BeanDevice®

Version 2.3.2

BEANAIR® BEANDEVICE® WILOW® USER MANUAL

BeanAir

Rethinking Sensing Technology

Wilow

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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: 3 KSPS per axis
- 24-bit delta-sigma analog-to-digital with synchronous measurement channel and temperature compensation
- SSD (Smart Shock Detection), the device wakes up on shock detection
- Non-contact actuation for faster and safer installation
- Current consumption in sleep mode: TBD
- 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 (±0.057° for ±15° version)
- Maximum sampling rate: 100 SPS per axis
- 24-bit delta-sigma analog-to-digital with synchronous measurement channel and temperature compensation
- SSD (Smart Shock Detection), the device wakes up on shock detection
- 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
- 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

5.1.2.2 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)
- SSD (Smart Shock Detection), the device wakes up on shock detection
- 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, weight: TBD)
- 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
- Scalable measurement range for shock detection: ± 2/4/6/8/16g
- Maximum sampling rate: 1.6 KSPS per axis (shock detection)
- Maximum sampling rate: 2 KSPS per axis (acceleration)
- Very Low Noise density: 150 µg/√Hz(shock detection)
- 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, weight: TBD)
- 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®:

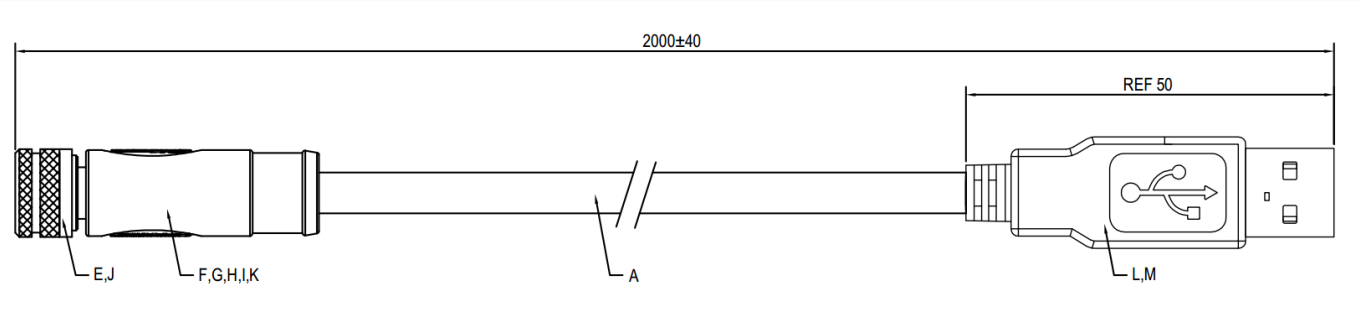


Figure 2: M8 to USB Cable

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

	Accelerometer specifications
Accelerometer technology	High precision accelerometer based on MEMS technology
Accelerometer measurement range	±2g and ±10g
Sensitivity	±2g Version : 0.24 µg/digit ±10g version: 0.59 µg/digit
Typical non-linearity	±0.1% FS
Analog to Digital converter	24-bit delta-sigma with temperature compensation Synhcronuous measurement channel
Sensor frequency response (-3 dB)	DC to 800 Hz
Maximum sampling rate	3 kSPS per axis
Noise spectral density	±2g Version : 45 µg/√Hz ±10g version: 100 µg/√Hz
Zero-g Offset Variation from RT over Temp	±2g Version : ±0.2 mg/°C ±10g version: ±0.1 mg/°C
Sensitivity Variation from RT over Temp	±2g Version : ±0.01 %/°C (XY) , ±0.02 %/°C (Z) ±10g version: ±0.01 %/°C
Offset Ratiometric Error	±2g Version : 4mg ±10g version: ±0.2% (XY) , ±0.1% (Z)
Sensitivity Ratiometric Error	±2g Version : ±1.25 % (X-Y) , ±0.2 % (Z) ±10g Version : ±1.6% (X-Y) , ±0.2 % (Z)
Cross Axis Sensitivity	0.02

Table 1 : Accelerometer Sensor Specifications

5.3.1.2 Sensor architecture

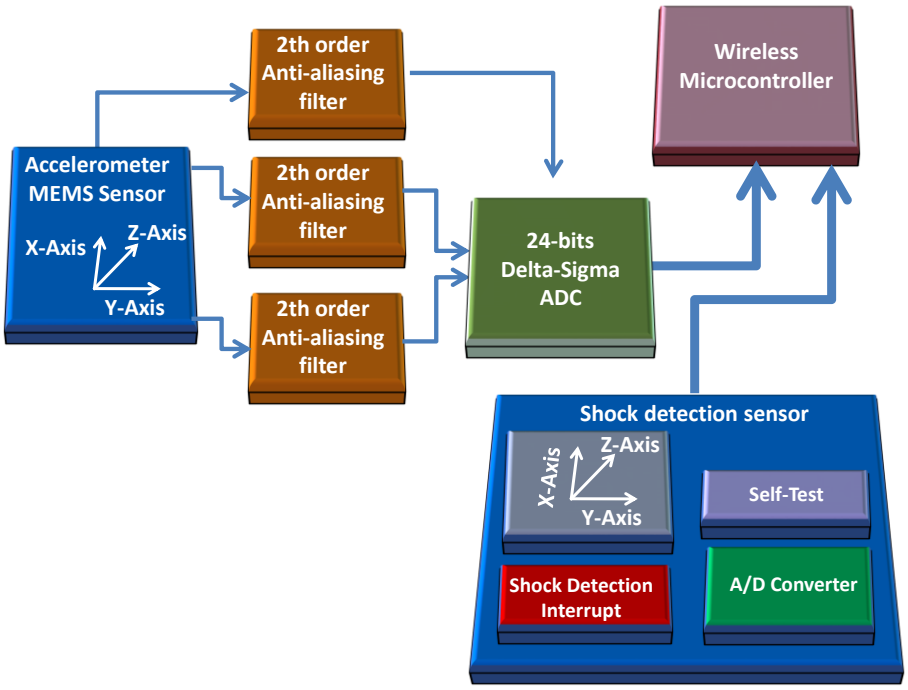


Figure 5: Accelerometer sensor design

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°
Noise density	0.0004 °/√Hz
Accuracy (Full scale)	±0.05°
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
	±0.013 %/°C without temperature compensation
Long term stability (@23°C)	< 0.004 °
Analog to Digital converter	24-bit delta-sigma analog-to-digital with temperature compensation Synchronous measurement channel
Sensor frequency Response (-3dB)	DC to 28 Hz
Noise spectral density DC to 100 Hz	0.0004 °/ √Hz

Table 2: Inclinometer sensor specifications

5.3.2.2 Sensor Architecture

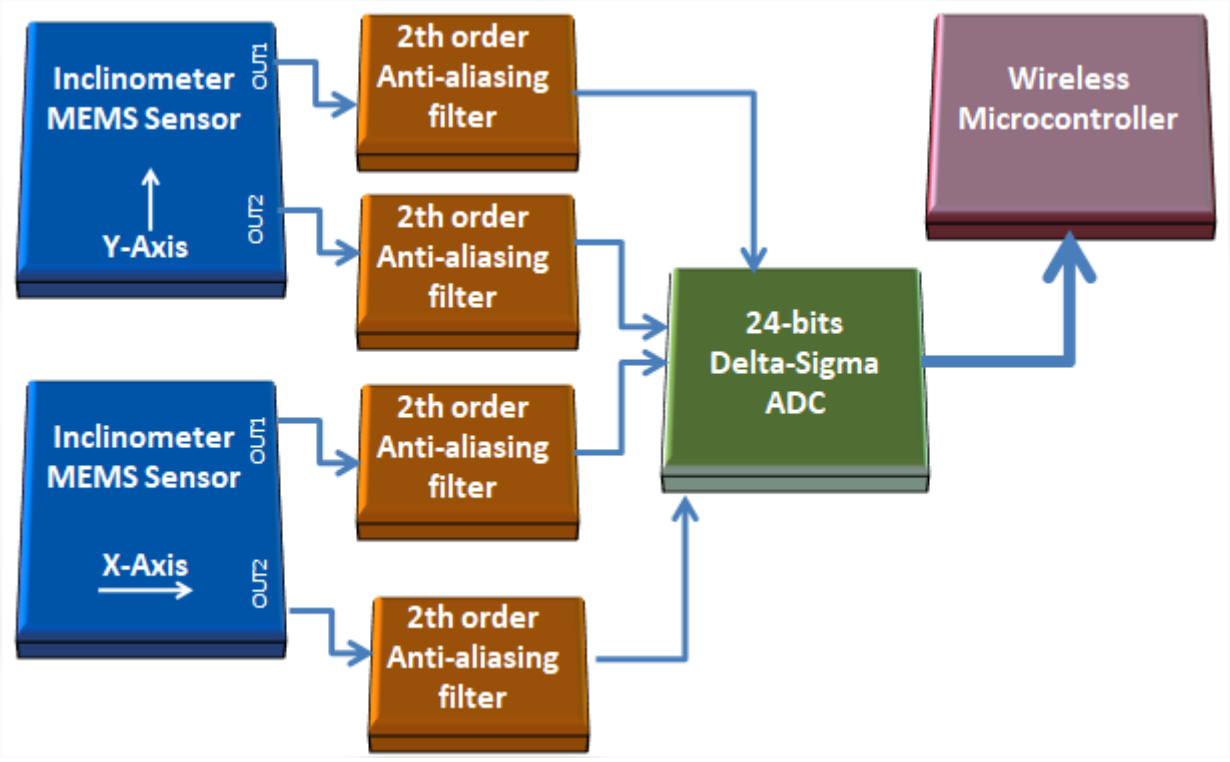


Figure 6: BeanDevice® WILO® HI-INC - MEMS Sensor Architecture

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 polynome 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 represents 99.73% of the inclinometer sensor population.

Temperature dependency of the inclinometer sensor offset (differential output)

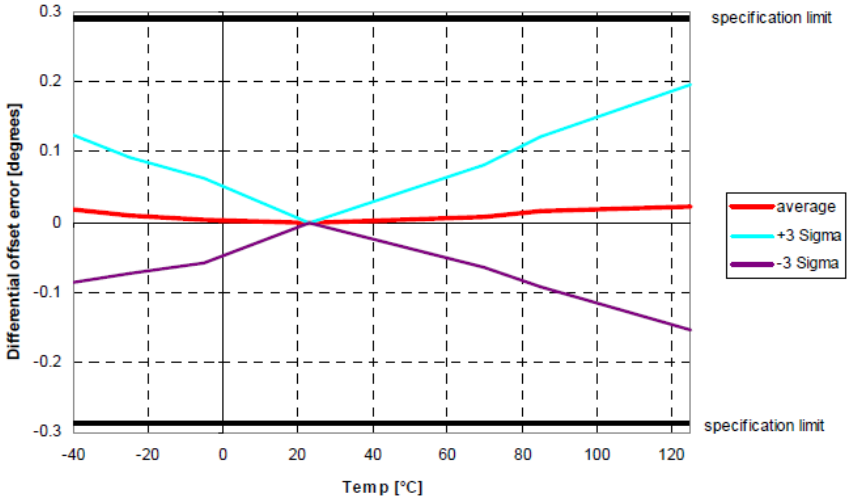


Figure 7 : Temperature dependency of the sensor sensitivity [%] (differential output)

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 software
Sensitivity	±2g range: 0.06 mg/digit ±4g range: 0.12 mg/digit ±6g range: 0.18 mg/digit ±8g range: 0.24 mg/digit ±16g range: 0.73 mg/digit
Typical non-linearity	±0.15% on the FS
Analog to Digital converter	12-bits 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 filter	Butterworth 2th order filter

5.3.3.2 Mems Sensor architecture

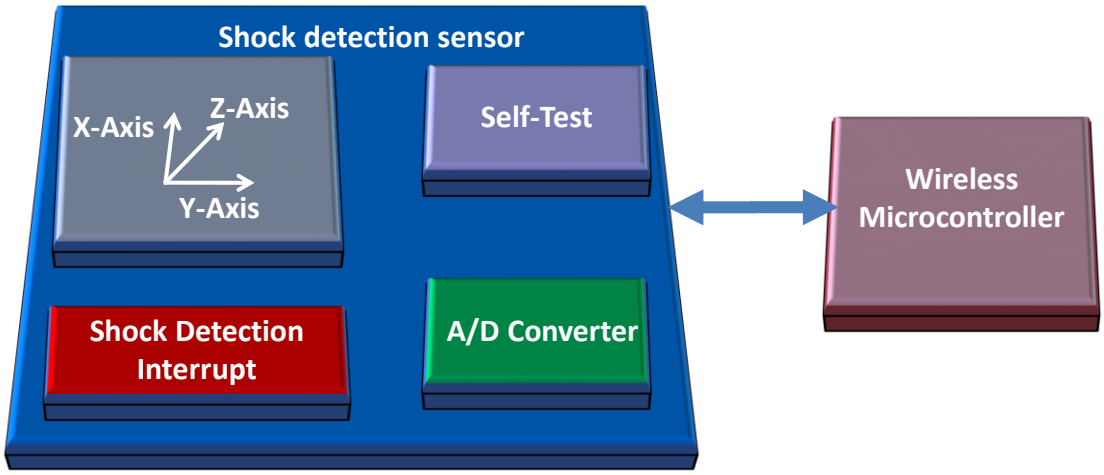


Figure 8: BeanDevice® WiLow® AX-3DS - MEMS Sensor Architecture

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_008 – "Data acquisition modes available on the BeanDevice®"

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

5.3.4.1 Sensor Architecture

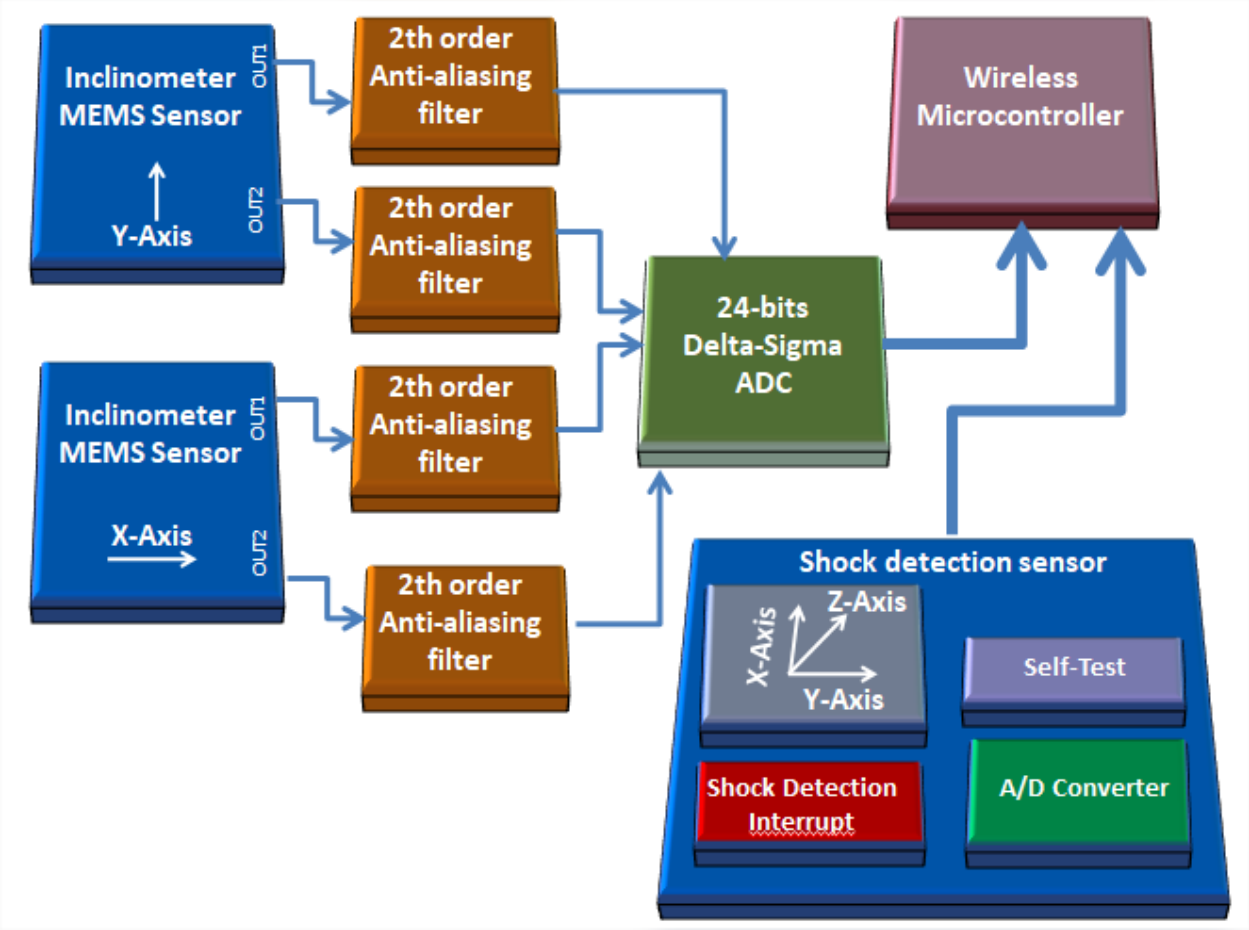


Figure 9: X-INC sensor architecture

5.3.5 Common technical specifications

5.3.5.1 Shock sensor specifications

	Shock sensor specifications
Shock Sensor technology	MEMS technology
Shock sensor range	±2g/±4g/±6g/±8g/±16g dynamically selectable from the BeanScape software
Sensitivity	±2g range: 0.06 mg/digit ±4g range: 0.12 mg/digit ±6g range: 0.18 mg/digit ±8g range: 0.24 mg/digit ±16g range: 0.73 mg/digit
Typical non-linearity	±0.15% on the FS
Analog to Digital converter	12-bits 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 filter	Butterworth 2th order filter

Table 4: Shock sensor specifications

5.3.5.2 Remote configuration parameters

	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
	Alarm Streaming Mode : 100 SPS by default
Sampling Rate (in streaming mode)	Minimum: 1 SPS
	Maximum: 3 kSPS per axis
Alarm Threshold	2 high levels alarms & 2 low levels alarms
Power Mode	Sleeping with Network Listening & Active

5.3.5.3 RF specifications

	RF Specifications
Wireless Protocol Stack	IEEE 802.11 b/g/n
WSN Topology	Point-to-Point / Star / Cluster-Tree
Crypto Engine	WPA2, WPS2, EAP-TTLS
Data rate	UDP: 16 Mbps TCP: 13 Mbps
RF Characteristics	ISM 2.4GHz – 4 Channels. Antenna diversity architecture designed by Beanair®
TX Power	18 dBm @ 1 DSSS 14.5 dBm @ 54 OFDM
Rx Sensitivity	-95.7 dBm @1 DSSS -74.0 dBm @54 OFDM
Maximum Radio Range	200m (L.O.S), radio range can be extended by adding Wifi repeater
Antenna	Omnidirectional radome antenna with antenna diversity Gain : 3 dBi Waterproof IP67

Table 5: RF specifications table

5.3.5.4 USB specifications

	USB specifications
USB standard	USB 2.0
Data Rate	Full speed operation(12MB/s)
Related functions	. Firmware update . Measurement logs donwload . Wifi & system configuration

Table 6: USB specifications

5.3.5.5 Embedded data logger

	Embedded Data logger
Storage capacity	Up to 4 million data points
Wireless data downloading	< 3 minutes (depending on the file size)

5.3.5.6 Environmental and Mechanical

	Environmental and Mechanical
Casing	Aluminum casing Dimensions in mm (LxWxH):33.5x59x65 mm without antenna & eyelet, Weight (battery included) : 200g
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) . FCC (North America) . ARIB STD-T66 Ver. 3.6 (Japan) . ROHS - Directive 2002/95/EC

5.3.5.7 Power Supply

	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 · During Radio transmission : 1 DSSS - 278 mA 54 OFDM - 229 mA · During sleeping : < 120 µA
External power supply	Two power supplies available: . USB Power supply 5V . 4.8VDC to 17.8 VDC

Table 7: Power supply specifications

5.3.5.8 Options

	Option(s)
M8 Cable	M8-5Pins Cable , cable length : 2 meters
Calibration certificate	Calibration certificate linked to national and internatiional standards (DRAKKS)

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 works 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.

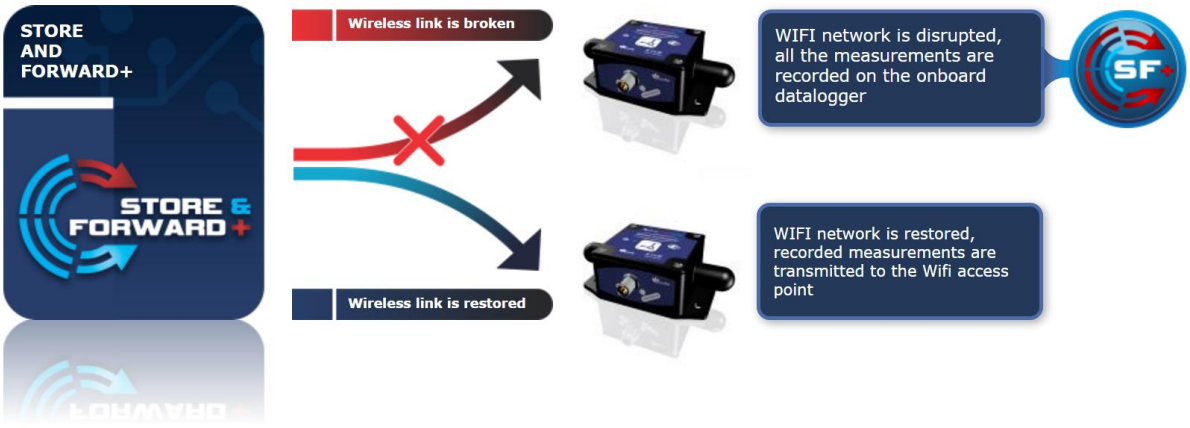


Figure 10 : Store and Forward+ mechanism

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!

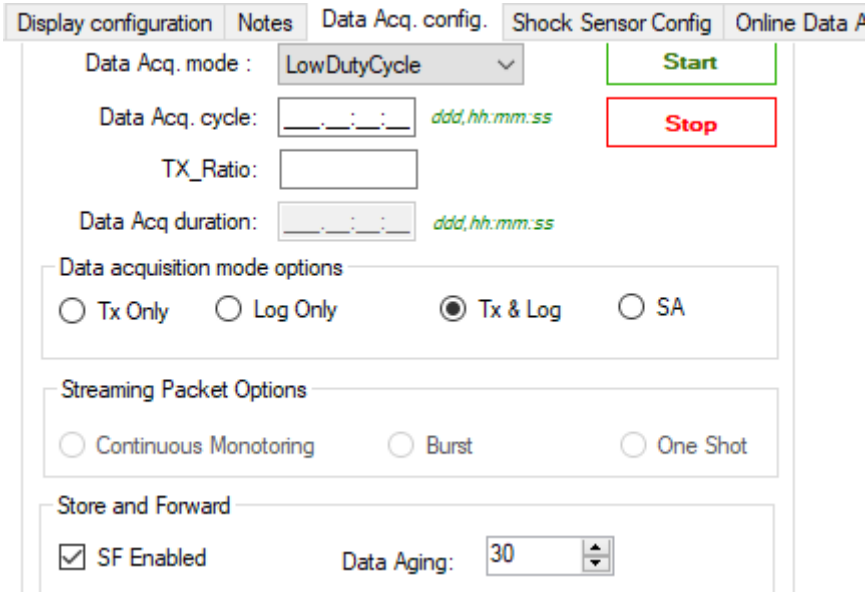
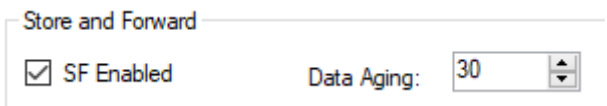
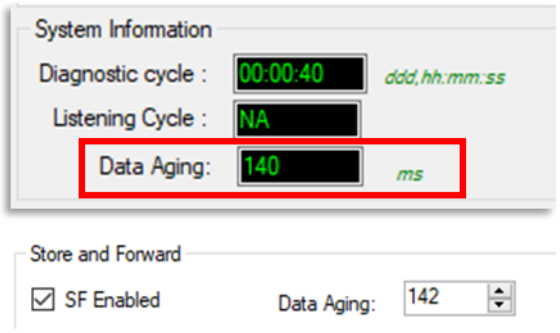


Figure 11: Store & Forward configuration frame

Check SF Enabled to enable Store & Forward+

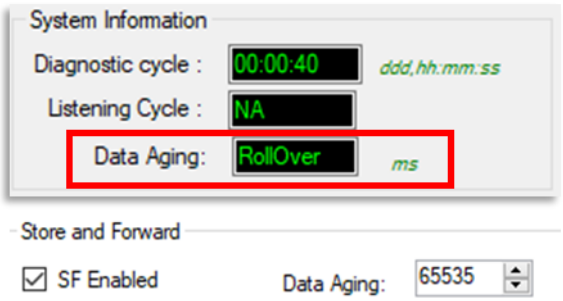


Enter Data aging value which is the duration of validity of non transmitted data before its deletion and validate.



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

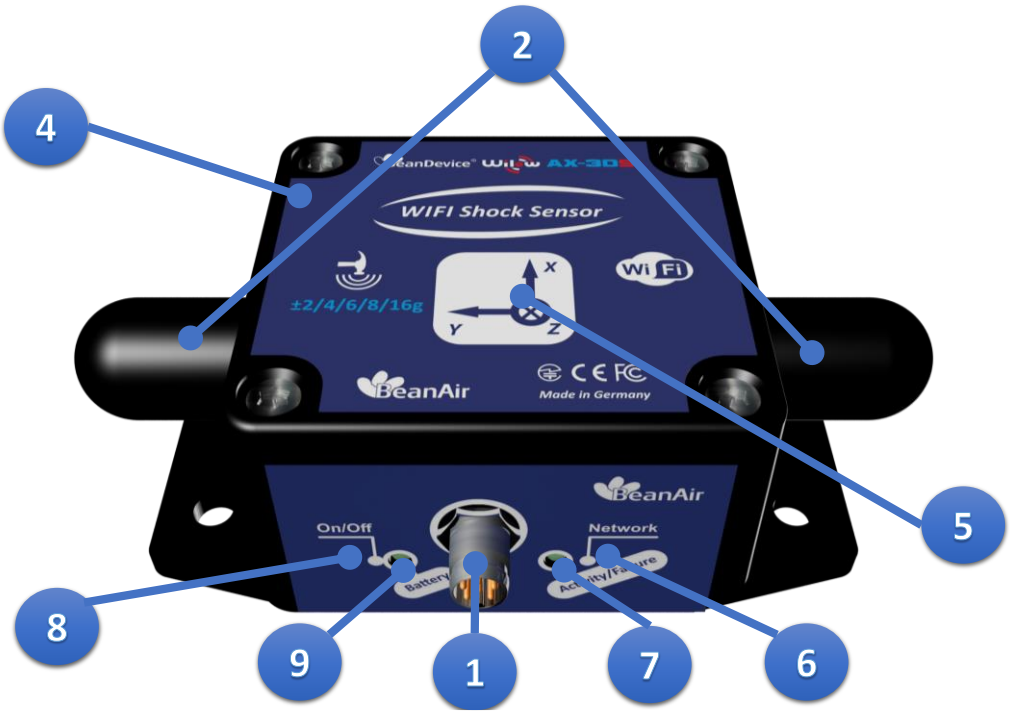


Figure 12 : BeanDevice® WiLow® product focus

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. ***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) ***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 : ✓ ***BeanDevice® WiLow® AX-3D****: measurement range (±2g and ±10g) and the three axis are displayed on the Label* ✓ ***BeanDevice® WiLow® HI-INC****: measurement range (±15° and ±30°) and the two axis are displayed on the Label* ✓ ***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®. Point the pole of the Neodymium magnet that was provided with your BeanDevice® towards the "Network" label circle. Hold the magnet for approximately ***2s***
7	"Activity/Failure LED"	This bi-color **GREEN** / **RED Led** represents the BeanDevice® : Cf. table below for led description
8	ON/OFF Non- contact button	Allows to power up/power off the BeanDevice®. 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

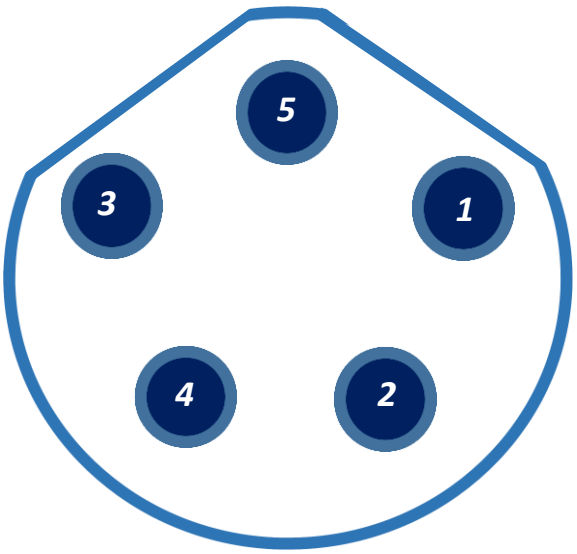
9	Battery charge indicator LED	This bi-color **GREEN** / **RED Led** indicates battery charge status: Cf. table below for led description

5.6.2 LEDs description

Operating status	Network LED	Battery Charge LED
The BeanDevice® WiLow® is power off	LED OFF	**No external power supply is connected:** LED OFF **External power supply is connected:** ***Green*** LED ON: Battery charged ***Red*** LED ON: Battery not charged ***Green*+*Red*** LED ON: Battery is charging
The BeanDevice® WiLow® is power on with wireless TX/RX activity	***Green*** LED: Wireless Network Activity ***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 then ***Green*** LED blinks twice (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

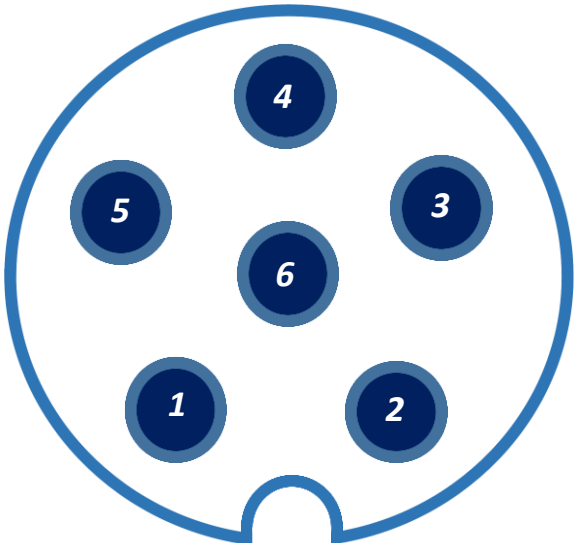


Interface Name	M8 Pin assignation
DC Voltage 4.8VDC to 17.8VDC	PIN1
USB Voltage	PIN2
DATA -	PIN3
DATA +	PIN4
GND	PIN5

Figure 13 : 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
USB Voltage	PIN1
DATA -	PIN2
DATA +	PIN3
Not used	PIN4
DC Voltage / SOLAR 4.8VDC to 17.8VDC	PIN5
GND	PIN6

Figure 14: 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 15: 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:

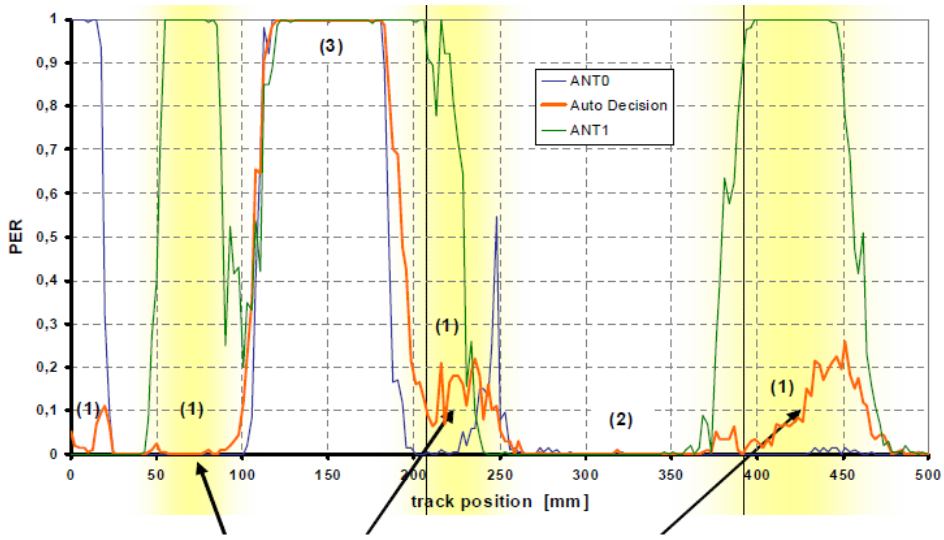
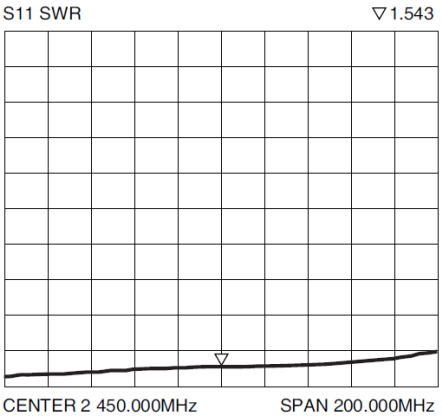


Figure 16 : Radome antenna performances

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*** ***Height: 11 mm***



Typical VSWR

Figure 17: 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 5VDC power supply, therefore compatible with Industrial USB power supply available on the market
• External power supply 4.8VDC up to 17.8 VDC including solar panel, no need to use an external solar power manager
• External power supply as 12VDC Lead Acid battery or lithium-ion battery pack with deep-discharge protection and maximum voltage of 17.8V.

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	400–1200 cycles
Nominal cell voltage	3.6 / 3.7 / 3.8/ 3.85 V, LiFePO4 3.2 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

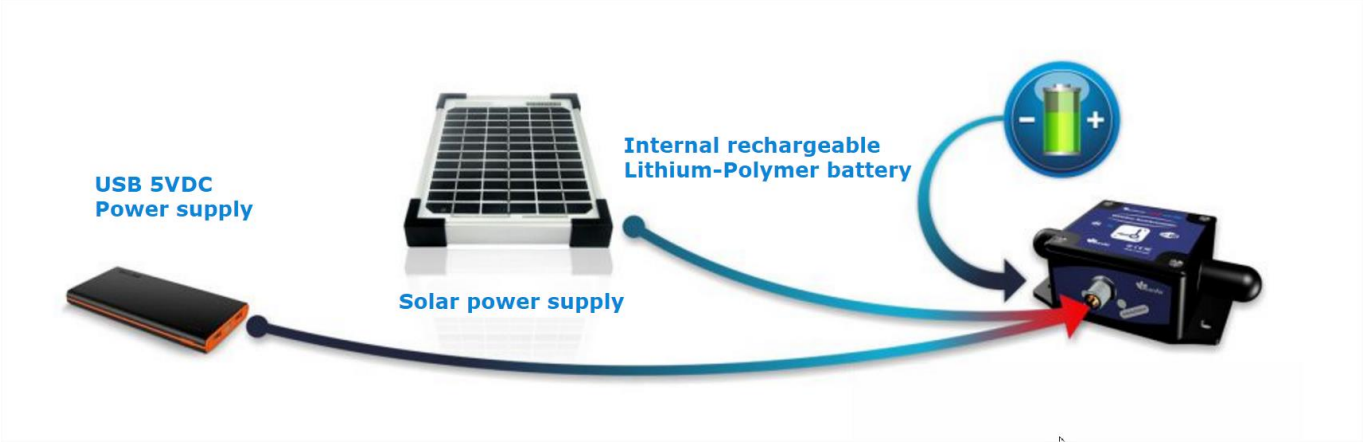


Figure 18 : Smart and Flexible Power supply

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 M8 Cable (REF: WILOW-CBL-M8-2M)

This accessory is provided as an option:

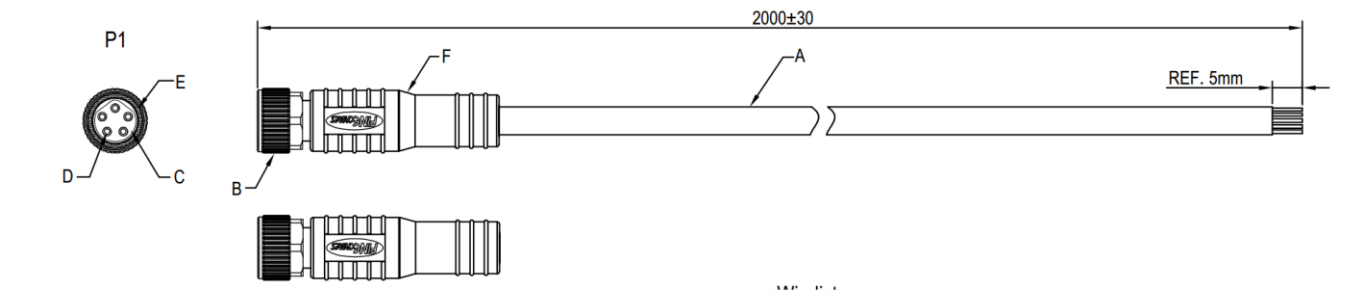
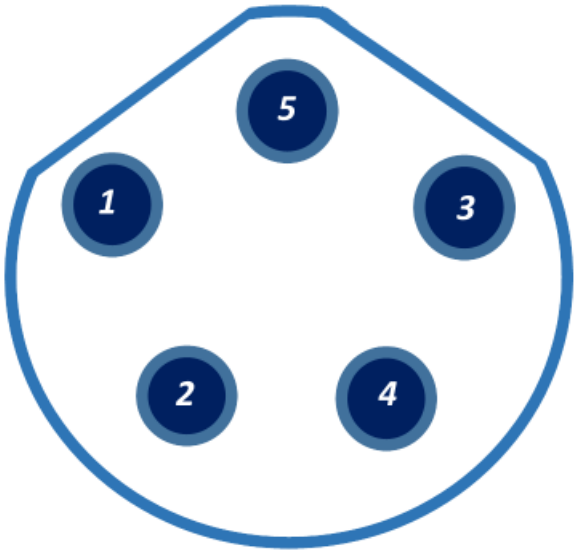


Figure 19: M8-5Pin cable

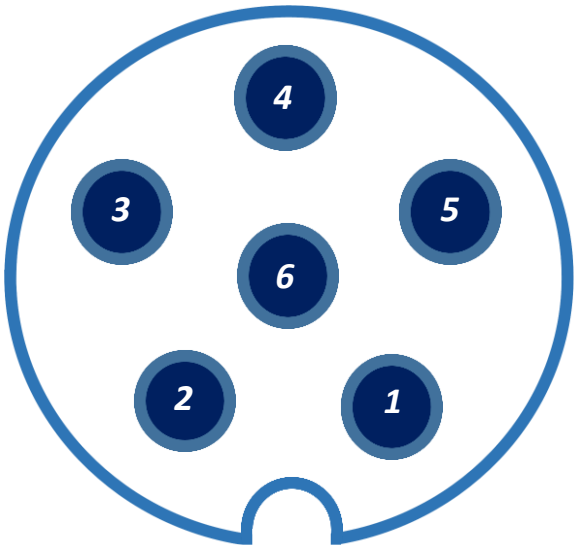
M8 5pin Plug- Pin assignation



Interface Name	M8 Pin assignation	Wire Color (A-coding)
DC Voltage 5VDC to 17VDC	PIN1	RED/BROWN
USB Voltage	PIN2	WHITE
USB-DATA -	PIN3	BLUE
USB-DATA +	PIN4	BLACK
GND	PIN5	GREY

Figure 20: M8-5Pin Plug Assignation and Wiring Color

M8 6pin Plug- Pin assignation



Interface Name	M8 Pin assignation	Wire Color (A-coding)
USB Voltage	PIN1	BROWN
USB-DATA -	PIN2	WHITE
USB-DATA +	PIN3	GREY
Not used	PIN4	BLUE
DC Voltage / SOLAR 4.8VDC to 17.8VDC	PIN5	GREEN
GND	PIN6	PINK

Figure 21: M8-6Pin Plug Assignation and Wiring Color

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-iot-sensors-download-area.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 DC Voltage compatible with Solar Energy Harvesting

DC Voltage	*Minimum current*
4.8 VDC to 17.8 VDC	1mA

5.7.6 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 8: 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

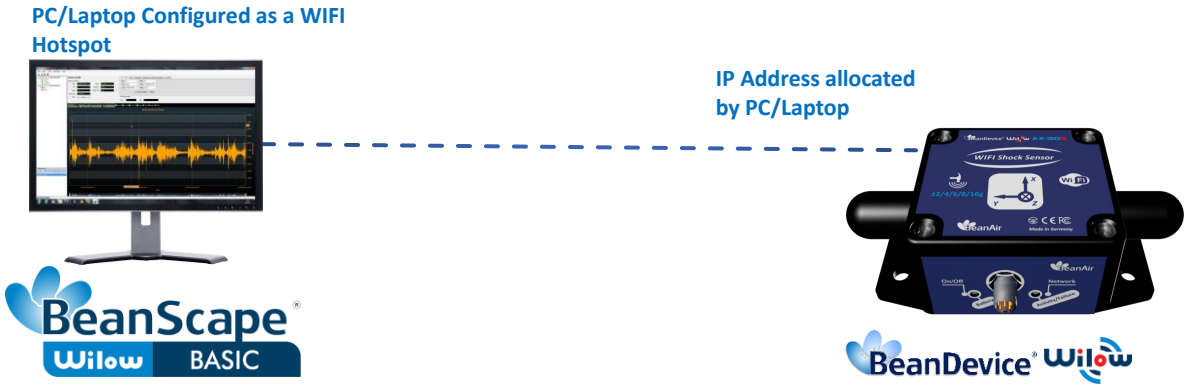


Figure 22: Direct connection to a PC/Laptop

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:

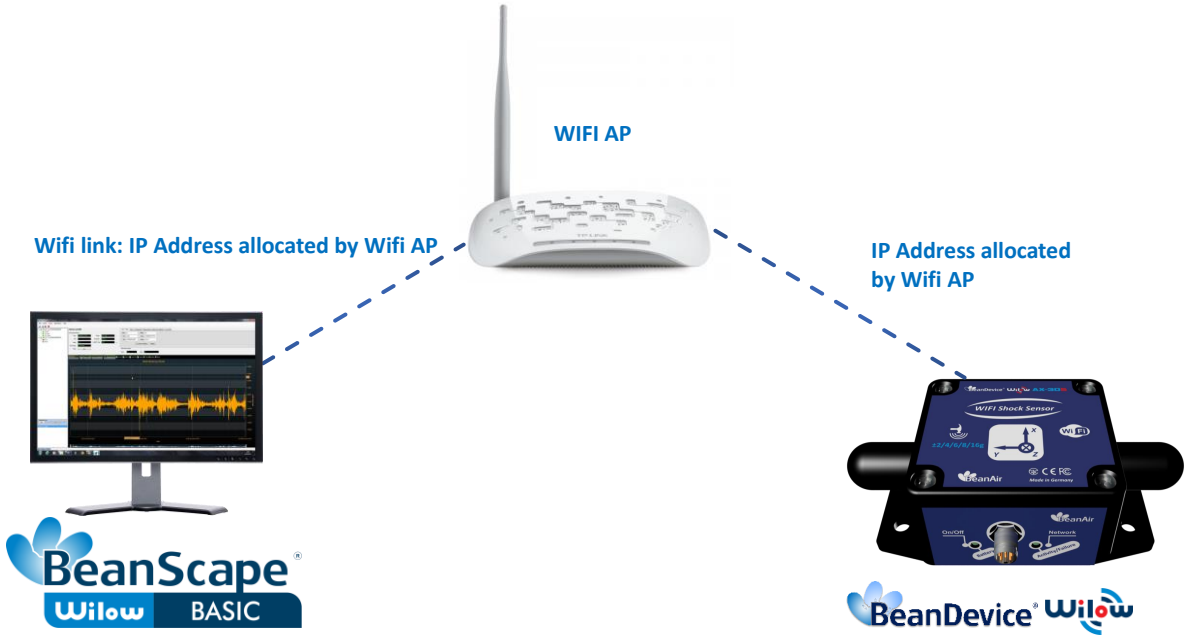


Figure 23: Connection to a WIFI AP

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"**

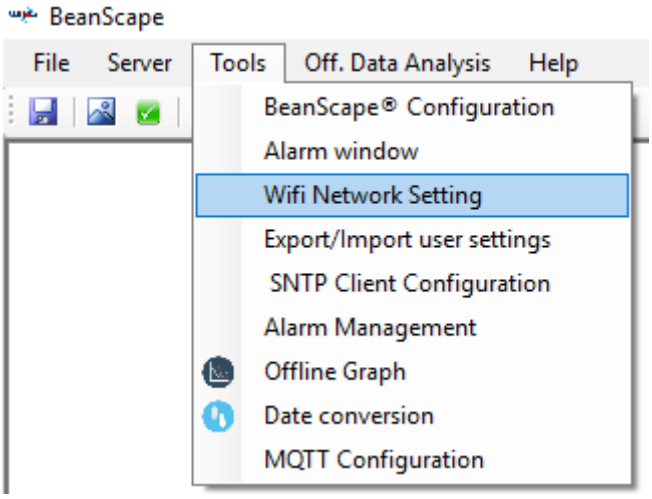


Figure 24: Wifi network setting

5. The following window should appear:

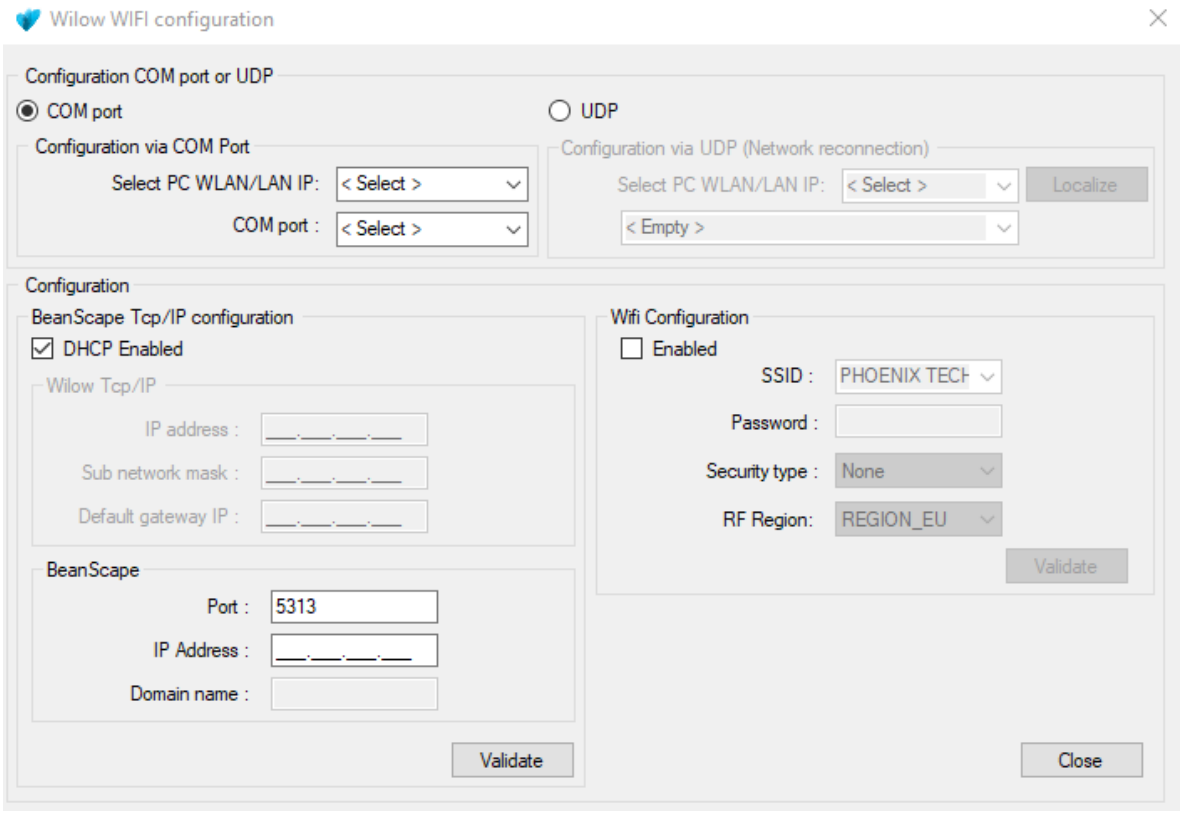


Figure 25: WiFi network setting window

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

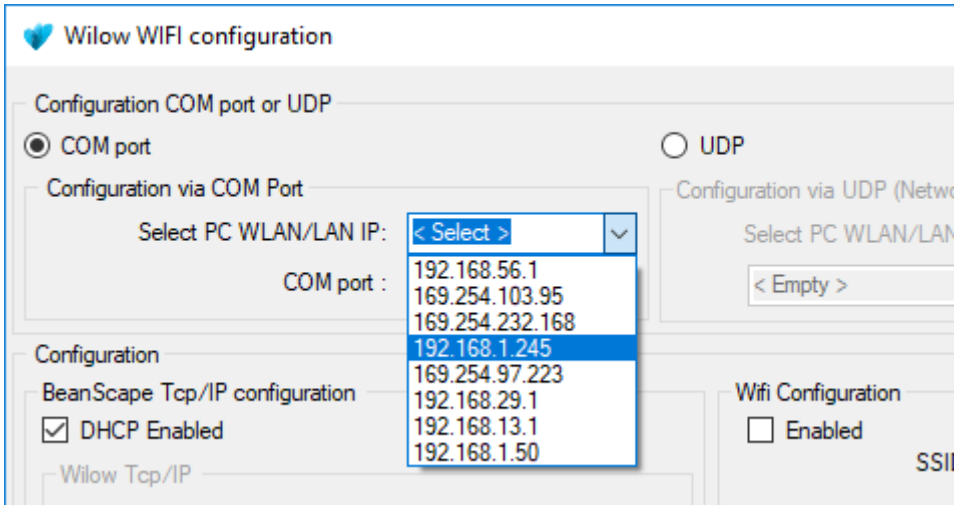


Figure 26: COM/LAN Port setting

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

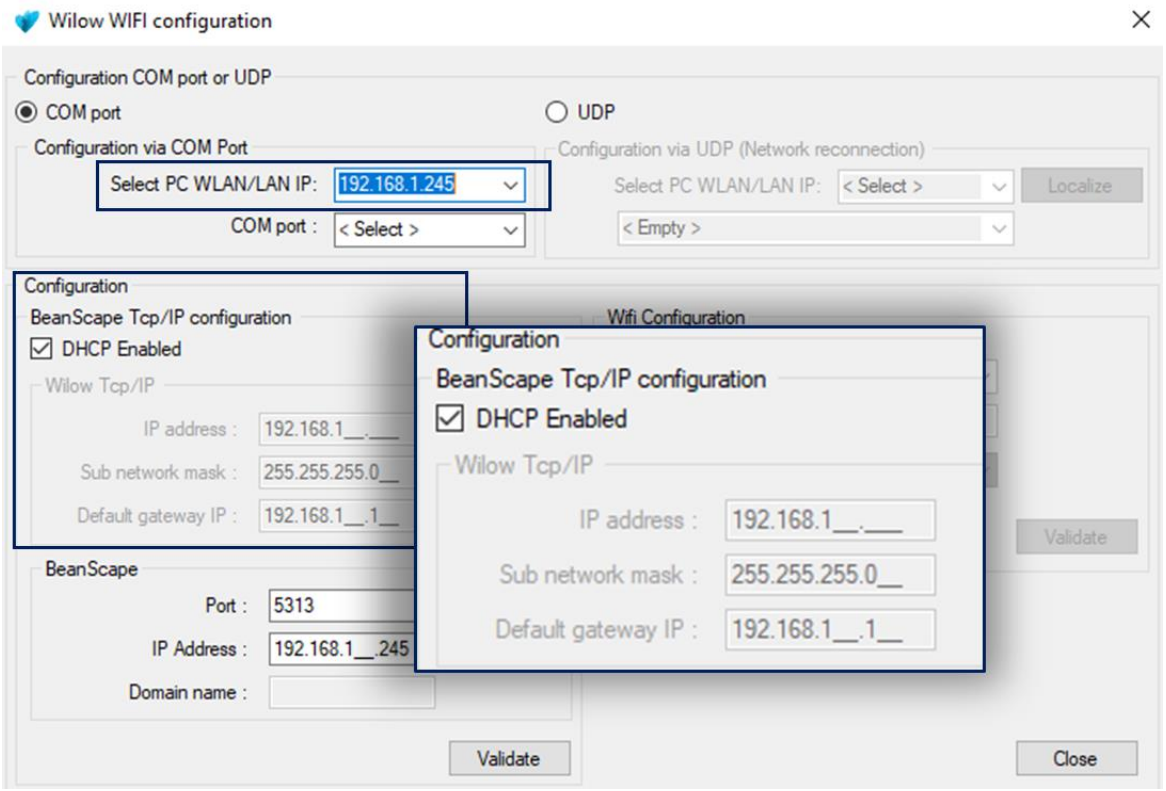


Figure 27: BeanDevice® WiLow IP setting

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

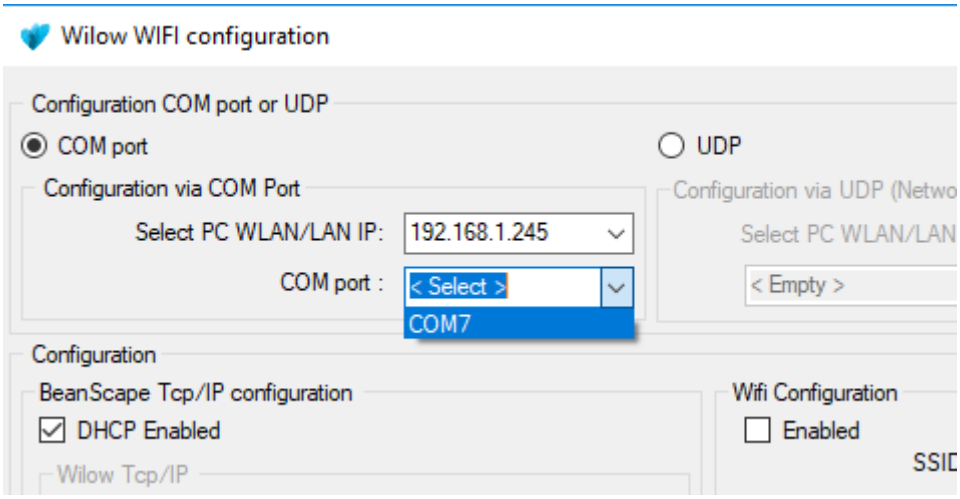


Figure 28: COM port selection

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.

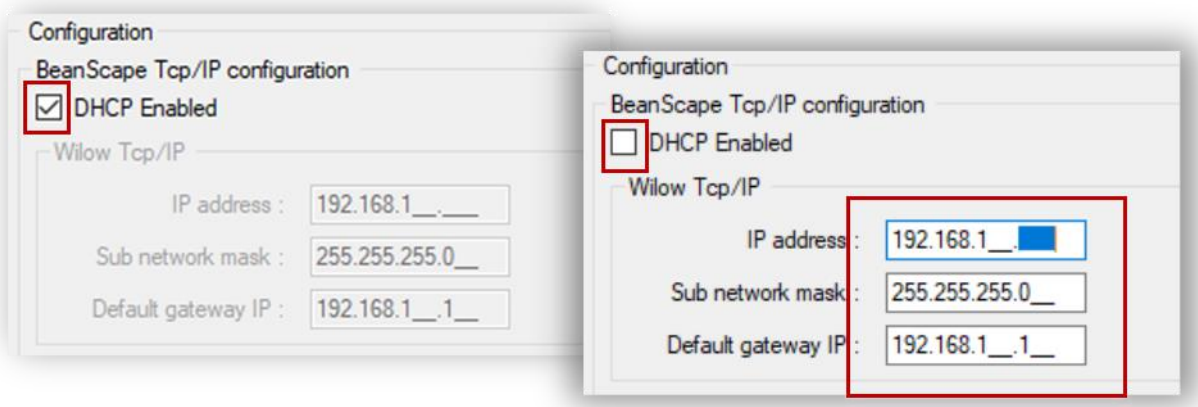


Figure 29: BeanDevice® WiLow® DHCP/Static IP

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

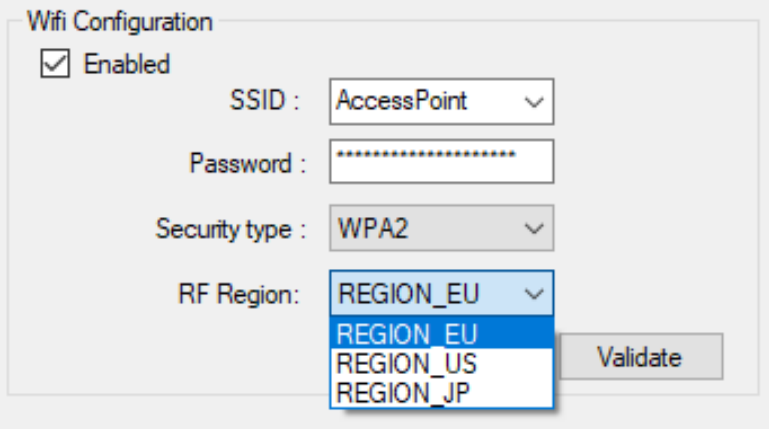


Figure 30: BeanDevice® WiLow® WiFi setting

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***".

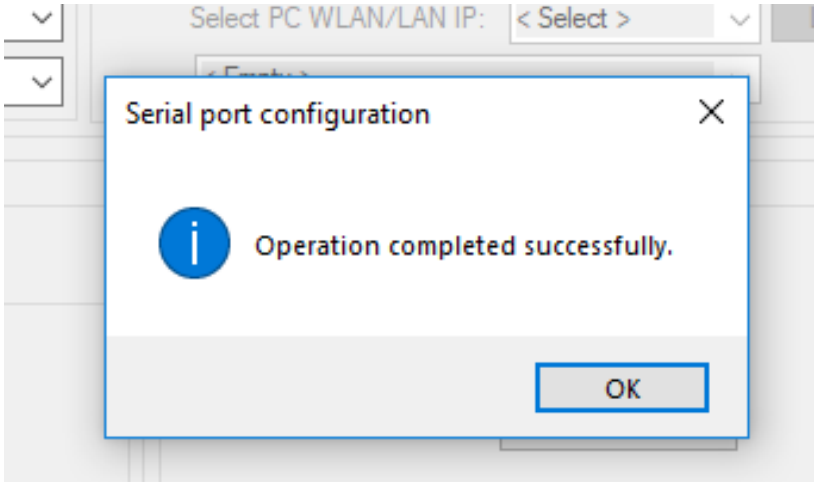


Figure 31: Successful WiFi network configuration

IF the TIMEOUT ERROR occurred while configuring your Bean device

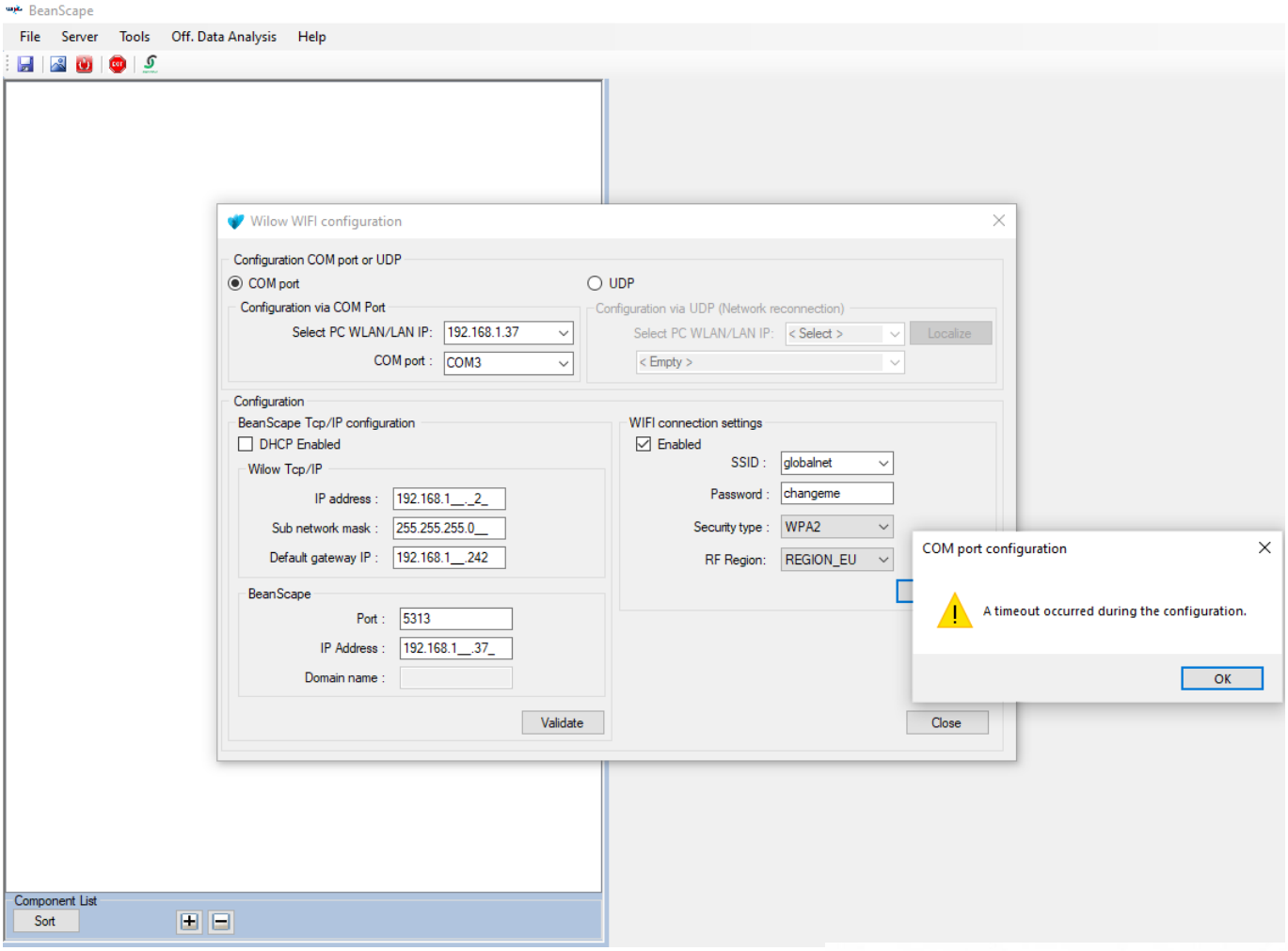


Figure 32:BeanScape® WiLow configuration error

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**

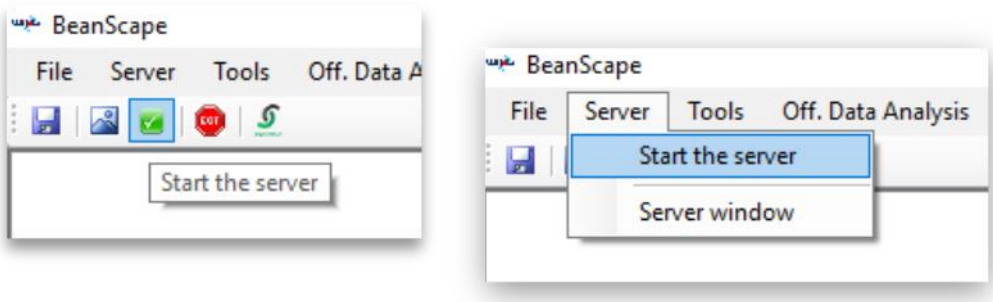


Figure 33: Start Server

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

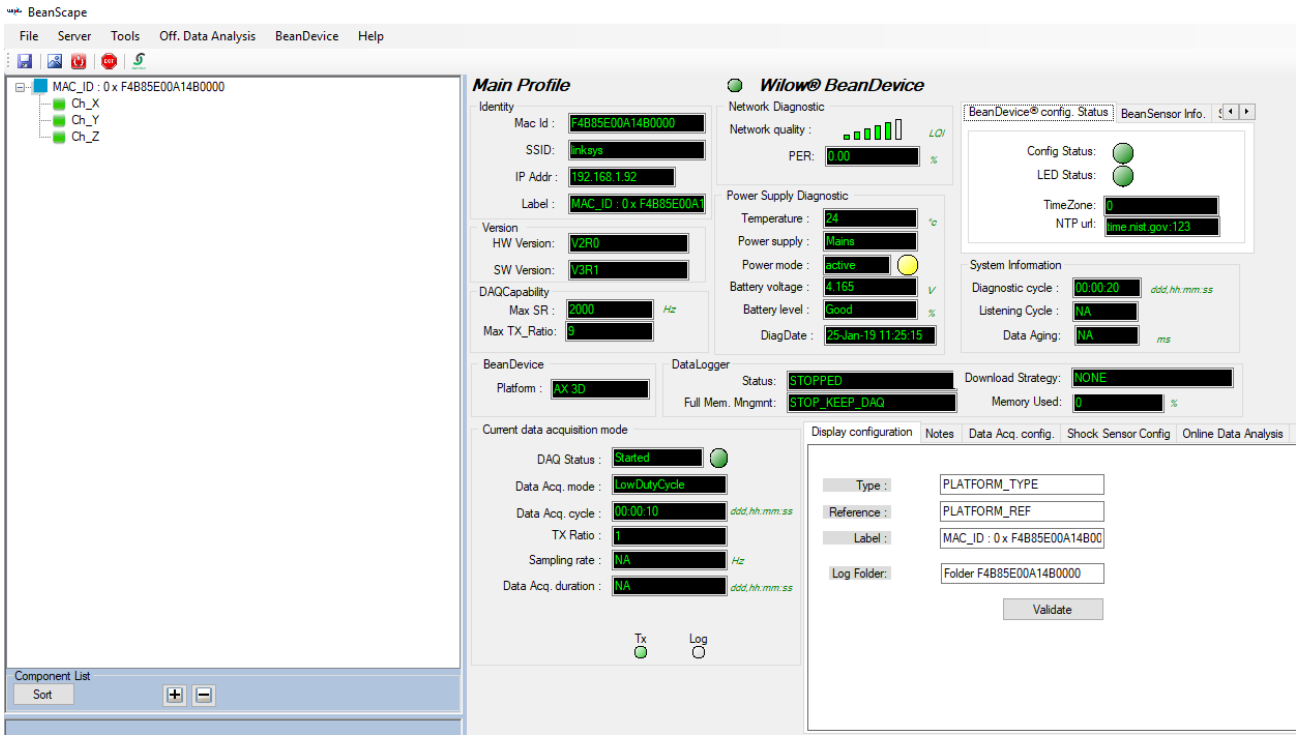


Figure 34: BeanScape® WiLow® Dashboard

See our Technical video Getting started with BeanDevice® Wilow

6.3 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"**:

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

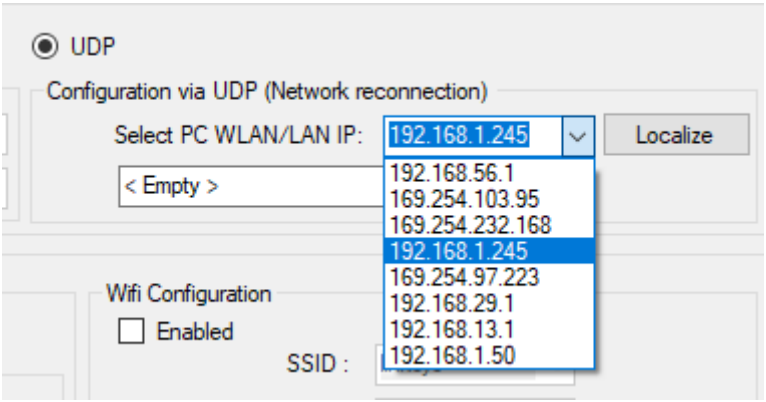


Figure 35: BeanDevice® WiLow® UDP Localization

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

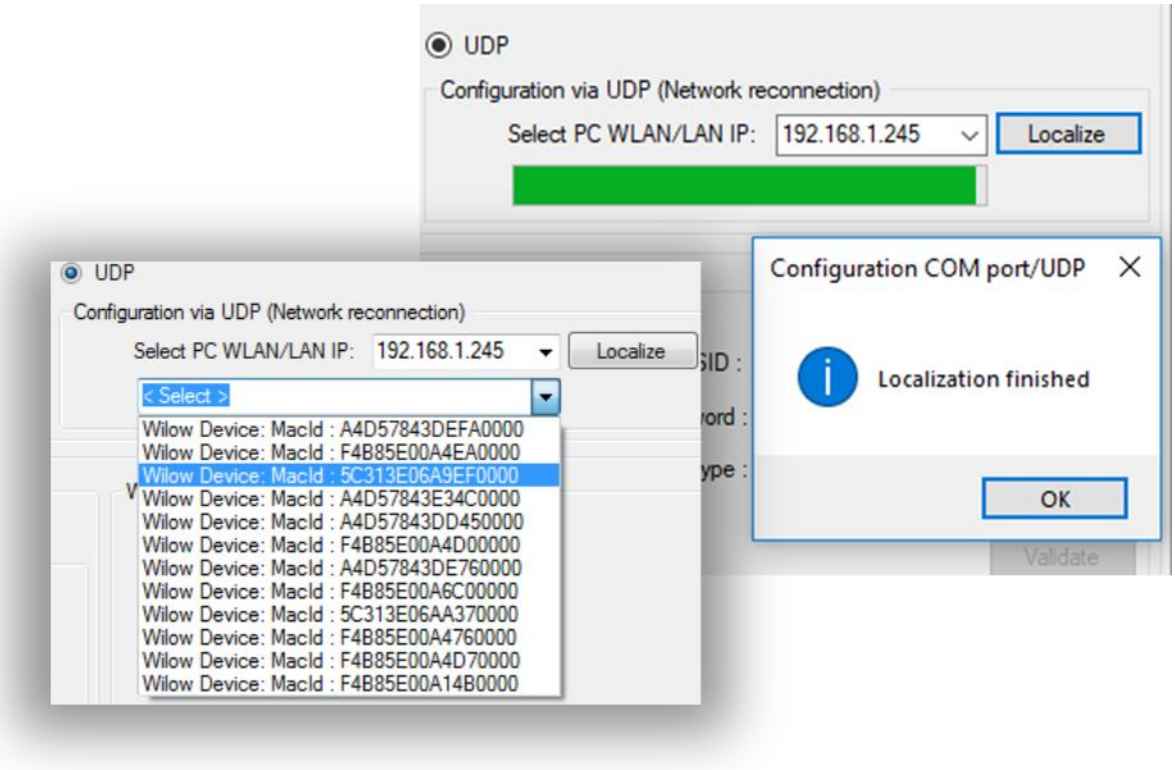


Figure 36: Successful BeanDevice® WiLow® Localization

7. SUPERVISION FROM THE BEANSCAPE® WILOW® SOFTWARE

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

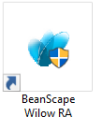
It is recommended to install MatLab MCR to ensure running the Online/Offline Data analysis

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

MaltLab 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.***

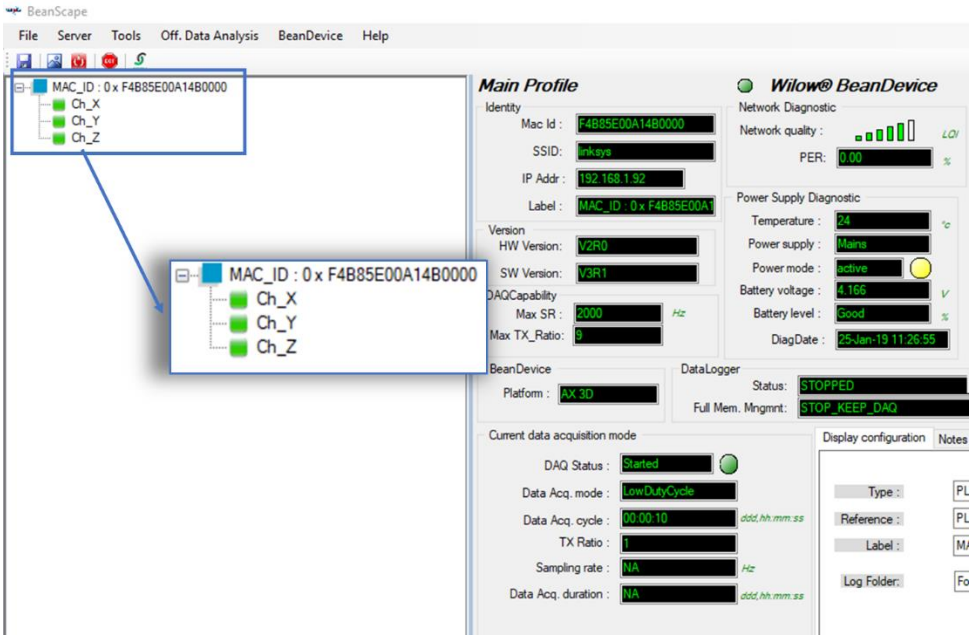


Figure 37: BeanDevice® WiLow® Profile

The user interface is organized as follow:

- Green on black background are displaying information

- Black on White/Grey background are 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;

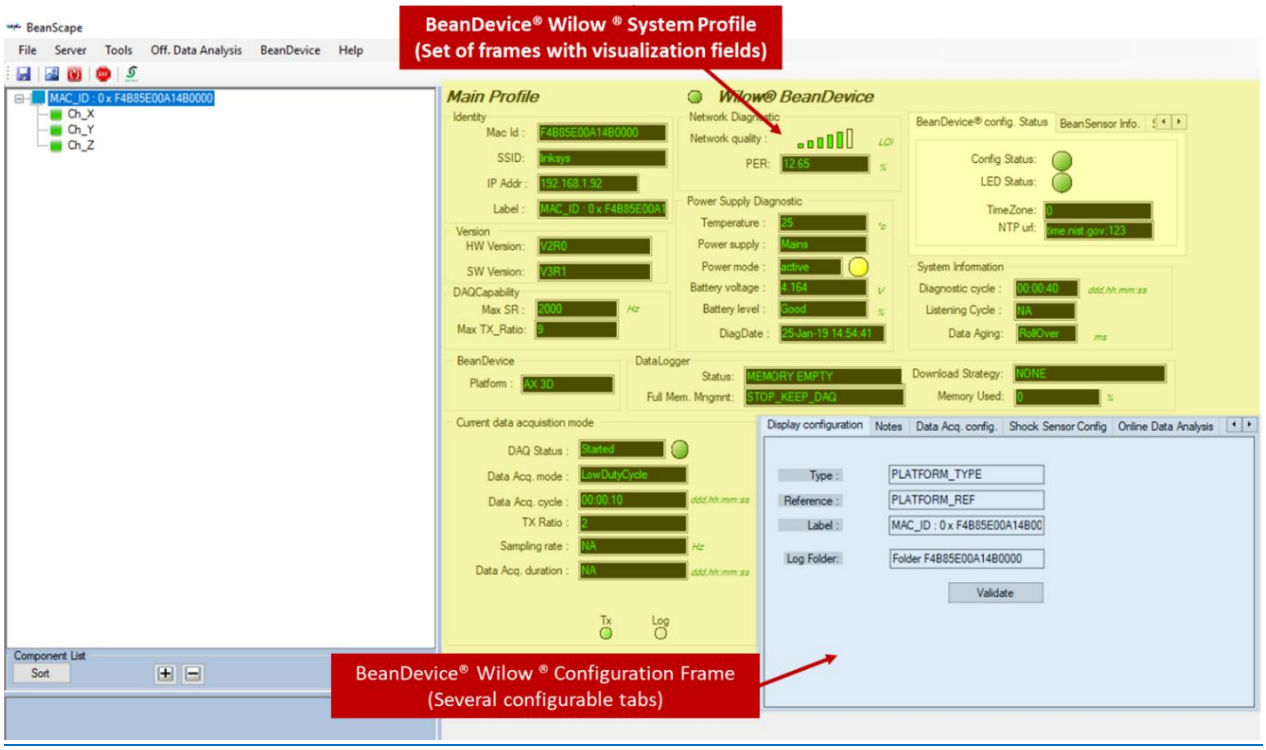


Figure 38 : BeanDevice® Wilow® System profile

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

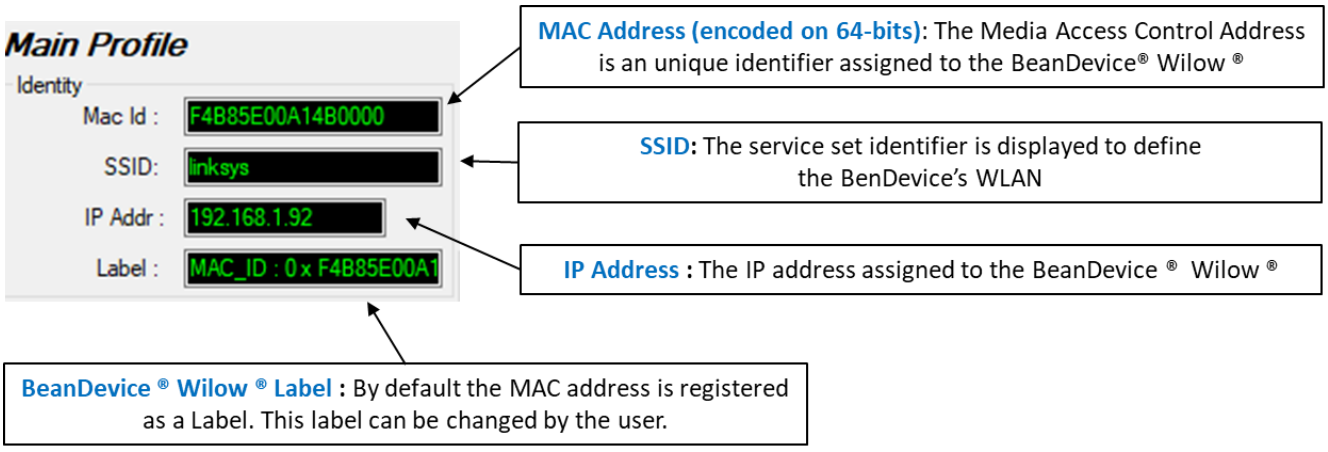


Figure 39: BeanDevice® Main Profile

7.2.2 Wireless Network Diagnostic frame

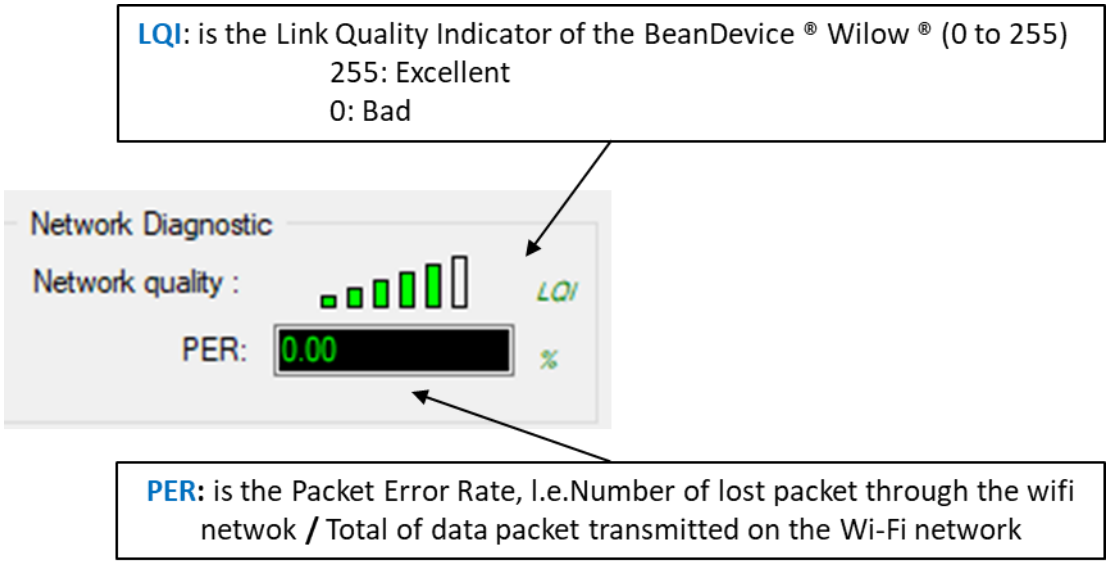


Figure 40: BeanDevice® network-link status

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 41 : Network Quality Indication

7.2.3 Power supply diagnostic frame

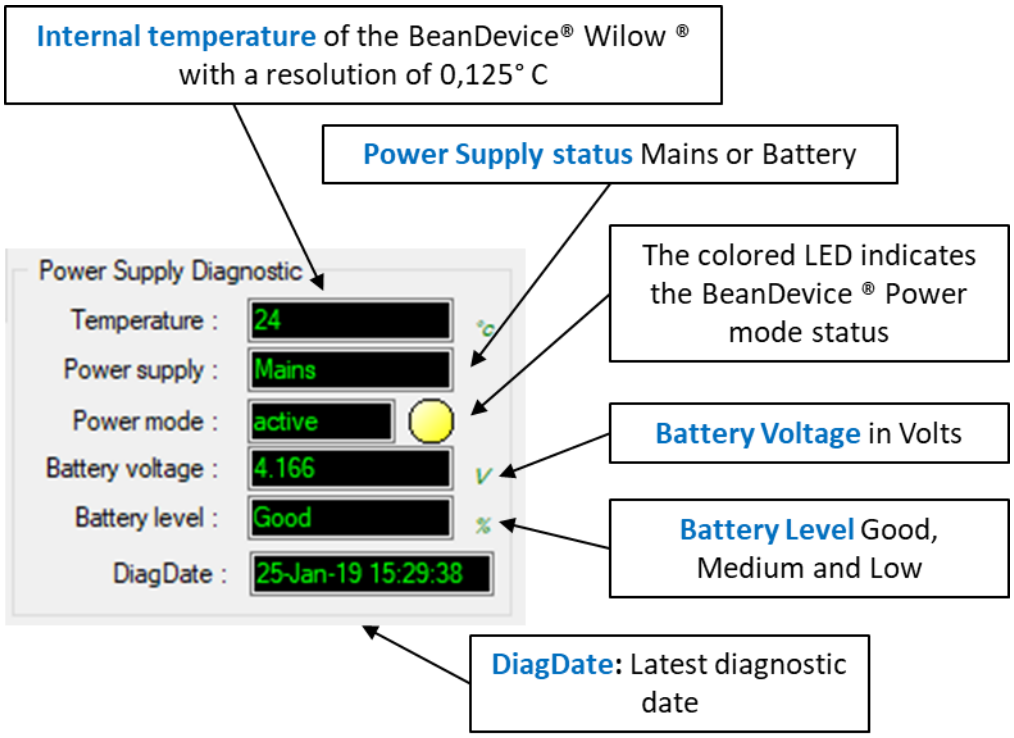


Figure 42: BeanDevice® power supply information

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.

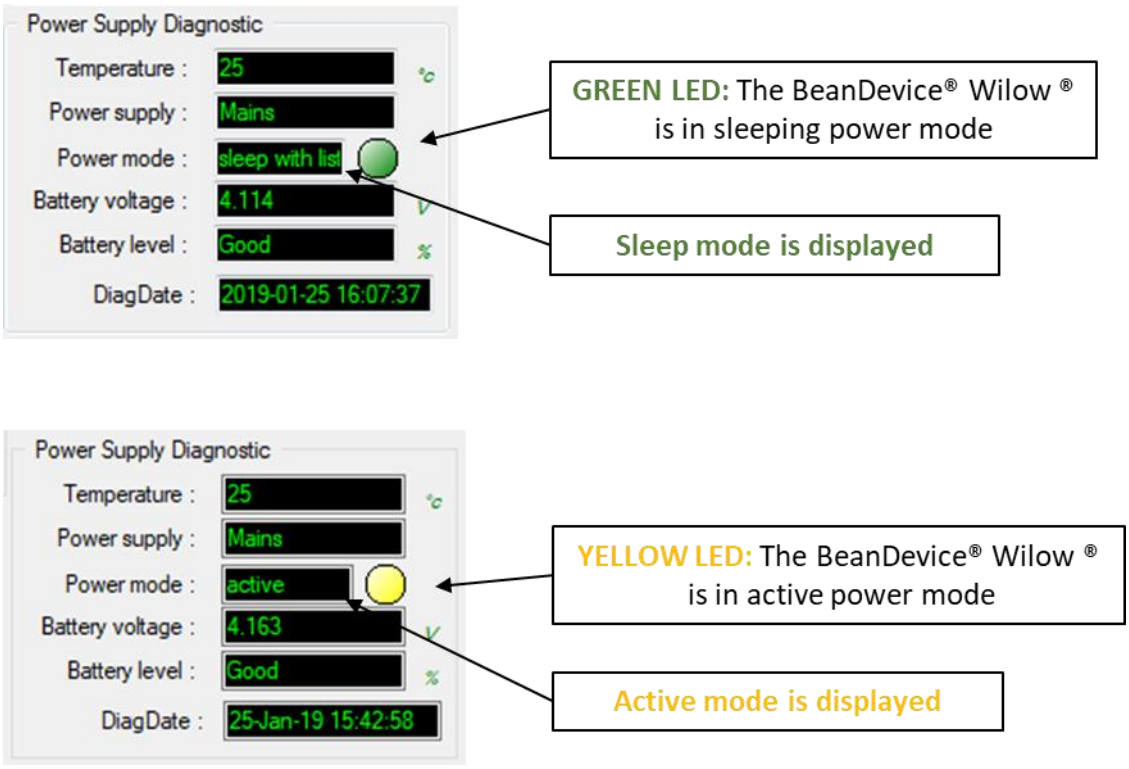


Figure 43: BeanDevice® Power modes

7.2.4 System status frame

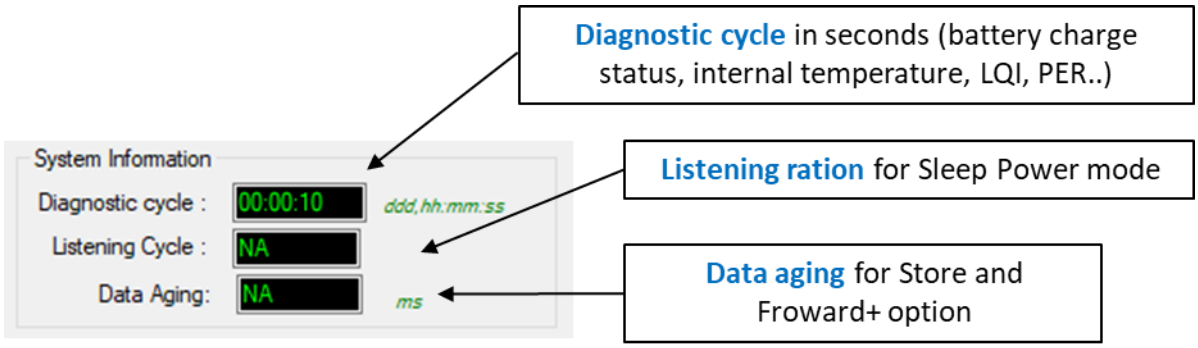


Figure 44 : System status frame

7.2.5 Platform frame

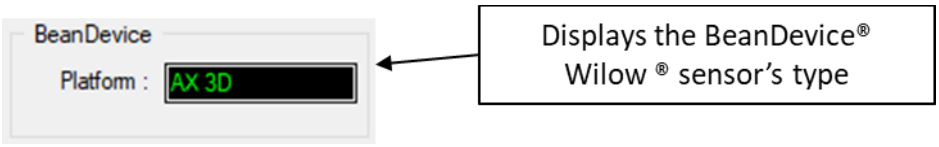


Figure 45: BeanDevice® WiLow sensor's type frame

7.2.6 Datalogger Status frame

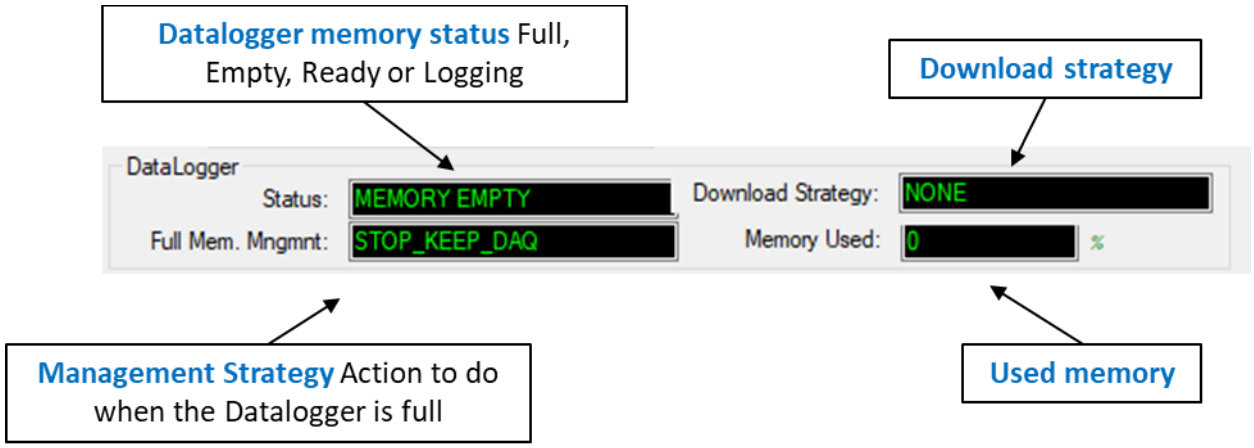


Figure 46: Datalogger frame

7.2.7 Data Acquisition (DAQ) Capability frame

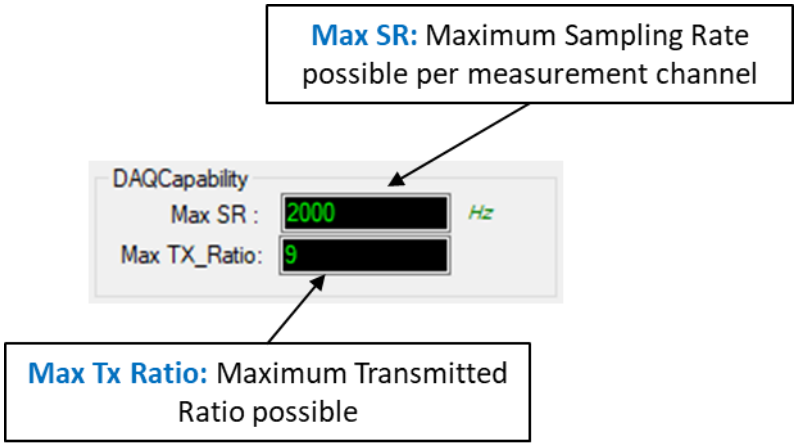


Figure 47:DAQ Capability frame

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.

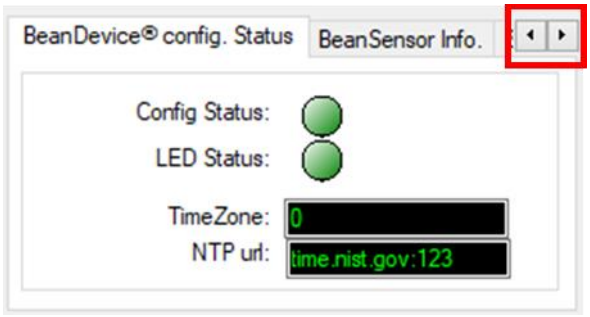


Figure 48:BeanDevice®Configuration Multi frame

7.2.8.1 BeanDevice® config. Status

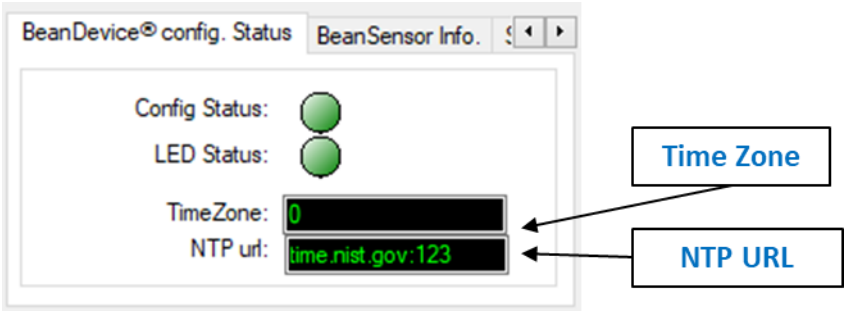


Figure 49: BeanDevice® config. status frame

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

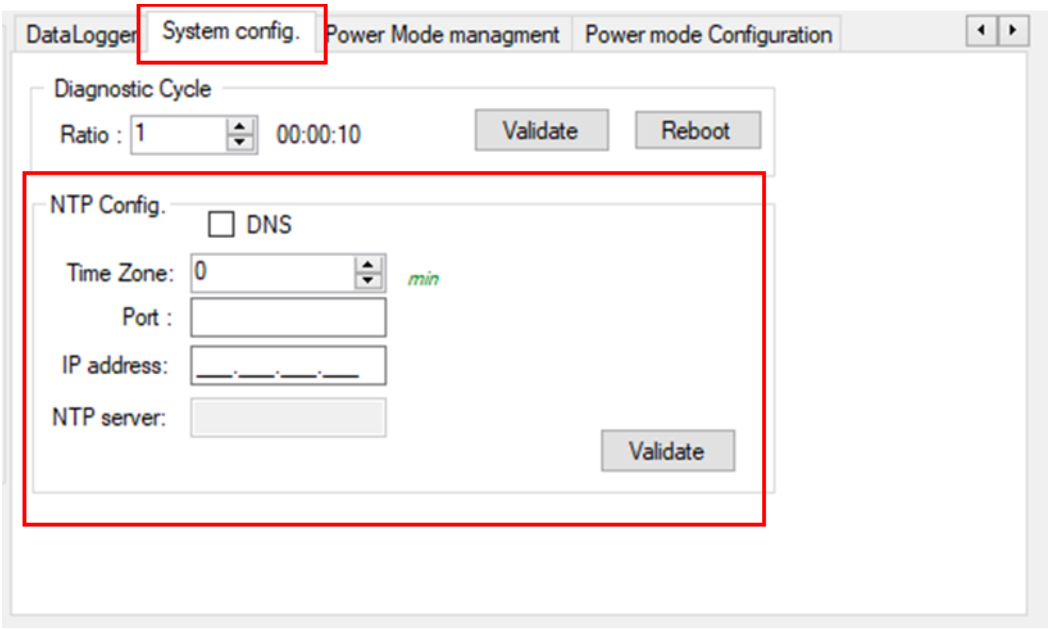


Figure 50: NTP system configuration frame

7.2.8.2 BeanSensor® Info.

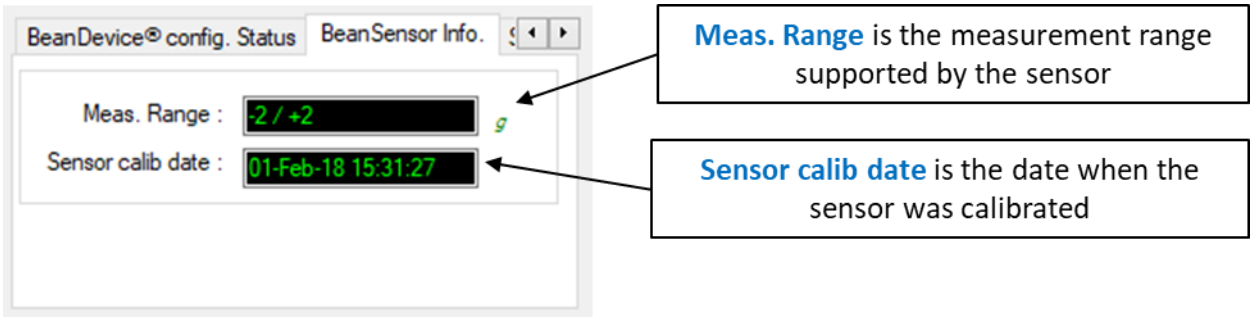


Figure 51: BeanSensor® Info frame

7.2.8.3 Shock Sensor Status

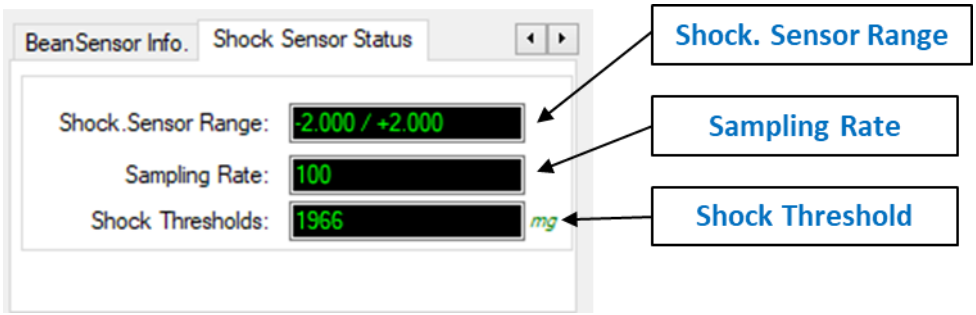


Figure 52: Shock Sensor status frame

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

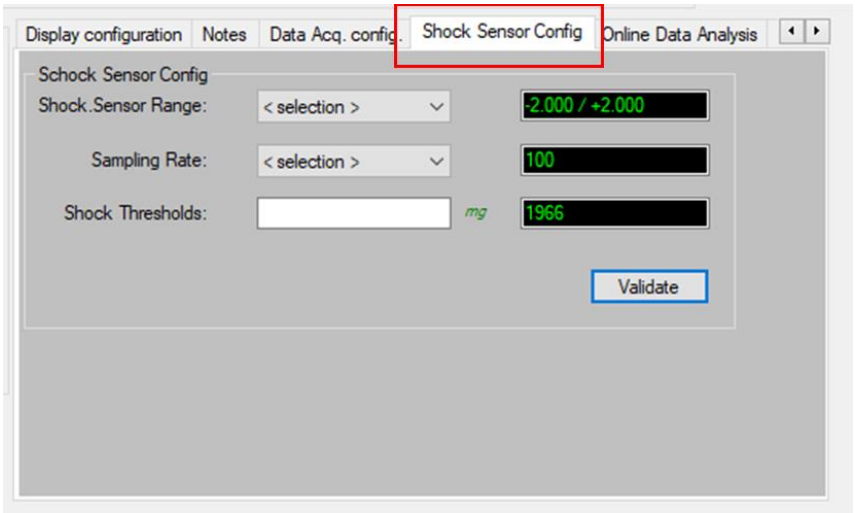


Figure 53: Shock sensorconfig frame

7.2.9 Product Version frame

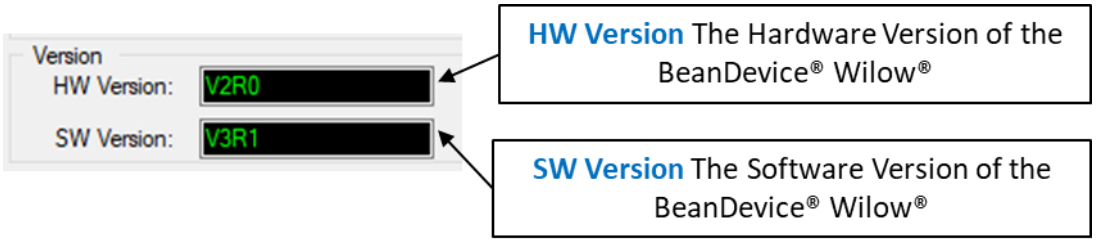


Figure 54: BeanDevice Hardware/Software version

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:

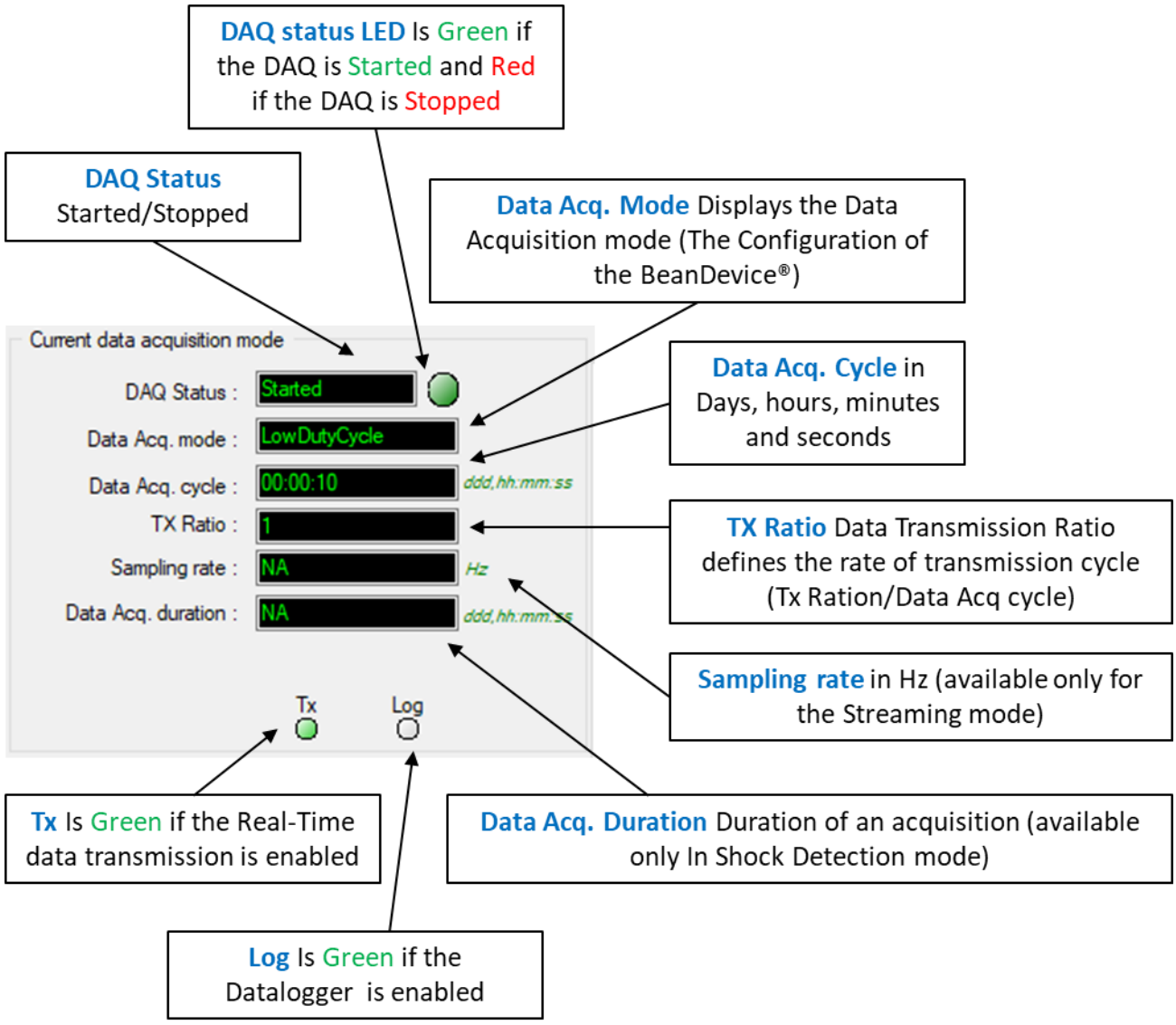


Figure 55: Frame current data acquisition mode

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

7.3 BEANDEVICE® WILOW® CONFIGURATION

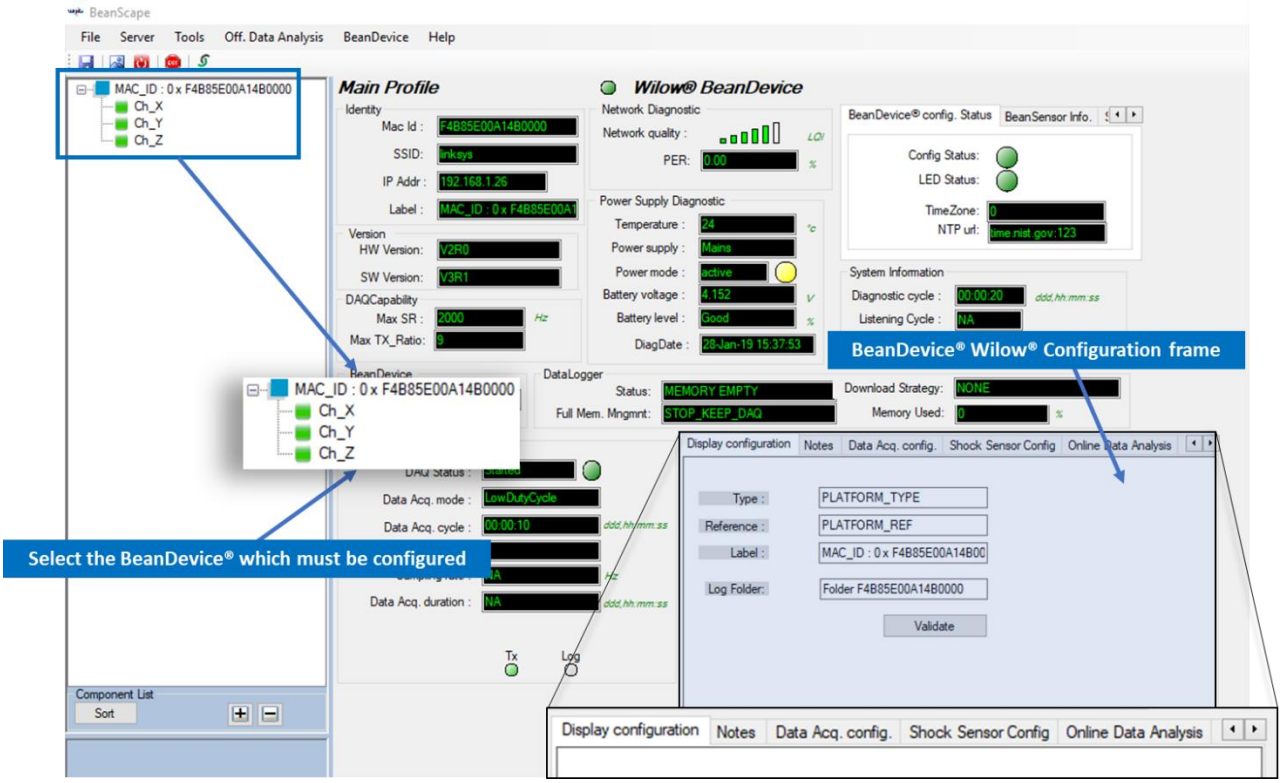


Figure 56: BeanDevice® configuration frame

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

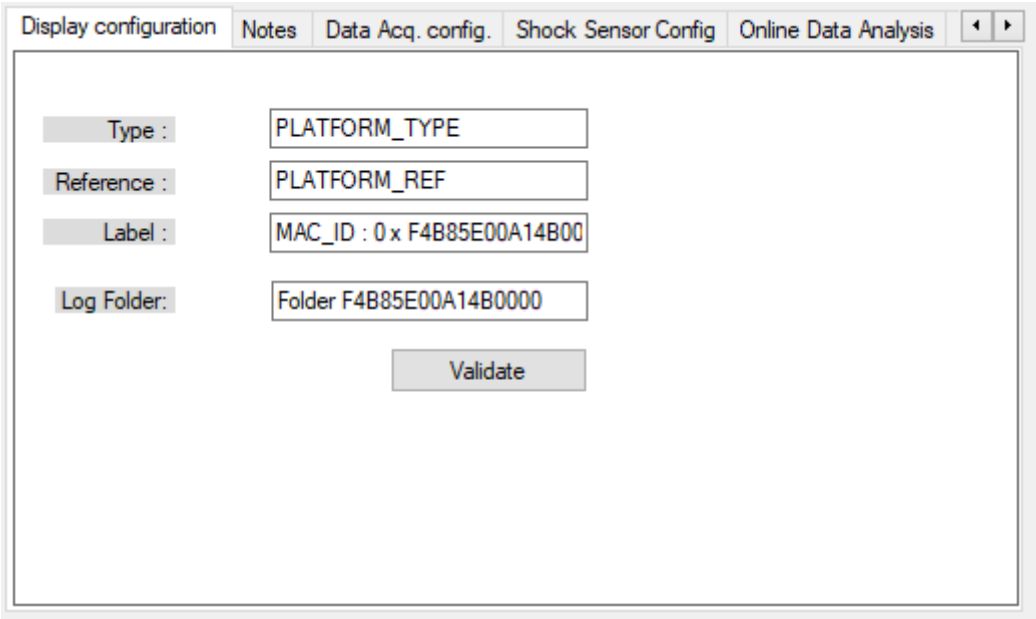


Figure 57: BeanDevice ® Display configuration tab

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

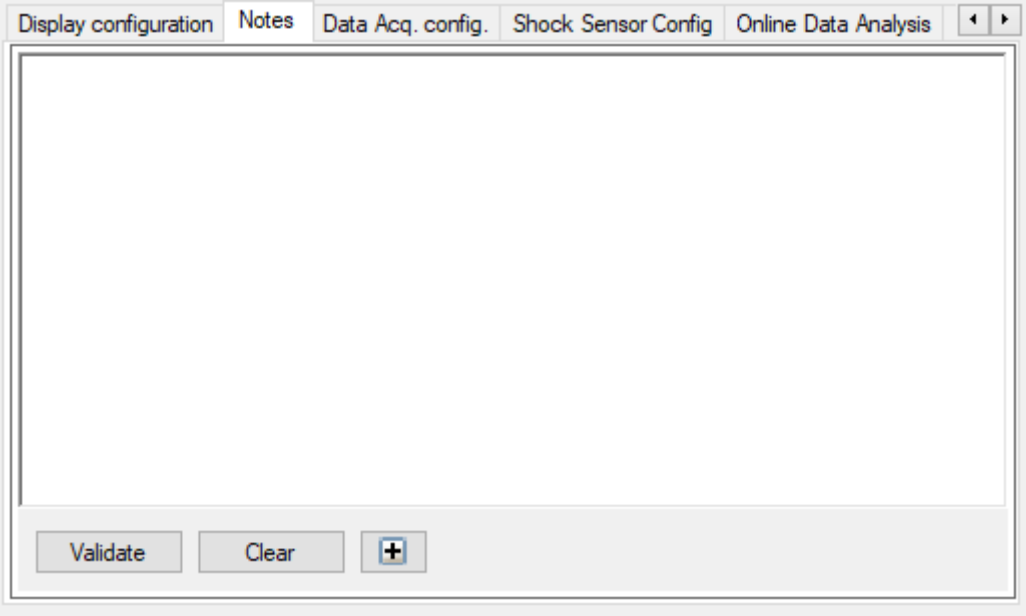


Figure 58: Tab: Notes

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

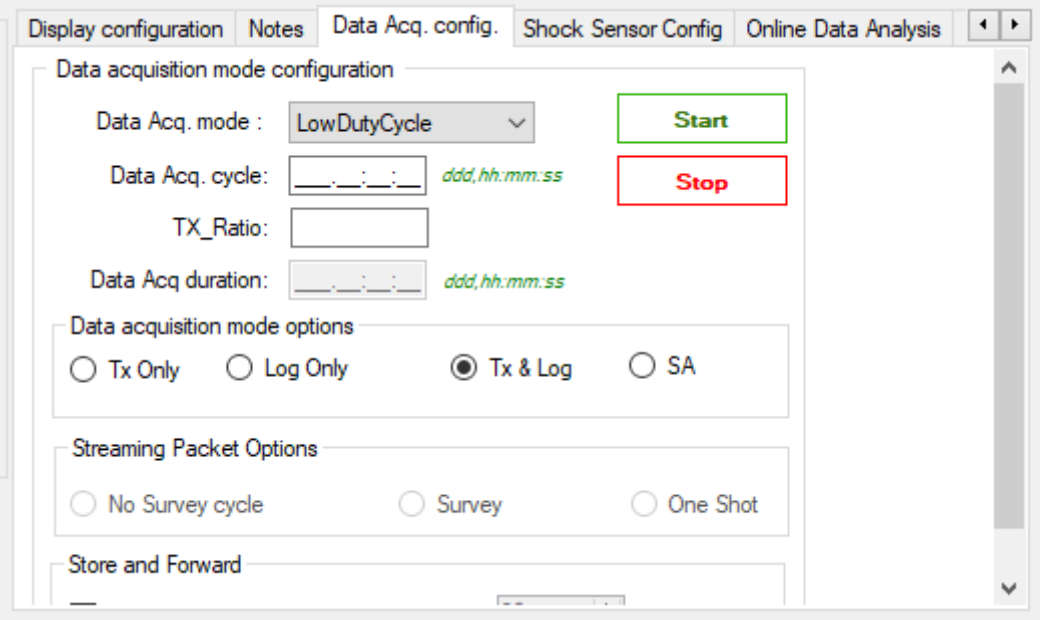


Figure 59: Data Acquisition configuration tab

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 ▪ Whenever an alarm threshold (fixed by the user) is reached (4 alarm threshold levels High/Low). ▪ 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. 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. This field is available in streaming mode: Choose carefully the Sampling rate value: ✓ 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_003 - "Wireless Network capacity"*** ✓ Power consumption increases with the sampling rate of your BeanDevice®	
Data acquisition duration	Data acquisition duration in streaming mode. The format is Day : Hour : Minute :Second The Data acquisition duration value cannot be higher than Data acquisition cycle.	

Options	***TX only***: Real-time data transmission is enabled ***Log only***: Real-time data logging is enabled ***TX & Log***: Real-time data transmission and data logging are enabled ***SA: Standalone:*** The BeanDevice® WiLow® logs all the data acquisition with no need of Wireless network
Streaming options	***No survey***: ***Survey***: ***One shot:*** streaming continuously for a predefined duration ***Continuous Monitoring***: streaming continuously ***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_008 – "Data acquisition modes available on the BeanDevice®"

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

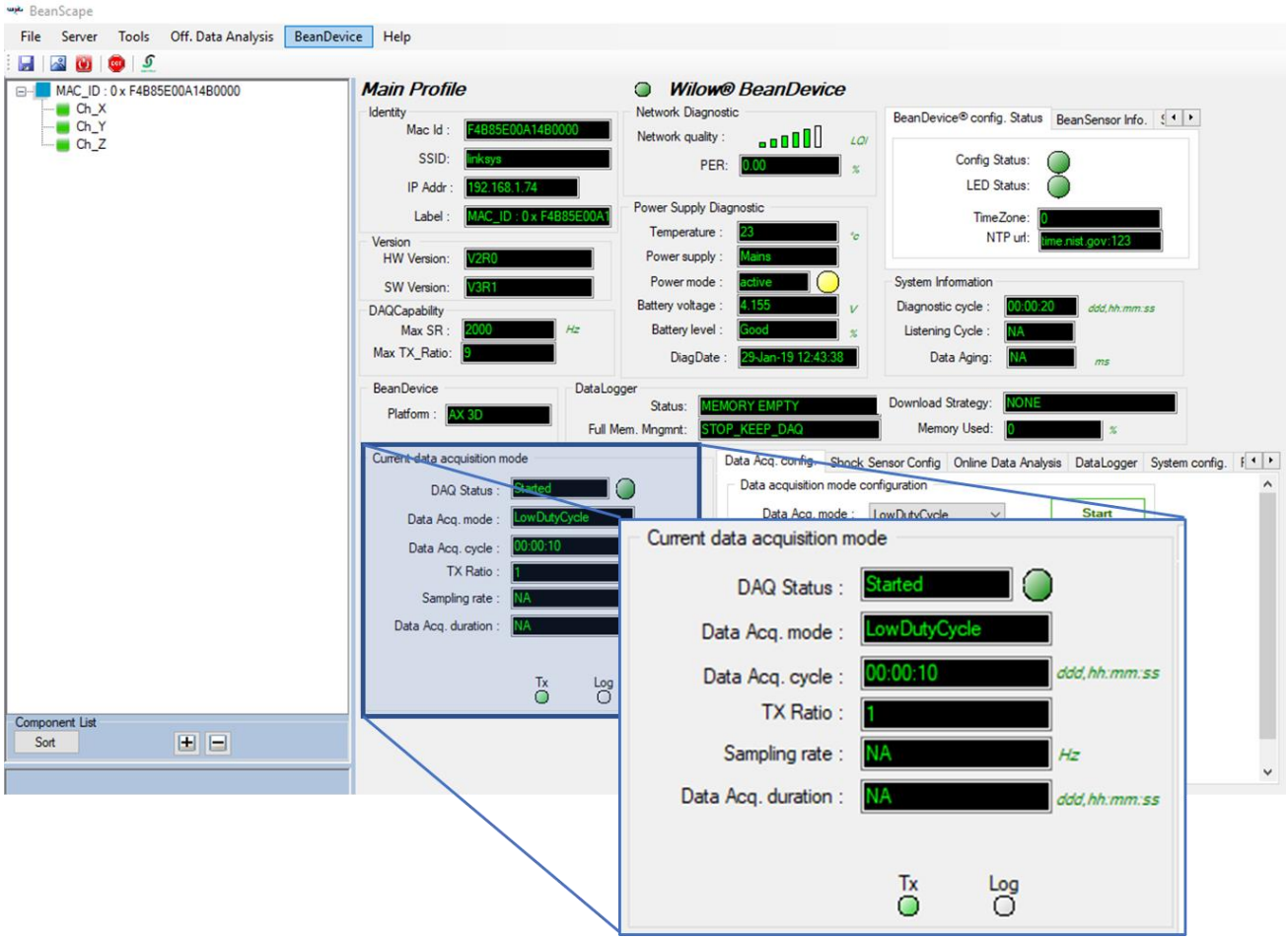


Figure 60: Current data acquisition mode display

For further information, please read the technical note TN_RF_008 – "Data acquisition modes available on the BeanDevice®"

7.3.4 Shock Sensor Config Tab

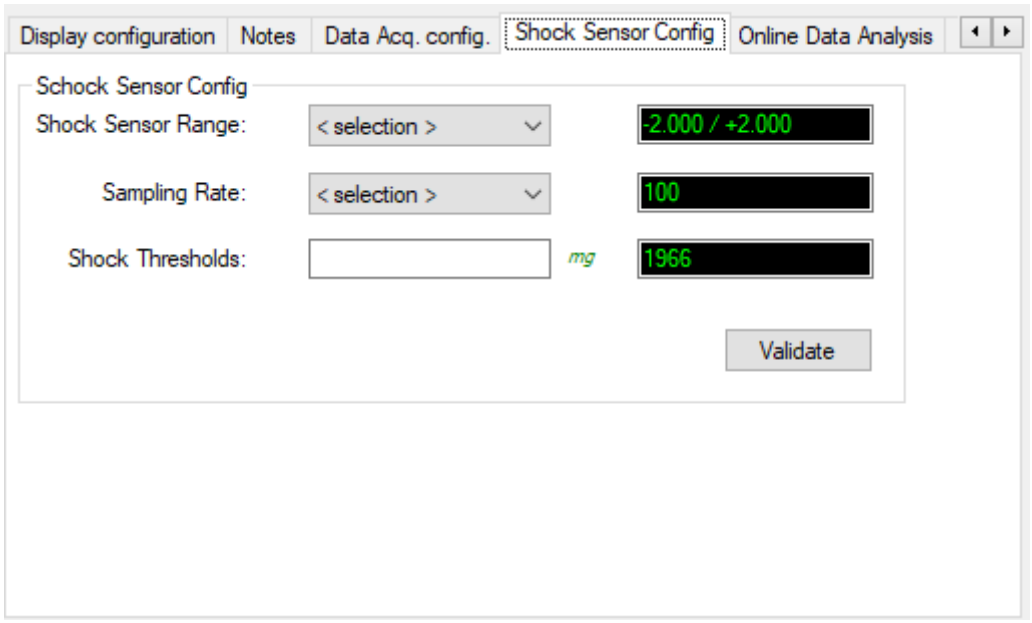
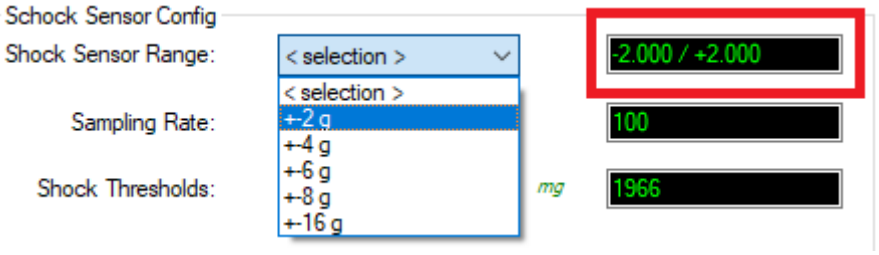


Figure 61: Shock Sensor Config tab

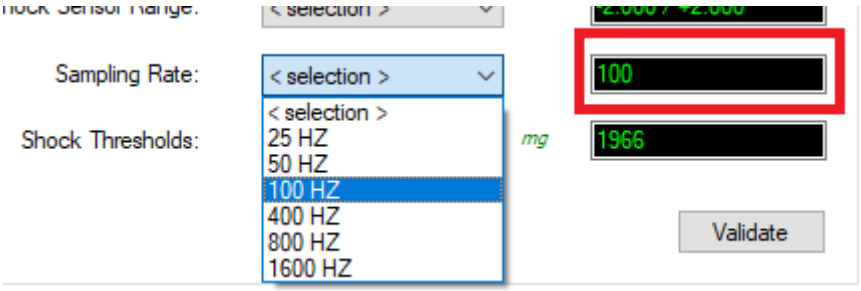
- ***Shock Sensor Range:*** This option allows the user to change the Shock sensor range from the list, as displayed below. The available Shock Ranges are +/-2g, +/-4g, +/-6g, +/-8g or +/-16g.

  The selected value will be displayed on the black case.



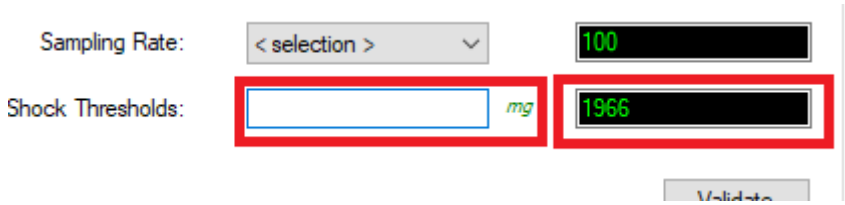
- ***Sampling Rate:*** This option allows to change the Sampling Rate of the Shock Senor from the listed values: 25Hz, 50Hz, 100Hz, 400Hz, 800Hz or 1600Hz.

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.

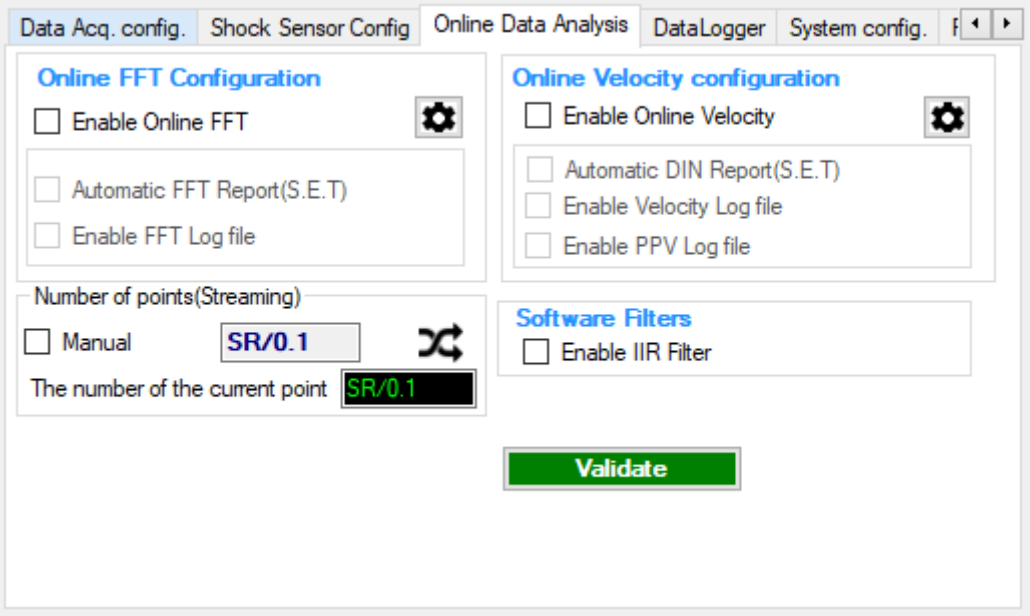


Figure 62: Signal Processing Tab

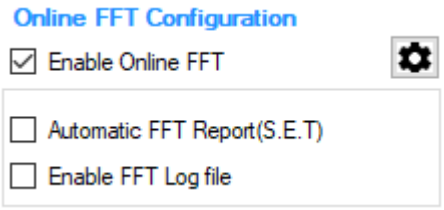
Parameter	Description
Online FFT Configuration	• **Enable Online FFT** : check to enable real time FFT processing ▪ **Automatic FFT Report (Set Mode)** : check for automatically sending the FFT report by email when alarm occurs on streaming with event-trigger(set) mode ▪ **Enable FFT Log file**: check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

7.3.5.1 Online FFT Configuration



- ***Enable Online FFT:*** Check to enable real time FFT processing for BeanDevice AX-3D on streaming mode and the FFT spectrum will appear below the Streaming graph in the sensor profile.

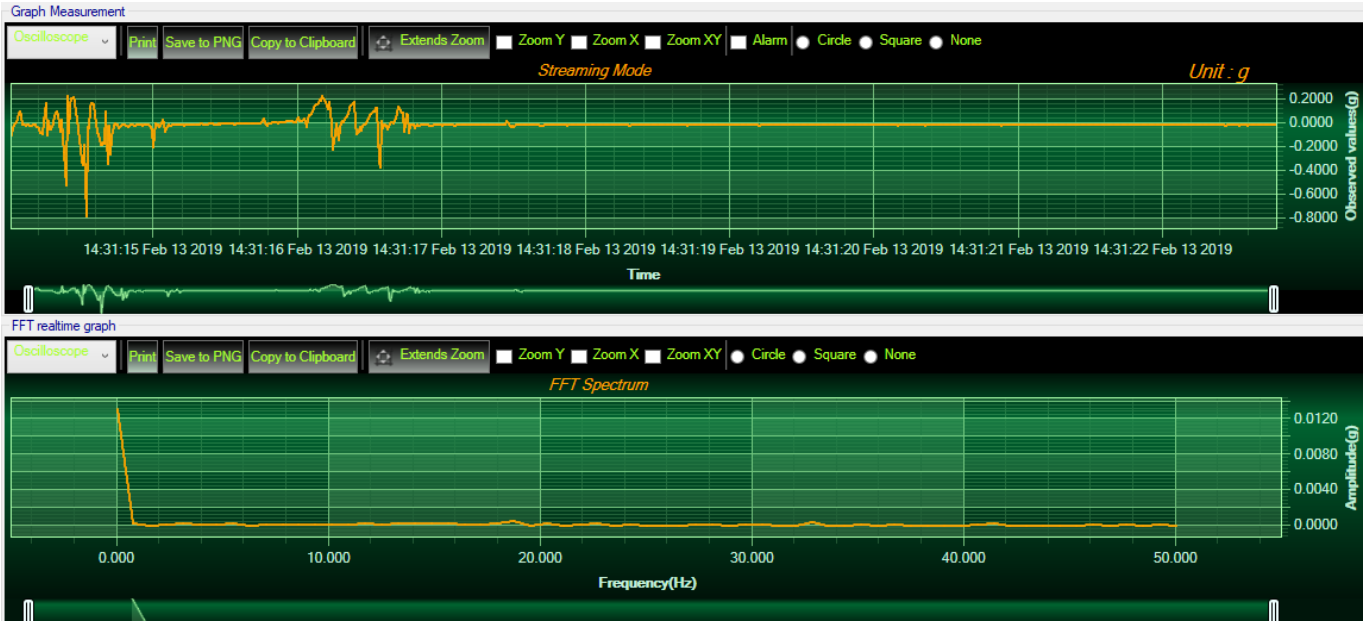


Figure 63: FFT Spectrum

- ***Automatic FFT Report (S.E.T)***: check to enable FFT report automatic generation when threshold is reached, or an acquisition cycle is reached on the S.E.T acquisition mode. All the reports will be transmitted via email, to the addresses configured on Alarm Management Option.

BeanScape® SMTP FFT REPORT: 13-Feb-19 14:37:53

[redacted]ail.com
to me

This mail is sent by BeanScape® Software

This mail contain the graph report due of a streaming alarm for Device 5C313E06A9A70000 , In the Sensor MAC_ID : 0 x 5C313E06A9A70000

Ch_Z : Max Amplitude= 0.9577 g , Frequency= 0 hz , VPPV Value = 143.973312014132

Ch_X : Max Amplitude= 0.0937 g , Frequency= 0 hz , VPPV Value = 143.973312014132

Ch_Y : Max Amplitude= 0.0726 g , Frequency= 0 hz , VPPV Value = 143.973312014132

Figure 64: FFT Report Email

- ***Enable FFT Log file***: check to enable FFT data to be stored in the log folder.

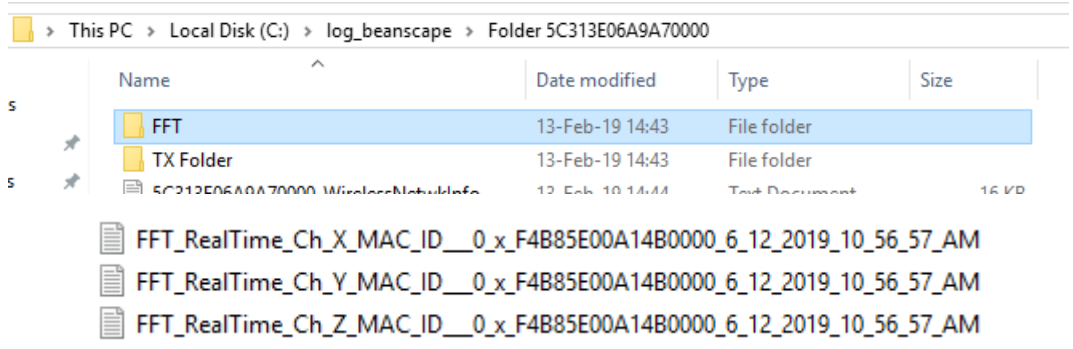
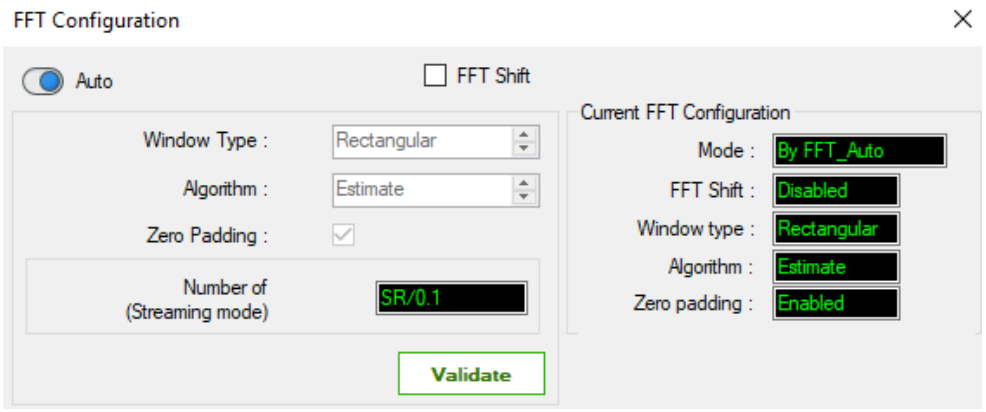


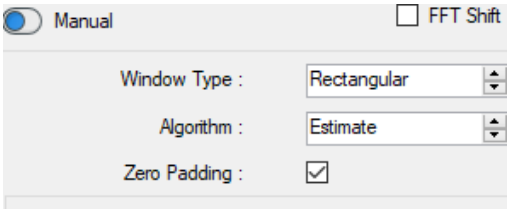
Figure 65: FFT Log Folder/Files

: FFT Advanced Configuration

The FFT configuration allows the user to activate the FFT Shift and to go for manual settings related to FFT.



Auto/Manual



- Window type:

Rectangular
Hamming
Hann
Blackman
Blackman Harris
Gaussian
Kaiser
Taylor
Triangular
Flattop
Bartlett
Bartlett-Hann

When the number of periods in the acquisition is not an integer, the endpoints are discontinuous. These artificial discontinuities show up in the FFT as high-frequency components as not present in the original signal. These frequencies can be much higher than the Nyquist frequency and are aliased between 0 and half of your sampling rate. This phenomenon is known as spectral leakage.

You can minimize these effects by using a technique called windowing.

Windowing reduces the amplitude of the discontinuities at the boundaries of each finite sequence acquired by the digitizer. Windowing consists of multiplying the time record by a finite-length window with an amplitude that varies smoothly and gradually toward zero at the edges. This makes the endpoints of the waveform meet and, therefore, results in a continuous waveform without sharp transitions. This technique is also referred to as applying a window.

There are several different types of window functions that you can apply depending on the signal. To understand how a given window affects the frequency spectrum, you need to understand more about the frequency characteristics of windows.

Selecting a window function is not a simple task. Each window function has its own characteristics and suitability for different applications. To choose a window function, you must estimate the frequency content of the signal.

- If the signal contains strong interfering frequency components distant from the frequency of interest, choose a smoothing window with a high side lobe roll-off rate.

- If the signal contains strong interfering signals near the frequency of interest, choose a window function with a low maximum side lobe level.

- If the frequency of interest contains two or more signals very near to each other, spectral resolution is important. In this case, it is best to choose a smoothing window with a very narrow main lobe.

- If the amplitude accuracy of a single frequency component is more important than the exact location of the component in a given frequency bin, choose a window with a wide main lobe.

- If the signal spectrum is rather flat or broadband in frequency content, use the uniform window, or no window.

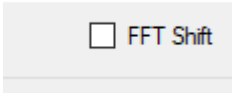
In general, the Hanning (Hann) window is satisfactory in 95 percent of cases. It has good frequency resolution and reduced spectral leakage. If you do not know the nature of the signal but you want to apply a smoothing window, start with the Hann window.

- Algorithm

Estimate	Determine a best-guess transform algorithm based on the size of problem.
Measure	Find a better algorithm by computing multiple transforms and measuring the run times.
Patient	Run a wider range of testing compared to 'measure', resulting in a better transform algorithm, but at the expense of higher computational cost to determine the parameters.
Hybrid	Use a combination of 'measure' for transforms with dimension length (number of points) 8192 or smaller and 'estimate' for transforms with dimension length (number of points) larger than 8192.

- Zero Padding: The use of zero padding enables you to estimate the amplitudes of frequencies correctly.

- ***FFT Shift***: Check to enable real time FFT Shift processing for BeanDevice AX-3D on streaming mode and the FFT spectrum will appear shifted below the Streaming graph in the sensor profile.



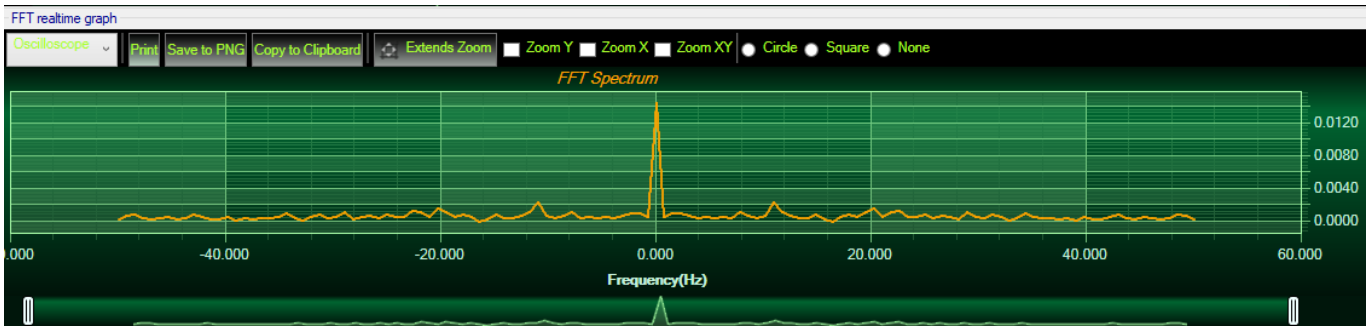
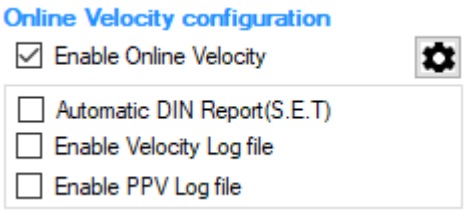


Figure 66: FFT Shift Spectrum

7.3.5.2 Online Velocity configuration



- ***Enable online Velocity***: check to enable real time Velocity processing, PPV and PVS, the velocity graph will be displayed.

  On the Graph side a real time DIN 4150 graph will be displayed on the right side of the screen.

  Under the DIN 4150 Graph, the PPV and the PVS values will be displayed in real time.

On the PPV frame, BeanScape will display PPV in mm/s, ZC Frequency in Hz, Peak Acceleration in g and Peak Displacement in mm.

It is important to notice that the PVS calculation required 3 active channels to be generated.

PPV: is a measurement of maximum ground particle movement speed, it is in millimeters per second (mm/sec), PPV is a "vector" quantity (i.e. it has both a value and an associated direction).

Peak Vector Sum (PVS): is simply the square root of the sum of the squares of the individual PPV values. PVS is a "scalar" quantity, i.e. one with only a value, which is always larger than the individual PPV vector values.

Scientific studies have shown that the PPV correlates best with damage potential of all the tested characterizations of ground movement (e.g. acceleration, displacement, or strain). Most, though not all, ground vibration standards are quoted in PPV values, although the "acceptable" values of PPV differ with the standard applied and with the frequency of the vibration components.

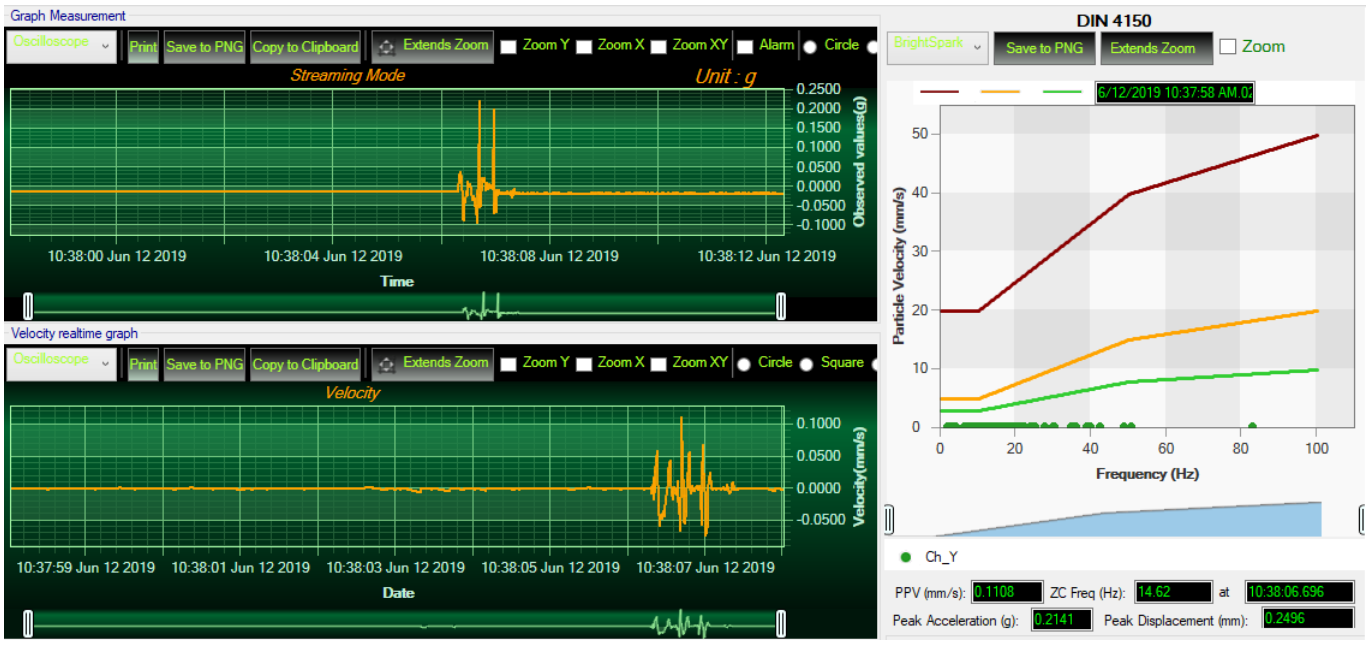


Figure 67: Velocity Graph

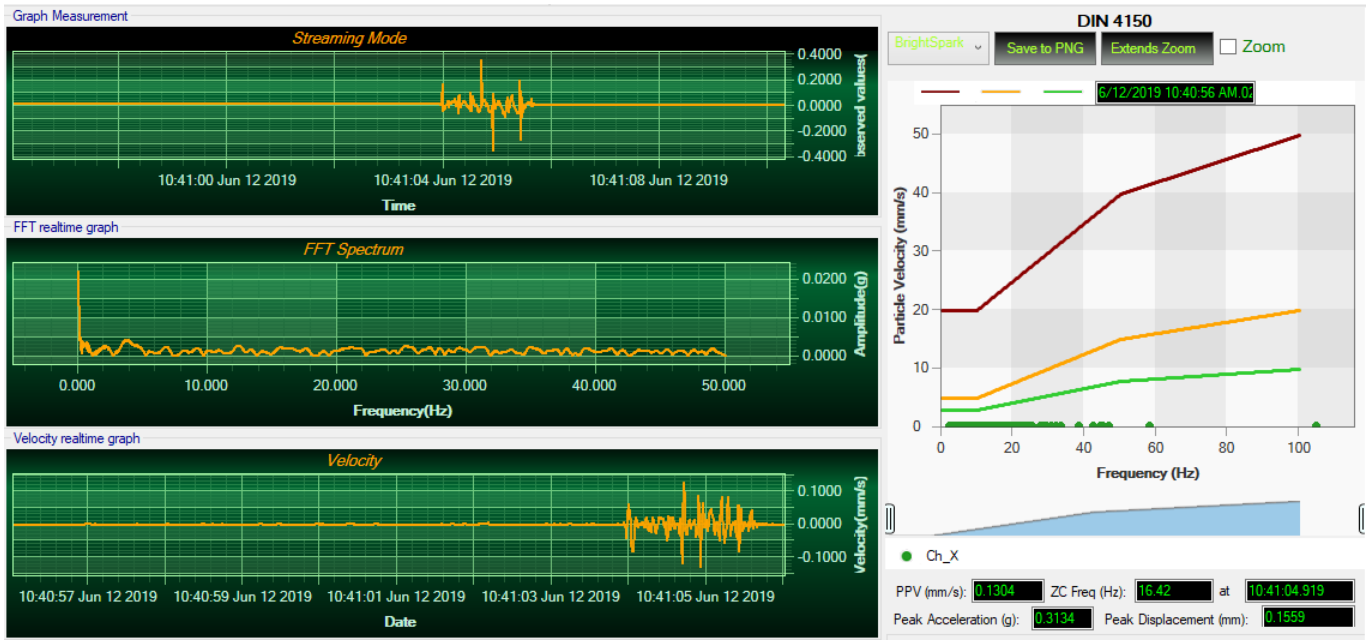


Figure 68: Velocity and FFT Graph, PPV and PVS

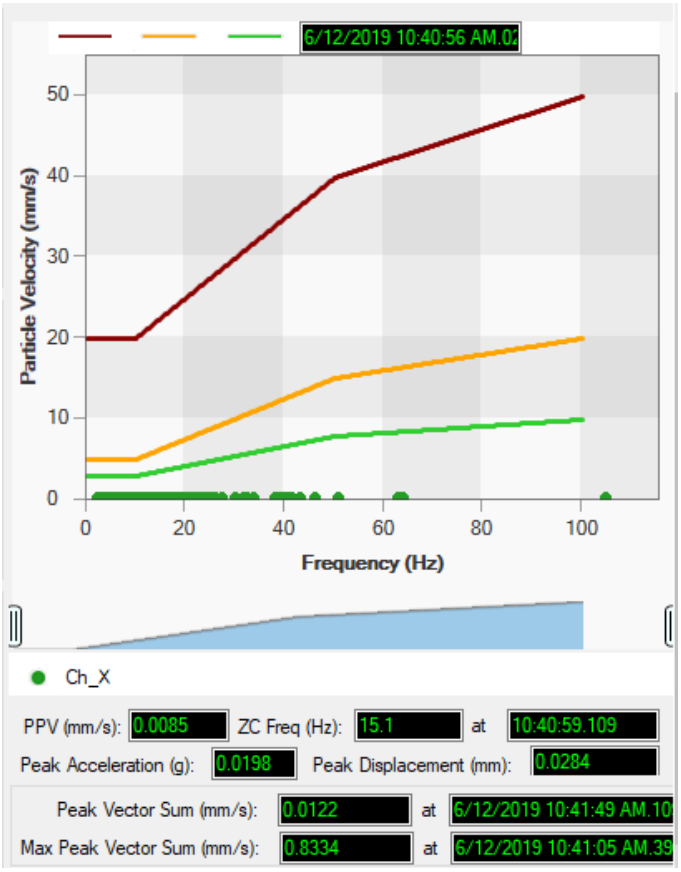
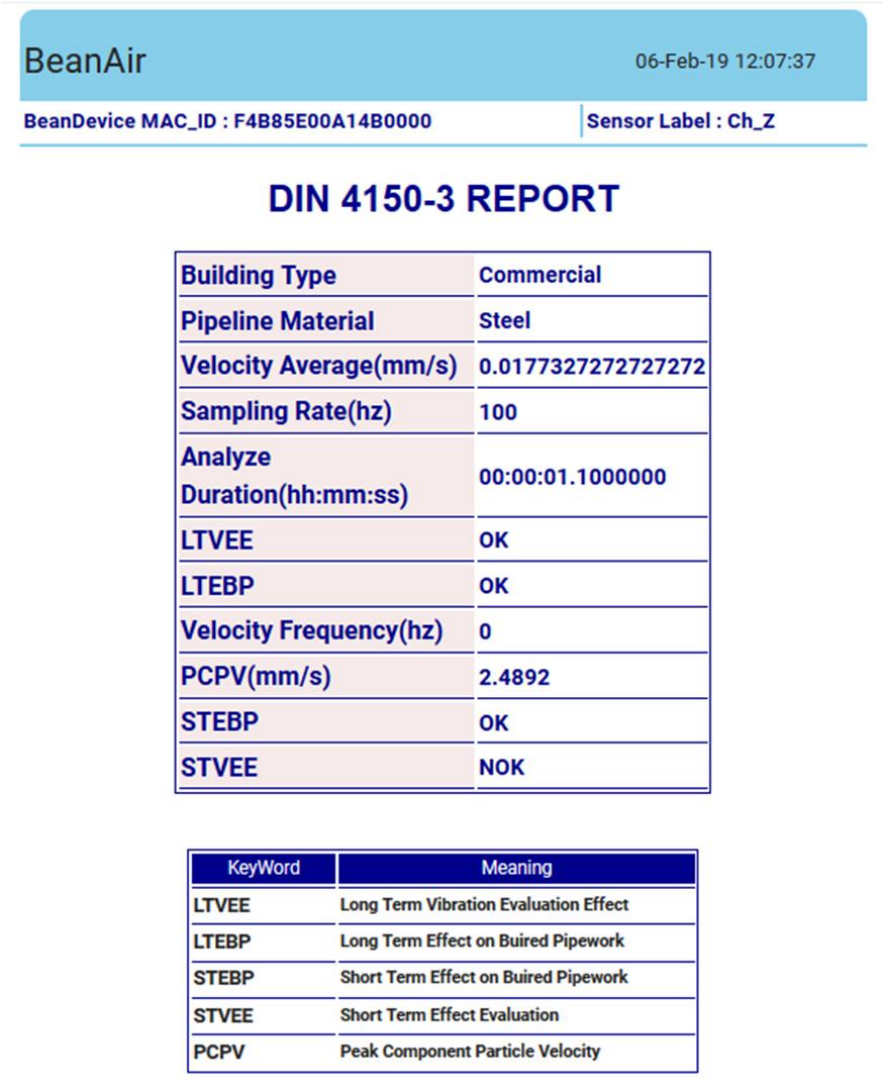


Figure 69: DIN 4150 Real Time Graph, PPV & PVS

- ***Automatic DIN Report (S.E.T)***: check to enable DIN4150-3 report automatic generation when threshold is reached, or an acquisition cycle is reached on the S.E.T acquisition mode.

  An automatic Report will be sent to the email addresses configured on Alarm Management Option.



BeanAir 06-Feb-19 12:07:37

BeanDevice MAC_ID : F4B85E00A14B0000 | Sensor Label : Ch_Z

DIN 4150-3 REPORT

Building Type	Commercial
Pipeline Material	Steel
Velocity Average(mm/s)	0.0177327272727272
Sampling Rate(hz)	100
Analyze Duration(hh:mm:ss)	00:00:01.1000000
LTVEE	OK
LTEBP	OK
Velocity Frequency(hz)	0
PCPV(mm/s)	2.4892
STEBP	OK
STVEE	NOK

KeyWord	Meaning
LTVEE	Long Term Vibration Evaluation Effect
LTEBP	Long Term Effect on Buired Pipework
STEBP	Short Term Effect on Buired Pipework
STVEE	Short Term Effect Evaluation
PCPV	Peak Component Particle Velocity

Figure 70: DIN 4150-3 Report email

- ***Enable Velocity Log file***: check to enable Velocity data to be stored in the log folder.

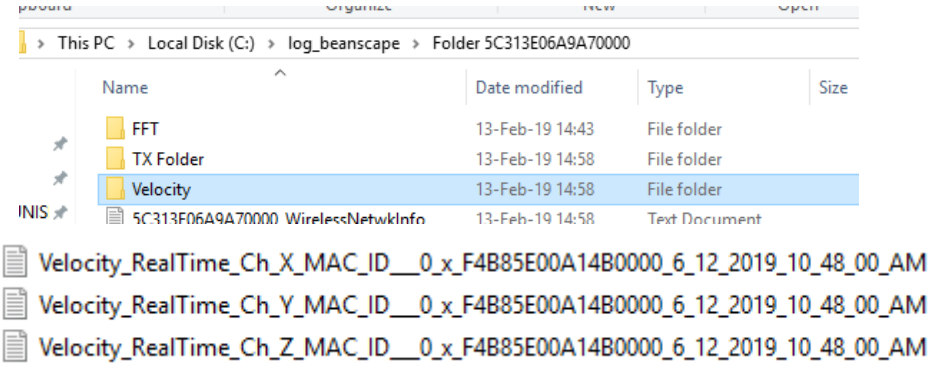


Figure 71: Velocity Log Folder/Files

- ***Enable PPV Log file***

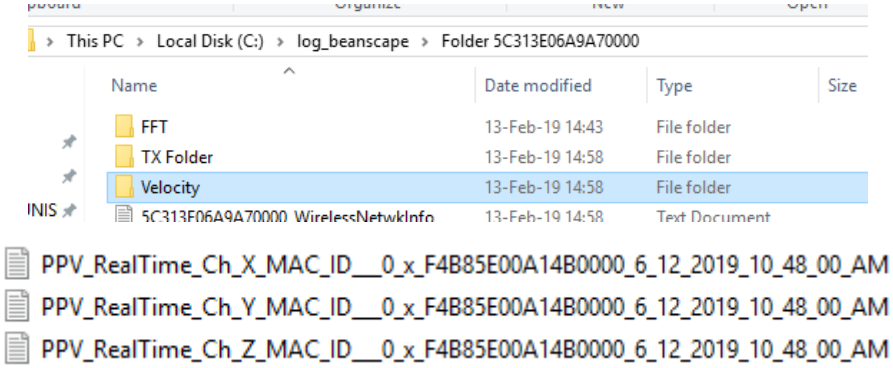


Figure 72: PPV Log Folder/Files

- : Velocity Advanced Configuration

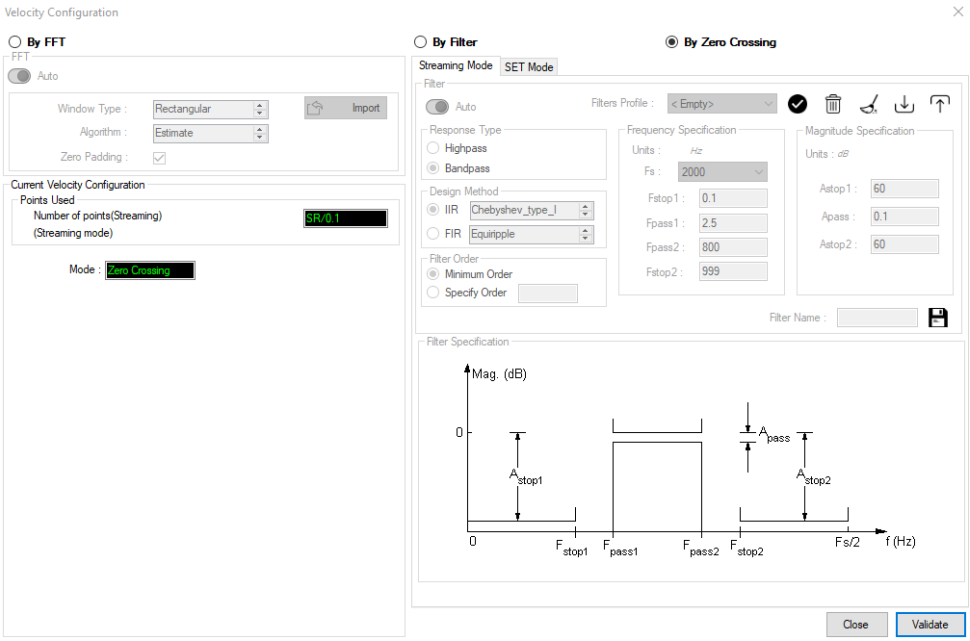
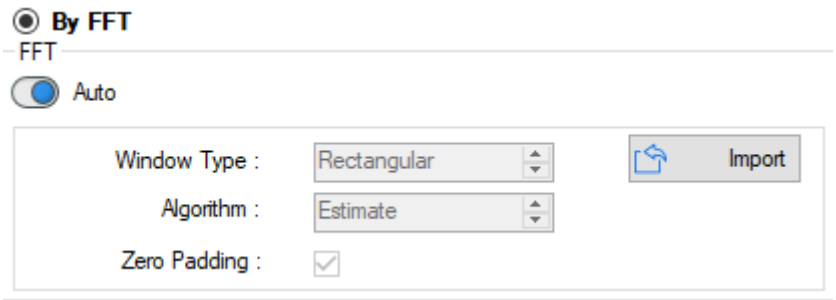


Figure 73: Velocity Advanced Configuration

By default, the Velocity is configured “By Zero Crossing”, to edit the Velocity settings user must select “By FFT” or “By Filter”.

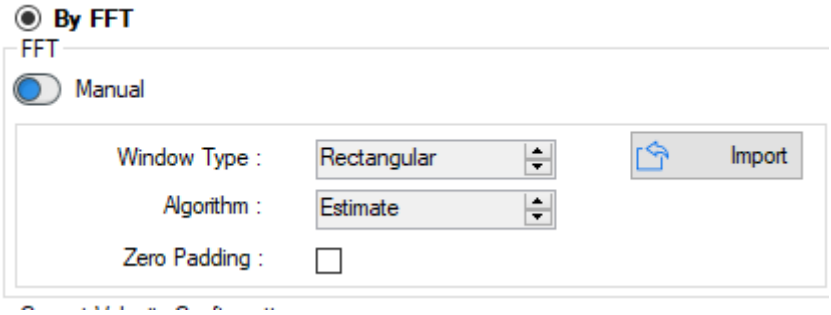
- **By FFT:** By selecting this option, the user will setup the Velocity basing on customized FFT settings.

  - Auto: If Auto is selected, The Velocity calculation will activate FFT Auto mode Settings

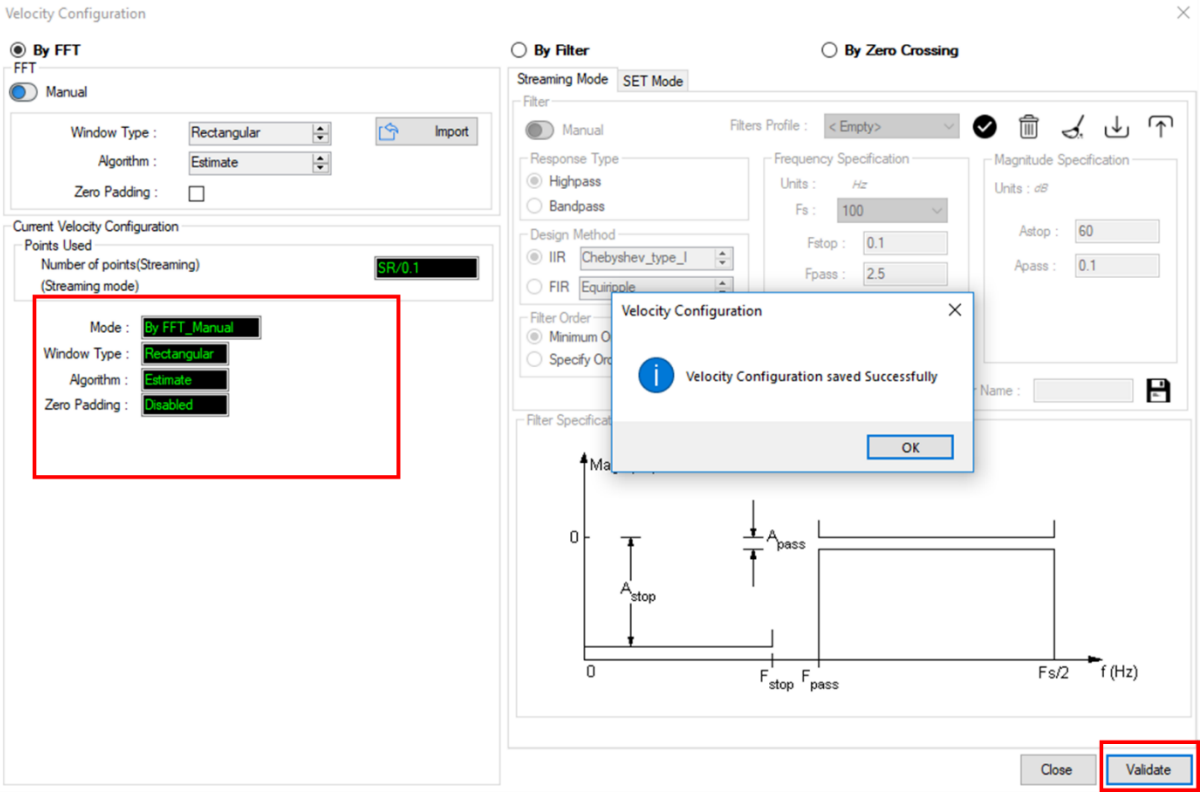


  - Manual: Once switched to Manual, the user must configure the FFT settings manually (Window Type, Algorithm & Zero Padding).

By clicking on Import the Configuration will import the FFT current settings, already configured on the FFT frame.

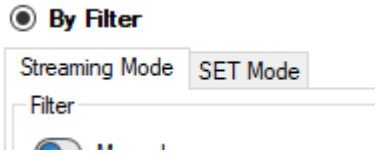


To save all settings Press Validate. The new settings should be displayed on the Left side of the Window.

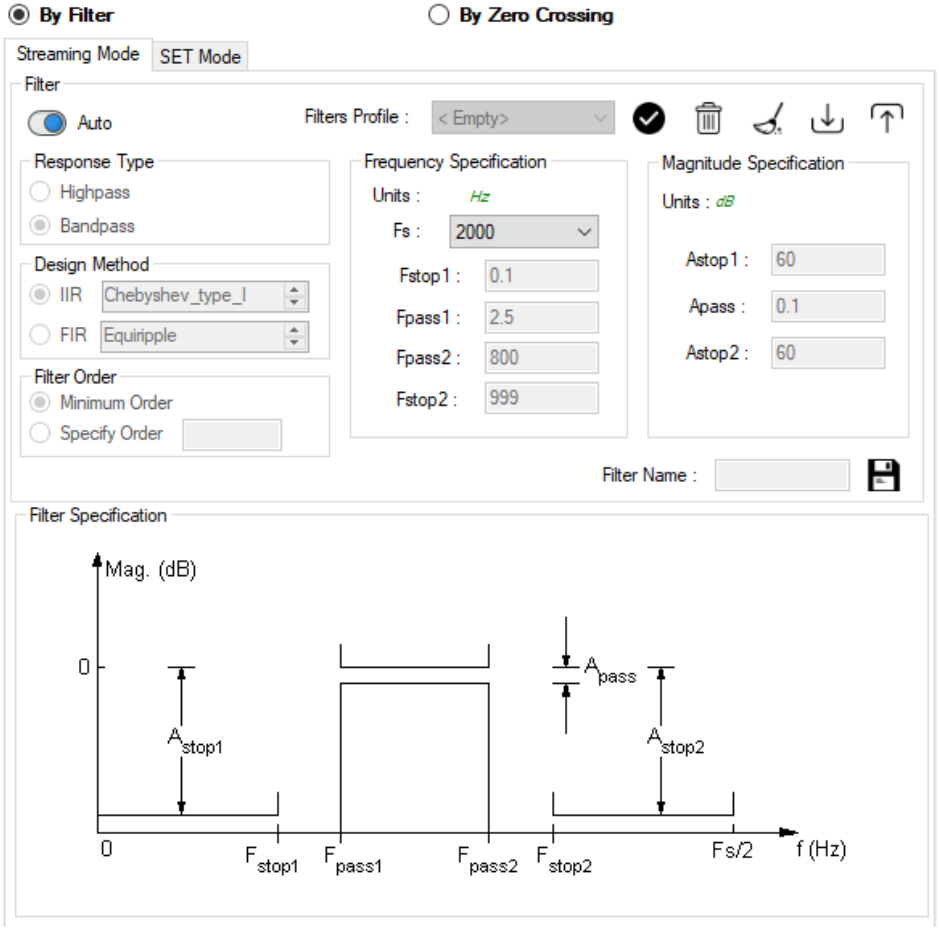


- **By Filter:** By selecting this option, the user will setup the Velocity basing on the Software Filter.

The Software filter is available for Streaming and S.E.T Mode.

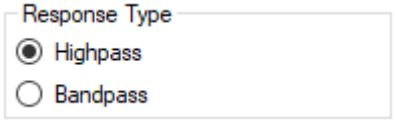


- Auto: If Auto is selected, Velocity Automatic filter will be configured



- Manual: Once switched to Manual, the user must configure manually the Filter settings.

  - ❖ Response Type: User should specify if the Response is **Highpass** or **Bandpass**

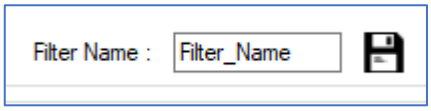


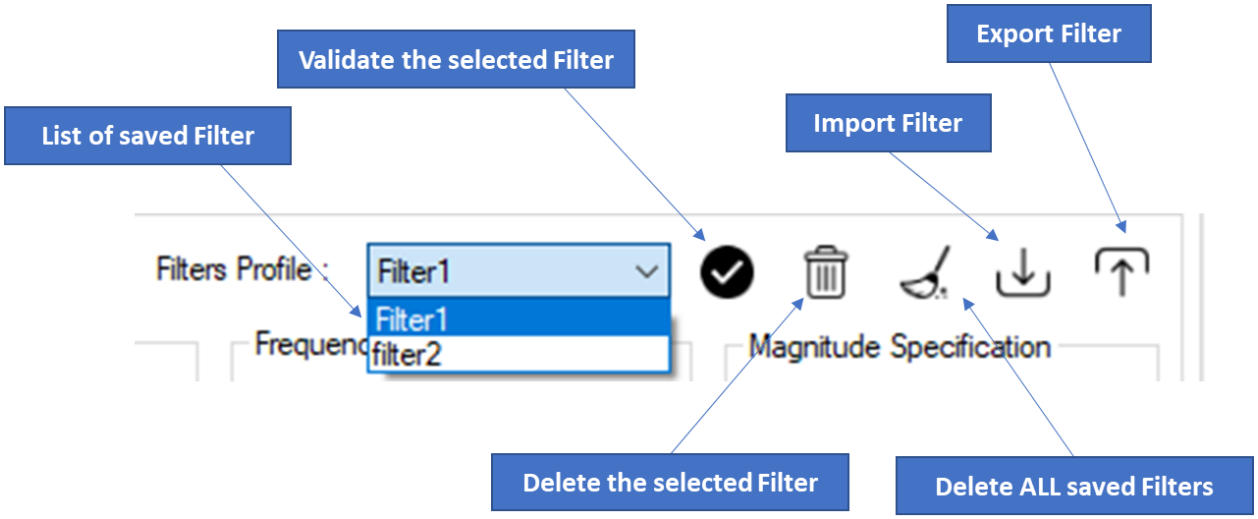
  - ❖ Design Method: User should Select the nature of the Filter between **IIR** or **FIR** From the List of every filter, user have to specify the method of the Filter: IIR: Chebyshev_type_I, Chebyshev_type_II or Butterworth

FIR: Equiripple, Generalized_Equiripple or Kaiser_Window

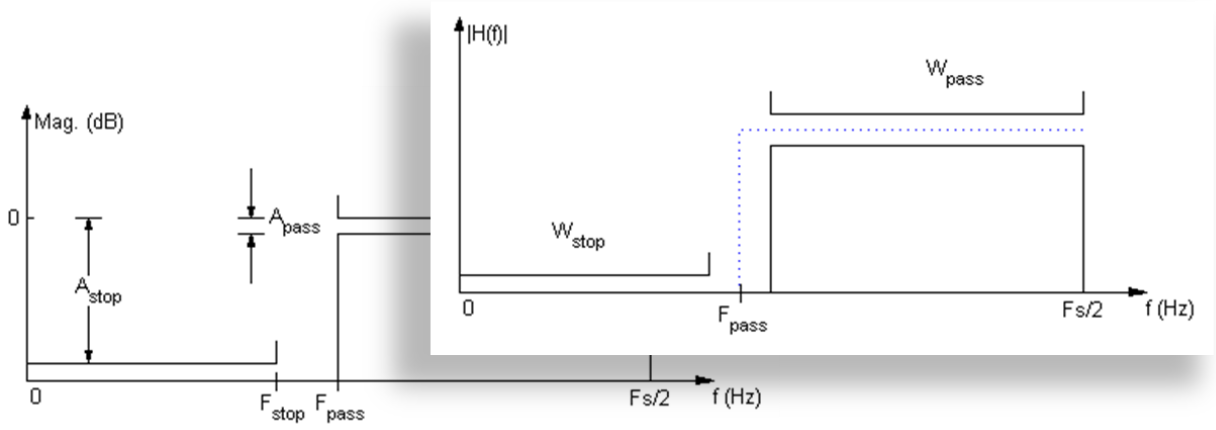
The Frequency Specification and The Magnitude Specification will be modified according the selected Design Method

- Filter Order: If the user is using IIR Design Method, Minimum Order will be selected automatically.
  If the FIR Design Method is selected, user must Specify Order.
- Frequency Specification: Is a customizable frame according to the Design Method.
- Magnitude Specification: Is a customizable frame according to the Design Method.
- Filter Profile: User can save a specific Configuration and re-use it later.

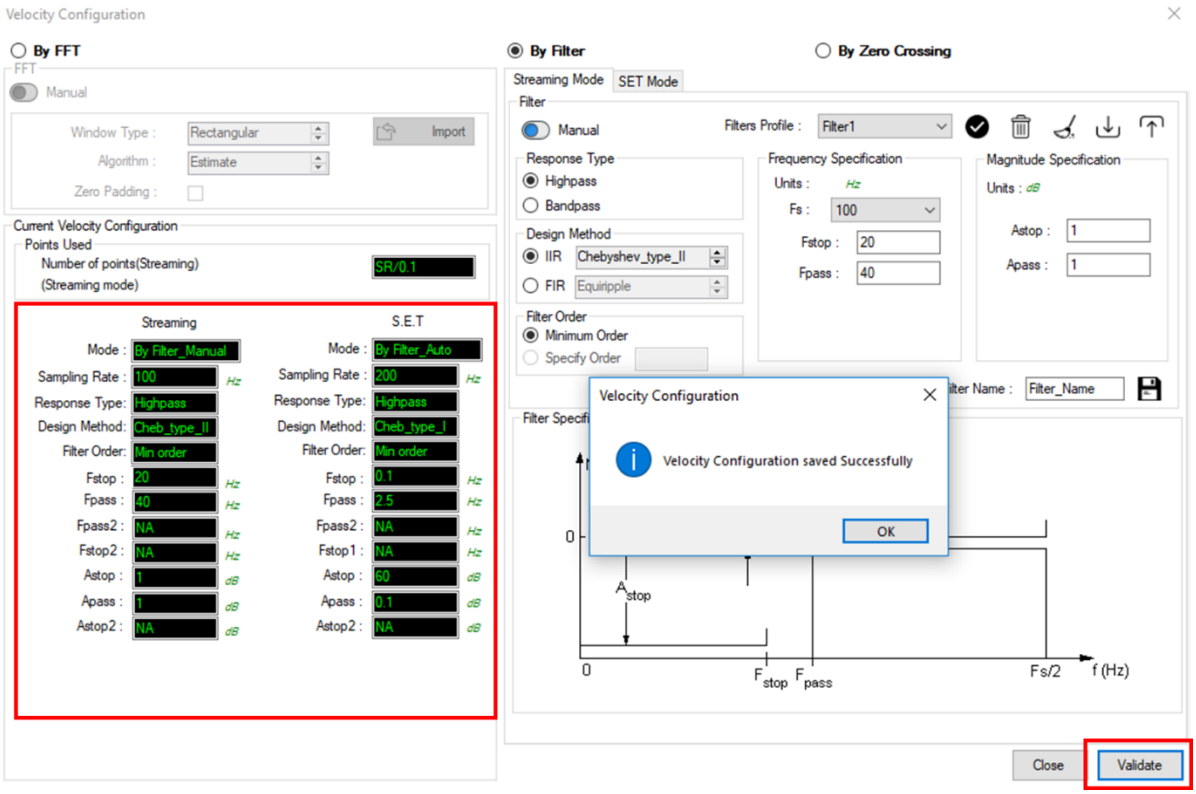




- Filter Specification: Is a Graphical Display of the Filter Specification depends on the user settings.



To save all settings Press Validate. The new settings should be displayed on the Left side of the Window.



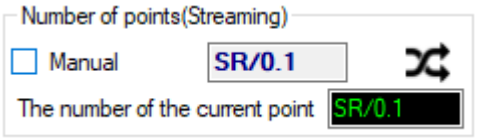
7.3.5.3 IIR Softlware Filter

- ***Enable IIR Filter***: Check to enable IIR filter

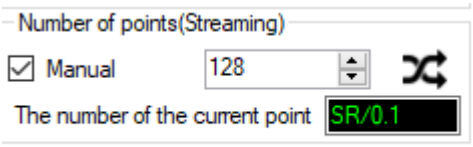
It is important to notice that the IIR filter may cause Amplitude attenuation.

It is important to notice if the signal is not high enough applying IIR filters may eliminate the entire signal

7.3.5.4 Number of Points (Streaming)

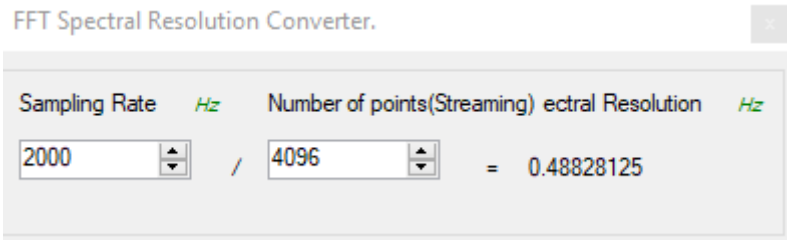


By default, the Number of Points is configured to be set automatically as Sampling Rate / 0.1 (SR/0.1). By moving to the Manual settings, user must choose a value between 128 and 32768.



It is important to notice that larger Number of Points provide higher spectral resolution but take longer to compute.

FFT Spectral Resolution Converter is simulation tool which will estimate the FFT Spectral Resolution regarding the Sampling Rate and the Number of Points.



The frequency resolution of each spectral line is equal to the Sampling Rate divided by the Number of Points. For instance, for example, if the Number of Points is 4096 and the Sampling Rate is 2000, the resolution of each spectral line will be:

2000/4096 = 0.48828125

The Number of Points should be equal or higher than the Samplig Rate (Acquisition time at least = 1 second)

It is important to notice that larger Number of Points provide higher spectral resolution but take longer to compute.

7.3.6 DataLogger Tab

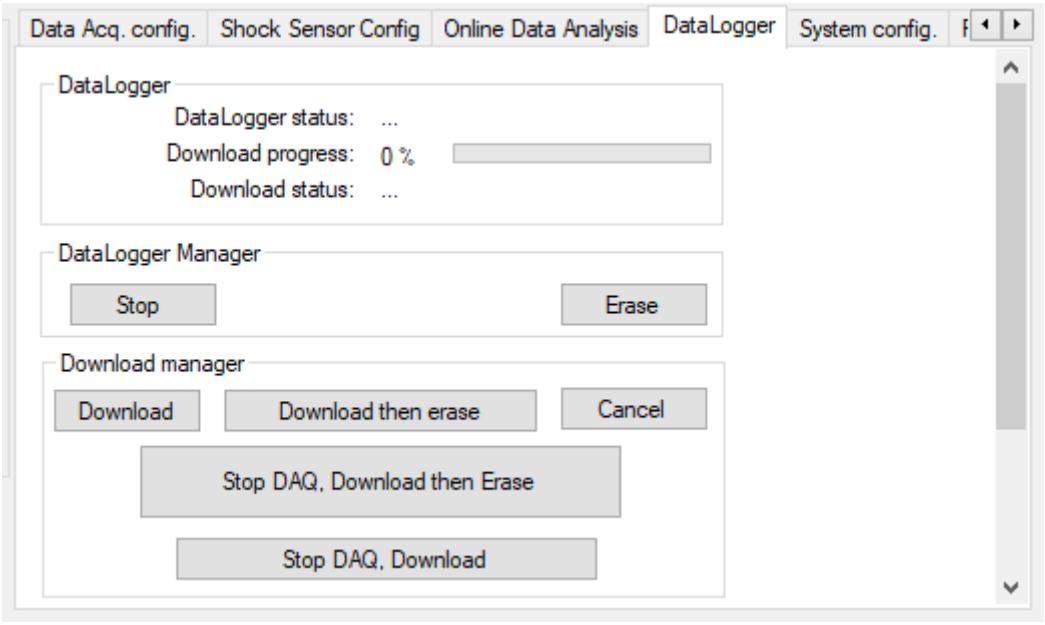
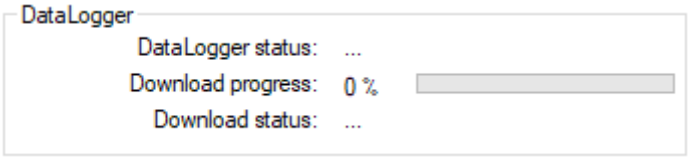


Figure 74 : Datalogger tab

The DataLogger tab is composed of four different fields:

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

7.3.6.1 Datalogger status

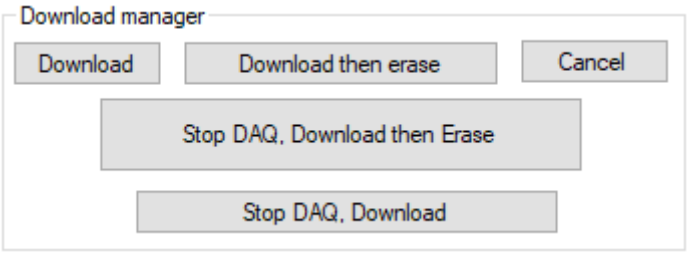


- ***Datalogger status***: Displays loggers' status, four status are available:
  - ***Ready***: the Datalogger is ready to register data
  - ***NotInit***: the Datalogger is not initialized
  - ***Active logs only***: Data acquisition is logged only
  - ***Active TX and Log***: Data acquisition is logged & 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

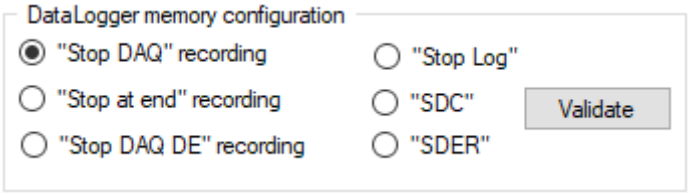
- ***Stop***: Stops Data Logging process
- ***Erase***: Erases all the logs on flash memory

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

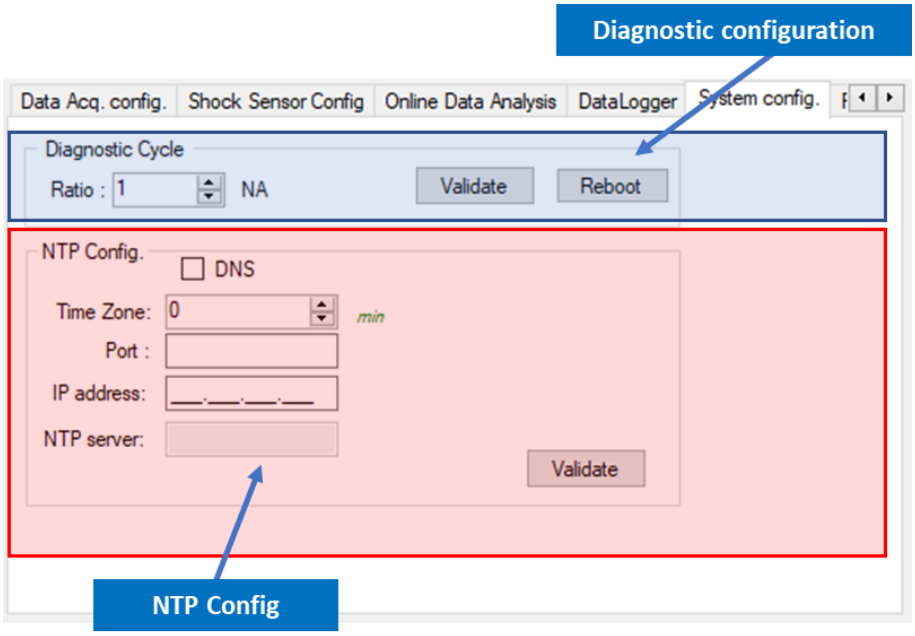


Figure 75: System configuration tab

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. ***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**
	The BeanDevice® Wilow® comes with an embedded SNTP Client, by default this device is working with UTC +0 Time Zone
	User can specify:
	• Time Zone with minutes resolution
	• NTP server :
	  ○ If DNS is activated : enter the port ID and the NTP server address
	  ○ If DNS is not enabled: enter the port ID and the NTP server IP
	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

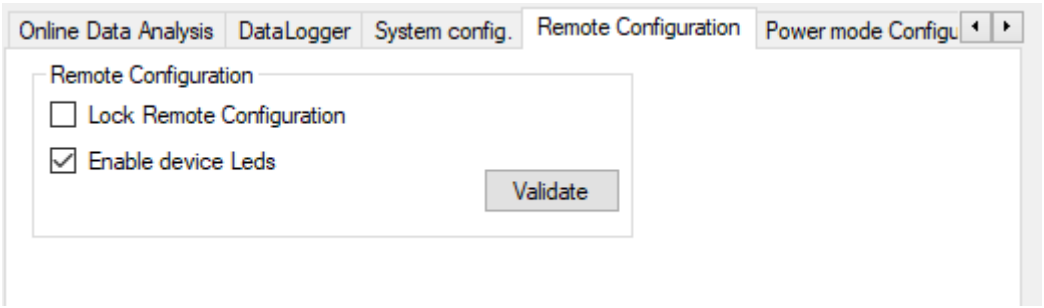
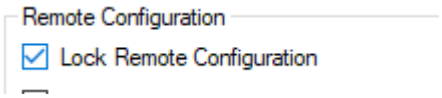


Figure 76: Remote Configuration

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



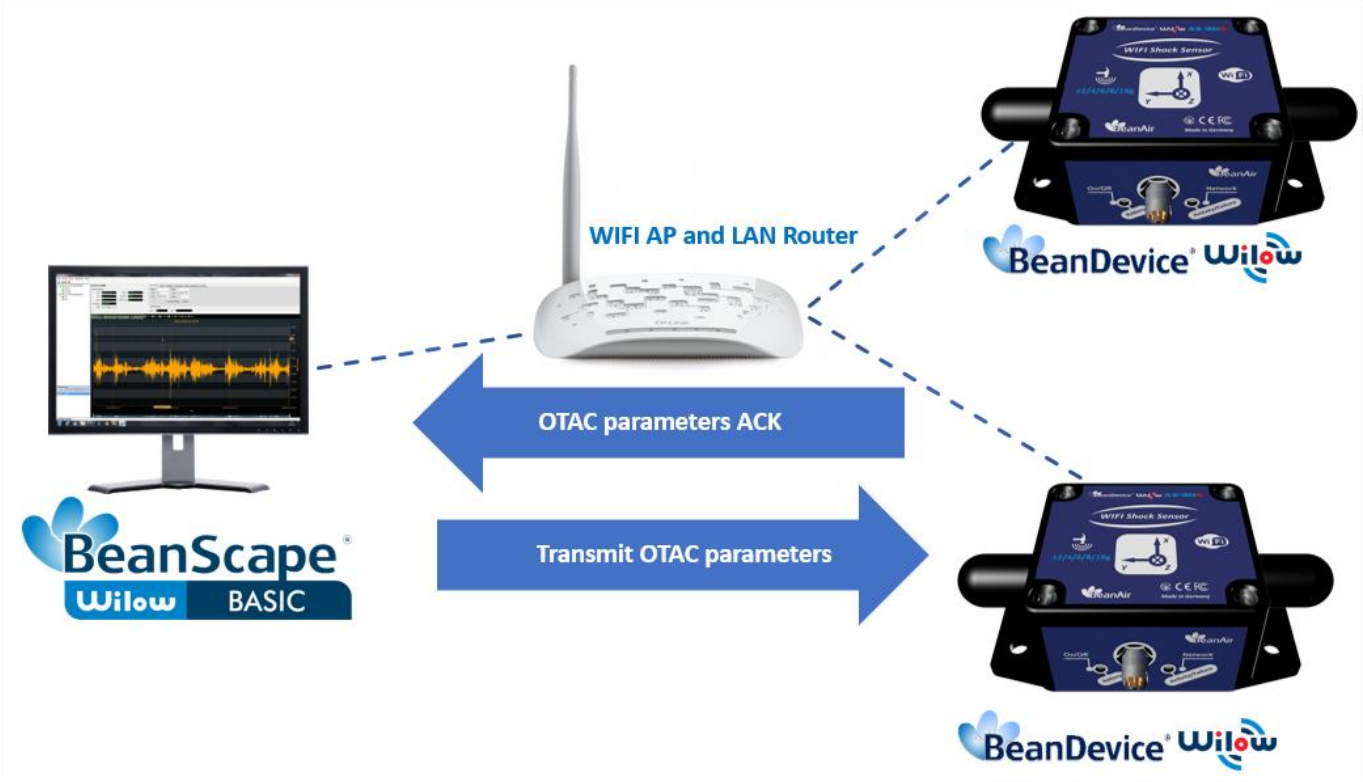
- ***Enable device Leds:*** By disabling this option the LEDs of the BeanDevice® WiLow® will not be able to do any signal or to blink until Enabling this functionality again.

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. ***Sleep:*** Sleeping mode is enabled. ***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:***

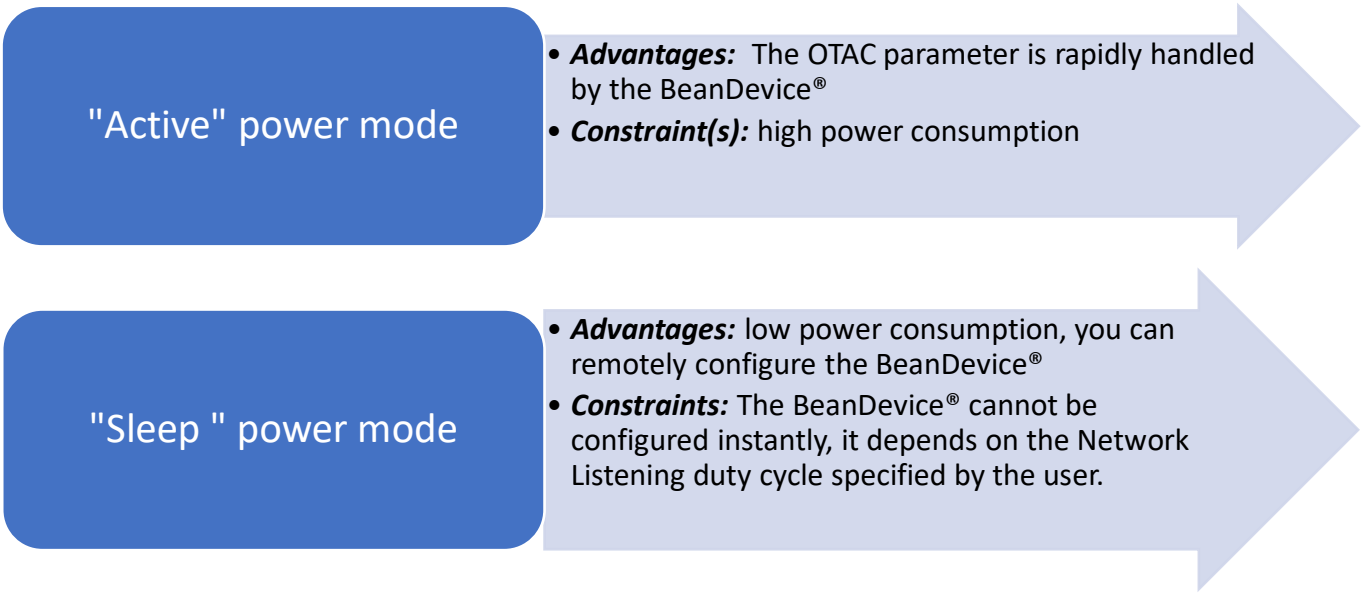
When the BeanDevice® operates in "**sleep mode**", it sends periodically a request (called listening cycle) to the router for an OTAC command.

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.*



- POWER MODE MANAGEMENT FROM THE BEANSCAPE®

Figure 77: Power mode management (display features)

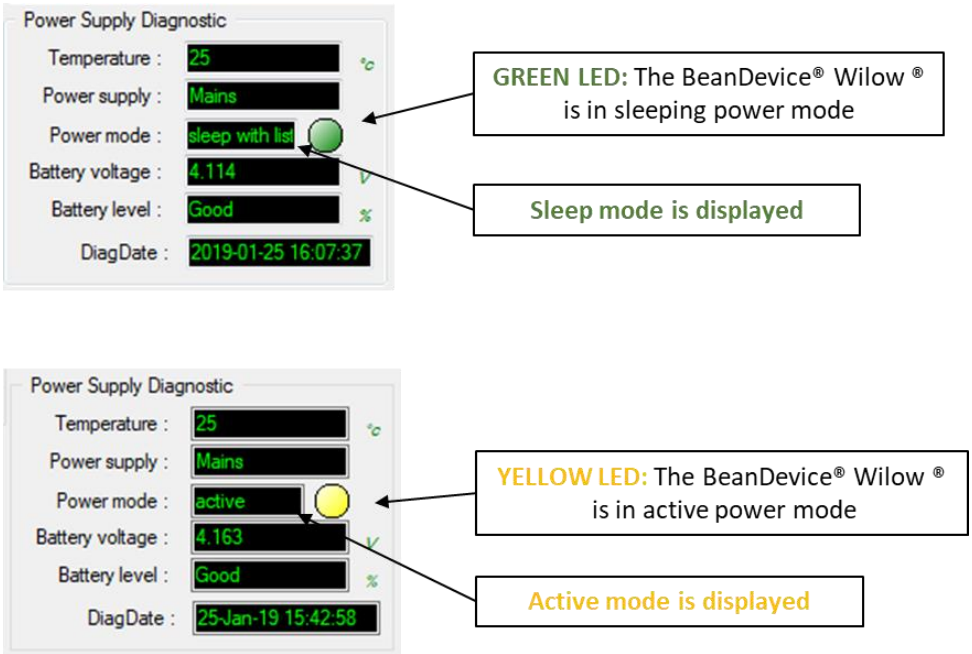


Figure 78: Power mode display

- ***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.

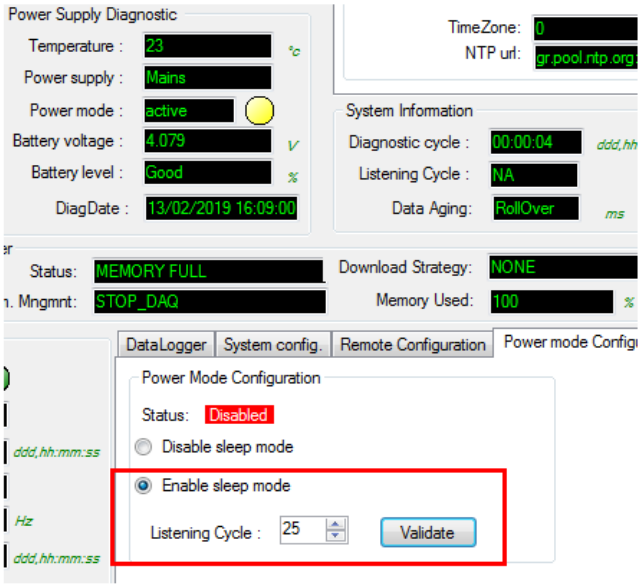


Figure 79: Enable sleep mode

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

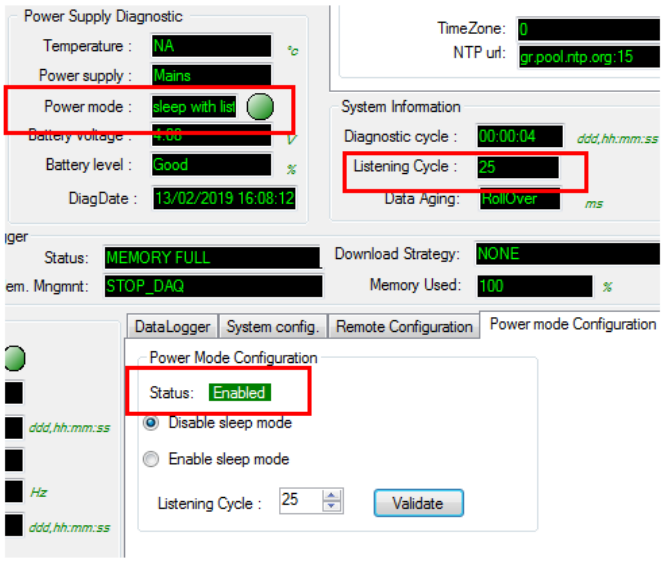


Figure 80: Sleep mode enabled (visual features)

- ***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.

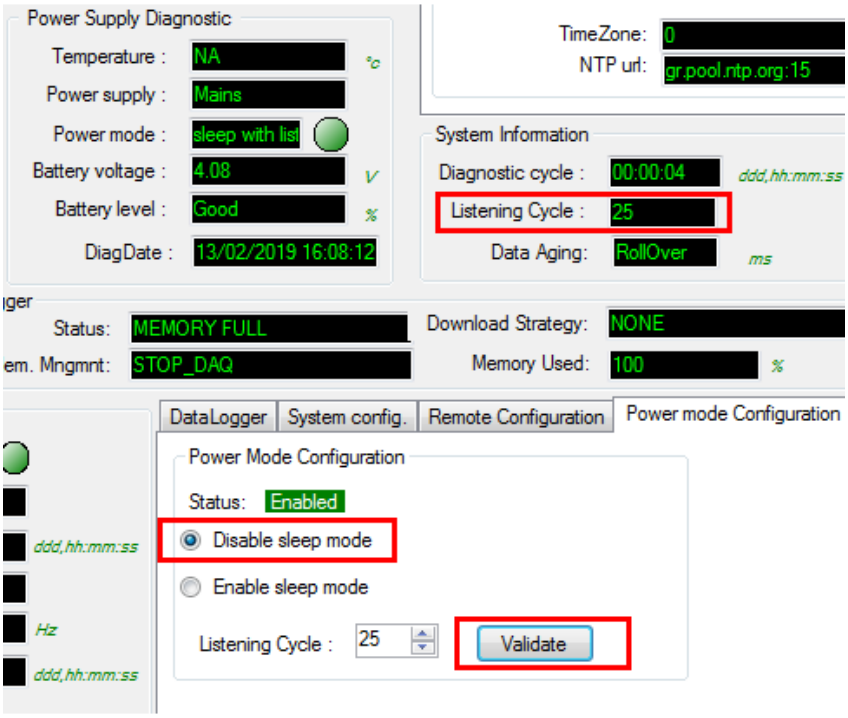


Figure 81: Disable sleep mode

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***

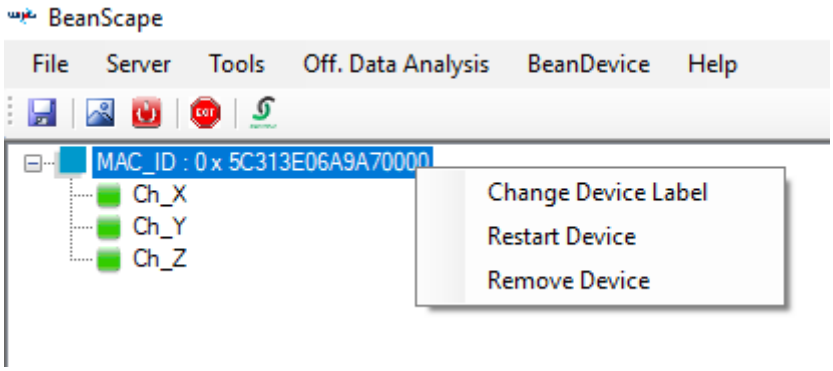


Figure 82: Right Click on BeanDevice® Profile

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

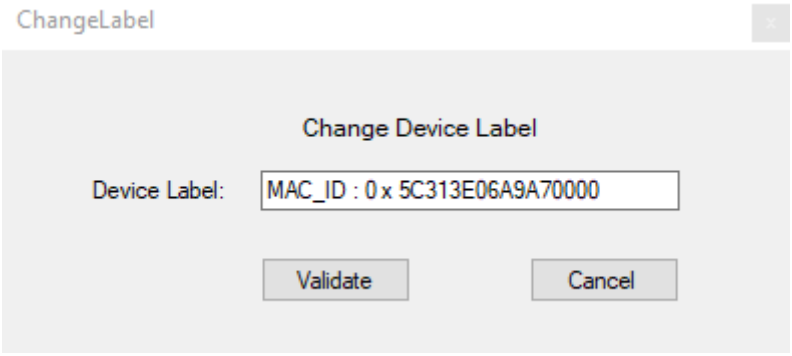


Figure 83: Right click- change label

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.

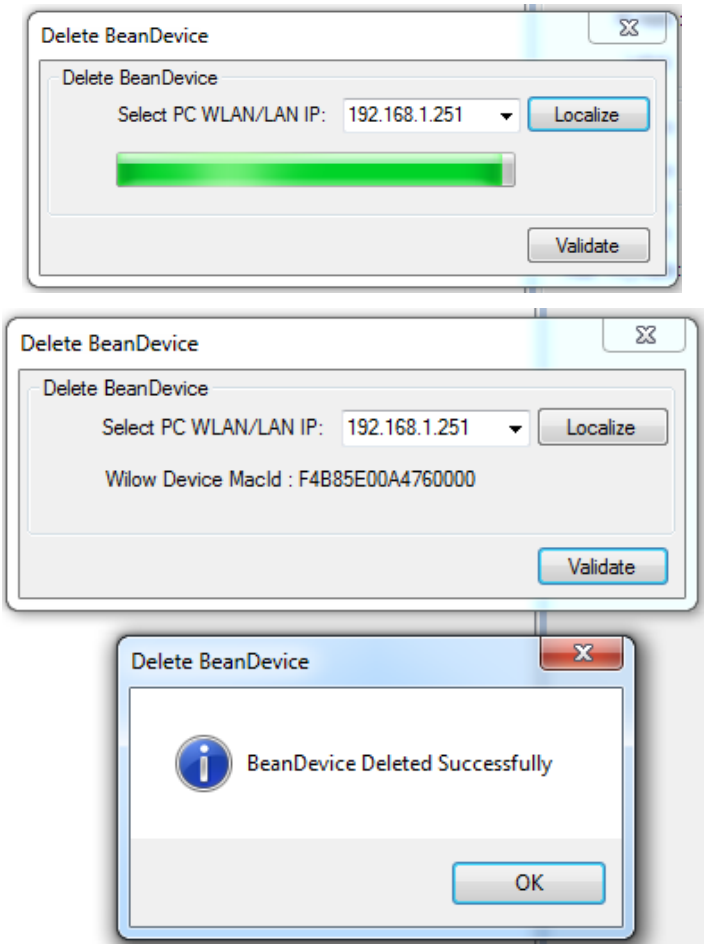


Figure 84: Right click- Remove BeanDevice®

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***

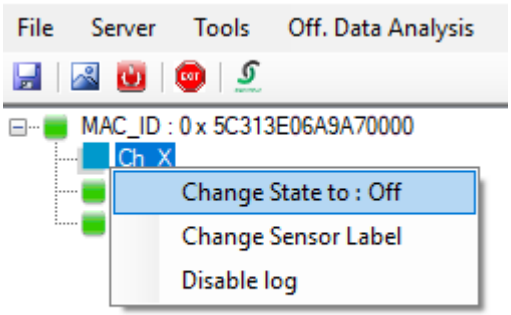


Figure 85: Right click on sensor channel

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.

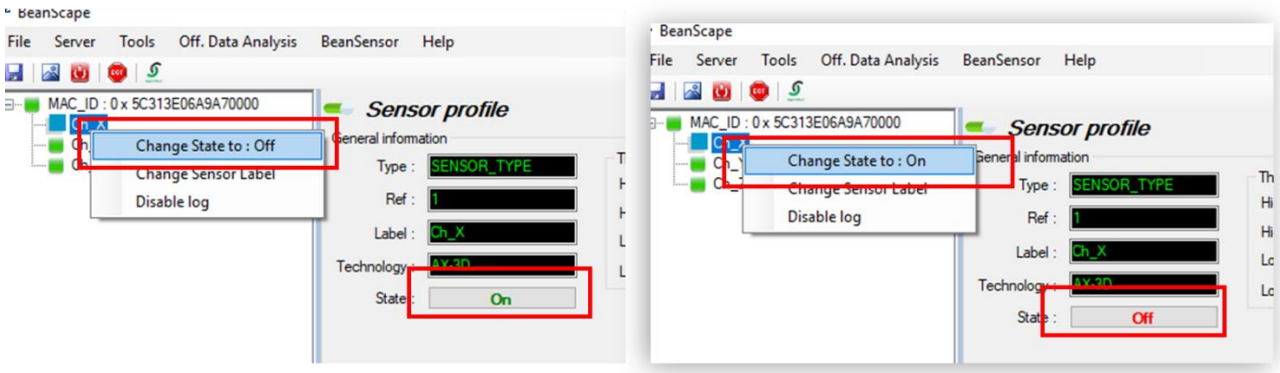


Figure 86: Change Sensor state functionality

Change sensor label: Used rename the sensor channel.

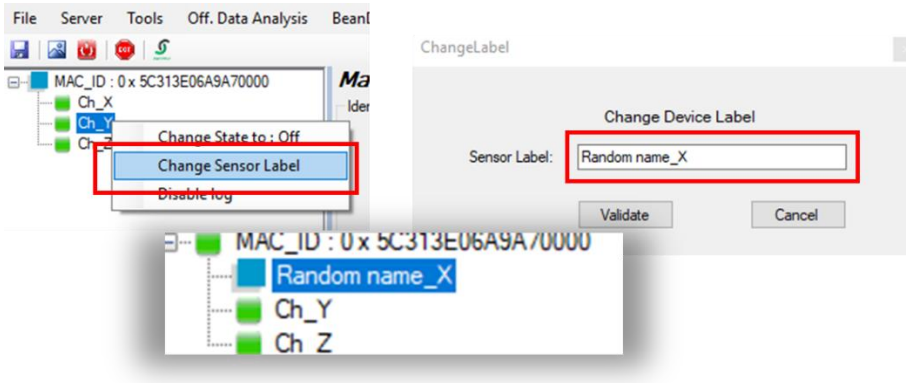


Figure 87: Change sensor label functionality

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.

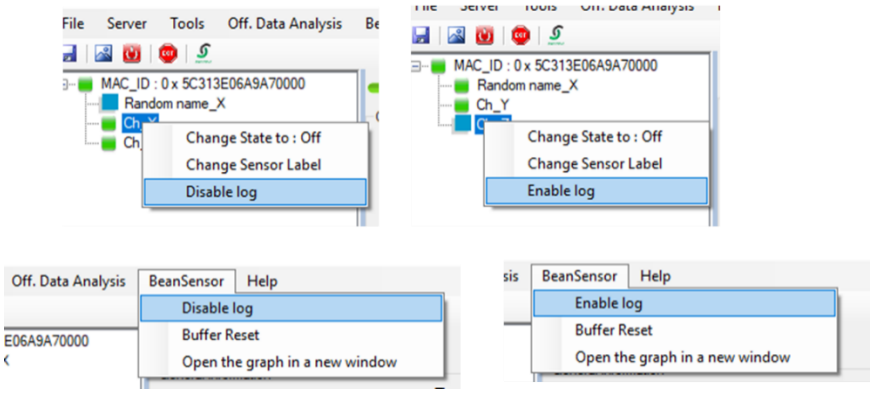
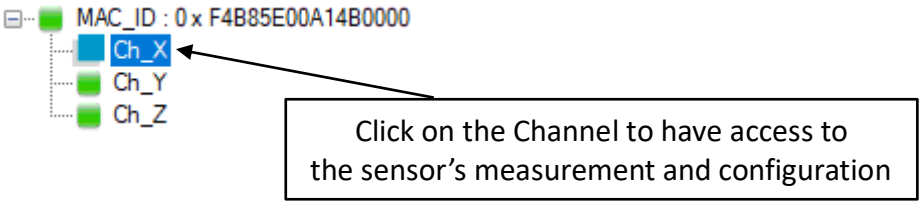


Figure 88: Disable log functionality

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 89: 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®***

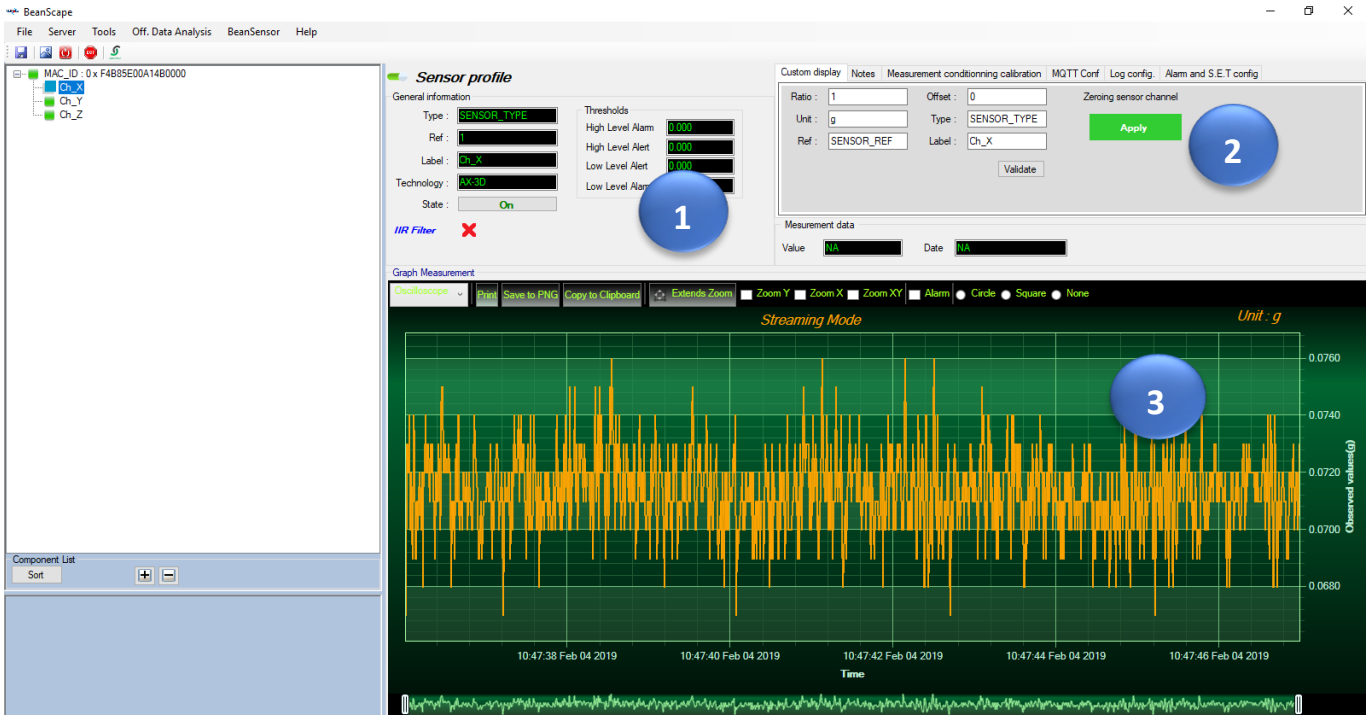


Figure 90: Overview: Sensor channel profile

7.4.1 Sensor channel status

7.4.1.1 Frame : General informations

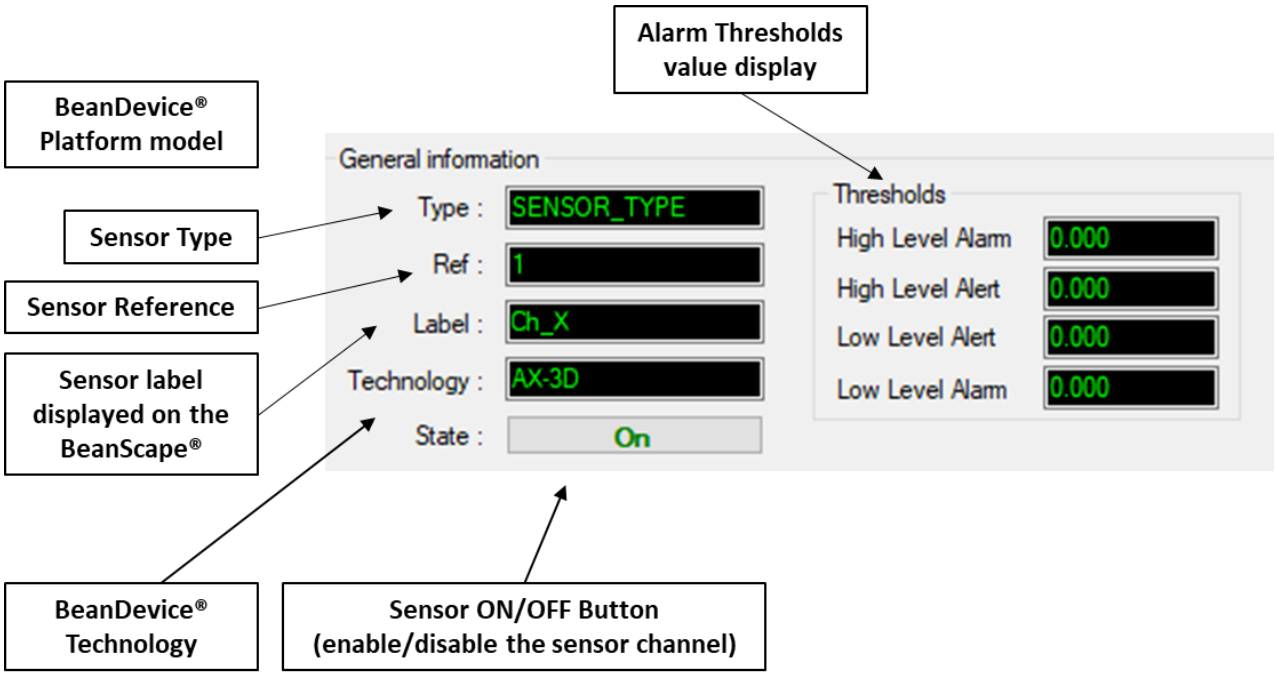


Figure 91: Sensor channel General information frame

7.4.1.2 Frame: Measurement data

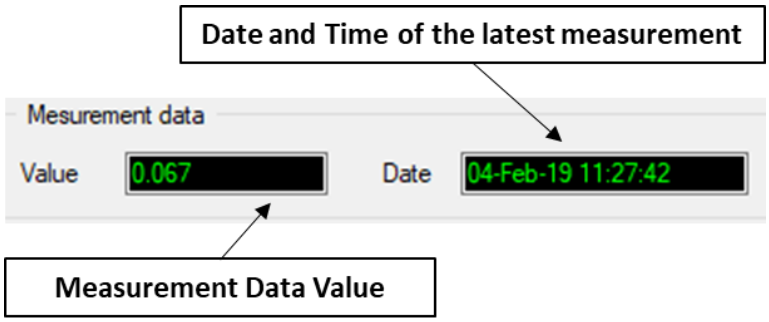


Figure 92: Measurement data frame

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.

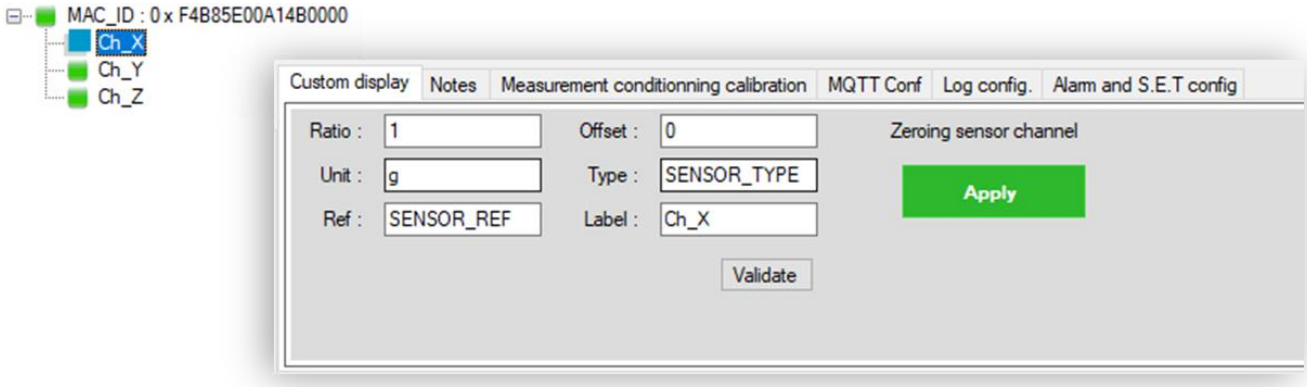


Figure 93: Sensor channel configuration frame

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:

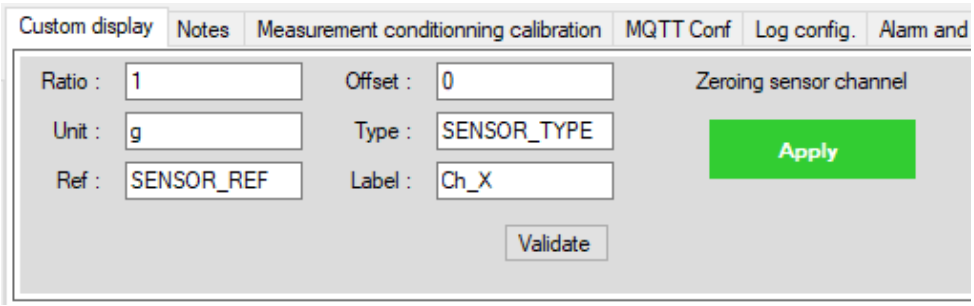
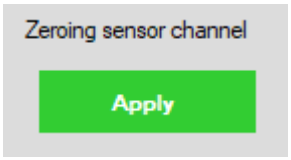


Figure 94: Sensor channel custom display tab

- ✓ ***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

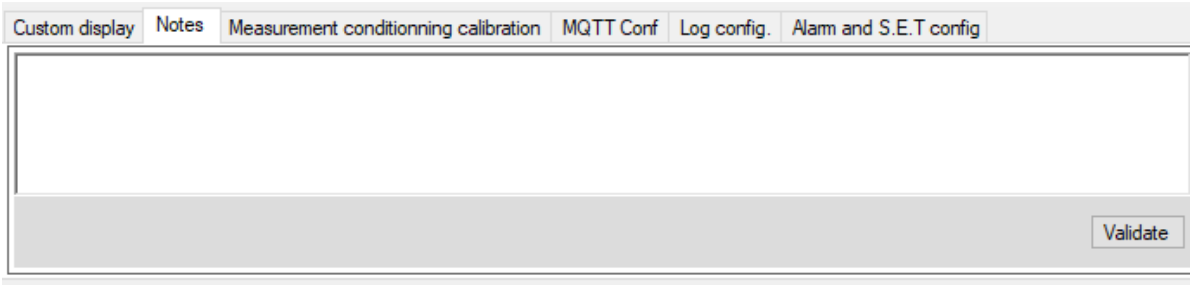
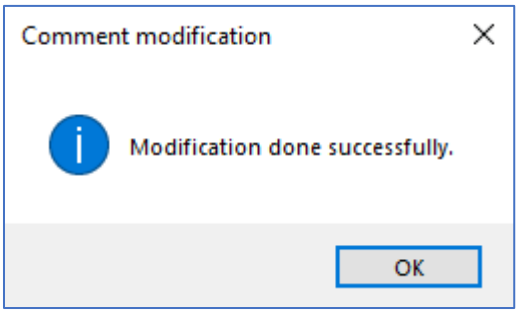


Figure 95: Sensor channel Notes tab

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:

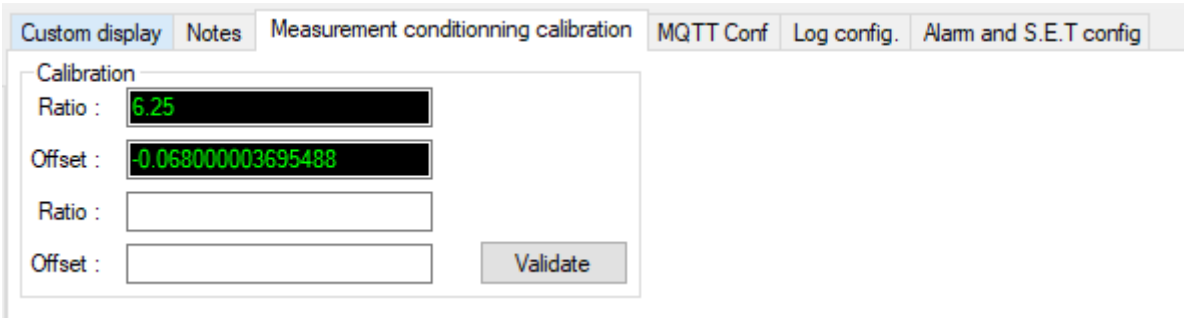


Figure 96: Sensor calibration tab

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

- ***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

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

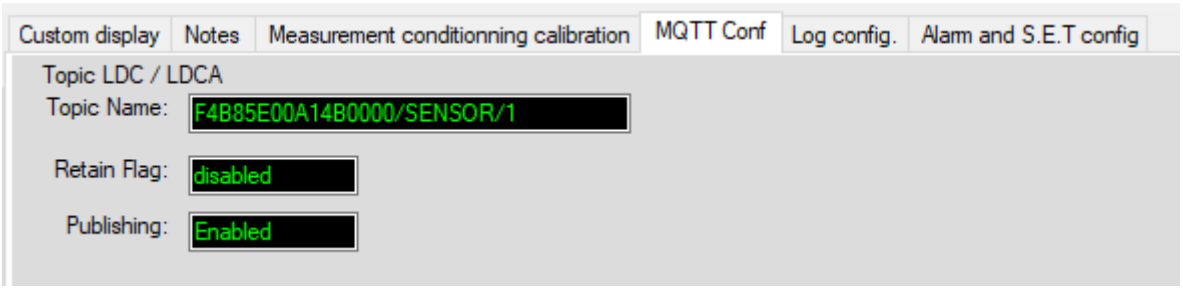


Figure 97: Sensor MQTT configuration tab

- ***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®:

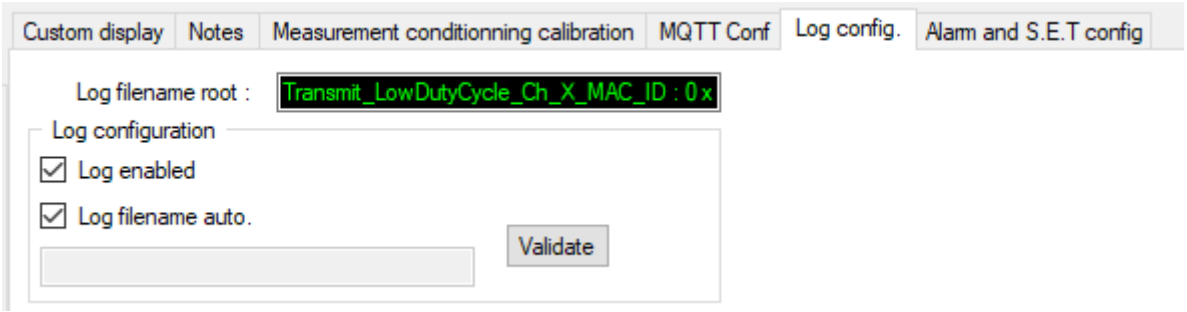


Figure 98: Log configuration tab

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) .

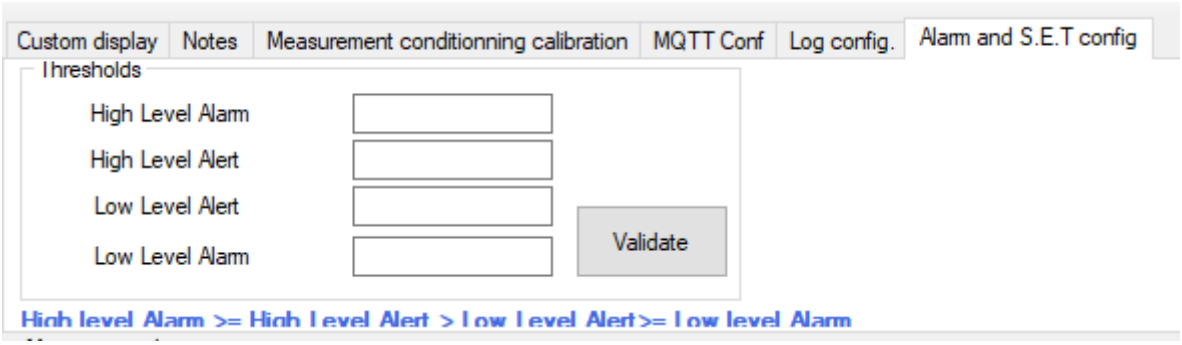


Figure 99: Alarm and S.E.T config tab

In Alarm or S.E.T mode, when a higher low 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

7.4.6 Graphical display

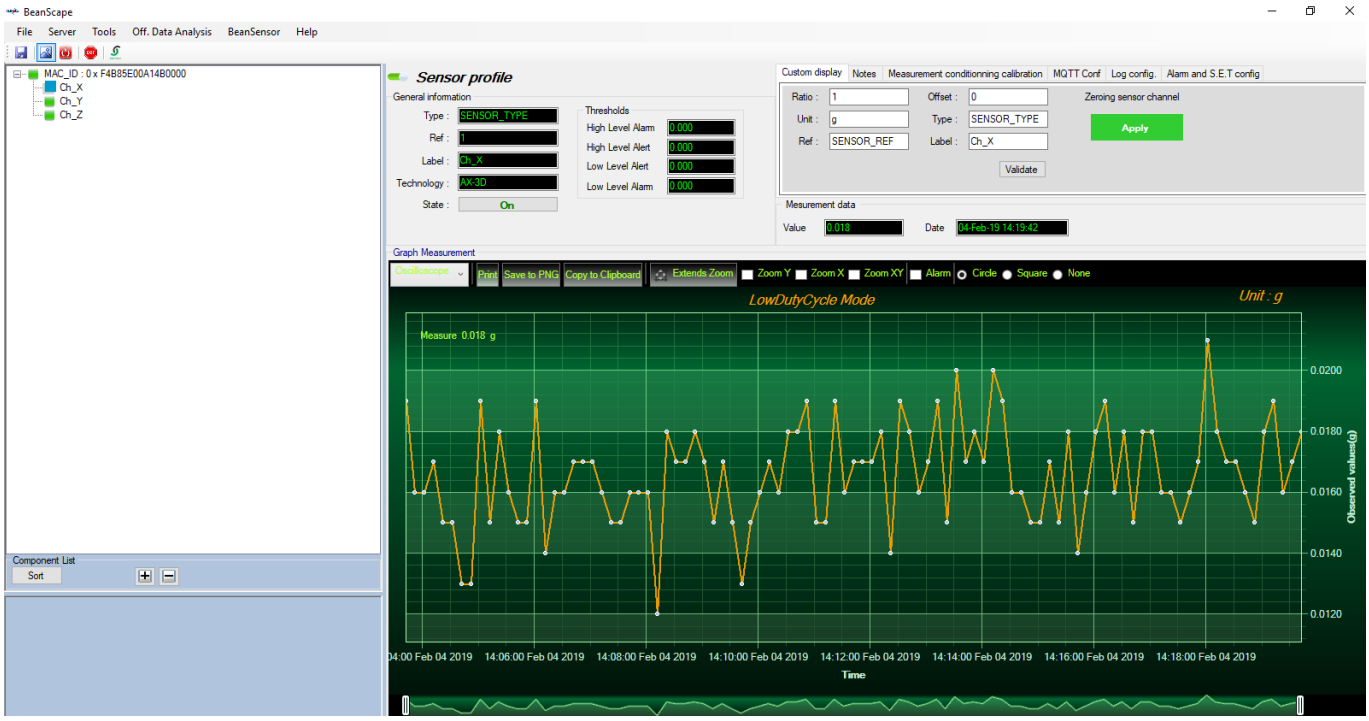


Figure 100: Overview: Channel acquisition graph visualization

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.

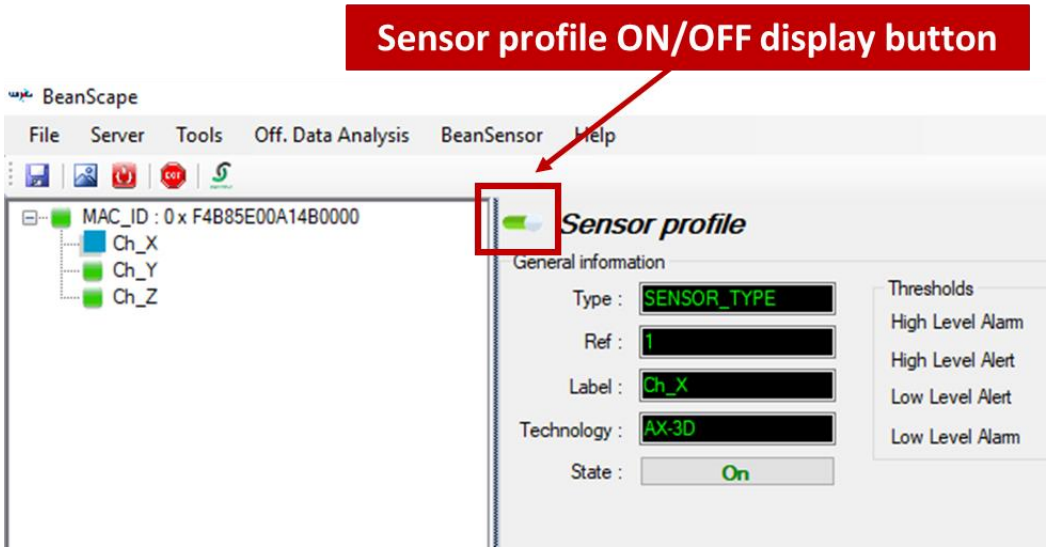


Figure 101: Sensor profile ON/OFF display button

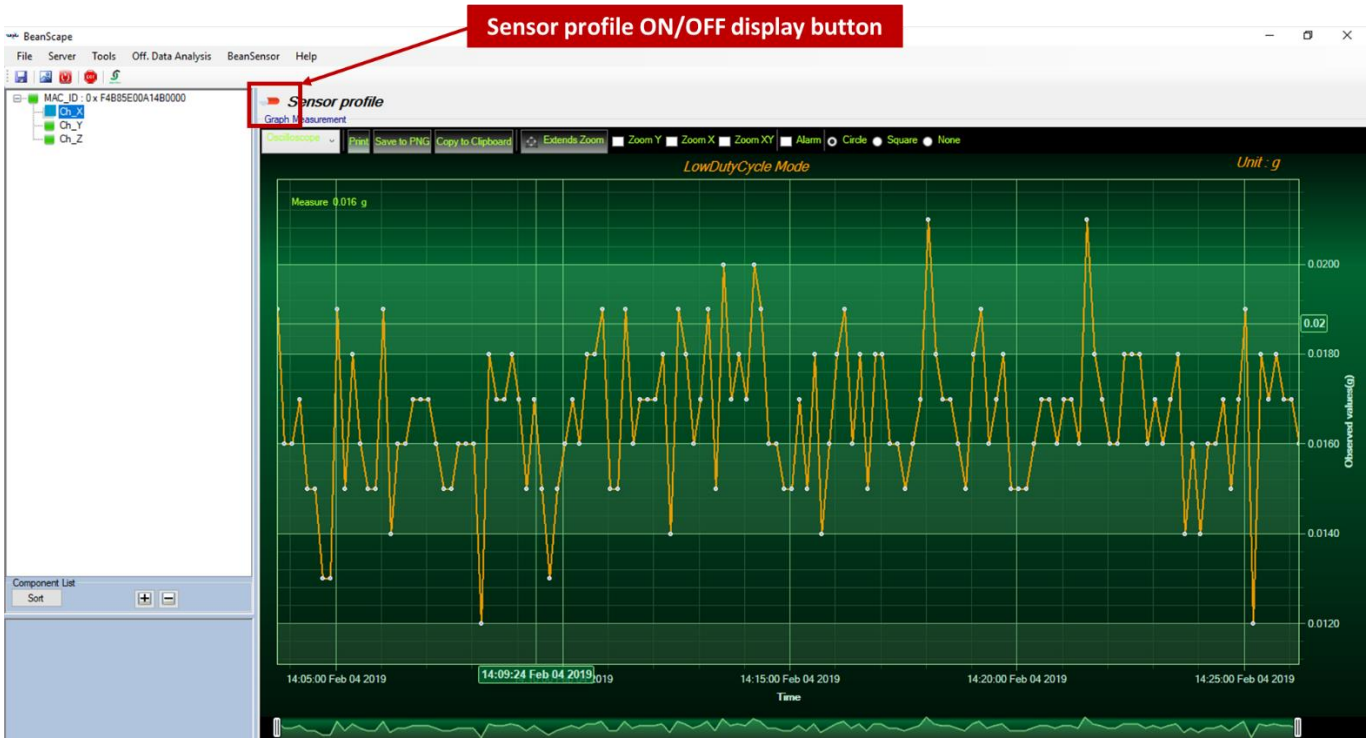
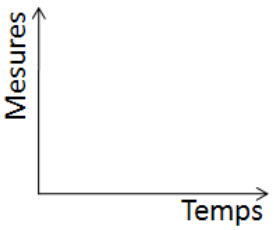


Figure 102: Wide view of the graph

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.

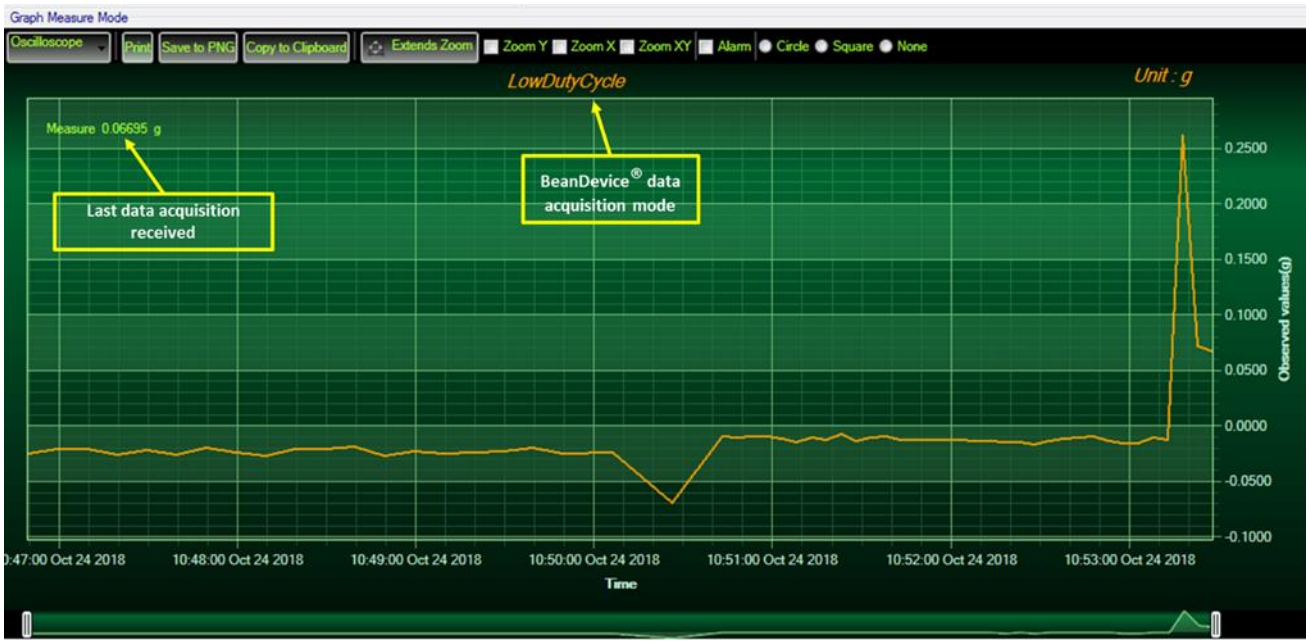


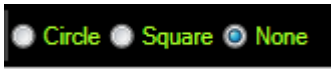
Figure 103: Example: Graph visualization

7.4.6.1 Frame: Display

Figure 104: Graph measure mode: Frame Display

7.4.6.2 Frame: Marks

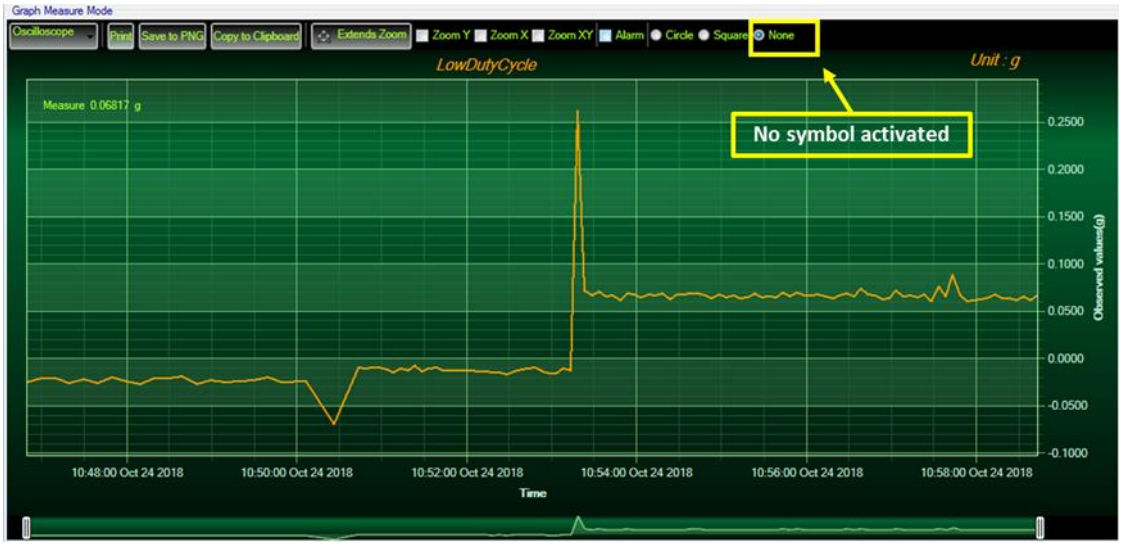
From this frame you can select the display mode of action of the chart. Three types of symbols are available:



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



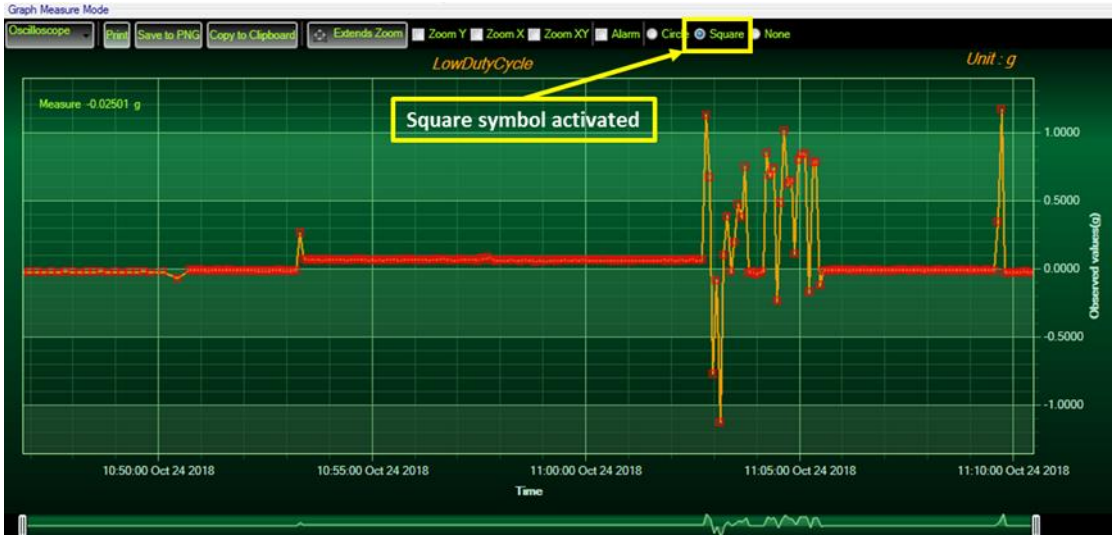


Figure 105: Graph measure mode: Frame Marks

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 DataDatalogger 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

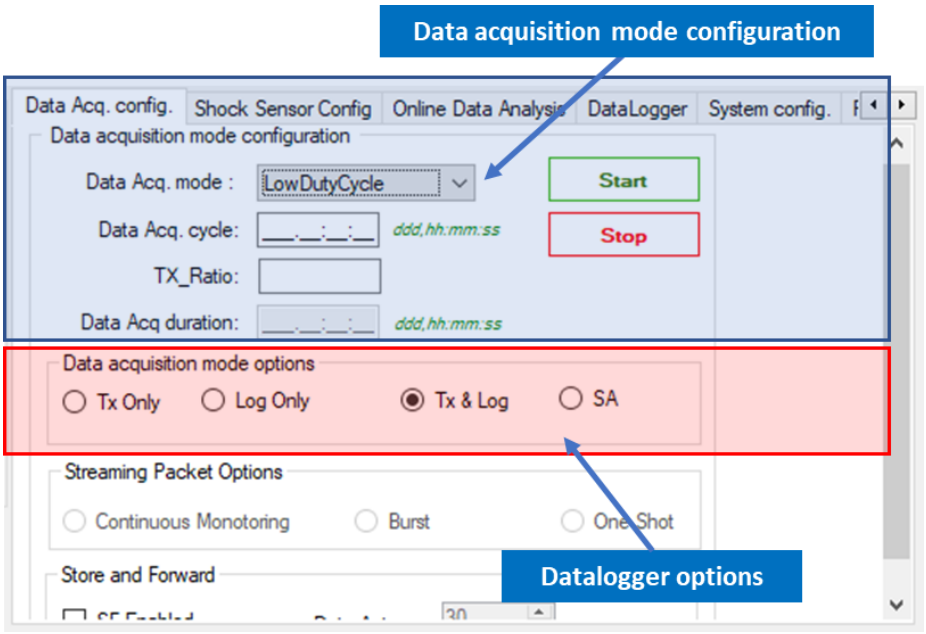


Figure 106: Tab: Data acquisition configuration

- ***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 DataDatalogger.

7.5.3 Configure a data acquisition mode with Datalogger

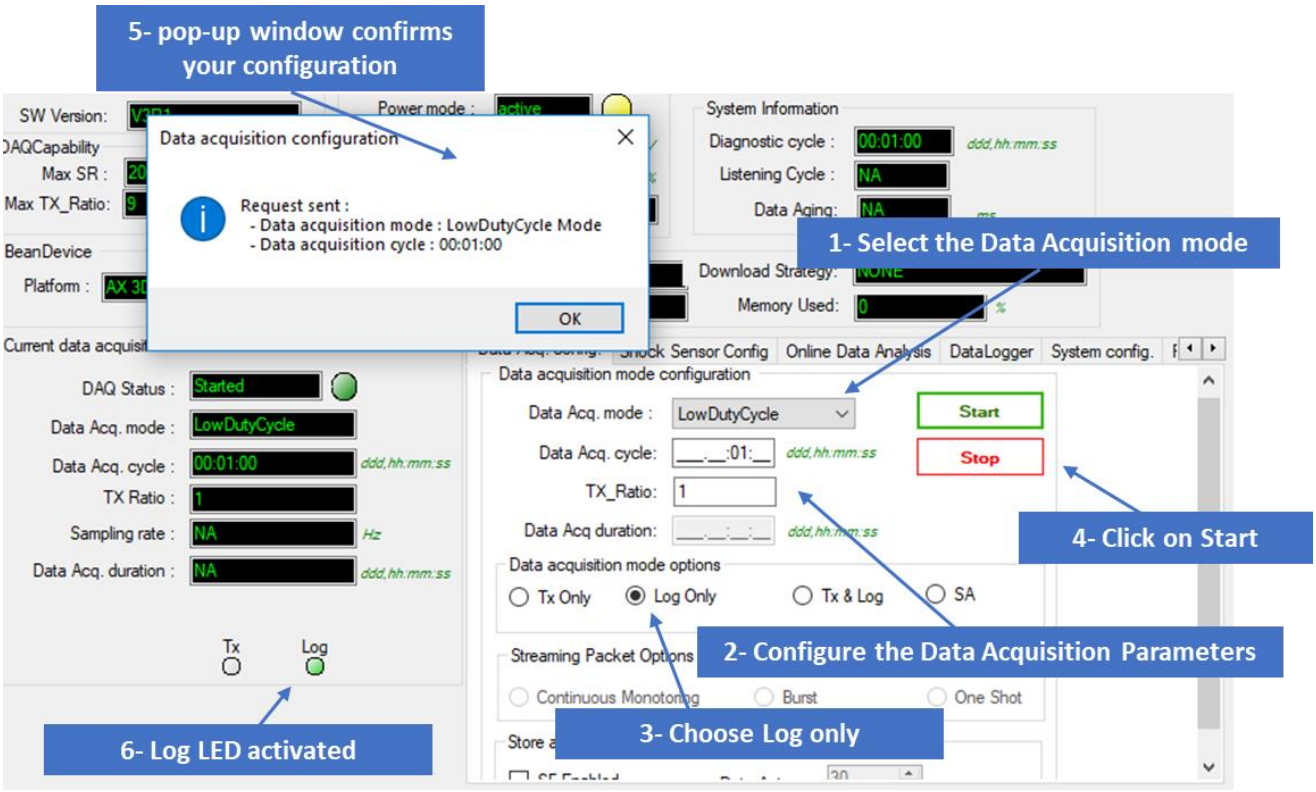


Figure 107: Overview: Data acquisition configuration scenario

7.5.3.1 LDCDA mode with Log only data logging option

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

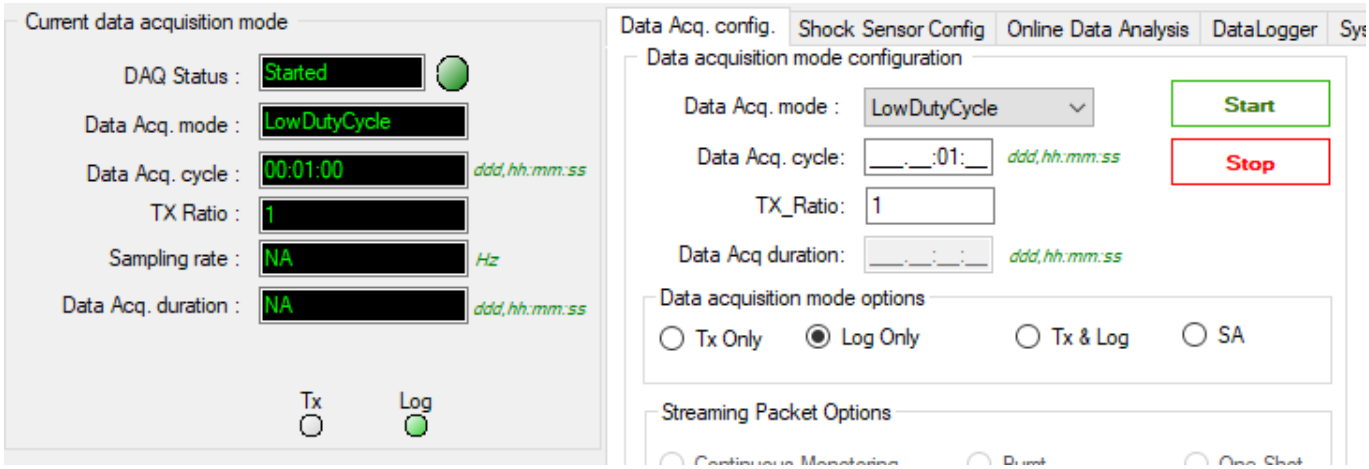


Figure 108: BeanDevice Configured with LDCDA mode with LOG only

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

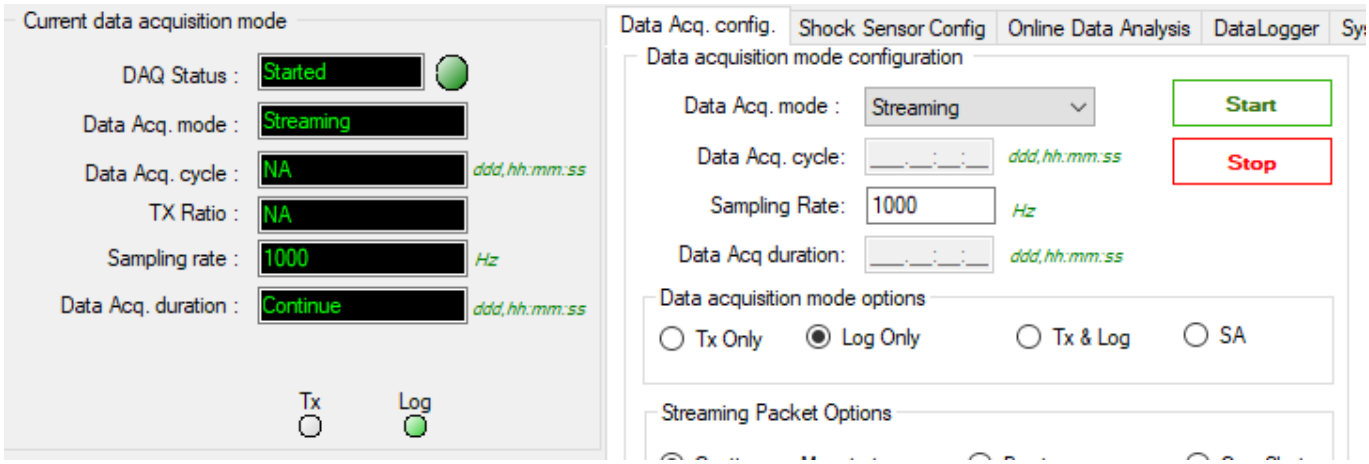


Figure 109: BeanDevice Configured with streaming mode with LOG only

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 connects 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

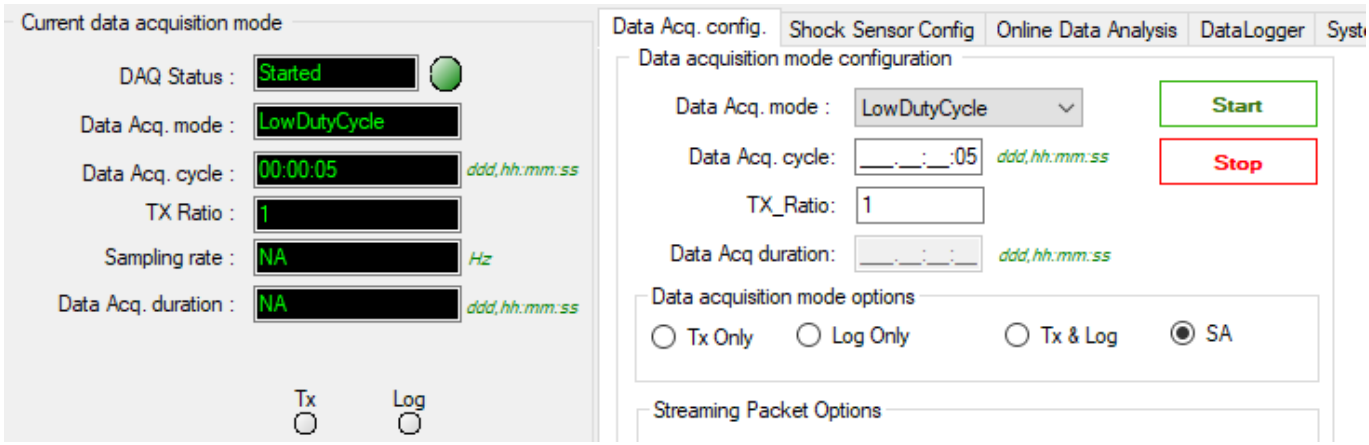
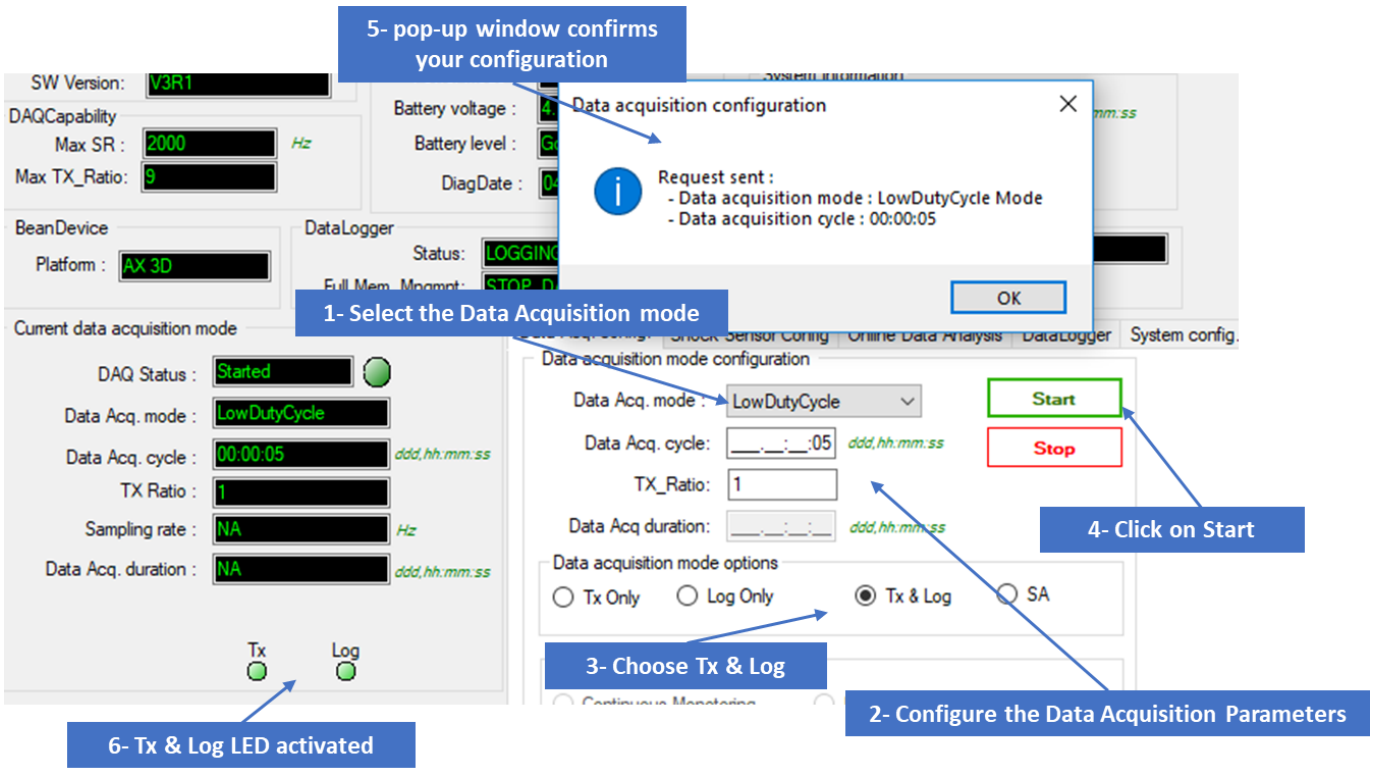


Figure 110: BeanDevice Configured with LDCDA mode with Stand Alone

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®

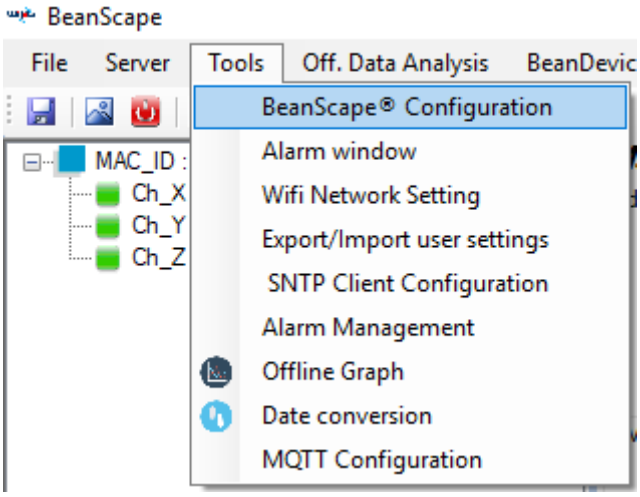


Figure 111: BeanScape® configuration menu

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

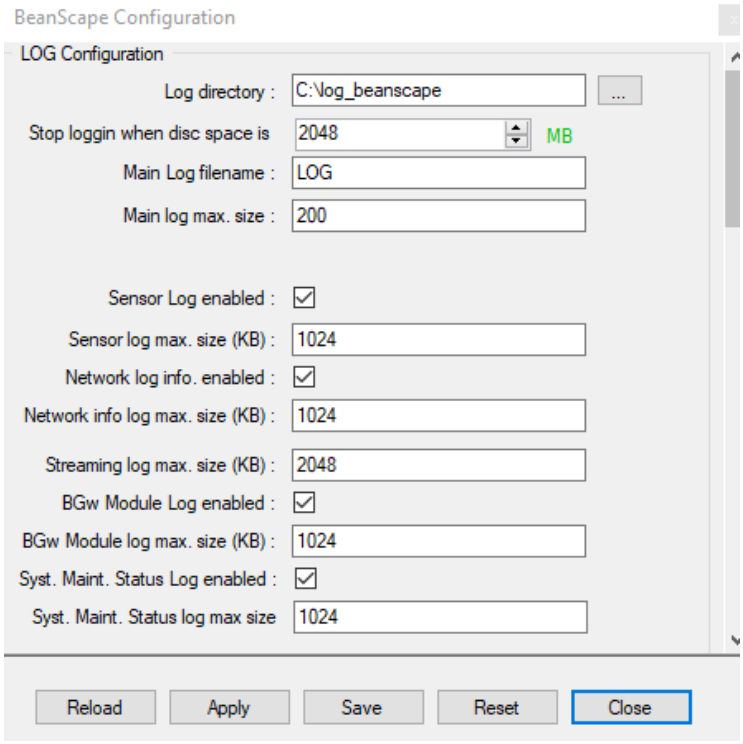
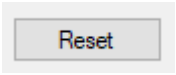


Figure 112: BeanScape® configuration window

- ✓ ***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:

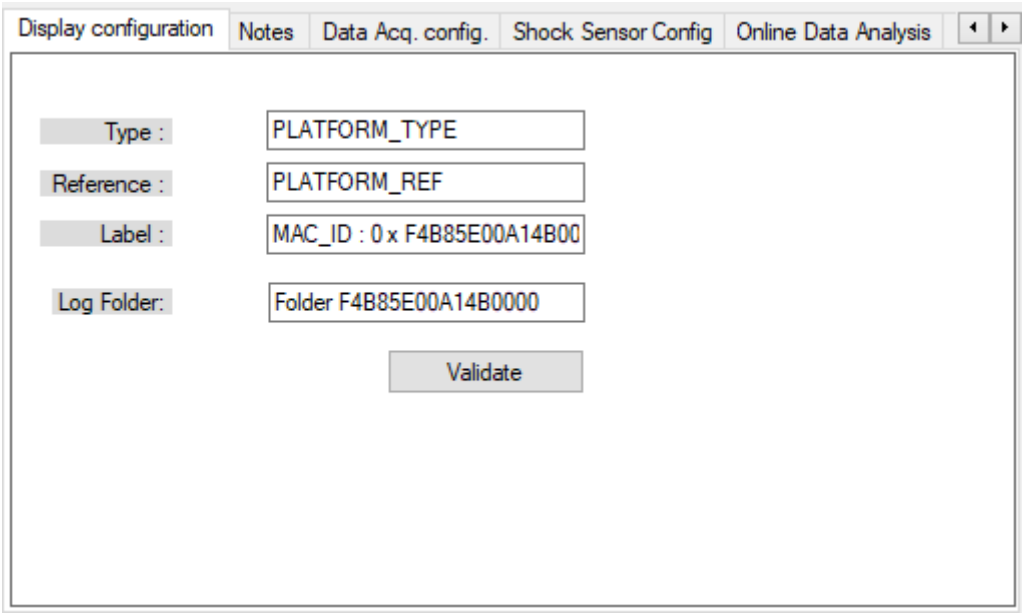
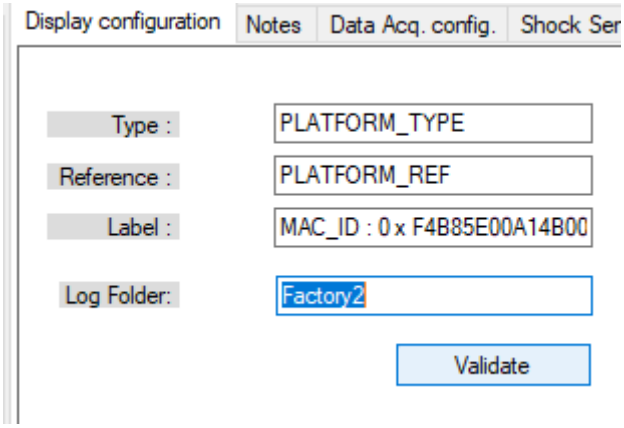


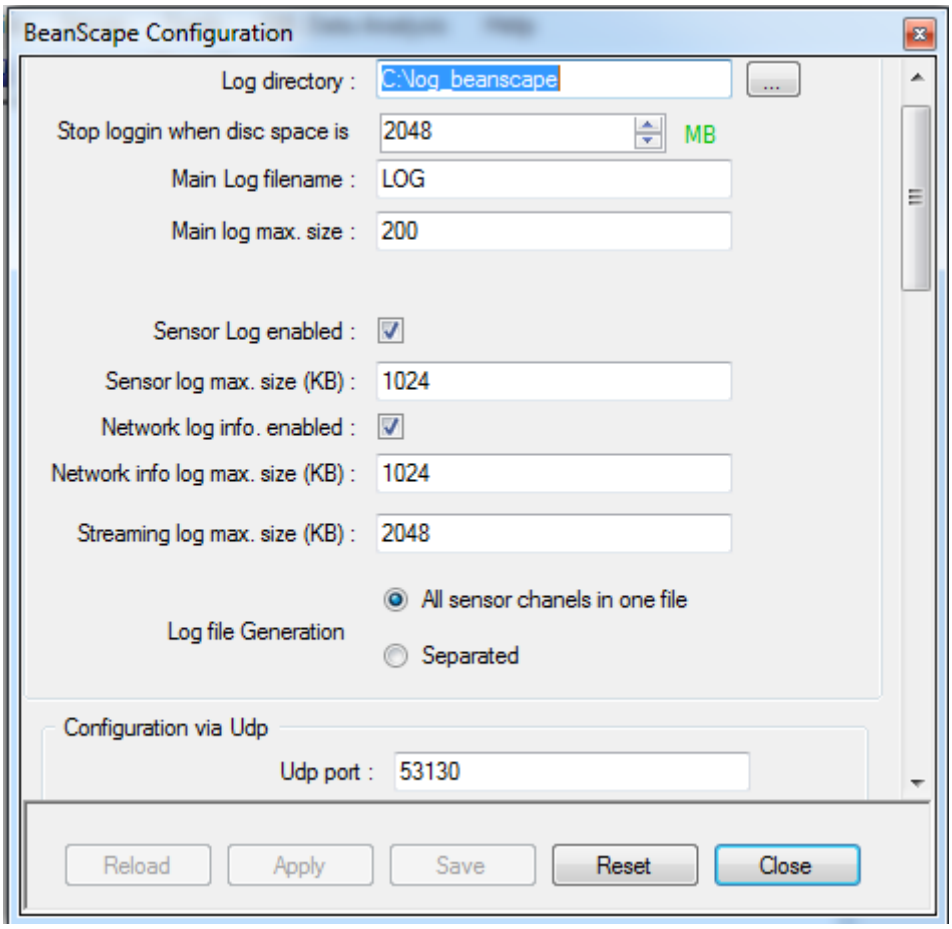
Figure 113: BeanDevice®Custom Display tab

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®.

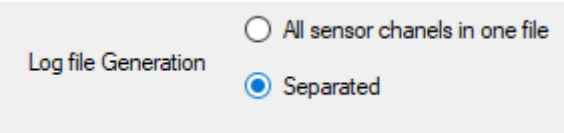


Figure 114: Log file generation option

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.

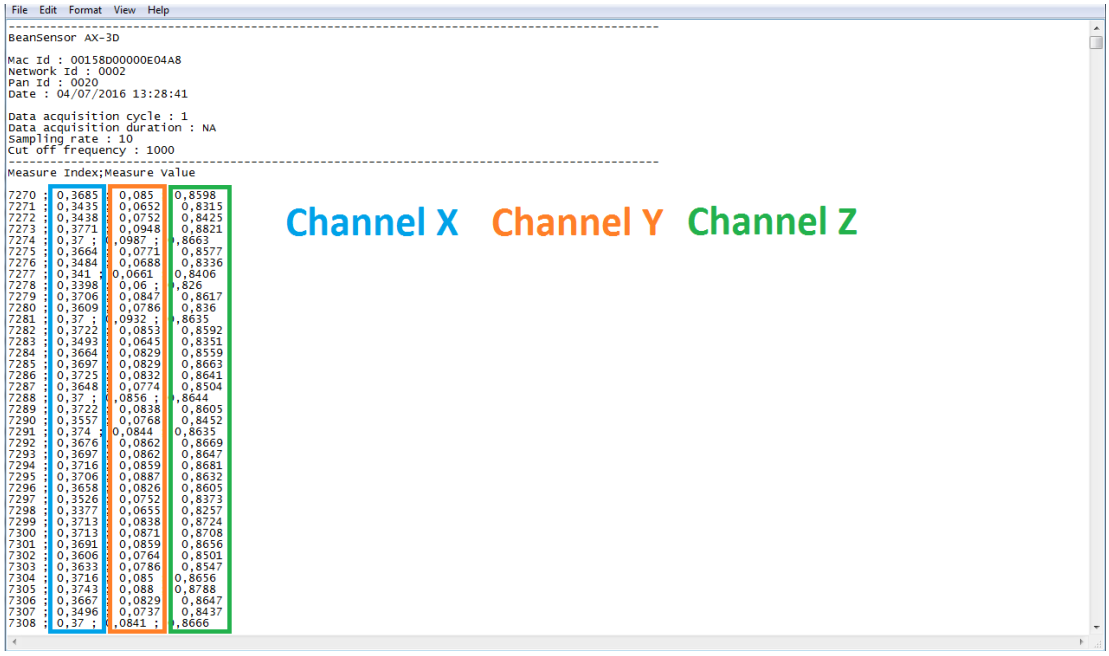


Figure 115: Example of Log file

8.1.5 Cache Data configuration (for Graph)

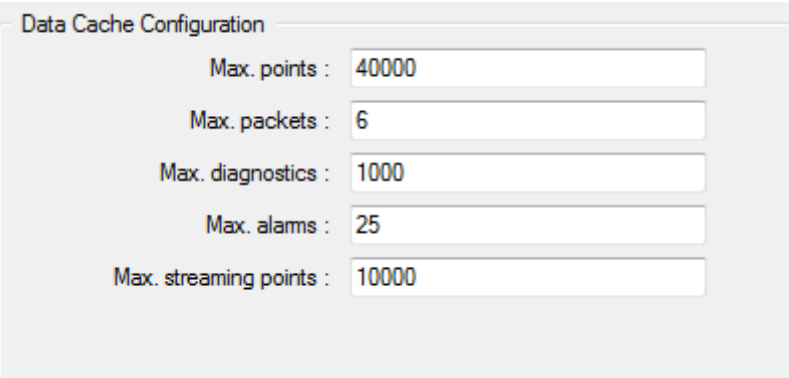


Figure 116: Data cache configuration options

- ✓ ***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:

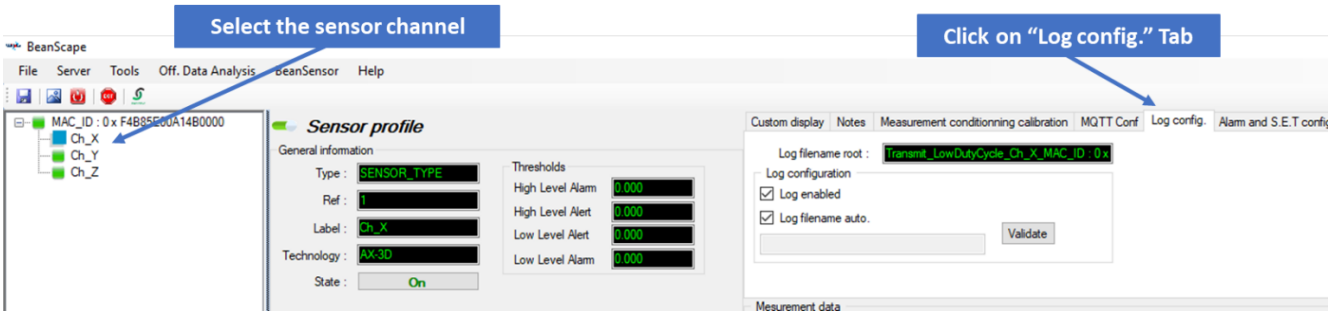


Figure 117: Overview: Log Config tab on BeanScape®

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

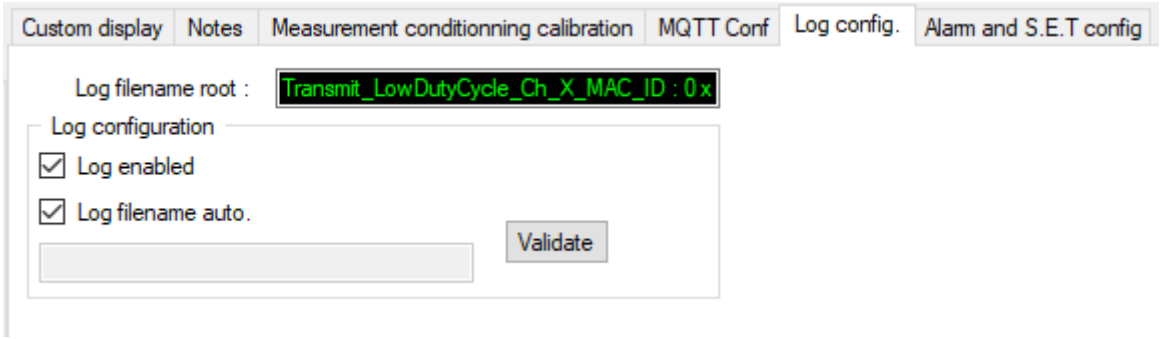


Figure 118: Log Config tab

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: <Label><Sensor channel Number> <MAC_ID>***
Solution 2	***The log file name can be fully customized: 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

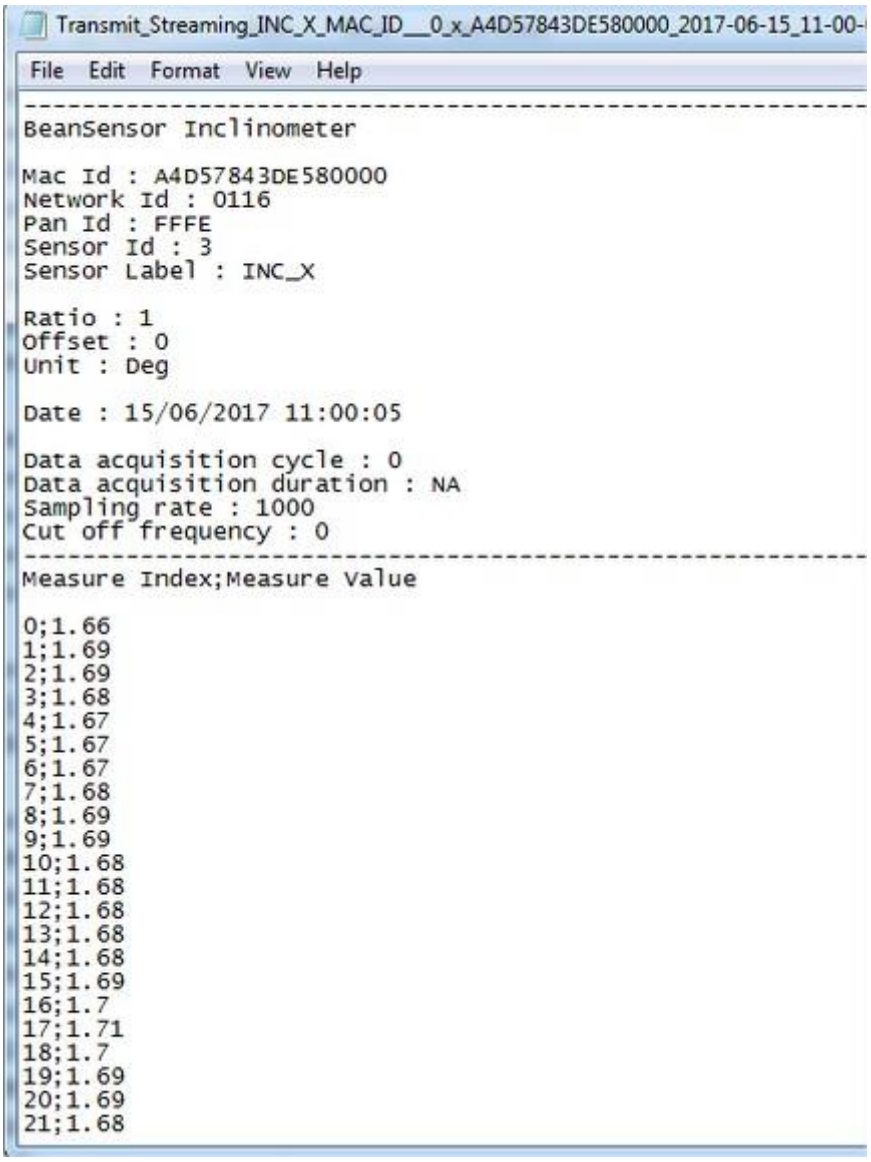


Figure 119: Log file example

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 120: Log file example

Once downloaded, the user will got 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

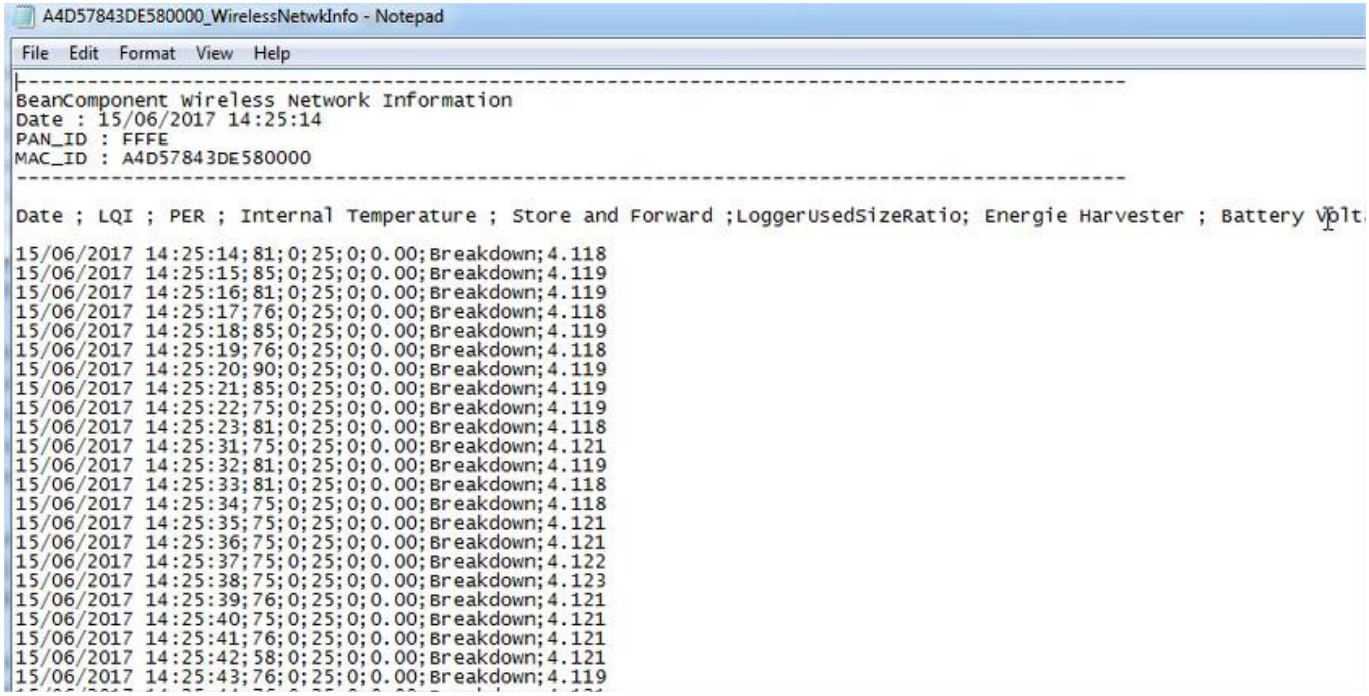


Figure 121: Wireless Network Info log file

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

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

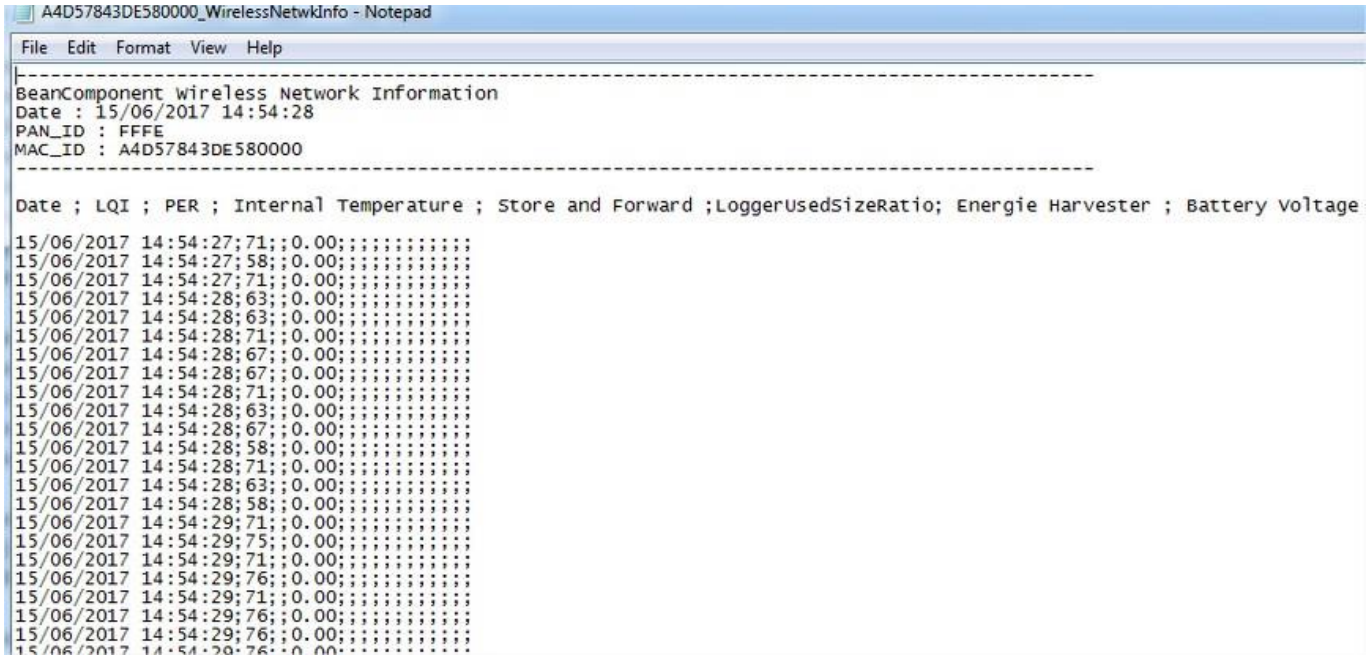
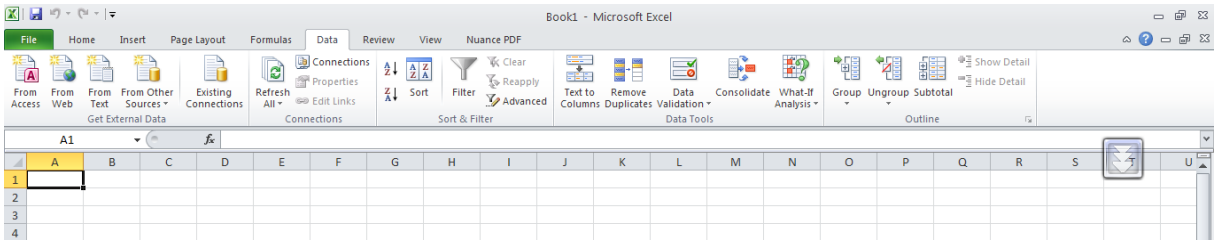


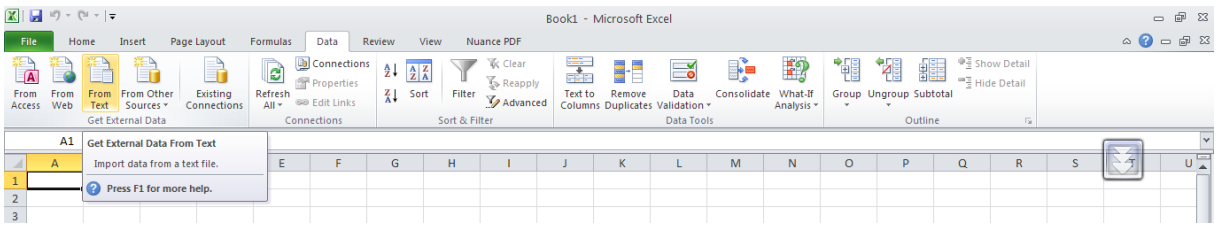
Figure 122: Wireless Network Info log file

8.1.8.3 How to open a measurement file with excel

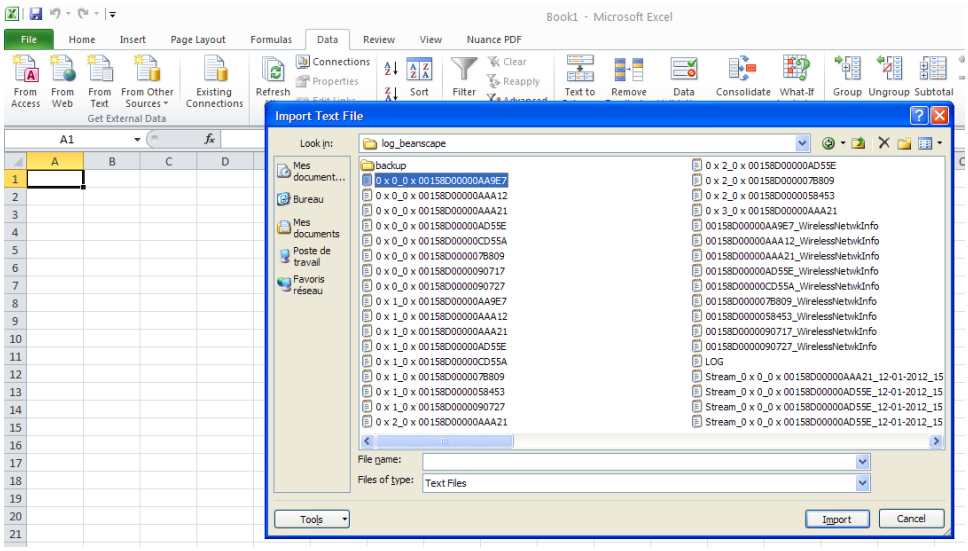
Step 1 : Open Excel



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

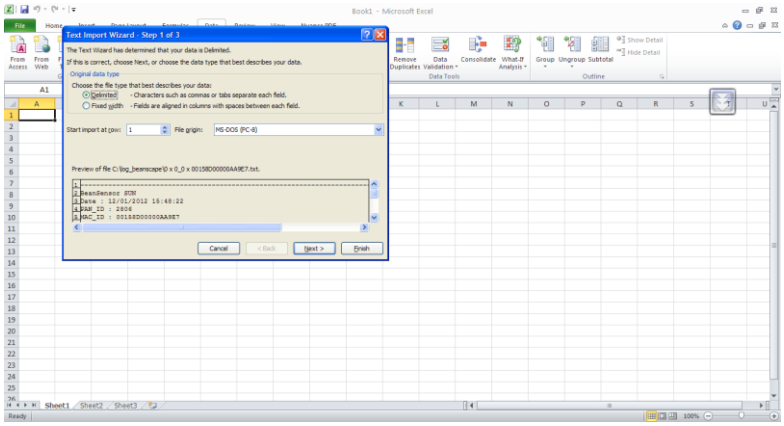


Step 3 : Choose your log file

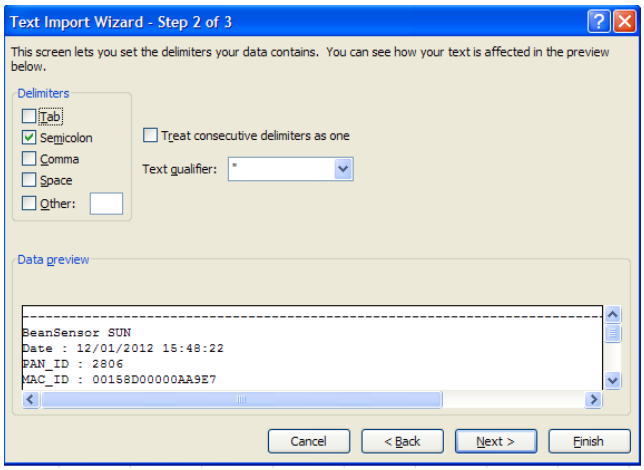


Step 4 : Text import wizard will open, select « Delimited » for Characters such as commas or tabs separate each field.

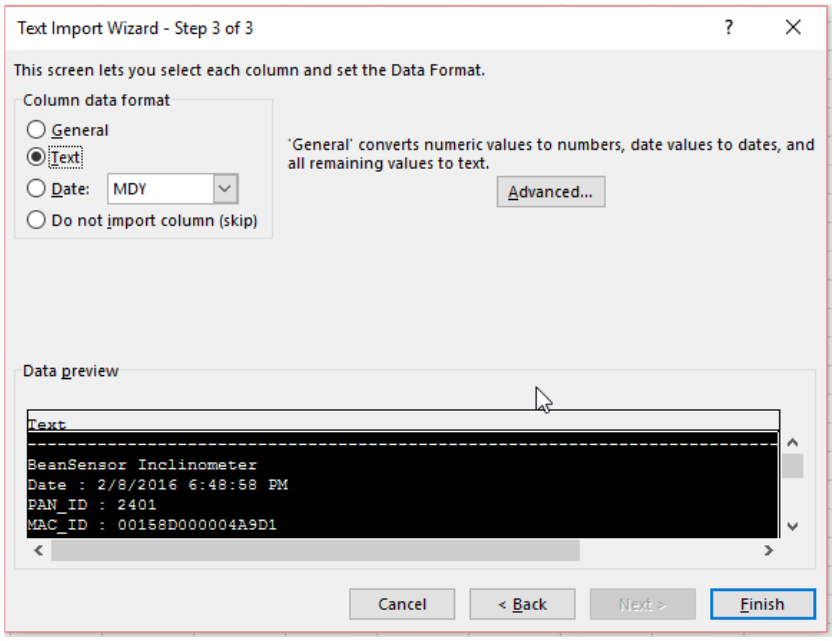
On "*Start import at row*" field: Select the number of lines that you want to suppress from the header:



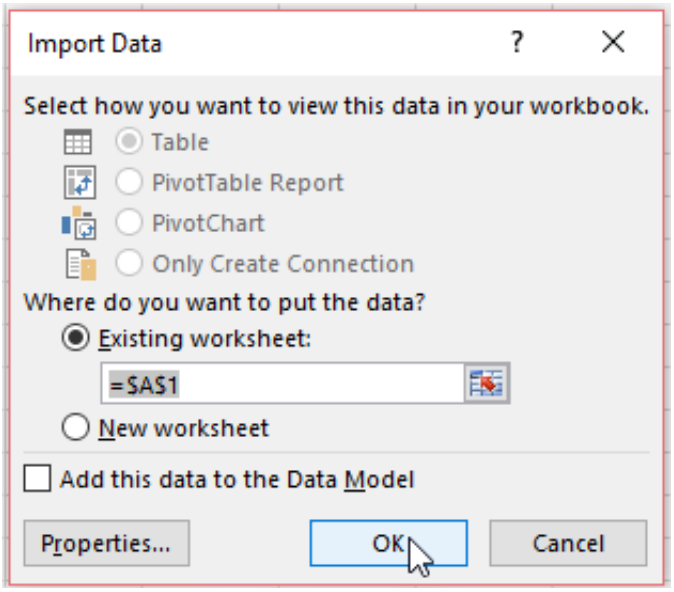
Select semicolon



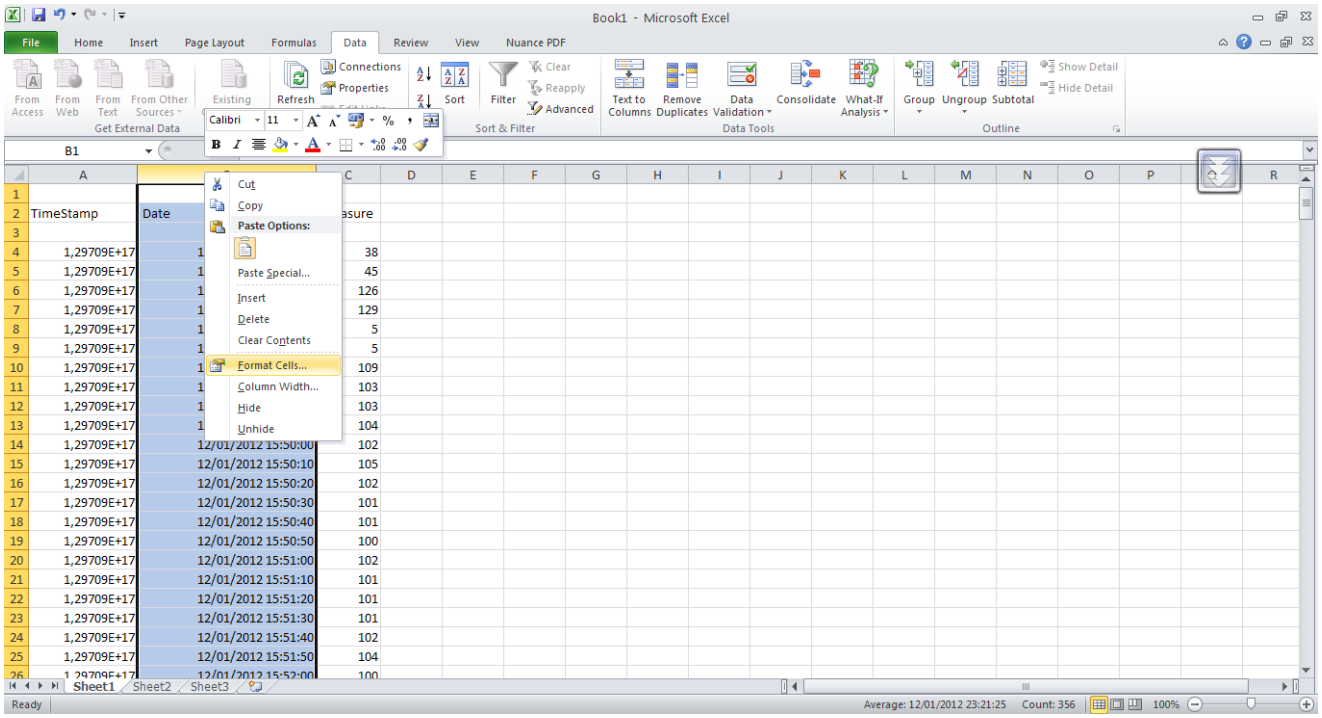
Select Text



Click on OK



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

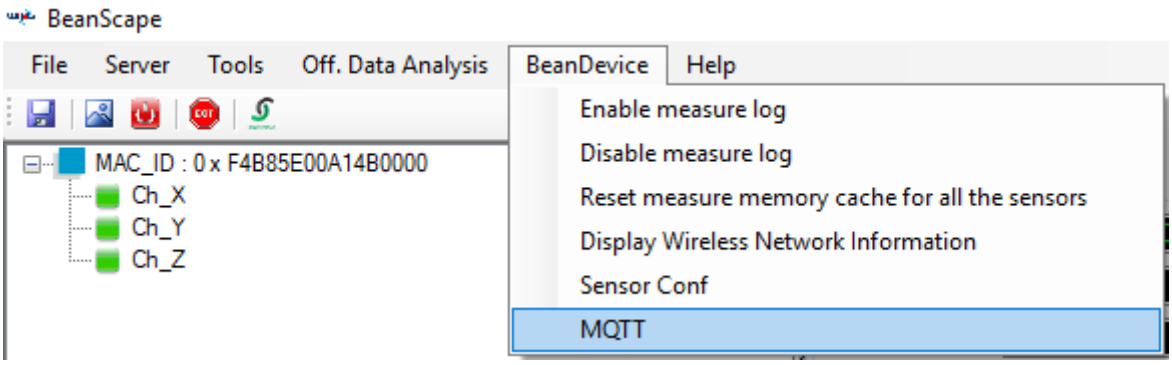


Figure 123: BeanDevice menu

An MQTT Module window will pop up.

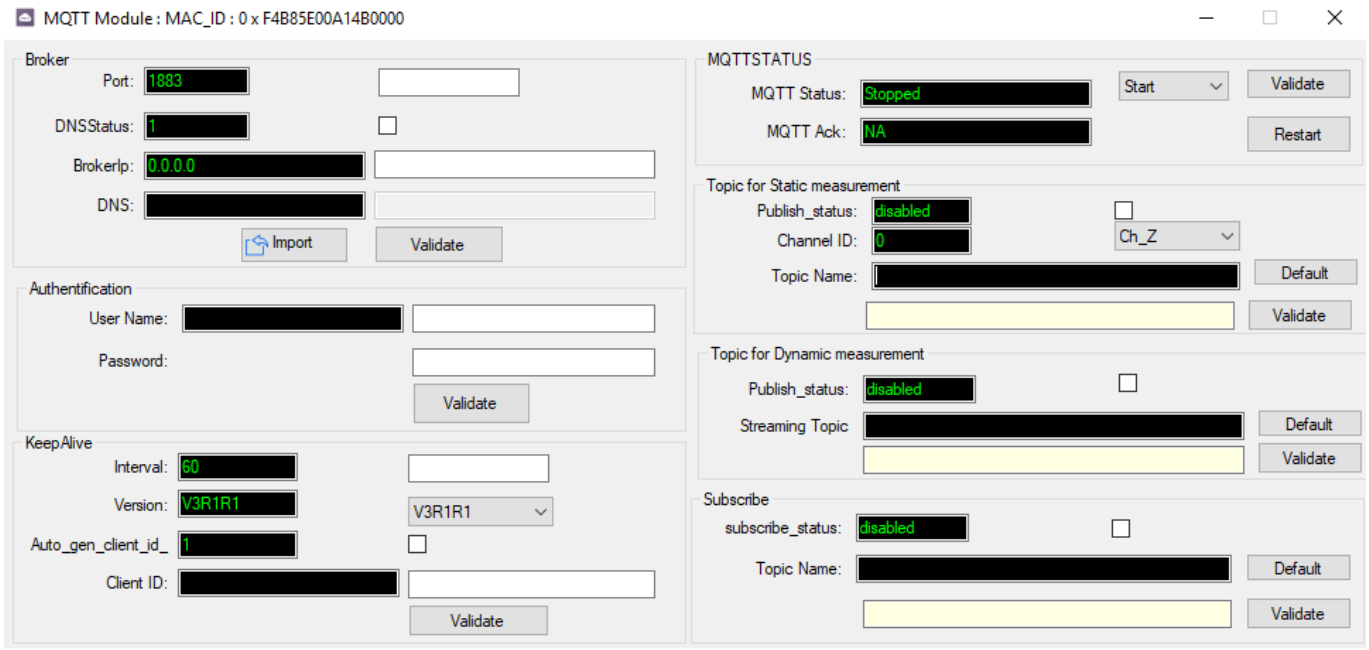


Figure 124: MQTT Module window

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.

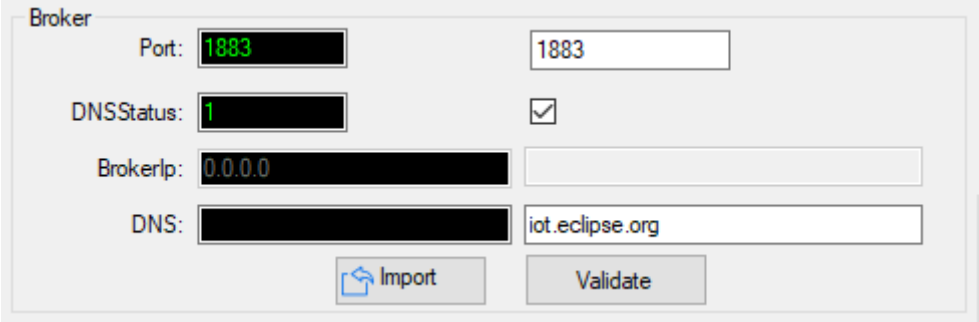


Figure 125: Broker frame

- ***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

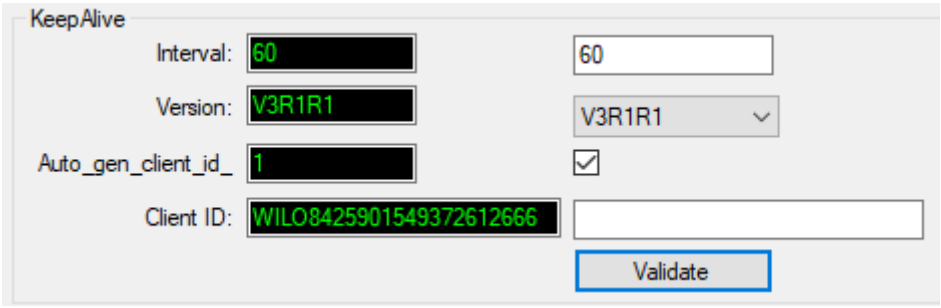


Figure 126: Keep alive frame

- ***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 127: Authentification frame

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

9.4 MQTT STATUS

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

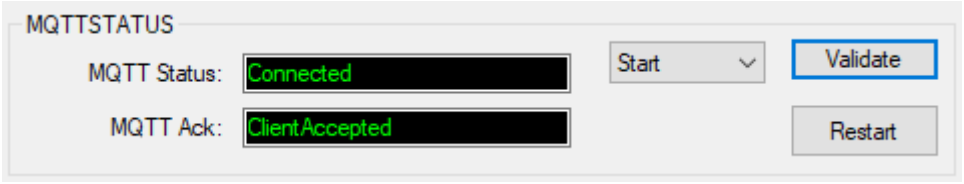


Figure 128: MQTT Status frame

- ***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

9.5 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,

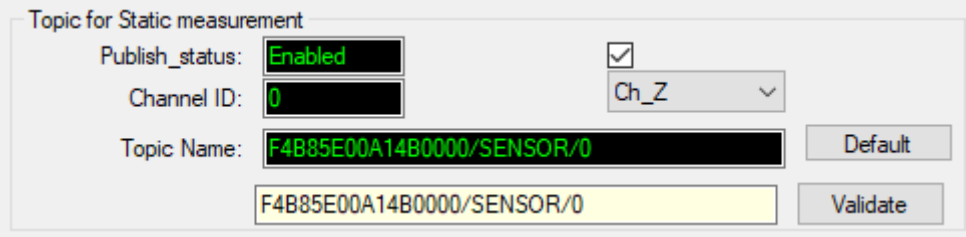


Figure 129: Topic for static measurement frame

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

9.6 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,

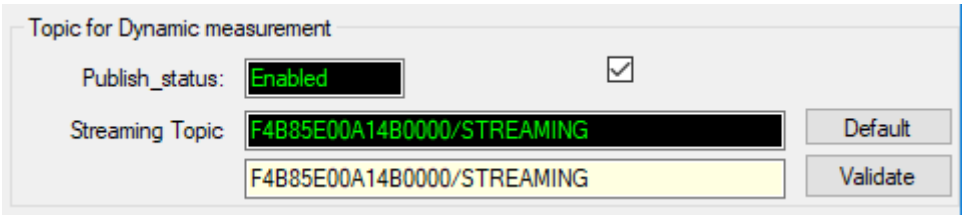


Figure 130: Topic for dynamic measurement frame

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

9.7 SUBSCRIBE

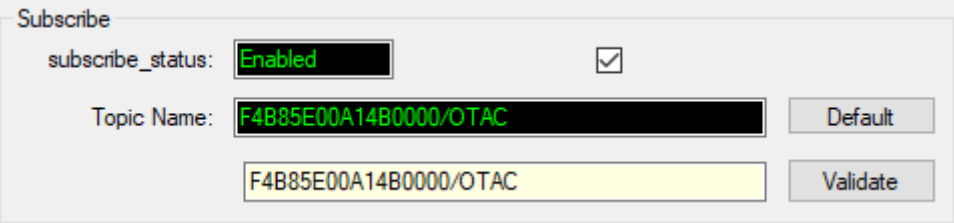


Figure 131: Subscribe

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

10. ONLINE AND OFFLINE DATA ANALYSIS TOOL (AVAILABLE ONLY ON BEANDEVICE® WILOW® AX-3D)

10.1 OFFLINE DATA ANALYSIS TOOL

10.1.1 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..

10.1.1.1 FFT File Generation

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.

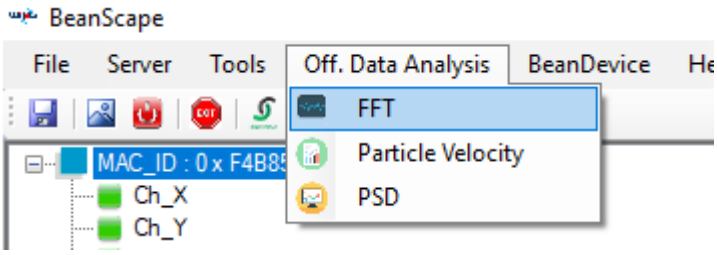


Figure 132: FFT offline data analysis on BeanScape® top menu

A new pop up window will appear, where the user is invited to browse Tx files to be treated and graphically displayed.

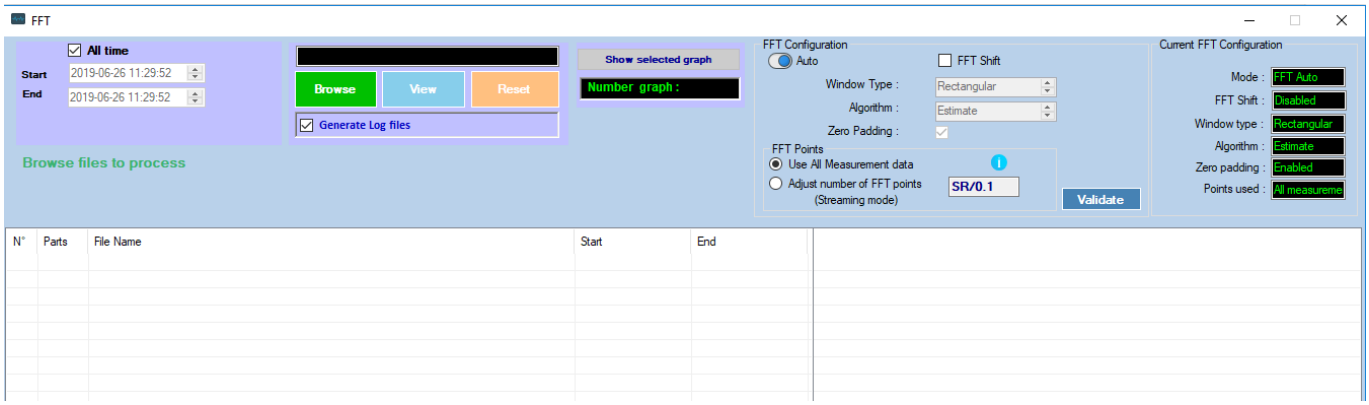


Figure 133: FFT tool window

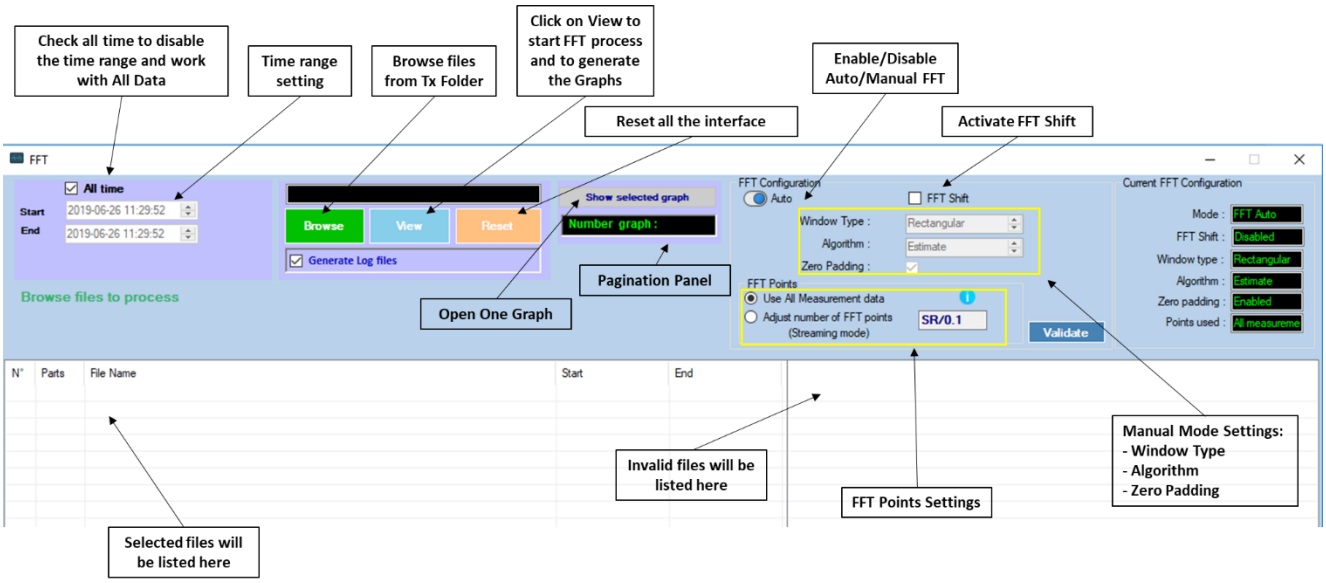


Figure 134: FFT window options

To import the files containing the logged measurement, the user should click on Browse, then import the files from log_beanscape folder, where Tx files are saved.

The FFT tool will generate as a result:

o Power spectral density and a new window displays

1: Click on Browse to choose files

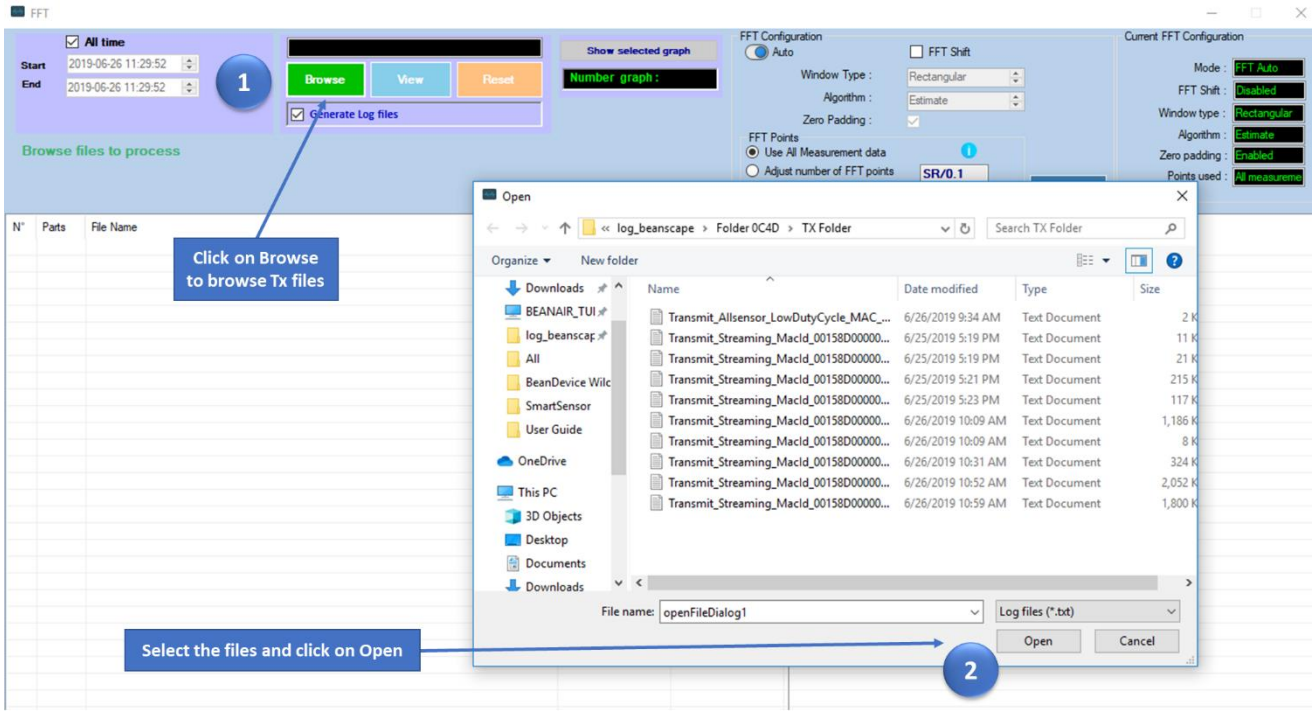


Figure 135: Browsing TX files on FFT window

2: Overview of the selected files

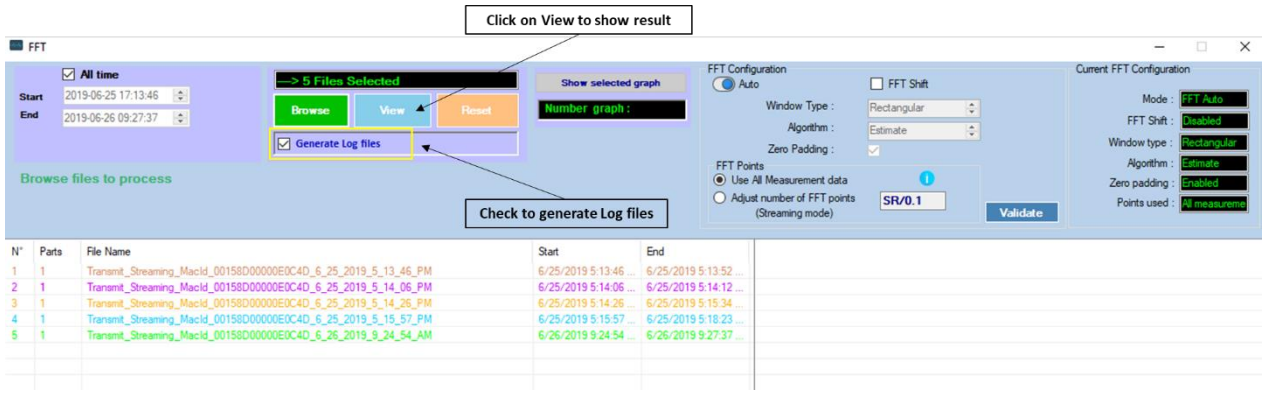


Figure 136: Overview: FFT window

3:Loading

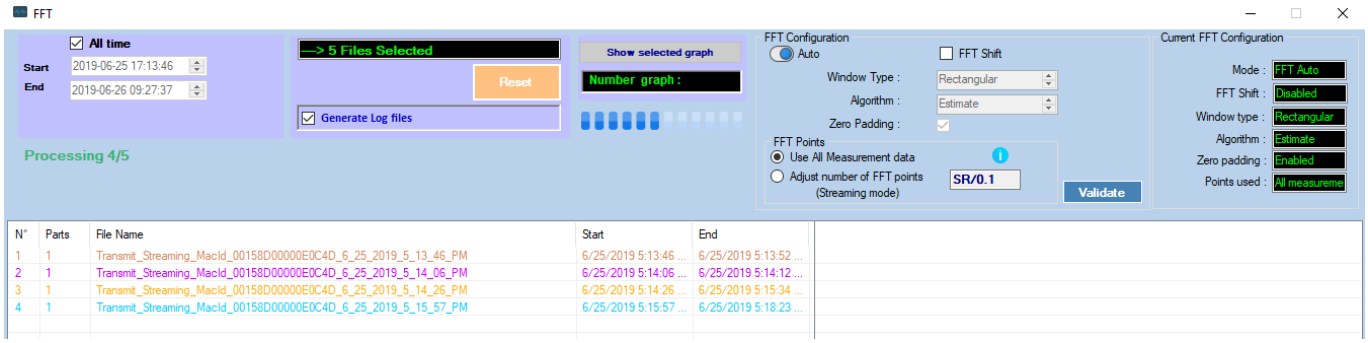


Figure 137: FFT features generation

4: FFT report generated with the following results:

a. Frequency

b. Amplitude

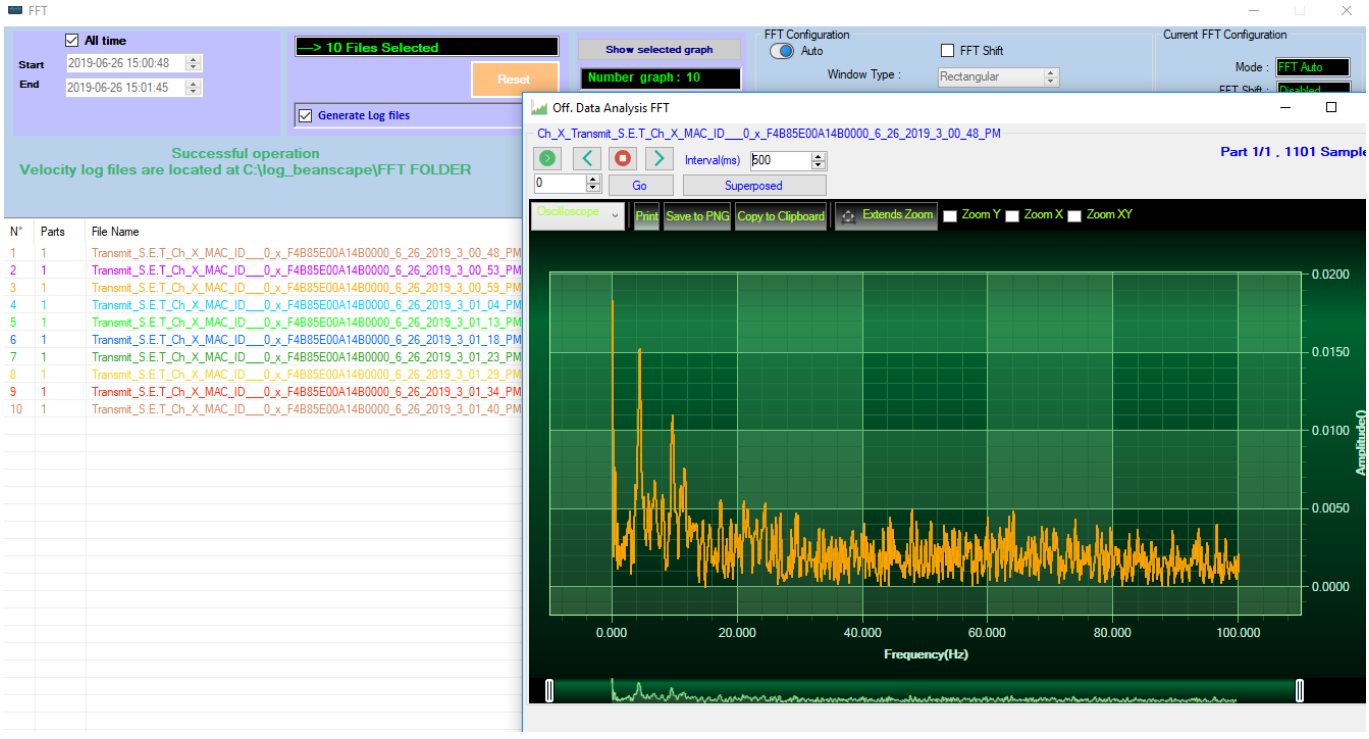


Figure 138: FFT genrated view

5: FFT LOG files generated

FFT LOG files will be generated in a folder located in log_beanscape repertory called FFT FOLDER.
In this folder, BeanScape® will create separate folders for each BeanDevice®.

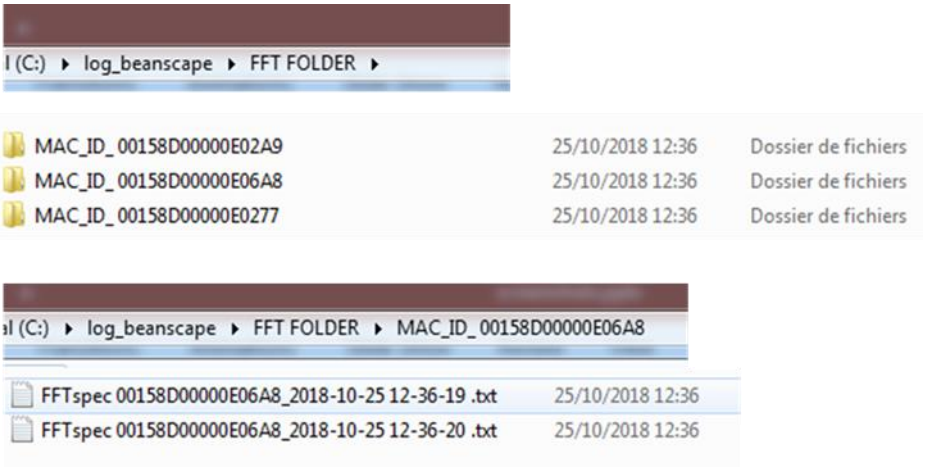


Figure 139: Generated FFT Log files

6: The graphs will be displayed automatically, it can be formatted to select the number of graphs to display simultaneously in this window.
An easy navigation bar on the top of the window, allow to the user to navigate between the graphs and select the page size.

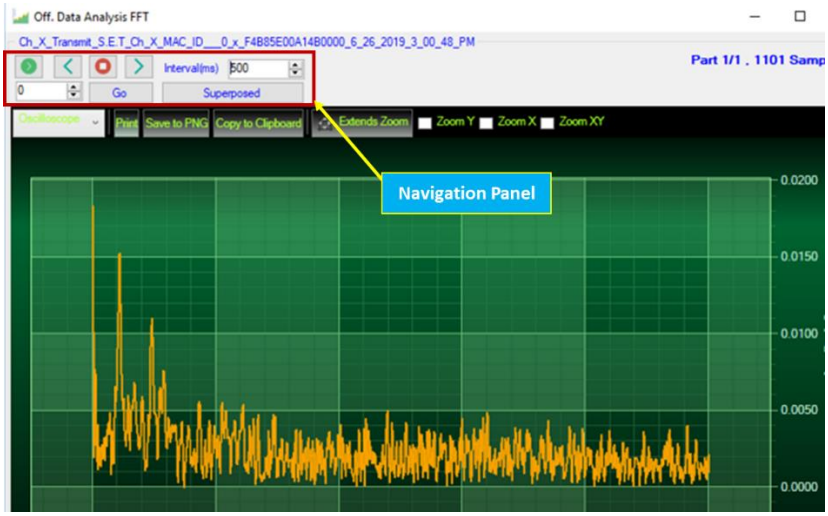


Figure 140: Graph display (Offline Data analysis)

7: Users can manually select and launch graph by double click or selecting file and click on “Show selected graph” button.

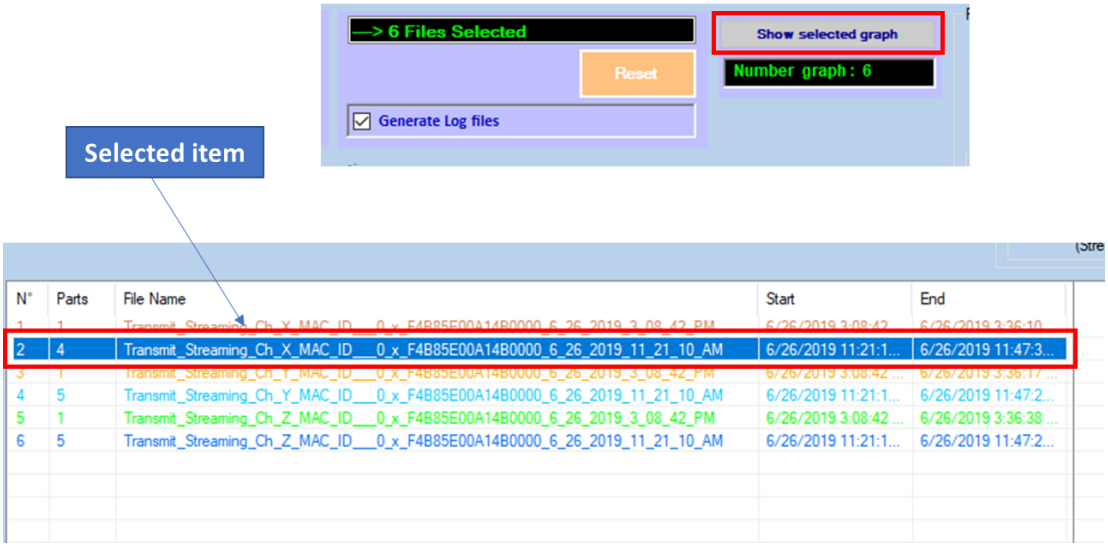


Figure 141: Selecting a graph to display

8: The selected graph is displayed

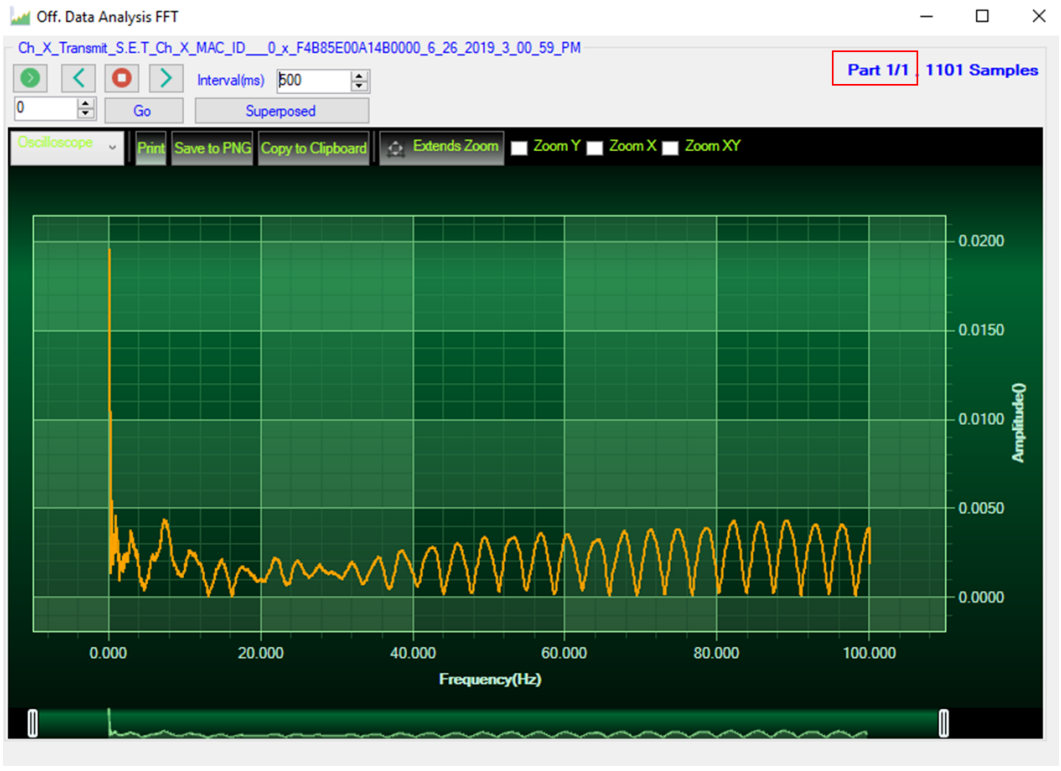


Figure 142: Selected graph display

Figure 143: Multigraph display

9: ***Make sure that the time range is within your measurements, otherwise the files will be considered as invalid.***

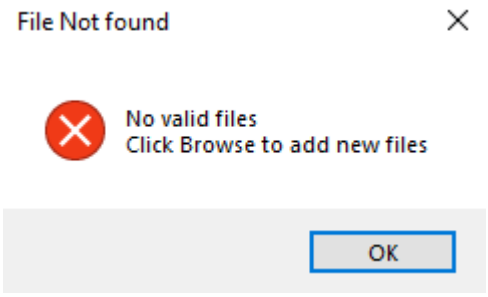


Figure 144: FFT invalid files

10.1.1.2 FFT shift

FFT shift allows to rearrange the FFT output by moving the zero-frequency component to the center of the array. It is useful for visualizing a Fourier transform with the zero-frequency component in the middle of the spectrum.

FFT shift option is activated when the checkbox “FFT shift” is checked.

Click on browse and import file containing the logged measurement, the result will be:

- Power spectral density and a new window displays (with zero-frequency at the center)

1. To use FFT Shift: check FFT Shift, Select files and click the “View” button:

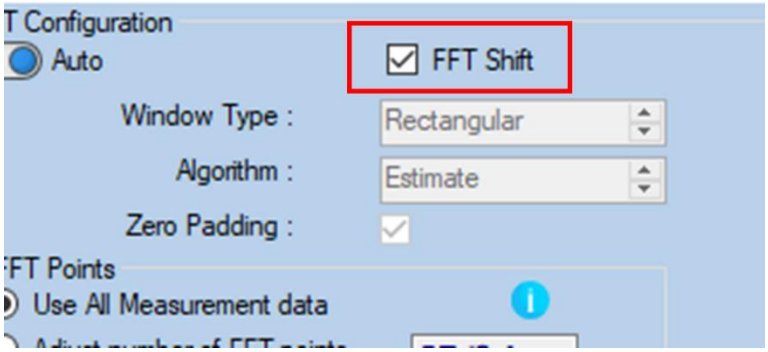


Figure 145: Offline FFT shift activation

2. FFT Spectrum with FFT Shift option enabled

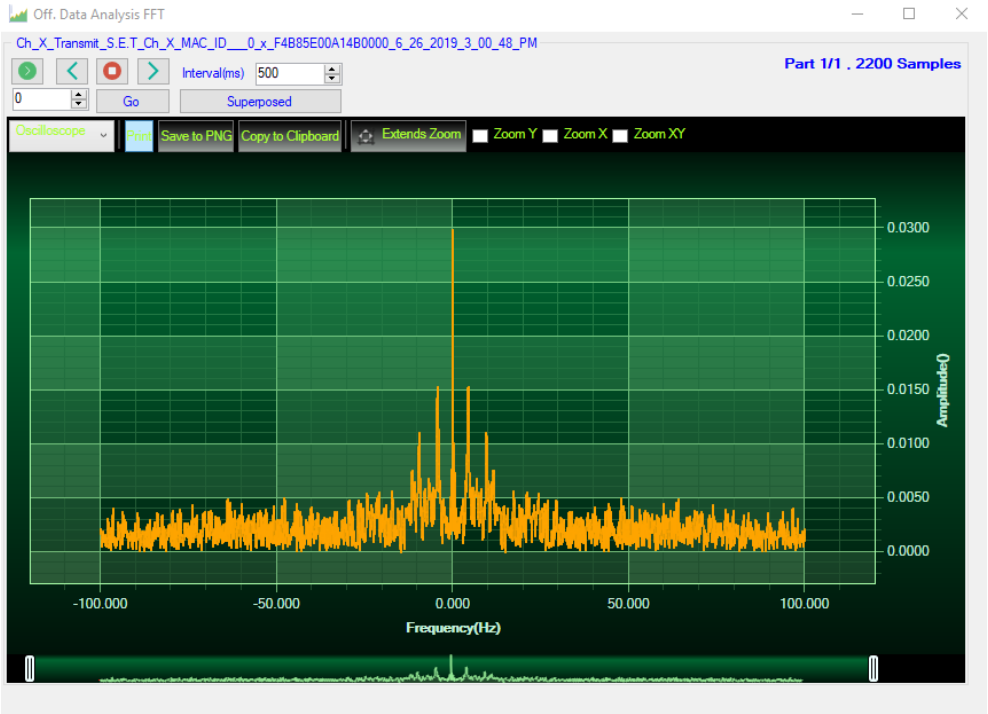


Figure 146: FFT shift spectrum

FFT and FFT shift video

10.2 PARTICLE VELOCITY (AVAILABLE ONLY ON BEANDEVICE® WILOW® AX-3D)

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.

The first step: Under Off.Data Analysis menu on the Beanscape® top menu, select Particle Velocity

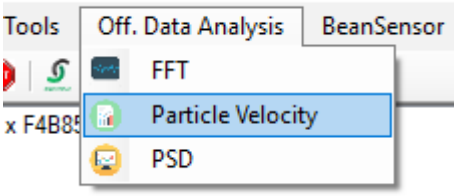


Figure 147: Particle Velocity on BeanScape® top menu

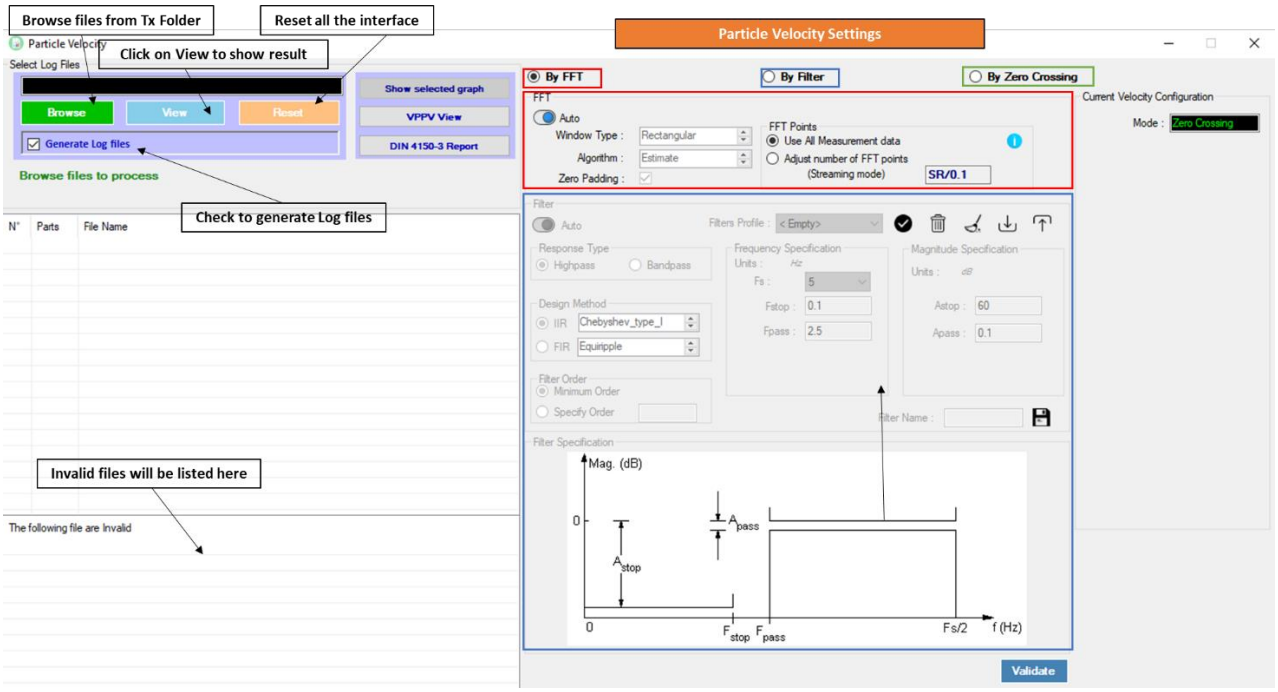
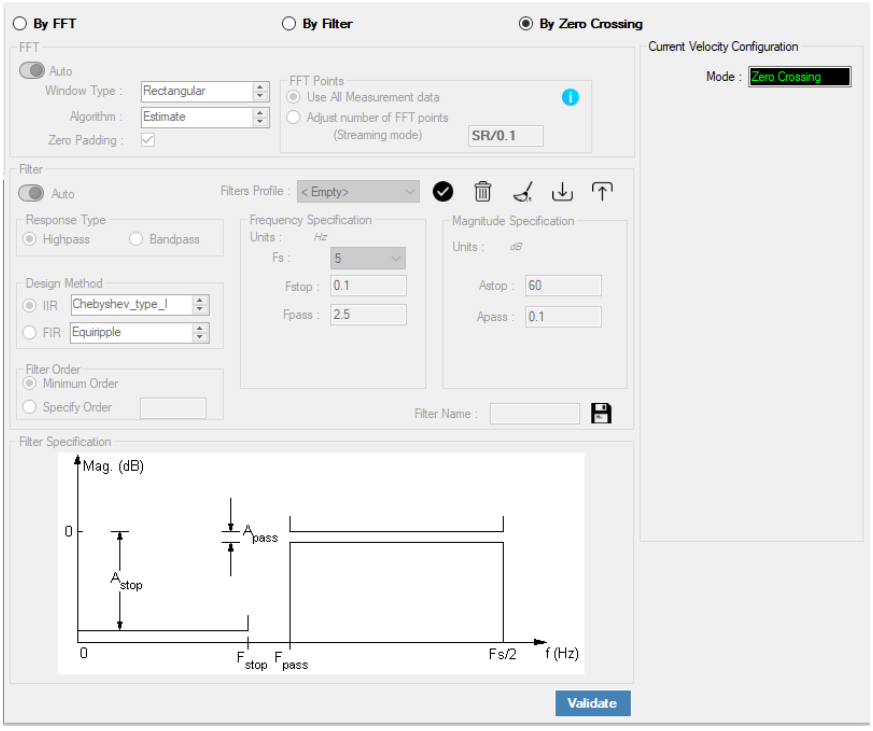


Figure 148: Particle Velocity window

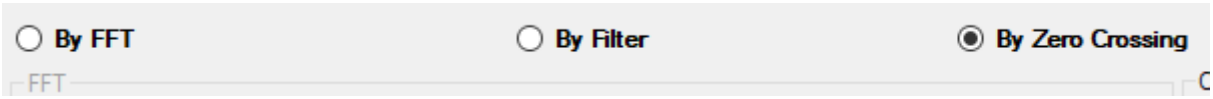
The second step is to browse and import the file containing the logged measurement. The result will be:

- Particle Velocity display window
- DIN report generated
- Velocity files created

3: Velocity Advanced Configuration.

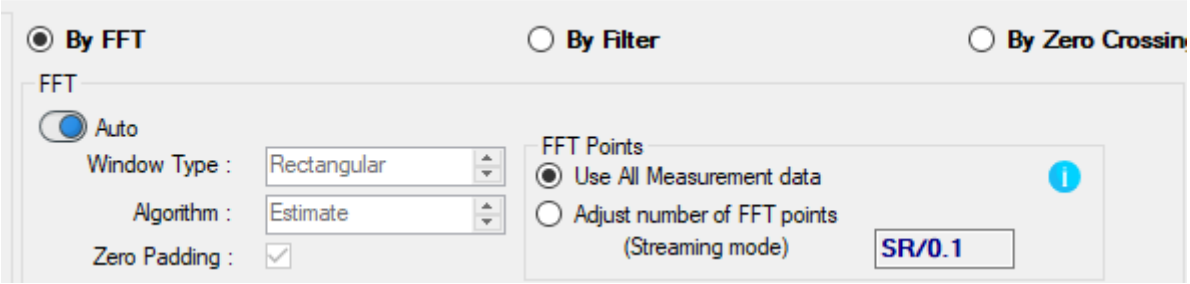


By default, the Velocity is configured “By Zero Crossing”, to edit the Velocity settings user must select “By FFT” or “By Filter”.

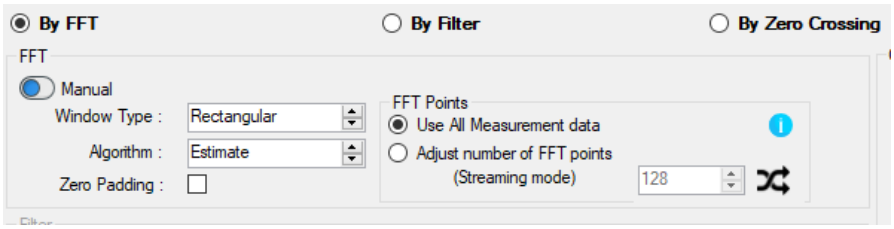


- **By FFT:** By selecting this option, the user will setup the Velocity basing on customized FFT settings.

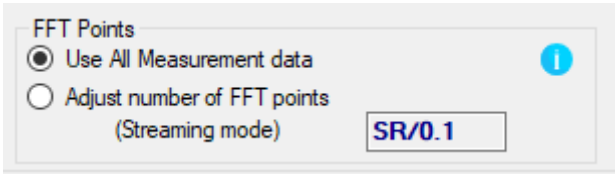
  - Auto: If Auto is selected, The Velocity calculation will activate FFT Auto mode Settings



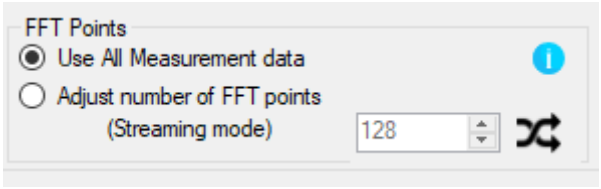
- Manual: Once switched to Manual, the user must configure the FFT settings manually (Window Type, Algorithm & Zero Padding).



- FFT Points:



By default, the Number of Points is configured to be set automatically as Sampling Rate / 0.1 (SR/0.1). By moving to the Manual settings, user must choose a value between 128 and 32768.



It is important to notice that larger Number of Points provide higher spectral resolution but take longer to compute.

The frequency resolution of each spectral line is equal to the Sampling Rate divided by the Number of Points. For instance, for example, if the Number of Points is 4096 and the Sampling Rate is 2000, the resolution of each spectral line will be:

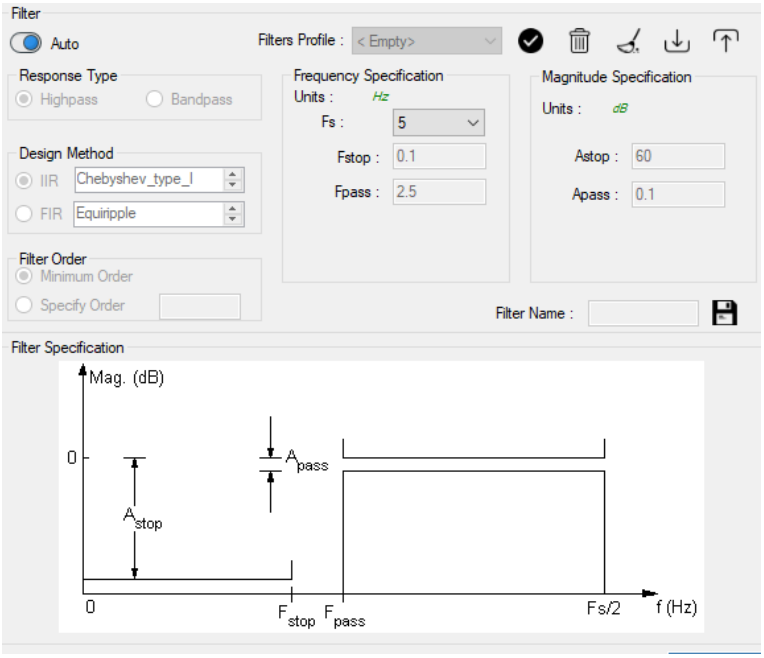
2000/4096 = 0.48828125

The Number of Points should be equal or higher than the Samplig Rate (Acquisition time at least = 1 second)

It is important to notice that larger Number of Points provide higher spectral resolution but take longer to compute.

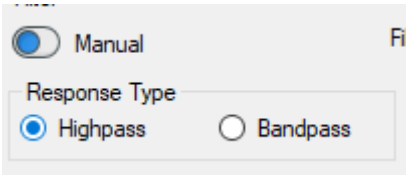
- **By Filter:** By selecting this option, the user will setup the Velocity basing on the Software Filter.

  - Auto: If Auto is selected, Velocity Automatic filter will be configured



  - Manual: Once switched to Manual, the user must configure manually the Filter settings.

    - Response Type: User should specify if the Response is **Highpass** or **Bandpass**

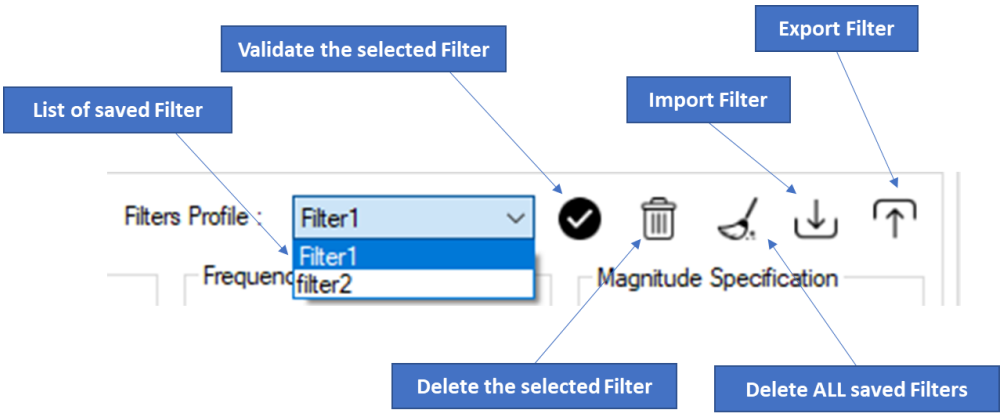


    - Design Method: User should Select the nature of the Filter between **IIR** or **FIR**
      From the List of every filter, user have to specify the method of the Filter:
      IIR: Chebyshev_type_I, Chebyshev_type_II or Butterworth
      FIR: Equiripple, Generalized_Equiripple or Kaiser_Window

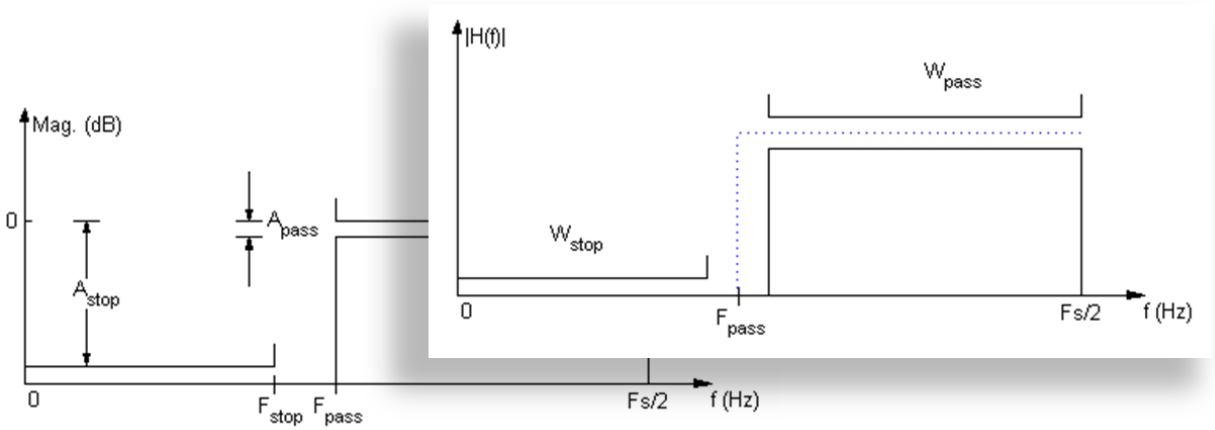
      The Frequency Specification and The Magnitude Specification will be modified according the selected Design Method

    - Filter Order: If the user is using IIR Design Method, Minimum Order will be selected automatically.
      If the FIR Design Method is selected, user must Specify Order.

- Frequency Specification: Is a customizable frame according to the Design Method.
- Magnitude Specification: Is a customizable frame according to the Design Method.
- Filter Profile: User can save a specific Configuration and re-use it later.



- Filter Specification: Is a Graphical Display of the Filter Specification depends on the user settings.



4: Click on browse button to choose TX Files.

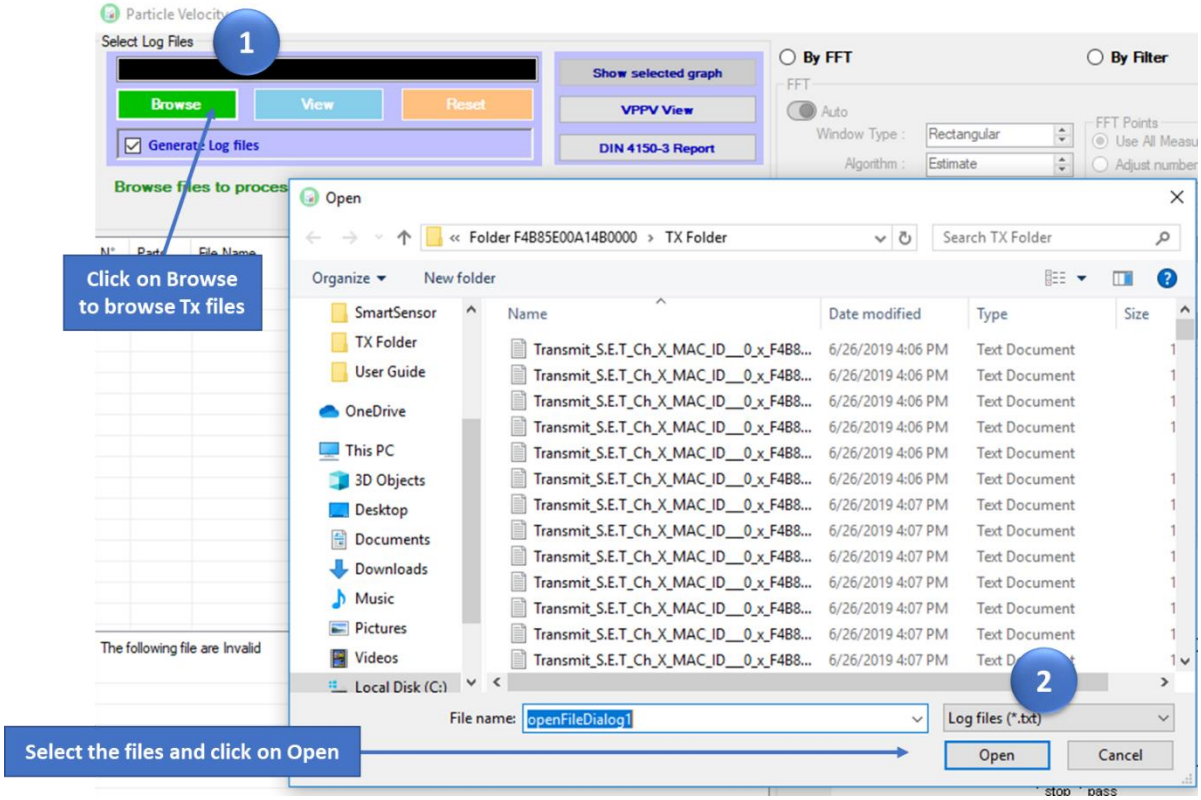


Figure 149: Browsing TX files into Particle Velocity tool

5: Loading.

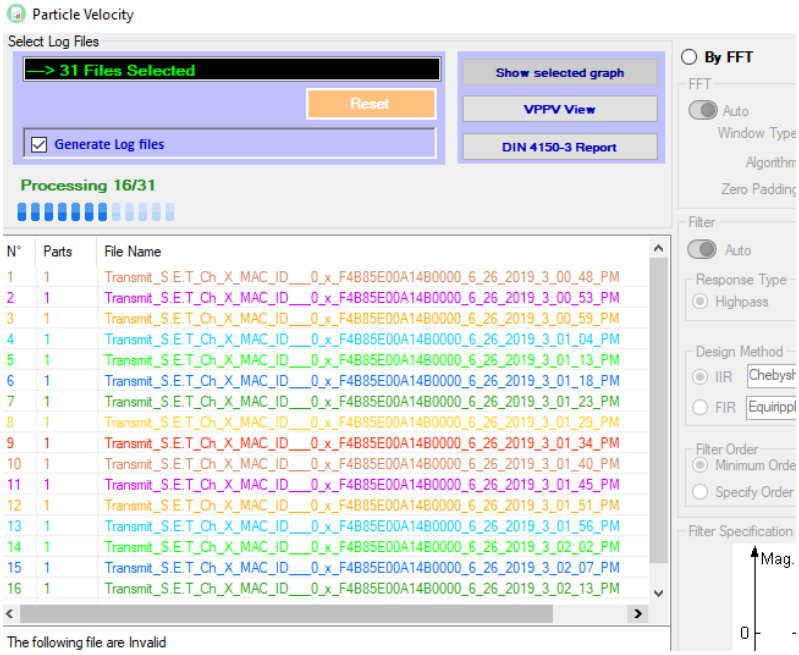


Figure 150: Generation of the Particle Velocity Calculation Result

6: The Particle Velocity Window will be displayed and will display:

- **Velocity Graph**
- **Particle Velocity Graph**
- **PPV Values**
- **Zero Crossing frequency values**
- **Peak Acceleration and Displacement values**

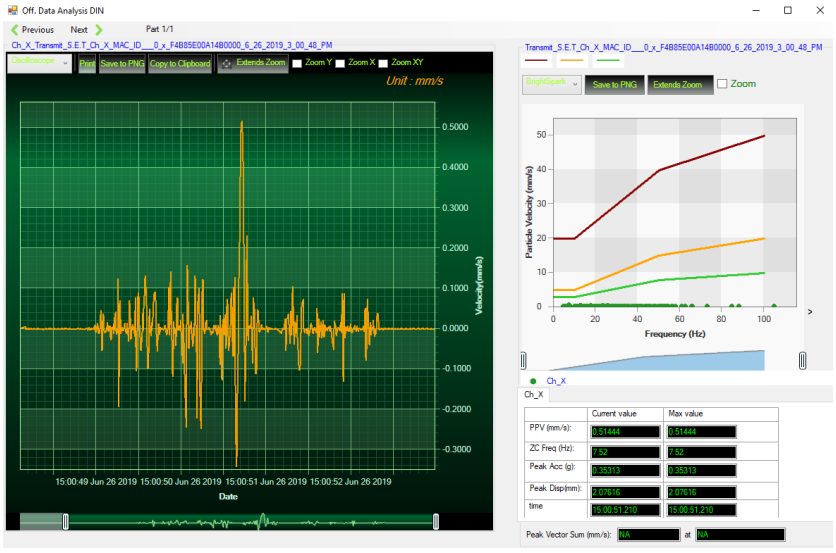


Figure 151: Particle Velocity Display Window

7: The VPPV and DIN Report:

VPPV & DIN Report will be generated by clicking on the VPPV View and DIN-4150-3 Report buttons

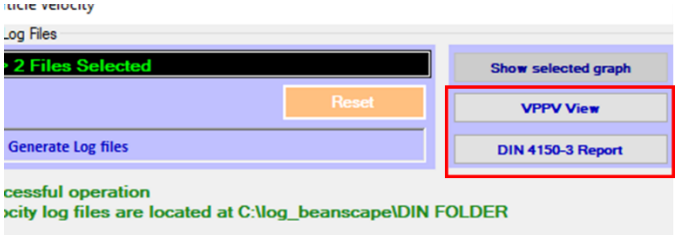
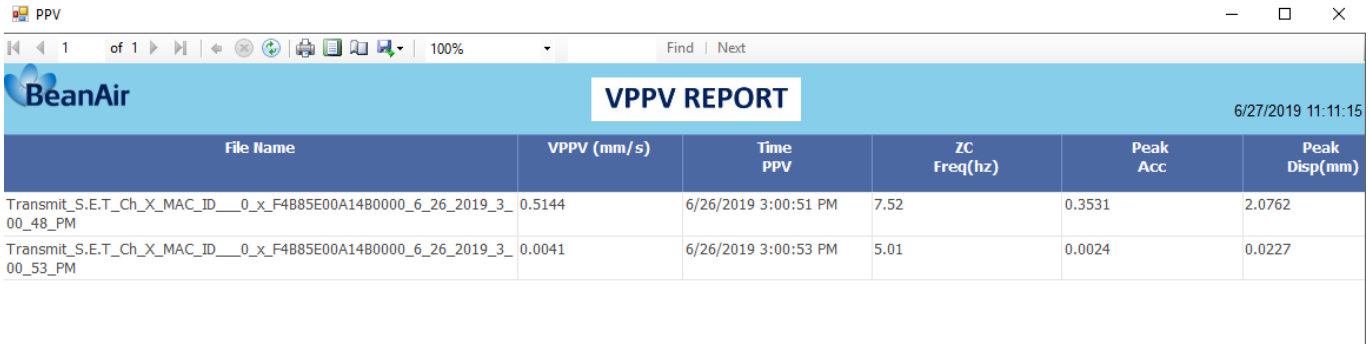


Figure 152: VPPV & DIN buttons



File Name	VPPV (mm/s)	Time PPV	ZC Freq(hz)	Peak Acc	Peak Disp(mm)
Transmit_S.E.T_Ch_X_MAC_ID___0_x_F4B85E00A14B0000_6_26_2019_3_00_48_PM	0.5144	6/26/2019 3:00:51 PM	7.52	0.3531	2.0762
Transmit_S.E.T_Ch_X_MAC_ID___0_x_F4B85E00A14B0000_6_26_2019_3_00_53_PM	0.0041	6/26/2019 3:00:53 PM	5.01	0.0024	0.0227

Figure 153: VPPV Report

File Name	Building type	Pipe Material	Velocity Average(mm/s	Sampling Rate(hz)	Analyze duration	LTVEE	LTEBP	Real Frequency(hz)	PCPV(mm/s)	STEBP	STVEE
Transmit_S.E.T_Ch_X_MAC_ID___0_x_F4B85E00A14B0000_6_26_2019_3_00_48_PM	Commercial	Steel	0.00270607272727273	200	00:00:05.5000000	OK	OK	7.52	0.51444	OK	OK
Transmit_S.E.T_Ch_X_MAC_ID___0_x_F4B85E00A14B0000_6_26_2019_3_00_53_PM	Commercial	Steel	-6.643636363636636E-05	200	00:00:05.5000000	OK	OK	5.01	0.0027	OK	OK

DIN 4150-3 REPORT

Keyword	Meaning
LTVEE	Long Term Vibration Evaluation Effect
LTEBP	Long Term Effect on Buried Pipe work
STEBP	Short Term Effect on Buried Pipe work
STVEE	Short Term Effect Evaluation
PCPV	Peak Component Particle Velocity

Figure 154: DIN Report

INFORMATION	DETAILS
Building type	User configurable
Pipeline Material	User Configurable
Velocity Average	Get the average of the signal after transforming the acceleration signal into velocity signal
Sampling Rate	In Hz
Analyse duration	BeanScape property
Long term vibration evaluation effect	1-Find the maximum velocity values over the Time 2- Compare the maximum velocity to the guideline value described on the Norm DIN 4150.

	3-Display if the result is OK or not (guideline respected or not)
Long term Effect on buried pipework	1-Find the maximum velocity values over the Time 2- Compare the maximum velocity to the guideline value described on the Norm DIN 4150. 3-Display if the result is OK or not (guideline respected or not)
Velocity Frequency	Get the signal frequency (FFT + windowing)
Maximum velocity (mm/s)	BeanScape Property
Short term Effect on buried pipework	1-Find the maximum velocity values over the Time 2- Compare the maximum velocity to the guideline value described on the Norm DIN 4150. 3-Display if the result is OK or not (guideline respected or not)
Short term vibration effect evaluation	1-find the maximum velocity value over the time. 2-Determine the significant frequency (use the FFT + windowing). 3-compare the maximum velocity to the guideline value described on the Norm DIN 4150 5-Display if the result is OK or not (guideline respected or not)

Signal windowing is used in this analysis. Windowing is a technique used to cut out a section of your data to measure, in order to minimize distortions that cause spectral leakage of the FFT.

DIN 4150-3 Interpretation video

10.3 ONLINE DATA ANALYSIS TOOL

10.3.1 Online FFT and FFT report

The FFT (Fast Fourier transform) operates by decomposing an N point time domain signal into N time domain signals each composed of a single point.

The second step is to calculate the N frequency spectra corresponding to these N time domain signals.

Lastly, the N spectra are synthesized into a single frequency spectrum.

When using FFT in SET mode, for best performance FFT points are automatically calculated on the number of data acquisition (sampling rate xdata acquisition duration).

Real time observation of FFT available for BeanDevice® Wilow® AX-3D only with Streaming and S.E.T acquisition modes and is enabled from the signal processing tab in the Configuration panel.

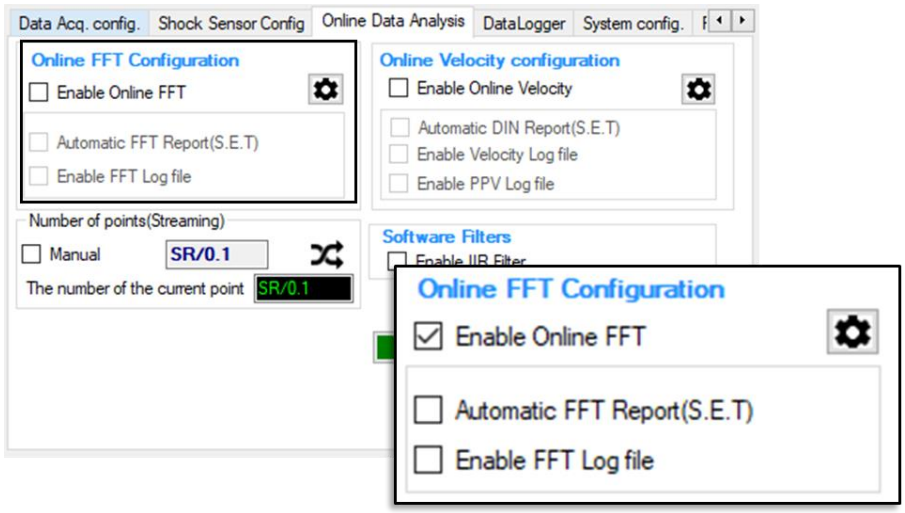


Figure 155: Online FFT configuration frame

- Check Enable Online FFT to view the display of FFT graph in the sensor profile

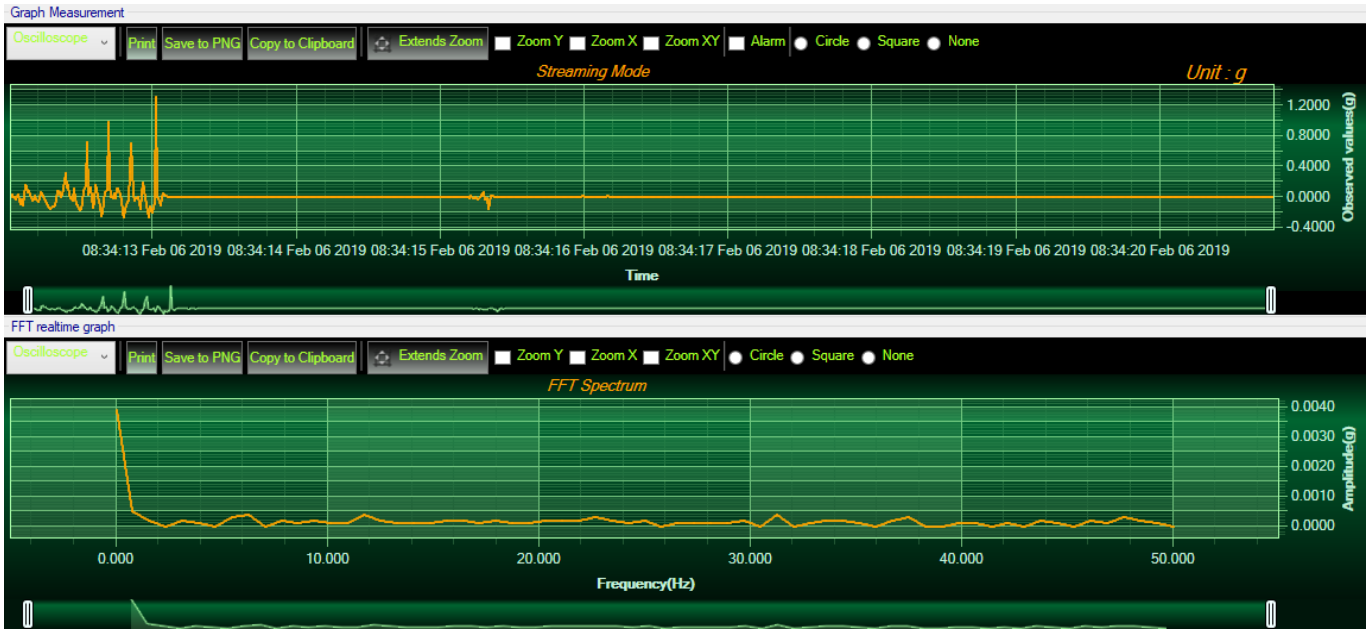
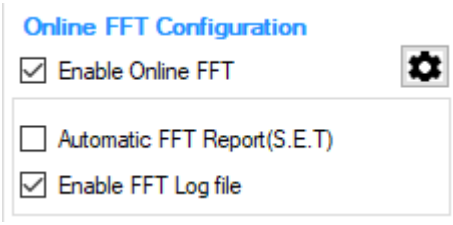


Figure 156: FFT spectrum

- Check Enable FFT Log file to generate log files in the log_beanscape directory.



The log files will be generated in a folder called “FFT” under the BeanDevice® repertory.

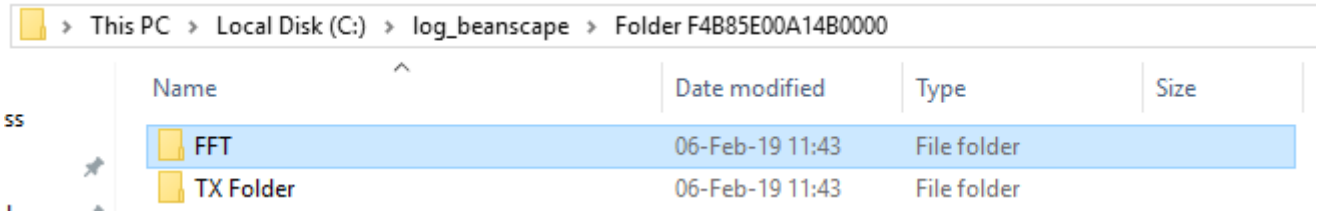


Figure 157: FFT log files folder

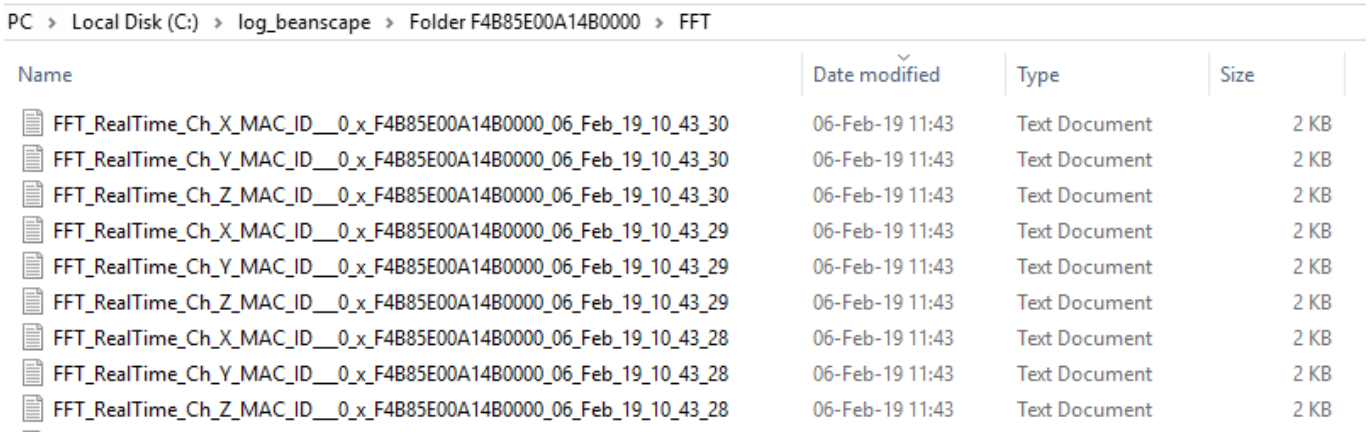
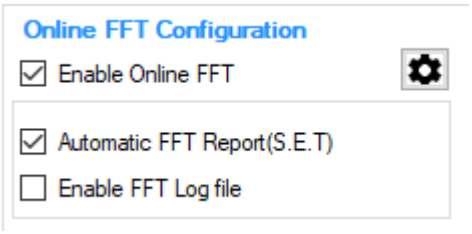


Figure 158: FFT log files folder

- Enabling Automatic Report: This functionality is available only in S.E.T mode. To activate automatic reports generation, check the option on Online FFT configuration frame



After enabling Real time FFT and setting SMTP configuration (more information on section 12) Following is an example of an FFT report emailed to concerned recipients.

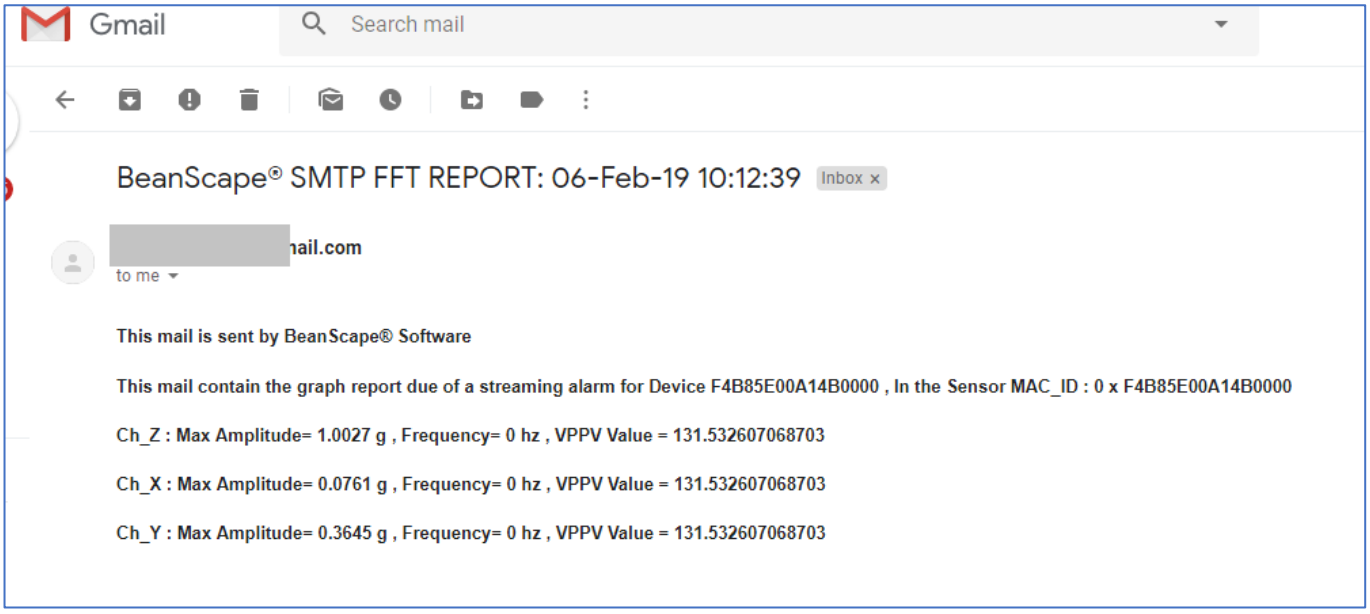
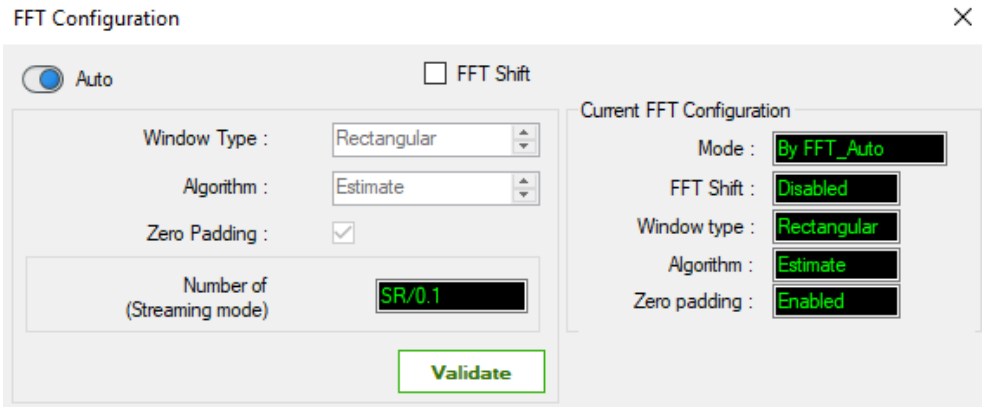


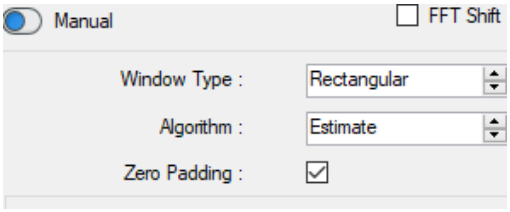
Figure 159: FFT report sent by email

- : FFT Advanced Configuration

The FFT configuration allows the user to activate the FFT Shift and to go for manual settings related to FFT.



- Auto/Manual



- Window type:

Rectangular
Hamming
Hann
Blackman
Blackman Harris
Gaussian
Kaiser
Taylor
Triangular
Flattop
Bartlett
Bartlett-Hann

When the number of periods in the acquisition is not an integer, the endpoints are discontinuous. These artificial discontinuities show up in the FFT as high-frequency components as not present in the original signal. These frequencies can be much higher than the Nyquist frequency and are aliased between 0 and half of your sampling rate. This phenomenon is known as spectral leakage.

You can minimize these effects by using a technique called windowing.

Windowing reduces the amplitude of the discontinuities at the boundaries of each finite sequence acquired by the digitizer. Windowing consists of multiplying the time record by a finite-length window with an amplitude that varies smoothly and gradually toward zero at the edges. This makes the endpoints of the waveform meet and, therefore, results in a continuous waveform without sharp transitions. This technique is also referred to as applying a window.

There are several different types of window functions that you can apply depending on the signal. To understand how a given window affects the frequency spectrum, you need to understand more about the frequency characteristics of windows.

Selecting a window function is not a simple task. Each window function has its own characteristics and suitability for different applications. To choose a window function, you must estimate the frequency content of the signal.

- If the signal contains strong interfering frequency components distant from the frequency of interest, choose a smoothing window with a high side lobe roll-off rate.

- If the signal contains strong interfering signals near the frequency of interest, choose a window function with a low maximum side lobe level.

- If the frequency of interest contains two or more signals very near to each other, spectral resolution is important. In this case, it is best to choose a smoothing window with a very narrow main lobe.

- If the amplitude accuracy of a single frequency component is more important than the exact location of the component in a given frequency bin, choose a window with a wide main lobe.

- If the signal spectrum is rather flat or broadband in frequency content, use the uniform window, or no window.

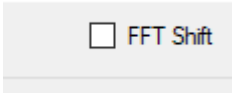
In general, the Hanning (Hann) window is satisfactory in 95 percent of cases. It has good frequency resolution and reduced spectral leakage. If you do not know the nature of the signal but you want to apply a smoothing window, start with the Hann window.

- Algorithm

Estimate	Determine a best-guess transform algorithm based on the size of problem.
Measure	Find a better algorithm by computing multiple transforms and measuring the run times.
Patient	Run a wider range of testing compared to 'measure', resulting in a better transform algorithm, but at the expense of higher computational cost to determine the parameters.
Hybrid	Use a combination of 'measure' for transforms with dimension length (number of points) 8192 or smaller and 'estimate' for transforms with dimension length (number of points) larger than 8192.

- Zero Padding: The use of zero padding enables you to estimate the amplitudes of frequencies correctly.

- FFT Shift: Check to enable real time FFT Shift processing for BeanDevice AX-3D on streaming mode and the FFT spectrum will appear shifted below the Streaming graph in the sensor profile.



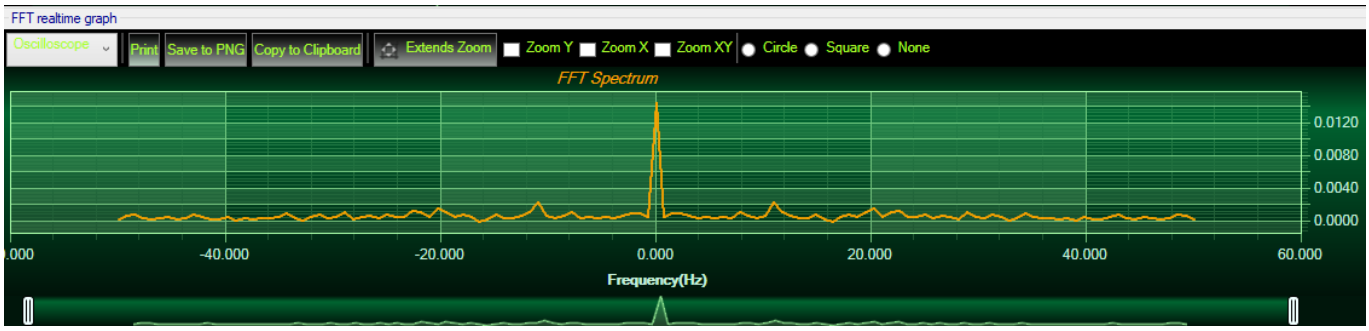


Figure 160: FFT Shift Spectrum

10.3.2 Online Velocity and Velocity report

Real time observation of velocity available for BeanDevice® Wilow® AX-3D only with Streaming and S.E.T acquisition modes and is enabled from the signal processing tab in the Configuration panel.

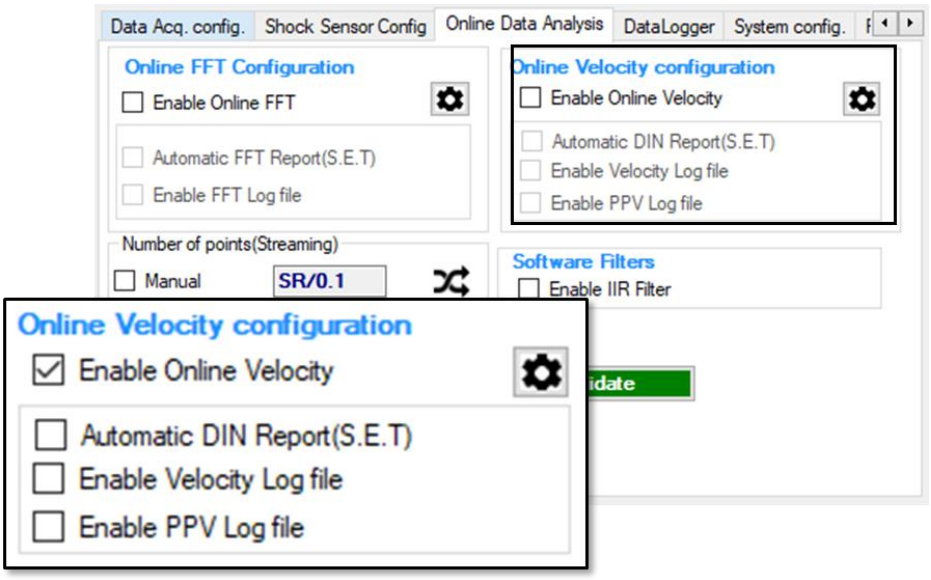


Figure 161: Online Velocity configuration tab

- ***Enable online Velocity***: check to enable real time Velocity processing, PPV and PVS, the velocity graph will be displayed.

On the Graph side a real time DIN 4150 graph will be displayed on the right side of the screen.

Under the DIN 4150 Graph, the PPV and the PVS values will be displayed in real time.

On the PPV frame, BeanScape will display PPV in mm/s, ZC Frequency in Hz, Peak Acceleration in g and Peak Displacement in mm.

It is important to notice that the PVS calculation required 3 active channels to be generated.

PPV: is a measurement of maximum ground particle movement speed, it is in millimeters per second (mm/sec), PPV is a "vector" quantity (i.e. it has both a value and an associated direction).

Peak Vector Sum (PVS): is simply the square root of the sum of the squares of the individual PPV values. PVS is a "scalar" quantity, i.e. one with only a value, which is always larger than the individual PPV vector values.

Scientific studies have shown that the PPV correlates best with damage potential of all the tested characterizations of ground movement (e.g. acceleration, displacement, or strain). Most, though not all, ground vibration standards are quoted in PPV values, although the "acceptable" values of PPV differ with the standard applied and with the frequency of the vibration components.

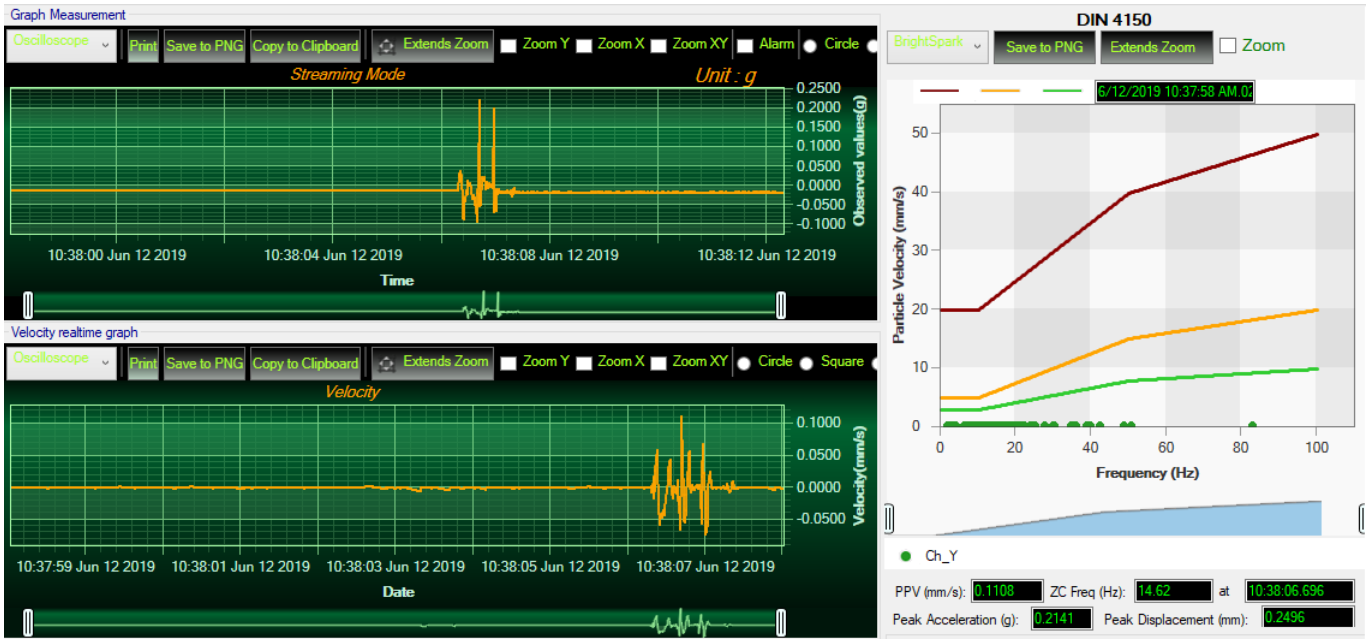


Figure 162: Velocity Graph

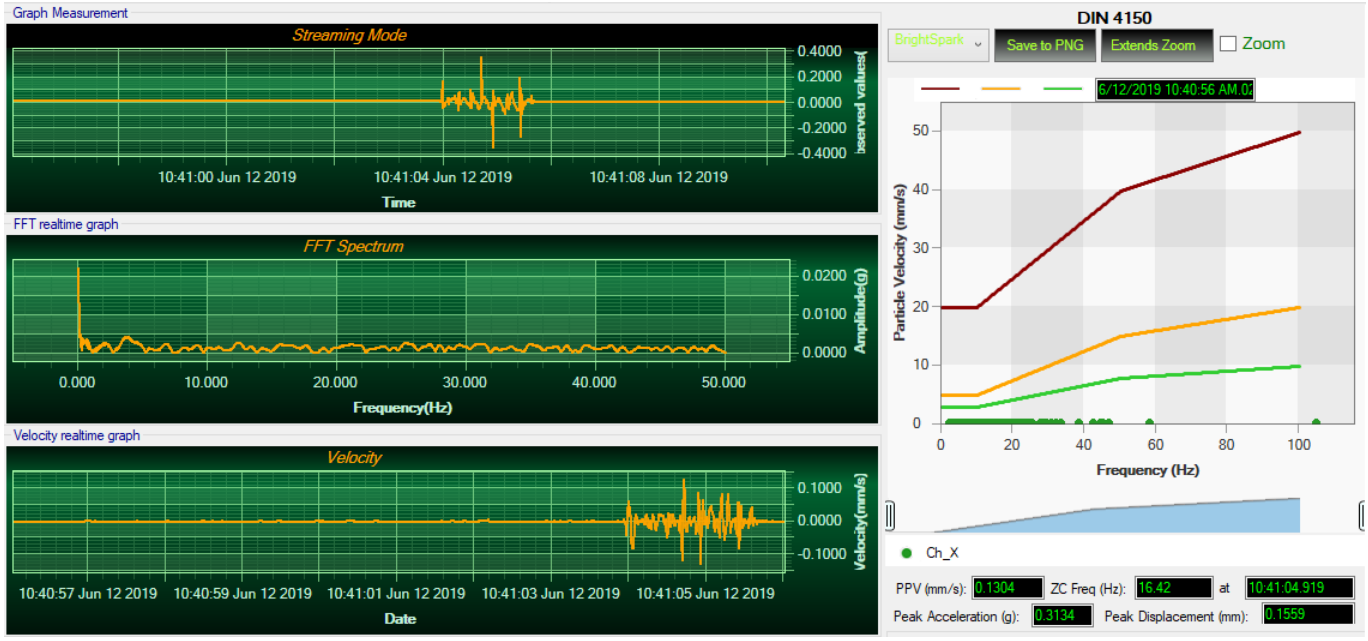


Figure 163: Velocity and FFT Graph, PPV and PVS

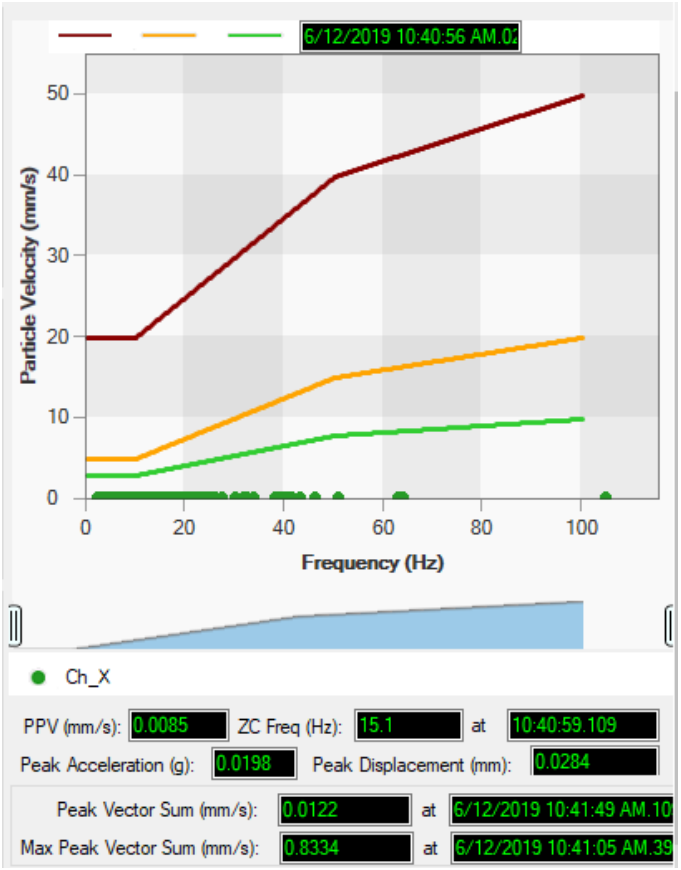


Figure 164: DIN 4150 Real Time Graph, PPV & PVS

- ***Automatic DIN Report (S.E.T)***: check to enable DIN4150-3 report automatic generation when threshold is reached, or an acquisition cycle is reached on the S.E.T acquisition mode.

  An automatic Report will be sent to the email addresses configured on Alarm Management Option.

BeanAir 06-Feb-19 12:07:37

BeanDevice MAC_ID : F4B85E00A14B0000 | Sensor Label : Ch_Z

DIN 4150-3 REPORT

Building Type	Commercial
Pipeline Material	Steel
Velocity Average(mm/s)	0.0177327272727272
Sampling Rate(hz)	100
Analyze Duration(hh:mm:ss)	00:00:01.1000000
LTVEE	OK
LTEBP	OK
Velocity Frequency(hz)	0
PCPV(mm/s)	2.4892
STEBP	OK
STVEE	NOK

KeyWord	Meaning
LTVEE	Long Term Vibration Evaluation Effect
LTEBP	Long Term Effect on Buired Pipework
STEBP	Short Term Effect on Buired Pipework
STVEE	Short Term Effect Evaluation
PCPV	Peak Component Particle Velocity

Figure 165: DIN 4150-3 Report email

INFORMATION	DETAILS
Building type	User configurable
Pipeline Material	User Configurable
Velocity Average	Get the average of the signal after transforming the acceleration signal into velocity signal
Sampling Rate	In Hz
Analyse duration	BeanScape property
Long term vibration evaluation effect	1-Find the maximum velocity values over the Time 2- Compare the maximum velocity to the guideline value described on the Norm DIN 4150. 3-Display if the result is OK or not (guideline respected or not)
Long term Effect on buried pipework	1-Find the maximum velocity values over the Time 2- Compare the maximum velocity to the guideline value described on the Norm DIN 4150. 3-Display if the result is OK or not (guideline respected or not)
Velocity Frequency	Get the signal frequency (FFT + windowing)
Maximum velocity (mm/s)	BeanScape Property
Short term Effect on buried pipework	1-Find the maximum velocity values over the Time 2- Compare the maximum velocity to the guideline value described on the Norm DIN 4150. 3-Display if the result is OK or not (guideline respected or not)
Short term vibration effect evaluation	1-find the maximum velocity value over the time. 2-Determine the significant frequency (use the FFT + windowing). 3-compare the maximum velocity to the guideline value described on the Norm DIN 4150 5-Display if the result is OK or not (guideline respected or not)

- ***Enable Velocity Log file***: check to enable Velocity data to be stored in the log folder.

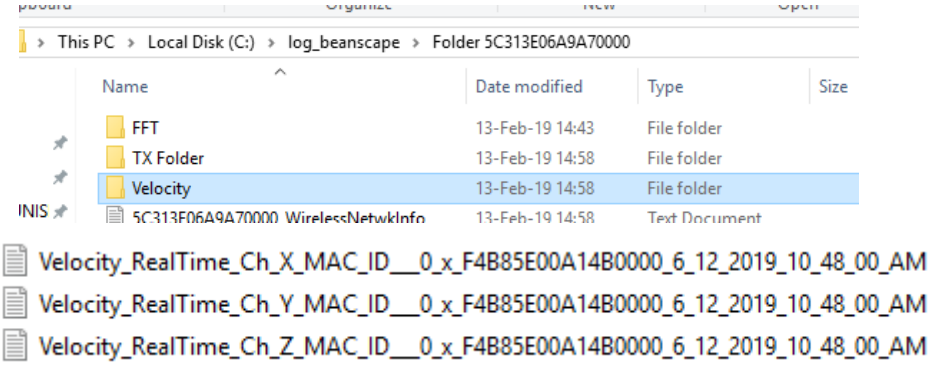


Figure 166: Velocity Log Folder/Files

- ***Enable PPV Log file***

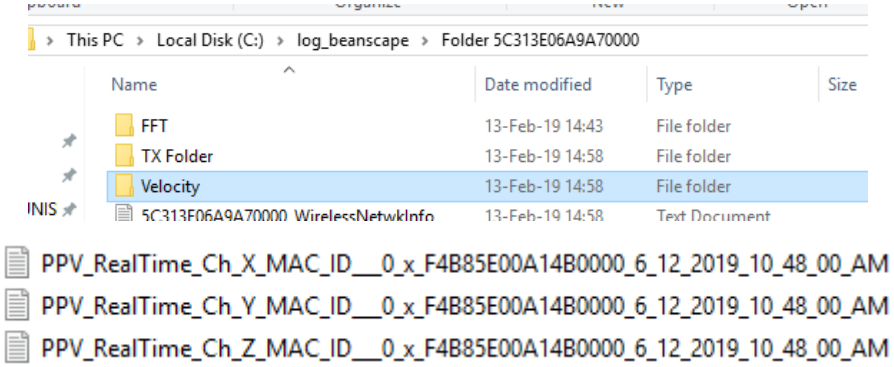


Figure 167: PPV Log Folder/Files

- : Velocity Advanced Configuration

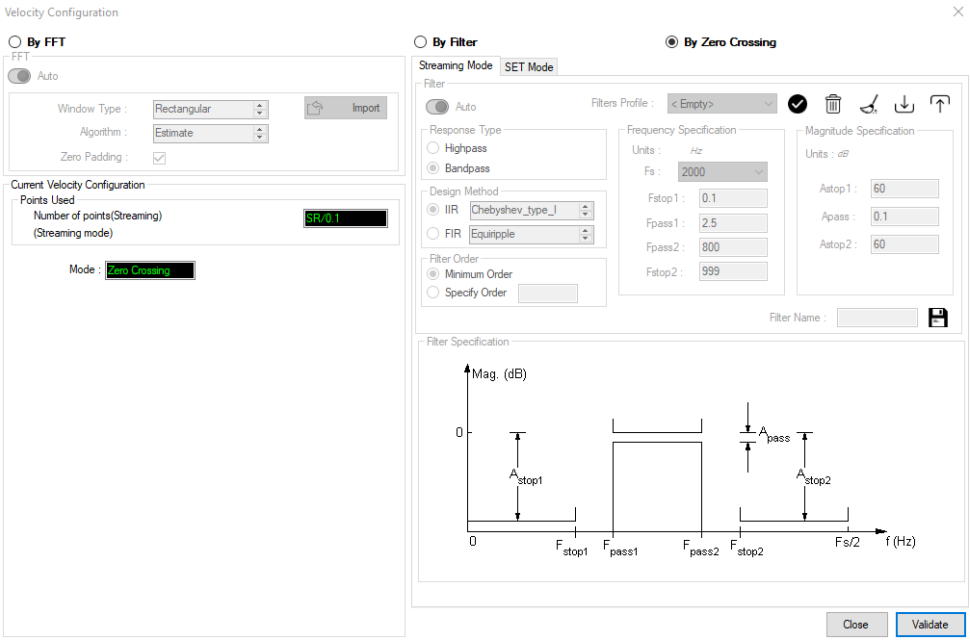
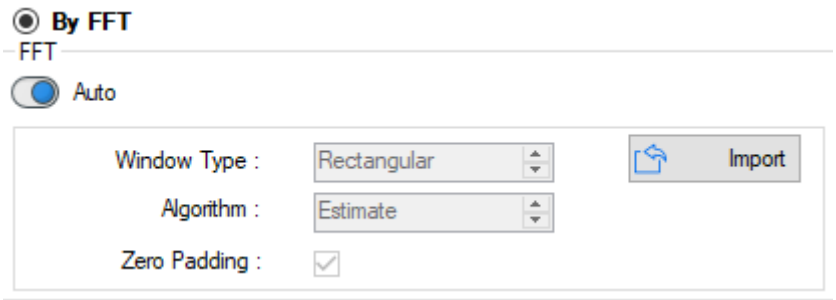


Figure 168: Velocity Advanced Configuration

By default, the Velocity is configured “By Zero Crossing”, to edit the Velocity settings user must select “By FFT” or “By Filter”.

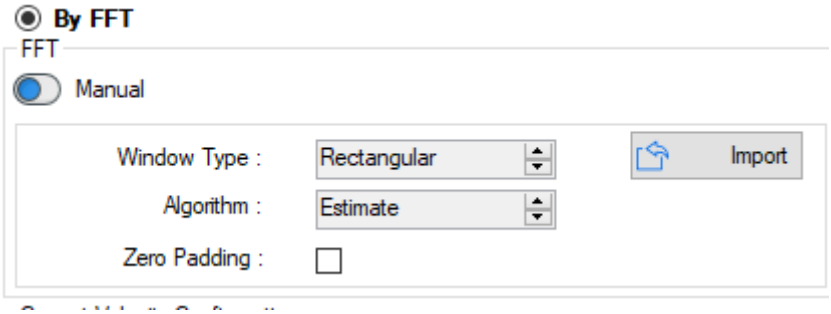
- **By FFT:** By selecting this option, the user will setup the Velocity basing on customized FFT settings.

  - Auto: If Auto is selected, The Velocity calculation will activate FFT Auto mode Settings

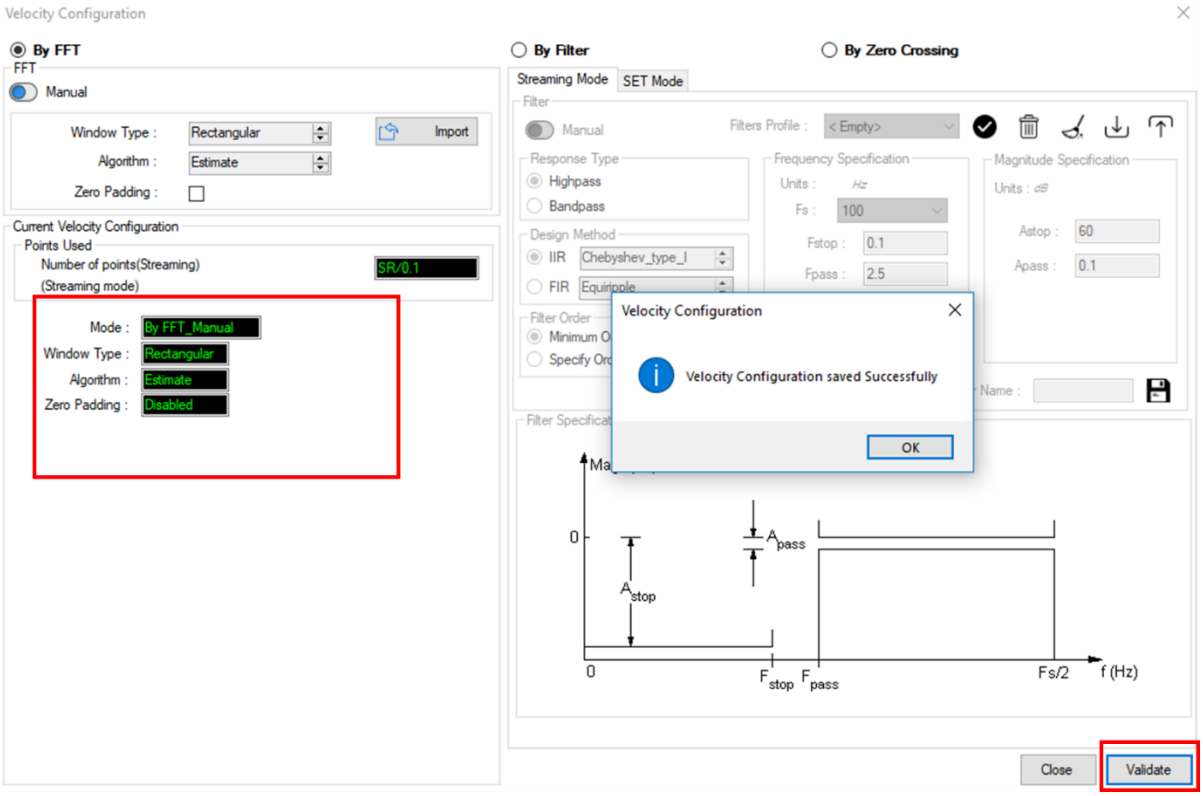


  - Manual: Once switched to Manual, the user must configure the FFT settings manually (Window Type, Algorithm & Zero Padding).

By clicking on Import the Configuration will import the FFT current settings, already configured on the FFT frame.

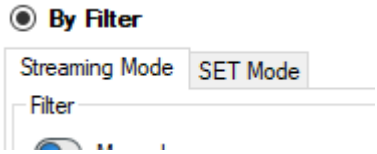


To save all settings Press Validate. The new settings should be displayed on the Left side of the Window.

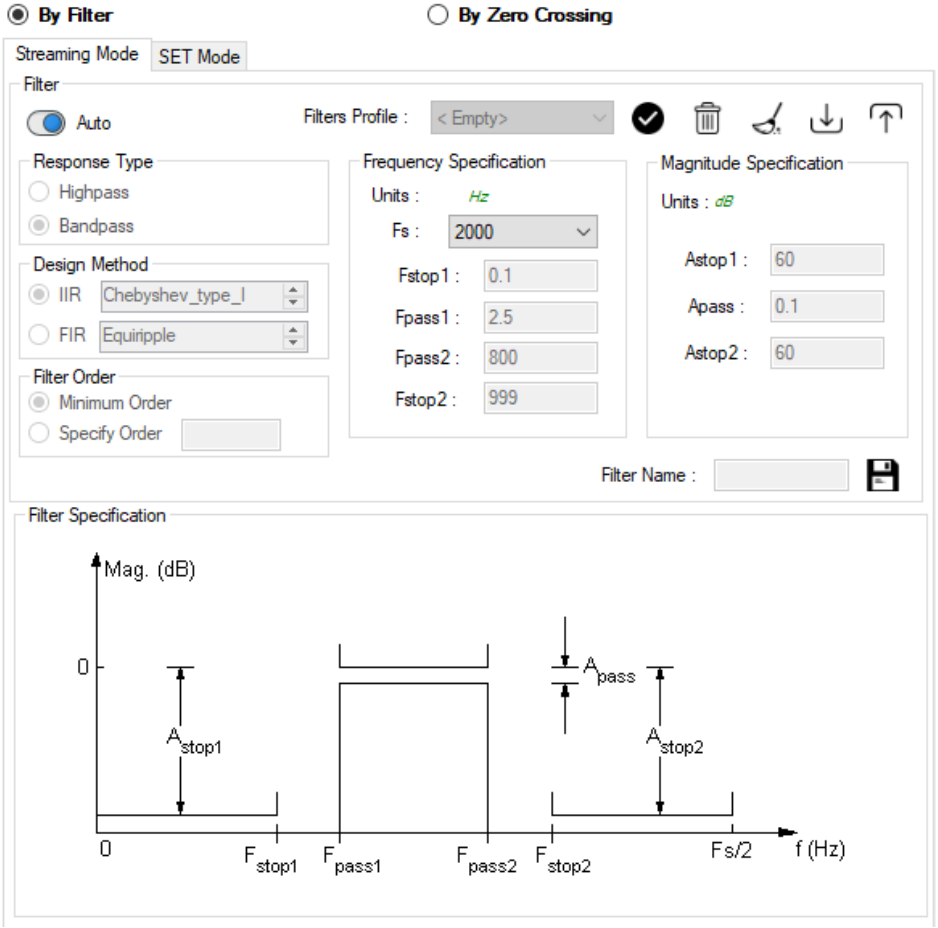

Velocity Configuration
By FFT
By Filter
By Zero Crossing
FFT
Manual
Window Type :
Rectangular
Import
Algorithm :
Estimate
Zero Padding :
Current Velocity Configuration
Points Used
Number of points(Streaming)
(Streaming mode)
SR/0.1
Mode :
By FFT_Manual
Window Type :
Rectangular
Algorithm :
Estimate
Zero Padding :
Disabled
Streaming Mode
SET Mode
Filter
Manual
Filters Profile :
< Empty>
Response Type
Highpass
Bandpass
Design Method
IIR
Chebyshev_type_I
FIR
Equiripple
Filter Order
Frequency Specification
Units :
Hz
Fs :
100
Fstop :
0.1
Fpass :
2.5
Magnitude Specification
Units : dB
Astop :
60
Apass :
0.1
Name :
Velocity Configuration
Velocity Configuration saved Successfully
OK
Filter Specifications
0
Apass
Astop
0
Fstop Fpass
Fs/2
f (Hz)
Close
Validate

- **By Filter:** By selecting this option, the user will setup the Velocity basing on the Software Filter.

The Software filter is available for Streaming and S.E.T Mode.

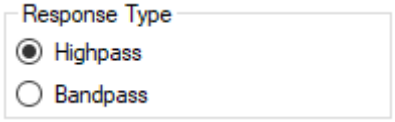


  - Auto: If Auto is selected, Velocity Automatic filter will be configured



  - Manual: Once switched to Manual, the user must configure manually the Filter settings.

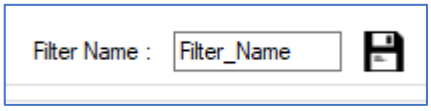
    - Response Type: User should specify if the Response is **Highpass** or **Bandpass**

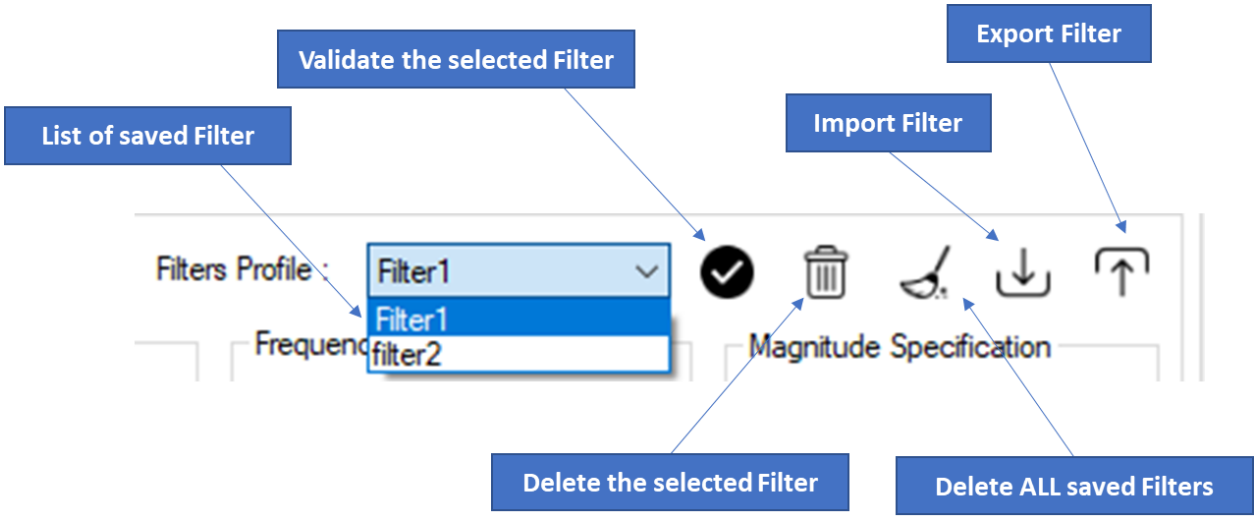


- Design Method: User should Select the nature of the Filter between **IIR** or **FIR**
  From the List of every filter, user have to specify the method of the Filter:
  IIR: Chebyshev_type_I, Chebyshev_type_II or Butterworth
  FIR: Equiripple, Generalized_Equiripple or Kaiser_Window

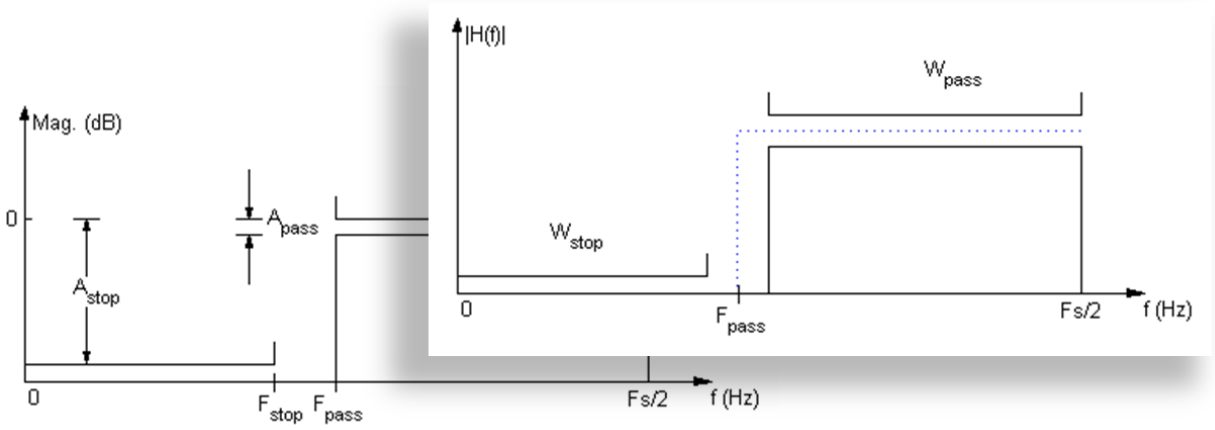
The Frequency Specification and The Magnitude Specification will be modified according the selected Design Method

- Filter Order: If the user is using IIR Design Method, Minimum Order will be selected automatically.
  If the FIR Design Method is selected, user must Specify Order.
- Frequency Specification: Is a customizable frame according to the Design Method.
- Magnitude Specification: Is a customizable frame according to the Design Method.
- Filter Profile: User can save a specific Configuration and re-use it later.

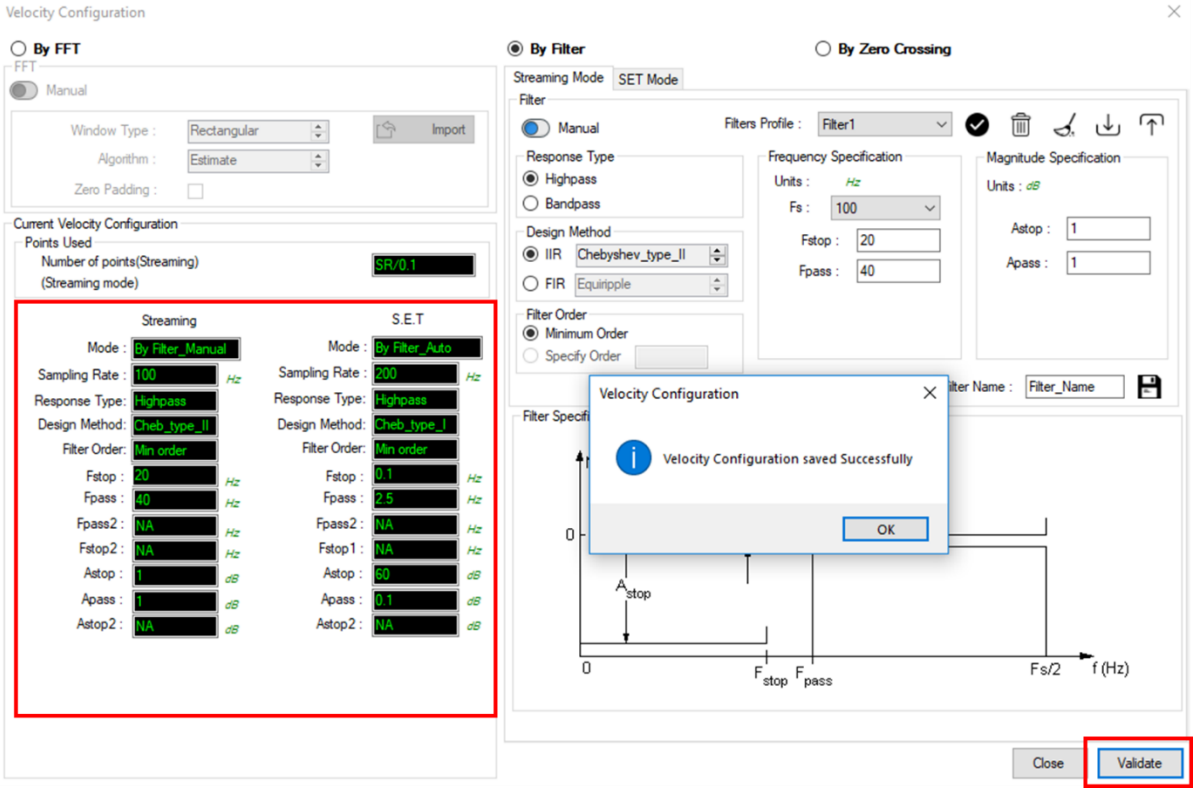




- Filter Specification: Is a Graphical Display of the Filter Specification depends on the user settings.



To save all settings Press Validate. The new settings should be displayed on the Left side of the Window.



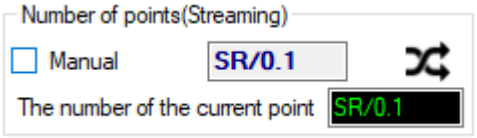
10.3.3 IIR Sofltware Filter

- ***Enable IIR Filter***: Check to enable IIR filter

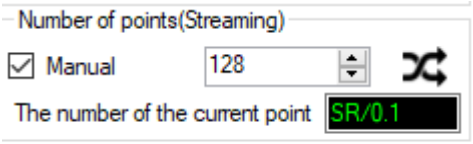
It is important to notice that the IIR filter may cause Amplitude attenuation.

It is important to notice if the signal is not high enough applying IIR filters may eliminate the entire signal

10.3.4 Number of Points (Streaming)

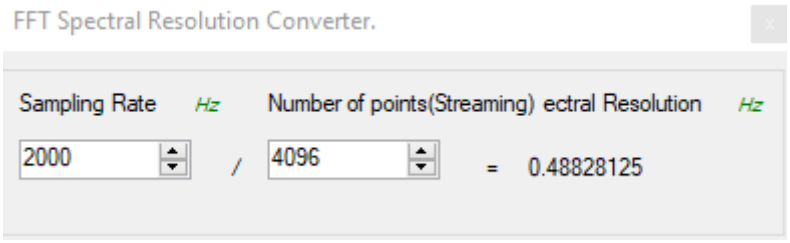


By default, the Number of Points is configured to be set automatically as Sampling Rate / 0.1 (SR/0.1). By moving to the Manual settings, user must choose a value between 128 and 32768.



It is important to notice that larger Number of Points provide higher spectral resolution but take longer to compute.

FFT Spectral Resolution Converter is simulation tool which will estimate the FFT Spectral Resolution regarding the Sampling Rate and the Number of Points.



The frequency resolution of each spectral line is equal to the Sampling Rate divided by the Number of Points. For instance, for example, if the Number of Points is 4096 and the Sampling Rate is 2000, the resolution of each spectral line will be:

2000/4096 = 0.48828125

The Number of Points should be equal or higher than the Samplig Rate (Acquisition time at least = 1 second)

It is important to notice that larger Number of Points provide higher spectral resolution but take longer to compute.

10.4 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.

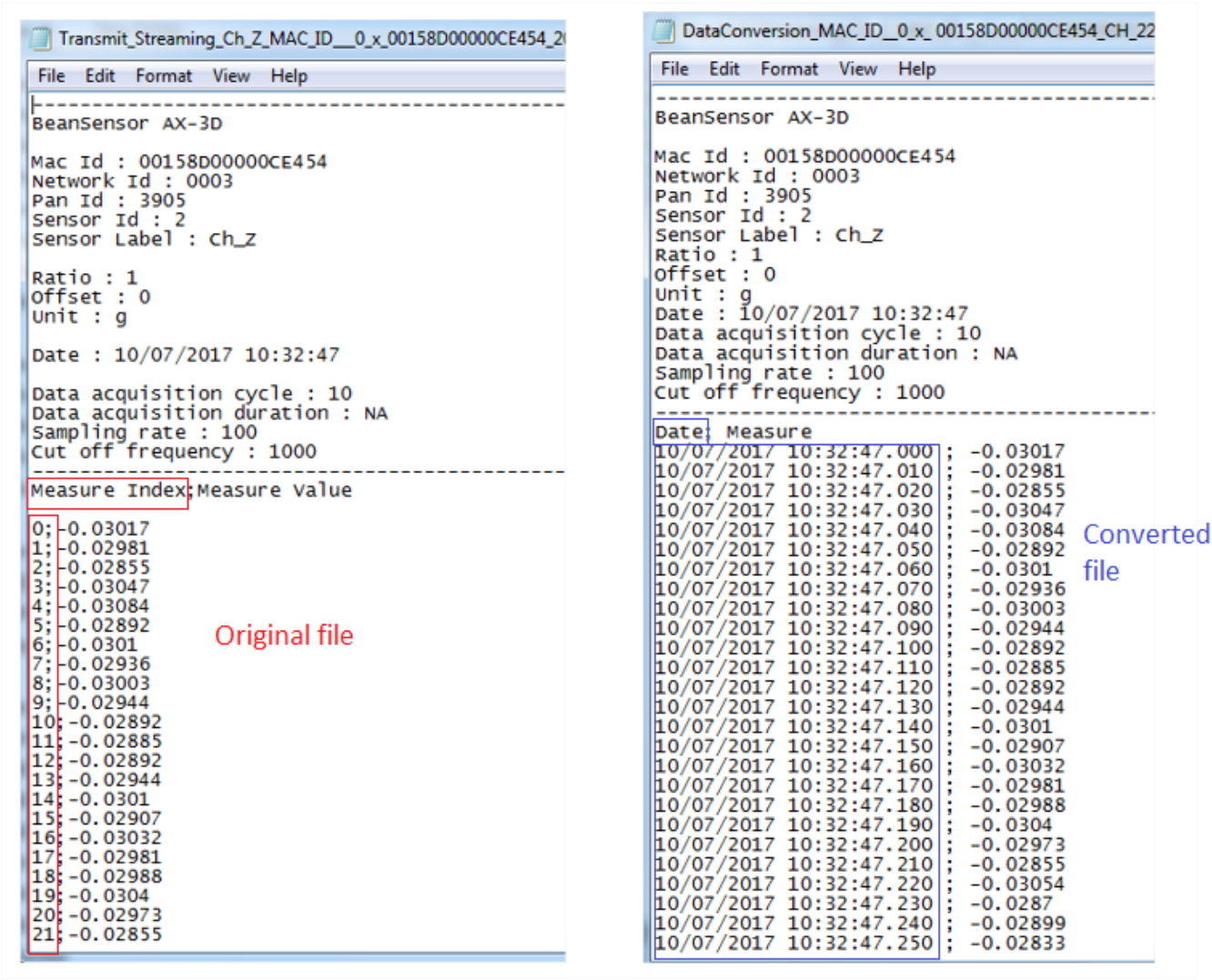


Figure 169: Date Conversion

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

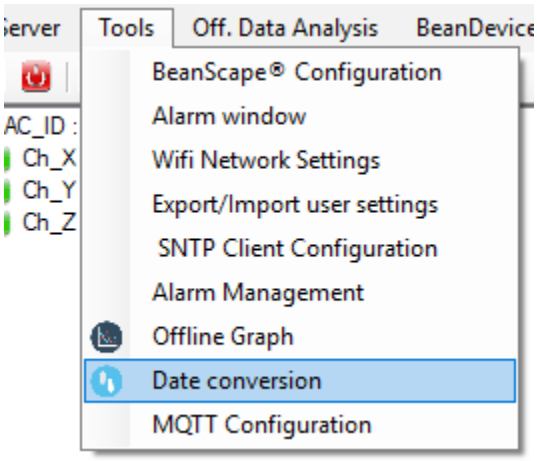


Figure 170: Date conversion option on BeanScape®

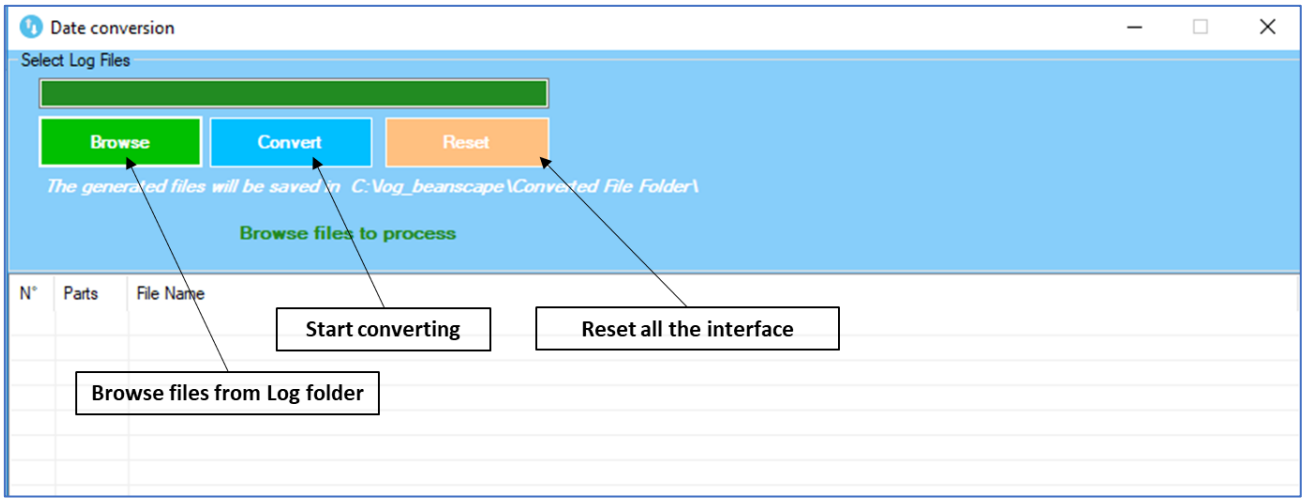


Figure 171: Date conversion window

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

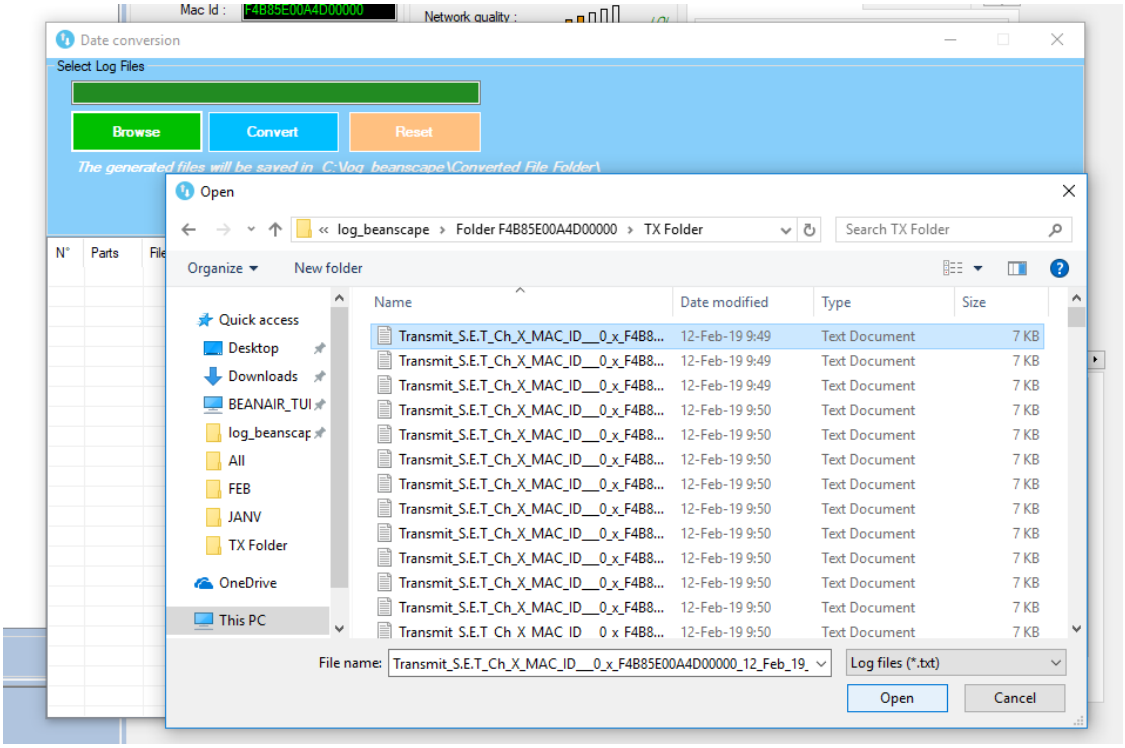


Figure 172: Importing files into data conversion window

- Overview of the selected files

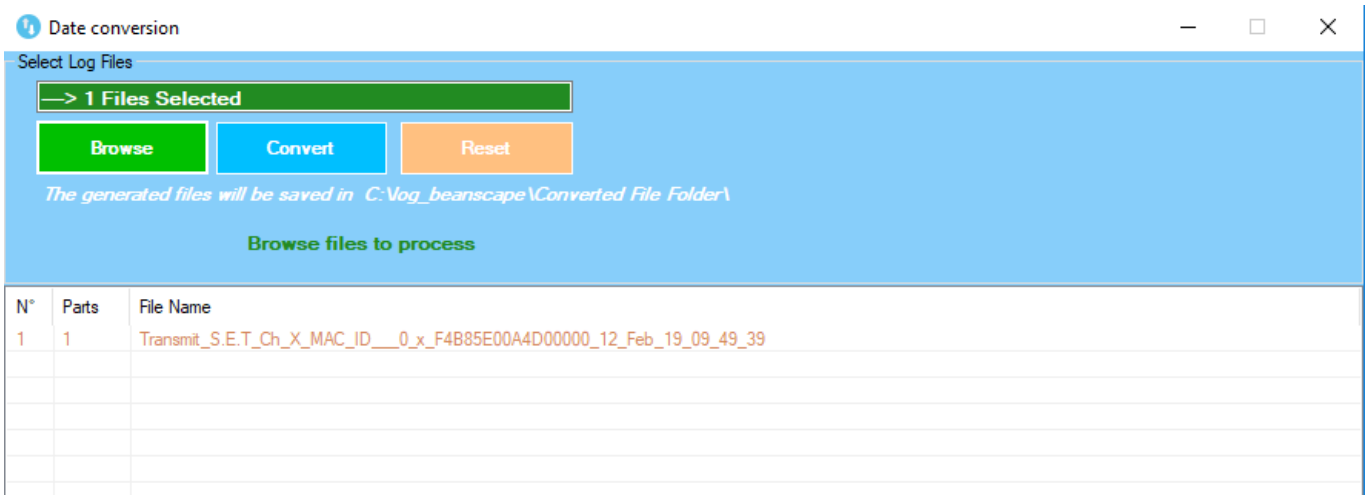


Figure 173: Overview of a selected file on Data conversion window

- 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**

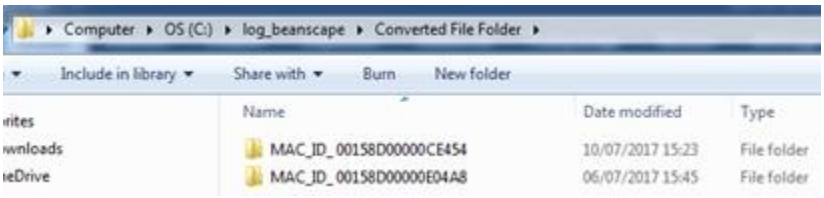


Figure 174: Converted file folder

10.5 OFFLINE GRAPH

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

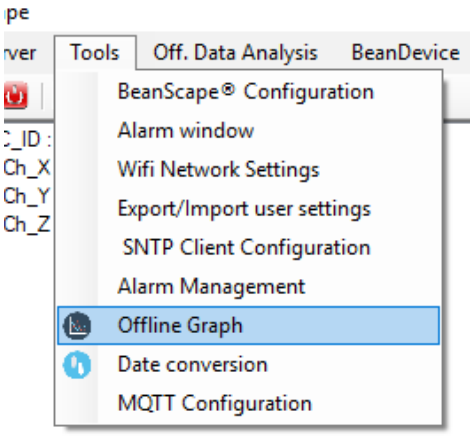


Figure 175: Offline graph option on BeanScape®

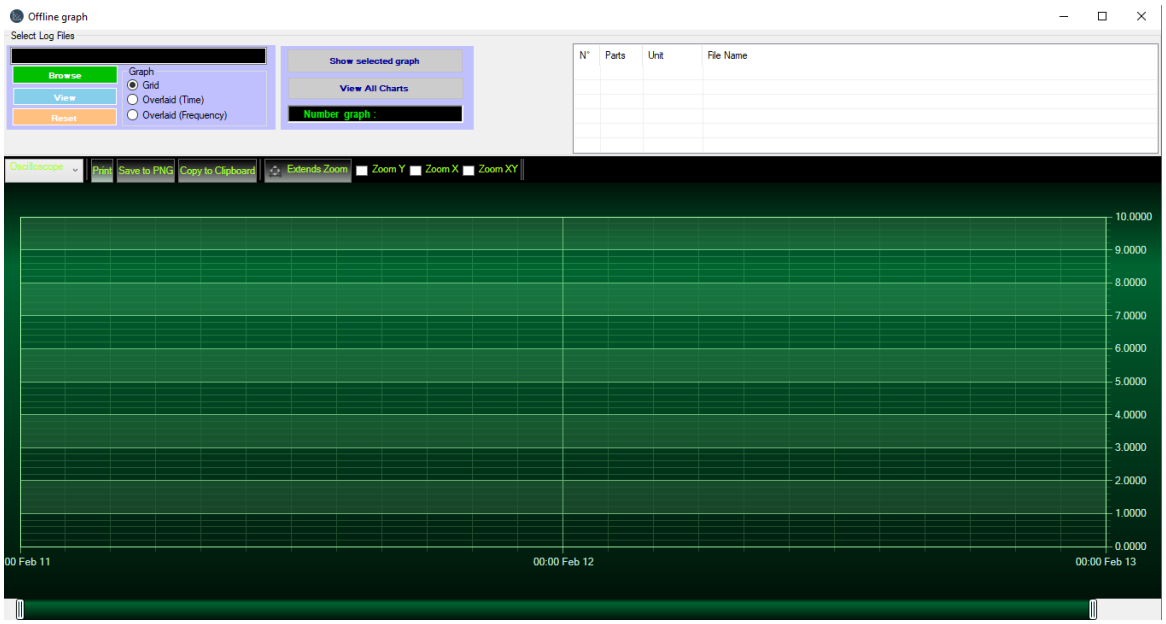


Figure 176: Offline graph window

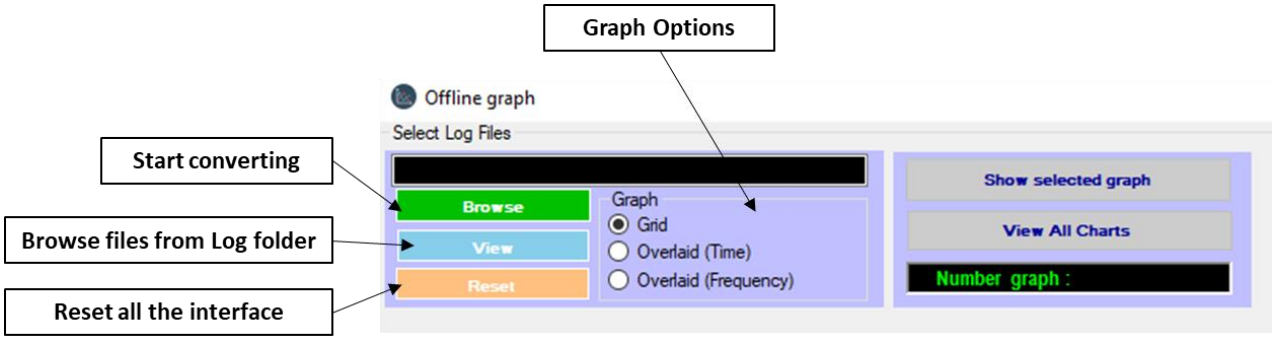


Figure 177: Offline graph window's options

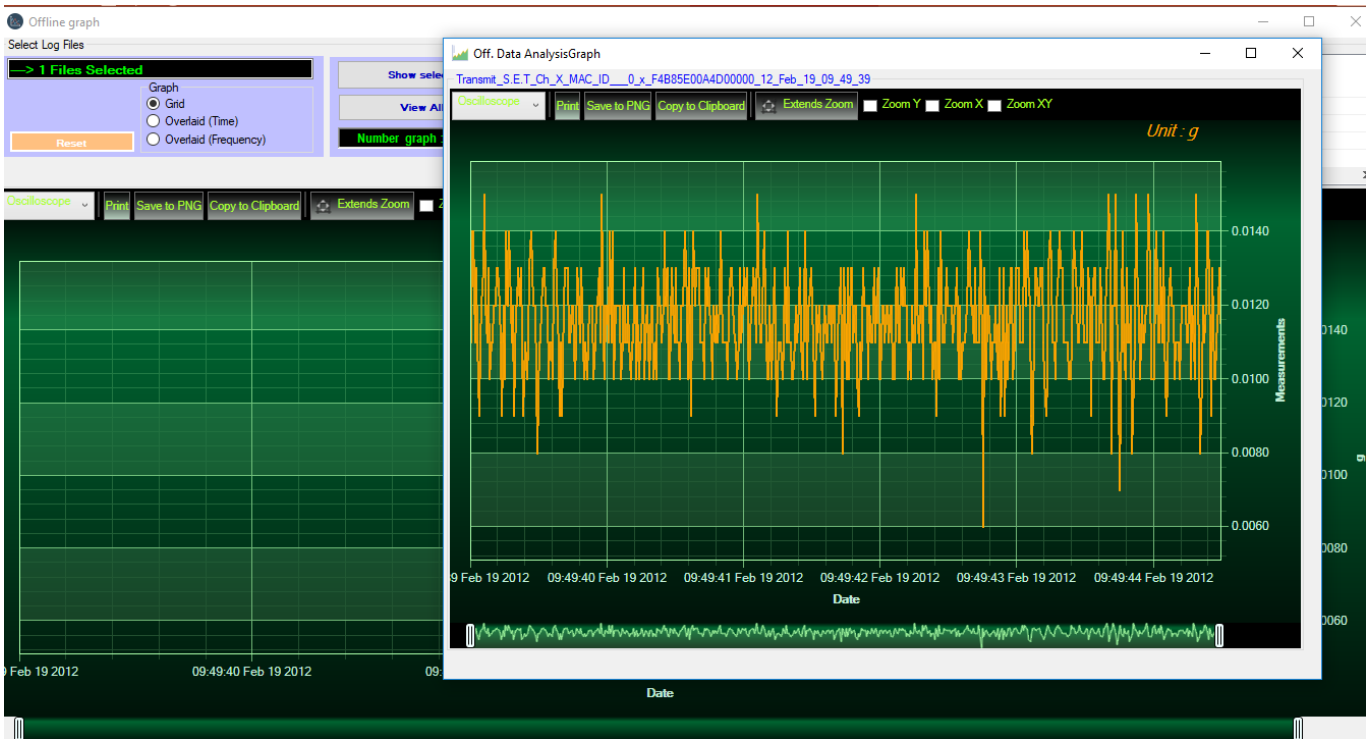


Figure 178: Offline displayed graph

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 179: Gird display of graphs

11.SNTP CLIENT

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®

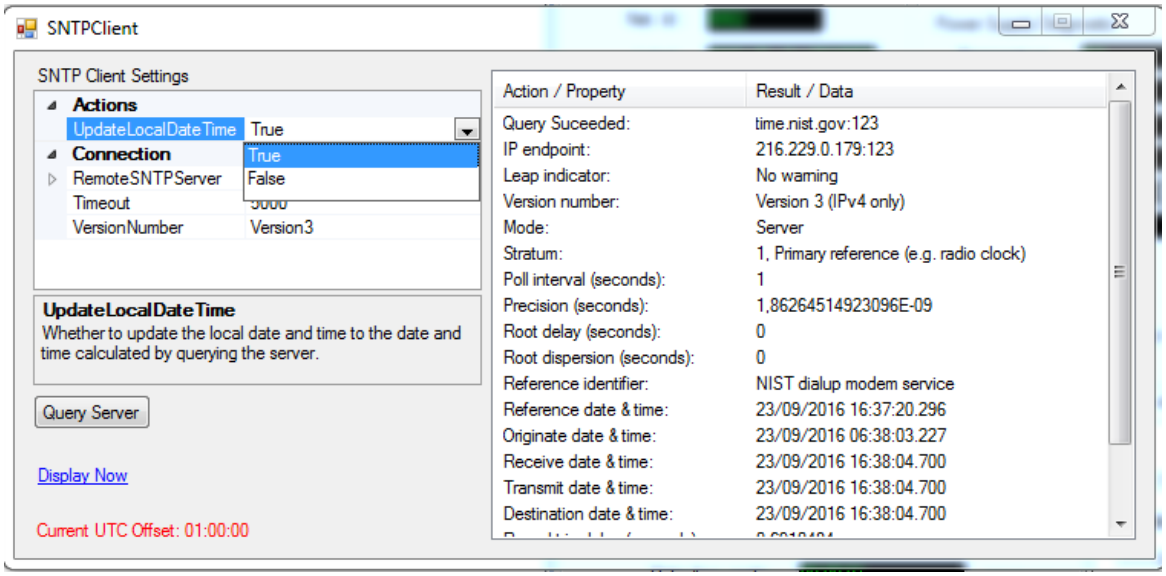


Figure 180: SNTP Client configuration

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

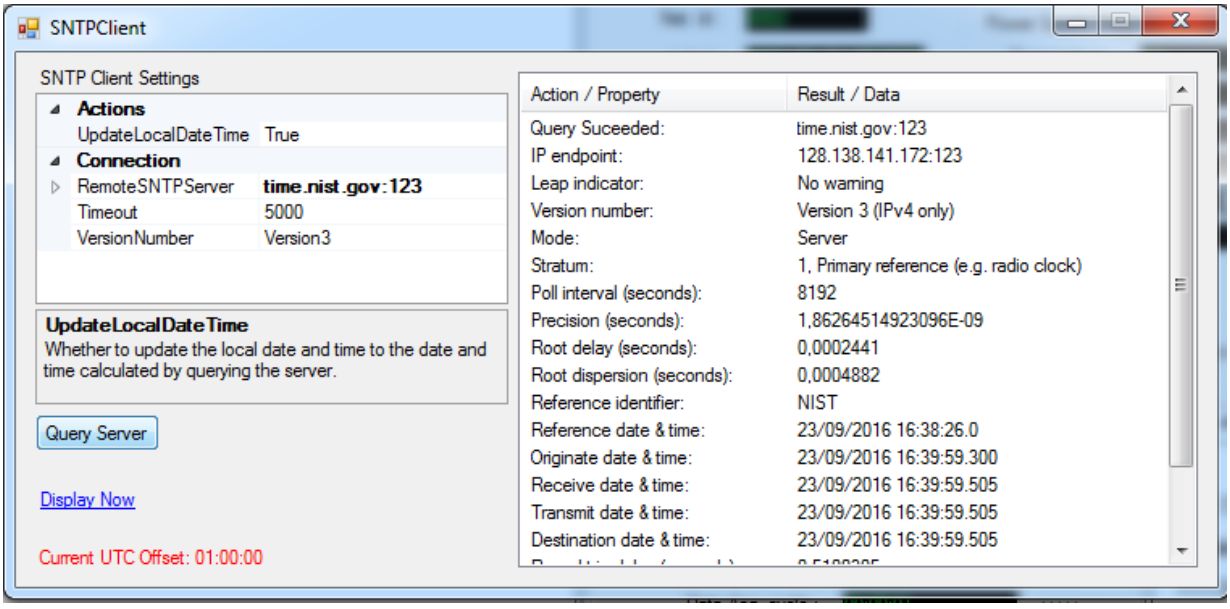


Figure 181: SNTP Client configuration

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

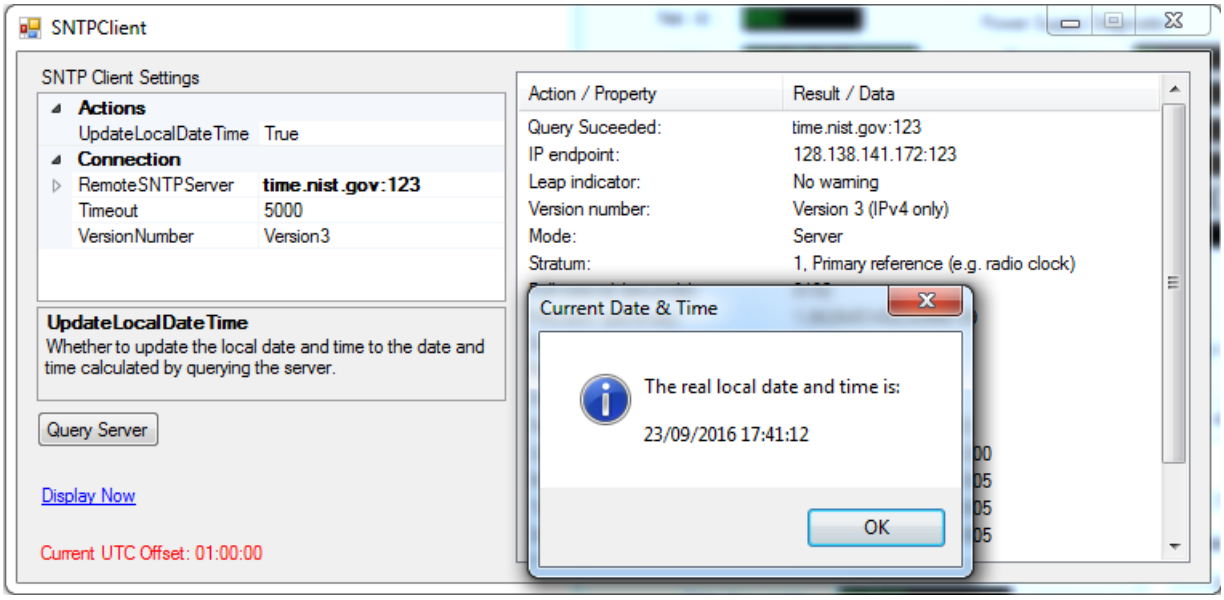


Figure 182: SNTP Client configuration

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

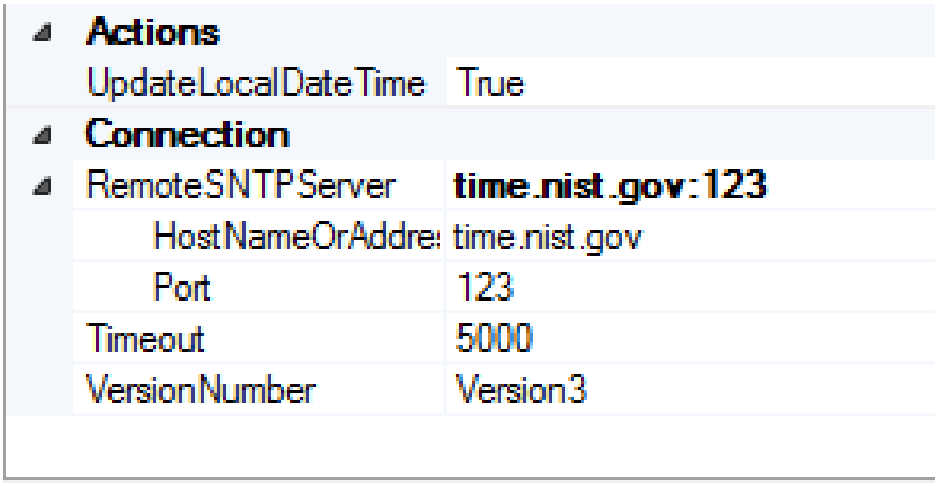


Figure 183: Example of SNTP server configuration

See "Configuring SNTP client" YouTube video

12.ALARM MANAGEMENT

Alarm management is a functionality used to setup SMTP configuration and to manage what to send (reports and log files) and to which email address when alarms occurs.

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

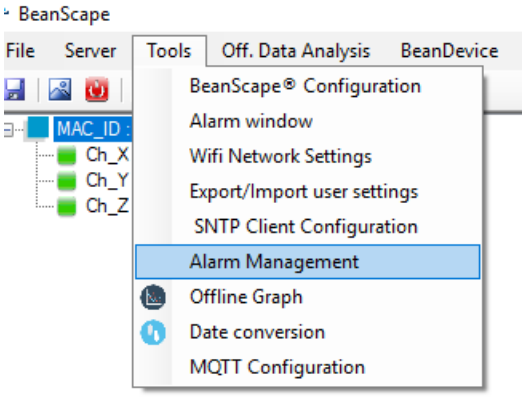


Figure 184: Alarm Management menu

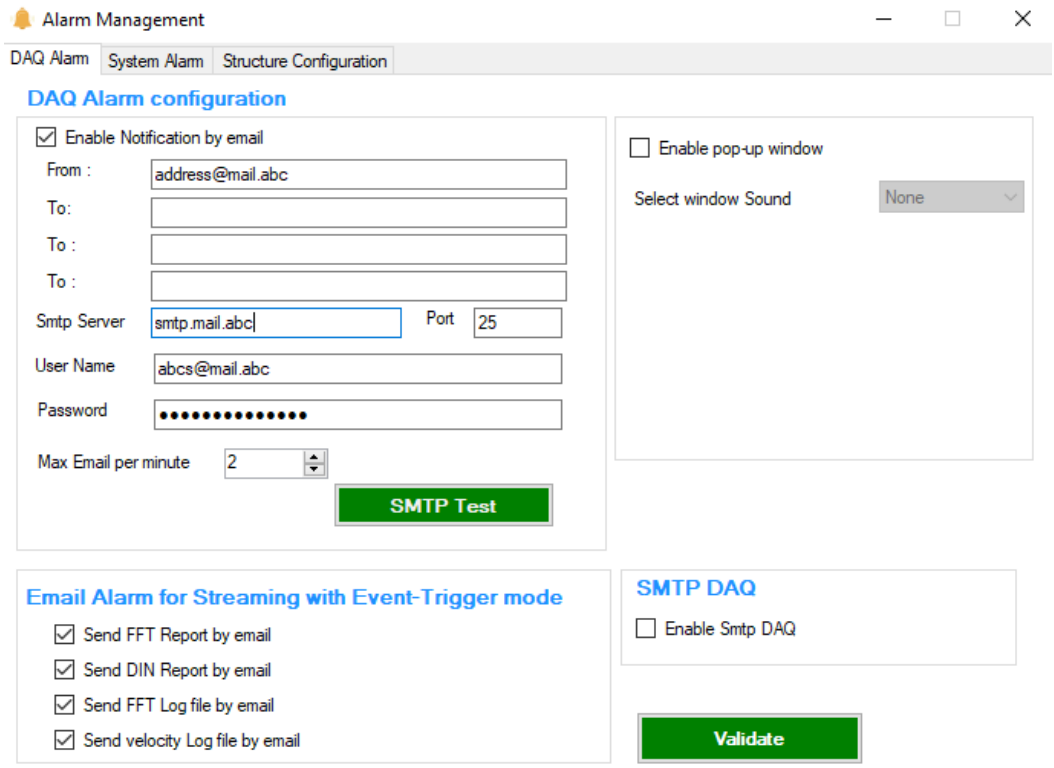


Figure 185: Alarm Management window

12.1 DAQ ALARM

In DAQ alarm, we setup the SMTP account for the measurement alarm notifications.

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

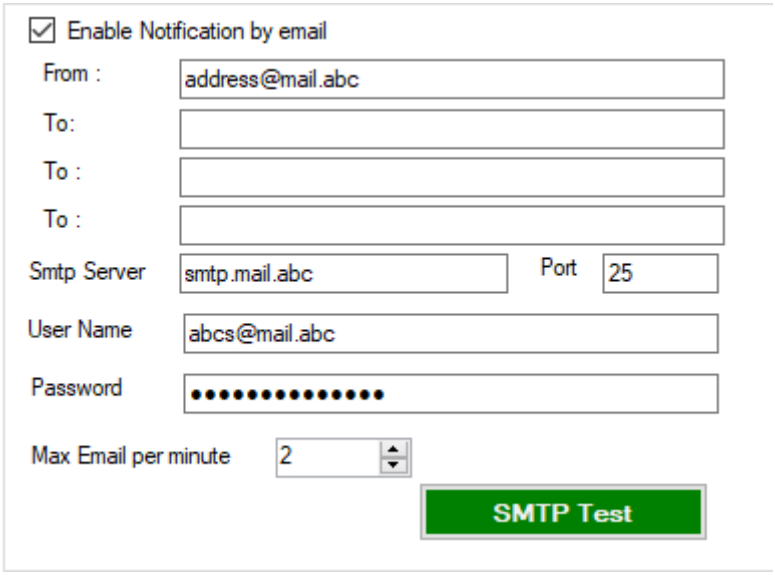


Figure 186: Alarm management: email setting

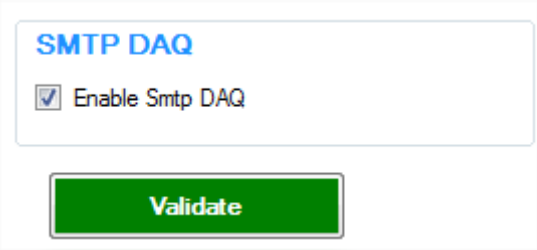
Chose the maximum number of emails allowed to be sent to your email address per minute.

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

To enable BeanScape® Wilow® to send notifications when alarm threshold is reached check enable SMTP DAQ and validate.



For Streaming with event –trigger mode, you can select what you want to receive in the Alarm email, by checking from this list below:

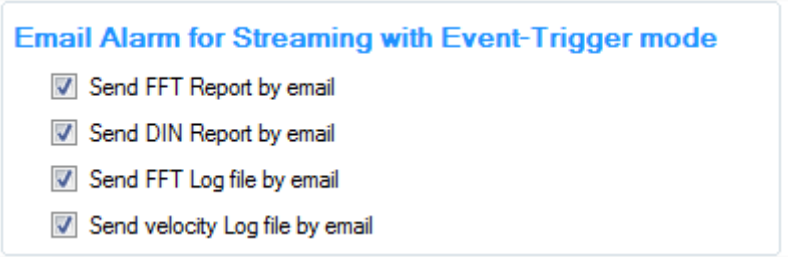


Figure 187: Email alarm for Streaming and S.E.T mode frame

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

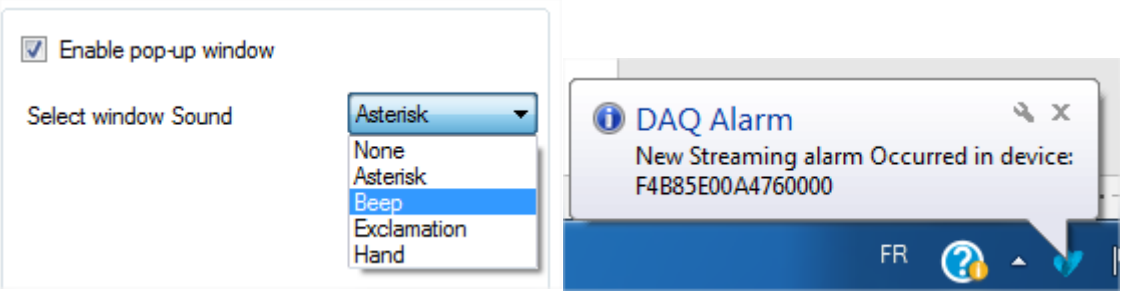


Figure 188: enabling pop-up window

12.2 SYSTEM ALARM

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

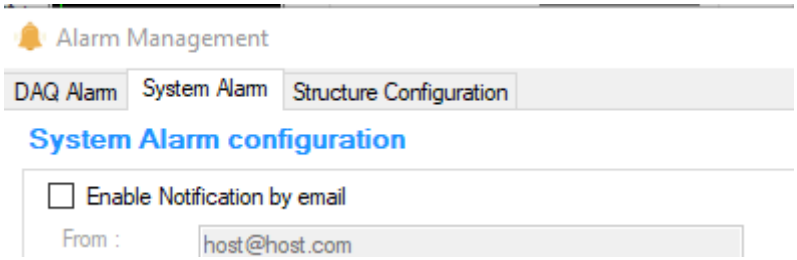


Figure 189: System Alarm tab

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

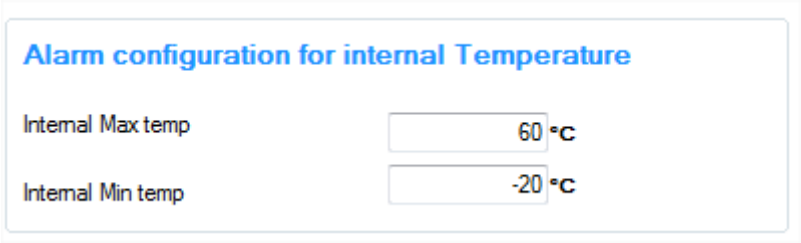
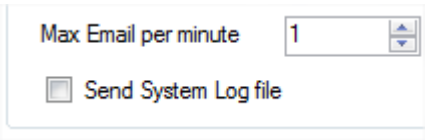


Figure 190: system alarm settings

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

12.3 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.

You can select 3 Building types from the list: **Commercial**, **Dwellings** and **Non_Classified.**

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

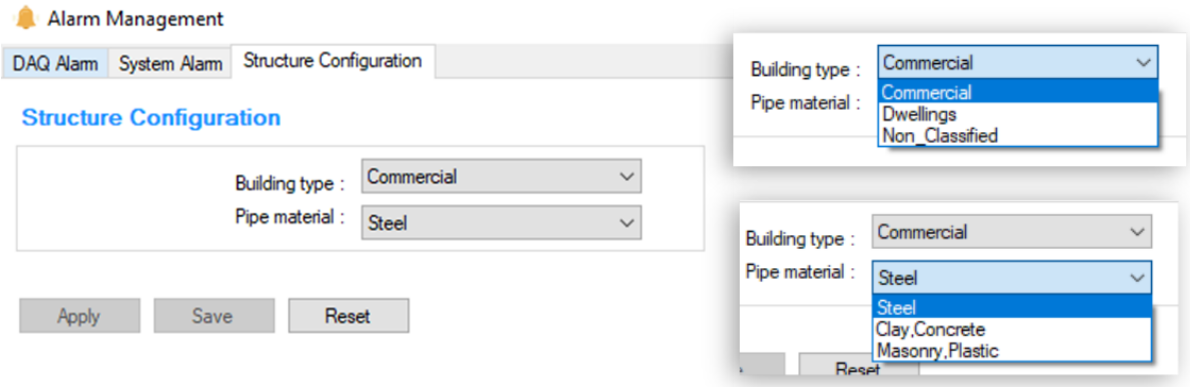


Figure 191: DIN 4150-3 Configuration

13. MAINTENANCE & SUPERVISION (FOR EXPERIENCED USER)

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

13.1 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*** ***H2 :2, 10, 13*** ***S2 : -2, -10, -13*** ***S1 : -2, -10, -13***	***H1 :20*** ***H2 :20*** ***S2 :0*** ***S1 :0***	***H1 :20*** ***H2 :20*** ***S2 :0*** ***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.

13.2 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

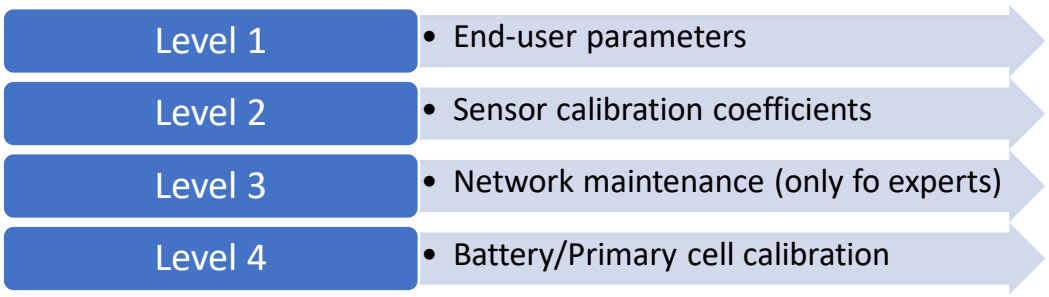
The following table gives you a list of recommendations in order to extend the battery autonomy of your BeanDevice® Wilow®:

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).

13.3 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:



13.3.1 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* *Low level :-2g or -10g*	*High level: 15° or 30°* *Low level: -15° or -30°*	*High level: 2g* *Low level :-2g*

Table 9: 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)

13.3.2 Level 2: Sensor calibration parameters

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

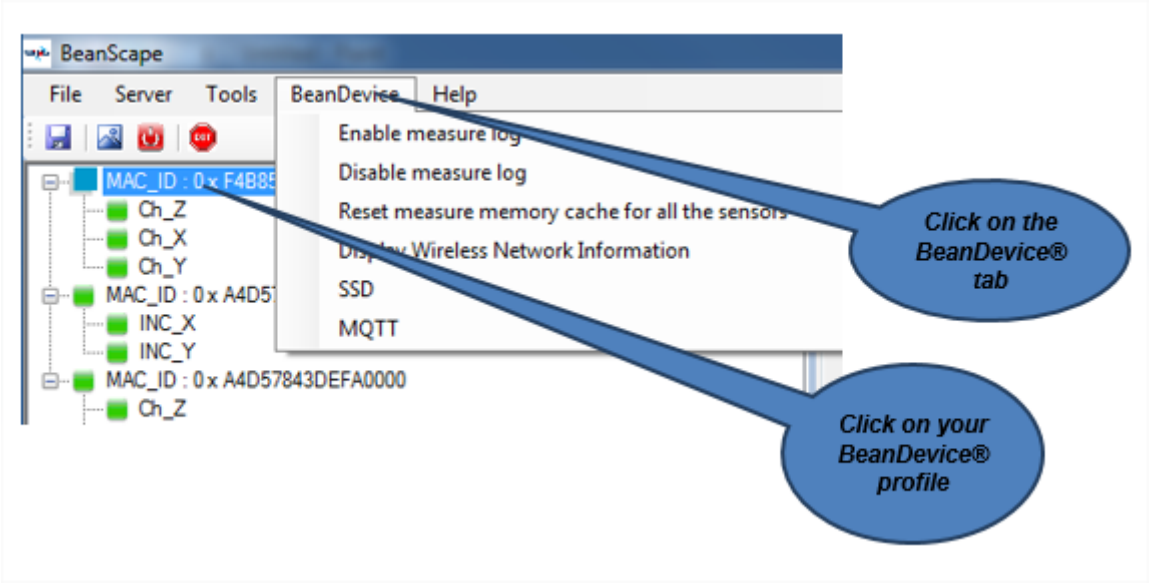
Parameter	*BeanDevice® WiLow® Version*		
	AX3D	**HI-INC**	***AX-3DS***
Sensor gain	OK	OK	OK
Sensor offset	OK	OK	OK

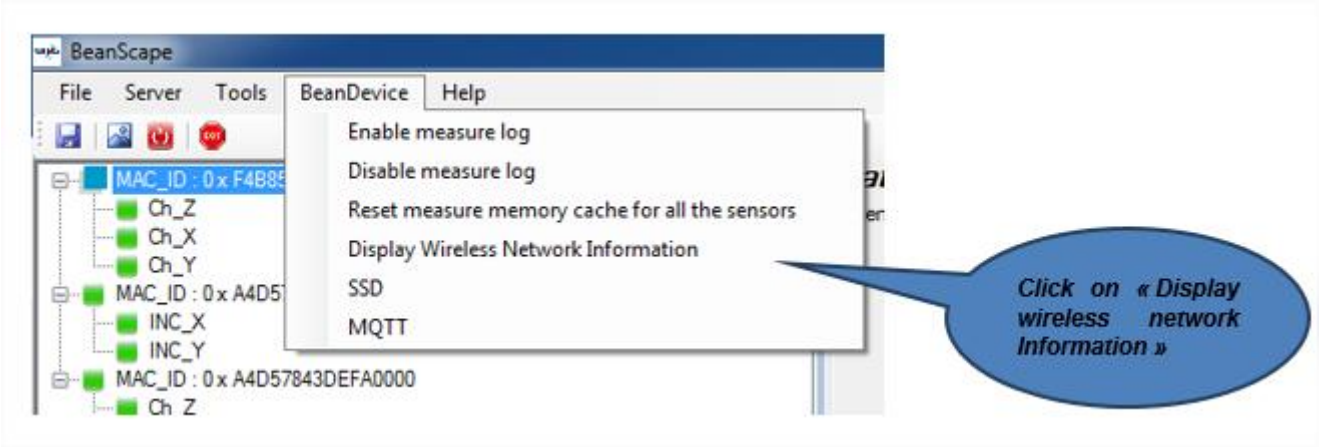
13.4 NETWORK DIAGNOSTIC FROM YOUR BEANSCAPE® WILOW® SOFTWARE

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

13.4.1 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”.





13.4.1.1 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.

13.4.1.2 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?"

13.4.1.3 Internal temperature monitoring

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

13.4.1.4 Battery charge monitoring

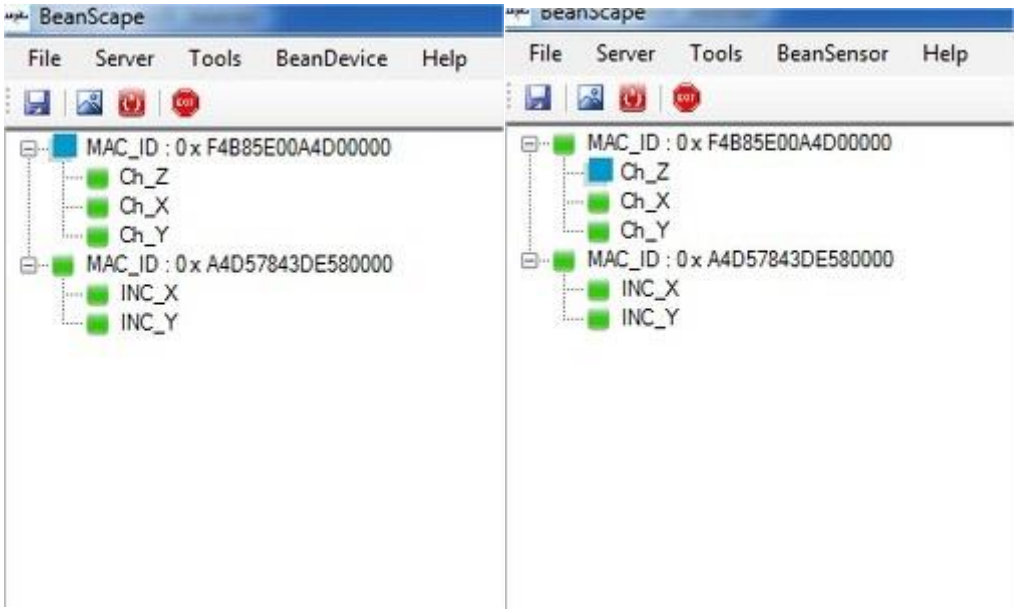
Battery charge is based on current accumulation. The **BeanDevice® Wilow®** integrates a current accumulator circuit which facilitates remaining capacity estimation by tracking the net current flow into and out of the battery. Current flow into the battery increments the current accumulator while current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

Voltage measurement corresponds to battery voltage.

13.4.2 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.

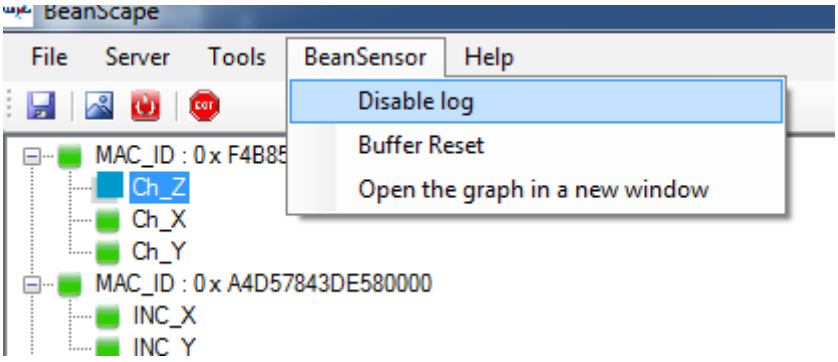


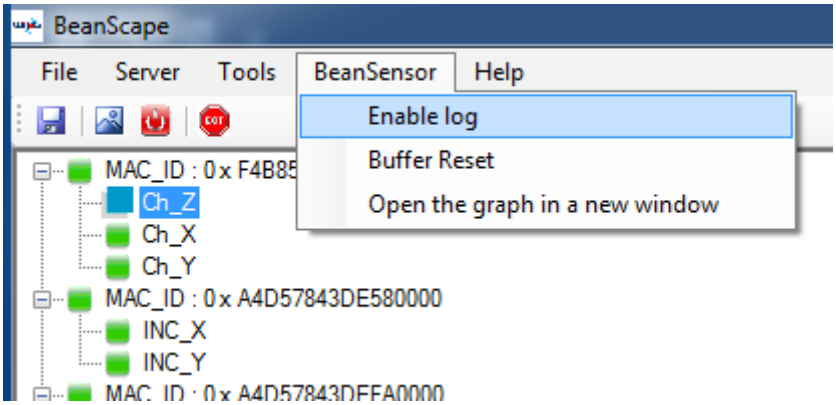
By clicking on the scrolling menu « BeanSensor », you can access to the following features:

13.4.2.1 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.





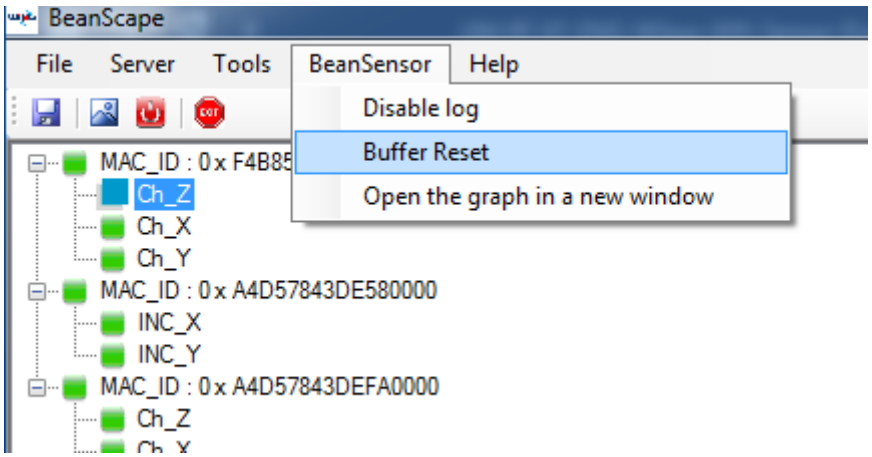
For further information about CSV log file, please read the BeanScape® user manual.

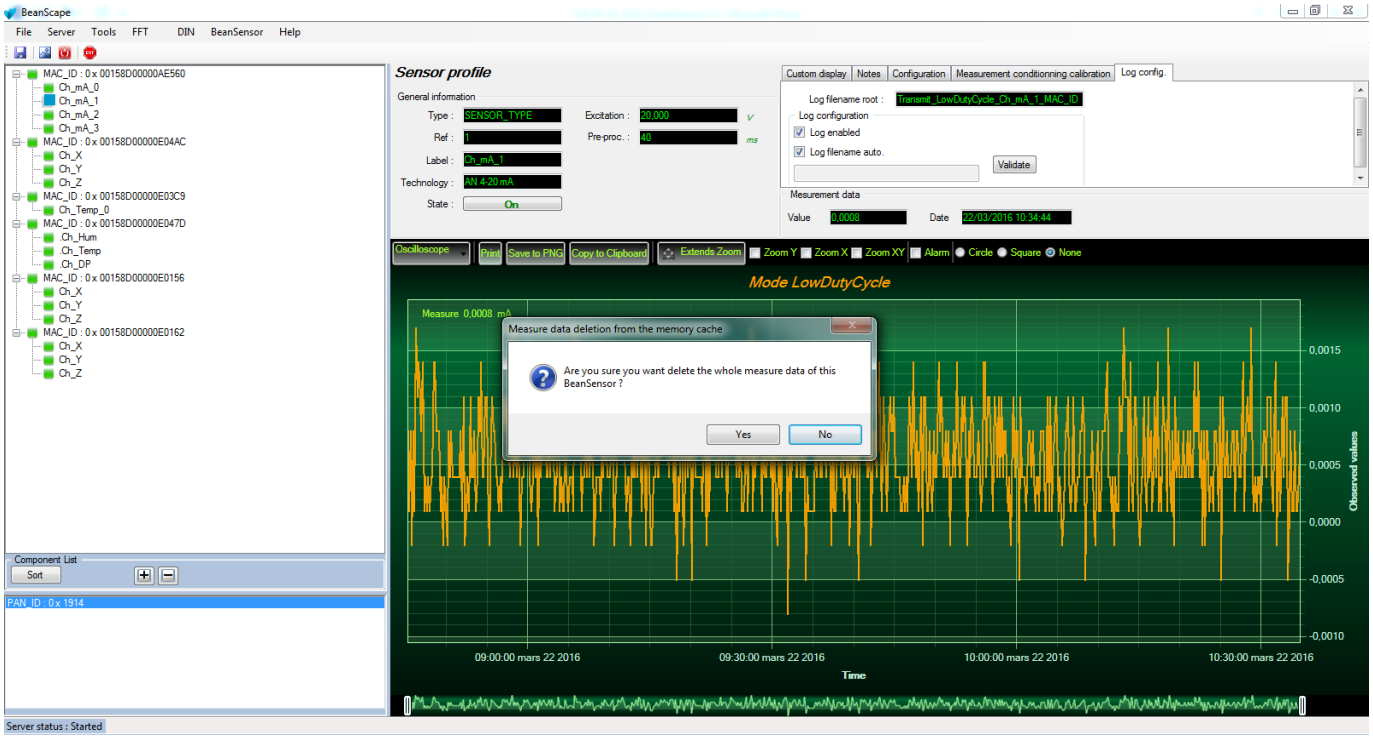
13.4.2.2 Buffer reset

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

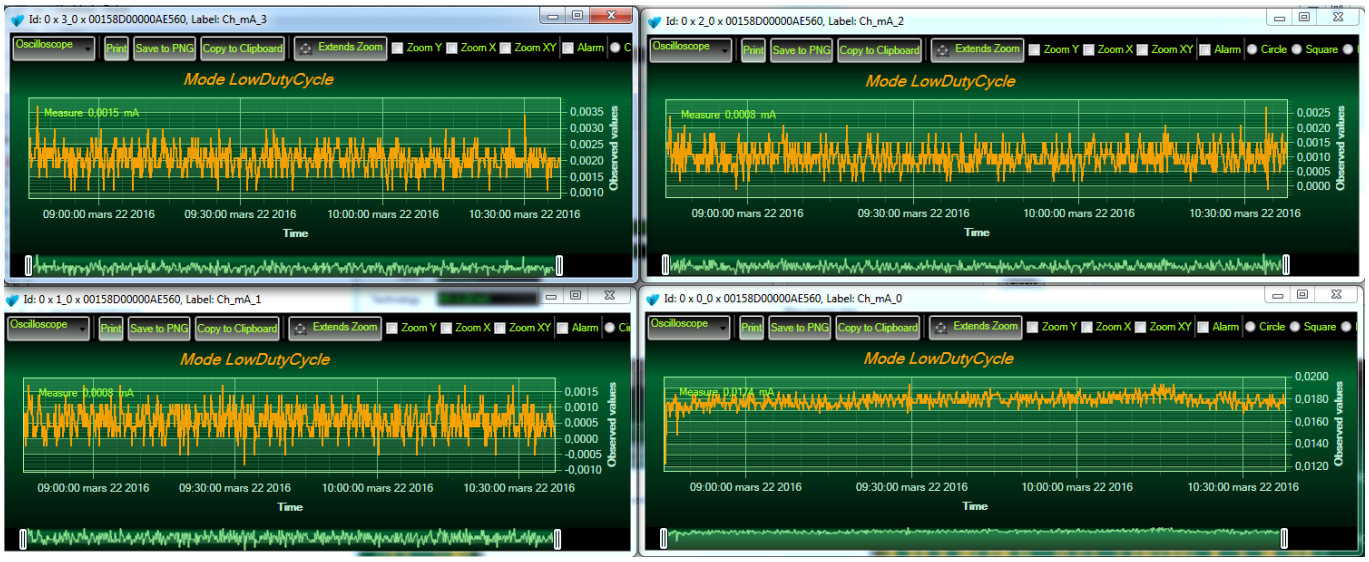




13.4.2.3 Open the graph in a new window

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.

14. 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.

15. APPENDICES

15.1 FFT WINDOW GRAPH ON MATLAB

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

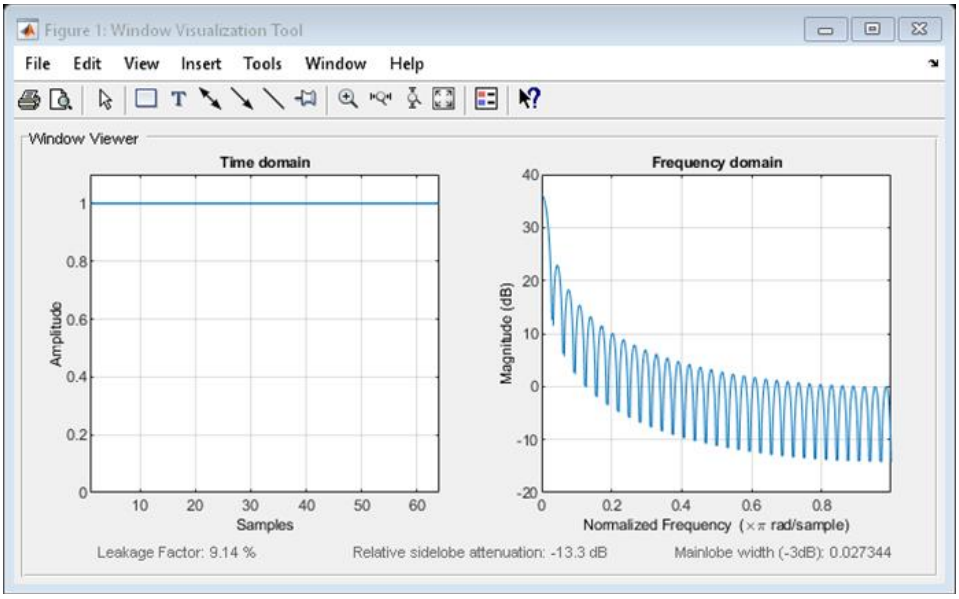


Figure 193: Rectangular Window Graph on MatLab

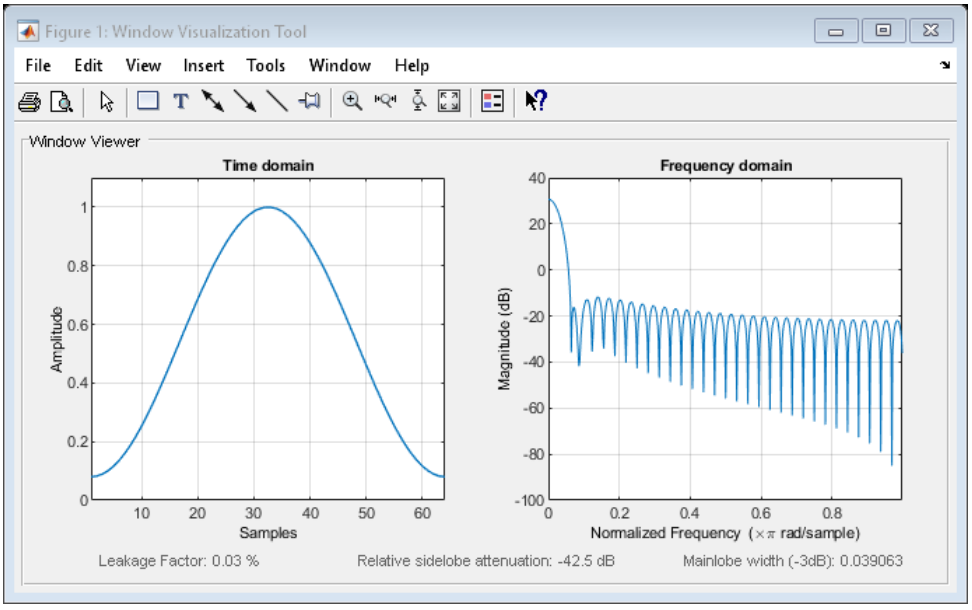


Figure 194: Hamming Window Graph on MatLab

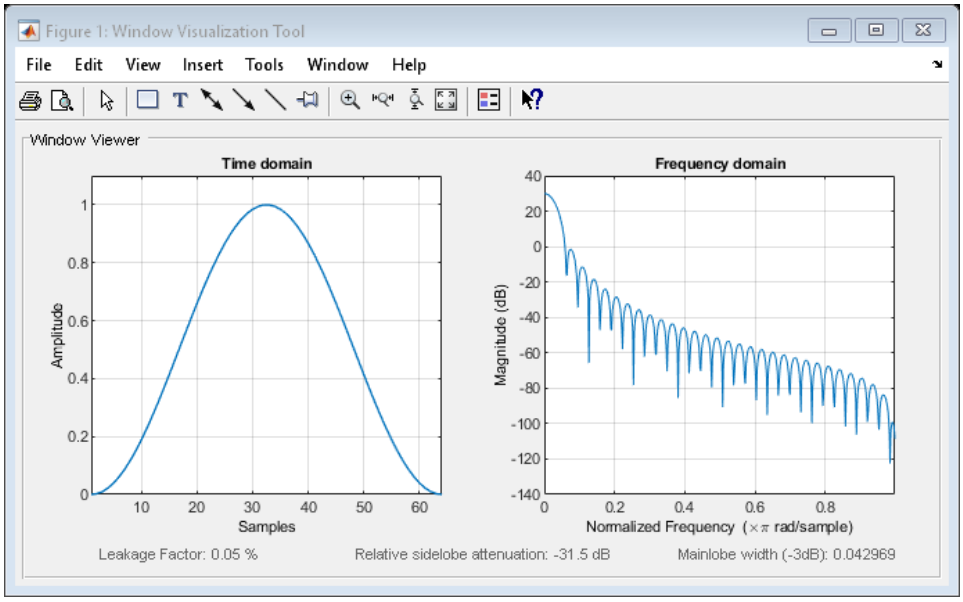


Figure 195: Hann Window Graph on MatLab

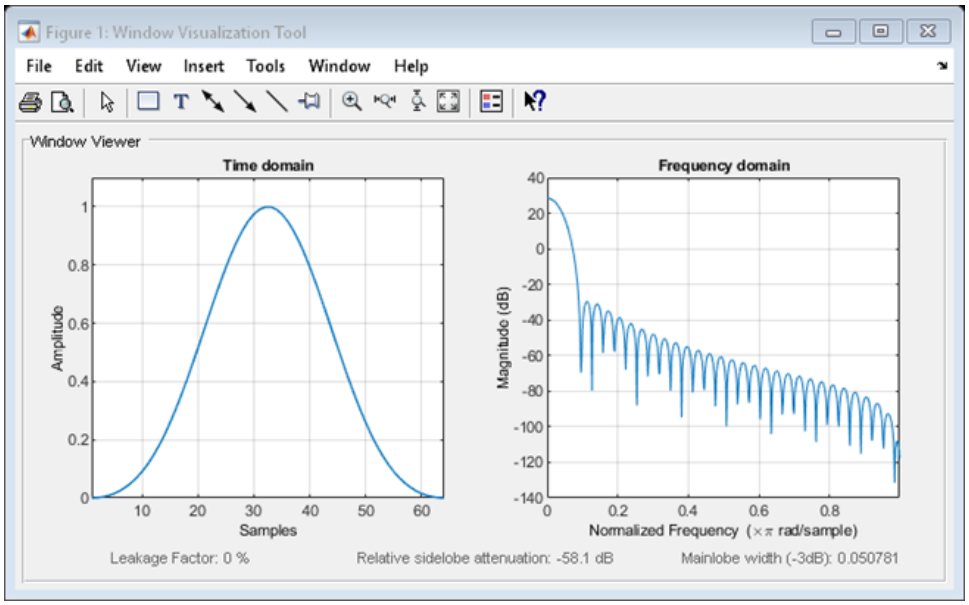


Figure 196: Blackman Window Graph on MatLab

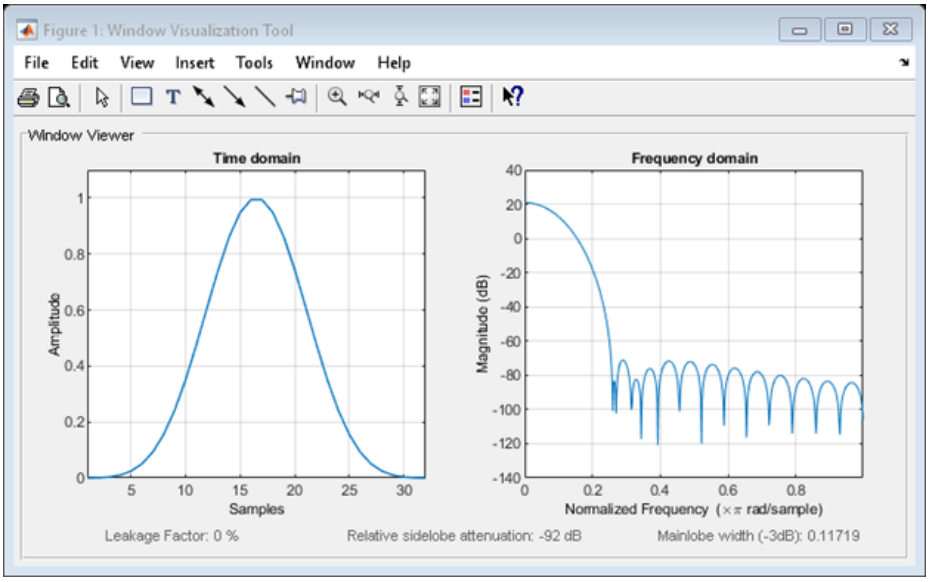


Figure 197: Blackman-Harris Window Graph on MatLab

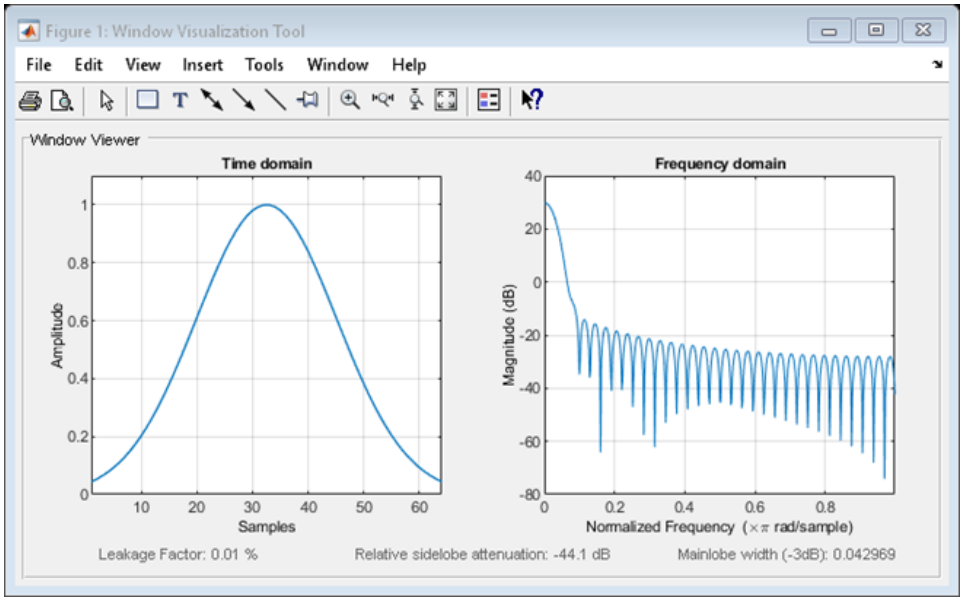


Figure 198: Gaussian Window Graph on MatLab

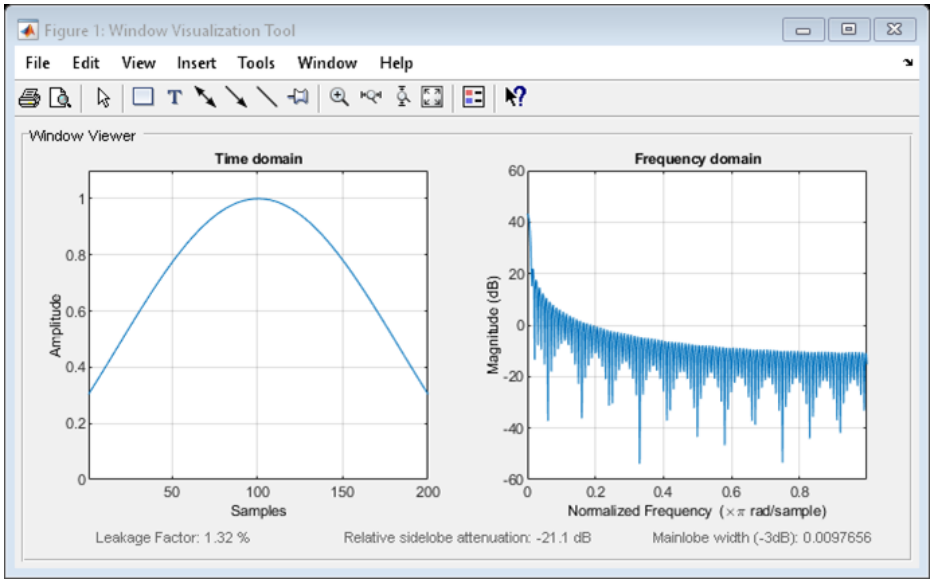


Figure 199: Kaiser Window Graph on MatLab

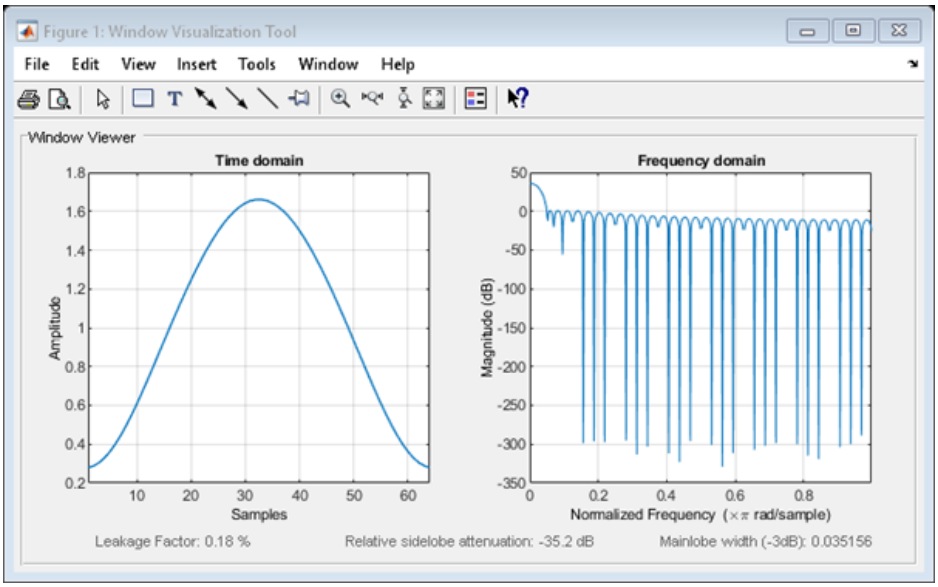


Figure 200: Taylor Window Graph on MatLab

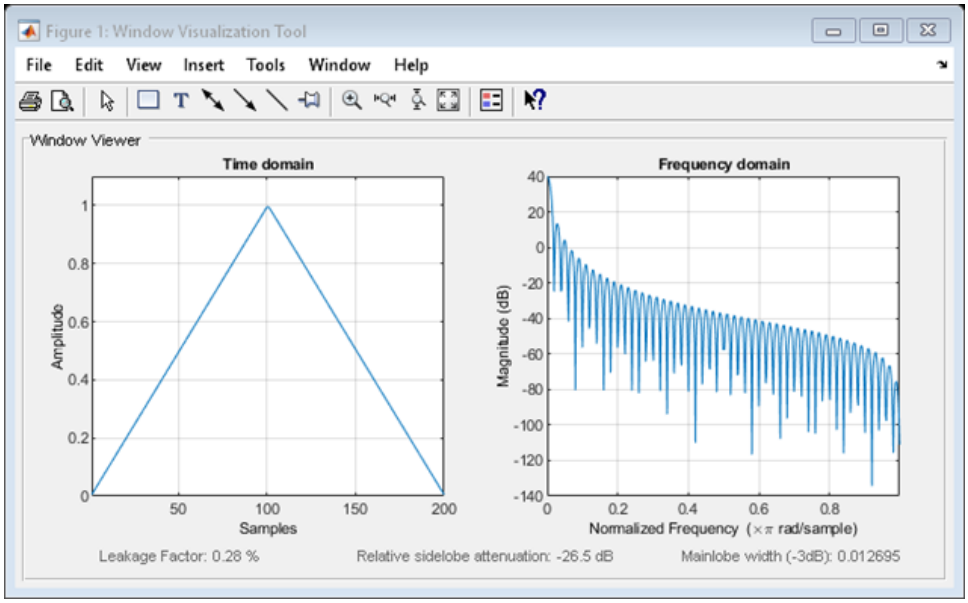


Figure 201: Triangular Window Graph on MatLab

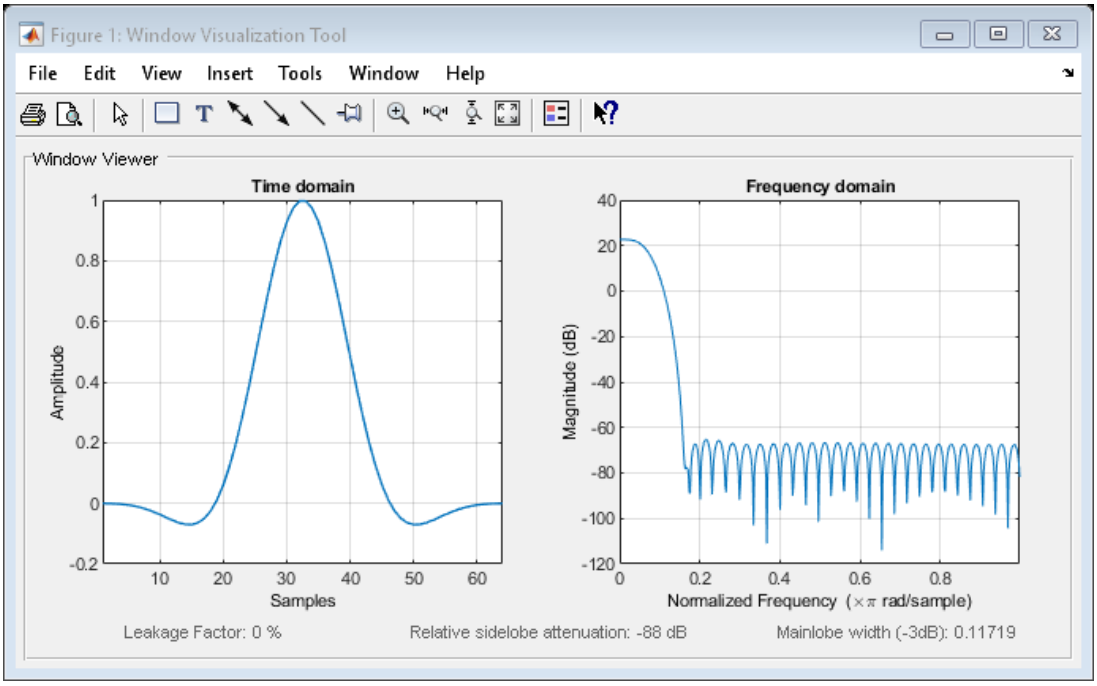


Figure 202: Flat Top Window Graph on MatLab

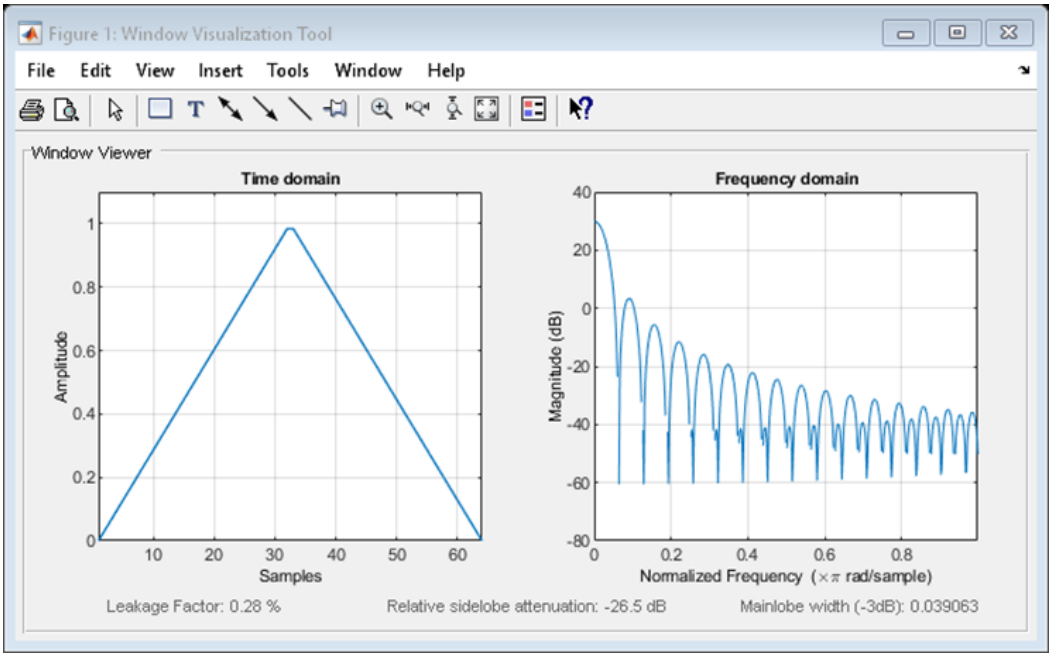


Figure 203: Bartlett Window Graph on MatLab

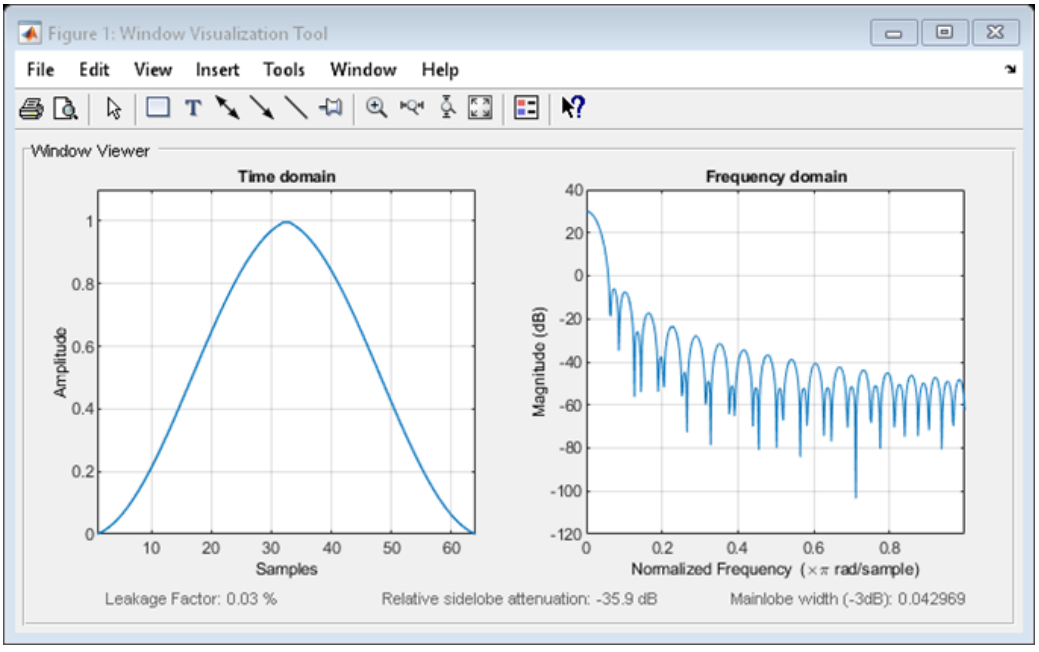


Figure 204: Bartlett-Hann Window Graph on MatLab

SCIENCE GATE
Your Automation Partner
SCIGATE AUTOMATION (S) PTE LTD
No.1 Bukit Batok Street 22 #01-01 Singapore 659592
Tel: (65) 6561 0488 Fax: (65) 6562 0588
Email: sales@scigate.com.sg Web: www.scigate.com.sg
Business Hours: Monday - Friday 8.30am - 6.15pm