



BEANAIR® SENSORS BRAND



# WIRELESS IOT TRI-AXIS INCLINOMETER

QUICK START



USER GUIDE



MECHANICAL DRAWING



STEP FILE



## SATEVIS® ALPHA-INC

SCALABLE MEASURING RANGE ( $\pm 10^\circ$  AND  $\pm 85^\circ$ )

# DATASHEET



[WWW.SATEVIS-SYSTEMS.COM](http://WWW.SATEVIS-SYSTEMS.COM)

## 1 MAIN FEATURES



High resolution  $0.0055^\circ$  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)



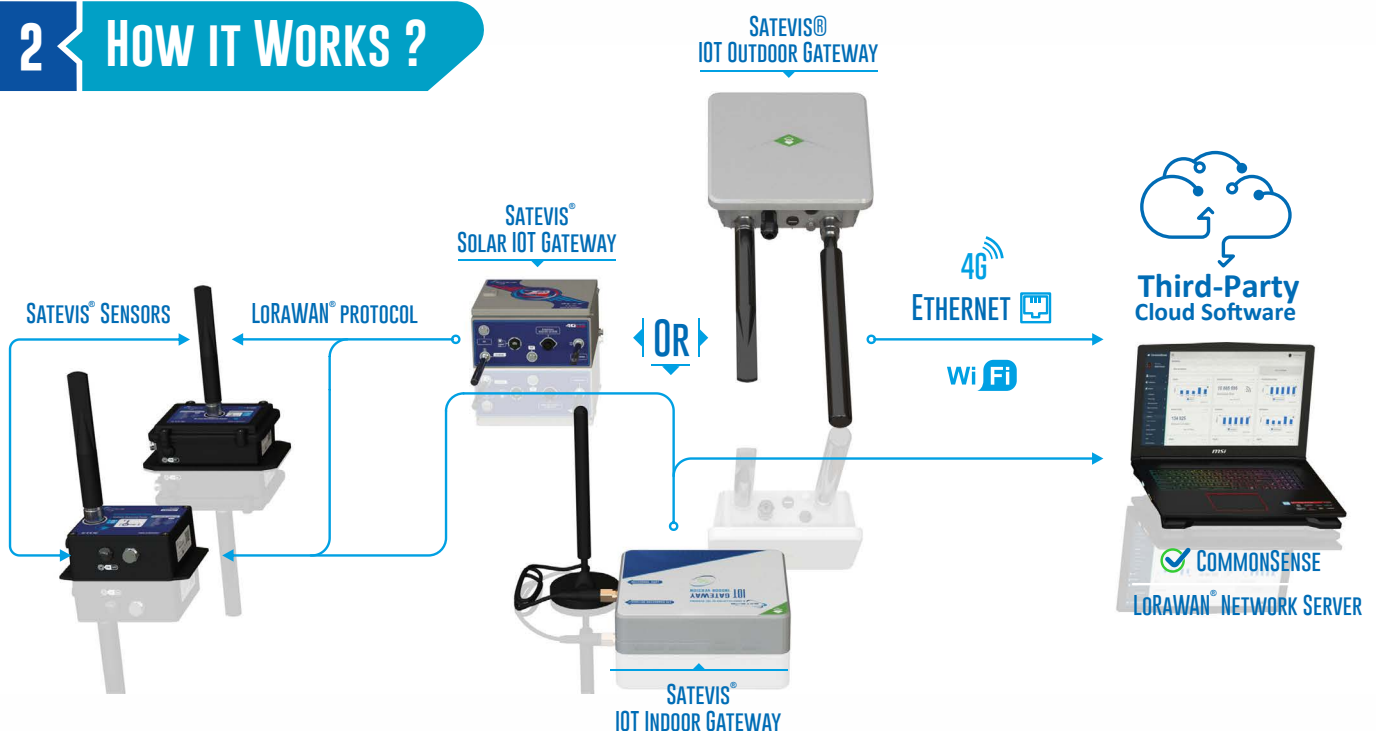
Excellent radio link.



Integrated battery pack

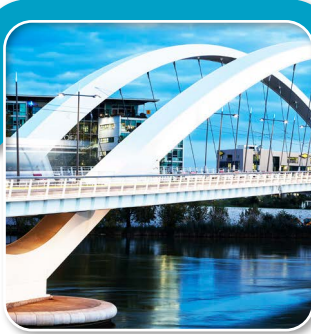
\* 15km Radio range if the device is in Line of sight, sensor configuration: +22dBm Radio Power, +5dBi Antenna, Gateway is installed on a Mast, 25 meters Height, +8dBi Antenna Gain

## 2 HOW IT WORKS ?



## 3 APPLICATIONS

BRIDGE



RAILWAY SLEEPERS



CRANE

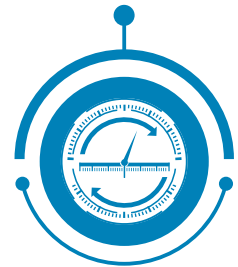


TUNNEL

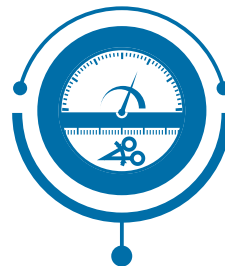
CONDITION MONITORING



LAND SURVEYING



STRUCTURAL HEALTH MONITORING

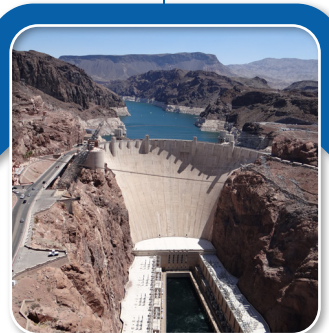


TEST AND MEASUREMENT

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).

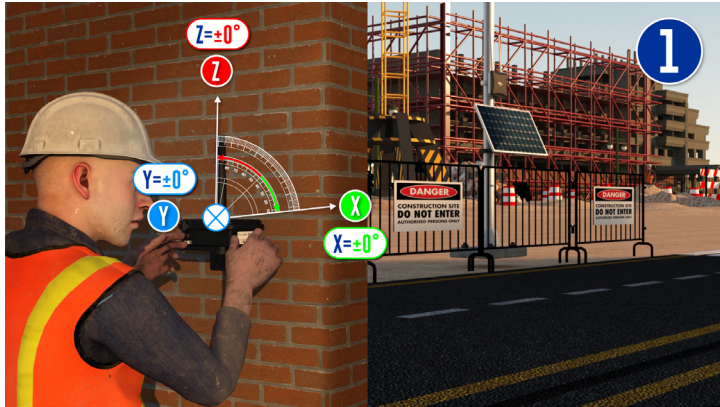


**Caption3:** The Activity Led blinks in **green color**, confirming that a data measurement is transmitted to the Lorawan network.



**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



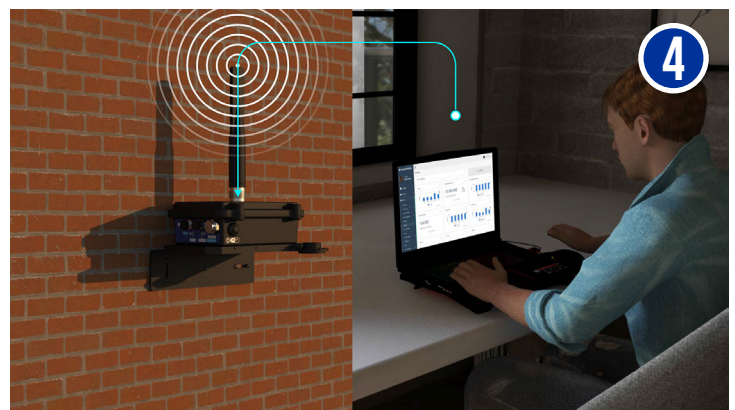
**Caption1:** Even if an angle bracket is used, it's sometimes difficult to bring a zero-offset on both **X** and **Y** axis ( in the case if Z axis is on the same direction than Earth Gravity).. In some cases, the field operator can not spend too much time on this task.



**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 : - Downlink formatter code (Alarm Threshold, Measurement mode....) - Uplink formatter code(Data measurement)
Data Acquisition mode	Different measurement mode are available: Low Duty Cycle Data Acquisition (LDCDA), Measurement heartbeat 20s to 24 hour 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 Mesurement 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 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 $\pm 0.02^\circ$ for $\pm 85^\circ$ measurement range
Sensor Accuracy (full scale, @ 25°C)	$\pm 0.015^\circ$ for $\pm 10^\circ$ range $\pm 0.02^\circ$ for $\pm 45^\circ$ range $\pm 0.04^\circ$ 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 DC to 40 Hz for $\pm 85^\circ$ measurement range
Calibration	Factory calibrated on 9 references point : 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. 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	<p>If 4 sensors Channels ( Tri-Axis Inclinator, 1 Internal Temperature) :</p> <p>380 000 Log sessions per sensor channel</p> <p>If 6 sensors Channels ( Example: Tri-Axis Inclinator, 1 Internal Temperature, External Temperature, External Humidity) :</p> <p>246 000 Log sessions per sensor channel</p>
Logged Information	<p>UTC Clock</p> <p>Data Measurement</p> <p>Monitoring Mode</p>
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	<p>Frequency Plan can be configured from USB:</p> <ul style="list-style-type: none"> <li>-Europe 868MHz</li> <li>- USA: 915MHz</li> <li>- Australia 915MHz</li> <li>- Asia 923MHz</li> <li>- Korea 920MHz</li> <li>- India 865Mhz</li> </ul> <p>Important : Depending on the destination region, Satevis Device will be delivered with Antenna for 868MHZ Frequencies ( Europe/India), or 915MH frequencies (USA/KOREA/ASIA/Australia)</p>
TX Power	<p>HP - High Power Transmission +22dBm</p> <p>LP- Low Power Transmission +14dBm</p>
Receiver Sensitivity	-136.5dBm sensitivity for SF12 with 125KHz BW
Link Budget	158dB
Maximum Radio Range	<ul style="list-style-type: none"> <li>- 15 Km in L.O.S. / Rural Environment</li> <li>- 2 Km in NLOS/ Urban Environment</li> </ul>
Antenna	<p>Waterproof N-Type Omni Antenna,</p> <p>Gain 5 dBi or 2dBi / VSWR ≤ 2.0</p> <p>Frequency range for AG-2dBi-868 and AG-5dBi-868 : 863-870 MHz</p> <p>Frequency range for AG-2dBi-915 and AG-5dBi-915 : 902-928 MHz</p> <p>Dimensions Ø22 x 64 mm for 2dBi</p> <p>Dimensions Ø22 x 180 mm for 5dBi</p>



## 5 TECHNICAL SPECIFICATIONS

### ENVIRONMENTAL AND MECHANICAL

Casing	Aluminum & Waterproof casing Dimensions in mm (LxWxH): 151x130x55 mm 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 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 ·FCC (North America) ·ARIB STD-T66 Ver 3.6 HS Code: 9031.80.20 EAR99 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>Green: network connection, data transmission</p> <p>Blue: 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 Ref: <a href="#">SAT-BRACK-MNT</a>
External Sensors	External Temperature and Humidity Sensor
Calibration certificate	<p>Calibration certificate provided by Satevis</p> <p>A static calibration method is used on a granite surface plate DIN876</p> <p>Ref: <a href="#">CERT-SATEVIS-INCLINOMETER</a></p>

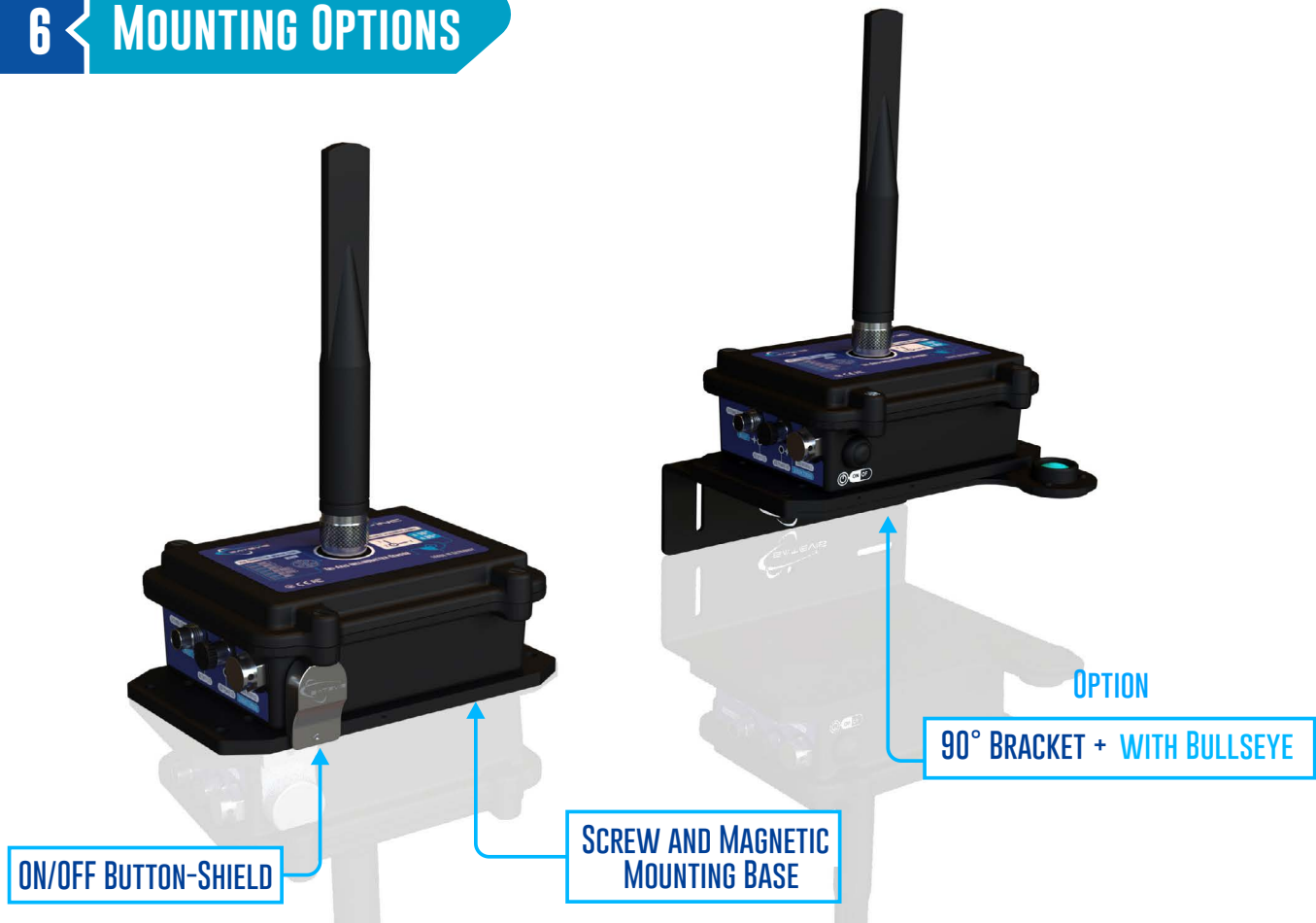
## OPTIONAL EXTERNAL SENSORS

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



## 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.



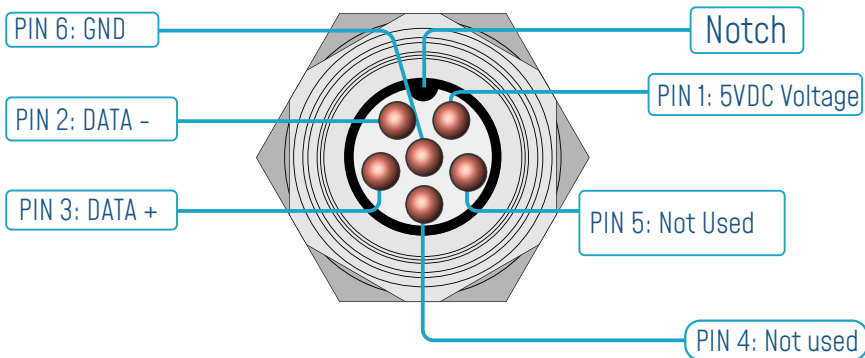
Satevis® Alpha-Inc comes with 2 levels of protection:

- 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.



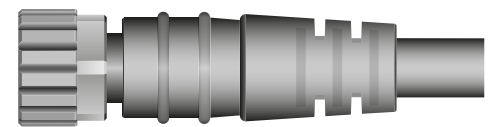
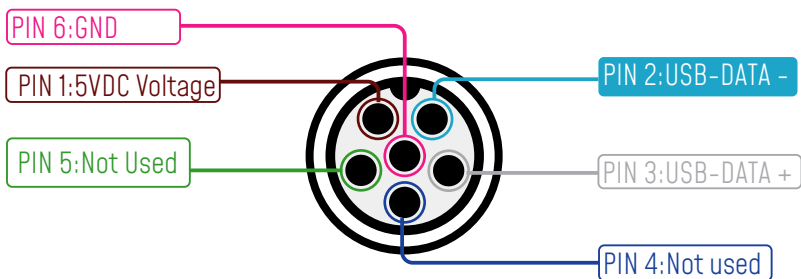
## 8 POWER SUPPLY

### M8 6pin Socket [MALE, A-CODING]- Pin assignment



Interface Name	M8 Pin assignment
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 assignment



M8-6Pins Plug

Interface Name	5VDC Voltage	USB DATA -	USB DATA +	Not used	Not Used	GND
M8 Pin assignment	PIN 1	PIN 2	PIN 3	PIN 4	PIN 5	PIN 6
Wire Color [A-coding]	BROWN	WHITE	GREY	BLUE	GREEN	PINK

## 9 DIFFERENT ANTENNA VERSIONS

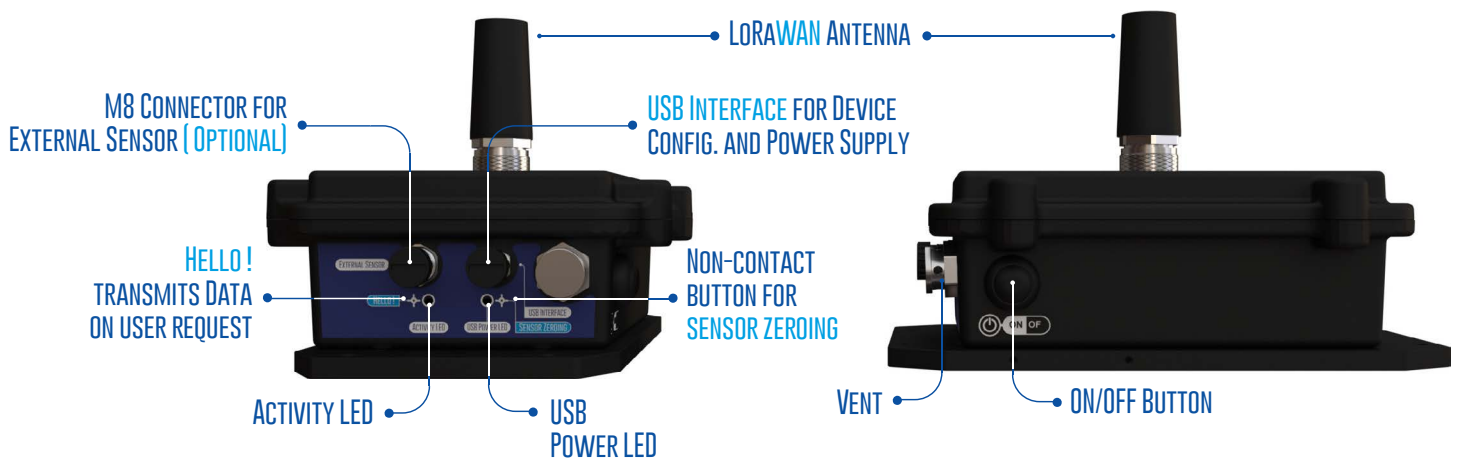


HIGH GAIN ANTENNA 5dBi



SMALL FORM FACTOR ANTENNA 2dBi

## 10 OVERVIEW



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