

# WIRELESS IOT TRI-AXIS INCLINOMETER

USER GUIDE



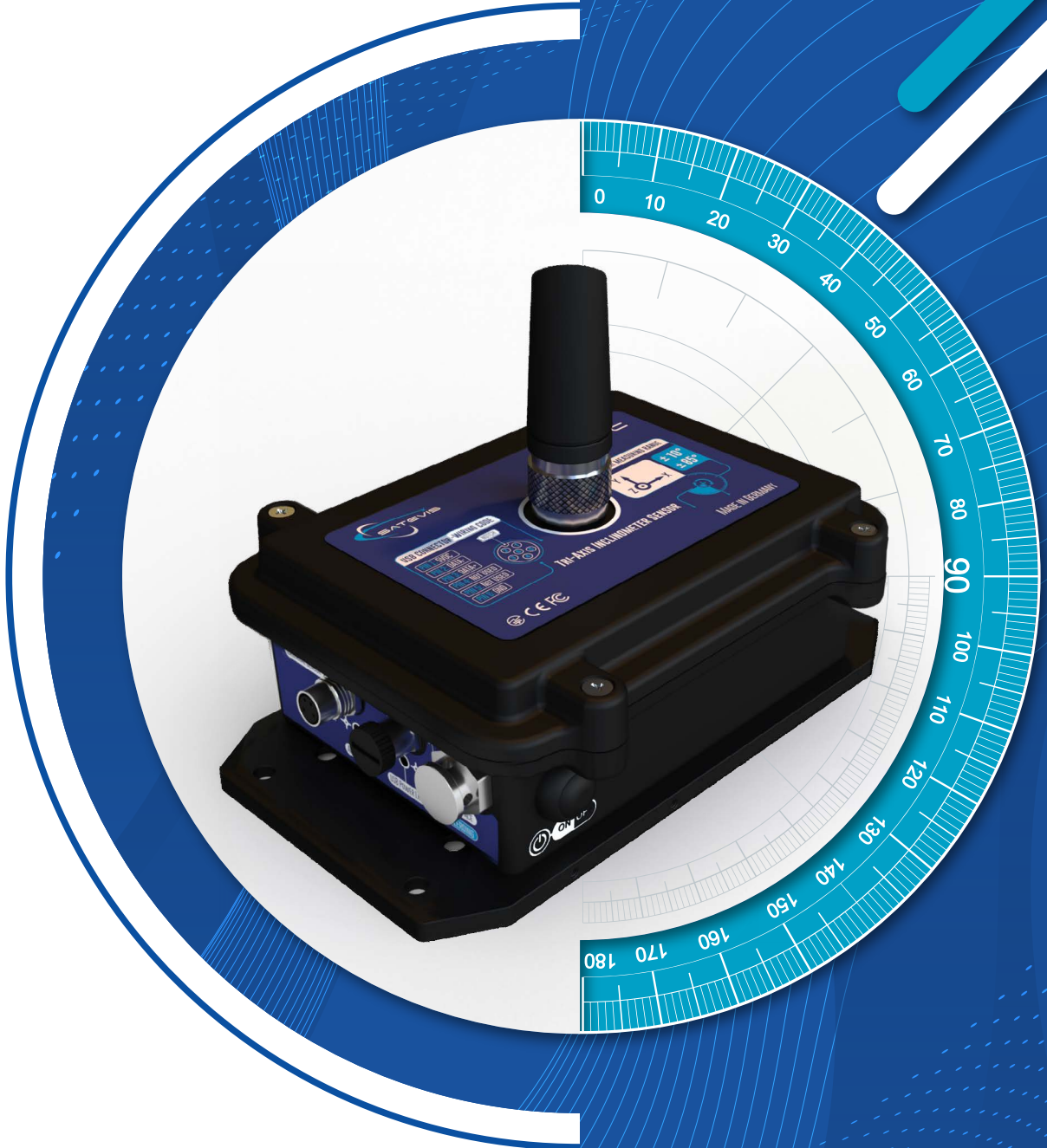
QUICK START



MECHANICAL DRAWING



STEP FILE



## 1 MAIN FEATURES



High resolution 0.0055° and a High precision ( $\pm 0.01^\circ$  for  $\pm 10^\circ$  range,  $\pm 0.02^\circ$  for  $\pm 85^\circ$  range)



LoRaWAN® Protocol: 15km Radio Range



MEMS inclinometer with scalable measuring range ( $\pm 10^\circ$  and  $\pm 85^\circ$ )



IP67 | Nema 6 / IP68 (M8 Connector cap mounted, self-fusing is used around antenna connector)

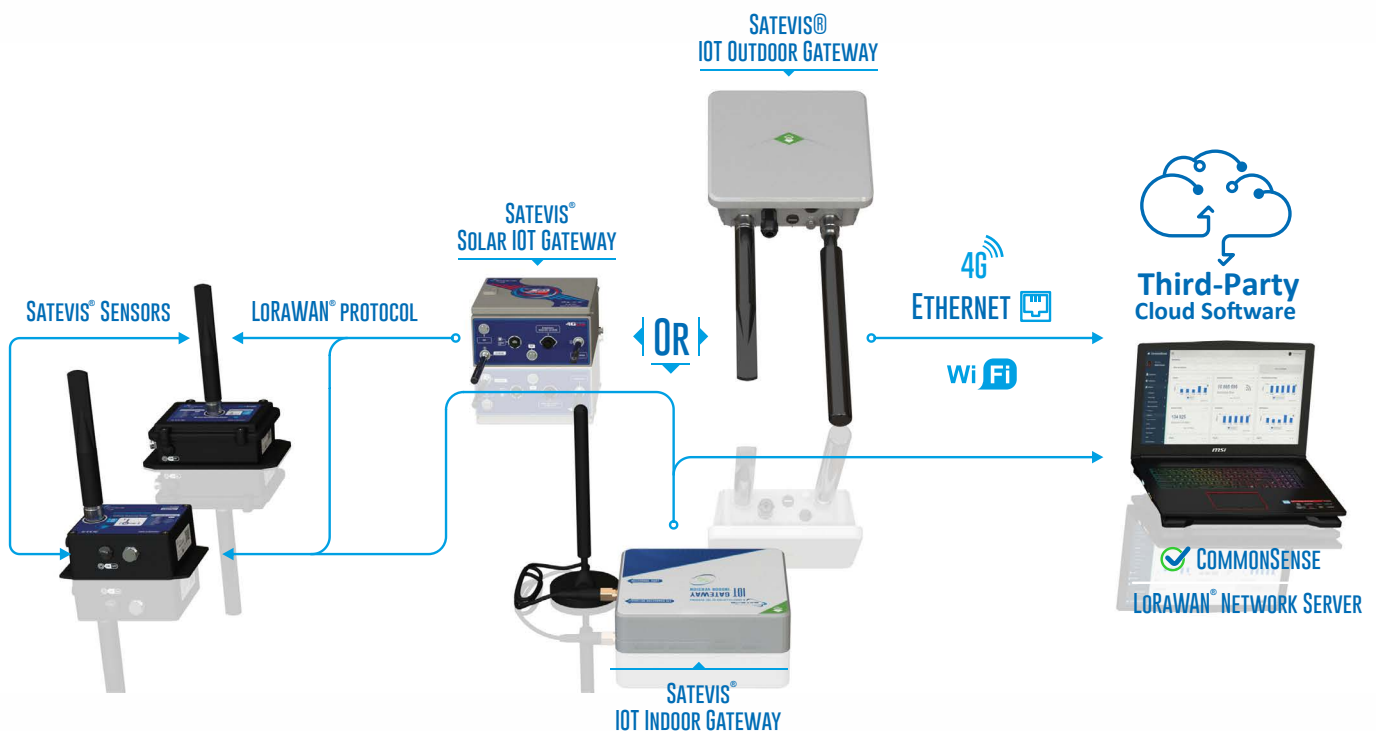


Excellent radio link.



Integrated battery pack

## 2 HOW IT WORKS ?



**3 APPLICATIONS**

**BRIDGE**



**RAILWAY SLEEPERS**



**CRANE**

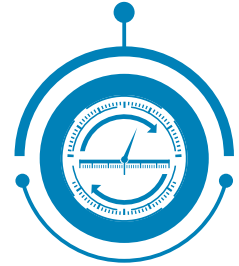


**TUNNEL**

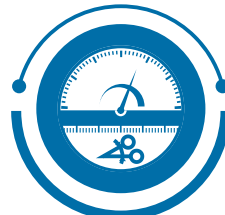
**CONDITION MONITORING**



**LAND SURVEYING**



**STRUCTURAL HEALTH MONITORING**

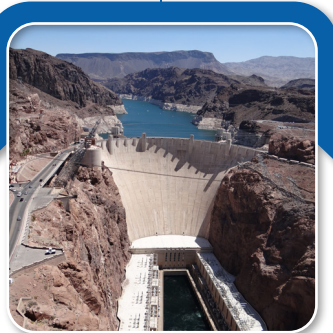


**TEST AND MEASUREMENT**

**CARGO SHIP**



**DAM**



**ANTENNA BASE STATION**



**CONSTRUCTION SITE**





## 4 NON-CONTACT BUTTONS AND LEDS DESCRIPTION

“HELLO!” FUNCTION HELPS THE FIELD OPERATOR TO CHECK THE SENSOR INSTALLATION & CONFIGURATION



**Caption1:** After installing the [Alpha-Inc inclinometer](#) , the field operator can check at any moment if the sensor is working properly.



**Caption2:** By Holding the magnet on the ‘Hello!’ label for more than 10s, the sensor wakes-up and transmits to the Lorawan network the data measurement followed by the system diagnostic ( battery status and network quality).

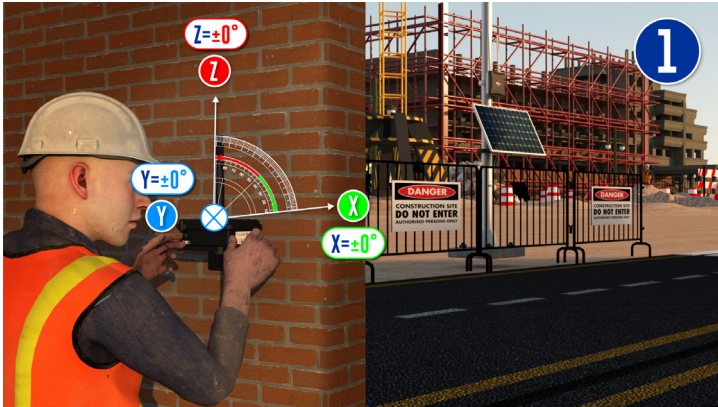


**Caption3:** The Activity Led blinks in **green color**, confirming that a data measurement is transmitted to the Lorawan network.



**Caption4:** The field operator can check on [Satevis® Cloud software](#) (or a third-party cloud software) if his sensor is working properly.

## SENSOR ZEROING FUNCTION SIMPLIFIES THE SENSOR INSTALLATION



**Caption1:** Even if an angle bracket is used, it's sometimes difficult to bring a zero-offset on both X and Y axis ( in the case if Z axis is on the same direction than Earth Gravity).. In some cases, the field operator can not spend too much time on this task.



**Caption2:** To enable the sensor zeroing function, hold the magnet on 'Sensor Zeroing' Label for more than 10s.



**Caption3:** The Activity LED blinks in blue, the sensor zeroing starts on both X and Y axis . When this process is done, the Activity led will blink again in blue color and transmits a data measurement to the Lo-rawan® network. If the sensor zeroing process is not done correctly ( the device is moving) the Activity Led will blink in Red color.



**Caption4:** The Sensor-zeroing process can be also done remotely from the cloud software.



## 5 TECHNICAL SPECIFICATIONS

### PRODUCT REFERENCE

SATEVIS-LORA-ALPHA-INC-MR-PS-RP-AG

**MR- Measurement Range:**  
10T : tri-axis  $\pm 10^\circ/\pm 85^\circ$

**PS - Power supply :**

**BP3S :** Battery Pack with 3 Primary Cell in series (3 x 6.5Ah , 3S1P configuration ) - Non Rechargeable battery pack

**RP- Radio Power**

**HP - High Power Transmission**  
+22dBm

**LP - Low Power Transmission**  
+14dBm

**AG - Antenna Gain**

**AG-2dBi-868:** 2dBi Antenna for EU/IND Regions (Europe /India)

**AG-5dBi-868:** 5dBi Antenna for EU/IND Regions (Europe /India)

**AG-2dBi-915:** 2dBi Antenna for US/KR/AS/AU Regions (USA/KOREA/ASIA/AUSTRALIA)

**AG-5dBi-915:** 5dBi Antenna for US/KR/AS/AU Regions (USA/KOREA/ASIA/AUSTRALIA)

**Example 1: SATEVIS-LORA-ALPHA-INC-10T-BP3S-LP-AG-2dBi-868**

Wireless Tri-axis Inclinator  $\pm 10^\circ/\pm 85^\circ$  with LoraWan connectivity, Powered from Battery Pack 3S, Low Power Radio +14dBm, 2dBi Antenna 868Mhz

**Example 2: SATEVIS-LORA-ALPHA-INC-10T-BP3S-HP-AG-5dBi-915**

Wireless Tri-axis Inclinator  $\pm 10^\circ/\pm 85^\circ$  with LoraWan connectivity, Powered from Battery Pack 3S, High Power Radio +22dBm, 5dBi Antenna 915MHz

### CONFIGURABLE SETTINGS FROM CLOUD SOFTWARE

|                            |  |
|----------------------------|--|
| Javascript formatter code  | Free Javascript formatter code to accelerate the integration of Satevis sensors in your own cloud software :<br>- Downlink formatter code (Alarm Threshold, Measurement mode....)<br>- Uplink formatter code(Data measurement) |
| Data Acquisition mode      | Different measurement mode are available:<br>Low Duty Cycle Data Acquisition (LDCDA), Measurement heartbeat 20s to 24 hour<br>Alarm measurement mode, Measurement heartbeat 10s to 24 hour                                     |
| Alarm Threshold            | Three levels of Alarm Thresholds <b>Minor Alarm</b> / <b>Severe Alarm</b> / <b>Critical Alarm</b>  |
| Scalable Measurement Range | $\pm 10^\circ$ , $\pm 85^\circ$ and automatic $\pm 10^\circ/\pm 85^\circ$  |

### SATEVIS SENSOR CONFIGURATOR (FROM USB)

|                    |   |
|--------------------|---|
| Configuration      | Frequency Plan, Device EUI, AppEUI, AppKey      |
| Firmware Upgrade   | Firmware upgrade through the USB                |
| Sensor calibration | Calibrations Points setup and Quick calibration |

## INCLINOMETER SENSOR

|  |  |
|--|--|
| Inclinometer Technology  | MEMS Technology  |
| Scalable Measuring Range   | user-selectable range $\pm 10^\circ$ or $\pm 85^\circ$ , with automatic range adjustment depending on the application  |
| Sensor resolution  | 0.0055° on full scale  |
| Noise density  | for $\pm 10^\circ$ range : 0.0007 °/√Hz on Y Axis, 0.008 °/√Hz on X, Z Axis<br>for $\pm 85^\circ$ range : 0.0012 °/√Hz on all axis   |
| Sensor precision (full scale, @ 25°C)                            | $\pm 0.01^\circ$ for $\pm 10^\circ$ measurement range<br>$\pm 0.02^\circ$ for $\pm 85^\circ$ measurement range   |
| Sensor Accuracy (full scale, @ 25°C)                             | $\pm 0.015^\circ$ for $\pm 10^\circ$ range<br>$\pm 0.02^\circ$ for $\pm 45^\circ$ range<br>$\pm 0.04^\circ$ outside $\pm 45^\circ$ range   |
| Offset temperature dependency (temperature range -25°C to +85°C) | $\pm 0.006^\circ/\text{°C}$  |
| Offset LifeTime Drift (@25°C)                                    | $\pm 0.08^\circ$   |
| Sensor frequency Response (-3 dB)                                | DC to 10 Hz for $\pm 10^\circ$ measurement range<br>DC to 40 Hz for $\pm 85^\circ$ measurement range   |
| Calibration  | Factory calibrated on 9 references point :<br>0° absolute, $\pm 5^\circ$ , $\pm 10^\circ$ , $\pm 30^\circ$ and $\pm 45^\circ$ with calibration settings backed up on the sensor Flash memory.<br>Calibration method used : Back-to-back calibration with an accurate reference sensor. |
| Sensor Zeroing function  | Sensor zeroing can be done after Satevis Sensor installation. User need to hold a magnet on the label " sensor zeroing" for approx. 10s, zero-offset is the performed on all sensor axis X/Y/Z   |

## POWER SUPPLY

|                            |  |
|----------------------------|--|
| Integrated battery pack    | Non-Rechargeable Battery Pack (3S1P configuration) - Lithium Thionyl Chloride Capacity 6.5Ah , Max Voltage 10.8Volts   |
| Current consumption @ 3,3V | <ul style="list-style-type: none"> <li>· During data acquisition : 15 to 20 mA</li> <li>· During Radio transmission : 80 mA for +22 dBm , 35 mA for +14dBm</li> <li>· During Battery Saver Mode : &lt; 15 <math>\mu</math>A</li> </ul> |
| External power supply      | USB Power 5VDC. When the device is powered from USB, the internal battery pack is disconnected from the power path.  |

## 5 TECHNICAL SPECIFICATIONS

### DATALOGGER / RECORDER

|                               |  |
|-------------------------------|--|
| Datalogger Size               | If 4 sensors Channels ( Tri-Axis Inclinator, 1 Internal Temperature) :<br>380 000 Log sessions per sensor channel<br>If 6 sensors Channels ( Example: Tri-Axis Inclinator, 1 Internal Temperature, External Temperature, External Humidity) :<br>246 000 Log sessions per sensor channel |
| Logged Information            | UTC Clock<br>Data Measurement<br>Monitoring Mode   |
| Remote configuration from LNS | DataLogger Start/Stop/Eraser   |
| Download Method               | From USB with Hyperterminal Software, CSV format   |

### RF SPECIFICATIONS

|                         |   |
|-------------------------|---|
| LoRaWAN® Stack          | LoRaWAN® V1.0.2 REVB CLASS A  |
| Activation Mode         | OTAA  |
| LoRaWAN® Frequency Plan | Frequency Plan can be configured from USB:<br>-Europe 868MHz<br>- USA: 915MHz<br>- Australia 915MHz<br>- Asia 923MHz<br>- Korea 920MHz<br>- India 865Mhz<br>Important : Depending on the destination region, Satevis Device will be delivered with Antenna for 868MHz Frequencies ( Europe/India), or 915MHz frequencies (USA/KOREA/ASIA/Australia) |
| TX Power                | HP - High Power Transmission +22dBm<br>LP- Low Power Transmission +14dBm  |
| Receiver Sensitivity    | -136.5dBm sensitivity for SF12 with 125KHz BW   |
| Link Budget             | 158dB   |
| Maximum Radio Range     | - 15 Km in L.O.S. / Rural Environment<br>- 2 Km in NLOS/ Urban Environment  |
| Antenna                 | Waterproof N-Type Omni Antenna,<br>Gain 5 dBi or 2dBi / VSWR ≤ 2.0<br>Frequency range for AG-2dBi-868 and AG-5dBi-868 : 863-870 MHz<br>Frequency range for AG-2dBi-915 and AG-5dBi-915 : 902-928 MHz<br>Dimensions Ø22 x 64 mm for 2dBi<br>Dimensions Ø22 x 180 mm for 5dBi   |



## 5 TECHNICAL SPECIFICATIONS

### ENVIRONMENTAL AND MECHANICAL

|                              |   |
|------------------------------|---|
| Casing                       | Aluminum & Waterproof casing<br>Dimensions in mm (LxWxH): 151x130x55 mm<br>Weight : 950g  |
| IP   NEMA Rating             | IP67   Nema 6 / IP68 (M8 Connector cap mounted , self-fusing is used around antenna connector)  |
| Shock resistance             | 100g during 50 ms   |
| Mounting base                | Screw mounting & magnetic mounting  |
| Operating Temperature        | -40°C to +75°C<br>Sunshield should be used if the device is exposed to sun radiation from +68°C   |
| Shielding                    | EMI SHIELDING GASKET  |
| Relative Humidity            | 0 to 98 %RH   |
| Norms & Radio certifications | ·CE Labelling Directive R&TTE (Radio) ETSI EN 300 328<br>·FCC (North America)<br>·ARIB STD-T66 Ver 3.6<br>HS Code: 9031.80.20<br>EAR99<br>ROHS - Directive 2002/95/EC |

### INCLUDED ACCESSORIES

- 1 x Battery Pack 3 x C-Size Cell - 6,5Ah (3S1P configuration)
- 1x Magnet for Sensor-Zeroing & Hello functions
- 2x M8 Cap for Power Supply & external optional sensor
- 1 x USB to M8 cable adapter, 2 meters length
- 1 x Self-amalgamating tape (25cm length)
- 1 x LoRaWAN® Antenna ( see antenna options on reference builder)
- 1x Button Shield

## AVAILABLE FUNCTIONS

|                 |   |
|-----------------|---|
| ON/OFF          | Mechanical latching Push button   |
| Hello           | Transmits Data on user request , works with a magnet pointing to Hello label  |
| Sensor Zeroing  | sensor zeroing on user request , works with a magnet pointing to sensor zeroing label   |
| Multi color LED | <p><b>Green:</b> network connection, data transmission</p> <p><b>Blue:</b> Sensor zeroing successful/Hello Message Transmitted successfully</p> |

## OPTIONAL ACCESSORIES AND SERVICES

|                         |  |
|-------------------------|--|
| 90° Bracket Mounting    | 90° Bracket mounting (with integrated eyelet) with 4 x M5 screws + Locknut<br>Ref: <a href="#">SAT-BRACK-MNT</a>   |
| External Sensors        | External Temperature and Humidity Sensor   |
| Calibration certificate | Calibration certificate provided by Satevis<br>A static calibration method is used on a granite surface plate DIN876<br>Ref: <a href="#">CERT-SATEVIS-INCLINOMETER</a> |

## OPTIONAL EXTERNAL SENSORS

|                                 |  |
|---------------------------------|--|
| Temperature and Humidity sensor | Ref: <a href="#">B-TH-01-150-M8</a>                          |
| Industrial Pressure sensor      | Ref: <a href="#">SAT-EXT-TIR</a> (available Q1-2025)         |
| Industrial Water Level Sensor   | Ref: <a href="#">SAT-EXT-WATER-LEVEL</a> (available Q2-2025) |

## BATTERY LIFE WITH FOR DIFFERENT MEASUREMENT MODE

|                                   |  |
|-----------------------------------|--|
| Measurement Cycle every minute    |  |
| Measurement Cycle every 5 minutes |  |
| Measurement Cycle every hour      |  |
| Measurement Cycle every 4 hours   |  |

## 6 MOUNTING OPTIONS



ON/OFF BUTTON-SHIELD

SCREW AND MAGNETIC MOUNTING BASE



OPTION

90° BRACKET + WITH BULLSEYE

## 7 DESIGNED FOR HARSH ENVIRONMENT FROM COLD TO TROPICAL COUNTRIES

All Satevis® sensors designed with a Rugged and Waterproof (IP67) Aluminum casing and integrate a Protective Vent, with Humidity and Pressure compensation.

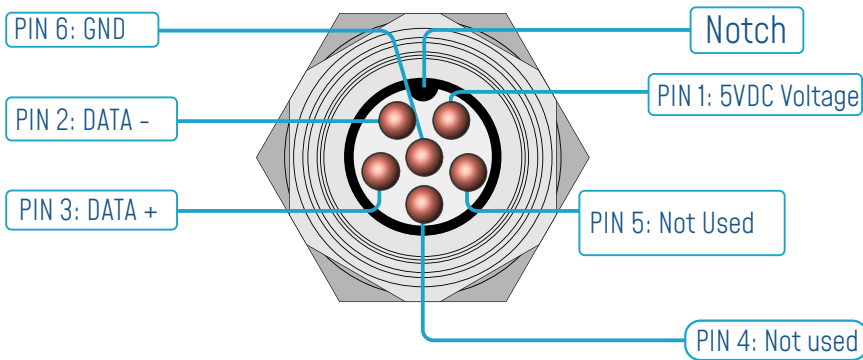


Satevis® Alpha-Inc comes with 2 levels of protection:

- IP67 Aluminum alloy casing.
- Electromagnetic protection with Shielded gasket on the lid.
- Ruggedized and ultra-low-power electronic design -40°C to +75°C.
- Humidity and Pressure Vent.

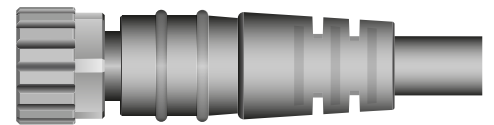
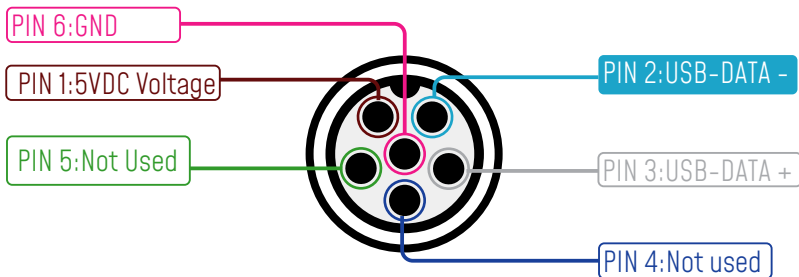
## 8 POWER SUPPLY

### M8 6pin Socket (MALE, A-CODING)- Pin assignation



| Interface Name | M8 Pin assignation |
|----------------|--------------------|
| 5VDC Voltage   | PIN 1              |
| DATA -         | PIN 2              |
| DATA +         | PIN 3              |
| Not used       | PIN 4              |
| Not Used       | PIN 5              |
| GND            | PIN 6              |

### M8 6pin Plug (FEMALE, A-CODING)- Pin assignation



M8-6Pins Plug

| Interface Name        | 5VDC Voltage | USB DATA - | USB DATA + | Not used    | Not Used     | GND         |
|-----------------------|--------------|------------|------------|-------------|--------------|-------------|
| M8 Pin assignation    | PIN 1        | PIN 2      | PIN 3      | PIN 4       | PIN 5        | PIN 6       |
| Wire Color (A-coding) | <b>BROWN</b> | WHITE      | GREY       | <b>BLUE</b> | <b>GREEN</b> | <b>PINK</b> |



## 9 DIFFERENT ANTENNA VERSIONS

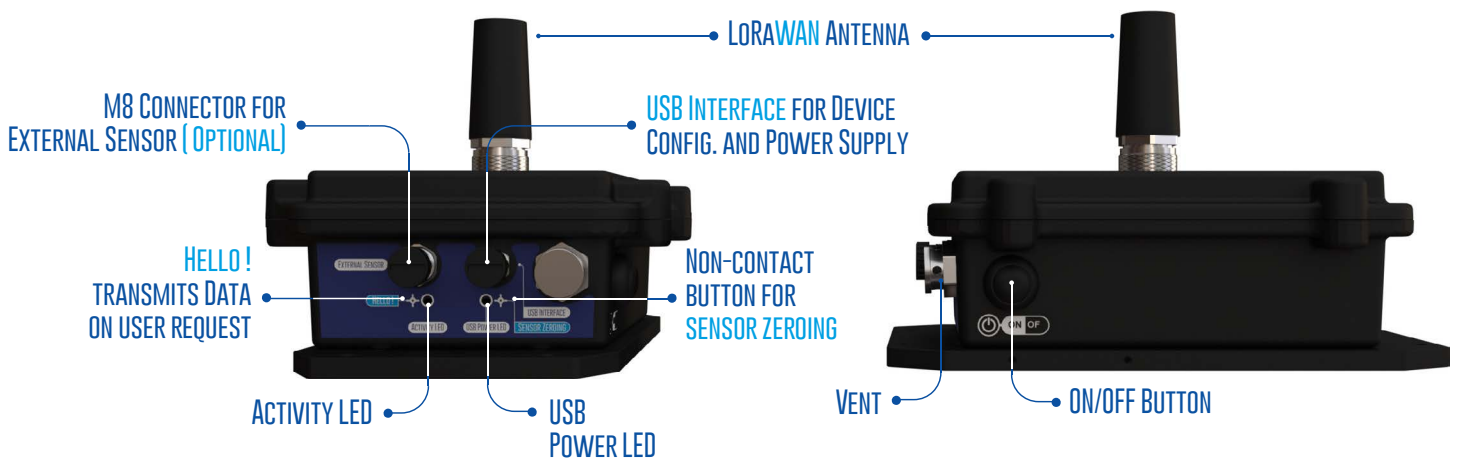


HIGH GAIN ANTENNA 5DBI



SMALL FORM FACTOR ANTENNA 2DBI

## 10 OVERVIEW



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