



BEANAIR® SENSORS BRAND



# WIRELESS IOT TRI-AXIS INCLINOMETER

QUICK START



USER GUIDE



MECHANICAL DRAWING



STEP FILE



## ALPHA-INC SK10°

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

# DATASHEET



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

## 1 MAIN FEATURES



Tri-Axis Inclinometer Sensors for an easy installation with scalable range  $\pm 10^\circ$  /  $\pm 85^\circ$



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) •  $\pm 0.01^\circ$  for  $\pm 10^\circ$  range  
•  $\pm 0.02^\circ$  for  $\pm 85^\circ$  range



Rugged, Compact & Waterproof Aluminum casing

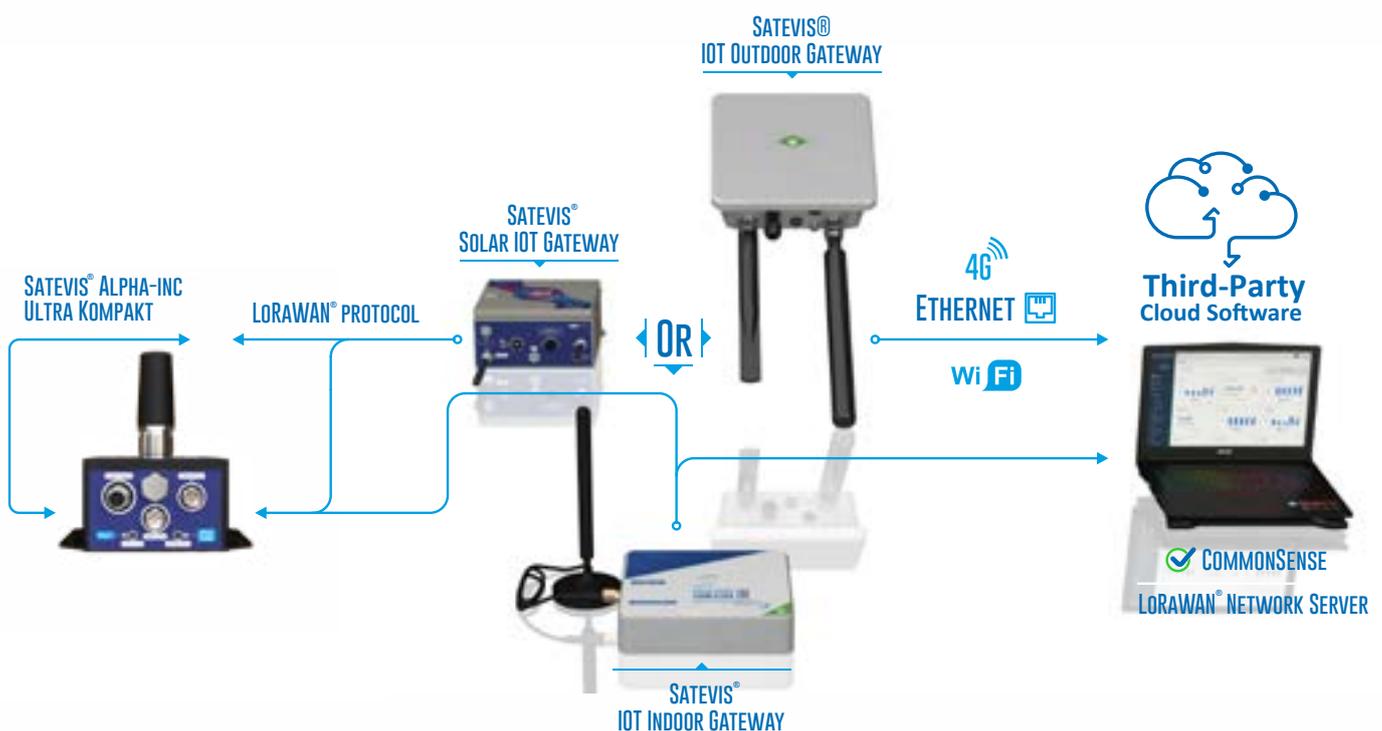


Open-standard LoraWan® Protocol with different Frequency Plan 868-923MHz



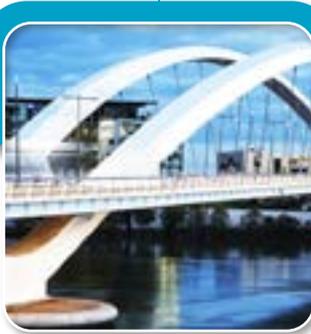
Lithium Primary Cell - D Size Cell 19Ah

## 2 HOW IT WORKS ?



**3 APPLICATIONS**

**BRIDGE**



**RAILWAY SLEEPERS**



**CRANE**



**TUNNEL**

**CONDITION MONITORING**



**LAND SURVEYING**



**STRUCTURAL HEALTH MONITORING**

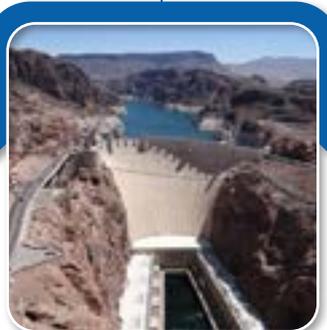


**TEST AND MEASUREMENT**

**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.

## 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

SAT-LORA-ALPHA-INC-SK-10T-MR-AG-AO

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

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-SK-10T-2dBi-868, Tri-axis Wireless Inclinator  $\pm 10^\circ/\pm 85^\circ$  with LoraWan connectivity, 2dBi Antenna 868Mhz

Example 2: SAT-LORA-ALPHA-INC-SK-10T-5dBi-915-DCO, Tri-axis Wireless Inclinator  $\pm 10^\circ/\pm 85^\circ$  with LoraWan connectivity, 5dBi Antenna 915MHz, Dry Contact Output for Alarms

### 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 10s to 24 hour Alarm measurement mode, Measurement heartbeat 10s to 24 hour
Alarm Threshold	Three levels of Alarm Threshold Alert < Action < Alarm
Scalable Measurement Range	$\pm 10^\circ$ , $\pm 90^\circ$ and automatic $\pm 10^\circ/\pm 90^\circ$

### SATEVIS LINK SOFTWARE (FROM USB)

Configuration	Frequency Plan, AppEUI, AppKey
Sensor calibration	User Calibration

### FIRMWARE UPGRADE (FROM USB)

Firmware Upgrade	Firmware upgrade through the USB with STCubeProgrammer (available on our FTP)
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## 5 TECHNICAL SPECIFICATIONS

### SENSOR SPECIFICATIONS

Inclinometer Technology	MEMS Technology
Scalable Measuring Range	user-selectable range $\pm 10^\circ$ or $\pm 90^\circ$ , with automatic range adjustment depending on the application
Sensor resolution	0.005°
Noise density	for $\pm 10^\circ$ range : 0.0007 °/√Hz on Y Axis, 0.008 °/√Hz on X, Z Axis for $\pm 90^\circ$ range : 0.0012 °/√Hz on all axis
Sensor precision (full scale, @ 25°C, Static Measurement Mode every 2s)	$\pm 0.009^\circ$ for $\pm 10^\circ$ measurement range $\pm 0.018^\circ$ for $\pm 90^\circ$ measurement range
Offset temperature dependency (temperature range -25°C to +85°C)	$\pm 0.0008^\circ/\text{°C}$
Sensitivity temperature dependency (temperature range -25°C to +85°C)	$\pm 0.1 \%$
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 $\pm 90^\circ$ measurement range
Calibration	Factory calibrated for $\pm 10^\circ$ range and $\pm 90^\circ$ with calibration settings backed up on the sensor Flash memory. Calibration method used : Back-to-back calibrated with a reference sensor. Sensors can be re-calibrated by the user.
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. 2s, zero-offset is adjusted on the sensor axis perpendicular to earth gravity.

### POWER SUPPLY

Integrated battery	Non-Rechargeable Lithium Thionyl Chloride D Size Capacity 19h , Max Voltage 3.6 Volts
Current consumption @ 3,3V	<ul style="list-style-type: none"> <li>· During data acquisition : 15 to 20 mA</li> <li>· During Radio transmission : 35 mA @14 dBm</li> <li>· During Battery Saver Mode : &lt; 11 <math>\mu</math>A</li> </ul>
External power supply	USB Power 5VDC. When the device is powered from USB, the internal battery is disconnected from the power path.

## RF SPECIFICATIONS

LoraWan Stack	MACV1.0.2
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>- China 779MHz</li> <li>- Australia 915MHz</li> <li>- Asia 923MHz</li> <li>- Korea 920MHz</li> <li>- India 865Mhz</li> </ul>
TX Power	22dBm @868/915MHz
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>- 2Km in NLOS/ Urban Environment"</li> </ul>
Antenna	Waterproof N-Type Antenna, Gain 1.08 dBi (868 MHz)/1.15dBi (915MHz)/0.93dBi (920MHz), VSWR 1.64 (864~923MHz)

## DATALOGGER / RECORDER

Datalogger Size	<p>If 4 sensors Channels ( Tri-Axis Inclinator, 1 Internal Temperature ) : 322 000 Log sessions per sensor channel</p> <p>If 6 sensors Channels ( Example: Tri-Axis Inclinator, 1 Internal Temperature, External Temperature, External Humidity ) : 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/Erase
Download Method	From USB with Hypeterminal Software, CSV format

## 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



## INTEGRATED TEMPERATURE SENSOR

Temperature Range	-40°C to +75°C
Measurement resolution	±0.06°C
Sensor Precision	±1°C

## 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	Green: nework connection, data tranmsision Blue: Sensor zeroing successful Red: transmission failure

## ENVIRONMENTAL AND MECHANICAL

Casing	Aluminum & Waterproof casing Dimensions in mm (LxWxH): 111x64x51 mm (without antenna) Weight : 350g
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
Operating Temperature	-40°C to +75°C Sunshield should be used if the device is exposed to long-term sun radiation from +75°C
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

- 1x Lithium Primary Cella - D Size Cell 19Ah with battery remover strap
- 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)

## OPTIONAL EXTERNAL SENSORS

Temperature and Humidity sensor	Ref: <a href="#">SAT-EXT-SENS-TH</a>
Industrial Pressure sensor	Ref: <a href="#">SAT-EXT-SENS-PRESS</a>

## OPTIONAL ACCESSORIES AND SERVICES

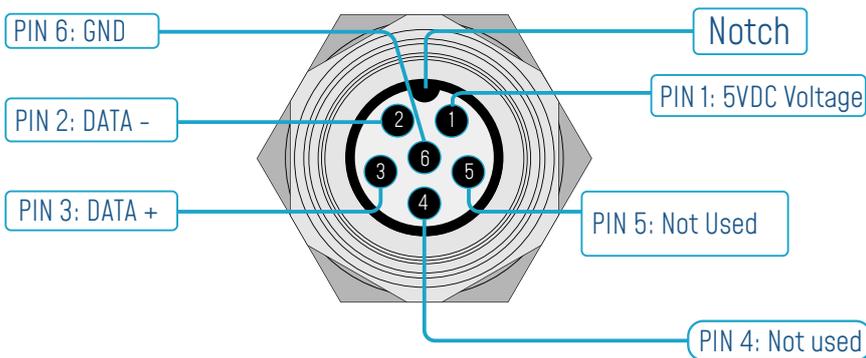
Magnetic Mounting	Magnetic Mounting Kit <a href="#">Ref: SAT-MAG-SK-MNT</a>
90° Bracket Mounting	990° Bracket mounting (with integrated eyelet) with 4 x M5 screws + Locknut <a href="#">Ref: SAT-BRACK-SK-MNT</a>
Connector Shield	3D PRINTED PLA MATERIAL Connector shield - <a href="#">REF: SATEVIS-SK-SHIELD</a>
Calibration certificate	Calibration certificate provided by Satevis A static calibration method is used on a granite surface plate DIN876 <a href="#">Ref: CERT-SATEVIS-INCLINOMETER</a>

## 6 MOUNTING OPTIONS



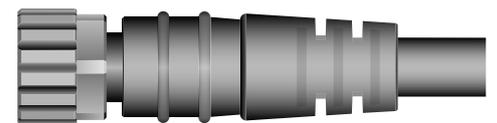
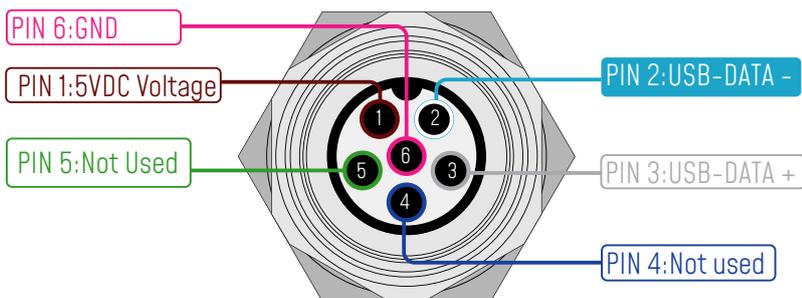
## 7 < USB CONNECTOR WIRING CODE

### M8 6pin Socket- 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- Pin assignation

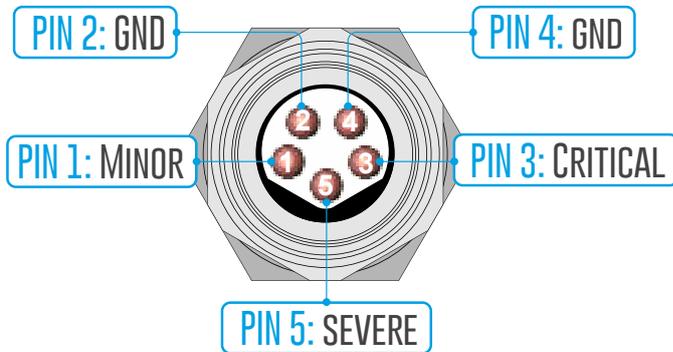


M8-6Pins Plug

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

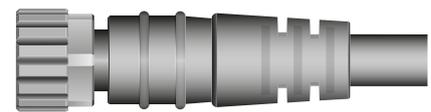
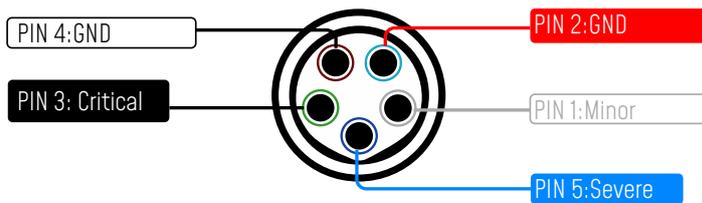
## 8 < ALARM OUTPUT WIRING CODE

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



M8 Pin Assignment	Interface Name
PIN 1	Minor
PIN 2	GND
PIN 3	Critical
PIN 4	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

DISPLACEMENT SENSOR WITH BALL JOINT AND EASY-SENSE FUNCTION

DIGITAL TEMPERATURE & HUMIDITY SENSORS WITH EASY-SENSE FUNCTION

DISPLACEMENT SENSOR WITH SPRING RETURN AND EASY-SENSE FUNCTION



## 10 DIFFERENT ANTENNA VERSIONS



HIGH GAIN ANTENNA 5DBI



SMALL FORM FACTOR ANTENNA 2DBI

## 11 OVERVIEW

