

Wireless inclinometer with integrated data logger
(high accuracy version)



2.4 GHz DATASHEET

SmartSensor

www.beanair.com



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MADE
IN 
GERMANY

Video



Product Video



Application Video

User Guide



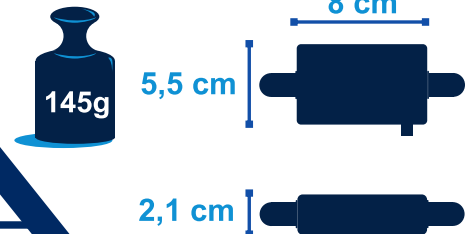
Quick Start



Mechanical Drawing



STEP File



OVERVIEW



Wireless inclinometer (measurement range $\pm 15^\circ$, $\pm 30^\circ$)



Time-synchronized wireless sensor networks (± 2.5 ms of accuracy)



Embedded data logger : up to 1 million data points (with events dating)



Waterproof IP67 casing (Nema 6)



Integrated Lithium-Ion battery charger



Excellent radio link relying on the radio antenna diversity developed by Beanair®

APPLICATIONS

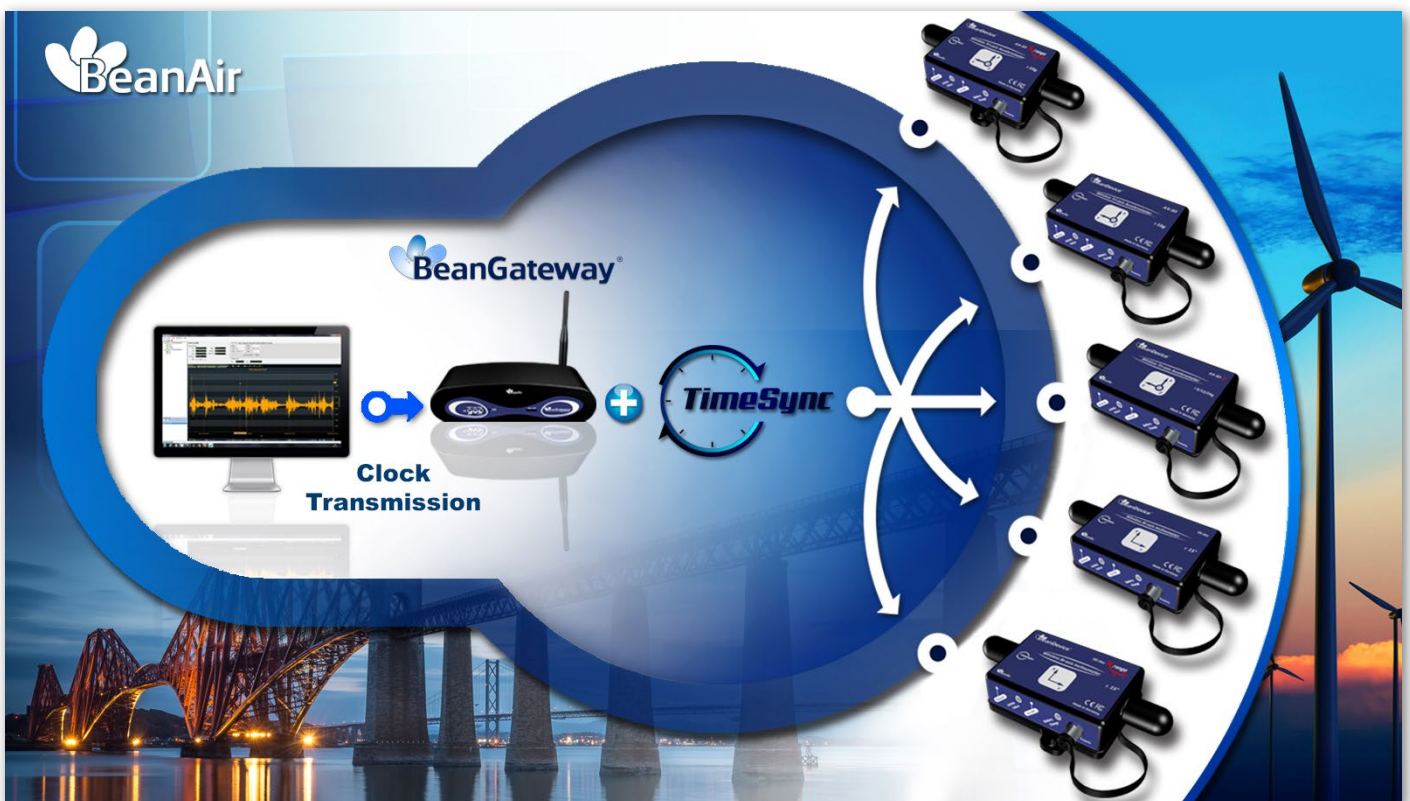
- ANTENNA POSITIONNING
- FLIGHT TEST MEASUREMENT
- BENCHMARK ON CAR FRAME STABILITY
- STRUCTURAL HEALTH MONITORING



For further information about bridge monitoring, please read the following applications note :
[AN_RF_002 – “Bridge monitoring with BeanAir® products”](#)

Time-Synchronized Wireless Sensor Networks

TimeSync function brings time-synchronization over the Wireless Sensor Network ($\pm 2.5\text{ms}$ of accuracy between each wireless sensor) and contributes to enhance user experience about correlation of remote sensing data and modal analysis.



Remote Configuration & Monitoring

BeanScape® Basic

The **BeanScape®** application allows the user to view all the data transmitted by the **BeanDevice® HI-INC**.

Thanks to the OTAC (Over-the-Air configuration) feature, the user can remotely configure the **BeanDevice® HI-INC**.

SEVERAL DATA ACQUISITION MODES ARE AVAILABLE ON THE BEANDEVICE® HI-INC :

- **Low Duty Cycle Data Acquisition mode (LDCDA)** : the data acquisition is immediately transmitted by radio. The transmission frequency can be configured from 1s to 24h.
- **Survey Mode**: the measured value is transmitted by radio whenever an alarm threshold (fixed by the user) is detected (4 alarms threshold levels High/Low). Meanwhile, the device sends frequently a beacon frame informing its current status.
- **Streaming Packet Mode** : all measured values are transmitted by packet within a continuous flow at 60 samples per second maximum.

BeanScape® Premium+ Add-on

The **BeanScape® Premium+** integrates an OPC DA server (Data Access). OPC DA is particularly well suited for real time measurement and data sharing. Each data/measurement can be associated to a tag or its attributes and shared with one or many OPC clients.



i For further information about the different data acquisition modes:

[TN-RF-008 – “Data acquisition modes available on the BeanDevice®”](#)

Antenna diversity

While the vast majority of wireless sensors show their limits in harsh industrial environment, the **BeanDevice® HI-INC** integrates an innovative antenna diversity design, boosting the radio link quality in environments subject to random and diverse disturbances. Antenna Diversity improves both the quality and reliability of a wireless link by 30%.



Embedded data logger up to 1 million data points

The **BeanDevice® HI-INC** integrates an embedded datalogger, which can be used to log data when a Wireless Sensor network can not be easily deployed on your site. All the data acquisition are stored on the embedded flash and then transmitted to the **BeanGateway®** when a Wireless Sensor Network is established.

The data logger function is compatible with all the data acquisition mode available on the **BeanDevice® HI-INC** :

- LowDutyCycle Data Acquisition
- Survey
- Streaming packet

EXAMPLE : TILT MEASUREMENT ON A BRIDGE

- In standalone operation, the **BeanDevice® HI-INC** stores all the measurements on its embedded datalogger. Thus, a direct connection with the **BeanGateway®** is not needed.
- During the measurement campaign, all the acquired measurements are stored on datalogger.
- Data logs can be transmitted to the **BeanGateway®** on request. Once a successful transmission is done, the user can choose to erase automatically the logs from the datalogger memory, so new ones can be stored.



For further information about data logger, please read the following technical note :
TN-RF-007 – “BeanDevice® DataLogger User Guide ”

Technical Specifications

Product reference	
BND-Hi-Inc –MR–PS	
MR – Measurement Range	PS - Power Supply
30B : bi-axial $\pm 15^\circ$	RB : Internal rechargeable battery
90B : bi-axial $\pm 30^\circ$	XT : External Power supply
<p>Example 1: BND-HI-INC-15B-RB-wireless bi-axial inclinometer with $\pm 15^\circ$ measurement range, internal rechargeable battery</p> <p>Example 2: BND-HI-INC-30B-XT-wireless bi-axial inclinometer with $\pm 30^\circ$ measurement range, external primary cell</p>	

Sensor specifications	
Inclinometer Technology	Accurate and low power MEMS technology
Measurement resolution (Bandwidth 10 Hz)	0.001°
Noise density	0.0004 °/√Hz
Accuracy (full scale, @ 25°C)	$\pm 0.05^\circ$ ($\pm 0.02^\circ$ on customer request)
Offset temperature dependency	$\pm 0.002^\circ/\text{C}$
Sensitivity temperature dependency	$\pm 0.005\%/\text{C}$
Long term stability (@23°C)	< 0.004 °
Analog to Digital converter	16-bits, SAR architecture (Successive Approximation Register) with temperature compensation
Sensor frequency Response (-3 dB)	DC to 28 Hz
Noise spectral density DC to 100 Hz	0.0004 °/√Hz
Anti-aliasing filter	Butterworth 5th order filter – cut-off frequency : 1 Hz to 100 Hz remotely programmable (BeanScape®)

Over-the-air configuration (OTAC) parameters

Data Acquisition mode (SPS = sample per second)	Low Duty Cycle Data Acquisition (LDCDA) Mode: 1s to 24 hour Streaming Mode (not available on XT version, External power supply) Survey Mode: 1s to 24h
Sampling Rate (in streaming packet mode)	Minimum: 1 SPS Maximum: 60 SPS on each axis
Alarm Threshold	2 High level and 2 Low level
Programmable cut-off frequency (Anti-aliasing filter)	1– 100 Hz
Power Mode	Sleep Active (not available on XT version, External power supply)

RF Specifications

Wireless Protocol Stack	Ultra-Power and license-free 2.4Ghz radio technology (IEEE 802.15.4E)
WSN Topology	Point-to-Point / Star
Data rate	250 Kbits/s
RF Characteristics	ISM 2.4GHz – 16 Channels. Antenna diversity designed by Beanair®
TX Power	+18 dBm
Receiver Sensitivity	-104dBm
Maximum Radio Range	650m (Line of Sight) , 30-100m (Non Line of Sight)
Antenna	Omnidirectional radome antenna with antenna diversity Gain : 3 dBi Waterproof IP67

Embedded Data logger

Storage capacity	up to 1 million data points
Wireless data downloading	3 minutes to download the full memory (average time)

TimeSync function : Clock synchronization over the Wireless Sensor Networks (WSN)

Clock synchronization accuracy	±2.5 ms (at 25°C)
Crystal specifications	Tolerance ±10ppm, stability ±10ppm

Environmental and Mechanical

Casing	Aluminum & Waterproof casing
	Dimensions in mm (LxWxH): 100x55x21 mm
	Weight (battery included) : 155g

IP NEMA Rating	IP67 Nema 6
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Shock resistance	100g during 50 ms
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Operating Temperature	RB : Internal rechargeable battery -20 °C to +65 °C during battery discharge 0 to 45°C during battery charge
	XT : External Power Supply -40 °C to +75 °C during battery discharge

Norms & Radio Certifications	· CE Labelling Directive R&TTE (Radio) ETSI EN 300 328
	· FCC (North America)
	· ARIB STD-T66 Ver 3.6
	ROHS - Directive 2002/95/EC

Power supply

Integrated battery charger	Integrated Lithium-ion battery charger with high precision battery monitoring : · Overvoltage Protection, Overcurrent/Short-Circuit Protection, Undervoltage Protection · Battery Temperature monitoring
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Current consumption @3,3V	· During data acquisition : 30 to 40 mA · During Radio transmission : 80 mA @ 18 dBm · During sleeping : < 38 µA
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External power supply	8-28VDC
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Rechargeable battery	High density Lithium-Ion rechargeable battery with a capacity of 950 mAh
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Option(s)	
External Power Supply	Wall plug-in, Switchmode power Supply 12V @ 1,25A with sealed M8 Plug (IP67/Nema 6) Ref: M8-PWR-12V
Solar Panel Kit (compatible with External Power Supply version only)	“High efficiency solar panel with Solar charging controller and Lead-acid battery Ref: X-SOL-5W-M8-2M
External Primary Cell in a Waterproof IP67 Casing	External Primary cell mounted in a IP67 aluminum Alloy casing: IP67 Battery Holder Lithium-thionyl chloride primary cell (Li-SOCl ₂) 6,5 Ah Ref: PRIM-XTENDER
M8 extension cable for external power supply	Molded cable with M8-3pins male plug Material: PVC with shield protection IP Rating : IP67 Nema 6 Cable length: 2 meters , Ref: CBL-M8-2M Cable length : 5 meters, Ref: CBL-M8-5M Cable length: 10 meters, Ref: CBL-M8-10M
Calibration certificate	Calibration certificate provided by Beanair GmbH A static calibration method is used on a granite surface plate DIN876

Getting started with a Wireless Sensor Networks

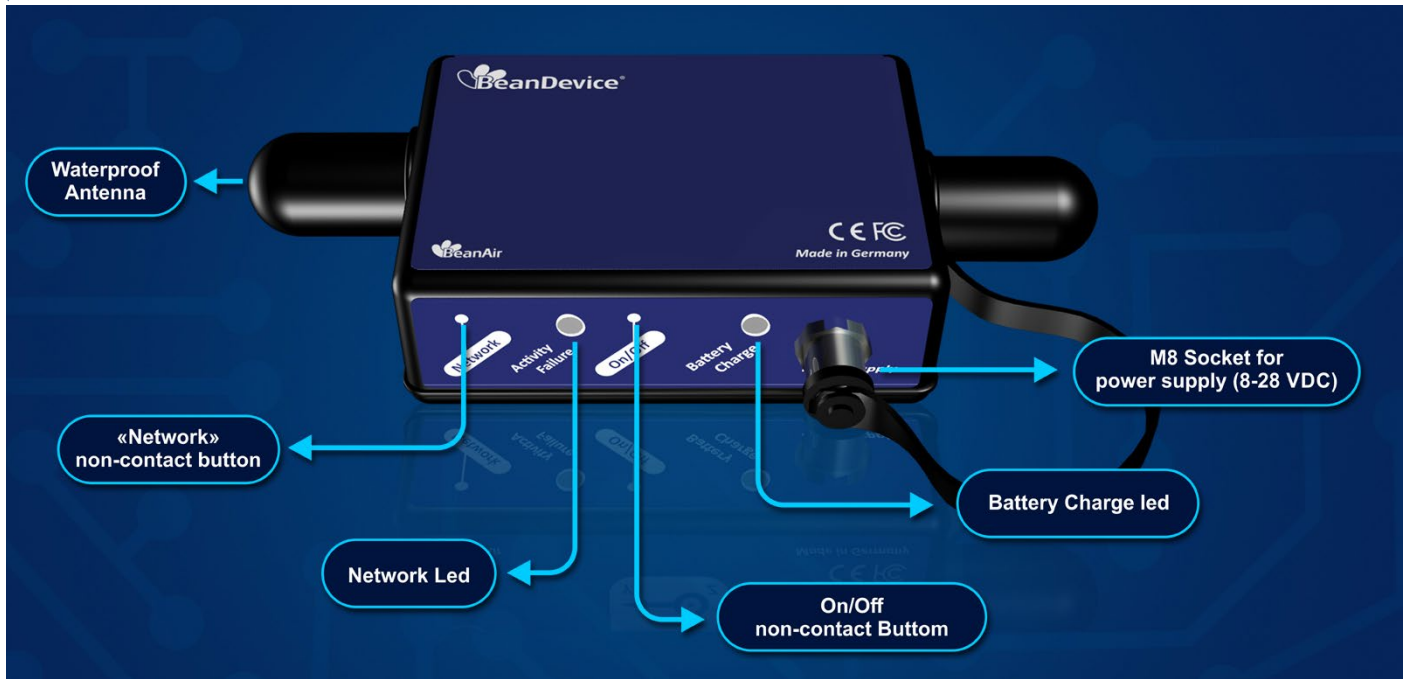
The **BeanDevice® HI-INC** operates only on our Wireless Sensor Networks, you will need the **BeanGateway®** and the **BeanScope®** for starting a wireless sensor Network.

The diagram illustrates the required hardware for a wireless sensor network. It features the BeanAir logo at the top left. The central components are the BeanDevice Hi-Inc sensor unit, the BeanGateway (available in Indoor and Outdoor versions), and the BeanScope software running on a laptop. A plus sign (+) indicates that the sensor and gateway are needed together, and another plus sign (+) indicates that the gateway and scope are needed together. The word "OR" is placed between the indoor and outdoor gateway options. At the bottom left, there is a "2year Warranty" logo. At the top right, the OPC FOUNDATION logo is shown with the note: "**OPC server is only available on the BeanScope® Premium**".



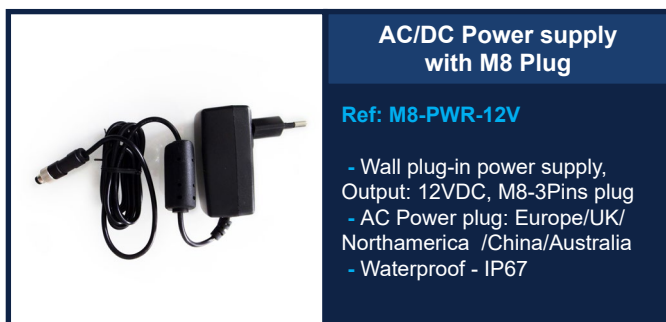
For further information about BeanDevice® battery life :
 TN-RF-002 Current consumption in active & sleeping mode
 TN-RF-012 Beandevide autonomy in Streaming and Streaming Packet Mode

Beandevic® Hi-Inc Front View



Product specifications are subject to change without notice. Contact Beanair for latest specifications.

Options and Accessories



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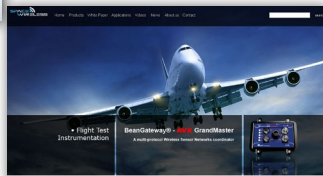
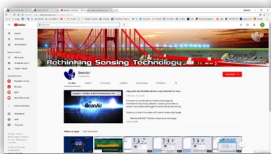
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