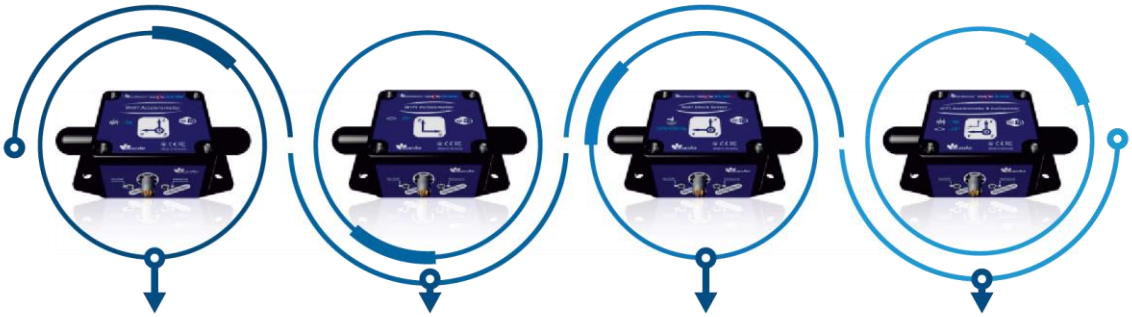
***Version 3.6.2***

BeanAir
WIRELESS IIOT SENSORS

# USER MANUAL BeanDevice® Wilow®

BeanDevice® Wilow



**Wilow® AX-3D**
WIFI VIBRATION SENSOR
±2G & ±10G

**Wilow® Hi-Inc**
WIFI INCLINOMETER
±15° OR ±30°

**Wilow® AX-3DS**
WIFI SHOCK SENSOR
±2/4/8/16G

**Wilow® X-Inc**
WIFI COMBO SENSORS
VIBRATION, INCLINATION
AND SHOCK MONITORING
±15°/30° . ±2G/10G

| DOCUMENT | | | |
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| VALIDATION | | | |
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| **Function** | **Destination** | **For validation** | **For info** |
| **Writer** | Fahd ESSID | ✓ | |
| **Reader** | Farouk Bouali | ✓ | |
| **Validation** | Antje Jacob | | ✓ |

| DIFFUSION | | | |
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| **Function** | **Destination** | **For action** | **For info** |
| **Reader n°1** | Antje Jacob, Production Manager | ✓ | |
| **Reader n°2** | Fahd Essid, Application Engineer | ✓ | |

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|---|---|---|---|
| **Version** | **Date** | **Auteur** | **Evolution & Status** |
| 1.0 | 12/10/2016 | Mootaz Amouri | • First version of the document |
| 1.1 | 21/05/2017 | Mohamed-Yosri Jaouadi | • Info about datalogger added |
| 1.2 | 08/06/2017 | Aymen jegham | • SNTP description<br>• MQTT description<br>• Log file |
| 1.3 | 17/07/2017 | Aymen jegham | • Power Mode management |
| 1.4 | 09/08/2017 | Aymen jegham | • SMTP<br>• FFT<br>• Store & Forward+ |
| 1.5 | 04/09/2017 | Aymen jegham | • Stand Alone option |
| 1.6 | 08/07/2018 | Youssef Shahine | • More descriptions added about FFT |

| UPDATES | | | |
|---|---|---|---|
| 1.7 | 23/07/2018 | Aymen jegham | • Information about BeanDevice® X-INC added<br>• Appendix 1: DAQ mode deleted<br>• Online and offline data analysis tool added |
| 1.8 | 15/10/2018 | Fahd Essid | • LEDS Description updated<br>• Troubleshooting update |
| 1.9 | 14/12/2018 | Youssef Shahine | • New Wiring code update (M8-6Pins specified) |
| 2.0 | 18/02/2019 | Fahd Essid | • Vocabulary update<br>• Commissioning mode deleted<br>• Offline & Online Data analyses updated<br>• SNTP information updated<br>• Alarm management updated<br>• Right-click functionality added<br>• Network configuration updated<br>• Graphical display added<br>• Sensor channel configuration updated<br>• Last will testament deleted<br>• Subscribe/Clear session deleted<br>• Screenshots updates |
| 2.0.1 | 29/04/2019 | Mohamed Bechir Besbes | • Weblinks update |
| 2.0.2 | 16/05/2019 | Mohamed Bechir Besbes | • Power Supply description update |
| 2.1 | 13/06/2019 | Fahd Essid | • Vocabulary update<br>• Online Data analysis updated<br>• Real Time FFT/Velocity updated<br>• WiFi RF Region update<br>• Shock Sensor specification update |
| 2.2 | 27/06/2019 | Fahd Essid | • Offline Data Analysis updated |
| 2.3 | 19/09/2019 | Bassem YAHYA | • Time out error during configuration description<br>• the Data acquisition duration section update |
| 2.3.1 | 02/10/2019 | Bassem YAHYA | • Alarm and alert order update |
| 2.3.2 | 08/10/2019 | Bassem YAHYA | • IIR Filters further notes |
| 2.4 | 23/10/2019 | Bassem YAHYA | • Math result feature<br>• Configuring the sensor wirelessly (AP mode) |
| 2.5 | 11.11.2019 | Shimon Abadi | • Wiring code updated (M8 Plug and Socket) |

| UPDATES | | | |
|---|---|---|---|
| 2.6 | 21/02/2020 | Seddik ATTIG | • Display more info about the Gmail and Hotmail emails configuration |
| 2.7 | 30/03/2020 | Seddik ATTIG | • Software filters<br>• SSL/TLS Configuration over MQTT<br>• Screenshot's update |
| 2.8 | 02/04/2020 | Seddik ATTIG | • Alarm Management<br>• Notification Management<br>• Power management |
| 2.9 | 03/04/2020 | Seddik ATTIG | • Online/Offline Data Analysis |
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| 3.1 | 20/04/2020 | Seddik ATTIG | • Videos links update |
| 3.2 | 29/06/2020 | Seddik ATTIG | • PPV Restrictions |
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| 3.5 | 19/08/2021 | Seddik ATTIG | • Advanced Calibration process |
| 3.6 | 02/09/2021 | Seddik ATTIG | • Virtual Tilt Calibration & features |
| 3.6.1 | 27/09/2021 | Seddik ATTIG | • Update the advanced calibration section<br>• Add import option to the calibration section |
| 3.6.2 | 12/11/2021 | Seddik ATTIG | • Links updated |

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Such changes will, nevertheless be incorporated into new editions of this document.

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# 1. TECHNICAL SUPPORT

For general contact, technical support, to report documentation errors and to order manuals, contact ***Beanair Technical Support Center*** (BTSC) at:

tech-support@Beanair.com

For detailed information about where you can buy the Beanair equipment/software or for recommendations on accessories and components visit:

www.Beanair.com

To register for product news and announcements or for product questions contact Beanair's Technical Support Center (BTSC).

Our aim is to make this user manual as helpful as possible. Keep us informed of your comments and suggestions for improvements.
Beanair appreciates feedback from the users of our information.

## 2. VISUAL SYMBOLS DEFINITION

| *Symbols* | *Definition* |
|---|---|
|  | ***Caution or Warning** – Alerts the user with important information about Beanair wireless sensor networks (WSN), if this information is not followed, the equipment /software may fail or malfunction.* |
|  | ***Danger** – This information MUST be followed if not you may damage the equipment permanently or bodily injury may occur.* |
|  | ***Tip or Information** – Provides advice and suggestions that may be useful when installing Beanair Wireless Sensor Networks.* |

# 3. ACRONYMS AND ABBREVIATIONS

| | |
|---|---|
| ***AES*** | Advanced Encryption Standard |
| ***CCA*** | Clear Channel Assessment |
| ***CSMA/CA*** | Carrier Sense Multiple Access/Collision Avoidance |
| ***GTS*** | Guaranteed Time-Slot |
| ***Ksps*** | Kilo samples per second |
| ***LLC*** | Logical Link Control |
| ***LQI*** | Link quality indicator |
| ***LDCDA*** | Low duty cycle data acquisition |
| ***MAC*** | Media Access Control |
| ***PAN*** | Personal Area Network |
| ***PER*** | Packet error rate |
| ***RF*** | Radio Frequency |
| ***SD*** | Secure Digital |
| ***WSN*** | Wireless sensor Network |

## 4. DOCUMENT ORGANISATION

| | |
|---|---|
| BeanDevice® WiLow® product description | • Details the BeanDevice® WiLow® product presentation |
| Connection to your WIFI Network | • Details the data acquisition mode available on the BeanDevice® WiLow® |
| Supervision from the Beanscape® | • Details the BeanDevice® Wilow® supervision from the BeanScape® |
| Log file and folder organization | • Decsribes log file and folder organziation on your PC |
| MQTT configuration | • MQTT publisher configuration on your BeanDevice® Wilow® |
| Offline data analysis Tool | • Descibes offline data analysis tool, only available on BeanDevice® Wilow® AX-3D |
| SNTP Client | • Simple net time protocol configuration |

# 5. BEANDEVICE® WILOW® PRODUCT LINE DESCRIPTION

- ✓ ***It is highly recommended to read all the user manual related to Beanair software & equipment (BeanScape® and BeanDevice® Wilow®) before getting start your BeanDevice® Wilow®.***
- ✓ ***Use only accessories supplied by Beanair (batteries, power supply unit, and antenna). Use of other materials may damage the BeanDevice® Wilow®;***
- ✓ ***Only Beanair is qualified to make changes on the BeanDevice® WiLow®;***
- ✓ ***Don't try to remove the adhesive label on the product; it contains important information such as the MAC address or sensor measurement range***

## 5.1 ABOUT WILOW® PRODUCT LINE

WiLow® product line is designed for Structural Health monitoring (SHM), Condition Maintenance Monitoring (CMS) and Test and Measurement.

It comes with different types of sensor for dynamic measurements:

- ***BeanDevice® WiLow® AX-3D***: WIFI Ultra Low Power accelerometer for vibration measurement
- ***BeanDevice® WiLow® HI-INC***: WIFI Ultra Low Power inclinometer for tilt/slope measurement
- ***BeanDevice® WiLow® AX-3DS***: WIFI Ultra Low Power shock sensor for shock monitoring
- ***BeanDevice® WiLow® X-INC***: WIFI Ultra Low Power combo sensors (accelerometer, inclinometer and shock)

### 5.1.1 BeanDevice® WiLow AX-3D (WIFI Low Power accelerometer)

#### 5.1.1.1 Main Features

Integrating the latest ULP (Ultra Low Power) Wi-Fi technology, the BeanDevice® WiLow AX-3D comes with outstanding features:

- ULP (Ultra Low Power) Wi-Fi Triaxial accelerometer based on MEMS Technology
- Open standard Wi-Fi technology – IEEE 802.11 b/g/n (2.4 GHz frequency band)
- Maximum Radio Range: 200 m (L.O.S)
- Excellent radio link budget thanks to our antenna diversity innovative design
- Measurement range: ±2g or ±10g
- Very Low Noise density: 45 µg/√Hz (±2g version), 100 µg/√Hz (±10g version)
- Maximum sampling rate: 2 KSPS per axis
- 24-bit delta-sigma analog-to-digital with synchronous measurement channel and temperature compensation
- Non-contact actuation for faster and safer installation
- Embedded Data Logger: up to 5 million data points (with events dating)
- Integrated lithium-polymer rechargeable battery with industrial battery charger (USB-5V and 4.8-17.8VDC)
- Waterproof (IP67 | Nema 6) aluminum casing (dimensions Lxlxh: TBD, weight:TBD)
- USB 2.0 for device configuration and 5V power supply
- Automatic report meeting the DIN4150-3 standard (Excel, PDF and Word) with FFT, PPV and Velocity values
- Store and Forward+: Lossless data transmission with hard real-time

#### 5.1.1.2 Applications

- ✓ Structural health monitoring
- ✓ Vibration analysis
- ✓ Inertial measurement
- ✓ Movement and Shock detection
- ✓ Test and Measurement

### 5.1.2 BeanDevice® WiLow® HI-INC (Wi-Fi Low Power Inclinometer)

#### 5.1.2.1 Main features

Integrating the latest ULP (Ultra Low Power) Wi-Fi technology, the BeanDevice® WiLow® HI-INC comes with outstanding features:

- ULP (Ultra Low Power) Inclinometer based on MEMS Technology
- Open standard Wi-Fi technology – IEEE 802.11 b/g/n (2.4 GHz frequency band)
- Maximum Radio Range: 200 m (L.O.S)
- Excellent radio link budget thanks to our antenna diversity innovative design
- Measurement range: ±15° or ±30° bi-axis
- MEMS Inclinometer with a high resolution 0.001° and a very high accuracy (±0.003° for ±15° version)
- Maximum sampling rate: 100 SPS per axis
- 24-bit delta-sigma analog-to-digital with synchronous measurement channel and temperature compensation
- Non-contact actuation for faster and safer installation
- Current consumption in sleep mode: 60 µA
- Embedded Data Logger: up to 5 million data points (with events dating)
- Integrated lithium-polymer rechargeable battery with industrial battery charger (USB-5V and 4.8-17.8VDC)
- Waterproof (IP67 | Nema 6) aluminum casing (LxWxh: 65x59x35mm, 220g)
- USB 2.0 for device configuration and 5V power supply
- Store and Forward+: Lossless data transmission with hard real-time

#### 5.1.2.2 Applications

- ✓ Structural Health Monitoring
- ✓ Crane Monitoring
- ✓ Rail sleepers monitoring
- ✓ Test and measurement

### 5.1.3 BeanDevice® WiLow® AX-3DS (Wi-Fi Low Power Wireless shock sensor)

#### 5.1.3.1 Main features

Integrating the latest ULP (Ultra Low Power) Wi-Fi technology, the BeanDevice® WiLow® AX-3DS comes with outstanding features:

- ULP (Ultra Low Power) Wi-Fi accelerometer sensor dedicated to shock detection with built-in data logger
- Open standard Wi-Fi technology – IEEE 802.11 b/g/n (2.4 Ghz frequency band)
- Maximum Radio Range: 200 m (L.O.S)
- Excellent radio link budget thanks to our antenna diversity innovative design
- Scalable measurement range: ± 2/4/8/16g
- Maximum sampling rate: 1.6 KSPS per axis
- Very Low Noise density: 150 µg/√Hz
- Non-contact actuation for faster and safer installation
- Current consumption in sleep mode: 120 uA
- Embedded Data Logger: up to 5 million data points (with events dating)
- Integrated lithium-polymer rechargeable battery with industrial battery charger (USB-5V and 4.8-1VDC)
- Waterproof (IP67 | Nema 6) aluminum casing (dimensions Lxlxh: 59x65x35)
- USB 2.0 for device configuration and 5V power supply

#### 5.1.3.2 Applications

- ✓ Health and usage monitoring systems (HUMS)
- ✓ Shock measurement on vehicles & trains
- ✓ Transportation Monitoring
- ✓ Drop testing
- ✓ Crash and impact testing
- ✓ Ride Quality Measurement

### 5.1.4 BeanDevice® WiLow® X-INC (Wi-Fi Low Power combo sensors: accelerometer, inclinometer and shock sensor)

#### 5.1.4.1 Main features

Integrating the latest ULP (Ultra Low Power) Wi-Fi technology, the BeanDevice® WiLow® X-INC comes with outstanding features:

- ULP (Ultra Low Power) Wi-Fi accelerometer sensor dedicated to shock detection with built-in data logger
- Open standard Wi-Fi technology – IEEE 802.11 b/g/n (2.4 GHz frequency band)
- Maximum Radio Range: 200 m (L.O.S)
- Excellent radio link budget thanks to our antenna diversity innovative design
- Maximum sampling rate: 2 KSPS per axis (acceleration)
- Very Low Noise density: 45µg/√Hz(acceleration)
- Non-contact actuation for faster and safer installation
- Current consumption in sleep mode: <100 ua
- Embedded Data Logger: up to 5 million data points (with events dating)
- Integrated lithium-polymer rechargeable battery with industrial battery charger (USB-5V and 4.8-1VDC)
- Waterproof (IP67 | Nema 6) aluminum casing (dimensions Lxlxh: 59x65x35)
- USB 2.0 for device configuration and 5V power supply

## 5.2 ACCESSORIES DESCRIPTION

In addition to the BeanDevice® WiLow® you will find inside the packet a list of accessories.

- ✓ *USB to M8-5pin cable adapter*
- ✓ *Magnet*
- ✓ *4 screws + Locknut*
- ✓ *Plastic cap*


### 5.2.1 USB to M8 Cable

The cable contains on the first side a M8-5 Pins standard plug that is used for connecting the USB cable to the BeanDevice® Wilow® and on the second side a USB connector to be inserted on the PC.

*Figure 1 : M8 to USB cable (2 meters Length)*

- ✓ *USB power supply*
- ✓ *USB data link*
- ✓ *2 meters of length*

USB interface is dedicated to:

- Firmware update
- Power supply the BeanDevice® through the USB power line (+5VDC)

**M8 to USB cable is provided with your BeanDevice® WiLow®:**

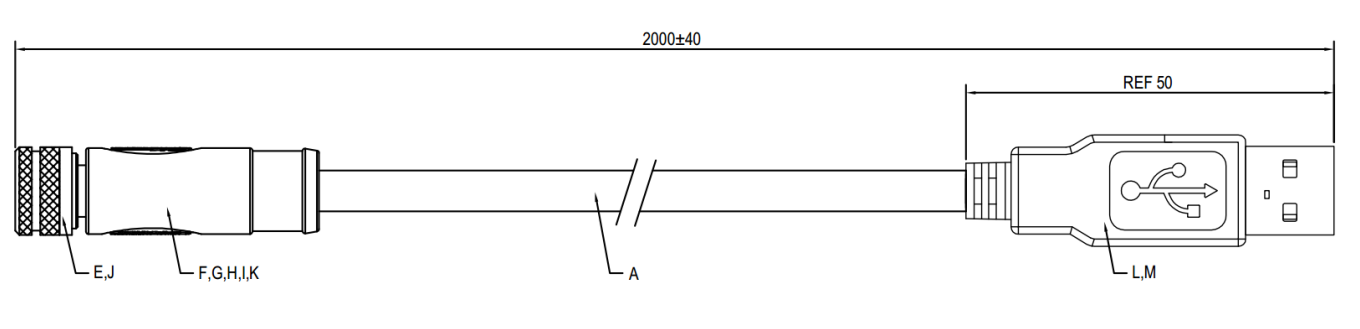



*Figure 2: M8 to USB Cable*

### 5.2.2 Magnet (for Power ON/Power OFF and Network operation)

A magnet is used to command the BeanDevice® WiLow®:

- Power ON / Power Off the BeanDevice®
- Perform a network reset

All what you have to do is to hold the magnet close to one of the two white circles as shown on the next picture:


*Figure 3 : Power ON/Power off and Network positions*

### 5.2.3 Screws and Locknut

Inside the packet, you have to find 4 screws and 4 locknuts that you can use to mount the BeanDevice® WiLow® on your structure.

*Figure 4: Screws and Locknut*

## 5.3 TECHNICAL SPECIFICATIONS

### 5.3.1 BeanDevice® WiLow®: AX-3D Sensor Characteristics

#### 5.3.1.1 Accelerometer sensor specifications

| Main accelerometer specifications | |
|---|---|
| **Accelerometer technology** | High precision accelerometer based on MEMS technology |
| **Measurement range** | Two versions: ±2g and ±10g |
| **Sensitivity** | ±2g Version : 660 mV/g<br>±10g version: 200 mV/g |
| **Typical non-linearity** | ±0.1% FS |
| **Analog to Digital converter** | 24-bit delta-sigma with temperature compensation<br>Synhcronuous measurement channel |
| **Sensor frequency response (-3 dB)** | DC to 800 Hz |
| **Maximum sampling rate** | 2 kSPS per axis |
| **Noise spectral density** | ±2g Version : 45 µg/√Hz<br>±10g version: 100 µg/√Hz |
| **Zero-g Offset Variation from RT over Temp** | ±2g Version : ±0.2 mg/°C<br>±10g version: ±0.1 mg/°C |
| **Sensitivity Variation from RT over Temp** | ±2g Version : ±0.01 %/°C (XY) , ±0.02 %/°C (Z)<br>±10g version: ±0.01 %/°C |
| **Offset Ratiometric Error** | ±2g Version : 4mg<br>±10g version: ±0.2% (XY) , ±0.1% (Z) |
| **Sensitivity Ratiometric Error** | ±2g Version : ±1.25 % (X-Y) , ±0.2 % (Z)<br>±10g Version : ±1.6% (X-Y) , ±0.2 % (Z) |
| **Cross Axis Sensitivity** | 0.02 |
| **Onboard temperature sensor** | Range -40°C to +65°C , accuracy ±1°C |
| **Anti-aliasing Hardware filter** | Butterworth 2th order filter |

*Table 1 : Accelerometer Sensor Specifications*

### 5.3.1.2 Sensor architecture

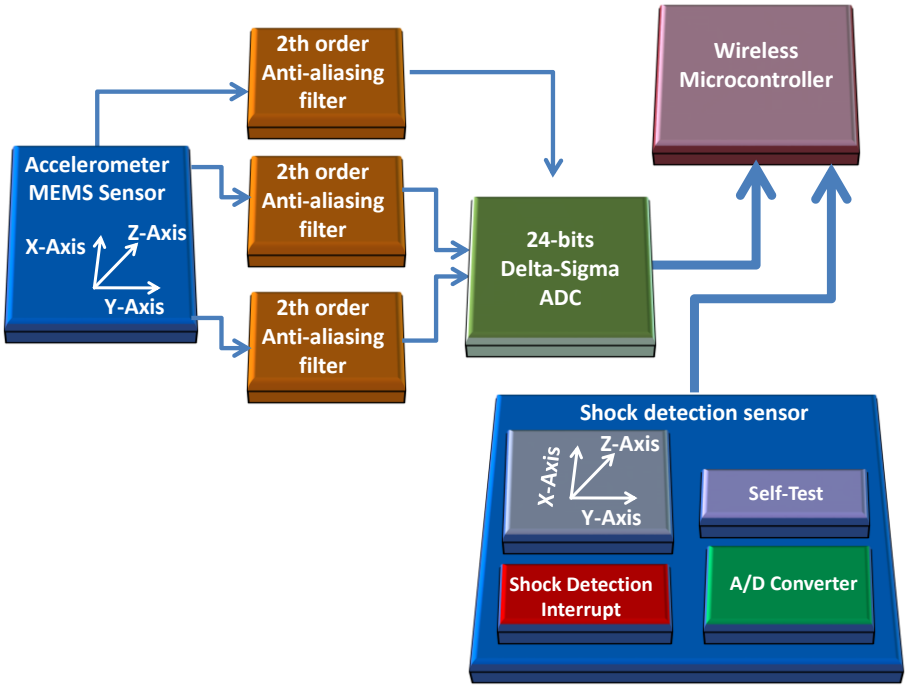



*Figure 5: Accelerometer sensor design*

***The Shock sensor is only available on the AX-3D which comes with a Hardware version 2.0***

***There is no Shock sensor on the AX-3D which comes with a Hardware version 2.1***

### 5.3.1.3 MEMS Accelerometer

The BeanDevice® WiLow® AX-3D integrates a tri-axis, silicon micromachined accelerometer with a full-scale output range of ±2g, ±10g.

Acceleration sensing is based on the principle of a differential capacitance arising from acceleration-induced motion of the sense element, which further utilizes common mode cancellation to decrease errors from process variation, temperature, and environmental stress. The sense element is hermetically sealed at the water level by bonding a second silicon lid wafer to the device using a glass frit.

### 5.3.2 BeanDevice® WiLow® HI-INC: Sensor Characteristics

#### 5.3.2.1 Inclinometer sensor specifications

| 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<br>±30B Version: ±0.004° or ±0.070 mm/m or ±14.4 arc seconds |
| Noise spectral density<br>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 analog-to-digital with temperature compensation<br>Synchronous measurement channel |
| Sensor frequency Response (-3dB) | DC to 28 Hz |

*Table 2: Inclinometer sensor specifications*

### 5.3.2.2 Sensor Architecture

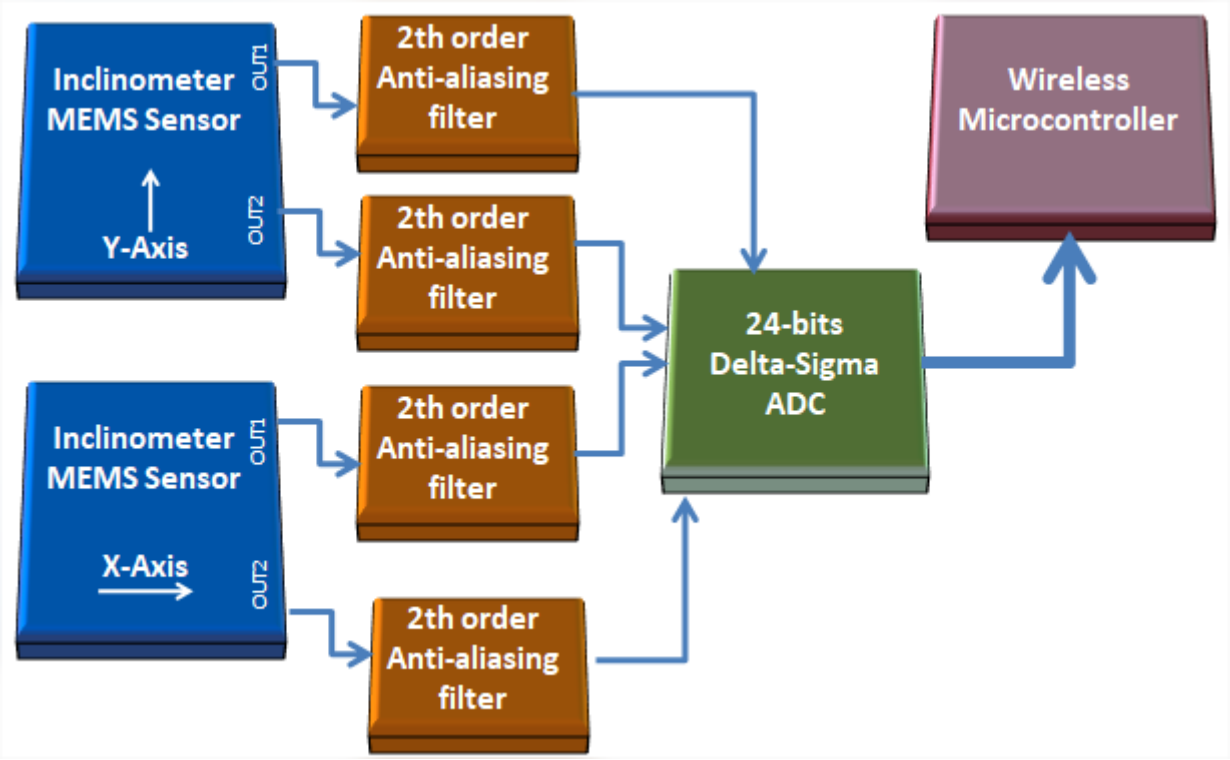



*Figure 6: BeanDevice® WILO® HI-INC - MEMS Sensor Architecture*

The BeanDevice® WiLow® HI-INC integrates a 3D-MEMS-based single axis inclinometer that uses the differential measurement principle. The high calibration accuracy combines extremely low temperature dependency, high resolution and low noise together with a robust sensing element design, to make the BeanDevice® WiLow® HI-INC an ideal choice for high accuracy leveling instruments.

The inclinometer used on the BeanDevice® WiLow® HI-INC ±15° and ±30° provides a differential output: the measuring axes of the sensing elements are mutually opposite in direction, thus providing two inclination signals which can be differentiated externally by our wireless processor.
The differential measurement principle removes all common mode measurement errors. Most of the error sources have similar effects on both sensing elements. These errors are removed from measurement result during signal differentiation. The differential measurement principle gives very efficient noise reduction, improved long term stability and extremely low temperature dependency.

### 5.3.2.3 Accuracy considerations

***Main error components are***:

- ***Zero Point Error***

  In most cases the most significant error component is the zero-point error. In the range -25 … +85°C it is ±0.057° (6δ limit) and the temperature dependence is typically ±0.002°/°C. The room temperature variation can be reduced by calibration at the instrument level and the effects of the temperature dependence dealt with by using temperature compensation.

### *Error Caused by the SIN Function:*

When used as an inclinometer, the output of the accelerometer is proportional to 1g * SIN (Phi + Phi0), where Phi is the inclination angle and Phi0 the internal mounting error. The internal mounting error is a maximum of ±2.9°, corresponding to ±50mg. This error is of importance when using large inclination angle amplitudes and is seen as an addendum to the non-linearity (Typically ±5mg in ±0.5g and ±10mg in ±1g).

### *Cross-axis Sensitivity*

The cross-axis sensitivity (4%) shows how much perpendicular acceleration or inclination is coupled to the signal.

### *Rectification of Vibration*

The effect of high frequency vibration is strongly suppressed by the over-damped sensing element (upper cut-off freq. $f_{-3dB}$ = 0 … 10Hz). In an extreme case, high amplitude vibrations (>5g) may cause a measurable zero-point shift.

#### 5.3.2.4 Offset & temperature dependencies

To achieve the best possible accuracy, an internal temperature sensor is used for sensitivity temperature dependency compensation. By using an additional 3rd order polynomial compensation curve based on average sensitivity temperature dependency curve and temperature measurement information, it is possible to reduce sensitivity temperature dependency from:

- ✓ 0.013%/°C down to 0.005%/°C for the BeanDevice® HI-INC WiLow® ±15°and ±30° versions

Typical offset and sensitivity temperature dependencies of the inclinometer sensor are presented in following diagrams. These results represent the typical performance of inclinometer sensor components. The mean value and 3 sigma limit (mean ± 3× standard deviation) and specification limits are presented in following diagrams. The 3 sigma limits represent 99.73% of the inclinometer sensor population.

***Temperature dependency of the inclinometer sensor offset (differential output)***

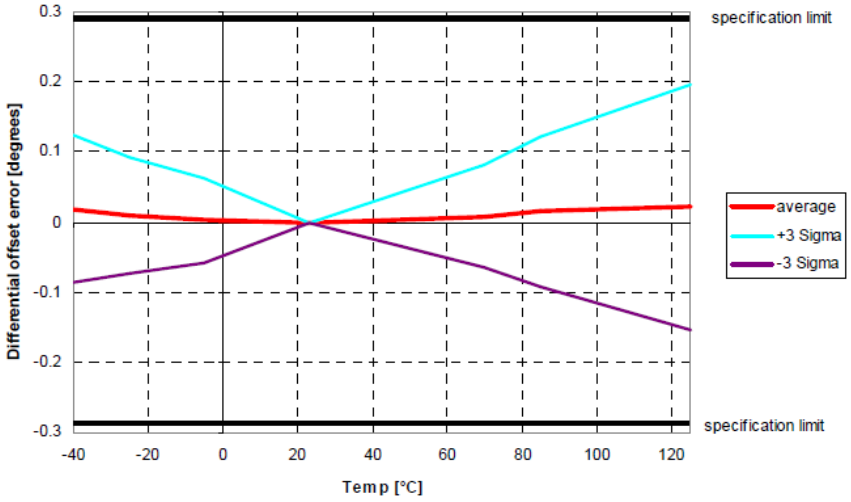



***Figure 7 : Temperature dependency of the sensor sensitivity [%] (differential output)***

### 5.3.3 BeanDevice® WiLow® AX-3DS: Sensor Characteristics

#### 5.3.3.1 Shock detection sensor specifications

| Shock sensor specifications | |
|---|---|
| Shock Sensor technology | MEMS technology |
| Shock sensor range | ±2g/±4g/±6g/±8g/±16g dynamically selectable from the BeanScape Wilow software |
| Sensitivity | ±2g range: 0.06 mg/digit<br>±4g range: 0.12 mg/digit<br>±6g range: 0.18 mg/digit<br>±8g range: 0.24 mg/digit<br>±16g range: 0.48 mg/digit |
| Typical non-linearity | ±0.15% on the FS |
| Analog to Digital converter | 16-bit with temperature compensation |
| Sensor frequency response (-3 dB) | DC to 800 Hz |
| Maximum sampling rate | 1.6 kSPS per axis |
| Noise spectral density | 150 µg/√Hz |
| Sensitivity change Vs temperature | ±0,01% /°C |
| Zero-g level change vs temperature (max delta from 25°C) | ±0.5 mg/°C |
| Typical zero-g level offset accuracy | ±40 mg |
| Anti-aliasing Hardware filter | Butterworth 2th order filter |

*Figure 8: Shock sensor specifications*

#### 5.3.3.2 Mems Sensor architecture

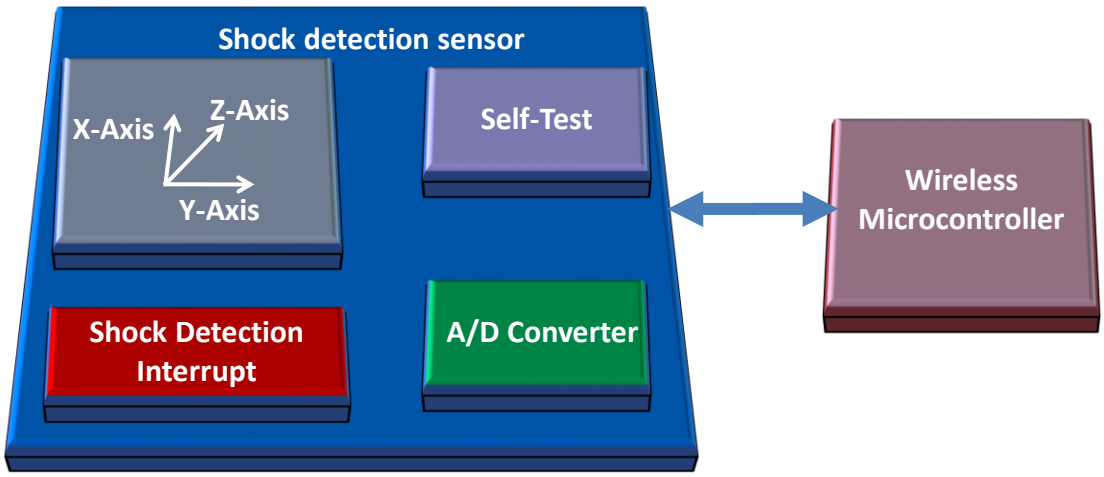



*Figure 9: BeanDevice® WiLow® AX-3DS - MEMS Sensor Architecture*

When configured with the "***Smart shock detection***" data acquisition mode, the BeanDevice® WiLow® AX-3DS wakes up when a threshold is reached.

#### 5.3.3.3 BeanDevice® current consumption in sleeping mode with SSD activated (Smart shock detection)

When SSD is activated, the BeanDevice will wake up if a shock is detected. During the sleeping mode, the sensors will continue to track a shock event.

Depending on the shock sensor sampling rate during the sleep mode, the BeanDevice® WiLow® current consumption can change:

| *Accelerometer sampling rate during sleeping* | *BeanDevice® WiLow® AX3DS Current consumption* |
|---|---|
| **0,5 Hz** | ***130 µA*** |
| **1 Hz** | ***200 µA*** |
| **2 Hz** | ***250 µA*** |
| **5 Hz** | ***300 µA*** |
| **10 Hz** | ***300 µA*** |
| **50 Hz** | ***400 µA*** |
| **100 Hz** | ***400 µA*** |
| **400 Hz** | ***500 µA*** |
| **1000 Hz** | ***600 µA*** |

***Table 3 : BeanDevice® WiLow® AX-3DS power consumption for a given sampling rate***

***For further information about the SSD (Smart Shock Detection) measurement mode, read the technical note TN-RF-18-Wilow-Wifi-Sensor-data-acquisition-modes.pdf***

## 5.3.4 BeanDevice® WiLow® X-INC: Combo Sensor accelerometer, inclinometer and shock sensor)

### 5.3.4.1 Accelerometer specifications

| | Accelerometer specifications |
|---|---|
| Accelerometer technology | High precision accelerometer based on MEMS technology |
| Measurement range | Two versions: ±2g and ±10g |
| Sensitivity | ±2g Version : 660 mV/g<br>±10g version: 200 mV/g |
| Typical non-linearity | ±0.1% FS |
| Analog to Digital converter | 24-bit delta-sigma with temperature compensation<br>Synhcronuous measurement channel |
| Sensor frequency response (-3 dB) | DC to 800 Hz |
| Maximum sampling rate | 2 kSPS per axis |
| Noise spectral density | ±2g Version : 45 µg/√Hz |
| Zero-g Offset Variation from RT over Temp | ±2g Version : ±0.2 mg/°C<br>±10g version: ±0.1 mg/°C |
| Sensitivity Variation from RT over Temp | ±2g Version : ±0.01 %/°C (XY) , ±0.02 %/°C (Z)<br>±10g version: ±0.01 %/°C |
| Offset Ratiometric Error | ±2g Version : 4mg |
| Sensitivity Ratiometric Error | ±2g Version : ±1.25 % (X-Y) , ±0.2 % (Z) |
| Cross Axis Sensitivity | 0.02 |

*Figure 10: Accelerometer sensor specifications*

### 5.3.4.2 Inclinometer specifications

| | 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<br>±30B Version: ±0.004° or ±0.070 mm/m or ±14.4 arc seconds |
| Noise spectral density<br>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 analog-to-digital with temperature compensation<br>Synchronous measurement channel |
| Sensor frequency Response (-3dB) | DC to 28 Hz |

*Figure 11: Inclinometer sensor specifications*

#### 5.3.4.3 Sensor Architecture

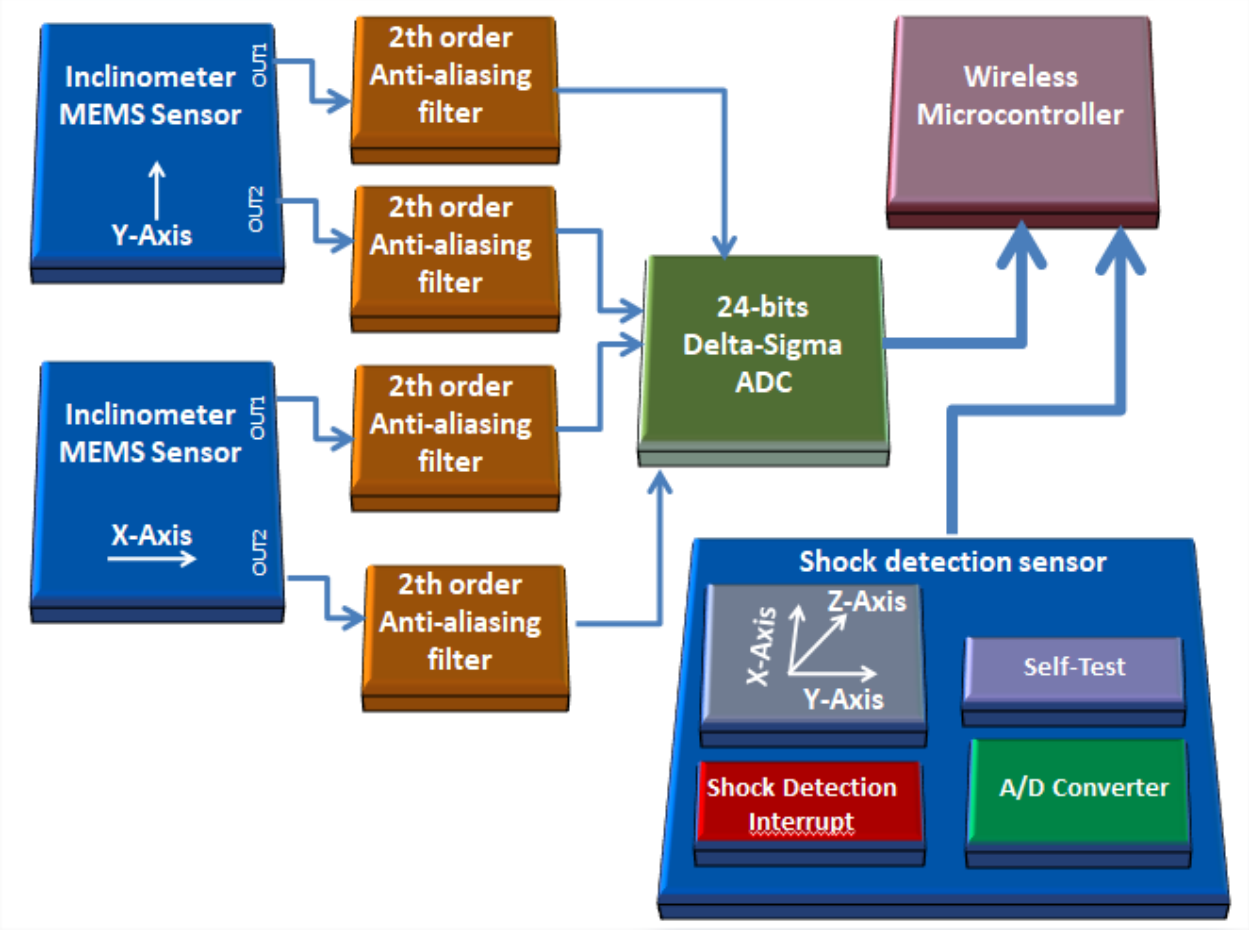



*Figure 12: X-INC sensor architecture*

### 5.3.5 Common technical specifications

#### 5.3.5.1 Remote configuration parameters

*Table 4: Remote configurations specifications*

| Remote configuration parameters | |
|---|---|
| **Data Acquisition mode** (**SPS** = sample per second) | Low Duty Cycle Data Acquisition (LDCDA) Mode: 1s to 24 hour |
| | Alarm -Low duty cycle: 1s to 24 hour |
| | Streaming mode : 100 SPS by default |
| | Streaming with event-trigger (SET) Mode : 100 SPS by default |
| **Sampling Rate** (in streaming mode) | Minimum: 1 SPS per axis |
| | Maximum: 2 kSPS per axis |
| **Alarm Threshold** | High and Low Levels alarms |
| **Power Mode** | Battery Saver & Active power modes |

### 5.3.5.2 RF specifications

*Table 5: RF specifications table*

| 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<br>TCP: 13 Mbps |
| RF Characteristics | ISM 2.4GHz. Antenna diversity designed by Beanair® |
| TX Power | 18 dBm @ 1 DSSS<br>14.5 dBm @ 54 OFDM |
| Rx Sensitivity | -95.7 dBm @1 DSSS<br>-74.0 dBm @54 OFDM |
| Maximum Radio Range | 200m (L.O.S), Radio range be extended by adding Wifi Bridge/Repeater |
| Antenna | Antenna diversity : 2 omnidirectional antenna with a gain of 2.8 dBi |
| OTA | Over the air firmware upgrade via WIFI |

### 5.3.5.3 USB specifications

*Table 6: USB specifications*

| USB specifications | |
|---|---|
| USB standard | USB 2.0 |
| Data Rate | Full speed operation(12MB/s) |
| Related functions | . Firmware update<br>. Wifi & system configuration |

### 5.3.5.4 Embedded data logger

*Table 7: Datalogger specifications*

| Embedded Data logger | |
|---|---|
| Storage capacity | up to 5 million data points |
| Wireless data downloading | 3 minutes to download the full memory (average time) |

#### 5.3.5.5 Environmental and Mechanical

***Table 8: Mechanical specifications***

| Environmental and Mechanical | |
|---|---|
| **Casing** | Aluminum casing<br>Dimensions in mm (LxWxH):35x59x65 mm without antenna & eyelet,<br>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** | . CE Labelling Directive R&TTE (Radio) ETSI EN 300 328 (Europe)<br>. FCC (North America)<br>. ARIB STD-T66 Ver. 3.6 (Japan)<br>. ROHS - Directive 2002/95/EC |

#### 5.3.5.6 Power Supply

***Table 9: Power supply specifications***

| Power supply | |
|---|---|
| **Rechargeable battery** | High density Lithium-Ion rechargeable battery with a capacity of 780 mAh |
| **Integrated battery charger** | Integrated Lithium-ion battery charger with high precision battery monitoring |
| **Current consumption @ 3,3V** | · During data acquisition : 20 to 30 mA<br>· During Radio transmission :<br>1 DSSS - 278 mA<br>54 OFDM - 229 mA<br>· During battery saver mode : < 100 µA |
| **External power supply** | . USB Power supply 5V<br>.**Optional auxiliary external Power Supply**: 6VDC to 24VDC compatible with solar energy harvesting |

#### 5.3.5.7 Included accessories

***Table 10: Included accessories***

| Included accessories | |
|---|---|
| **M8 plastic cap** | 1pcs, Ref: WL-PC |
| **M8 to USB cable** | 1pcs M8-6pins to USB Cable, 2 meters length. Ref:WL-CBL-M8-6P-USB-2M |
| **Magnet for power on/power off** | 1pcs Magnet. Ref: WL-MGN |
| **Wall mounting kit** | 4 pcs M5 screws+ Locknut. Ref:WL-WIFI-SCMKIT |

### 5.3.5.8 Options

***Table 11: Optional accessories***

| Optional Accessories and Services | |
|---|---|
| **Power-supply** | Wall plug-in, Switchmode power Supply 12V @ 1,25A with USB plug<br>Provided with power adapter:<br>North America/Japan/China or Europe or UK or Australia<br>**REF: WL-USB-5V-PWR** |
| **M8 Cable** | M8-6Pins Cable, Waterproof ( IP67) and shielded cable , cable length :<br>2 meters. Ref: ***WL-CBL-M8-6P-2M***<br>5 meters.Ref: ***WL-CBL-M8-6P-5M*** |
| **WIFI AP/Repeater/Bridge (wifi link extension)** | Wireless AP/Repeater with an integrated N-Type RF connector + High Gain Antenna<br>Wifi Acess Point/Bridge/Repeater<br>Integrated N-Type RF connector + High Gain Antenna with 9 dBdi of Gain.<br>Casing : Outdoor UV Stabilized Plastic, Dimensions (w/o antenna): 190 x 46 mm, Weight: 196 g<br>Antenna Connector: N-Type Connector (male), Power over Ethernet power supply (24VDC)<br>Max. Power Consumption: 6 Watts , Operating Temperature: -40 to 80° C<br>Shock and Vibration: ETSI300-019-1.4<br><br>Included:<br>1x AC to 24VDC POE Power supply<br>1x High Gain Antenna 9dBi<br>1 x Power adapter (EU or UK or US)<br><br>**Ref: WL-AP-UBIQ-TIT-7DBI for 7dBi Antenna**<br>**Ref: WL-AP-UBIQ-TIT-9DBI for 9dBi Antenna** |
| **X-Solar Wilow series** | X-SOLAR: Stand-alone solar power systems<br>---<br>Includes :<br>- Solar Panel 20W (cable length 5 meters or 10 meters) Solar Panel Specifications:<br>- Solar charging controller with 5VDC of Voltage Output, Number of Power Outputs: x4 (M8-3Pins Socket)- Provided without M8-3pins Plug or M8 cable adapter (see options)<br>- Battery Technology: Valve regulated lead acid battery, Capacity: 12Ah<br>Can be used with Wilow Sensors Operating in Streaming Mode & Works with 5V powered USB Beandevice Wilow<br>**REF: X-SOL-WILOW-12AH-20W-4CH-5V-5M** (5 meters of cable),<br>**X-SOL-WILOW-12AH-20W-4CH-5V-10M** (10 meters of cable)<br>Not adapted to our 2.4GHz Sensor series |

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

## 5.4 MQTT: READY FOR INDUSTRIAL INTERNET OF THINGS


Ready for Industrial Internet of things (IIOT) applications, WiLow® sensors integrate natively **MQTT** (Message Queuing Telemetry Transport) data frame, a lightweight and open-source (OASIS & ISO/IEC 20922:2016 standards) Internet of Things protocol.

**MQTT** is based on publish/subscribe paradigm, therefore user can easily connect, configure and manage several WiLow® sensors at the same time from a unique IOT software platform.

Users looking for a high level of security can count on a mechanism to notify interested parties to an abnormal disconnection of a client using the Last Will and Testament feature.

No need to spend several months to develop a specific and complex supervision software, user can easily integrate WiLow® sensors in a third-party IOT Cloud platform (Amazon web services, IBM Watson, Microsoft Azure, Facebook Messenger, Alibaba Cloud….).

Non-developer users can still use the BeanScape® software to setup a quick and affordable WIFI sensor network.

***For more info:***

- Read our technical note about MQTT communication protocol: click here
- Download our MQTT client for Android: click here
- Visit MQTT Organization website: http://mqtt.org/

## 5.5 STORE AND FORWARD+

The store and forward technique work by storing the message transmitted by WiLow® sensors to a Wi-Fi access point/ Wi-Fi receiver. If the message is not received due to a network disruption, it will be retransmitted on the next transmission cycle. This technique allows bringing a lossless data transmission.

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

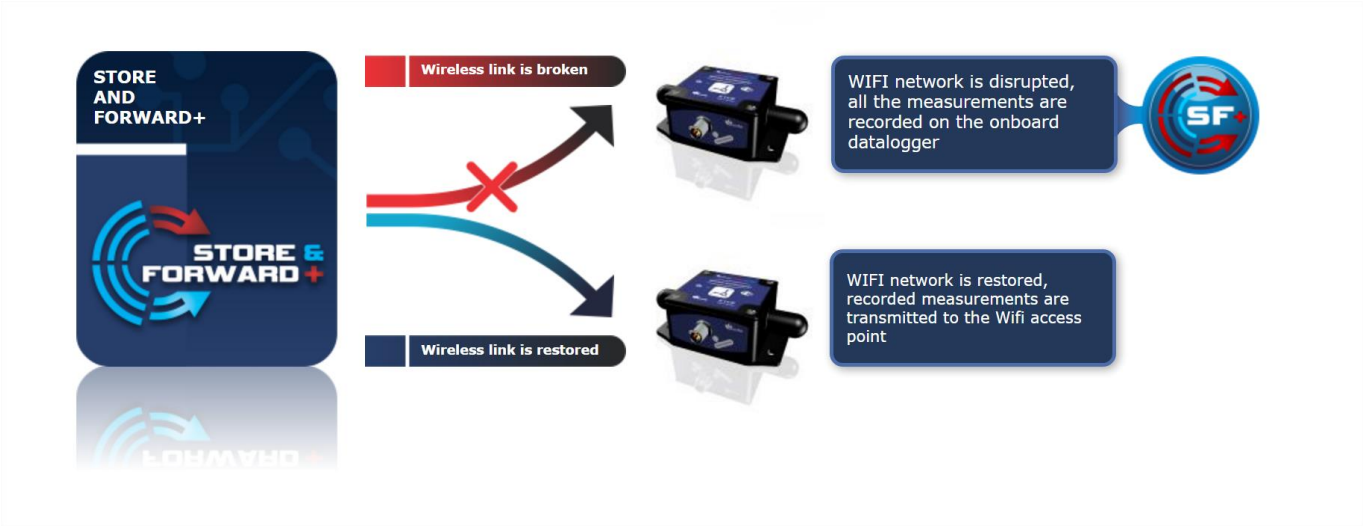



*Figure 13 : Store and Forward+ mechanism*

### 5.5.1 Configuration

To configure the Store & forward+ option on your Wilow go to your BeanDevice configuration panel and click on Data Acq. Config tab!

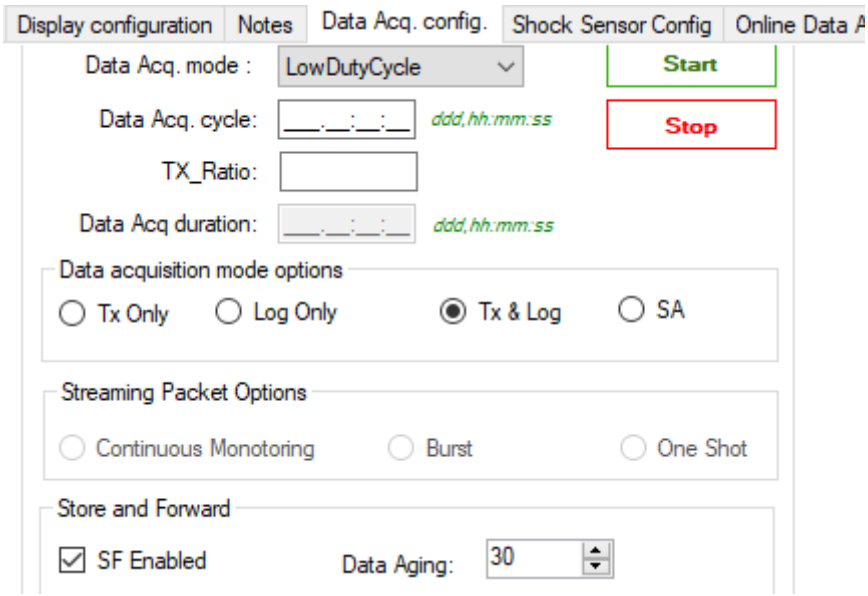
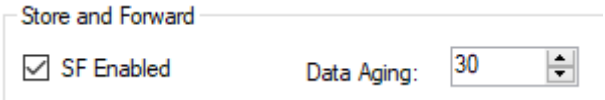
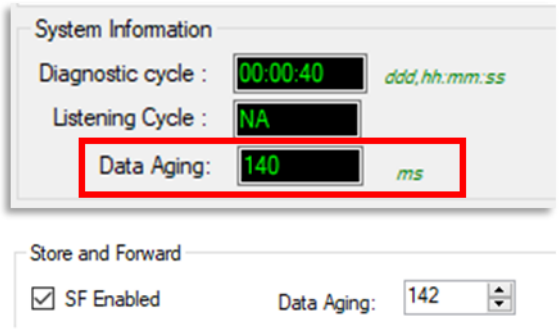



*Figure 14: Store & Forward configuration frame*

Check SF Enabled to enable Store & Forward+

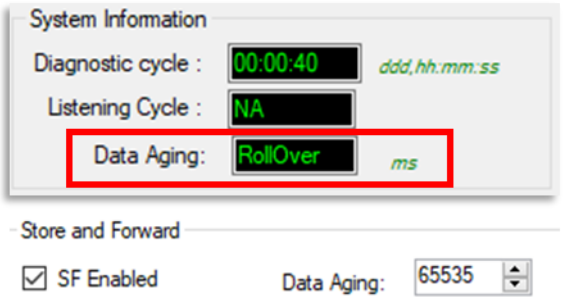


Enter Data aging value which is the duration of validity of non-transmitted data before its deletion and validate.




Data aging will then be displayed on the System frame.

30 ms is the minimum value possible and 65535 ms is the maximum value, when 65535 is entered, Rollover is displayed.




Store & Forward+ will efficiently decrease data loss and PER.

## 5.6 PRODUCT FOCUS

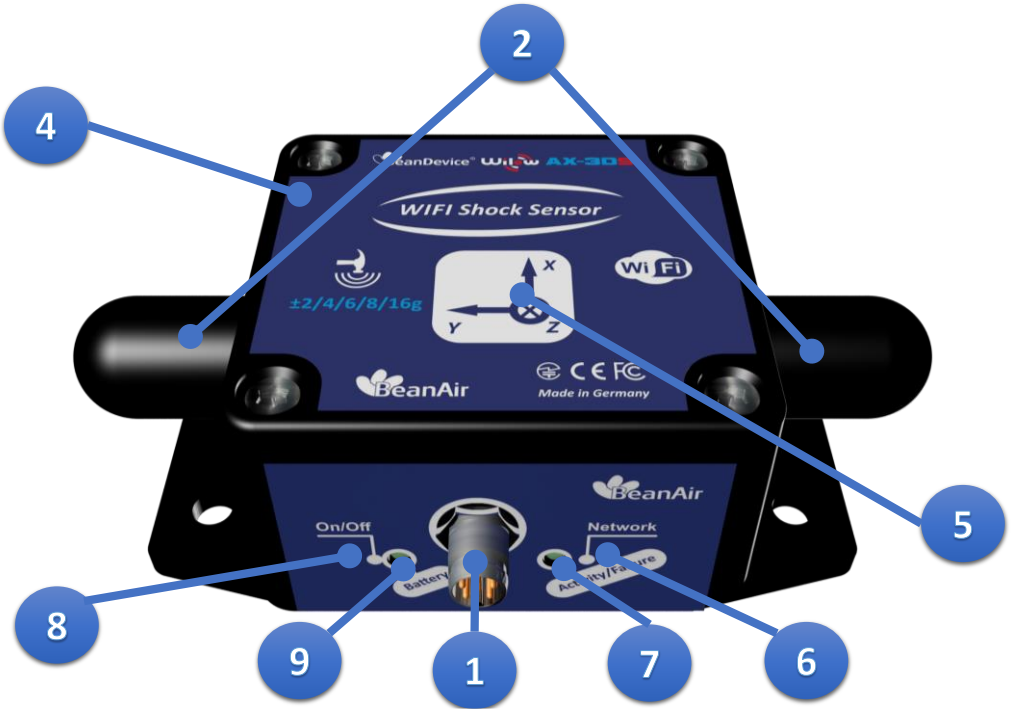



*Figure 15 : BeanDevice® WiLow® product focus*

### 5.6.1 Casing description

| Number | Function | Description |
|---|---|---|
| 1 | M8-5 Pins Contacts Socket (USB 2.0 and DC Power Supply) | ***4.8-17.8VDC*** power supply. The socket sealing is assured with a screw cap.<br>  ***Don't forget to protect the M8 socket with a M8 protection cap provided with your product if it's not used.*** |
| 2 | Radome antenna | Waterproof IP67 Radome antenna |
| 3 | MAC ID Label | Unique identifier assigned to the BeanDevice® Wilow® (64-bit)<br>  ***Every WiLow® device must have a 64-bit MAC address that allows unique identification of the device within a global network.*** |
| 4 | BeanDevice® Wilow® product version label | Three label version are available :<br>✓ ***BeanDevice® WiLow® AX-3D****: measurement range (±2g and ±10g) and the three axis are displayed on the Label*<br>✓ ***BeanDevice® WiLow® HI-INC****: measurement range (±15° and ±30°) and the two axis are displayed on the Label*<br>✓ ***BeanDevice® WiLow® AX-3DS****: measurement range and the three axis are displayed on the Label* |
| 5 | Acceleration/inclination axis | Indicates acceleration/inclination on X/Y/Z axis |
| 6 | "Network " non-contact button | "**Network context**" non-contact button restores the factory settings on the BeanDevice®.<br>Point the pole of the Neodymium magnet that was provided with your BeanDevice® towards the "Network" label circle. If the BeaDevice® is in **Active power mode**, hold the magnet for approximately ***10s,*** if the BeanDevice® is in **sleep mode**, hold the magnet for approximately ***15s*** |
| 7 | "Activity/Failure LED" | This bi-color **GREEN** / **RED Led** represents the BeanDevice®:<br>Cf. table below for led description |
| 8 | ON/OFF Non- contact button | Allows to power up/power off the BeanDevice®.<br>Point the pole of the Neodymium magnet that was provided with your BeanDevice towards the "ON/OFF" label circle. Hold the magnet for approximately 2s to power on the device. |

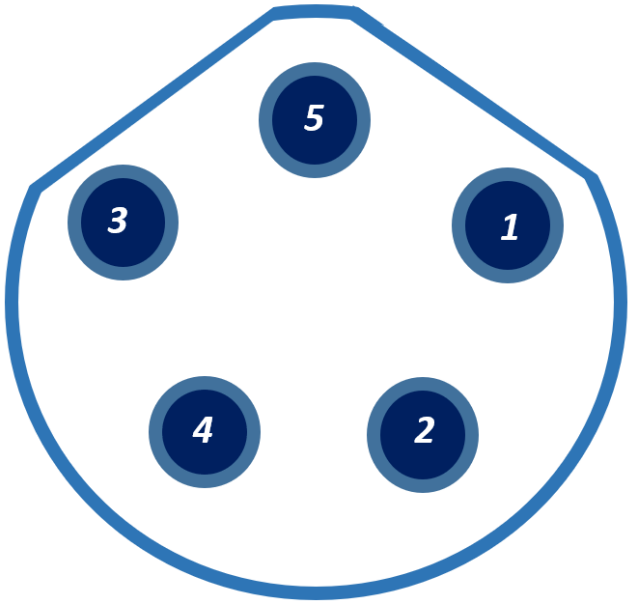
| | | |
|---|---|---|
| | | To power off the BeanDevice®, hold the magnet for ***5s*** if the device is in **Active power mode**, otherwise if the BeanDevice is in **sleep mode**, hold the magnet for ***10s*** |
| 9 | Battery charge indicator LED | This bi-color **GREEN** / **RED Led** indicates battery charge status:<br>Cf. table below for led description |

### 5.6.2 LEDs description

| Operating status | Network LED | Battery Charge LED |
|---|---|---|
| **The BeanDevice® WiLow® is power off** | LED OFF | **<u>No external power supply</u> is connected:**<br>LED OFF<br><br>**<u>External power supply</u> is connected:**<br>***Green*** LED ON: Battery charged<br>***Red*** LED ON: Battery not charged<br>***Green*+*Red*** LED ON: Battery is charging |
| **The BeanDevice® WiLow® is power on with wireless TX/RX activity** | ***Green*** LED: Wireless Network Activity<br>***Red*** LED: Wireless transmission failure | |
| **The BeanDevice® WiLow® is power on** | ***Green*** led blinks twice | |
| **The BeanDevice® WiLow® is power off (was power on before)** | ***Red*** LED ON during 2s | |
| **The BeanDevice® WiLow® is power on & a network Reset is performed** | ***Red*** LED ON during 2s<br>then<br>***Green*** LED blinks twice<br>(Repeated twice) | |
| **The BeanDevice® WiLow® is power on & waits for a network activity** | ***Green*** LED blinks every 10s | |

### 5.6.3 M8 socket wiring code (BeanDevice® Wilow® side)

***M8 5pin Socket- Pin assignation***

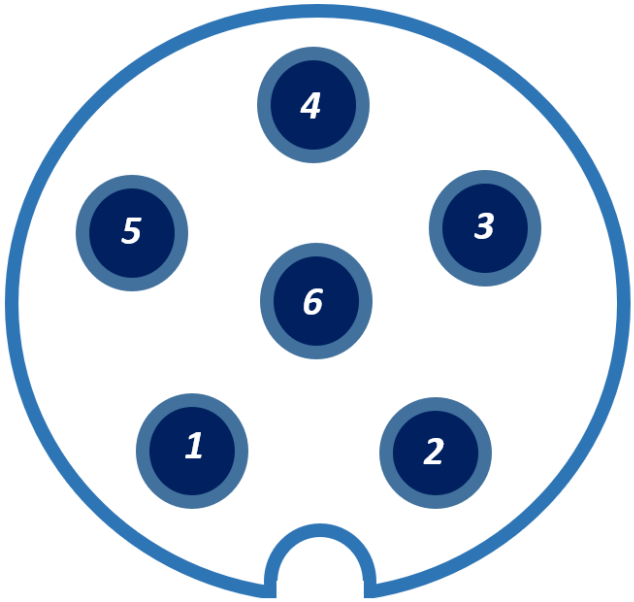



| Interface Name | M8 Pin assignation |
|---|---|
| Not used | PIN1 |
| 5VDC Voltage | PIN2 |
| DATA - | PIN3 |
| DATA + | PIN4 |
| GND | PIN5 |

*Figure 16 : M8-5Pin Socket pin assignation*

The new Beandevice® Wilow® design comes with a M8-6pin socket **(from the 20/12/2018):**

***M8 6pin Socket- Pin assignation***




| Interface Name | M8 Pin assignation |
|---|---|
| 5VDC Voltage | PIN1 |
| DATA - | PIN2 |
| DATA + | PIN3 |
| Not used | PIN4 |
| DC Voltage 6-24VDC (-EHR version only) | PIN5 |
| GND | PIN6 |

*Figure 17: M8-6Pin Socket pin assignation*

### 5.6.4 Mechanical drawing

The BeanDevice® Wilow® comes with an *IP67* rating without corrosion protection. So, do not install the BeanDevice® Wilow® in a marine environment with high turbulence.


*Figure 18: Mechanical drawing - BeanDevice® WiLow® AX-3D/HI-INC/INC/X-INX*

***Drawing is available on the following web link: Click here***

***Step File is available on the following web link: Click here***

### 5.6.5 Antenna diversity

Antenna diversity is a technique that maximizes the performance of an antenna system. It allows the radio to switch between two antennas that have very low correlation between their received signals. Typically, this is achieved by spacing two antennas around 0.25 wavelengths apart or by using two orthogonal polarizations. So, if a packet is transmitted and no acknowledgement is received, the radio system can switch to the other antenna for the retry, with a different probability of success.

The diagram below provides information on the radome antenna performance:

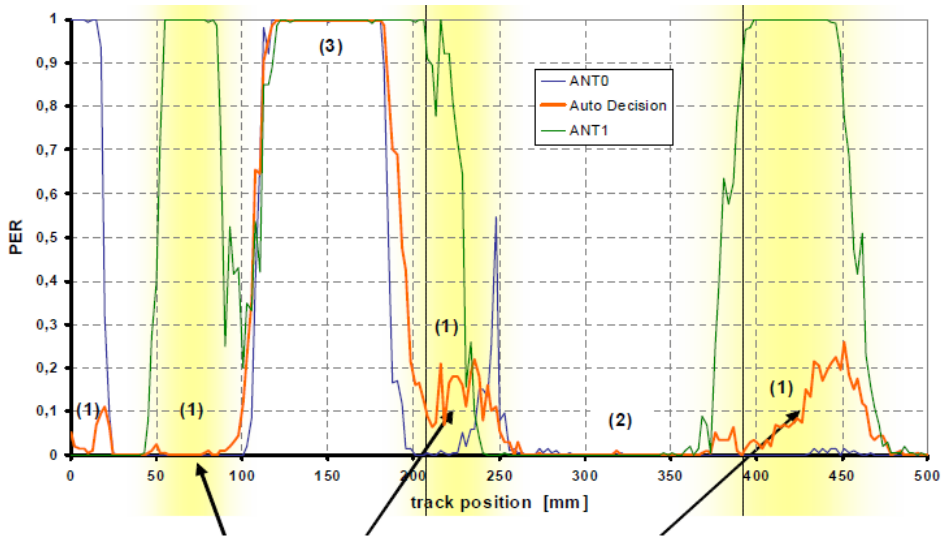
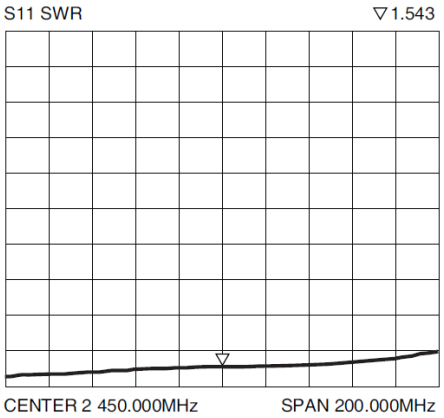



*Figure 19 : Radome antenna performances*

The radome antenna radio used on BeanDevice® WiLow® product is a tamper resistant and unobtrusive.

### 5.6.6 Radome antenna

| ***Electrical specifications*** | |
|---|---|
| ***Picture*** |  |
| ***Center Frequency*** | ***2,45 GHz*** |
| ***Gain*** | ***2,5 dBi*** |
| ***Wavelength*** | ***¼ -wave*** |
| ***VSWR*** | ***<1.9 typ. At center*** |
| ***Impedance*** | ***50 Ω*** |
| ***Size*** | ***Diameter: 27mm***<br>***Height: 11 mm*** |




Typical VSWR


*Figure 20: Antenna position on the BeanDevice® WiLow® AX-3D*

***Never try to change the antenna integrated on the BeanDevice® WiLow®. This action may void the product warranty.***

### 5.6.7 Mounting Guidelines

- ✓ For vibration measurement, the mass of the wireless accelerometer must be <1/10 of the mass of the object under study.
- ✓ Mounting surfaces need to be clean, free of any residue from epoxies, waxes, paint or other foreign materials.
- ✓ Mounting surface should be flat.
- ✓ The mounting hole must be checked to ensure it is longer than the mounting screw so as to prevent "bottoming out".
- ✓ Use a torque wrench for tightening screws to the manufacturer's specifications. Do not use electric tools as their frequencies may damage the accelerometer.
- ✓ Spread mating surface with a light coating of silicone grease, heavy machine oil or bees wax to ensure contact issecure thereby maximizing the usable frequency range.
- ✓ Secure the cable using clamps, o-rings, tape or other materials most suited to the application. Ensure that you have sufficient slack to allow for free movement of the sensor.
- ✓ Inspect mounting holes and remove any debris, burrs or other foreign materials.

### 5.6.8 Wireless inclinometer special instructions (BeanDevice® WiLow® HI-INC)

The BeanDevice® WiLow® HI-INC is designed for a horizontal mounting, i.e. the base plate of the inclinometer needs to be placed on the horizontal plane of the object to be measured.

Avoid shock and vibration during measurement, as these could corrupt the measurement results. Inclination sensors that base on a fluidic measurement principle are optimal for static measurements and suitable to only a limited extent of dynamic measurement.

### 5.6.9 Mechanical Mounting Options

By default, the BeanDevice® Wilow® comes with a screw mounting lid. But two other mounting options are available, for example if you are going to monitor the tilt of a pole or a vertical structure, you will have to use a 90° bracket.

In other cases when the use of the BeanDevice® Wilow® is on a metallic structure and will not be for a long term or making mounting holes in the structure is not allowed we can go for the Magnet mounting which is a magnetic extension to glue the BeanDevice® Wilow® to the metallic structure.

See our video to choose the right mounting procedure for your Wilow® BeanDevice®

## 5.7 POWER SUPPLY DESCRIPTION

WiLow® sensors can be power supplied from different power sources:

• Internal rechargeable Lithium-Polymer battery
• USB or External Power 5VDC power supply, therefore compatible with Industrial USB power supply available on the market

| Lithium-Ion Battery | |
|---|---|
| **Charge/discharge efficiency** | 80–90% |
| **Self-discharge rate** | 0.35% to 2.5% per month depending on state of charge |
| **Cycle durability** | 400–500 cycles |
| **Nominal cell voltage** | 3.6 V |

| Lead–acid car battery | |
|---|---|
| **Charge/discharge efficiency** | 50–95% |
| **Self-discharge rate** | 3–20%/month |
| **Cycle durability** | <350 cycles |
| **Nominal cell voltage** | 2.1 V |
| **Charge temperature interval** | Min. −35 °C, max. 45 °C |

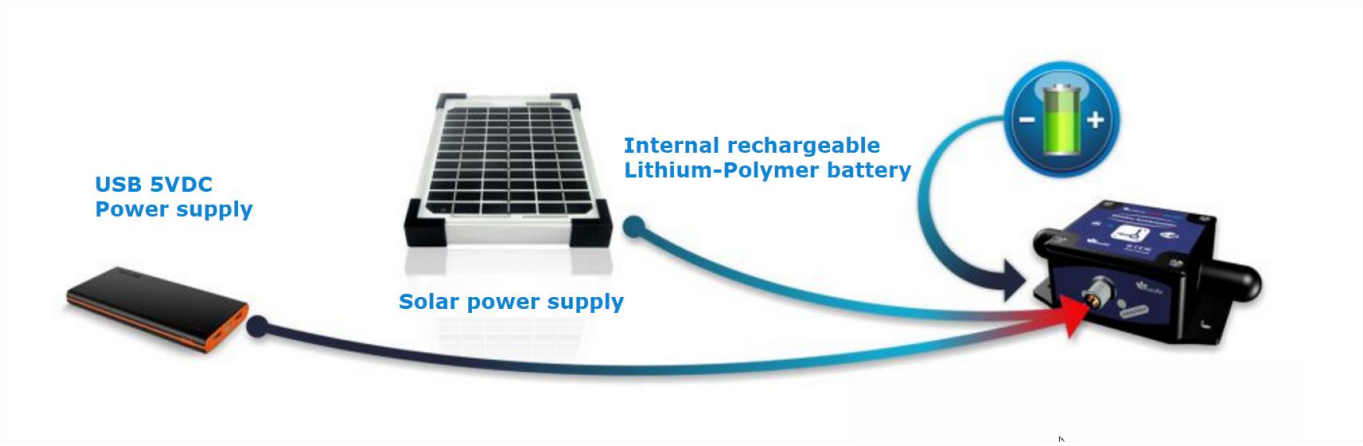



*Figure 21 : Smart and Flexible Power supply*

**If you are using a USB Power Bank, make sure that your power bank doesn't switch off when the BeanDevice Wilow® battery is fully charged.**

**The power bank should be only used to charge the BeanDevice Wilow battery, don't use it for long term monitoring.**

**Alternative external power supply should be considered for long term monitoring.**

### 5.7.1 Integrated Lithium-ion Rechargeable battery

The BeanDevice® WiLow® integrates a Lithium-Ion rechargeable battery:

| *Battery Capacity @25°C* | *Nominal Voltage @25°C* | *Charge/Discharge cycle @25°C* | *Full charge duration* |
|---|---|---|---|
| 750 mAh | 4,2V | 370 | 3h maximum |

***The rechargeable battery can be used as an UPS (uninterruptible power supply) battery on your BeanDevice® WiLow®. It provides an emergency power when the external power source, typically the utility mains, fails.***

***Do not try to change the integrated battery. This action may void the product warranty.***

### 5.7.2 USB/Power supply cord

This accessory is provided as an option:

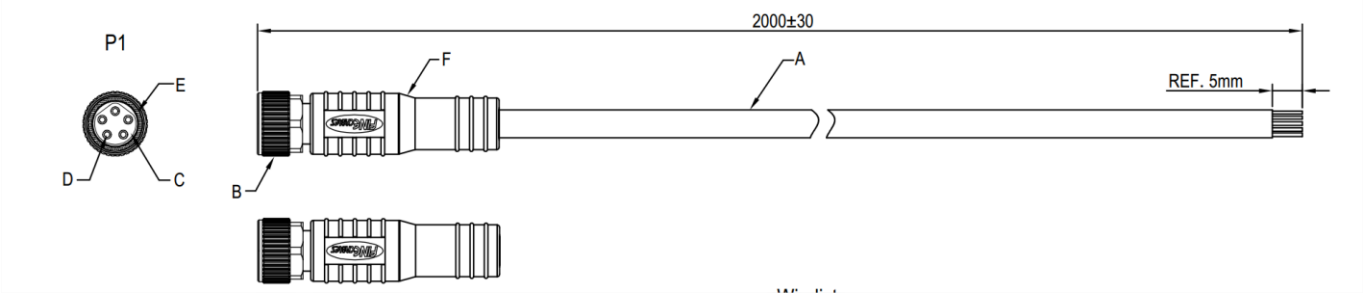
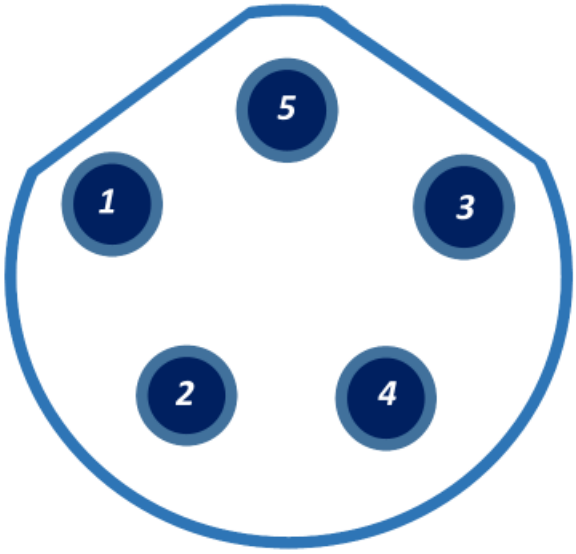



*Figure 22: M8-5Pin/M8-6Pin cable*

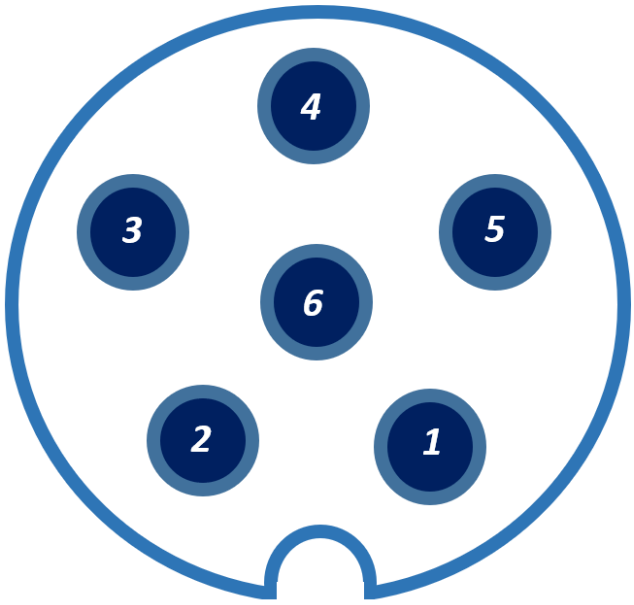
### M8 5pin Plug- Pin assignation




| Interface Name | M8 Pin assignation | Wire Color (A-coding) |
|---|---|---|
| Not Used | PIN1 | RED/BROWN |
| 5VDC Voltage | PIN2 | WHITE |
| USB-DATA - | PIN3 | BLUE |
| USB-DATA + | PIN4 | BLACK |
| GND | PIN5 | GREY |

*Figure 23: M8-5Pin Plug Assignation and Wiring Color*

### M8 6pin Plug- Pin assignation




| Interface Name | M8 Pin assignation | Wire Color (A-coding) |
|---|---|---|
| 5VDC Voltage | PIN1 | BROWN |
| USB-DATA - | PIN2 | WHITE |
| USB-DATA + | PIN3 | GREY |
| Not used | PIN4 | BLUE |
| DC Voltage 6-24VDC (-EHR version only) | PIN5 | GREEN |
| GND | PIN6 | PINK |

*Figure 24: M8-6Pin Plug assignation and Wiring Color (since December 2018)*

### 5.7.3 FTDI Driver

In some costumer cases, the Operating System cannot recognize automatically the COM port connection.

It is recommended to update manually the FTDI driver.

To download the FTDI driver, please visit our FTP support server

https://beanair.com/firmware-for-wilow-industrial-iot-sensors.html

or download it directly from:

https://www.ftdichip.com/Drivers/CDM/CDM%20v2.12.28%20WHQL%20Certified.zip

### 5.7.4 USB Power supply

| *USB Voltage* | *Minimum current* |
|---|---|
| 5VDC | 200 mA |

**If you are using a USB Power Bank, make sure that your power bank doesn't switch off when the BeanDevice Wilow® battery is fully charged.**

### 5.7.5 How to extend the battery life

Battery autonomy depends on several parameters:

- The environment where the BeanDevice® WiLow®
- Data acquisition mode

The following table provides a list of recommendations in order to extend the battery life of your BeanDevice® WiLow®:

| *Influence factors on battery life* | *Observations* | *Recommendations* |
|---|---|---|
| **Sleep mode** | **Sleep mode can be configured from the BeanScape® software** | **By activating this power mode on your BeanDevice®, you will increase the battery autonomy of your BeanDevice®. By activating sleeping power mode, the BeanDevice® current consumption can decrease from 30 mA to 10-45 microamperes.** |
| **Sampling rate in streaming mode** | **Power consumption will grow with the sampling rate.** | **Choose the right sampling rate on your BeanScape® interface.** |
| **Packet Error Rate (PER)** | **A high packet error rate can cause a higher retransmission data and this increase the current consumption.** | Try to replace your BeanDevice® in an area where the radio link is much better (see Link Quality Indicator value). |

## 5.8 SENSOR CALIBRATION

### 5.8.1 Factory Calibration procedure

#### 5.8.1.1 BeanDevice® WiLow® HI-INC (WIFI Low Power inclinometer)

The calibration procedure is based on a side-by-side comparison with a reference tilt meter. For better measurement stability, the two tilt meters are mounted on a sinus table.

#### 5.8.1.2 BeanDevice® WiLow® AX-3D/AX-3DS (WIFI Low Power Accelerometer)

A static calibration method is used to calibrate the sensor.

### 5.8.2 How often to recalibrate the BeanDevice® WiLow®?

Depending on the operating environmental conditions, the following table summarize how often user should recalibrate its sensor:

| *BeanDevice® Wilow® version* | *Operating temperature < 40°C* | *Operating temperature > 40°C* |
|---|---|---|
| **BeanDevice® WiLow® AX-3D** | **6 years** | **3 years** |
| **BeanDevice® WiLow® AX-3DS** | **3 years** | **2 years** |
| **BeanDevice® WiLow® HI-INC** | **6 years** | **3 years** |

*Table 12: BeanDevice® WiLow® re-calibration*

# 6. CONNECTION TO YOUR WIFI NETWORK

## 6.1 WIFI NETWORK CONFIGURATION

### 6.1.1 Direct connection to PC/Laptop

If you decide to connect directly your PC/Laptop/Smartphone to your **BeanScape® WiLow®:**

- If you use a smartphone: enable the WIFI Hotspot on your smartphone (for more information consult your smartphone user guide)
- If you use a PC/Laptop: enable the WIFI Hotspot on your PC. If you are familiar with DOS environment, launch DOS and use these scripts:
  - netsh wlan set hostednetwork mode=allow ssid=**YourHotSpotName** key=**Yourpassword**
  - Then start your hosted network: netsh wlan start hostednetwork

**Some WIFI chipset cannot accept a Hotspot configuration; we will suggest you to use a Wi-Fi AP to establish a connection between your BeanDevice® Wilow® and your BeanScape® software**

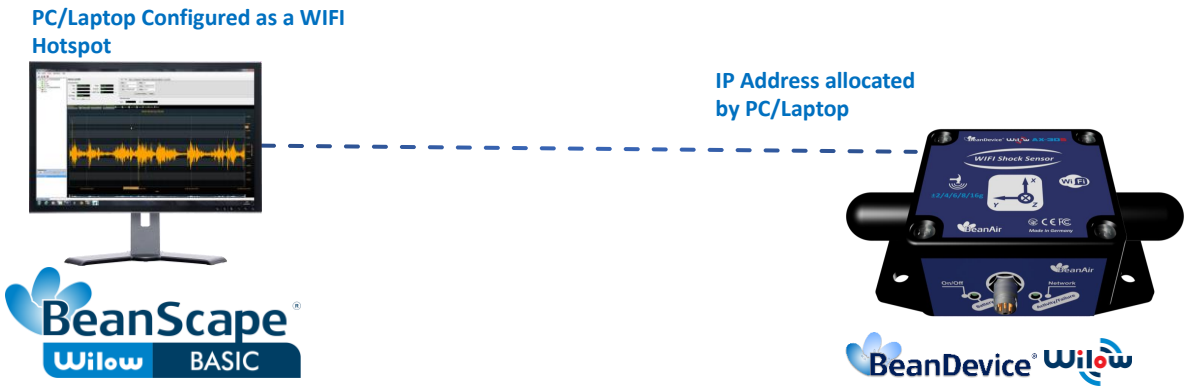



*Figure 25: Direct connection to a PC/Laptop*

### 6.1.2 Connection to a WIFI AP

If you decide to connect your **BeanScape® WiLow®** to a WIFI AP, the network architecture will come as follow:

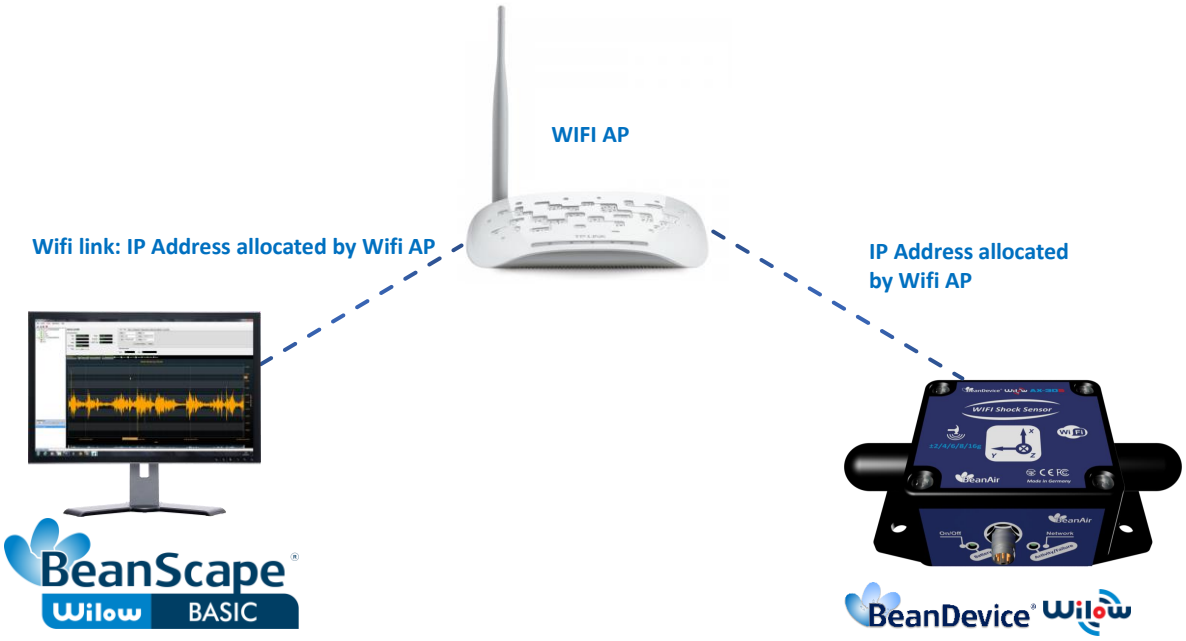



*Figure 26: Connection to a WIFI AP*

## 6.2 BEANDEVICE® WILOW® CONFIGURATION

Along this part we have to follow the next steps:

1. Firstly, install **BeanScape® WiLow®,** then move to the icon on the desktop and double click on it to start the software
2. Connect your **BeanDevice WiLow®** to your PC by using the M8 to USB Cable provided with your device,
3. Power on your **BeanDevice® WiLow®** by holding the magnet on the ON/OFF label, you will see the Network led blinking in green color,
4. Select Tools on the BeanScape® menu and choose "**LAN/WAN Config"**

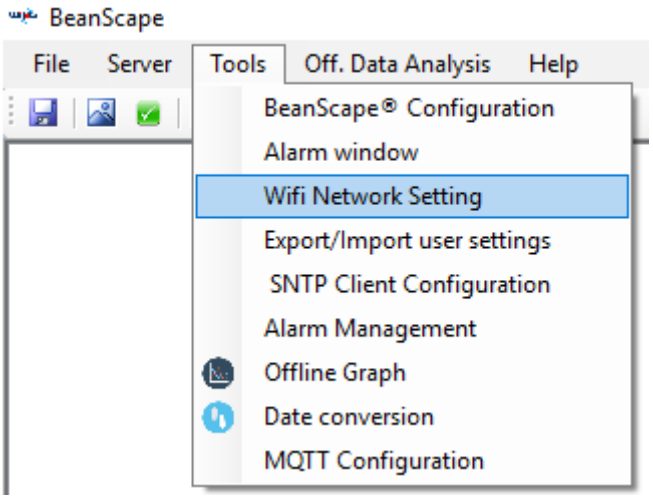



*Figure 27: Wifi network setting*

**5.** The following window should appear:

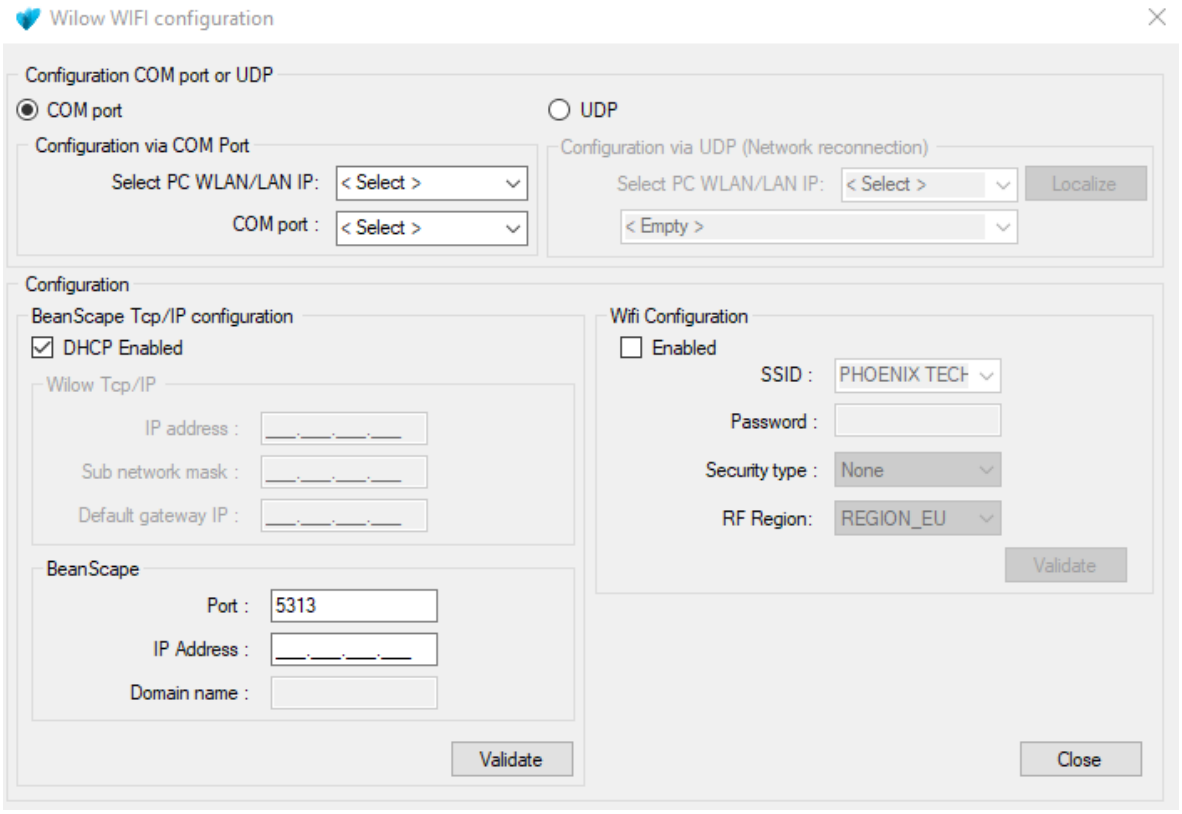



*Figure 28: WiFi network setting window*

**6.** On LAN/WLAN config select your PC IP Address sharing the same WIFI Hotspot/Access Point with your BeanDevice® WiLow®.

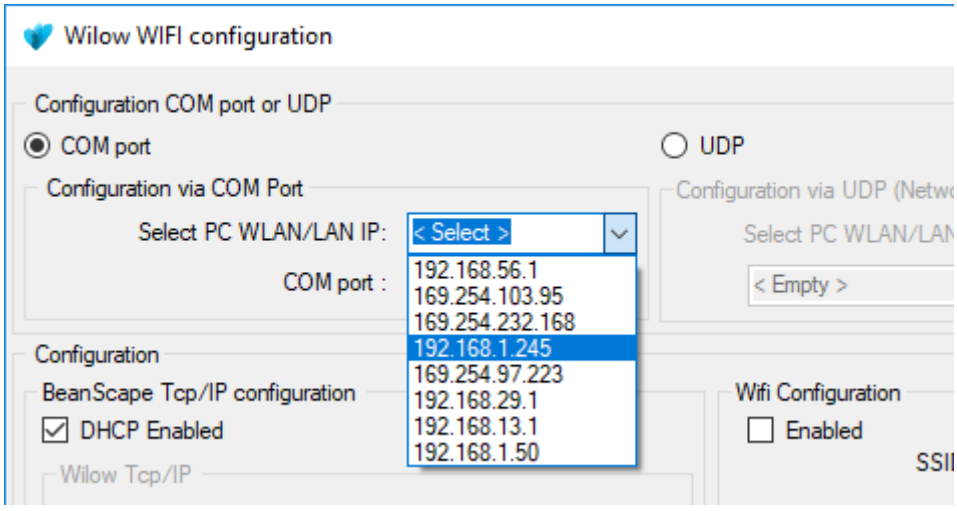



*Figure 29: COM/LAN Port setting*

After selecting the right IP Address, the field “TCP/IP configuration is automatically filled out.

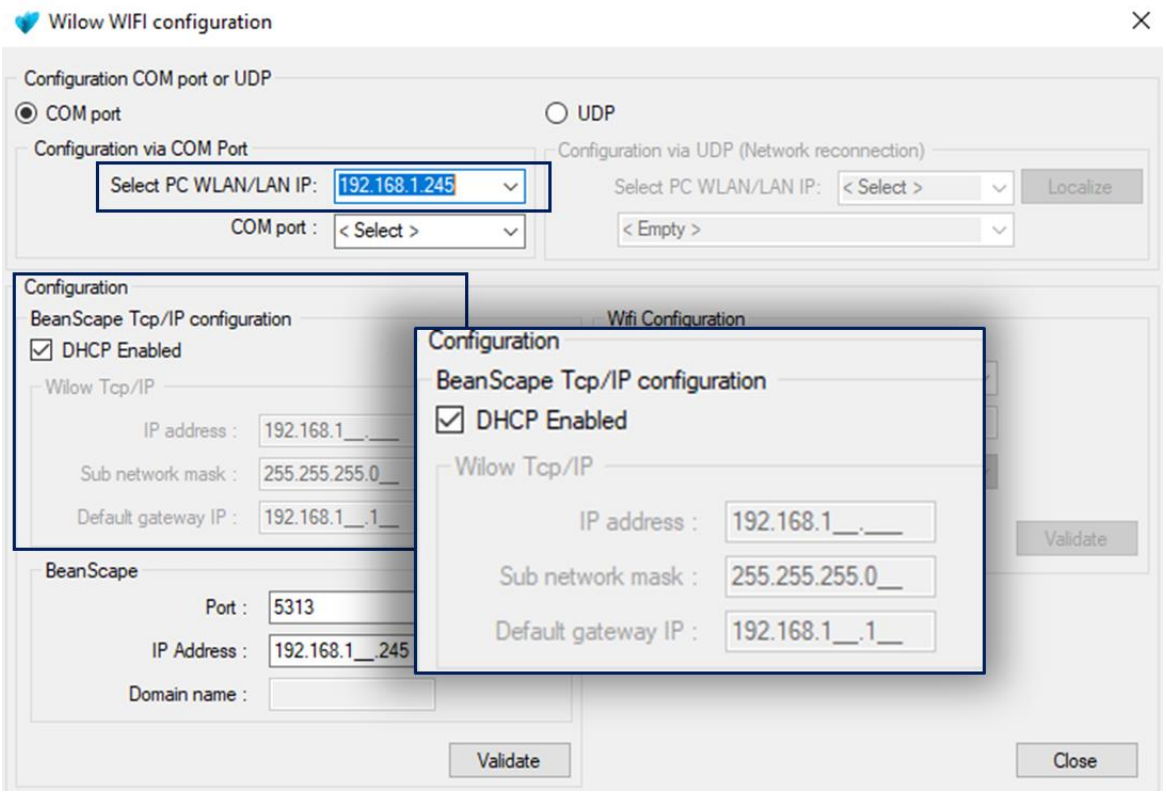



*Figure 30: BeanDevice® WiLow IP setting*

7. Select the right Serial Port number (COM Port) used to connect your **BeanDevice® WiLow®**

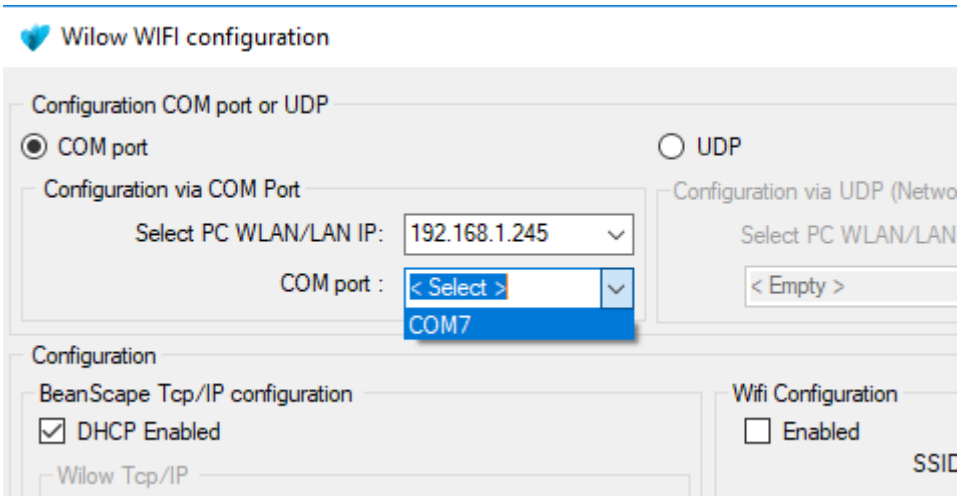



*Figure 31: COM port selection*

8. Configurate your IP settings, if you choose to use a Dynamic IP allocation, **Check DHCP Box**, otherwise to set a Static IP, you have to **Uncheck the DHCP Box** and configurate the Network settings.

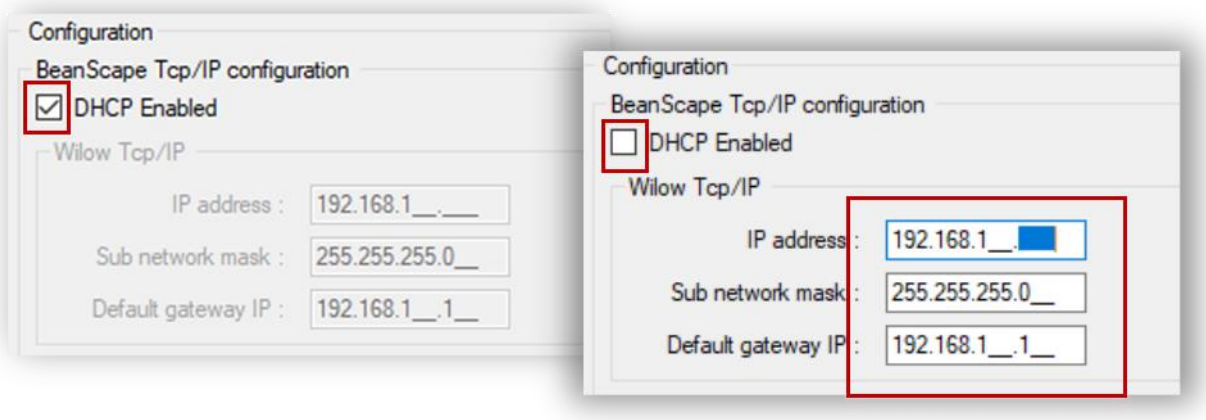



*Figure 32: BeanDevice® WiLow® DHCP/Static IP*

**9.** Enter your WIFI settings (SSID, password and security type), which will be used to connect the BeanDevice® WiLow® to your Wireless Network.

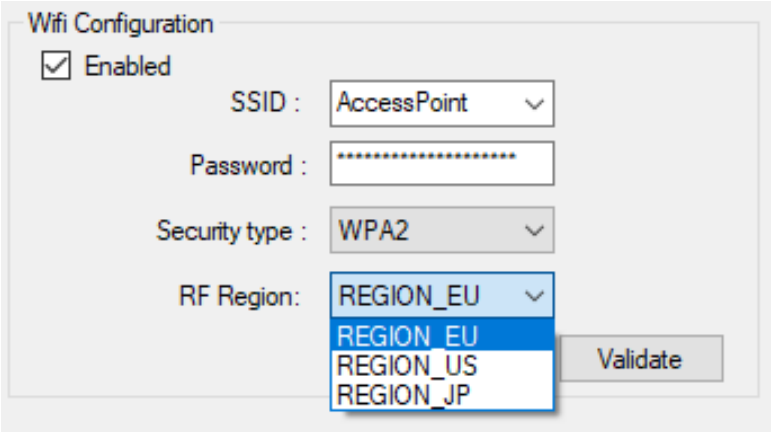



*Figure 33: BeanDevice® WiLow® WiFi setting*

***It is mandatory to precise the RF Region information used in your Access Point/Router. Some of the RF Channels are denied to use in some countries. By default, the RF Region is REGION_EU***

**10.** To finish the configuration, Click on Validate. A pop-up window will display "***Operation completed successfully***".

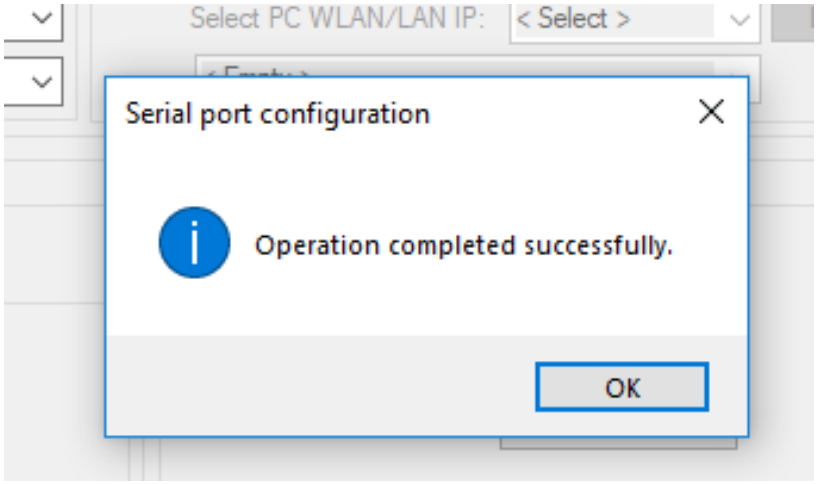



*Figure 34: Successful WIFI network configuration*

***IF the TIMEOUT ERROR occurred while configuring your Bean device***

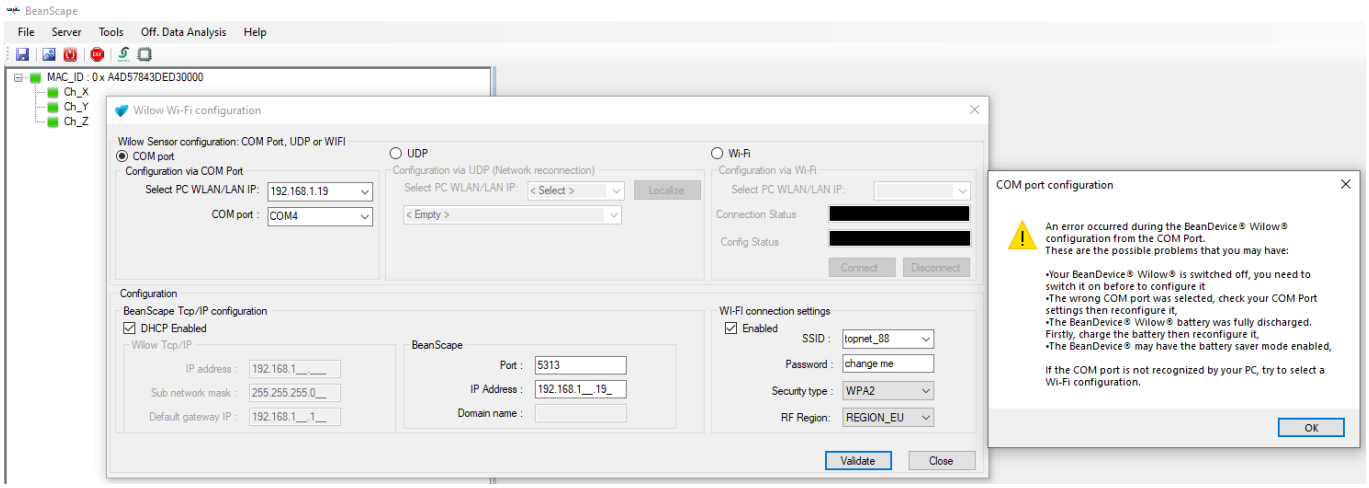



*Figure 35:BeanScape® WiLow configuration error*

***Please make sure that the device is ON***

Point your magnet toward The On/Off non-contact button of your BeanDevice to power it On.

A green led will blink if it's on.

A red led will blink if it's off.


**On/Off Non Contact Button**

**11.** To start the server, click directly on the Start button on the Menu bar, or go to **Server** then select **Start the Server**

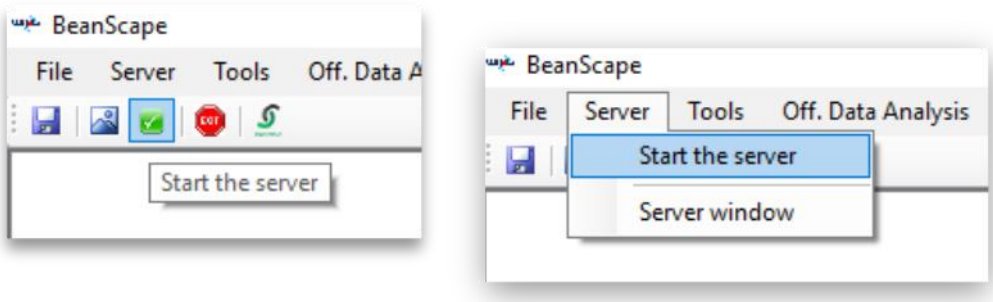



*Figure 36: Start Server*

You will see your **BeanDevice® WiLow®** profile displayed as follow:

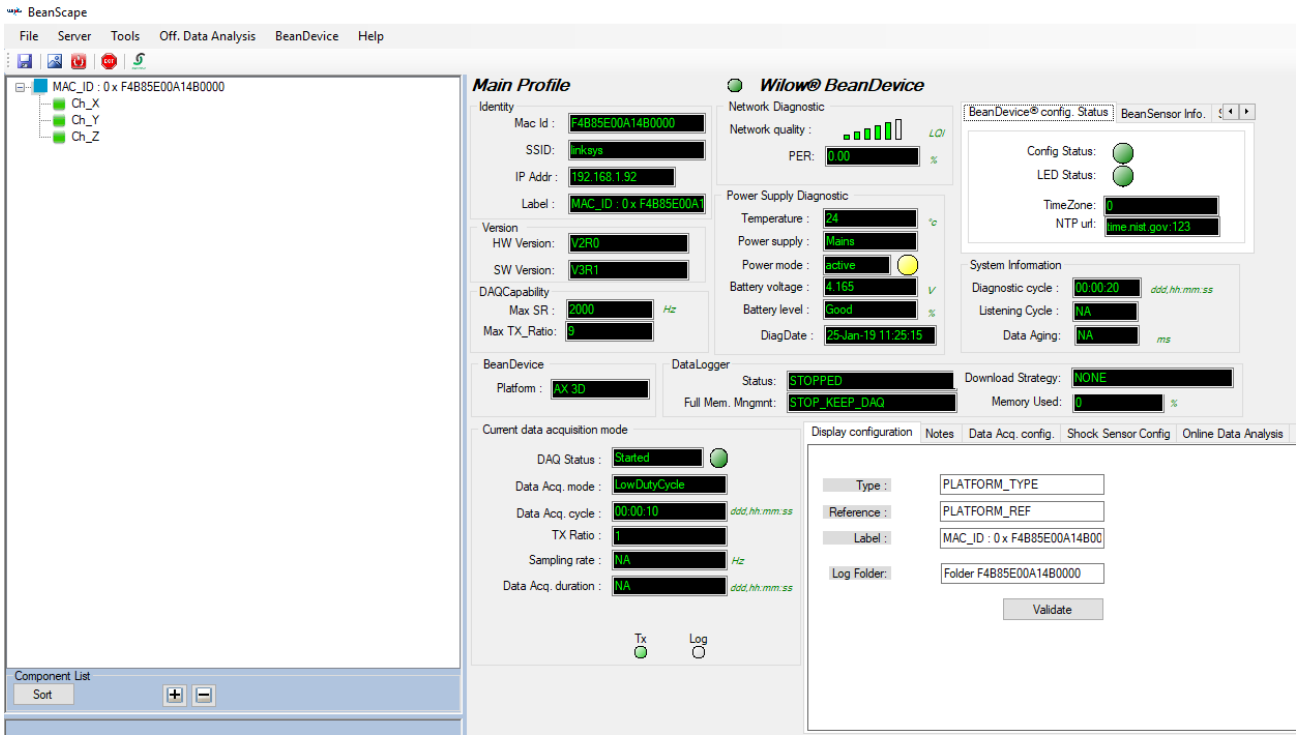



*Figure 37: BeanScape® WiLow® Dashboard*

See our Technical video Getting started with BeanDevice® Wilow

## 6.3 CONFIGURING THE SENSOR WIRELESSLY (AP MODE)

This feature allows the user to configure its BeanDevice® WiLow®. without the usage of the USB cable.

First of all we must set the device in Access point mode.

In order to do that we need to:

1. Turn the device off.
2. Keep the magnet on the (On/off) sign for 10 seconds until the Network led blinks in orange color (Green Red)


*Figure 38 Setting the BeanDevice® WiLow®. as an access point*

***The device will in Access point mode for 5 min***

After that the device will appear in your Network list with its mac Id as you see in the following picture

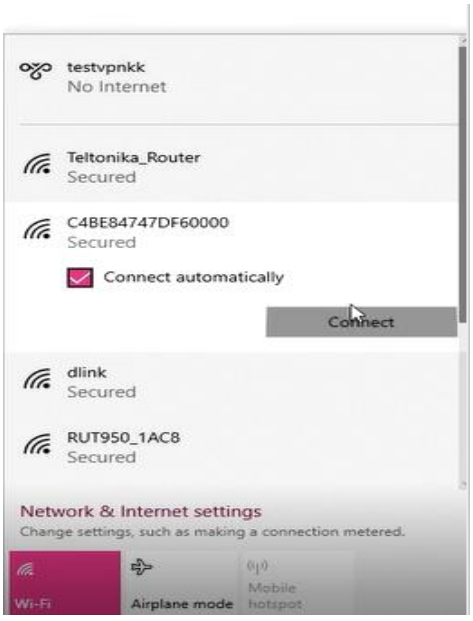



*Figure 39: Device set as AP*

Connect to it the password is "**beanairwilow**".

Once connected, you have to Select Tools on the BeanScape® menu and choose **"LAN/WAN Config"**:

1. On LAN/WLAN config select WIFI BeanDevice® WiLow®.

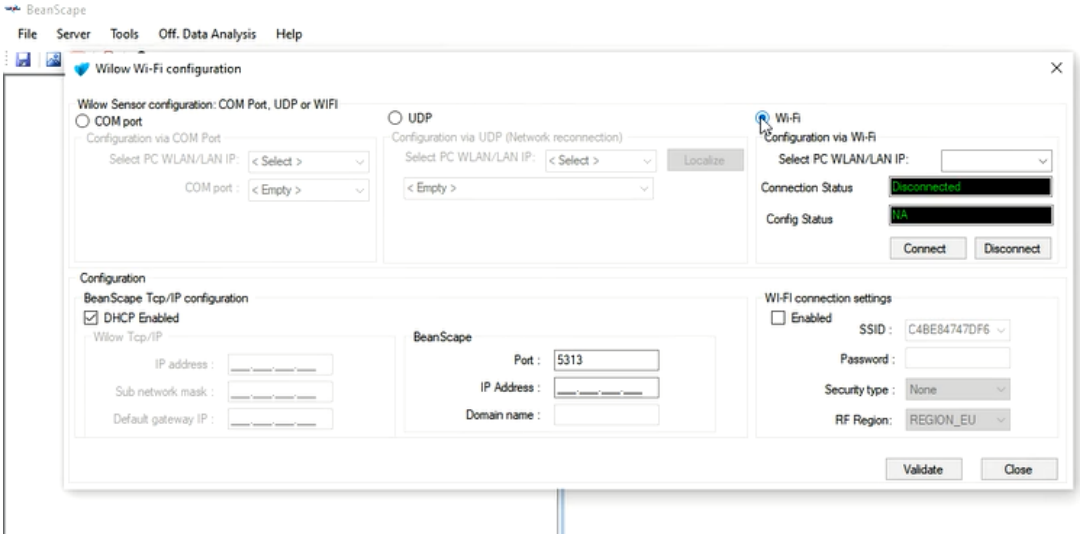



*Figure 40 : Configurations of the BeanDevice*

2. Select your WLAN/LAN ip and press on connect
3. Enable WIFI connection settings and enter the:
   SSID
   Password
   Security type
   RF Region

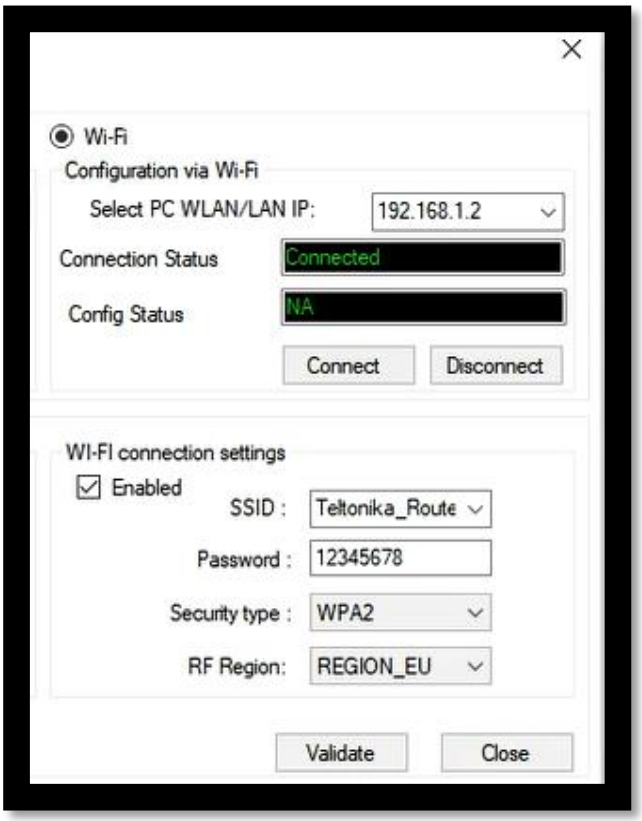



*Figure 41 WIFI settings*

4. Type your PC ip in this field:
   (You can check it by selecting command prompt and typing ipconfig)


*Figure 42 Ip Address field*

5. Validate and connect on the same WIFI that you selected the parameters of, in **step 3.**
6. Start the server

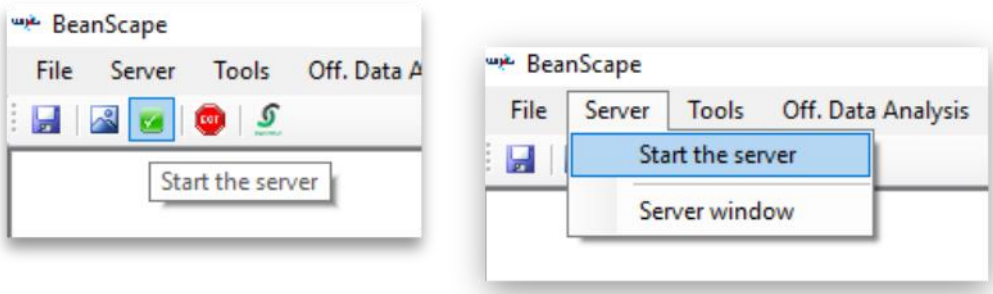



*Figure 43 : Server Launching*

The device is now Connected.


*Figure 44: Device connected*

[See our technical video “Overview of WIFI Access Point Mode for Wilow IOT Sensors.” on YouTube]

### 6.4 LOCALIZE A BEANDEVICE® WILOW®

To localize a BeanDevice® Wilow® already configured and connected to the same Network, you have to Select Tools on the BeanScape® menu and choose **“LAN/WAN Config”**:

7. On LAN/WLAN config select your PC IP Address sharing the same WIFI Hotspot/Access Point with your BeanDevice® WiLow®.

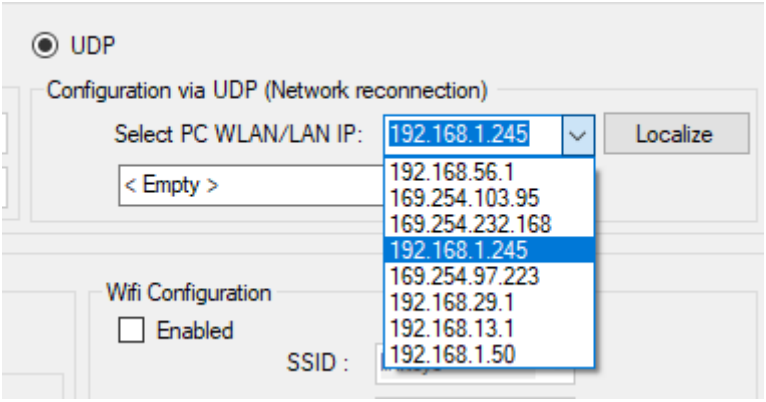



*Figure 45: BeanDevice® WiLow® UDP Localization*

8. Click on Localize and select the BeanDevice® Wilow that you like to use from the list:

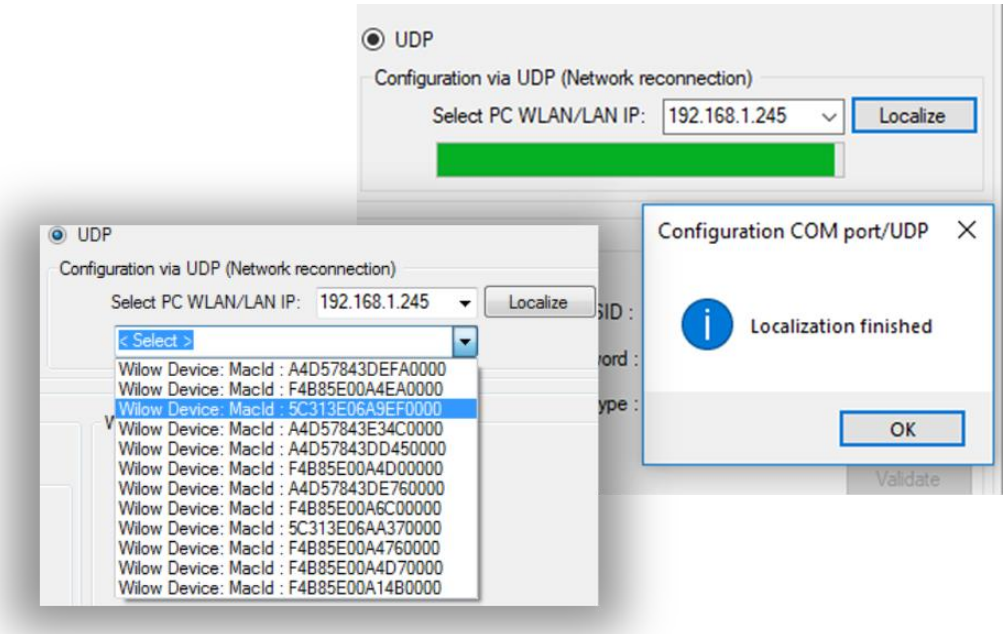



*Figure 46: Successful BeanDevice® WiLow® Localization*

# 7. SUPERVISION FROM THE BEANSCAPE® WILOW® SOFTWARE

***For more information about the BeanScape®, please read the BeanScape® User Manual.***

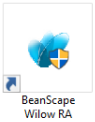
***It is recommended to install MATLAB MCR to ensure running the Online/Offline Data analysis***

**MATLAB MCR 64 bits download link**
***http://ssd.mathworks.com/supportfiles/downloads/R2015a/deployment_files/R2015a/installers/win64/MCR_R2015a_win64_installer.exe***

**MATLAB MCR 32 bits download link**
***http://ssd.mathworks.com/supportfiles/downloads/R2015a/deployment_files/R2015a/installers/win32/MCR_R2015a_win32_installer.exe***

## 7.1 STARTING THE BEANSCAPE®

The BeanScape® is a supervision software monitor fully dedicated to Beanair WSN (Wireless Sensor Networks):

1. ***Start the BeanScape® by double-clicking on the BeanScape® icon*** 

2. ***Make sure that your BeanDevice® WiLow® is connected to your WIFI Network***
3. ***Click on the button « start »*** 
4. ***All the BeanDevice® WiLow® connected to your Wi-Fi Hotspot will appear on your left window***
5. ***Select the BeanDevice® Wilow or its related sensor channel you want to configure.***

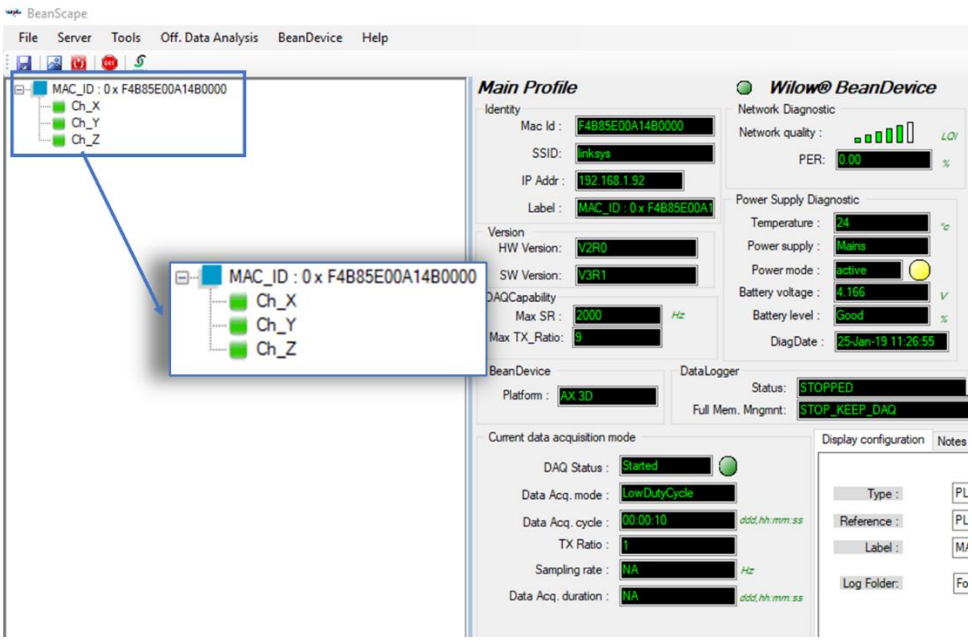
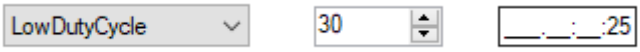



*Figure 47: BeanDevice® WiLow® Profile*

***The user interface is organized as follow***:

- Green on black background is displaying information


- Black on White/Grey background is a customizable field




You can configure your BeanDevice® Wilow from the page "***BeanDevice® WiLow® System Profile***". This page is composed of two parts:

- ✓ BeanDevice® Wilow information display;
- ✓ BeanDevice® configuration;

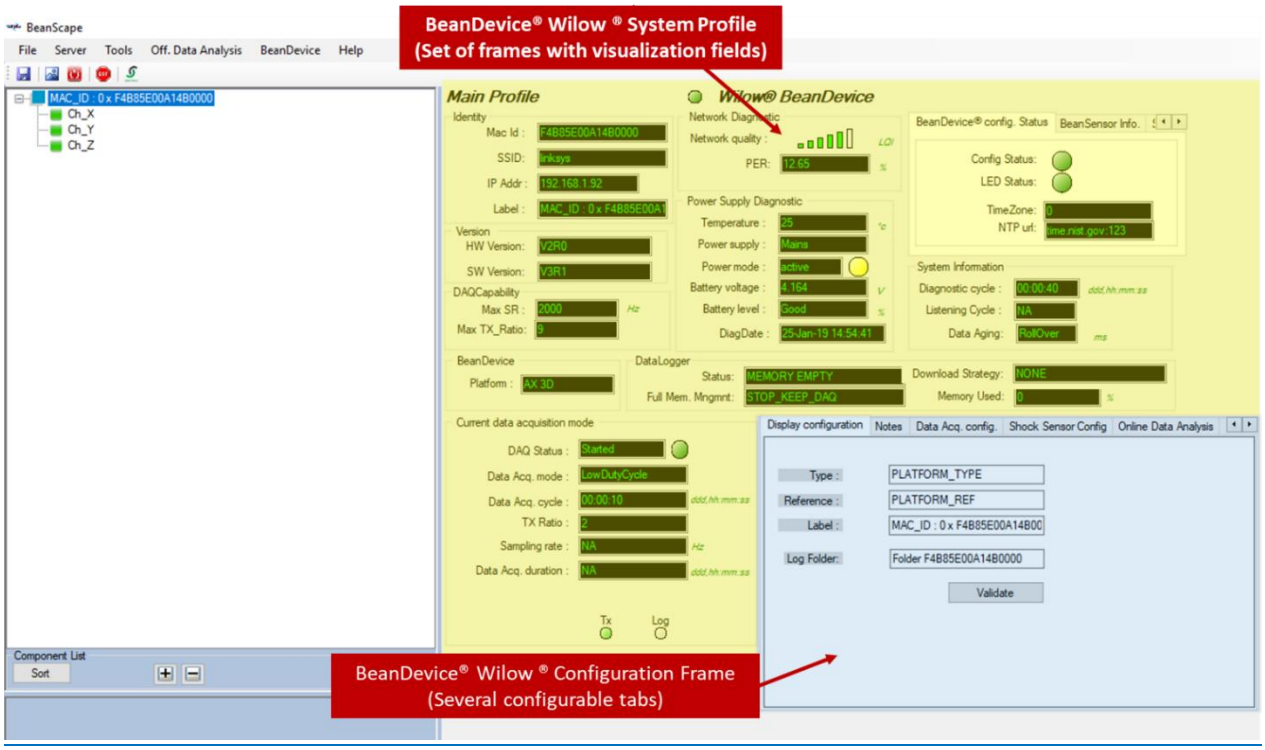



*Figure 48 : BeanDevice® Wilow® System profile*

## 7.2 SYSTEM PROFILE

You will find below a description of the data information fields making up for each frame.

### 7.2.1 Identity frame

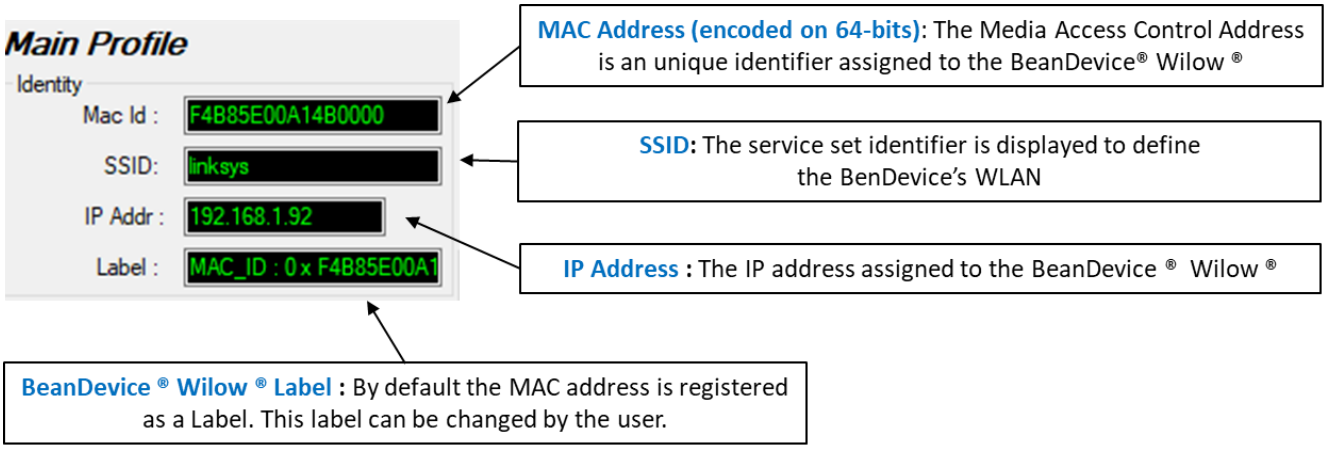



*Figure 49: BeanDevice® Main Profile*

### 7.2.2 Wireless Network Diagnostic frame

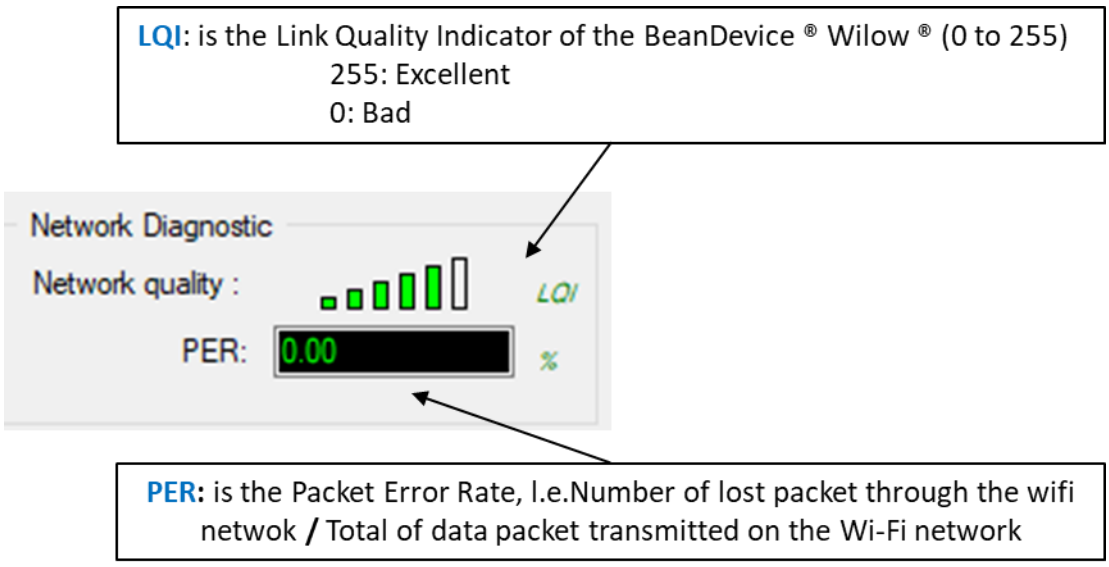



*Figure 50: BeanDevice® network-link status*

| Number of bars | Color | Link quality indicator |
|---|---|---|
| 5 to 6 bars | Green | Very good |
| 4 bars | Green | Good |
| 3 bars | Red | medium |
| to 2 bars | Red | bad |

*Figure 51 : Network Quality Indication*

### 7.2.3 Power supply diagnostic frame

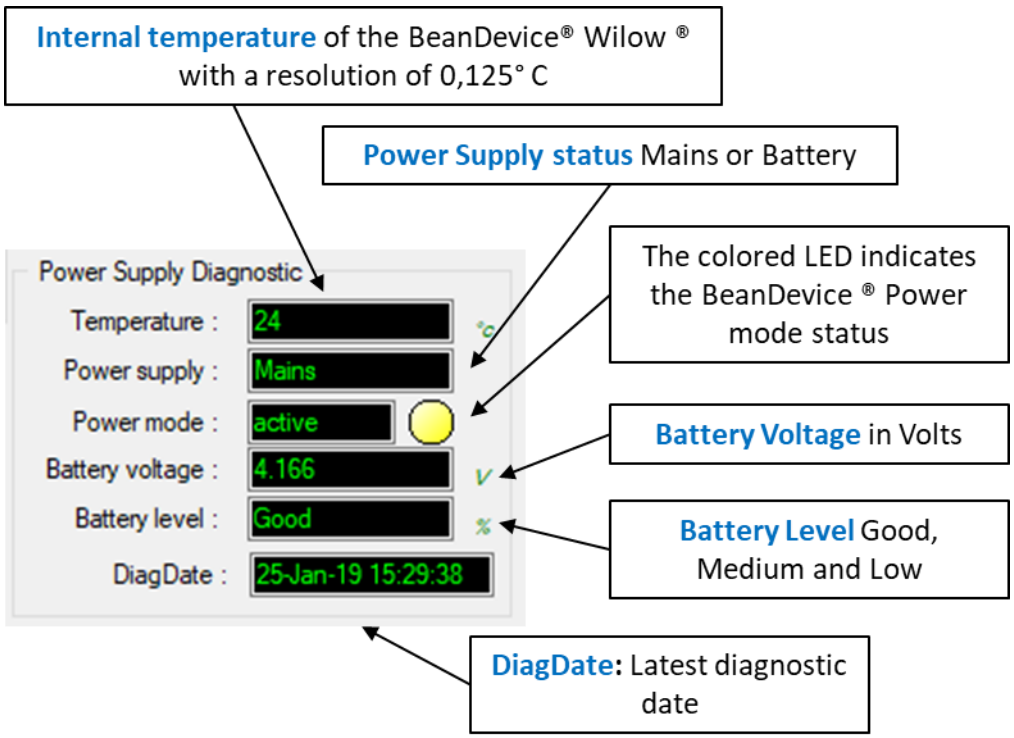



*Figure 52: BeanDevice® power supply information*

***The BeanDevice® Wilow integrates an internal temperature sensor, it enables the following functions:***

- ✓ ***Battery temperature monitoring during charging***
- ✓ ***Temperature compensation on measurement***
- ✓ ***Alarm notification transmission to WIFI Network if the internal temperature is abnormally high***

***Power supply status is updated when the BeanDevice® Wilow® is plugged/unplugged from external power supply.***

***If your battery level is low, it is highly recommended to recharge your battery. Your BeanDevice® Wilow® integrates a battery charger.***

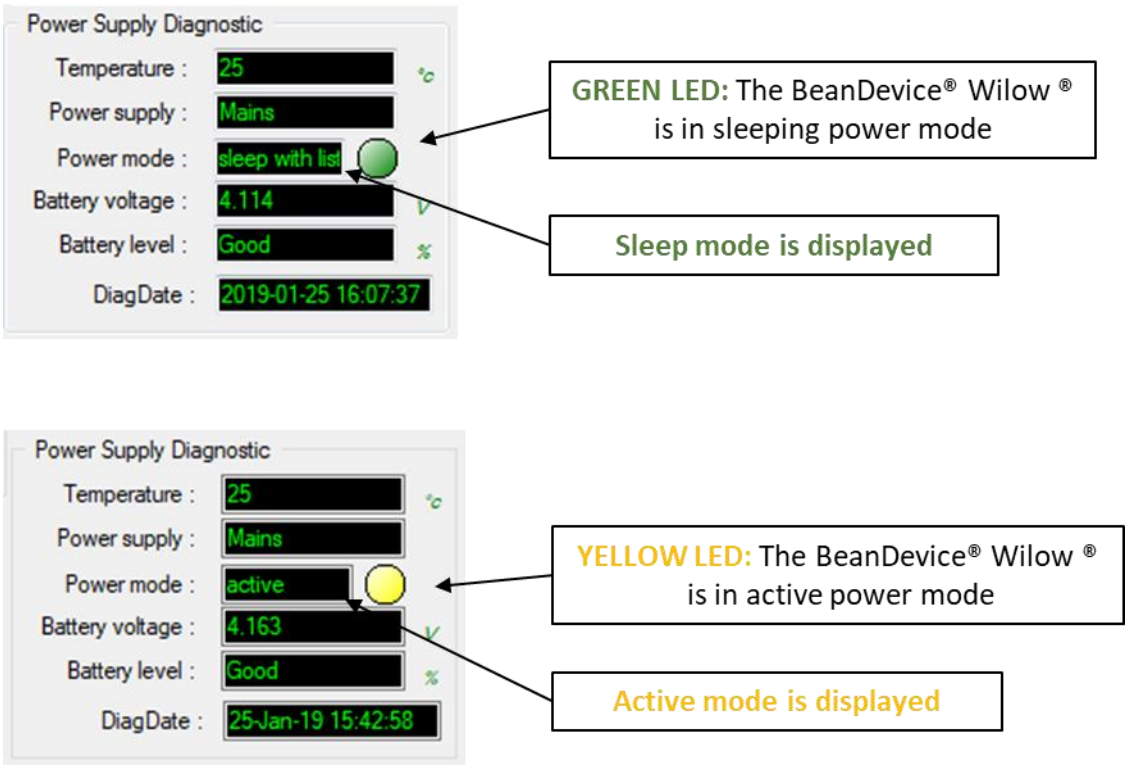



*Figure 53: BeanDevice® Power modes*

### 7.2.4 System status frame

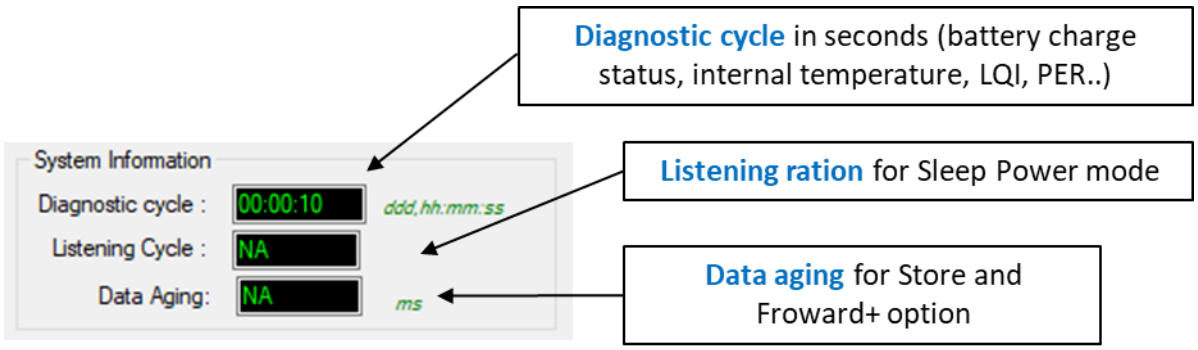



*Figure 54 : System status frame*

### 7.2.5 Platform frame

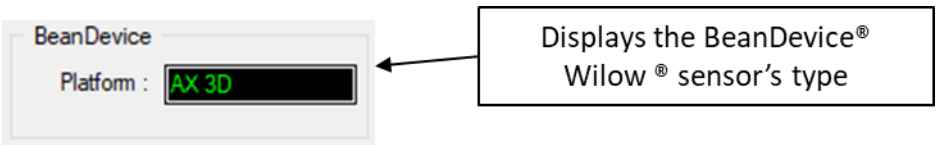



*Figure 55: BeanDevice® WiLow sensor's type frame*

### 7.2.6 Datalogger Status frame

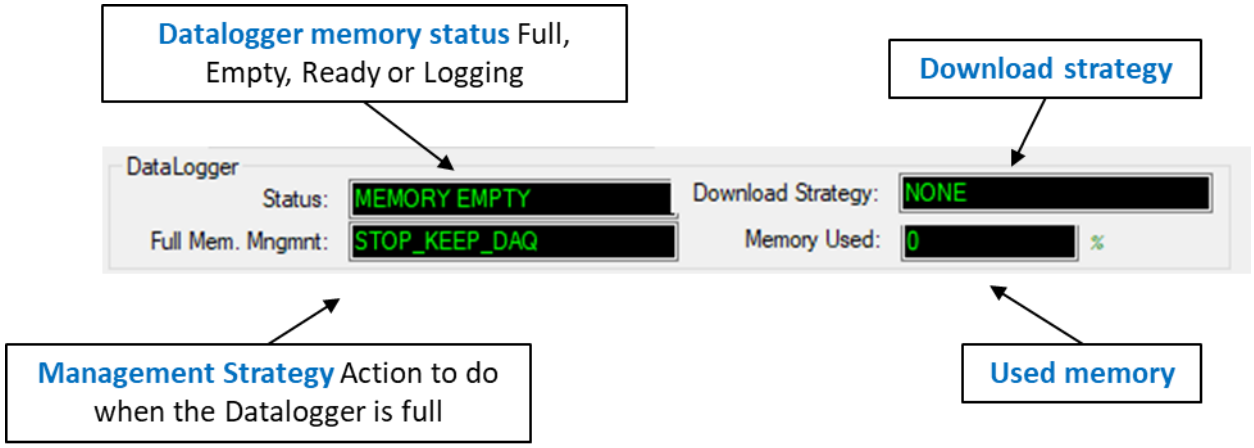



*Figure 56: Datalogger frame*

### 7.2.7 Data Acquisition (DAQ) Capability frame

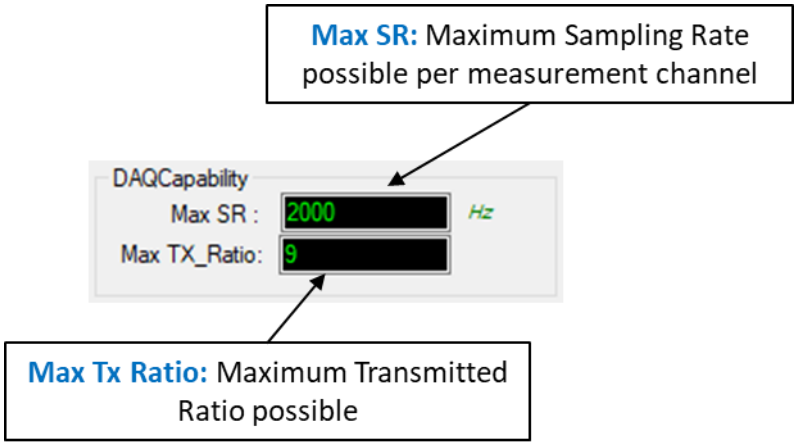



*Figure 57:DAQ Capability frame*

### 7.2.8 Device configuration

The Device configuration's information is sorted in 3 tabs displayed on Top-right of the dashboard. The first tab displays the **BeanDevice® config. Status** the second displays the **BeanSensor Info.** And the third one is for **Shock Sensor Status.** Using the navigation buttons facilitate the navigation between the tabs.

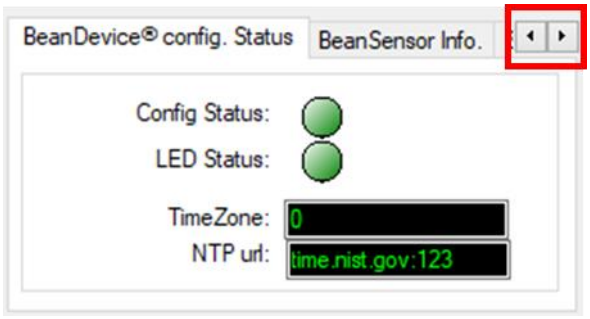



*Figure 58:BeanDevice®Configuration Multi frame*

### 7.2.8.1 BeanDevice® config. Status

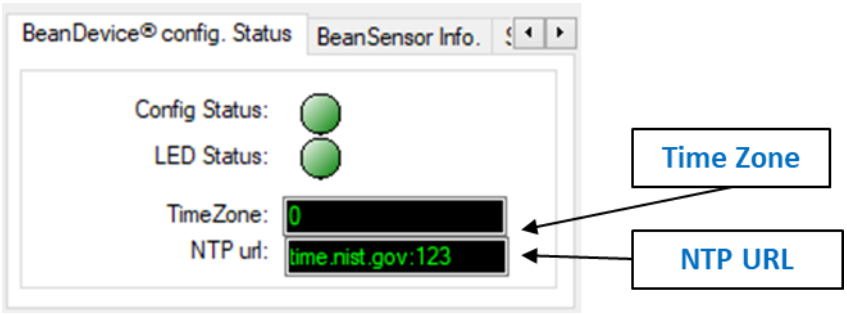



*Figure 59: BeanDevice® config. status frame*

The information related to the time zone and the NTP configuration is to set from the main configuration frame.

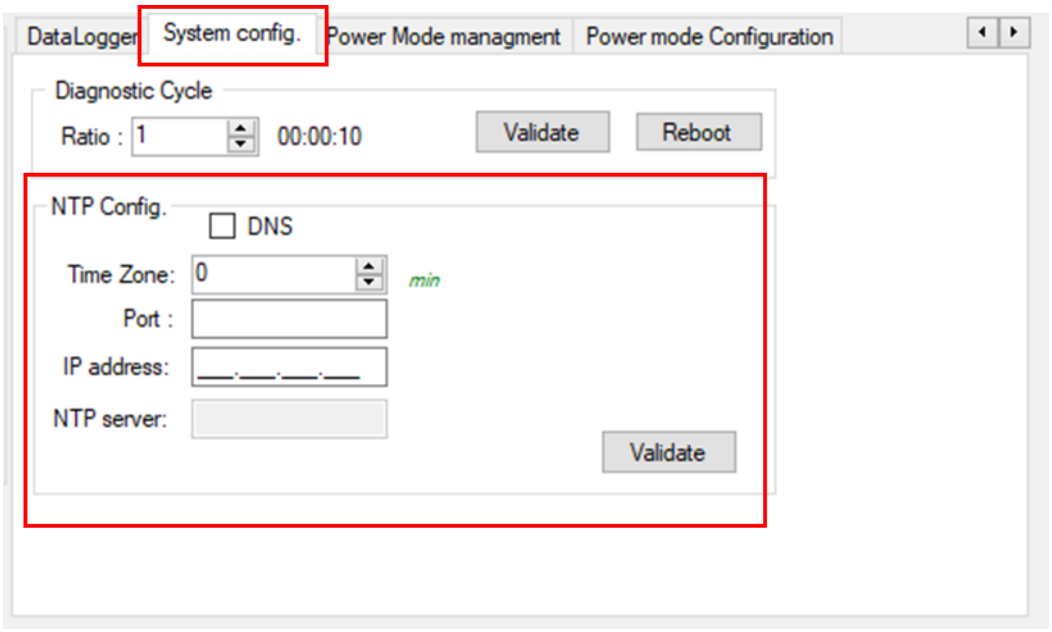



*Figure 60: NTP system configuration frame*

### 7.2.8.2 BeanSensor® Info.

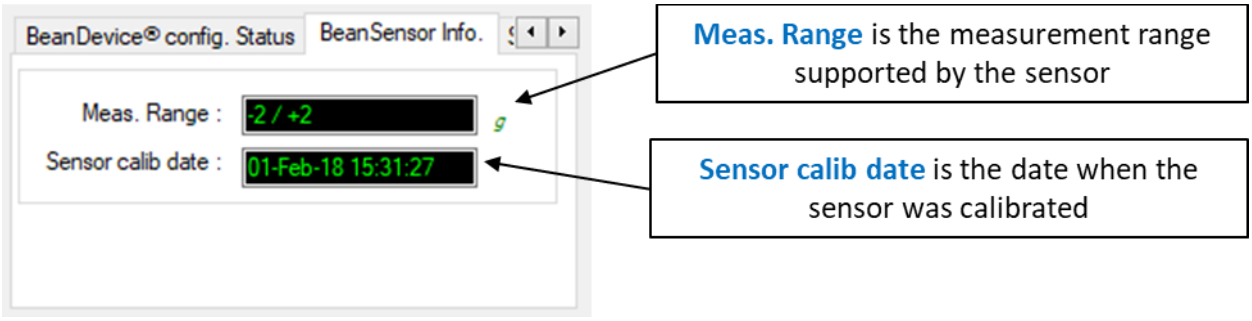



*Figure 61: BeanSensor® Info frame*

### 7.2.8.3 Shock Sensor Status

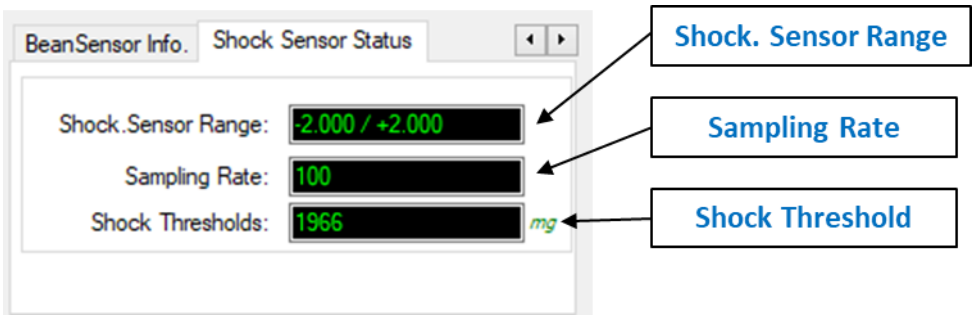



*Figure 62: Shock Sensor status frame*

The information displayed on Shock sensor Status tab can be set from the main configuration frame, from the Shock Sensor Config tab.

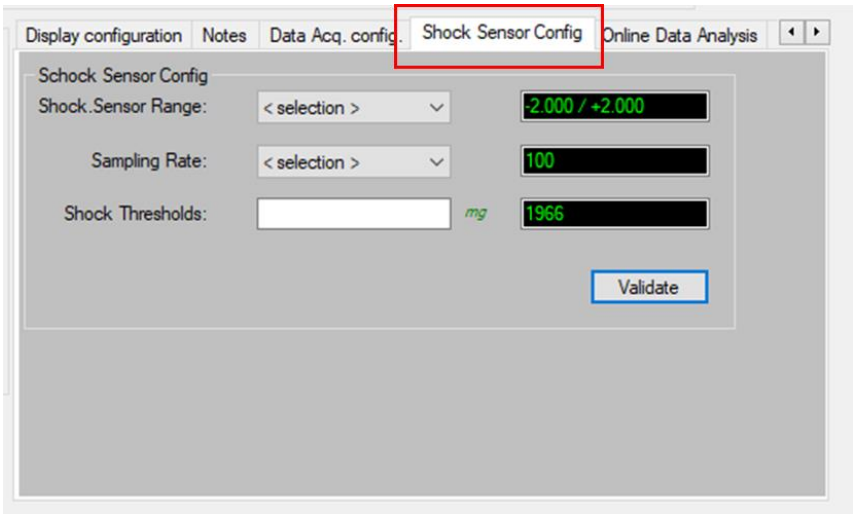



*Figure 63: Shock sensor config frame*

### 7.2.9 Product Version frame

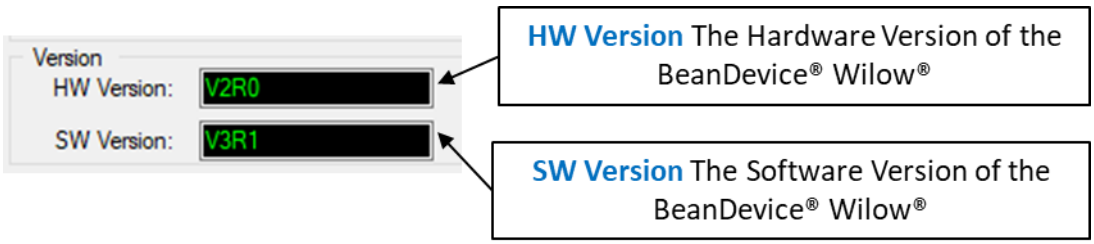



*Figure 64: BeanDevice Hardware/Software version*

***V (version)*** related to a major modification of the embedded software.

***R (Release)*** related to a minor modification of the embedded software

***These ID versions should be transmitted to our technical support center when you encounter a material or software dysfunction.***

### 7.2.10 Current Data Acquisition mode frame

This frame displays all the information returned by the BeanDevice® WiLow® on its actual data acquisition mode:

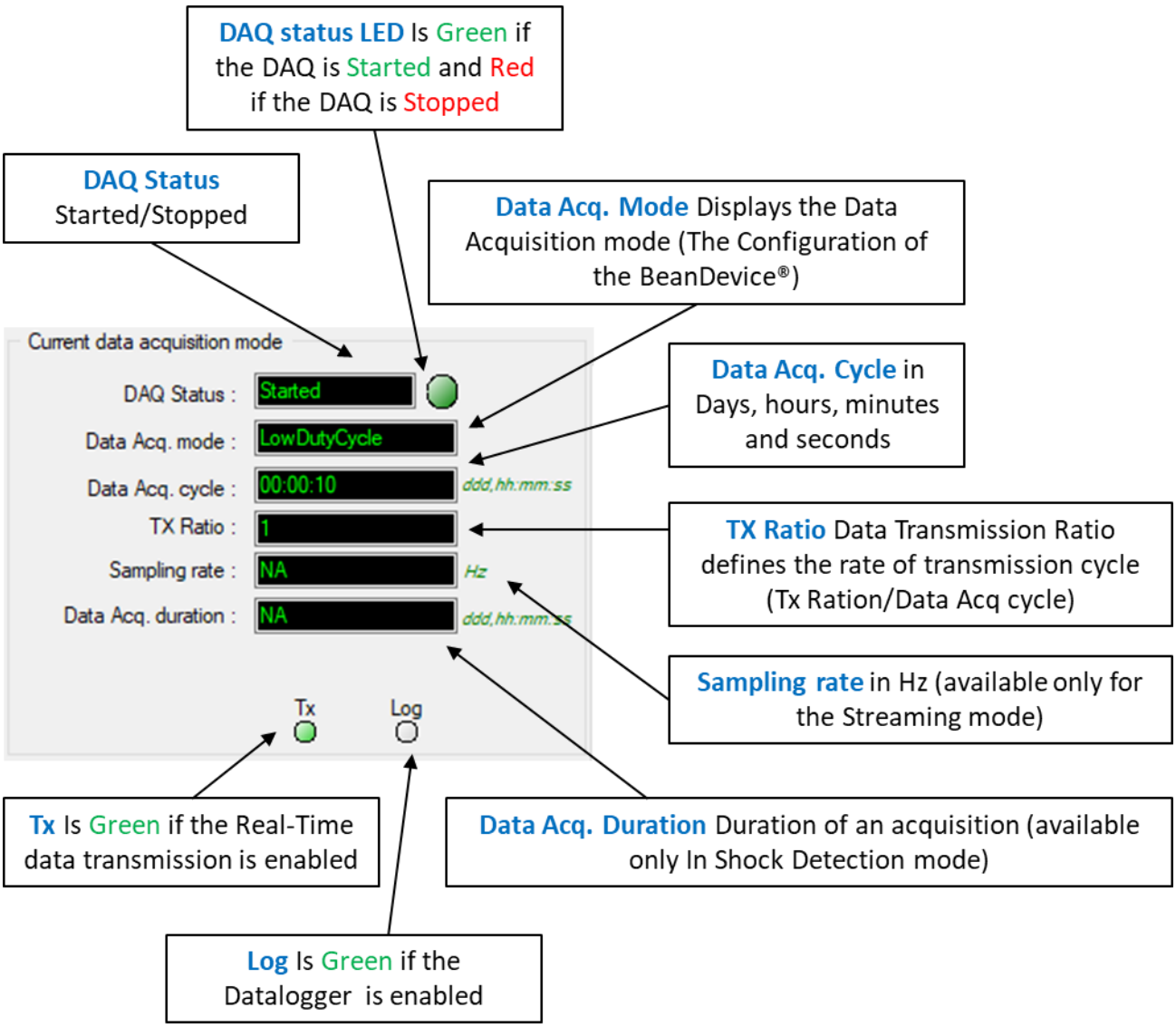



*Figure 65: Frame curent data acquisition mode*

***Please read the following section for more information about Data acquisition modes:*** "click here"

## 7.3 BEANDEVICE® WILOW® CONFIGURATION

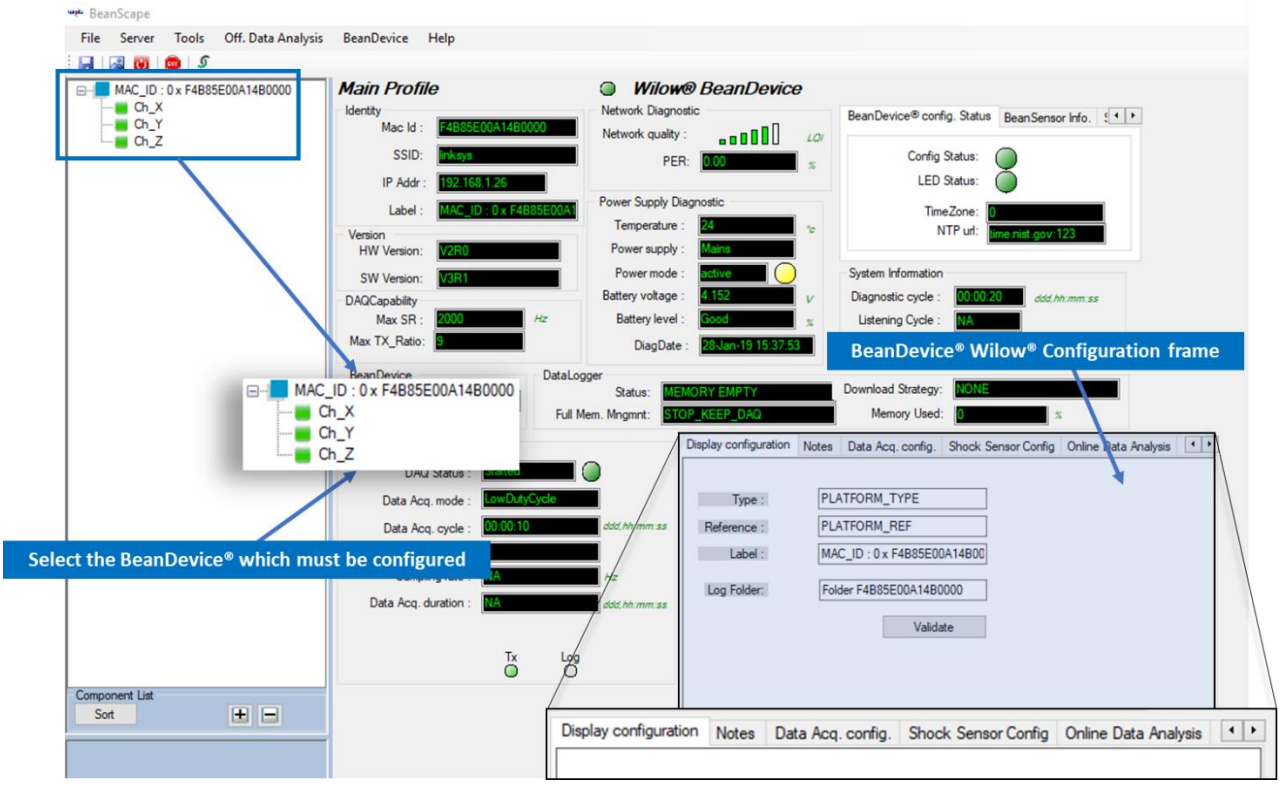



*Figure 66: BeanDevice® configuration frame*

Move down to the configuration frame which is composed of several Tabs and includes BeanDevice® OTAC (Over the Air Configuration) Parameters:

| Tab | Description |
|---|---|
| ***BeanDevice® WiLow® Label*** | Customize the BeanDevice® WiLow®label |
| ***Notes*** | This area contains the notes related to the BeanDevice® WiLow®. |
| ***Data Acquisition configuration*** | Configure the Data acquisition mode on your BeanDevice® WiLow®, set the acquisition cycle or the sampling rate, enable/disable the datalogger function. |
| ***Shock configuration*** | Smart Shock Detection configuration (available only on BeanDevice® WiLow® AX-3D and BeanDevice WiLow® AX-3DS) |
| ***Datalogger*** | Onboard datalogger configuration |
| ***System configuration*** | Configure the diagnostic cycle |
| ***Power Mode Management*** | Configure the Power mode on your BeanDevice® Wilow (Active mode, Sleep mode) |

### 7.3.1 Display configuration

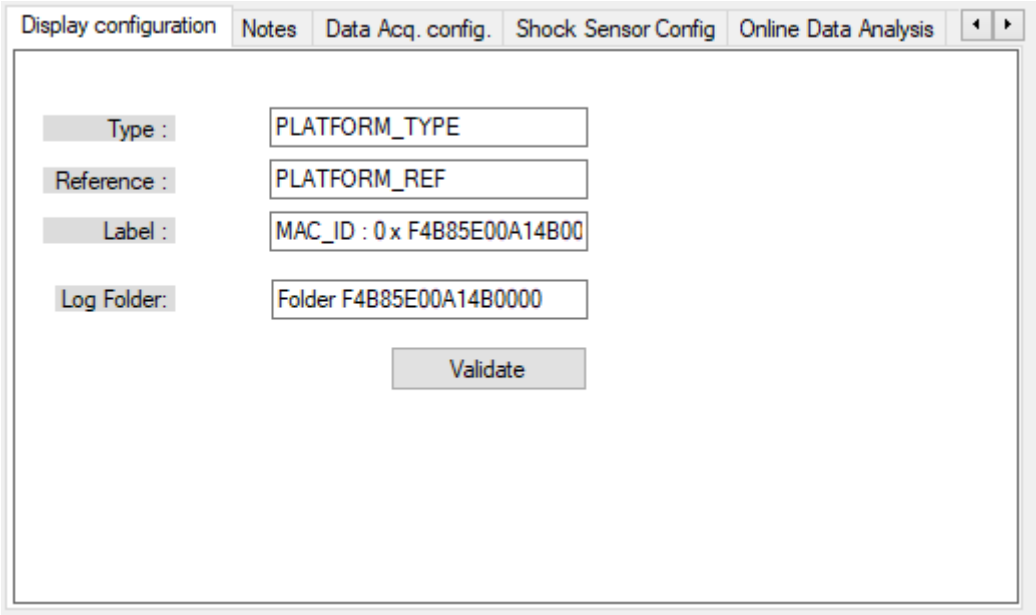



*Figure 67: BeanDevice ® Display configuration tab*

| Parameter | Description |
|---|---|
| ***Type*** | You can enter here the type of BeanDevice® WiLow® you want to use |
| ***Reference*** | You can assign an internal reference to the BeanDevice® WiLow® you have purchased. |
| ***Label*** | You can assign any sort of Label to your BeanDevice® WiLow®. Therefore, the user can easily associate the BeanDevice® with its equipment (example: Room_N521_Second_Floor) |
| ***Log Folder*** | Specify the log folder where the received measurement logs should be backed up |

Click on "***Validate***" if you want to validate your configuration.

### 7.3.2 Notes Tab

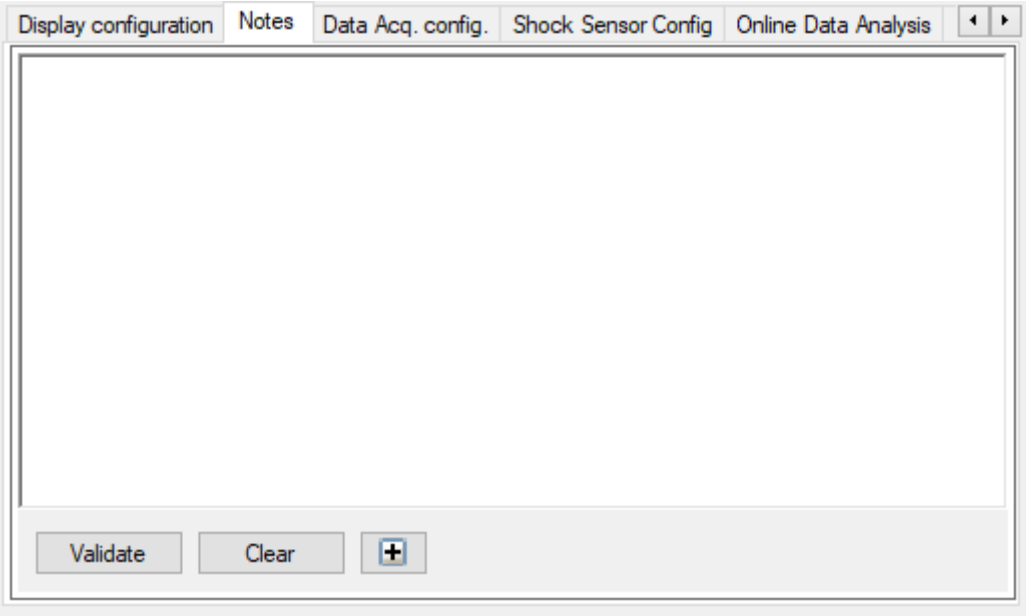



*Figure 68: Tab: Notes*

This field contains your notes concerning the BeanDevice®. To change this field, enter your text and click on « ***Validate*** » button. To back up your text, press the icon

***Example***: Machine failure n°XX, requested intervention.

### 7.3.3 Data acquisition configuration Tab

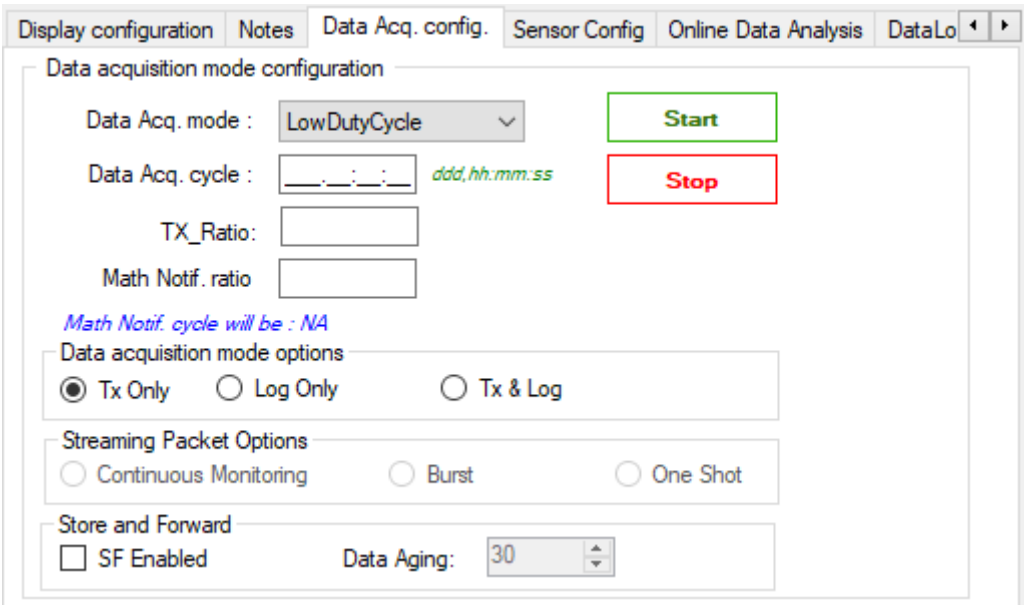



*Figure 69: Data Acquisition configuration tab*

| Parameter | | Description |
|---|---|---|
| Data Acquisition modes | ***Low duty cycle Data Acquisition (LDCDA)*** | Low duty cycle data acquisition is adapted for static measurement (tilt, pressure, temperature) requiring a low power consumption on your BeanDevice®. The duty cycle can be configured between 1 data acquisition & transmission per second to 1 data acquisition & transmission per day. |
| | ***Alarm*** | A data acquisition is transmitted<br>▪ Whenever an alarm threshold (fixed by the user) is reached (4 alarm threshold levels High/Low).<br>▪ A transmission cycle is reached, the transmission cycle is configurable through the BeanScape® 1s to 24h |
| | ***Streaming*** | Streaming is more suitable for users requiring a high data sampling rate (maximum 2 KHz). In order to achieve these performances, data sampling are transmitted by packet; |

| | | |
|---|---|---|
| | ***Shock Detection*** | If a shock threshold is detected, the BeanDevice® starts to transmit all the Data acquisition to the WIFI Network |
| | ***S.E.T*** | The streaming with event trigger mode allows user to receive notification via email when the measurement reaches the preconfigured thresholds, the measurement is in streaming mode with high sampling rates (up to 200 Sps) unlike in the alarm mode. |
| Data acquisition Cycle | Select the Data acquisition cycle between 1s and 24hours.<br>The format is: Day : Hour : Minute :Second | |
| Sampling rate | Select the sampling rate of your BeanDevice® between 1 sample per second and 2000 Samples per second at maximum.<br>This field is available in streaming mode:<br>Choose carefully the Sampling rate value:<br>✓ The PER (Packet Error Rate) can increase if the Sampling rate is high on your BeanDevice®. For further information read the technical note ***TN_RF_014 - "Wireless Network capacity"***<br>✓ Power consumption increases with the sampling rate of your BeanDevice® | |
| Data acquisition duration | Data acquisition duration in streaming mode.<br>The format is Day: Hour: Minute: Second<br>The Data acquisition duration value cannot be higher than Data acquisition cycle. | |
| Options | ***TX only***: Real-time data transmission is enabled<br>***Log only***: Real-time data logging is enabled<br>***TX & Log***: Real-time data transmission and data logging are enabled<br>***SA: Standalone:*** The BeanDevice® WiLow® logs all the data acquisition with no need of Wireless network | |

| | |
|---|---|
| Streaming options | ***No survey***:<br>***Survey***:<br>***One shot:*** streaming continuously for a predefined duration<br>***Continuous Monitoring***: streaming continuously<br>***Burst***: Streaming data every predefined cycle and for a predefined duration |
| Store and Forward+ | ***SF Enabled***: enable Store and forward option |

***For further information about the Shock detection mode please refer to this technical note TN_RF_018 – "Data acquisition modes available on the BeanDevice®"***

***See our technical video "Stop Button Overview" on YouTube***

All the modifications are displayed on "***Current data acquisition mode***" frame:

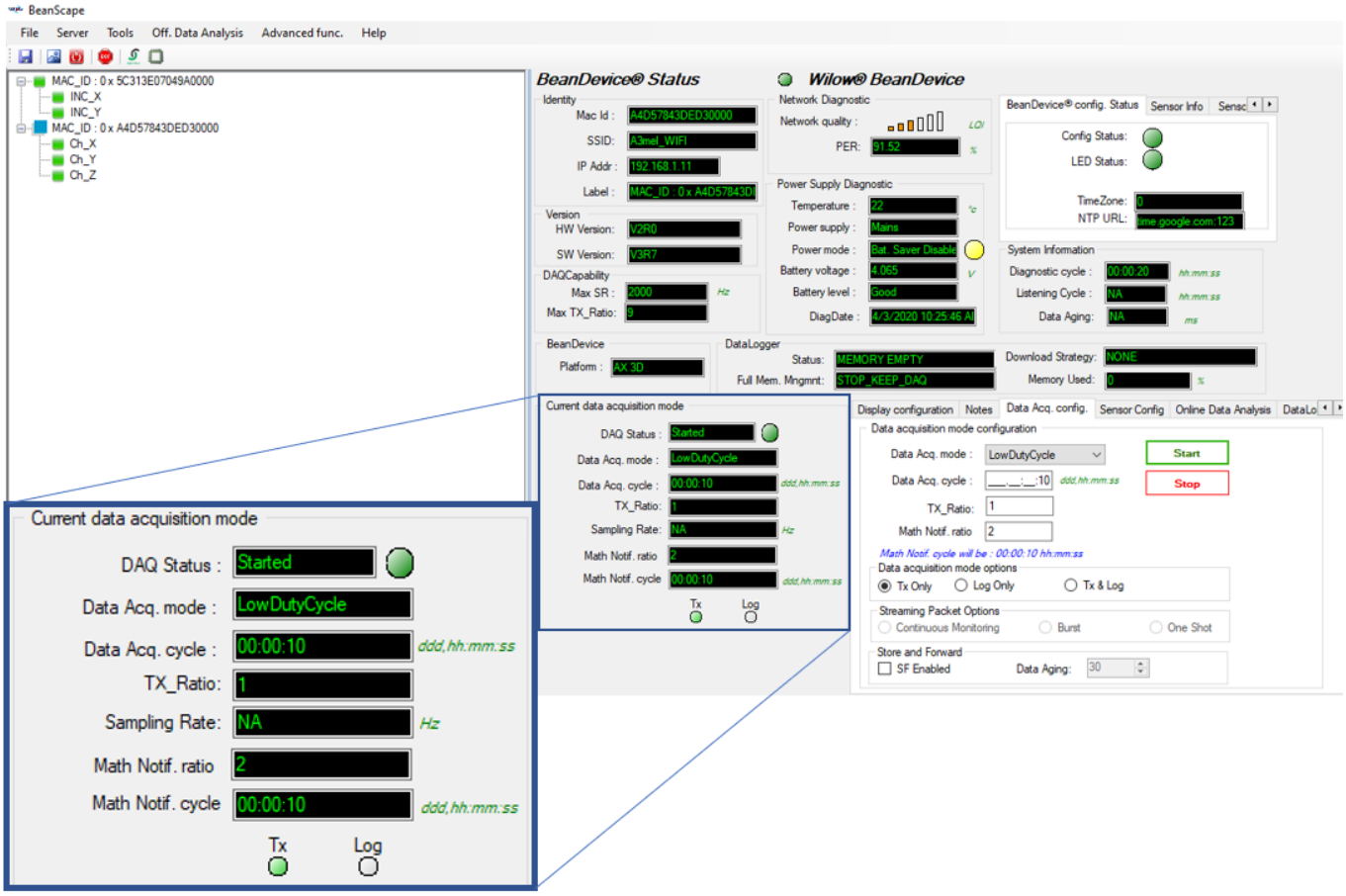



*Figure 70: Current data acquisition mode display*

***For further information, please read the technical note TN_RF_018 – "Data acquisition modes available on the BeanDevice®"***

### 7.3.4 Shock Sensor Config Tab

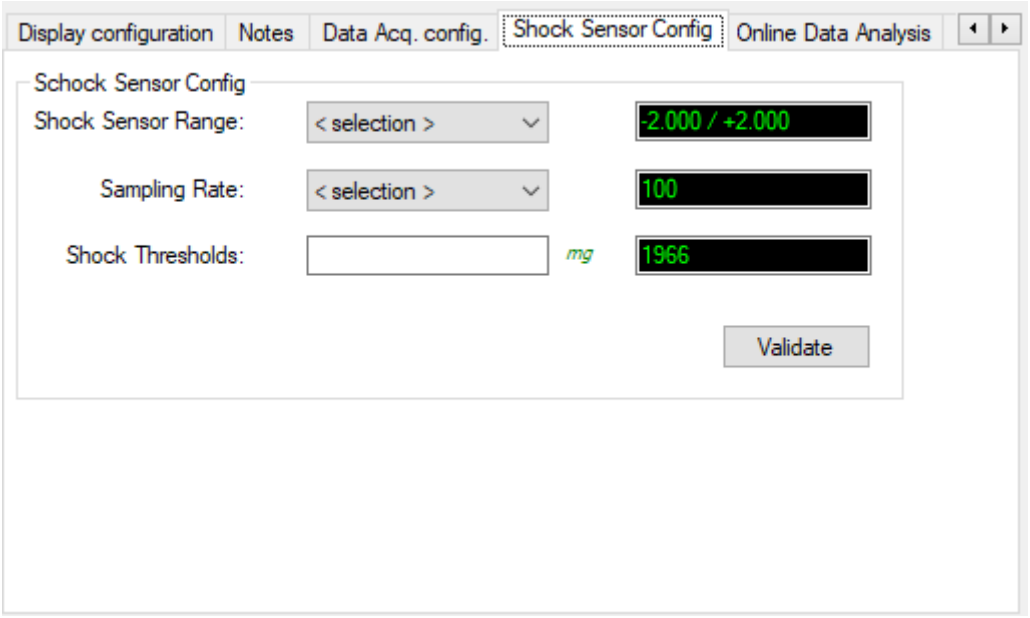
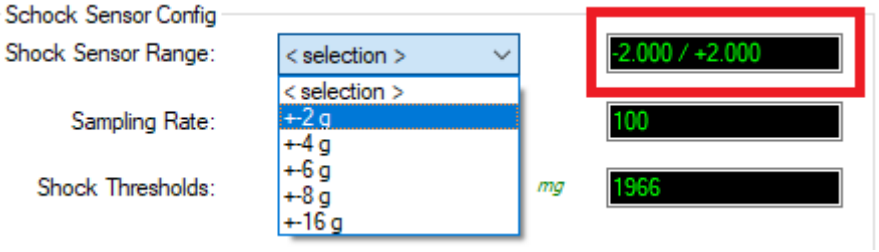



*Figure 71: Shock Sensor Config tab*

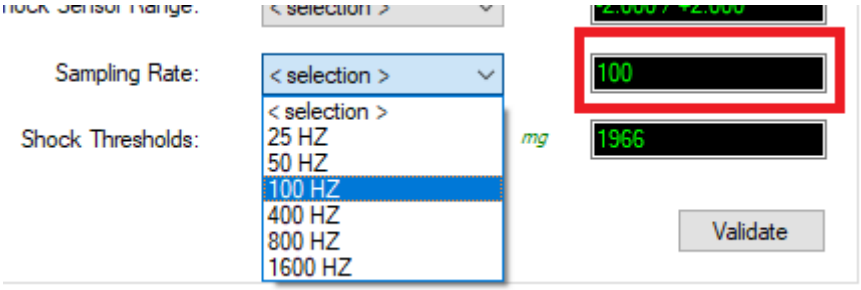
- ***Shock Sensor Range:*** This option allows the user to change the Shock sensor range from the list, as displayed below. The available Shock Ranges are +/-2g, +/-4g, +/-6g, +/-8g or +/-16g.

  The selected value will be displayed on the black case.



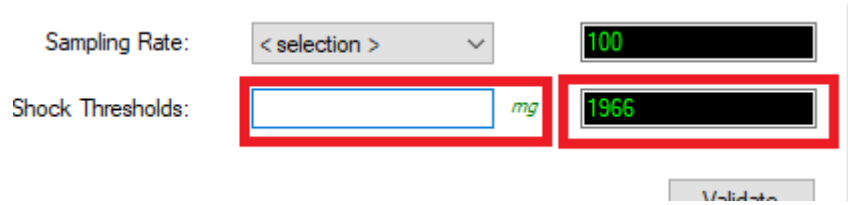
- ***Sampling Rate:*** This option allows to change the Sampling Rate of the Shock Senor from the listed values: 25Hz, 50Hz, 100Hz, 400Hz, 800Hz or 1600Hz.

The selected value will be displayed on the black case.




- ***Shock Thresholds:*** This input is used to change the Shock Thresholds. The value should be written manually.

The Unit of the Shock Thresholds is "**mg**". The selected value will be displayed on the black case.



### 7.3.5 Online Data Analysis Tab (only available on the BeanDevice® Wilow® AX-3D)

In signal processing tab, we setup the real time FFT and real time velocity (PPV & PVS), as well enable/disable the IIR filter.

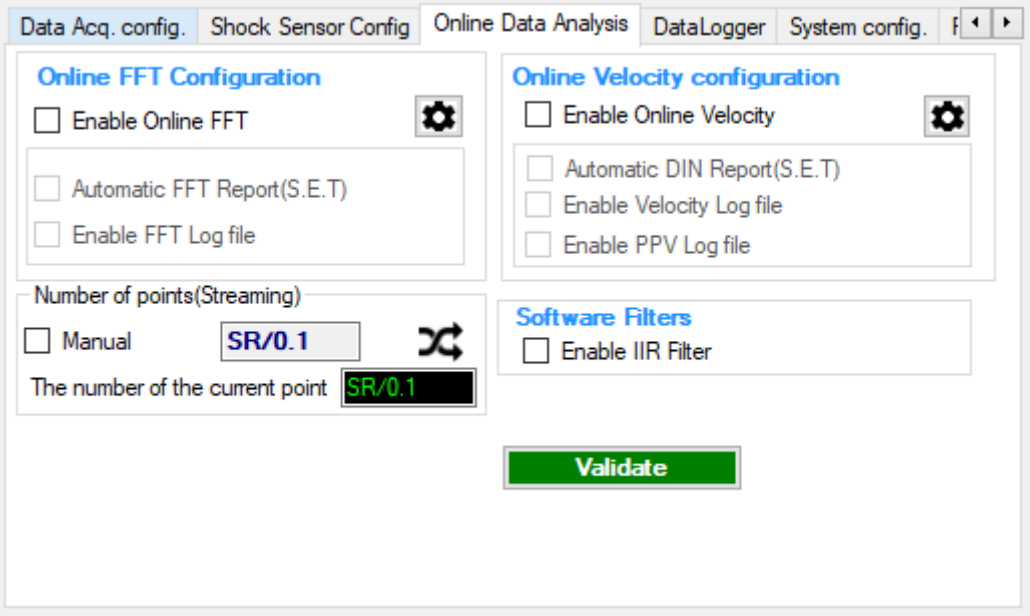



*Figure 72: Signal Processing Tab*

| Parameter | Description |
|---|---|
| *Online FFT Configuration* | • **Enable Online FFT**: check to enable real time FFT processing<br>▪ **Automatic FFT Report (Set Mode):** check for automatically sending the FFT report by email when alarm occurs on streaming with event-trigger(set) mode<br>▪ **Enable FFT Log file**: check to create FFT folder and log all real time FFT data<br>▪ ⚙ : check to modify the FFT Advanced Configuration settings |
| *Online Velocity configuration* | • **Enable Online Velocity**: check to enable real time velocity processing<br>• **Automatic DIN Report (Set Mode):** check for automatically sending the DIN 4150-3 report by email when alarm occurs on streaming with event-trigger(set) mode<br>• **Enable Velocity Log file:** check to create Velocity folder and log all real time Velocity<br>• **Enable PPV Log file:** check to create PPV Log file<br>• ⚙ : check to modify the Velocity Advanced Configuration settings |

| | |
|---|---|
| ***Software filters*** | • **Enable IIR Filter**: check to enable the IIR (infinite impulse response) filter for the High sampling rate acquisition modes. |
| ***Number of points(Streaming)*** | • **Manual:** check to configure the number of points related to the Sreaming manually.<br>•  **:** check to modify the FFT Spectral Resolution Converter |

Click on "***Validate***" if you want to validate your configuration.

 For streaming with event trigger (S.E.T mode), notification by email configuration should be configured on tools -> alarm management

 In order to use Real time PPV, you should use high sampling rate to provide good PPV values.

 You need to sample at 200Hz at least to provide good PPV values.

 By using SET mode, you need to choose the highest sampling rate which is 200Hz and don't forget to enter a DAQ duration higher than 10s.

 For Streaming mode, choose at least 500Hz and above with a minimum DAQ duration of 10s, to provide good PPV measurement.

 ***For further information about the Shock detection mode please refer to this technical note TN_RF_018 – "Data acquisition modes available on the BeanDevice®"***

### 7.3.6 DataLogger Tab

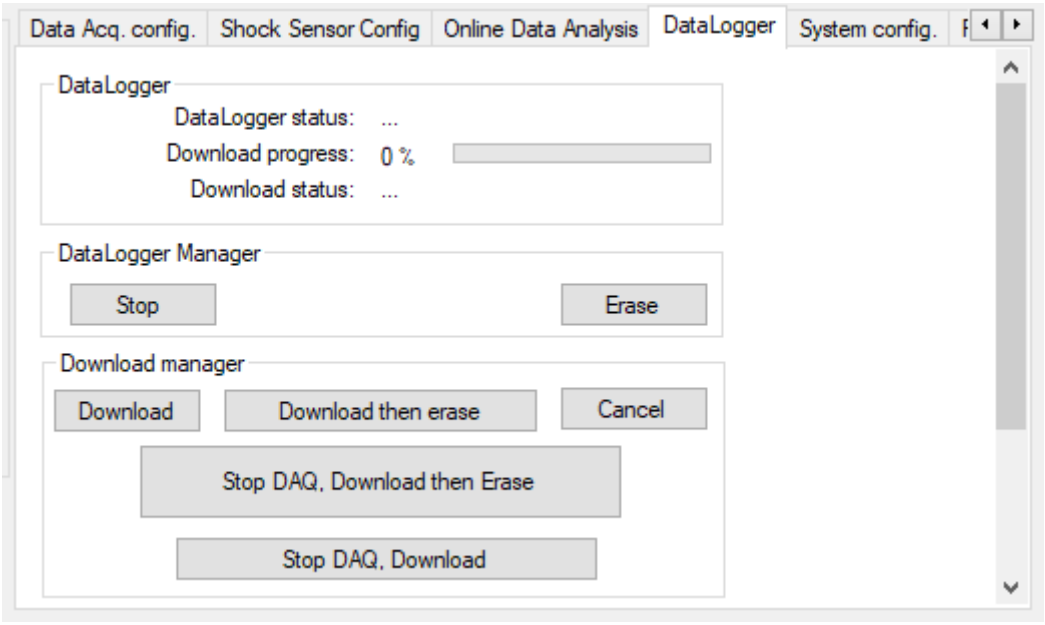
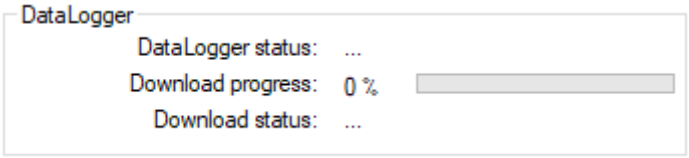



*Figure 73 : Datalogger tab*

The DataLogger tab is composed of four different fields:

- ***Datalogger Status***
- ***Datalogger manager***
- ***Download manager***
- ***Datalogger memory configuration***

#### 7.3.6.1 Datalogger status



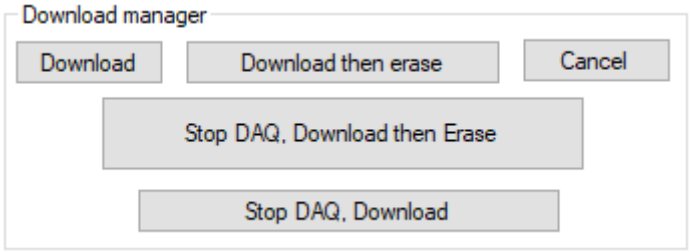

- ***Datalogger status***: Displays loggers' status, four status are available:
  - ***Ready***: the Datalogger is ready to register data
  - ***NotInit***: the Datalogger is not initialized
  - ***Active logs only***: Data acquisition is logged only
  - ***Active TX and Log***: Data acquisition is logged & transmitted by Radio
  - ***Stopped***: Datalogger is stopped
- ***Download progress***: Displays the download process 0 to 100%. If 100%, all the data logs are successfully downloaded on your PC.

- ***Download status***: Displays the download status, two types of status are available:
  - ***Processing***: Data logs download is under process
  - ***Completed:*** Data Logs are completely downloaded on your PC

#### 7.3.6.2 Datalogger manager

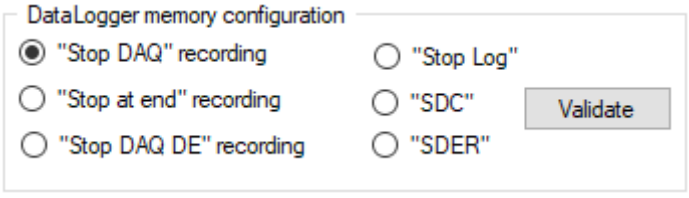

- ***Stop***: Stops Data Logging process
- ***Erase***: Erases all the logs on flash memory

#### 7.3.6.3 Download manager




- ***Download***: Starts to download all the logs on the flash memory
- ***Download then erase***: downloads all the logs and the erase them.
- ***Cancel***: Stops the download process
- ***Stop DAQ, download then erase***: Stop the acquisition, download the data logged then erase it
- ***Stop DAQ, Download***: Stop the acquisition then download (without erasing the data logged)

#### 7.3.6.4 Datalogger memory configuration




Datalogger strategies when the Memory if full

- ***"Stop DAQ" recording***: Stop the acquisition when the memory is full
- ***"Stop at end" recording:*** Data recording stops when the memory is full
- ***"Stop DAQ DE"recording:*** Stop the acquisition ,Download then erase the recording
- ***"Stop Log":*** Stop logging and recording (switch to TX recording)

- ***"SDC":*** Stop the acquisition then download recording
- ***"SDER":*** Download the recording then erase the data logged then restart recording again

***For further information about Datalogger Please read the following section***

***See our technical video "Wilow - Wi-Fi Sensors-Downloading data logs - Wilow IOT sensors" on YouTube***

***See our technical video "Wilow - Wi-Fi Sensors- Datalogger memory configuration" on YouTube***

### 7.3.7 System configuration Tab

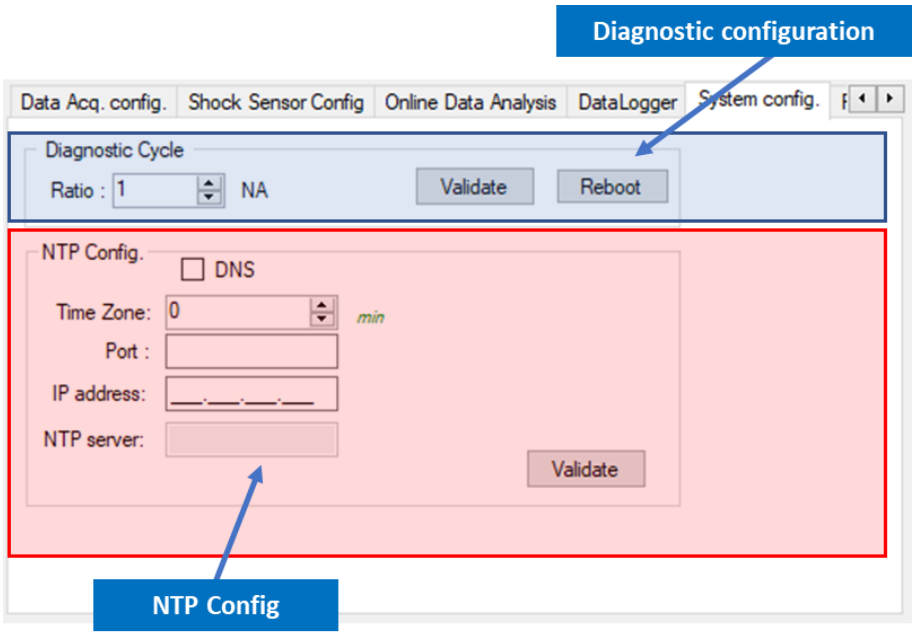



*Figure 74: System configuration tab*

| *Parameter* | *Description* |
|---|---|
| ***Diagnostic cycle*** | You can set the BeanDevice® Wilow® diagnostic cycle (Battery status, LQI, PER ...). Diagnostic cycle is a ratio of the data acquisition transmission cycle.<br><br>***Ex***: If you try to set the diagnostic cycle ratio at 2 while the data acquisition cycle is set at 5s, the diagnostic cycle will be settled to 10s ; |
| ***Reboot*** | Restarts your BeanDevice® Wilow® from BeanScape® software. |
| ***NTP config*** | **NTP (Net Time protocol) configuration**<br>The BeanDevice® Wilow® comes with an embedded SNTP Client, by default this device is working with UTC +0 Time Zone<br>**User can specify:**<br>• Time Zone with minutes resolution<br>• NTP server:<br>  ○ If DNS is activated: enter the port ID and the NTP server address<br>  ○ If DNS is not enabled: enter the port ID and the NTP server IP<br>We recommend you to use **time.nist.gov** (PORT ID :123) NTP server |

***See our technical video "Wilow - Wi-Fi Sensors-Diagnostic cycle on BeanDevice® Wilow" on YouTube***

***See our technical video "Wilow - Wi-Fi Sensors-NTP Net Time Protocol configuration" on YouTube***

### 7.3.8 Remote Configuration

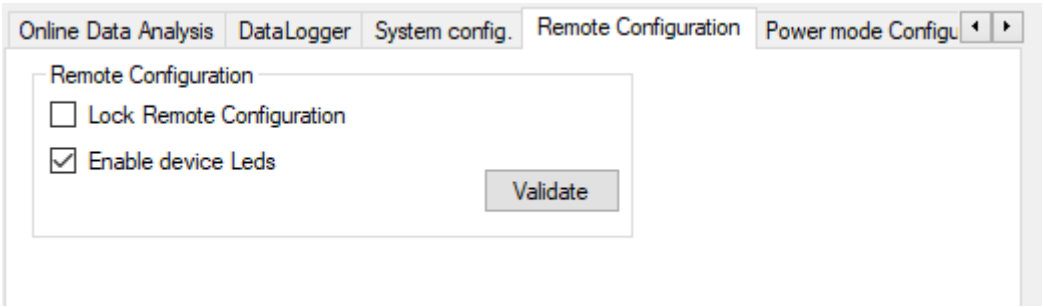
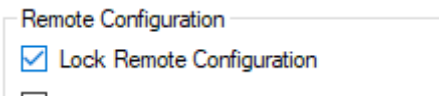



*Figure 75: Remote Configuration*

- ***Lock Remote Configuration:*** By enabling this option the BeanDevice® WiLow® will not receive any command (OTAC) from BeanScape® except the Unlock Remote Configuration Command.



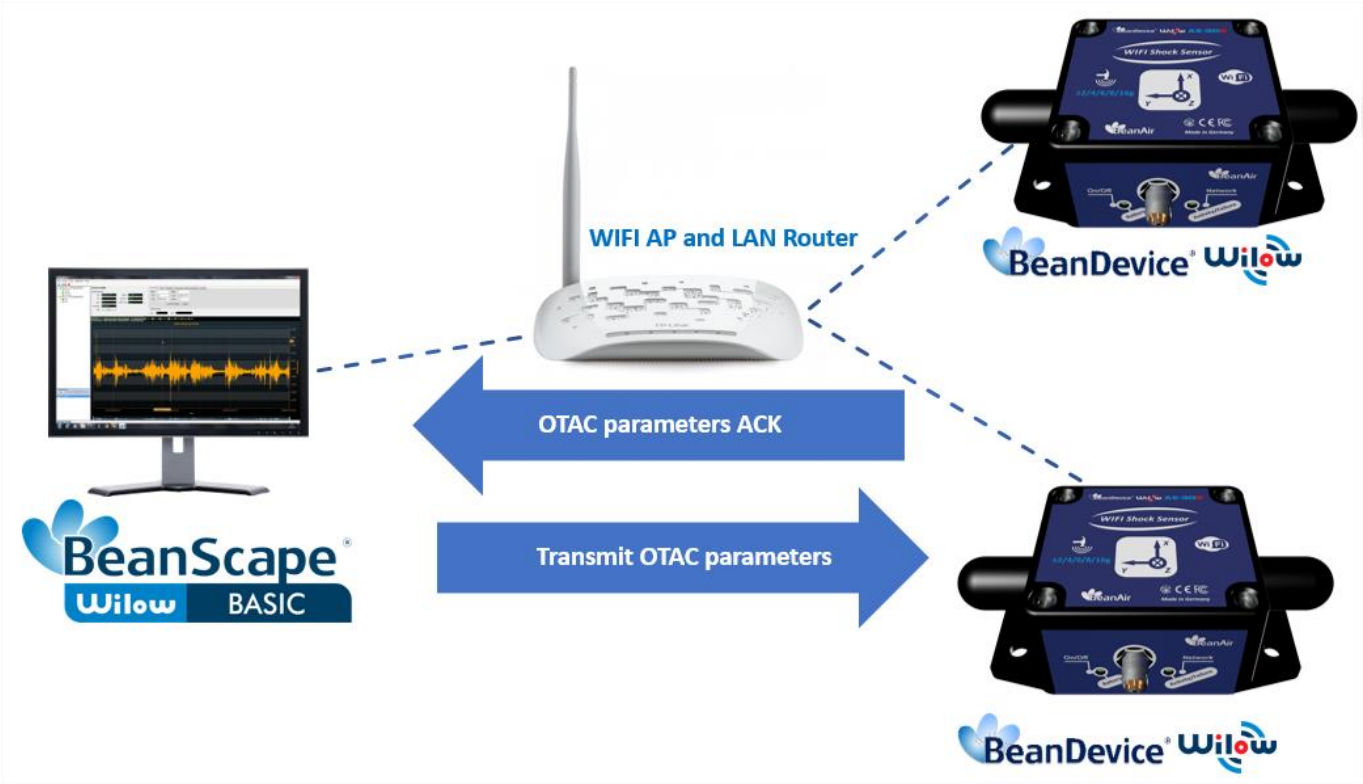

- ***Enable device Leds:*** By disabling this option the LEDs of the BeanDevice® WiLow® will not be able to do any signal or to blink until Enabling this functionality again.

### 7.3.9 Power mode configuration Tab

✓ ***Power mode configuration:*** Configure the Power mode on your BeanDevice®

| *Parameter* | *Description* |
|---|---|
| ***Power mode configuration*** | ***Active:*** Sleeping mode is disabled. The BeanDevice® operates in Active power mode.<br>***Sleep:*** Sleeping mode is enabled.<br>***Ratio***: Setup the Ratio of the listening cycle. This ratio depends on the data acquisition low duty cycle. |

✓ ***« ACTIVE» POWER MODE:*** In active power mode, the BeanDevice® is active every time. The Wi-Fi link between the BeanDevice® and the router is always conserved.




If your BeanDevice® is set to "**Active**" power mode, your battery may drain quickly. If you want to extend your battery autonomy, you must configure your BeanDevice® in "**sleep**" power mode.

In active mode, your BeanDevice® is always active; it will receive instantly your OTAC command

- ✓ ***SLEEP POWER MODE:***

When the BeanDevice® operates in "**sleep mode**", it sends periodically a request (called listening cycle) to the router for an OTAC command.

The user can easily configure the listening cycle depending on the data acquisition low duty cycle. In sleep mode, it is possible to remotely transmit an OTAC configuration to the BeanDevice® without sacrificing its ultra-low power consumption.

**Example 1**: The Data Acquisition Cycle in Low Duty Cycle mode doesn't affect the Listening Cycle of the Sleep Mode. The BeanDevice® will receive OTAC After the Listening Cycle.

If the Data Acquisition Cycle is 15 seconds and the Listening Cycle is 60 seconds, the OTAC will be received every 60 seconds.

***The minimum sleep cycle possible is 25 seconds (data acquisition cycle is set to 1 second) as the lowest ratio value possible is 25.***

"Active" power mode

- ***Advantages:*** The OTAC parameter is rapidly handled by the BeanDevice®
- ***Constraint(s):*** high power consumption

"Sleep " power mode

- ***Advantages:*** low power consumption, you can remotely configure the BeanDevice®
- ***Constraints:*** The BeanDevice® cannot be configured instantly, it depends on the Network Listening duty cycle specified by the user.

- POWER MODE MANAGEMENT FROM THE BEANSCAPE®

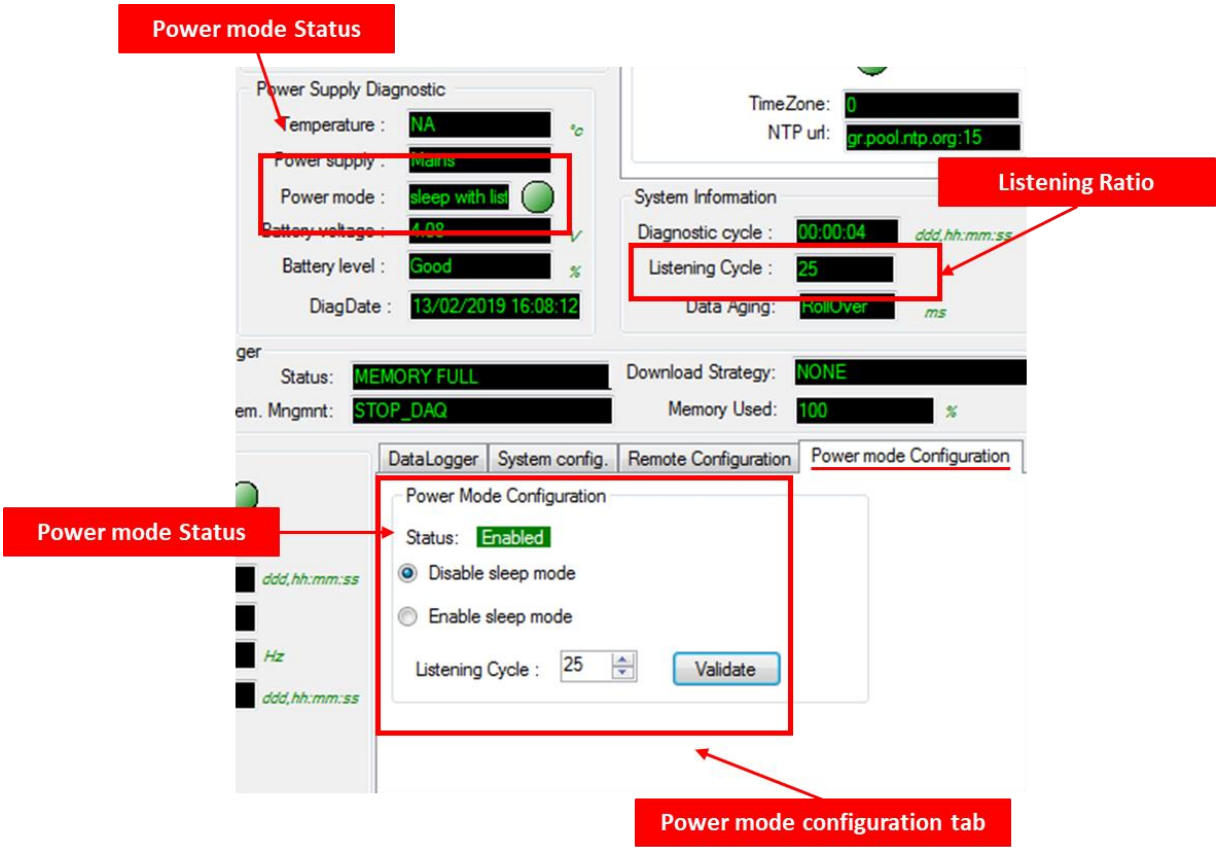



*Figure 76: Power mode management (display features)*

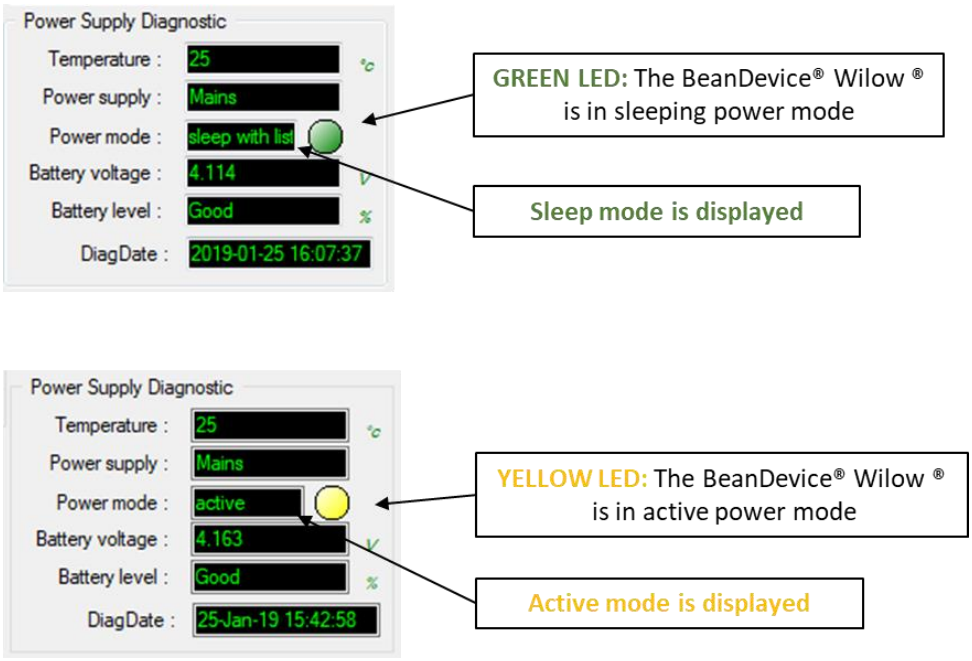



*Figure 77: Power mode display*

- ***Enable sleep mode:*** To enable the Sleep mode, the user should select the radio button "Enable sleep mode" and set the Listening Ratio. To confirm the configuration, click on validate.

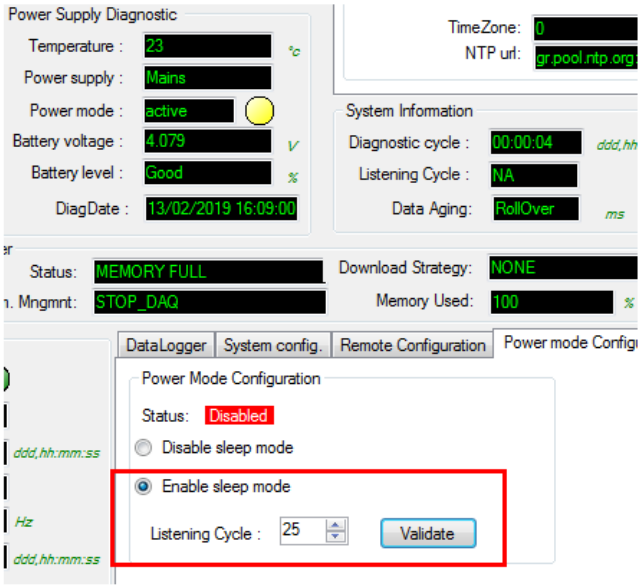



*Figure 78: Enable sleep mode*

Once enabled, the BeanScape® will display the new power mode and the listening cycle.

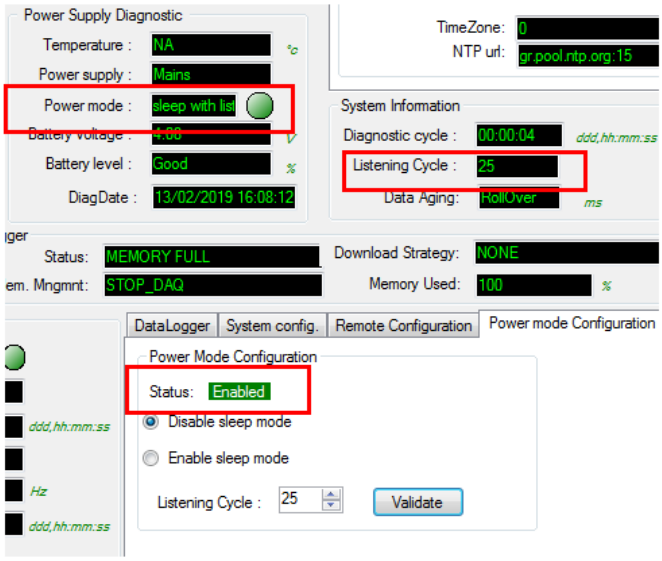



*Figure 79: Sleep mode enabled (visual features)*

- ***Disable sleep mode:*** To disable the Sleep mode, the user should select the radio button "Disable sleep mode" and click on validate.

***The Sleep mode will not be disabled immediately by clicking on validate, it will take place after finishing the Listening Cycle.***

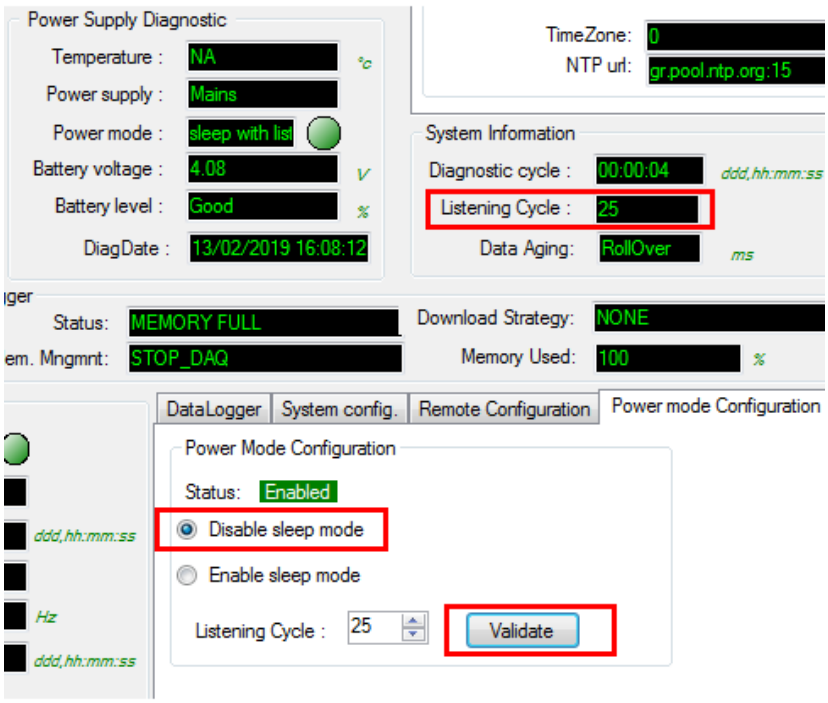



*Figure 80: Disable sleep mode*

### 7.3.10 Right Click functionalities

BeanScape® offers access to quick functionalities in relation with BeanDevices® WiLow®. By using the mouse, Right Click on the BeanDevice® WiLow® profile then you can quickly

- ***Change the Device Label***
- ***Restart the Device***
- ***Remove the Device***

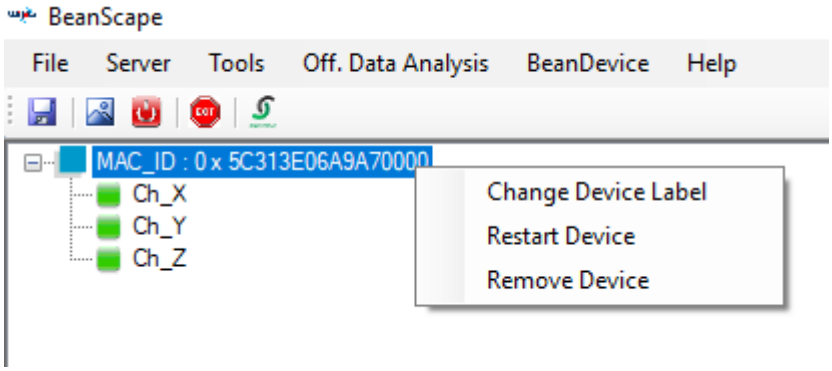



***Figure 81: Right Click on BeanDevice® Profile***

**Change the Device Label:** Used to change the BeanDevice® WiLow® Label directly instead to use the main configuration frame.

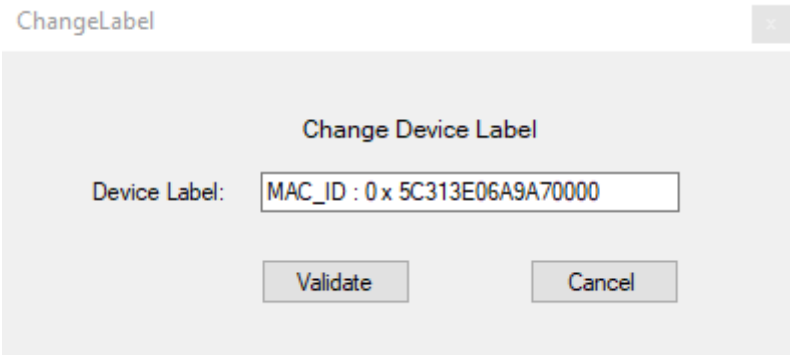



***Figure 82: Right click- change label***

**Restart Device:** Used to restart the BeanDevice® WiLow®

**Remove Device:** Used to remove the BeanDevice® WiLow® from the list. By selecting this option the BeanScape® will ask the user to Localize the BeanDevice® WiLow on the Network before finishing the Remove operation.

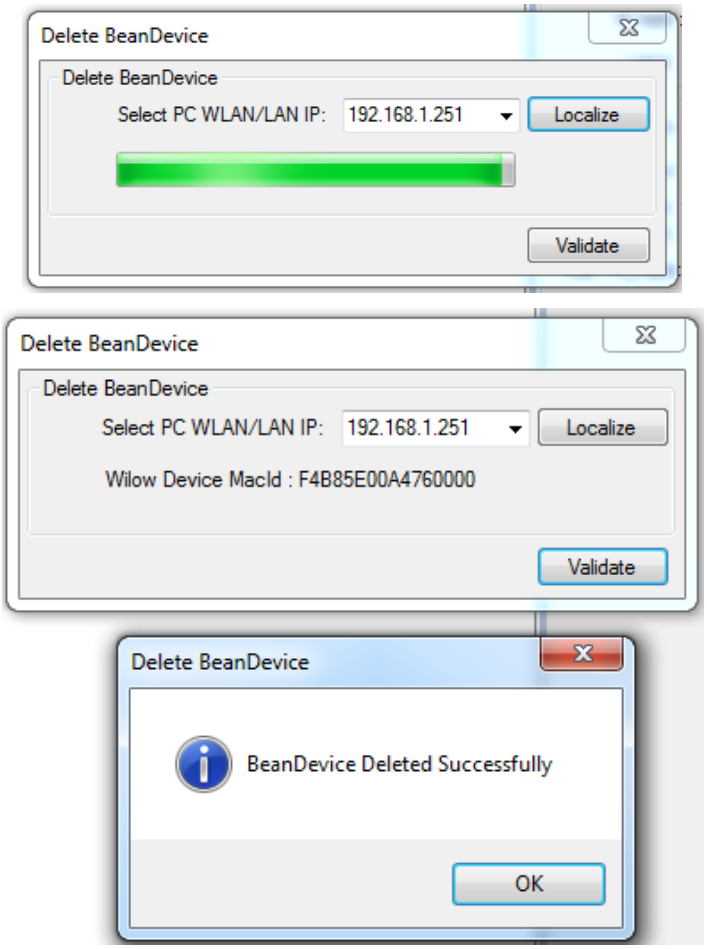



*Figure 83: Right click- Remove BeanDevice®*

BeanScape® offers also the access to quick functionalities in relation with BeanSensor® By using the mouse, Right Click on the sensor channel then you can quickly

- ***Change State to ON/OFF***
- ***Change Sensor Label***
- ***Disable/Enable log***

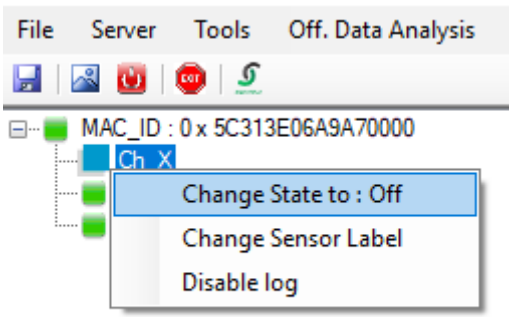



*Figure 84: Right click on sensor channel*

**Change state to ON/OFF:** Used to disable or enable the sensor channel. User can also use the State button on the sensor profile dashboard.

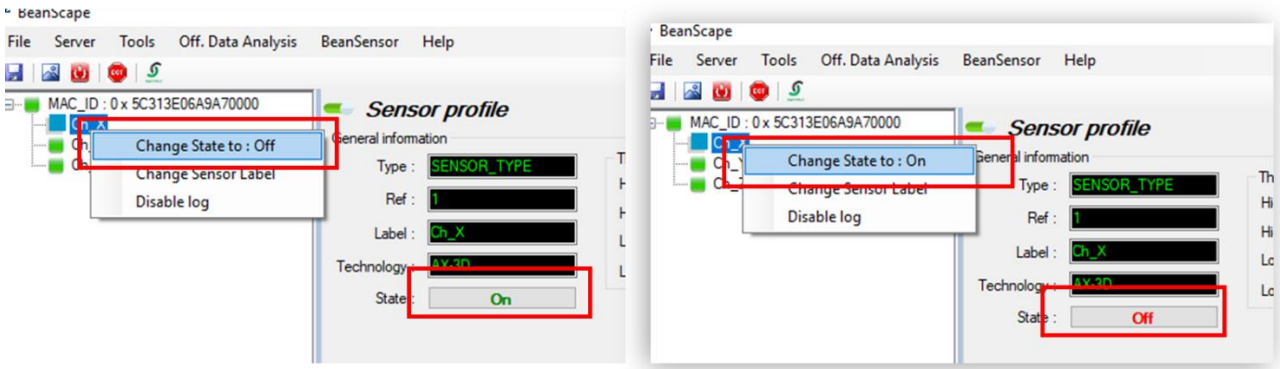



*Figure 85: Change Sensor state functionality*

**Change sensor label:** Used rename the sensor channel.

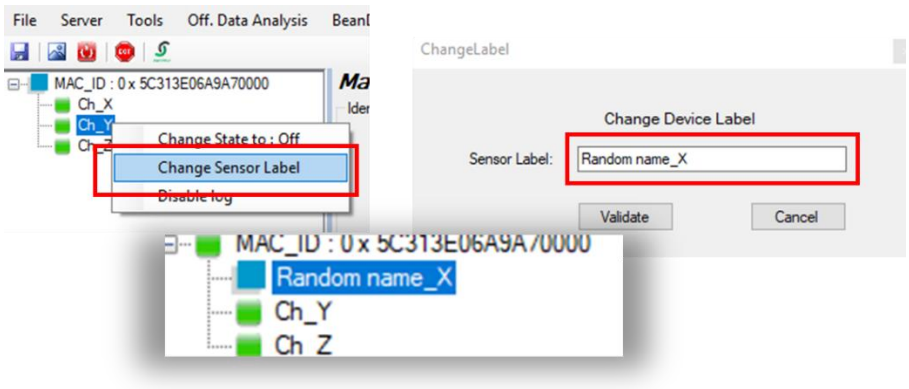



*Figure 86: Change sensor label functionality*

**Disable/Enable log:** Used to disable or enable the log on a specific channel. By using this functionality, the log file will not record data from that channel. Disable/Enable log functionality can be used also from the BeanSensor menu.

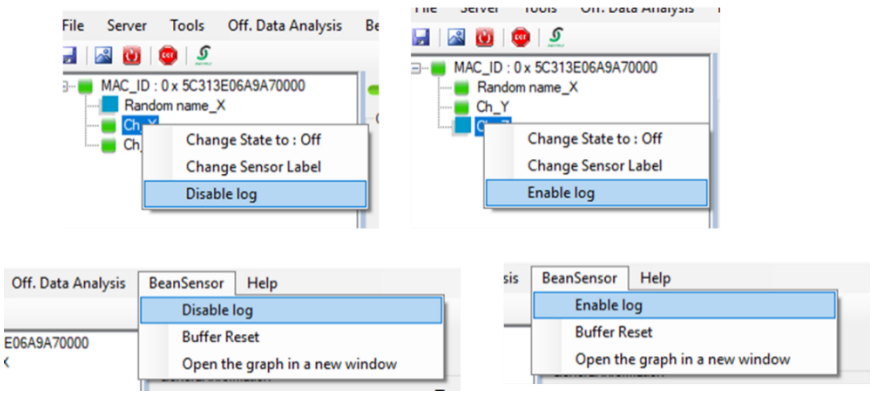
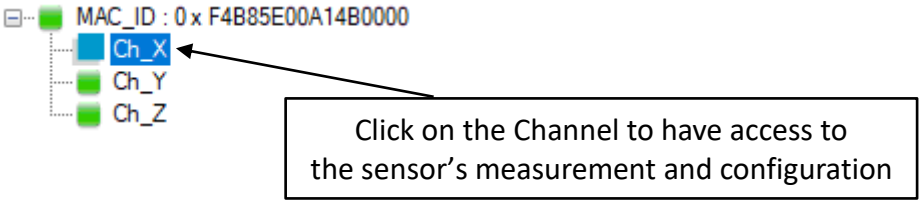



*Figure 87: Disable log functionality*

***The Right click functionalities are available also when using MQTT, the only exception is the "Remove functionality". With MQTT user will not be asked to localize the device, he clicks on remove and the device will be directly deleted from the list.***


*Figure 88: Right click remove functionality (MQTT)*

## 7.4 SENSOR CHANNEL PROFILE




The screen « ***Sensor channel profile*** » consists of three parts:

1. ***General information about the measurement channel;***
2. ***Measurement channel configuration;***
3. ***A graph which displays in real-time data measurements transmitted by BeanDevice® Wilow®***

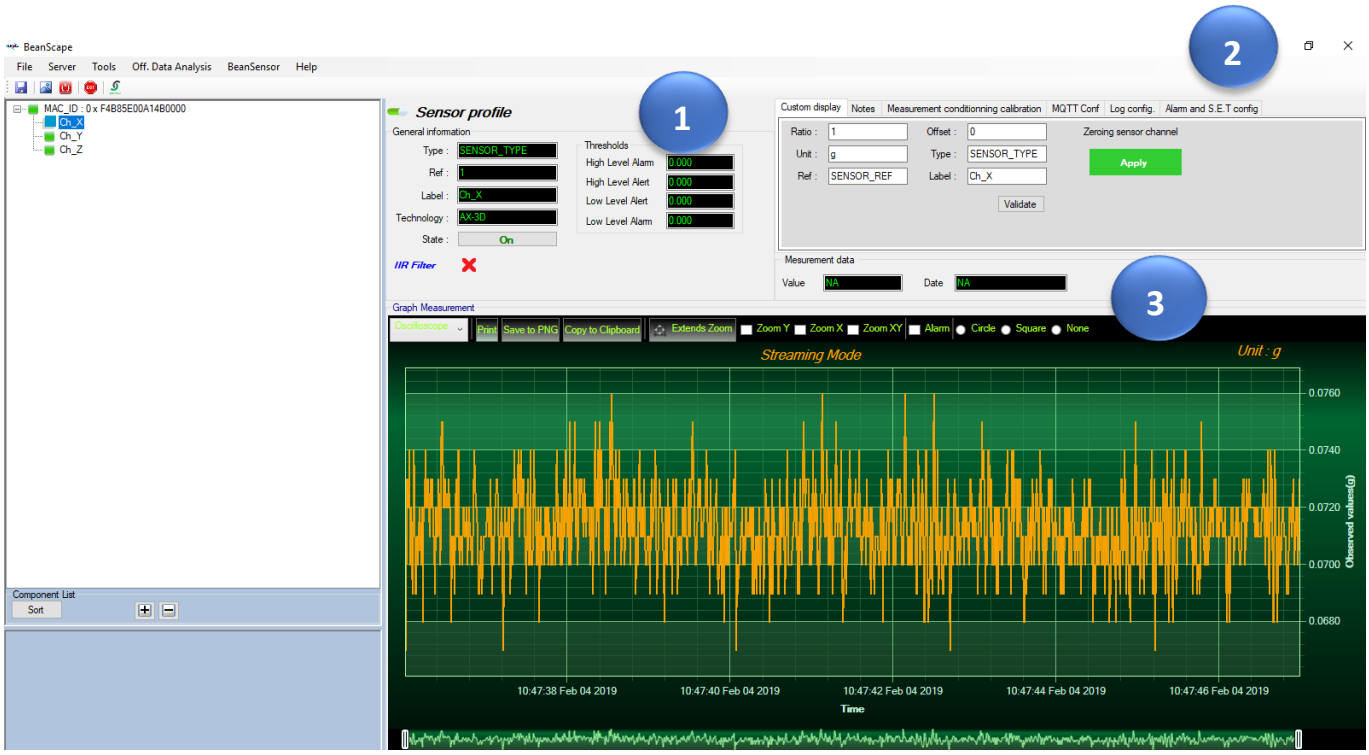



*Figure 89: Overview: Sensor channel profile*

## 7.4.1 Sensor channel status

### 7.4.1.1 Frame: General information

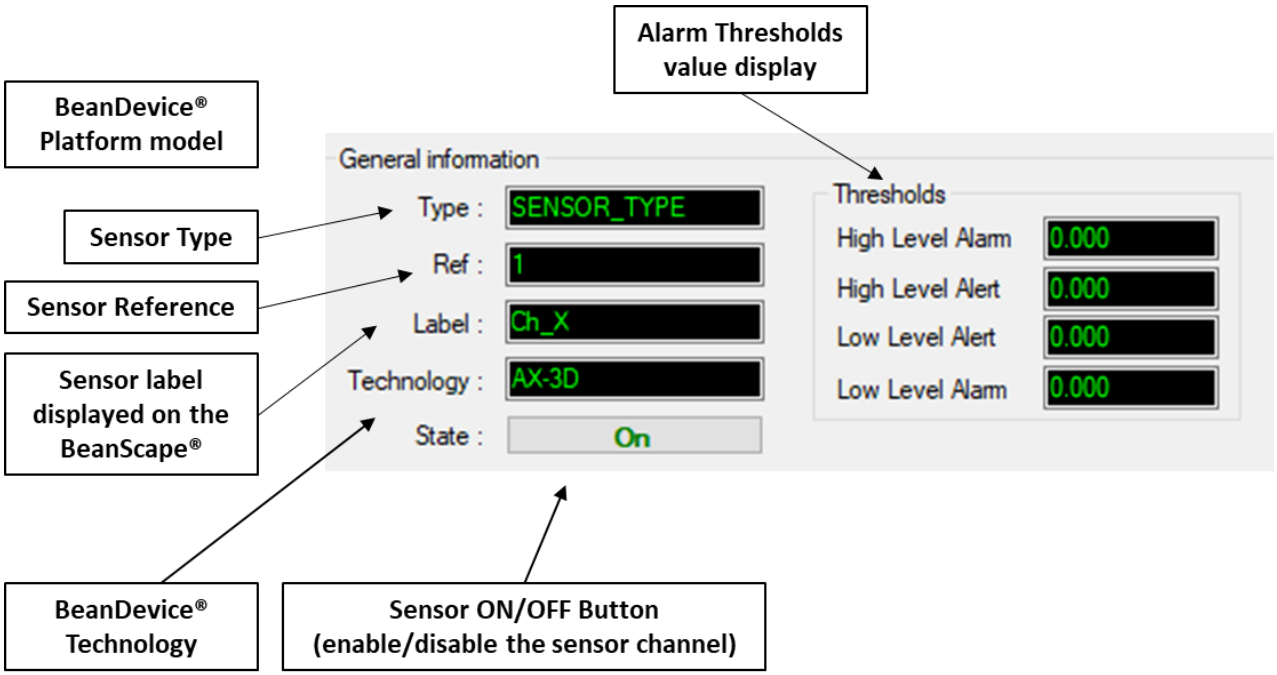



*Figure 90: Sensor channel General information frame*

#### 7.4.1.2 Frame: Measurement data

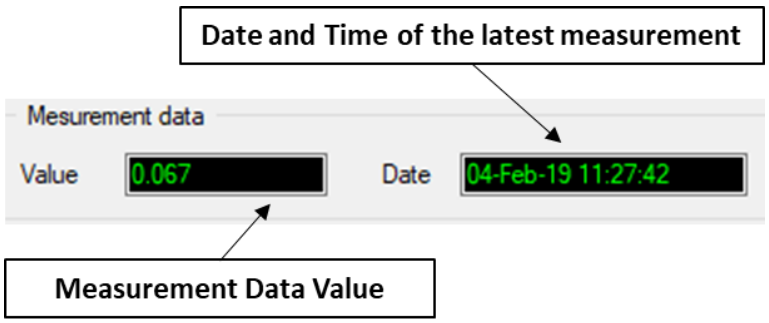



*Figure 91: Measurement data frame*

By default, sensor unit format is

- g for the BeanDevice® WiLow® AX-3D & AX-3DS
- ° for the BeanDevice® WiLow® HI-INC

### 7.4.2 Sensor channel configuration

Here you can see that for each Sensor its own configuration frame accessible by clicking on the sensor's channel to setup.

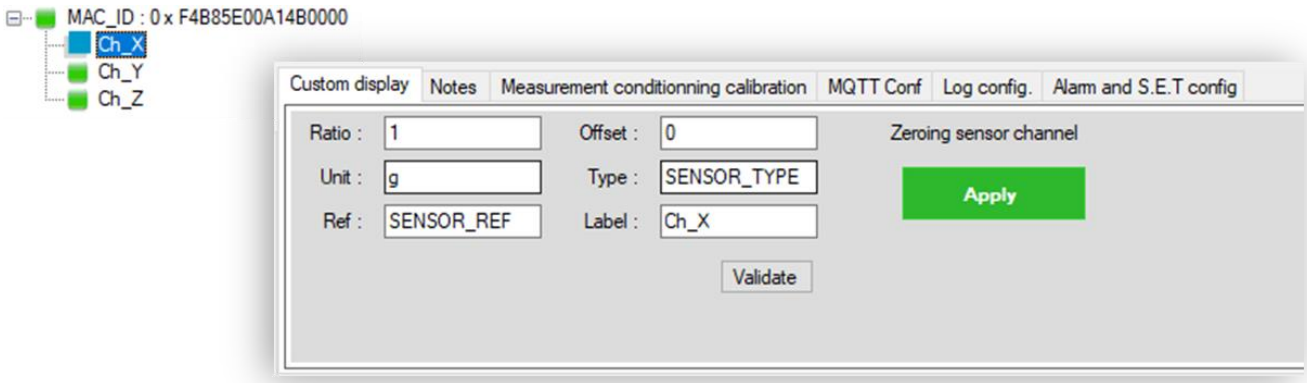



*Figure 92: Sensor channel configuration frame*

This frame contains a set of 6 tabs:

| | |
|---|---|
| Custom Display | • Allows the end user to customzie the sensor |
| Notes | • Contains notes relating to the BeanDevice® Wilow sensor |
| Measurement conditioning calibration | • Sensor channel calibration interface |
| MQTT Conf | • Contains information about Mqtt status |
| Log config | • Logs configuration on the BeanScape® |
| Alarm and S.E.T config | • Allows The user to configure the alarm thresholds related to the sensor |

#### 7.4.2.1 Tab: Custom display

These parameters allow the user to customize his sensor:

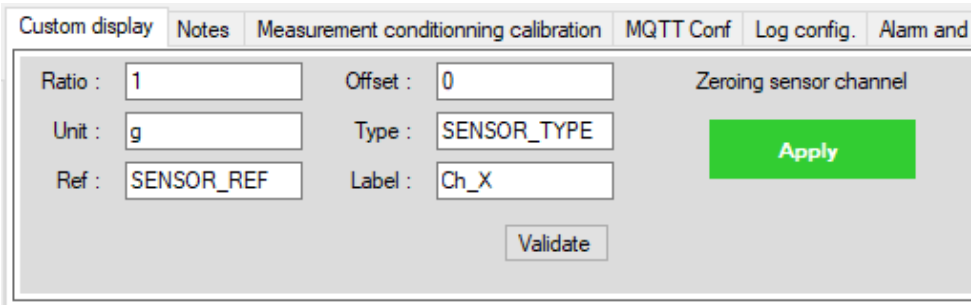
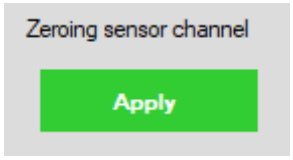



*Figure 93: Sensor channel custom display tab*

- ✓ ***Type***: Describe the sensor type (ex: load cell, pressure, Strain gage +/- 2 mv/V, LVDT,…. )
- ✓ ***Unit***: customer sensor unit (bar, °C, l/h….)
- ✓ ***Ratio*** : Sensor Ratio coefficient (***RAT*** );
- ✓ ***Offset*** : Sensor Offset coefficient (***OFF***);
- ✓ ***Label***: Give a name to your sensor. (***ex*** : Sensor on Stator Machine 1, sensor in Room 2 Floor 3)

***Zeroing***

***In order to secure accurate and precise Velocity and FFT measurements on axis that's mounted toward the earth gravity you should Apply zeroing to cancel earth gravity.***




### 7.4.2.2 Tab : Notes

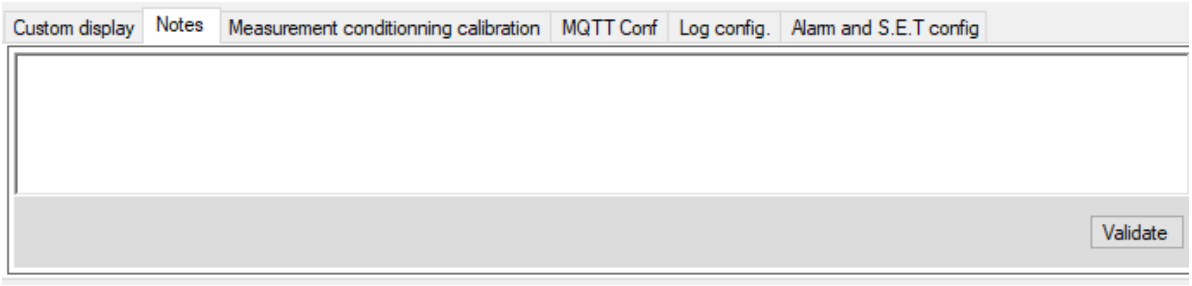
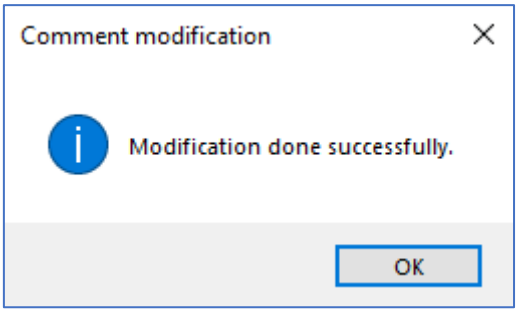



***Figure 94: Sensor channel Notes tab***

This field contains notes relating to the BeanDevice® sensor. To change this field, enter a value or free text and click the "Validate" button.

A new window opens; accept your modifications by clicking on "OK".




To back up your text click on the icon "Backup your Database"

### 7.4.2.3 Measurement Conditioning calibration

***WARNING: These calibration coefficients should be accessible to an advanced user. A wrong calibration will result in false measurements.***

These coefficients are used to calibrate the ***internal accelerometer/inclinometer*** sensors:

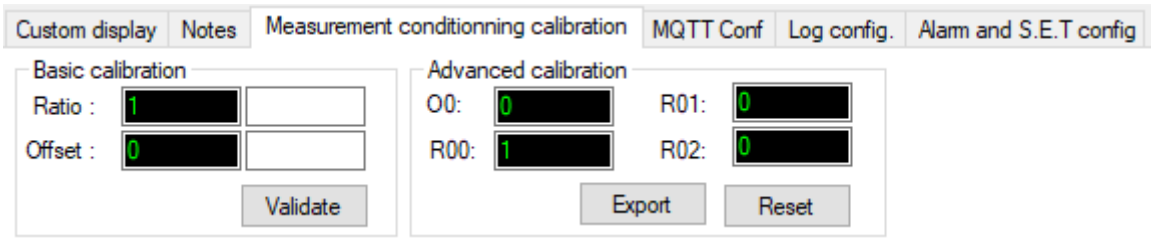



*Figure 95: Sensor calibration tab*

The BeanScape® provides a Basic calibration and Advanced calibration interface for each measurement channel:

Basic Calibration:

- ***Ratio***: multiplier coefficient
- ***Offset***: adder/subtracted coefficient. its unit is the sensor unit

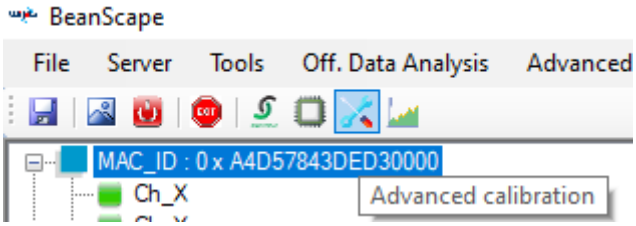
$$Calibrated\_value = (Ratio \times Non\_Calibrated\_Value) + Offset$$

Enter the calibration coefficients and then click on validate.

***The calibrations coefficients are backed up on the BeanDevice® flash memory, and cannot be lost if the BeanDevice® is switched off***

Advanced Calibration:

These values are obtained through an advanced calibration process.




For further details have a look to section 13.

### 7.4.3 MQTT Conf

Here you can see your current MQTT topic's Name and Status, whether it is publishing or not and whether retains flag is enabled or disabled

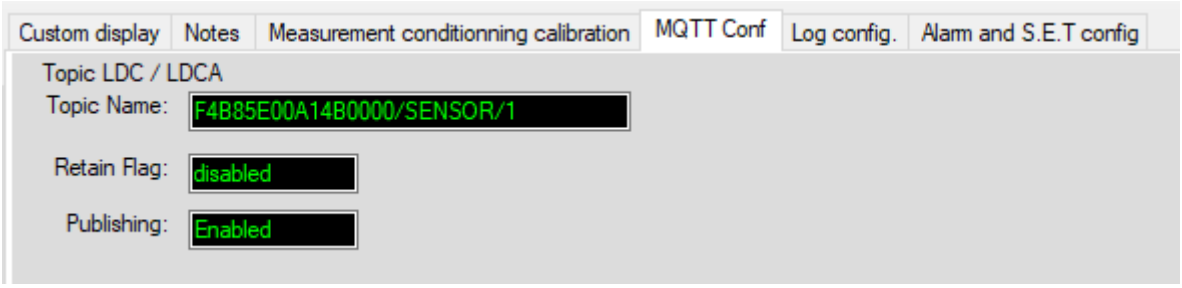



*Figure 96: Sensor MQTT configuration tab*

- ***Topic Name:*** The MQTT specification defines topic as the key that identifies the information channel to which payload data is published. Subscribers will then use the key to identify the information channels (E.g. : measurements on Z Axis) on which they want to receive published information.
- ***Retain Flag:*** The broker will store the last retained message for that topic and each client that subscribes, will receive that message immediately after subscribing.
- ***Publishing:*** That shows if the Topic publishing is enabled or disabled.

### 7.4.4 Log file configuration tab

***This tab should not be confused with the Datalogger feature available on the Beandevice®:***

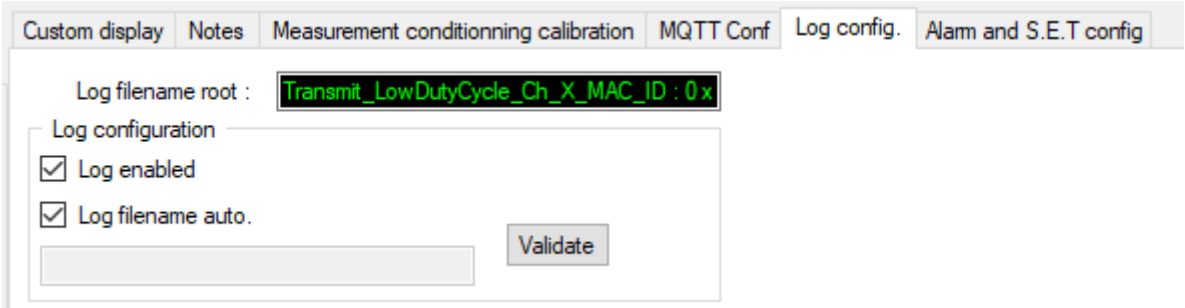



*Figure 97: Log configuration tab*

By default, Log file name is built with the measurement channel & BeanDevice® MAC Address:

< ***Sensor Channel Number*** > < ***MAC_ID*** >

- ✓ ***Log enabled***: If checked, Log is enabled on the BeanScape®
- ✓ ***Log filename auto***.: If checked, Log file name is named automatically

Click on ***validate*** in order to validate all your modifications.

For users who want to rename the log file, two solutions are provided:

- ✓ ***Add automatically the channel "Label" in your log file name:***

  ***<Label><Sensor channel Number> <MAC_ID>***

- ✓ ***The log file name can be fully customized: Uncheck the case « Log filename auto" and add your own label***

### 7.4.5 Alarm and S.E.T conf tab

In this tab, you can configure threshold high values (High Level Alarm & High-Level Alert) and low values (Low Level Alert a Low-Level Alarm).

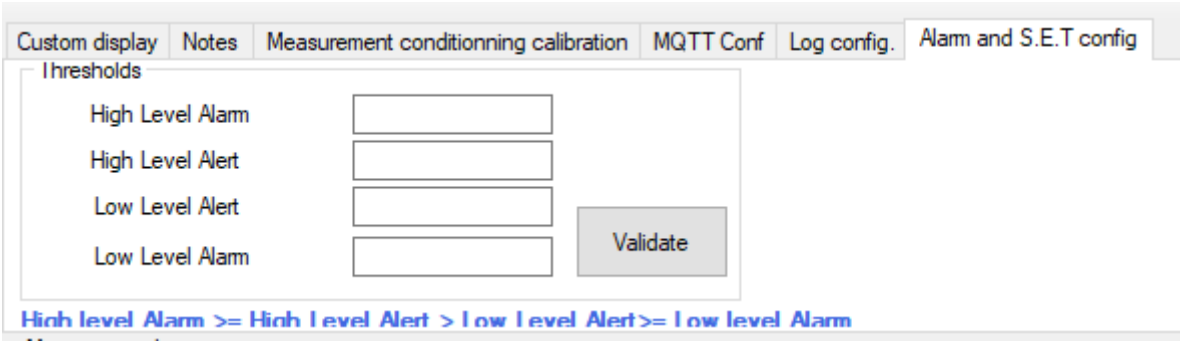



***Figure 98: Alarm and S.E.T config tab***

In Alarm or S.E.T mode, when a high/low level threshold value is reached, an alarm notification is transmitted to the supervision system:

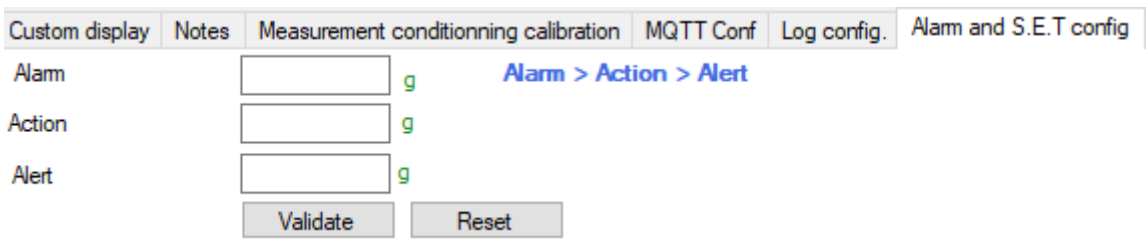
- If the measurement value is higher than High level alarm/High level alert, an alarm notification is transmitted to the supervision system
- If the measurement value is lower than Low level alarm/Low level alert, an alarm notification is transmitted to the supervision system

Threshold values must be organized in this manner:

**High level alarm >=High level alert > Low level alert>= Low level alarm**

***Starting from firmware 3.7, the alarm thresholds topology has been changed and become based on triple A topology.***

**Alarm > Action > Alert**



### 7.4.6 Graphical display

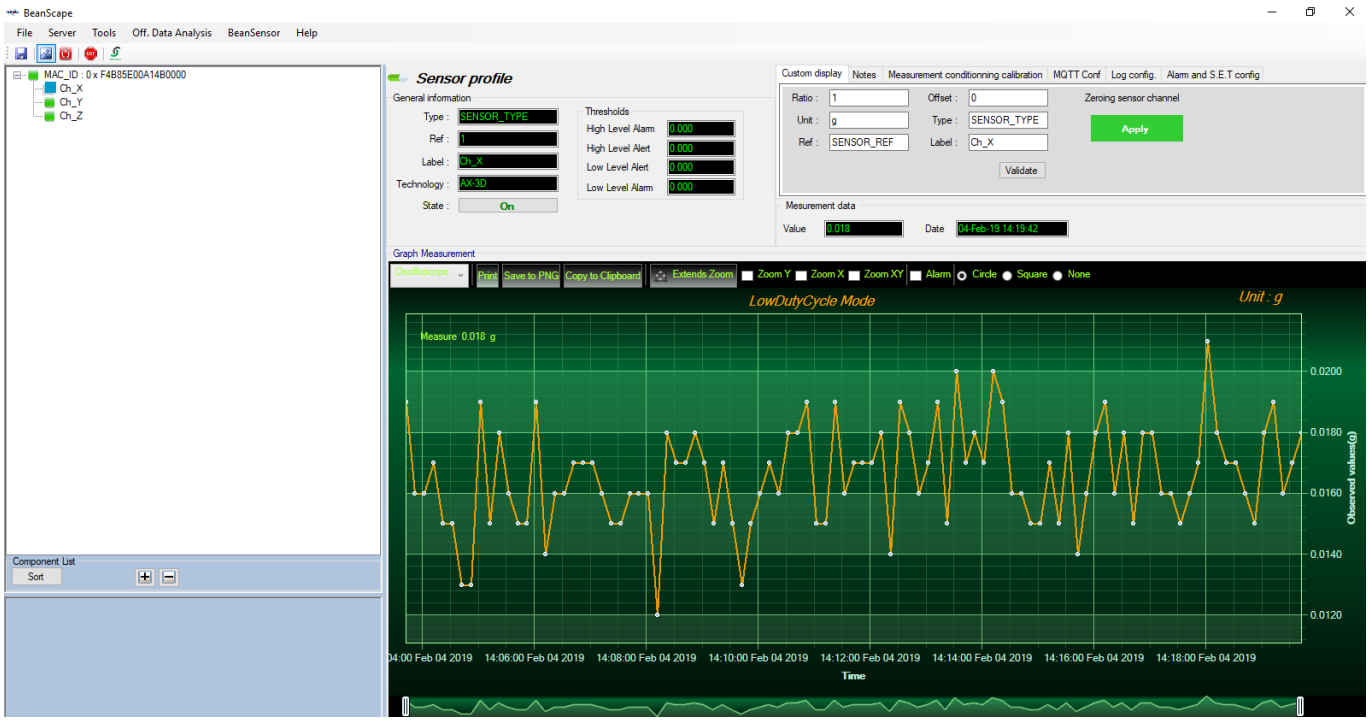



*Figure 99: Overview: Channel acquisition graph visualization*

***To have a wide display view of the graph, it is recommended to click on the Green button on the top of the sensor's channel configuration area to hide it.***

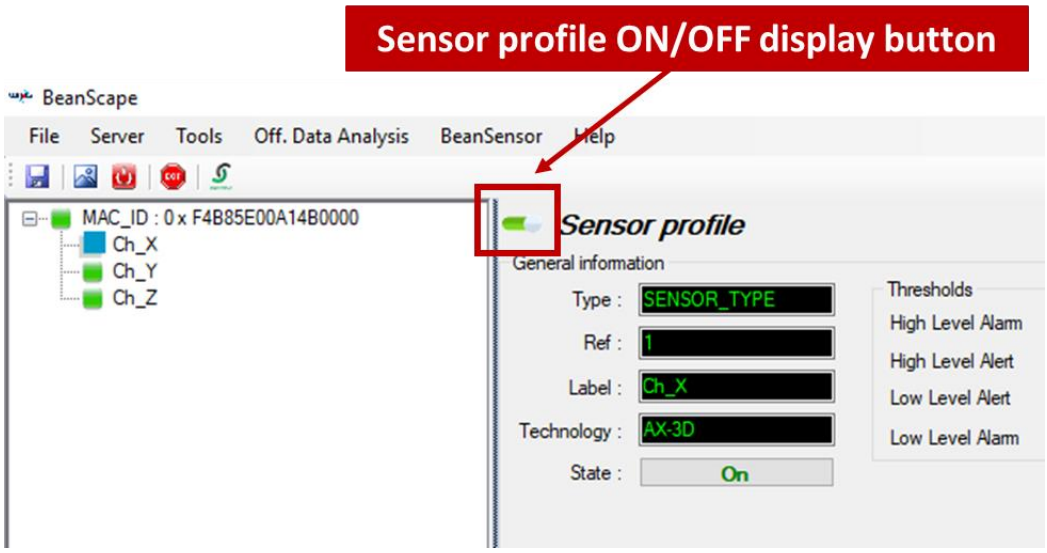



*Figure 100: Sensor profile ON/OFF display button*

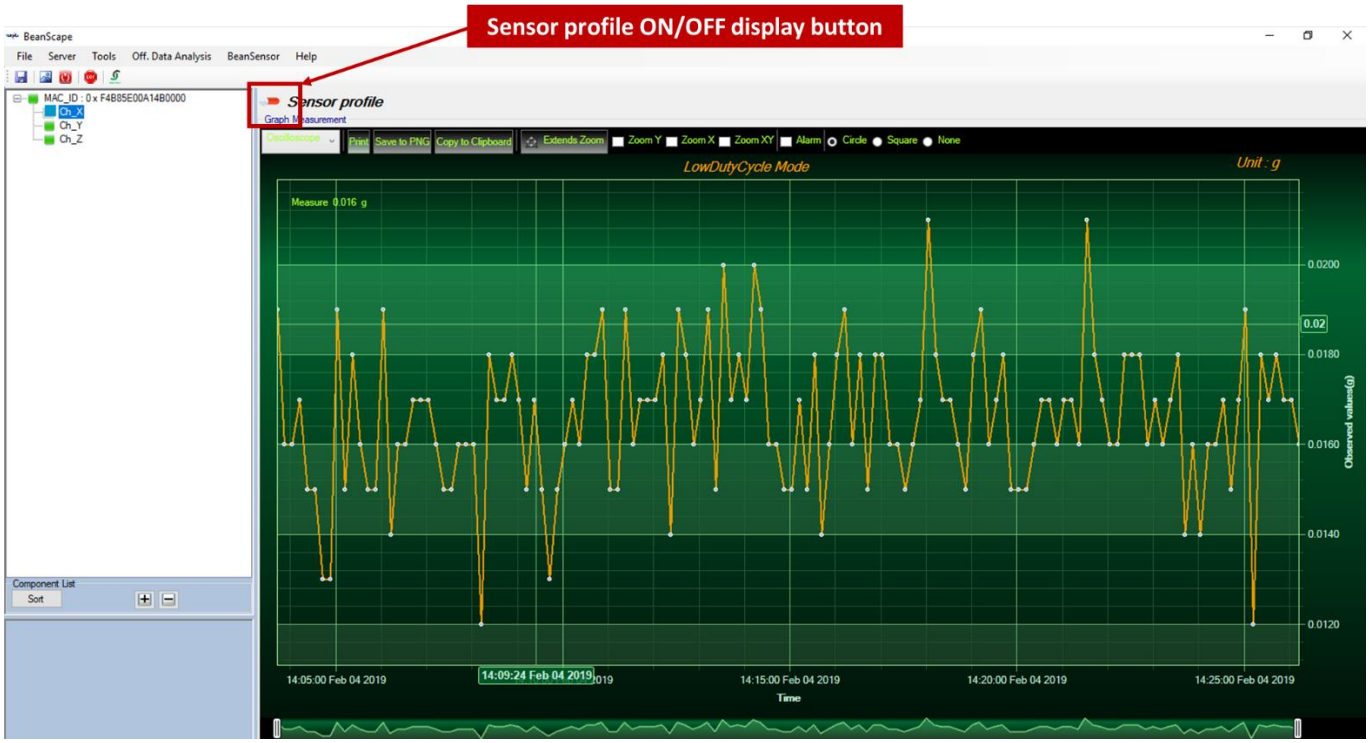
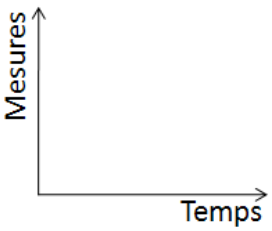



*Figure 101: Wide view of the graph*

The chart is composed of two parts:

- ***Part 1***: This is a preview window, allowing you to observe sensors acquisitions
- ***Part 2***: A strip on the side composed of different frames allows customizing the graph

The graph has two axes:




**Axe-X**: Timeline

**Axes-Y:** received sensor acquisitions

The BeanDevice® WILO® data acquisition mode and the last data acquisition can be visualized directly from the graph.

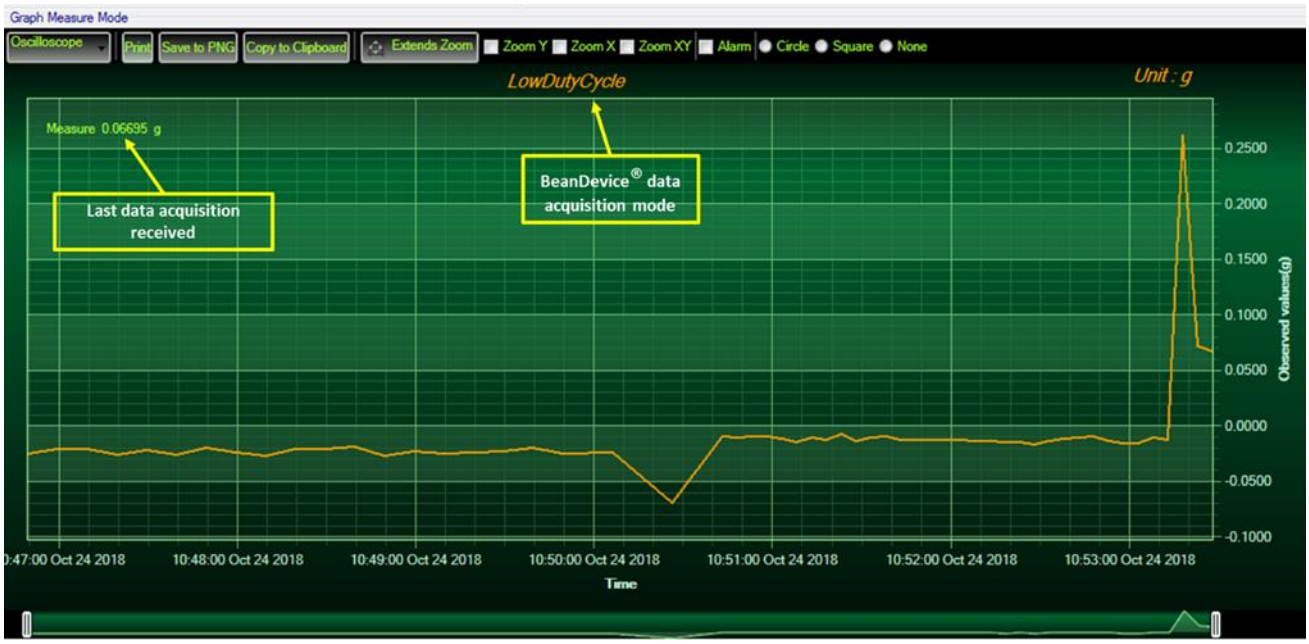


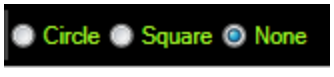

*Figure 102: Example: Graph visualization*

7.4.6.1 Frame: Display


*Figure 103: Graph measure mode: Frame Display*

7.4.6.2 Frame: Marks

From this frame you can select the display mode of action of the chart. Three types of symbols are available:




***Circle***: Brings up a point on each bar graph

***Square***: brings up a square on each measure of the graph

***None***: No logs is displayed on the graph

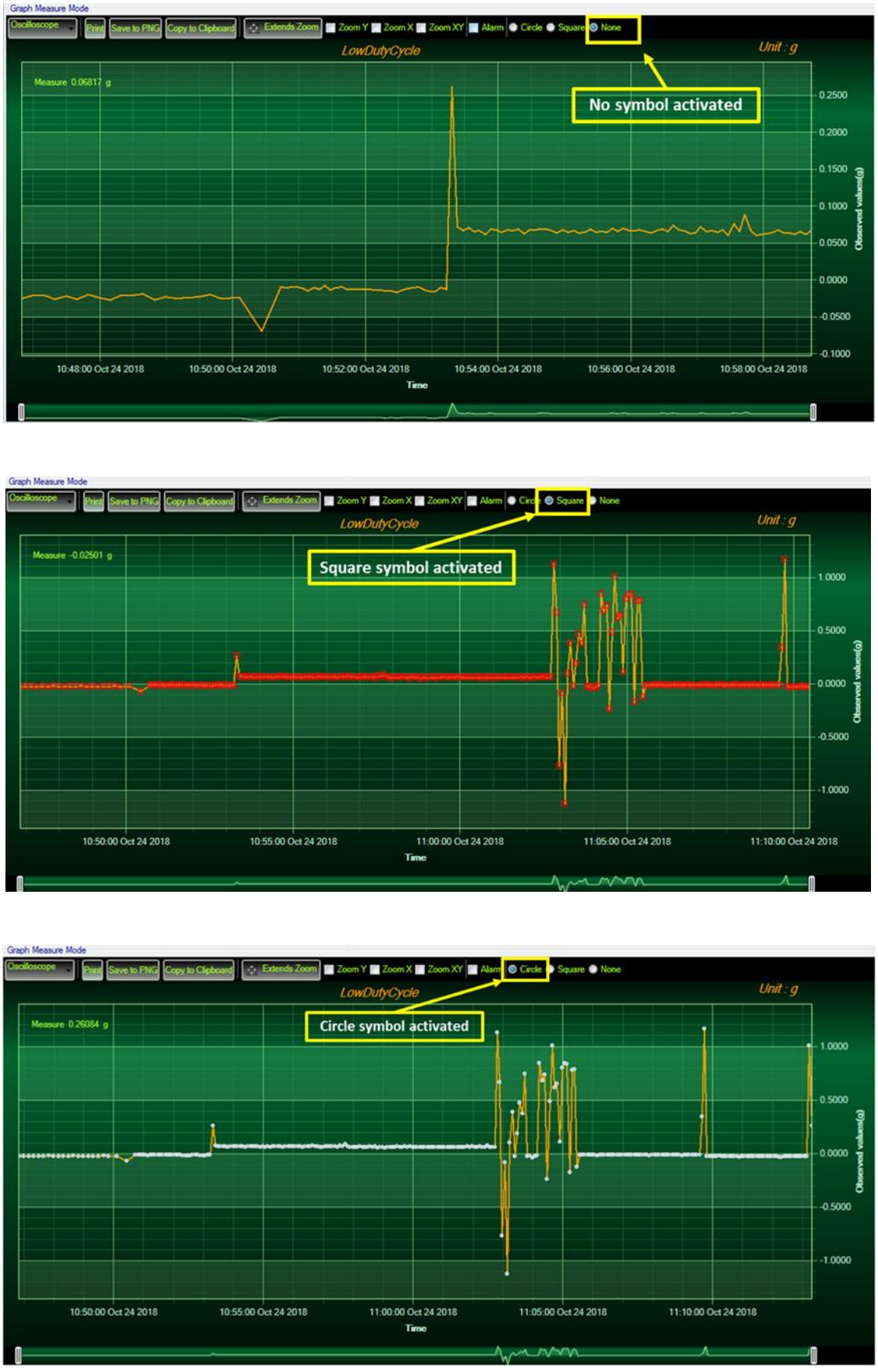



*Figure 104: Graph measure mode: Frame Marks*

7.4.6.3 Frame: Scale

From this frame, the scaling of the graphics can be customized to suit your needs.


**Checkbox "Zoom X and Y Zoom"**

These boxes are useful for performing a graph zoom from the mouse wheel, there are four cases:

- ✓ ***Case 1***: Case "Zoom X" ticked. The graph zoom will only affect the X axis.
- ✓ ***Case 2***: Case "Zoom Y" ticked. The graph zoom will only affect the Y axis.
- ✓ ***Case 3***: Case "Zoom XY" ticked." Zoom will affect both X and Y axes
- ✓ ***Case 4***: Case "Zoom X ", "Zoom XY "and "Zoom Y " not ticked. The zoom function from the mouse wheel is disabled.

## 7.5 DATALOGGER CONFIGURATION

All the BeanDevice® integrates an onboard DataDatalogger based on a flash memory. It integrates a wide spectrum of advanced features:

- ✓ Very fast download (< 5 minutes for 1 million data acquisition, <25 minutes for 8 millions data acquisition)
- ✓ A great flexibility for the user who can choose three configurations: Datalogging only or Datalogging + Data transmission or Data transmission
- ✓ The BeanDevice® can operate in standalone mode, without the necessity to be always connected to a Wireless Sensor Networks
- ✓ Datalogging is compatible with a maximum sampling rate of 2 Ksamples/s per channel

### 7.5.1 Datalogger capacity

***The following table shows the Datalogger capacity regarding the version of the BeanDevice®:***

| BeanDevice® | Datalogger capacity |
|---|---|
| **AX-3D** | 5 million data points |
| **AX-3DS** | 5 million data points |
| **Hi-Inc** | 5 million data points |

### 7.5.2 Data acquisition configuration tab

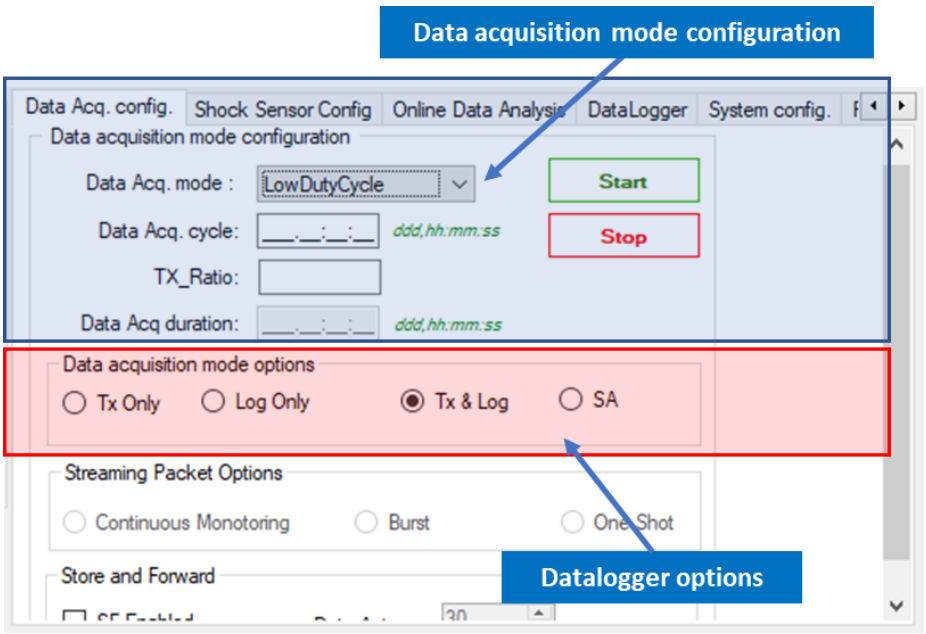



*Figure 105: Tab: Data acquisition configuration*

- ***TX only***: The BeanDevice® transmits the data acquisition without Data logging
- ***Log only***: The BeanDevice® logs the data acquisition without wireless transmission
- ***TX & Log***: The BeanDevice® transmits and logs the data acquisition;
- ***SA (Standalone)***: The BeanDevice® logs the data acquisition without wireless transmission. The BeanDevice stores all the measurements on its embedded Datalogger.

### 7.5.3 Configure a data acquisition mode with Datalogger

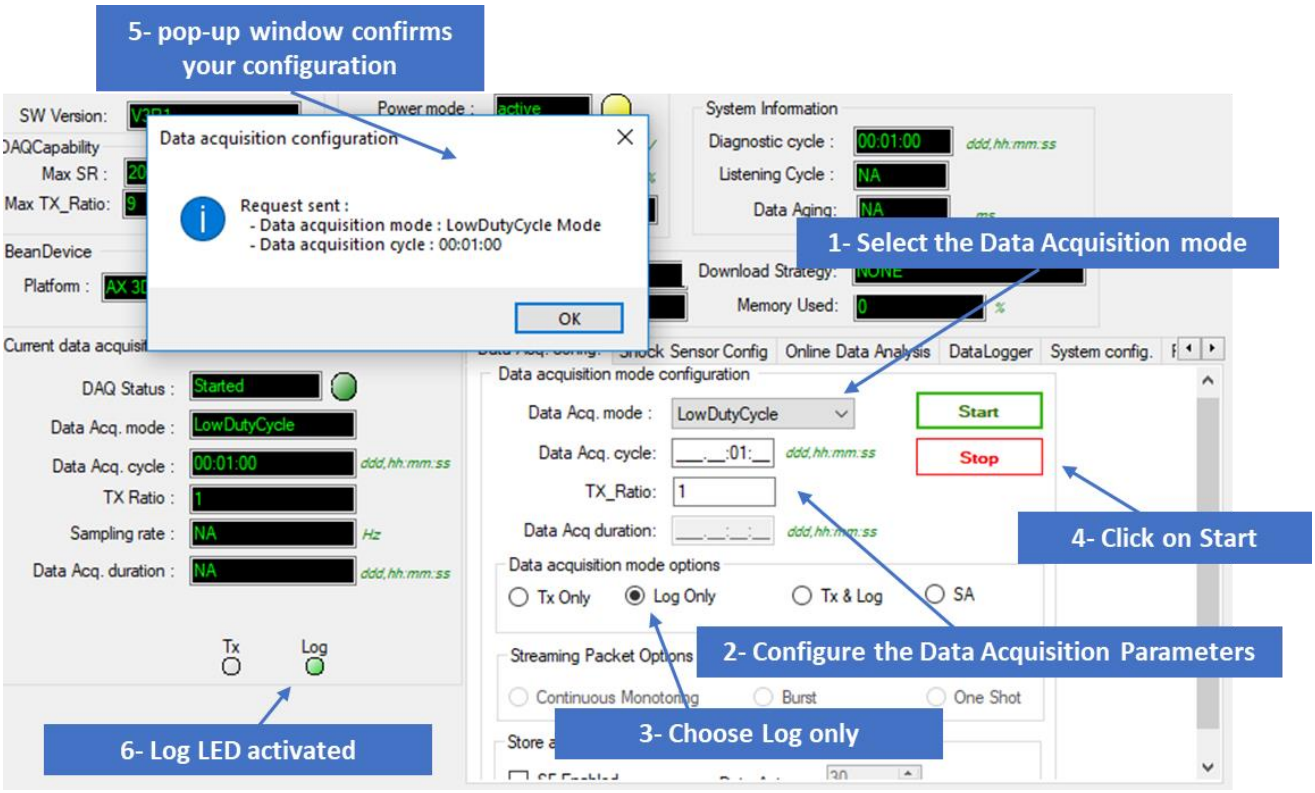



*Figure 106: Overview: Data acquisition configuration scenario*

#### 7.5.3.1 LDCDA mode with Log only data logging option

With LDCDA mode, when the BeanDevice® is restarted, the Datalogger should continue storing data.

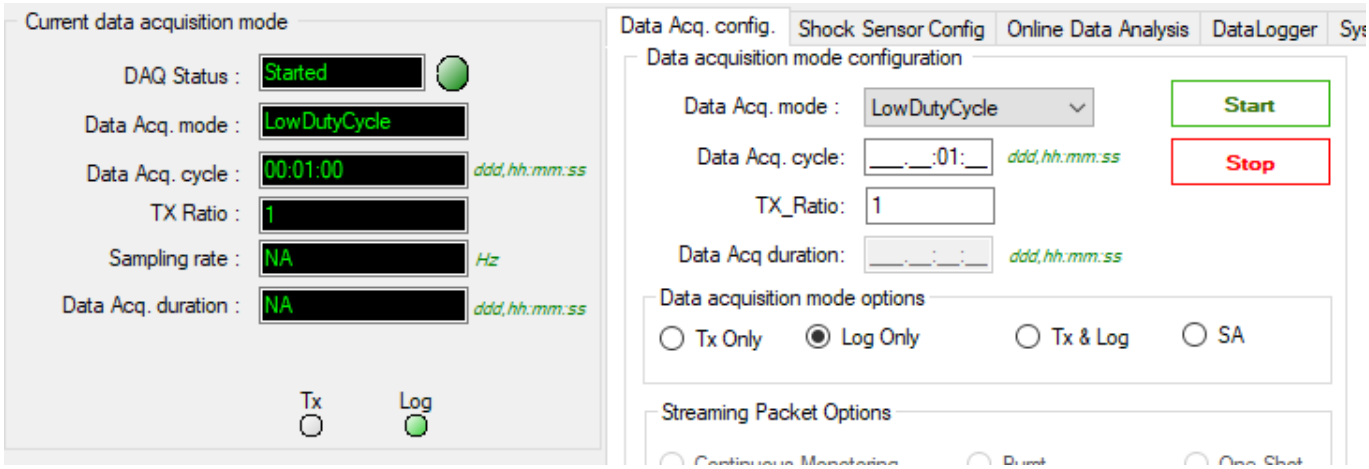



*Figure 107: BeanDevice Configured with LDCDA mode with LOG only*

#### 7.5.3.2 Streaming mode with Log only data logging option

The same steps are to be followed as for LDCDA mode. After powering off and then on the BeanDevice®, the Datalogger restarts logging

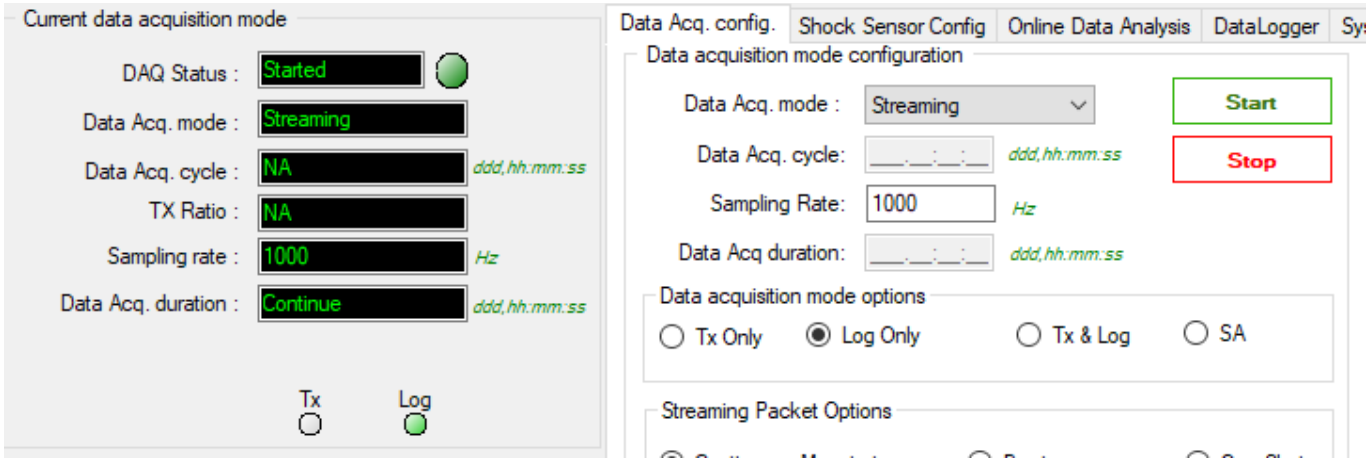



*Figure 108: BeanDevice Configured with streaming mode with LOG only*

### 7.5.4 Configure a Data Acquisition mode with Standalone option

Standalone option is similar to Log only option with the difference that the BeanDevice continues to log the data even if it is no more connected to the network.

Check **SA** to configure your BeanDevice to function on standalone, validate and turn it off. now when you turn it on, your BeanDevice will start to log data independently from the Wireless network.

After finishing logging and when you want to extract your logged data from the BeanDevice, turn it off and turn it on in the periphery of your Wi-Fi network, it will connect to your BeanScape supervision software and it is from there you will download your logged data

***For further information about downloading logged data Please read the following section:***
"click here"

See our technical video "Wilow - Wi-Fi Sensors- Datalogger memory configuration" on YouTube

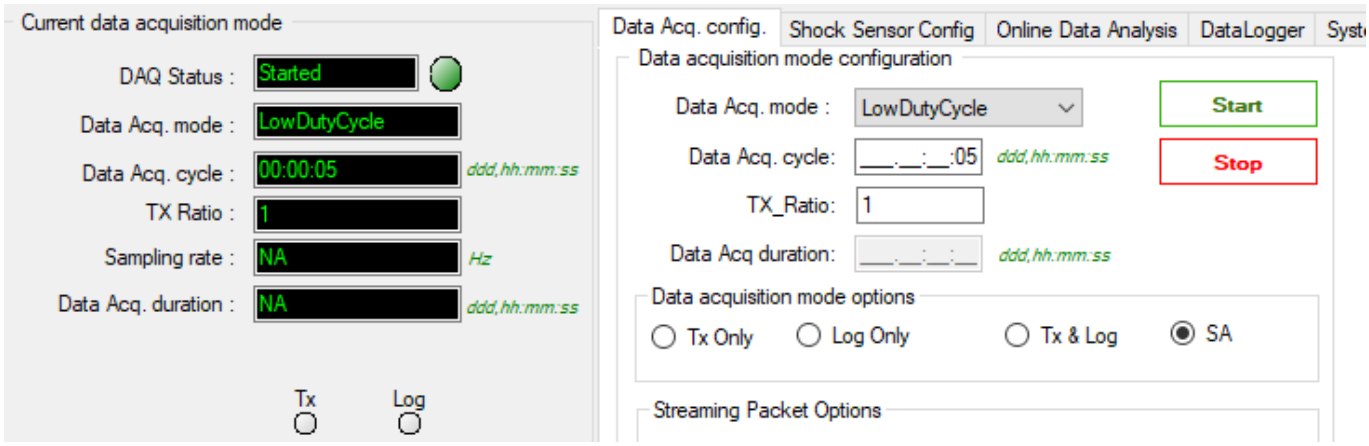
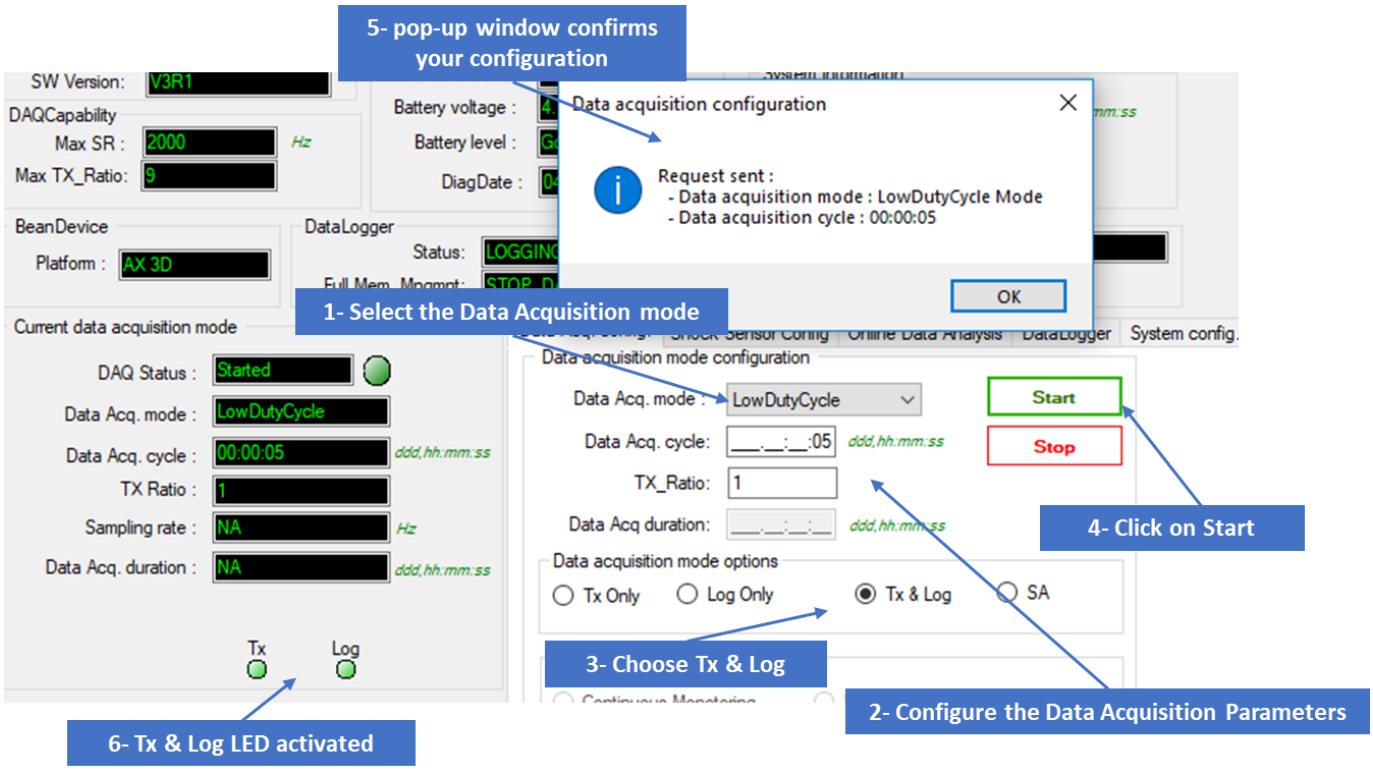



*Figure 109: BeanDevice Configured with LDCDA mode with Stand Alone*

### 7.5.5 Configure a Data Acquisition mode with TX & Log option

If the user chooses to configure the Data Acquisition mode with ***TX & Log option*** activated:




See “Wilow - Wi-Fi Sensors-How to setup Wilow datalogger” YouTube video

# 8. LOG FILE & FOLDER ORGANIZATION

### 8.1.1 Log file directory

By default, the Log file directory is: ***C:\log_beanscape***

To change it and have access to the BeanScape® advanced settings, select **Tools** from the Top menu bar, then BeanScape®

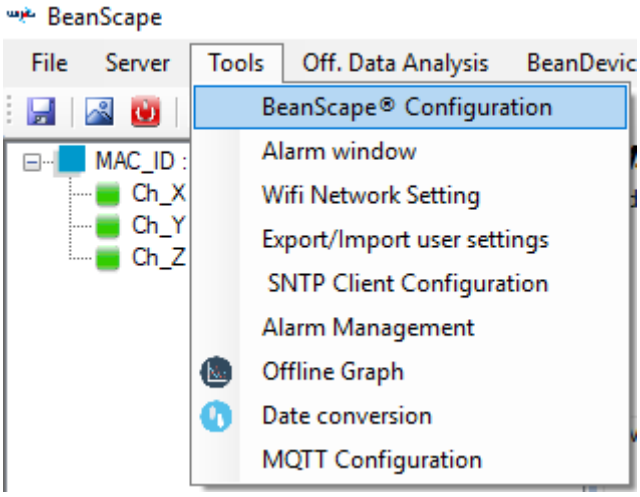



*Figure 110: BeanScape® configuration menu*

This window lets you configure the logs, and the data cache.

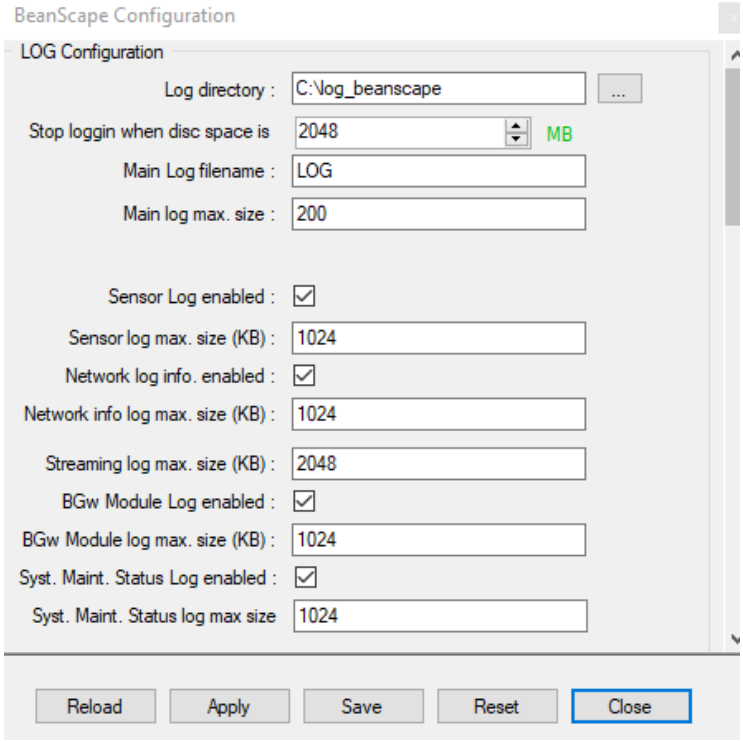
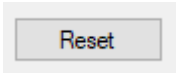



*Figure 111: BeanScape® configuration window*

- ✓ ***LOG directory***: Enter here the path/folder where you would want to save the LOG files.
- ✓ ***Main log filename***: Here you may enter the desired name in order to save the LOG file.
- ✓ ***Main log max. size (KB):*** Maximum file size in Kilobytes (KB) for your principal LOG file
- ✓ ***Sensor Log Enabled***: Check this box if you want to enable the sensor(s) data acquisition in your LOG file
- ✓ ***Sensor log max. size (KB)*** : Maximum size in Kilobytes (KB) of sensor log files (**except** for streaming & streaming data acquisition mode)
- ✓ ***Network log info. enabled*** : Check this box if you want to enable network information in your LOG file
- ✓ ***Network info log max. size (KB)*** : Maximum size in Kilobytes for your network information LOG file
- ✓ ***Streaming log max. size :*** Maximum size in Kilobytes (KB) of sensor log files (***only*** for streaming & streaming data acquisition mode)

***Clicking on the button*** 

***reverts to the original configuration.***

### 8.1.2 Log folder

By Default, log files linked to the ***BeanDevice® WiLow®*** are stored in the log folder (located in C:/log_beanscape directory):

"***Folder MAC_ID***"

Only the last 4 Char of BeanDevice® MAC ID are displayed.

User can change log folder name by clicking on "Custom display" tab located on the **BeanDevice® *WiLow®*** profile:

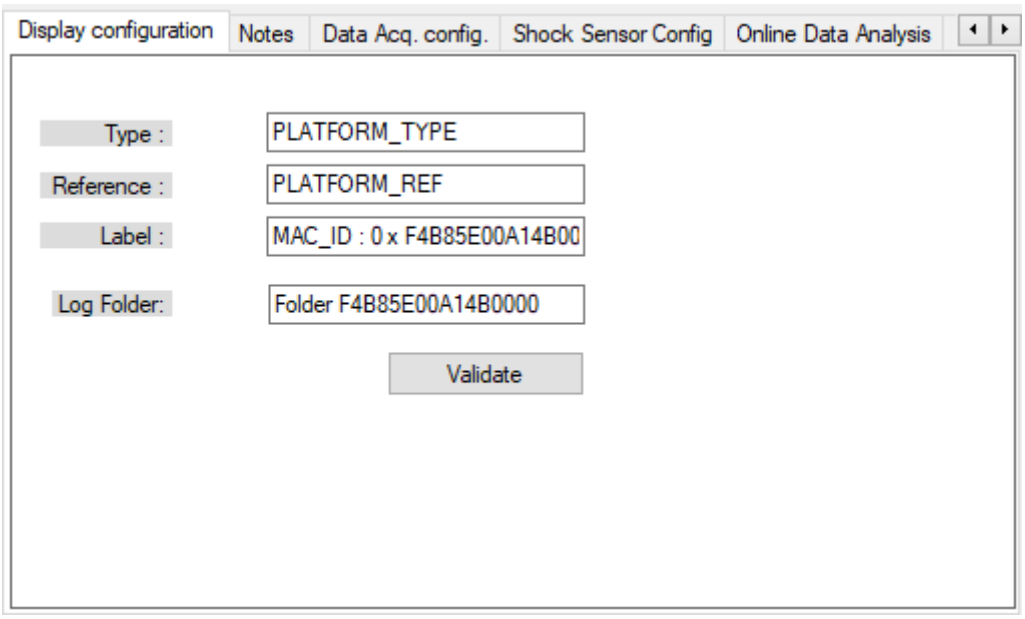
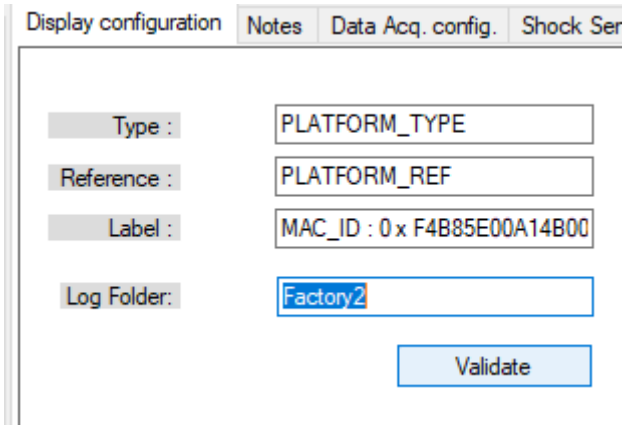


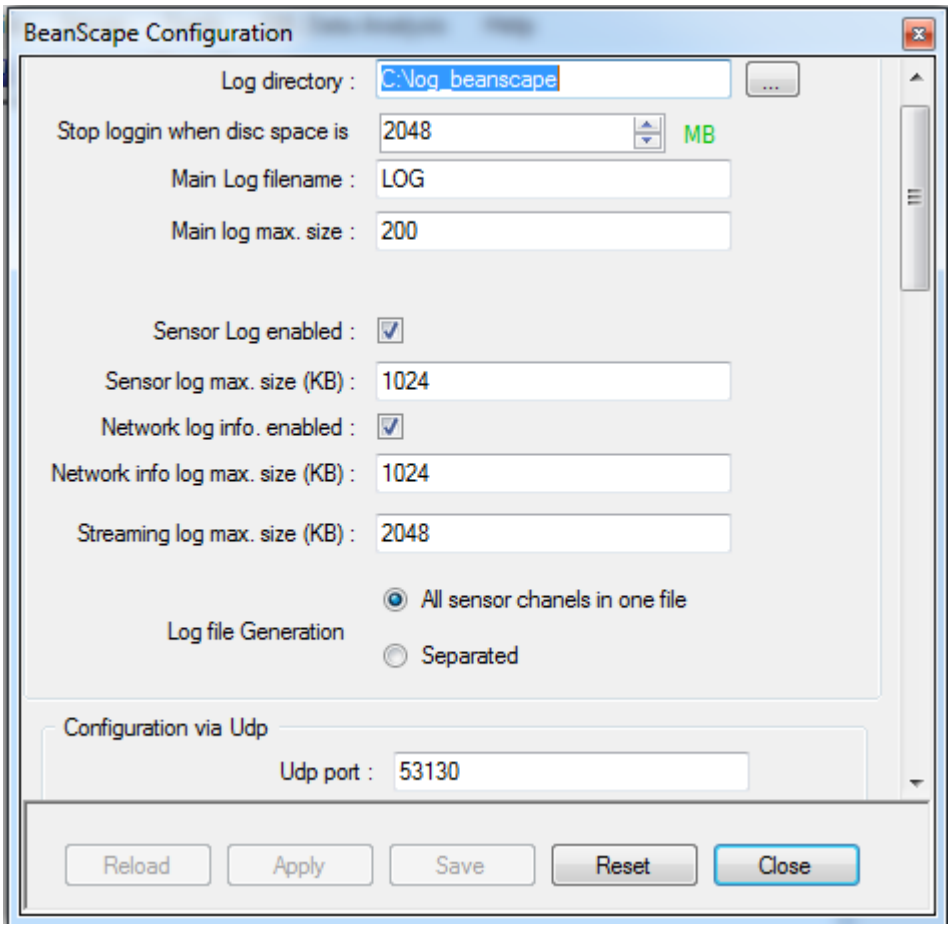

***Figure 112: BeanDevice®Custom Display tab***

Enter your own log folder name, then click on validate.

The following example shows the log folder changed to "Factory2":



### 8.1.3 Log file size configuration




- ✓ ***LOG directory***: Enter here the path/folder where you would want to save the LOG files.
- ✓ ***Main log filename***: Here you may enter the desired name in order to save the LOG file.
- ✓ ***Main log max. size (KB):*** Maximum file size in Kilobytes (KB) for your principal LOG file
- ✓ ***Sensor Log Enabled***: Check this box if you want to enable the sensor(s) data acquisition in your LOG file
- ✓ ***Sensor log max. size (KB)***: Maximum size in Kilobytes (KB) of sensor log files (**except** for streaming & streaming packet data acquisition mode)
- ✓ ***Network log info. enabled***: Check this box if you want to enable network information in your LOG file
- ✓ ***Network info log max. size (KB)***: Maximum size in Kilobytes for your network information LOG file
- ✓ ***Streaming log max. size:*** Maximum size in Kilobytes (KB) of sensor log files (***only*** for streaming & streaming packet data acquisition mode)

### 8.1.4 Log file generation

By default, 1 log file is linked to 1 sensor channel. The user can select a log file linked to all the sensor channels present on the BeanDevice®.

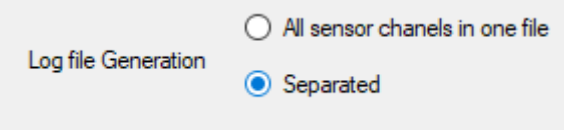



*Figure 113: Log file generation option*

Once "All sensor channels in one file" option is selected, user can see all the channel in one single file under the C:\log_beanscape directory.

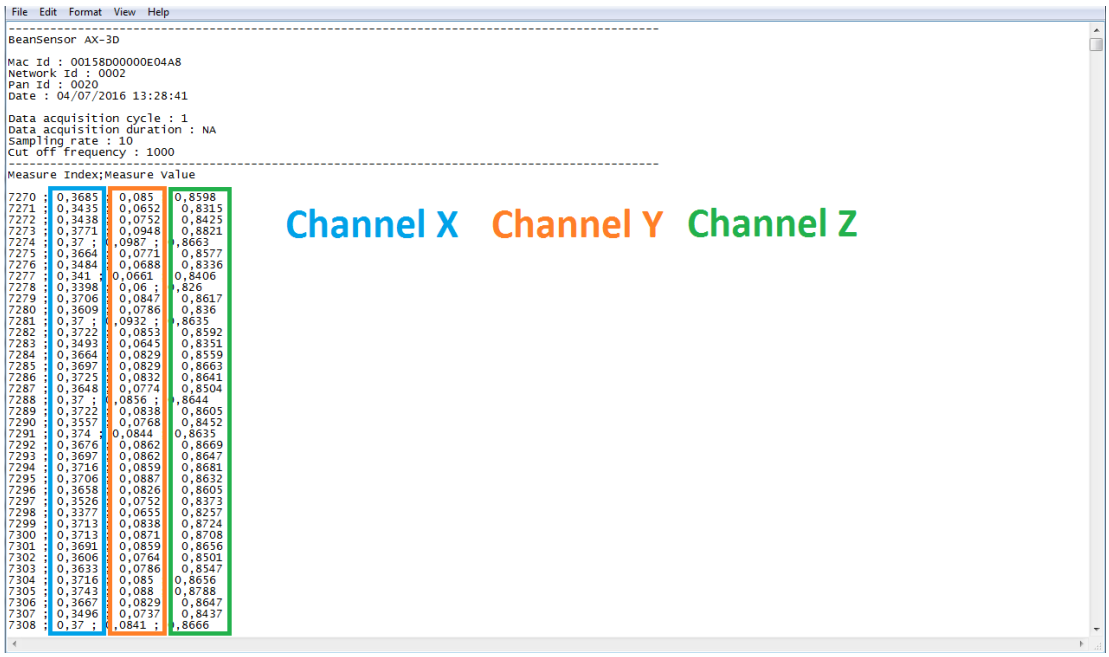



*Figure 114: Example of Log file*

### 8.1.5 Cache Data configuration (for Graph)

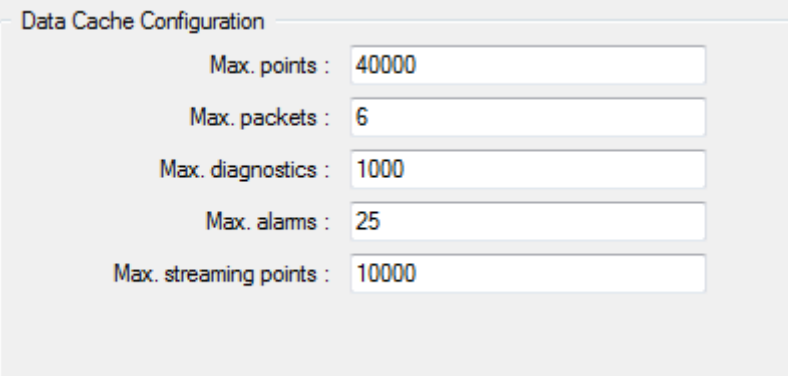



*Figure 115: Data cache configuration options*

- ✓ ***Maximum number of points***: Set here the maximum number of points displayed on the BeanScape® graph
- ✓ ***Maximum number of packets***: Set here the maximum number of packets displayed on the BeanScape® graph
- ✓ ***Max number of diagnostics***: Set here the maximum number of diagnostics displayed on the BeanScape® graph
- ✓ ***Max number of alarms***: Set here the maximum number of alarms displayed on the BeanScape® graph
- ✓ ***Maximum streaming points***: Set here the maximum number of points displayed in Streaming/Streaming Packet on the BeanScape® graph

***Please note that the values backed up by the BeanScape® may affect the memory capacity of your computer depending upon the size of every file.***

### 8.1.6 Log file related to data acquisition (TX Folder)

#### 8.1.6.1 Log filename root

For each sensor channel a log file is automatically created by the BeanScape®.

The user can easily change the log file root:

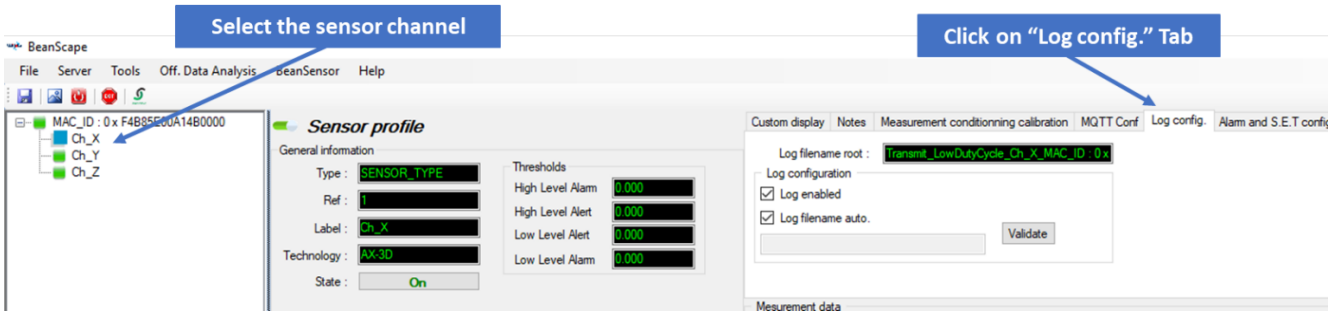



*Figure 116: Overview: Log Config tab on BeanScape®*

***This tab should not be confused with the Datalogger feature available on the BeanDevice®.***

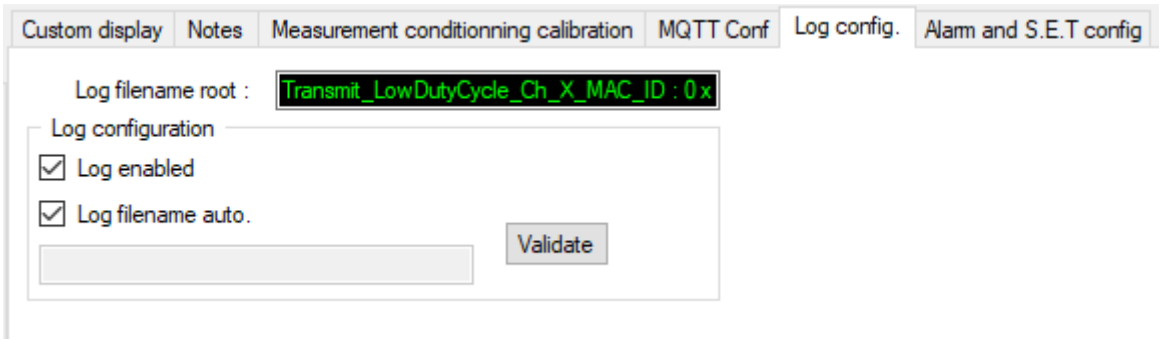



*Figure 117: Log Config tab*

By default, Log file name is built with the measurement channel & ***BeanDevice®*** MAC Address:

< Sensor Channel Number > <MAC_ID>

- ✓ ***Log enabled***: If checked, Log is enabled on the BeanScape®
- ✓ ***Log filename auto***.: If checked, Log file name is named automatically

Click on ***validate*** in order to validate all your modifications.

For users who want to rename the log file, two solutions are provided:

| | |
|---|---|
| ***Solution 1*** | ***Add automatically the channel "Label" in your log file name:*** <br> ***<Label><Sensor channel Number> <MAC_ID>*** |
| ***Solution 2*** | ***The log file name can be fully customized:*** <br> ***Uncheck the case « Log filename auto" and add your own label*** |

#### 8.1.6.2 Specific case: log filename creation in “Streaming”/”Streaming” mode

In streaming or Streaming mode, log filename is built as follow:

**Transmit_Streaming**_Sensor_channel_MAC_ID_DATE_partXXX

- ✓ ***Sensor channel = Sensor channel***
- ✓ ***MAC_ID: BeanDevice® MAC ID***
- ✓ ***DATE: date when the streaming mode starts***
- ✓ ***partXXX : Log file sequence number, part000 corresponds to the first log file***

***Example***:

Transmit_Streaming_INC_Y_MAC_ID___0_x_A4D57843DE580000_2017-06-15_11-00-05_part000

Transmit_Streaming_INC_Y_MAC_ID___0_x_A4D57843DE580000_2017-06-15_11-00-05_part001

8.1.6.3 Log file analysis

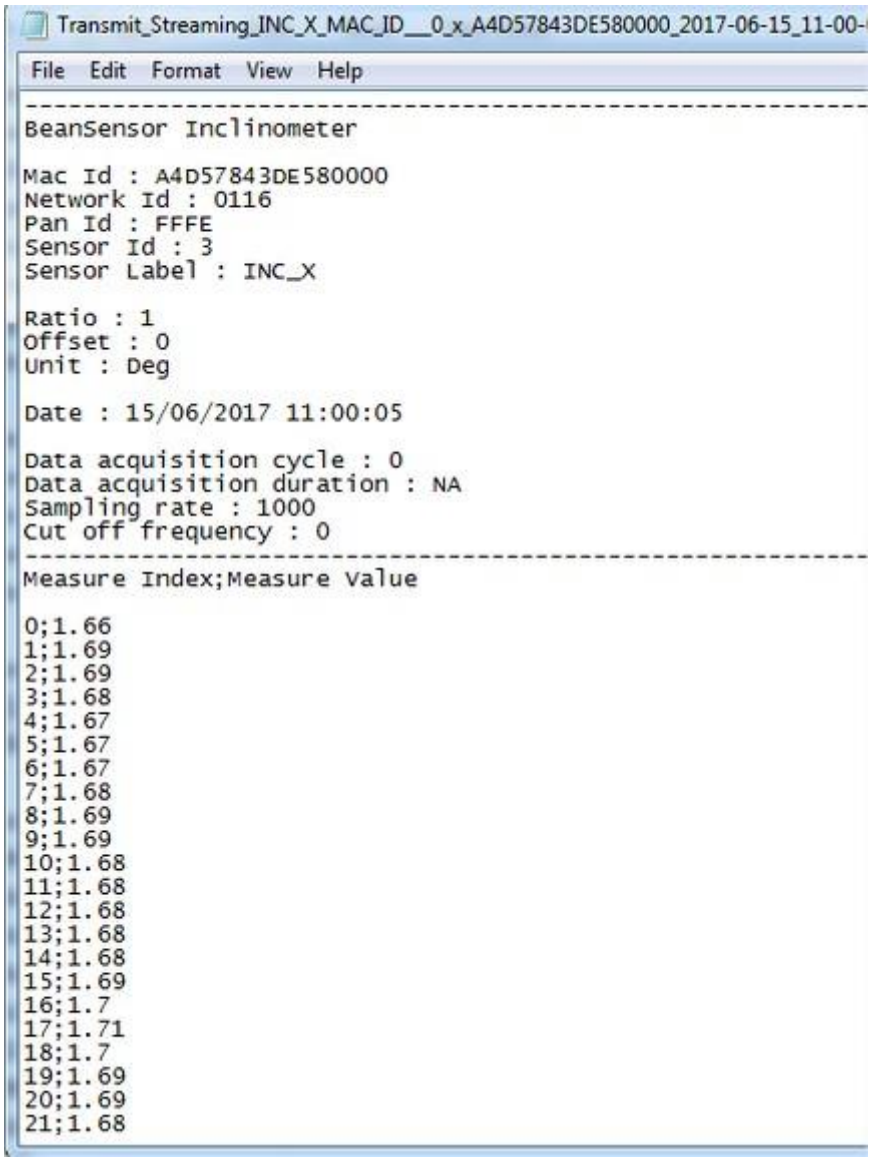



*Figure 118: Log file example*

The date which is displayed in the log file corresponds to the date when the streaming mode starts.

***Measure index*** allows the user to use a timestamp, the time value between the Index N and N+1 corresponds to the period rate.

***Example***: Data acquisition starts at 17h55min05s

A data acquisition with a measurement index of 30 (value -0,0035) corresponds to a time 17h55min05s30ms.

### 8.1.7 Log file related to Datalogger (Datalogger Folder)

#### 8.1.7.1 Log filename organization

Datalogger filename is built as follow:

**MAC_ID_Streaming_ DATE**

- ✓ ***MAC_ID: BeanDevice® MAC ID***
- ✓ ***DATE: date when the streaming mode starts***

#### 8.1.7.2 Log file analysis

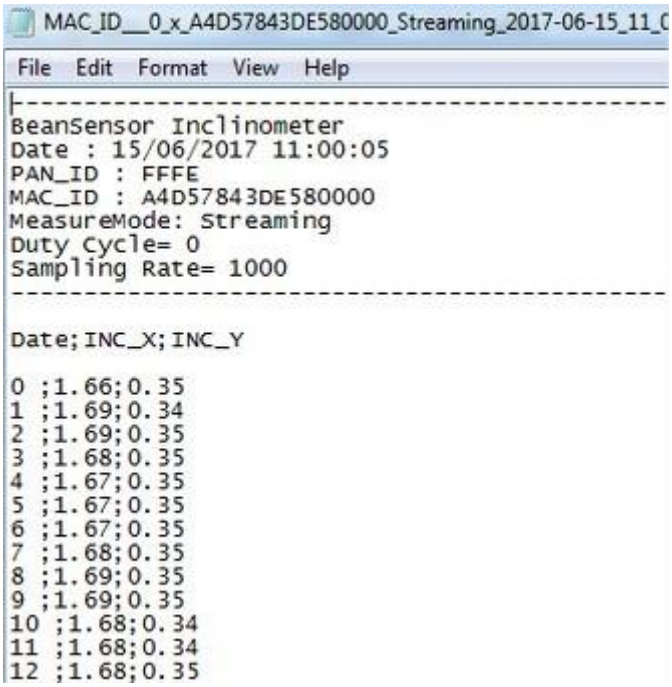



*Figure 119: Log file example*

Once downloaded, the user will get the same files as the Log files related to TX folder, a start time reference is noted, and an indexed measurement recorded.

### 8.1.8 Log file related to Wireless Network diagnostic

#### 8.1.8.1 Log filename organization

Wireless Diagnostic log filename is built as follow:

**MAC_ID_WirelessNetwkInfo**

- ✓ ***MAC_ID: BeanDevice® MAC ID***

#### 8.1.8.2 Log file analysis

Log file related to wireless network diagnostic provides the following information:

- ***Date*** : diagnostic date
- ***LQI***: BeanDevice® Link quality indicator
- ***PER*** : Packet Error Rate
- ***Internal temperature***: internal battery voltage
- ***LoggerUsedSizeRatio***: datalogger available memory size
- ***Energie Harvester***:energie harvester status
- ***Battery voltage***: battery voltage

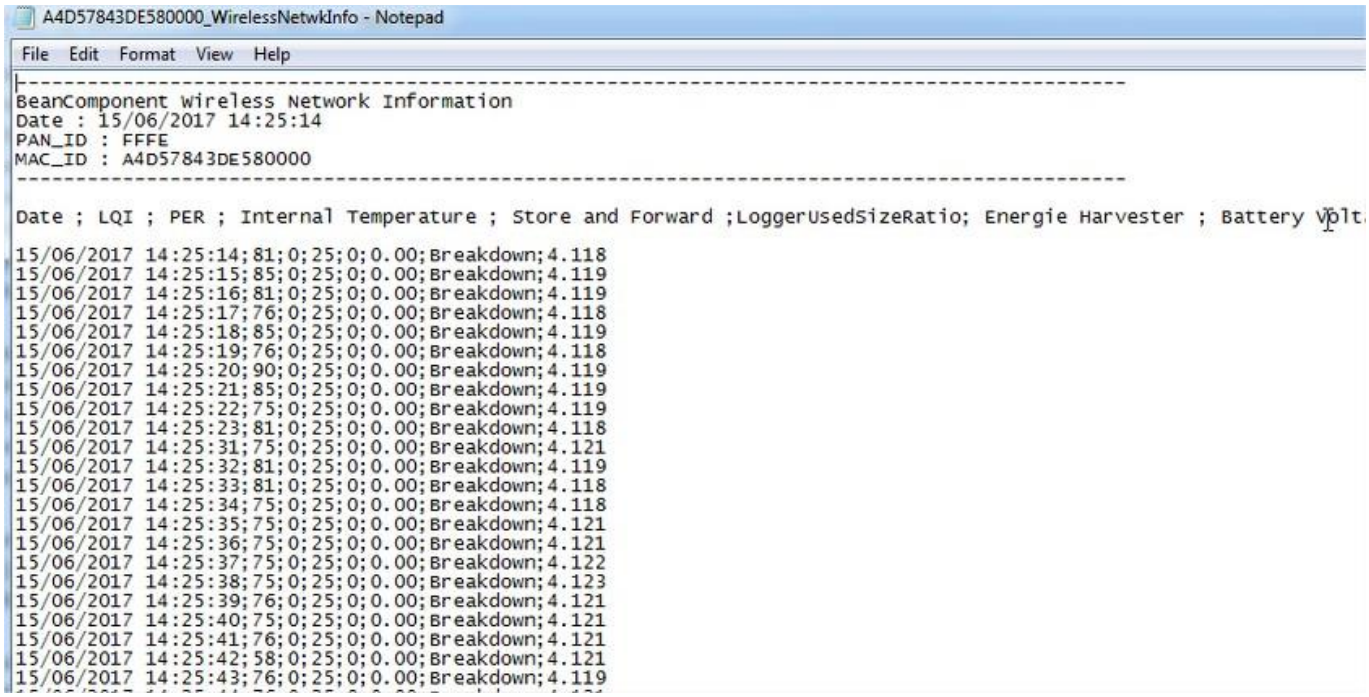



*Figure 120: Wireless Network Info log file*

If the BeanDevice® is configured with the streaming data acquisition mode, the following diagnostic information are not refreshed:

- ***Battery voltage***
- ***Battery level***
- ***Internal temperature***

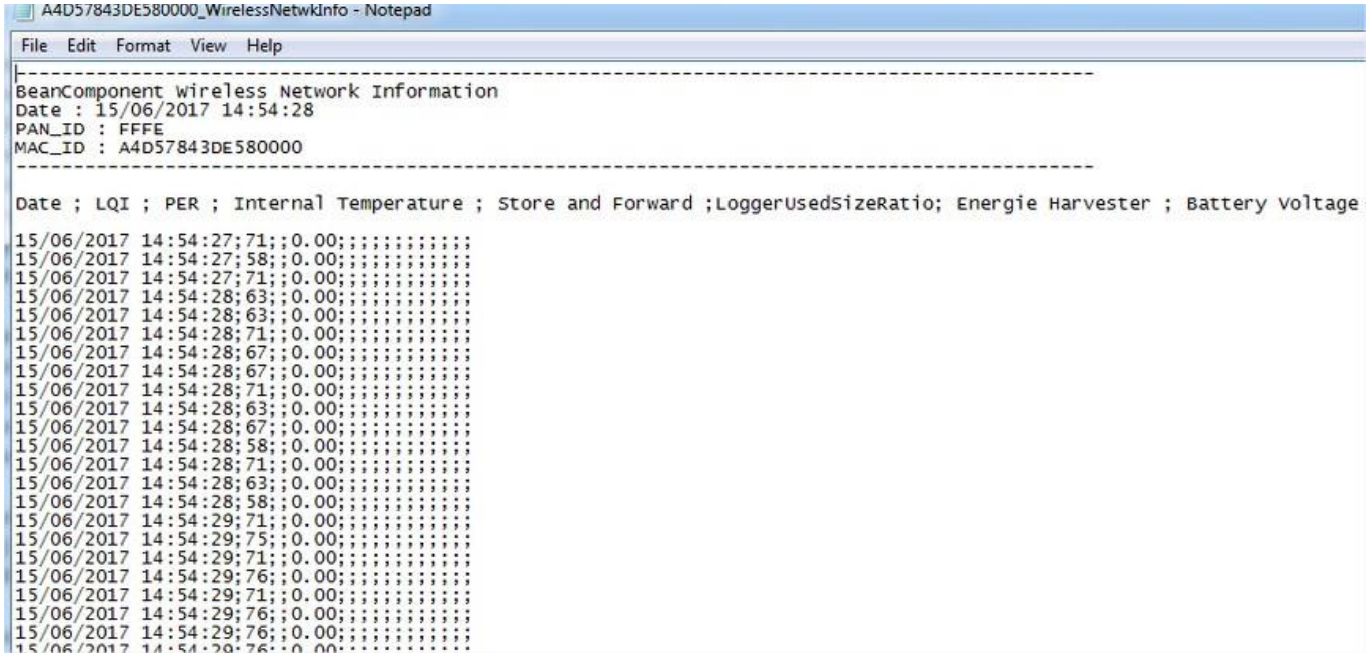
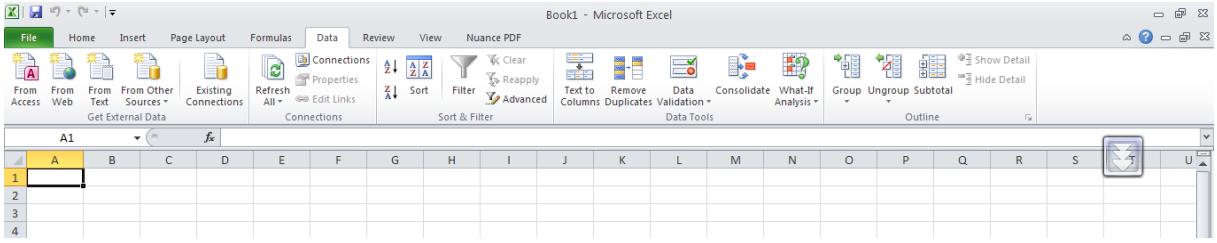


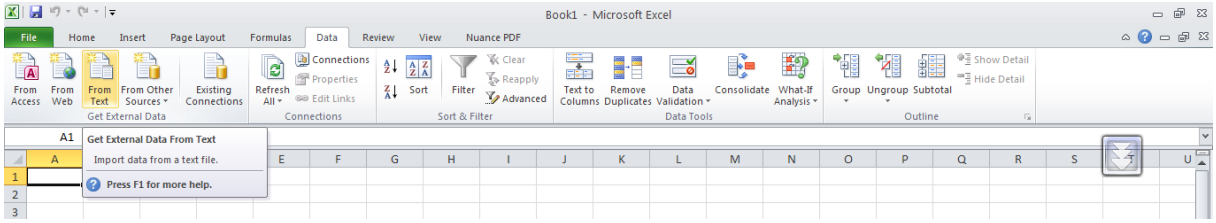

***Figure 121: Wireless Network Info log file***

### 8.1.8.3 How to open a measurement file with excel

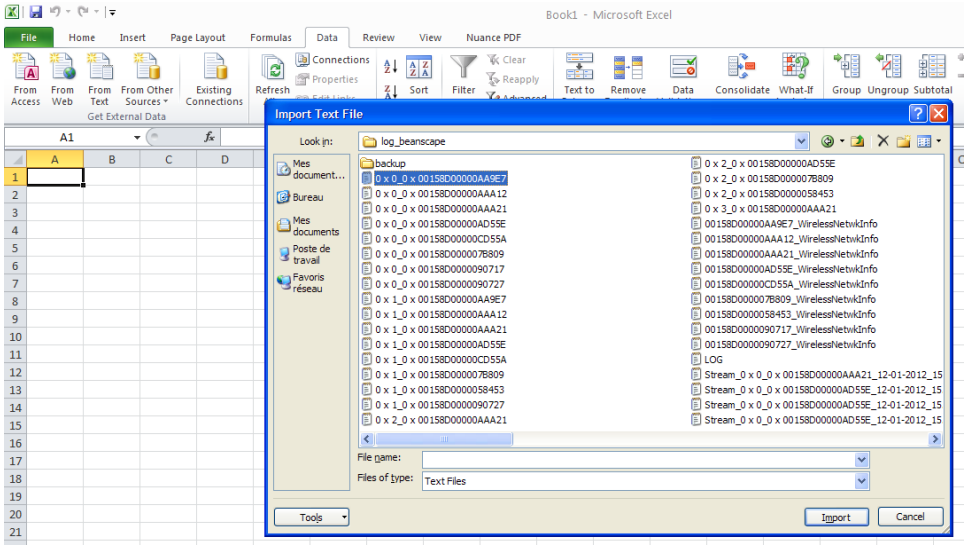
***Step 1 : Open Excel***




***Step 2: Go on « Data » Tab, then select "From Text"***

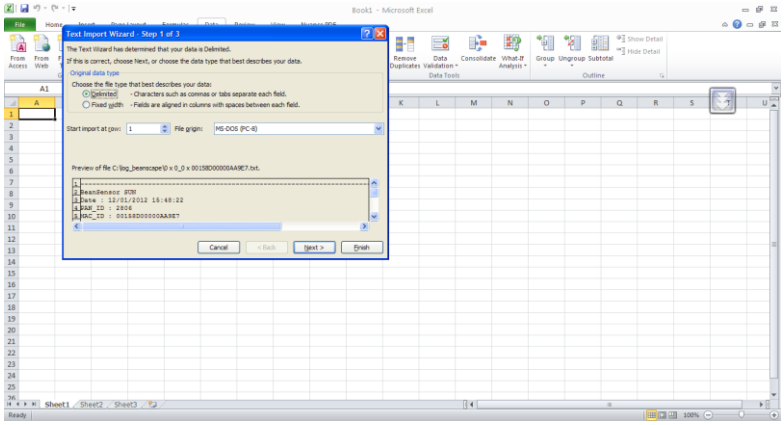


## *Step 3 : Choose your log file*

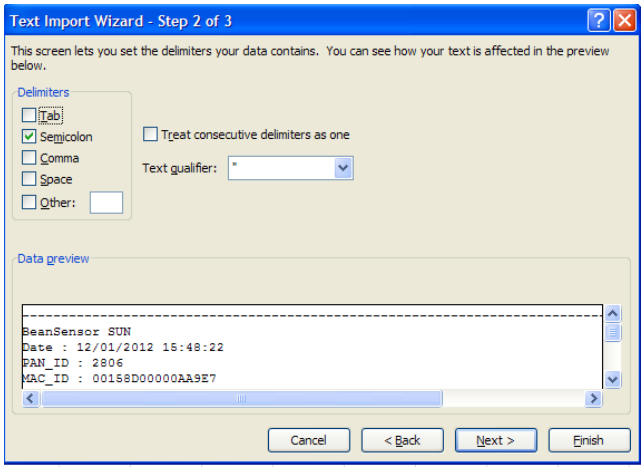



## *Step 4 : Text import wizard will open, select « Delimited » for Characters such as commas or tabs separate each field.*

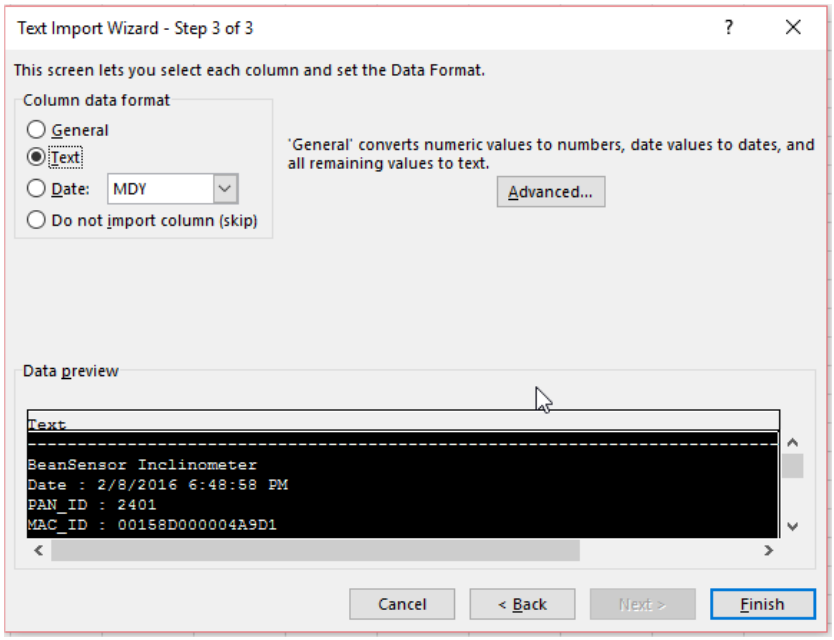
On "***Start import at row***" field: Select the number of lines that you want to suppress from the header:



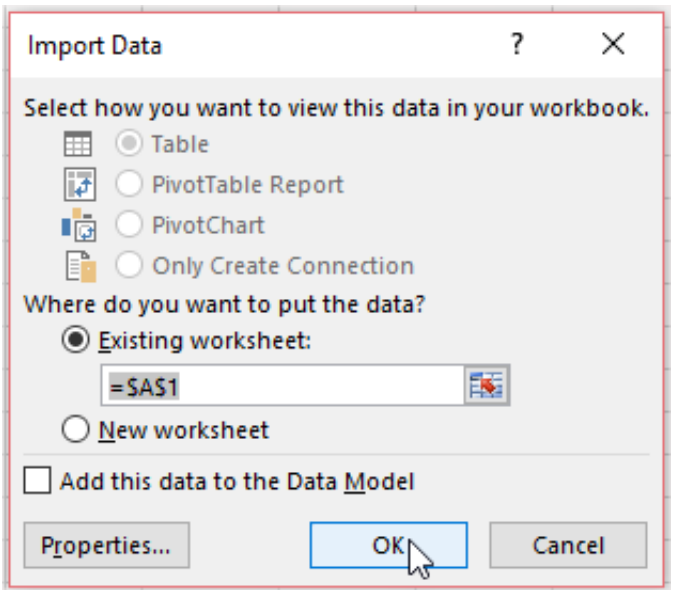
**Select semicolon**



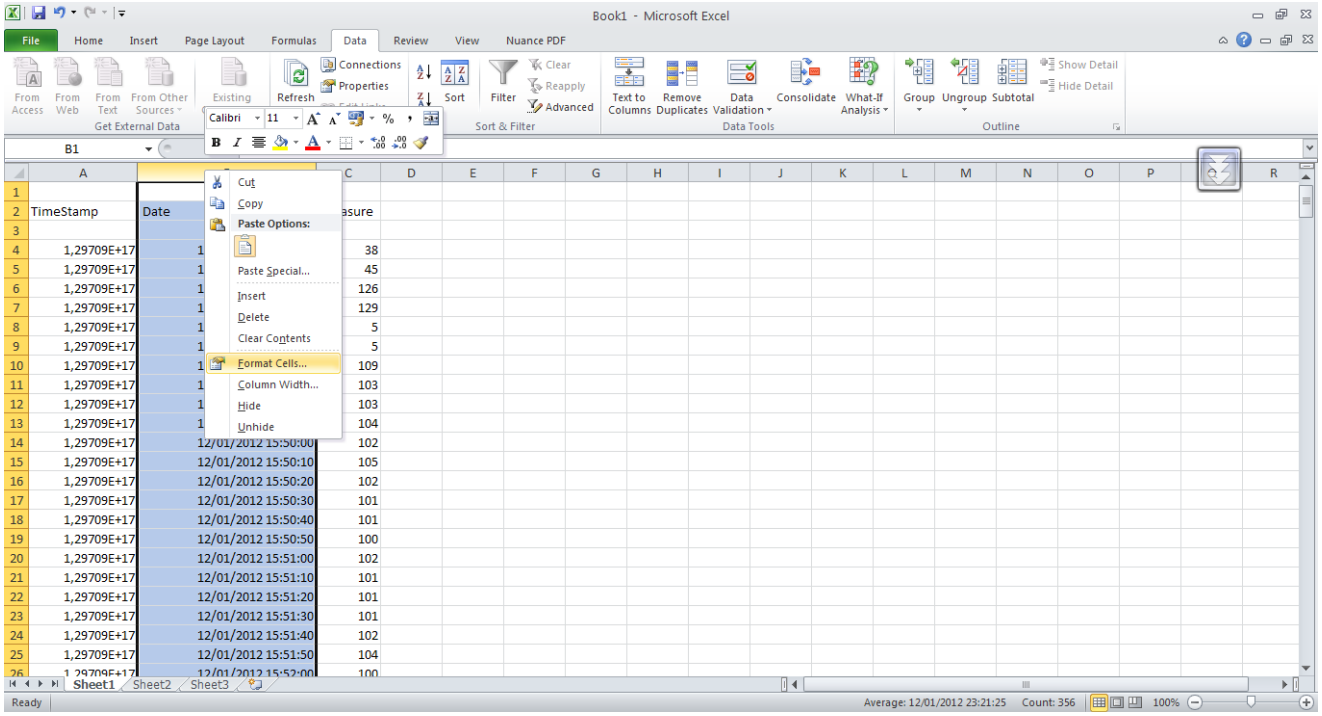

**Select Text**


Text Import Wizard - Step 3 of 3
This screen lets you select each column and set the Data Format.
Column data format
General
Text
Date: MDY
Do not import column (skip)
'General' converts numeric values to numbers, date values to dates, and all remaining values to text.
Advanced...
Data preview
Text
BeanSensor Inclinometer
Date : 2/8/2016 6:48:58 PM
PAN_ID : 2401
MAC_ID : 00158D000004A9D1
Cancel
< Back
Next >
Finish

**Click on OK**


Import Data
Select how you want to view this data in your workbook.
Table
PivotTable Report
PivotChart
Only Create Connection
Where do you want to put the data?
Existing worksheet:
=$A$1
New worksheet
Add this data to the Data Model
Properties...
OK
Cancel

Click on format cells:




See “Exporting a log file to Excel” YouTube video

# 9. MQTT CONFIGURATION

In order to configure MQTT Select your BeanDevice® and go to BeanDevice® menu and scroll down to MQTT

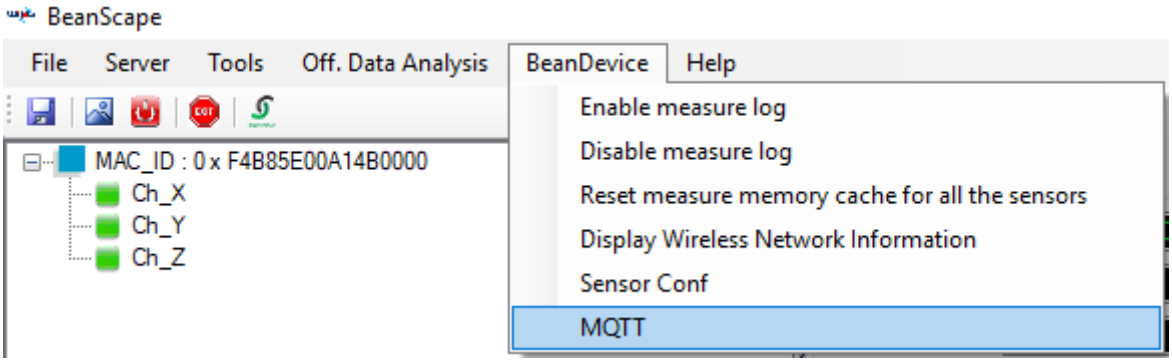



*Figure 122: BeanDevice® menu*

An MQTT Module window will pop up.

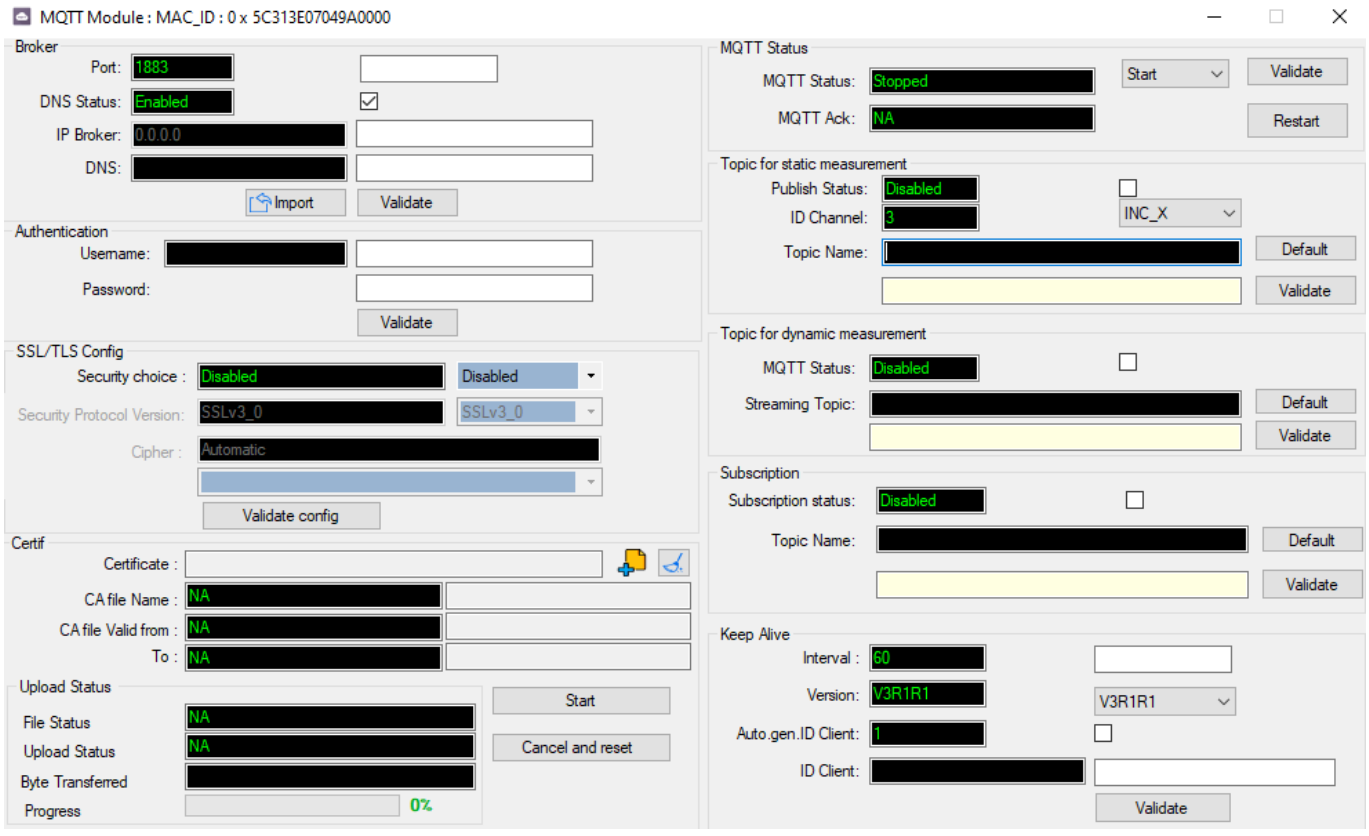



*Figure 123: MQTT Module window*

## 9.1 BROKER

The broker is responsible for distributing messages to interested clients based on the topic of a message and there are two categories of brokers, one that is hosted on the Internet, the other is running on internal network.

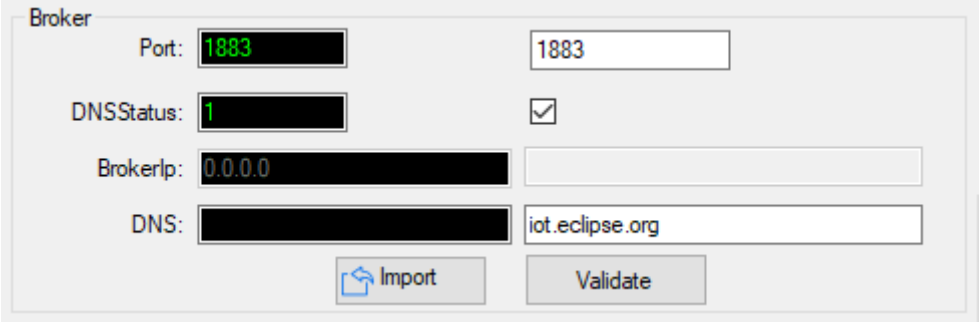



*Figure 124: Broker frame*

- ***Port***: TCP/IP port to use with MQTT. 1883 and 8883 are the reserved ports for use with MQTT
- ***DNSStatus***: check if you want to enter your broker DNS. DNSStaus is 1
- ***Brokerlp***: enter your broker IP address after unchecking DNSStatus. DNSStatus is 0
- ***DNS***: domain name server of your Broker

## 9.2 KEEP ALIVE

The keep alive functionality assures that the connection is still open and both broker and client are connected to one another

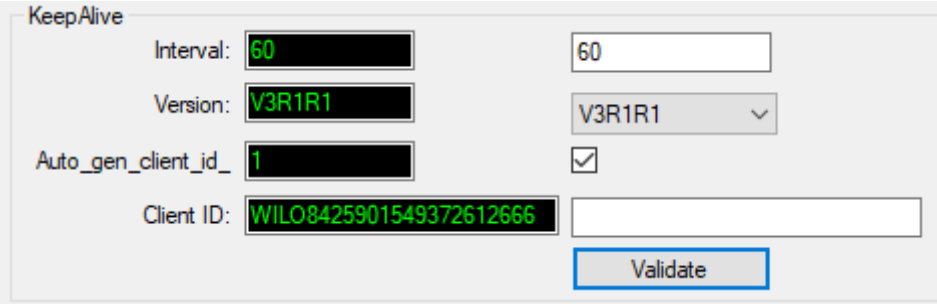



*Figure 125: Keep alive frame*

- ***Interval***: The interval is the longest possible period of time, which broker and client can endure without sending a message.
- ***Version***: MQTT protocol version
- ***Auto_gen_client_ID***: check for auto generate a Client ID
- ***Client ID***: Enter your client ID

## 9.3 AUTHENTIFICATION

MQTT broker can be configured to require client authentication using a valid username and password before a connection is permitted.


*Figure 126: Authentication frame*

- ***User Name:*** specify your user name
- ***Password:*** enter your password

## 9.4 SSL/TLS

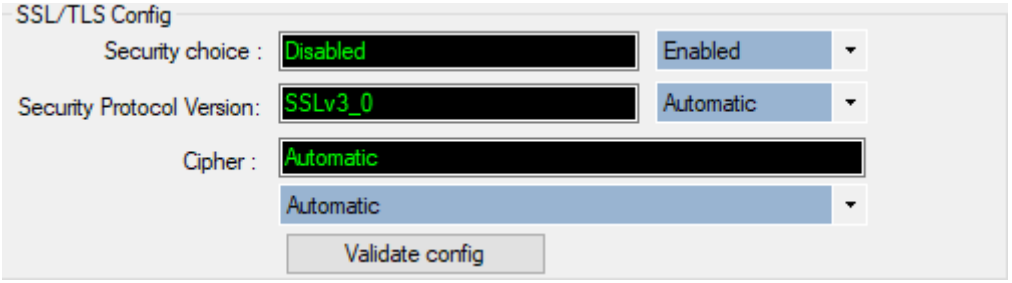



*Figure 127: SSL/TLS*

- ***Security choice:*** Enable or disable the security.
- ***Security Protocol Version:*** Choose the security protocol (Automatic choice is recommended).
- ***Cipher:*** Choose the cipher suit (Automatic choice is recommended).

## 9.5 CERTIF

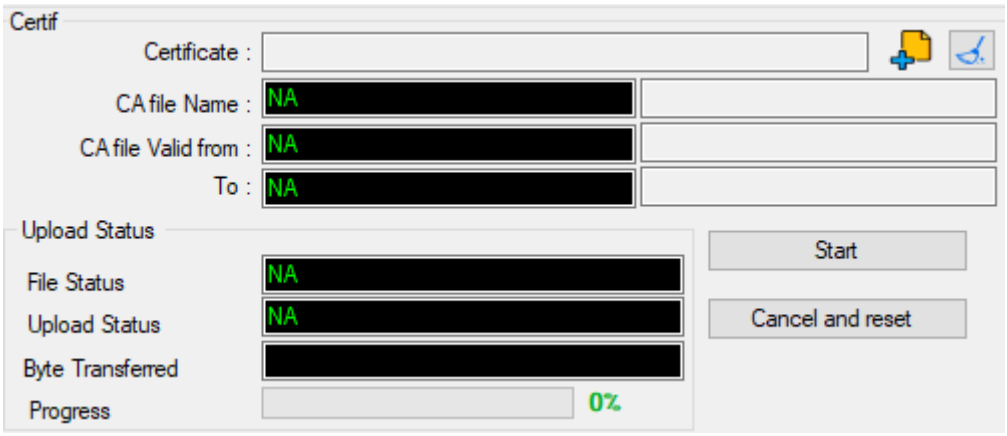



*Figure 128 Certification*

- ***Certificate:*** choose the certificate from local machine.
- ***CA file Name:*** enter the name of the file.
- ***CA file Valid from:*** choose the sender.
- ***To:*** choose the receiver (we can check the validity of the file on the Beanscape® side before send it to avoid problems).
- ***Start:*** starting the process of the sending.
- ***Cancel and reset:*** cancelling the sending of the file and reset the information.

**For further information about the SSL/TLS please refer to the SSL/TLS Technical note**

.

## 9.6 MQTT STATUS

Here you can check your MQTT different status, connected, stopped, connecting or disconnecting and can start your connection from here.


*Figure 129: MQTT Status frame*

- ***MQTT Status:*** shows the current status of the MQTT module:

- Connecting: trying to establish a connection
- Connected: connection established
- Disconnecting: disconnecting the Client
- Stopped: the connection is stopped

- ***Start/Stop:*** select and **Validate** to start or stop your MQTT Client connection
- ***Restart:*** restart your connection

## 9.7 TOPIC FOR STATIC MEASUREMENT

A topic is a string used by the broker to filter messages for each connected client. Using this Topic for static measurement you will receive LowDutyCycle & alarm acquisition modes that are publishing to the MQTT broker,

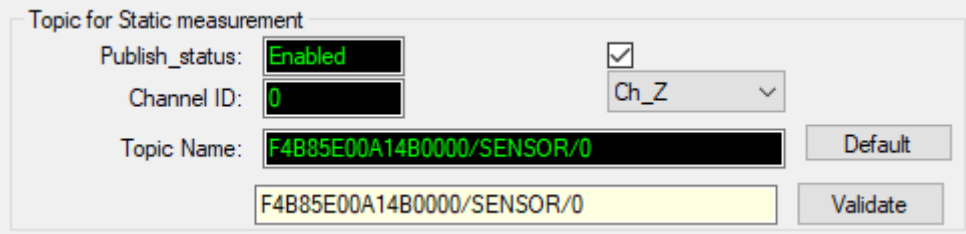



*Figure 130: Topic for static measurement frame*

- ***Publish_status:*** Check the check-button and **validate** to enable publishing
- ***Channel ID:*** channel identification
- ***Topic Name:*** Field to enter your topic's name

## 9.8 TOPIC FOR DYNAMIC MEASUREMENT

Using this Topic for Dynamic measurement you will receive Streaming, S.E.T & Shock detection acquisition modes that are publishing to the MQTT broker,

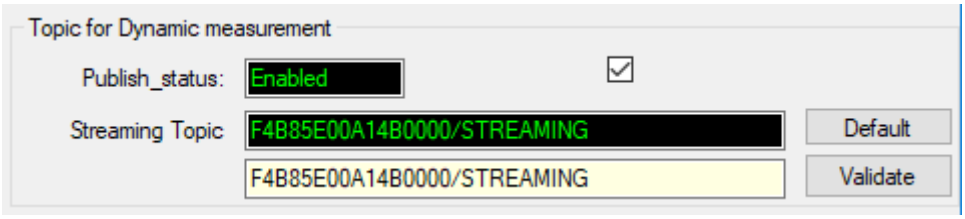



*Figure 131: Topic for dynamic measurement frame*

- ***Publish_status:*** check the check-button and **validate** to enable publishing
- ***Streaming Topic:*** Text field to enter your streaming topic's name

## 9.9 SUBSCRIBE

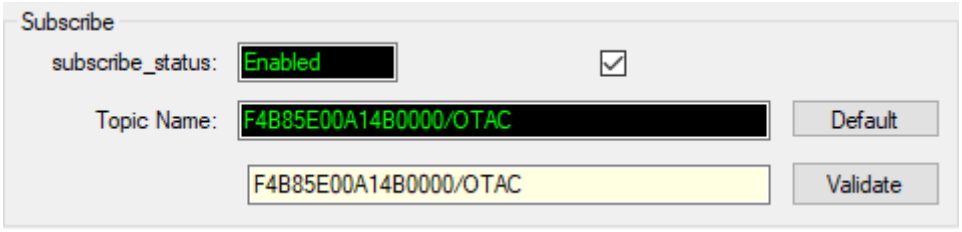



***Figure 132: Subscribe***

- ***Subscribe_status:*** check the check-button and **validate** to enable subscribing
- ***Topic Name:*** Field to enter your topic's name to subscribe to

# 10. OFFLINE DATA ANALYSIS TOOL

## 10.1 FFT (FAST FOURIER TRANSFORM) WAVEFORM ANALYSIS MODULE (AVAILABLE ONLY ON BEANDEVICE® WILOW® AX-3D)

The Fast Fourier Transform (FFT) resolves a time waveform into its sinusoidal components. The FFT takes a block of time-domain data and returns the frequency spectrum of the data. The FFT is a digital implementation of the Fourier transform. Thus, the FFT does not yield a continuous spectrum. Instead, the FFT returns a discrete spectrum, in which the frequency content of the waveform is resolved into a finite number of frequency lines, or bins.

***FFT (Fast Fourier transform) module is only compatible with "Streaming" and "S.E.T" measurement modes.***

The BeanScape® Software includes an FFT module used for spectrum analysis. Under the menu Off.Data Analysis displayed on the BeanScape® top menu, select FFT to have access to FFT spectrum analysis module.

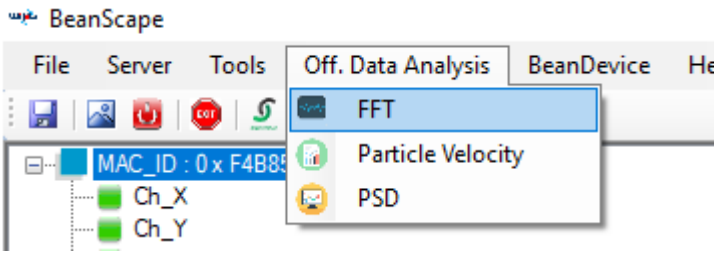



*Figure 133: FFT Feature*

***For further information about the Offline FFT Data Analysis Tool please refer to this technical note TN_RF_18 – "Data acquisition modes available on the BeanDevice®"***

## 10.2 PARTICLE VELOCITY (AVAILABLE ONLY ON BEANDEVICE® WILOW® AX-3D ±2G VERSION)

According to the DIN4150-3, the BeanScape® software Particle Velocity option acts as follow:

1-Display Particle velocity which is calculated from the acceleration.

2-Implement an analysis report.

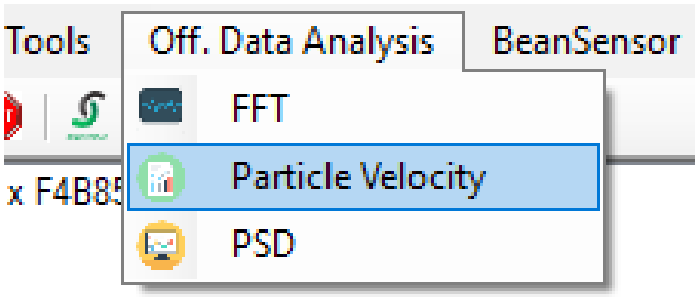



*Figure 134: Particle Velocity menu*

*For further information about the Offline Particle Velocity Data Analysis Tool please refer to this technical note TN_RF_18 – "Data acquisition modes available on the BeanDevice®"*

## 11. ONLINE DATA ANALYSIS TOOL

Click on the online data analysis tab to explore the available features.

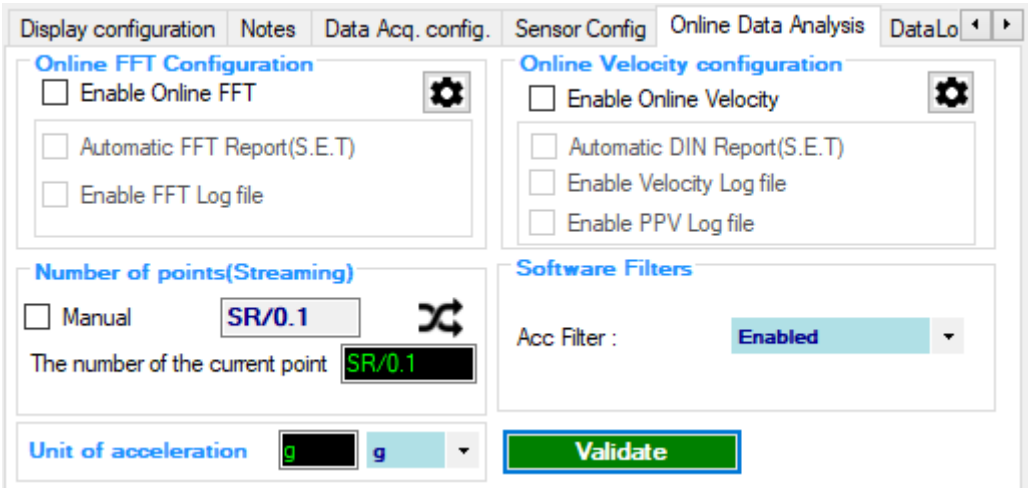



*Figure 135: Online Data Analysis tool*

*For further information about the Offline Data Analysis Tool please refer to this technical note TN_RF_18 – "Data acquisition modes available on the BeanDevice®"*

# 12. TOOLS TAB

From this tab, user have the possibility to access to many features and configurations related to BeanScape®/BeanDevice® management.

By simply clicking on Tools tab several topics will be displayed as follow

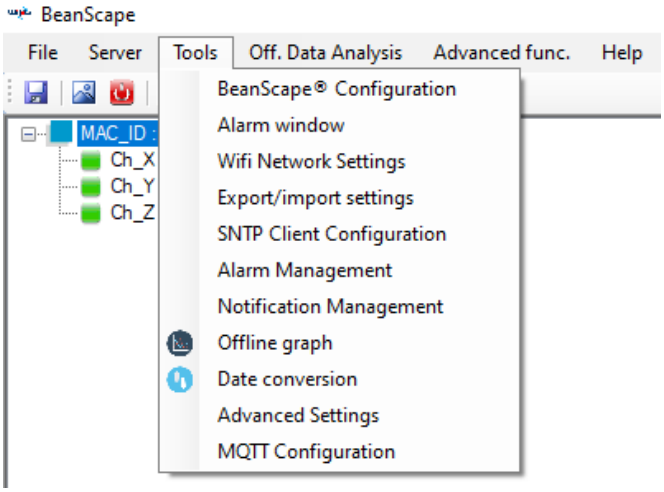



*Figure 136: Tools Tab Main Menu*

## 12.1 BEANSCAPE CONFIGURATION

BeanScape® menu window contains several configuration options related to the system configuration, Log file management and many other options.

### 12.1.1 Log File Organization

In Log Configuration frame, all the options are related to the Log file generation, seize and WIFI connection management.

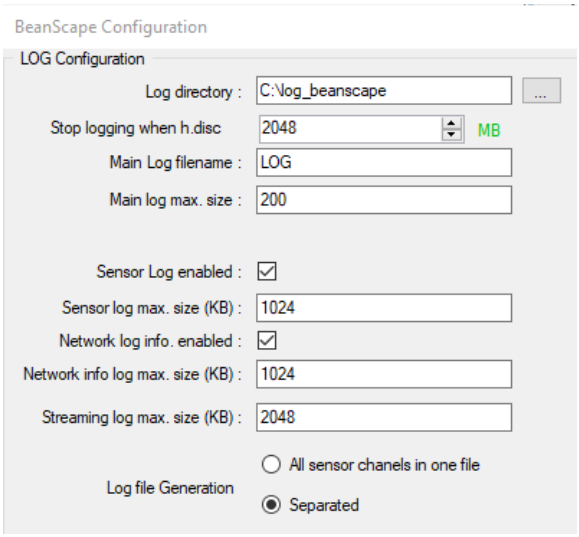



*Figure 137: Log file Configuration*

For further details please have a look to section 8 in this document.

### 12.1.2 Configuration via UDP

User can configure the UDP port from this section, by default the port number is 53130.


*Figure 138: UDP Port Configuration*

### 12.1.3 Keep Alive App

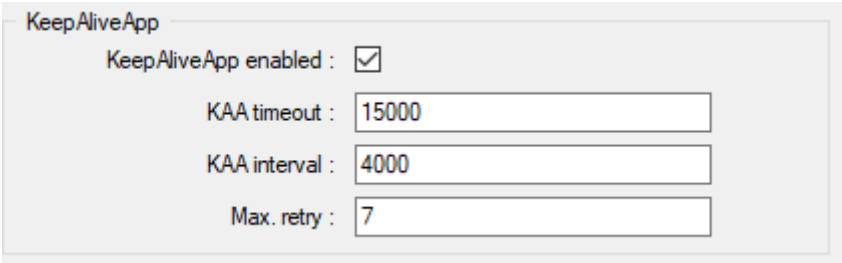



*Figure 139: Keep alive tab*

Three parameters related to keepalive are available:

- **Keep alive timeout** is the duration between two keep alive transmissions in idle condition. TCP keepalive period is required to be configurable and by default is set to no less than 2 hours.
- **Keep alive interval** is the duration between two successive keep alive retransmissions, if acknowledgement to the previous keep alive transmission is not received.
- **Max retry** is the number of retransmissions to be carried out before declaring that remote end is not available.

Keepalive packet contains null data. In a TCP/IP over Ethernet network, a keepalive frame is of 60 bytes, while acknowledge to this also null data frame and is of 54 bytes.

### 12.1.4 Language Configuration

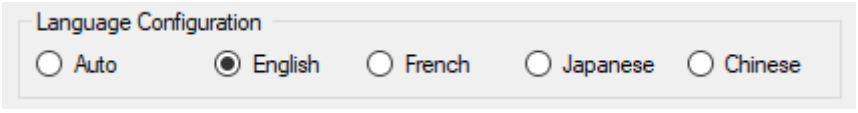



*Figure 140: Language configuration*

- ✓ ***Auto***: The BeanScape® will use the OS language by default
- ✓ ***English***: select English language
- ✓ ***French***: select French language

- ✓ **Japanese**: Select Japanese language
- ✓ **Chinese**: Select Chinese language

This configuration will be updated when the BeanScape® is restarted.

### 12.1.5 System Configuration

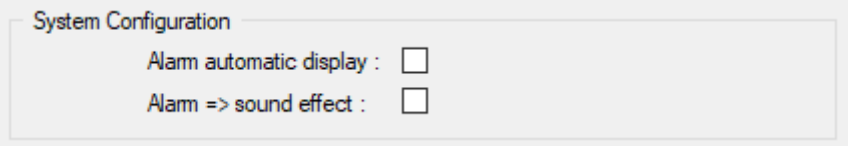



*Figure 141: System Configuration*

- ✓ ***Alarm automatic display:*** Check this box if you want to see an alarm window displayed automatically when a window alarm threshold is exceeded.
- ✓ ***Alarm ➔ Sound Effect:*** Check this box if you want to hear a sound effect when a threshold is exceeded.

### 12.1.6 Remote Access

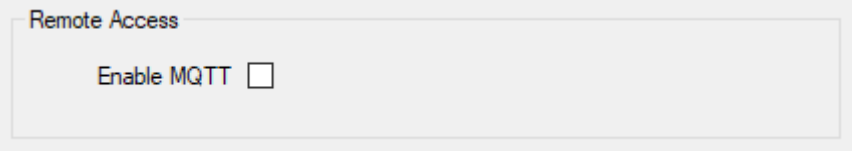



*Figure 142: Remote Access*

Check Enable MQTT Protocol for remote Access.

### 12.1.7 Date and Time Format

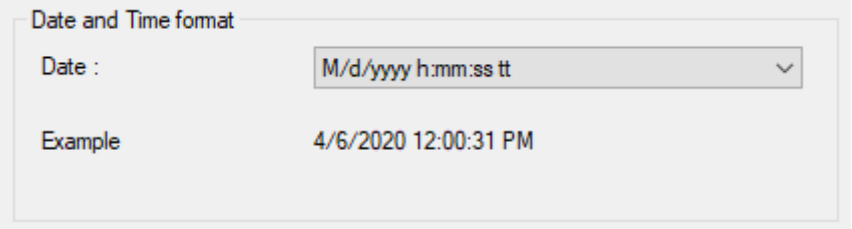



*Figure 143: Date and Time Configuration*

Scroll down the Date Menu and select your suitable format from the list.

### 12.1.8 BeanScape® MultiSite Configuration

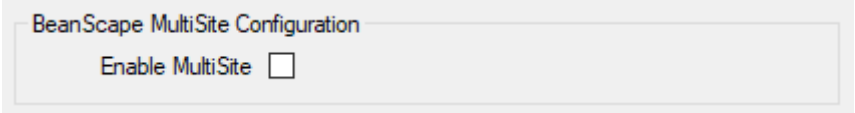



*Figure 144: BeanScape MultiSite Configuration*

In order to open more than one BeanScape® software session, check enable MultiSite options.

### 12.1.9 G-Value

Because there are slight variations in the G value about earth's surface within the value of G dependent upon location, user have the possibility to set the corresponding G value from BeanScape Configuration option.

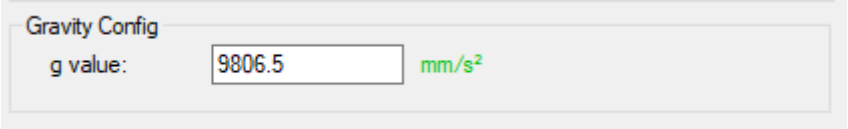



*Figure 145: G-Value Configuration*

## 12.2 WIFI NETWORK SETTINGS

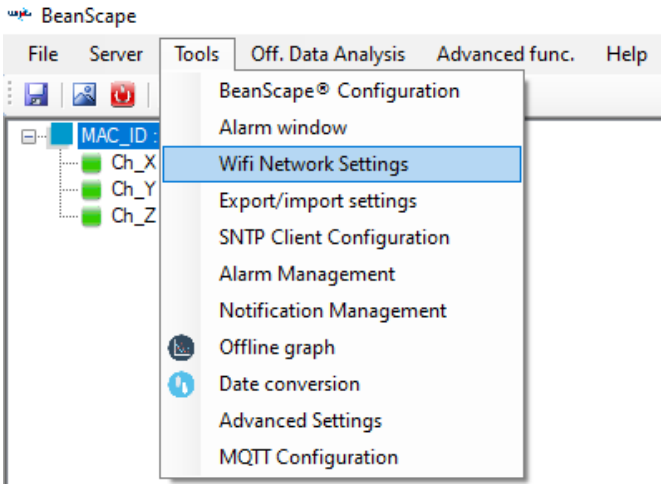



*Figure 146: WIFI Network Settings*

By clicking on WIFI Network Settings, new windows will pop up

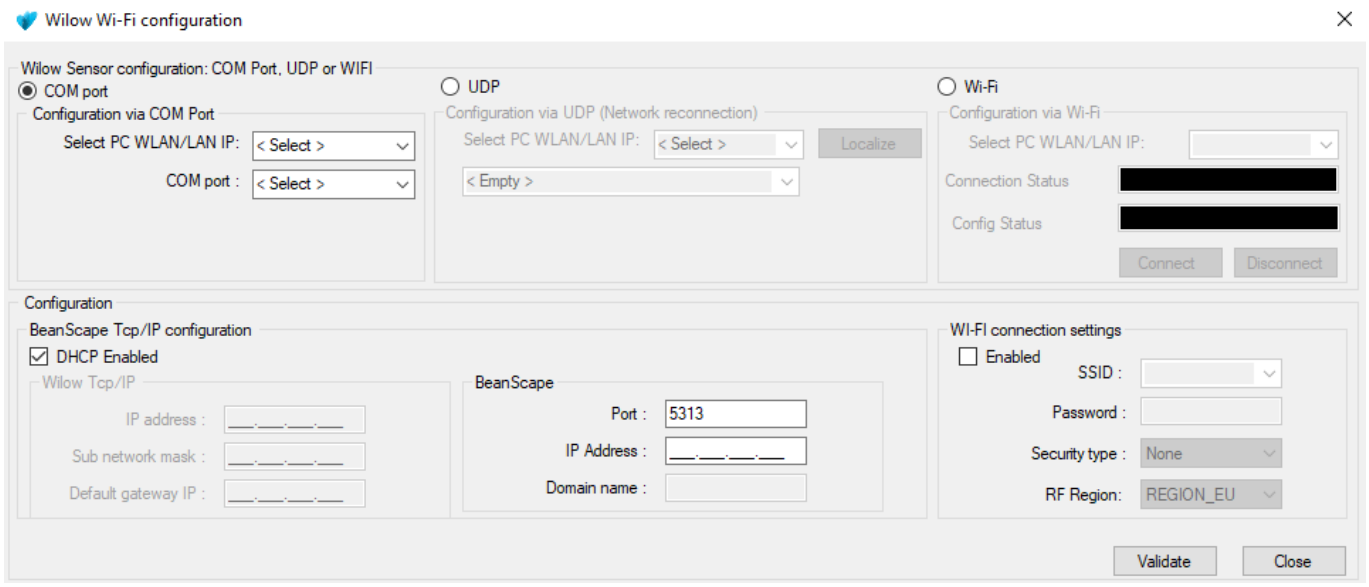



*Figure 147: WIFI Configuration*

From this window user can configure his BeanDevice® and enter Router settings in order to connect the BeanDevice® on BeanScape Software.

For further details refer to BeanDevice® Configuration section.

## 12.3 EXPORT/IMPORT USER SETTINGS (ONLY FOR ADVANCED USER)

### 12.3.1 Custom User Configuration: Export Function

Click on the tab ***Tools*** then "***Export/Import user settings***"

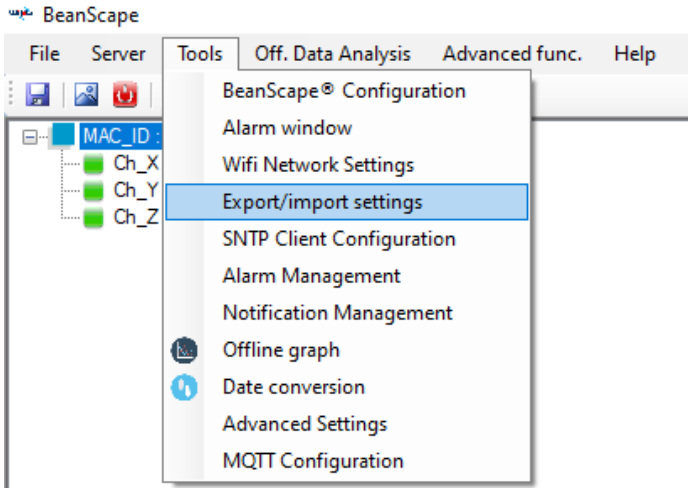



*Figure 148: Export/Import feature*

A new window will appear, which contains the **Custom User Configuration** and the **BeanScape Configuration**,

- **Custom User Configuration** refers to the BeanDevice® Configuration settings.
- **BeanScape Configuration** is related to BeanScape® settings.

Under Custom User Configuration click on ***Export***:

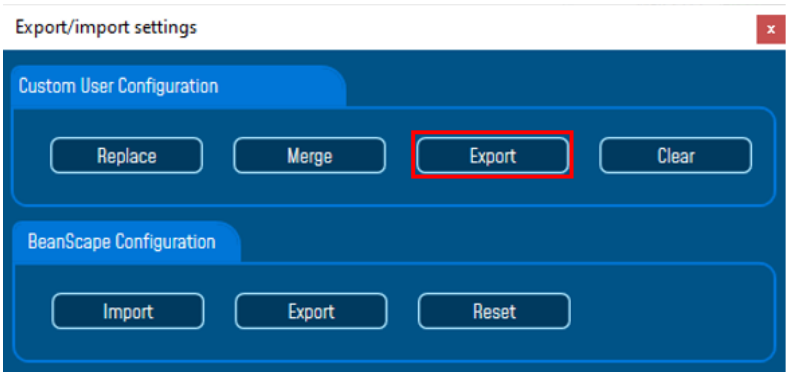



***Figure 149: Custom user configuration window***

User configuration is exported in XML format:

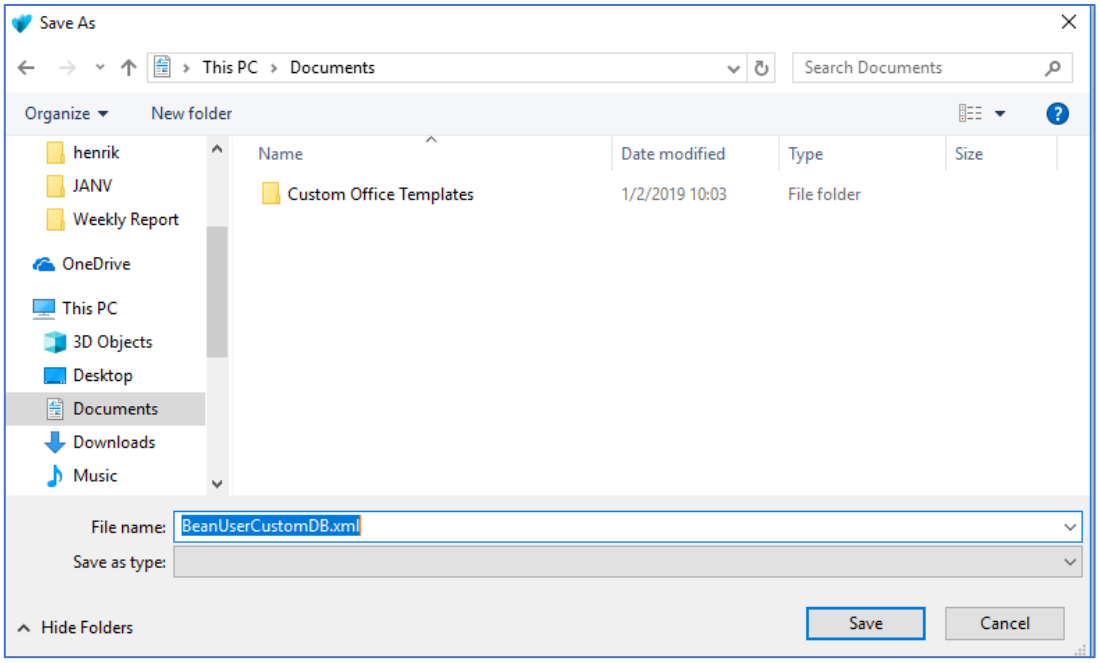



***Figure 150: User export***


*Figure 151: Custom DB example*

### 12.3.2 Custom User Configuration: Import Function

#### 12.3.1 Import Function

Click on ***Replace*** to import user configuration, by choosing replace function the old Custom_DB will be replaced with the new one.

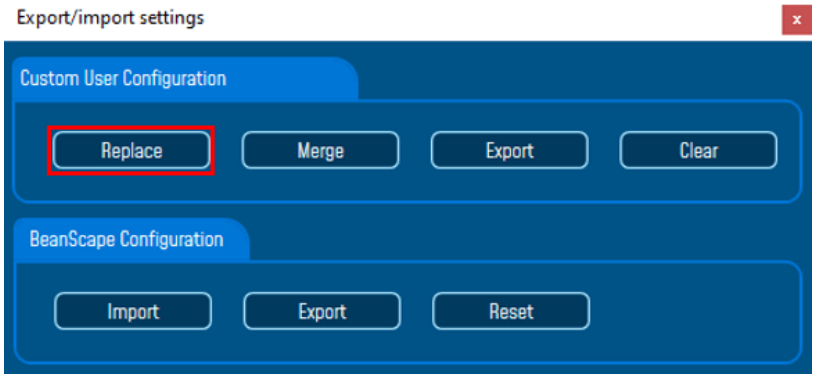



*Figure 152: Custom user configuration window*

By choosing ***Merge*** function the old Custom_DB will be merged with the new one.

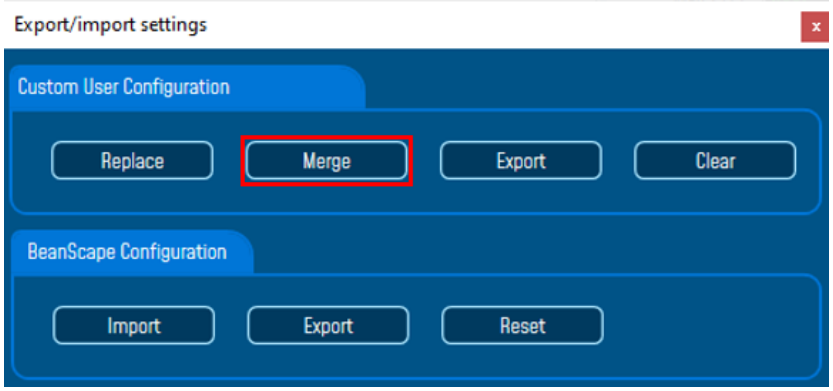



*Figure 153: Custom user configuration (merge)*

Click on **Clear** to clear the Custom_DB.

***Don't try to change manually the XML file, there is a high risk to corrupt it.***

### 12.3.2 BeanScape® configuration

#### 12.3.2.1 Export Function

Click on "***Export"*** to export BeanScape configuration

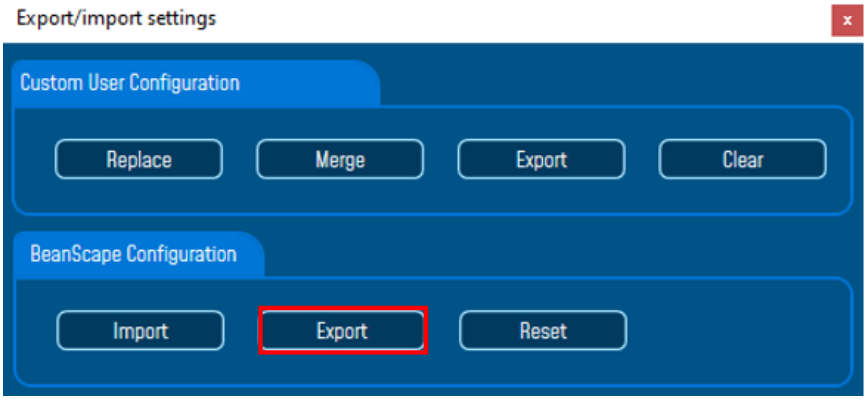



*Figure 154: Export BeanScape configuration settings*

BeanScape configuration is exported in XML format:

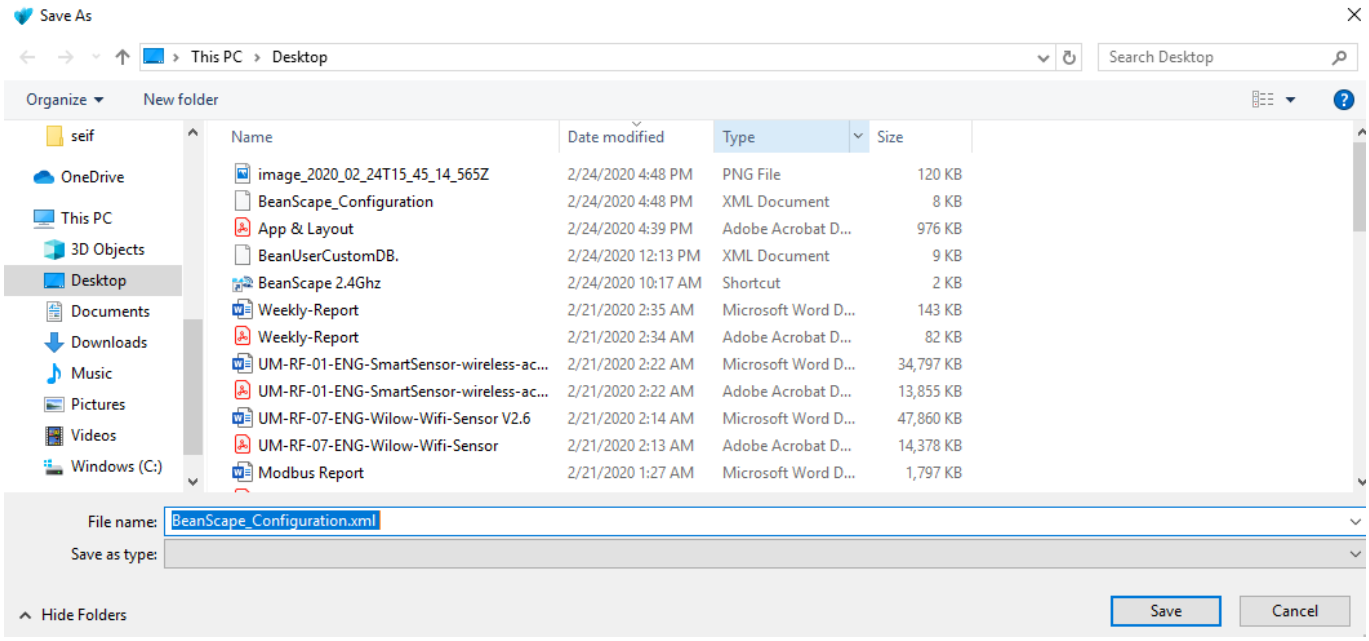



*Figure 155: BeanScape® configuration exportation*

### 12.3.2.2 Import Function

Click on ***Import*** to import BeanScape configuration

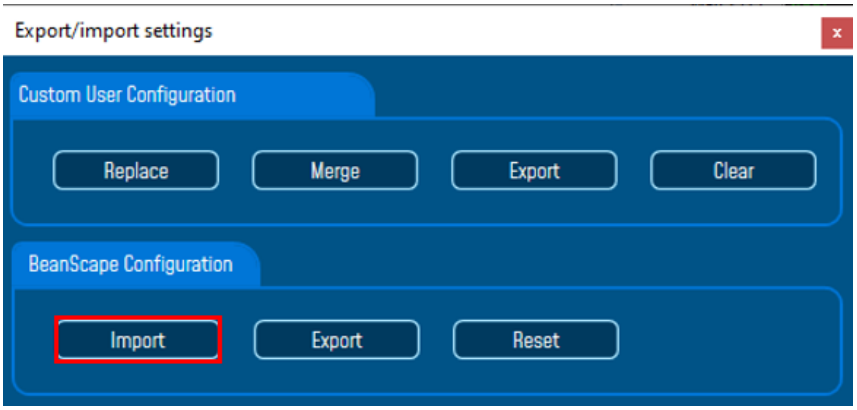



*Figure 156: Import BeanScape® config settings*

Click on **Reset** to reset the BeanScape configuration.

## 12.4 SNTP CLIENT

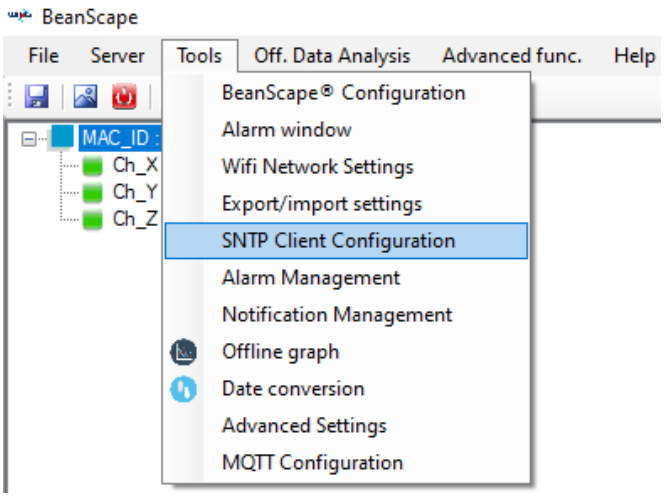



*Figure 157: SNTP Client Configuration*

SNTP refers to Simple Network Time Protocol. This function could be used to query a Network Time Protocol (NTP) server and give the time drift of the computer clock relative to the server clock.

- Set “UpdateLocalDate Time” to **True** to synchronize the Time with The Computer hosting the BeanScape®

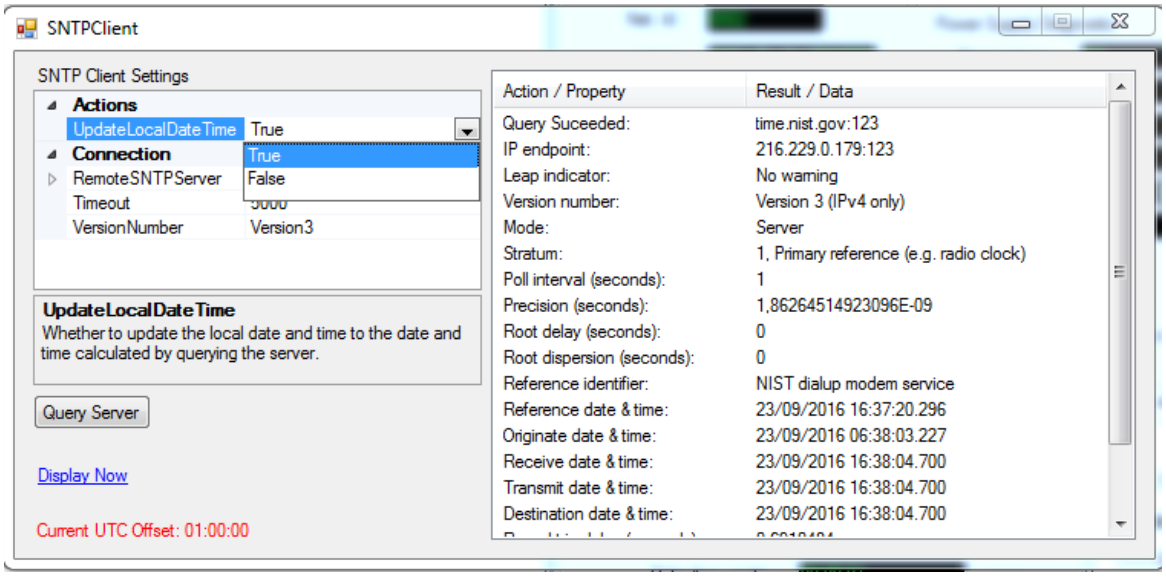



*Figure 158: SNTP Client configuration*

- Press Query Server to update the clock of your computer based on network clock

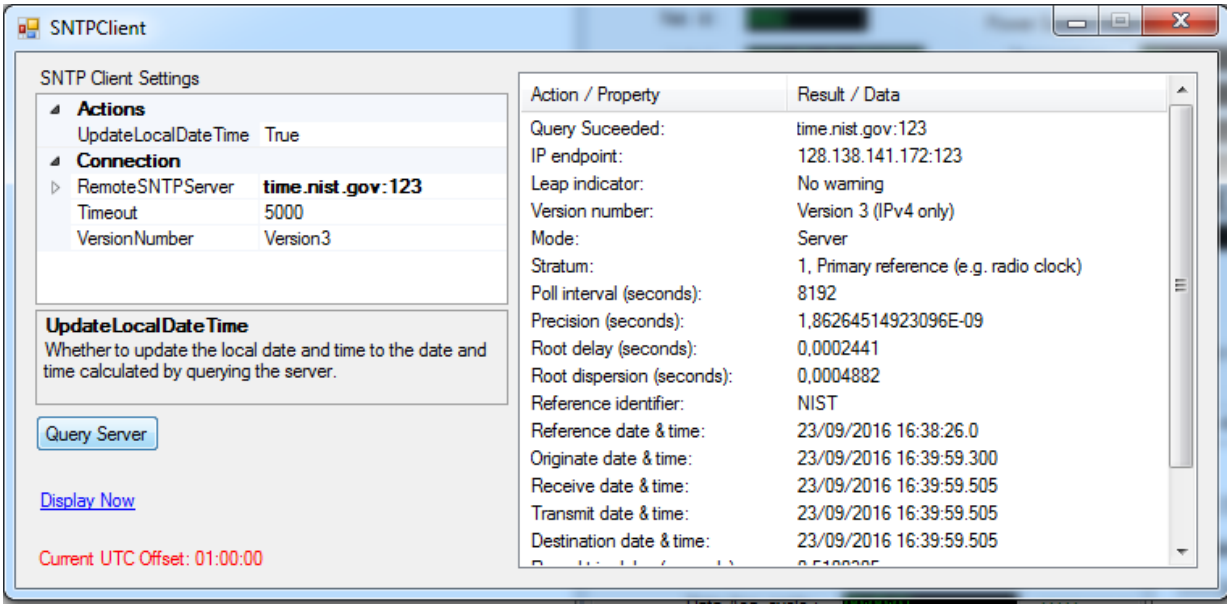



*Figure 159: SNTP Client configuration*

- You can display also the current server time by clicking on Display Now

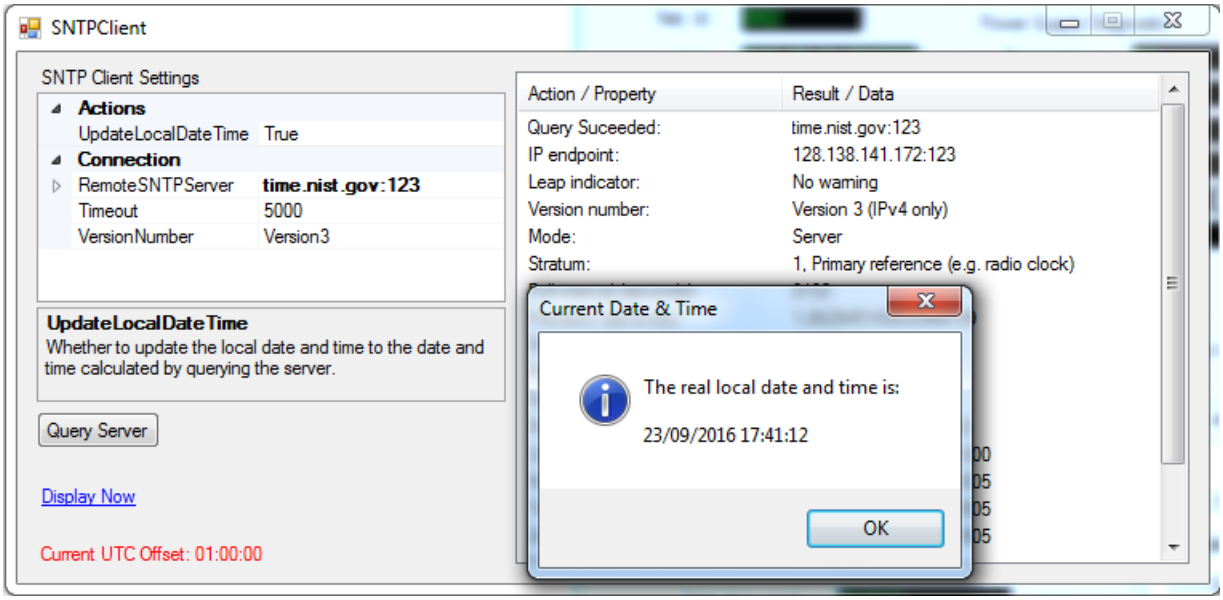



*Figure 160: SNTP Client configuration*

- As an example, we are using the following settings for the SNTP server:

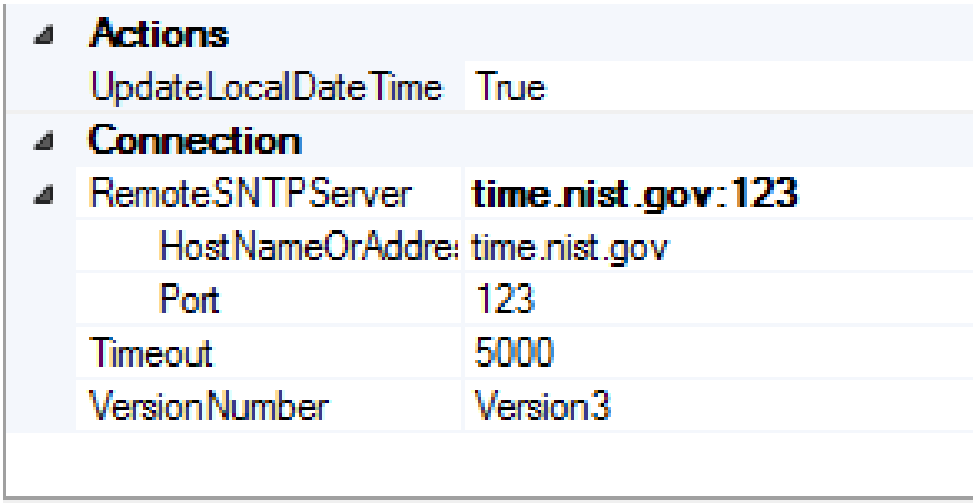



*Figure 161: Example of SNTP server configuration*

See "Configuring SNTP client" YouTube video

## 12.5 ALARM MANAGEMENT

User can receive alarms notification by email. This function is only available with "**Alarm**" data acquisition mode, "**S.E.T**" mode or "**SSD**".

From your BeanScape® software click on **"Tools"** tab then **"Alarm Management"**

The alarm management window is essentially made up of three tabs, one for configuring the ***DAQ Alarm, System Alarm and Structure Configuration***

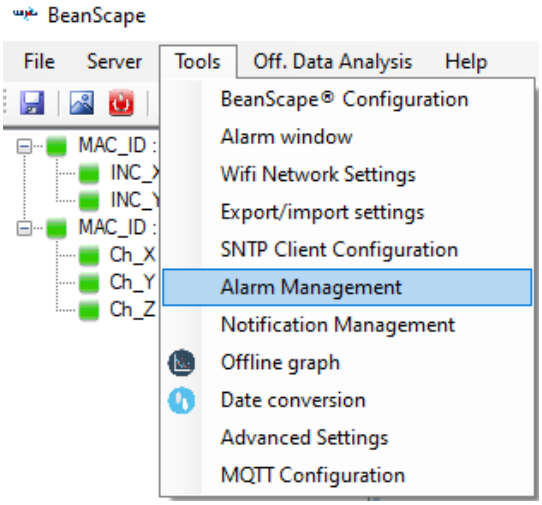



*Figure 162: Alarm Management menu*

A new window will pop up with **DAQ alarm SMTP configuration** and reports management, also other system related to alarm notification (Internal temperature, Battery level, Packet Error Rate, Link Quality Indicator) are configured from this window

Check on **Enable Notification by email**: 

and fill out the parameters described below:

| Field | *Description* |
|---|---|
| *From* | *Enter the email address sending the alarm notification* |
| *To* | *Enter the receiver(s) address(es) for alarm notification (max. 3)* |
| *SMTP server* | *Enter your Outgoing SMTP server* |
| *Port* | *Enter your port Number for your outgoing SMTP server* |
| *User name* | *Enter your full email address* |
| *Password* | *Enter the password (case sensitive) of your email account* |
| *Max Email per minute* | *Maximum number of emails allowed to be sent in one minute* |

*Table 13: Alarm Management content*

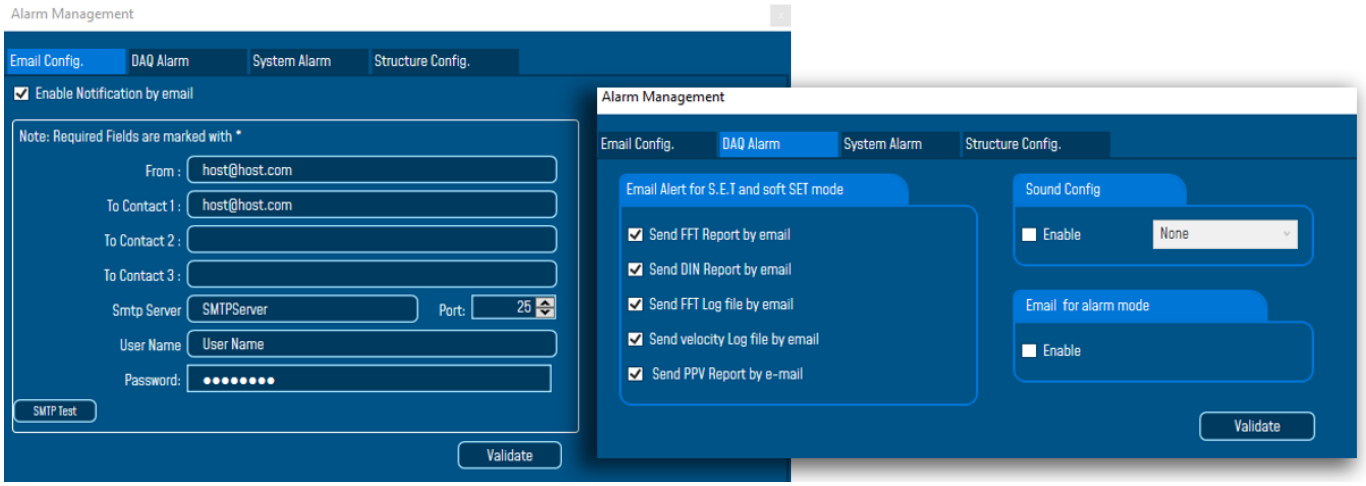



*Figure 163: Alarm Management window*

**Users who use the Gmail or Hotmail emails, it's recommended to use the port number 25 while setting the SMTP configuration. Otherwise, users will face issues concerning receiving the Alarm emails.**

**Do not use the port number 488 instead of 25 while configuring the SMTP server in order to cancel all the issues that might affect the process of receiving the Alarm Emails.**

**Concerning the number port of the Gmail and Hotmail SMTP, it's highly recommended to use the port number 25 for both servers. DO NOT use any other port number**

## 12.6 DAQ ALARM

In DAQ alarm, user configure the SMTP account for the measurement alarm notifications.

First, by checking ***Enable Notification by email*** and entering account credentials properly:

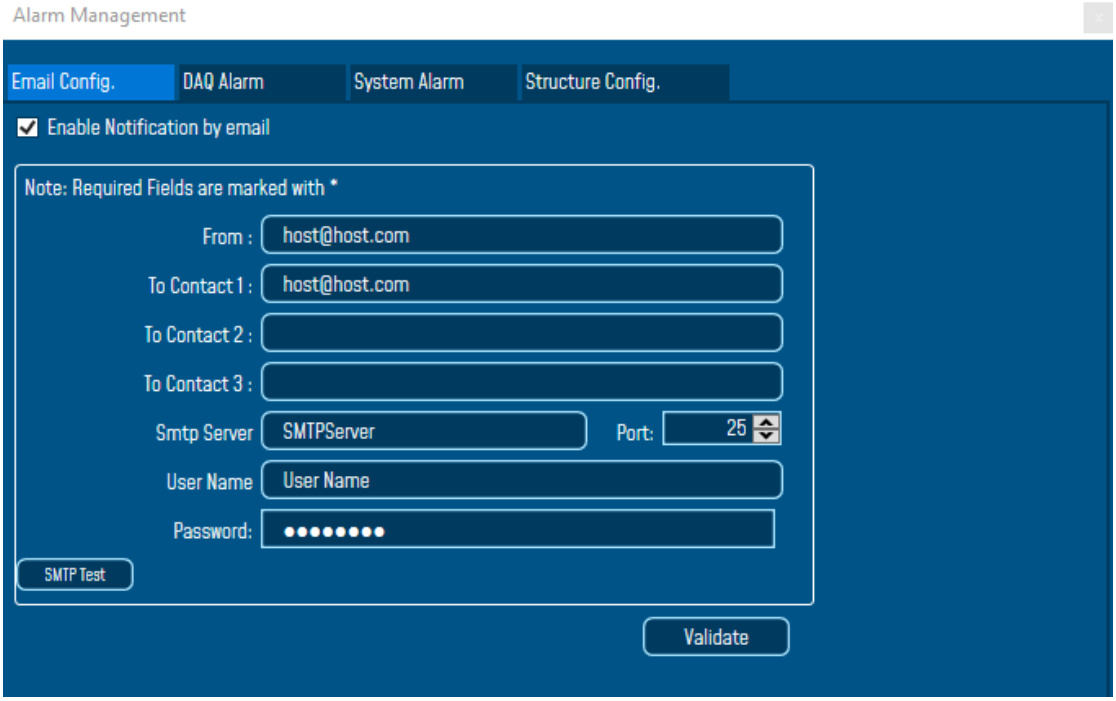



***Figure 164: Alarm management: email setting***

Chose the maximum number of emails allowed to be sent to your email address per minute (it goes from 1 to 6).

| Field | *Description* |
|---|---|
| ***From*** | ***Enter the email address sending the alarm notification*** |
| ***To*** | ***Enter the receiver address for alarm notification*** |
| ***SMTP server*** | ***Enter your Outgoing SMTP server*** |
| ***Port*** | ***Enter your port Number for your outgoing SMTP server*** |
| ***User name*** | ***Enter your full email address*** |
| ***Password*** | ***Enter the password of your email account*** |

In order to check if your account is well configured, validate then send a test email by clicking on **SMTP Test**, a test email will be received at your email inbox.

This email is sent by the Beanscape® Software To test your SMTP Config

Several **Email Alarm** options are available for S.E.T mode, user can select the Specific Report/File related to his measurement.

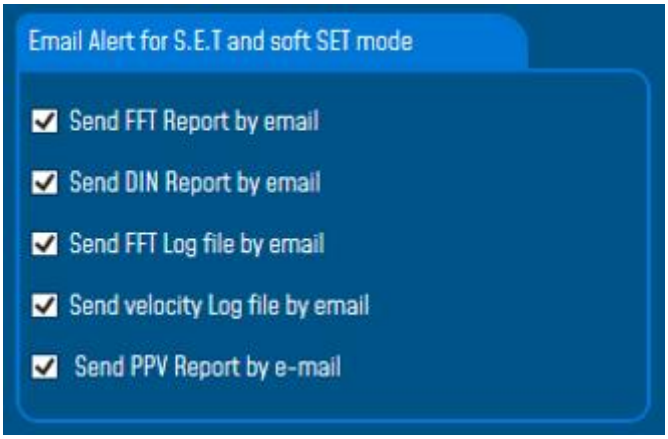



*Figure 165: Email alarm for Streaming and S.E.T mode frame*

***More details about FFT Report/ Log files can be found on the Data acquisition modes available on the BeanDevice® Technical note***

**See S.E.T mode Alarm Notification**

You can also enable pop-up window by checking Enable pop-up window and select your window sound here:


*Figure 166: enabling pop-up window*

To enable email notification for Alarm/Survey mode, check **Enable email** then click on **validate**.

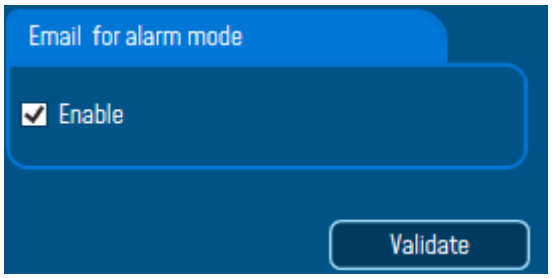



*Figure 167: Email Alarm for Alarm mode*

## 12.7 SYSTEM ALARM

Same as the DAQ Alarm tab, the **System Alarm tab** contains SMTP configuration in order to receive notification on system status, as the status of the system internal temperature.

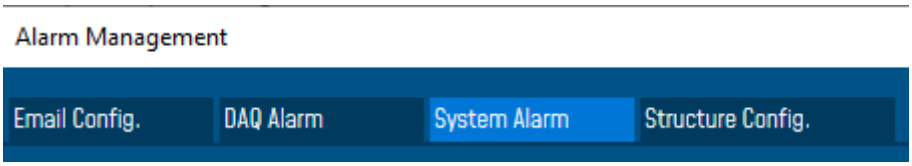



*Figure 168: System Alarm tab*

In System alarm, we setup the SMTP account for alarm in case the internal temperature of the BeanDevice® exceeded the predefined working temperature.

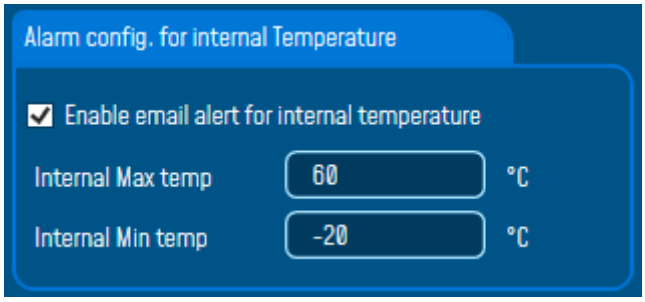
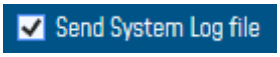



*Figure 169: system alarm settings*

You can also choose to receive the system log file in case of a system alarm, by checking this checkbox.




See « Alarm by email » Youtube video

## 12.8 STRUCTURE CONFIGURATION

Structure Configuration tab is used to select the Building type and the pipe material that should be displayed on the DIN Report and the Velocity Log file.

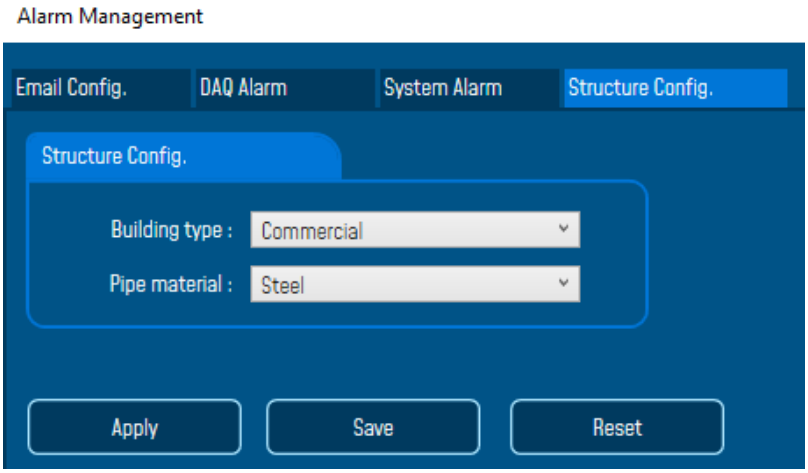



*Figure 170: Structure Configuration*

You can select 3 Building types from the list: **Commercial**, **Residential School** and **Historic or sensitive.**

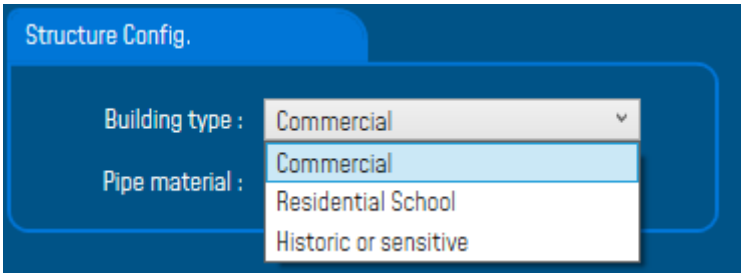



*Figure 171: Building Types*

For the Pipe material, the list contains: **Steel**, **Clay Concrete** and **Masonry Plastic.**

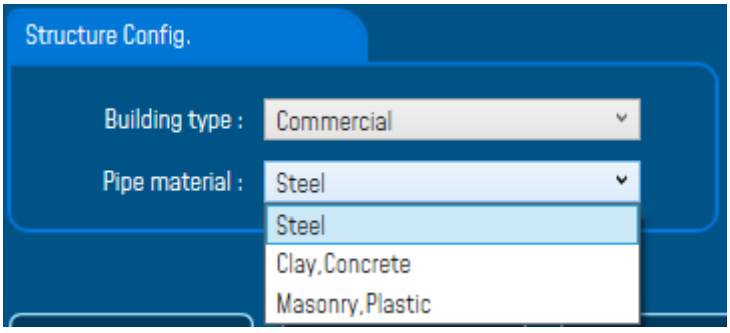



*Figure 172: DIN 4150-3 Configuration*

**BeanDevice MAC_ID : A4D57843DEA90000**

## DIN 4150-3 REPORT

| | |
|---|---|
| **SensorLabel** | **Ch_Z** |
| **Building Type** | Commercial |
| **Pipeline Material** | Steel |

*Figure 173: Building type & pipeline Material on the DIN Report*

```
------------------------------ Velocity Report --

Building type = Commercial
Pipeline Material = Steel
Velocity Average = 4.49583548167709E-12 (mm/s)
```

*Figure 174: Building type & Pipeline Material on the Velocity Log file*

## 12.9 NOTIFICATION MANAGEMENT

Several notification options are available, linked to the BeanDevice® status information and BeanScape® software.

Click on Tools Tab and navigate to Notification Management option, new window will pop up.

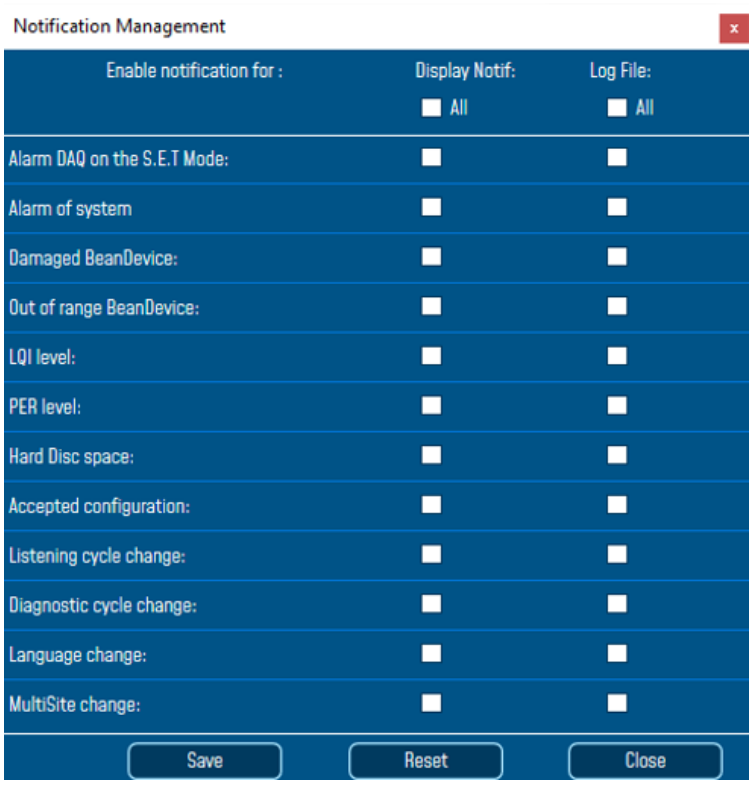



*Figure 175: Notification Management Window*

By enabling the notification option, user have the possibility to choose a displayed notification message on the screen of his PC and a received Log file containing the notification details.

| *Notification for* | *Description* |
|---|---|
| *Alarm DAQ on S.E.T mode* | *A notification message will pop up whenever an alarm threshold occurred and after reaching the DAQ duration* |
| *Alarm of system* | *Whenever the BeanDevice® internal temperature goes over the thresholds a notification message will pop up on the screen* |
| *Damaged BeanDevice®* | *Whenever the BeanDevice® does not connect properly a notification message will pop up* |

| | |
|---|---|
| ***BeanDevice® out of range*** | ***BeanScape® will notify you if the BeanDevice® is out of range and the network link is so poor*** |
| ***LQI Level*** | ***Notification message will pop up displaying the LQI Level if the LQI was poor*** |
| ***PER Level*** | ***Notification message will pop up displaying the PER Level if the PER was high*** |
| ***Hard Disc Space*** | ***Notification message will pop up displaying the hard disc current available space*** |
| ***Accepted configuration*** | ***Notification message will pop up whenever you start new DAQ mode*** |
| ***Listening Cycle change*** | ***Whenever user change the listening cycle duration BeanScape® notify you with this change*** |
| ***Diagnostic Cycle change*** | ***Whenever user change the diagnostic cycle duration BeanScape® notify you with this change*** |
| ***Language change*** | ***By changing BeanScape® language a notification message will be displayed*** |
| ***Multisite change*** | ***By enabling/Disabling the Multisite option a message notification will pop up displaying the new modification*** |

***Table 14: Notification management options***

### Notification example for SET mode DAQ

Check **display notif** and **log file** boxes for Alarm DAQ on the SET mode, whenever a measurement reaches the threshold a notification message will pop up on the screen.

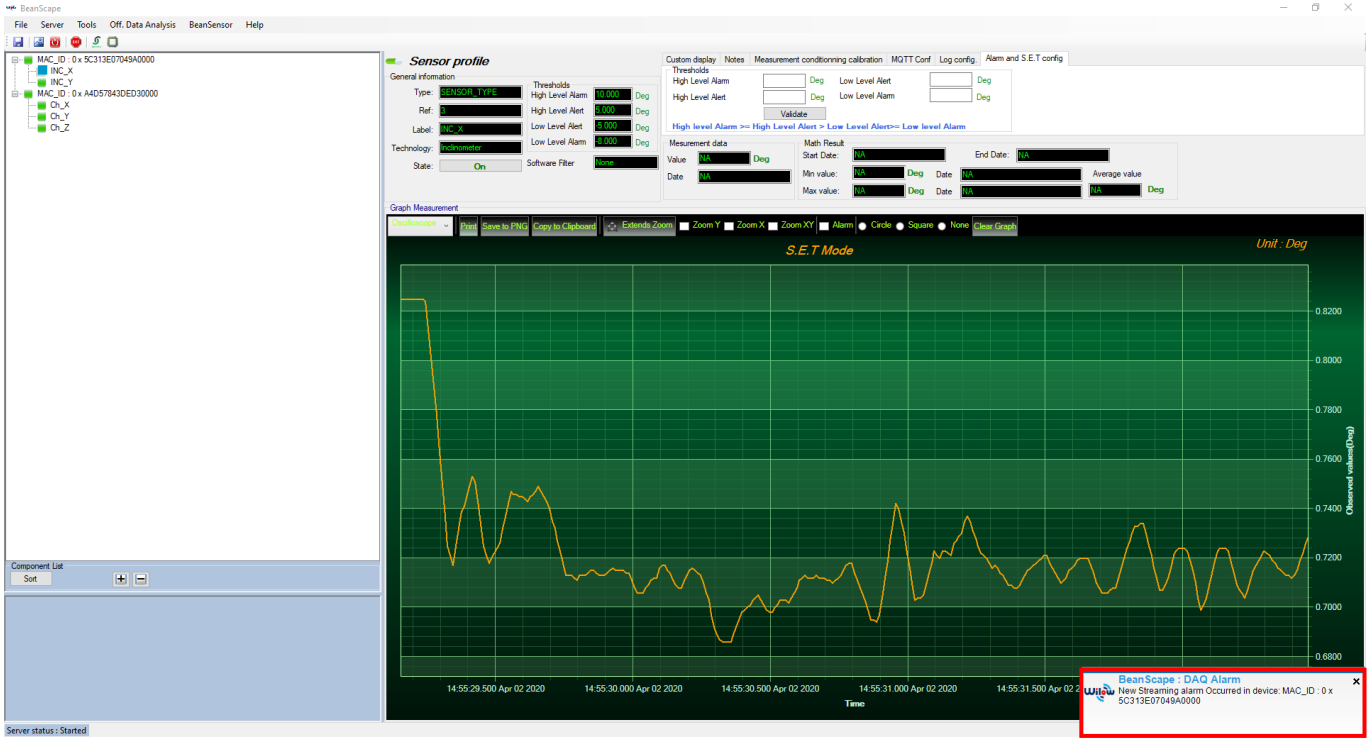
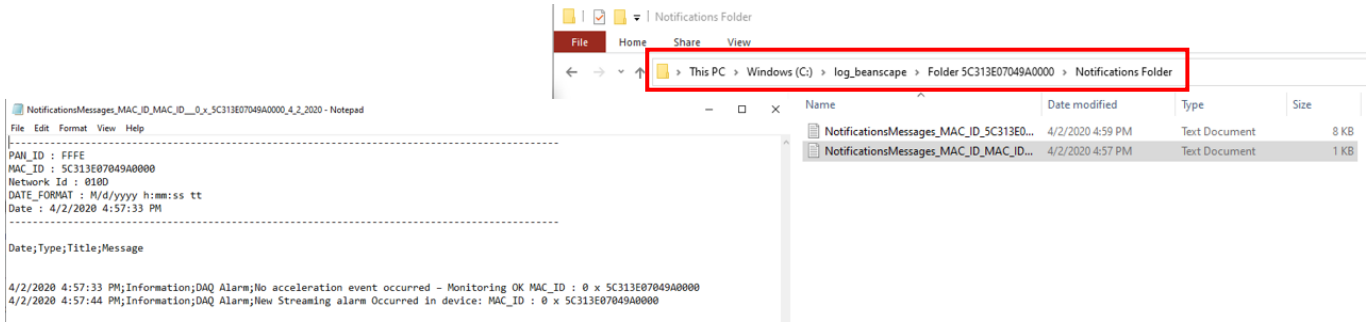



***Figure 176: Notification message for SET mode***

By checking enabling Log File for SET mode notification, a Notification folder will be created under log_beanscape folder, inside the BeanDevice® folder that contains the notification file.




## Notification example for PER & LQI

If the network link quality was so poor, a new message will pop up on the screen saying that your BeanDevice LQI is low please check your network quality.

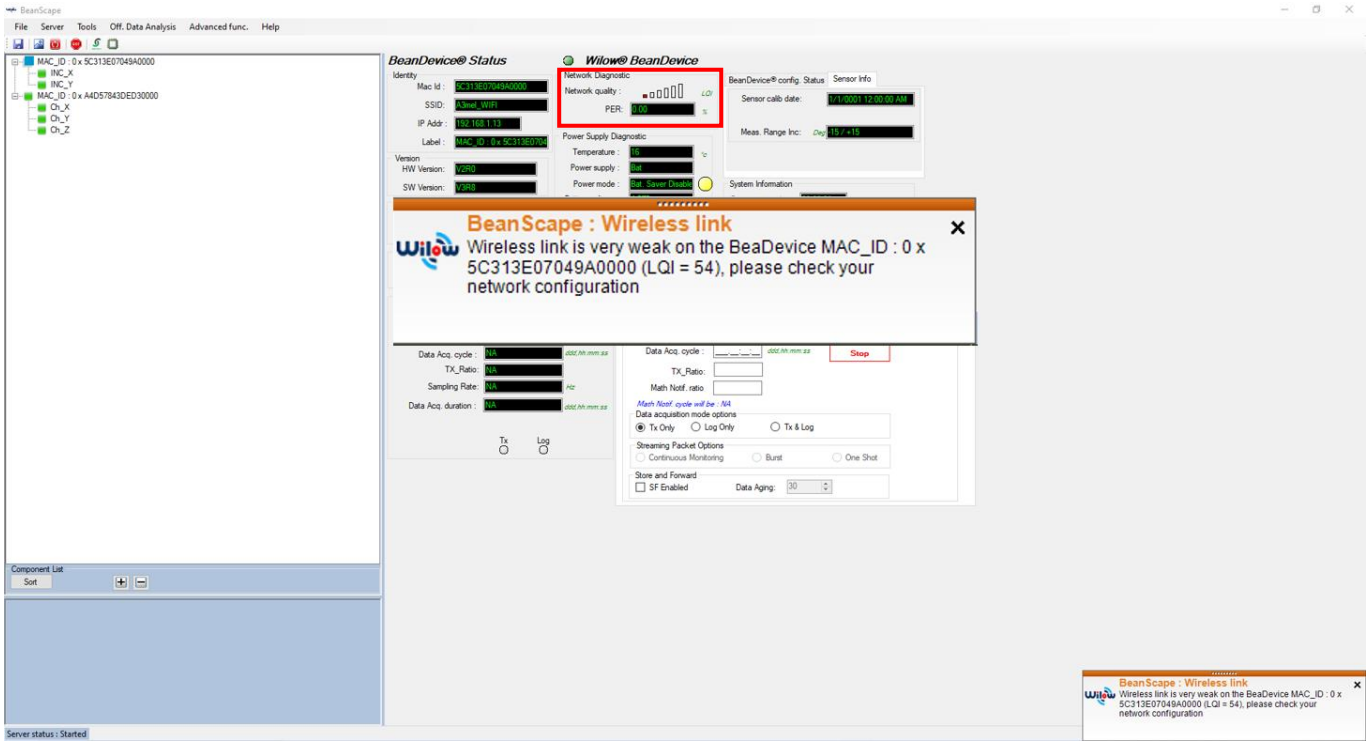



*Figure 177: LQI notification message*

In the same Notification log file, you will find the LQI notification message.

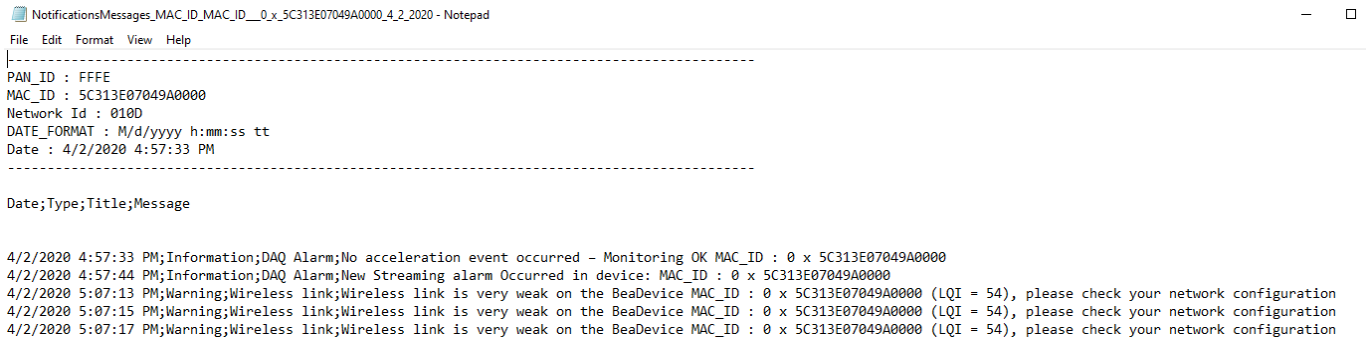



*Figure 178: LQI notification file*

## 12.10 DATE CONVERSION

Data downloaded from the data logger are organized in a system well optimized to minimize non-important data and leave maximum storage space for measurement values, hence using indexation to refer to measurement timing.

To make these files more readable we use this data conversion tool.

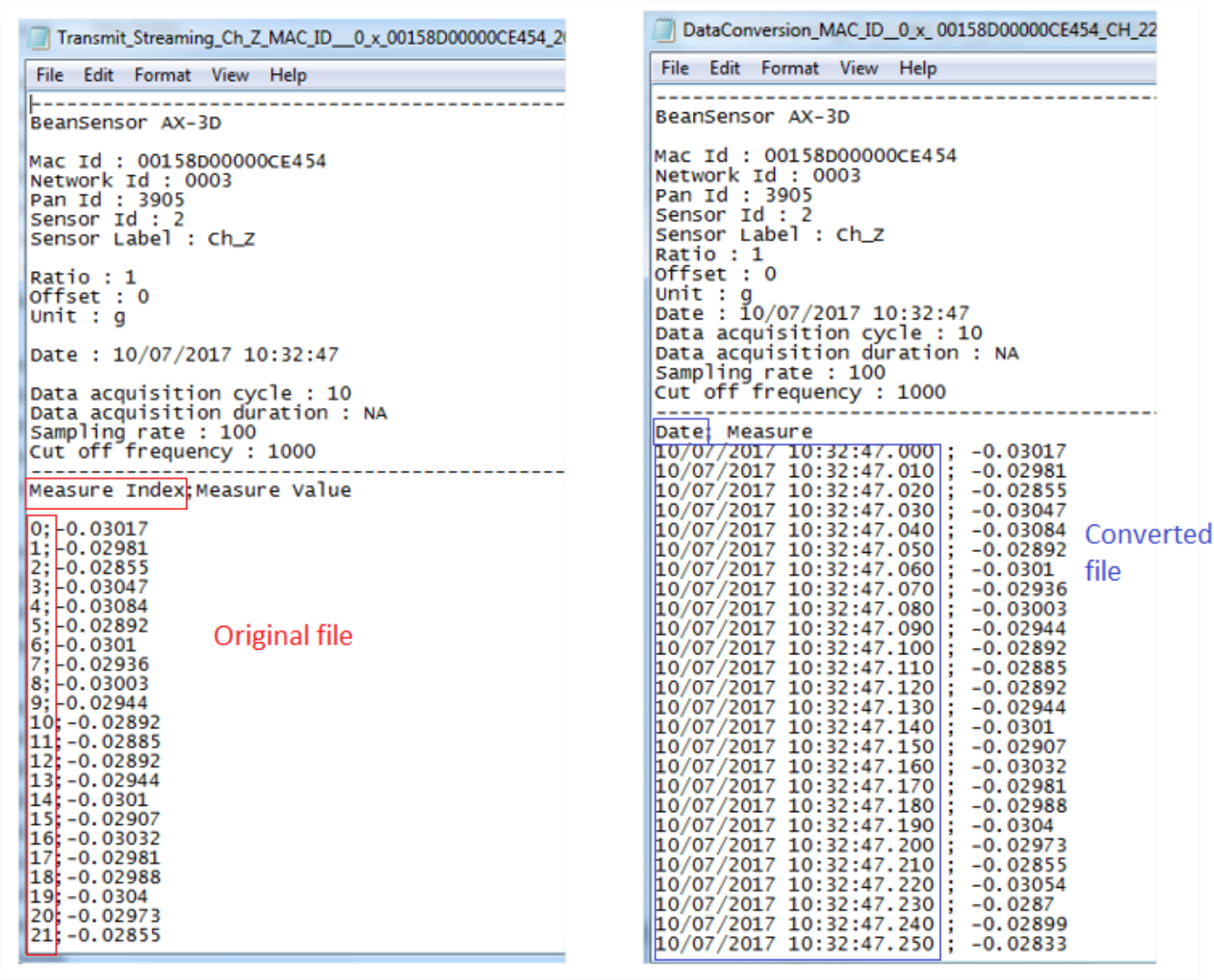



*Figure 179: Date Conversion*

- To use the Date Conversion, go to Tools and select Date Conversion

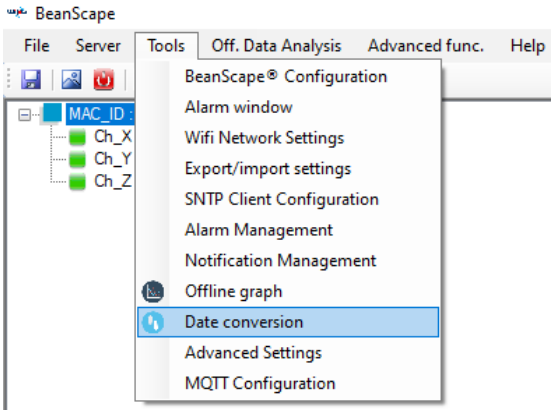



*Figure 180: Date conversion option on BeanScape®*

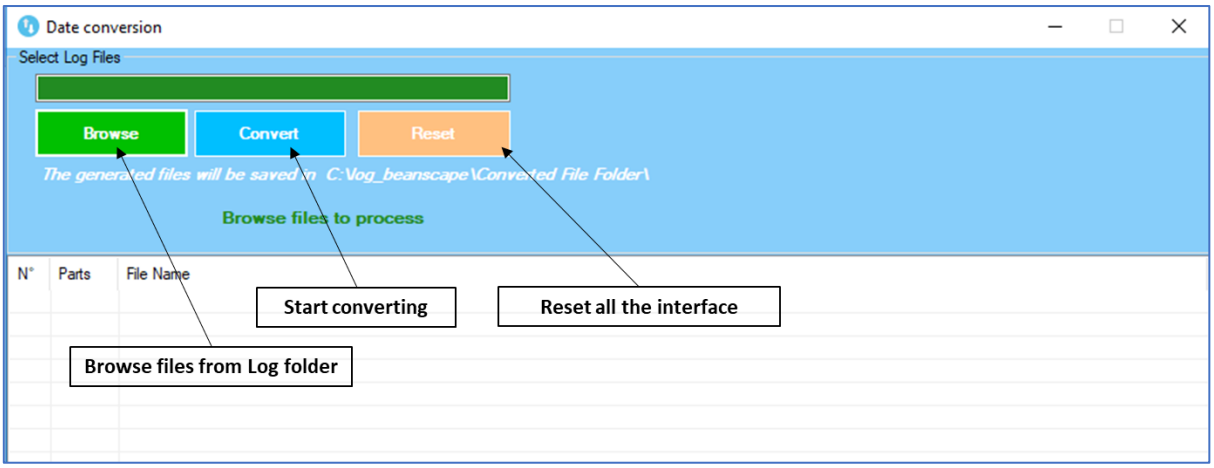



*Figure 181: Date conversion window*

- Click on browse and import streaming file containing the logged measurement.

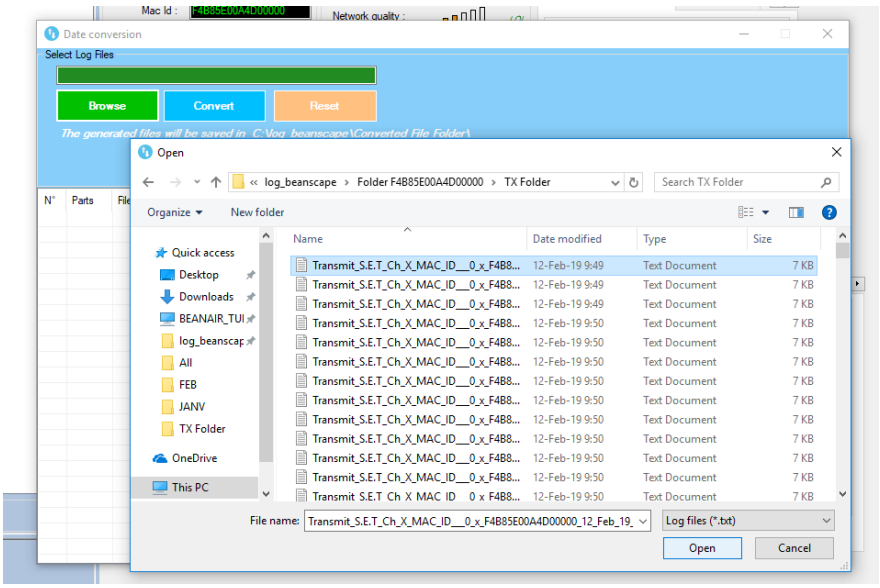



*Figure 182: Importing files into data conversion window*

- Overview of the selected files

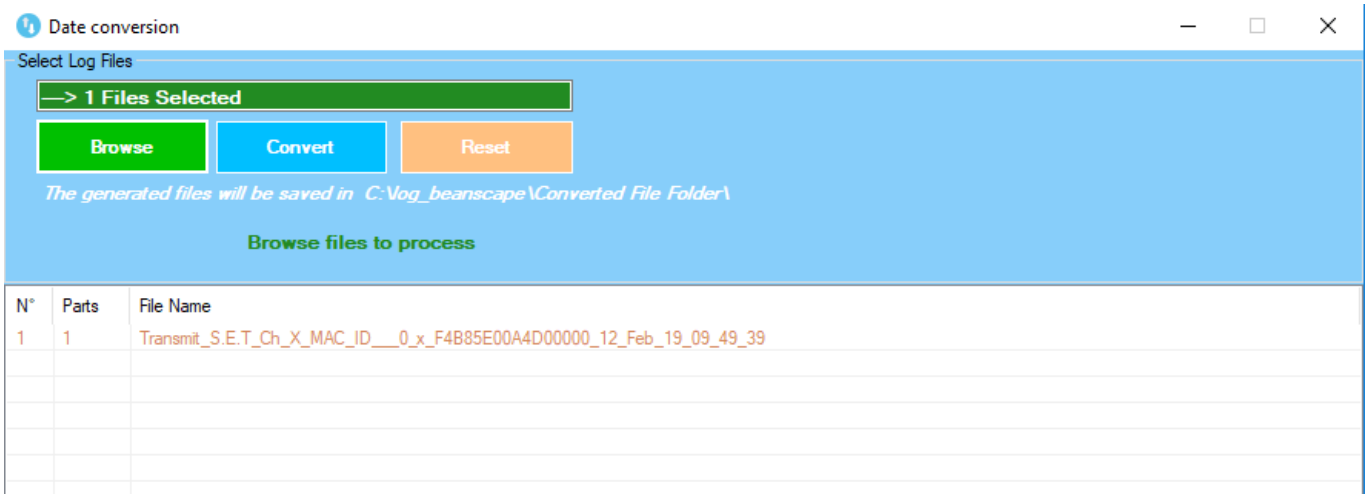



*Figure 183: Overview of a selected file on Data conversion window*

- Select the converted file to view or go to your log directory and you will find all the converted files in a new generated folder named **Converted File Folder**

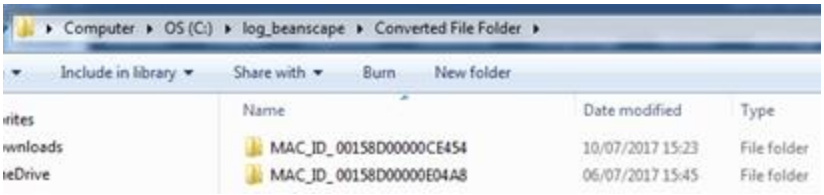



*Figure 184: Converted file folder*

## 12.11 OFFLINE GRAPH

Offline graph permit user to read previously recorded measurement. To use this option, go to Tools and select Offline Graph.

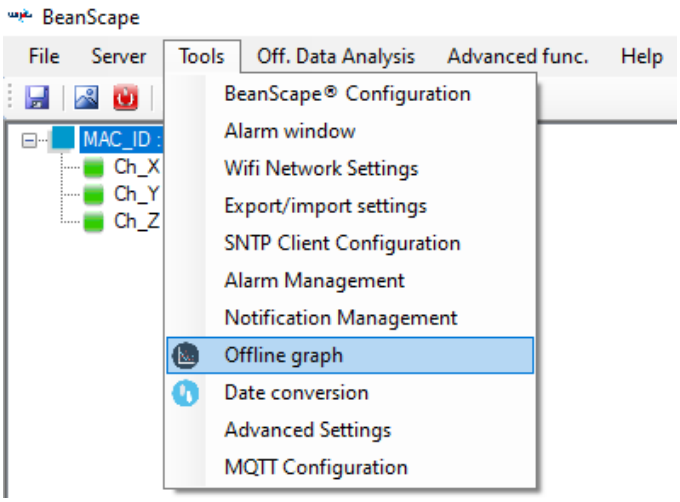



*Figure 185: Offline graph option on BeanScape®*

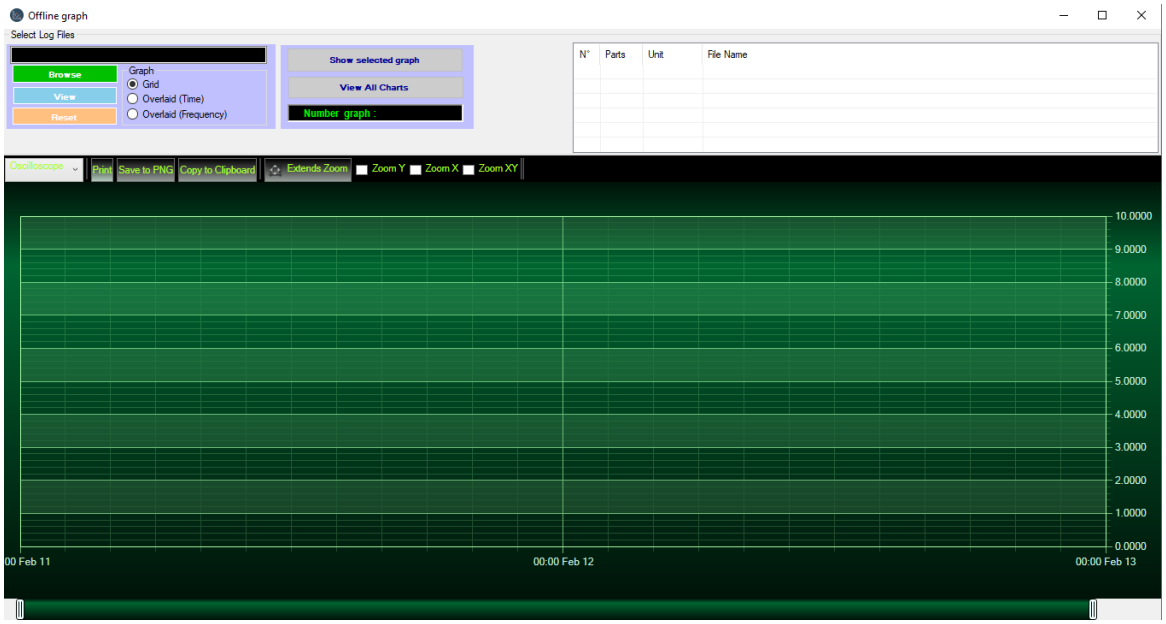



*Figure 186: Offline graph window*

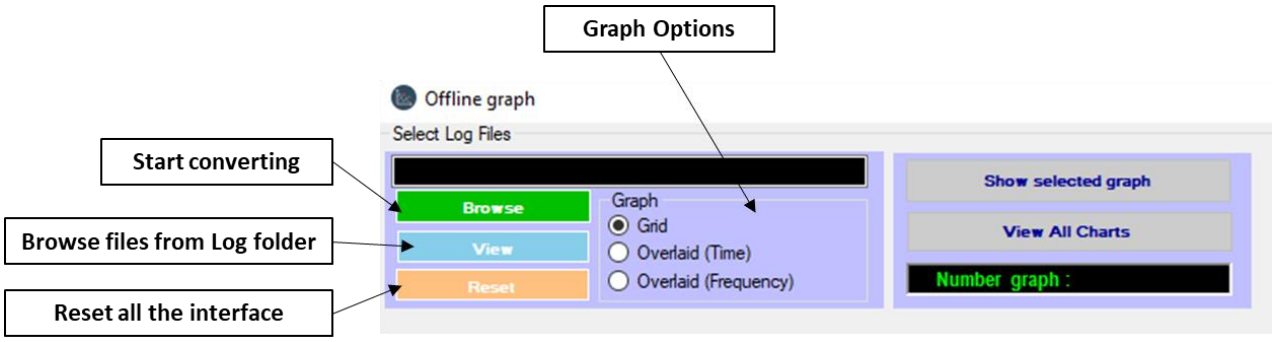



*Figure 187: Offline graph window's options*

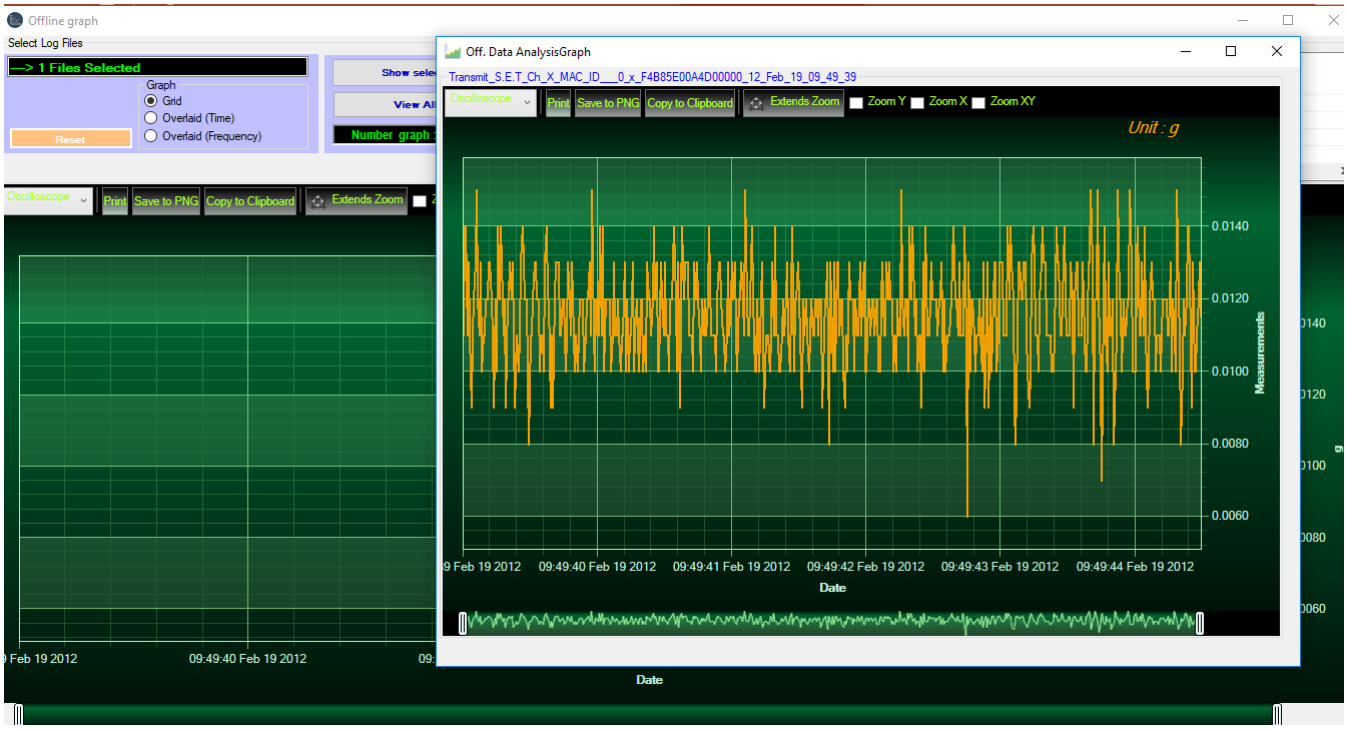



*Figure 188: Offline displayed graph*

Browse file or different files and then click view or select one file to show the graph, or you can choose to view all charts.


*Figure 189: Gird display of graphs*

# 13. BEANDEVICE® ADVANCED CALIBRATION

The advanced calibration configuration is only available for the accelerometer such the **AX-3D**, **AX3DS** and the **X-Inc**.

Click on the Calibration Icon on the top left side in order to have access to the calibration menu.

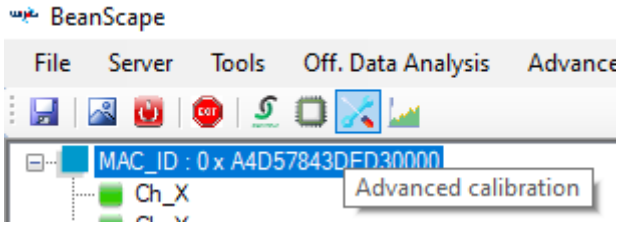



*Figure 190: Advanced Calibration Icon*

Two different options are available, either to do a new configuration or to import an existing configuration from a file.

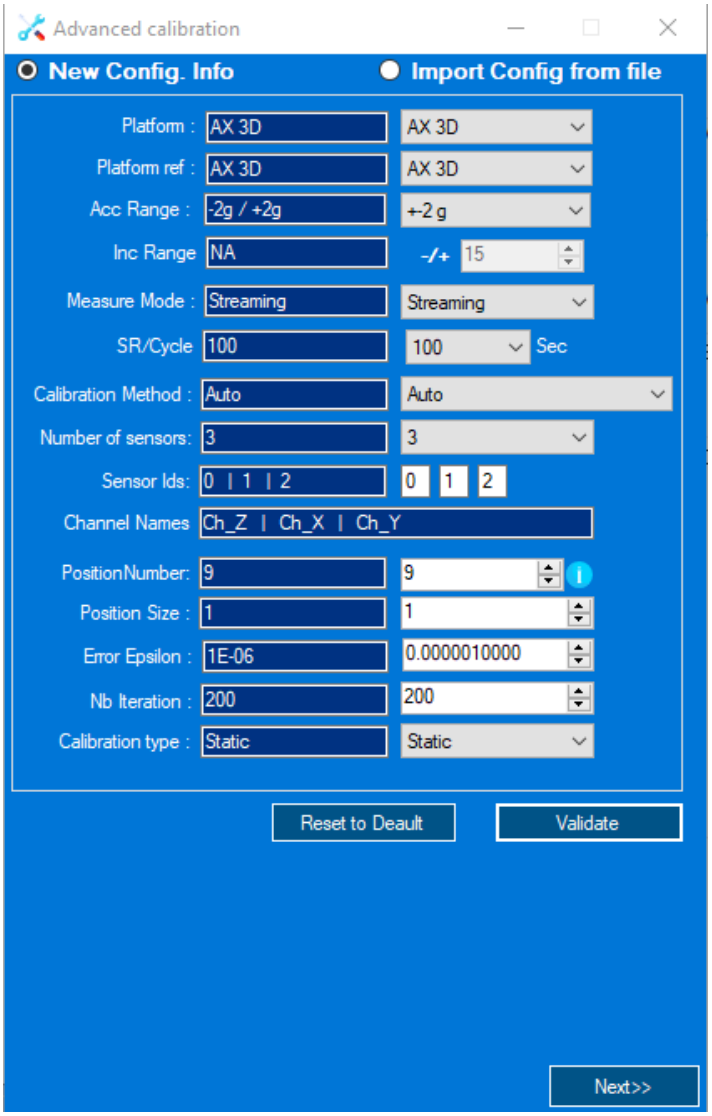



*Figure 191: Advanced Calibration settings*

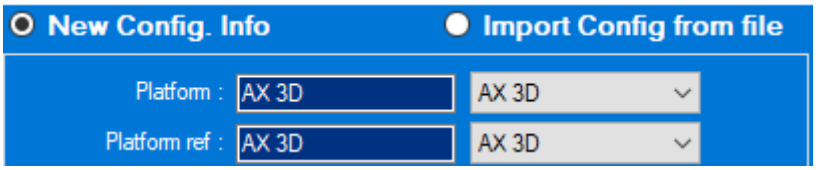
## 13.1 NEW CONFIGURATION

### 13.1.1 New Configuration settings

13.1.1.1 Configure the calibration settings

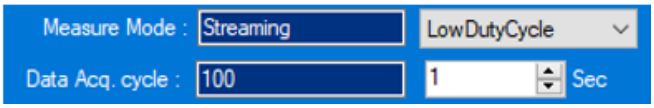
For the calibration process you should use 2 different BeanDevices®, one as a reference and the other for calibration.

First of all, select the Device platform that you want to calibrate and the reference BeanDevice platform.



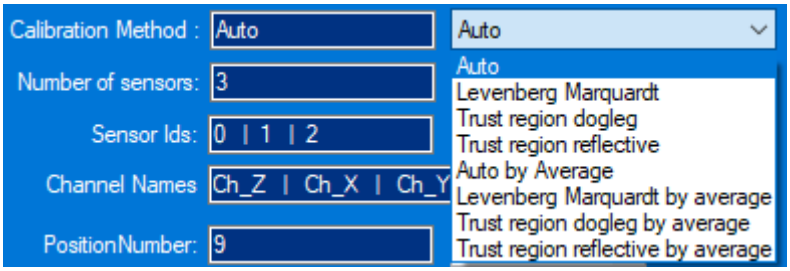

Then select the BeanDevice® acceleration or/and inclination measurement range based on your selected device platform.


Select the suitable measurement range, either dynamic (Streaming) with the suitable sampling rate or static (Low duty cycle) with the DAQ cycle.


Select the calibration method to use, there are several different available methods.

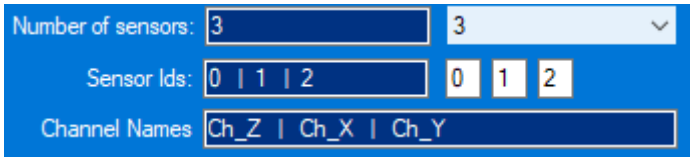
It's recommended to use the Auto option which is the default selected option, however if you will use high number of positions with high sampling rate use one of the Average methods.




For more information about the MATLAB methods please visit the following webpage:

https://www.mathworks.com/help/optim/ug/fsolve.html?searchHighlight=fsolve&s_tid=srchtitle

Choose the number of sensors to calibrate.




Choose carefully the number of positions on which the calibration process will be based on.

You should not have same values in the log file using different positions, each position should have its own values which are different from other position values.

You should choose a number of positions higher than the minimum values displayed as following.

FormCalibInfo

| Device | Calibration Mode | Active Sensor | Minimum number of positions |
|---|---|---|---|
| AX3D<br>AX3DS<br>XINC | Dynamic | 1<br>2<br>3 | 2<br>6<br>12 |
| | Static | 1<br>2<br>3 | 2<br>5<br>9 |
| V-INC AX3D<br>V-INC AX3DS | Number of measurements = (Number of position) * (Size of position,).<br>The number of measurements must be greater than 250 | | |

Then select the position size, position size stands for the amount of data for each position.

The position size should be less or equal to the maximum data number in each file.

For example, if the log file contains 1000 Data, you should choose 1000 points or less.


Configure the error tolerance.


Choose the number of iterations, you need to choose carefully the number of iterations on which will depend the calibration values


Finally, choose the calibration methodology either static or dynamic. It depends on your application.


After configuring all the settings don't forget to click on Validate button. 


13.1.1.2 Perform a DAQ to generate the files

After configuring the calibration settings, and based on that you should perform a DAQ to generate the files.

For static calibration method you can use a granite desk however for a dynamic calibration method you can use a vibratory machine.

The same previous calibration method should be performed either it's static or dynamic.

Then start the same DAQ mode with the same sampling rate configured before in the calibration settings.

Redo the same measurements with different device positions.

The number of positions is already configured in the calibration configuration before.

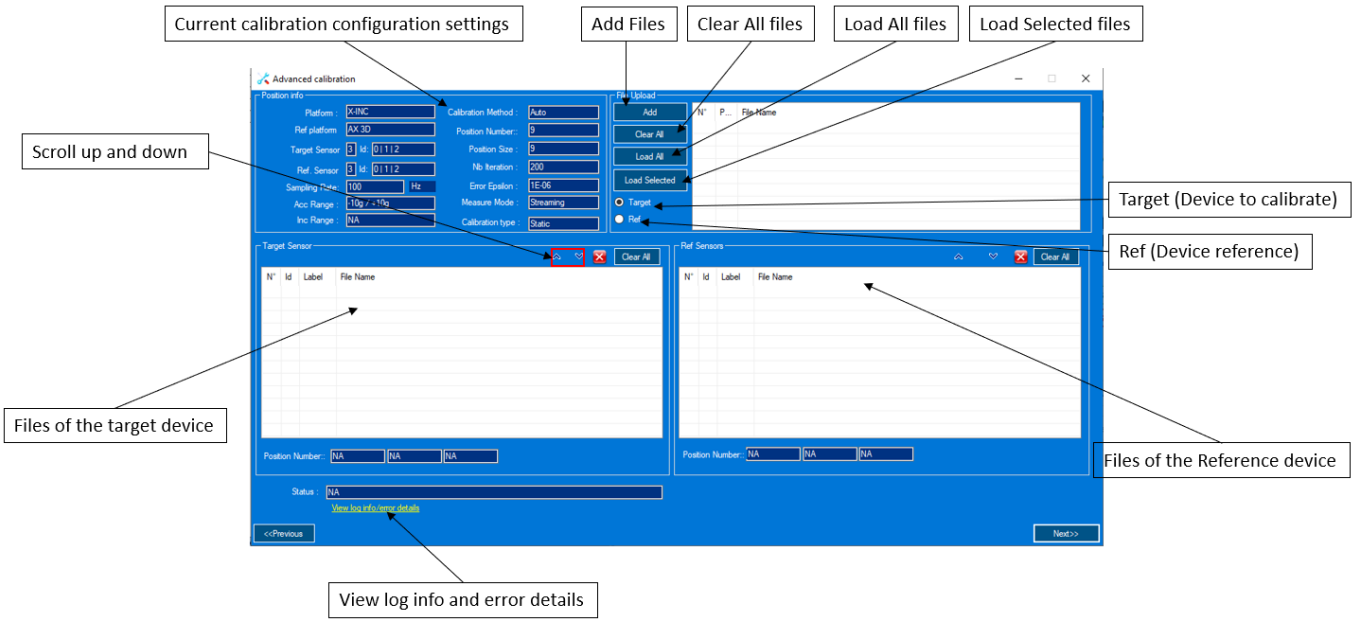
***The minimum number of positions using static calibration method is 9 positions, however using Dynamic calibration method the number of positions is 12.***

***Always make sure to use a number of positions higher than the minimum number for both calibration methods.***

After generating the files, go back to the calibration window and click on next button Next>> to move to the next step.

### 13.1.2 Loading files

Once you hit next button a new window will be displayed.




First of all, choose target then click on Add button Add to add all the files of the target device,

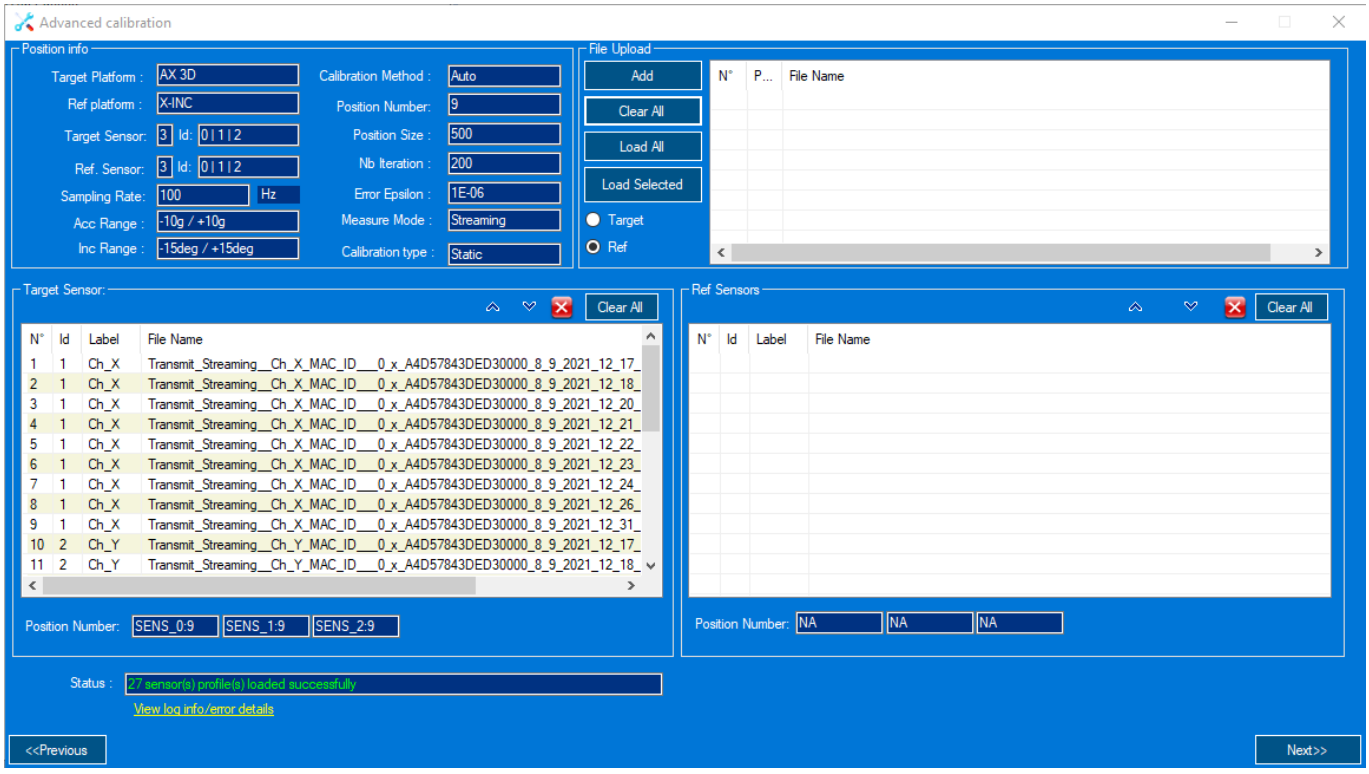
then click on Load All Load All ,

after that click on clear all Clear All to clear the field,

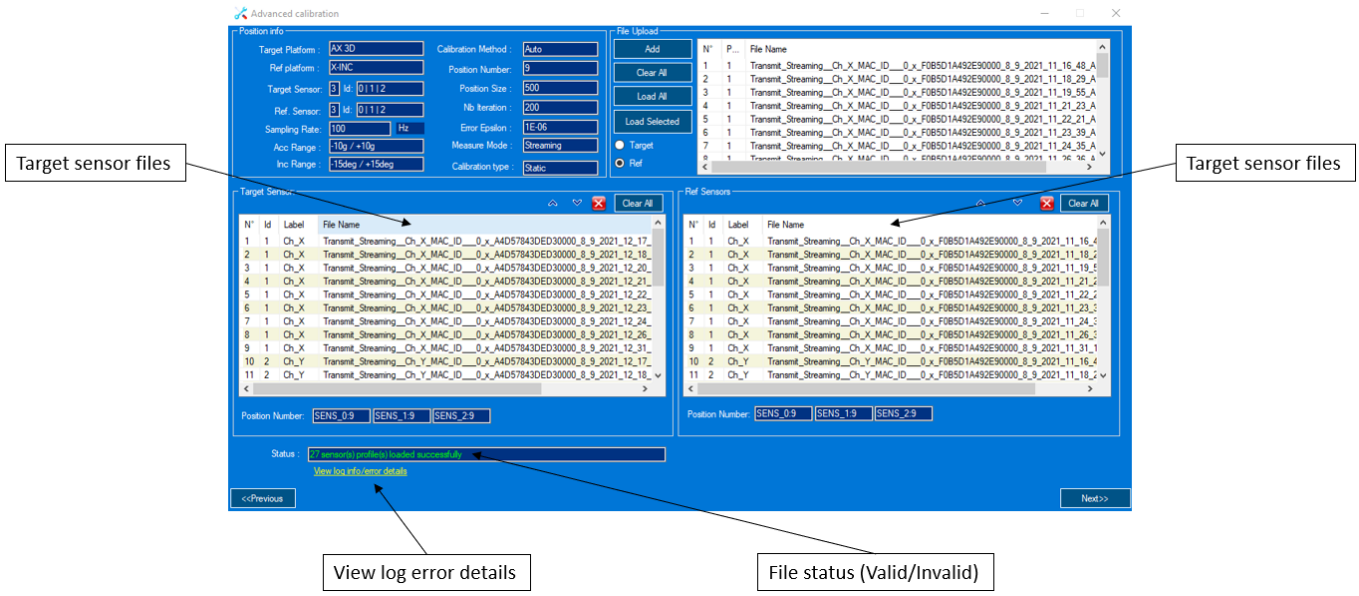
then switch to ref option and load the files of the reference device.

The target sensor file will be displayed on the left panel side and the reference senor files will be displayed on the right one.

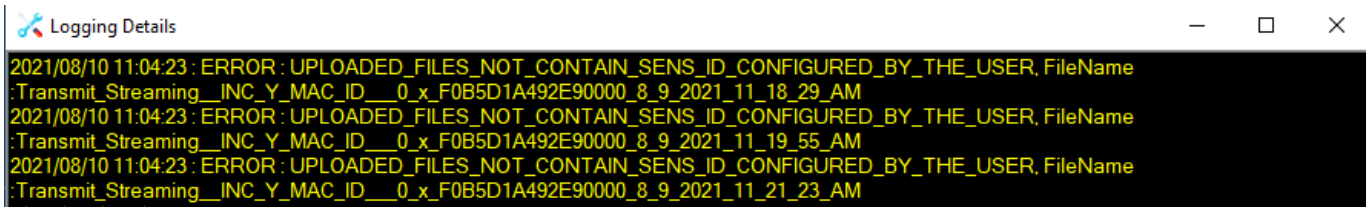
***The number of selected files should be exactly equal to the Position Number, otherwise you cannot proceed due to a compatibility error***

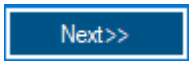



Redo the same steps to load the reference device files.

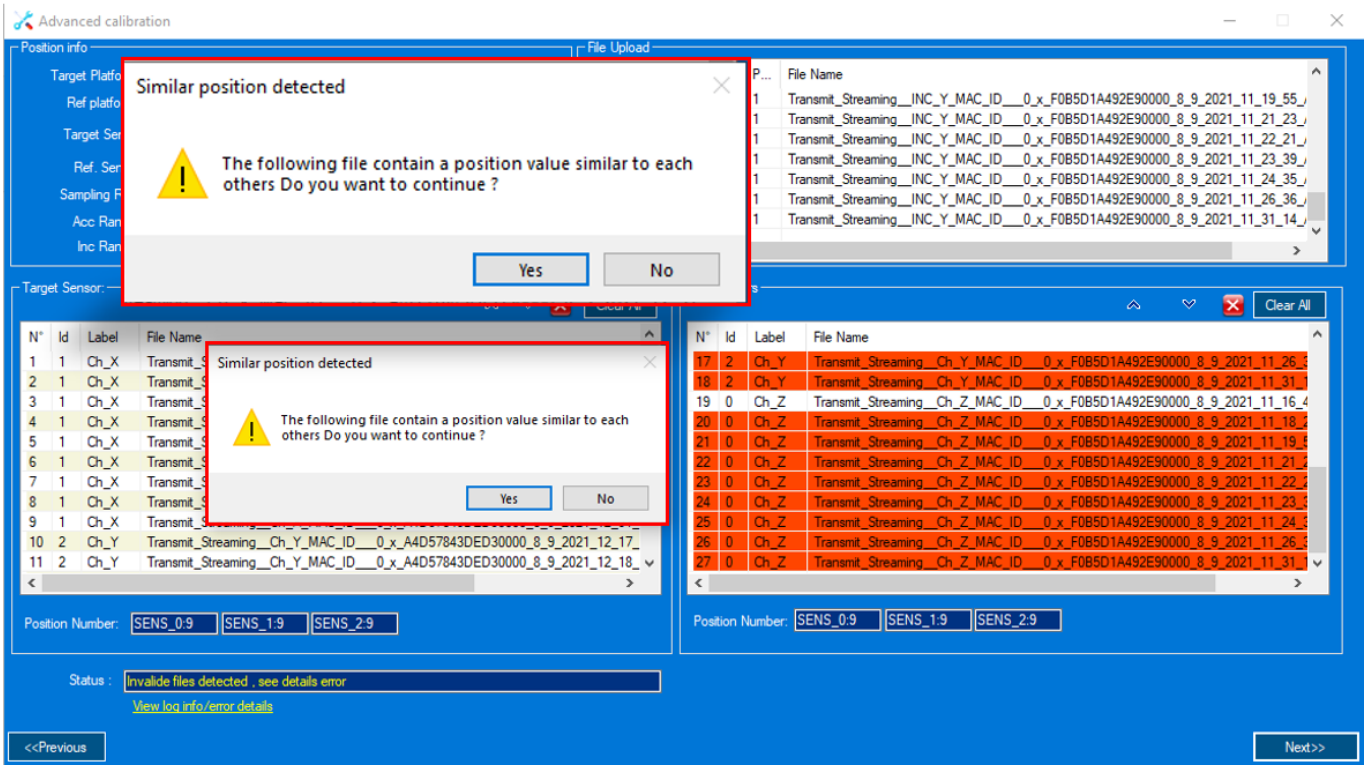



You can see the loaded logs status (valid / invalid) and check the view error details.


Then Click on Next button  to move to the next step

In case of a detection of a similar position shared between different files a notification message will pop up on the screen, and the files which contain the same position will be selected and displayed in red.

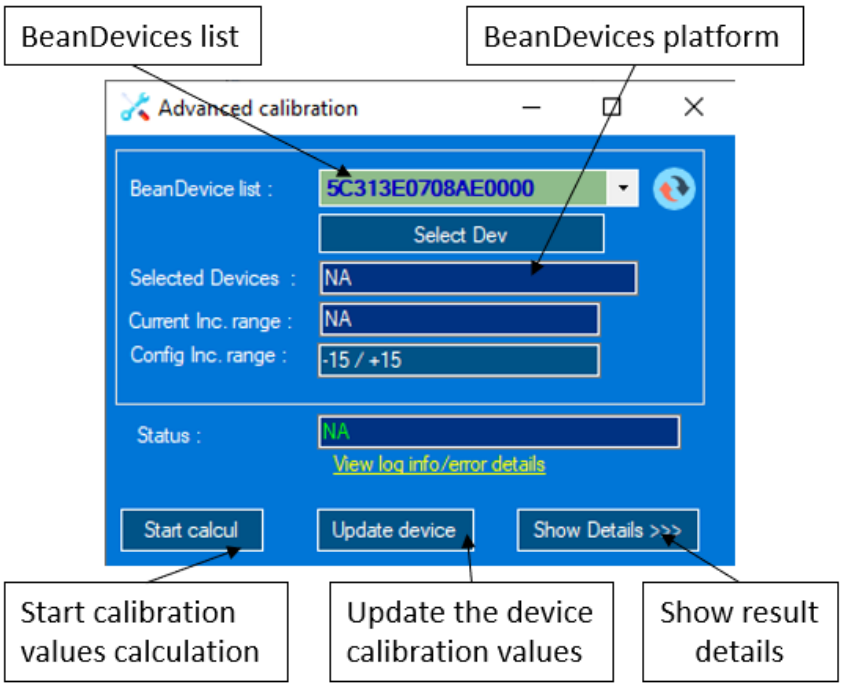



In this case you need to need to generate new log files without having the same position.

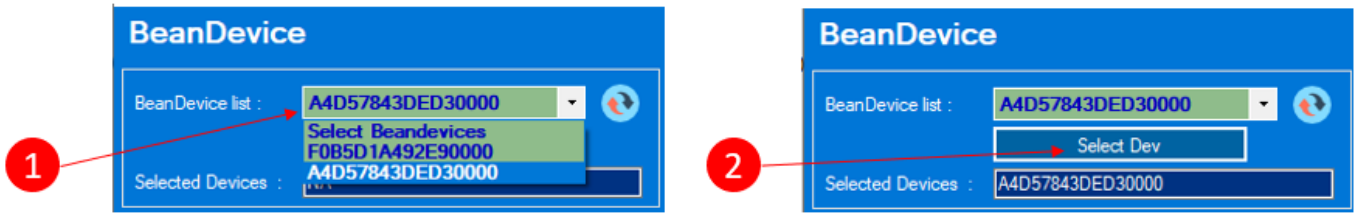
### 13.1.3 Loading Calibration Values

After the validation process of the target and reference sensors log files, the next step is generating the calibration values for each sensor.

Once you click next the following window will be displayed

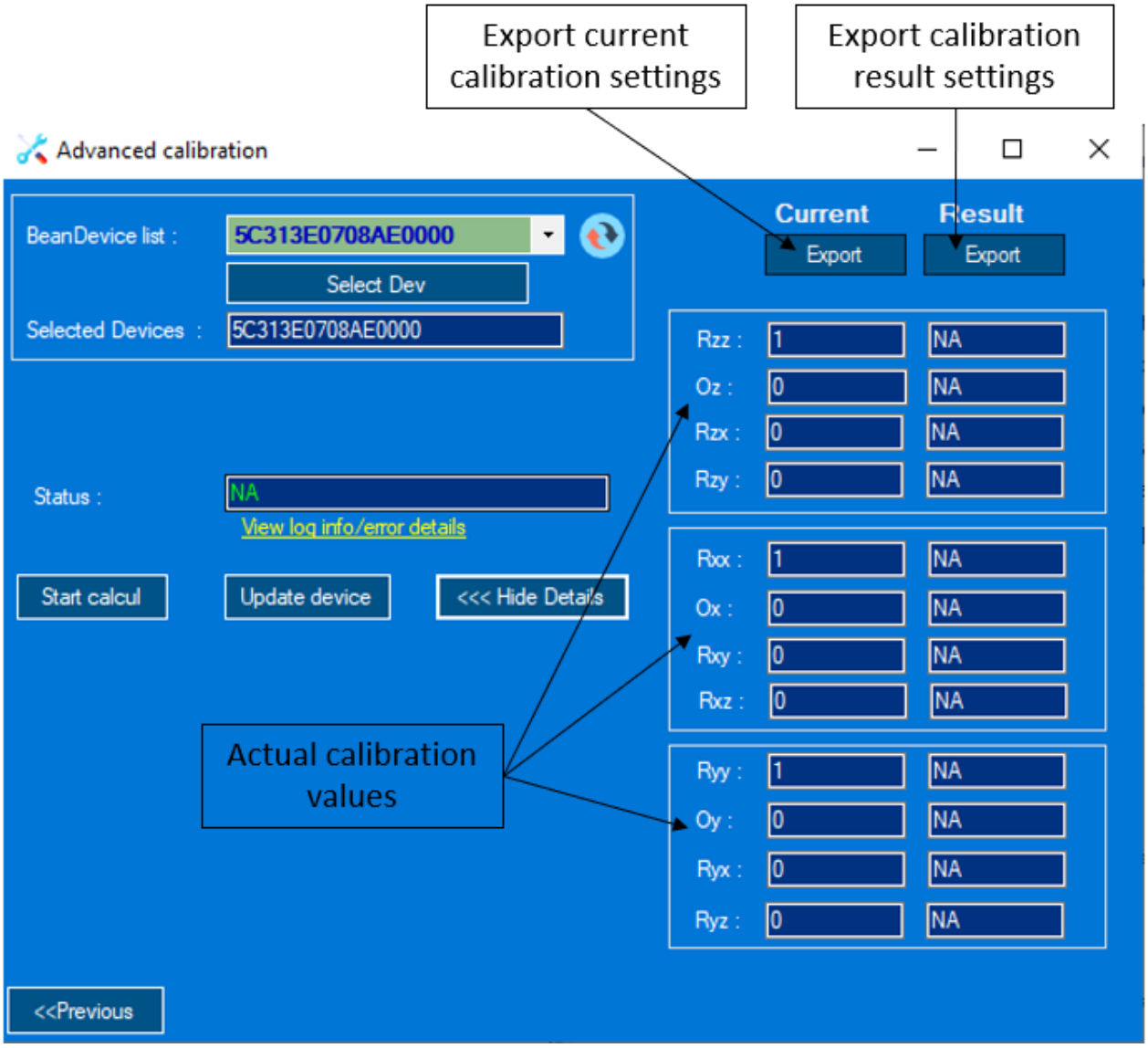


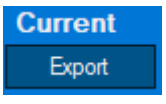
1- First of all select the BeanDevice® from the BeanDevices® list, then click on Select Dev button to validate your choice. The BeanDevice.



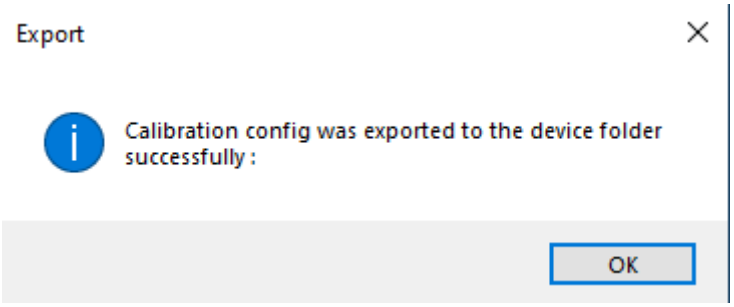

Once the device was selected, its current calibration settings will be loaded automatically.

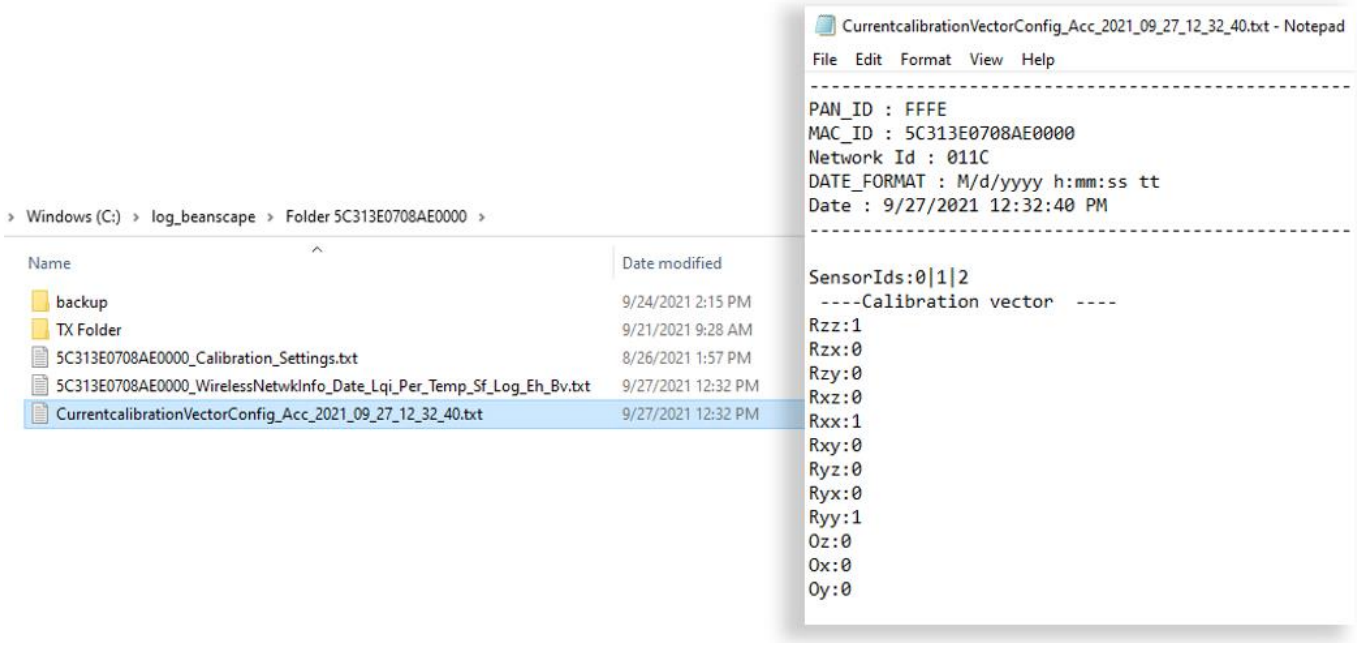
To see the current calibration settings, click on Show Details button 


You can back up your current calibration settings by exploring the Export option 

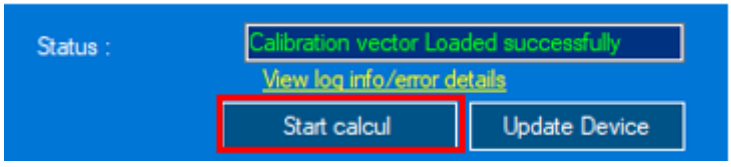
The calibration file will be saved inside the BeanDevice folder on your computer hard disk C partition.



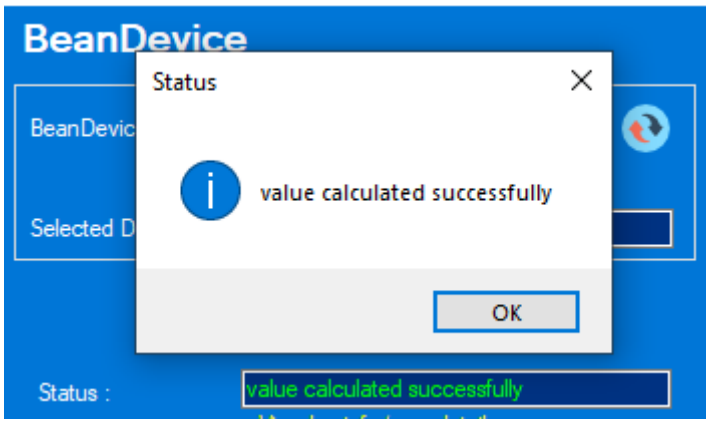



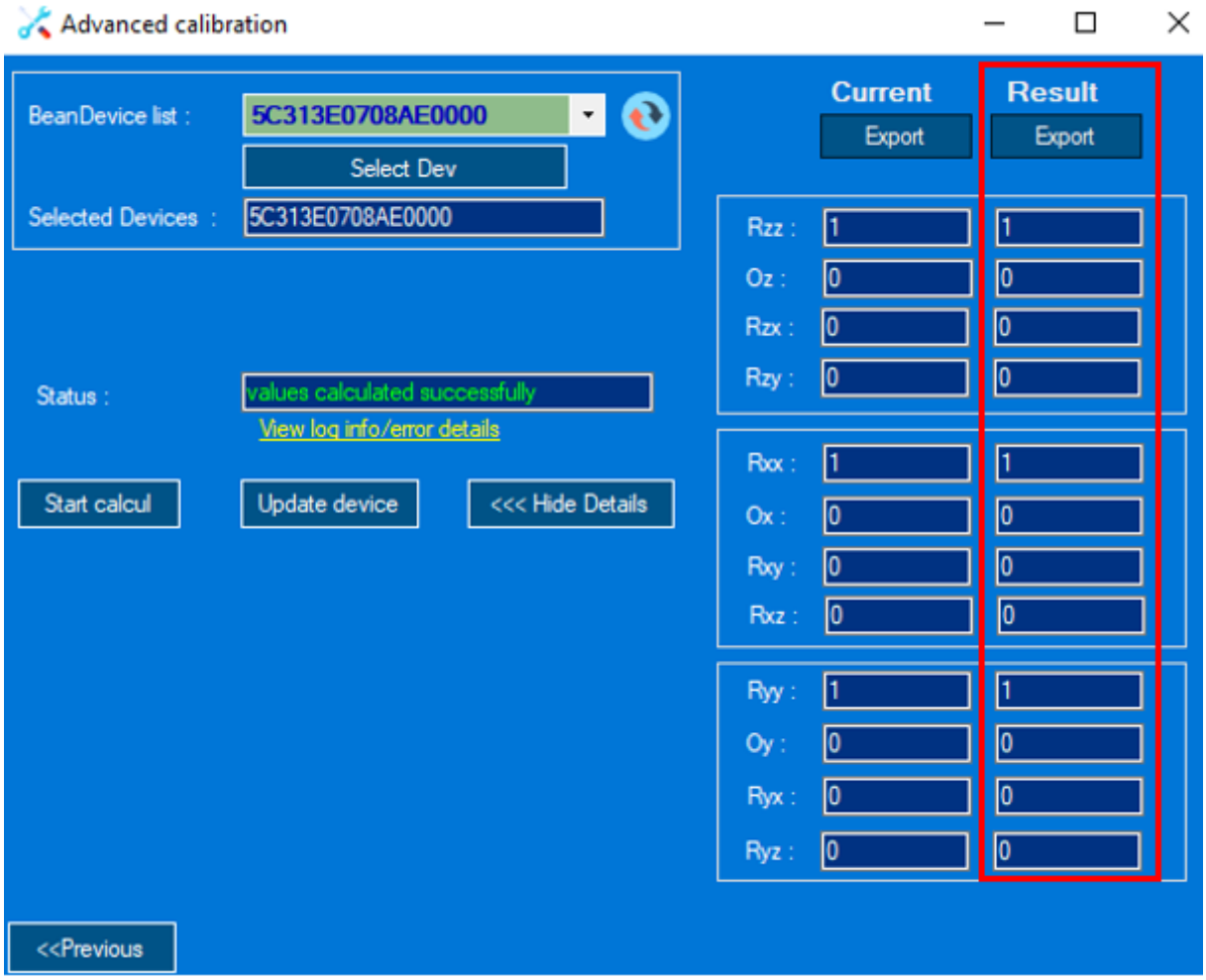

If you face any issue make sure to check the log error/info details.


2- After adjusting the configuration click on “start the calculation” button to obtain the new calibration values.

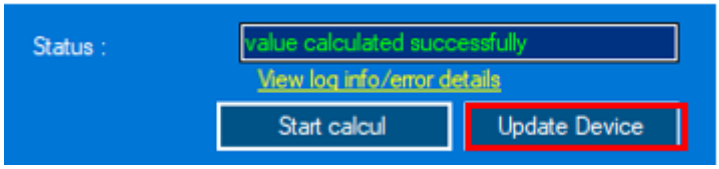



Once the calculation process is finished, new pop up message will be displayed telling that the calculation was done successfully and the result fields will be updated with the new values.

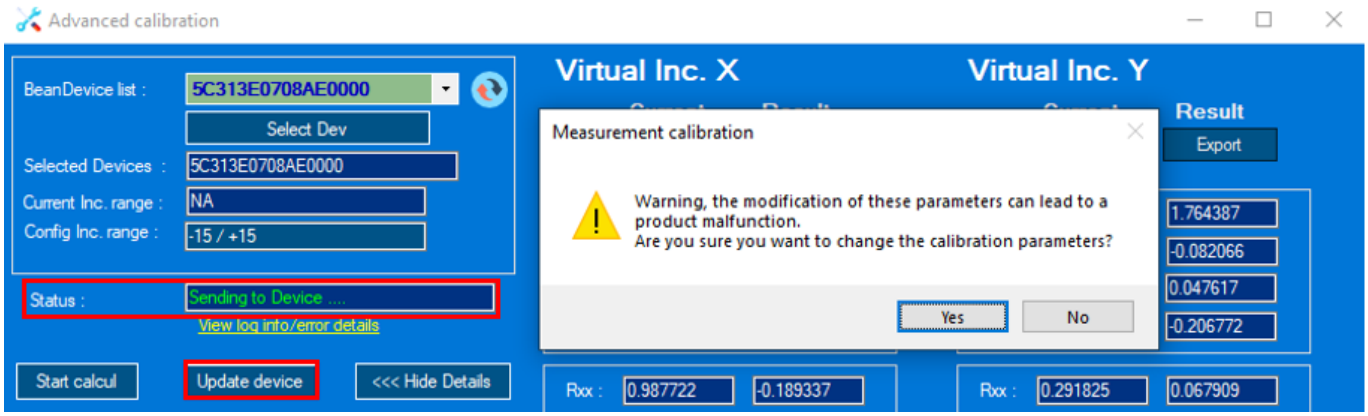


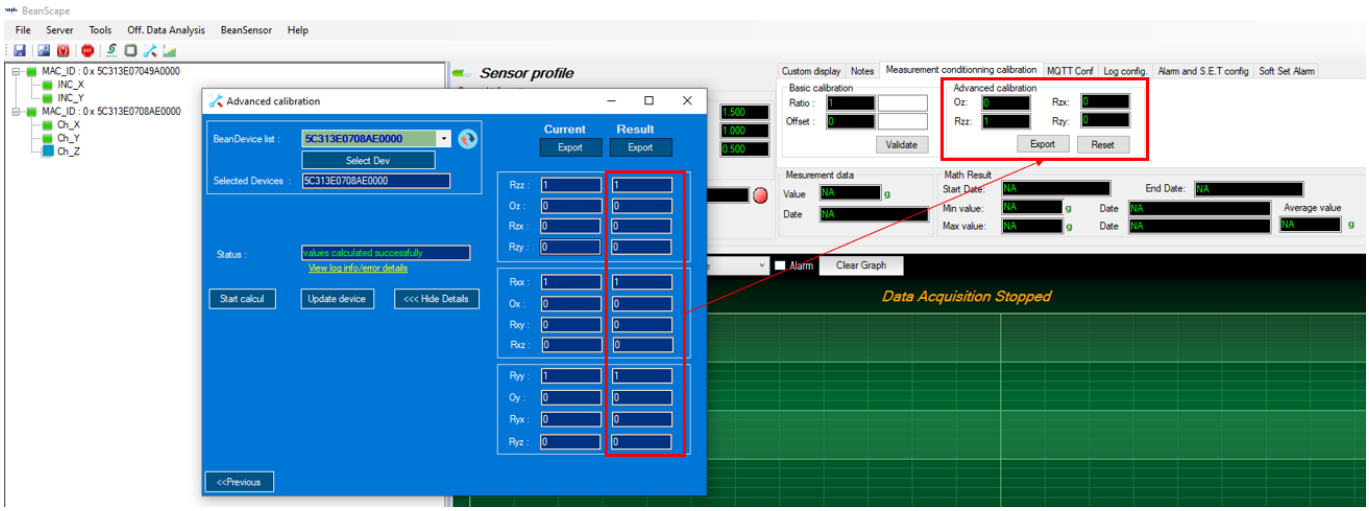

3- Now you can easily load the new calibration settings to the device by clicking on update device button.




When you try to update the device with the new calibration values, a warning message will pop up to make sure that you confirm the process, hit yes.

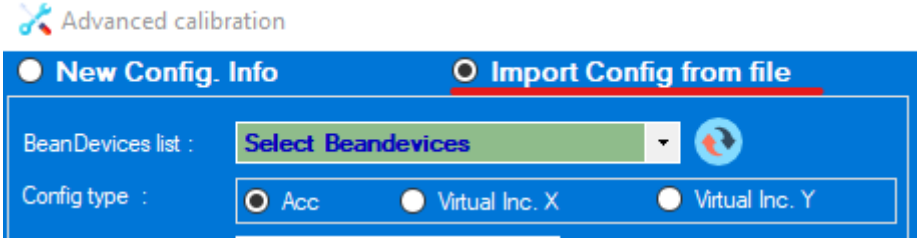



With that the calibration fields will be updated with the new values.

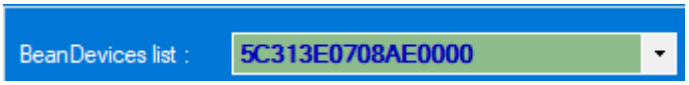



## 13.2 IMPORTE CONFIGURATION FROM A FILE

If you have already a file from a reference sensor which is already calibrated, you don't need to go through the calibration instructions mentioned above. You can just use that file to calibrate your device using the Import configuration.




First of all, select the device which you want to calibrate.

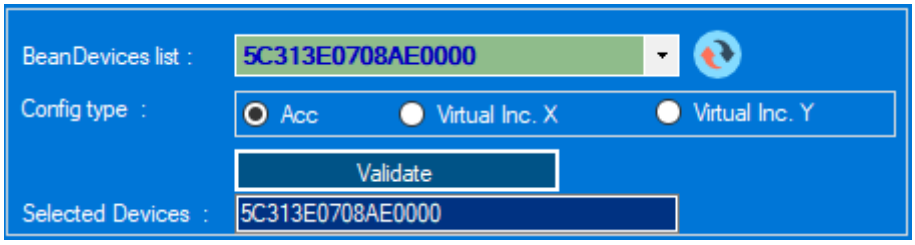



A notification message will be displayed in the status frame saying that the BeanDevice® has been selected successfully otherwise check the info/error details option

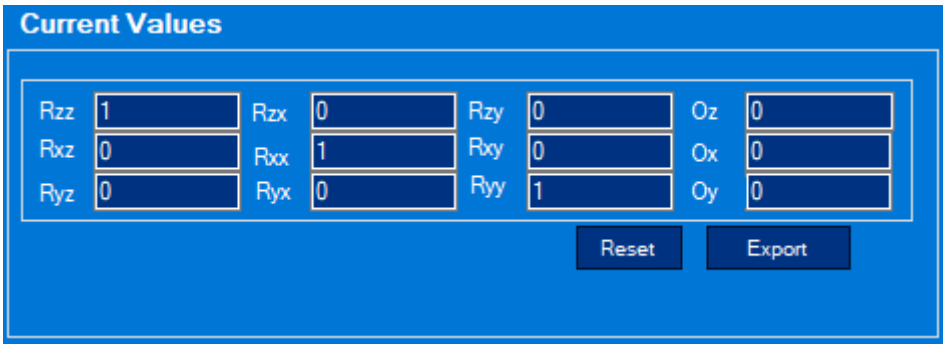
Then select the configuration type

- **Acceleration** if you will calibrate an accelerometer
- **Virtual INC-X** or **Virtual INC-Y** if you will calibrate your virtual tilt axis.

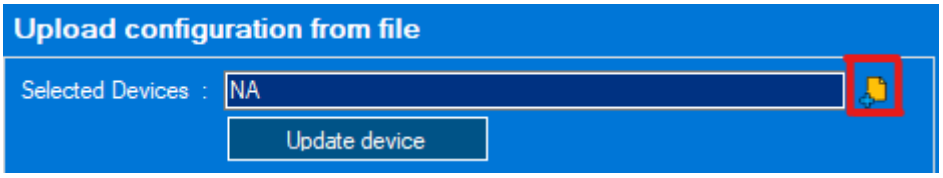
Don't forget to click on Validate button to confirm your choice. 

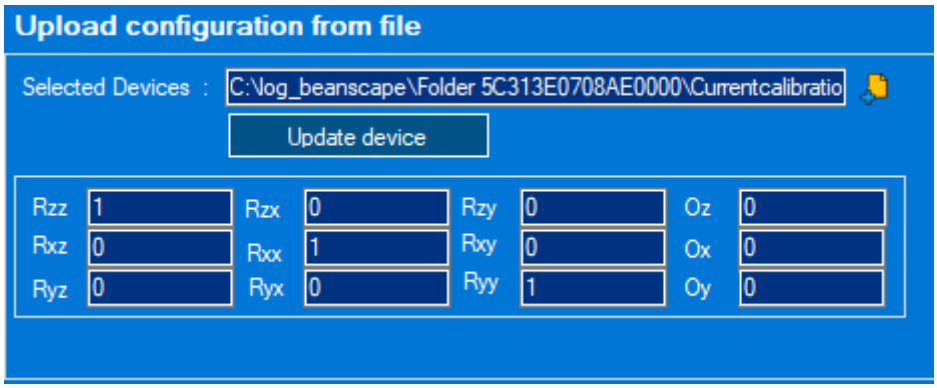

Once you validate the configuration, the current calibration settings which are backed up on the device will be displayed.




Now, navigate to the Upload configuration from file section and click on the file icon to select the file.




Then select the reference file and the new calibration values will be automatically loaded.




Click on Update device to back up the new calibration settings on the device. 

# 14. VIRTUAL TILT

The virtual tilt is a new feature available on the accelerometer devices only (**AX-3D** & **AX-3DS**) compatible with the **firmware version 4.4** and above.

The virtual tilt obtained based on the acceleration results passing through different calculation process.

You can enable or disable the virtual tilt sensor based on your application needs.

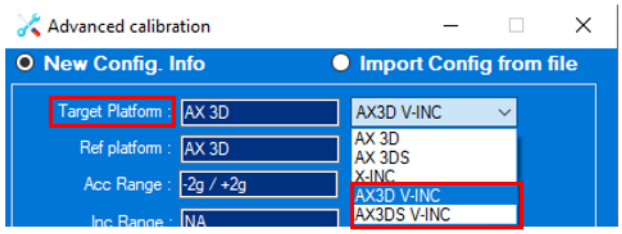
Before enabling the virtual tilt option, you should go through a virtual tilt calibration procedure.

To calibrate a virtual tilt, you can use a sinus table or a reference device (inclinometer).

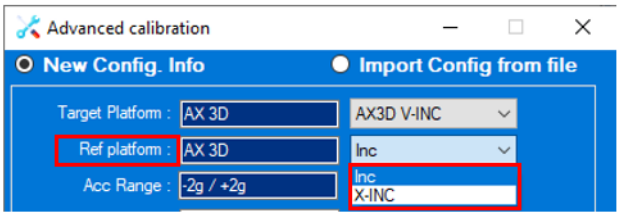
## 14.1 VIRTUAL TILT CALIBRATION

The calibration can be done using a reference device or using a Sinus table.

The target platform can be either AX-3D V-INC or AX-3DS V-INC and the reference device can be Hi-INC or X-INC.




BeanDevice Platform to calibrate



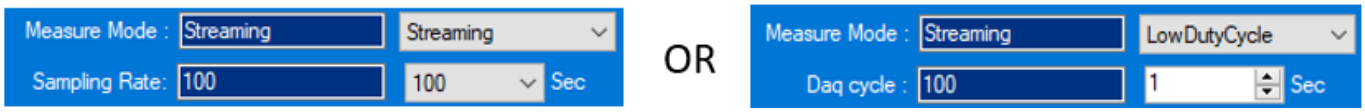

BeanDevice Platform Reference

Select your BeanDevice® target acceleration measurement range, you can find this info from the BeanDevice® dashboard under sensor info tab.


Choose the virtual inclinometer measurement range which goes from ±1deg up to ±90deg.


***You should definitely should your virtual Inc range within the reference Inclinometer range.***

Choose a measurement mode with DAQ cycle or suitable sampling rate.




Choose an equivalent number of positions.

***The number of positions will determine the calibration resolution and the calibration step value to cover the virtual tilt measurement range.***

***The resolution =*** $\frac{Virtual\ Tilt\ measurement\ range}{Number\ of\ positions}$ ***= Error rate = Calibration step***

In our example:

The number of positions is 27 and the virtual tilt measurement range is ±4 deg

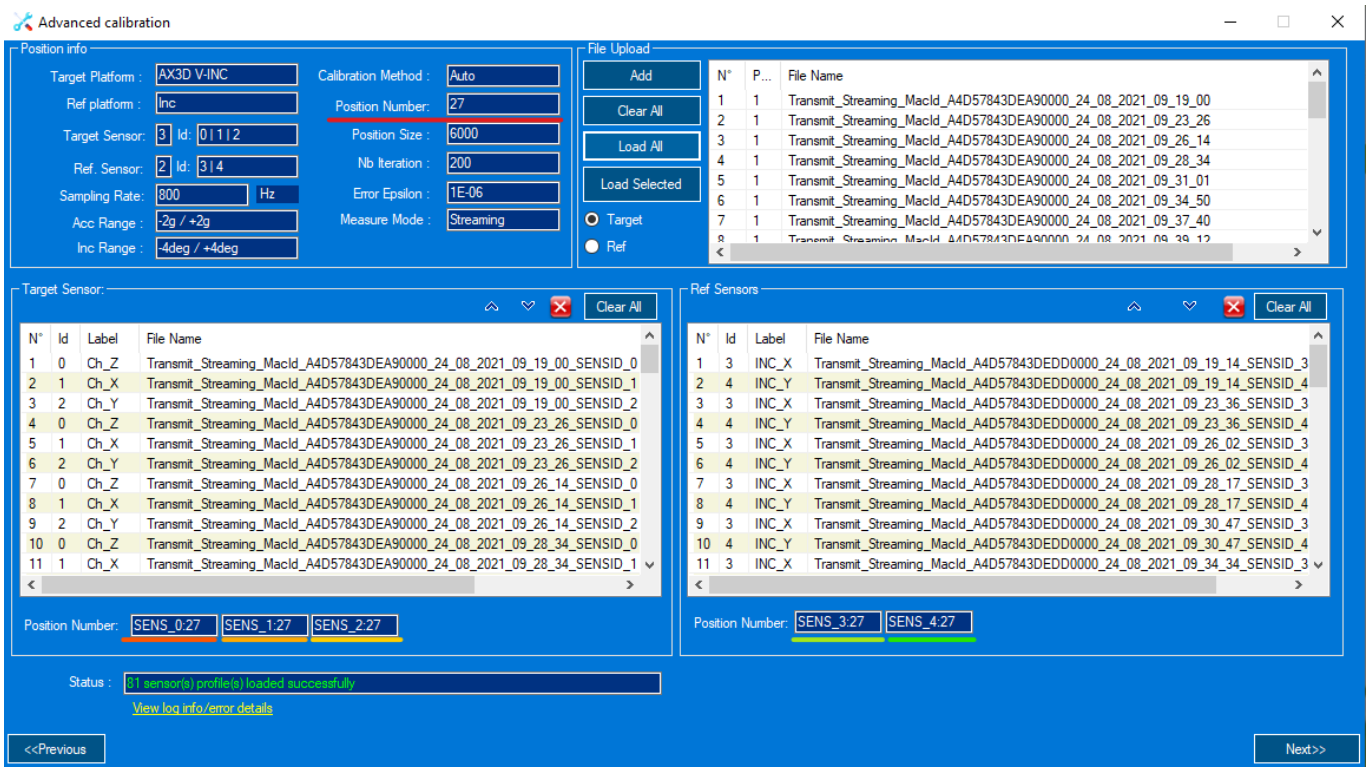
Resolution = error rate = calibration step = $\frac{2*4}{27}$ = 0.3

The position size is the data amount which will be used in the calibration calculation, it should not be higher than the number of data in the log file.

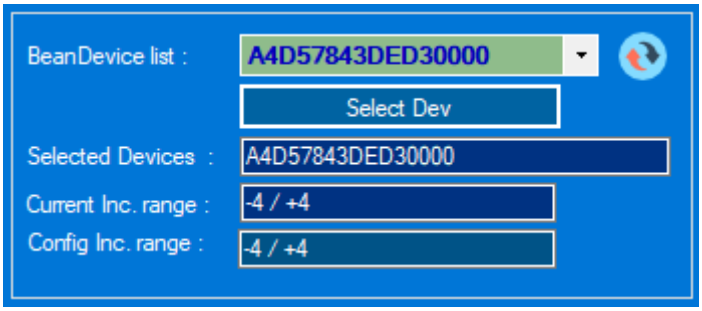

Choose the iteration number.


After that click on **Validate** then **Next**.

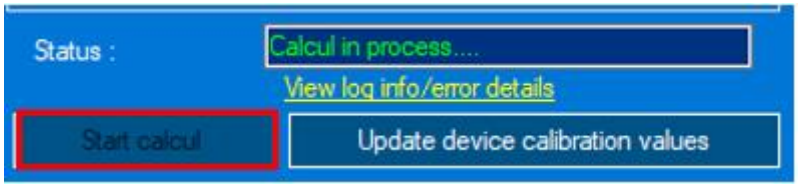
Now just put the files for the target device and reference device, and make sure that the number of files is exactly equal to the number of positions configured earlier.




Select the BeanDevice® from the list then confirm your choice by clicking on Select Dev button.




Now, just start the calculation process.



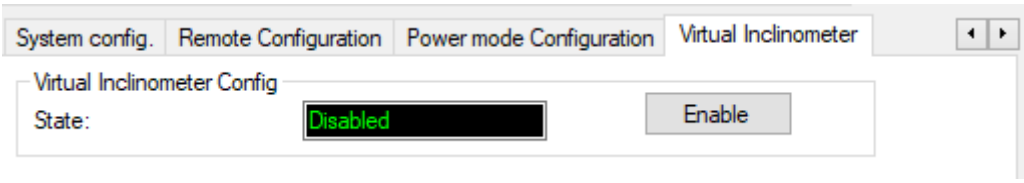

The results will be displayed in the following window.


Now just load the new calibration settings on your BeanDevice by clicking on **Update device calibration values** button.

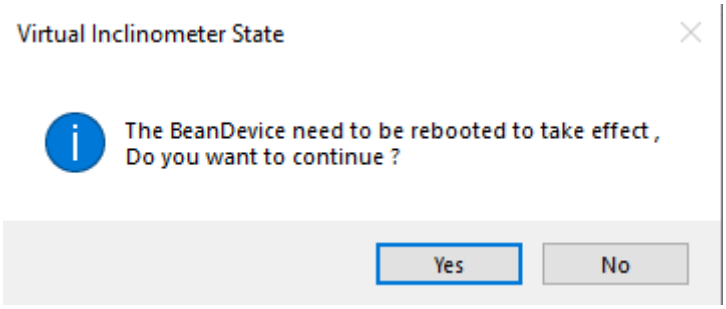
## 14.2 ENABLE VIRTUAL TILT SENSORS

Once the calibration process is finished and the BeanDevice is updated with the new calibration values, now is the time to enable the virtual tilt sensors.

So, Virtual Inclinometer tab then Enable the Virtual Inclinometer sensors.

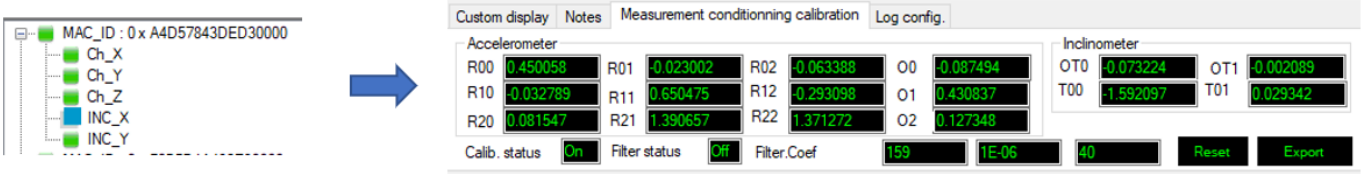



To Enable the virtual tilt, you should reboot the BeanDevice® so click on Yes when the notification message will pop up.

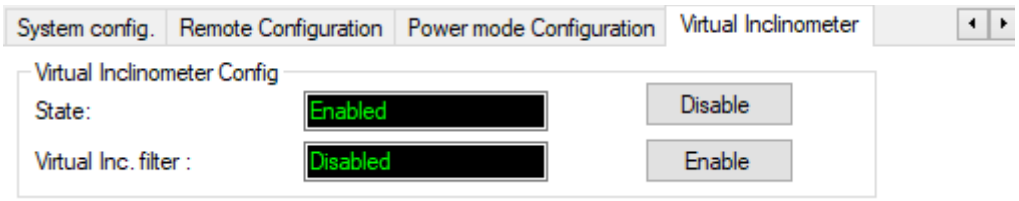



After that you will see the Accelerometer has now 5 sensors with the Virtual Tilt option.


You can verify the calibration setting by clicking on the virtual tilt sensor profile then go to measurement conditioning calibration.



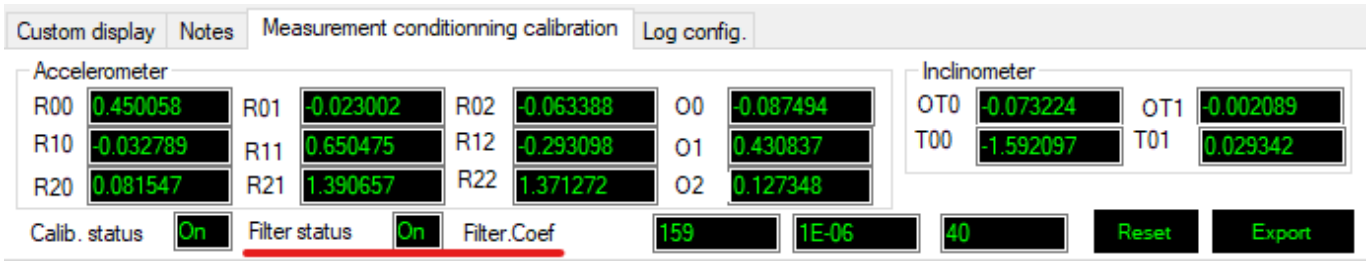

Another option is available by enabling the virtual tilt option, is the virtual inclinometer filter.




You can enable the virtual tilt filter by clicking on Enable button.

***The Virtual tilt will be enabled only if the calibration settings are correct otherwise it will be always OFF even when you enable the filter option.***

***You can always check the virtual tilt filter status from the measurement conditioning calibration tab***


Custom display
Notes
Measurement conditionning calibration
Log config.
Accelerometer
R00 0.450058
R01 -0.023002
R02 -0.063388
O0 -0.087494
R10 -0.032789
R11 0.650475
R12 -0.293098
O1 0.430837
R20 0.081547
R21 1.390657
R22 1.371272
O2 0.127348
Inclinometer
OT0 -0.073224
OT1 -0.002089
T00 -1.592097
T01 0.029342
Calib. status
On
Filter status
On
Filter.Coef
159
1E-06
40
Reset
Export

# 15. MAINTENANCE & SUPERVISION (FOR EXPERIENCED USER)

This section allows to an experienced user to configure correctly the Wireless Sensor Networks.

## 15.1 RESTORING FACTORY SETTINGS

If desired, the user can perform a Network context deletion. It allows to restore default parameters on the BeanDevice®:

| *Parameter* | *BeanDevice® WiLow® version* | | |
|---|---|---|---|
| | **AX-3D** | **AX-3DS** | **HI-INC** |
| *Power Mode* | *Active* | | |
| *Data Acquisition duty cycle* | *10s* | | |
| *Acquisition duration time* | *OK* | | |
| *Sampling rate* | *OK* | | |
| *Data Acquisition mode* | *LowDutyCycle* | | |
| *C s Threshold* | *H1 :2, 10, 13*<br>*H2 :2, 10, 13*<br>*S2: -2, -10, -13*<br>*S1: -2, -10, -13* | *H1 :20*<br>*H2 :20*<br>*S2 :0*<br>*S1 :0* | *H1 :20*<br>*H2 :20*<br>*S2 :0*<br>*S1 :0* |
| *Anti-aliasing Filter cut-off frequency* | *100 Hz* | */* | *100 Hz* |

To restore these defaults parameters, you must perform a *Network context deletion*. The “Network” non-contact button is outside the product. Hold the magnet on the button network ("Network") for more than 2 seconds.


*“Network” Reed non-contact button*

## 15.2 EXTENDING BATTERY LIFE

The battery autonomy depends on several parameters:

- ✓ The environment where the BeanDevice® WiLow® is deployed
- ✓ Data acquisition mode which is configured

The table below presents the BeanDevice® WiLow® current consumption during radio TX or during sleep phase:

| *Current consumption during radio TX at 25°C, powered by a battery of 3.6V* | *Current consumption in sleep phase at 25°C, powered by a battery of 3.6V* |
|---|---|
| 250-280 mA | < 100 uA |

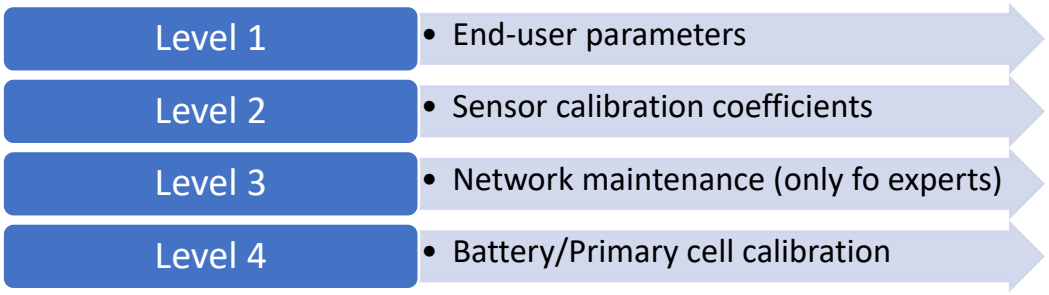
The following table gives you a list of recommendations in order to extend the battery autonomy of your BeanDevice® Wilow®:

| Influence factors on battery lifetime | Observations | Recommendations |
|---|---|---|
| ***Sleep power mode on your BeanDevice® Wilow®*** | Sleep power mode can be configured on the BeanDevice® from the BeanScape® | By activating this power mode on your BeanDevice®, you will increase the BeanDevice® battery life. |
| ***Sampling rate in streaming mode*** | Power consumption will grow with the sampling rate. | Choose the right sampling rate on your BeanScape® interface. |
| ***Packet Error Rate (PER)*** | A high packet error rate can cause a higher retransmission data and this increase the current consumption. | Try to replace your BeanDevice® in an area where the radio link is much better (see Link Quality Indicator value). |

## 15.3 OVER-THE-AIR CONFIGURATION (OTAC) PARAMETERS BACKED UP ON FLASH

The BeanDevice® WiLow® integrates an internal flash memory used for backing up OTAC (Over-the-air configuration) parameters.

This memory is organized into several levels:




### 15.3.1 Level 1: End-user OTAC parameters

The following table presents all the defaults configuration parameters:

| *Parameter* | *BeanDevice® WiLow® version* | | |
|---|---|---|---|
| | AX3D | HI-INC | *AX-3DS* |
| *Power Mode* | *Active* | *Active* | *Active* |
| *Data Acquisition duty cycle* | *10s* | *10s* | *10s* |
| *Acquisition duration time* | *N.A.* | *N.A.* | *N.A.* |
| *Sampling rate* | *N.A.* | *N.A.* | *N.A.* |
| *Data Acquisition mode* | *LowDutyCycle* | *LowDutyCycle* | *LowDutyCycle* |
| *Alarms Threshold* | *High level: 2g or 10g*<br>*Low level :-2g or -10g* | *High level: 15° or 30°*<br>*Low level: -15° or -30°* | *High level: 2g*<br>*Low level :-2g* |

*Table 15: End-user OTAC parameters*

To restore these defaults parameters, you must perform a *Network context deletion*.

The “Network” non-contact button is outside the product. Hold the magnet on the button network ("Network") for more than 2 seconds.


*Figure 192: Network Reed button position*

***Level 2, 3 & 4 of Configuration parameters are not affected by network context deletion (by hardware or software)***

### 15.3.2 Level 2: Sensor calibration parameters

The table below presents the sensor calibration parameters depending on BeanDevice® version:

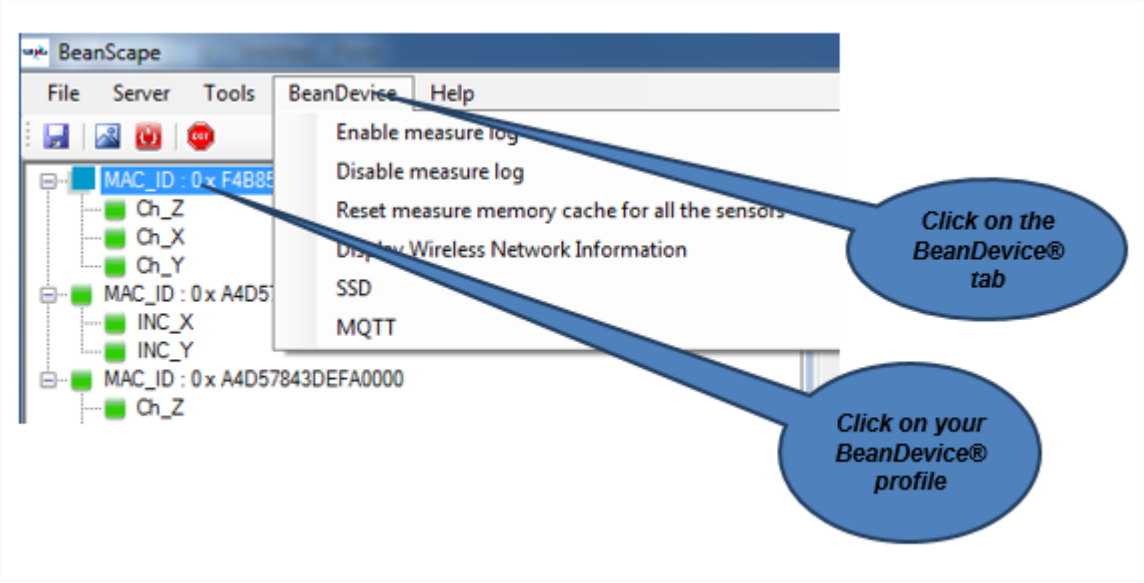
| *Parameter* | *BeanDevice® WiLow® Version* | | |
|---|---|---|---|
| | **AX3D** | **HI-INC** | ***AX-3DS*** |
| ***Sensor gain*** | OK | OK | OK |
| ***Sensor offset*** | OK | OK | OK |

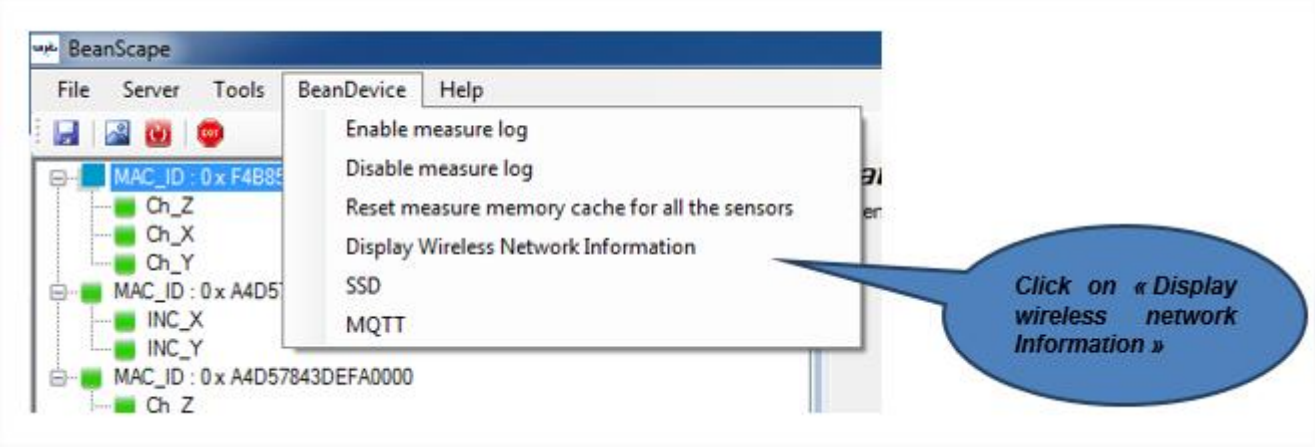
## 15.4 NETWORK DIAGNOSTIC FROM YOUR BEANSCAPE® WILOW® SOFTWARE

The BeanScape® provides network diagnostic information which is described in this chapter.

### 15.4.1 Displaying Network information

1. Launch your BeanScape® WiLow® application
2. Select your BeanDevice® WiLow® profile, a new tab “BeanDevice®" will appear in your BeanScape® toolbar;
3. Click on this tab, and then click on "View History Network”.



#### 15.4.1.1 Packet Error Rate

**Packet error rate** (PER) is the number packet errors divided by the total number of transferred packet during a studied time interval. PER is a unit less performance measure, often expressed as a percentage number.

#### 15.4.1.2 LQI (Link Quality Indicator)

LQI (Link Quality Indicator) represents the radio signal quality in your Environment. It is possible that LQI is low due to EMC interference or metal presence in the environment.

**If you encounter such problems, several solutions are proposed to increase your LQI:**

- ✓ Try to configure your receiver antenna and your transmitter antenna on the same antenna pattern (cf. the Beam with of your antenna)
- ✓ Use a high gain antenna (in outdoor use only) for a better RF Link Budget
- ✓ Mount your BeanDevice® Wilow® or WIFI AP/Repeater on a top of a mast or a building.

***For further information, read the application note on "How to extend your wireless range?"***

#### 15.4.1.3 Internal temperature monitoring

An internal temperature sensor is used for onboard & battery temperature monitoring

#### 15.4.1.4 Battery charge monitoring

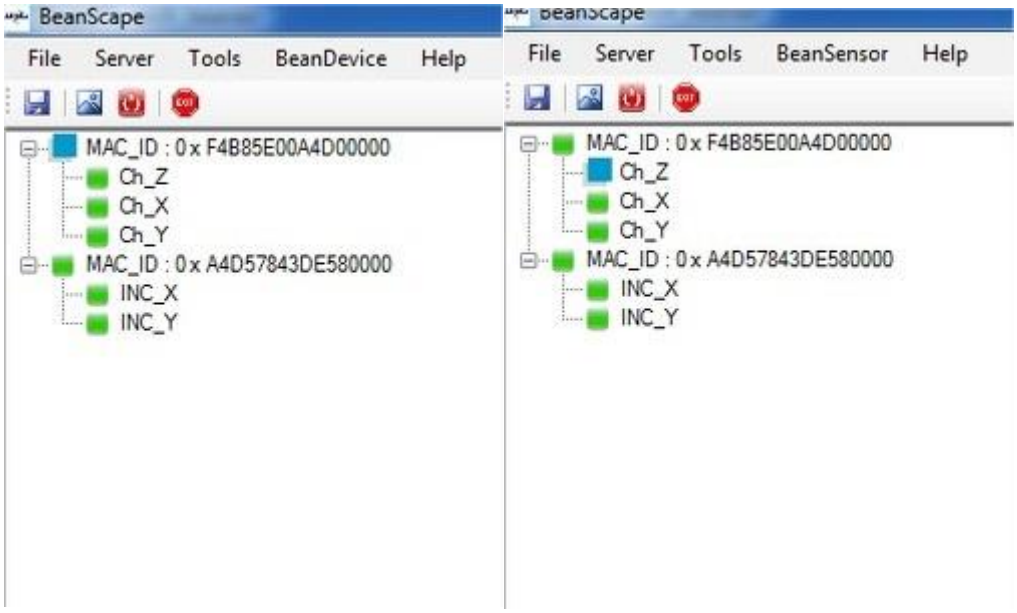
Battery charge is based on current accumulation. The **BeanDevice® Wilow®** integrates a current accumulator circuit which facilitates remaining capacity estimation by tracking the net current flow into and out of the battery. Current flow into the battery increments the current accumulator while current flow out of the battery decrements it.

Voltage measurement corresponds to battery voltage.

### 15.4.2 Scrolling menu « BeanDevice® »

The BeanDevice® scrolling menu provides access to additional features: like the multi-graph mode (display of multiple windows on a graph measuring the same screen), deleting graphs displayed and the activation / deactivation of logging measurements.

To access to this scrolling menu, click on the sensor attached to your BeanDevice®. You will then see the BeanDevice® scrolling menu appearing.

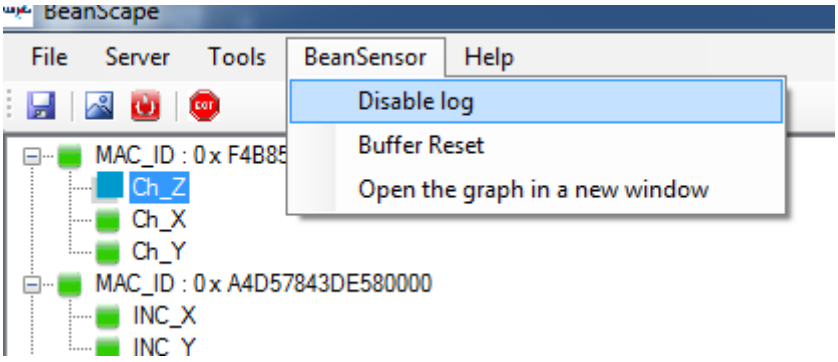


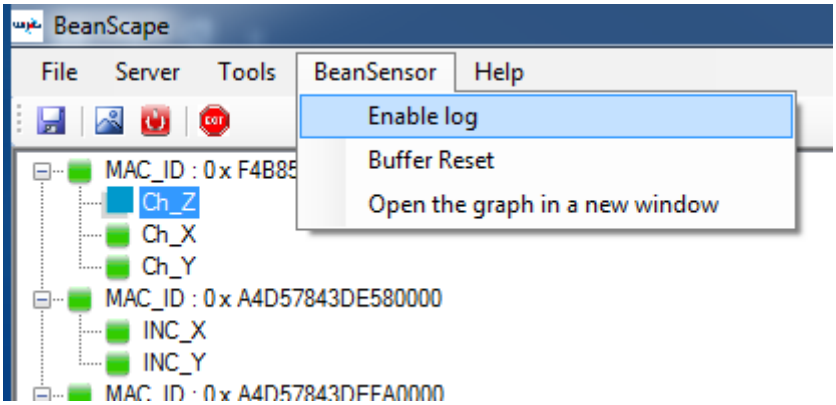

By clicking on the scrolling menu « BeanSensor », you can access to the following features:

15.4.2.1 Disable/Enable log

All the data received on the BeanScape® are stored in a log file in CSV format.

This feature allows you to enable / disable data logging on your log file.





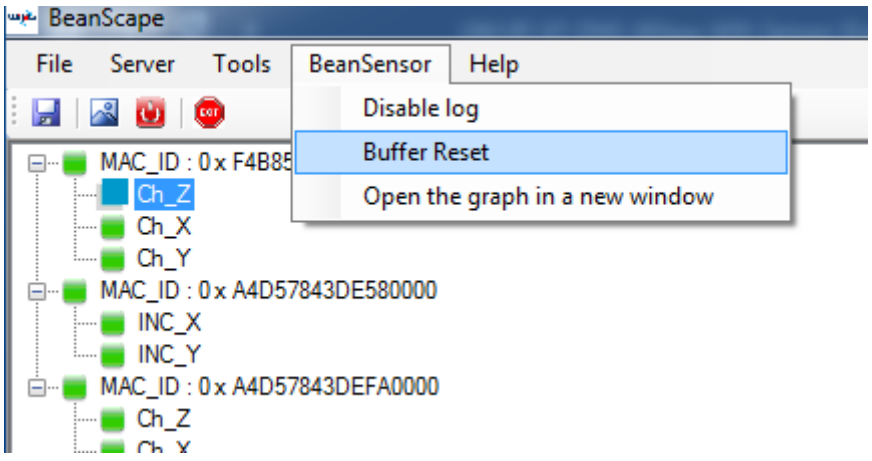

***For further information about CSV log file, please read the BeanScape® user manual.***

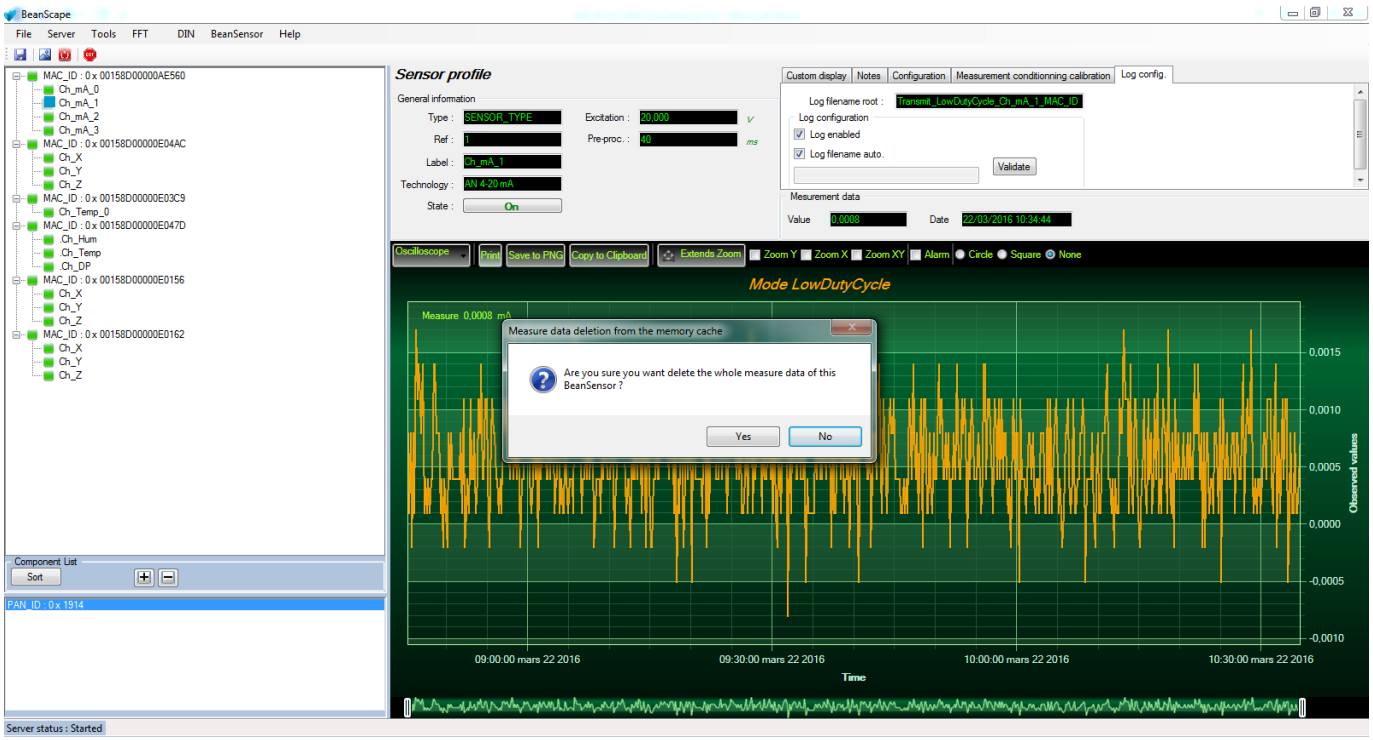
15.4.2.2 Buffer reset

This function clears the graphical display concerning recorded measurements of your sensor. The data stored in a log are not affected by this function.

By clicking on « Buffer reset », a second window appears asking you to confirm your choice:

- Yes, you accept to delete the whole measure data of this BeanSensor
- No, don't delete the whole measure data of this BeanSensor

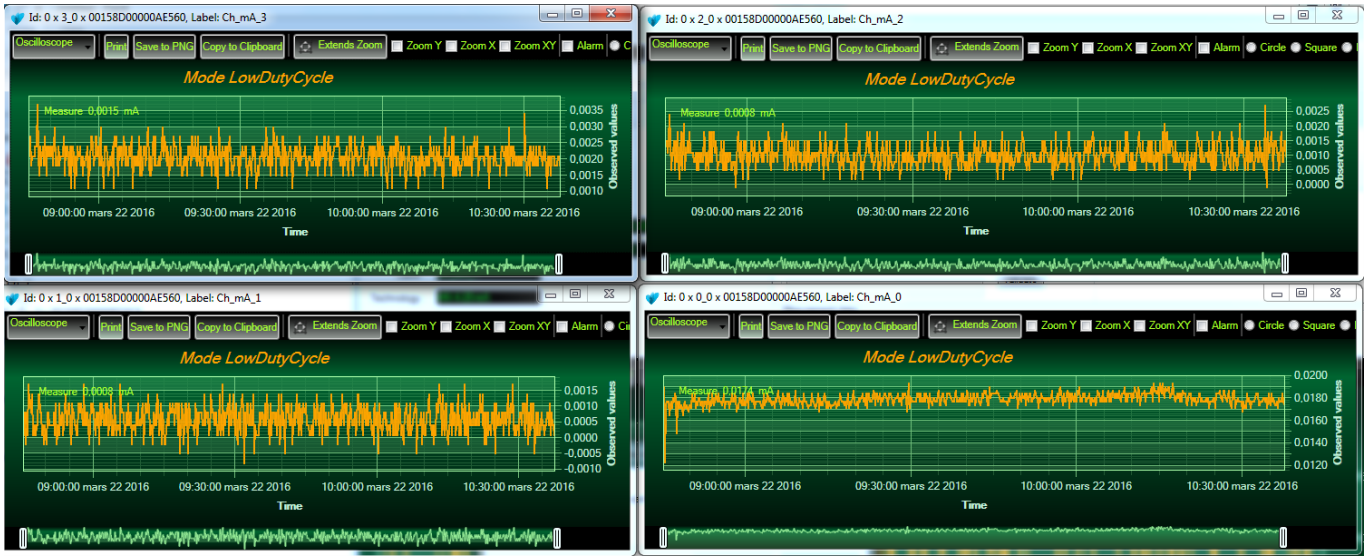





### 15.4.2.3 Open the graph in a new window

By clicking on “Open the graph in a new window”, you can open a graph corresponding to your sensor.

You can easily open several graphs in a window.




***The multi-graph mode requires a lot of resources on your computer, it is recommended to install the BeanScape® software on a powerful computer.***

## 16. TROUBLESHOOTING

✓ ***Why the BeanDevice® WiLow® LEDS are not activated?***

If there is no wireless network activity, the led will be inactive. Make sure you have powered your BeanDevice® with a charged battery.

✓ ***What should I do if interference is present on the radio channel?***

Choose an appropriate WiFi radio channel.

✓ ***Why the BeanDevice® WiLow® does not provide the right measurement value?***

- Check if your sensor channel is activated on your BeanScape® interface (ON Position)?;
- Check if your BeanDevice® is powered up;
- Check your LQI quality, if your LQI is under 50-60. You must change your antenna position, or your product position;
- Check your data acquisition mode, maybe you have specified a data acquisition which is too long ;

***Why the BeanDevice® WiLow® doesn't respond when I try to configure it (Over-the-air-configuration)?***

✓ If your BeanDevice® WILO® operates with sleep power mode, the RF Hardware operates also with a sleep power mode. Therefore your BeanDevice® WILO will not receive in real-time the OTAC configuration;

✓ Check the LQI (Link Quality Indicator) value, if this value is under 80, the over-the-air configuration will not be easy. Try to decrease the wireless range between the BeanDevice® WILO® and the WIFI Access Point or WIFI Repeater .

***Why do I have too much noise on my sensor signal ?***

✓ Check your external power supply quality

***Why I see 1g on the axis pointing to the ground ?***

✓ Accelerometers are devices that measure acceleration, which is the rate of change of the velocity of an object. They measure in meters per second squared (m/s2) or in G-forces (g). A single G-force for us here on planet Earth is equivalent to 9.8 m/s2 = 1g.

- ✓ The gravitational force has three vector components, in X, Y & Z directions, the accelerometer should read 1g on the Z axis (Z axis is pointed to the ground), it's usual to view 1g on this axis as it's the gravity. Our sensors are MEMS based and are working between DC to 800Hz . It's a normal behavior.

# 17. APPENDICES

## 17.1 FFT WINDOW GRAPH ON MATLAB

The following graphs represent the graphical display of each window function on MatLab:

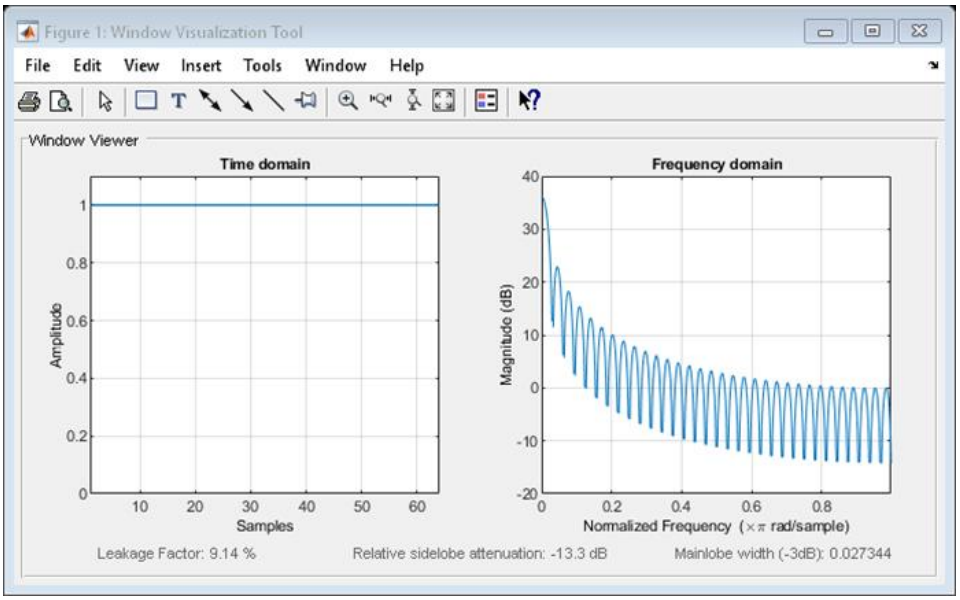



*Figure 193: Rectangular Window Graph on MatLab*

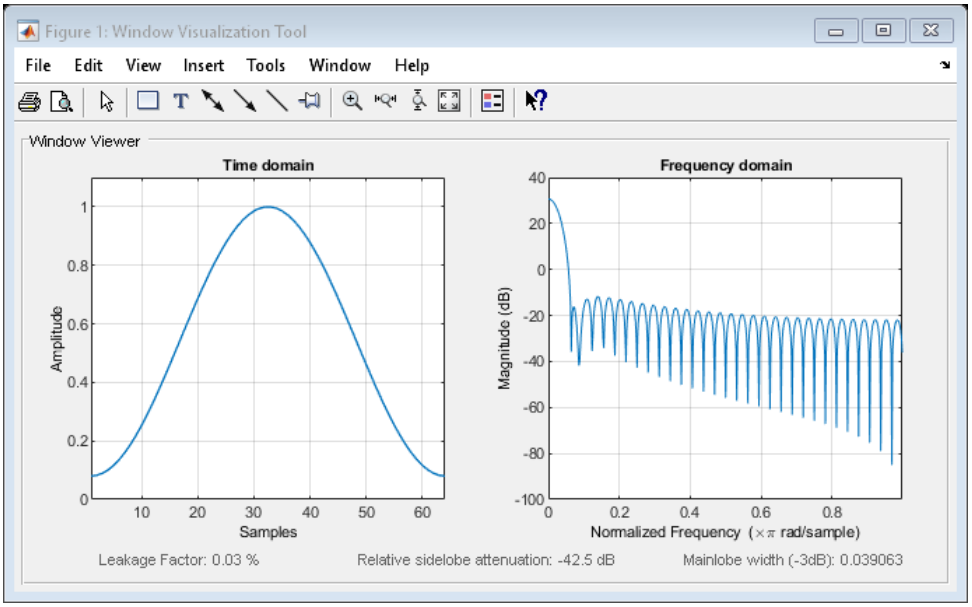



*Figure 194: Hamming Window Graph on MatLab*

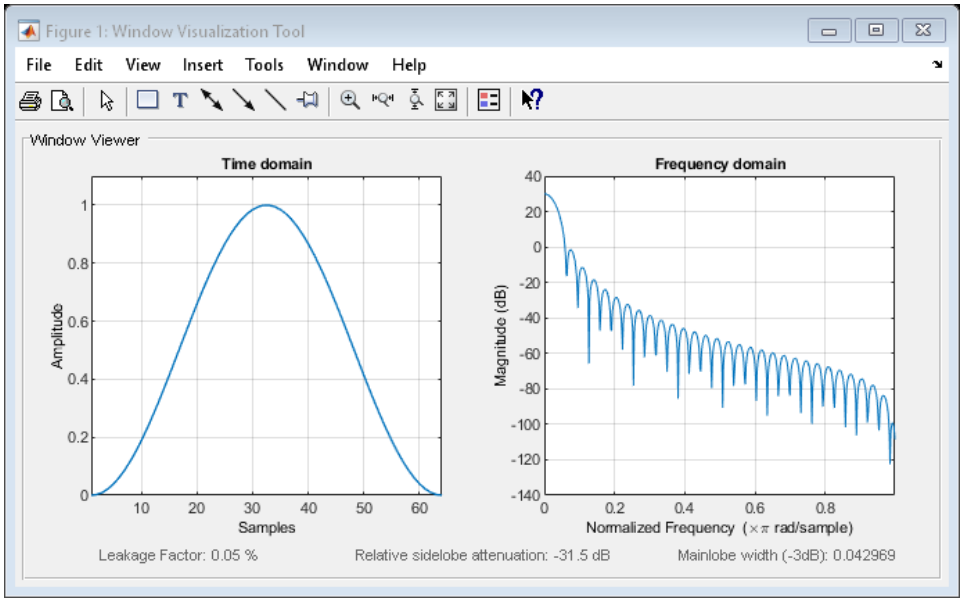



*Figure 195: Hann Window Graph on MatLab*

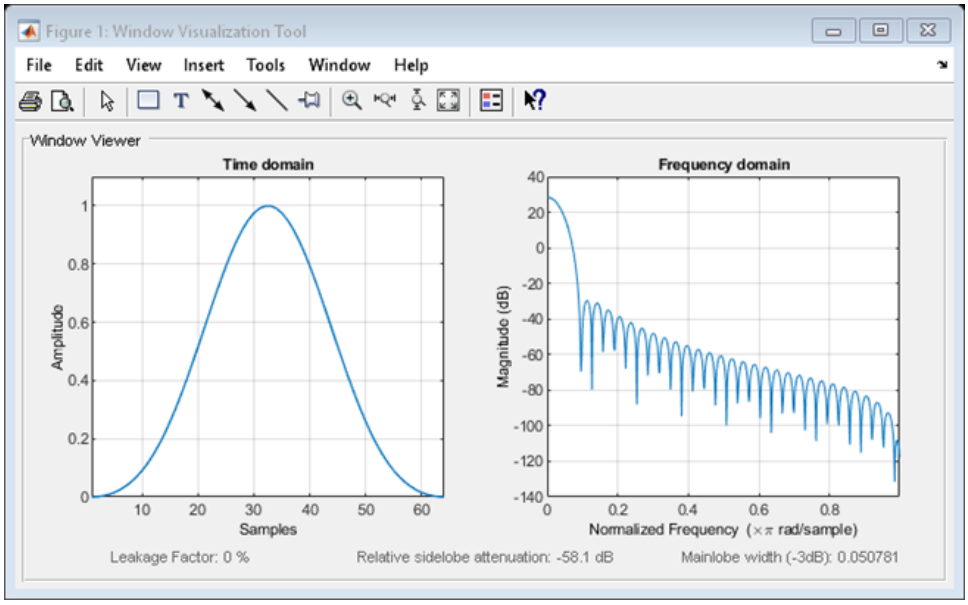



*Figure 196: Blackman Window Graph on MatLab*

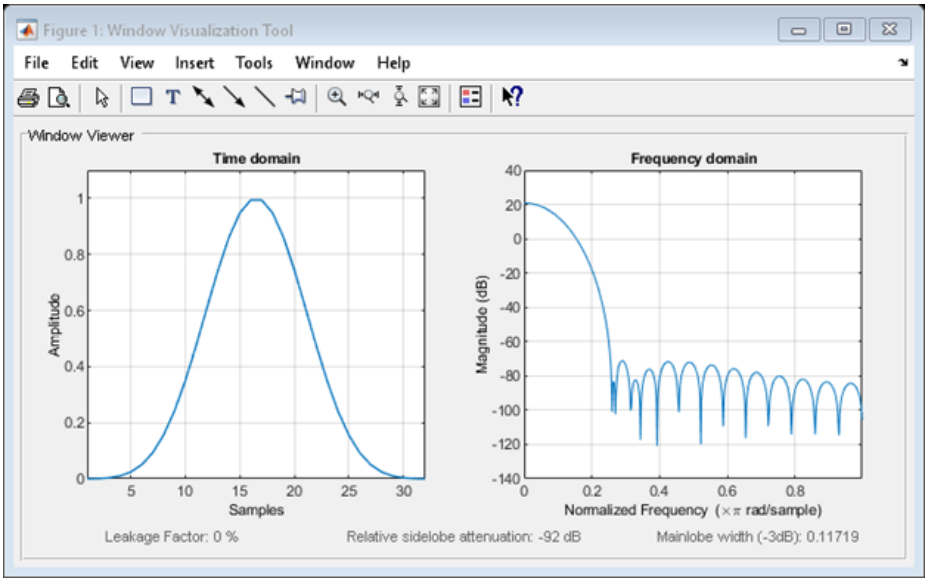



*Figure 197: Blackman-Harris Window Graph on MatLab*

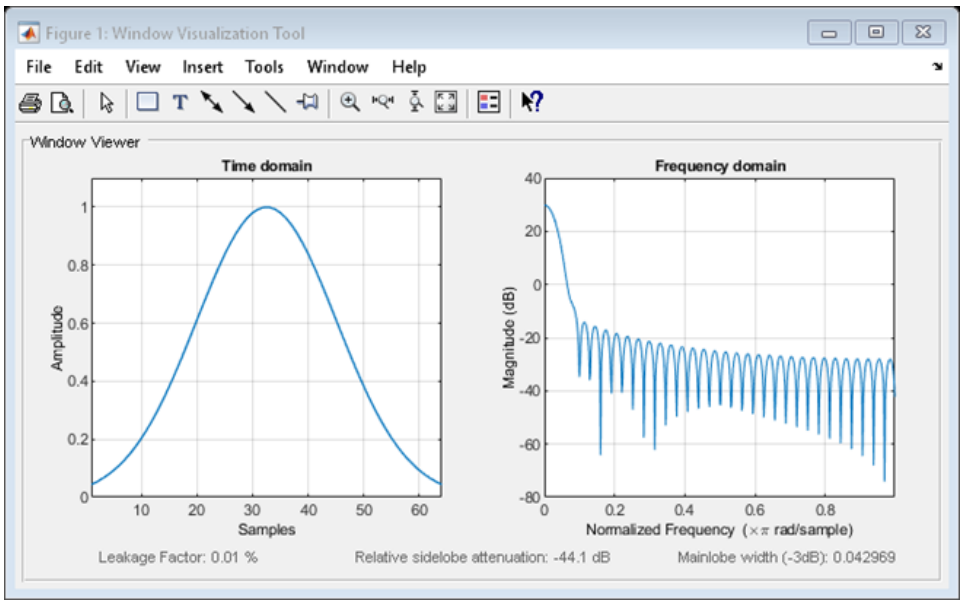



*Figure 198: Gaussian Window Graph on MatLab*

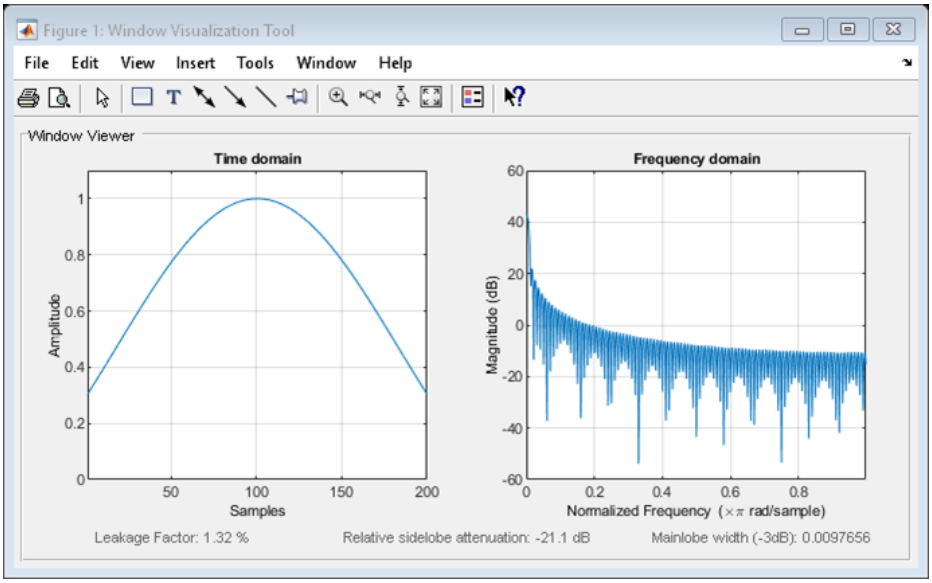



*Figure 199: Kaiser Window Graph on MatLab*

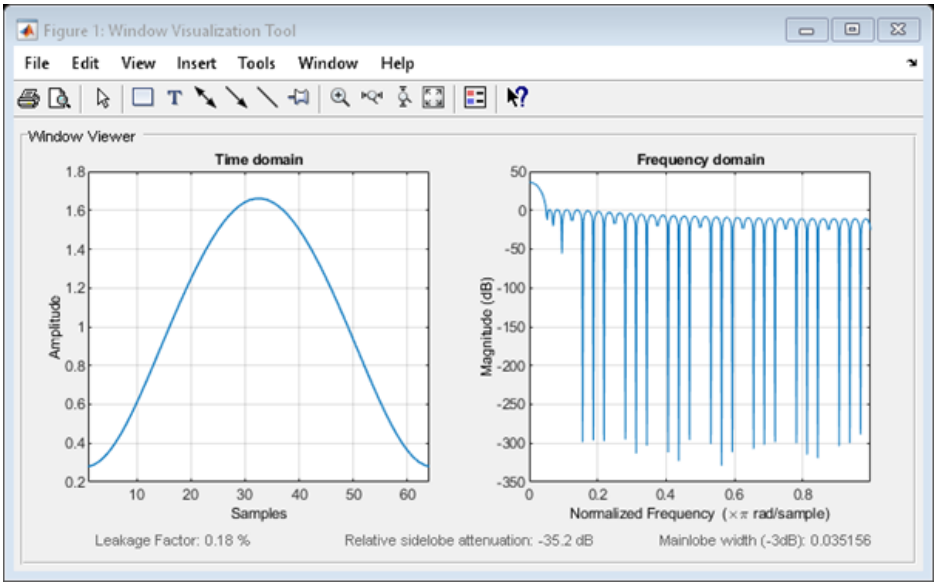



*Figure 200: Taylor Window Graph on MatLab*

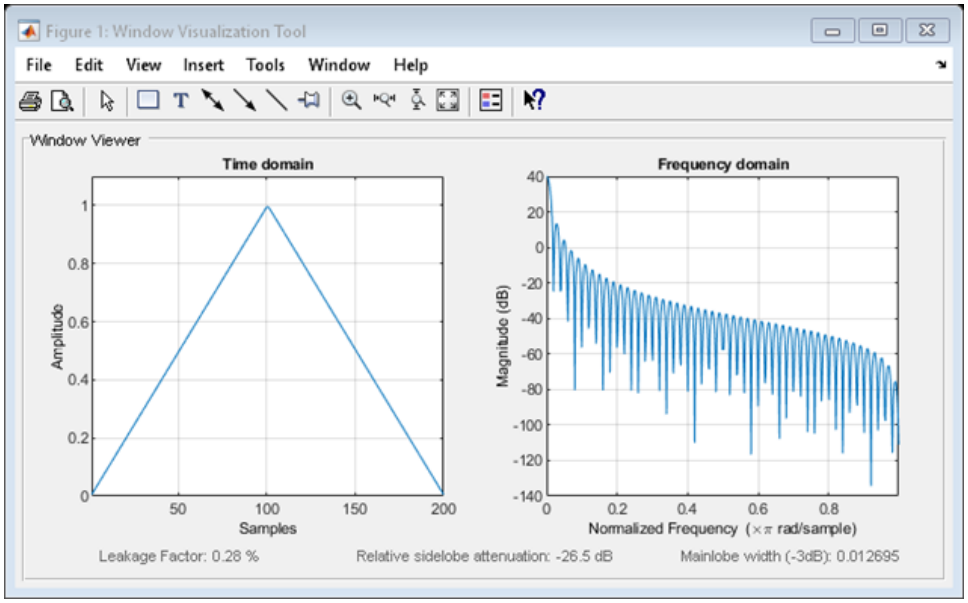



*Figure 201: Triangular Window Graph on MatLab*

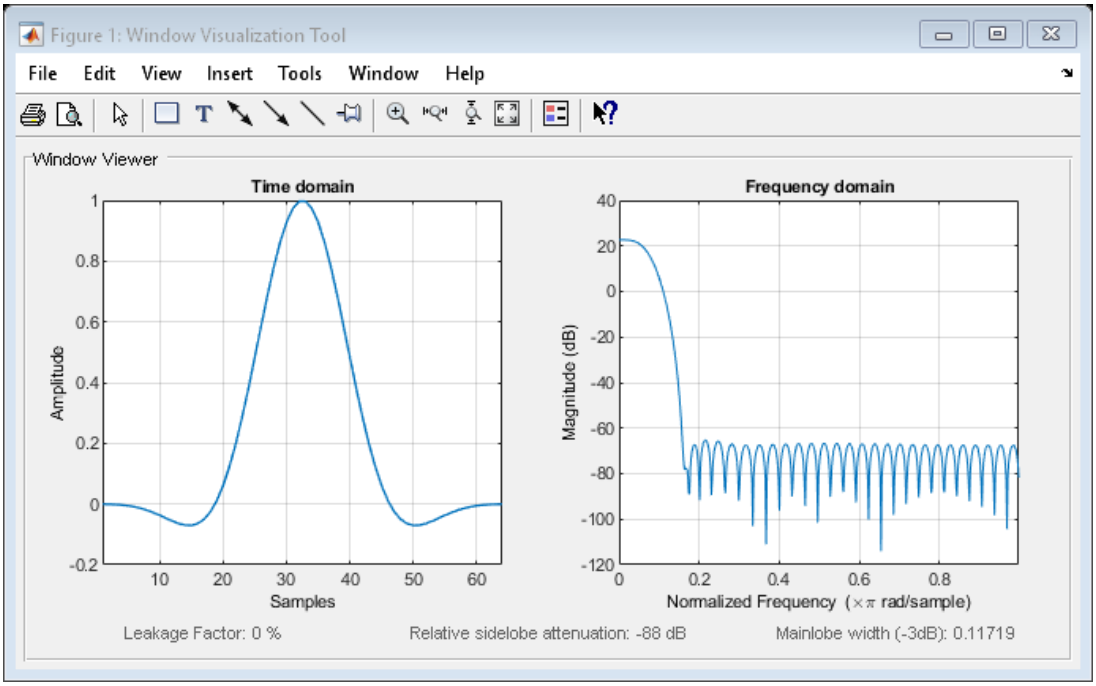



*Figure 202: Flat Top Window Graph on MatLab*

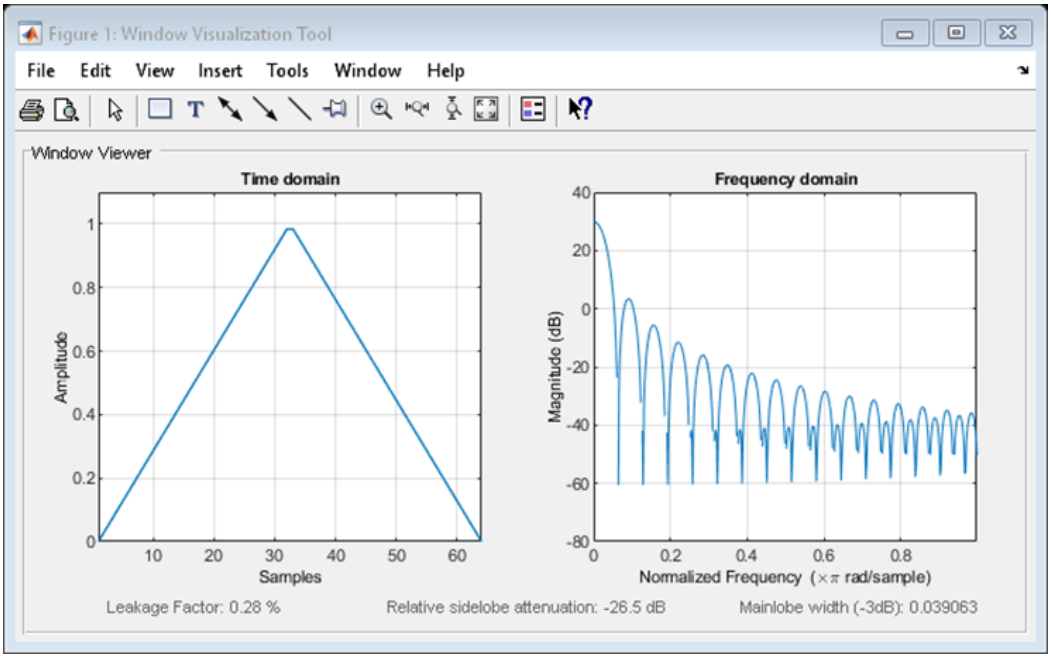



*Figure 203: Bartlett Window Graph on MatLab*

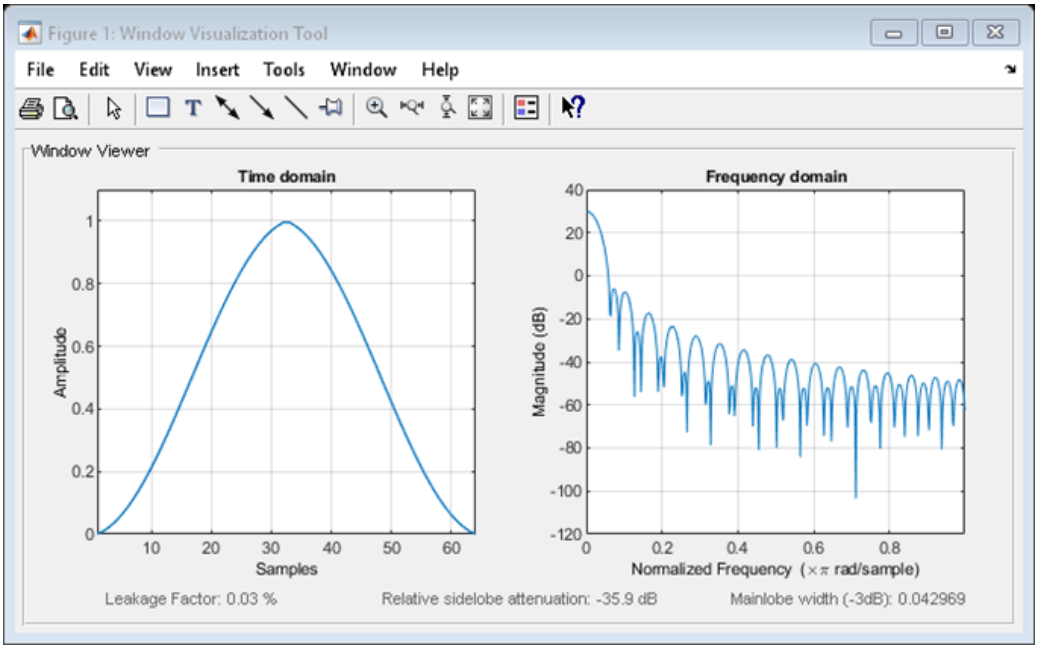



*Figure 204: Bartlett-Hann Window Graph on MatLab*