SATEVIS

BEANAIR® SENSORS BRAND

α·INC

WIRELESS IOT BI-AXIS INCLINOMETER

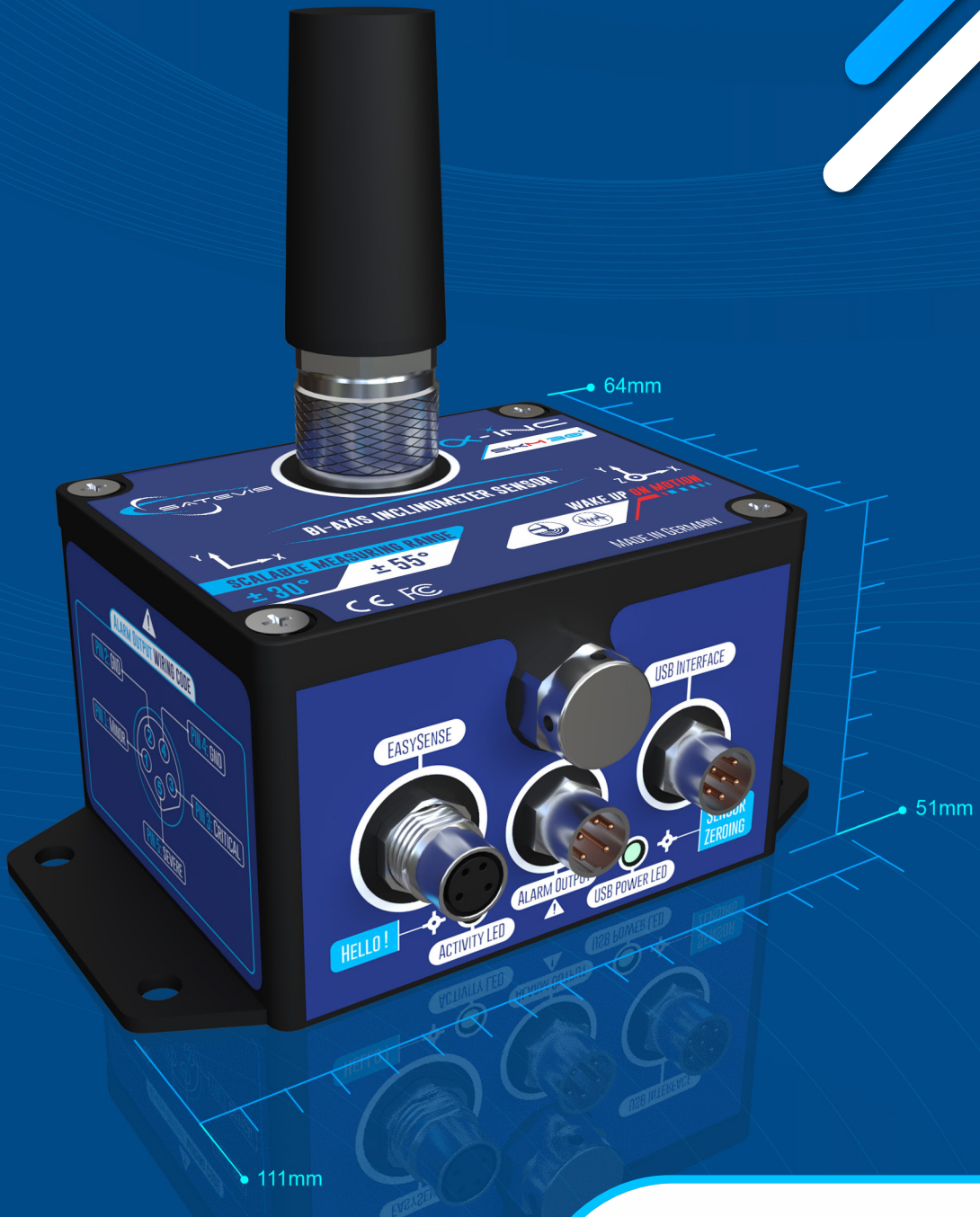
QUICK START

USER GUIDE

MECHANICAL DRAWING

STEP FILE

BATTERY LIFE SIMULATION



ALPHA-INC SKM30°

SCALABLE MEASURING RANGE (±30° AND ±55°)

DATASHEET

IOT

IP67

WWW.SATEVIS-SYSTEMS.COM

1 MAIN FEATURES

Bi-Axis Inclinometer Sensors for an easy installation with scalable range ±30° / ±55°

Ultra Long range :
- 8km-10km in L.O.S (Line of Sight)
- 500m-1Km in NLOS (Urban environment)

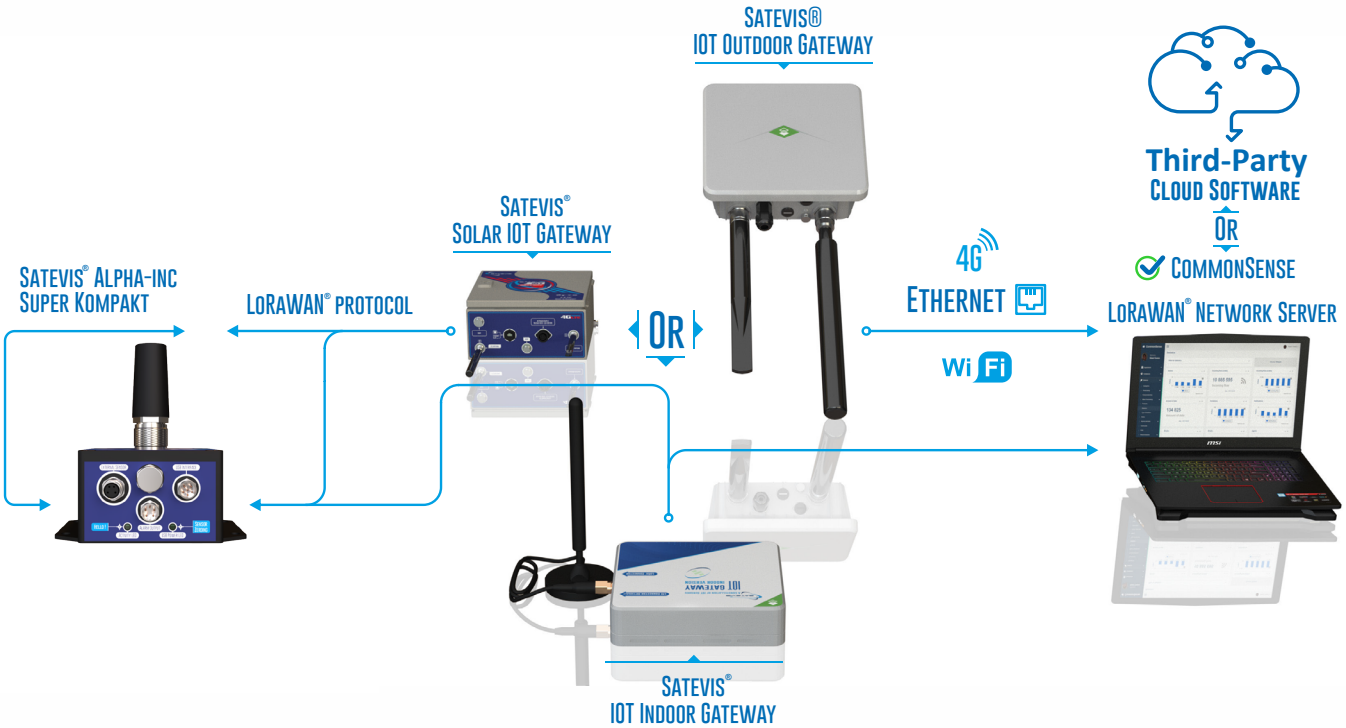
Sensor Precision/Repeatability (full scale, 25°C)
- ±0.00183° for ±30° range
- ±0.00366° for ±55° range

Rugged, Compact & Waterproof Aluminum casing

Open-standard LoraWan® Protocol with different Frequency Plan 868-923MHz

Lithium Primary Cell - D Size Cell 19Ah

2 HOW IT WORKS ?



3 APPLICATIONS

BRIDGE



RAILWAY SLEEPERS





CRANE

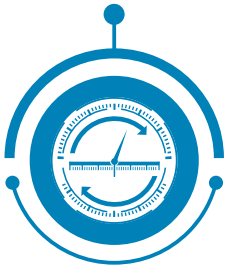


TUNNEL

CONDITION MONITORING

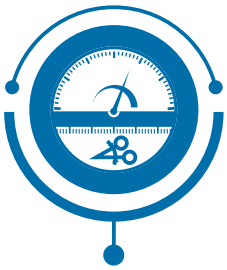


LAND SURVEYING





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.



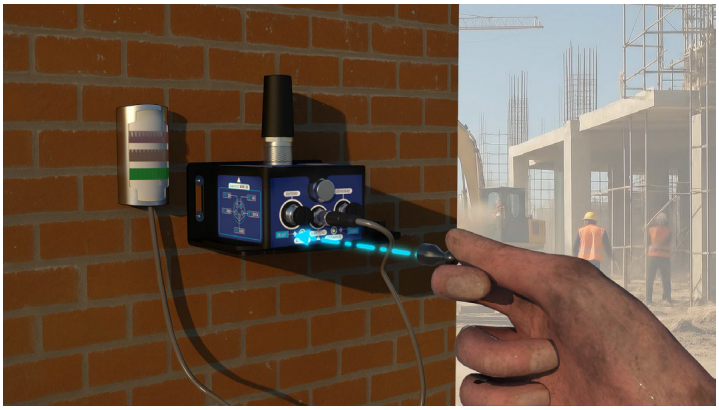
Caption2: By Holding the magnet on the 'Hello!' label for more than 10s, the sensor wakes-up and transmits to the Lorawan network the data measurement followed by the system diagnostic (battery status and network quality).



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.





Caption 5-6: When your Satevis® Sensor , is integrated with external alarm systems, the Hello function lets you test the connection by sending a short pulse to the alarm output ensuring proper functionality without triggering an actual alarm.

4 EFFORTLESS SENSOR INSTALLATION WITH AUTOMATIC ZEROING

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 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 Lorawan® 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

SAT-LORA-ALPHA-INC-SKM-30T-MR-AG-AO

MR– Measurement Range:
30°: Bi-axis ±30°/±55°

AO- Alarm Output
Dry Contact Alarm Output
Leave it empty if this option is not requested

AG - Antenna Gain
2dBi-868: 2dBi Antenna for EU/IND Regions (Europe /India)
5dBi-868: 5dBi Antenna for EU/IND Regions (Europe /India)
2dBi-915: 2dBi Antenna for US/KR/AS/AU Regions (USA/KOREA/ASIA/AUSTRALIA)
5dBi-915: 5dBi Antenna for US/KR/AS/AU Regions (USA/KOREA/ASIA/AUSTRALIA)

Example 1: SAT-LORA-ALPHA-INC-SKM-30T-2dBi-868 , Bi-axis Wireless Inclinometer ±30°/±55° , wake-up on motion function, LoraWan connectivity, 2dBi Antenna 868Mhz
Example 2: SAT-LORA-ALPHA-INC-SKM-30T-5dBi-915-DCO , Bi-axis Wireless Inclinometer ±30°/±55°, wake-up on motion function, LoraWan connectivity, 5dBi Antenna 915MHz, Alarm Output

DIFFERENT ANTENNA VERSIONS

HIGH GAIN ANTENNA 5DBI



SMALL FORM FACTOR ANTENNA 2DBI



INCLINOMETER SENSOR

Inclinometer Technology	MEMS Technology
Scalable Measuring Range	User-selectable static range ±30° or ±55°, or automatic range (the range switches automatically between ±30° and ±85° at runtime based on measured tilt)
Sensor resolution	0.00183° for ±30° range 0.00366° for ±55° range
Noise density	0.0009 °/√Hz
Sensor Precision/Repeatability (full scale, 25°C)	±0.00183° for ±30° range ±0.00366° for ±55° range
Sensor accuracy (full scale, 25°C)	±0.005° for ±30° range (±30° range selected) ±0.01° for ±45° range (±55° range selected) ±0.02° outside ±45° range (±55° range selected)
Offset temperature dependency (temperature range −40°C to +80°C)	±0.002°/°C
Offset LifeTime Drift (@25°C)	±0.05 °
Sensor frequency Response (-3 dB)	DC to 10 Hz for ±30° measurement range DC to 40 Hz for ±55° measurement range
Calibration	Factory calibrated at 9 reference points: 0° absolute, ±5°, ±10°, ±30° and ±45°, with calibration settings stored in the sensor Flash memory. Calibration method: back-to-back calibration against a high-accuracy reference sensor. Calibration values and date of calibration are available via Satevis Link. Optional: certificate of calibration (Ref: CERT-SATEVIS-INCLINOMETER).
Sensor Zeroing function	Sensor zeroing can be performed after installation. Hold the supplied magnet against the "Sensor Zeroing" label for approximately 10 s; the zero-offset is then applied to the X, Y and Z axes. It can also be performed remotely via a downlink.

CONFIGURATION TOOLS (FROM USB)

Satevis Link software (free)	Configure : frequency plan, AppEUI, AppKey Download: Factory calibration data
Tera Term (free , open-source)	Firmware upgrade: free during the product lifetime Download Datalogger: using fast YModem method Batch configuration : Excel template --> CSV --> upload. All monitoring-mode timing parameters, per-channel alarm thresholds, LoRaWAN settings (frequency plan, AppEUI, AppKey). Designed for fast multi-device deployment.

5 TECHNICAL SPECIFICATIONS

WAKE-UP ON SHOCK/IMPACT/MOTION	
Accelerometer Technology	Dual Low-g and High-G MEMS accelerometer , wakes the inclinometer when it detects motion, shock or impact above a configurable threshold, then sends a LoRaWAN alert.
Integrated High-g Shock/Impact accelerometer	±32/±64/±128/±256/±320 g, for high-g shock/impact detection. Range configurable via downlink or batch configuration tool
Integrated Low-g shock/impact/motion accelerometer	±2/±4/±8/±16 g, for low-g shock/impact/motion detection. Range configurable via downlink or batch configuration tool.
Low-g wake-up Threshold	Step = range/64 (or range/256 in fine mode). Examples: ±2 g -> 31.25 mg steps (7.8 mg fine); ±16 g ->250 mg steps. Configurable via downlink or batch configuration tool.
High-g wake-up Threshold	Step = 1 g (ranges ±32…±256 g) or 1.25 g (±320 g range), 8-bit setting. Max threshold = selected range (up to 255 g at ±256 g, 318.75 g at ±320 g). Configurable via downlink or batch configuration tool.
Trigger Axis	X, Y, Z: each one enabled individually or in any combination
Trigger Logic	Low-g OR high-g, or low-g only / high-g only
Minimum event duration	0 to 3 samples (1 step = 1/sampling rate). Example: at 30 Hz, steps are about 33 ms.
Filtering	Configurable high-pass or slope filter, which removes gravity and slow tilt from the trigger.
Low-g accelerometer Monitoring rate	Selectable values 1.875 / 7.5 / 15 / 30 Hz in Energy Saver Mode
High-g accelerometer monitoring rate	480 Hz to 7.68 kHz, enabled or disabled via downlink
Hold-off Time after event detection	Configurable 1–60 s. Impacts during hold-off are ignored and not reported.
Wake-up Latency	About 1 sampling period + minimum duration. Examples: low-g at 30 Hz -> ⩽ 35 ms (duration = 0); high-g at 480 Hz -> ⩽ 3 ms. The LoRaWAN uplink time comes on top of this and depends on the spreading factor (typically 0.1–2 s).
Maximum Event uplink rate	About 1 per hold-off period, limited by the LoRaWAN regional duty cycle (e.g. EU868 1%: about 1 uplink per 2.5 min at SF12, a few seconds at SF7).

RF SPECIFICATIONS

LoraWan Stack	LORAWAN V1.0.2 REVB / CLASS A
Activation Mode	OTAA only
LoraWan Frequency Plan	Frequency Plan can be configured with Satevis Link software (USB Connection): - Europe 868MHz - USA: 915MHz - China 779MHz - Australia 915MHz - Asia 923MHZ - Korea 920MHz - India 865Mhz Important : the device is supplied with the antenna matching the destination region – 868 MHz variant (Europe, India) or 915 MHz variant (USA, Korea, Asia, Australia).
TX Power	Low TX Power Radio: 14dBm @868/915MHz
Receiver Sensitivity	-136.5dBm sensitivity for SF12 with 125KHz BW
Link Budget	155 dB with High Gain Antenna 153 dB with Low Profile Antenna
Maximum Radio Range	-8-10 Km in L.O.S. / Rural Environment -500m to 1km in NLOS/ Urban Environment Test conditions: 5dBi antenna used on sensors, Gateway Installed on a mast 10 meters Height, with 8dBi High Gain Antenna. Sensor installed on 1-2 meters Height, SF12
Antenna	Waterproof N-Type Omni Antenna, Gain 5 dBi or 2dBi / VSWR ⩽ 2.0 Frequency range for AG-2dBi-868 and AG-5dBi-868 : 863-870 MHz Frequency range for AG-2dBi-915 and AG-5dBi-915 : 902-928 MHz Dimensions Ø22 x 64 mm for 2dBi Dimensions Ø22 x 180 mm for 5dBi

AVAILABLE UPLINKS/DOWNLINKS

Javascript formatter code	Free JavaScript formatter code to accelerate the integration of Satevis sensors with your LNS (LoRaWAN Network Server) : - Downlink formatter code (Alarm Threshold, Monitoring mode....) - Uplink formatter code(Data measurement)
Monitoring mode	Different measurement modes are available: Slow measurrement (battery saving), Measurement heartbeat 30s to 24 hours Alarm measurement mode, Measurement heartbeat 30s to 24 hours
Alarm Threshold	Alarm Threshold configurable for each sensor channel, Three levels of Alarm Threshold Minor < Severe < Critical
Scalable Mesurement Range	±30°, ±55°
Battery Diagnostic Report	Battery Voltage & Temperature, Power Source USB/Battery, Datalogger Status, Data Loss during Transmission, Battery advanced Diag Overvoltage/Under-Voltage

INTEGRATED TEMPERATURE SENSOR

Inclinometer compensation sensor	Integrated in the inclinometer die. Resolution: 0.06 °C. Accuracy: ±1 °C over −40 °C to +80 °C.
Temperature sensor used to monitor battery	Mounted under the cell. Resolution: 0.05 °C. Accuracy: ±1 °C over −40 °C to +80 °C.

DATALOGGER / RECORDER

Datalogger Size	If 3 sensors Channels (Bi-Axis Inclinometer, 1 Internal Temperature) : 380 000 Log sessions per sensor channel If 5 sensors Channels (Example: Tri-Axis Inclinometer, 1 Internal Temperature, External Temperature, External Humidity) : 279 000 Log sessions per sensor channel
Logged Information	UTC Clock Data Measurement Monitoring Mode
Remote configuration from LNS	DataLogger Start/Stop/Erase
Download Method	From USB with Tera Term Terminal Software, CSV format

AVAILABLE FUNCTIONS

ON/OFF	Operated from a magnet
Hello	Transmits Data and Sensor Quick Diag 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. Operated from a magnet.
Multi color LED	Green: Power ON Blue: Sensor zeroing successful/Hello Message Transmitted successfully Red: Fault or Switching off

ENVIRONMENTAL AND MECHANICAL

Casing	Aluminum Waterproof casing (see IP rating below for sealing conditions) Dimensions in mm (LxWxH): 111x51x64 mm (without antenna) Weight : 350g (with 5dbi Antenna and cell)	
IP | NEMA Rating	IP67 / NEMA 6 as supplied IP68 when M8 connector cap is fitted, connector shield (REF: SATEVIS-SK-SHIELD) is used and antenna connector is sealed with self-fusing tape (see user guide)	
Shock resistance	100 g, 50 ms half-sine (per IEC 60068-2-27)	
Mounting base	Screw mounting	
Operating Temperature	-40°C to +80°C A sunshield is recommended where prolonged solar exposure may raise the enclosure temperature above +60 °C, to avoid measurement drift and reduced battery life (check Ref: SATEVIS-SK-SHIELD).	
Relative Humidity	0 to 98 %RH, non-condensing	
Norms & Radio certifications	· CE marking per Directive 2014/53/EU (RED) · EN 300 220-1 / -2 · EN 301 489-1, EN 301 489-3 (SRD) · EN 62368-1:2014+A11:2017 (safety) · FCC Part 15.247 (USA) · ISED RSS-247 (Canada) · ARIB STD-T66 Ver 3.6	-HS Code: 9031.80.20 -EAR99 -RoHS 3 (2015/863); REACH SVHC

POWER SUPPLY

Replaceable Primary Cell	Non-Rechargeable , standard and swappable Lithium Thionyl Chloride D Size . Capacity 19Ah (@4mA) , Nominal Voltage 3.6 Volts Ex: EVE ER34615
Current consumption @ 3.6VDC	· During data acquisition : 8-10 mA · During Radio transmission : 19 mA @ +14 dBm · During Battery Saver Mode : < 9 µA
External power supply	USB Power 5VDC. When the device is powered from USB, the internal battery pack is disconnected from the power path.

ALARM OUTPUT (OPTIONAL)

Dry Contacts	3 x Dry contacts Output to trigger external Alarm system : Minor Alarm, Severe Alarm , Critical Alarm
Connector Type	M8-5 Pins Male socket

MINOR ALARM



SEVERE ALARM



CRITICAL ALARM



STANDARD VERSION





VERSION WITH ALARMS OUTPUT

INCLUDED ACCESSORIES

1x Lithium Primary Cell - D Size Cell 19Ah with battery remover strap
1x Magnet for Sensor-Zeroing & Hello functions
2x M8 Cap for USB & Easy-Sense sockets
1 x USB to M8 cable adapter, 2 meters length
1 x Self-fusing tape (25cm length)
1 x LoraWan Antenna (see antenna options on reference builder)

OPTIONAL EXTERNAL SENSORS

Temperature and HumIdity sensor	Ref: EASY-SENSE-TH-CL-XX
Displacement Sensor (Spring Return or Ball Joint)	Ref: SAT-EASY-SENSE-DISP-SR-XX , SAT-EASY-SENSE-DISP-BJ-XX

OPTIONAL ACCESSORIES AND SERVICES

Magnetic Mounting	Magnetic Mounting Kit Ref: SAT-MAG-SK-MNT
90° Bracket Mounting	90° Bracket mounting (with integrated eyelet) with 4 x M5 screws + Locknut Material : Aluminum AL6061, Black Anodized Ref: SAT-BRACK-SK-MNT
Connector Shield	Connector & Sun shield, 3D-printed glass-fibre-reinforced ASA with High-UV Stability, Max Heat deflection temperature 105°C - REF: SATEVIS-SK-SHIELD
Calibration certificate	Calibration certificate provided by Satevis A static calibration method is used on a granite surface plate DIN876 Ref: CERT-SATEVIS-INCLINOMETER

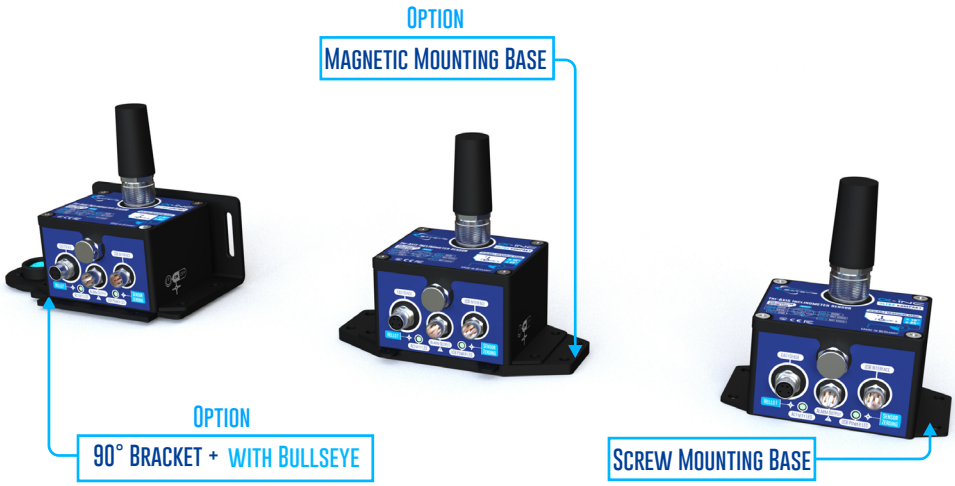
BATTERY LIFE WITH FOR DIFFERENT REFRESH CYCLE @25DEGC AND LORAWAN MODEM CONFIGURED WITH SF7 AIRTIME

Refresh Cycle every 1 minute	5.5 years
Refresh Cycle every 5 minutes , 1Hour, 4 hours	10 years ; limited by shelf-life

For more information about battery life at different temperature , use the battery simulation file:

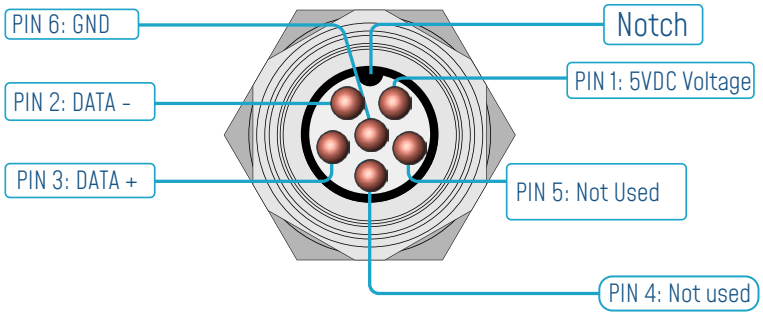
BATTERY LIFE SIMULATION

6 MOUNTING OPTIONS



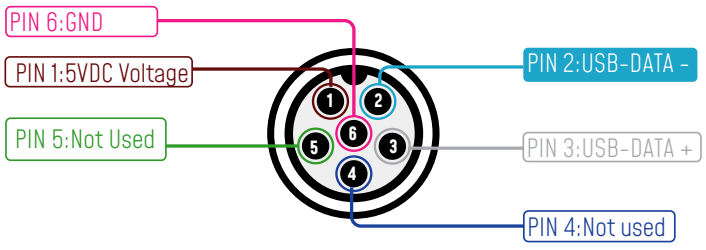
7 USB CONNECTOR WIRING CODE

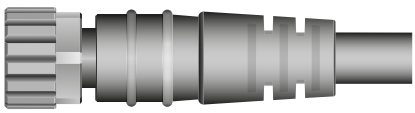
M8 6pin Socket (MALE, A-CODING)- Pin assignation



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



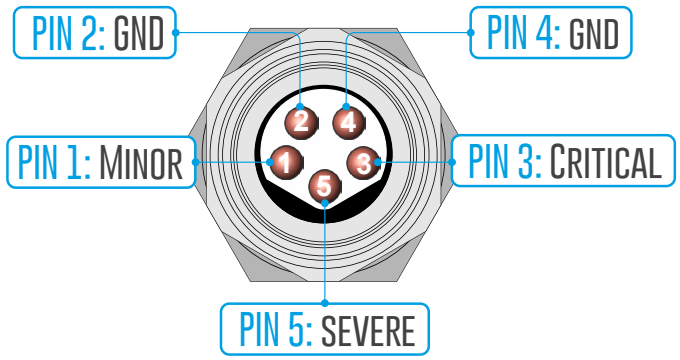


M8-6Pins Plug

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)	BROWN	WHITE	GREY	BLUE	GREEN	PINK

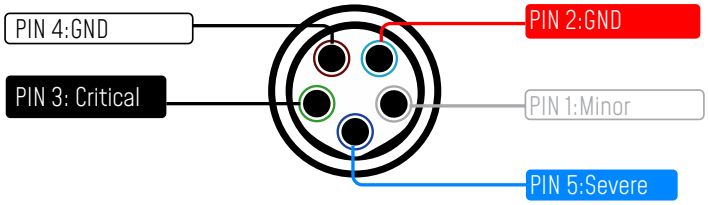
8 ALARM OUTPUT WIRING CODE

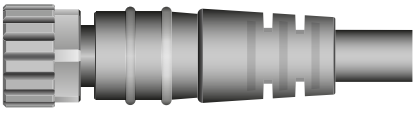
M8 5pin Socket (MALE, A-CODING)- Pin assignation



M8 Pin Assignation	Interface Name
PIN 1	Minor
PIN 2	GND
PIN3	Critical
PIN4	GND
PIN 5	Severe

M8 5pin PLUG (FEMALE, A-CODING)- Pin assignation

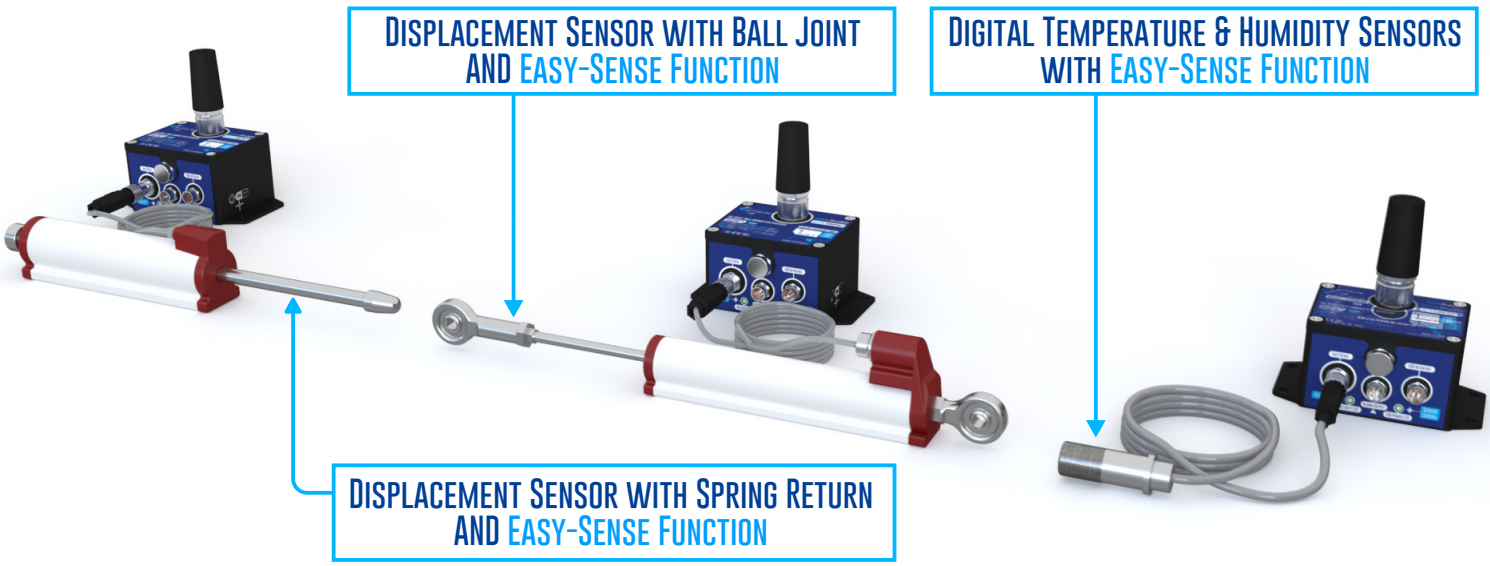




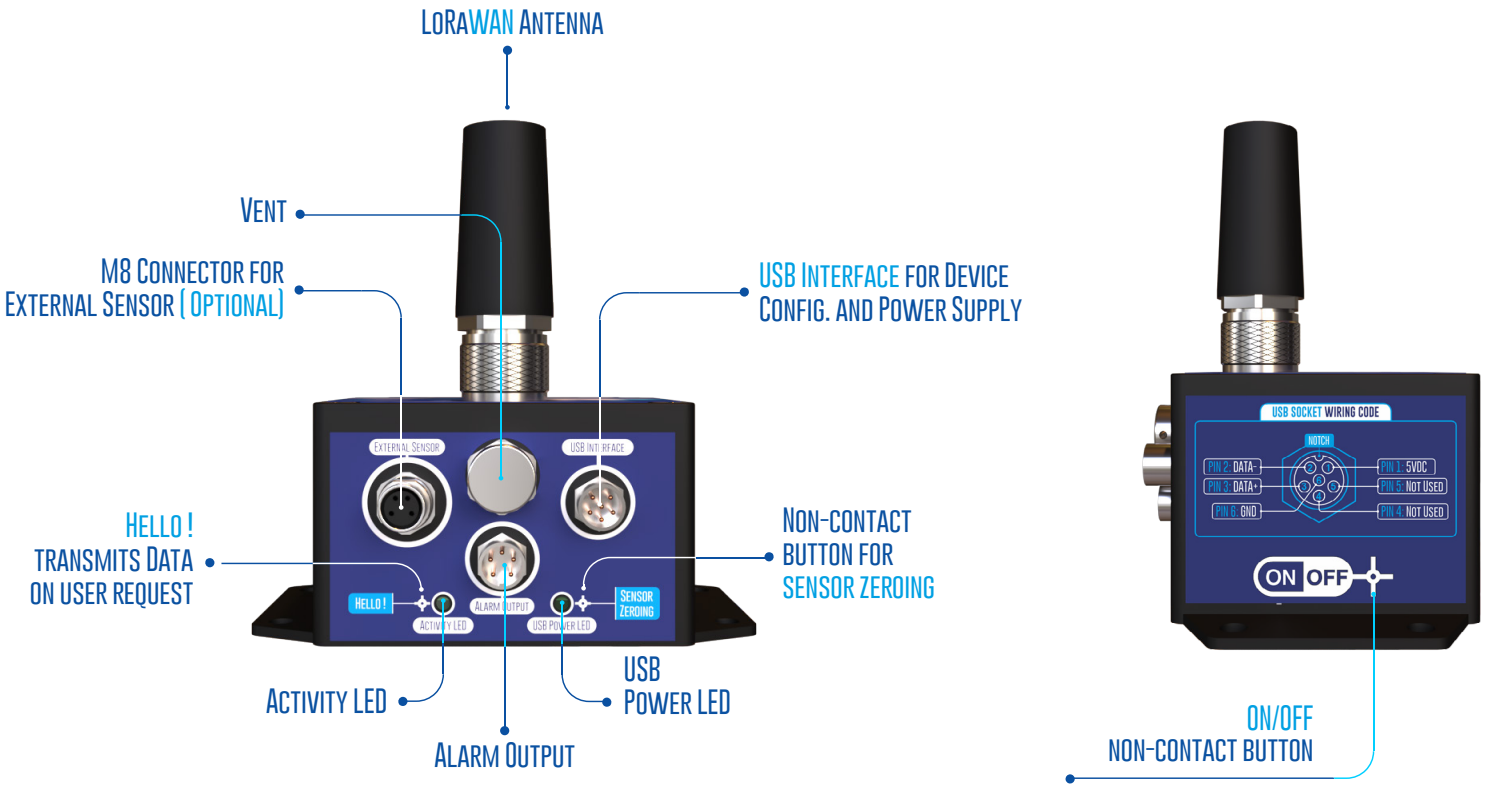
M8-5 Pins Plug

Interface Name	MINOR	GND	CRITICAL	GND	SEVERE
M8 Pin assignation	PIN 1	PIN 2	PIN 3	PIN 4	PIN 5
Wire Color (A-coding)	GREY	RED	BLACK	WHITE	BLUE

9 EASY SENSE



10 OVERVIEW


LORAWAN ANTENNA
VENT
M8 CONNECTOR FOR EXTERNAL SENSOR (OPTIONAL)
USB INTERFACE FOR DEVICE CONFIG. AND POWER SUPPLY
HELLO ! TRANSMITS DATA ON USER REQUEST
NON-CONTACT BUTTON FOR SENSOR ZEROING
ACTIVITY LED
ALARM OUTPUT
USB POWER LED
EXTERNAL SENSOR
USB INTERFACE
HELLO !
ACTIVITY LED
ALARM OUTPUT
USB POWER LED
SENSOR ZEROING
USB SOCKET WIRING CODE
NOTCH
PIN 2: DATA-
PIN 3: DATA+
PIN 6: GND
PIN 1: 5VDC
PIN 5: NOT USED
PIN 4: NOT USED
ON OFF
ON/OFF NON-CONTACT BUTTON