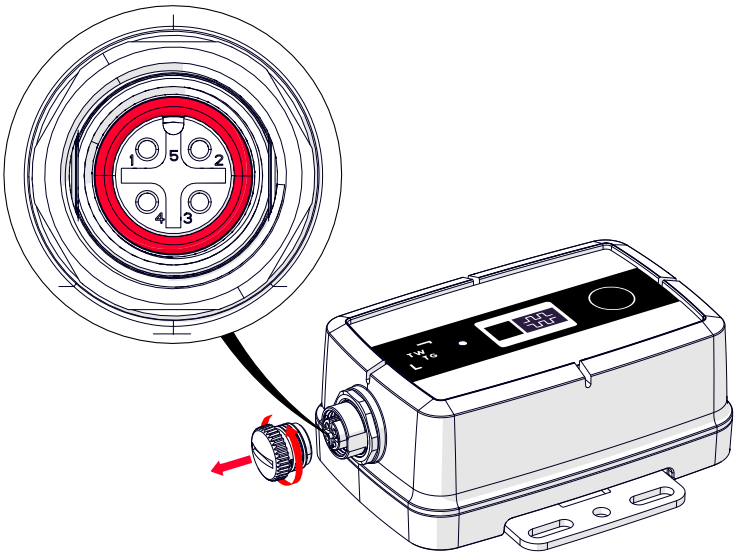


Figure 21: M12 Connector O-ring Location

2. Connect the Sensor connector to the Transmitter. Ensure correct polarity before inserting the connector. The polarity notch is facing up. Completely tighten the connector but do not use excessive force. If the connector is not fully inserted, water and dust resistance rating cannot be guaranteed.

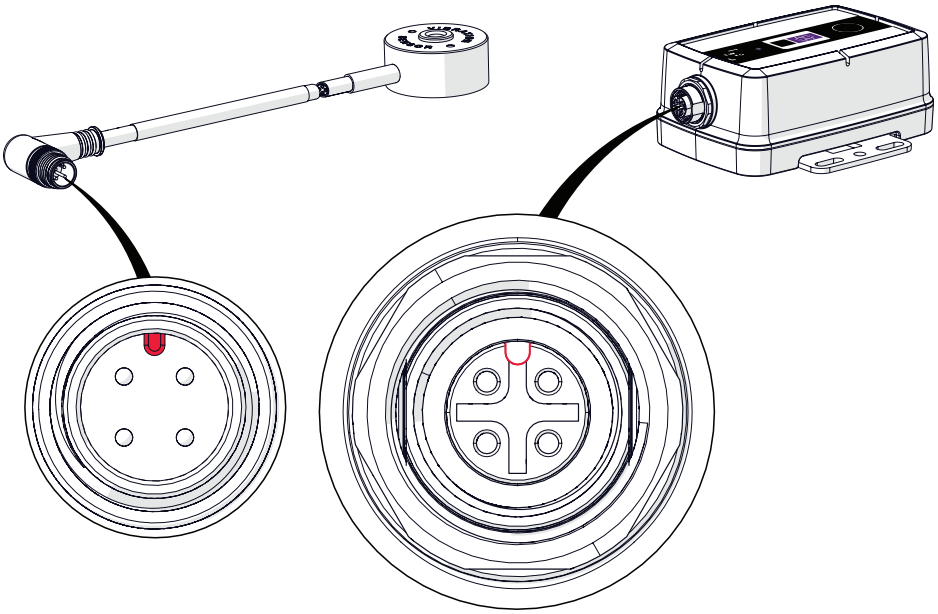


Figure 22: M12 Connector Polarity Mark

7 Product Functionalities

A detailled description of setting-up communication and configuring device settings can be found in "Communication protocol", refer to table 1. Related Documents.

7.1 Application Event Message

The Vibration Sensor measures and reports the vibrations either by set intervals (a timer-based trigger) or a condition-based trigger.

7.1.1 Event-triggers

Event-messages are triggered on one of the following triggers:

- **Timer (periodic)**:
  The timer trigger is configurable through the following configurations:
  - *measurement_interval_seconds*
    Interval in seconds, at which the vibration sensor is read.
  - *periodic_event_message_interval*
    Interval in the number of measurements at which the application event messages are periodically sent. The periodic counter is reset on every event message.

- **Condition**:
  A condition-based trigger can be either of the following tresholds:
  - *rms velocity trigger_x*
  - *peak acceleration trigger_x*
  - *rms velocity trigger_y*
  - *peak acceleration trigger_y*
  - *rms velocity trigger_z*
  - *peak acceleration trigger_z*

7.1.2 Content application event message

- **Rms velocity**
  The measured rms velocity for each of the axis (X,Y,Z) in units of 0.01 mm/s.
  - Maximum;
  - Average;
  - Minimum.
- **Acceleration**
  The measured acceleration for each of the axis (X,Y,Z) in units of 0.01 m/s$\hat{2}$.
  - Maximum;
  - Average;
  - Minimum.
- **Temperature**
  The connected sensor temperature in units of 0.1 ℃:
  - Maximum;
  - Average;
  - Minimum.
- **Trigger**
  Source of the trigger for the application event message:
  - "timer" (0);
  - "condition_0" (1);
  - "condition_1" (2);
  - "condition_2" (3);

  - "condition_3" (4).
- **Condition_n**
  The current state of each condition.

7.2 Sensor data message

The FFT (sensor data message) is split between a configurable amount of messages. For a detailed explanation of available configurations see "Communication Protocol" in Related Documents. The sensor data message can be recombined to a full spectrum as shown in figure Example FFT.

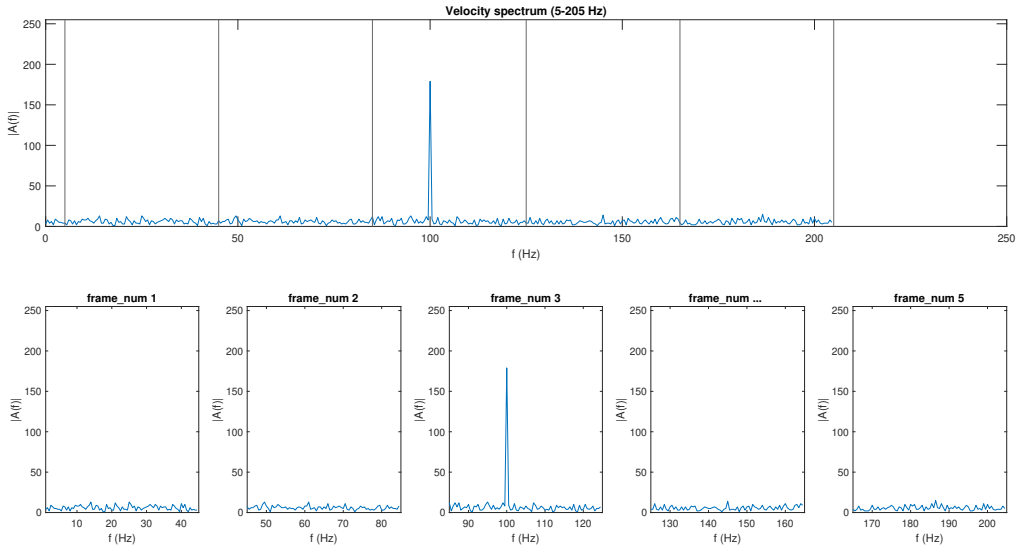


Figure 23: Example FFT

7.3 Device Status

Next to reporting the application events, the Vibration Sensor also reports on the device status itself. This is done through a device status messages. A device status message is sent periodically and includes a range of device health parameters, including the following:

- event_counter;
- battery_voltage;
- PCB temperature;
- tx_counter;
- avg_rssi;
- avg_snr.

See "Communication Protocol" in Related Documents for a detailed explanation.

7.4 Default Configuration

The Transmitter is delivered with a default configuration. The default configuration includes:

- Measurement interval of 15 mins;
- Event-based message at the time of each periodic trigger with an interval of 16 measurements. (16 * 15 = 240 minutes);
- Device status message interval of 24 hours;
- Enabled event confirmation messages;
- All triggers disabled;
- Disabled data messages confirmation (FFT);
- Disabled FFT.

See "Communication Protocol" in Related Documents for a detailed explanation of all default configuration values.

8 Maintenance

8.1 Battery Specifications

Specifications	
Manufacturer	Saft
Part number	LS-17500
Quantity	2
Battery Type / Size	Type A
Chemistry	Lithium Thionyl Chloride
Terminal Type	Standard
Dimensions	50.9 x 17.13 mm
Battery Life	>5 years*

Table 6: Battery Specifications

**Note: Applicable to default configuration. Battery lifetime depends on average ambient temperature, network quality and device configuration.*

8.2 Battery Replacement

The battery can be replaced using the battery replacement kit. See Accessories and Spare Parts. This kit consists of the following parts:

- 2X SAFT LS-17500 battery;
- 4X O-Ring;
- 1X Gasket.

8.2.1 Required tools

- Torque screwdriver with TX20 bit;
  - See Assembly of device for torque settings;
- Loctite 243;
- ESD strap.

IMPORTANT: ESD Sensitive Electronics

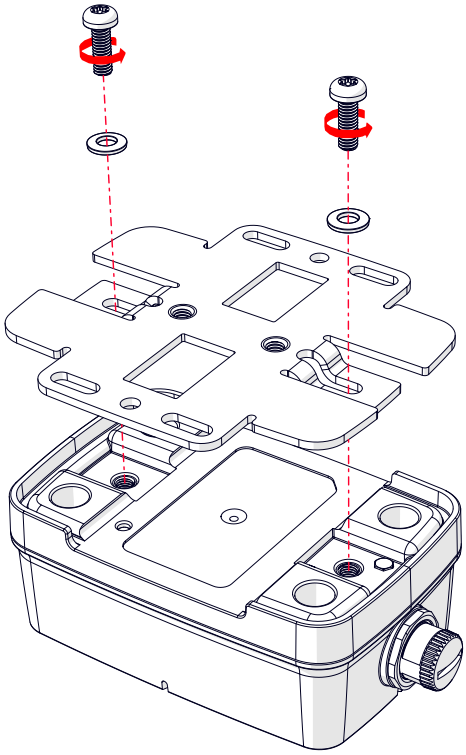
The product shall be installed in such a way that the risk for electrostatic discharges is minimised.

- Take proper precaution such as a grounded wrist strap and avoid touching the electronics board

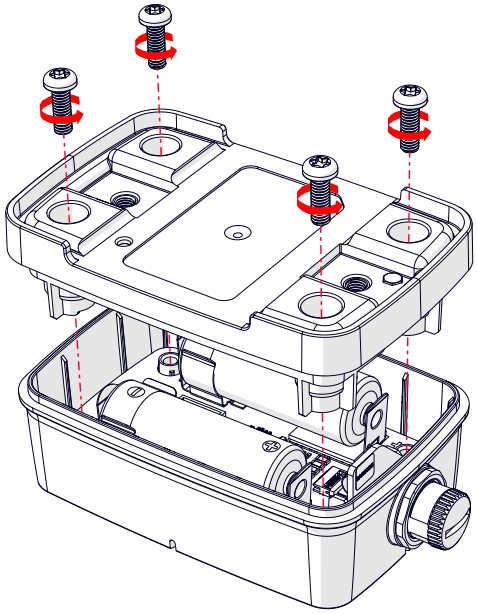
8.2.2 Disassembly of device

WARNING - DO NOT OPEN WHEN AN EXPLOSIVE ATHMOSPHERE IS PRESENT

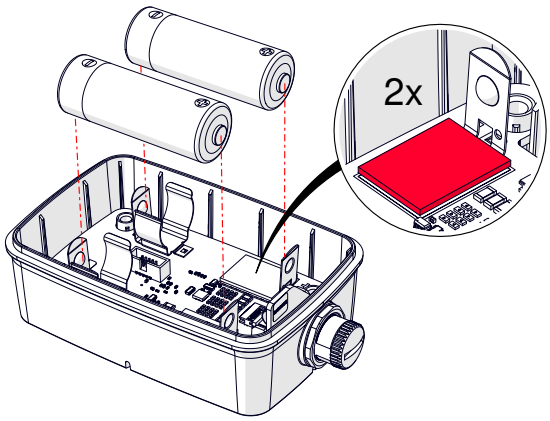
- This equipment shall only be opened by TWTG or by a competent instructed person;
  - The battery is serviceable by said persons;
  - Only use SAFT LS17500 batteries.



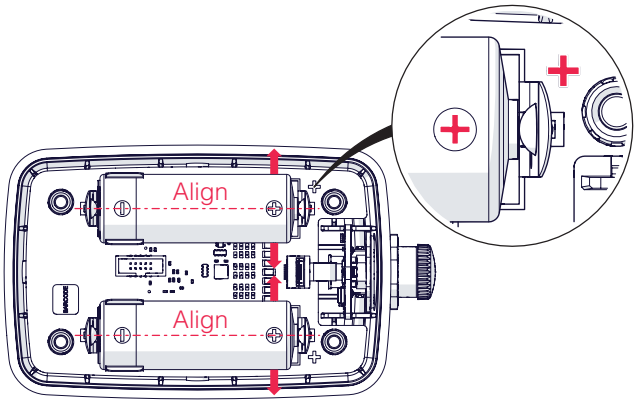
Step 1: Remove the two M4 screws and washers fixing the bracket



Step 2: Remove the four M4 screws and remove the lower housing



Step 3: Remove the batteries, inspect presence of insulating pads, marked in red



Step 4: Place the two new batteries in the battery holder with the positive side facing the positive markings on the circuit board

8.2.3 Built-In Self-Test Procedure

When the device is deactivated a built-in self-test is performed upon insertion of the battery. This test is not executed when the device is already activated. Use the deactivation sequence as described in Device Deactivation and reinsert the batteries if a self-test is needed.

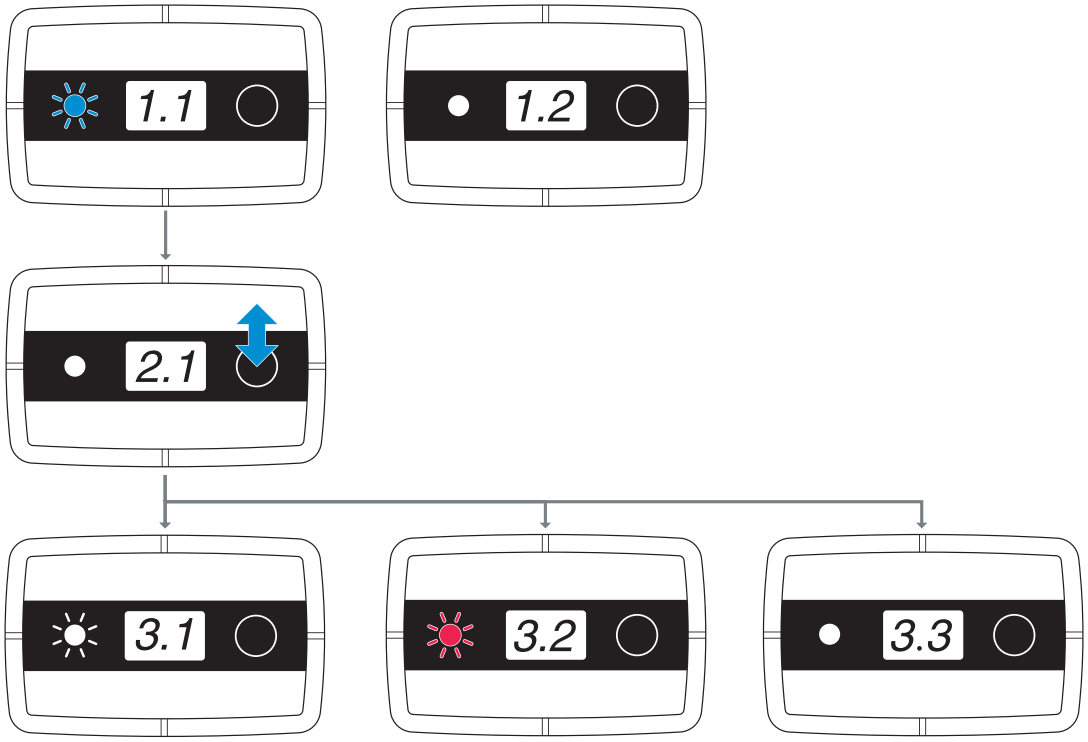


Figure 24: Built-in self-test

1: After successful replacement of the battery the device will go into self test mode. This mode is activated for 30 seconds;

1.1: A BLUE LED will show after inserting the battery;

1.2: If no LED is shown, check the battery and / or device;

2: Start the test;

2.1: Press and Release the button;

3: Test Results;

3.1: LED turns bright WHITE for 5 seconds. Self test passed;

3.2: LED turns RED, self test failed. Check device;

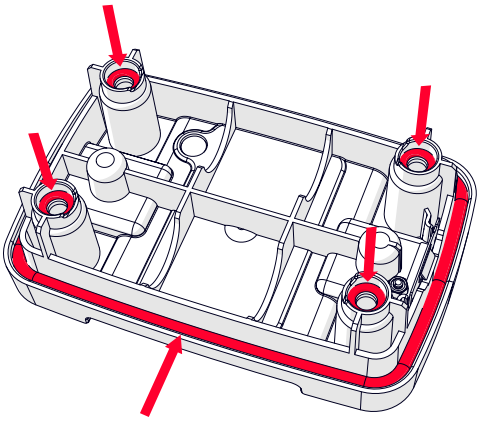
3.3: No LED, no response from device. Check device.

After pressing the button once and passing the self-test the device will leave the self-test mode. Pressing the button again will show the device status, as explained in Read device status.

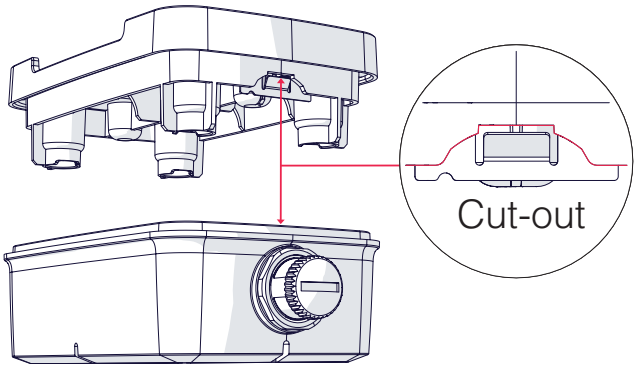
8.2.4 Assembly of device

IMPORTANT - USE THE SPECIFIED TORQUE SETTINGS

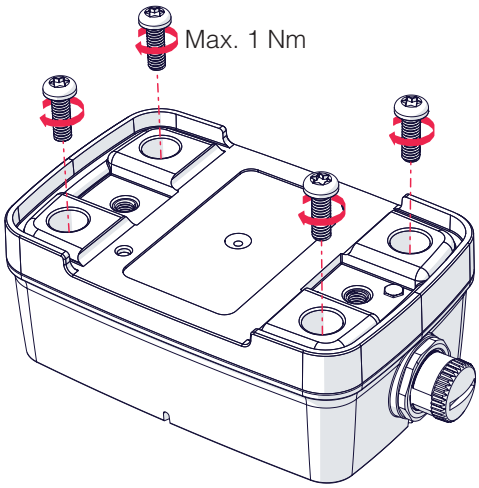
- Use a torque screwdriver to verify the applied torque;
- Failure to do so can result in water ingress;
- Improper assembly will void the warranty.



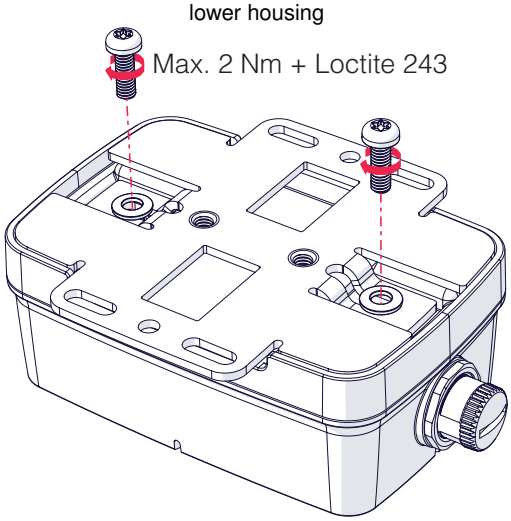
Step 5: Replace the 4 O-Rings surrounding the screws and the gasket in the outer edge of the enclosure



Step 6: Place the lower housing back onto upper housing. Please see make sure that the cut out on the lower housing matches the upper housing. Tighten the four screws to fix the lower housing



Step 7: Tighten the four M4 screws to fix the lower housing. Use a torque screwdriver to set the maximum torque to 1 Nm.



Step 8: Fix the bracket using the two M4 bolts and washers. Use a torque screwdriver to set the maximum torque to 2 Nm.

9 Accessories and Spare Parts

Type	Order code	Description
Battery Replacement Kit	5029_P20-002_Battery-Replacement-Kit	Including two batteries, 4 O-Rings, 1 gasket
Magnet Kit Temporary Installation	5030_DS-XX-XX-XX_Magnet-Kit-Temporary-Installation	Including 2 magnets, 4 washers, 4 screws, installation manual
Chemically Bonded Adapter	2013_P20-002_VB-Adapter-Bonded	Chemically Bonded Adapter
Magnetic Mounting Adapter (Flat)	080A122	Flat surface magnet, 1.5" diameter, 50 lbf, 1/4-28 threaded hole w/mounting stud Including mounting bolt
Magnetic Mounting Adapter (Curved)	080A132	Curved surface magnet, 1.5" diameter, 55 lbf, 1/4-28 threaded hole w/mounting stud Including mounting bolt

Table 7: Available Accessoires & Spare Parts

10 Declaration of Conformity

This product complies with the following standards:

1. ATEX Directive (2014/34/EU):
    - EN 60079-0:2012 +A11:2013
    - EN 60079-0:2018
    - EN 60079-11:2012
2. Radio Equipment Directive (2014/53/EU):
    - EN 300 220-1 V3.1.1
    - EN 300 220-2 V3.1.1
    - EN 300 330 V2.1.1
    - Draft EN 301 489-1 V2.2.0
    - Draft EN 301 489-3 V2.1.1
    - EN 60529
    - EN 62311:2018
    - EN 62368-1:2014
3. Radio Regulation 2017
4. WEEE Directive 2003/1008/EC
5. RoHS (2011/65/EU)

For the full Declaration of Conformity see:

www.twtg.io/legal