

BeanDevice® WILOW® HI-INC

ULP (ULTRA-LOW-POWER) WIRELESS IOT INCLINOMETER

PRODUCT VIDEO



USER GUIDE



QUICK START



MECHANICAL DRAWING



STEP FILE



MQTT TOOLKIT FOR IOT  
SENSOR



2 year  
Warranty

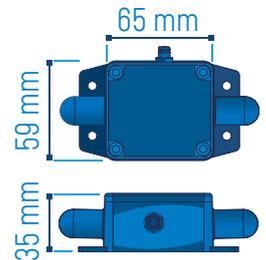
MADE IN GERMANY



001A-08148



220g



MAIN FEATURES

- ULP (Ultra Low Power) Wifi technology
- High precision bi-axis inclinometer  $\pm 15^\circ$  or  $\pm 30^\circ$  with great measurement repeatability ( $\pm 0.003^\circ$  on full Scale for  $\pm 15B$  version)
- Embedded data logger: up to 5 million data points (with events dating)
- Waterproof (IP67/NEMA 6) and Rugged aluminum casing,
- Over the Air Firmware upgrade via WIFI
- Store and Forward+: lossless data transmission
- Excellent radio link relying on the radio antenna diversity designed by Beanair®
- IIOT Ready: integrates MQTT data exchange, an open-source Internet of Things (IOT) protocol
- USB 2.0 link for device configuration (including firmware upgrade)
- Smart and Flexible power supply :
  - Internal Rechargeable Lithium Battery (780 mAh)
  - External 5VDC power supply compatible with both USB power and solar energy harvesting

APPLICATIONS



Land Surveying

Test and Measurement



Structural Health Monitoring

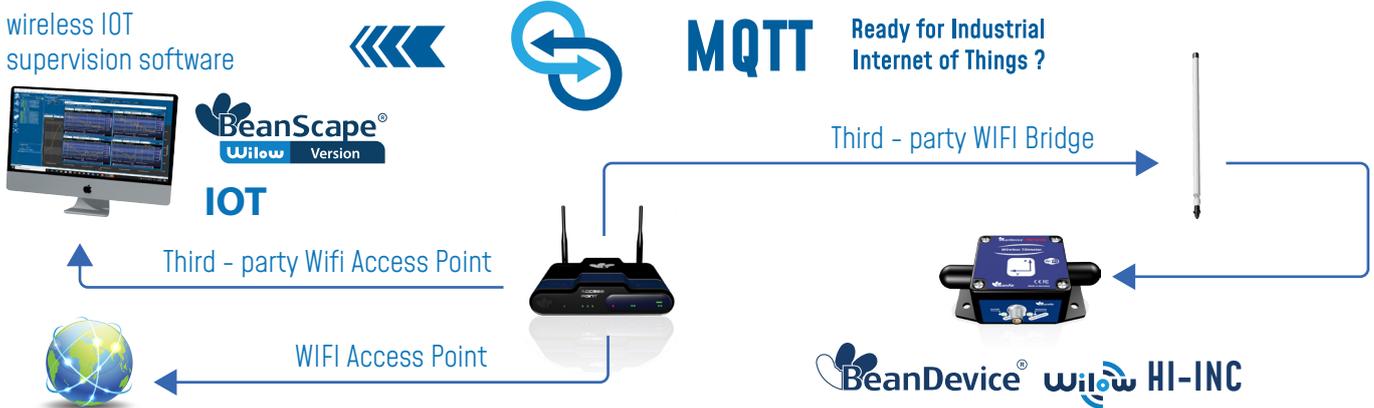
AN OPEN-STANDARD & INDUSTRIAL WIFI TECHNOLOGY

- ULP (Ultra Low power) Wifi – IEEE 802.11 b/g/n
- Lower total cost of ownership-works with existing access points
- Large installed base and consequent broad-based familiarity with configuration, use and troubleshooting at the physical and link layers
- Easy provisioning & IT friendly : our ULP wifi sensors use IP-over-Ethernet networking environment



**BeanDevice® WILLOW® HI-INC**

**MQTT | OPEN-STANDARD INTERNET OF THINGS PROTOCOL.**



**EHR-AUXILIARY POWER SUPPLY COMPATIBLE WITH SOLAR ENERGY HARVESTING 8-24VDC**



**A RELIABLE WIFI TECHNOLOGY THANKS TO OUR "STORE AND FORWARD+" FUNCTION**



The store and forward technique works by storing the message transmitted by the **BeanDevice® Willow HI-INC** to a Wifi access point/ Wifi receiver. If the message is not received due to a network disruption, it will be retransmitted on the next transmission cycle. This technique allows to bring a lossless data transmission.

User can also enable the Hard real-time option; i.e. the message must be received by the Wifi Access Point/Wifi Receiver within the confines of a stringent deadline. It is automatically deleted if it failed to reach its destination within the allotted time span.

**TECHNICAL SPECIFICATIONS**

**PRODUCT REFERENCE**

**BND-WILOW-HI-INC -MR-MO-EXPWR-HG**

MR - Measurement Range:	MO - Mounting option	EXPWR - Auxiliary External Power supply	-HG - High Gain External Antenna 5dBi
15B : bi-axis ±15°	BR - 90° Mounting bracket	EHR - Power supply compatible with solar energy harvesting 8-24VDC	If this field is left blank, Integrated Radome Antenna will be provided
30B : bi-axis ±30°	M - Magnetic Mounting		

**Example 1: BND-WILOW-HI-INC-15B-BR**

- ULP WIFI bi-axis inclinometer (measurement range ±15°) with 90° bracket mounting, Radome Antenna

**Example 2: BND-WILOW-HI-INC-30B-M**

- ULP WIFI bi-axis inclinometer (measurement range ±30°) with magnetic mounting

**Example 3: BND-WILOW-HI-INC-15B-EHR-HG**

- ULP WIFI bi-axis inclinometer (measurement range ±15°), with auxiliary external Power supply compatible with Energy Harvesting 8-24VDC, High Gain Antenna 5dBi

**INCLINOMETER SENSOR SPECIFICATIONS**

Inclinometer Technology	Inclinometer based on MEMS Technology
Measurement resolution (Bandwidth 10 Hz)	0.001° or 0.0174 mm/m or 3.6 arc seconds
Measurement Repeatbility (Full scale, @25°C, Static Measurement mode : LowDutyCycle or Alarm mode)	±15B Version: ±0.003° or ±0.052 mm/m or ±10.8 arc seconds ±30B Version: ±0.004° or ±0.070 mm/m or ±14.4 arc seconds
Noise spectral density DC to 100 Hz	0.0004 °/√Hz
Offset temperature dependency (temperature range -25°C to +85°C)	±0.002 °/°C
Sensitivity temperature dependency (temperature range -25°C to +85°C)	±0.005 %/°C with temperature compensation
Long term stability (@23°C)	< 0.004 °
Analog to Digital converter	24-bit delta-sigma with temperature compensation Synhchronuous measurement channel. Data are transmitted in 12-bits format for better network management
Sensor frequency Response (-3dB)	DC to 28 Hz
Calibration	Factory calibrated 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.

## TECHNICAL SPECIFICATIONS

### REMOTE CONFIGURATION PARAMETERS

Data Acquisition mode (SPS = sample per second)	<ul style="list-style-type: none"> <li>• Low Duty Cycle Data Acquisition (LDCDA) Mode: 1s to 24 hour</li> <li>• Alarm -Low duty cycle: 1s to 24 hour</li> <li>• Streaming mode : 100 SPS by default</li> <li>• Streaming with event-trigger (SET) Mode : 100 SPS by default</li> </ul>
Sampling Rate (in streaming packet mode)	Minimum: 1 SPS Maximum: 2 KSPS per axis
Alarm Threshold	High and Low Levels alarms
Power Mode	Battery Saver & Active power modes

### RF SPECIFICATIONS

Wireless Protocol Stack	IEEE 802.11 b/g/n
WSN Topology	Point-to-Point / Star / Cluster-Tree
Crypto Engine	WPA2, WPS2
Data rate	UDP: 16 Mbps TCP: 13 Mbps
RF Characteristics	ISM 2.4GHz. Antenna diversity designed by Beanair®
TX Power	18 dBm @ 1 DSSS 14.5 dBm @ 54 OFDM
Rx Sensitivity	-95.7 dBm @1 DSSS -74.0 dBm @54 OFDM
Maximum Radio Range	With High Gain Antenna : 100-200m (L.O.S), 40-80m (N.L.O.S.) With Integarted Radome Antenna : 50-100m (L.O.S), 20-50m (N.L.O.S.) In both case Radio Range can be extended by adding Wifi Bridge/Repeater"
Antenna	Antenna diversity : High Gain Antenna : 2 x N-Type Antenna 5dBi Radome Antenna : 2 x Antenna 2,2 dBi
OTA	Over the air firmware upgrade via WIFI

### EMBEDDED DATA LOGGER

Storage Capacity	1 million data logs per sensor channel (streaming mode)
Wireless data downloading	2 minutes to download the full memory (average time)

**TECHNICAL SPECIFICATIONS**

**ENVIRONMENTAL AND MECHANICAL**

Casing	Aluminum casing Dimensions in mm (LxWxH):35x59x65 mm without antenna & eyelet, Weight (with internal battery, w/o mounting option) : 220g
IP   NEMA Rating	IP67   Nema 6
Shock resistance	100g during 50 ms
Operating Temperature	-40 °C to +65 °C
Norms & Radio Certifications	<ul style="list-style-type: none"> <li>• CE Labelling Directive R&amp;TTE (Radio) ETSI EN 300 328(Europe)</li> <li>• FCC (North America)</li> <li>• ARIB STD-T66 Ver. 3.6 (Japan)</li> <li>• ROHS - Directive 2002/95/EC</li> </ul>

**POWER SUPPLY**

Rechargeable battery	High density Lithium-Ion rechargeable battery with a capacity of 900 mAh
Integrated battery charger	Integrated Lithium-ion battery charger with high precision battery monitoring
Battery Life	see Battery life table herefater and battery life simulation toolkit available on our website
External power supply	<ul style="list-style-type: none"> <li>• USB Power supply 5V</li> <li>• Optional auxiliary external Power Supply: 8VDC to 24VDC compatible with solar energy harvesting</li> </ul>

**INCLUDED ACCESSORIES**

M8 plastic cap	1pcs, <a href="#">Ref: WL-PC</a>
M8 to USB cable	1pcs M8-6pins to USB Cable, 2 meters length. <a href="#">Ref : WL-CBL-M8-6P-USB-2M</a>
Magnet for power on/power off	1pcs Magnet. <a href="#">Ref: WL-MGN</a>
Wall mounting kit	4 pcs M5 screws + Locknut. <a href="#">Ref : WL-SCMKIT</a>

**OPTIONS (NOT INCLUDED)**

Power-supply	Wall plug-in, Switchmode power Supply 12V @ 1.25A with USB plug <a href="#">Ref: WL-USB-5V-PWR</a>
M8 Cable	M8-6Pins Cable , cable length : - 2 meters. <a href="#">Ref: WL-CBL-M8-6P-2M</a> - 5 meters. <a href="#">Ref: WL-CBL-M8-6P-5M</a>
WIFI AP/Repeater (wifi link extension)	Wireless AP/Repeater with an integrated N-Type RF connector + High Gain Antenna Casing : Polycarbonate Waterproof casing Dimensions: 190 x 46 mm Weight: 196 g Antenna Connector: N-Type Connector (male) Power Supply: 24V, 0.5A PoE Adapter (included) Power Method: Passive Power over Ethernet Max. Power Consumption: 6 Watts Operating Temperature: -40 to 80° C Shock and Vibration: ETSI300-019-1.4 <a href="#">Ref: WL-AP-UBIQ-TIT-7DBI</a> for 7dBi Antenna <a href="#">Ref: WL-AP-UBIQ-TIT-9DBI</a> for 9dBi Antenna
Solar Panel	Polycrystalline Solar Panel for BeanDevice® Wilow® power supply Maximum Power : 3W Optimum operating Voltage: 12 VDC Dimension: 235 mm x 135 mm x 17mm Protection Frame: Aluminum Frame , Waterproof IP67 Length : 2 meters ( <a href="#">Ref: WL-SLP-3W-2M</a> ) or 5 meters ( <a href="#">Ref: WL-SLP-3W-5M</a> ) with M8 plug for a direct to connection to the BeanDevice® Wilow® Country of origin: solar panel from China, assembled and tested in Germany
Calibration certificate	Calibration certificate provided by Beanair GmbH A static calibration method is used on a granite surface plate DIN876 ( <a href="#">Ref: WL-CERT-CAL</a> )

Solar Panel	Polycrystalline Solar Panel for BeanDevice® Wilow® power supply Maximum Power : 5W , Optimum operating Voltage: 12 VDC Protection Frame: Aluminum Frame , Waterproof IP67 The 3W solar panel works only with LowDutyCycle & Survey/Alarm data acquisition with battery saver mode enabled The 5W solar panel works only with LowDutyCycle, Survey/Alarm & streaming burst data acquisition with battery saver mode enabled Country of origin: solar panel from China, assembled and tested in Germany <a href="#">REF: WL-SLP-5W-2M</a> ,5W Solar panel with 2 meters of cable length <a href="#">REF: WL-SLP-5W-5M</a> ,5W Solar panel with 5 meters of cable length
Calibration certificate	Calibration certificate provided by Beanair GmbH A static calibration method is used on a granite surface plate DIN876 <a href="#">Ref: WL-CERT-CAL</a>

**Conditions: Battery saver mode enabled , Temperature 25degC, BeanDevice listening to new config every 18h**

Battery Saver mode Enabled, Measurement Cycle every minute  
 Battery Saver mode Enabled, Measurement Cycle every 5 minutes  
 Battery Saver mode Enabled, Measurement Cycle every hour

**Battery Life with Slow Measurement Rate (LDCDA) Internal LiPO Battery**

32 days  
 66 days  
 87 days

**Conditions: Battery saver mode enabled , Temperature 25degC, BeanDevice listening to new config every 18h**

Battery Saver mode Enabled, Measurement Cycle 20s to 1 measurement per day

**Battery Life with Slow Measurement Rate (LDCDA) External 5W Solar Panel (REF: WL-SLP-5W-2M) EHR Option**

>= 3 years (depends on battery cycle life)

**Conditions: Battery saver mode enabled Temperature 25degC**

Wakes up every 2 hours, Sample at 200Hz during 20s  
 Wakes up every 1 hour, Sample at 500Hz during 20s  
 Wakes up every 20 minutes, Sample at 200Hz during 20s

**Battery Life with Fast Measurement Rate (Streaming Burst)- Internal Battery**

50 days  
 33 days  
 15 days

**Conditions: Battery saver mode enabled Temperature 25degC**

All timing combinatios related to streaming burst option

**Battery Life with Fast Measurement Rate (Streaming Burst)- with X-SOLAR-7AH or X-SOLAR-14AH**

>= 3 years (depends on battery cycle life)

**Conditions: 25degC**

Sampling Rate 2000Hz  
 Sampling Rate 1000Hz  
 Sampling Rate 100Hz

**Battery Life with Fast Measurement Rate (Continuous Streaming)- Internal Battery**

11hours 7 minutes  
 12hours 32 minutes  
 16hours 28 minutes

**Conditions: 25degC**

Sampling Rate 10Hz to 2000Hz

**Internal Battery Life with Fast Measurement Rate (Continuous Streaming)-with X-SOLAR-7AH or X-SOLAR-14AH**

>= 3 years (depends on battery cycle life)

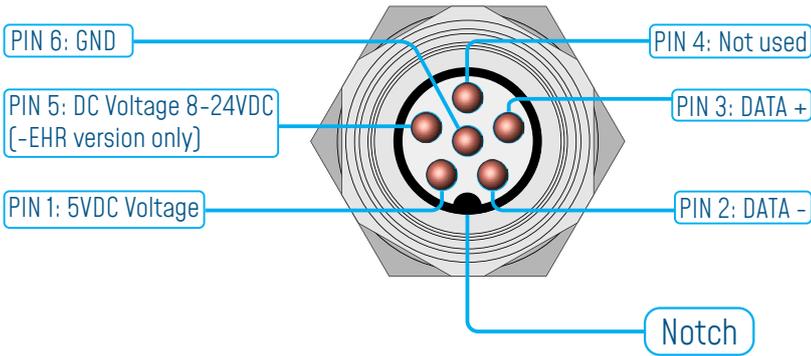
**BeanDevice® WILOW® HI-INC**

**BEANDEVICE® WILOW® FRONT VIEW**



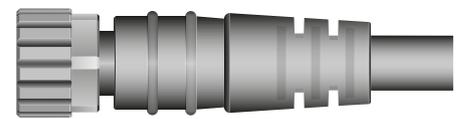
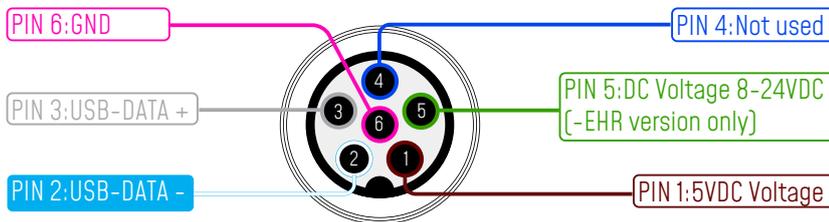
**EXTERNAL POWER SUPPLY WIRING CODE**

**M8-6Pins socket [ Male, A-Coding] - PIN ASSIGNATION**



Interface Name	M8 Pin assignment
5VDC Voltage	PIN 1
DATA -	PIN 2
DATA +	PIN 3
Not used	PIN 4
DC Voltage 8-24VDC [-EHR version only]	PIN 5
GND	PIN 6

**M8-6Pins Plug [ Female, A-Coding] - PIN ASSIGNATION**



M8-6Pins Plug

Interface Name	5VDC Voltage	USB DATA -	USB DATA +	Not used	DC Voltage 8-24VDC [-EHR version only]	GND
M8 Pin assignment	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>

**BeanDevice® WILOW® HI-INC**

**MECHANICAL MOUNTING OPTIONS**

By default, the [BeanDevice® Wilow®](#) comes with a screw mounting lid.

Two other mounting options are available:

- Magnetic mounting , add the extension -M on your product reference
- 90° bracket, add the extension -BR on your product reference

Mechanical Mounting Options Video



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