BeanAir
WIRELESS IIOT SENSORS

USER MANUAL

BeanDevice® 2.4 GHz

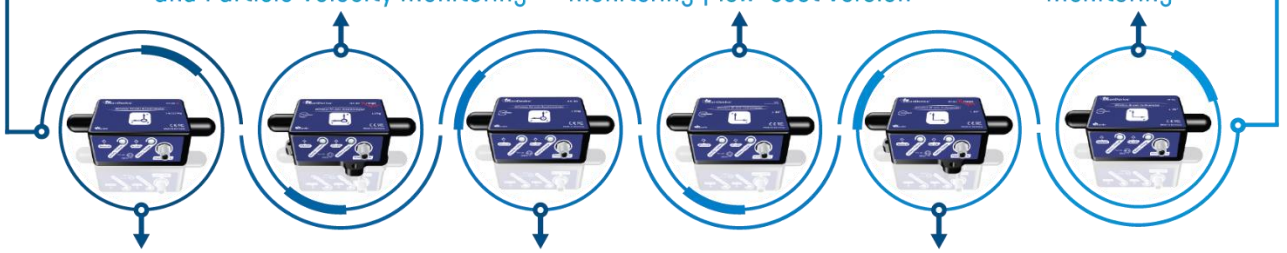
SmartSensor

BeanDevice® 2.4GHz

AX-3D XRange
High Performance wireless IIOT vibration sensor | acceleration and Particle Velocity monitoring

INC
Wireless IIOT inclinometer sensor tilt, inclination, slope monitoring | low-cost version

HI-INC
Wireless IIOT inclinometer tilt, inclination, slope monitoring



AX-3DS
Wireless IIOT accelerometer sensor Shock and impact monitoring

AX-3D
High Performance wireless vibration sensor | acceleration and velocity monitoring

Hi-Inc XRange
High performance wireless IIOT inclinometer sensor | tilt, inclination, slope monitoring

DOCUMENT			
Document ID	UM_RF_01	**Version**	V2.2
External reference		**Date**	02/07/2019
Author	Fahd Essid, Application/Support Engineer		
		Project Code	
Document's name	SmartSensor wireless accelerometer inclinometer and shock sensor user manual		

VALIDATION			
Function	**Destination**	**For validation**	**For info**
Writer	Youssef Shahine	✓	
Reader	Mohamed-Yosri Jaouadi	✓	
Validation	Antje Jacob		✓

DIFFUSION			
Function	**Destination**	**For action**	**For info**
Reader n°1	Antje Jacob, Production Manager	✓	
Reader n°2	Mohamed-Yosri Jaouadi., Embedded software engineer	✓	

UPDATES			
Version	**Date**	**Auteur**	**Evolution & Status**
2.1	26/06/2012	Christophe Dontegreuil	• BeanDevice® HI-INC accuracy considerations BeanDevice® mounting
2.2	15/11/2012	Christophe Dontegreuil	• New version of the streaming mode Primary Cell replacement instructions and Calibration added
2.3	10/03/2013	Christophe Dontegreuil	XRange version added
2.4	22/05/2014	Christophe Dontegreuil	Detailed information about log files creation & management
2.5	29/11/2014	Maxime Obr.	• TimeSync function description • Log folder organization added
2.6	06/02/2016	Maxime Obr.	• Sensor calibration section added • More details about power supply wiring code for Xtend option • Exporting a log file on excel added

UPDATES			
2.7	21/03/2016	Rasha Friji	• Standalone option • Battery level display
2.8	27/09/2016	Salah Riahi	• BeanDevice versions suppressed • Tx Power management suppressed
2.9	22/12/2016	Salah Riahi	• Exporting a log file to Excel video added
2.10	12/03/2018	Aymen JEGHAM	• New technical Videos added • System Maintenance (primary cell change & calibration) suppressed
2.11	3/05/2018	Aymen JEGHAM	• Signal processing • Alarm threshold • Zeroing • S.E.T acquisition mode
2.12	10/07/2018	Youssef Shahine	• Technical features updated • Alarm Management description transferred from BeanScape® UM to BeanDevice® 2.4GHZ User Manual • Offline analysis tool description transferred from BeanScape® UM to BeanDevice® 2.4GHZ UM
2.13	20/07/2018	Aymen JEGHAM	• Dedicated section **Online data analysis tool** • Diagram updated “Offline and online data analysis tool”
2.14	30/07/2018	Aymen JEGHAM	• Vocabulary update • Off. Graph and date conversion location update
2.15	26/10/2018	Fahd ESSID	• Screenshots update • LEDs Description update • Tab signal processing changed to Online Data analysis and updated • Sensor channel profile update • Data acquisition log file update • Offline graph update • Offline data analysis update • Online data analysis update
2.16	03/12/2018	Fahd ESSID	• Graphical Display updated

UPDATES			
2.17	11/01/2019	Fahd ESSID	• Right click functionalities added • Alarm Management updated • Alarm Management Note added • DIN 4150-3 Configuration added
2.18	20/03/2019	Fahd ESSID	• DIN Display updated • Tab Sensor Config Added
2.19	25/06/2019	Mohamed Bechir Besbes	• Firewall exception for BeanScape
2.2	02/07/2019	Fahd ESSID	• Vocabulary update • Online/Offline Data Analysis update

Disclaimer

The contents are confidential and any disclosure to persons other than the officers, employees, agents or subcontractors of the owner or licensee of this document, without the prior written consent of Beanair GmbH, is strictly prohibited.

Beanair makes every effort to ensure the quality of the information it makes available. Notwithstanding the foregoing, Beanair does not make any warranty as to the information contained herein, and does not accept any liability for any injury, loss or damage of any kind incurred by use of or reliance upon the information.

Beanair disclaims any and all responsibility for the application of the devices characterized in this document, and notes that the application of the device must comply with the safety standards of the applicable country, and where applicable, with the relevant wiring rules.

Beanair reserves the right to make modifications, additions and deletions to this document due to typographical errors, inaccurate information, or improvements to programs and/or equipment at any time and without notice.

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

Contents

List of Tables

List of Figures

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 ABREVIATIONS

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. RELATED DOCUMENTS & VIDEOS

4.1 WHITE PAPER WEBPAGE

Application notes, technical notes and user guides are available on our White Paper webpage:

Click here

Home | Products | Applications | Success Stories | Support | News & Events | Videos | About | Contact

Reference Number	Document Name	Related product	Description
AN_RF_002	Structural Health Monitoring on bridges	All BeanAir products	The aim of this document is to overview BeanAir® products suited for bridge monitoring, their deployment, as well as their capacity and limits by overviewing various data acquisition modes available on each BeanDevice®
AN_RF_003	IEEE 802.15.4 2.4 GHz Vs 868 MHz	All BeanAir products	Comparison between 868 MHz frequency band and a 2.4 GHz frequency band
AN_RF_005	BeanGateway & Data Terminal Equipment Interface	BeanGateway®	DTE interface Architecture on the BeanGateway®
AN_RF_006	How to extend your wireless range	All BeanAir products	A guideline very useful for extending your wireless range
AN_RF_007	BeanAir WSN Deployment	All BeanAir products	Wireless sensor networks deployment guidelines

Technical Notes

Reference Number	Document Name	Related product	Description
TN-RF-001	Wireless range benchmarking	BeanDevice® 2.4GHz Sensor series	Wireless range tests results of BeanDevice® 2.4GHz inside (N.L.O.S.) and outside a Building (L.O.S.)
TN-RF-002	Current consumption in active & sleeping mode	BeanDevice® 2.4GHz Sensor series	Current consumption estimation in active and sleeping mode.
TN-RF-003	Aggregation capacity of Wireless Network	BeanDevice® 2.4GHz Sensor series	Overview of aggregation capacity of wireless sensor networks in streaming mode
TN-RF-004	MQTT Communication Protocol	BeanDevice® Wilow® sensor series	MQTT Communication Protocol for a seamless integration into a third-party IOT software

Figure 1 : White Paper webpage

4.2 FEATURED VIDEOS

All the videos are available on our YouTube channel

Beanair video link (YouTube)	*Related products*
First step into Beanair Wireless Sensor Networks	*All*
Wireless Sensor Networks	*All*
Wireless Sensor Networks dedicated to Structural Health Monitoring	*All*
BeanGateway® - Ethernet Outdoor version introduction	*BeanGateway® - Ethernet Outdoor version introduction*
BeanGateway® – Ethernet Indoor version presentation	*BeanGateway® Ethernet Indoor version*
BeanDevice® AN-XX wireless range demonstration	*BeanDevice® AN-V/AN-420/AN-mV Standard and Extender*
BeanDevice® AN-XX presentation	
Self-powered data logger	*BeanDevice® AN-V/AN-420/AN-mV Xtender*
BeanDevice® AX-3D presentation	*BeanDevice® AX-3D*
BeanDevice® HI-INC presentation	*BeanDevice® HI-INC*
Wireless inclinometer with integrated datalogger	
BeanDevice® AX-3DS presentation	*BeanDevice® AX-3DS*
Wireless Accelerometer dedicated to shock detection	
High performance wireless accelerometer	*BeanDevice® AX-3D Xrange*
Wireless temperature and humidity sensor with integrated data logger	*BeanDevice® ONE-TH*
High performance wireless inclinometer	*BeanDevice® HI-INC Xrange*
High Grade and affordable wireless sensor networks for environmental monitoring	*Ecosensor products*

4.3 TECHNICAL VIDEOS

All the videos are available on our Youtube channel

Beanair video link (Youtube)	*Related products*
How to launch the BeanScape® software	*BeanScape®*
BeanGateway® Ethernet/LAN Configuration, directly connected to the Laptop/PC	*BeanGateway®*
How to remove a BeanDevice® from your Network	*BeanDevice®*
Energy Scan	*BeanGateway®*
Synchronous Multicasting process	*BeanGateway®*
Manual channel selection	*BeanGateway®*
Automatic Channel selection	*BeanGateway®*
Authorized Channels	*BeanGateway®*
Fast Fourier Transform waveform analysis module	*BeanScape®*

5. ACRONYMS AND ABBREVIATIONS

BeanDevice® product overview	•Details the BeanDevice® product presentation
Data acquisition mode description	•Details the data acquisition mode available on the BeanDevice® • ***Related Technical Note:*** TN_RF_008 - "Data acquisition mode available on the BeanDevice®"
BeanDevice® installation guidelines	•Details the installation guidelines of the BeanDevice® •***Related Technical Note:*** TN_RF_010 - "Beandevice® Power Management " •***Related Technical Note:*** TN_RF_007- "Beandevice® DataLogger user Guide" •***Related Technical Note:*** TN_RF_006- "Beandevice® wireless network association"
BeanDevice® supervision from the Beanscape®	•Details the BeanDevice® supervision from the BeanScape®
BeanDevice® maintenance & supervision (for experienced user)	•Details the BeanDevice® maintenance (for experienced user)
Troubleshooting	•Frequently asked questions
Installation procedures	•Details the installation procedures

6. PRODUCT DESCRIPTION

- ✓ ***It is highly recommended to read all the user manual related to Beanair software & equipment (BeanScape® 2.4GHz, BeanGateway® 2.4GHz, BeanDevice® 2.4GHz) before getting start your BeanDevice® 2.4GHz.***
- ✓ ***Use only accessories supplied by Beanair (batteries, power supply unit, and antenna). Use of other materials may damage the BeanDevice® 2.4GHz;***
- ✓ ***Only Beanair is qualified to make changes on the BeanDevice® 2.4GHz;***
- ✓ ***Don't try to remove the adhesive label on the product; it contains important information such as the MAC address or sensor measurement range***

6.1 ABOUT SMARTSENSOR PRODUCT LINE

SmartSensor product line was initially designed for Structural Health monitoring (SHM), Condition Maintenance Monitoring (CMS) and Testbed applications.

It comes with different types of sensor for dynamic measurements:

- Wireless accelerometer for vibration measurement
- Wireless inclinometer for tilt/slope measurement
- Wireless shock sensor for shock monitoring

6.2 BEANDEVICE® 2.4GHZ AX-3D

6.2.1 Featured video

Click here

6.2.2 Main features

Main Features
• Wireless Tri-axis accelerometer based on MEMS Technology • Measurement range: ±2g, ±10g • Very Low noise Density: • 45 µg/√Hz (±2g version), 100 µg/√Hz (±10g version), • Excellent radio link thanks to the radio antenna diversity developed by Beanair® • Maximum sampling rate: 3.5 KSPS • **TimeSync function :** Time Synchronization through wireless sensor network • Maximum Radio Range: 650 m (L.O.S) • Ultra-Power Radio Technology IEEE 802.15.4 • Current consumption in idle mode: **< 30 uA** • Embedded logger: up to ***1 million*** data points (with events dating) • Entirely autonomous system with an integrated Lithium-Ion battery charger • Anti-aliasing Butterworth filter (***5th order***) with a cut-off frequency of ***1 Hz to 2 KHz*** (remotely programmable from the BeanScape®) • Watertight aluminum enclosure IP66 (dimensions Lxlxh : 80x55x21 mm - weight 145g rechargeable battery included) - suitable for Harsh Industrial Environment

6.2.3 Applications

This **BeanDevice® AX-3D** is suitable for the following applications:

- Ground vibration Monitoring on construction site
- Dynamic measurement on rolling stock
- Condition monitoring
- Structural Health Monitoring (SHM)
- Vibration analysis

6.3 BEANDEVICE® 2.4GHZ HI-INC - 2.4GHZ SERIES (WIRELESS INCLINOMETER)

6.3.1 Main features

BeanDevice® HI-INC:Wireless Inclinometer

Main Features

- Wireless Inclinometer based on MEMS Technology
- Measurement range:
  - mono-axis or bi-axis ±15°
  - mono-axial or bi-axis ±30°
  - bi-axis +/-90°
- Excellent resolution:
  - 0,001° for ±15° & ±30° version
  - 0,0025° for ±90° version
- **TimeSync function :** Time Synchronization through wireless sensor network
- Excellent radio link thanks to the antenna diversity developed by Beanair®
- Streaming mode: 200 SPS on each channel
- Maximum Radio Range : 650 m (L.O.S)
- Ultra-Power Radio Technology IEEE 802.15.4
- Current consumption in idle mode : **< 30 uA**
- Embedded logger : up to 1 000 000 data acquisition records (with events dating)
- Entirely autonomous system with an integrated Lithium-Ion battery charger
- Anti-aliasing Butterworth filter (5th order) with a cut-off frequency of 1 Hz to 2 KHz (remotely programmable from the BeanScape®)
- Watertight Aluminum enclosure IP66
- Dimensions LxWxH : 80x55x21 mm—weight 145g (rechargeable battery included) -suitable for Harsh Industrial Environment

6.3.2 Applications

- ✓ Platform Leveling and stabilization
- ✓ Laser level rotation
- ✓ Slope measurement (Building, infrastructure & construction)
- ✓ Oïl drilling
- ✓ Axial rotor measurement

6.4 BEANDEVICE® 2.4GHZ AX-3DS - 2.4GHZ SERIES (WIRELESS SHOCK SENSOR)

6.4.1 Main features

Main Features	
• Wireless tri-axis accelerometer • Scalable measurement range (two versions) : ***±6g/±12g/±24g or ±2g/±4g/±8g*** • Excellent radio link thanks to the antenna diversity developed by Beanair® • Advanced and smart shock detection • Non-contact actuation for faster installation • Maximum sampling rate: 3.5 KSPS (maximum) • Maximum radio range : 650 m (L.O.S) • Ultra-Low Power Radio Technology IEEE 802.15.4 • Current consumption during deep sleeping mode : < 28 uA • ***Embedded Data Logger*** : up to ***1 million*** data points • Entirely autonomous system with an integrated Lithium-Ion battery charger • ***Watertight aluminum enclosure IP66*** (dimensions LxWxH : 80x55x21mm)—weight 135g (rechargeable battery included) -suitable for Harsh Industrial Environment	

6.4.2 Applications

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

6.5 BEANDEVICE® 2.4GHZ AX-3D XRANGE – 2.4GHZ SERIES (HIGH PERFORMANCE WIRELESS ACCELEROMETER)

6.5.1 Main features

Main Features

- Wireless Tri-axis accelerometer based on MEMS Technology
- Measurement range (2 versions): ±2g & ±10g
- Very Low noise Density:
  - 45 µg/√Hz (± 2g version)
  - 100 µg/√Hz (± 10g version)
- **TimeSync function :** Time Synchronization through wireless sensor network
- Watertight IP67 aluminum enclosure coming with a rugged base plate and three-point-mounting
- Excellent radio link relying on the radio antenna diversity developed by Beanair®
- Non-contact actuation for quick mounting
- Maximum sampling rate: 3.5 KSPS
- Maximum Radio Range : 650 m (L.O.S)
- Ultra-Power radio technology IEEE 802.15.4
- Current consumption in sleeping mode : < 30 µA
- Embedded data logger : up to ***8 millions*** data points
- OPC server allowing real time access from your IT system to the BeanScape® (available on BeanScape® Premium+)
- Entirely autonomous system with an integrated Lithium-Ion battery charger
- Anti-aliasing Butterworth filter (5th order) with a cut-off frequency of 1 Hz to 2 KHz (remotely programmable from the BeanScape®)
- Fully calibrated sensor

6.5.2 Applications

This **BeanDevice® AX-3D Xrange** is suitable for the following applications:

- Ground vibration Monitoring on construction site
- Dynamic measurement on rolling stock
- Condition monitoring
- Structural Health Monitoring (SHM)
- Vibration analysis

6.6 BEANDEVICE® HI-INC XRANGE (HIGH PERFORMANCE WIRELESS INCLINOMETER)

6.6.1 Main features

Main Features	
▪ Wireless Inclinometer based on MEMS Technology ▪ Measurement range: ±15° & ±30° (mono-axis & bi-axis) ▪ Excellent resolution (0.001°) & accuracy (±0.05°) ▪ Temperature compensated sensor ▪ Excellent radio link thanks to the antenna diversity developed by Beanair® ▪ Non-contact actuation for quick mounting ▪ Maximum sampling rate: 200 SPS ▪ Maximum radio range : 650 m (L.O.S) ▪ Ultra-Power Radio Technology IEEE 802.15.4 ▪ Current consumption in sleeping mode : < 30 µA ▪ Embedded data Logger : up to ***8 million*** data points ▪ OPC server allowing real time access from your IT system to the BeanScape® (available on **BeanScape® Premium+**) ▪ Entirely autonomous system with an integrated Lithium-Ion battery charger ▪ Watertight IP67 aluminum enclosure coming with a rugged base plate and three-point-mounting ▪ Anti-aliasing Butterworth filter (5th order) with a cut-off frequency of 1 Hz to 100Hz (remotely programmable from the BeanScape®) ▪ Fully calibrated sensor	

6.7 TECHNICAL SPECIFICATIONS

6.7.1 BeanDevice® 2.4GHz AX-3D

Product reference
BND-AX3D -*MR* G-RB
MR *– **Measurement Range (1g = 9806.65 mm/s^2)***
2 :±2g measurement range
10 :±10gmeasurement range
Example : BND-AX3D-10G-RB, Wireless Accelerometer with 10g measurement range

	Accelerometer Specifications
Accelerometer technology	Accurate and low power MEMS technology
Sensitivity	±2g Version : 660 mV/g ±10g version: 200 mV/g
Typical non-linearity	±0.1% FS
Analog to Digital converter	16-bit, SAR architecture (Successive Approximation Register) with temperature compensation
Sensor frequency response (-3 dB)	DC to 800 Hz
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	2%
Anti-aliasing filter	Butterworth 5th order filter – cut-off frequency : 1 Hz to 2000 Hz remotely programmable (BeanScape®)

	Over-the-air configuration (OTAC) parameters
Data Acquisition mode (**SPS** = sample per second)	Low Duty Cycle Data Acquisition (LDCDA) Mode: 1s to 24 hour Streaming Mode
Sampling Rate (in streaming mode)	Minimum: 1 SPS Maximum: 3 kSPS per axis (one axis enabled) 1.5 kSPS per axis (2-axis enabled) 1 kSPS per axis (3-axis enabled)
Programmable Cut-off frequency (Anti-aliasing filter)	1– 2000 Hz
Power Mode	Sleep & Active

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

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

TimeSync function : Clock synchronization over the Wireless Sensor Networks (WSN)	
Clock synchronization accuracy	±2.5 ms (at 25°C)
Crystal specifications	Tolerance ±10ppm, stability ±10ppm

	Environmental and Mechanical
Casing	Aluminum & Waterpoof casing Dimensions in mm (LxWxH): 100x55x21 mm Weight (battery included) : 155g
IP|NEMA Rating	IP67 | Nema 6
Shock resistance	100g during 50 ms
Operating Temperature	-20 °C to +65 °C during battery discharge 0 to 45°C during battery charge
Norms & Radio certifications	· CE Labelling Directive R&TTE (Radio) ETSI EN 300 328 · FCC (North America) · ARIB STD-T66 Ver 3.6 ROHS - Directive 2002/95/EC

	Power supply
Integrated battery charger	Integrated Lithium-ion battery charger with high precision battery monitoring :
	· Overvoltage/Overcurrent/Short-Circuit/Undervoltage protection
	· Battery Temperature monitoring
Current consumption @ 3,3V	· During data acquisition : 20 to 30 mA
	· During Radio transmission : 70 mA @ 18 dBm
	· During sleeping : < 30 µA
External power supply	8-28VDC
Rechargeable Lithium-Polymer battery	Capacity 1.25 Ah

	Options
External Power Supply	Wall plug-in, Switchmode power Supply 12V @ 1,25A with sealed M8 Plug (IP67/Nema 6) **Ref: M8-PWR-12V**
M8 extension cable for external power supply	Molded cable with M8-3pins male plug **Material:** PVC with shield protection **IP Rating :** IP67 | Nema 6 Cable length: 2 meters , **Ref: CBL-M8-2M** Cable length : 5 meters, **Ref: CBL-M8-5M** Cable length: 10 meters, **Ref: CBL-M8-10M**
Calibration certificate	Calibration certificate provided by Beanair GmbH A static calibration method is used on a granite surface plate DIN876

6.7.2 Beandevice® AX-3DS

Product reference
BND-AX3DS -*MR* -RB-*SCM*
MR – Measurement Range (1g = 9806.65 mm/s^2) **24G:** ±6/12/24g measurement range **8G**: ±2/4/8g measurement range
PS - Power supply : **RB :** Rechargeable battery
MO - Mounting Option **SCM** - Screw Mounting Lid **MM** - Magnet Mounting Lid Leave it empty if there is no mounting option
Example 1 : **BND-AX3DS-24G-RB**—Wireless Accelerometer with ±6/12/24g measurement range , rechargeable battery ***Example 2:*** **BND-AX3DS-8G-RB-SCM**—Wireless Accelerometer with ±2/4/8g measurement range , rechargeable battery, screw mounting option

	Sensor specifications
Accelerometer Technology	Low power MEMS technology
Scalable measurement range	***24G Version*** :±6g / ±12g/ ±24g ***8G Version:*** ±2g / ±4g/ ±8g
Measurement resolution	***24G Version:*** 3 mg/digit @±6g , 6 mg/digit @±12g , 12 mg/digit @±24g ***8G Version:*** 1mg/digit @±2g , 2 mg/digit @±4g , 3.9 mg/digit @±8g
Typical non-linearity	±0,15%
Sensitivity change Vs temperature	±0,01% /°C
Zero-g level change vs temperature (max delta from 25°C)	***24G Version*** :±0,4 mg/°C ***8G Version:*** ±0,1 mg/°C
Typical zero-g level offset accuracy	***24G Version:*** ±70 mg ***8G Version:*** ±20 mg
Analog to Digital converter	12-bit with temperature compensation
Noise spectral density @ BW 10Hz	***24G Version:*** 650 µg/√Hz ***8G Version:*** 218 µg/ √Hz
Anti-aliasing filter	Butterworth 2th order filter

	Over-the-air configuration (OTAC) parameters
Data Acquisition mode (**SPS** = sample per second)	Data Acquisition mode
	Streaming Mode
	Shock detection
Shock detection function	· Shock threshold in mg
	· Data acquisition sample rate in sleeping mode
	· Data acquisition sample rate after the shock detection
	· Shock detection hysteresis
Sampling Rate (in streaming mode)	Minimum: 1 SPS
	Maximum: 3 kSPS per axis (one axis enabled) 1.5 kSPS per axis (2-axis enabled) 1 kSPS per axis (3-axis enabled)
Power Mode	Sleep & Active

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

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

	Environmental and Mechanical
Casing	Aluminum & Waterpoof casing
	Dimensions in mm (LxWxH): 100x55x21 mm Weight (battery included) : 155g
IP|NEMA Rating	IP67 | Nema 6
Shock resistance	100g during 50 ms
Operating Temperature	-20 °C to +65 °C during battery discharge 0 to 45°C during battery charge
Norms	· CE Labelling Directive R&TTE (Radio) ETSI EN 300 328 · FCC (North America) · ARIB STD-T66 Ver 3.6
	ROHS - Directive 2002/95/EC

	Power Supply
Integrated battery charger	Integrated Lithium-ion battery charger with high precision battery · Overvoltage/Overcurrent/Short-Circuit/Undervoltage protection · Battery Temperature monitoring
Current consumption @3,3V	· During data acquisition : 20 to 30 mA · During Radio transmission : 60 mA @ 18 dBm · During sleeping mode: 68uA · During deep sleeping mode : 28 uA
External power supply	8-28VDC
Rechargeable battery	Capacity 1.25 Ah

	Options
External Power Supply	Wall plug-in, Switchmode power Supply 12V @ 1,25A with sealed M8 Plug (IP67/Nema 6) Ref: M8-PWR-12V
M8 extension cable for external power supply	Molded cable with M8-3pins male plug Material: PVC with shield protection IP Rating : IP67 | Nema 6 Cable length: 2 meters , Ref: CBL-M8-2M Cable length : 5 meters, Ref: CBL-M8-5M Cable length: 10 meters, Ref: CBL-M8-10M
Calibration certificate	Calibration certificate provided by Beanair GmbH A static calibration method is used on a granite surface plate DIN876

6.7.3 BeanDevice® INC

Product reference
BND-INC –*MR* –*PS*
MR– Measurement Range: **30B :** bi-axial ±30° **90B :** bi-axial ±90°
PS - ***Power supply*** : ***RB*** : Internal rechargeable battery ***XT*** : External Power Supply
Example 1 : **BND-INC-30B-RB**-wireless bi-axial inclinometer with ±30° measurement range, internal rechargeable battery ***Example 2*** : **BND-INC-90B-XT**-wireless bi-axial inclinometer with ±90° measurement range, external primary cell

	Sensor specifications
Inclinometer Technology	Accurate and low power MEMS technology
Measurement resolution (Bandwidth 10 Hz)	0.0025°
Noise density	0.0008 °/√Hz
Accuracy (full scale, @ 25°C)	±0,1°
Offset temperature dependency	±0.008 °/°C
Sensitivity temperature dependency	±0.008 %/°C
Long term stability (@23°C)	< 0.014 °
Analog to Digital converter	16-bits, SAR architecture (Successive Approximation Register) with temperature compensation
Sensor frequency Response (-3 dB)	DC to 28 Hz
Noise spectral density DC to 100 Hz	0.0008 °/ √Hz
Anti-aliasing filter	Butterworth 5th order filter – cut-off frequency : 1 Hz to 100 Hz remotely programmable (BeanScape®)

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

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

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

TimeSync function : Clock synchronization over the Wireless Sensor Networks (WSN)	
Clock synchronization accuracy	±2.5 ms (at 25°C)
Crystal specifications	Tolerance ±10ppm, stability ±10ppm

	Environmental and Mechanical
Casing	Aluminum & Waterpoof casing Dimensions in mm (LxWxH): 100x55x21 mm Weight (battery included) : 155g
IP|NEMA Rating	IP67 | Nema 6
Shock resistance	100g during 50 ms
Operating Temperature	**RB : Internal rechargeable battery** -20 °C to +65 °C during battery discharge 0 to 45°C during battery charge **XT : External Power Supply** -40 °C to +75 °C during battery discharge
Norms & Radio certifications	· CE Labelling Directive R&TTE (Radio) ETSI EN 300 328 · FCC (North America) · ARIB STD-T66 Ver 3.6 ROHS - Directive 2002/95/EC

	Power supply
Integrated battery charger	Integrated Lithium-ion battery charger with high precision battery monitoring : · Overvoltage/Overcurrent/Short-Circuit/Undervoltage protection · Battery Temperature monitoring
Current consumption @3,3V	· During data acquisition : 30 to 40 mA · During Radio transmission : 80 mA @ 18 dBm · During sleeping : < 38 µA
External power supply	8-28VDC
Rechargeable battery	High density Lithium-Ion rechargeable battery with a capacity of 950 mAh

	Options
External Power Supply	Wall plug-in, Switchmode power Supply 12V @ 1,25A with sealed M8 Plug (IP67/Nema 6) Ref: M8-PWR-12V
Solar Panel Kit (compatible with External Power Supply version only)	High effeciency solar panel with with Solar charging controller and Lead-acid battery **Ref: X-SOL-5W-M8-2M**
External Primary Cell in a Waterproof IP67 Casing	Exernal Primary cell mounted in a IP67 aluminum Alloy casing: IP67 Battery Holder Lithium-thionyl chloride primary cell (Li-SOCl2) 6,5 Ah **Ref: PRIM-XTENDER**
M8 extension cable for external power supply	Molded cable with M8-3pins male plug Material: PVC with shield protection IP Rating : IP67 | Nema 6 Cable length: 2 meters , Ref: CBL-M8-2M Cable length : 5 meters, Ref: CBL-M8-5M Cable length: 10 meters, Ref: CBL-M8-10M
Calibration certificate	Calibration certificate provided by Beanair GmbH A static calibration method is used on a granite surface plate DIN876

6.7.4 Beandevice® HI-INC

Product reference	
BND-HI-INC-***MR*** **-** ***PS***	
MR – ***Measurement Range*** : 15B : bi-axis ±15° 30B : bi-axis ±30°	***PS*** - ***Power supply*** : ***RB*** : Internal rechargeable battery ***XT*** : External power supply
Example 1 : **BND-HI-INC-15B-RB**-wireless bi-axial inclinometer with ±15° measurement range, internal rechargeable battery ***Example 2*** : **BND-HI-INC-30B-XT**-wireless mono-axial inclinometer with ±30° measurement range, external primary cell	

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

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

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

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

TimeSync function : Clock synchronization over the Wireless Sensor Networks (WSN)	
Clock synchronization accuracy	±2.5 ms (at 25°C)
Crystal specifications	Tolerance ±10ppm, stability ±10ppm

	Environmental and Mechanical
Casing	Aluminum & Waterpoof casing Dimensions in mm (LxWxH): 100x55x21 mm Weight (battery included) : 155g
IP|NEMA Rating	IP67 | Nema 6
Shock resistance	100g during 50 ms
Operating Temperature	**RB : Internal rechargeable battery** -20 °C to +65 °C during battery discharge 0 to 45°C during battery charge **XT : External Power Supply** -40 °C to +75 °C during battery discharge
Norms & Radio certifications	· CE Labelling Directive R&TTE (Radio) ETSI EN 300 328 · FCC (North America) · ARIB STD-T66 Ver 3.6
	ROHS - Directive 2002/95/EC

	Power supply
Integrated battery charger	Integrated Lithium-ion battery charger with high precision battery monitoring : · Overvoltage/Overcurrent/Short-Circuit/Undervoltage protection · Battery Temperature monitoring
Current consumption @3,3V	· During data acquisition : 30 to 40 mA · During Radio transmission : 80 mA @ 18 dBm · During sleeping : < 38 µA
External power supply	8-28VDC
Rechargeable battery	High density Lithium-Ion rechargeable battery with a capacity of 950 mAh

	Options
External Power Supply	Wall plug-in, Switchmode power Supply 12V @ 1,25A with sealed M8 Plug (IP67/Nema 6) Ref: M8-PWR-12V
Solar Panel Kit (compatible with External Power Supply version only)	High effeciency solar panel with with Solar charging controller and Lead-acid battery **Ref: X-SOL-5W-M8-2M**
External Primary Cell in a Waterproof IP67 Casing	Exernal Primary cell mounted in a IP67 aluminum Alloy casing: IP67 Battery Holder Lithium-thionyl chloride primary cell (Li-SOCl2) 6,5 Ah Ref: PRIM-XTENDER
M8 extension cable for external power supply	Molded cable with M8-3pins male plug Material: PVC with shield protection IP Rating : IP67 | Nema 6 Cable length: 2 meters , Ref: CBL-M8-2M Cable length : 5 meters, Ref: CBL-M8-5M Cable length: 10 meters, Ref: CBL-M8-10M
Calibration certificate	Calibration certificate provided by Beanair GmbH A static calibration method is used on a granite surface plate DIN876

6.7.5 BeanDevice® AX-3D XRange

Product reference
BND-AX3D-**MR**-XR-**PS**-**MO**
MR – Measurement Range (1g = 9806.65 mm/s^2)
2 :±2g measurement range
10 :±10gmeasurement range
PS - Power Supply **RB :** Built-in rechargeable Lithium-Polymer battery 2Ah
MO - Mounting Option **SCM** - Screw Mounting Lid **MM** - Magnetic Mounting Lid
Example n °1 : ***BND-AX3D-10G-XR-RB-SCM*** , High performance wireless accelerometer with 10g measurement range, built-in rechargeable battery, screw mounting **Example n°2: BND-AX3D-2G-XR-RB-MM,** High performance wireless accelerometer with 2g measurement range, built-in rechargeable battery, Magnet Mounting

	Accelerometer Specifications
Accelerometer technology	Accurate and low power MEMS technology
Sensitivity	±2g Version : 660 mV/g ±10g version: 200 mV/g
Typical non-linearity	±0.1% FS
Analog to Digital converter	16-bit, SAR architecture (Successive Approximation Register) with temperature compensation
Sensor frequency response (-3 dB)	DC to 800 Hz
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
Anti-aliasing filter	Butterworth 5th order filter – cut-off frequency : 1 Hz to 2000 Hz remotely programmable (BeanScape®)

	Over-the-air configuration (OTAC) parameters
Data Acquisition mode (**SPS** = sample per second)	Low Duty Cycle Data Acquisition (LDCDA) Mode: 1s to 24 hour
	Streaming Mode
Sampling Rate (in streaming mode)	Minimum: 1 SPS
	Maximum: 3 kSPS per axis (one axis enabled) 1,5 kSPS per axis (2-axis enabled) 1 kSPS per axis (3-axis enabled)
Sampling Rate (in streaming packet mode with data logger only)	Minimum: 1 SPS
	Maximum: 4 kSPS maximum per axis (one or two axis enabled) 3,5 kSPS per axis (3-axis enabled)
Programmable Cut-off frequency (Anti-aliasing filter)	1– 2000 Hz
Power Mode	Sleep & Active

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

	Embedded data logger
Storage capacity	up to 8 millions data points
Wireless data downloading	20 minutes to download the full memory (average time)

TimeSync function : Clock synchronization over the Wireless Sensor Networks (WSN)	
Clock synchronization accuracy	±2.5 ms (at 25°C)
Crystal specifications	Tolerance ±10ppm, stability ±10ppm

	Environmental and Mechanical
Casing	Aluminum & Waterpoof casing · Dimensions in mm (LxWxH): 100 x 60 x 31 (without antennas and mounting eyelet) · Weight (with internal battery) : 217g (screw mounting) and 245g (magnetic mounting)
IP|NEMA Rating	IP67 | Nema 6
Base plate	· Aluminum black anodized AL 7075 with rugged three-point-mounting · Screw Mounting Option: the device should be mounted on a flat and smooth surface with 3 screws, dimension M5. Mounting torque 5 ±1Nm · Magnetic Mounting Option: the device should be mounted on a steel surface.
Shock resistance	150g during 50 ms
Operating Temperature	-20 °C to +65 °C during battery discharge 0 to 45°C during battery charge
Norms & Radio certifications	· CE Labelling Directive R&TTE (Radio) ETSI EN 300 328 · FCC (North America) · ARIB STD-T66 Ver 3.6
	ROHS - Directive 2002/95/EC

	Power supply
Integrated battery charger	Integrated Lithium-ion battery charger with high precision battery monitoring : · Overvoltage Protection, Overcurrent/Short-Circuit Protection, Undervoltage Protection · Battery Temperature monitoring
Current consumption @ 3,3V	· During data acquisition : 20 to 30 mA · During Radio transmission : 40 mA @ 0dBm , 80 mA @ 18 dBm · During sleeping : < 30 µA
External power supply	8-28VDC
Rechargeable Lithium-Polymer battery	Capacity 2Ah

	Options
External Power Supply	Wall plug-in, Switchmode power Supply 12V @ 1,25A with sealed M8 Plug (IP67/Nema 6) Ref: M8-PWR-12V
Bracket Mounting	90° Bracket for BeanDevice (Xrange smartsensor) with 4 x M5 screws + Locknut **Ref: SMART-BRACK-MNT**
M8 extension cable for external power supply	Molded cable with M8-3pins male plug Material: PVC with shield protection IP Rating : IP67 | Nema 6 Cable length: 2 meters , Ref: CBL-M8-2M Cable length : 5 meters, Ref: CBL-M8-5M Cable length: 10 meters, Ref: CBL-M8-10M
Calibration certificate	Calibration certificate provided by Beanair GmbH A static calibration method is used on a granite surface plate DIN876

6.7.6 BeanDevice® HI-INC Xrange

Product reference
BND-HI-INC-*MR* -XR- *PS- MO*
MR– Measurement Range: **15B :** bi-axis ±15° **30B :** bi-axis ±30°
PS - Power supply : **RB :** Internal rechargeable battery **XT :** External power supply
MO - Mounting Option **SCM** - Screw Mounting Lid **MM** - Magnetic Mounting Lid
Example 1: ***BND-HI-INC-15B-XR-RB-SCM*** **,** High performance wireless bi-axis inclinometer with ±15° measurement range, internal rechargeable battery, Screw mounting ***Example 2:*** ***BND-HI-INC-30M-XR-XT-MM*** **,** High performance wireless mono-axis inclinometer with ±30° measurement range, external power supply, Magnet Mounting

	Sensor specifications
Inclinometer Technology	Accurate and low power MEMS technology
Measurement resolution (Bandwidth 10 Hz)	0,001°
Noise density	0.0004 °/√Hz
Accuracy (Full scale)	±0.05° (±0.02° on customer request)
Offset temperature dependency (temperature range –25°C to +85°C)	±0.002 °/°C
Sensitivity temperature dependency (temperature range –25°C to +85°C)	±0.005 %/°C with temperature compensation
Long term stability (@23°C)	< 0.004 °
Analog to Digital converter	16-bits, SAR architecture (Successive Approximation Register) with temperature compensation
Sensor frequency Response (-3 dB)	DC to 28 Hz
Noise spectral density DC to 100 Hz	0.0004 °/ √Hz
Anti-aliasing filter	Butterworth 5th order filter – cut-off frequency : 1 Hz to 100 Hz remotely programmable (BeanScape®)

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

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

	Embedded data logger
Storage capacity	up to 8 millions data points
Wireless data downloading	20 minutes to download the full memory (average time)

TimeSync function : Clock synchronization over the Wireless Sensor Networks (WSN)	
Clock synchronization accuracy	±2.5 ms (at 25°C)
Crystal specifications	Tolerance ±10ppm, stability ±10ppm

	Environmental and Mechanical
Casing	Aluminum & Waterpoof casing
	· Dimensions in mm (LxWxH): 100 x 60 x 31 (without antennas and mounting eyelet) · Weight (with internal battery) : 217g (screw mounting) and 245g (magnetic mounting)
IP|NEMA Rating	IP67 | Nema 6
Base plate	· Aluminum black anodized AL 7075 with rugged three-point-mounting · Screw Mounting Option: the device should be mounted on a flat and smooth surface with 3 screws, dimension M5. Mounting torque 5 ±1Nm · Magnetic Mounting Option: the device should be mounted on a steel surface.
Shock resistance	150g during 50 ms
Operating Temperature	**RB : Internal rechargeable battery** -20 °C to +65 °C during battery discharge 0 to 45°C during battery charge **XT : External Power Supply** -40 °C to +75 °C during battery discharge
Norms & Radio certifications	· CE Labelling Directive R&TTE (Radio) ETSI EN 300 328 · FCC (North America) · ARIB STD-T66 Ver 3.6
	ROHS - Directive 2002/95/EC

	Power supply
Integrated battery charger	Integrated Lithium-ion battery charger with high precision battery monitoring :
	· Overvoltage/Overcurrent/Short-Circuit/Undervoltage protection
	· Battery Temperature monitoring
Current consumption @3,3V	· During data acquisition : 30 to 40 mA
	· During Radio transmission : 80 mA @ 18 dBm
	· During sleeping : < 30 µA
External power supply	8-28VDC
Rechargeable battery	High density Lithium-Ion rechargeable battery with a capacity of 1.25 Ah

	Options
External Power Supply	Wall plug-in, Switchmode power Supply 12V @ 1,25A with sealed M8 Plug (IP67/Nema 6) Ref: M8-PWR-12V
Solar Panel Kit (compatible with External Power Supply version only)	High effeciency solar panel with with Solar charging controller and Lead-acid battery **Ref: X-SOL-5W-M8-2M**
Bracket Mounting	90° Bracket for BeanDevice (Xrange smartsensor) with 4 x M5 screws + Locknut **Ref: SMART-BRACK-MNT**
External Primary Cell in a Waterproof IP67 Casing	Exernal Primary cell mounted in a IP67 aluminum Alloy casing: IP67 Battery Holder Lithium-thionyl chloride primary cell (Li-SOCl2) 6,5 Ah **Ref: PRIM-XTENDER**
M8 extension cable for external power supply	Molded cable with M8-3pins male plug Material: PVC with shield protection IP Rating : IP67 | Nema 6 Cable length: 2 meters , Ref: CBL-M8-2M Cable length : 5 meters, Ref: CBL-M8-5M Cable length: 10 meters, Ref: CBL-M8-10M
Calibration certificate	Calibration certificate provided by Beanair GmbH A static calibration method is used on a granite surface plate DIN876

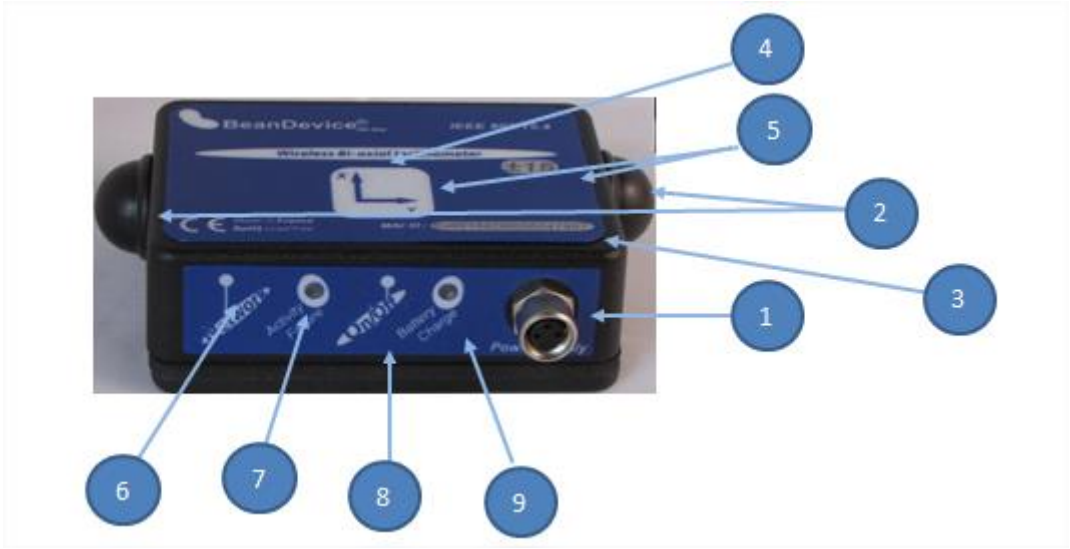
	Environmental and Mechanical
Enclosure	· Aluminum & Watertight (IP66) enclosure · Dimensions in mm (LxWxH): 100 x 71 x 30 (135 x 71 x 30 with antennas), Weight (battery included) : 165g
Base plate	· Aluminum black anodized AL 7075 with rugged three-point-mounting · The sensor module is to be mounted on a flat and smooth surface with 3 screws, dimension M5. Mounting torque 5 ±1Nm
Shock resistance	200g during 50 ms
Operating Temperature	-20 °C to +65 °C
Norms	CE Labelling Directive R&TTE (Radio) ETSI EN 300 328
	ROHS - Directive 2002/95/EC

	Power supply
Integrated battery charger	Integrated Lithium-ion battery charger with high precision battery monitoring : · Overvoltage Protection · Battery Temperature monitoring · Current accumulation measurement
Current consumption @3,3V	· During data acquisition : 20 to 30 mA · During Radio transmission : 40 mA @ 0dBm , 80 mA @ 18 dBm · During sleeping : < 30 µA
External power supply	External power supply : +8v to +28v
Rechargeable battery	High density Lithium-Ion rechargeable battery with a capacity of 1.35 Ah (referenced as BAT1.35DMG)

	Option(s)
Power-supply bloc	Wall plug-in, Switch mode power Supply 12V @ 1,25A with sealed M8 Plug (IP67)
Calibration certificate	Calibration certificate provided by Beanair A static calibration method is used on a granite surface plate DIN876

6.8 PRODUCT FOCUS

6.8.1 Casing description



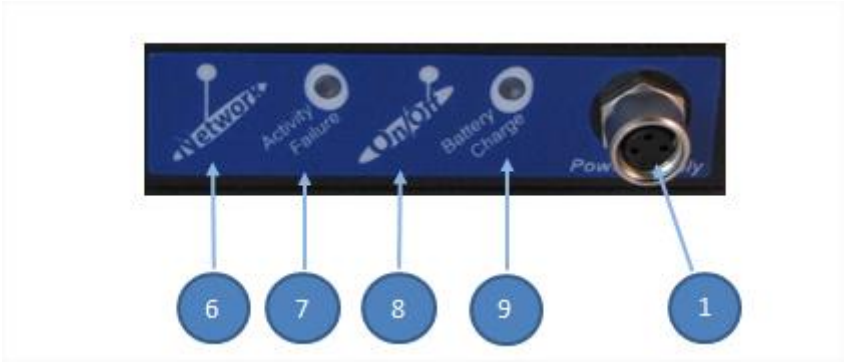


Figure 2: Casing description

Number	Function	Description
1	M8-3 Contacts Socket for power supply input	***DC 8-28 volts*** power supply. The socket sealing is assured with a screw cap.  ***If you don't use the external power supply, don't forget to protect the M8-3 pins socket with a M8 protection cap.***
2	Radome antenna	Waterproof IP67 Radome antenna
3	MAC ID Label	Unique identifier assigned to the BeanDevice® (64-bytes)  ***Every wireless network product which is based on the IEEE 802.15.4 standard must have a 64-bit MAC address that allows unique identification of the device within a global network.***
4	BeanDevice® product version label	Three label version are available : ✓ ***BeanDevice® AX-3D****: measurement range and the three axis are indicated on the Label* ✓ ***BeanDevice® HI-INC****: measurement range and the three axis are indicated on the Label* ✓ ***BeanDevice® AX-3DS****: measurement range and the three axis are indicated 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*** ***Please read the following section for more information*** "click here"
7	"Network 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 (refer fig. 3) (**V1R2 only**).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

6.8.2 Leds description

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

6.8.3 Mechanical drawing for standard version

The BeanDevice® AX-3DS/AX-3D/HI-INC/INC products use the same sensor housing.

Enclosure Features

Material	Aluminum
Protection	IP66
Dimensions	(L/l/h : 80x55x21 mm)
Weight	135g battery included

Figure 3: Mechanical drawing - BeanDevice® AX-3D/HI-INC/INC

6.8.4 Mechanical drawing for Xrange version

The BeanDevice® AX-3D/HI-INC Xrange products use the same sensor housing.

Enclosure Features

Material	Aluminum
Protection	IP67
Dimensions	(L/l/h : 100x71x30 mm)
Weight	165g battery included

Table 1 : BeanDevice AX-3D/HI-INC/INC enclosure feature

6.8.5 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:

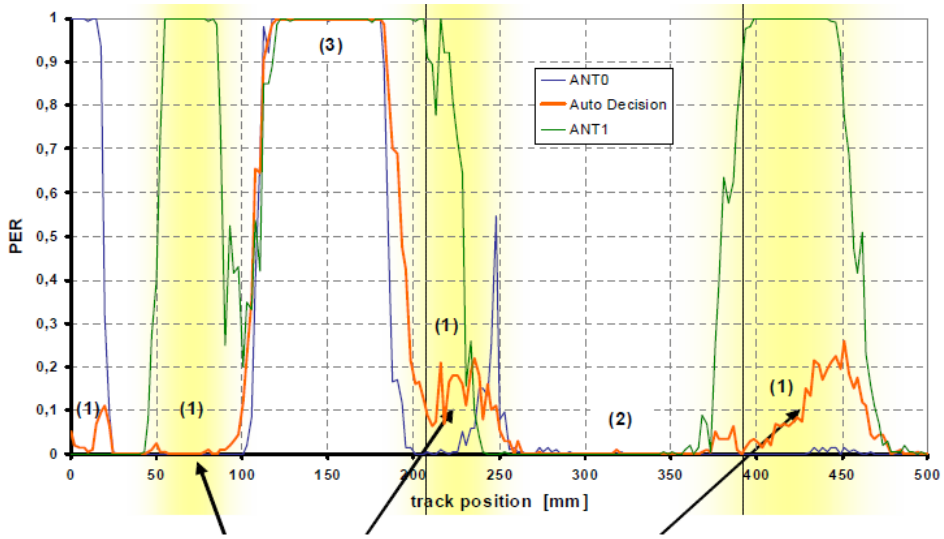
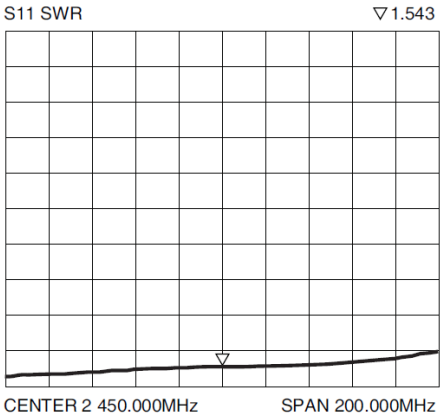


Figure 4 : Radome antenna performances

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

6.8.6 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 5: Antenna position on the BeanDevice AX-3D

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

6.9 MOUNTING INSTRUCTIONS

6.9.1 Adhesive mounting instructions (BeanDevice® INC, HI-INC, AX-3D, AX-3DS)

Characteristics	SmartSensor
Mounting techniques	Adhesive mounting
Flatness	0,1 mm
Surface Roughness	0,1 mm
Surface treatment	Satin black textured polyester powder paint
Material	AL 6061

6.9.1.1 Components needed for a non-permanent mounting

Aluminum Foil Tape	Use an aluminum foil offering a good breaking load & water resistant for outdoor use. ***Example***: Advance Tapes – Ref: 196074 - Thickness 0,09mm - Breaking load: 35 N/cm - Adhesion: 4 N/cm - Water resistant	
High strength Epoxy Glue	High Strength Epoxy Adhesive – Resin ***Example***: Radio spares 159-3957	

6.9.1.2 Reference edge

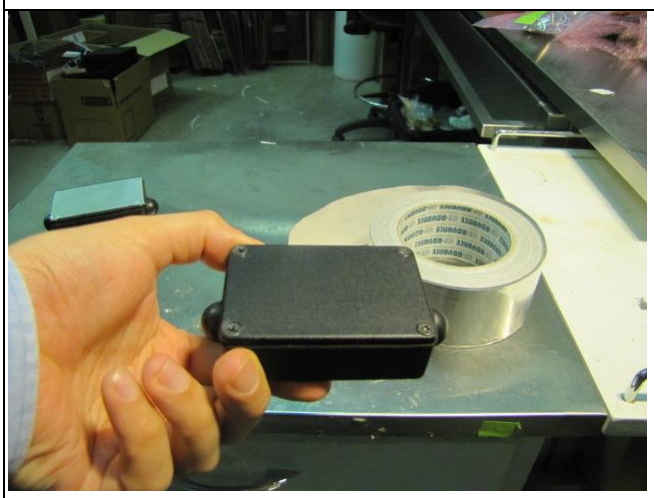
The BeanDevice® has a mounting reference angle (red line) for an optimal mounting of the product, which is parallel to the Y-axis. This reference edge must be placed exactly parallel to the object to be measured to prevent or minimize any mechanical offset/cross sensitivity.

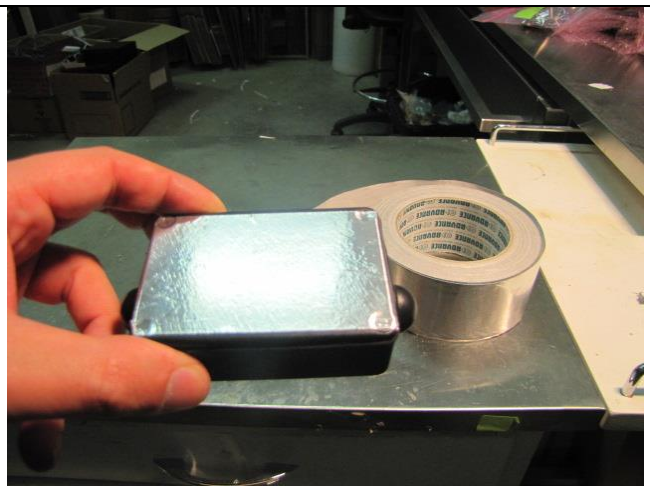
Figure 6: BeanDevice® mounting reference angle

6.9.1.3 Mounting instructions for non-permanent mounting

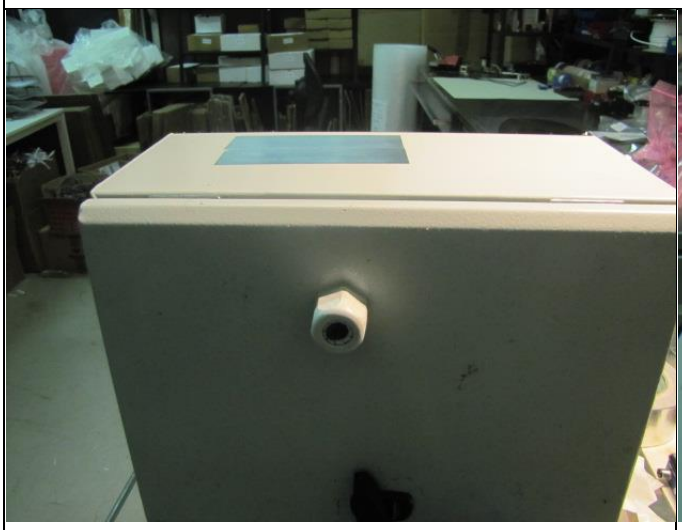
For a non-permanent mounting we recommend to use the following process:

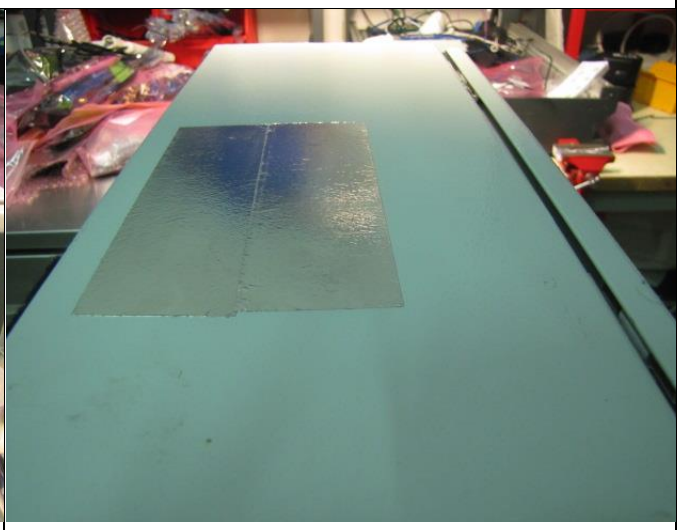
Step 1: Fix the aluminum foil tape on the back side of your BeanDevice® casing. Surface should be clean, dry and free from Grease.



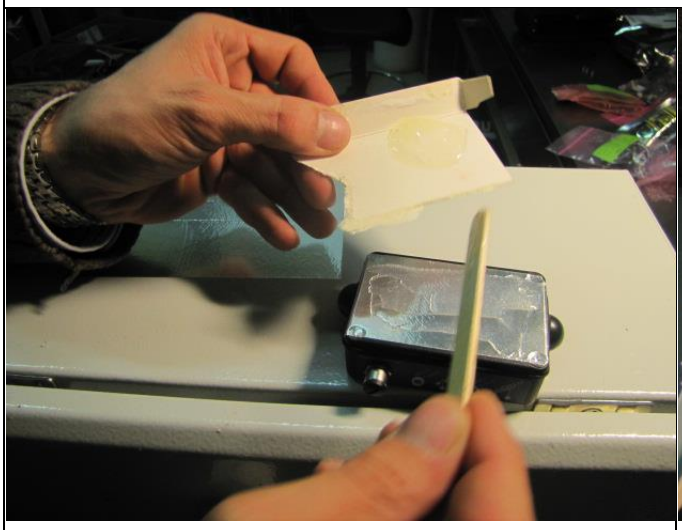


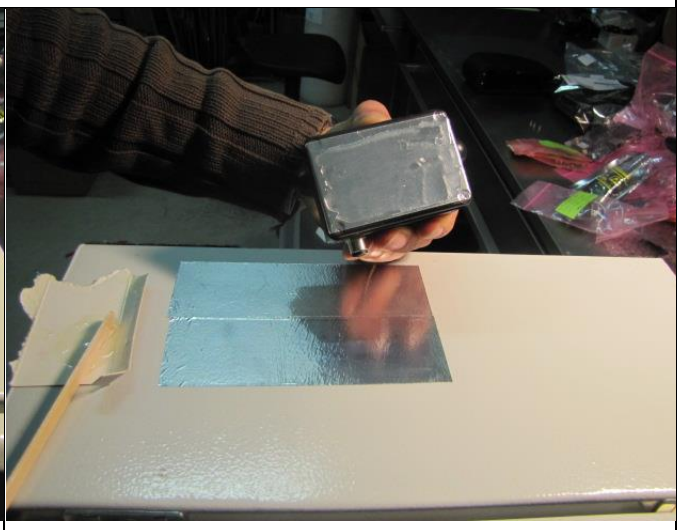
Step 2: Mount the aluminum foil tape on the equipment where you wanted to mount the BeanDevice®. Surface should be clean, dry and free from Grease.



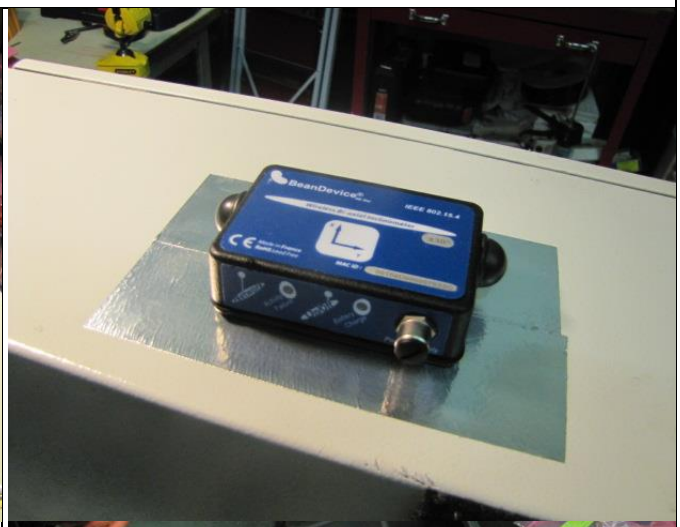


Step 3: Mix equal amount s of resin and hardener for 1 minute. Mixture should be used within 15-20 minutes. Apply the mixture on your BeanDevice®

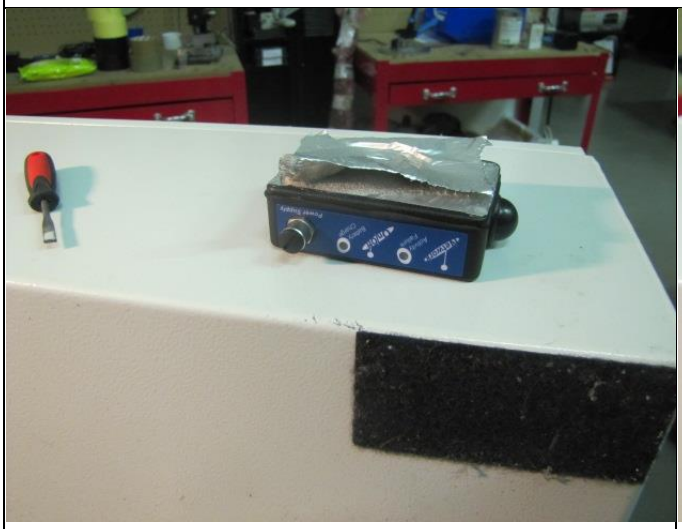




Step 4: Clamp the two surface together until adhesive has cured (depending of the type of epoxy glue that you use, it can take 1 hour to 1 day). Your BeanDevice® is ready to be used for indoor and outdoor application.



Step 5: You can unmount the BeanDevice® very easily. Use a knife or a sharp object to unmount the BeanDevice®. Your BeanDevice® is clean and ready to be used on another application.



6.9.2 Screw Mounting (BeanDevice® AX-3D Xrange & BeanDevice® HI-INC Xrange)

Characteristics	SmartSensor Xrange
Mounting techniques	**Screw mounting Three M5 drilled flanges**
Flatness	**38,1 µm**
Surface Roughness	**RA 1.6 (µm)**
Surface treatment	**Black anodized (Corrosion-proof)**
Material	**AL 7075 (twice harder than AL6061)**

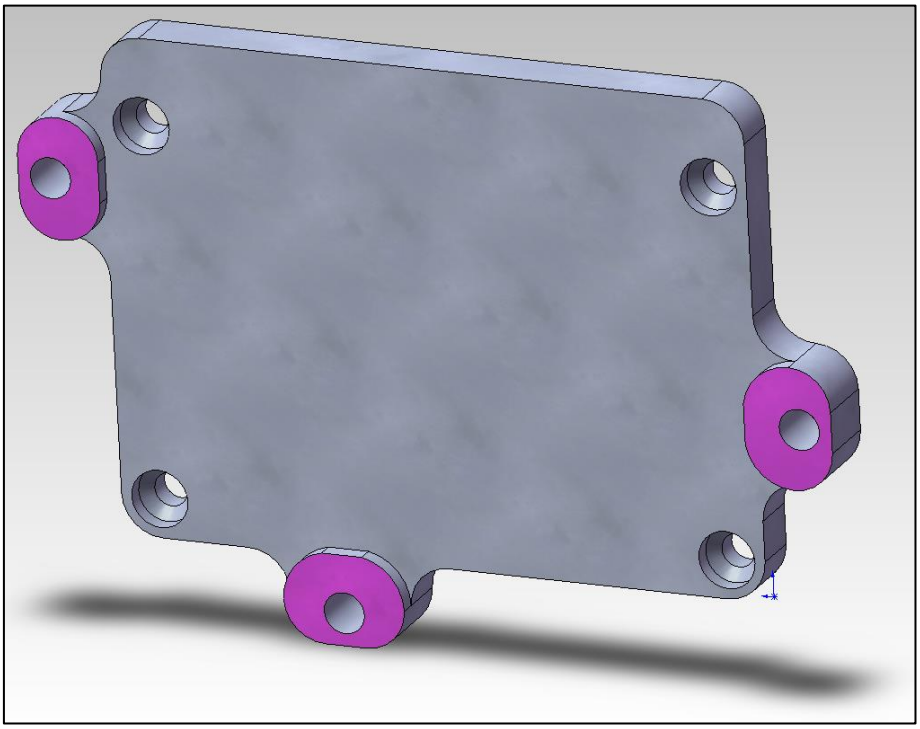


Figure 7: Xrange base plate overview

- ✓ 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 is secure 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.

6.9.3 Wireless inclinometer special instructions (BeanDevice® HI-INC, INC & HI-INC Xrange)

The BeanDevice® 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.

6.10 BEANDEVICE® 2.4GHZ POWER SUPPLY

6.10.1 Integrated Lithium-ion Rechargeable battery (Xtend version excluded)

The BeanDevice® 2.4GHz from SmartSensor product lines integrates a Lithium-Ion rechargeable battery (except XTend version):

BeanDevice® version	*Battery Capacity @25°C*	*Nominal Voltage @25°C*	*Charge/Discharge cycle @25°C*
BeanDevice® 2.4GHz AX-3D	1250 mAh	4,2V	370
BeanDevice® 2.4GHz AX-3DS			
BeanDevice® 2.4GHz HI-INC	950 mAh		

The rechargeable battery can be used as an UPS (uninterruptible power supply) battery on your BeanDevice®. 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.

6.10.2 External Primary cell (Xtend version only)

The battery life can be increased by using an external primary cell with a capacity of 6500 mAh. The primary cell is integrated in a watertight (IP65) enclosure.

Figure 8: External Primary cell

there is no battery charger on this production version

6.10.2.1 Primary cell specifications

The Primary lithium-thionyl chloride cell (***Li-SoCl2***) provides the following features:

Primary Cell Capacity	*Size*	*Nominal Voltage*	*Operating temperature range*	*Maximum recommended continuous current*	*Pulse Capability*
6000 mAh	*C-size spiral cell*	*3,6 V*	*- 55°C/+ 80°C*	*1.5A*	*2.5 A during 0.1s*

A Primary Cell is not a rechargeable battery; do not try to recharge it. You will damage your primary cell and your BeanDevice®

We recommend you the following primary cell provider:

Provider	Model
SAFT	LSH14
Europa Batteries	ER26500M
EVE	
Able Battery	

6.10.2.2 Main advantages of primary cell

These are the main advantages of using a primary cell:

- ✓ The operating temperature of your BeanDevice® is extended: -55°C to +80°C instead of -20°C to +75°C;
- ✓ The self-discharge of a primary cell is **2%/year** instead of 12%/year for a rechargeable battery;
- ✓ The capacity of a primary cell is 6000 mAh instead of 1250 mAh,

Please read the following section for more information about the primary cell replacement and calibration: "click here"

6.10.3 How to change the Primary cell on the BeanDevice® (Xtend version only)

This section concerns the BeanDevice® provided with an external primary cell power supply.

All the BeanDevice® HI-INC/AX-3D/AX-3DS provided with an internal rechargeable battery are not concerned by this section.

Step 1 : Open the screw cap

- Open the screw cap on the battery holder
- The primary cell (C Size) is inside the battery holder

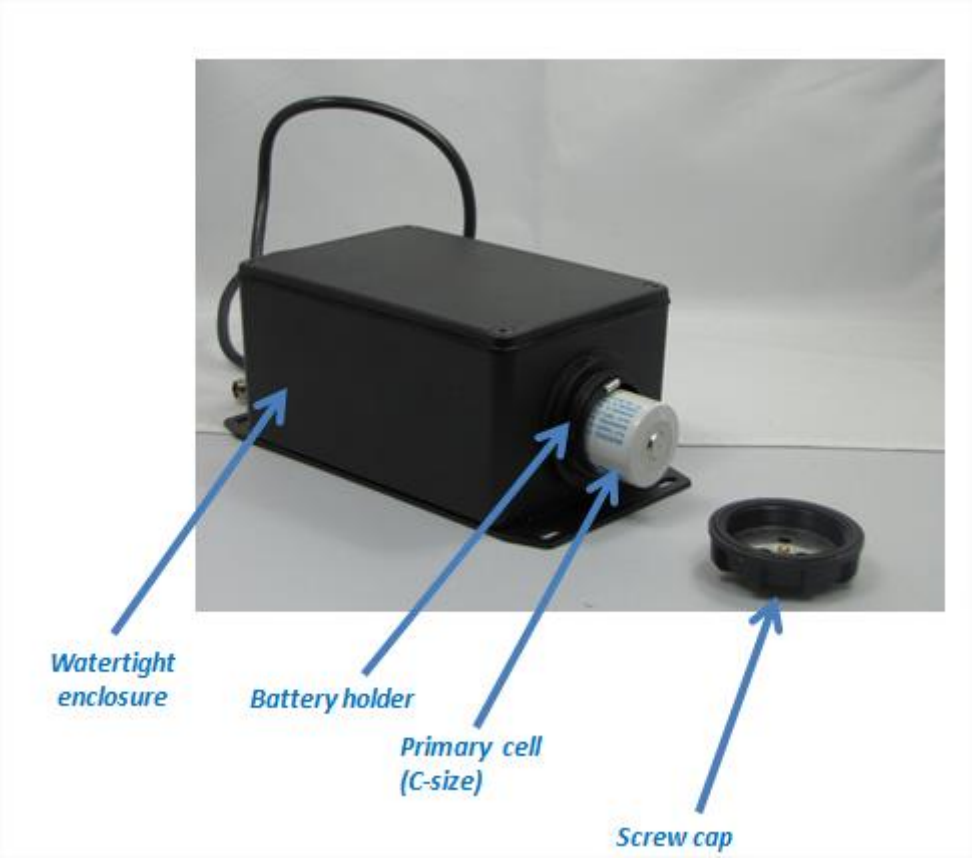


Figure 9: Changing the External Primary cell

Step 2 : Change the primary Cell

- Change the primary cell
- Check the battery polarity: pole + is on the screw cap side;

Figure 10: Changing the External Primary cell

Step 3 : Close the screw cap

- Close properly the screw cap
- Don't forget the Gasket, it's very important to maintain a watertight seal on your device

Do not invert the battery polarity; your BeanDevice® will not work.

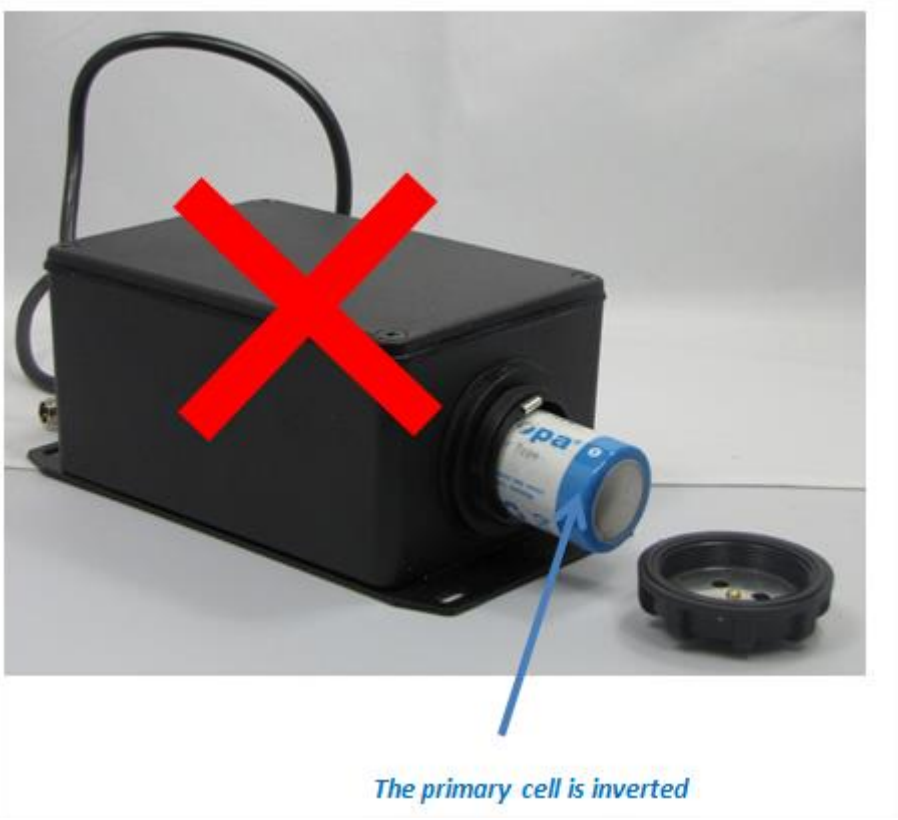


Figure 11: Changing the External Primary cell (wrong practice)

Step 4: Connect your primary cell enclosure to your BeanDevice®

- Screw the M8 Plug on the M8 socket of your BeanDevice®
- Make sure that your M8 plug is correctly connected to your M8 socket, otherwise the sealing between the enclosures is not maintained;

Figure 12: Changing the External Primary cell (connecting the BeanDevice®)

Check the Power mode of you BeanDevice®

***Example:** If your BeanDevice® is operating in "Sleeping" power mode. You should Power off then power on your BeanDevice®, the new configuration parameter is loaded during the cold start of your BeanDevice®.*

For further information about Power mode management, please read the technical note TN_RF_010 – « BeanDevice® Power Management »

Step 5: Check your battery charge level

- Check the battery charge level which is dsplayed in the "***Power Supply Diagnostic frame***" , battery charge level should be Good

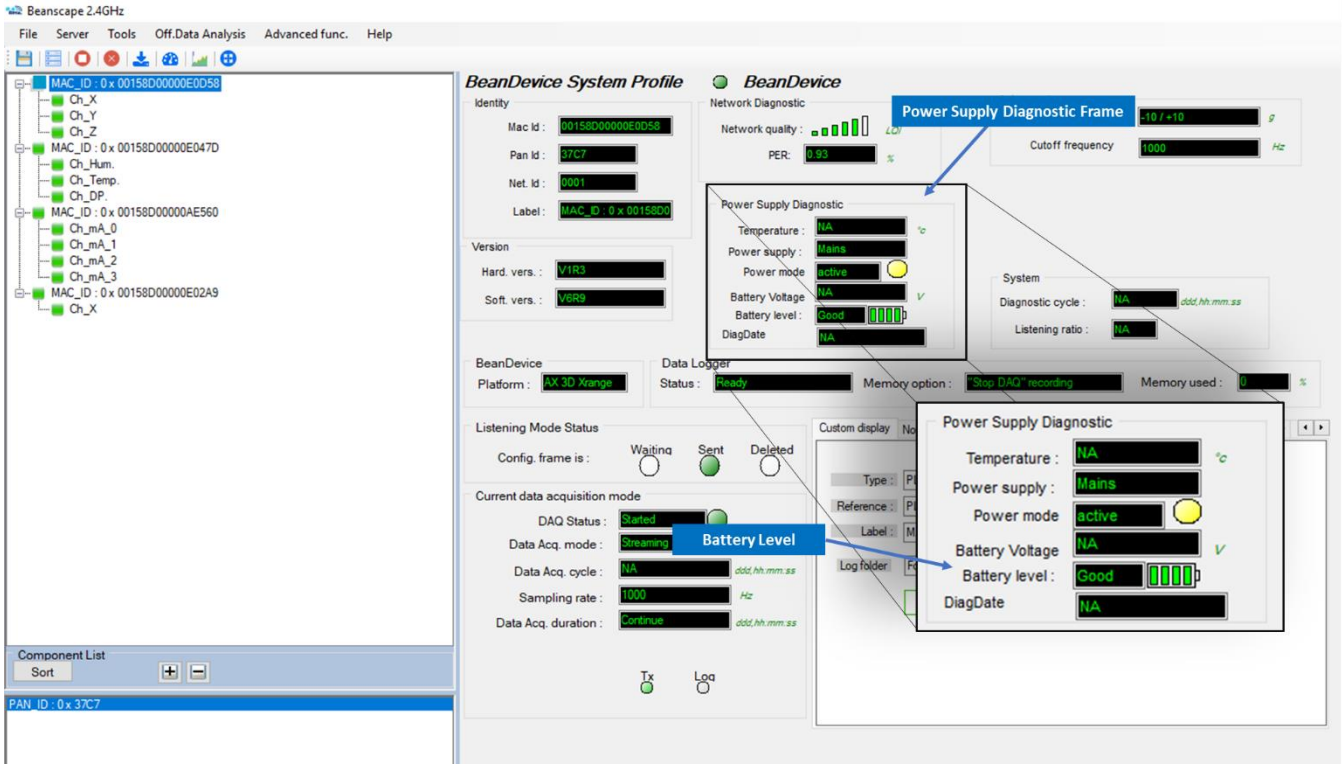


Figure 13: Power supply diagnostic frame on BeanScape®)

The nominal voltage of a primary cell is 3,6 Volts instead of 4,2 volts for a rechargeable battery. This value is correct.

Make sure that the power mode configured on your BeanDevice® is in "sleep power mode". If the power mode is configured in active, the battery autonomy of your BeanDevice® will be dramatically reduced.

6.10.4 AC-To-DC power adapter (option)

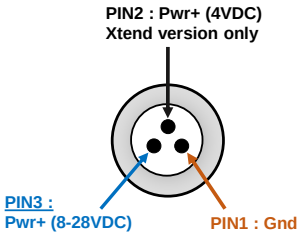
The BeanDevice® can also be powered by an AC-to-DC adapter ***8-28Volts***. The power adapter can be used for recharging Lithium-Ion battery or to power supply continuously the BeanDevice®.
A M8-3Pins standard plug is used for connecting the power adapter to the BeanDevice®.
If battery charge is very low, connect the power adapter in order to recharge your internal battery.

Figure 14: M8-3P Wall Plug-in power supply

Only the M8 plug is fully sealed, the power adapter is not sealed.

6.10.5 Power supply wiring code

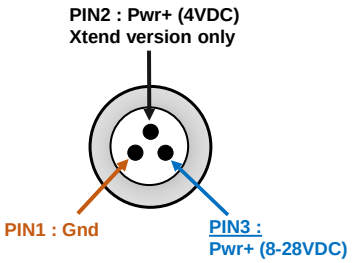
M8 Socket (A-Coding) - Pin Assignation

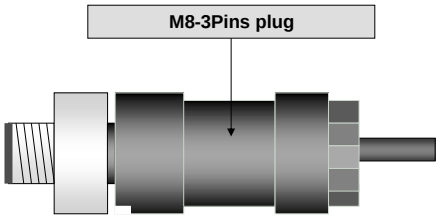


Interface Name	M8 Pin assignation	Wire Color (A-coding)
Power Supply 8-28VDC	*PIN3*	*Blue*
Power Supply 4VDC (available on Xtend version only)	*PIN2*	*Black*
Ground	*PIN1*	*Brown*

Figure 15: M8 socket Power supply Wiring code

M8 Plug (A –Coding) - Pin Assignation





Interface Name	M8 Pin assignation	Wire Color (A-coding)
Power Supply 8-28VDC	*PIN3*	*Blue*
Power Supply 4VDC (available on Xtend version only)	*PIN2*	*Black*
Ground	*PIN1*	*Brown*

Figure 16: M8 Plug Power supply Wiring code

If a M8 plug with a molded cable is used, the wiring code comes as follow:

Pin Number	*Description*	*Color code*
PIN3	**Pwr+ : Power supply 8-28VDC**	**Blue**
PIN1	**Ground**	Brown

Table 2 : M8-3P Plug Wiring code

If a M8 plug with a molded cable is used, the wiring code comes as follow:

Pin Number	*Description*	*Color code*
PIN3	**Pwr+ : Power supply 8-28VDC**	**Blue**
PIN2	**PM_Primary cell power supply (4V Maximum)**	**Black**
PIN1	**Ground**	**Brown**

Table 3 : M8-3P Plug Wiring code (Xtend version)

6.11 RESTORING FACTORY SETTINGS

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

Parameter	*BeanDevice® version*		
	AX-3D – standard and Xrange version	**AX-3DS**	**HI-INC – Standard and Xrange version**
Power Mode	*Active*		
Data Acquisition duty cycle	*10s*		
Acquisition duration time	*OK*		
Sampling rate	*OK*		
Data Acquisition mode	*LowDutyCycle*		
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.

Figure 17: Network Reed non-contact button

7. BEANDEVICE® SUPERVISION FROM THE BEANSCAPE®

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. ***Click on the button « start »*** 
3. ***All the BeanDevice® connected to the WSN will appear on your left window***
4. ***Select the BeanDevice® you want to configure. You can configure your BeanDevice® and its attached sensors.***

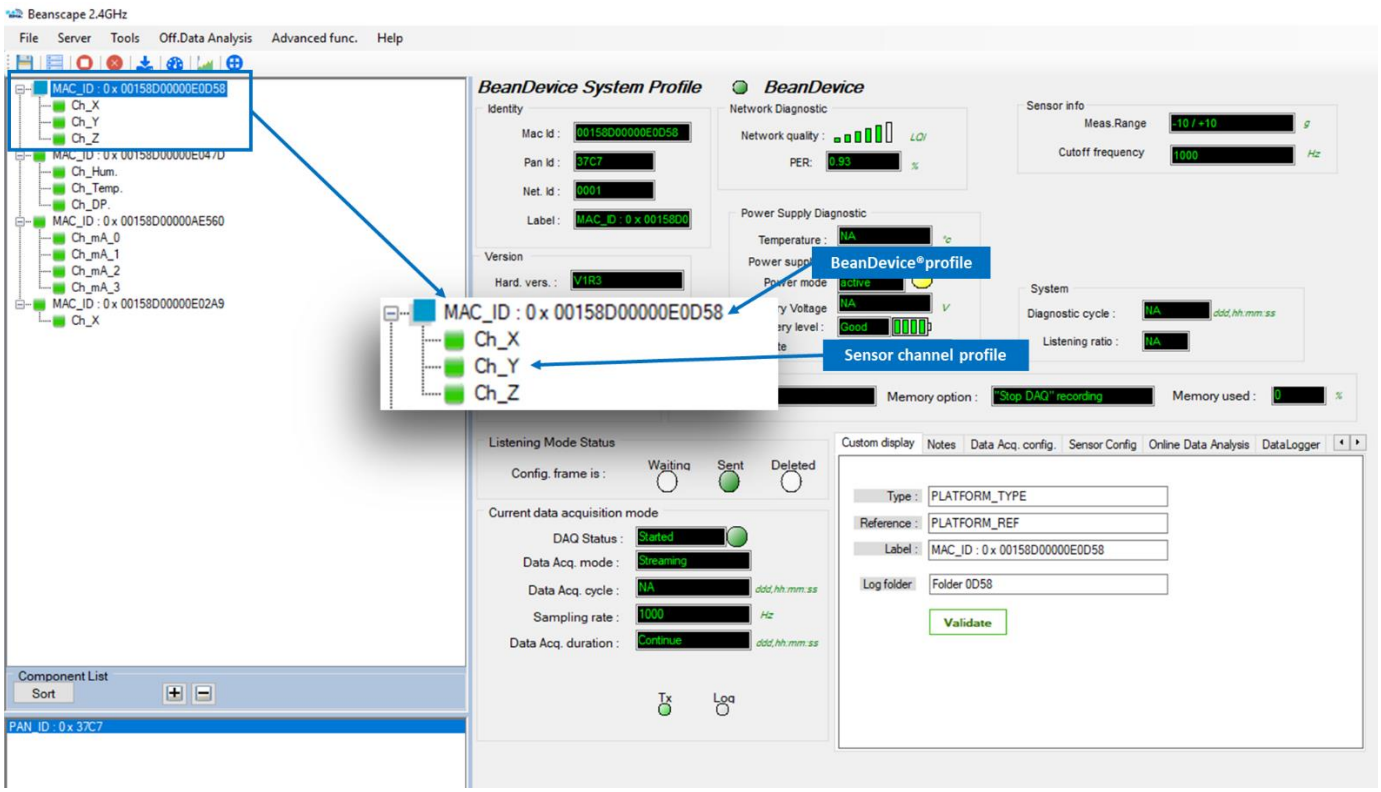
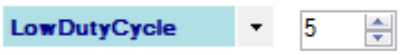


Figure 18: BeanDevice® display on BeanScape®

The user interface is organized as follow:

- Green on black background are displaying information

- Black on white background and Dark blue on light blue are customizable field;



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

- ✓ BeanDevice® information display
- ✓ BeanDevice® configuration

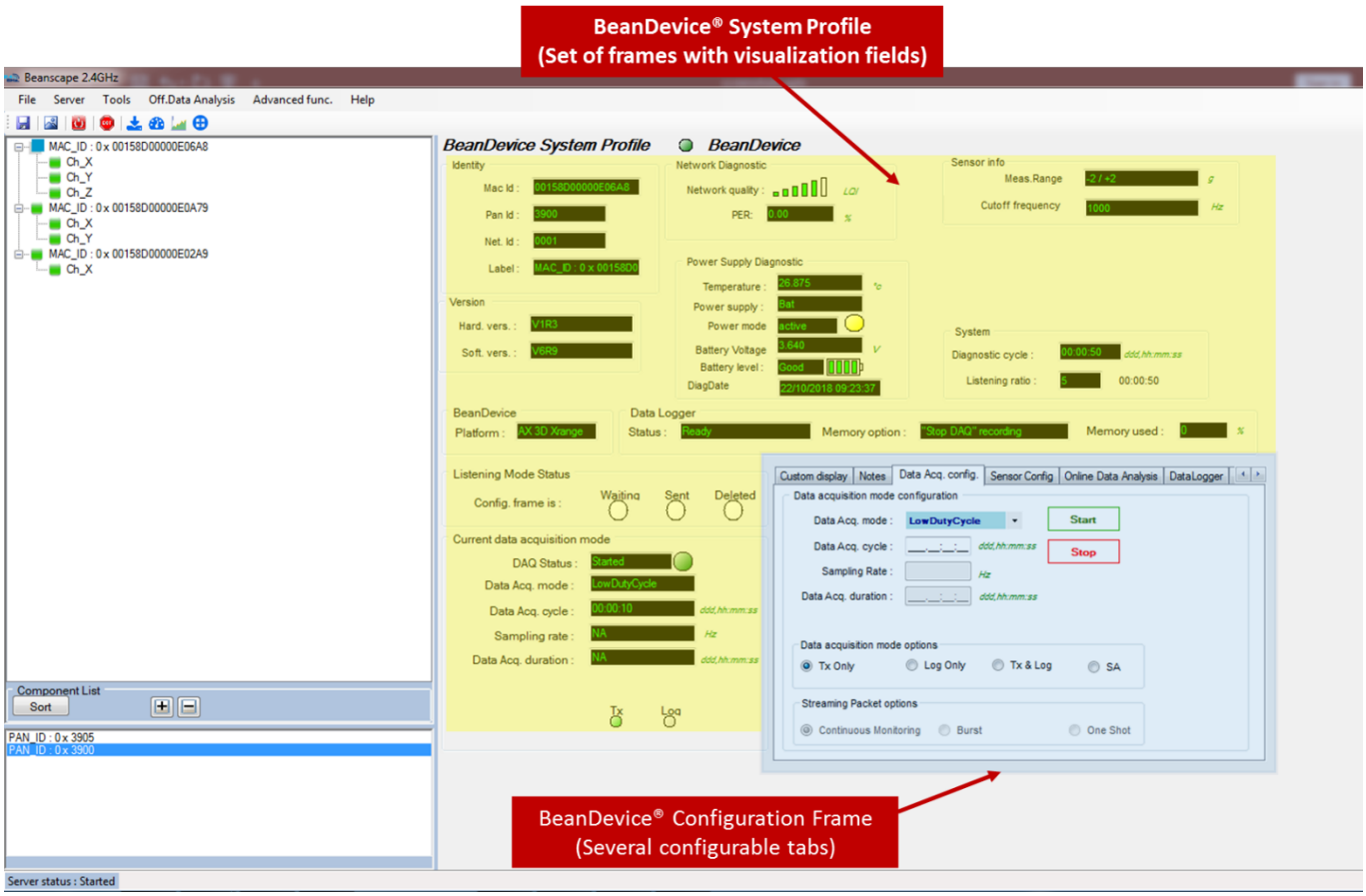


Figure 19: Overview: BeanDevice® System Profile on BeanScape®

7.2 DISPLAYING THE BEANDEVICE® INFORMATION

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

7.2.1 Frame: Identity

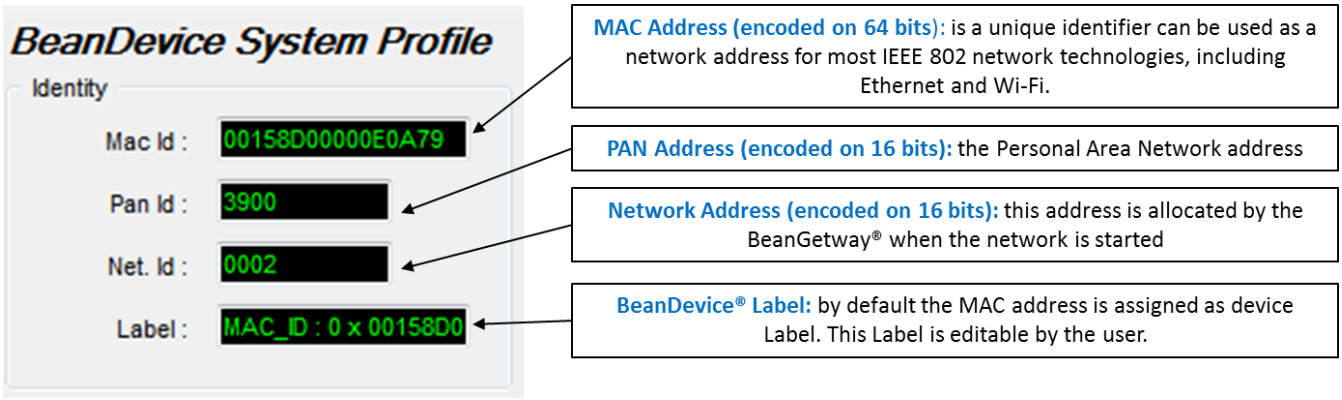


Figure 20: BeanDevice® Identity

How the PAN ID is assigned ?

The BeanGateway® starts the WSN, assigning a PAN ID (Personal Area Network identifier) to the network. The PAN ID is pre-determined and cannot be modified. If you use several WSN, before deploying your BeanDevice® check to which WSN is assigned your BeanDevice®.

7.2.2 Frame : Wireless Network Diagnostic

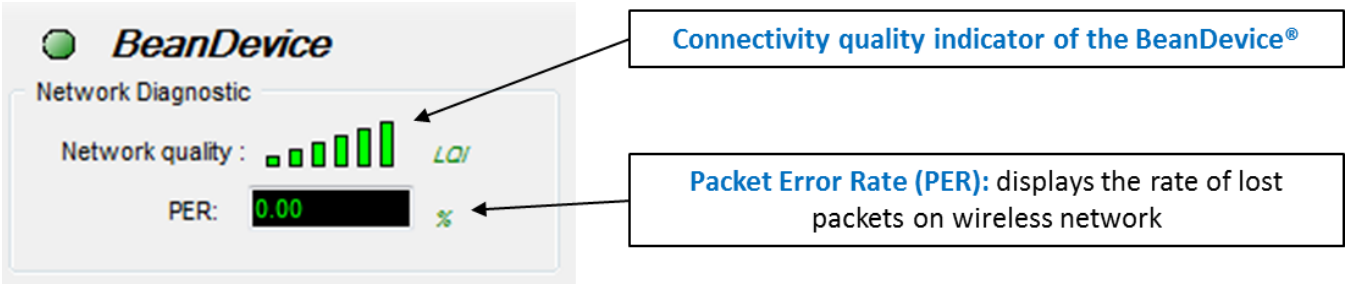


Figure 21: BeanDevice® network-link status

PER = Number of lost packet/Total of packet transmitted

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

7.2.3 Frame: Power supply diagnostic

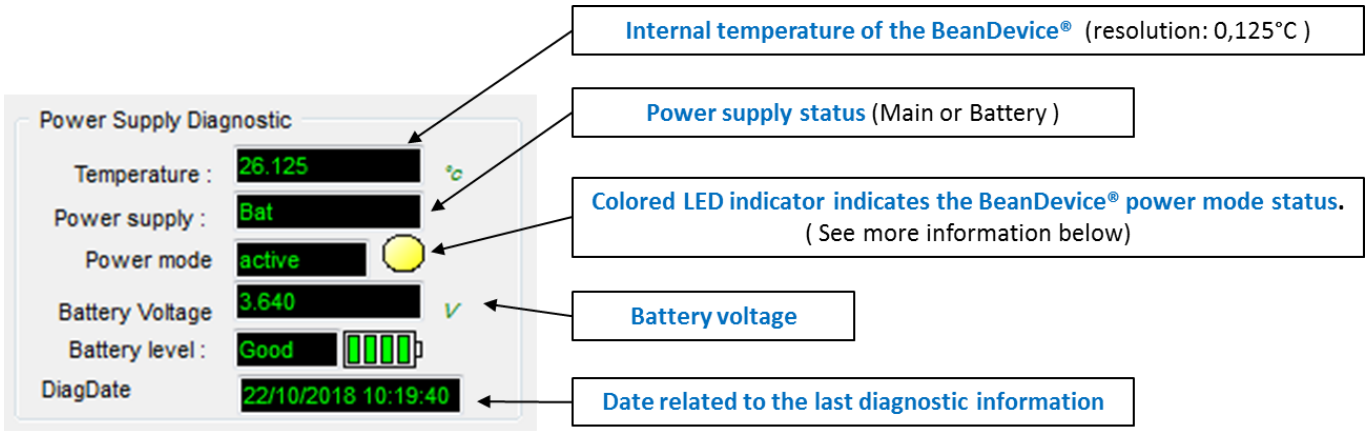


Figure 22: BeanDevice® Power Supply information

The BeanDevice® incorporates an internal temperature sensor:

- ✓ ***Battery temperature monitoring during charging ;***
- ✓ ***Temperature compensation of the analog conditioning chain ;***
- ✓ ***An alarm notification is send to the BeanGaeway® if the internal temperature is anormally high ;***

When you plug the BeanDevice® on an external power supply, the power supply status is automatically detected.

If your primary cell charge level is low, it is highly recommended to recharge your battery. Your BeanDevice® from SmartSensor product lines integrates a battery charger.

For further information about Power mode management, please read the technical note TN_RF_010 – « BeanDevice® Power Management »

When using the Streaming mode or the S.E.T mode, BeanScape® stops to display the full Battery health status information on the Power Supply Diagnostic frame until stopping the acquisition.

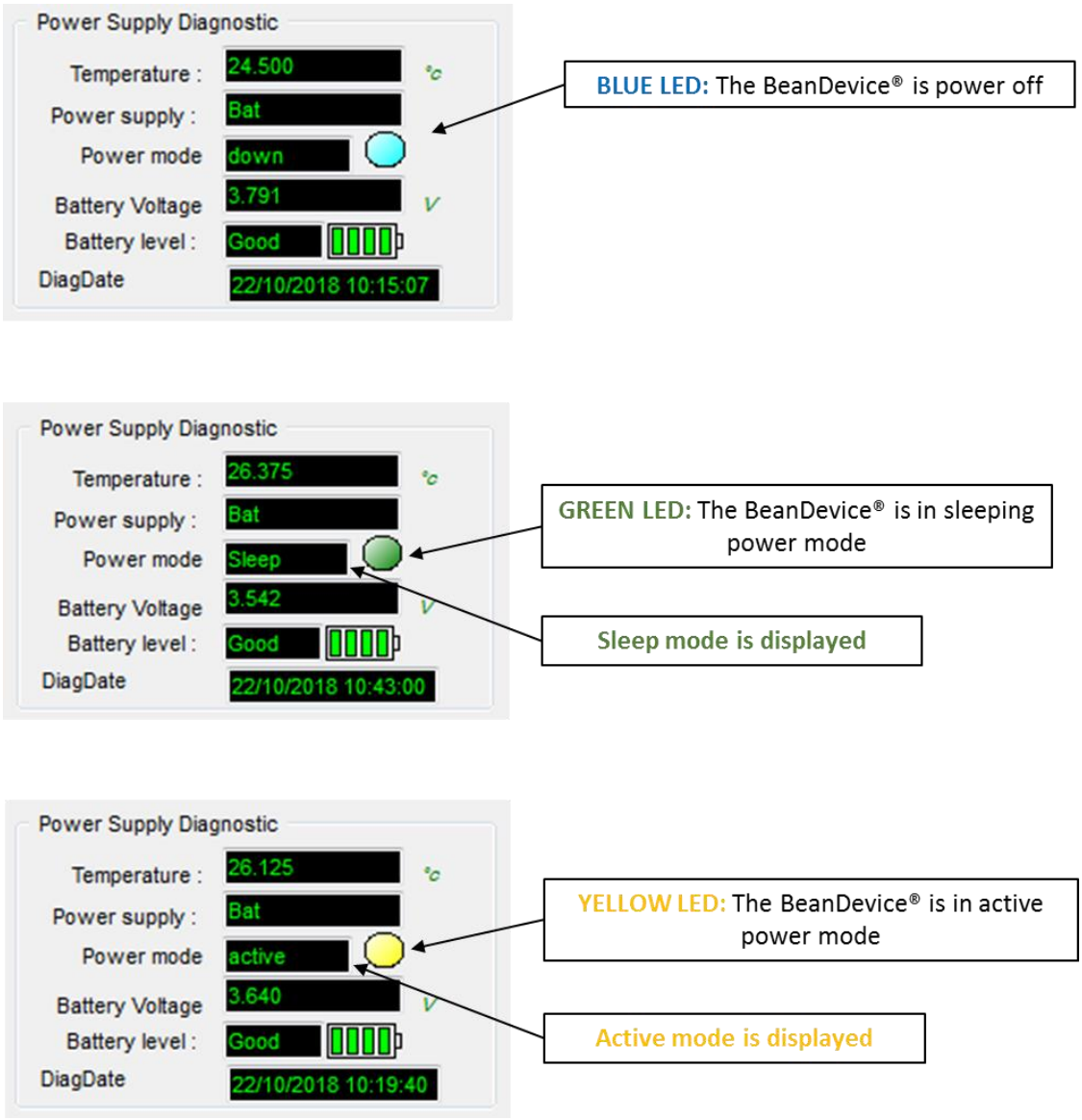


Figure 23:BeanDevice® Power modes

7.2.4 Frame : System

Figure 24: BeanDevice® Diagnostic cycle information

* The diagnostic cycle is a regular period during which the system collects information about the BeanDevice® (battery charge status, internal temperature, LQI, PER ..).

How to convert dBm to mW

Zero dBm equals one milliwatt. A 3dB increase represents roughly doubling the power, which means that 3 dBm equals roughly 2 mW. For a 3 dB decrease, the power is reduced by about one half, making −3 dBm equal to about 0.5 milliwatt. To express an arbitrary power P as x dBm, or go in the other direction, the following equations may be used:

$$x = 10\log_{10}(1000P) \text{ Or, } x = 10\log_{10}P + 30$$

And

$$P = 10^{(x/10)}/1000 \text{ Or, } P = 10^{(x-30)/10}$$

Where P is the power in W and x is the power ratio in dBm.

7.2.5 Frame : BeanDevice®

According to the BeanDevice® version, the information displayed in the frame will not be the same. For example, for the BeanDevice® AX-3D Xrange:

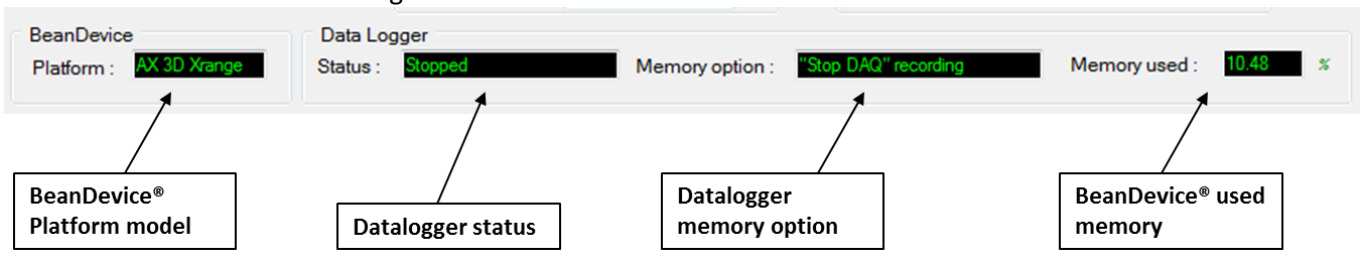


Figure 25: Frame BeanDevice® on BeanScape®

7.2.6 Frame : Product Version

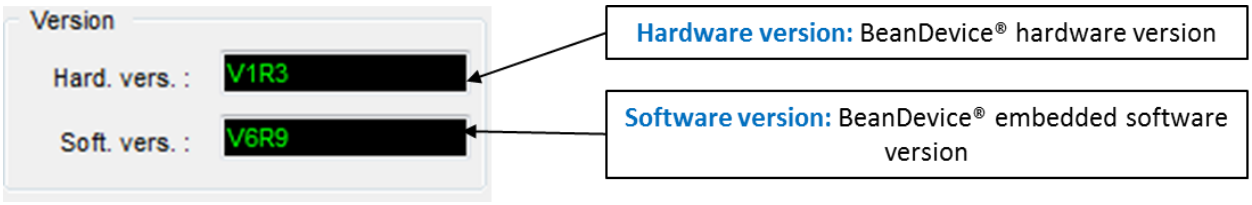


Figure 26: BeanDevice® Product version frame

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 encountered a material or software dysfunction.

7.2.7 Frame : Current Data Acquisition mode

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

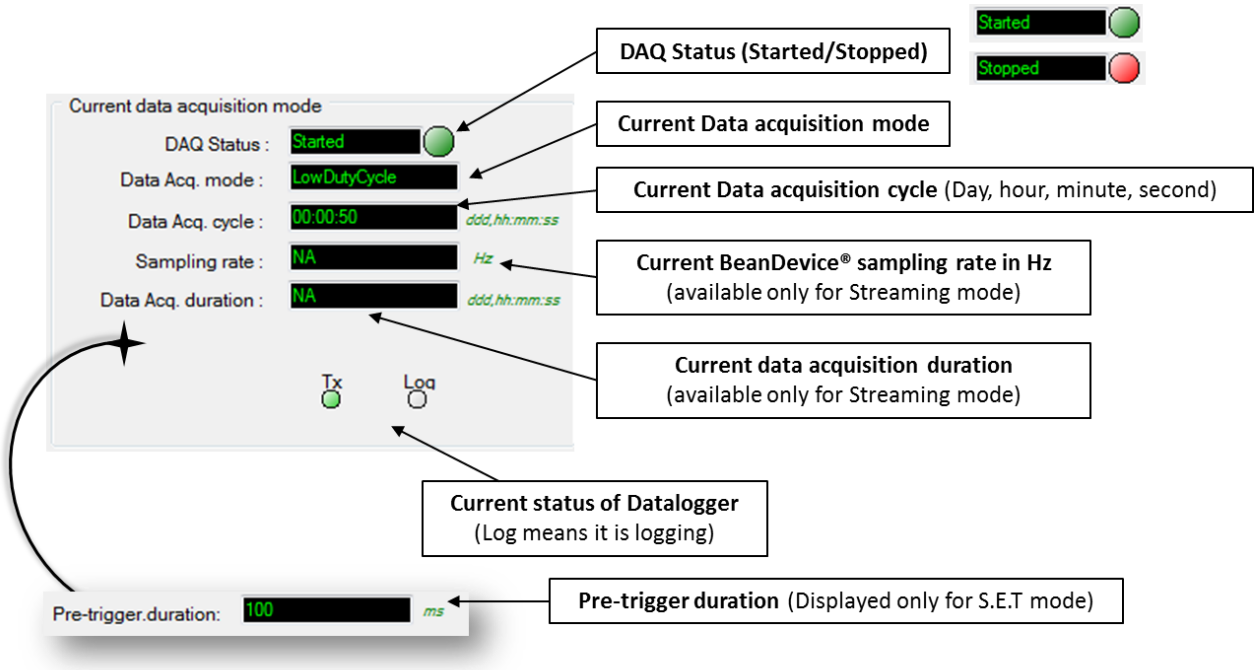


Figure 27: Frame: Current data acquisition mode

7.3 BEANDEVICE® CONFIGURATION

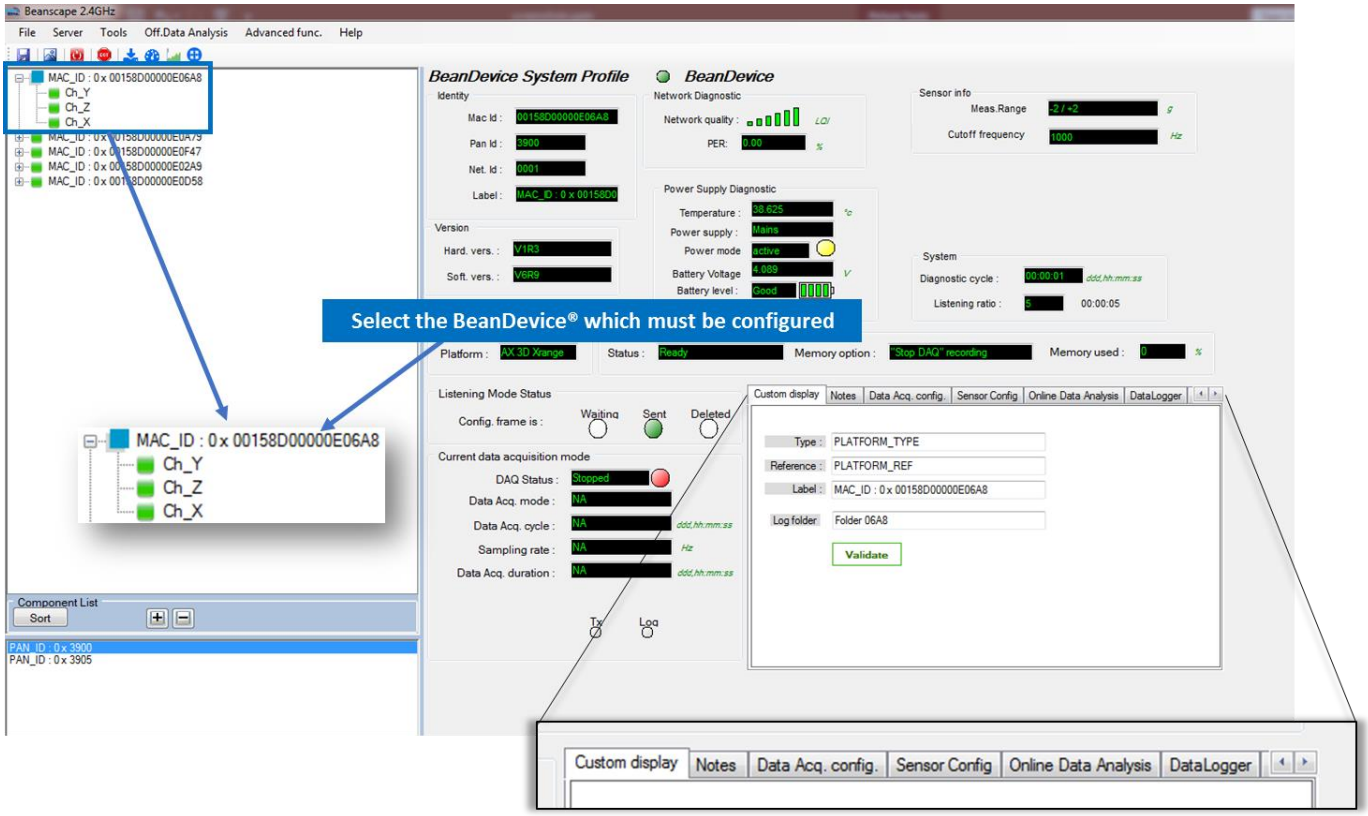


Figure 28: BeanDevice® configuration frame

This frame is composed of several Tabs and includes BeanDevice® OTAC (Over the Air Configuration) Parameters:

Tab	Description
Custom Display	Customize the BeanDevice® label
Notes	This area contains the notes related to the BeanDevice®.
Data Acquisition configuration	Configure the Data acquisition mode on your BeanDevice®, set the acquisition cycle or the sampling rate, enable/disable the datalogger function.
Datalogger	Manage the Datalogger function on the BeanDevice®
System configuration	Configure the diagnostic cycle and the TX Power
Power Mode Management	Configure the Power mode on your BeanDevice® (Active mode, Sleep power mode)

7.3.1 Tab: Custom Display

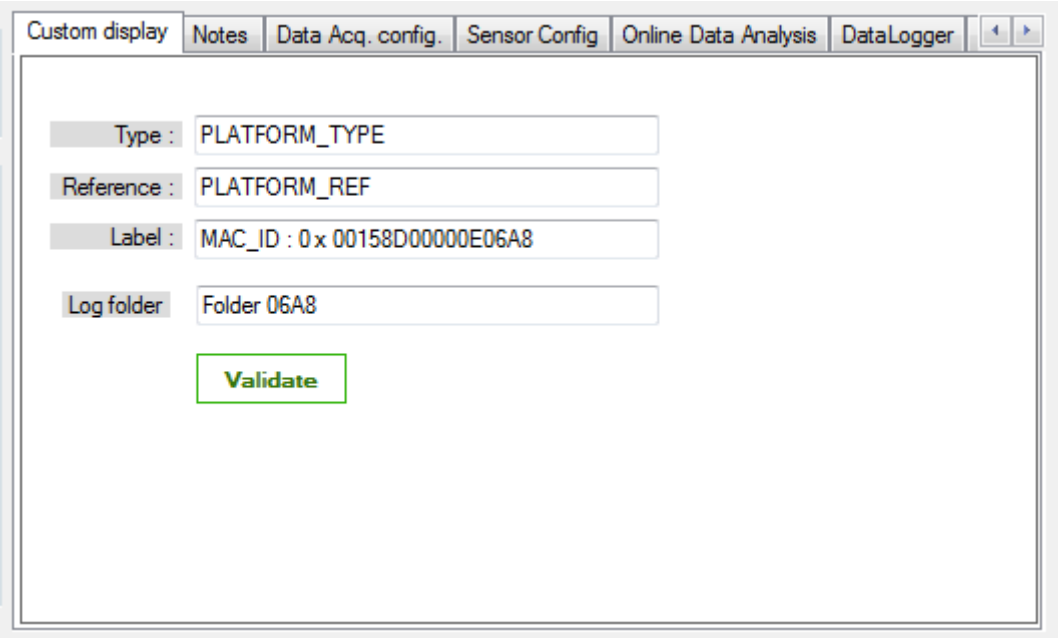


Figure 29: BeanDevice® custom display tab

Parameter	*Description*
Type	You can enter here the type of BeanDevice® you want to use
Reference	You can assign an internal reference to the BeanDevice® you have purchased.
Label	You can assign any sort of Label to your BeanDevice®. Therefore, the user can easily associate the BeanDevice® with its equipment (example: Room_N521_Second_Floor)

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

7.3.2 Tab: Notes

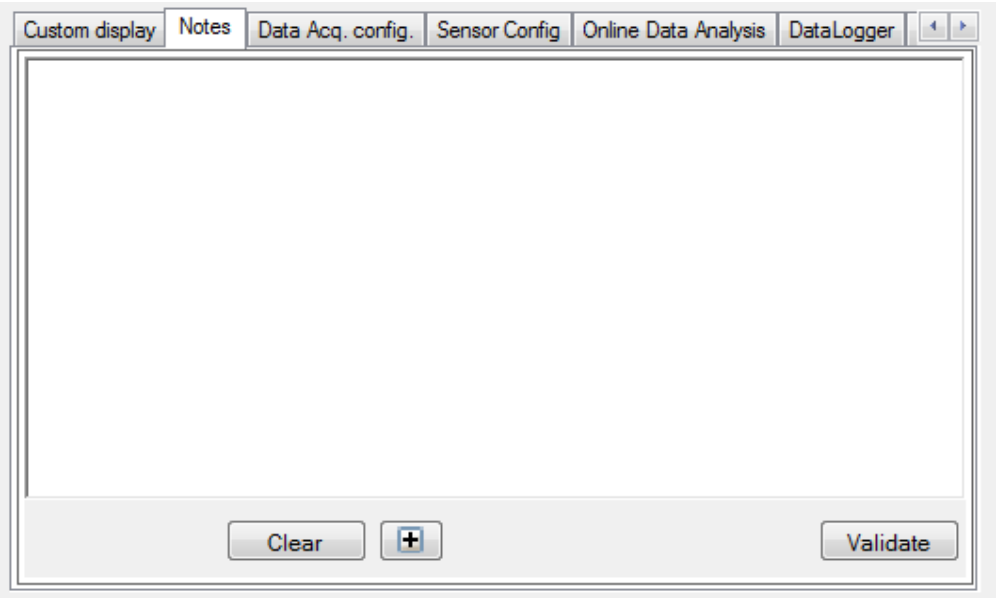


Figure 30: Tab : Notes

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 Tab : Data Acquisition configuration

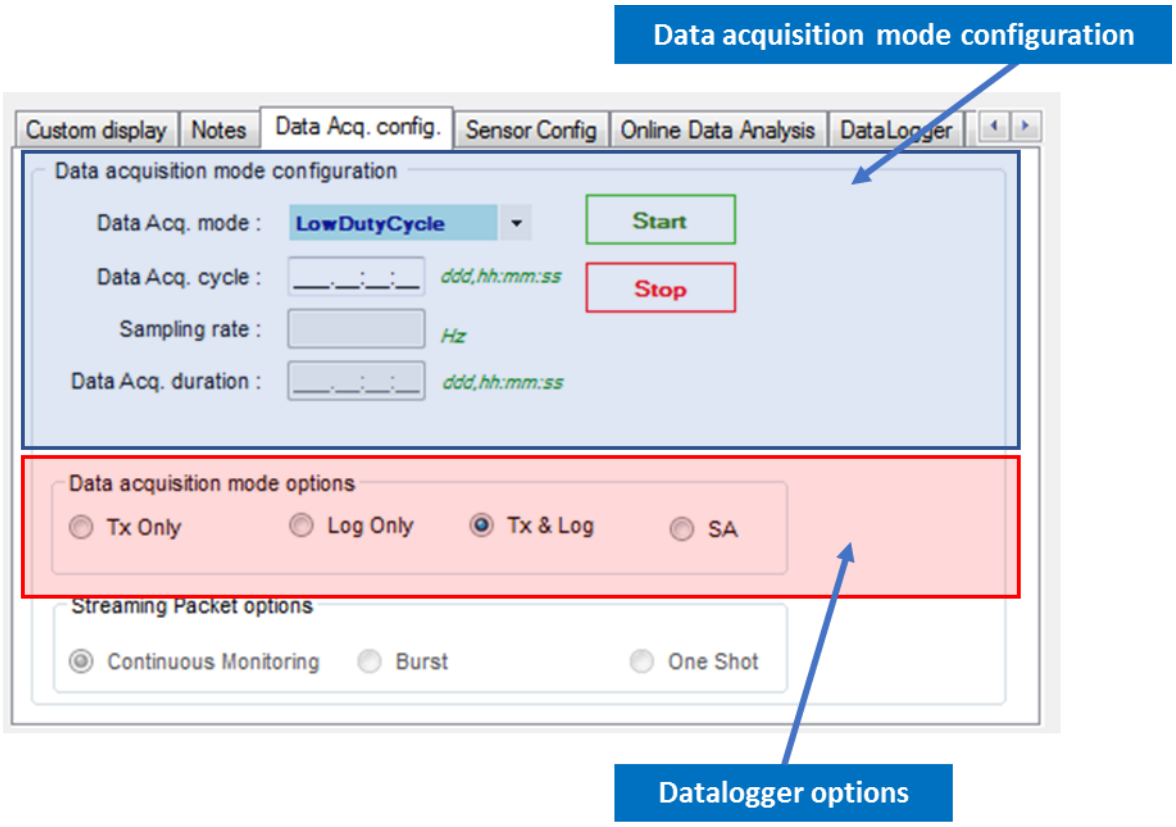


Figure 31: Tab: Data acquisition configuration

Parameter		Description
Data Acquisition mode	*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.
	Survey	Survey mode is a mix between the LDCDA mode and Alarm mode. 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 1 KHz).

	Shock Detection	When the Shock detection ode is activated (only available for the BeanDevice AX-3DS) the BeanDevice will wake up if a shock is detected. During the sleeping mode of the BeanDevice®, the sensor will continue to track a shock event.
	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 1Ksps)
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 5000 Samples per second maximum. The resolution is 1 sample per second. If Datalogger is selected, the maximum sampling rate is 2000 samples per second. This field is available in streaming : 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 can be higher than Data acquisition cycle.

Options	
	TX only: The BeanDevice® transmits the data acquisition without Datalogging ***Log only***: The BeanDevice® logs the data acquisition without wireless transmission ***Tx & Log***: The BeanDevice® transmits and logs the data acquisition; For further information about the Datalogger feature, read the technical note TN_RF_007 – "BeanDevice® Datalogger User Guide" ***SA: Standalone:*** The BeanDevice® logs the data acquisition without wireless transmission. The BeanDevice stores all the measurements on its embedded datalogger. Thus, a direct connection with the BeanGateway® is not needed.

For further information about the Datalogger, please read the technical note TN_RF_007 – "BeanDevice® Datalogger User Guide"

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

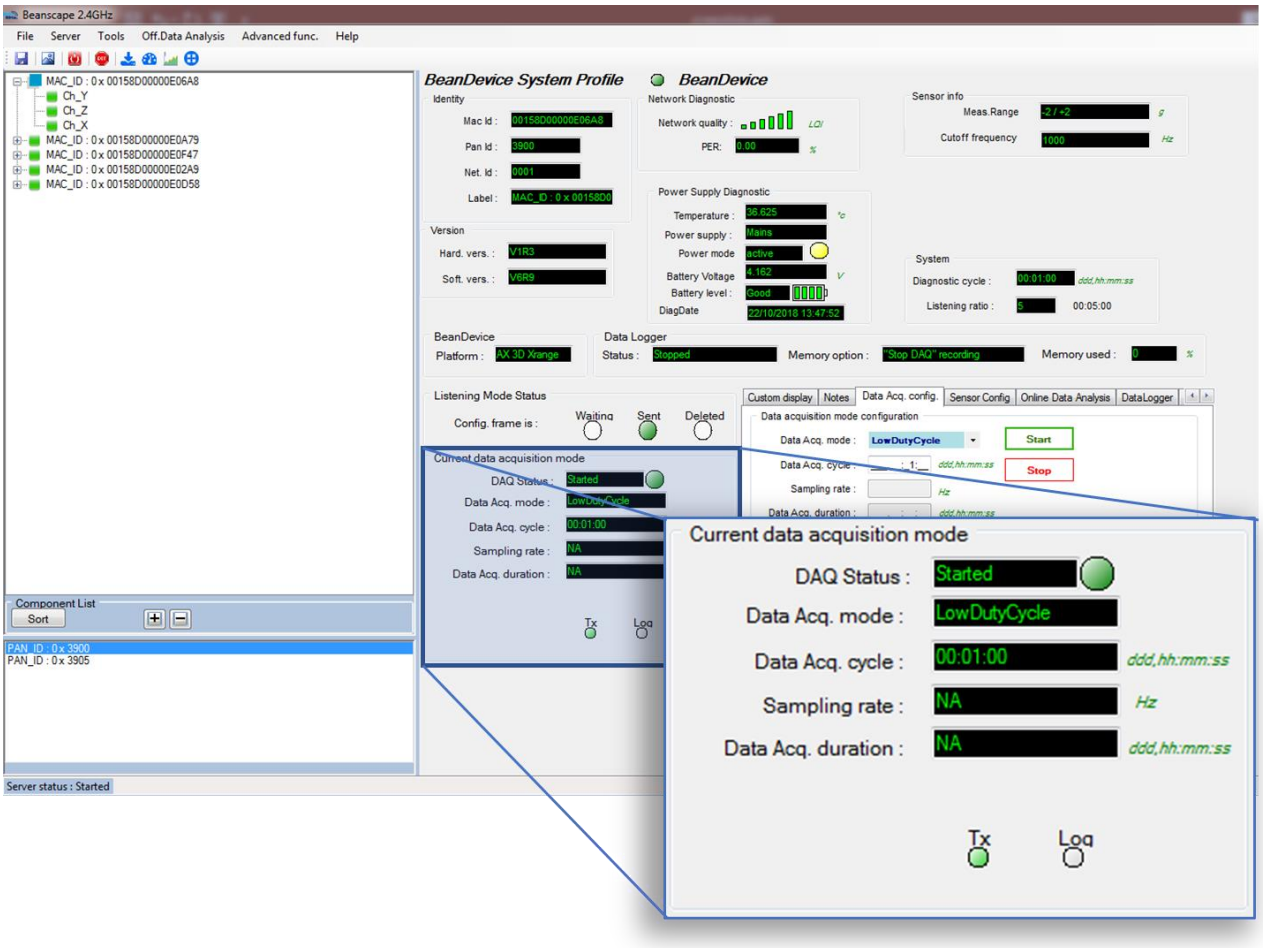


Figure 32: Current data acquisition mode display

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

7.3.4 Tab: Sensor Config

Sensor Config tab offers different functionalities according the nature of the BeanDevice®.

7.3.4.1 BeanDevice® AX-3D and AX-3D X-range Sensor config Tab

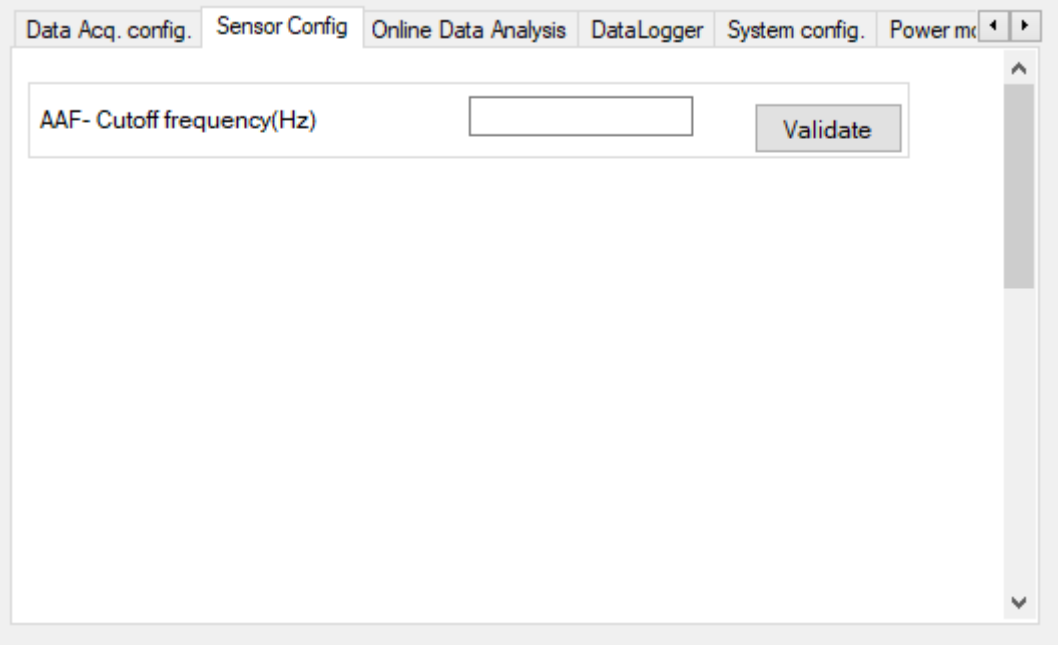


Figure 33:BeanDevice® AX 3D and AX 3D X-range Sensor Config tab

When using the BeanDevice® Ax-3D or AX-3D Xrange, the Sensor Config Tab will be used to set the Sensor AAF-Cut frequency.

7.3.4.2 BeanDevice® Hi-Inc Sensor and Hi-Inc X-range Config Tab

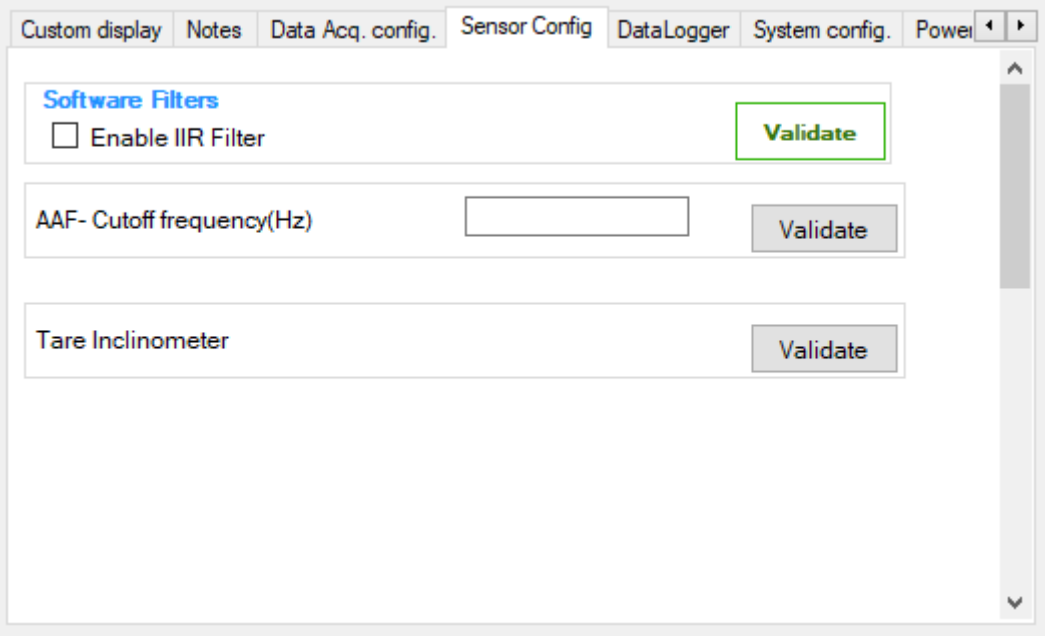


Figure 34: BeanDevice® Hi-Inc and Hi-Inc X-range Sensor Config tab

When using the BeanDevice® Hi-Inc or Hi-Inc X-range, user can have access to these functionalities:

- ***IIR Filter:*** Enable/Disable IIR Filter
- ***AAF-Cutoff Frequency:*** Used to set the Cutoff frequency
- ***Tare Inclinometer:*** Used to calibrate the Zero Degree during the calibration process.

7.3.4.3 BeanDevice® AX-3DS Sensor Config Tab

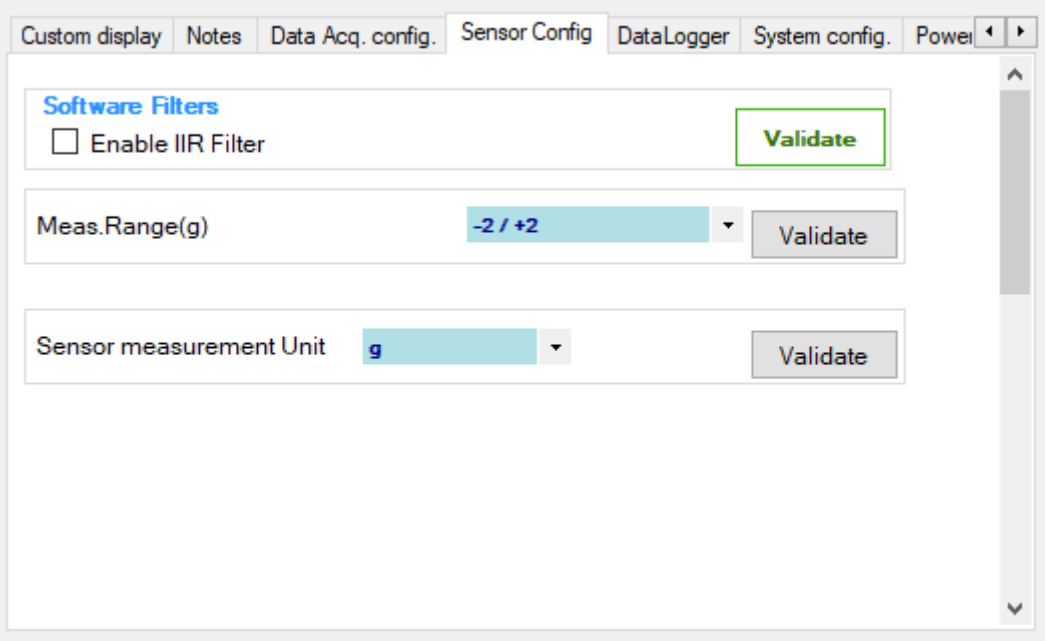


Figure 35: : BeanDevice® Hi-Inc and AX-3DS Sensor Config tab

When using the BeanDevice® AX-3DS, user can have access to these functionalities:

- ***IIR Filter:*** Enable/Disable IIR Filter
- ***Meas. Range:*** Used to set Measurement Range according to the Sensor measurement unit.
- ***Sensor measurement Unit:*** Used can select between g or mm/s²

7.3.5 Tab: Online Data Analysis

Online data analysis is available on the following hardware platform only :

- ***BeanDevice® AX-3D***
- ***BeanDevice® AX-3D Xrange.***

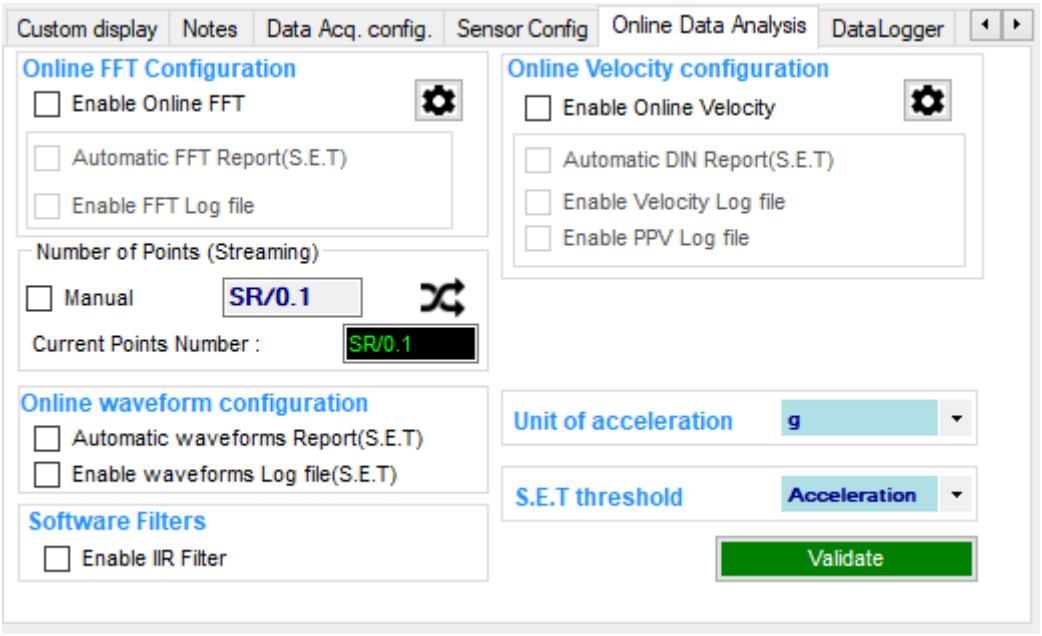
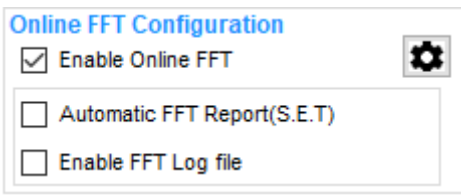


Figure 36: Signal processing tab

Signal processing tab is composed of six different fields:

- ***Online FFT Configuration***
- ***Online Velocity configuration***
- ***Online waveform config***
- ***Software filters***
- ***Unit of acceleration***
- ***S.E.T threshold***

7.3.5.1 Online FFT Configuration



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

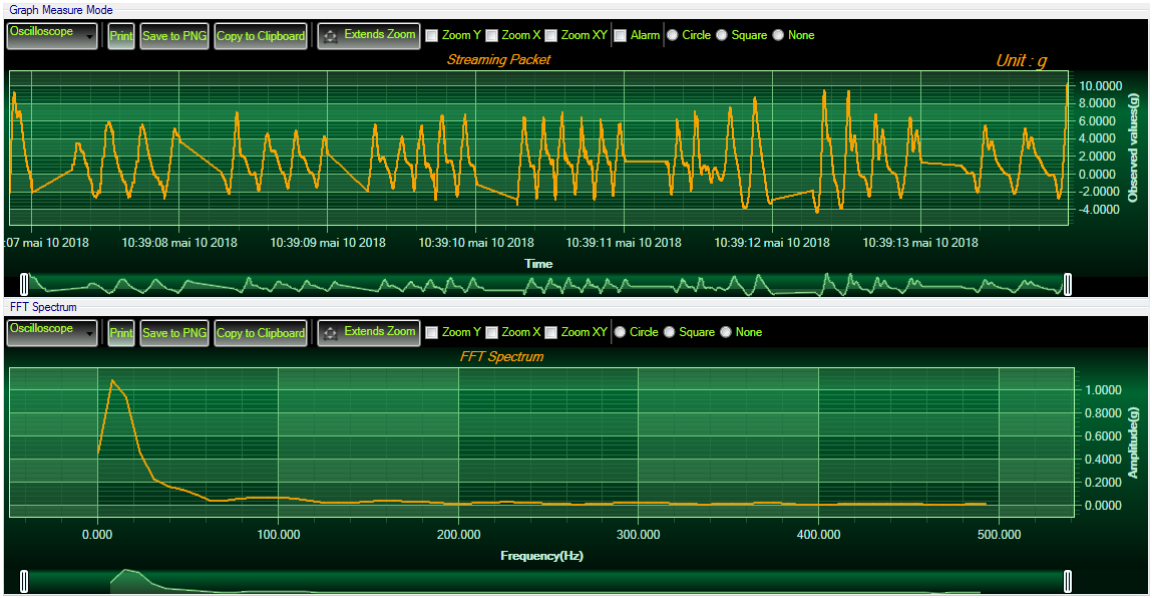


Figure 37: FFT Spectrum

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

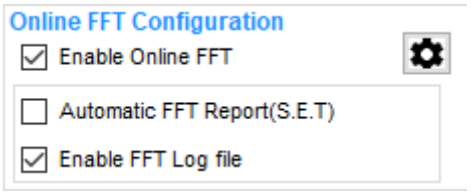


Figure 38: Online FFT Configuration frame

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

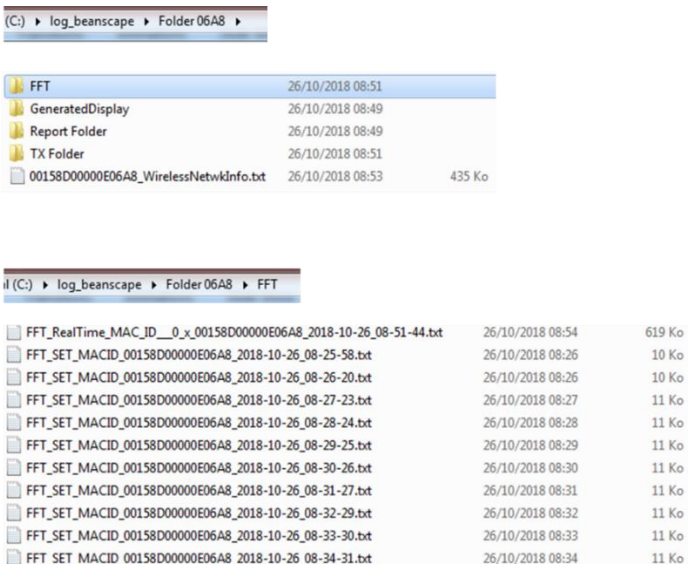


Figure 39: FFT log files folder

3: 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

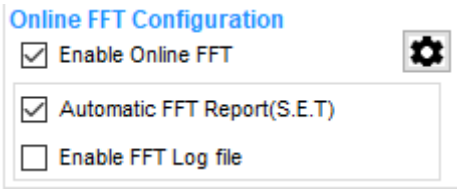
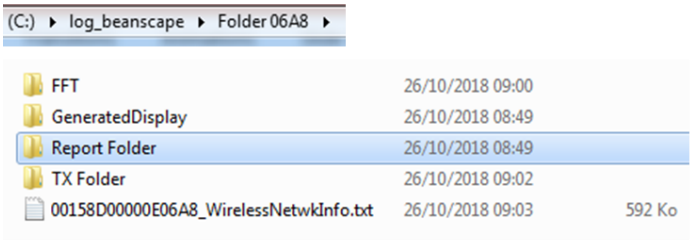


Figure 40:Enabling Automatic FFT Report

The Reports will be generated in your log_beanscape directory, under “Report Folder” repertory.



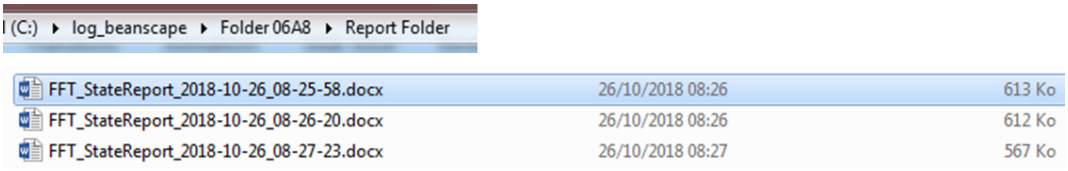
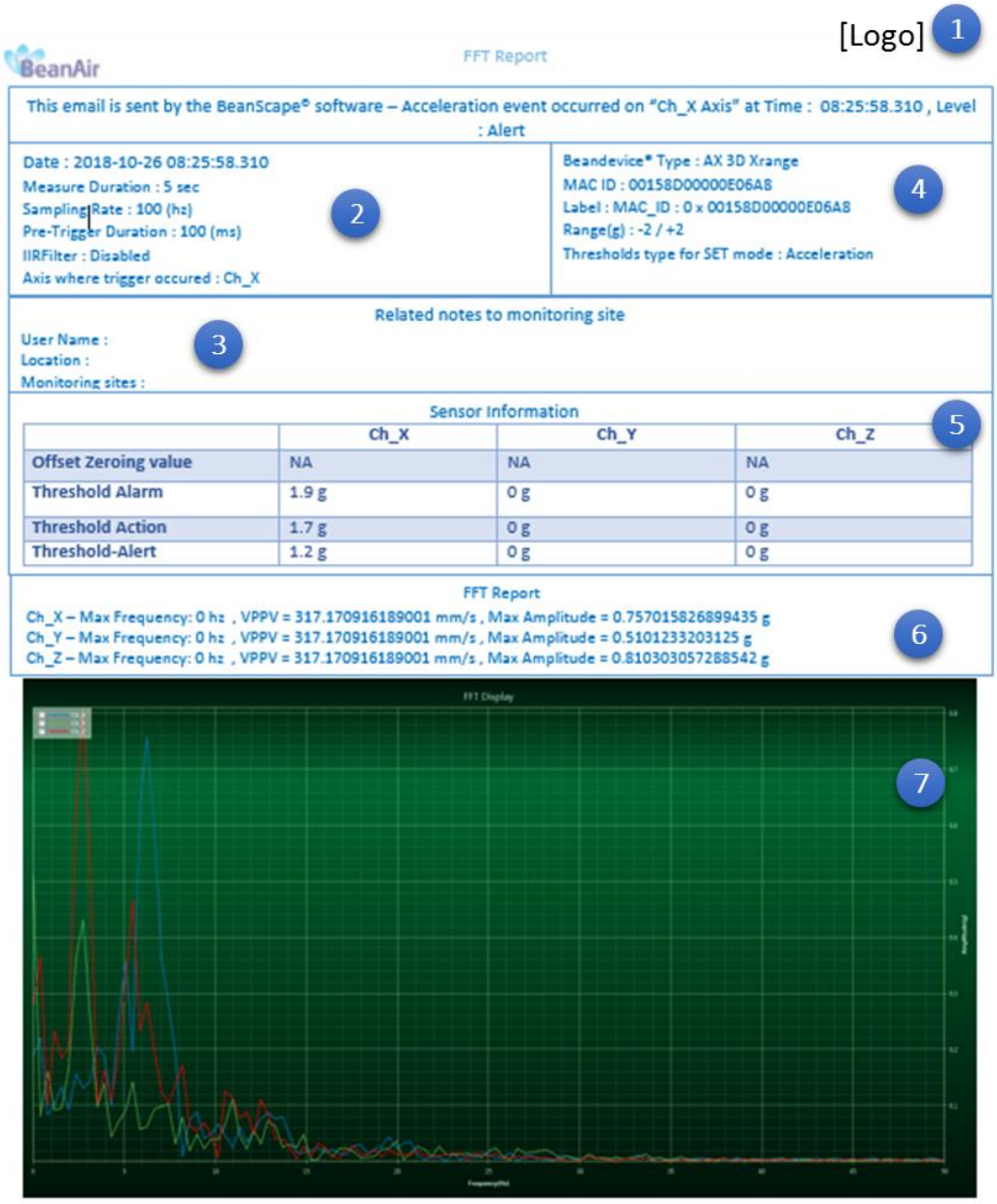


Figure 41: Report Folder

For further information about the configuration of Online FFT please refer to section 7.3.4 of this user manual

After enabling Real time FFT and setting SMTP configuration (more information on section 8), this is an example of an FFT report emailed to concerned recipients.



	Ch_X	Ch_Y	Ch_Z
Offset Zeroing value	NA	NA	NA
Threshold Alarm	1.9 g	0 g	0 g
Threshold Action	1.7 g	0 g	0 g
Threshold-Alert	1.2 g	0 g	0 g

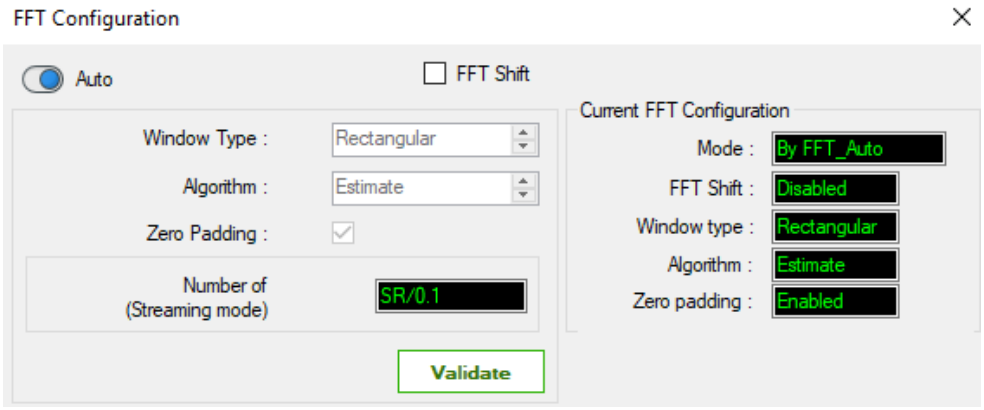
Figure 42: FFT Report (S.E.T mode)

1	Logo of your company, you can upload it from the alarm management configuration window. Tools→Alarm management
2	General information about the Measurement, Date, duration sampling rate ,pre-trigger duration, IIR filter status and triggered axis
3	Information related to monitoring site: user, location and monitoring sites (can be configured from the Alarm tool window. This field can be configured be from the alarm management configuration window Tools→Alarm management
4	BeanDevice® Information: Type, MAC ID and label, measurement range, and Alarm Type : Acceleration or Velocity
5	Alarm thresholds value on each Axis, the three levels of alarms are displayed Action-Alert-Alarm
6	FFT Report with Max Frequency for each Axis, VPPV (Vector Peak Particle Velocity) value and Max amplitude
7	Graph Area – 3 Axis are displayed on the same graph

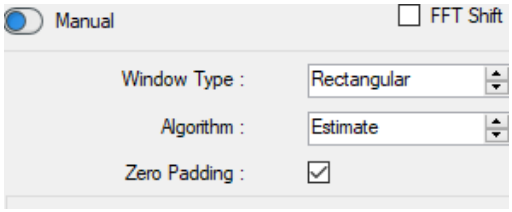
For further information about managing your notification and reports email please refer to section 8: Alarm management.

-  : 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.

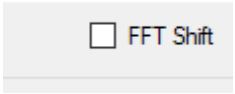
In general, the Hanning (Hann) window is satisfactory in 95 percent of cases. It has good frequency resolution and reduced spectral leakage. If you do not know the nature of the signal but you want to apply a smoothing window, start with the Hann window.

- 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.



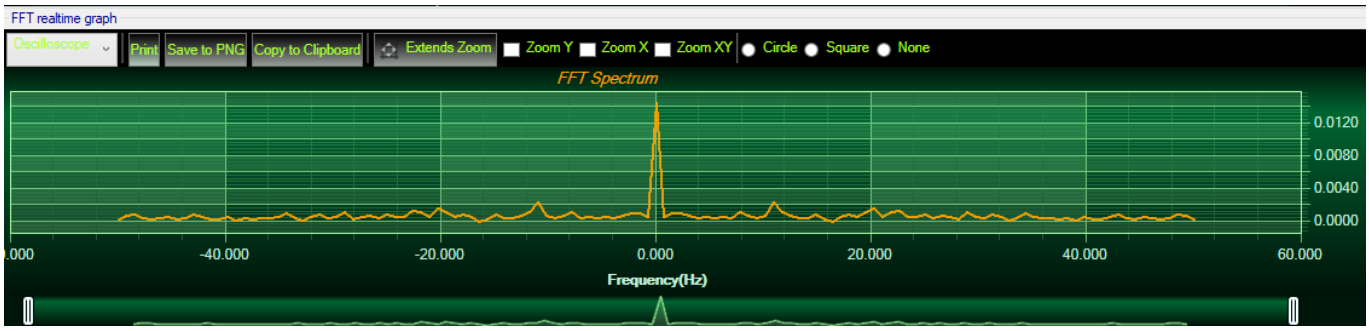


Figure 43: FFT Shift Spectrum

7.3.5.2 Online Velocity configuration

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

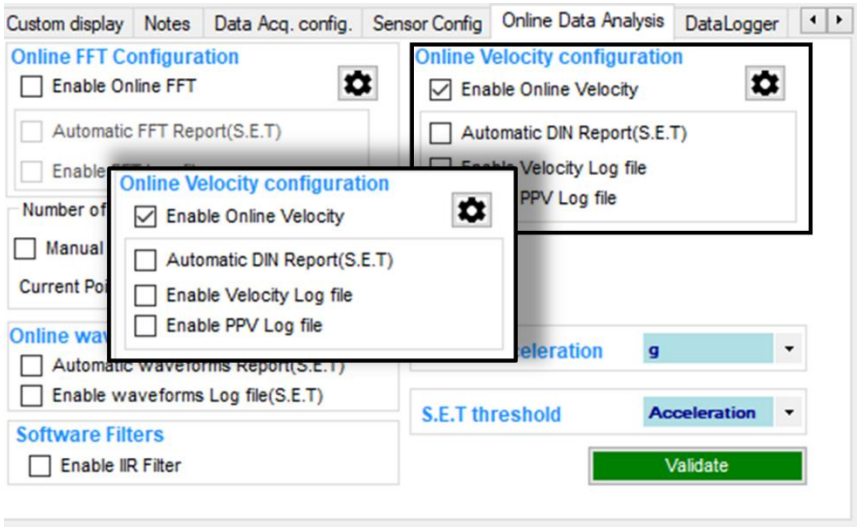


Figure 44: Online Velocity configuration tab

- ***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.

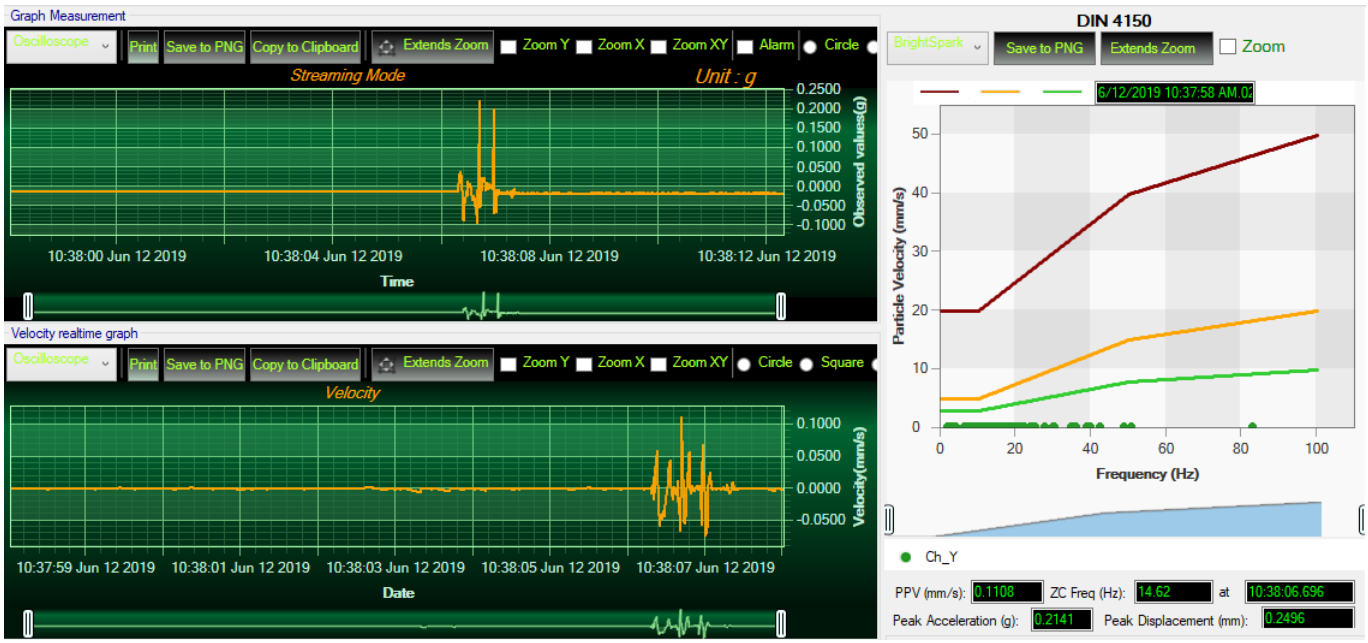


Figure 45: Velocity Graph

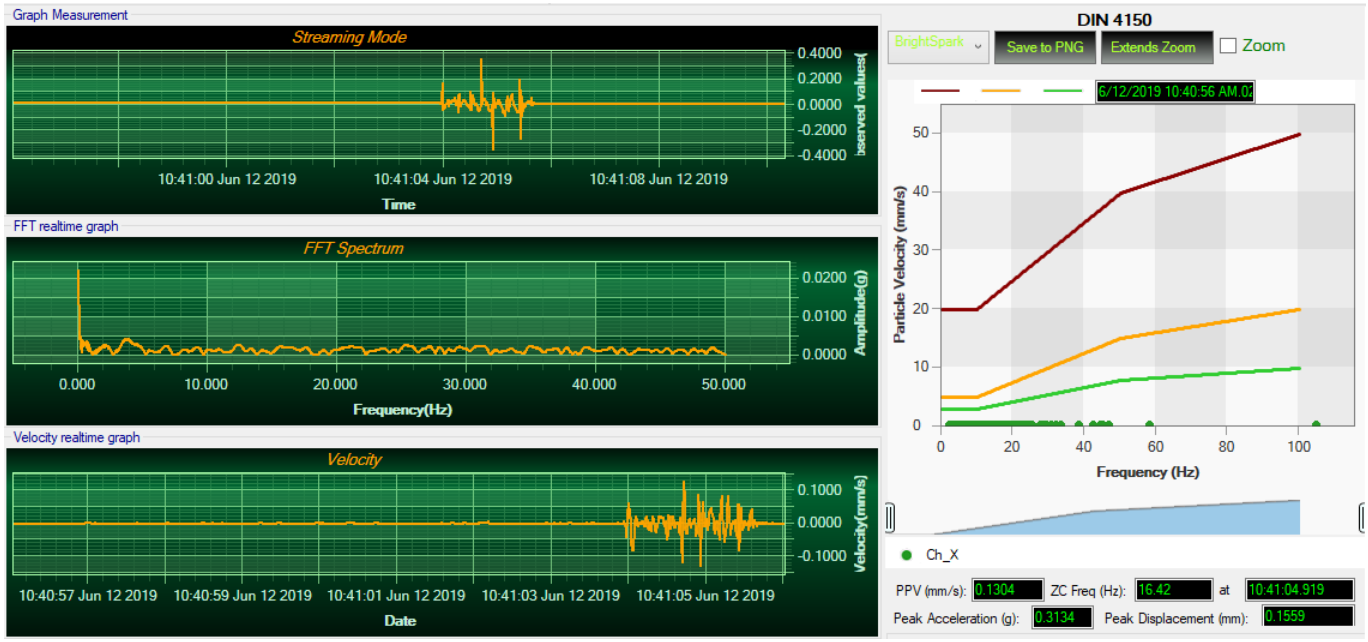


Figure 46: Velocity and FFT Graph, PPV and PVS

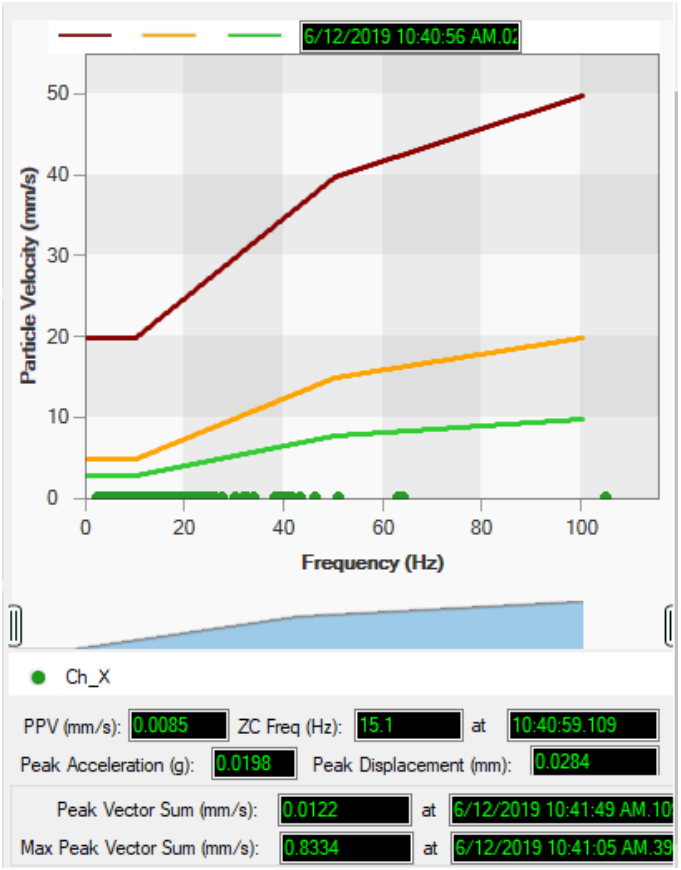


Figure 47: DIN 4150 Real Time Graph, PPV & PVS

- ***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 48: 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.

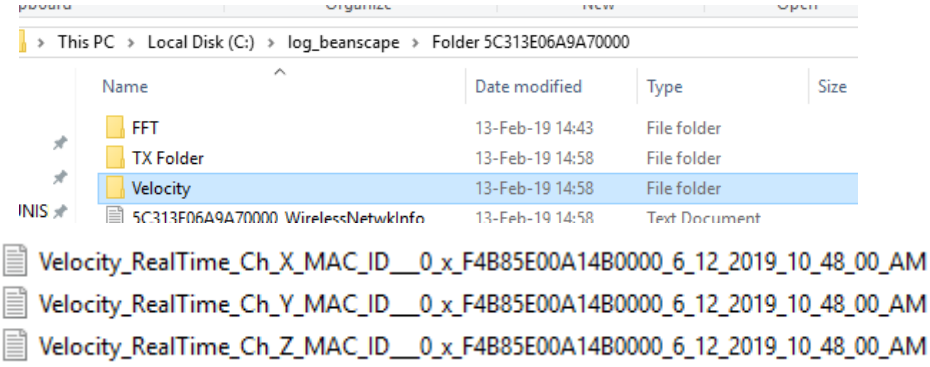


Figure 49: Velocity Log Folder/Files

- ***Enable PPV Log file***

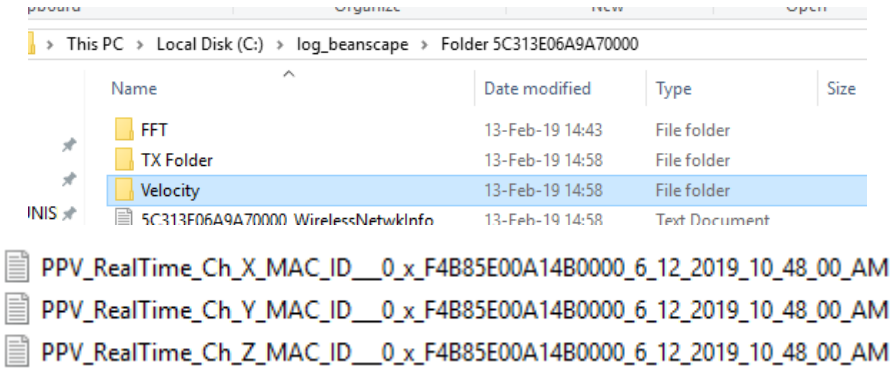


Figure 50: PPV Log Folder/Files

: Velocity Advanced Configuration

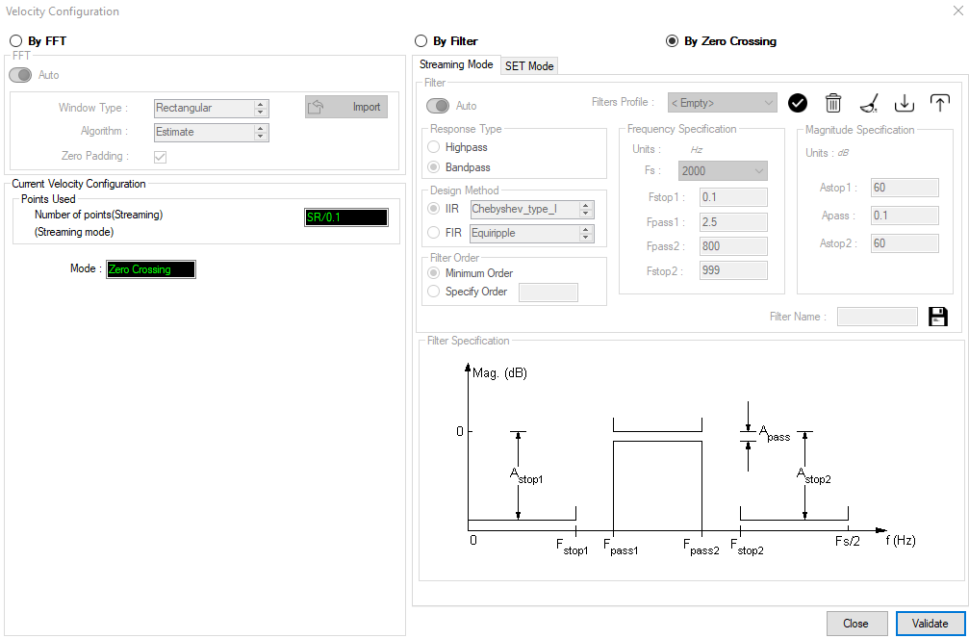
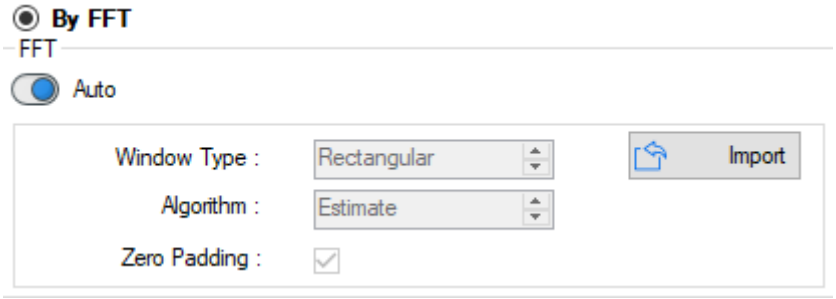


Figure 51: Velocity Advanced Configuration

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

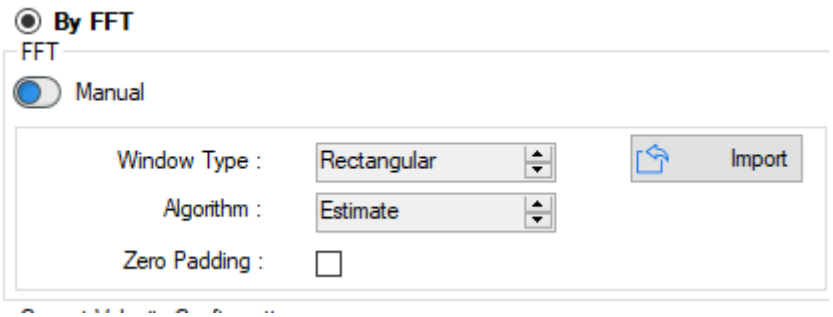
- **By FFT:** By selecting this option, the user will setup the Velocity basing on customized FFT settings.

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

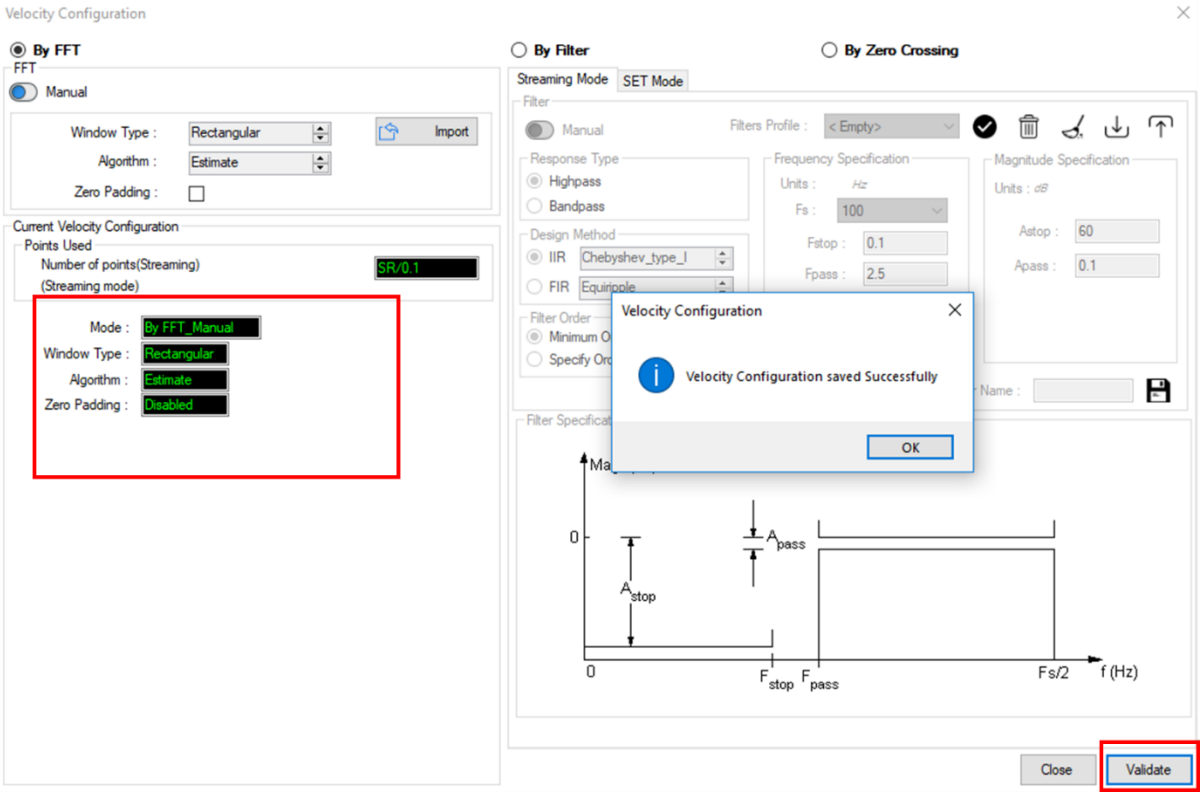


- Manual: Once switched to Manual, the user must configure the FFT settings manually (Window Type, Algorithm & Zero Padding).

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

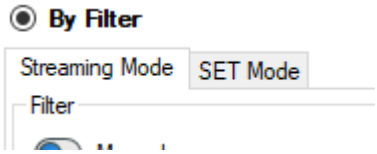


To save all settings Press Validate. The new settings should be displayed on the Left side of the Window.

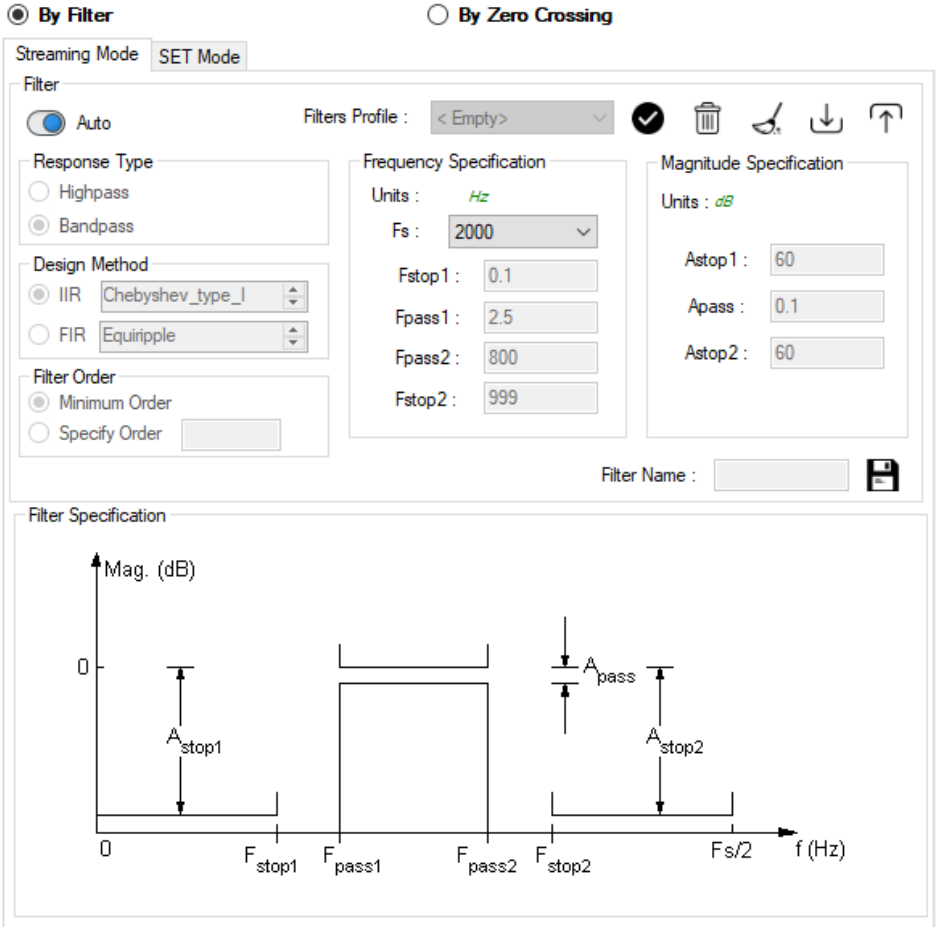


- **By Filter:** By selecting this option, the user will setup the Velocity basing on the Software Filter.

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

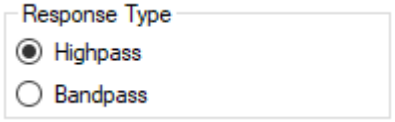


  - Auto: If Auto is selected, Velocity Automatic filter will be configured



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

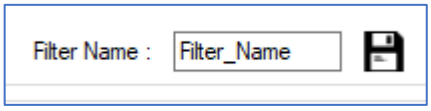
    - <u>Response Type:</u> User should specify if the Response is **Highpass** or **Bandpass**

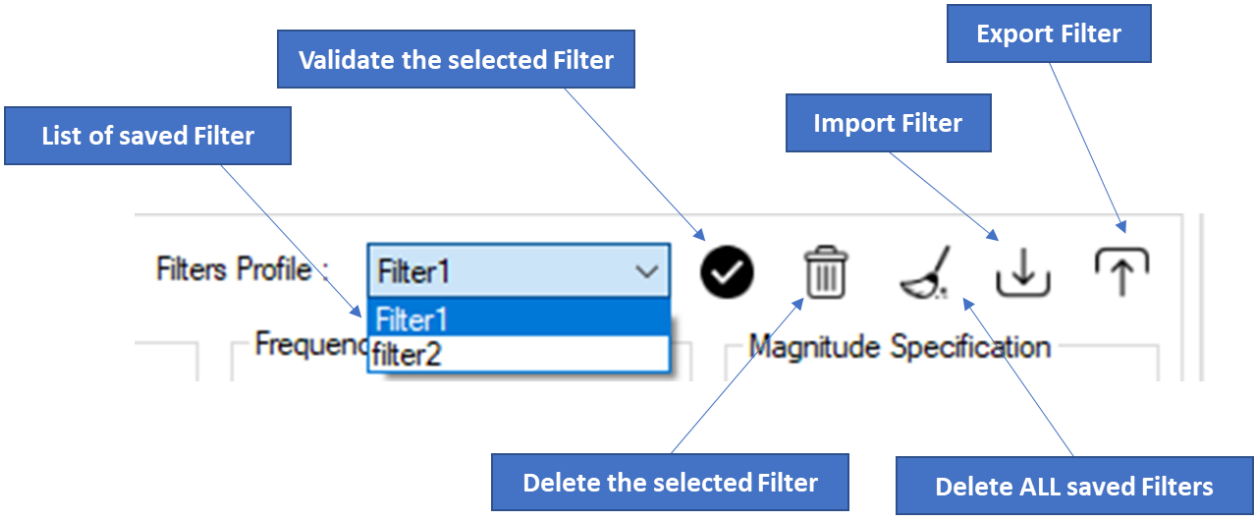


- Design Method: User should Select the nature of the Filter between **IIR** or **FIR**
  From the List of every filter, user have to specify the method of the Filter:
  IIR: Chebyshev_type_I, Chebyshev_type_II or Butterworth
  FIR: Equiripple, Generalized_Equiripple or Kaiser_Window

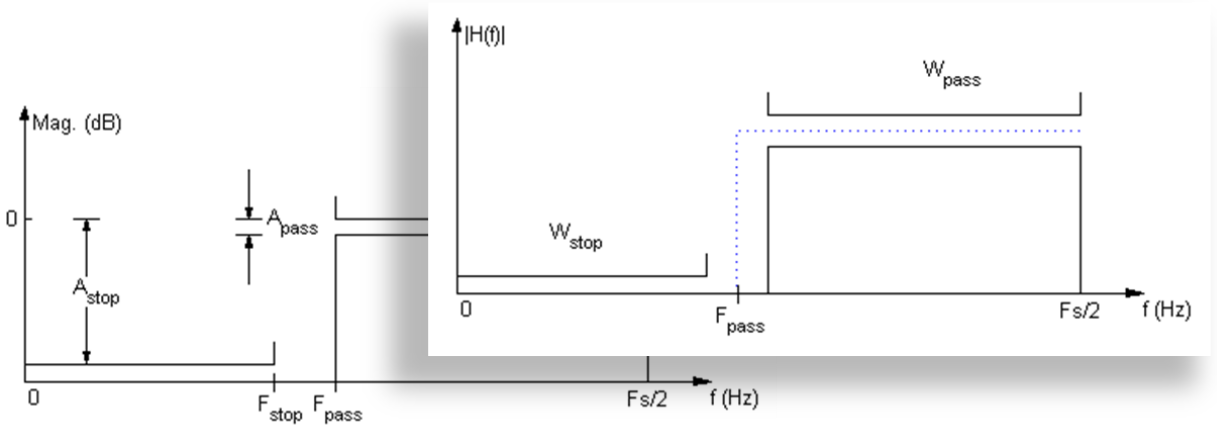
The Frequency Specification and The Magnitude Specification will be modified according the selected Design Method

- 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.

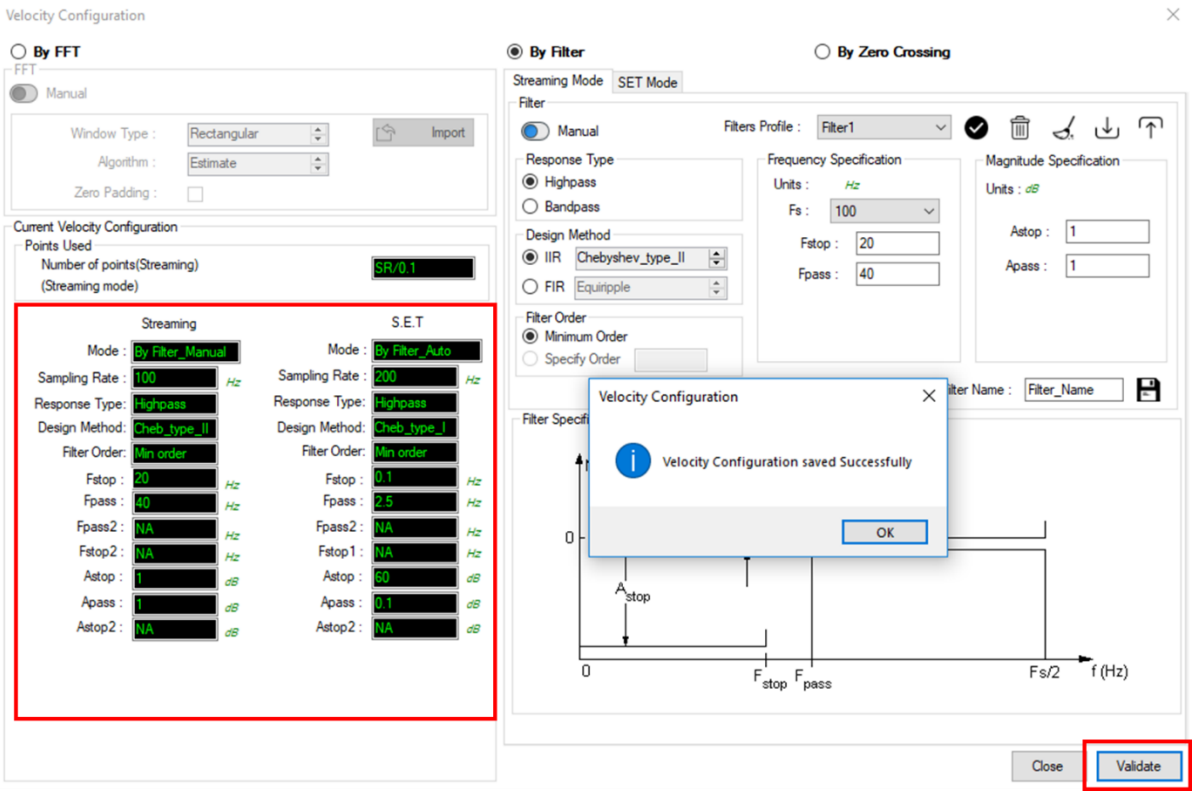




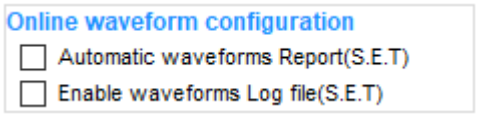
- Filter Specification: Is a Graphical Display of the Filter Specification depends on the user settings.



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



7.3.5.3 Online waveform configuration



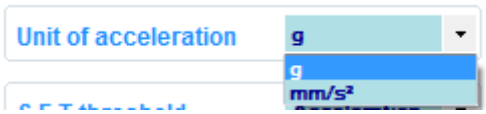
- ***Automatic Wave Report(S.E.T)***: Check to enable waveform reports, this is only available for S.E.T mode
- ***Enable Wave Log file:***check to enable logging wave form for real-time data(only S.E.T mode)

7.3.5.4 Software filters

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

7.3.5.5 Unit of acceleration

Select which unit to be used for acceleration measurement.



7.3.5.6 S.E.T threshold

In so many cases the threshold is needed to be set in mm/s and not in g or mm/s², you need to configure your S.E.T threshold parameters before starting.

To configure the threshold to be set in mm/s, you need to go to Online Data Analysis and change S.E.T threshold from acceleration to Velocity.

7.3.6 Tab: Datalogger

For further information about the Datalogger, please read the technical note TN_RF_007 – "BeanDevice® Datalogger User Guide "

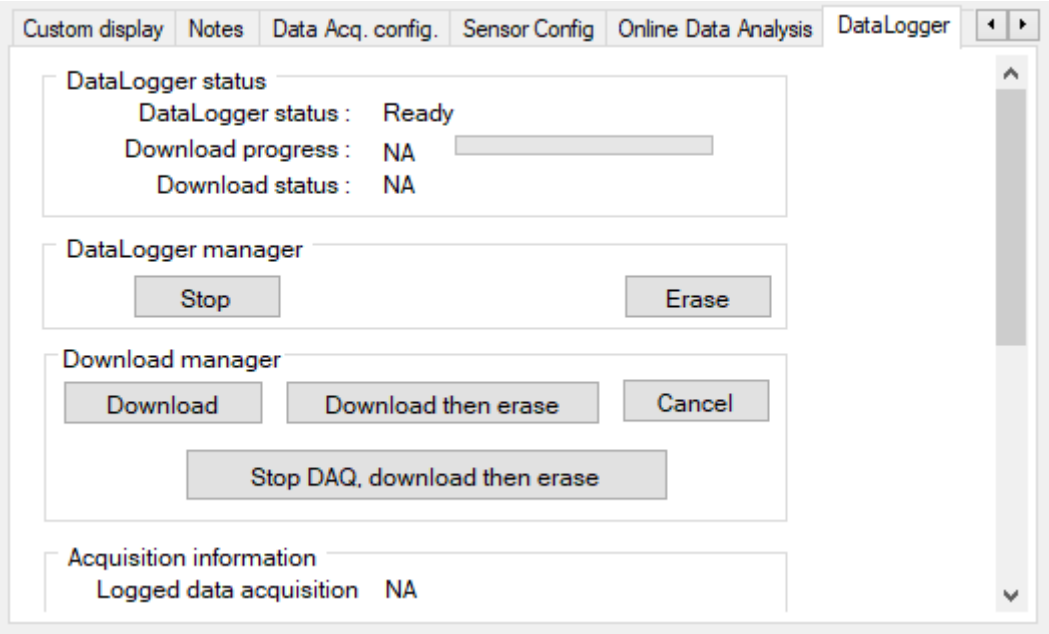
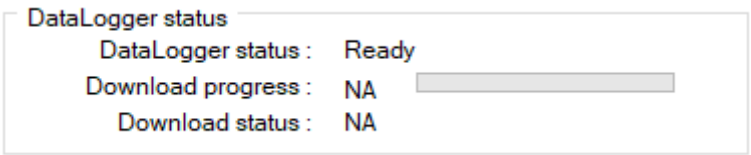


Figure 52: Datalogger Tab

Data logger tab is composed of five different fields:

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

7.3.6.1 Datalogger status



- ***Datalogger status***: Displays logger 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;

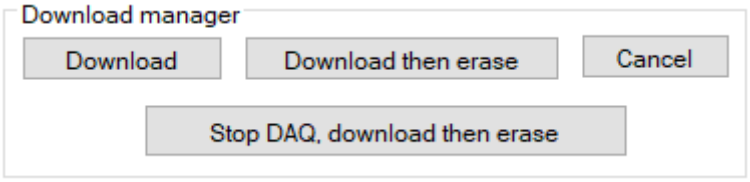
- ***Active TX and Log***: Data acquisition is logged & transmitted by Radio;
- ***Stopped***: Datalogger is stopped;

- ***Download process***: 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***: Stops & 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***.

7.3.7 Tab : System config.

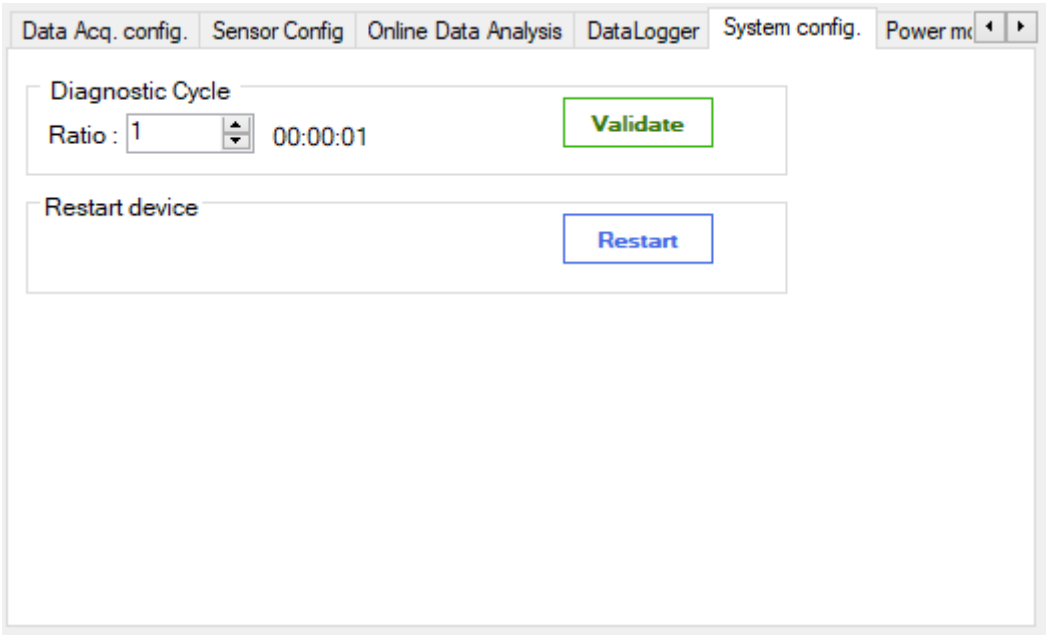


Figure 53: System Configuration Tab

Parameter	Description
Diagnostic cycle	You can set the BeanDevice® diagnostic cycle (Battery status, LQI, PER ...). The Diagnostic cycle is a ratio of the data acquisition 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 ;
Restart Device	You can restart your BeanDevice® from BeanScape®.

7.3.8 Tab : Power mode management

For further information about Power mode management, please read the technical note TN_RF_010 – « BeanDevice® Power Management »

This Tab is composed of three frames:

- ✓ ***Power mode configuration:*** Configure the Power mode on your BeanDevice®
- ✓ ***Sleep with listening config. :*** Configuration settings for Sleep power mode

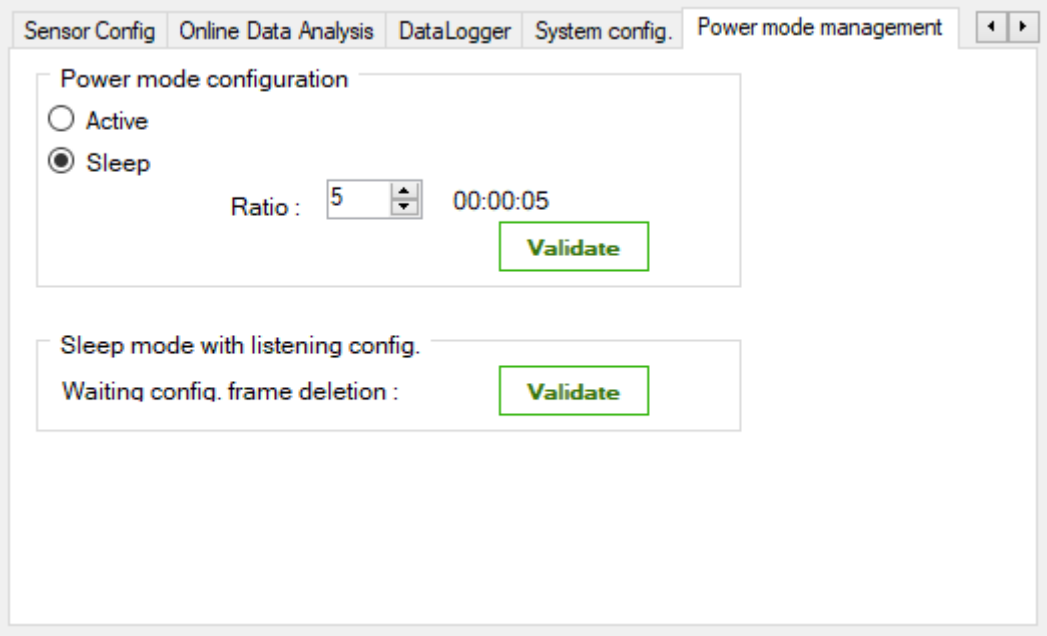


Figure 54: Power Mode Management Tab

Parameter	Description
Power mode configuration	***Active:*** Sleeping power mode is disabled. The BeanDevice® operates in Active power mode. ***Sleep:*** Sleep power mode is enabled. ***Ratio***: Fix the Ratio of the listening cycle. This ratio depends on the data acquisition low duty cycle.
Sleep mode with listening config	By clicking on "validate", the pending OTAC frame is deleted

7.3.9 Right Click functionalities

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

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

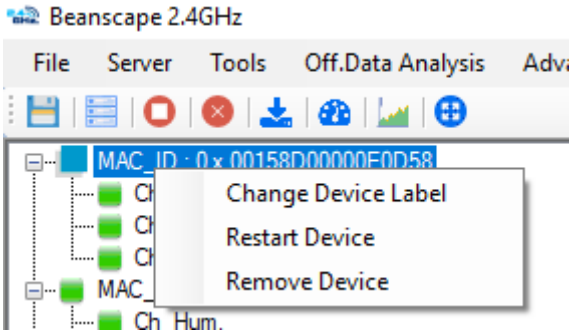


Figure 55: Right Click on BeanDevice® Profile

7.4 SENSOR CHANNEL PROFILE

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

1. ***General information on the measurement channel;***
2. ***Measurement channel configuration;***
3. ***A graph which displays in real-time sensor signals during data acquisition;***

Figure 56: Overview: Sensor channel profile

7.4.1 Sensor channel status

7.4.1.1 Frame: General information

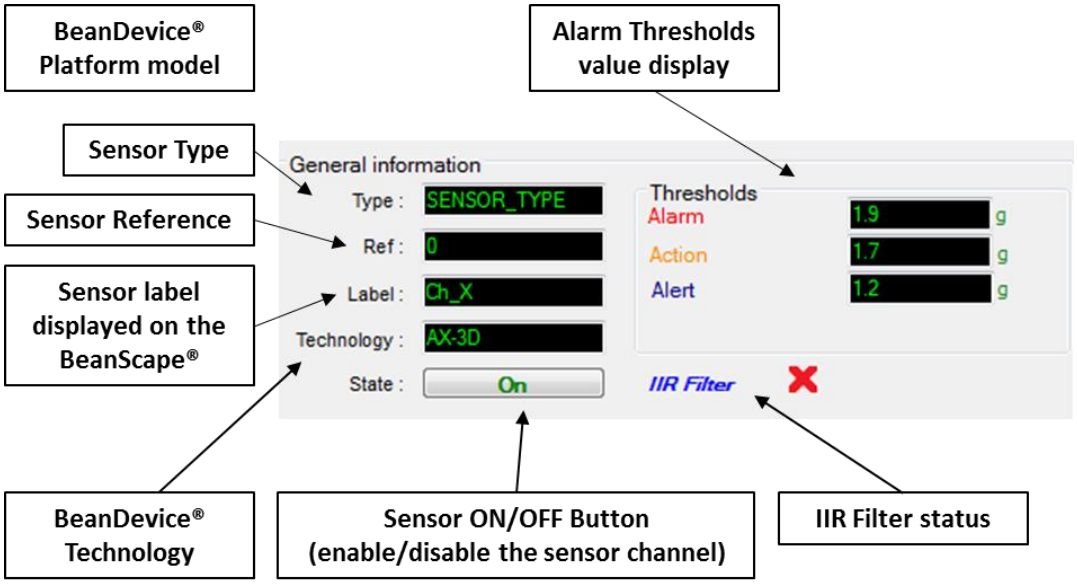


Figure 57: Sensor Channel General information frame

7.4.1.2 Frame: Measurement data

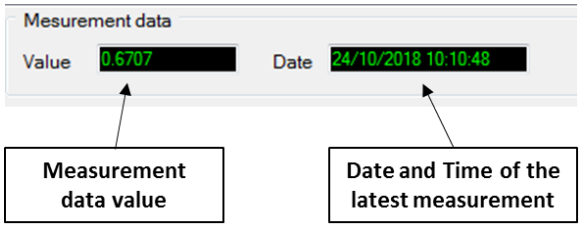


Figure 58: Measurement data frame

By default, sensor unit format is

- G or mm/s² for the BeanDevice AX-3D & AX-3DS
- ° for the BeanDevice HI-INC

7.4.2 Sensor channel configuration

This frame contains a set of 5 tabs:

Custom Display	• Allows the end user to customzie the sensor
Notes	• Contains notes relating to the BeanDevice® sensor
Alarm Config	• Sensor configuration interface. The user can configure the alarm thresholds related to the sensor • Depending on the BeanDevice® version which is used, other configuration parameters are available
Sensor calibration	• Sensor channel calibration
Log config	• Logs configuration on the BeanScape®

7.4.2.1 Tab: Custom display

These parameters allow the user to customize his sensor:

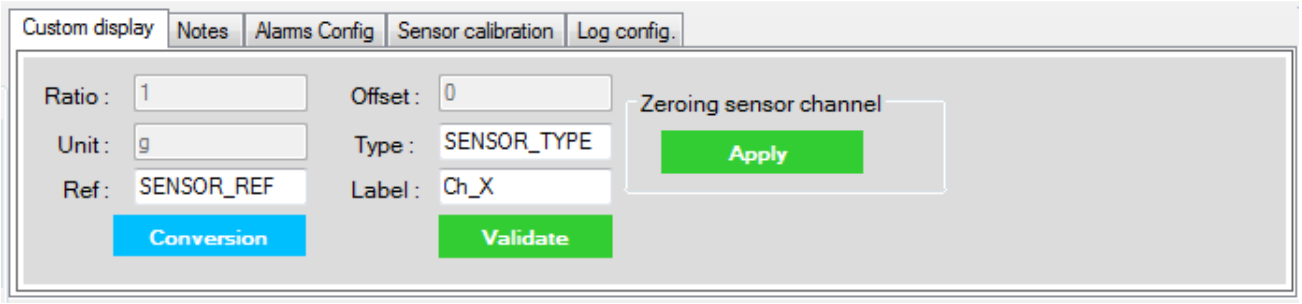


Figure 59: Sensor channel custom display tab

- ✓ ***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)

Measurement conversion formula:

Converted Measurement = Measurement x RAT + OFF

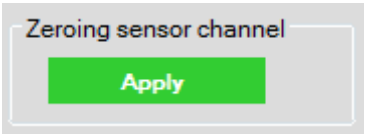
Example with a temperature sensor: By default, the temperature unit is in degree Celsius. The user wants to convert the unit in degree Fahrenheit.

Converted Measurement [°F] = Measurement[°C] x RAT + OFF

With **RAT** = 1.8 and **OFF** = 32

Zeroing

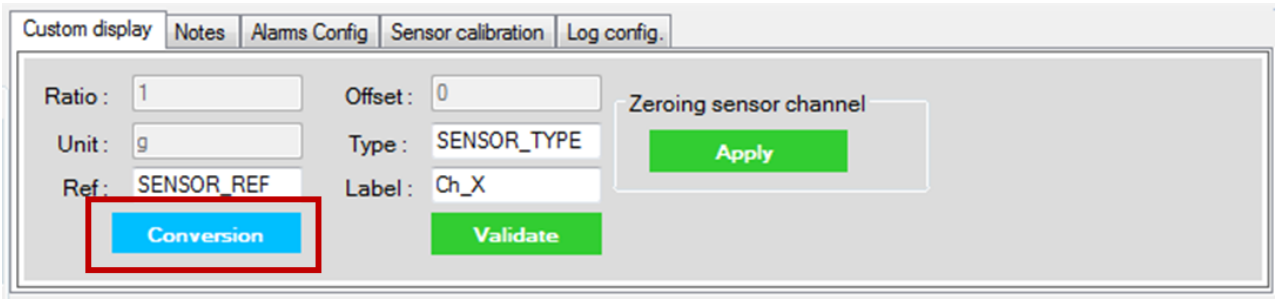
In order to secure accurate and precise Velocity and FFT measurements on axis that's mounted toward the earth gravity you should Apply zeroing to cancel earth gravity.



Conversion assistant

To avoid conversion error, a conversion assistant is available to help you to setup quickly your measurement channel of your BeanDevice®.

Click on conversion assistant from the tab "***Custom display***", a window will open allowing you to do a linear conversion.



On the left column, the user can enter the non-converted measurement data. On the right column, the user can enter the converted measurement values with the desired unit.

The ratio and offset values are calculated automatically by the conversion assistant.

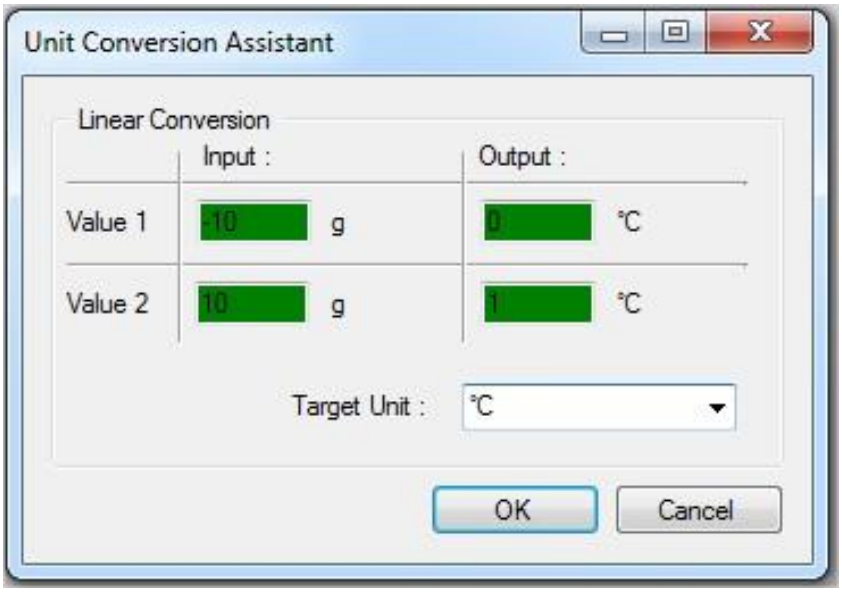


Figure 60: Unit Conversion Assistant

7.4.2.2 Tab : Notes

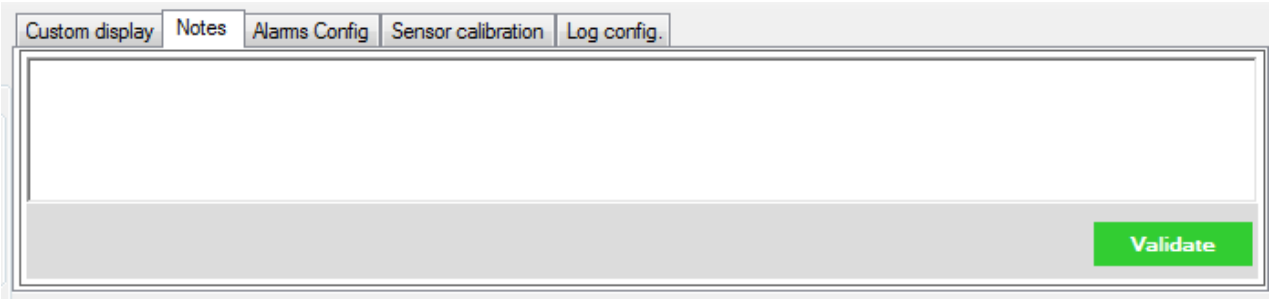
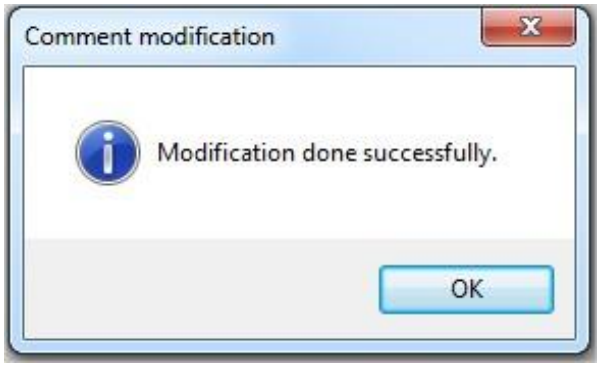


Figure 61: Sensor channel notes tab

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 backup your text click on the icon "Backup your Database" 

7.4.2.3 Tab: Alarms Config - BeanDevice® AX-3D

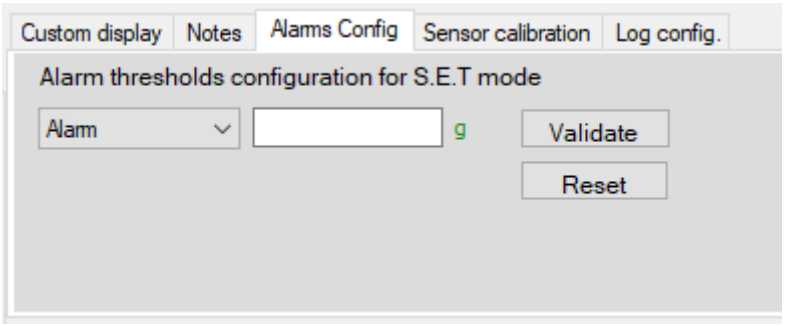


Figure 62: Alarm configuration tab (BeanDevice® AX-3D)

Parameter	*Description*
Alarm threshold configuration for S.E.T mode	For BeanDevice AX-3D and in the S.E.T mode (Streaming with event triggering) the threshold is based on AAA(Alert/Action/Alarm) with : Alert values < Action value < Alarm value. Measurement exceeding each threshold will results in notification sent with the appropriate reports and info via email and audio notification on the computer will take place.

7.4.2.4 Tab: Alarms Config - BeanDevice® HI-INC

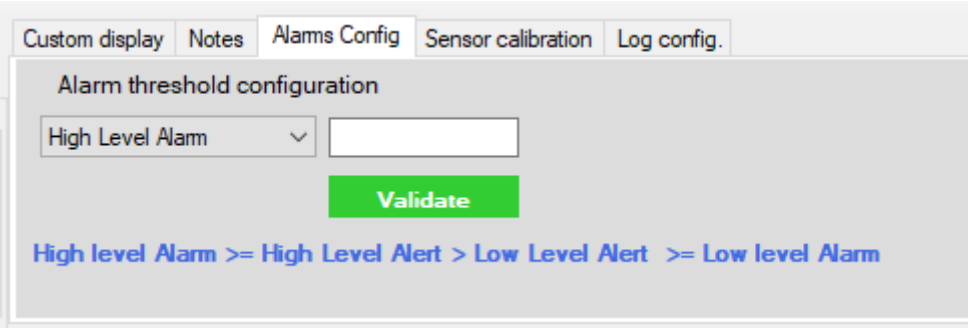


Figure 63: Alarm configuration tab (BeanDevice® HI-Inc)

Parameter	*Description*
Alarm threshold	You can configure threshold high values (High level alarm, High level alert) and low values (Low level alarm, Low level alert). In alarm mode, when a higher low threshold value is reached, an alarm notification is transmitted to the BeanGateway ; ✓ If the sensor value is higher than High level alarm/High level alert, notification is send to the BeanGateway/BeanScape; ✓ If the sensor value is lower than Low level alarm/Low level alert, notification is send to the BeanGateway/BeanScape. Threshold values must be organized in this manner: High level alarm >=High level alert > Low level alarm >= Low level alert
Cutoff Frequency	***Cutoff frequency :*** Configure the anti-aliasing filter cutoff frequency The range of cutoff frequency which can be configured is: ✓ ***0 Hz to 2 KHz*** if the product is a BeanDevice AX-3D ✓ ***0 Hz to 2 KHz*** if the product is a BeanDevice AX-HD ✓ ***0 Hz to 60 Hz*** if the product is a BeanDevice HI-INC

For further information about the alarms threshold configuration, please read the technical note ponse TN_RF_008 – "Data acquisition modes available on the BeanDevice®"

7.4.2.5 Tab: Alarms Config Configuration - BeanDevice® AX-3DS

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®"

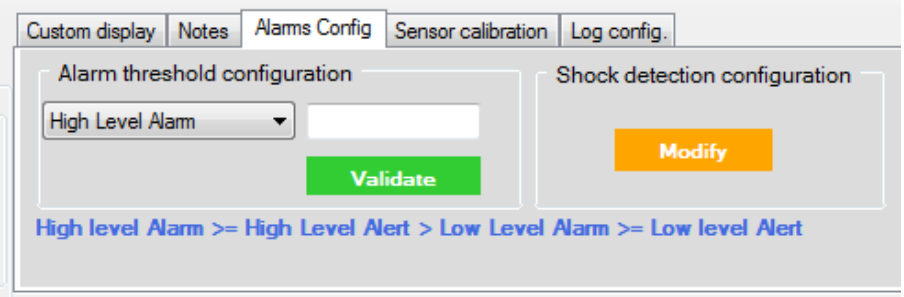


Figure 64: Alarm configuration tab (BeanDevice® AX-3DS)

Parameter	Description
Alarm threshold	You can configure threshold high values (High level alarm, High level alert) and low values (Low level alarm, Low level alert). In alarm mode, when a higher low threshold value is reached, an alarm notification is transmitted to the BeanGateway ; If the sensor value is higher than High level alarm/High level alert, notification is send to the BeanGateway/BeanScape; If the sensor value is lower than Low level alarm/Low level alert, notification is send to the BeanGateway/BeanScape. Threshold values must be organized in this manner: High level alarm >=High level alert > Low level alarm >= Low level alert ***Alarm thresholds are not available for SSD (Smart shock detection mode)***
Accelerometer range configuration	✓ The user can change the measurement range of the accelerometer: • ***BeanDevice® AX-3DS 24G***: ±6g or ±12g or ±24g • ***BeanDevice® AX-3DS 8G*** : ±2g or ±4g or ±8g
Shock detection configuration	Click on modify, a new window will open.

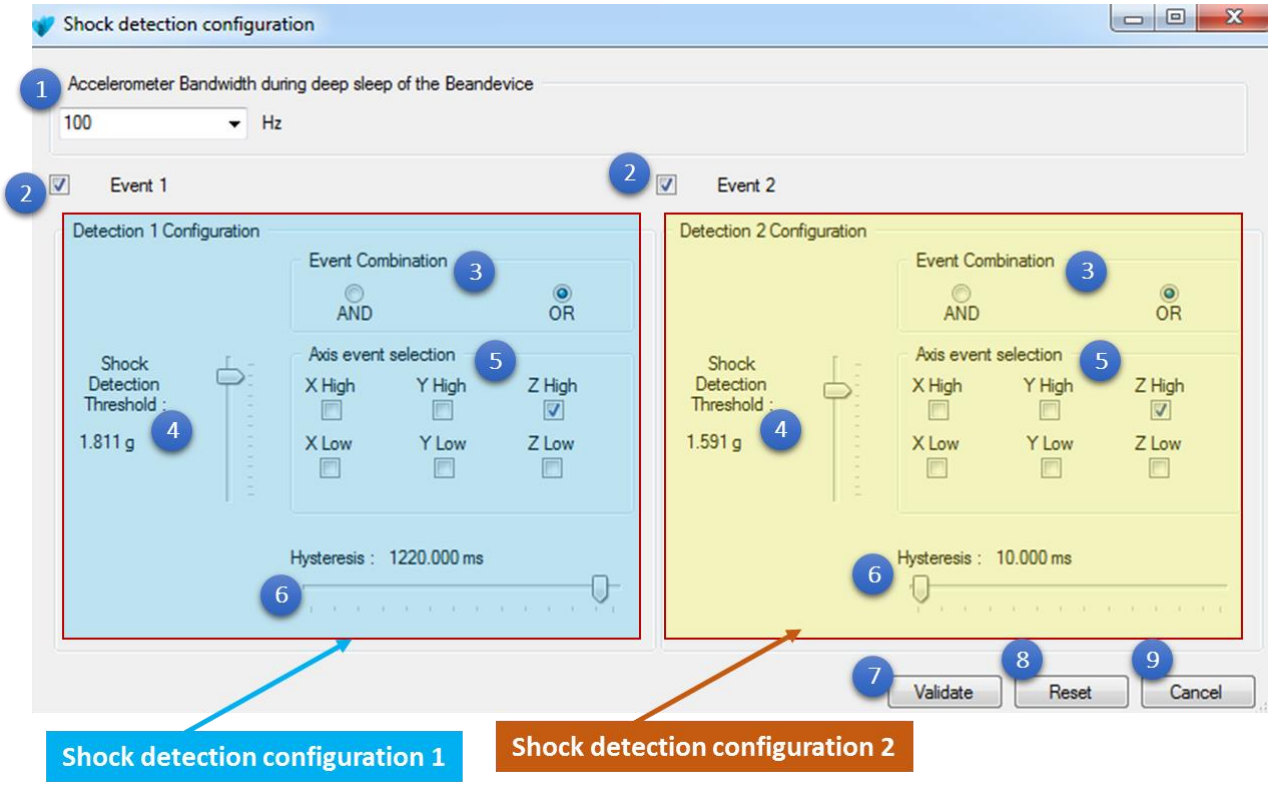
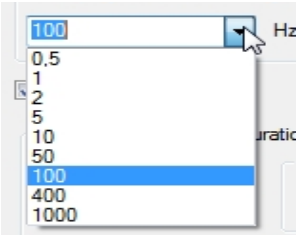


Figure 65: Shock detection configuration window

1

Changes the accelerometer bandwidth during the sleep period of the BeanDevice®:



Depending on the sampling rate of the accelerometer during the sleep period, the BeanDevice® current consumption can vary:

Accelerometer sampling rate during sleep period	*BeanDevice® Current consumption*
0,5 Hz	***21 µA***
1 Hz	***31 µA***
2 Hz	***50 µA***
5 Hz	***78 µA***
10 Hz	***130 µA***
50 Hz	***302 µA***
100 Hz	***308 µA***
400 Hz	***343µA***
1000 Hz	***413 µA***

2

The user can select two events profile ***Event 1*** and ***Event 2.***

3

Event combination

The user can use two logical combinations: ***AND*** and ***OR*** combination on the axis event selection.

4

Set the shock detection threshold

Unit value: g

The threshold resolution depends highly on the acceleration range.

On the axis event selection frame, if the high axis is selected, the threshold value will be positive.

If the Low axis is selected, the threshold value will be negative.

Example: For a threshold value settled at 2g, if X High Axis **OR** X Low Axis is selected.

For all the values upper than 2g on the X Axis, a shock event is detected

For all the values less than -2g on the X Axis, a shock event is detected.

5

Axis event selection

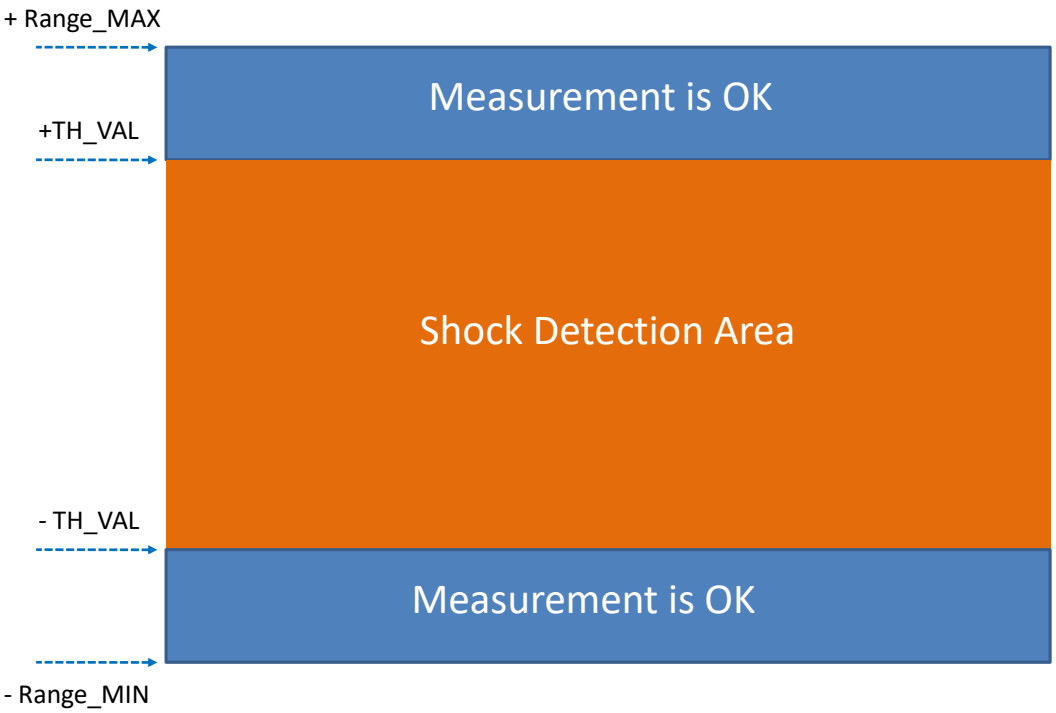
The user can associate a shock event with an axis: X Axis High, X Axis Low, Y Axis High, Y axis Low, Z Axis High, Z Axis Low.

The **AND/OR** combination is not available for two events on the same axis, i.e. the following combinations are not possible: X High **and/or** X Low, Y High **and/or** Y Low, Z High **and/or** Z Low.

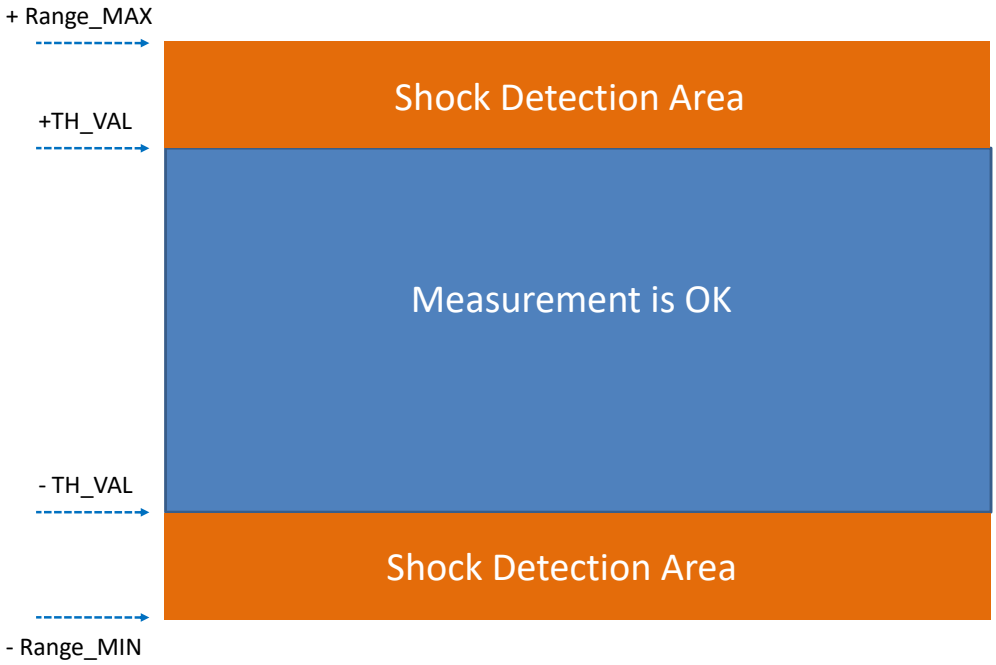
- ***TH_VALUE*** is the shock detection threshold settled by the user
- ***Range_MAX*** is the maximum measurement of the wireless accelerometer

Several configuration of shock detection are possible on the same axis:

- The user selects ***XX Axis Low,*** all the shocks events are detected on the following acceleration range [-TH_VALUE ;+TH_VALUE]



- The user selects XX Axis High, ***all the shocks are detected*** on the following acceleration range [Range_MIN ; -TH_VAL] and [+TH_VALUE; Range_MAX];



- The user selects a high event on the axis (+TH_VALUE), a shock is detected if the threshold value +TH_VALUE is reached:

6	***Hysteresis*** The user can fix an hysteresis on threshold value Choose closely the value of the hysteresis. The resolution depends on the accelerometer bandwidth during sleep or deep sleep.
7	***VALIDATE*** Click here to validate your new configuration
8	***RESET*** Click to restore a default configuration
9	***CANCEL*** Click here to cancel your configuration

Depending on your sensor resolution, the displayed threshold value can differ from the reference value.

7.4.2.6 Tab : Sensor 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:

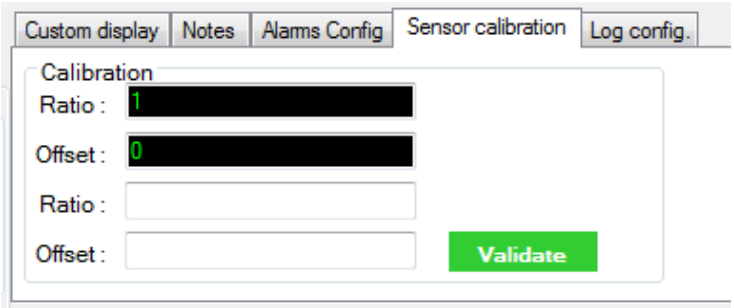


Figure 66: Sensor calibration tab

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 x 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

7.4.2.7 Tab: Log configuration

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

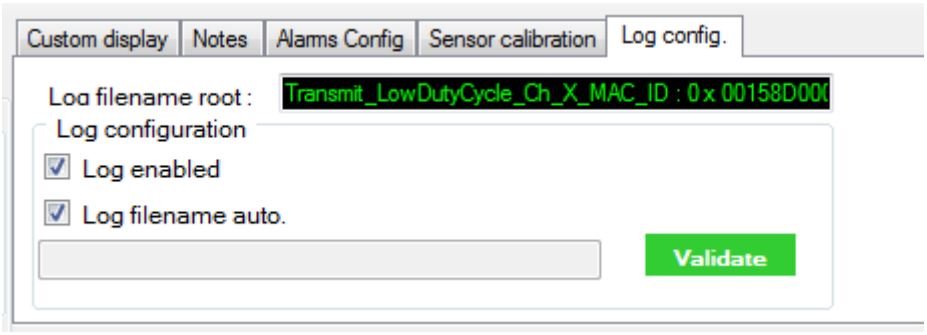


Figure 67: Log configuration tab

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:

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***

7.4.2.8 Right Click functionalities

Graphic BeanScape® offers access to quick functionalities in relation to Sensor channels. By using the mouse, Right Click on the channel under the BeanDevice® profile then you can quickly:

- ***Change State to: off***
- ***Change Sensor Label***
- ***Disable Log***

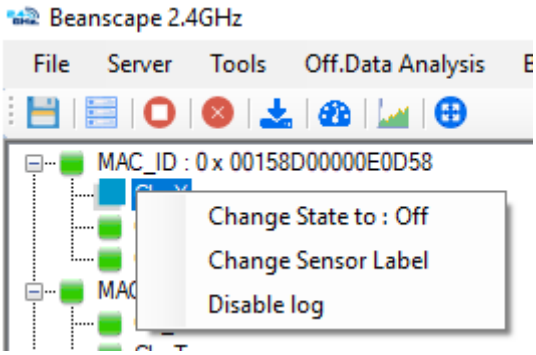


Figure 68: Right Click on the Sensor's Channel

7.4.3 Graphical display

By selecting the suitable sensor's channel, user will get this view on his BeanScape® software.

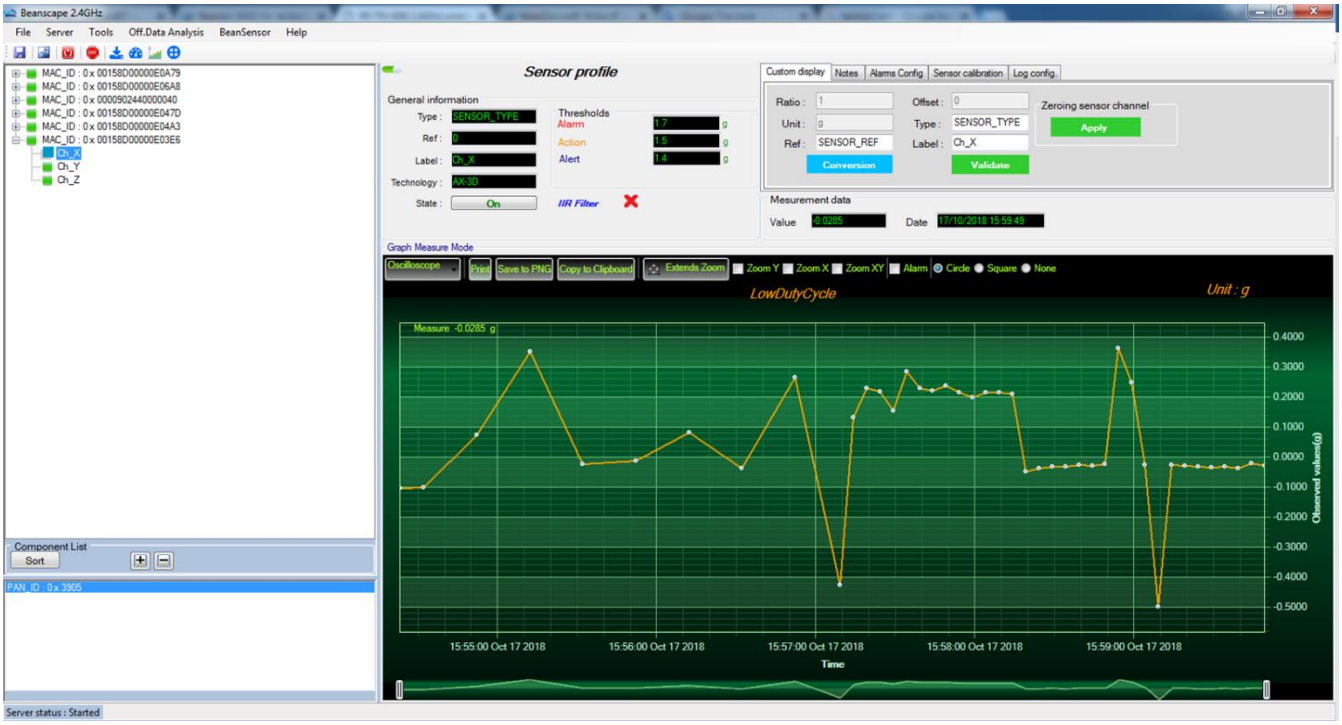


Figure 69: Overview: Channel acquisition graph visualization

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.

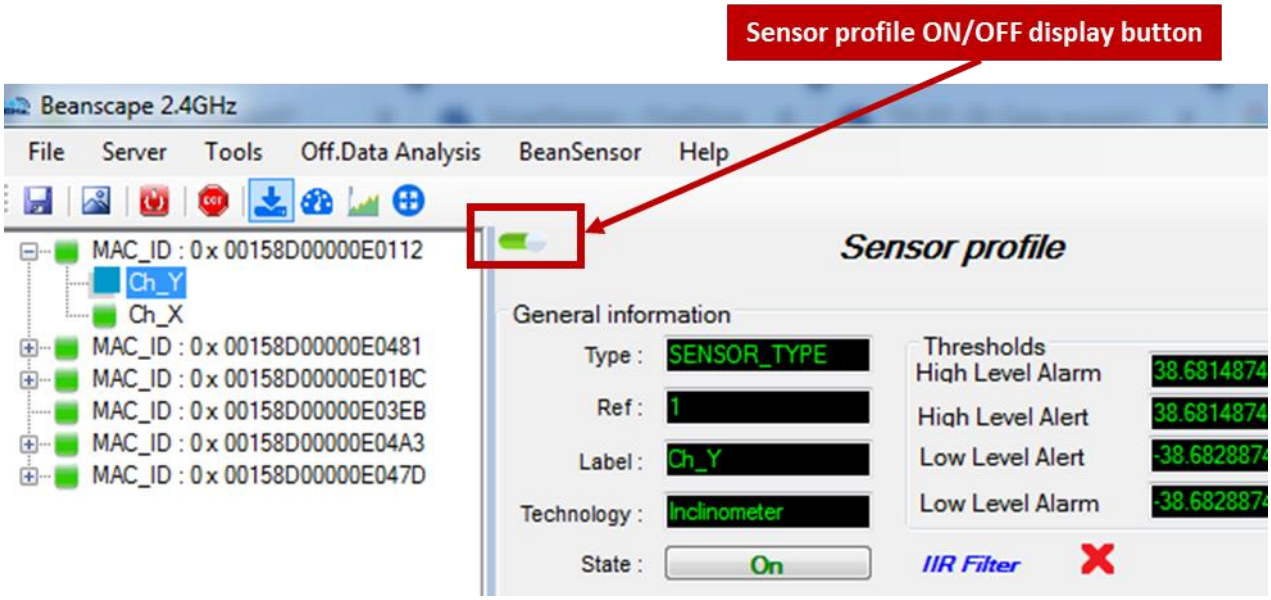


Figure 70: Sensor profile ON/OFF display button

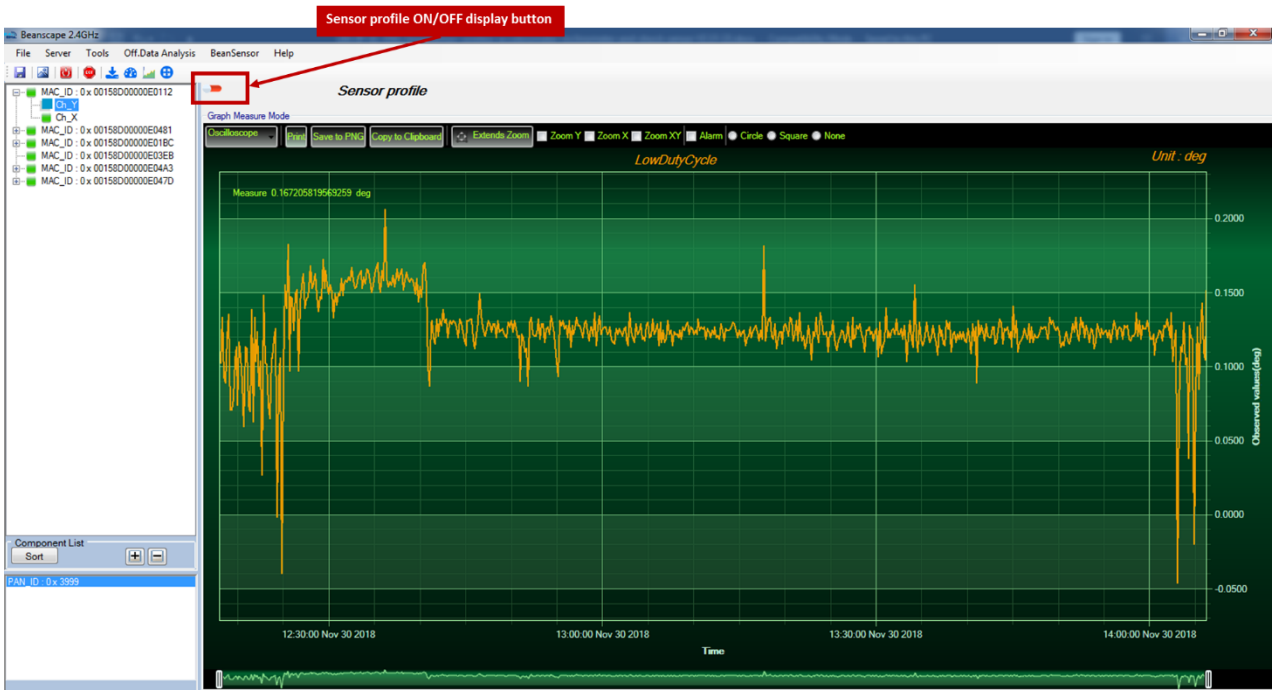


Figure 71: Wide view of the graph

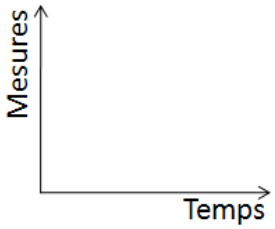
The chart is composed of two parts:

- ***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® data acquisition mode and the last data acquisition can be visualized directly from the graph.

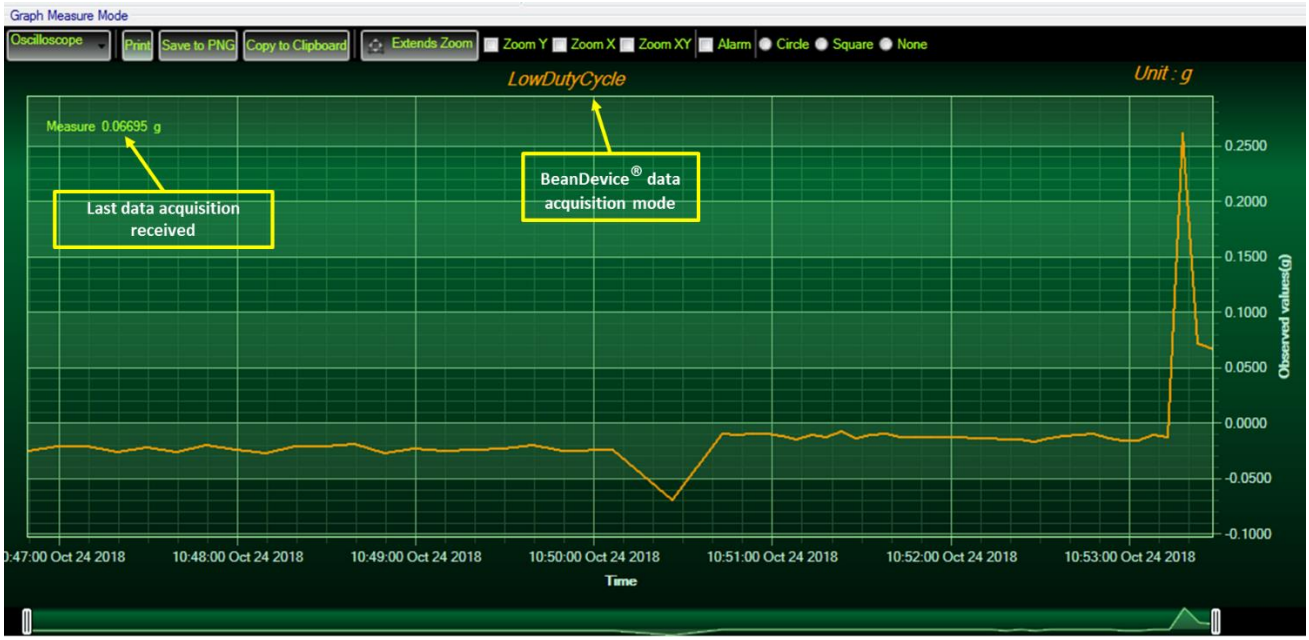


Figure 72: Example: Graph visualization

7.4.3.1 Frame: Display

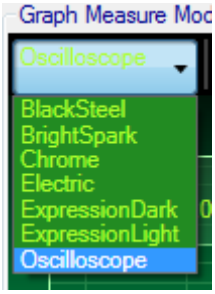
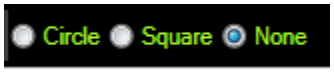


Figure 73: Graph measure mode: Frame Display

7.4.3.2 Frame: Marks

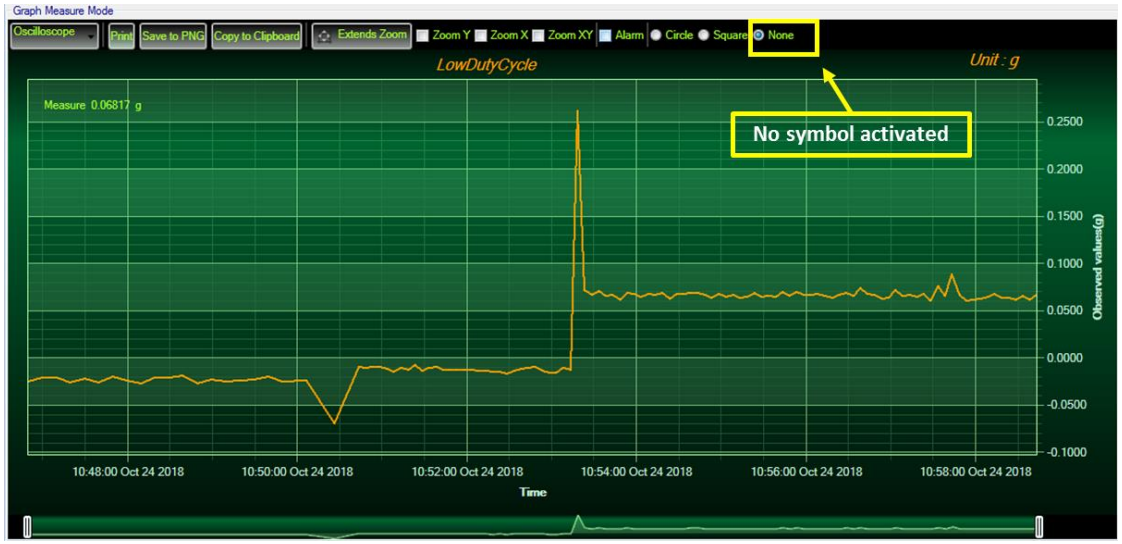
From this frame you can select the display mode of action of the chart. Three types of symbols are available:



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



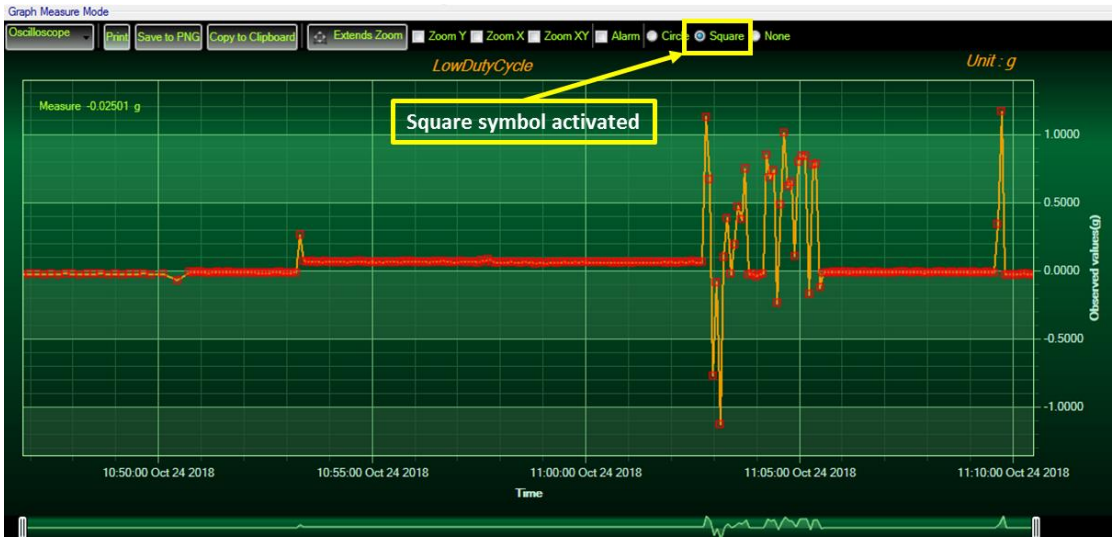


Figure 74: Graph measure mode: Frame Marks

7.4.3.3 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:

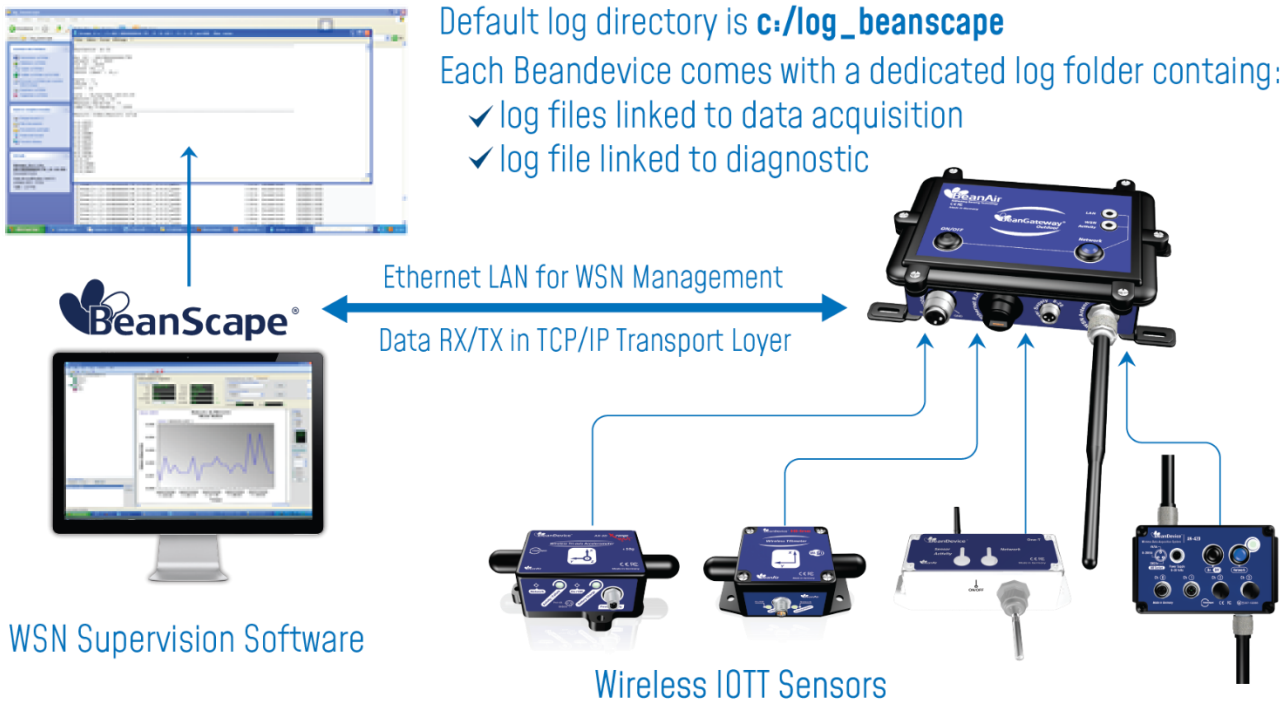
- ***Case 1***: Case "Zoom X" ticked. The graph zoom will only affect the X axis.
- ***Case 2***: Case "Zoom Y" ticked. The graph zoom will only affect the Y axis.
- ***Case 3***: Case "Zoom XY" ticked." Zoom will affect both X and Y axes
- ***Case 4***: Case "Zoom X ", "Zoom XY "and "Zoom Y " not ticked.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

7.5 DATALOGGER CONFIGURATION

Please read the technical note TN_RF_007 – "BeanDevice® datalogger User Guide "

7.6 OPTIONS FOR LOG FILE GENERATION & FOLDER ORGANIZATION

7.6.1 Log file system overview



7.6.2 Log file directory

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

Click on the tab Tools then Options to configure advanced settings in ***BeanScape®***:

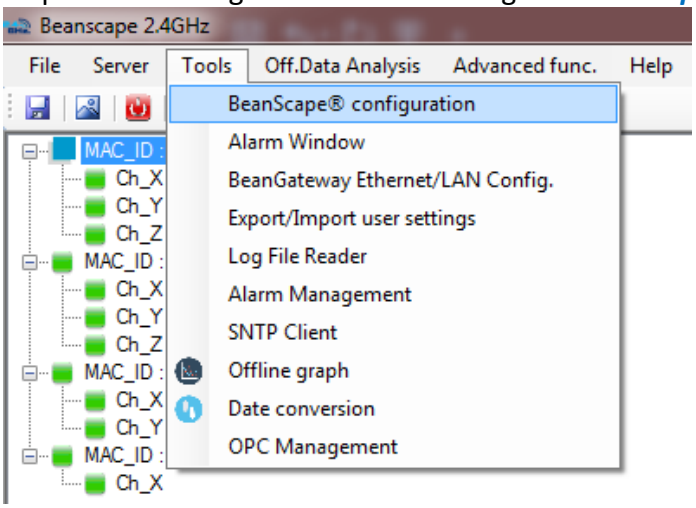


Figure 75: BeanScape® configuration menu

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

- ✓ A second window is displayed:

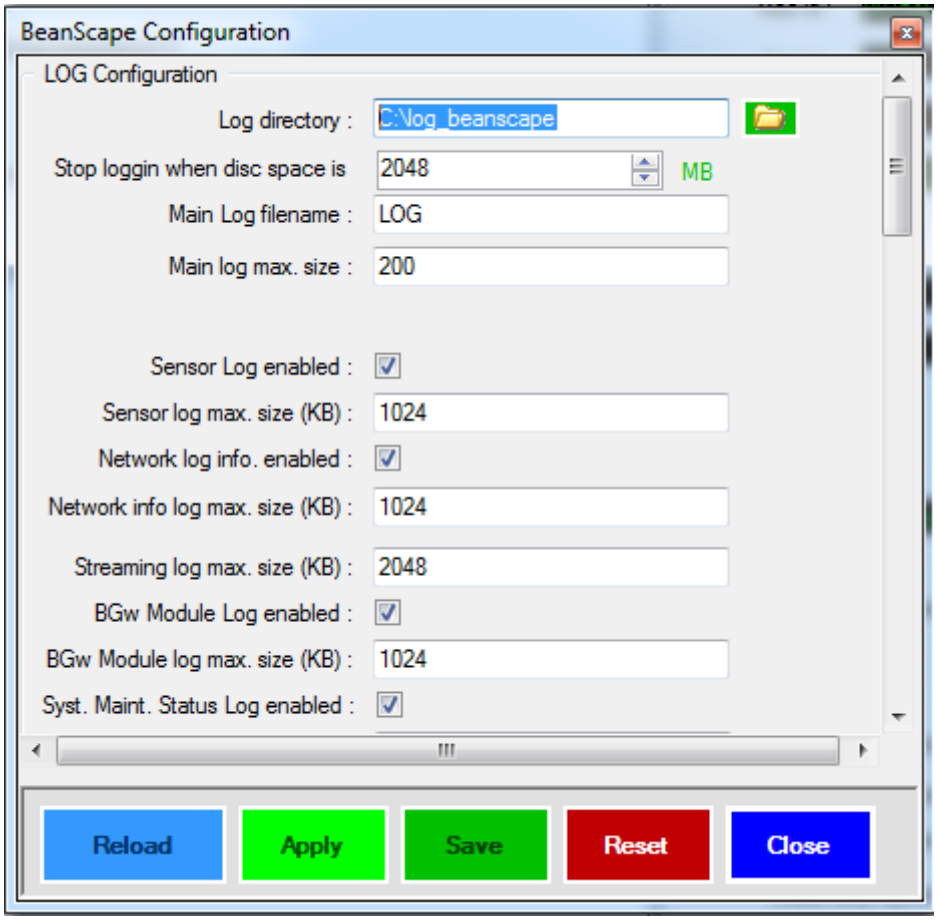


Figure 76: BeanScape® configuration window

- ✓ Clicking the button 

reverts back to its original configuration.

7.6.3 Log folder

By Default log files linked to the ***BeanDevice®*** 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®** profile:

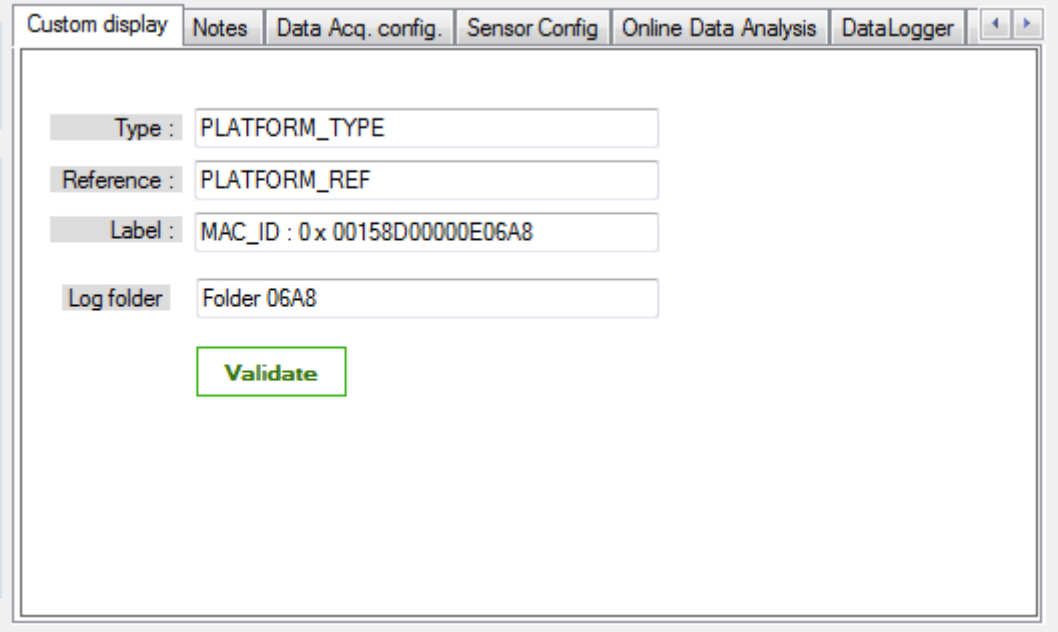
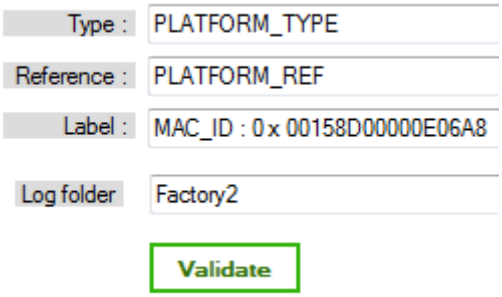


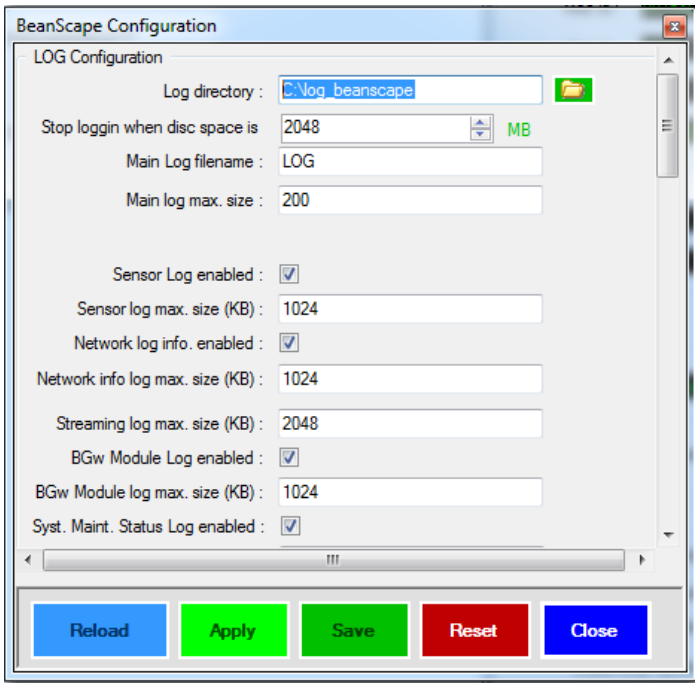
Figure 77: BeanDevice® Custom Display tab

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

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



7.6.4 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 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)

7.6.5 All sensor channels in one log file

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®.

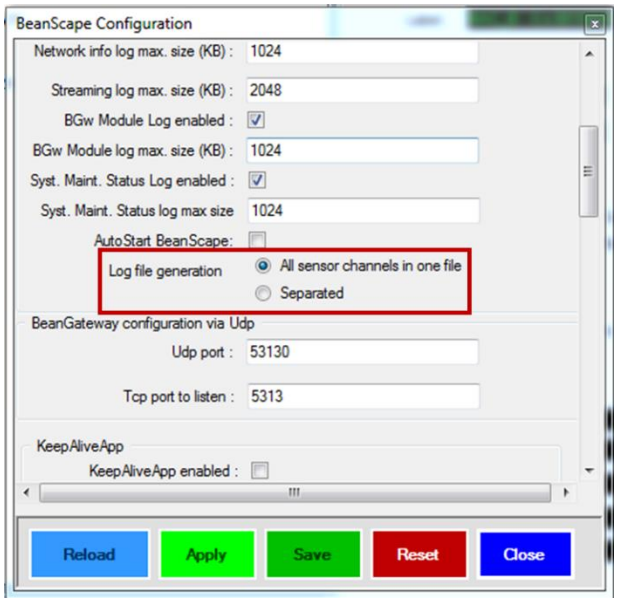


Figure 78: Log file generation options

- You should have all channels data recorded in one single file located in your C:\log_beanscape directory

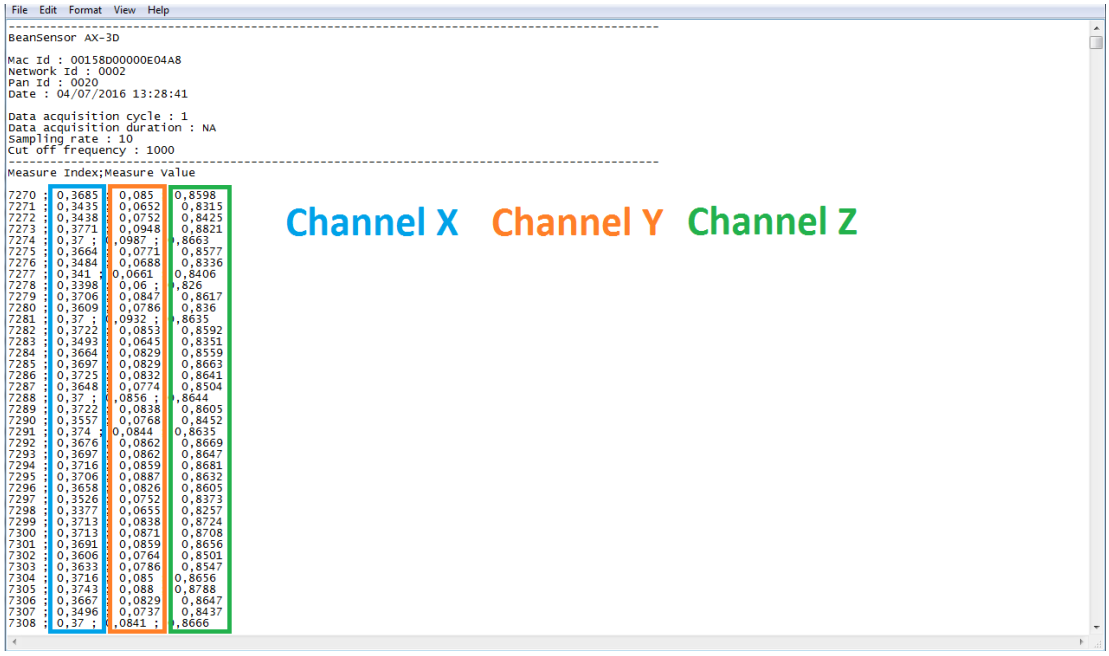


Figure 79: Example of Log file

7.6.6 Cache Data configuration (for Graph)

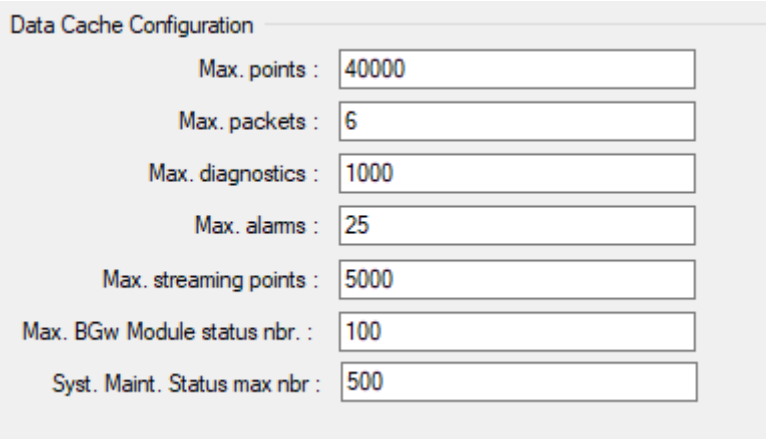


Figure 80: Data cache configuration options

- ✓ ***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 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.

7.6.7 Data acquisition Log file

7.6.7.1 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:

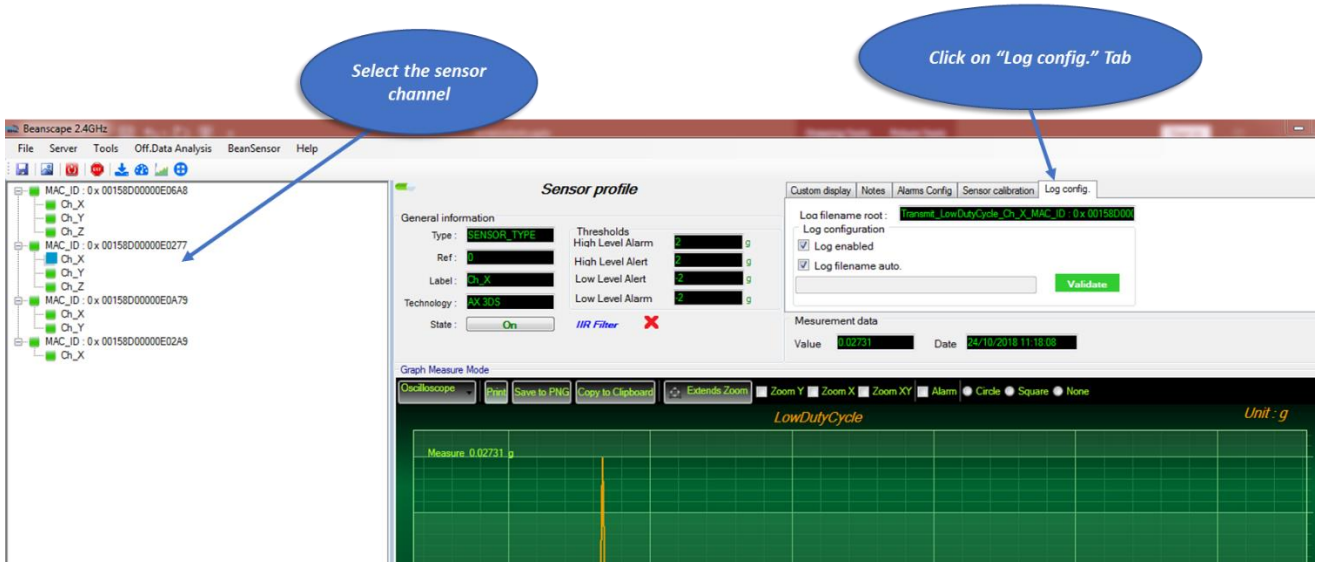


Figure 81: Overview: Log Config tab on BeanScape®

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

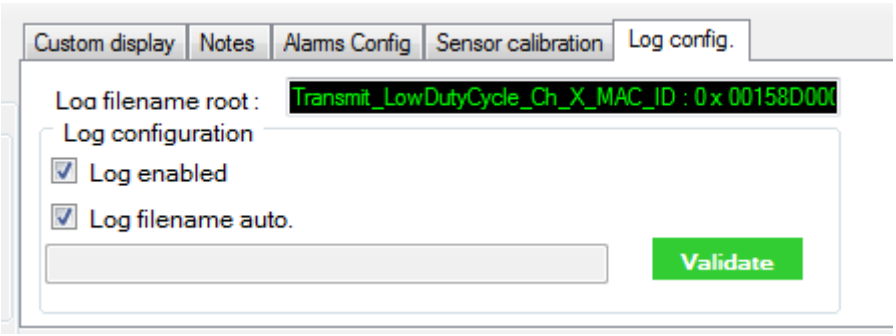


Figure 82: Log config tab

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***

7.6.7.2 Specific case: log filename creation in "Streaming" mode

In streaming mode, log filename is built as follow (separated channels):

Transmit_Streaming_Sensor_channel_MAC_ID_DATE

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

Example:

Transmit_Streaming_Ch_X_MAC_ID__0_x_00158D00000E06A8_2018-10-24_11-42-31.txt	24/10/2018 11:45	1 Ko
Transmit_Streaming_Ch_Y_MAC_ID__0_x_00158D00000E06A8_2018-10-24_11-42-31.txt	24/10/2018 11:45	1 Ko
Transmit_Streaming_Ch_Z_MAC_ID__0_x_00158D00000E06A8_2018-10-24_11-42-31.txt	24/10/2018 11:45	1 Ko
Transmit_Streaming_Ch_X_MAC_ID__0_x_00158D00000E06A8_2018-10-24_11-45-14.txt	24/10/2018 11:47	192 Ko
Transmit_Streaming_Ch_Y_MAC_ID__0_x_00158D00000E06A8_2018-10-24_11-45-14.txt	24/10/2018 11:47	185 Ko
Transmit_Streaming_Ch_Z_MAC_ID__0_x_00158D00000E06A8_2018-10-24_11-45-14.txt	24/10/2018 11:47	181 Ko

In streaming mode, log filename is built as follow (all channels in one file):

Transmit_Streaming_Sensor_channel_MAC_ID_DATE_**PART**

- ✓ ***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_MacId_00158D00000E06A8_24_10_2018_11_42_31_part1.txt	24/10/2018 11:44	2,064 Ko
Transmit_Streaming_MacId_00158D00000E06A8_24_10_2018_11_42_31_part2.txt	24/10/2018 11:44	174 Ko

7.6.7.3 Log file analysis

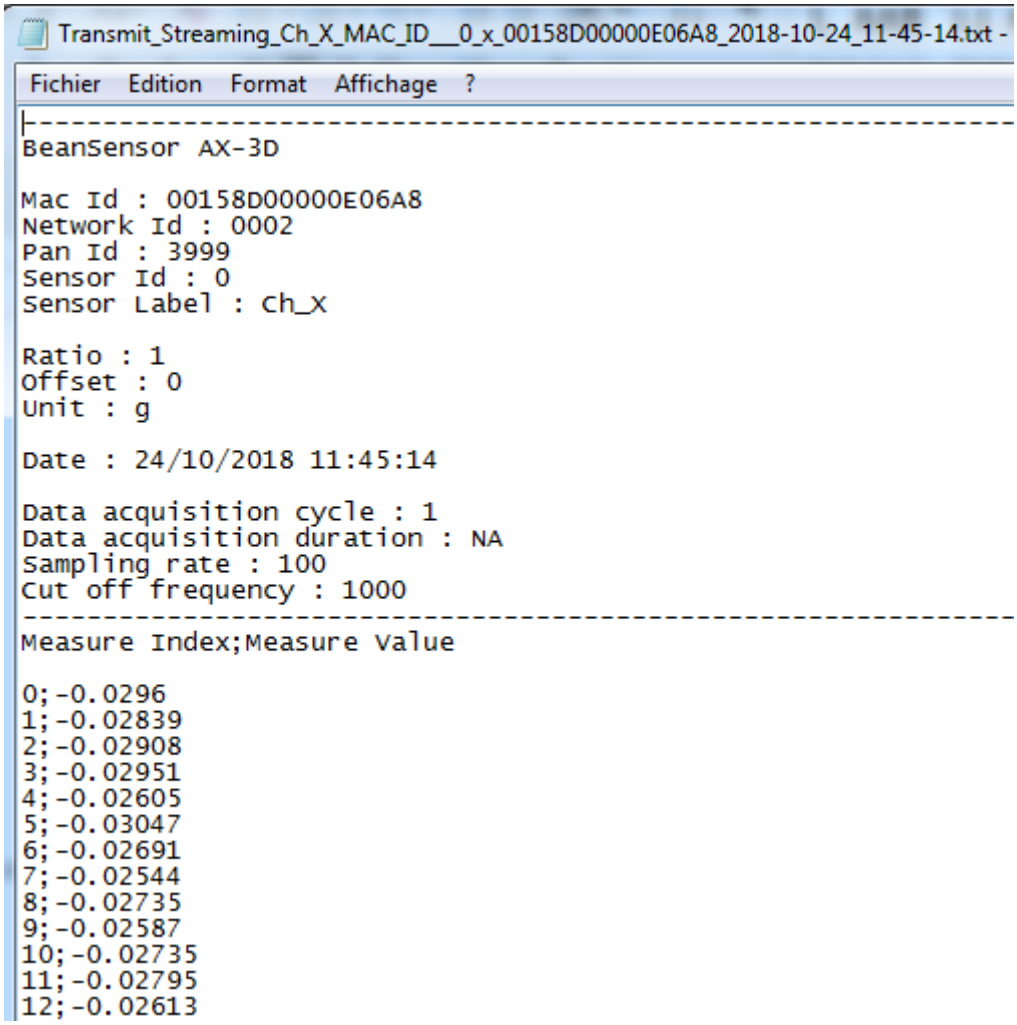


Figure 83: Log file example (Streaming mode)

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.

7.6.8 Log file related to Wireless Network diagnostic

7.6.8.1 Log filename organization

Wireless Diagnostic log filename is built as follow:

MAC_ID_WirelessNetwkInfo

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

7.6.8.2 Log file analysis

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

- ***Date*** : diagnostic date
- ***LQI TX***: Link quality indicator on the BeanDevice® side
- ***LQI RX***: Link quality indicator on the BeanGateway® side
- ***Local PER TX***: Local Packet Error Rate on the BeanDevice® side
- ***Local PER Rx***: Local Packet Error Rate on the BeanGateway® side
- ***Global PER***: N.A.
- ***Battery voltage***: internal battery voltage
- ***Battery level***: battery level of charge
- ***Internal temperature***: Local temperature of the BeanDevice®

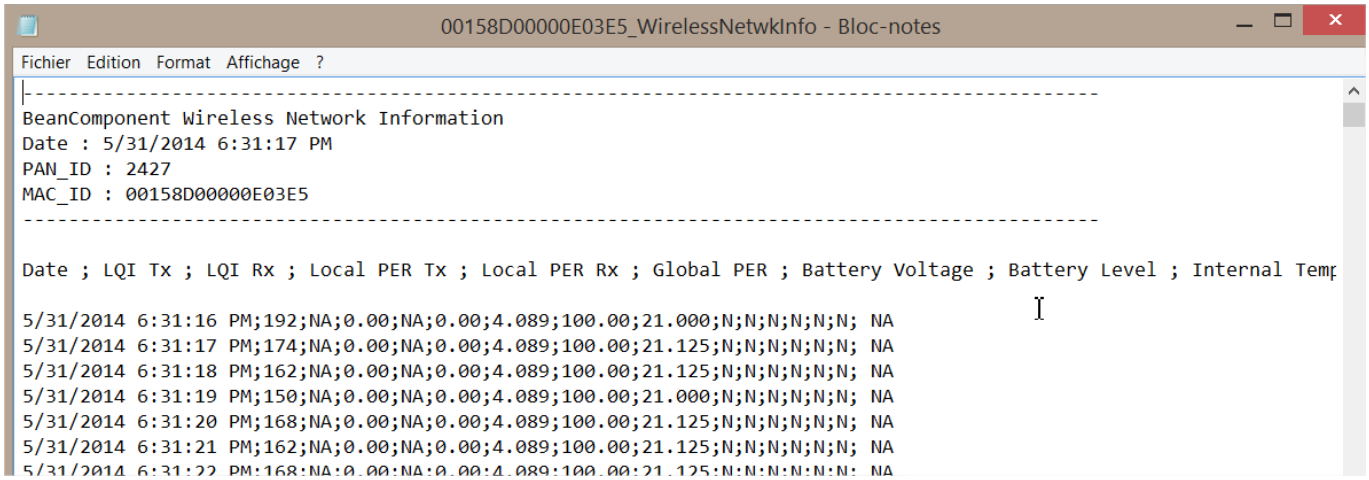


Figure 84: Wireless Network Info log file

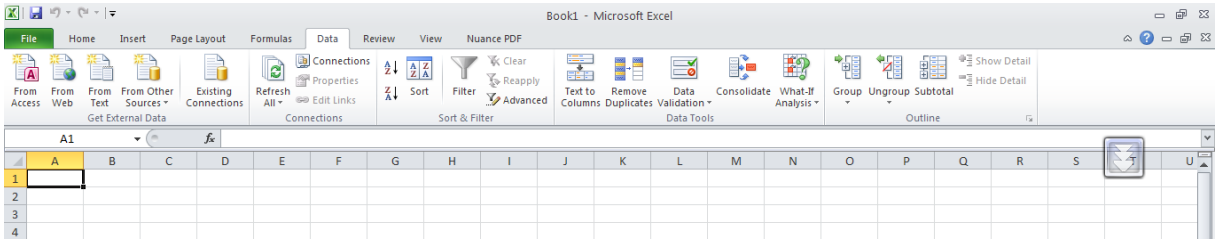
If the BeanDevice® is configured with the streaming data acquisition mode, the following diagnostic information are not refreshed:

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

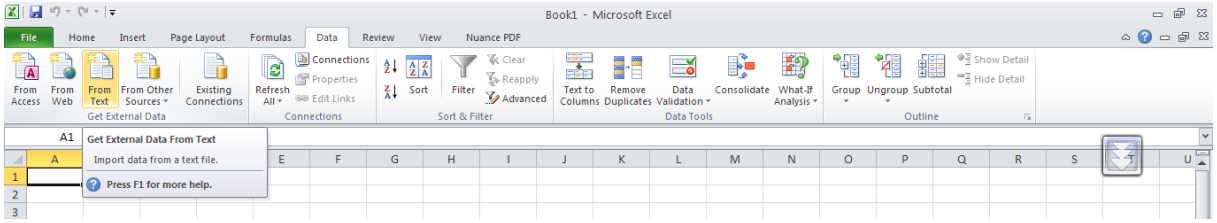
```
Fichier  Edition  Format  Affichage  ?
--------------------------------------------------------------------------------------------
BeanComponent Wireless Network Information
Date : 5/15/2014 4:50:44 PM
PAN_ID : 31BB
MAC_ID : 00158D00000AD564
--------------------------------------------------------------------------------------------

Date ; LQI Tx ; LQI Rx ; Local PER Tx ; Local PER Rx ; Global PER ; Battery Voltage ; Battery Level ; Internal Temperature

5/15/2014 4:50:43 PM;174;NA;0.00;NA;0.00;4.094;0.00;24.625;N;N;N;N;N;N; NA
15/05/2014 16:50:45.0000000;168;;0.00;;;;;;;;;;;;
15/05/2014 16:50:45.1500000;180;;0.00;;;;;;;;;;;;
15/05/2014 16:50:45.3000000;162;;0.00;;;;;;;;;;;;
15/05/2014 16:50:45.4500000;168;;0.00;;;;;;;;;;;;
15/05/2014 16:50:45.6000000;174;;0.00;;;;;;;;;;;;
15/05/2014 16:50:45.7500000;186;;0.00;;;;;;;;;;;;
15/05/2014 16:50:45.9000000;138;;0.00;;;;;;;;;;;;
15/05/2014 16:50:46.0500000;144;;0.00;;;;;;;;;;;;
```

7.6.8.3 How to open a measurement file with excel

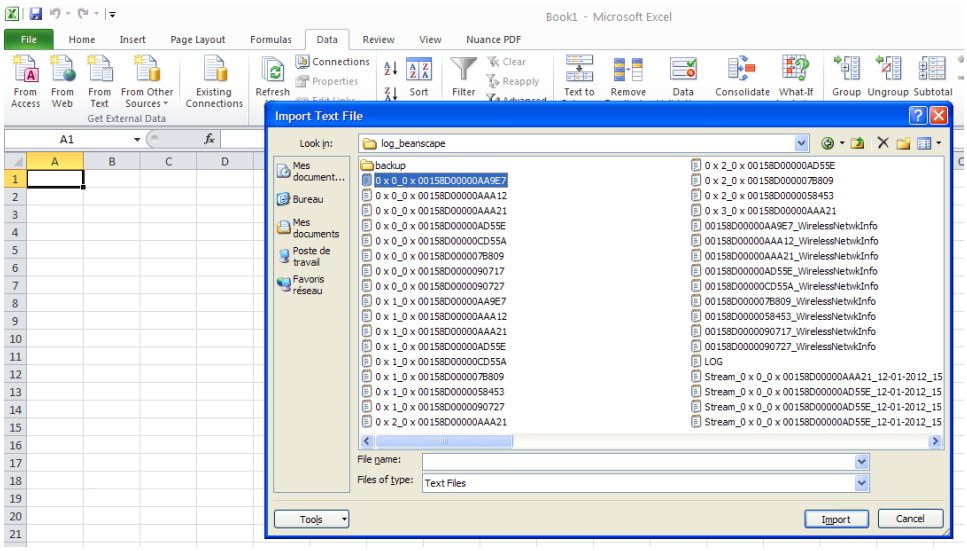
Step 1 : Open Excel



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

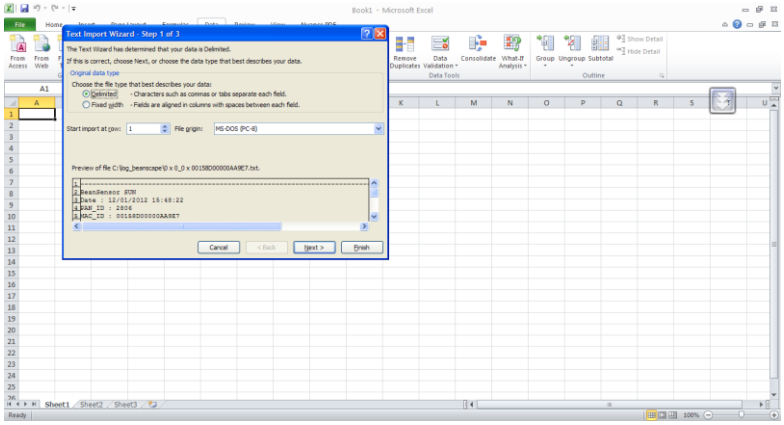


Step 3 : Choose your log file

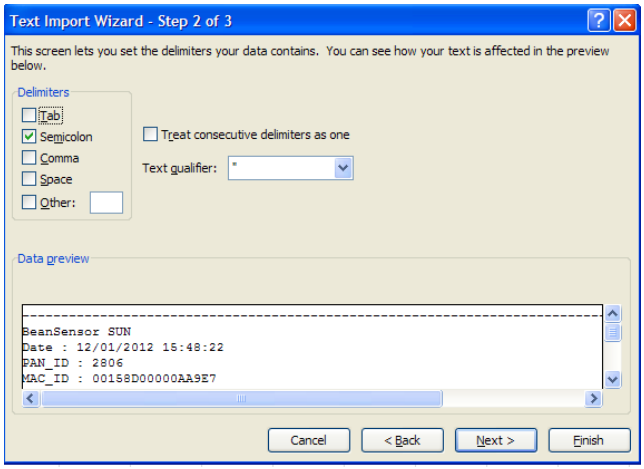


Step 4 : Text import wizard will open, select « Delimited » for Characters such as commas or tabs separate each field.

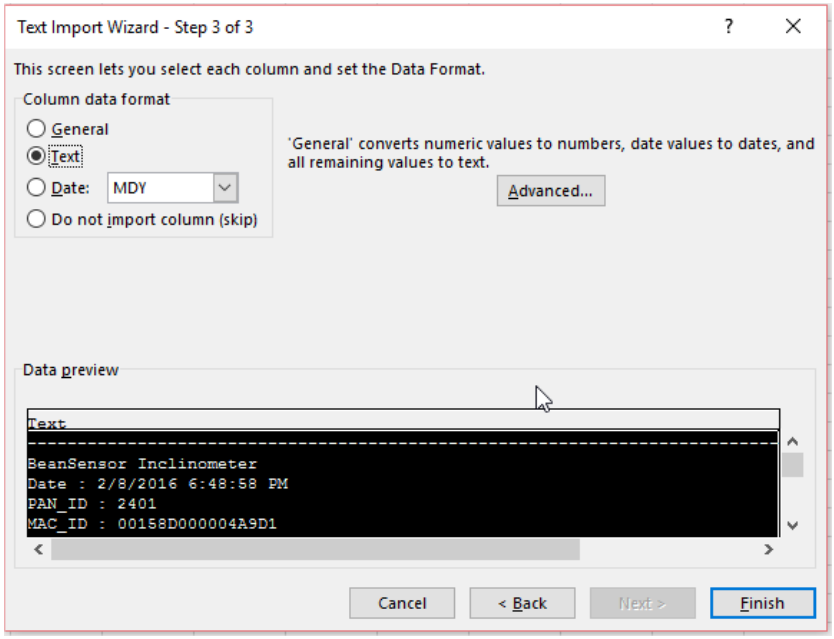
On "***Start import at row***" field: Select the number of lines that you want to suppress from the header:



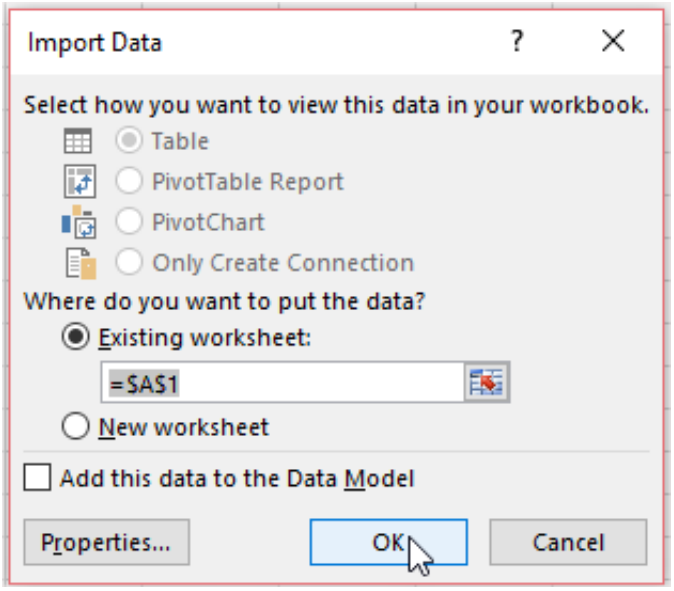
Select semicolon



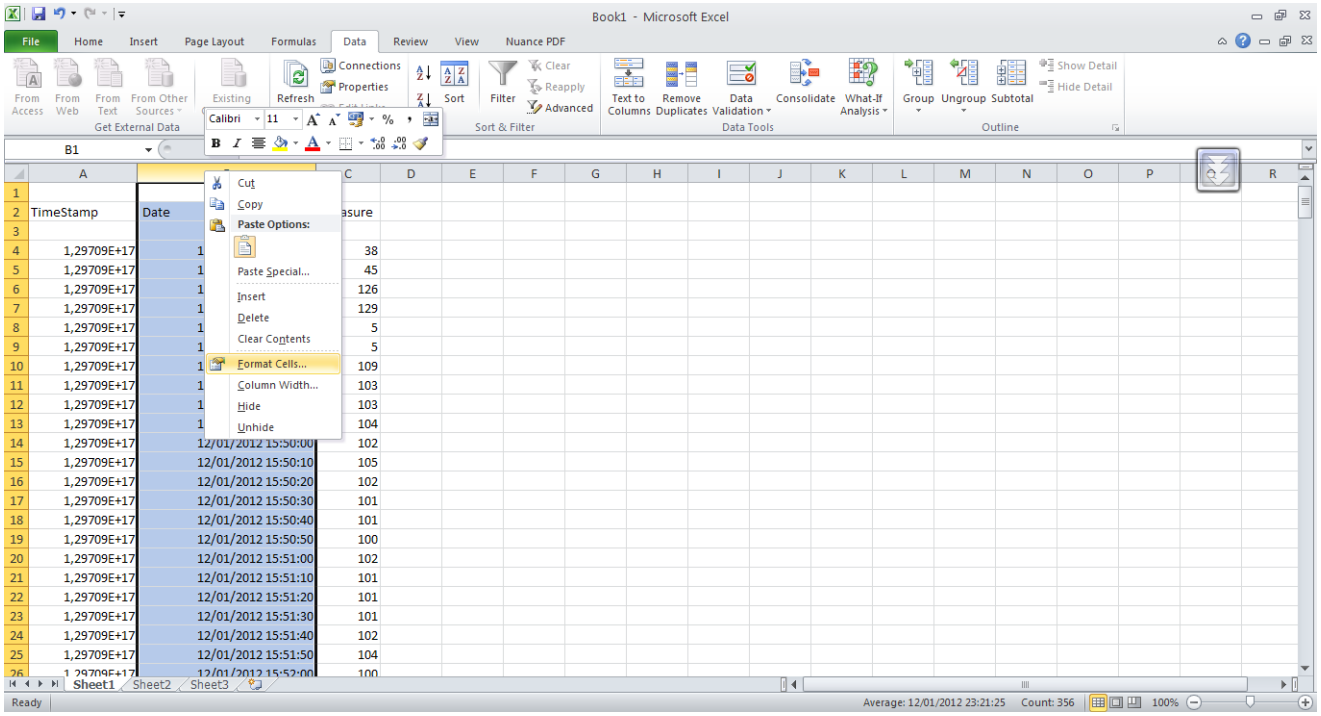
Select Text



Click on OK



Click on format cells:



See “Exporting a log file to Excel” Youtube video

8. ALARM MANAGEMENT

8.1 DAQ ALARM

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

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

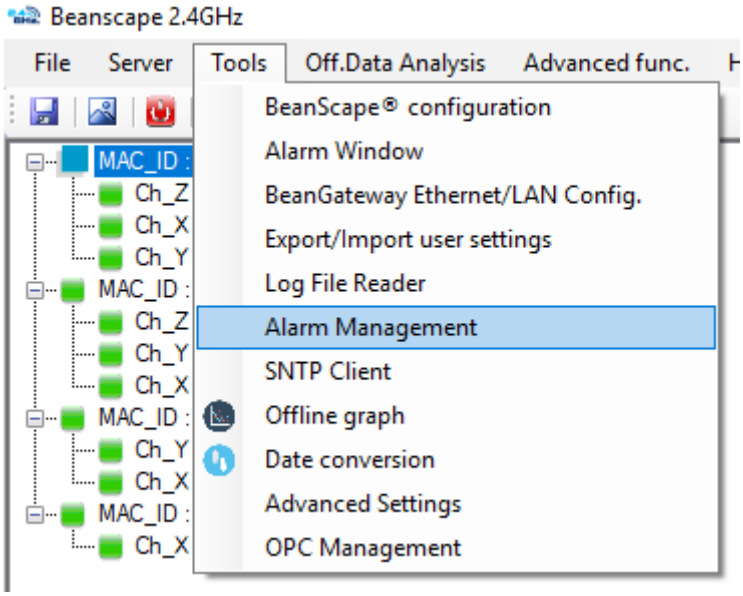
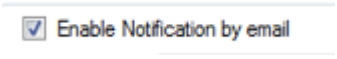


Figure 85: Alarm management menu

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

Check on **Enable Notification by email**: 

and fill out the parameters described below:

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

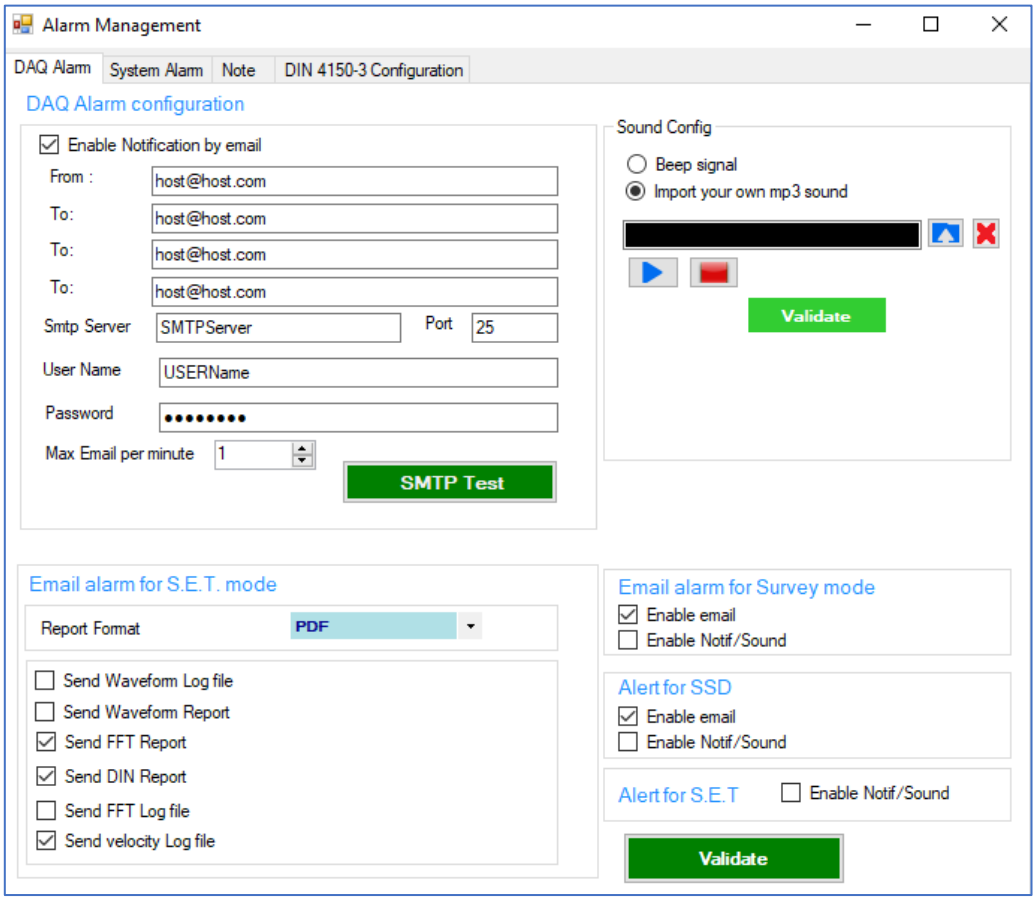


Figure 86: Alarm management window

On the **Email alarm for S.E.T mode** panel, you can select Report format (word, PDF, png) and the specific Report/File related to the S.E.T mode to be sent via email.

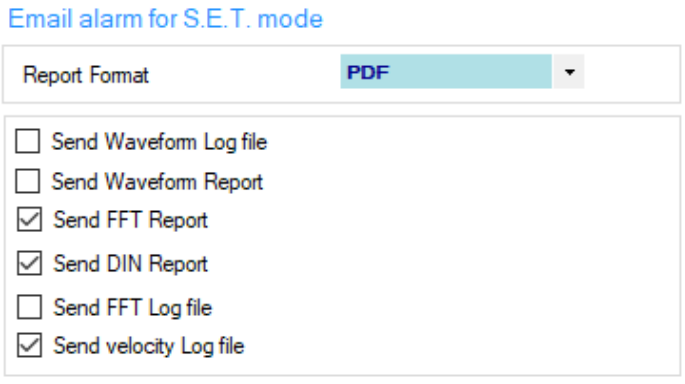


Figure 87: Frame: Email alarm for S.E.T mode

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

See « Alarm by email » Youtube video

See «S.E.T mode for 2.4GHz» Youtube video

If a threshold is reached, it is possible to have audio alarm on your PC, it is also possible to import your own MP3 sound.

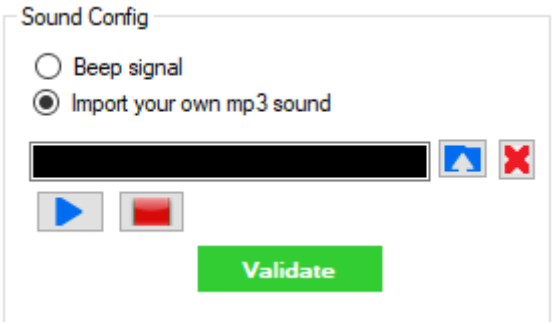


Figure 88: Frame: Soud config

To enable email notification for survey mode and Smart Shock Detection, check Enable email, for Audio notification on PC check Enable Notif/Sound

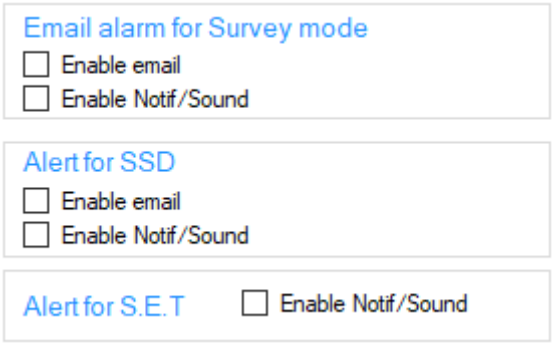


Figure 89: Email alarm for Survey mode and Alert for Shock detection

To Test your Configuration, you can send a test email by clicking on SMTP Test, if everything is ok and you received your email then Validate and close the window.

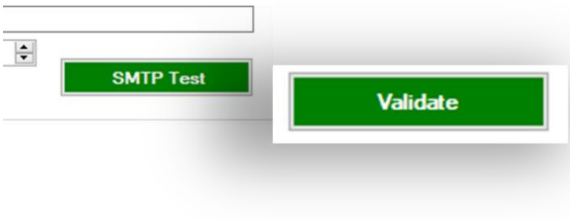


Figure 90: Alarm Mailing SMTP Test

8.2 SYSTEM ALARM

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

- **Internal temperature**: email notification if the internal temperature reached the pre-defined levels.
- **Battery level**: email notification if the battery level reached the pre-defined minimum and maximum voltages.
- **Packer error rate**: email notification if the PER reaches the pre-defined levels
- **Link quality indicator**: email notification when the LQI reaches the pre-defined levels

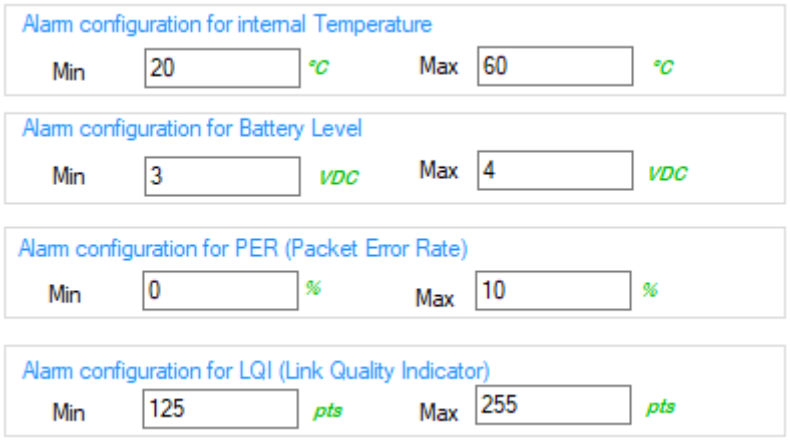


Figure 91: System Alarm Settings

From System Alarm, user can receive Alert for Datalogger by enabling Notification or Emails, also receiving Alert for Diagnostic.

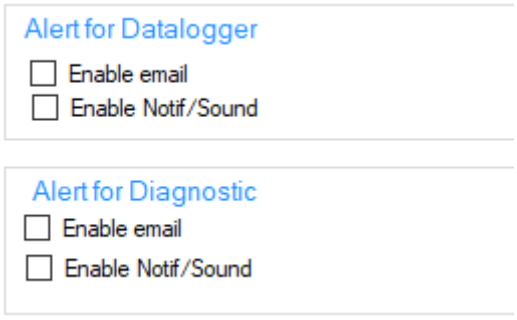


Figure 92: Enable/Disable Notif/mail for Diagnostic and Datalogger

8.3 NOTE

In this area user can upload a logo and other textual information related to monitoring site:

- **User Name**
- **Monitoring Site**
- **Location**

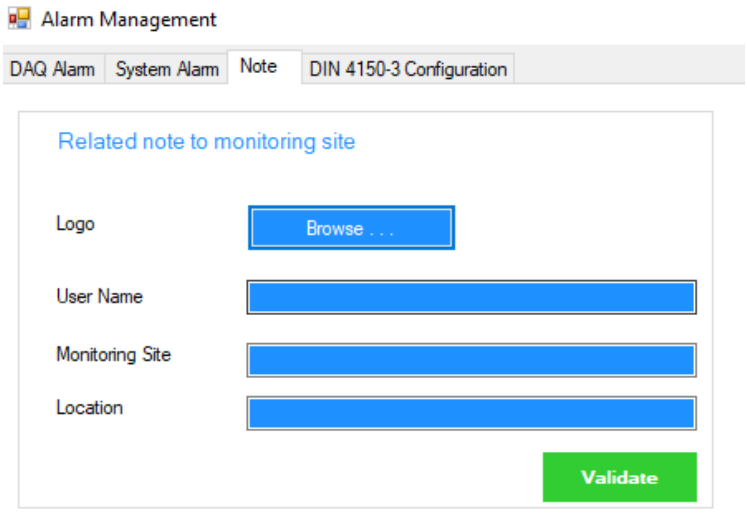


Figure 93: Alarm Note settings

8.4 DIN 4150-30 CONFIGURATION

Din 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.**

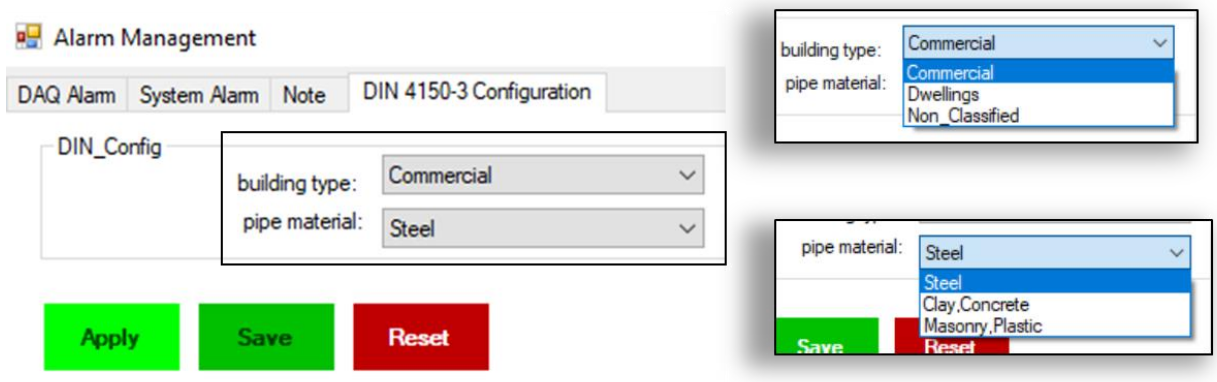


Figure 94: DIN 4150-3 Configuration

Ch_Z – Max Frequency: 0 hz , VPPV = 119.329442495219 mm/s , Max Amplitude = 0.688049814453125 g

	Ch_X	Ch_Y	Ch_Z
Building Type	*Commercial*	*Commercial*	*Commercial*
Pipeline Material	*Steel*	*Steel*	*Steel*
Velocity Average(mm/s)	*0.0031145223880597*	*0.00540280099502487*	*-0.00366334328358209*

Figure 95: Building type & Pipeline Material on the DIN Report

```
=====> No acceleration event occurred - Monit

-------------------------------------------
---------------------------- DIN Report ----
Building type = Dwellings
Pipeline Material = Masonry,Plastic
Velocity Average (mm/s) = -0.0007515524999999
```

Figure 96: Building type & Pipeline Material on the Velocity Log file

9. OFFLINE GRAPH

Offline Graph gives the ability to read previous measurements files, proceeding by browsing the files and then clicking on view.

Under the Tool menu on the BeanScape® software, select Offline Graph option, a new window will pop up, and will be ready to be used to display graphs from the saved measurements.

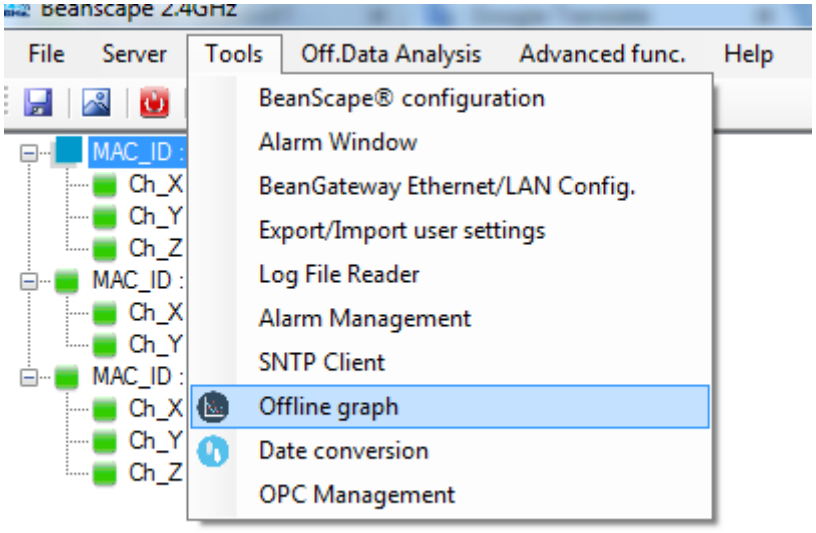


Figure 97: Offline graph menu on BeanScape®

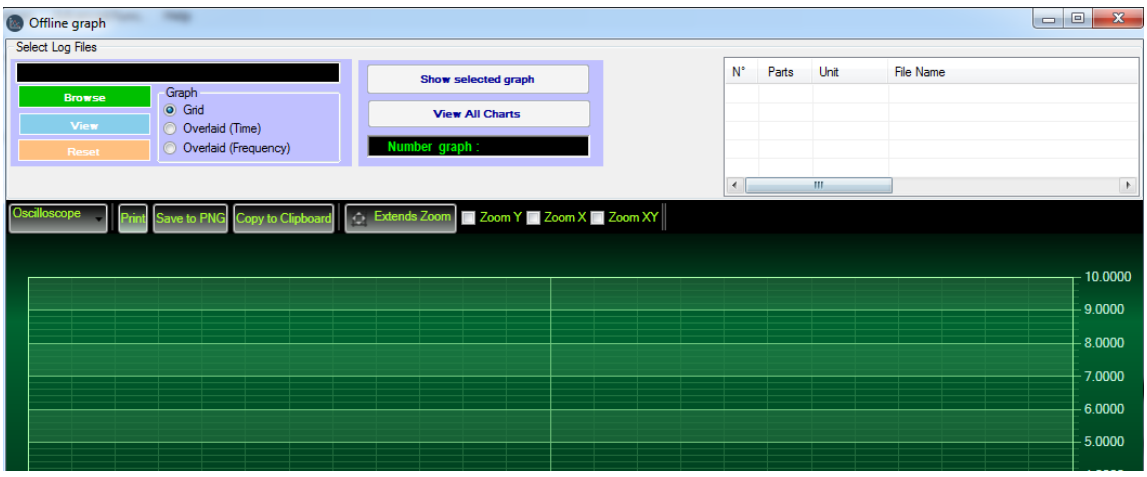


Figure 98: Offline graph window

- Chose Grid if you want to see the graphs displayed on a grid
- Chose overlaid if you want to see the graphs displayed overlaid (pick Time for temporal x axis or frequency for frequential x axis)

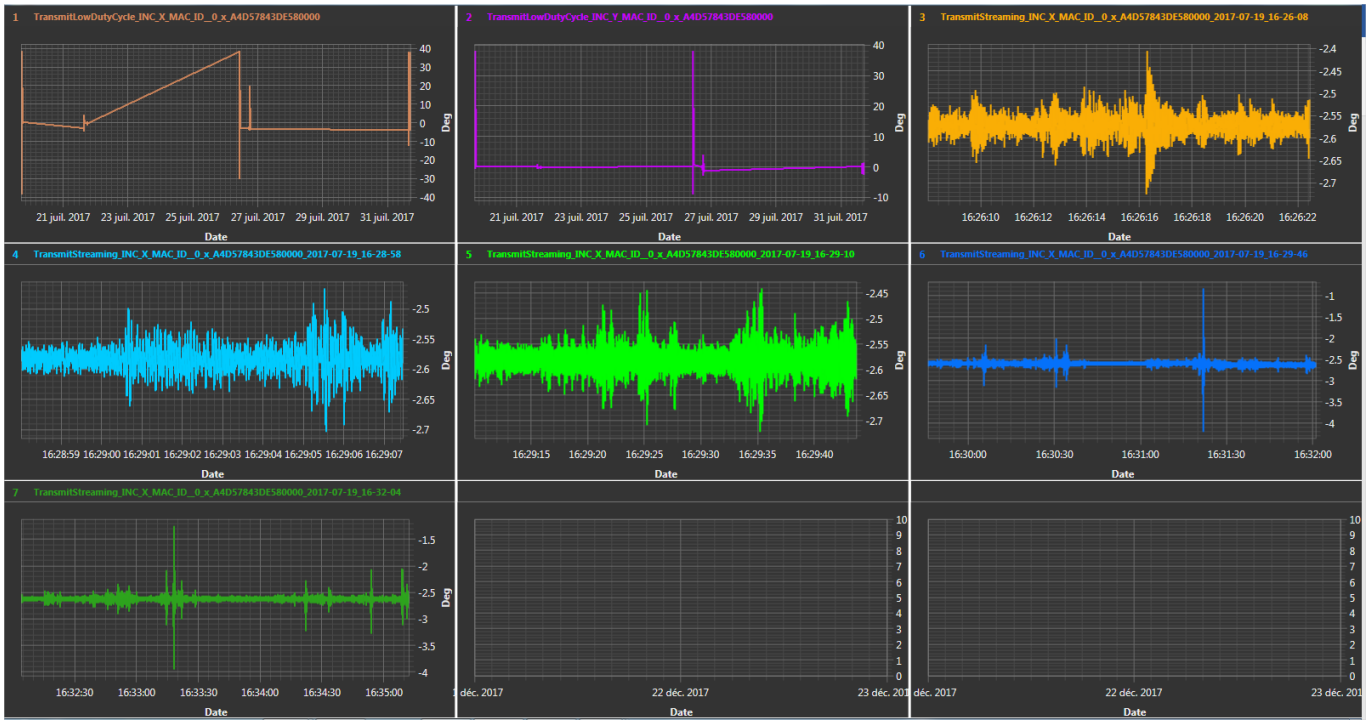


Figure 99: Grid display of graphs

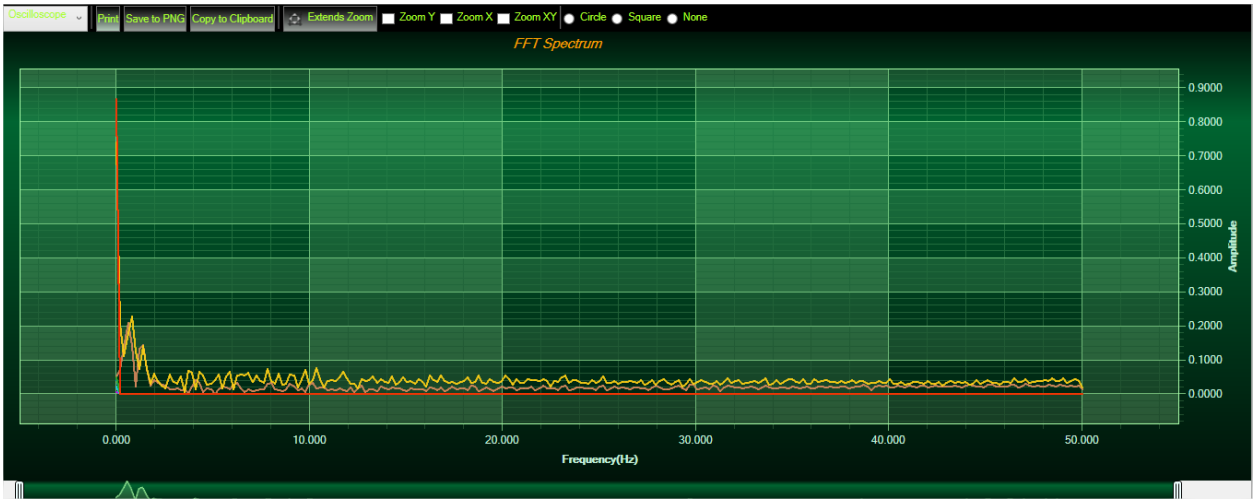


Figure 100: Overlaid (frequency)display of FFT graphs

10. DATE CONVERSION

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

To make these files more readable we use the Data Conversion tool.

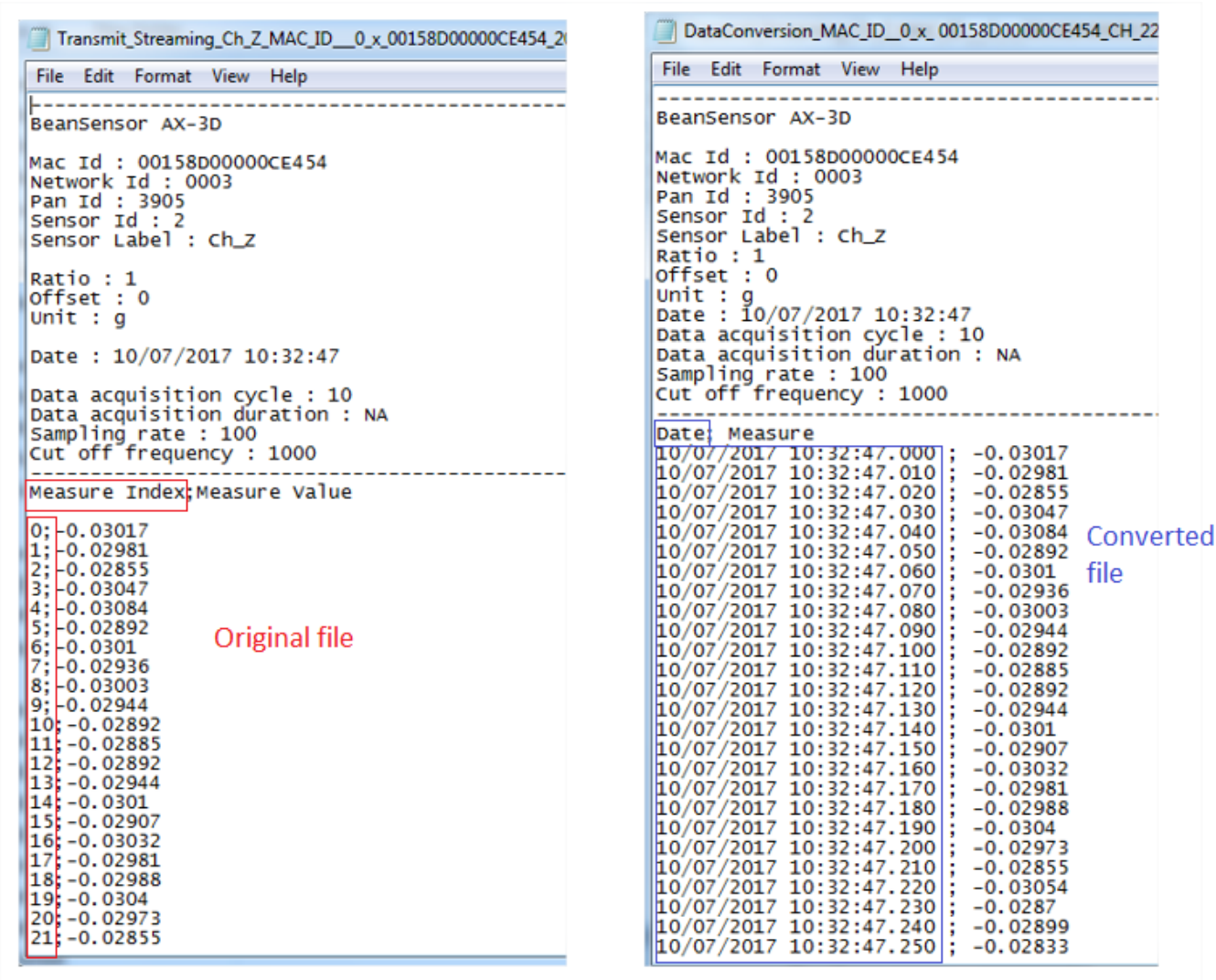


Figure 101: Data conversion example

Under the Tool menu on the BeanScape® software, select Data Conversion, a new window will pop up, where downloaded data can be converted.

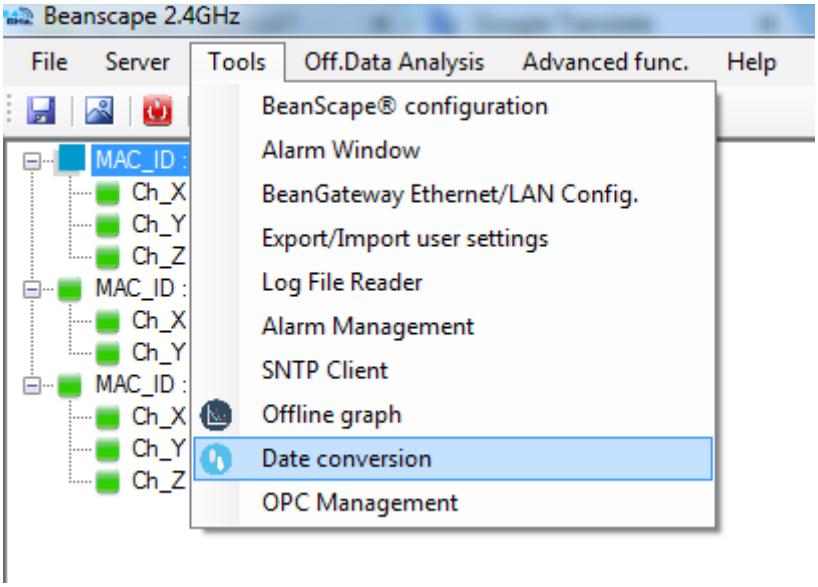


Figure 102: Data Conversion menu on BeanScape®

A new window will open:

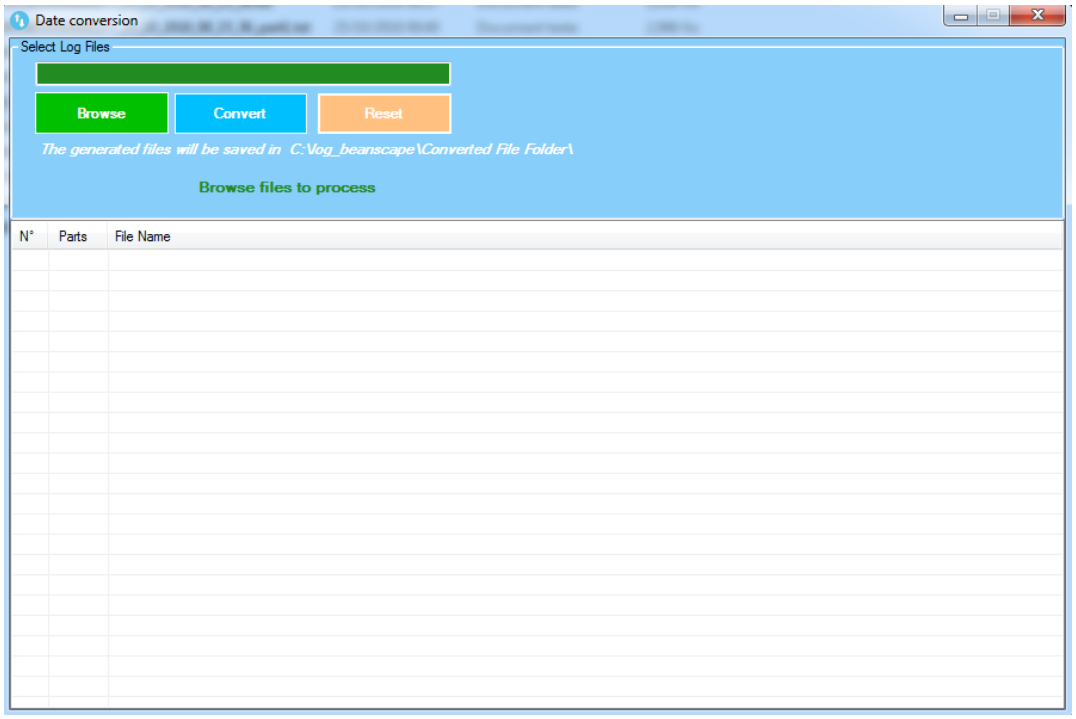


Figure 103:Data Conversion window

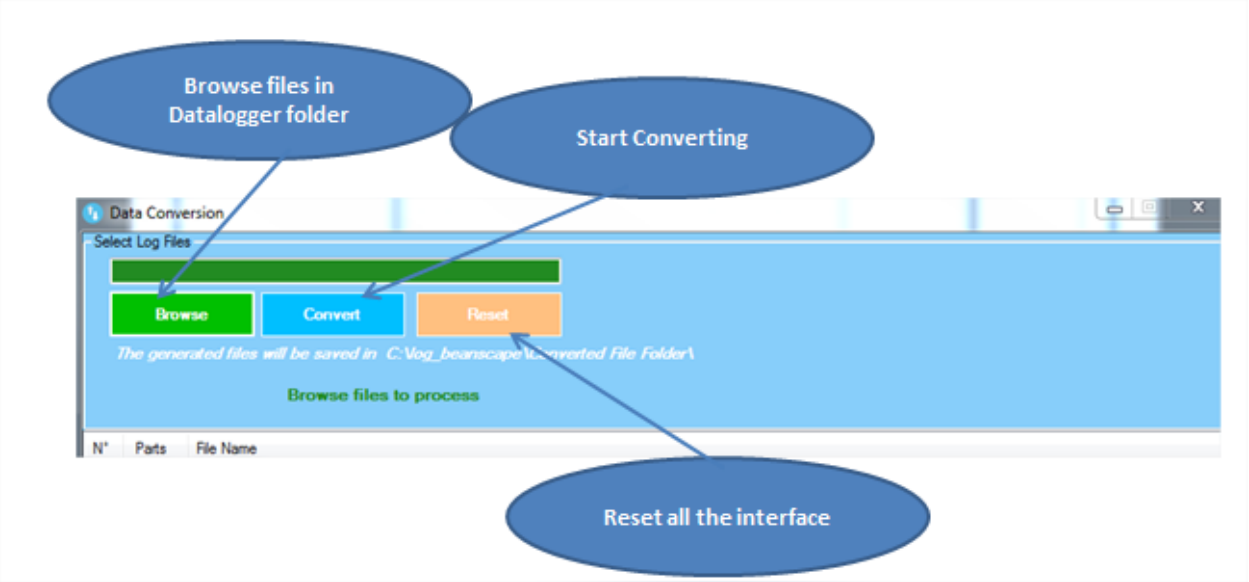


Figure 104: Data Conversion main options

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

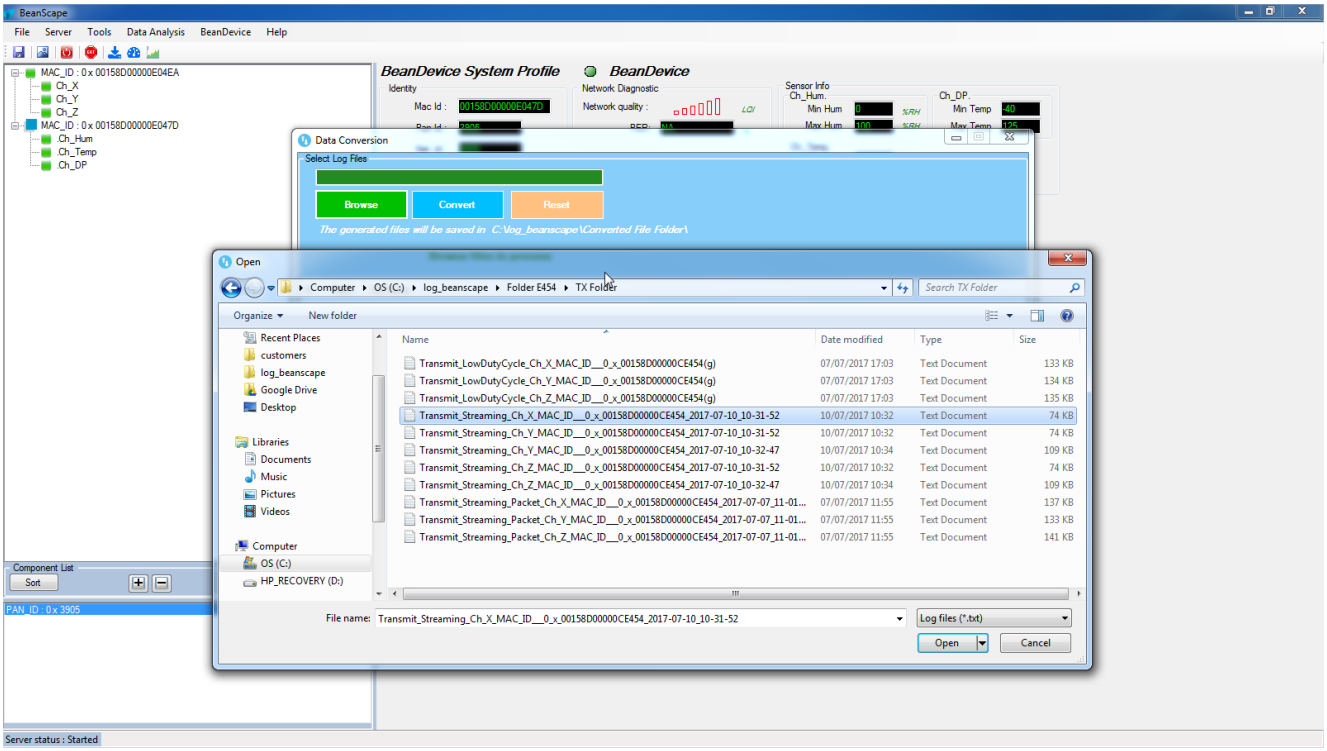


Figure 105: Importing files into Data Conversion tool

- Overview of the selected files

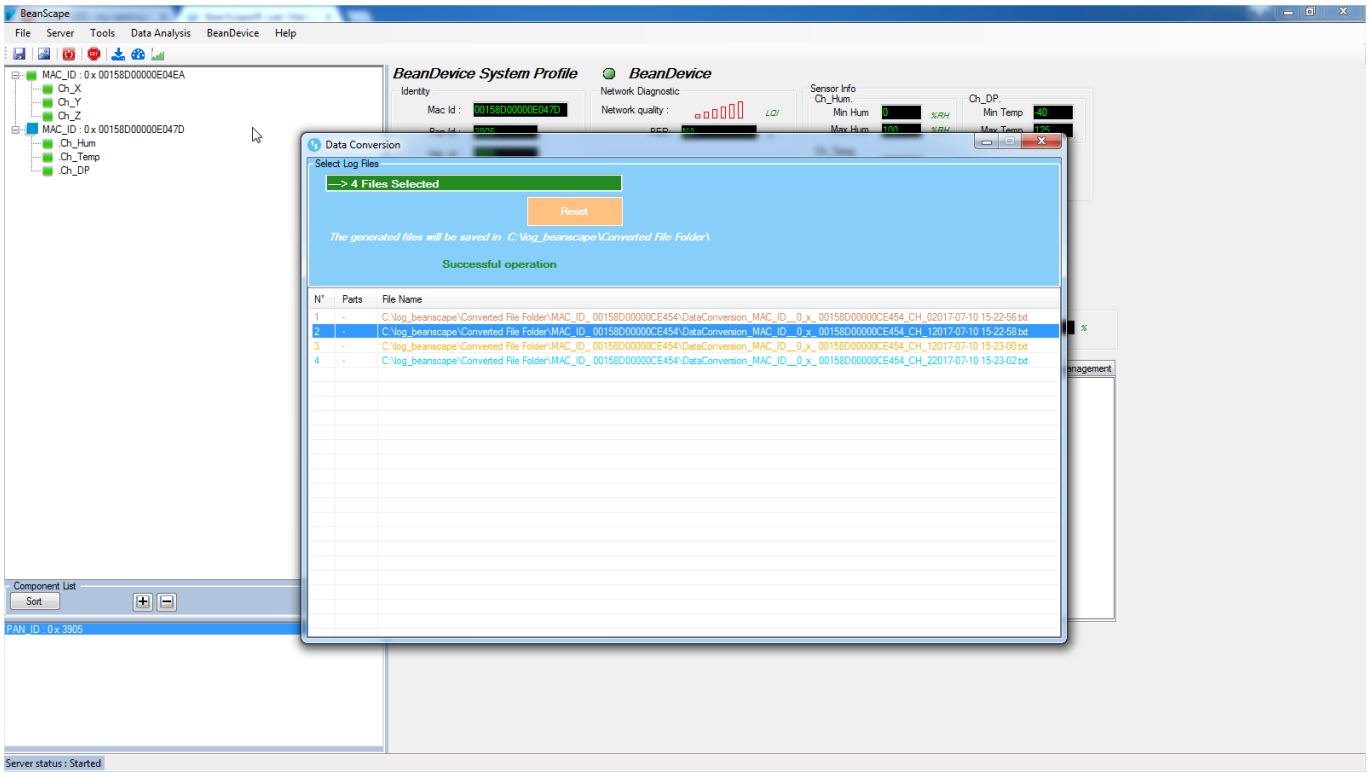


Figure 106: Overview of the selected files on Data Conversion window

- 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**

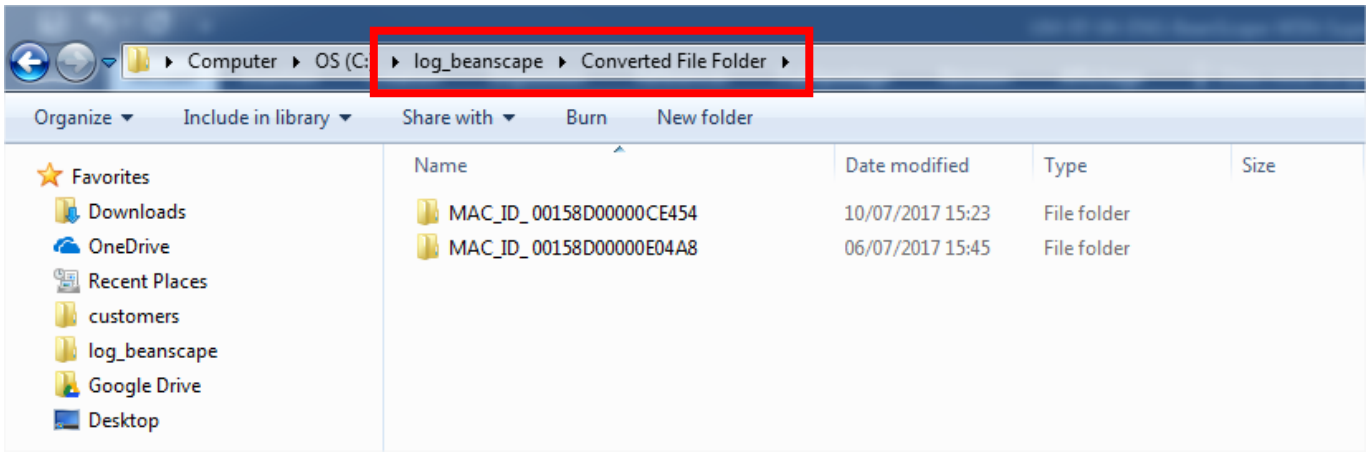


Figure 107: Overview: Converted File Folder

11. ONLINE AND OFFLINE DATA ANALYSIS TOOL

Online and offline analysis tool is only available on BeanDevice® AX-3D and BeanDevice® AX-3D Xrange

11.1 OFFLINE DATA ANALYSIS TOOL

11.1.1 FFT (Fast Fourier Transform) waveform analysis module

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.

11.1.1.1 FFT 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.

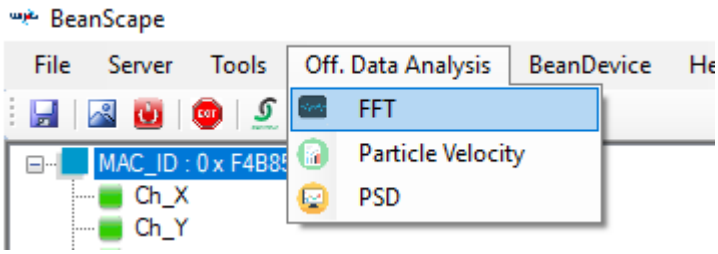


Figure 108: FFT offline data analysis on BeanScape® top menu

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

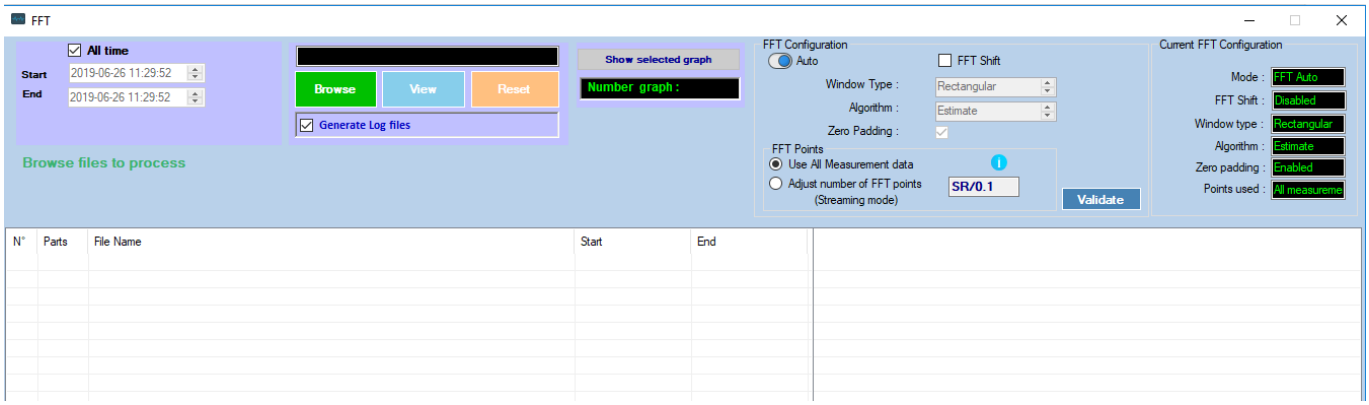


Figure 109: FFT tool window

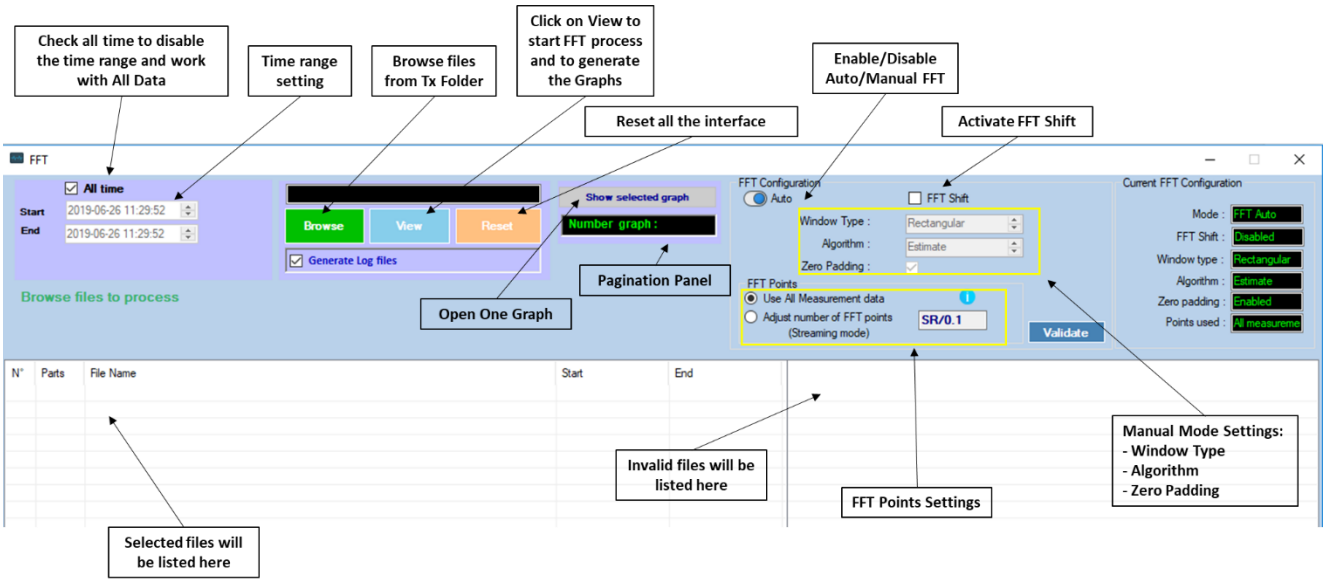


Figure 110:FFT tool options

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:

- Power spectral density and a new window displays

1: Click on Browse to choose files

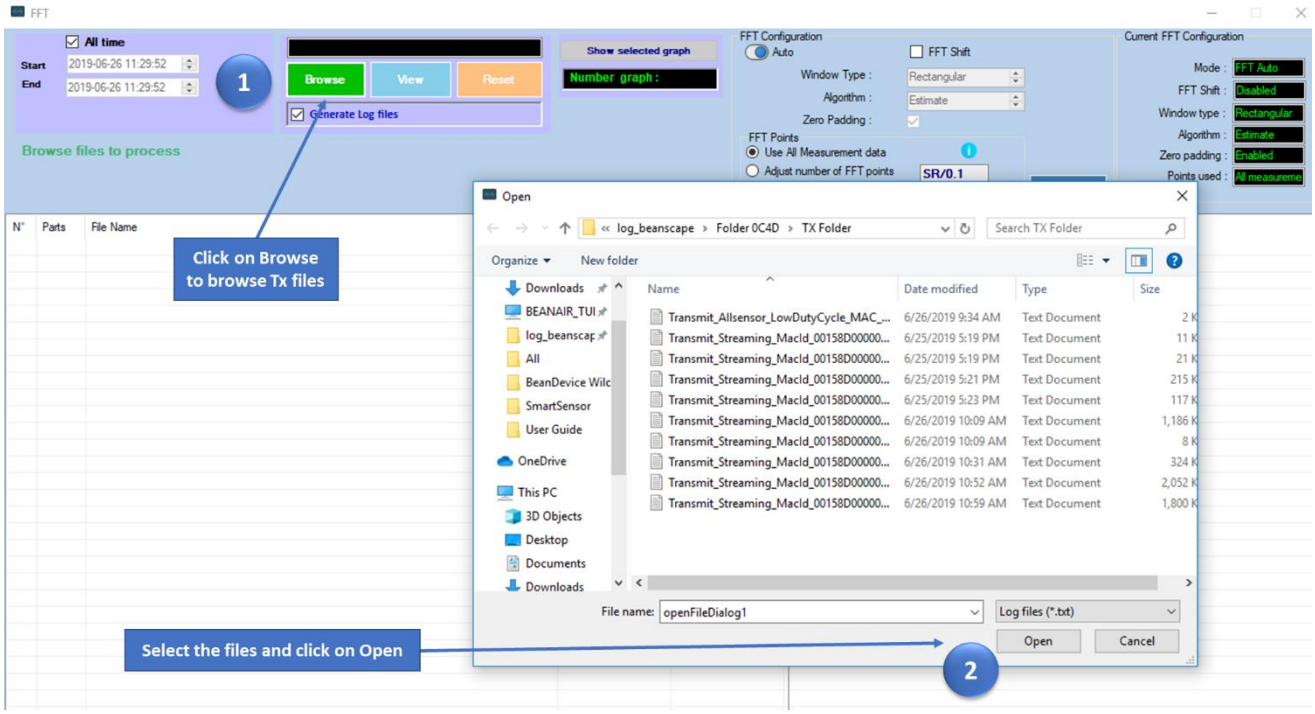


Figure 111: Browsing TX files on FFT tool

2: Overview of the selected files

Figure 112: Overview: FFT window

3:Loading

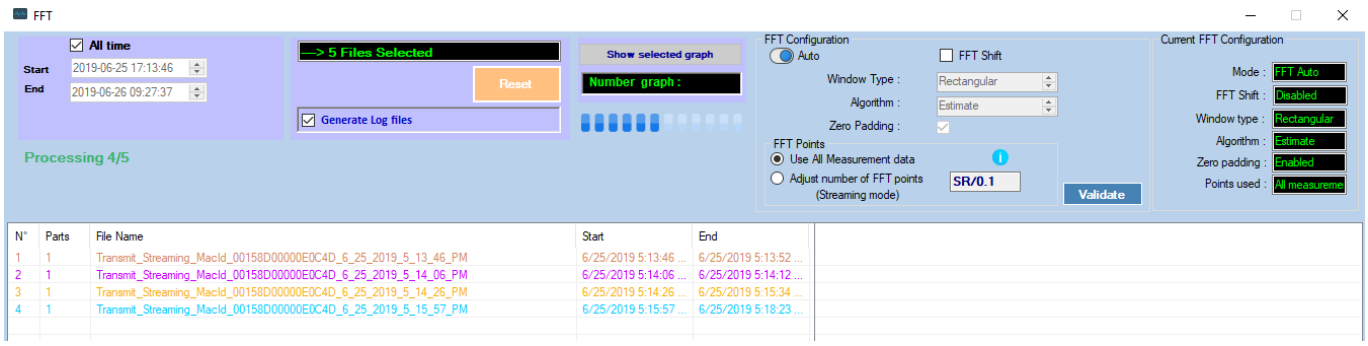


Figure 113: FFT generation

4: FFT report generated with the following results:

a. Frequency

b. Amplitude

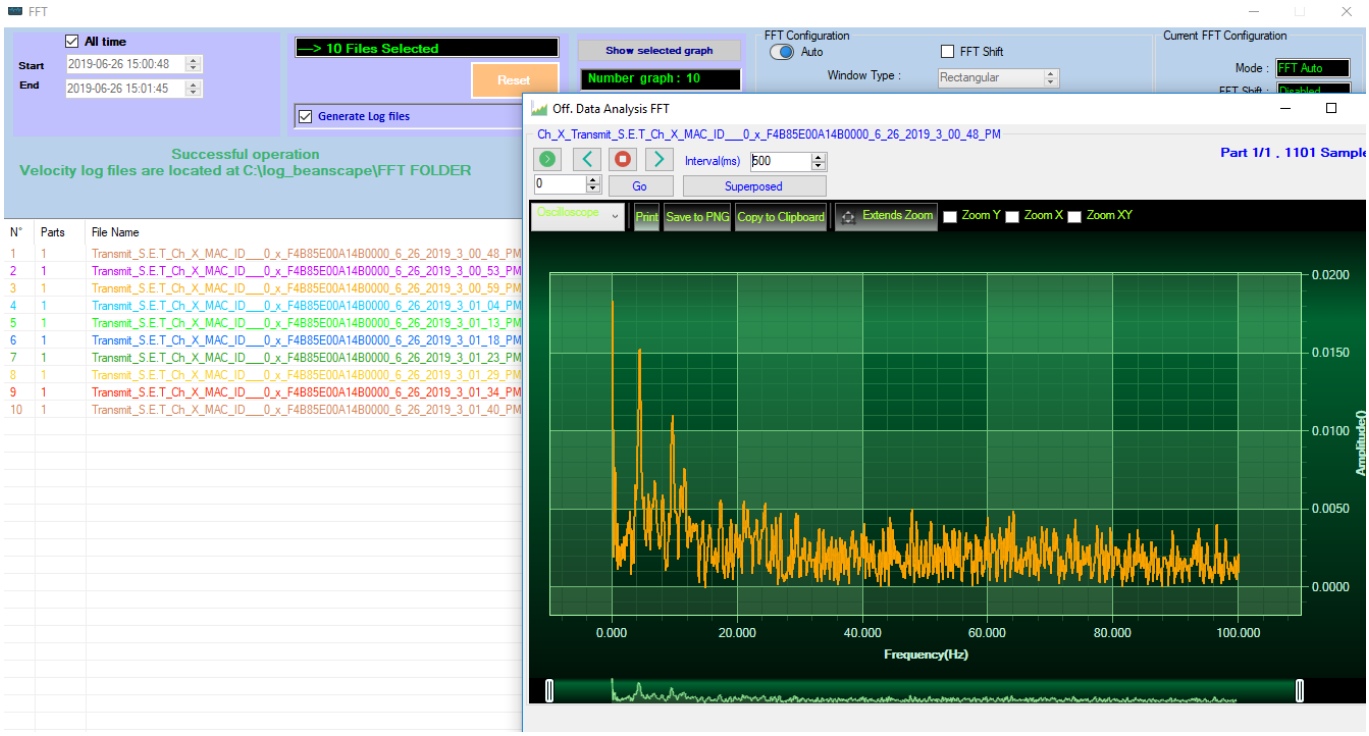


Figure 114: FFT generated View

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®.

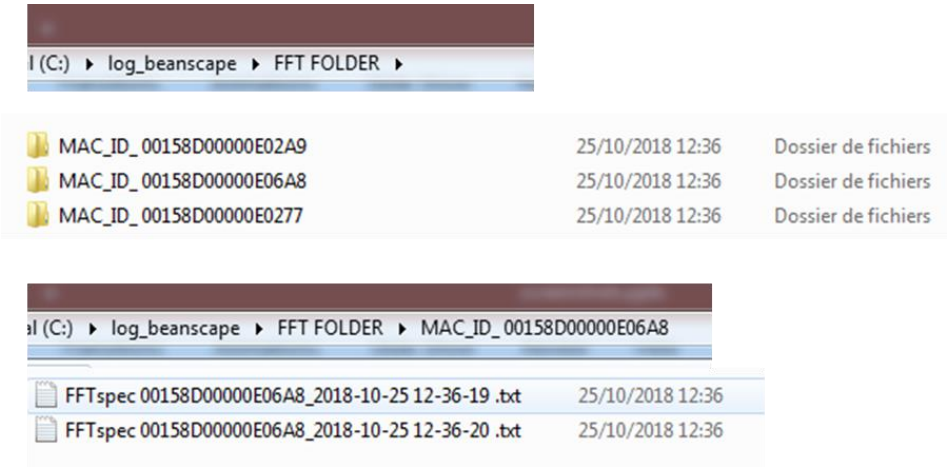


Figure 115: Generated FFT Log files

6: The graphs will be displayed automatically when VPPV Report is generated via a pop-up window, that 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.

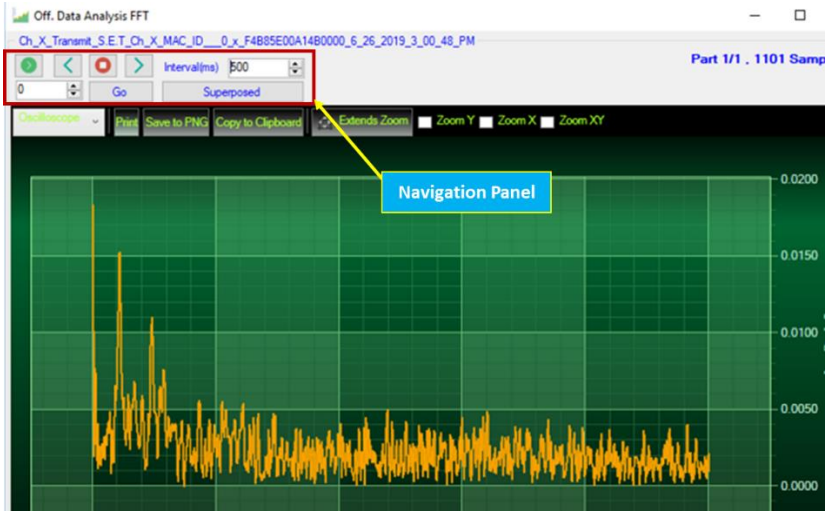


Figure 116: Graph display (Offline Data Analysis)

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

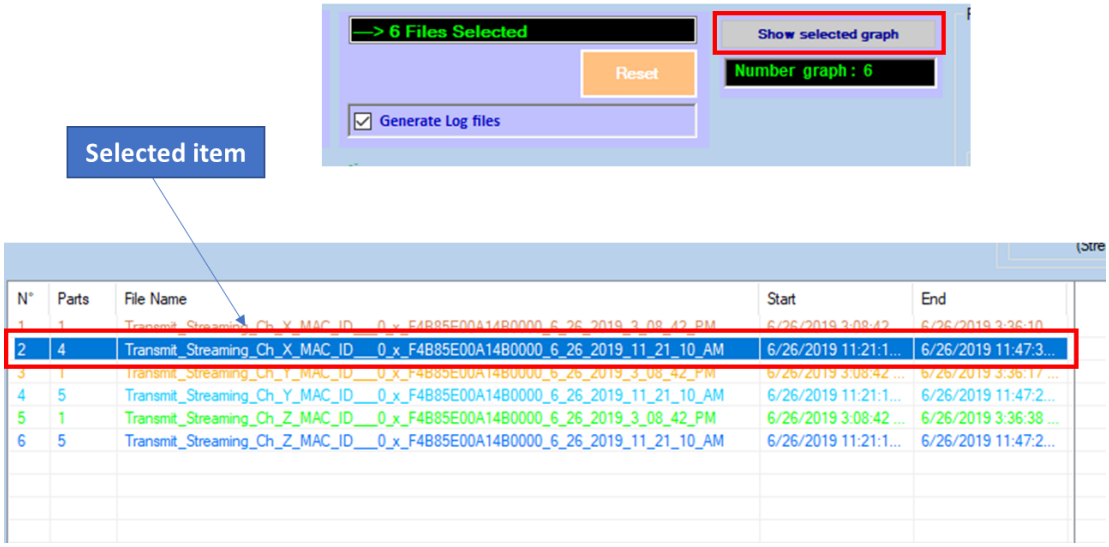


Figure 117: Selecting a graph to display

8: The selected graph is displayed

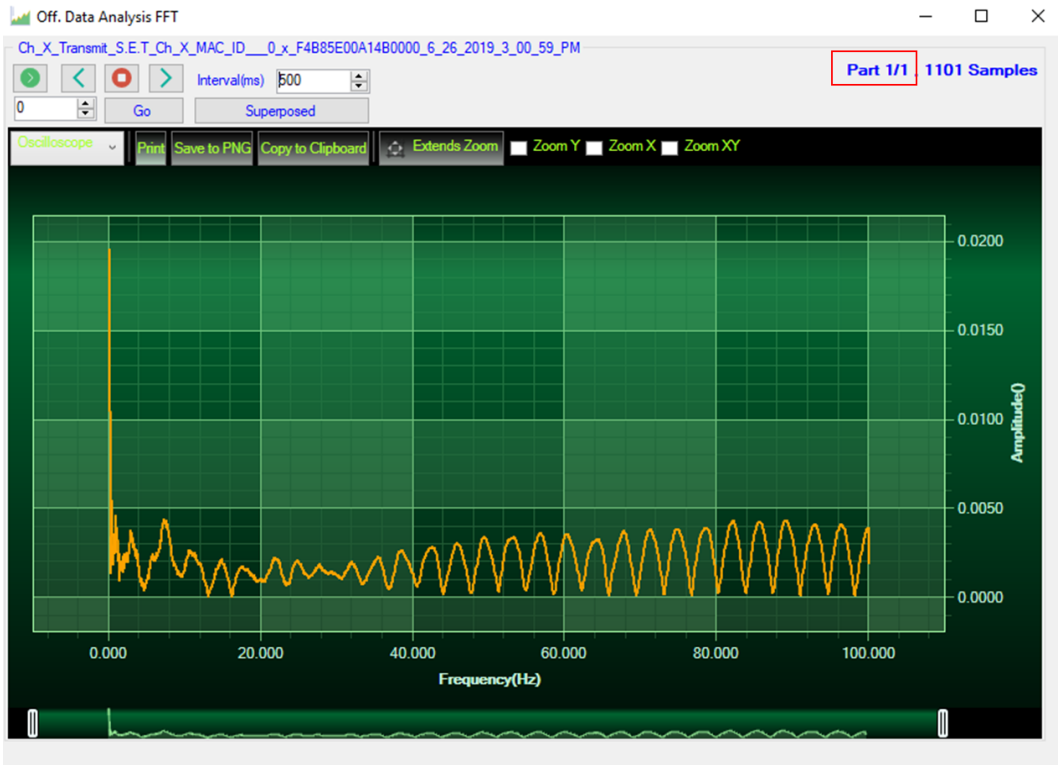


Figure 118: Selected graph display

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

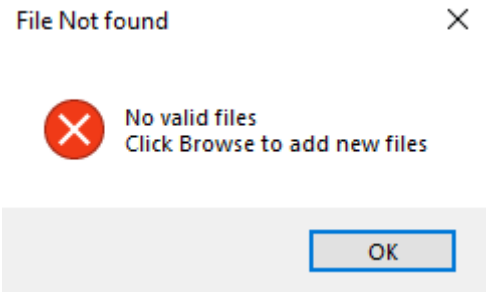


Figure 119: FFT invalid files

11.1.1.2 FFT shift

FFT shift allows sorting 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 FFTShift: check FFTShift, Select files and click the “View” button:

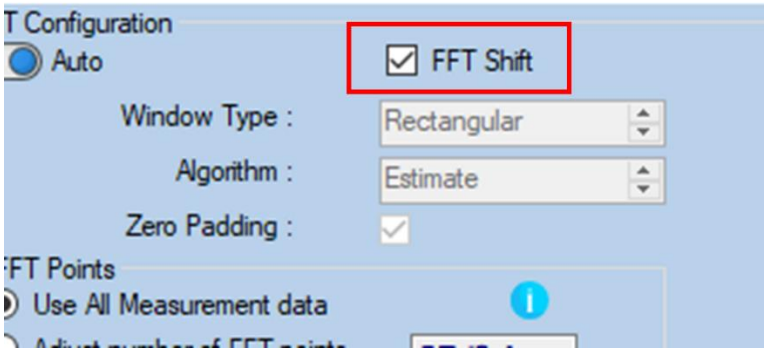


Figure 120: FFT Shift activation

2: FFT Spectrum with FFT Shift option enabled

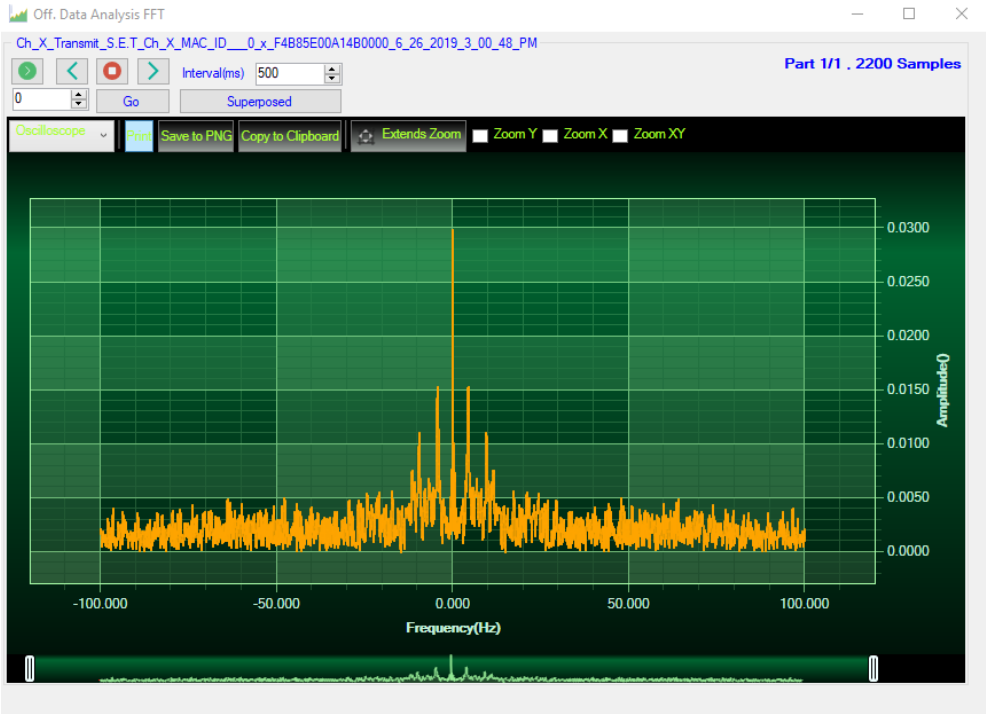


Figure 121: Gird of FFTShift spectra

FFT and FFT shift video

11.1.2 Particle Velocity

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

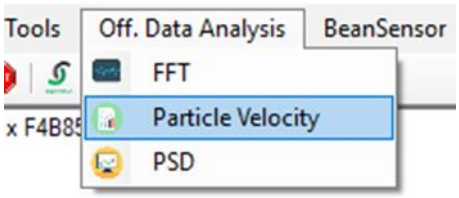


Figure 122: DIN on BeanScape® top menu

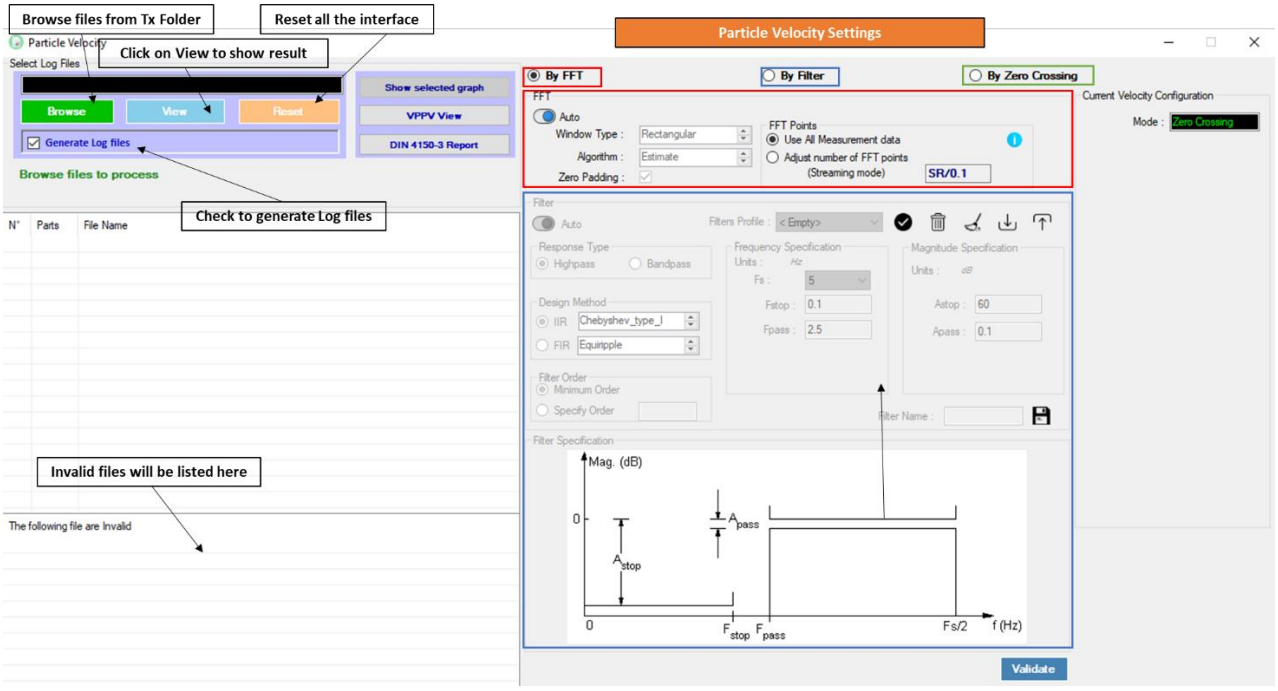
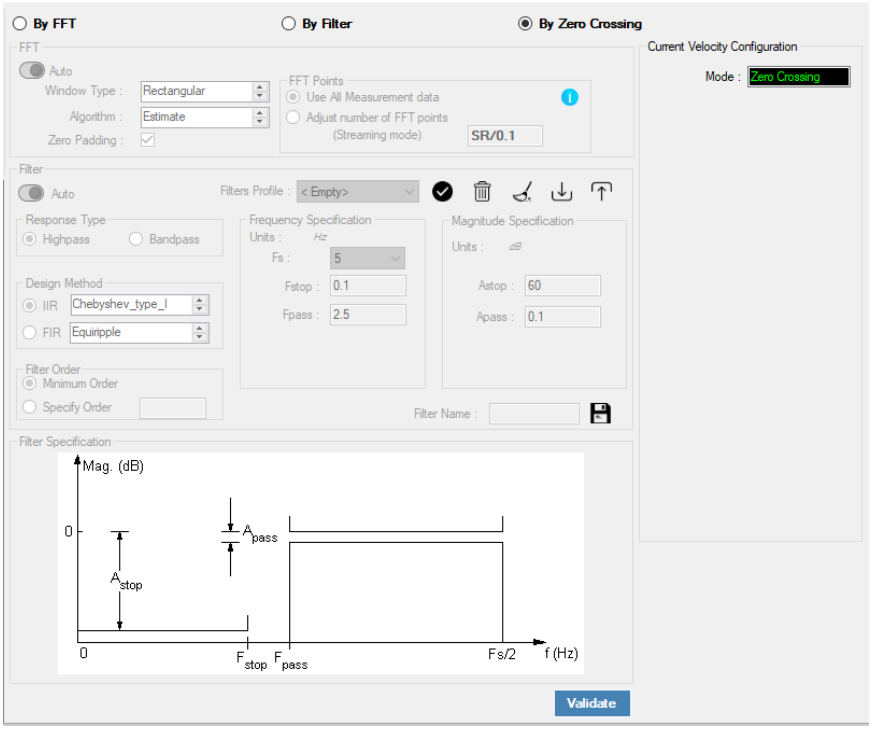


Figure 123: Particle Velocity window

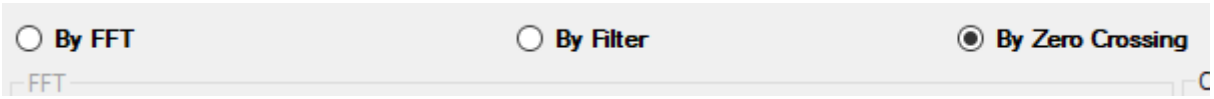
The second step is to browse and import the file containing the logged measurement. The result will be:

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

3: Velocity Advanced Configuration.

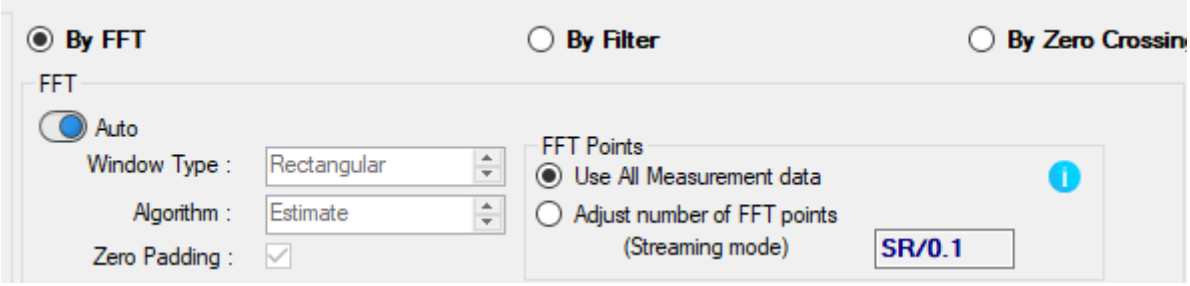


By default, the Velocity is configured “By Zero Crossing”, to edit the Velocity settings user must select “By FFT” or “By Filter”.

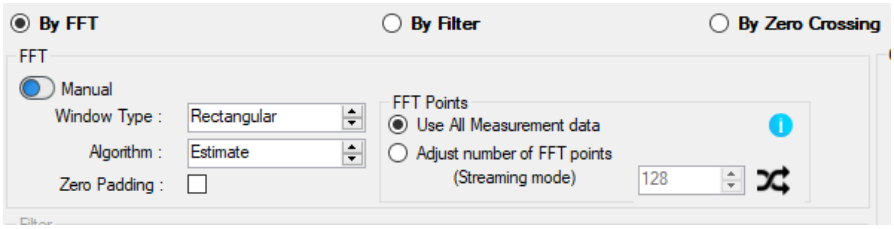


- **By FFT:** By selecting this option, the user will setup the Velocity basing on customized FFT settings.

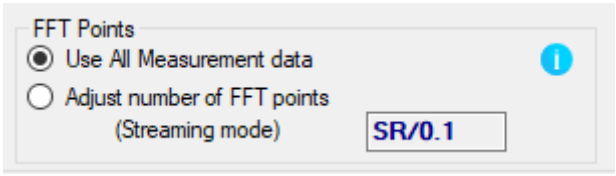
  - Auto: If Auto is selected, The Velocity calculation will activate FFT Auto mode Settings



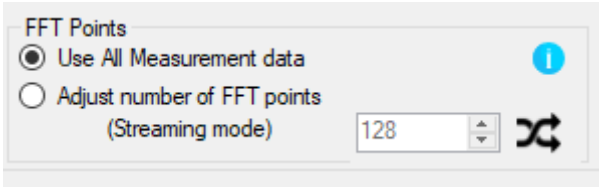
- Manual: Once switched to Manual, the user must configure the FFT settings manually (Window Type, Algorithm & Zero Padding).



- 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:

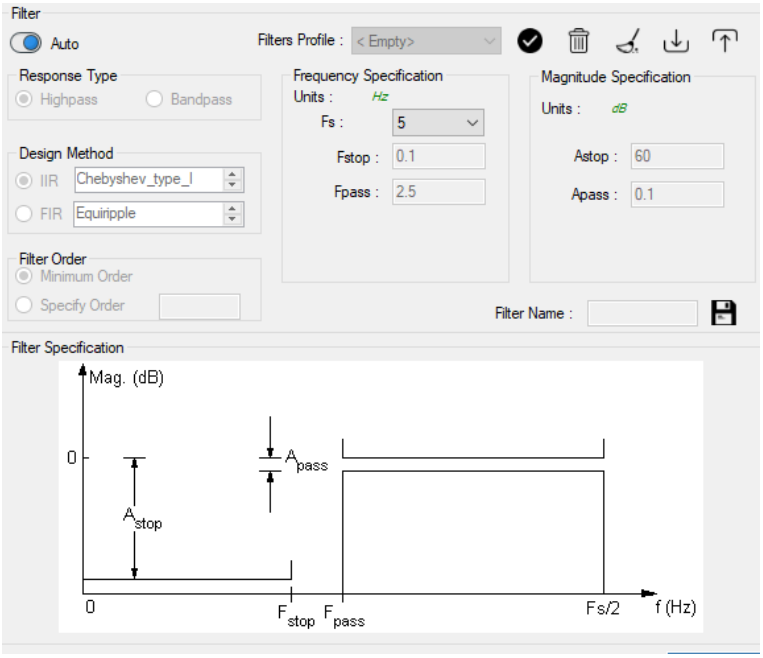
2000/4096 = 0.48828125

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.

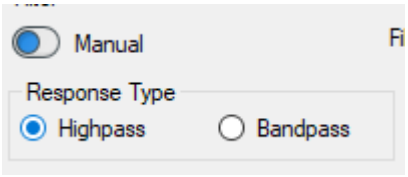
- **By Filter:** By selecting this option, the user will setup the Velocity basing on the Software Filter.

  - 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**

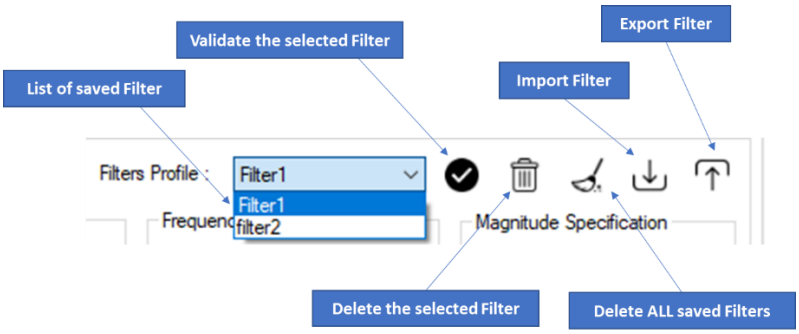


    - Design Method: User should Select the nature of the Filter between **IIR** or **FIR**
      From the List of every filter, user have to specify the method of the Filter:
      IIR: Chebyshev_type_I, Chebyshev_type_II or Butterworth
      FIR: Equiripple, Generalized_Equiripple or Kaiser_Window

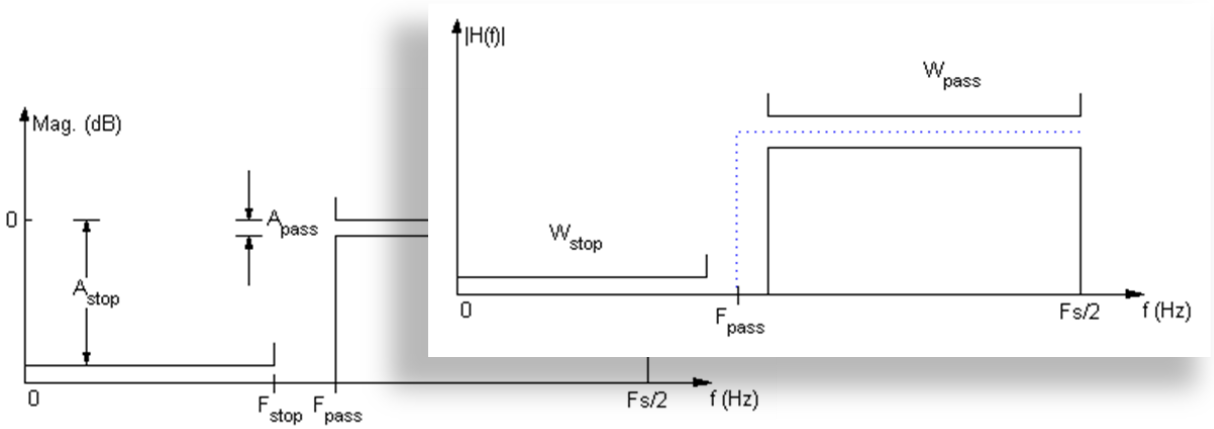
      The Frequency Specification and The Magnitude Specification will be modified according the selected Design Method

    - 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.

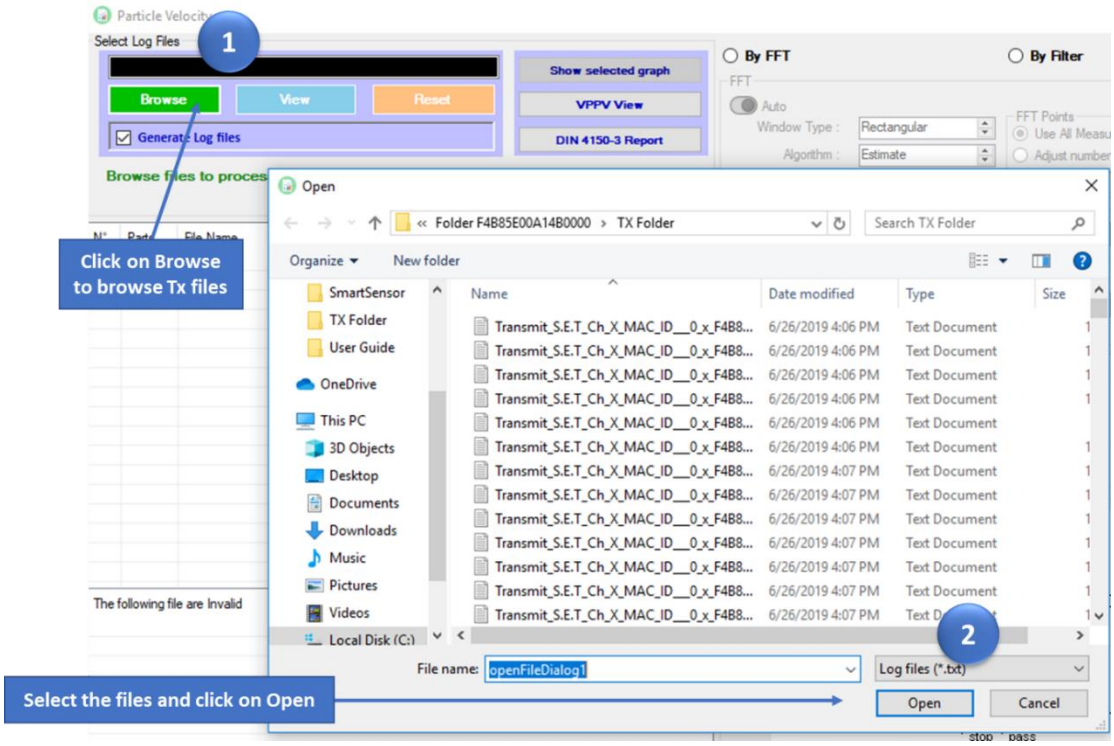


Figure 124: Browsing TX files into Particle Velocity tool

5: Loading.

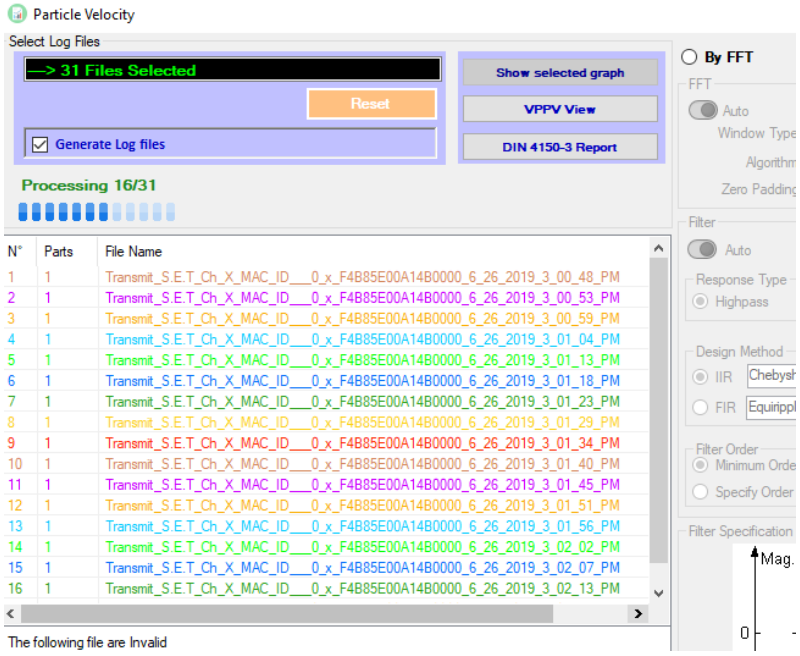


Figure 125: Particle Velocity result generation

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**

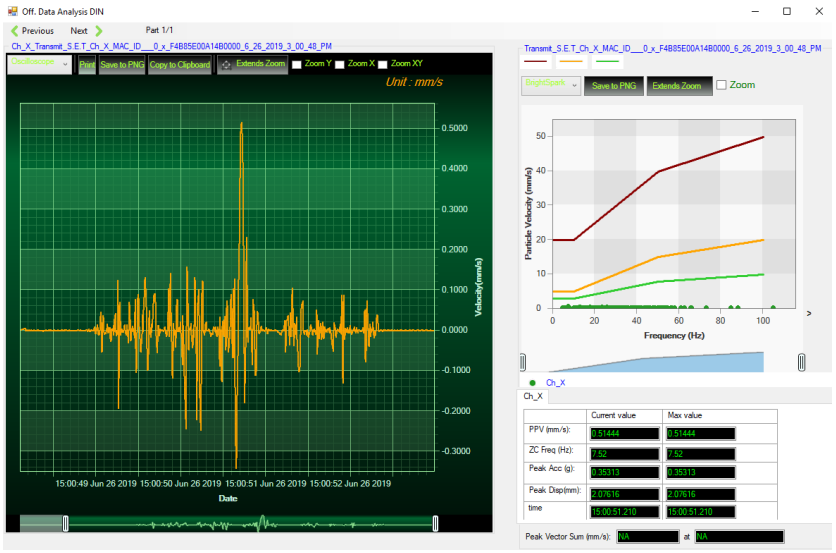


Figure 126: Particle Velocity Display Window

6: The VPPV and DIN Report:

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

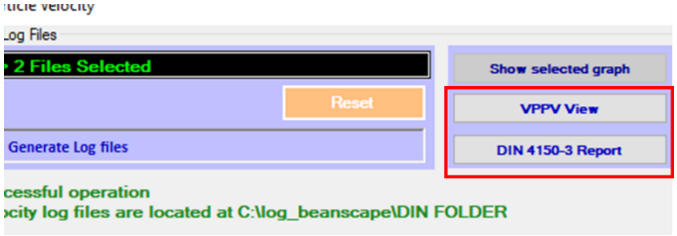
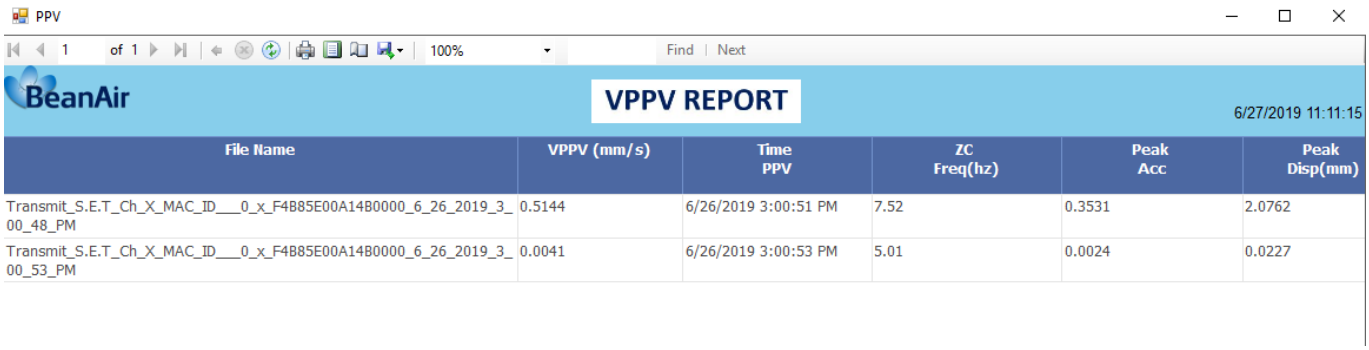
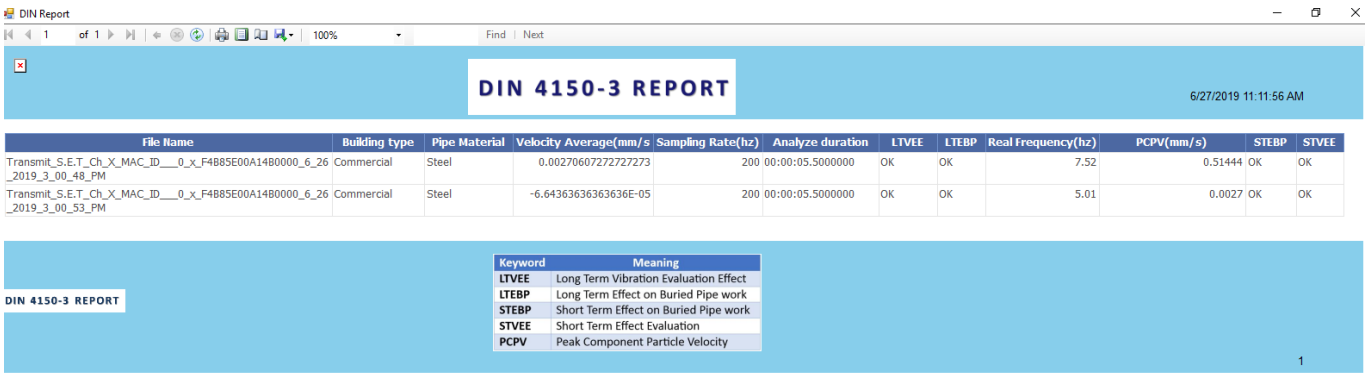


Figure 127: VPPV & DIN buttons



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 128: 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

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 129: 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)
Real 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

11.2 ONLINE DATA ANALYSIS TOOL

11.2.1 Online FFT

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 AX-3D only with Streaming and S.E.T acquisition modes and is enabled from the Online Data Analysus tab in the Configuration panel.

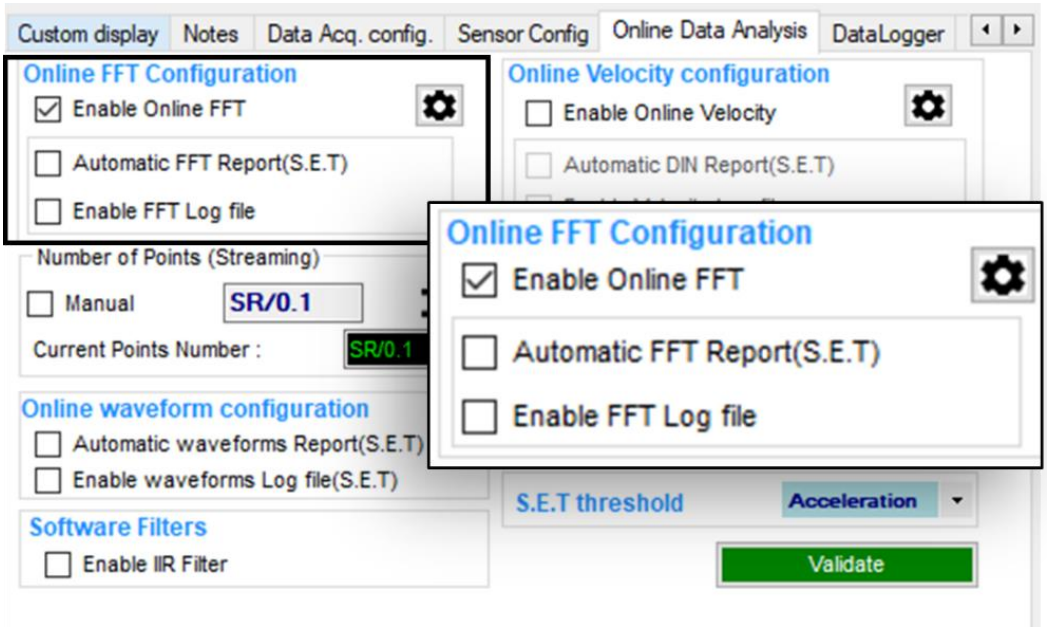


Figure 130: Online FFT Configuration frame

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

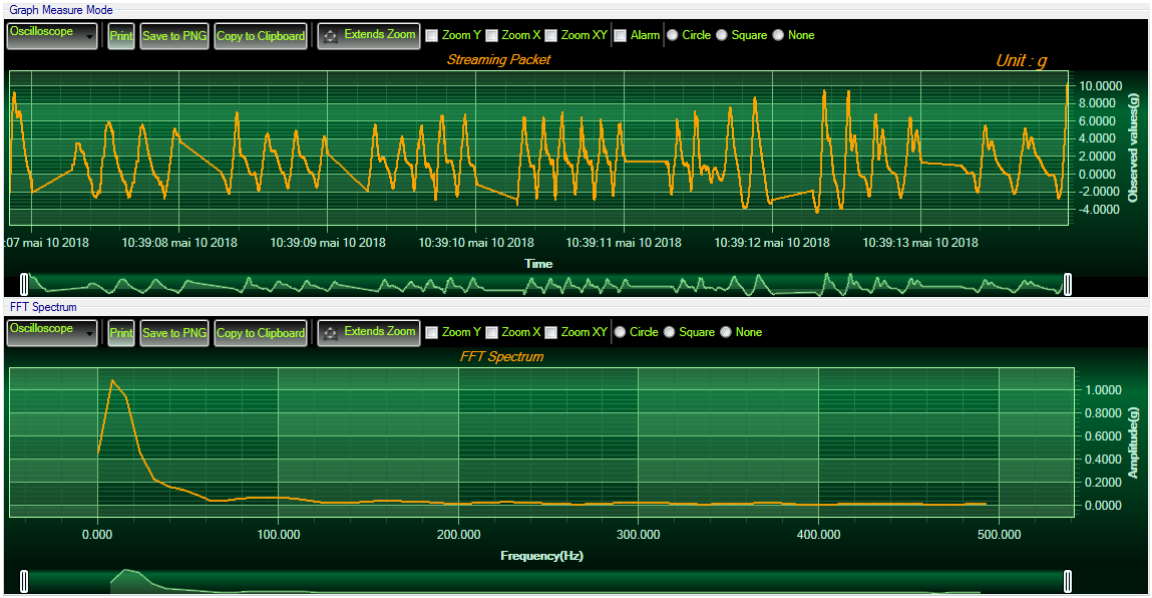


Figure 131: FFT Spectrum

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

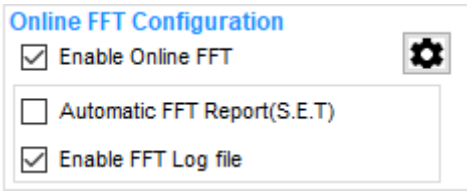


Figure 132: Online FFT Configuration frame

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

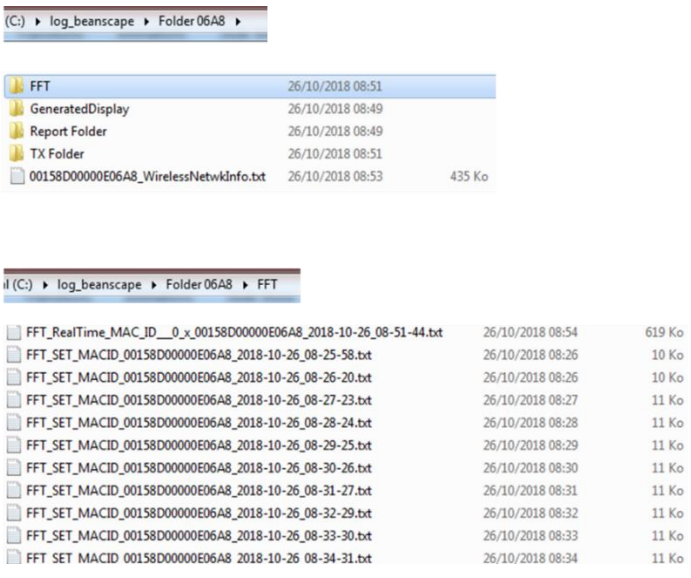


Figure 133: FFT log files folder

3: 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

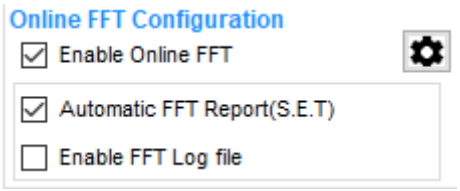
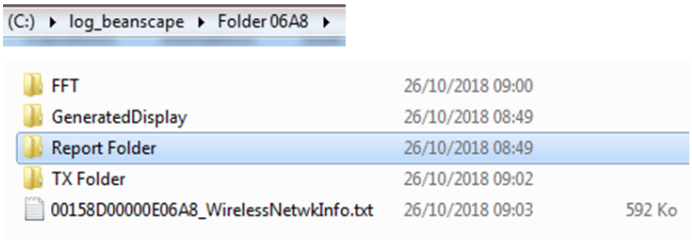


Figure 134:Enabling Automatic FFT Report

The Reports will be generated in your log_beanscape directory, under "Report Folder" repertory.



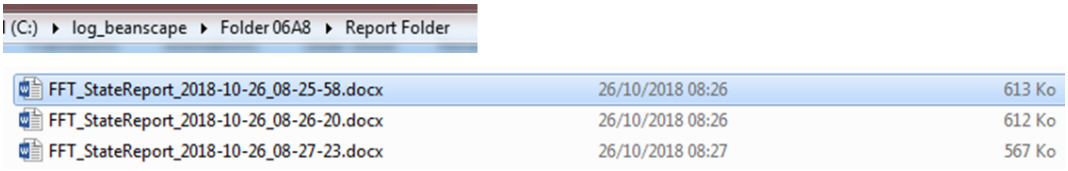
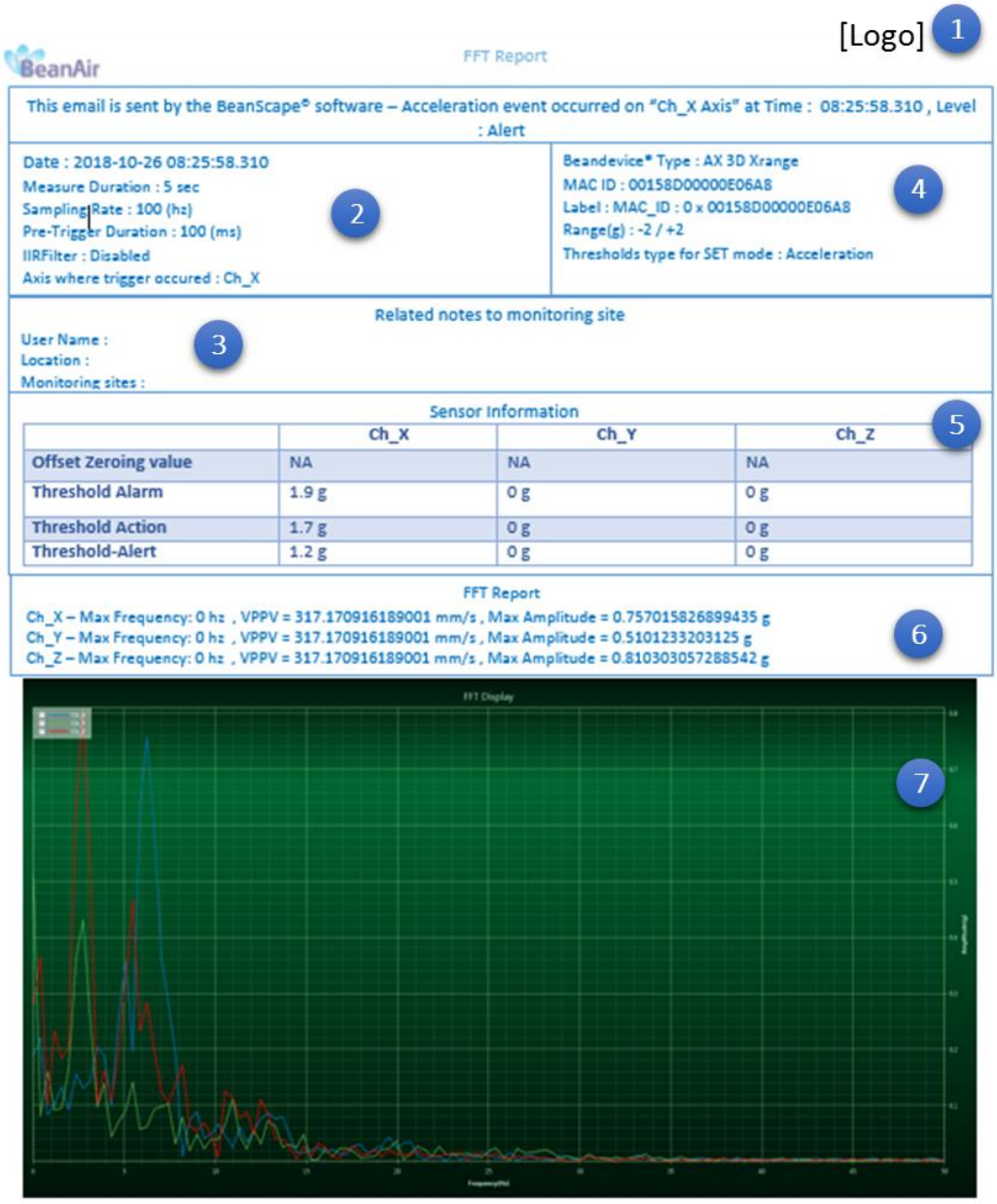


Figure 135: Report Folder

For further information about the configuration of Online FFT please refer to section 7.3.4 of this user manual

After enabling Real time FFT and setting SMTP configuration (more information on section 8), this is an example of an FFT report emailed to concerned recipients.



	Ch_X	Ch_Y	Ch_Z
Offset Zeroing value	NA	NA	NA
Threshold Alarm	1.9 g	0 g	0 g
Threshold Action	1.7 g	0 g	0 g
Threshold-Alert	1.2 g	0 g	0 g

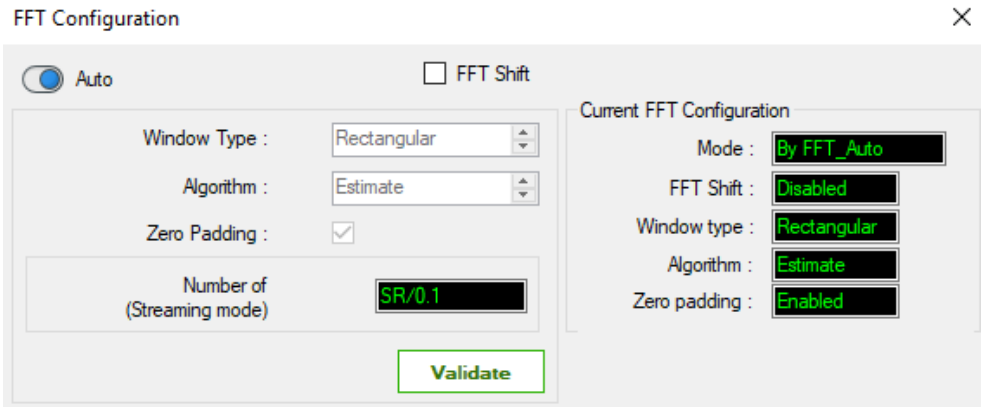
Figure 136: FFT Report (S.E.T mode)

1	Logo of your company, you can upload it from the alarm management configuration window. Tools→Alarm management
2	General information about the Measurement, Date, duration sampling rate ,pre-trigger duration, IIR filter status and triggered axis
3	Information related to monitoring site: user, location and monitoring sites (can be configured from the Alarm tool window. This field can be configured be from the alarm management configuration window Tools→Alarm management
4	BeanDevice® Information: Type, MAC ID and label, measurement range, and Alarm Type : Acceleration or Velocity
5	Alarm thresholds value on each Axis, the three levels of alarms are displayed Action-Alert-Alarm
6	FFT Report with Max Frequency for each Axis, VPPV (Vector Peak Particle Velocity) value and Max amplitude
7	Graph Area – 3 Axis are displayed on the same graph

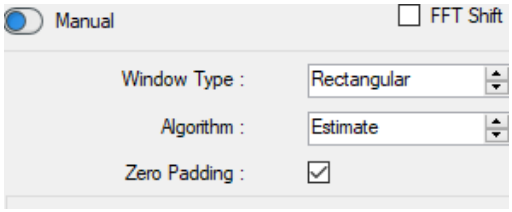
For further information about managing your notification and reports email please refer to section 8: Alarm management.

-  : 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.

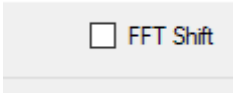
In general, the Hanning (Hann) window is satisfactory in 95 percent of cases. It has good frequency resolution and reduced spectral leakage. If you do not know the nature of the signal but you want to apply a smoothing window, start with the Hann window.

- 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.



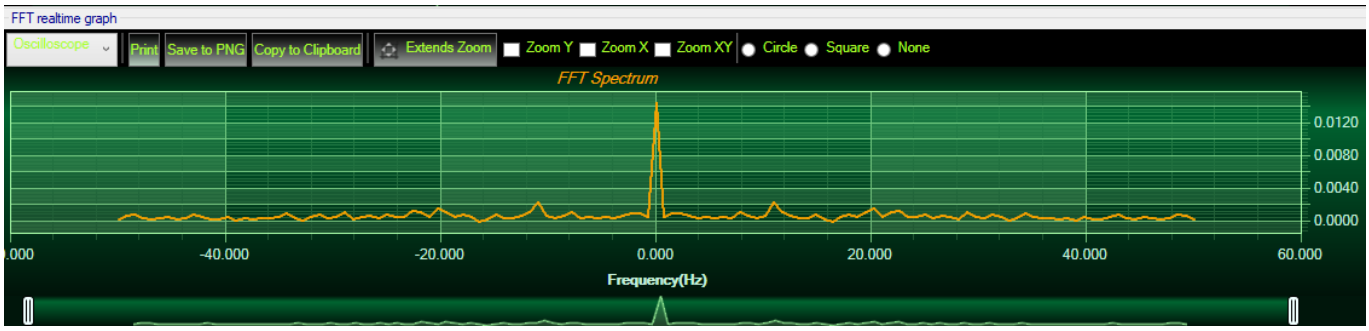


Figure 137: FFT Shift Spectrum

11.2.2 Online Velocity

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

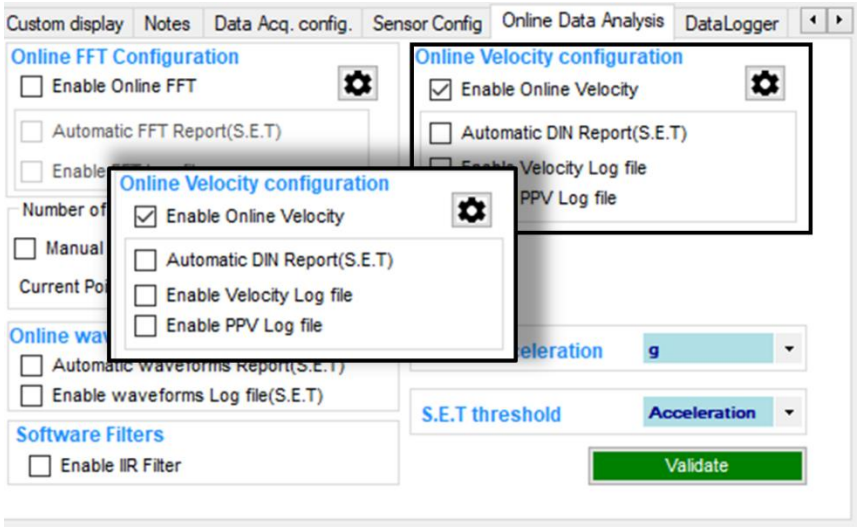


Figure 138: Online Velocity configuration tab

- ***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.

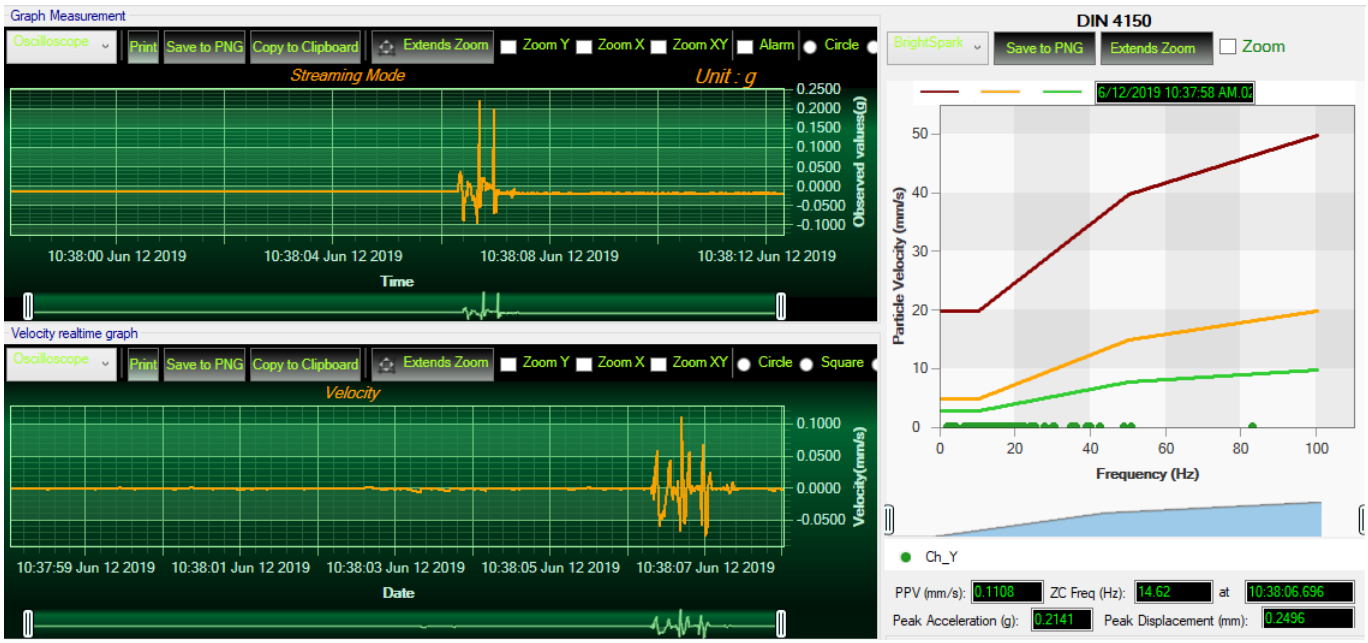


Figure 139: Velocity Graph

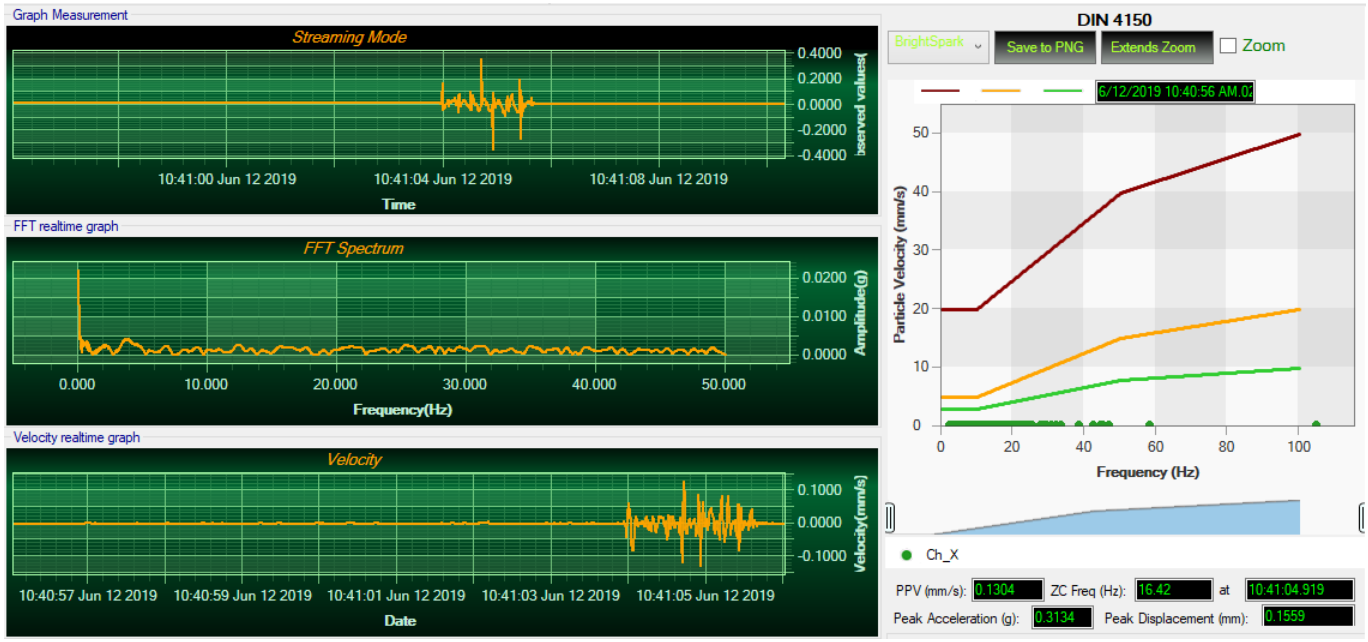


Figure 140: Velocity and FFT Graph, PPV and PVS

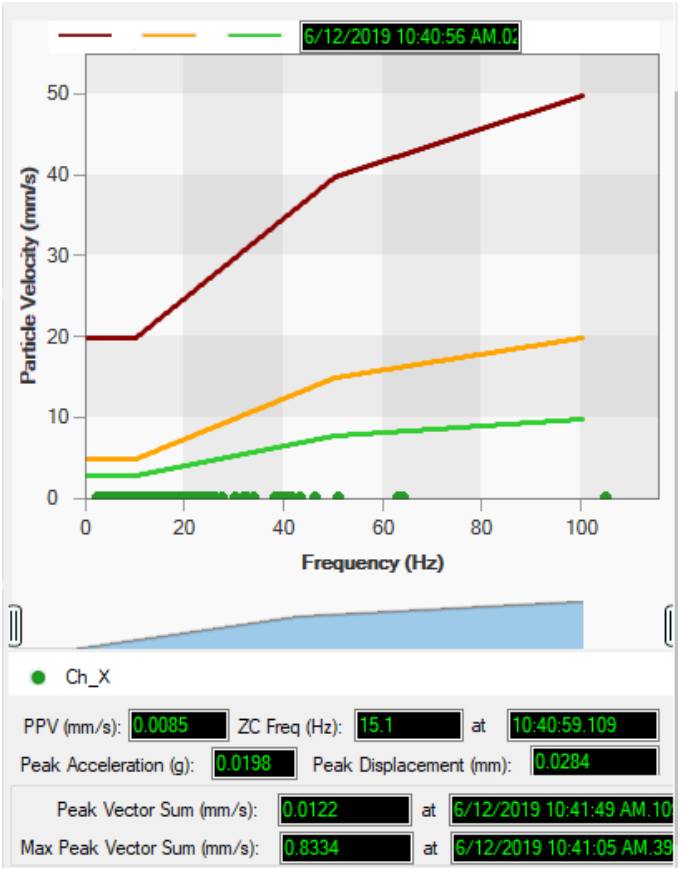


Figure 141: DIN 4150 Real Time Graph, PPV & PVS

- ***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 142: 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.

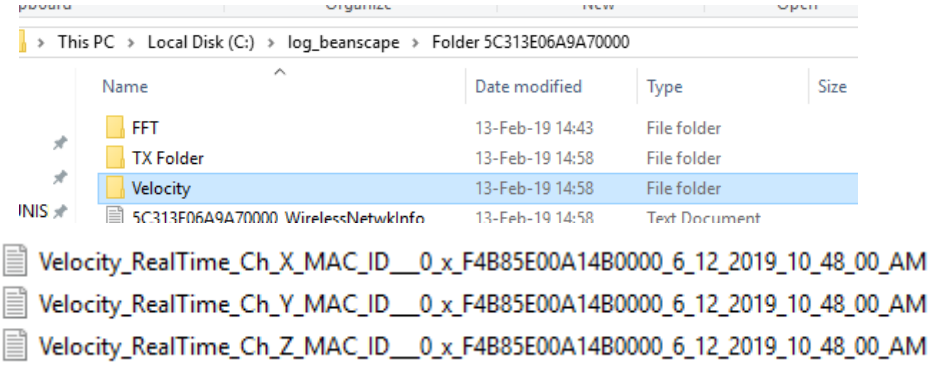


Figure 143: Velocity Log Folder/Files

- ***Enable PPV Log file***

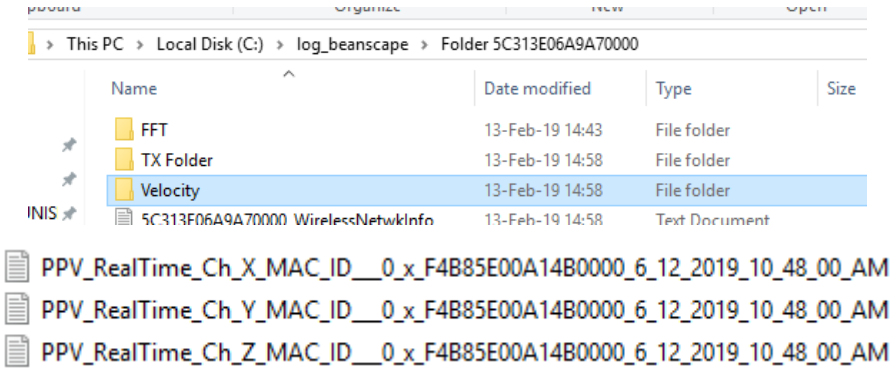


Figure 144: PPV Log Folder/Files

: Velocity Advanced Configuration

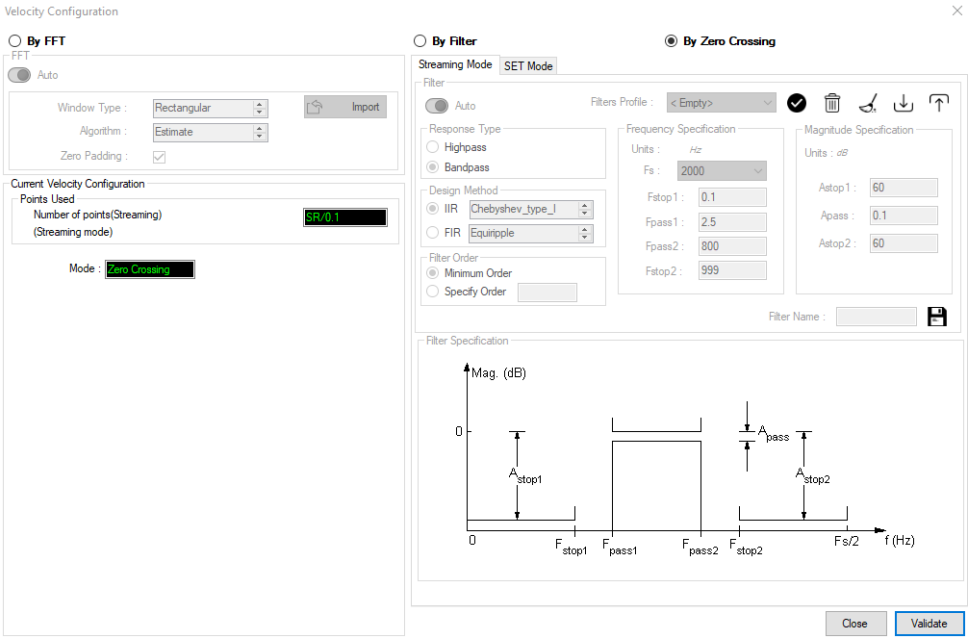
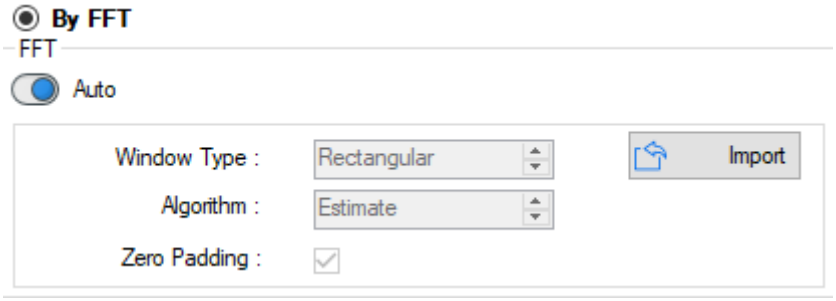


Figure 145: Velocity Advanced Configuration

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

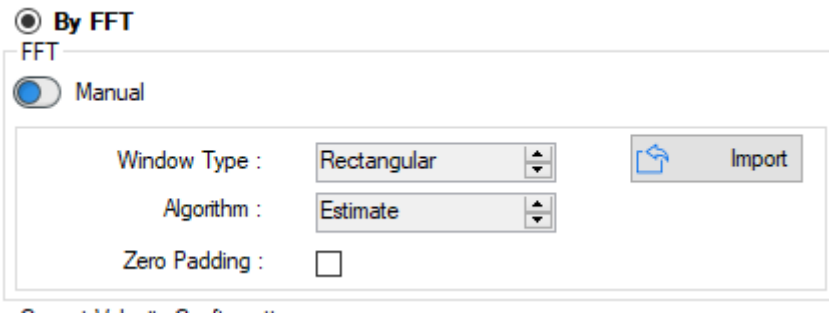
- **By FFT:** By selecting this option, the user will setup the Velocity basing on customized FFT settings.

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

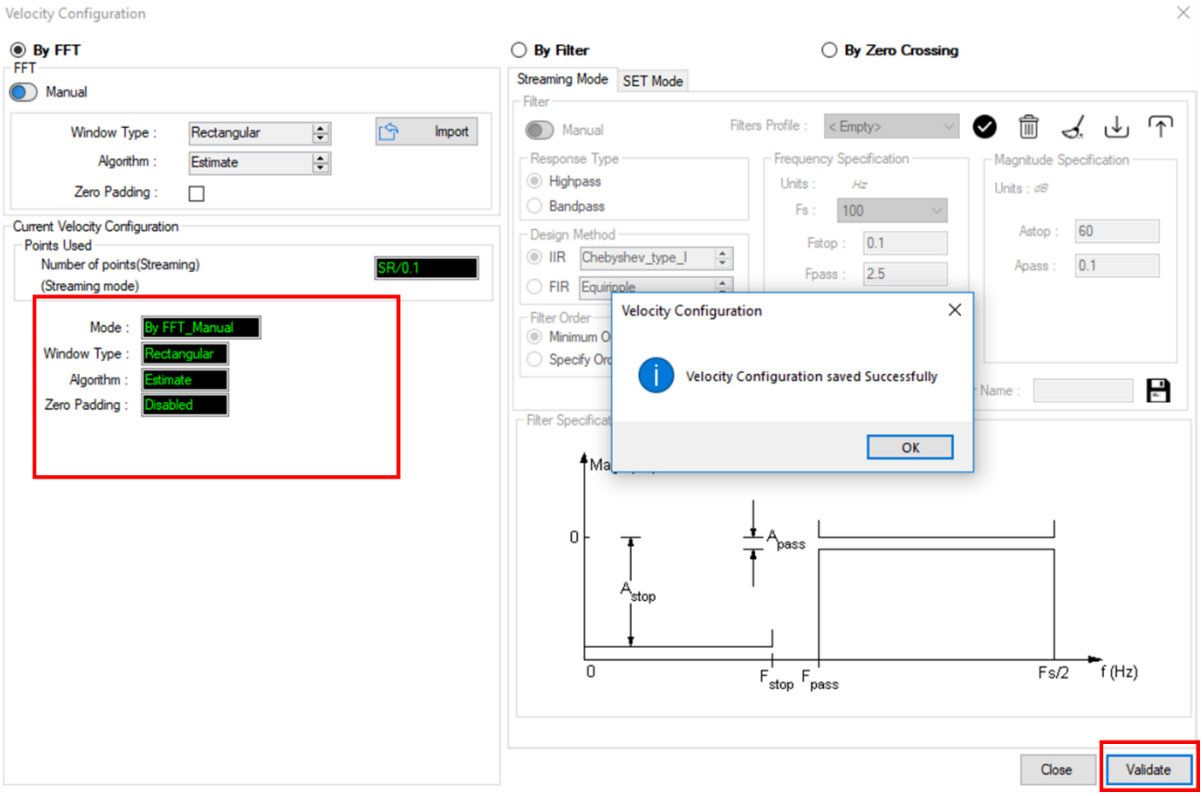


- Manual: Once switched to Manual, the user must configure the FFT settings manually (Window Type, Algorithm & Zero Padding).

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

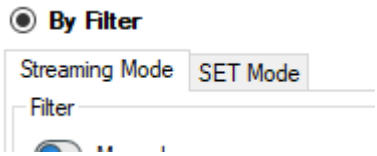


To save all settings Press Validate. The new settings should be displayed on the Left side of the Window.

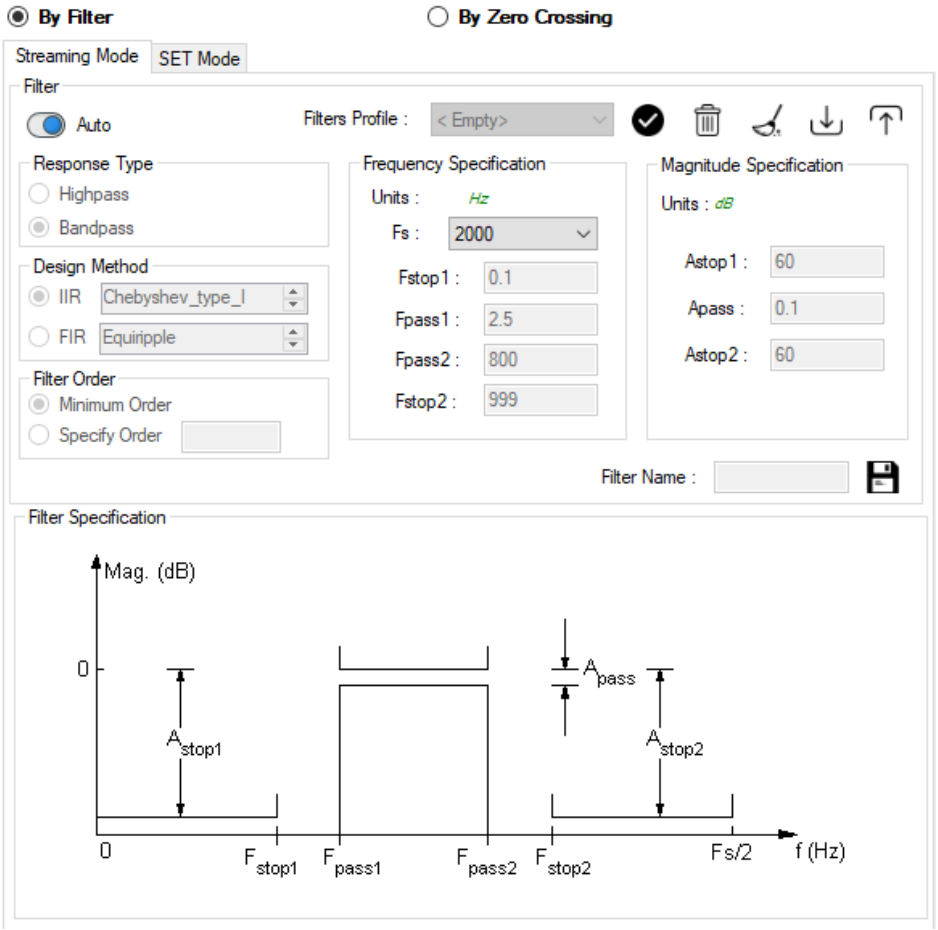


- **By Filter:** By selecting this option, the user will setup the Velocity basing on the Software Filter.

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

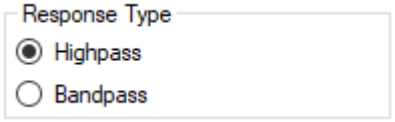


  - Auto: If Auto is selected, Velocity Automatic filter will be configured



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

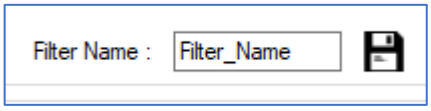
    - Response Type: User should specify if the Response is **Highpass** or **Bandpass**

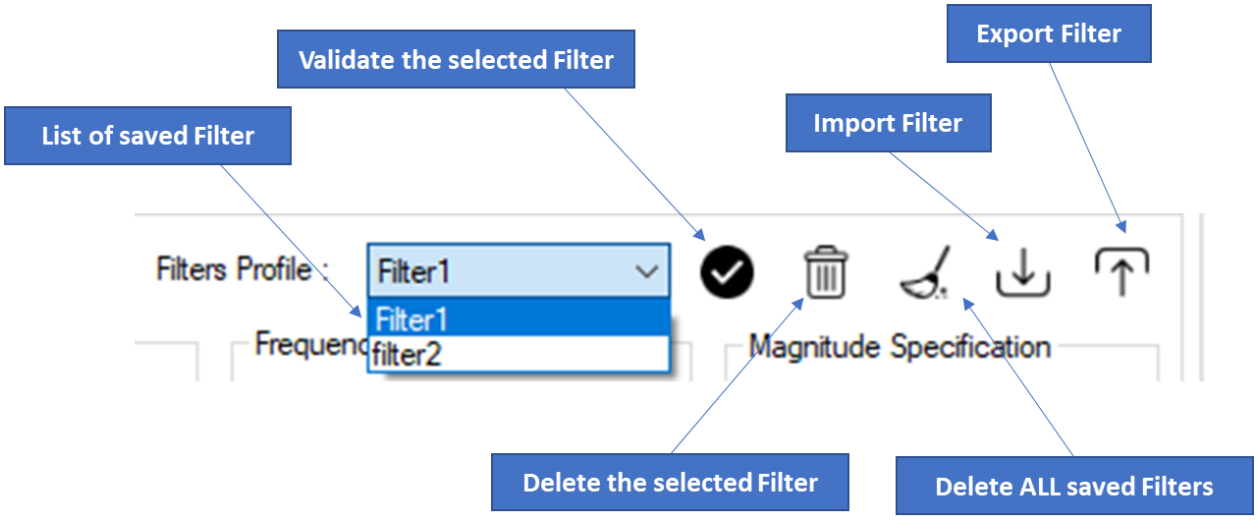


- Design Method: User should Select the nature of the Filter between **IIR** or **FIR**
  From the List of every filter, user have to specify the method of the Filter:
  IIR: Chebyshev_type_I, Chebyshev_type_II or Butterworth
  FIR: Equiripple, Generalized_Equiripple or Kaiser_Window

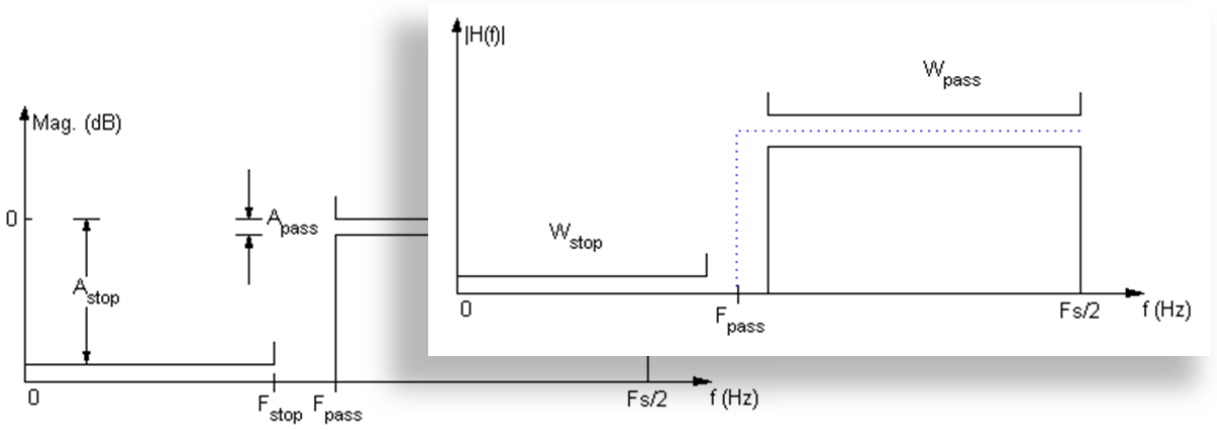
The Frequency Specification and The Magnitude Specification will be modified according the selected Design Method

- 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.

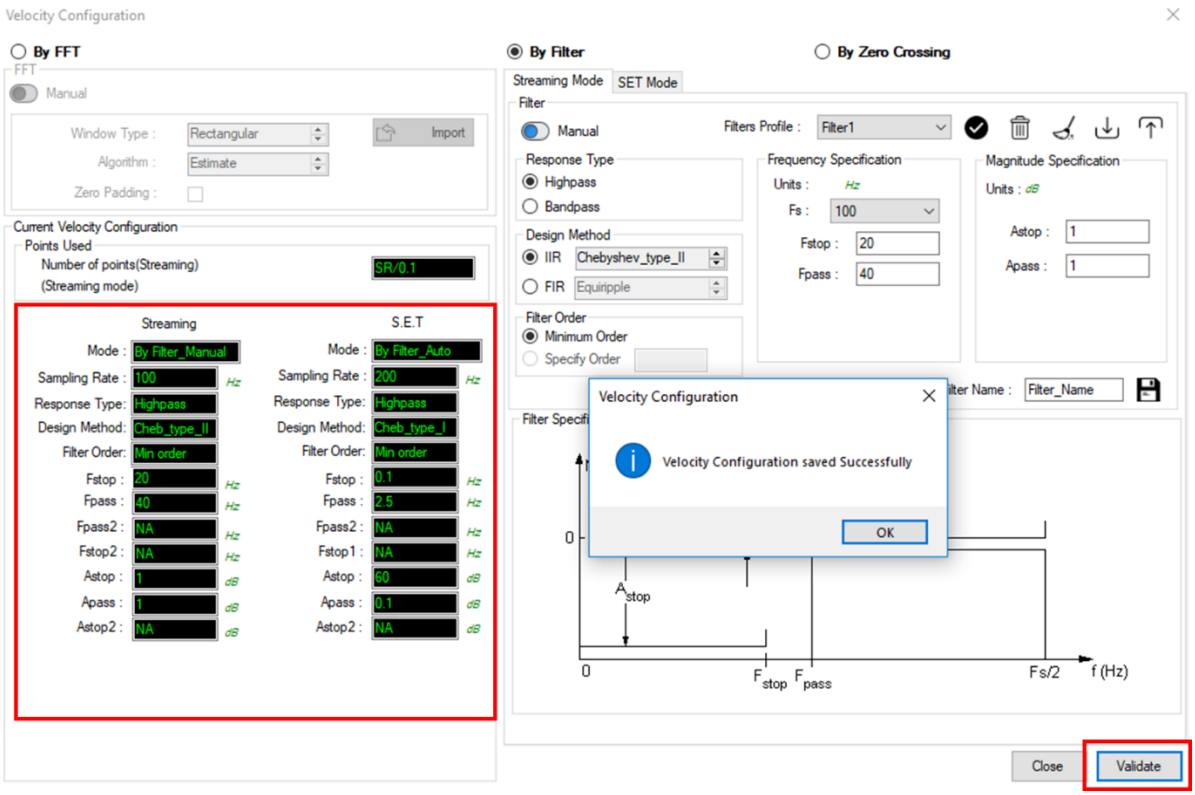




- Filter Specification: Is a Graphical Display of the Filter Specification depends on the user settings.



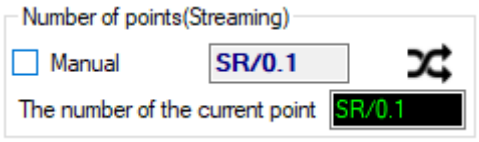
To save all settings Press Validate. The new settings should be displayed on the Left side of the Window.



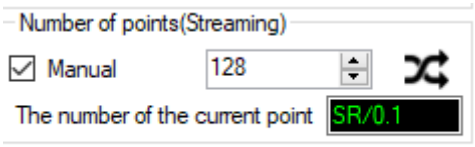
11.2.3 IIR Sofltware Filter

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

11.2.4 Number of Points (Streaming)

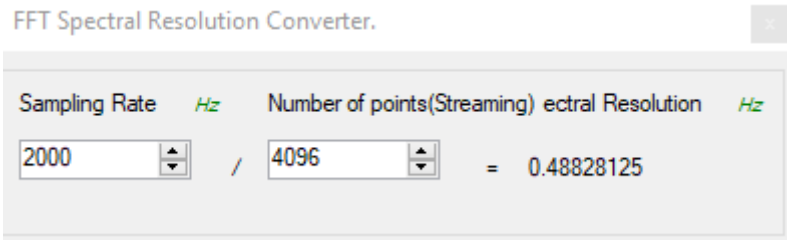


By default, the Number of Points is configured to be set automatically as Sampling Rate / 0.1 (SR/0.1). By moving to the Manual settings, user must choose a value between 128 and 32768.



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.



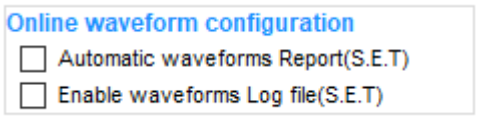
The frequency resolution of each spectral line is equal to the Sampling Rate divided by the Number of Points. For instance, for example, if the Number of Points is 4096 and the Sampling Rate is 2000, the resolution of each spectral line will be:

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.

11.2.5 Online Waveform Configuration



- ***Automatic Wave Report(S.E.T)***: Check to enable waveform reports, this is only available for S.E.T mode
- ***Enable Wave Log file:***check to enable logging wave form for real-time data(only S.E.T mode)

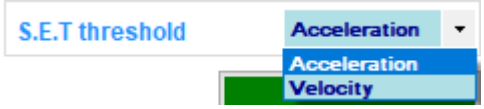
11.2.6 Unit of acceleration

Select which unit to be used for acceleration measurement.

- G
- mm/s²

11.2.7 S.E.T threshold

In many cases the threshold is needed to be set in mm/s and not in g or mm/s², you need to configure your S.E.T threshold parameters before starting. To configure the threshold to be set in mm/s, you need to go to Online Data Analysis and change S.E.T threshold from acceleration to Velocity.



12. APPENDICES

12.1 APPENDICE 1: INSTALLATION PROCEDURES

12.1.1 Sealing

The product BeanDevice® comes with an *IP67* rating. So, do not install the BeanDevice® in a marine environment with high turbulence.
Do not install the BeanDevice® up front to prevent the accumulation and infiltration of water from the front of the case.

If the BeanDevice® is used in a cold environment, it will be better to integrate it inside a plastic casing.

12.1.2 Coexistence With other Frequencies at 2.4 GHz

The BeanDevice® is sensitive to noise 2.4GHz (Wi-Fi as a source for example), but many protections are already in place, particularly in the IEEE 802.15.4®.
It should however be careful when installing the product, check all the possibilities of radio channels on the frequency range 2.4-2.5GHz. The operation of the product will be improved.

For further information, read the application note: AN_RF_004 – "Coexistence of Beanair WSN at 2.4GHz"

12.1.3 Temperature & Humidity

The BeanDevice® SmartSensor series comes with an operating temperature of -20°C to +65°C.

BeanDevice® products can operate in an area with 90% humidity.
However, the wireless range can be reduced in the presence of water. Avoid mounting the BeanDevice® in an enclosure surrounded by water, or near bushy plants (plants are composed of 90% water), ...

12.1.4 Reflections, Obstructions and Multipath

For further information, read the application note: AN_RF_007 :" Beanair_WSN_Deployment"

12.1.5 shock & Vibration resistance

Shock resistance on BeanDevice® products are:

Shock resistance
50g during 50 ms

Do not force connections.

12.1.6 Antenna

Check the LQI (Link Quality Indicator) of your BeanDevice® for being sure that your antenna is right oriented.

For further information, read the application note: AN_RF_007 :" Beanair_WSN_Deployment"

12.2 APPENDICE 2: SENSOR CHARACTERISTICS

12.2.1 BeanDevice® AX-3D & AX-3D Xrange

12.2.1.1 Sensor architecture

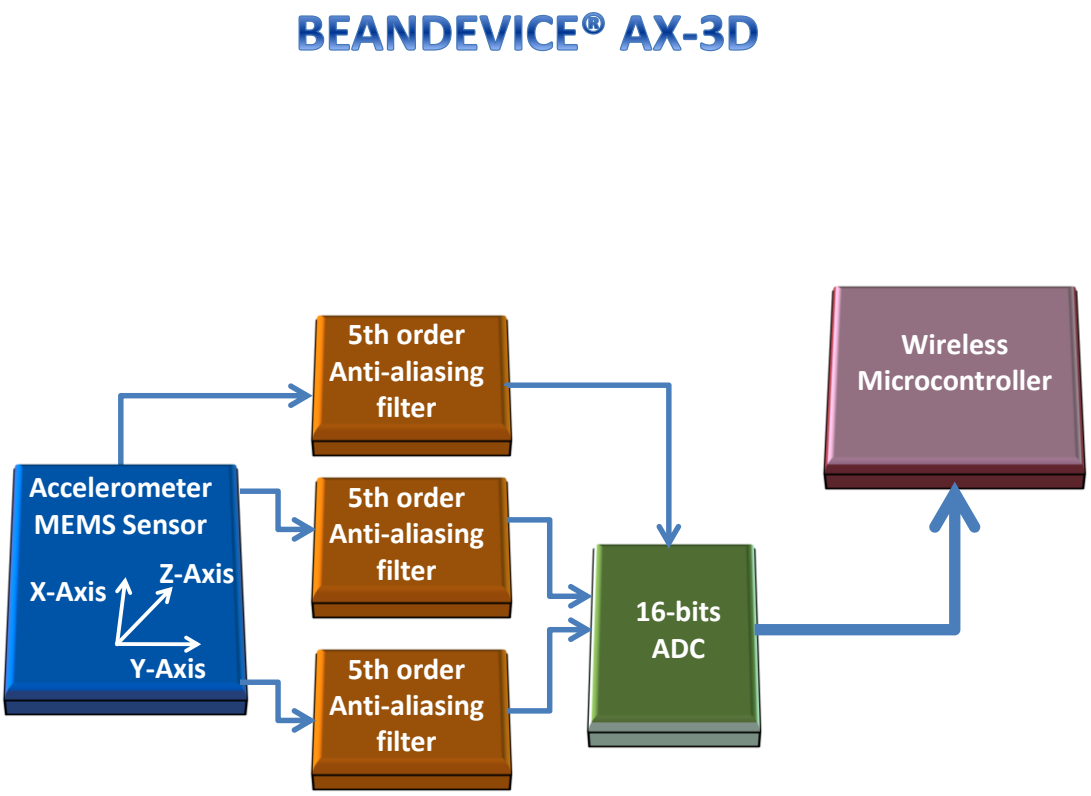


Figure 146: Sensor design

12.2.1.2 MEMS Accelerometer

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

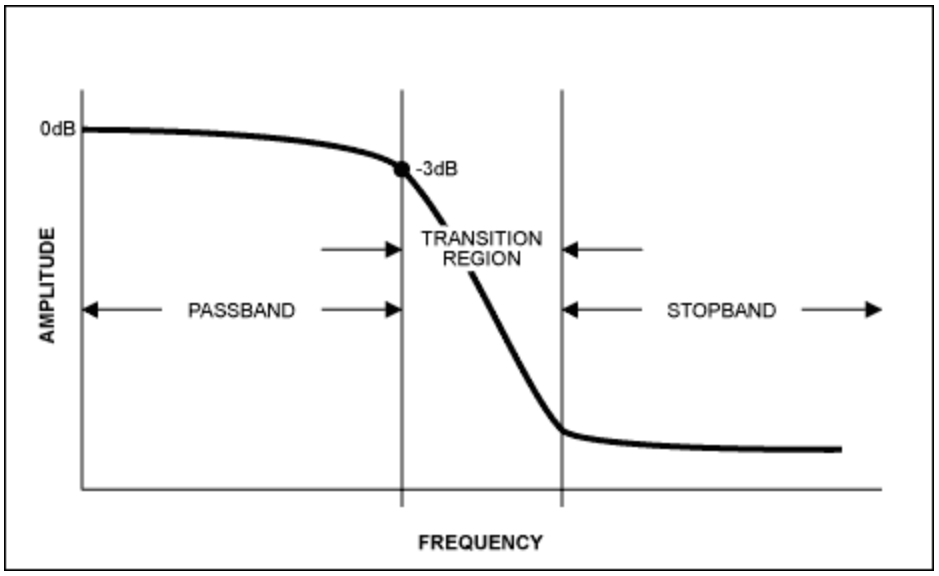
Acceleration sensing is based on the principle of a differential capacitance arising from acceleration-induced motion of the sense element, which further utilizes common mode cancellation to decrease errors from process variation, temperature, and environmental stress. The sense element is hermetically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

12.2.1.3 5th order Anti-aliasing filter

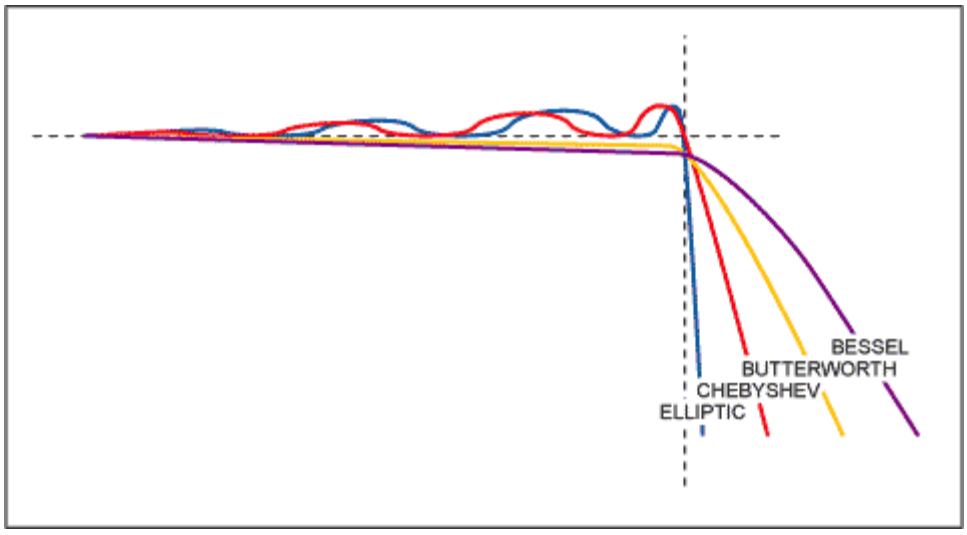
BeanDevice® AX-3D & HI-INC products integrates a high-performance 5th order Butterworth filter.

12.2.1.4 Why using an anti-aliasing filter?

When selecting an analog filter, the goal is to provide a cutoff frequency that removes unwanted signals from the ADC input or at least attenuates them to the point that they will not adversely affect the circuit. An anti-aliasing filter is a low-pass filter that accomplishes this. How does one select the right filter? The key parameters that need observation are the amount of attenuation (or ripple) in the passband, the desired filter rolloff in the stopband, the steepness in the transition region and the phase relationship of the different frequencies as they pass through the filter.



Once the signal frequencies of interest are known, use a simple filter program to determine the filter topology needed to meet the passband, stopband, and transition region requirements. Of the four basic filter types, each has its own advantages

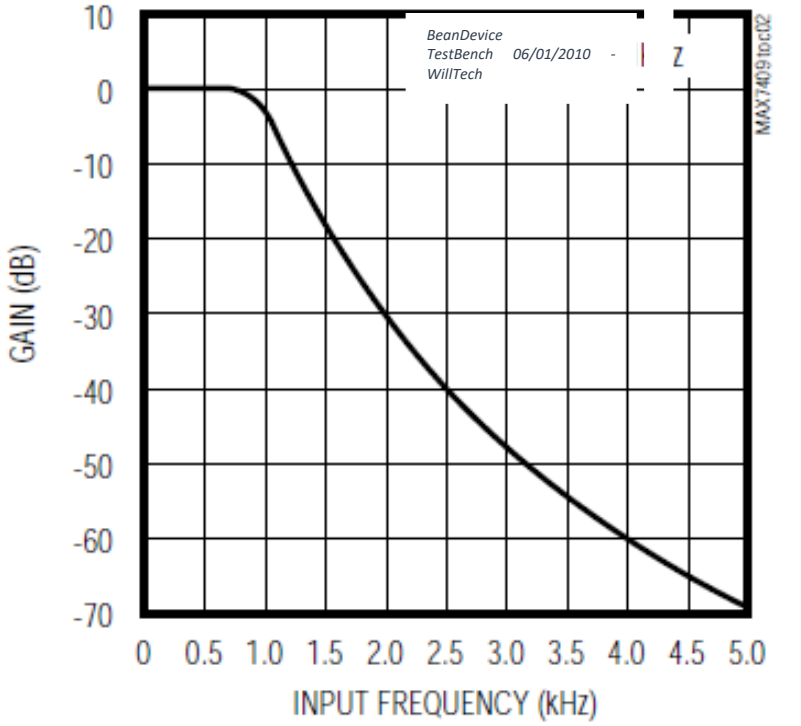


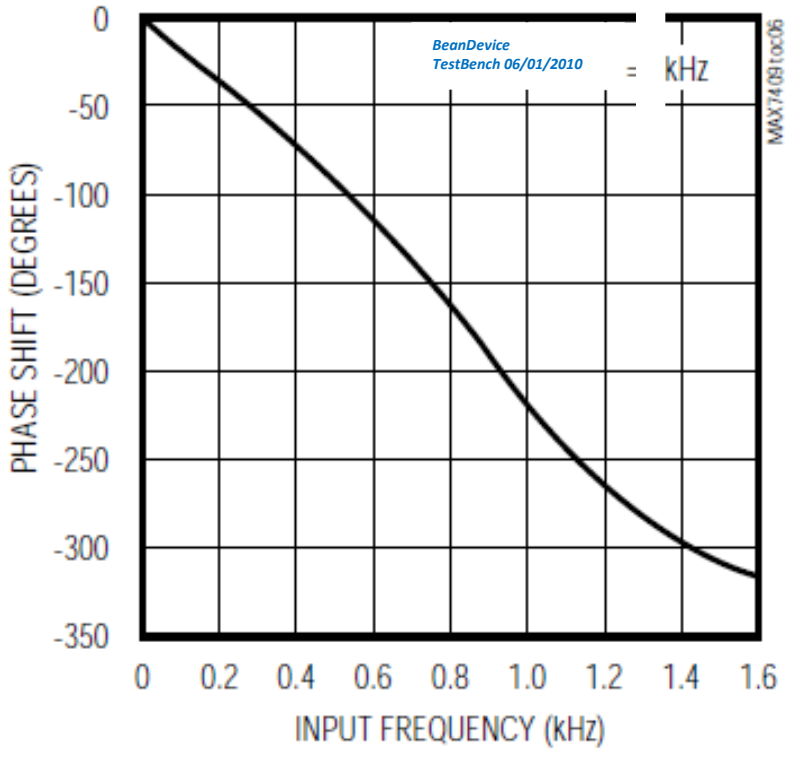
The Butterworth filter used on the BeanDevice® SmartSensor product lines, has the flattest passband region, meaning it has the least attenuation over the desired frequency range. The Bessel filter has a more gradual roll-off but its key advantage is that it has a linear phase response, meaning each frequency component is delayed by an equal amount of time as it passes through the filter. A linear phase response is often specified as a constant group delay, since group delay is defined as the derivative of the phase response with respect to frequency. The Chebyshev filter has a steeper rolloff but more ripple in the passband. The Elliptic filter has the steepest rolloff. For a simple anti-aliasing filter, often times a simple single-pole passive RC filter is acceptable. In other cases an active filter works well. One advantage of an active filter is that for multi-order filters, the operation of the filter is less sensitive to the values of the external components, in particular, the 'Q' value of the filter.

12.2.1.5 Anti-aliasing filter features

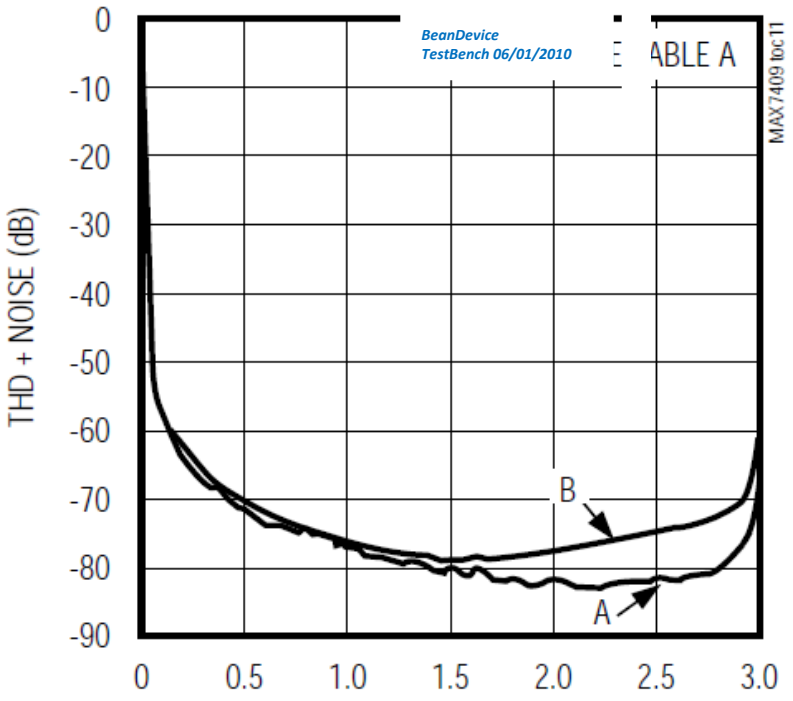
specifications	*Typical*
Type of Lowpass filter	*5-th Butterworth response*
Total harmonic distortion plus Noise (THD + N)	*-81 dB*
Typical Harmonic Distortion	*-86,4 dB*
Cutoff frequency (or corner frequency)	*Configurable from the BeanScape® :* *AX-3D : 0 à 2 KHz* *AX-HD : 0 à 2 KHz* *HI-INC : 0 à 60 Hz*

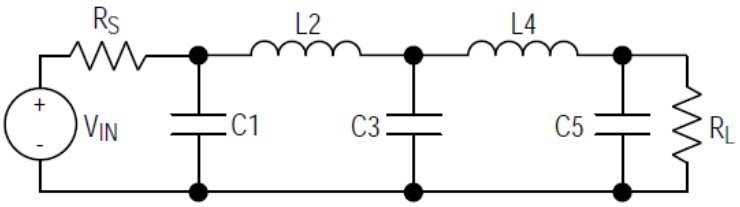
Table 4: Frequency & Phase response curve cutoff frequency 1 KHz





Total Harmonic Distortion plus Noise vs Input signal amplitude





5th-order Ladder Filter network

12.2.1.6 Analog Digital Converter

The Analog-to-Digital (16-bits) converter is based on a true SAR (Successive Approximation Register) architecture with no missing codes.
The ADC integrates an internal temperature sensor, which is useful for performing a system calibration.
The internal reference is temperature-compensated to within 10 mV. The reference is trimmed to provide a typical drift of ±10 ppm/°C.

12.2.2 BeanDevice® HI-INC & HI-INC Xrange

12.2.2.1 Sensor architecture

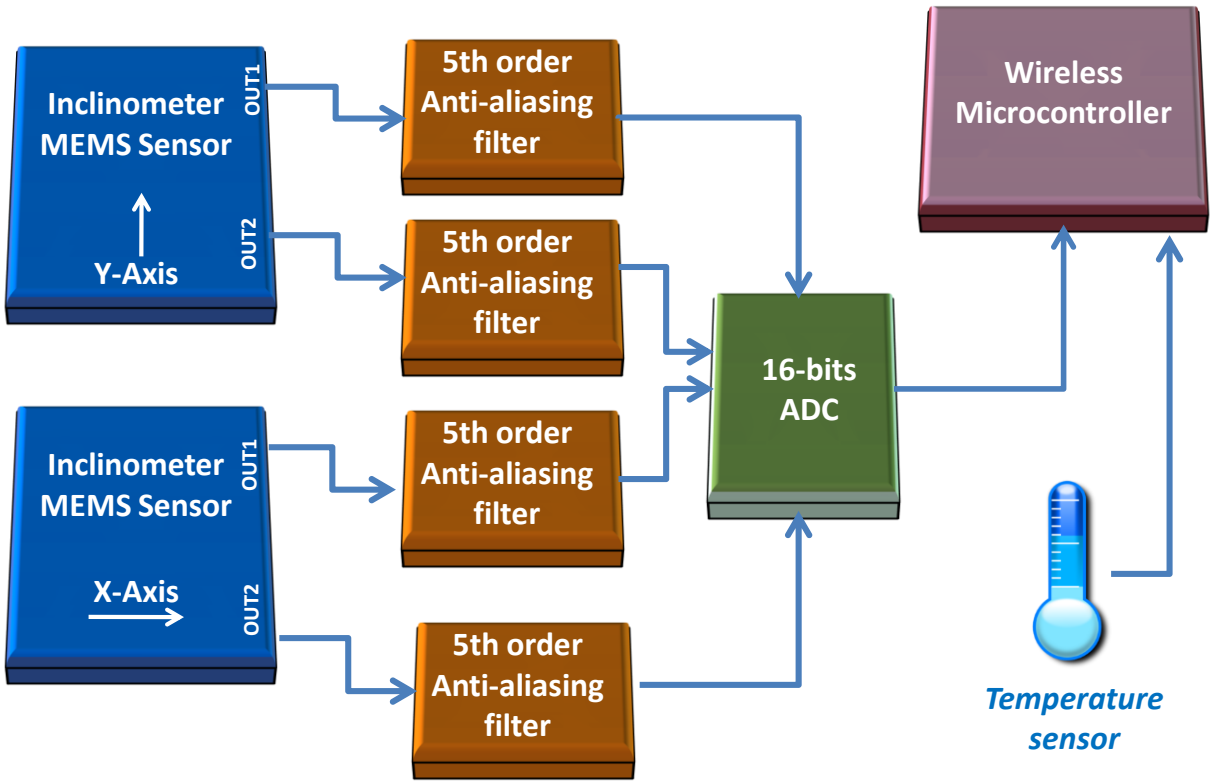


Figure 147: Inclinometer Block Diagram (BeanDevice® HI-INC ±30° and ±15° versions)

12.2.3 Inclinometer Block Diagram (BeanDevice® version)

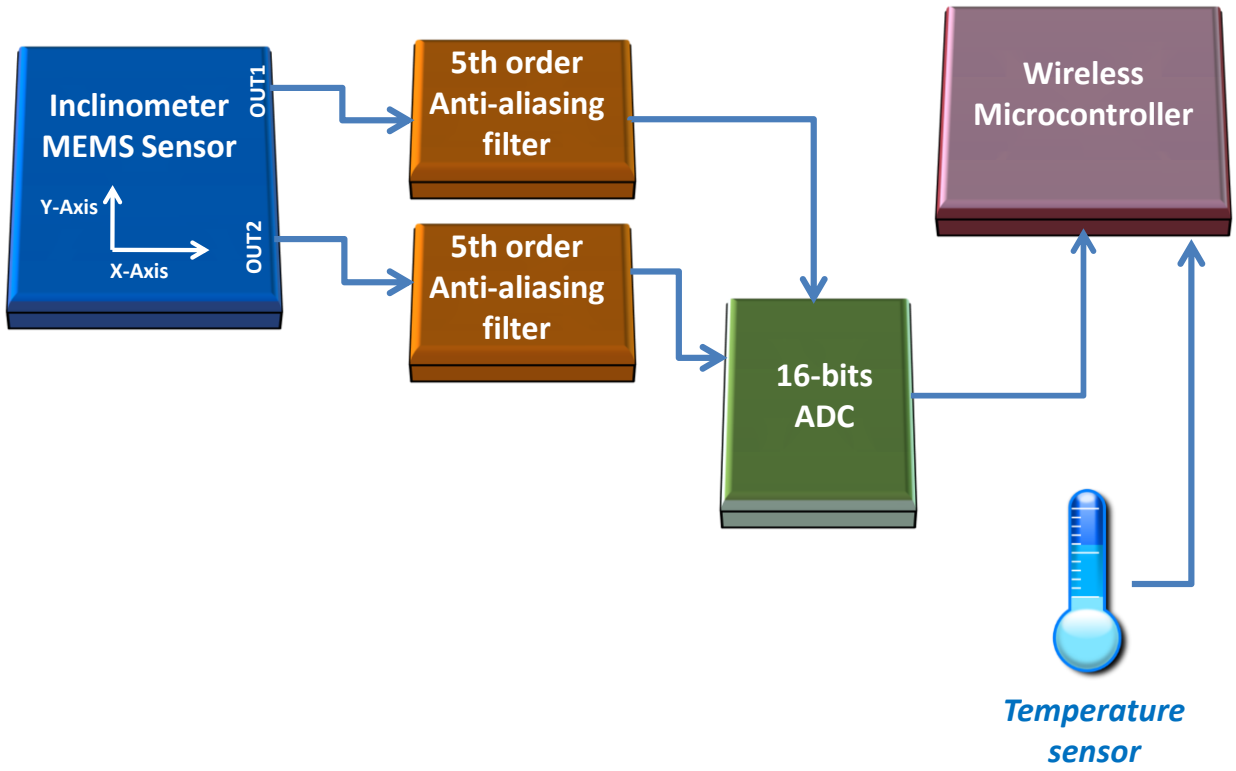


Figure 148: Inclinometer Block Diagram (BeanDevice® version)

12.2.4 MEMS Inclinometer & differential output

The BeanDevice® 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® HI-INC an ideal choice for high accuracy leveling instruments.

The inclinometer used on the BeanDevice® 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.

12.2.5 5th order Anti-aliasing filter

Same specifications as BeanDevice® AX-3D

12.2.6 Analog to digital converter

Same specifications as BeanDevice® AX-3D

12.2.7 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.

12.2.8 Offset & temperature dependencies

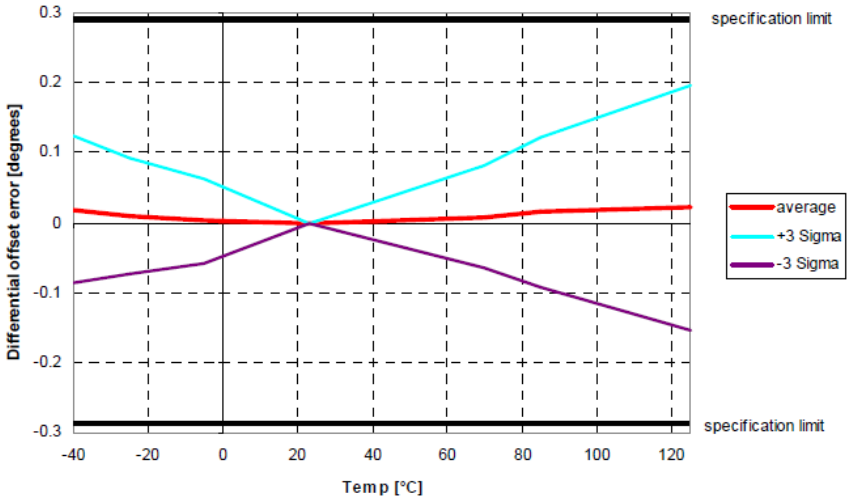
To achieve the best possible accuracy, an internal temperature sensor is used for sensitivity temperature dependency compensation. By using an additional 3rd order polynome compensation curve based on average sensitivity temperature dependency curve and temperature measurement information, it is possible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

- ✓ 0.013%/°C down to 0.005%/°C for the BeanDevice® HI-INC ±15°and ±30° versions
- ✓ 0.014%/°C down to 0.008%/°C for the BeanDevice® HI-INC ±90°

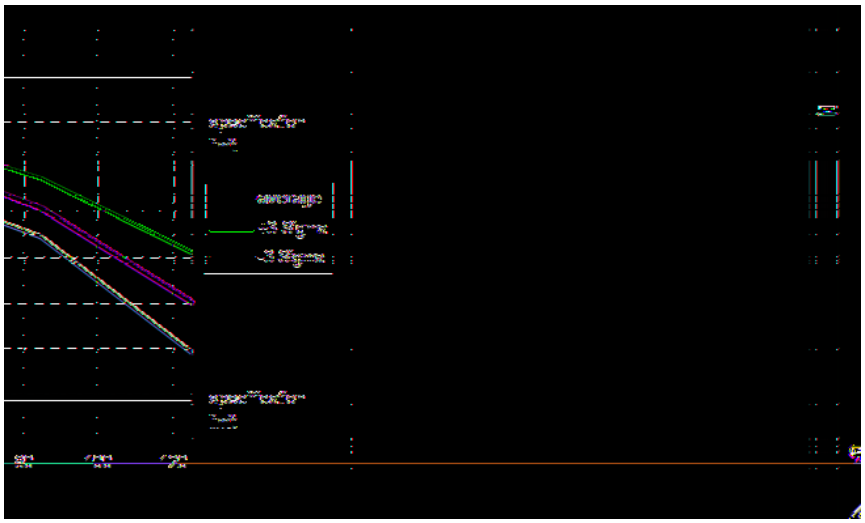
Typical offset and sensitivity temperature dependencies of the inclinometer sensor are presented in following diagrams. These results represent the typical performance of inclinometer sensor components. The mean value

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)



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



12.2.9 BeanDevice® AX-3DS

12.2.9.1 Mems Sensor architecture

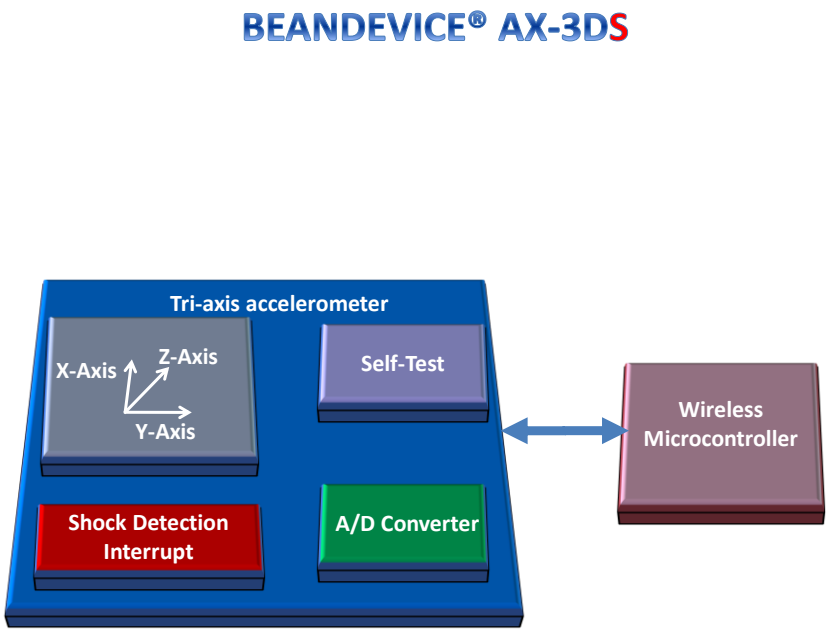


Figure 149: BeanDevice® AX-3DS mems Sensor architecture

12.2.9.2 Shock detection trigger

The shock detection trigger allows the BeanDevice® AX-3DS to wake up when a threshold is reached. The threshold value can be modified from the BeanScape®.

This feature is used for "***Smart shock detection***" data acquisition mode.

12.2.9.3 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 of the BeanDevice®, the sensor will continue to track a shock event.

Depending on the sampling rate of the accelerometer during sleeping, the BeanDevice® current consumption can change:

Accelerometer sampling rate during sleeping	*BeanDevice® AX3DS Current consumption*
0,5 Hz	***21 µA***
1 Hz	***31 µA***
2 Hz	***50 µA***

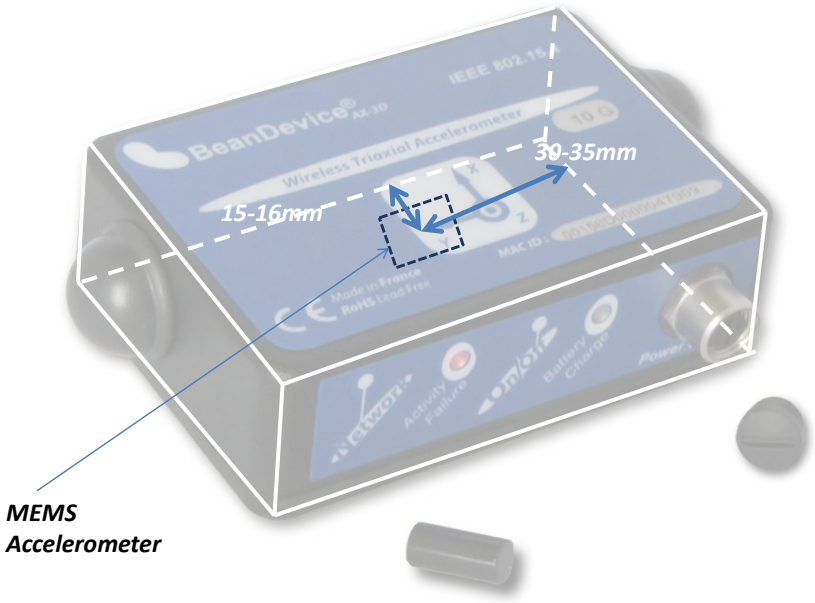
5 Hz	*78 µA*
10 Hz	*130 µA*
50 Hz	*302 µA*
100 Hz	*308 µA*
400 Hz	*343µA*
1000 Hz	*413 µA*

Table 5 : BeanDevice® 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®"

12.2.10 Sensor position inside the casing

12.2.10.1 BeanDevice® AX-3D



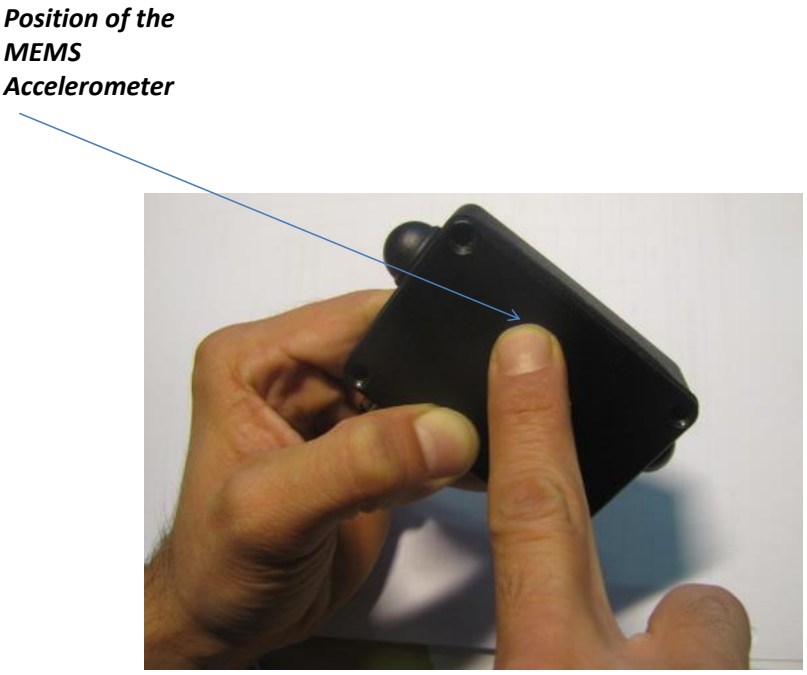


Figure 150: Overview: MEMS Accelerometer in BeanDevice® AX-3D

12.3 APPENDICE 3: MAINTENANCE & SUPERVISION (FOR EXPERIENCED USER)

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

12.3.1 Extending battery life

The battery autonomy depends on several parameters:

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

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

BeanDevice® version	*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*
BeanDevice® AX-3D & BeanDevice® AX-3D XRange	60-61 mA	< 30 uA

BeanDevice® HI-INC ***BeanDevice® HI-INC XRange*** ***BeanDevice® INC***	**70-73 mA**	**<30uA**
BeanDevice® AX-3DS ***BeanDevice® AX-3DS XRange***	**50-55 mA**	**<30uA**

For further information, please read the technical note "TN_RF_002 V1.0 - Current consumption in active & sleeping mode"

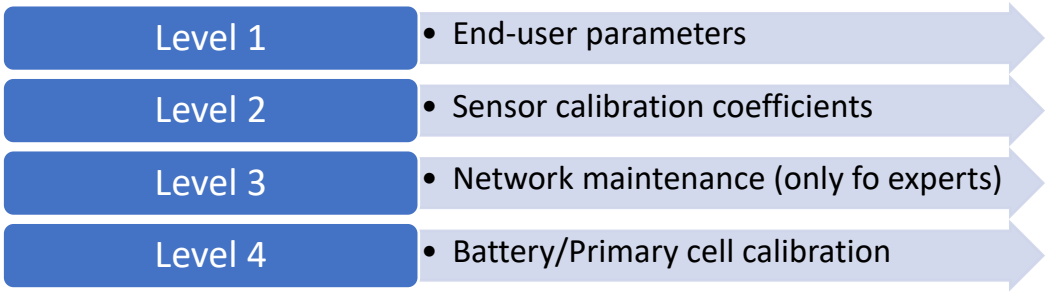
The following table gives you a list of recommendations in order to extend the battery autonomy of your BeanDevice®:

Influence factors on battery lifetime	Observations	Recommendations
Sleeping power mode on your BeanDevice®	Sleeping power mode can be configured on the BeanDevice® from the BeanScape®	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 micro-amperes. ***For further information, please read the technical note TN_RF_010 – « BeanDevice® Power Management »***
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).

12.3.2 Over-the-air Configuration (OTAC) parameters backed up on Flash

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

This memory is organized into several levels:



12.3.2.1 Level 1: End-user OTAC parameters

The following table presents all the defaults configuration parameters:

Parameter	*BeanDevice® version*		
	AX3D & AX-3D Xrange	**HI-INC & HI-INC XRange**	***AX-3DS* & *AX-3DS* XRange**
Power Mode	***Active***	***Active***	***Active***
Data Acquisition duty cycle	***10s***	***10s***	***10s***
Acquisition duration time	***OK***	***OK***	***OK***
Sampling rate	***OK***	***OK***	***OK***
Data Acquisition mode	***LowDutyCycle***	***LowDutyCycle***	***LowDutyCycle***
Alarms Threshold	***H1 :2 ou10*** ***H2 :2 ou 10*** ***S2 :-2 ou -10*** ***S1 :-2 ou -10***	***H1 :20*** ***H2 :20*** ***S2 :0*** ***S1 :0***	***H1 :20*** ***H2 :20*** ***S2 :0*** ***S1 :0***
Anti-aliasing Filter cut-off frequency	***100 Hz***	***10 Hz***	***10 Hz***

Table 6: 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 151: Network reed non-contact button

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

12.3.2.2 Level 2: Sensor calibration parameters

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

Parameter	*BeanDevice® Version*		
	AX3D & AX-3D Xrange	**HI-INC & HI-INC XRange**	***AX-3DS* & *AX-3DS* XRange**
Sensor gain	OK	OK	OK
Sensor offset	OK	OK	OK

Network diagnostic from your BeanScape® software

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

12.3.2.3 Displaying Network information

1. Launch your BeanScape® application
2. Select your BeanDevice® profile, a new tab "Advanced func." will appear in your BeanScape® toolbar;
3. Click on this tab, and then click on "BeanDevice® health status (history)".

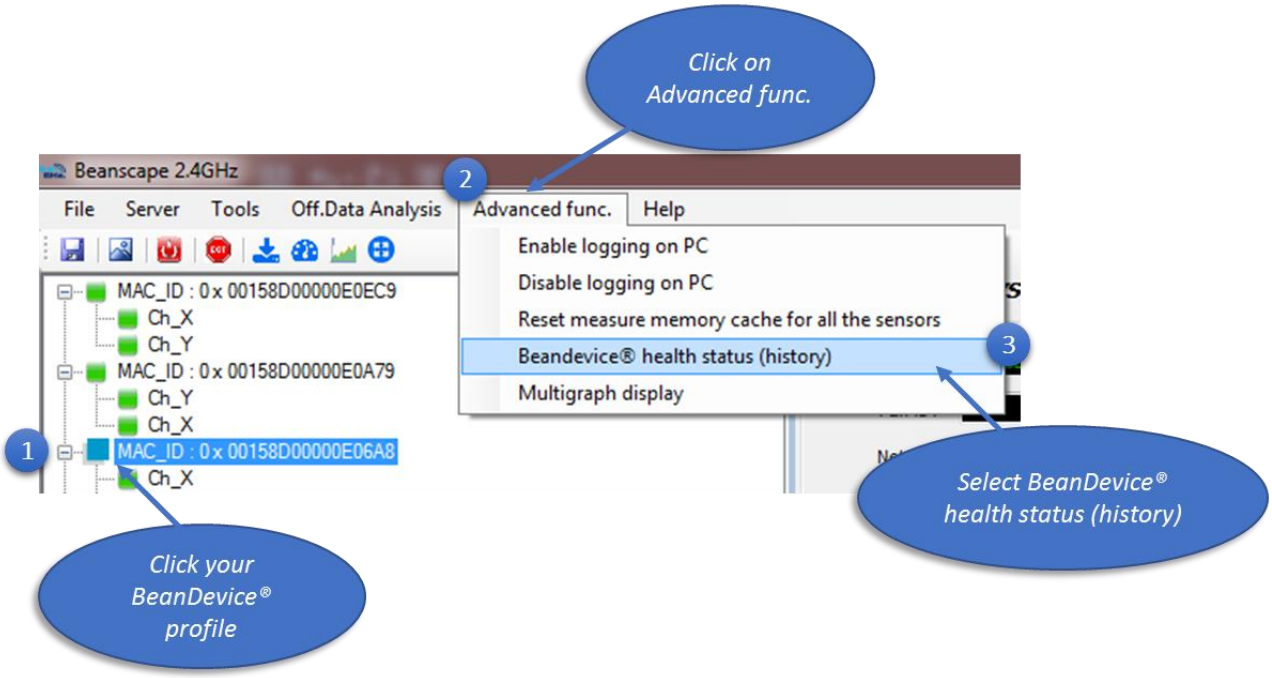


Figure 152: BeanDevice® health status option

A new window occurs:

Figure 153: BeanDevice® health status window

12.3.2.4 Packet Error Rate

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

PER is only available with IEEE 802.15.4 Network; it represents the ratio of “lost data/data send” between the BeanDevice® and the BeanGateway®.

12.3.2.5 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
- ✓ Fix your BeanDevice & BeanGateway on a top of a mast or a building.

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

12.3.2.6 Internal temperature monitoring

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

12.3.2.7 Battery charge monitoring

Battery charge is based on current accumulation. The BeanDevice® 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.

12.3.3 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.

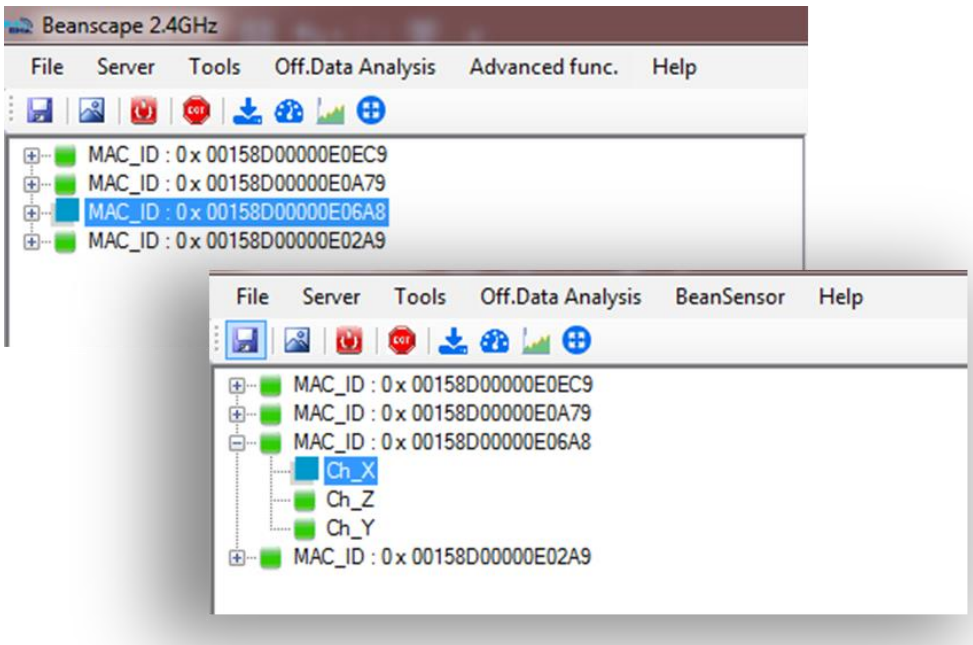


Figure 154: BeanDevice® Scolling menu

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

12.3.3.1 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.

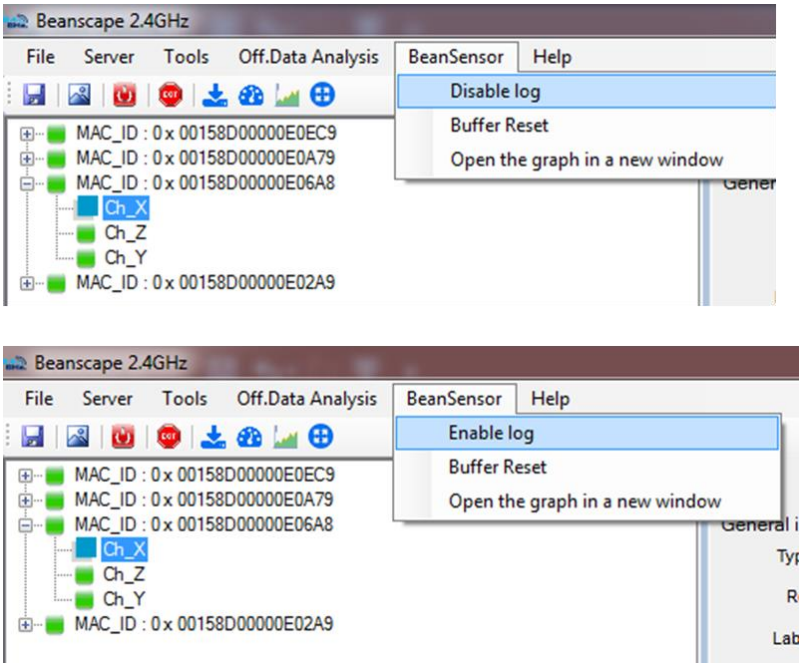


Figure 155: BeanSensor: Enable/Disable Log

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

12.3.3.2 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;

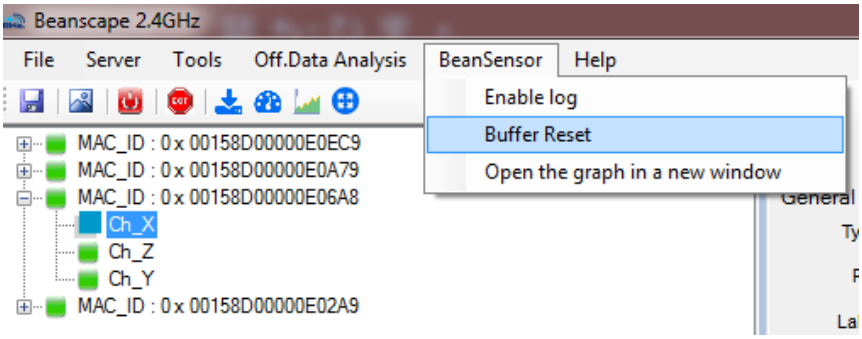


Figure 156: BeanSensor: Buffer Reset option

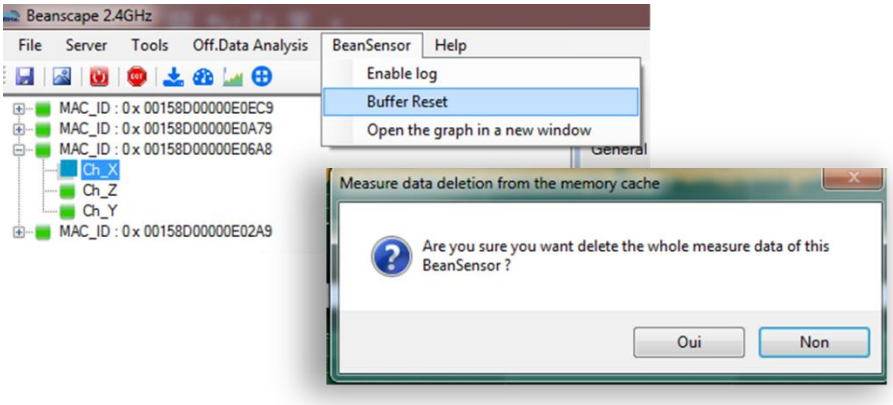


Figure 157: Buffer Reset

12.3.3.3 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.

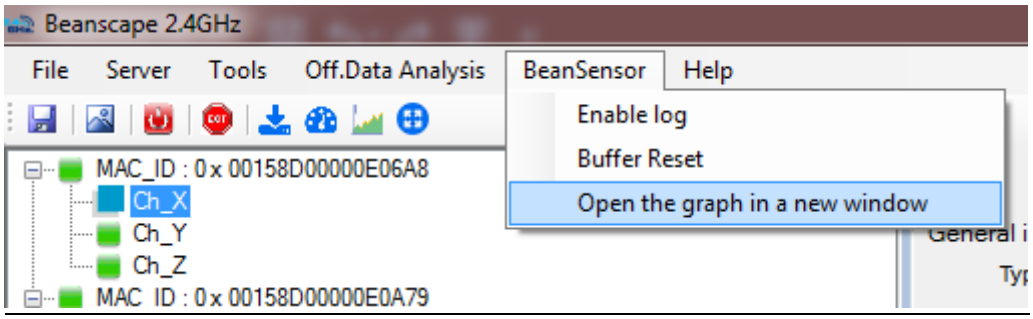


Figure 158: BeanSensor: Open the graph in a new window

You can easily open several graphs in a window.

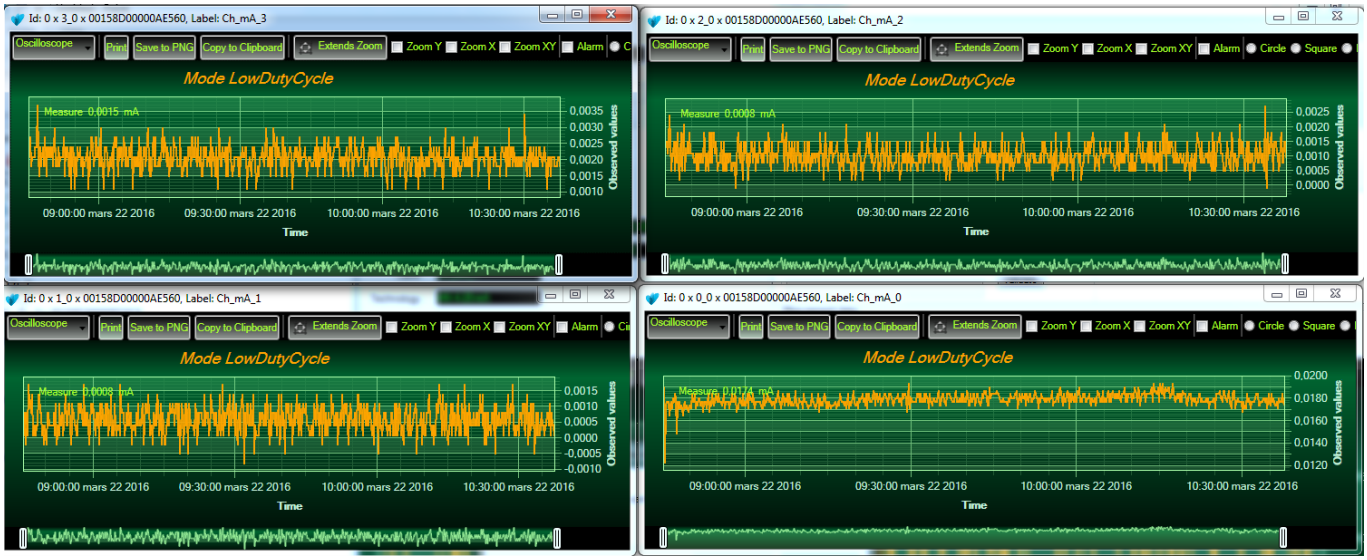


Figure 159: Graphs opened in separated windows

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

12.4 APPENDICE 4: TROUBESHOOTING

✓ ***Why the Red LED is flashing?***

Each time a packet is lost by the BeanDevice®, Nwk/Activity led will blink in red. Try to decrease the wireless range between the BeanGateway® and the BeanDevice®.

✓ ***Why the BeanDevice® 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?***

Please turn off your BeanDevice ®, and then choose an appropriate channel. The channel selection is done from the BeanGateway ®.
For further information, please Read BeanGateway User's Manual BeanGateway ®.

✓ ***Why the BeanDevice® 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;
- If you use a BeanDevice® AN-XX :
  - Check your sensor power supply, maybe you need to increase/decrease your power supply;
  - Check your sensor preprocess time. Maybe your sensor preprocess time is too short?
  - Check the wiring code of your sensor plug;

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

- ✓ If your BeanDevice® operates with sleep phase, the RF Hardware operates also with a sleep phase. Therefore an Over-the-air-configuration will not be possible.
- ✓ 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® and the BeanGateway®.
- ✓ If your BeanDevice® works in streaming mode, in order to keep a full synchronization of the data acquisition, any over-the-air-configuration is authorized.

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

- ✓ If you use a BeanDevice® AX3D/HI-INC/AX-3DS: don't forget to configure the cutoff frequency of your anti-aliasing filter
- ✓ If you use a BeanDevice® AN-mV: use a shielded cable.

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.

12.5 APPENDIX 5: SENSOR CALIBRATION

12.5.1 Factory Calibration procedure

12.5.1.1 Beandevice® HI-INC/INC & HI-INC Xrange (Wireless Inclinometer)

The calibration procedure is based on a side-by-side comparison with a reference tiltmeter (Level development, Ref: SOLAR-2-05-1-RS232, accuracy ±0.01° on the FS). For a better measurement stability, the two tiltemeters are mounted on a sinus table (Mecamag, ref: 1005/02/175100S, accuracy ±5 seconds, planity ±0.005/100mm).

12.5.1.2 BeanDevice® AX-3D/AX-3DS & AX-3D Xrange (Wireless Accelerometer)

A static calibration method is used to calibrate the sensor.

12.5.2 Re-calibration

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

BeanDevice® version	*Operating temperature < 40°C*	*Operating temperature > 40°C*
BeanDevice® AX-3D & BeanDevice® AX-3D Xrange	**6 years**	**3 years**
BeanDevice® AX-3DS	**3 years**	**2 years**
BeanDevice HI-INC, BeanDevice® HI-INC Xrange and BeanDevice® INC	**6 years**	**3 years**

Click here for more information about calibration settings

12.6 FIREWALL EXCEPTION FOR BEANSCAPE®

By default, firewall blocks all unknown network traffic coming in to the network. To permit traffic through the firewall we create exceptions (or rules) that allow certain traffic on the network. In our case the rules are defined by the software which is BeanScape.

Usually when launching BeanScape for the first time your Windows OS will ask you to add an exception and to allow the software to use your network resources, however in case this doesn't occur or rejected, manually adding BeanScape to exceptions list is possible through these following steps:

1. Use your Search bar at the windows launcher and look for "Allow an app through Windows Firewall"

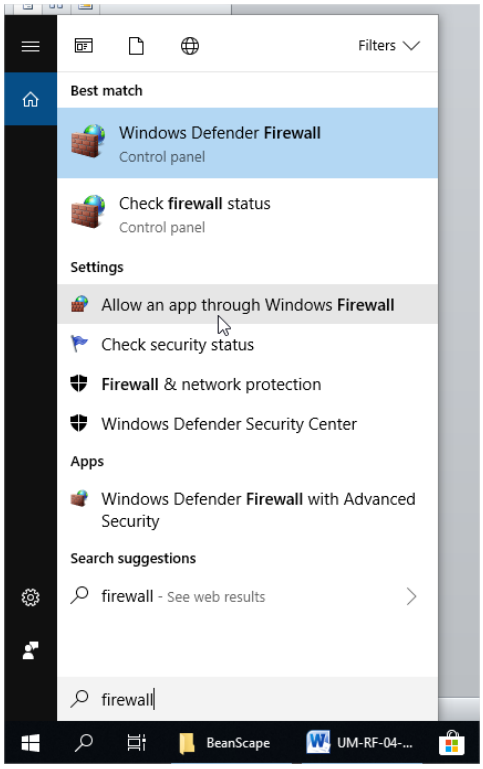


Figure 160 :Windows search for firewall screenshot

2. Look for BeanScape in the list and check its box, check Private if you are only willing to use BeanScape in your LAN or Public for allowing remote access from outside the LAN.Validate and your BeanScape will be allowed in your network.

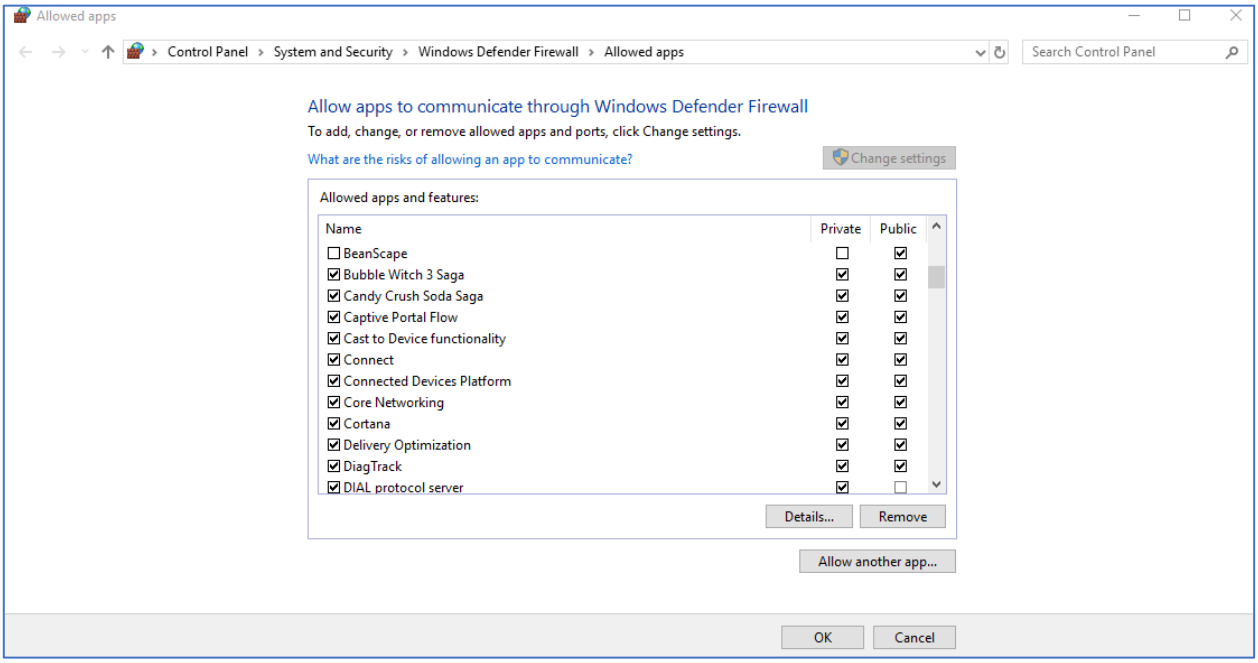


Figure 161: allowed apps window

If you are not familiar to configure a firewall exception, you can directly from BeanScape® add this rule automatically.

On the BeanScape® menu select Tools, then Advanced Settings then click on validate to add BeanScape® to the Firewall.

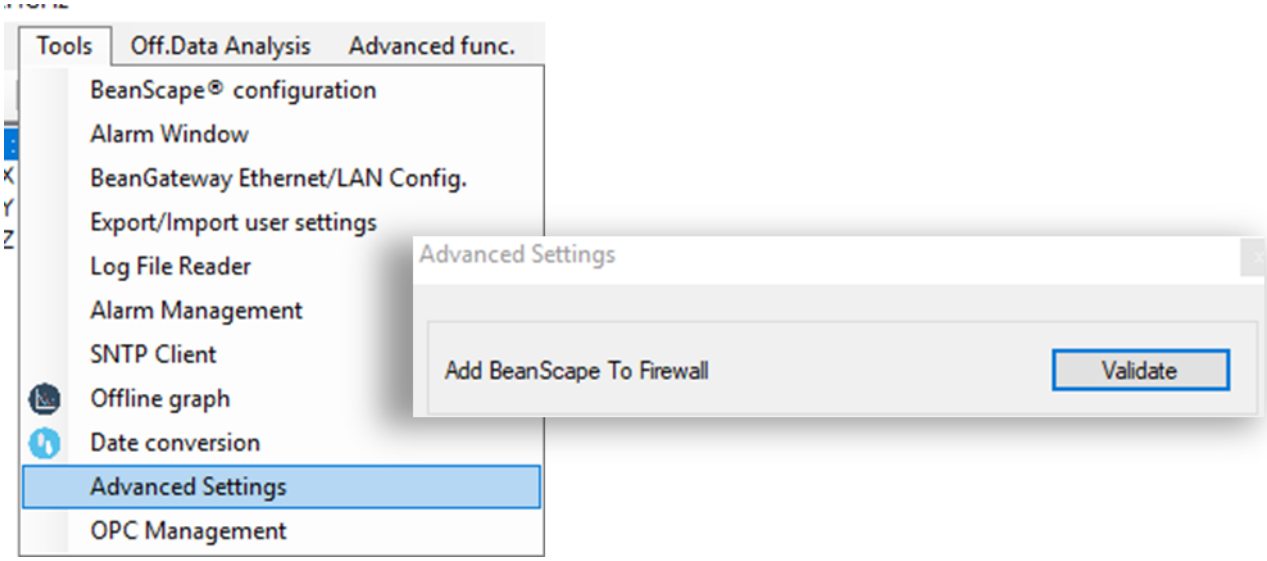


Figure 162: Firewall auto exception