BeanDevice®

Version 2.3.1

TECHNICAL NOTE

DATA ACQUISITION MODE AVAILABLE ON WILOW®

BeanAir

Rethinking Sensing Technology

Wilow

DOCUMENT			
Document ID	TN-RF-18	**Version**	V2.3.1
External reference	N.A.	**Date**	12/11/2021
Author	Fahd ESSID, Application/Support Engineer		
		Project Code	
Document's name	Wilow WIFI sensor data acquisition modes updated		

VALIDATION			
Function	**Destination**	**For validation**	**For info**
Writer	Aymen Jegham	✓	
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**
V1.0	28/09/2017	Aymen Jegham	• Creation of the document
V1.1	12/02/2018	Aymen Jegham	• S.E.T mode added
V1.2	12/07/2018	Aymen Jegham	• BeanDevice® Wilow® X-INC added: available data acquisition mode, • Max Sampling rate table updated • Data acquisition field description updated • Alarms thresholds for SET mode added
V1.3	26/07/2018	Aymen Jegham	• Screenshots updated
V1.4	03/07/2019	Fahd ESSID	• Vocabulary Update • Commissioning mode deleted • Shock Sensor Config added • Online Data Analysis added

			• Offline Data Analysis added
V1.4.1	02/10/2019	YAHYA Bassem	• Alarm threshold management (Alarm mode) update
V1.5	03/04/2020	Seddik ATTIG	• Screen shots update • Online/offline data analysis for AX-3D • Online data analysis for Hi-Inc
V1.6	20/04/2020	Seddik ATTIG	• Videos links update
V1.7	29/06/2020	Seddik ATTIG	• PPV Restrictions
V1.8	17/07/2020	Seddik ATTIG	• Streaming burst with saver battery mode • Triple A Alarm thresholds with alarm mode and SET mode
V1.9	30/09/2020	Seddik ATTIG	• Updates on the Firmware version 4.1
V2.0	27/10/2020	Seddik ATTIG	• Acceleration filter • Restrictions using the online data analysis features. • Acceleration unit
V2.1	27/11/2020	Seddik ATTIG	• Soft SET DAQ mode
V2.2	26/03/2021	Seddik ATTIG	• Update Shock detection section
V2.3	08/04/2021	Seddik ATTIG	• Update the offline velocity section • Update the video links.
V2.3.1	12/11/2021	Seddik ATTIG	• Links updated

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 ABBREVIATIONS

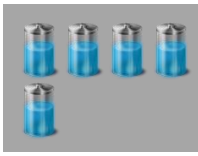
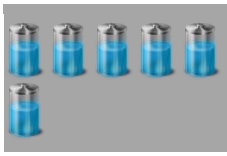
AES	Advanced Encryption Standard
CCA	Clear Channel Assessment
CSMA/CA	Carrier Sense Multiple Access/Collision Avoidance
GTS	Guaranteed Time-Slot
Ksps	Kilo samples per second
LLC	Logical Link Control
LQI	Link quality indicator
LDCDA	Low duty cycle data acquisition
MAC	Media Access Control
PAN	Personal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

4. DOCUMENT ORGANIZATION

Systen Overview	• Describes all the data acquisition available on the Beandevice® Wilow®
Data acquisition configuration from the BeanScape® software	• DAQ configuration is detailed on that field
Examples of Data Acquisition	• Configuration examples from the BeanScape® Wilow software
Appendix 1	• Flowchart diagrams for different acquisition mode

1. ADVANTAGES & LIMITS OF EACH DATA ACQUISITION MODE

The following table presents the advantages & limits of the different Data acquisition mode:

	Low Duty Cycle	Alarm	Streaming	S.E.T	Smart Shock Detection
Wireless Stack compatibility	*ULP (Ultra Low power) Wi-Fi – IEEE 802.11 b/g/n*				
Low consumption					
Low Duty Cycle	*1s to 1day*				
Data sampling	*N.A.*		*1 Sps to 2 Ksps maximum (per channel)*	*1 Sps to 200 Sps maximum(per channel)*	*1 Sps to 2 Ksps maximum(per channel)*
Data acquisition type	*Static*	*Static*	*Dynamic*	*Dynamic*	*Dynamic*
Class of application	*Static measurement with sleeping mode*	*Monitoring on remote sites (lack of external power supply)*	*Dynamic measurement: Vibration, acceleration, strain gauge*	*Monitoring on remote sites (lack of external power supply) with a better robustness of the solution*	*Shock detection (BeanDevice Wilow AX-3DS only)*
Network Size					

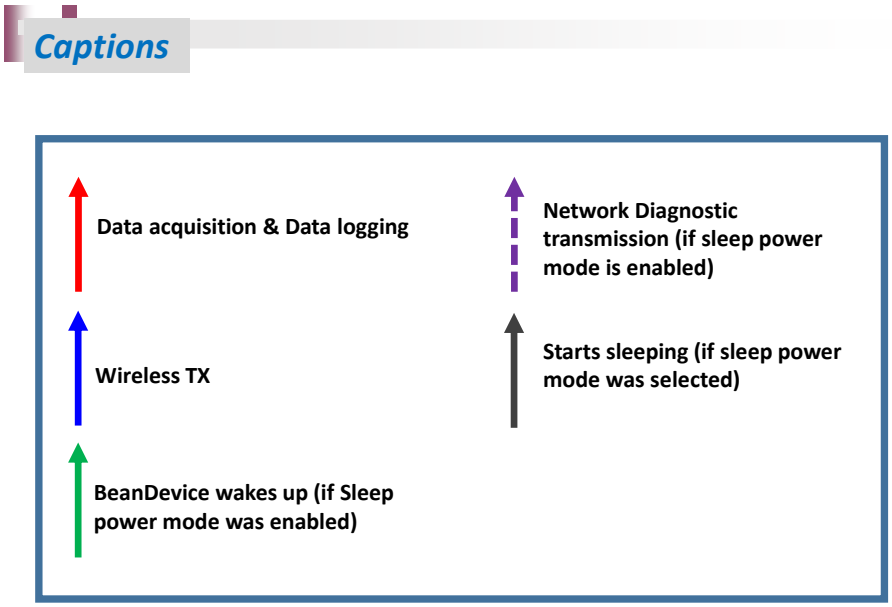
2. AVAILABLE DATA ACQUISITION MODE

The following table presents the different Data acquisition mode available on the BeanDevice® Wilow®:

Data acquisition Mode	*BeanDevice® Wilow® AX3D*	*BeanDevice® Wilow® AX3DS*	BeanDevice® Wilow® *HI-INC*	BeanDevice® Wilow® *X-INC*
Low Duty Cycle Data Acquisition(LDCDA)	✓	✓	✓	✓
Alarm	✓	✓	✓	✓
Streaming	✓	✓	✓	✓
Shock detection	✓	✓		✓
Streaming with event-trigger (SET)	✓	✓		✓

3. SYSTEM OVERVIEW

3.1 CAPTIONS



3.2 LOW DUTY CYCLE DATA ACQUISITION (LDCDA)

3.2.1 Operation Mode

LDCDA is suitable for static measurement (tilt, pressure, temperature….) requiring a low power operation on your BeanDevice® Wilow®.

Measurement duty cycle can be configured between one Data acquisition & transmission per second to one Data acquisition & transmission per day.

Low Duty Cycle Data Acquisition Mode

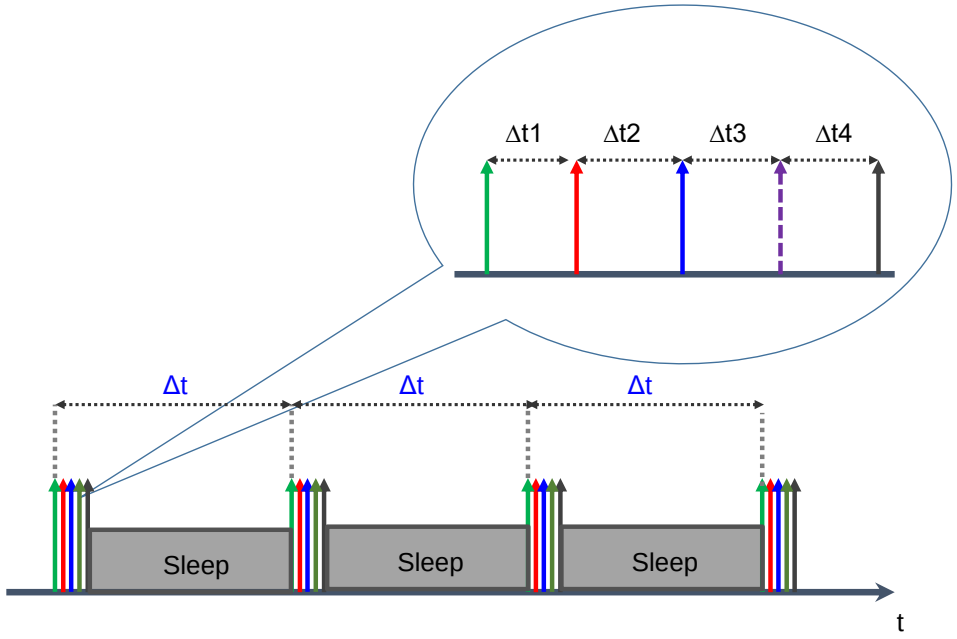


Figure 1: LDCDA Mode

In Low Duty Cycle Data acquisition (LDCDA), the BeanDevice® Wilow® operates as follows:

- ✓ ***Step 1*** *: A Data acquisition is performed;*
- ✓ ***Step 2****:* ***If Datalogger feature is enabled****: Data acquisition is backed up on the BeanDevice® Wilow® Datalogger;*
- ✓ ***Step 3:*** *If* ***"Wireless transmission"*** option is enabled*: The Data acquisition is transmitted;*
- ✓ ***Step 4****: A Network diagnostic is performed and transmitted (depending on the diagnostic cycle defined by the user)*
- ✓ ***Step 5:*** *The* ***BeanDevice® Wilow®*** goes to sleep *(if "sleep" or "sleep with network listening" power mode is enabled)*

Go to the LDCDA Flowchart diagram section for a flowchart representation of the LDCDA Data acquisition mode.

See "Low duty cycle data acquisition mode on BeanDevice® Wilow" YouTube video

3.2.2 Data acquisition cycle

Data acquisition cycle is user-definable from the ***BeanScape®*** supervision software***;*** it includes a series of protection mechanisms against unauthorized configurations:

Data Acquisition cycle (depending on the power mode status)		*Data acquisition duty cycle (in seconds)*
Minimum values	BeanDevice® Wilow® is operating with "Sleep power mode"	*1s*
	The BeanDevice Wilow® is operating with "Active" power mode	*1s*
Maximum value		*1day (86400 seconds)*

If a short Data acquisition cycle is configured, the battery life will decrease rapidly. For a better battery life, make sure that its power mode is configured in "sleep mode".

3.3 « ALARM»

3.3.1 Operation mode

The alarm mode allows user to receive notification via email when the measurement reaches the preconfigured thresholds

- ✓ Data acquisition is done with a duty cycle of ***Cm*** (configurable with the BeanScape®)
- ✓ Data transmission is done with a duty cycle of ***Ct = N*Cm,*** N is configurable from the BeanScape® supervision software, **N** is the TX Ratio.
- ✓ During the data acquisition period, whenever an alarm threshold (user-configurable) is reached (4 alarm threshold levels High/Low), an alarm notification is transmitted to the ***BeanScape®***;
- ✓ Alarm Notif delay represents the measurement in seconds duration for every cycle .

Alarm Mode

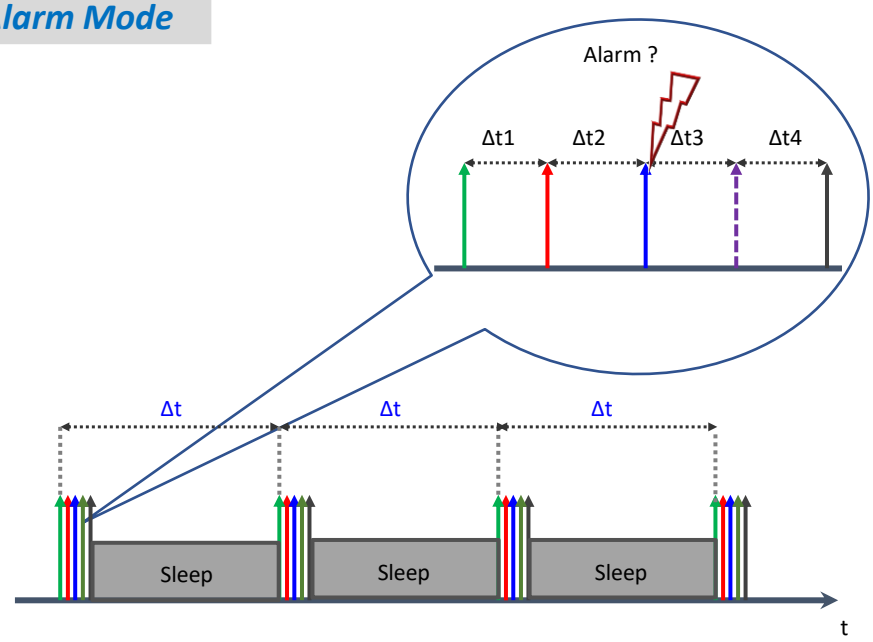


Figure 2: Alarm mode operation

In alarm mode, the BeanDevice® Wilow® operates as follows:

- ✓ ***Step 1:*** *The* ***BeanDevice® Wilow®*** *wakes up (if sleep mode/ sleep mode with network listening is selected), all the sensors connected to the BeanDevice® are also activated*
- ✓ ***Step 2:*** *A Data acquisition is performed*
- ✓ ***Step3****: If the Data logger function is enabled: the Data acquisition is registered on the* ***BeanDevice® Wilow®*** *data logger if* a measurement cycle is reached
- ✓ ***Step 4:*** *If "Wireless transmission" option is enabled: The Data acquisition is transmitted to the* ***BeanScape ®*** if a transmission cycle is reached*;*
- ✓ ***Step 5:*** *A Network diagnostic is performed and transmitted to* ***BeanDevice® Wilow®*** *(depending on diagnostic cycle defined by the user);*
- ✓ ***Step 6:*** *The* ***BeanDevice® Wilow®*** goes to sleep period *(if sleep mode is selected);*

If the alarms thresholds (High level alarm >=High level alert > Low level alert>= Low level alarm) are not well defined, *you can end up with spurious and untimely alarms. Do not forget to properly configure the alarms thresholds before starting the alarm mode.* ***Read the section "Alarm threshold configuration from the BeanScape®".***

See “Alarm mode on BeanDevice Wilow” YouTube video

4.1.1 Alarm threshold management (Alarm mode)

This section is related to the alarm thresholds management on the BeanDevice® Wilow®.

Four alarms thresholds are available. The user can remotely configure the threshold values from the BeanScape ®:

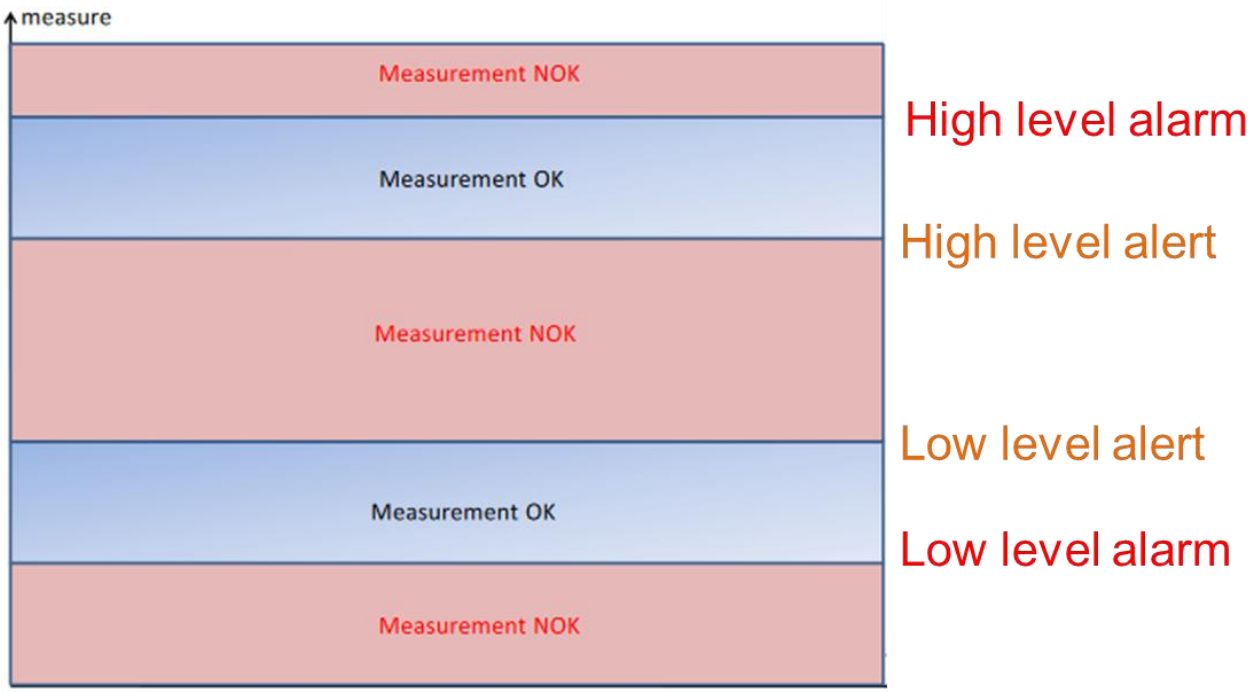
- **2 Alarm levels (High level alarm & Low-level alarm)**
- **2 Alert levels (High level alert & Low-level alert)**

Alarms threshold are organized as follows:

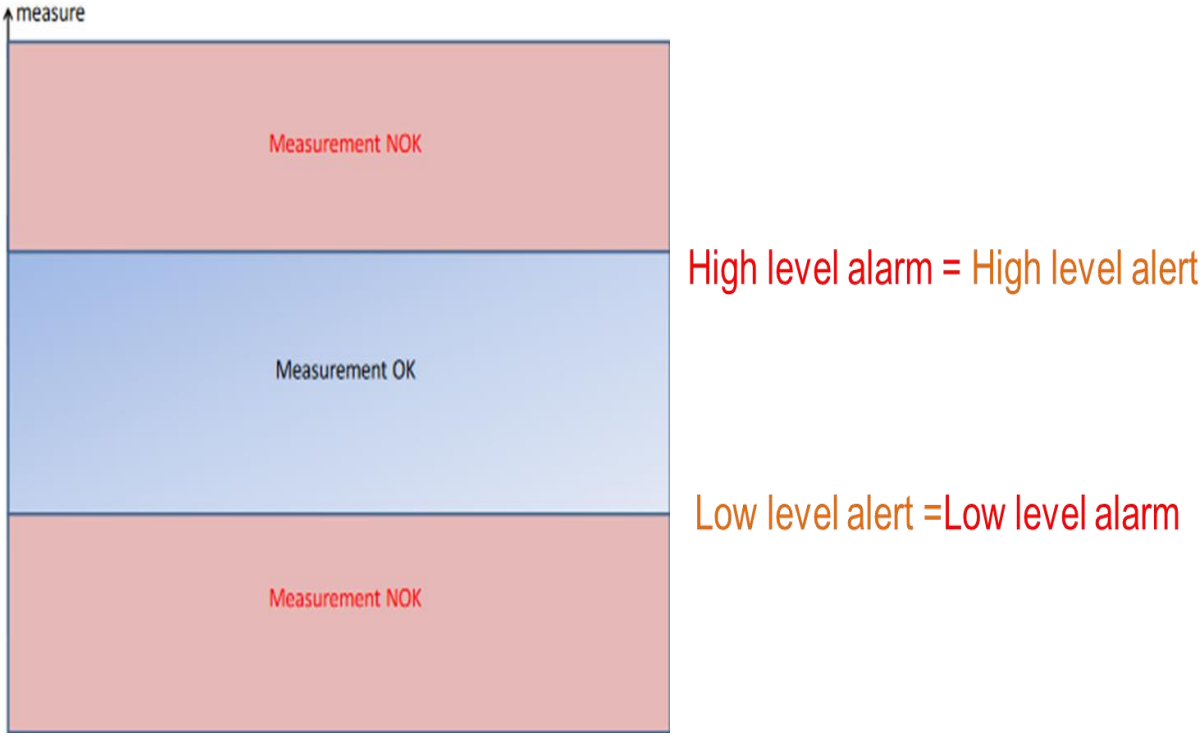
High level alarm >=High level alert > Low level alert>= Low level alarm

Several configurations are possible:

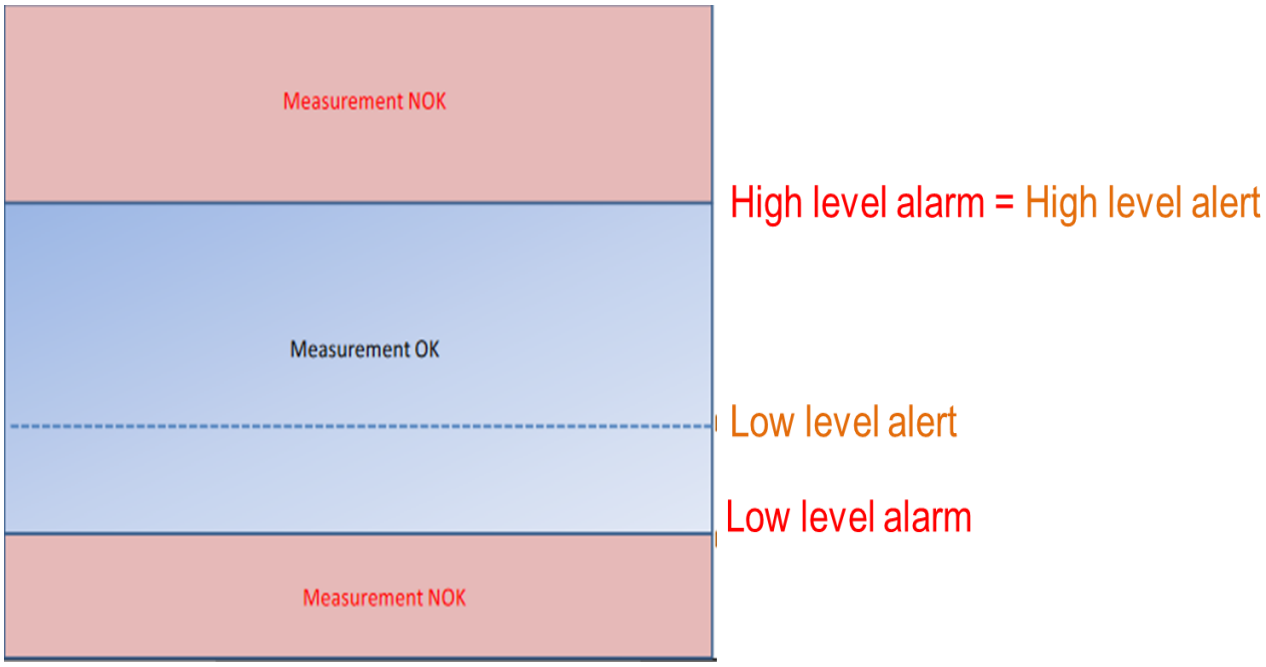
If (High level alarm >=High level alert > Low level alert>= Low level alarm)



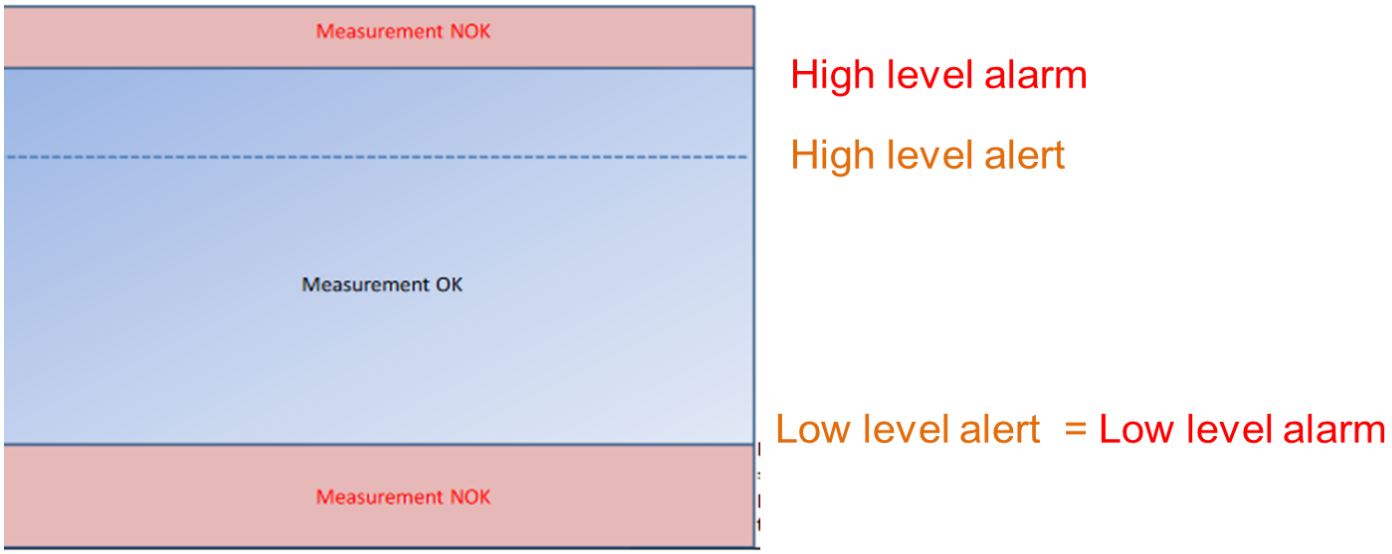
If (High level alarm =High level alert) & (Low level alert= Low level alarm)



If (High level alarm =High level alert) & (Low level alert > Low level alarm)



If (High level alarm > High level alert) & (Low level alert = Low level alarm)



If the alarms thresholds (High level alarm High level alert Low level alert = Low level alarm) are not well defined, **you can end up with spurious and untimely alarms. Do not forget to properly configure the alarms thresholds before starting the alarm mode.**

Alarm mode on firmware version 4.0 and above

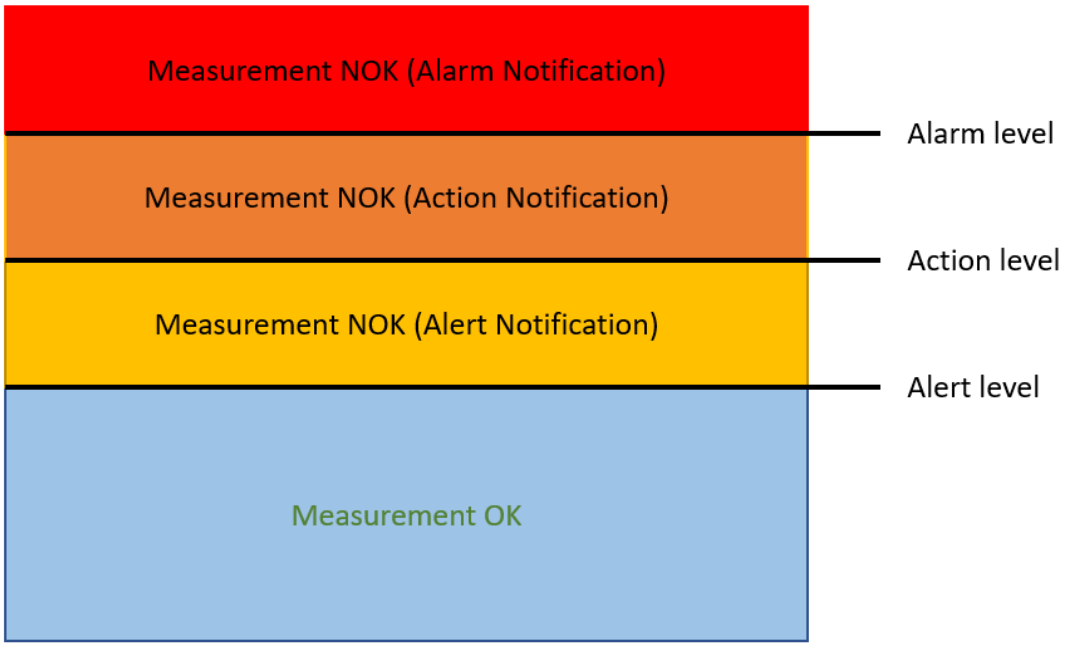
From the BeanDevice® Wilow firmware version V4R0 the Alarm threshold architecture was improved and changed from 4 levels of Alarm to 3 Alarm levels for both Alarm mode and also SET mode.

The threshold is based on AAA (Alert/Action/Alarm) with:

Alert value < Action value < Alarm value

Measurement exceeding each threshold will result in notification sent with the appropriate reports and info via email and audio notification on the computer will take place.

To configure your thresholds, click on Alarm and S.E.T Config tab after selecting the related measurement channel.



3.4 STREAMING

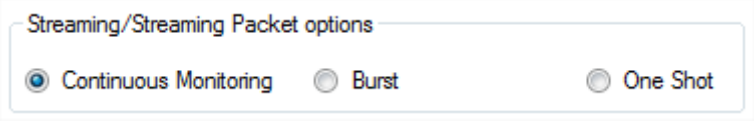
3.4.1 Operation mode

Streaming mode is dedicated to dynamic data acquisition (vibration, strain gauge, deformation, acceleration…).

It is suitable for users requiring a high data sampling rate (maximum sampling rate is 2 Ksps).

For completing this type of data acquisition, the BeanDevice® Wilow® provides other options:

- ✓ ***« Continuous monitoring » option***: Data acquisition is transmitted to the ***BeanScape®*** in a continuous flow rate. This mode is adapted for continuous monitoring on machines.
- ✓ ***« Burst » option***: Data acquisition is transmitted to the ***BeanScape®*** in a burst flow rate
- ✓ ***« One Shot » option***: Data acquisition is transmitted to the ***BeanScape®*** during a period time, then the ***BeanDevice® Wilow®*** will be stoped



See “Streaming mode on BeanDevice® Wilow” YouTube video

3.4.1.1 Streaming with “**continuous monitoring**” option

In streaming mode with continuous monitoring option selected, all measured values are transmitted in real-time within a continuous flow at 2000 samples per second maximum.

The BeanDevice® Wilow® operates as follows:

- ✓ ***Step 1*** *: A Data acquisition is performed with a high sampling rate*
- ✓ ***Step 2****: If Data logger function is enabled: the Data acquisition is backed up on the BeanDevice® Data logger;*
- ✓ ***Step 3:*** *If “Wireless transmission” option is enabled:* Data is transmitted to the ***BeanScape®*** *in the real time of acquisition*
- ✓ ***Step 4****:* Step 1 to Step 3 are repeated without stopping;

3.4.1.2 Streaming with **“One shot”** option

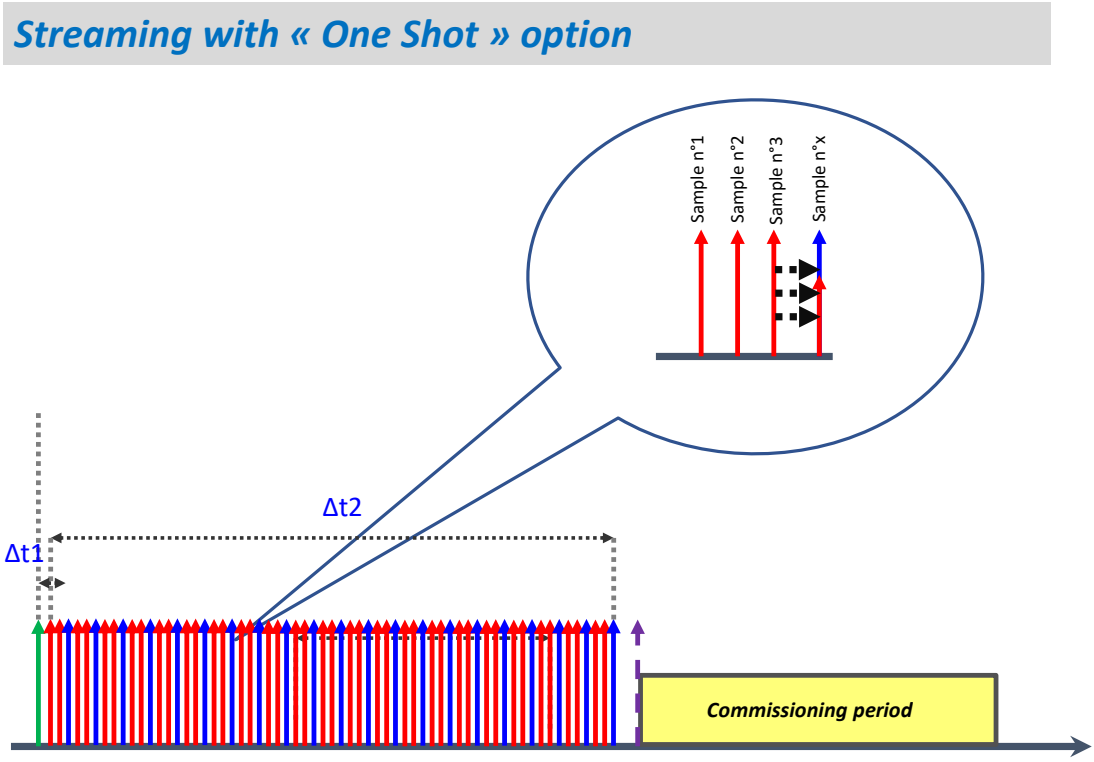


Figure 3: Streaming with one shot option

*The **BeanDevice® Wilow®** operates as follows:*

- ✓ ***Step 1**: A Data acquisition is performed with a data sampling rate (defined by user),*
- ✓ ***Step 2**: **If "Datalogger" option is enabled**: Data acquisition is backed up on built-in data logger* in real time
- ✓ ***Step 3: If "Wireless transmission" option is enabled**:* Data acquisition is transmitted to the **BeanScape®**
- ✓ ***Step 4**: **Step 1** to **Step 3*** are repeated until the data acquisition duration is completed
- ✓ ***Step 5**:* At the end of data acquisition duration, *a Network diagnostic is performed and transmitted to the **BeanScape® Wilow®***
- ✓ ***Step 6**: The **BeanDevice® Wilow®*** will be stoped, and will wait for a new OTAC request;

3.4.1.3 Streaming mode with "Burst" option

*The **BeanDevice® Wilow®** operates as follows:*

- ✓ ***Step 1**: A Data acquisition is performed with a data sampling rate (defined by user),*
- ✓ ***Step 2**: **If "Datalogger" option is enabled**: Data acquisition is backed up on built-in data logger* in real time
- ✓ ***Step 3: If "Wireless transmission" option is enabled**:* Data acquisition is transmitted to the **BeanScape®**
- ✓ ***Step 4**: **Step 1** to **Step 3*** are repeated until the data acquisition duration is completed
- ✓ ***Step 5**:* At the end of data acquisition duration, *a Network diagnostic is performed and transmitted to the **BeanScape® Wilow®***
- ✓ ***Step 6**: The **BeanDevice® Wilow®*** goes to sleep power mode *(if sleep mode/ sleep with network listening power mode is enabled);*
- ✓ ***Step 7: BeanDevice® Wilow®** wakes up and starts again from Step 1 when the predefined acquisition cycle is reached.*

3.4.2 Maximum sampling rate

The following table describes the maximum sampling rate depending on the number of sensor channels activated.

BeanDevice® Wilow® Model		BeanDevice® Wilow® AX-3D	BeanDevice® Wilow® HI-INC	BeanDevice® Wilow® AX3DS	BeanDevice® Wilow® X-INC
Number of enabled DAQ /Sensor channel	*1 Channel*	**2 KSPS**	**2 KSPS**	**1.6 KSPS**	**2 KSPS**
	2 Channels	**2 KSPS**	**2 KSPS**	**1.6 KSPS**	**2 KSPS**
	3 Channels	**2 KSPS**	**2 KSPS**	**1.6 KSPS**	**2 KSPS**

Table 1: Maximum sampling rate

Take notice: 1 KSPS == 1Ksamples per second with a resolution of 24-bits

The WSN comes with the following restrictions:

- ✓ *Data acquisition duration must be lower than Data acquisition cycle. .*

Streaming mode: PER (Packet Error Rate) will increase proportionately with the sampling rate, mainly if several BeanDevice® Wilow® are connected on the same WSN. It is highly recommended to test several WSN topologies in order to find the right suitability between the WSN size and the sampling rate.

3.5 SMART SHOCK DETECTION (AVAILABLE ONLY ON THE BEANDEVICE® WILOW® AX-3DS, AX-3D & X-INC)

3.5.1 Operation mode

The **BeanDevice® Wilow® AX-3DS, X-INC & AX-3D** integrates ***Smart Shock Detection*** technology, which permits to detect & recognize a shock event during its sleeping mode.

The SSD function is available on the BeanDevice Wilow AX-3D, Wilow X-Inc only with hardware version 2.0

The BeanDevice® Wilow® wakes up when a shock event is detected, all the measurement Data are transmitted instantly.

3.5.2 During a shock detection

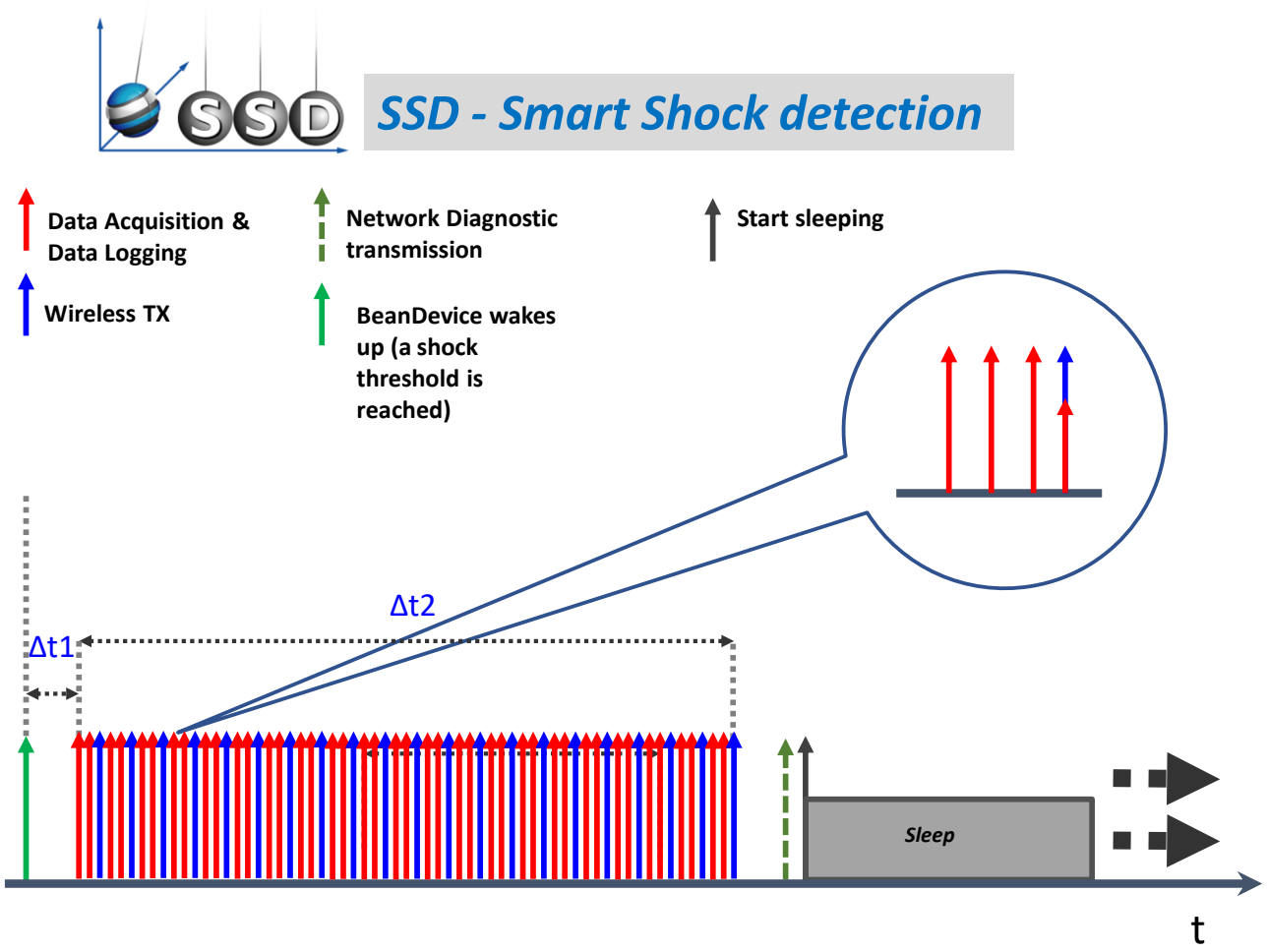


Figure 4: Smart Shock Detection

Δt1 = 12.5 ms, Latency time between the device wake up and the first data acquisition

Δt2 **-** Data sampling duration. This value can be configured by the user from the BeanScape® software.

SSD mode operates as follow:

- ✓ ***Step 1****: A shock threshold is reached (user-configurable), the* ***BeanDevice® Wilow®*** *wakes up*
- ✓ ***Step 2****: A data acquisition is performed with a high sampling rate*
- ✓ ***Step3****:* The data acquisition is registered on the BeanDevice® Wilow® datalogger and transmitted to the ***BeanScape®*** *in real time*
- ✓ ***Step 4****:* Step 2 to Step 3 are repeated until the sampling duration (**Δt2**) is completed;
- ✓ ***Step 5:*** *A Network diagnostic is automatically performed and transmitted to the* ***BeanScape®***
- ✓ ***Step 7:*** *The* ***BeanDevice® Wilow®*** goes to sleep

The SSD function is not available on the BeanDevice Wilow AX-3D and Wilow X-Inc with a hardware version 2.1

Users working with the BeanDevice Wilow AX-3D and Wilow X-Inc with a hardware version 2.1 will not have access to SSD function

From the hardware version 2.1 the SSD function is only available on the BeanDevice AX-3DS.

See “Smart Shock Detection (SSD) mode” YouTube video

3.6 STREAMING WITH EVENT TRIGGER (S.E.T)

3.6.1 Operation mode

The streaming with event trigger mode allows user to receive notification via email when the measurement reaches the preconfigured thresholds, the measurement is in streaming mode with high sampling rates (up to 200 Sps) unlike in the alarm mode.

- ✓ Data acquisition is done with a high sampling rate up to 200 Sps (configurable with the BeanScape® Wilow®)
- ✓ Notif cycle is a cyclic period when the BeanDevice® Wilow® wakes up from sleep, performs acquisition, and sends notification independently from reaching the configured threshold.
- ✓ Whenever an alarm threshold (user-configurable) is reached (three alarm threshold levels High/Low), an alarm notification is transmitted to the *BeanScape®* Wilow®.
- ✓ Data acquisition duration represents the measurement duration after a threshold is reached.

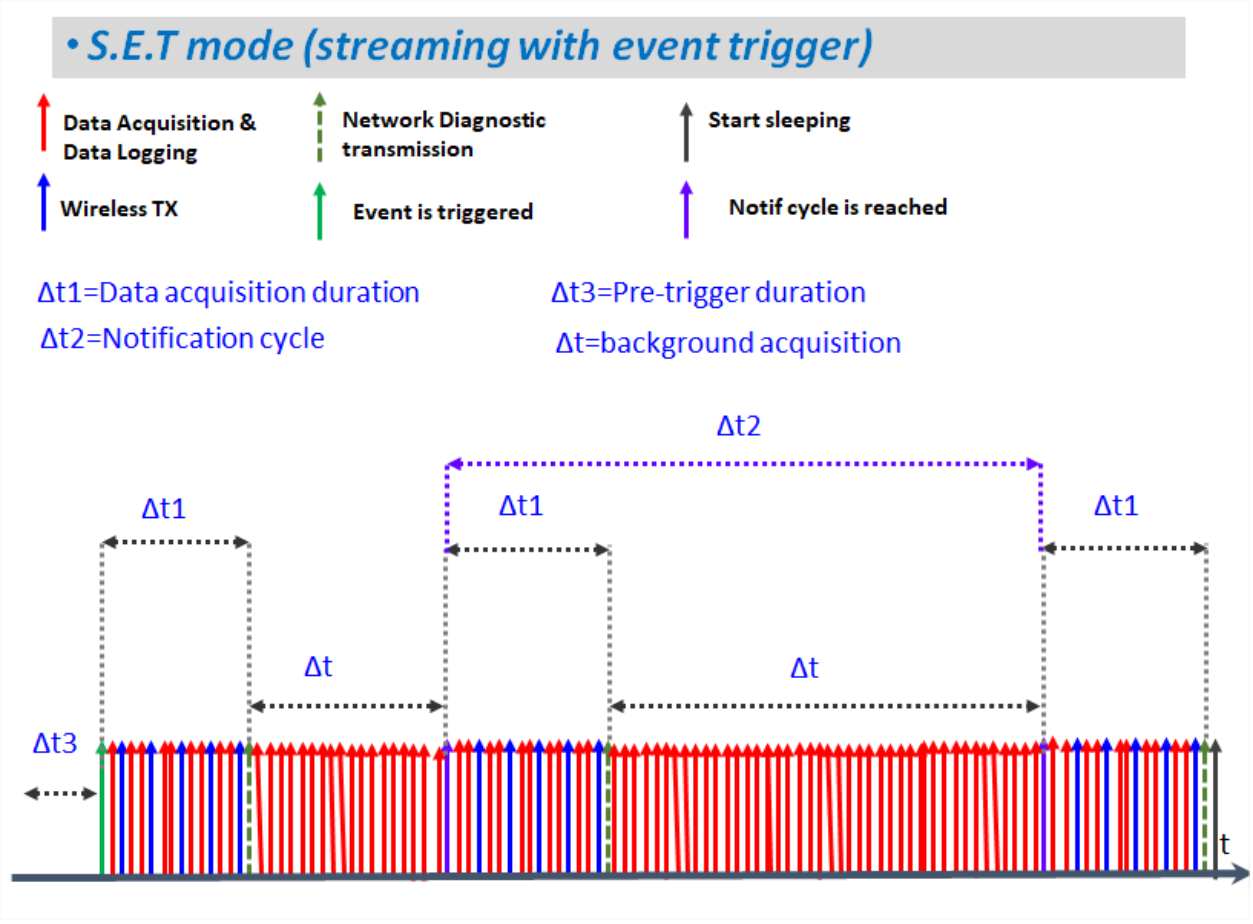


Figure 5 : Streaming with Event Trigger

- **Δt2> Δt1 :**Notification cycle should be higher than Data acquisition duration
- **Δt :** The BeanDevice® is in continuous acquisition mode without wireless transmitting ,only when threshold is reached the data will be transmitted through wireless, displayed on BeanScape and stored in log files .

See “Streaming with Event Trigger mode” YouTube video

3.7 SOFTWARE STREAMING WITH EVENT TRIGGER (SOFT S.E.T) (AVAILABLE ONLY ON THE AX-3D)

3.7.1 Operation mode

The soft SET mode is similar exactly to the SET mode but the only difference between them is the threshold levels unit.

The SET mode thresholds are based on the acceleration unit while the soft SET thresholds are based on the velocity unit.

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 2000 Sps) unlike in the alarm mode.

- ✓ Data acquisition is done with a high sampling rate up to 2000 Sps (configurable with the BeanScape® Wilow®)
- ✓ Notif cycle is a cyclic period when the BeanDevice® Wilow® wakes up from sleep, performs acquisition, and sends notification independently from reaching the configured threshold.
- ✓ Whenever an alarm threshold (user-configurable) is reached (three alarm threshold levels High/Low), an alarm notification is transmitted to the *BeanScape®* Wilow®.
- ✓ Data acquisition duration represents the measurement duration after a threshold is reached.

4. DATA ACQUSITION MODE CONFIGURATION FROM THE BEANSCAPE® WILOW®

1. *Open your BeanScape® Wilow®*
2. *Click on your BeanDevice® Wilow® profile*
3. *Click on "Data Acq. config tab"*

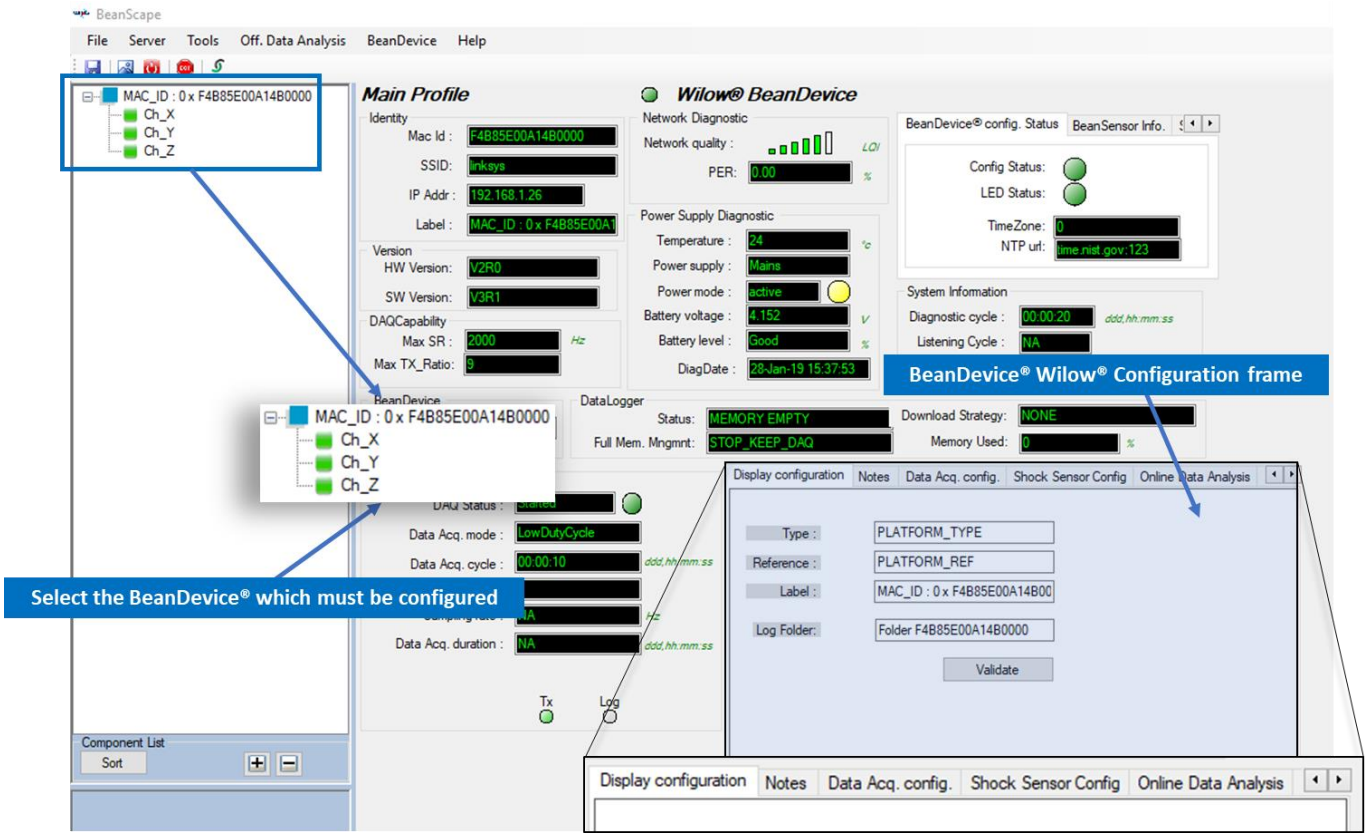


Figure 6: Data Acquisition frame

4.1 TAB: DATA ACQUISITION CONFIGURATION

4.1.1 Overview

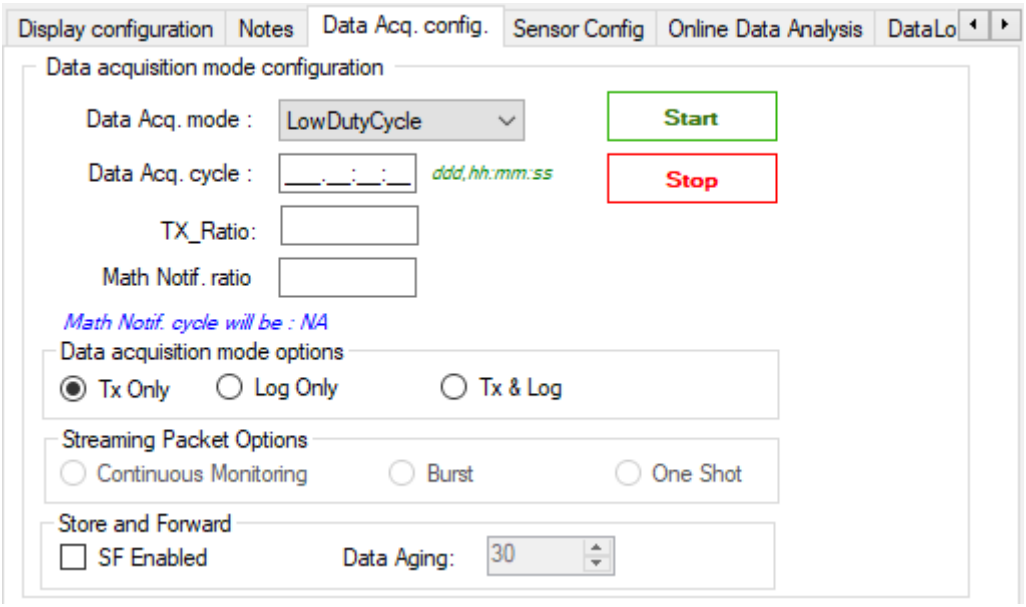


Figure 7: Data Acquisition configuration Tab

All your modifications are displayed on "***Current Data acquisition mode***" frame:

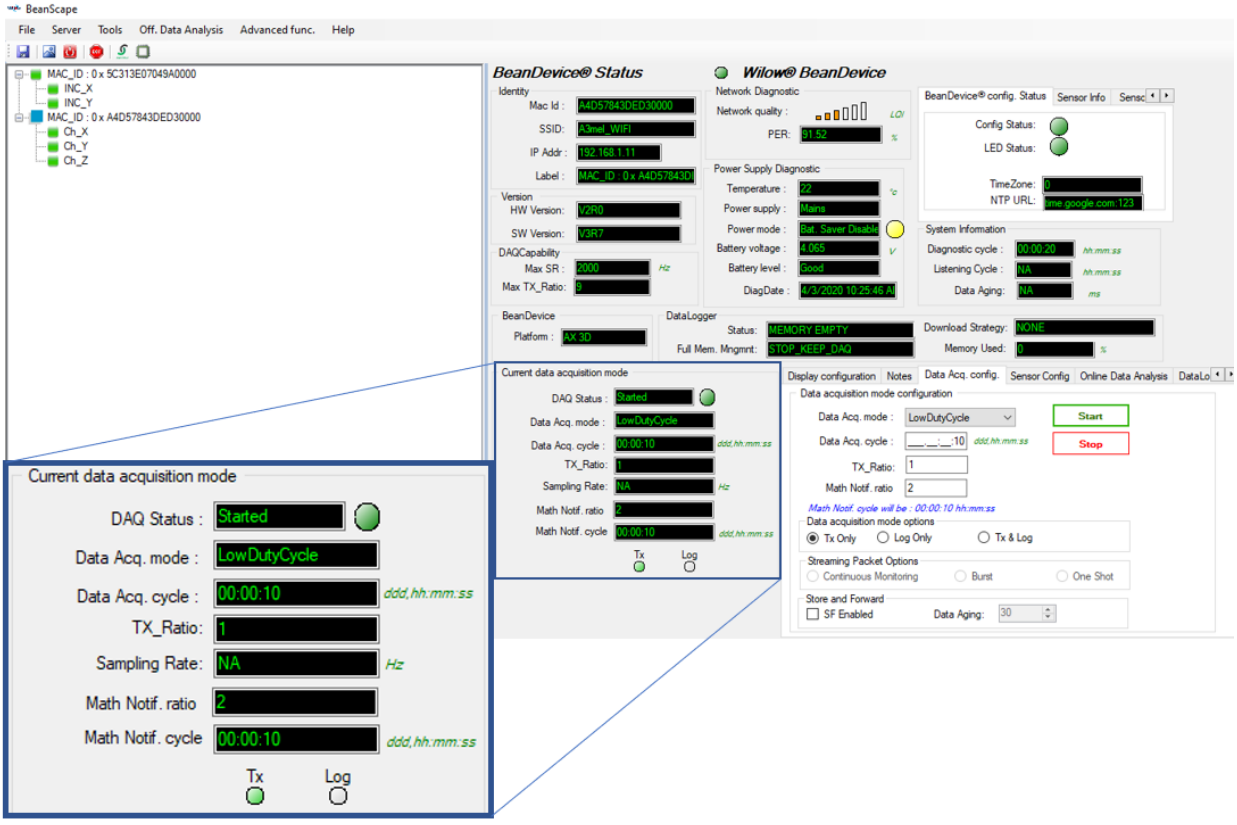


Figure 8: Current DAQ mode

Data acquisition modes

Data acquisition modes	Description
Low duty cycle Data Acquisition (LDCDA)	Low duty cycle Data acquisition is dedicated for static measurement (tilt, pressure, temperature) requiring a low power on your BeanDevice® Wilow®. The duty cycle can be configured between one Data acquisition & transmission per second to one Data acquisition & transmission per day.
Alarm	In Alarm mode, a data acquisition is transmitted: • If a transmission cycle is reached (the transmission cycle is configurable through the BeanScape® 1s to 24h) • If an alarm threshold (user-configurable) is reached.
Streaming	Streaming mode is suitable for users requiring a high Data sampling rate (maximum 2 KHz).
SSD (Smart Shock Detection)	Smart shock detection mode is only available on the BeanDevice® Wilow® AX-3DS & AX-3D If a shock threshold is reached, the BeanDevice® Wilow® starts to transmit all the Data acquisition to the BeanScape ®.
Streaming with event-trigger (SET)	The streaming with event trigger mode allows user to receive notification via email when the measurement reaches the preconfigured thresholds, the measurement is in streaming mode with high sampling rates (up to 200 Sps) unlike in the alarm mode

4.1.2 Parameters related to "Low duty cycle Data acquisition mode"

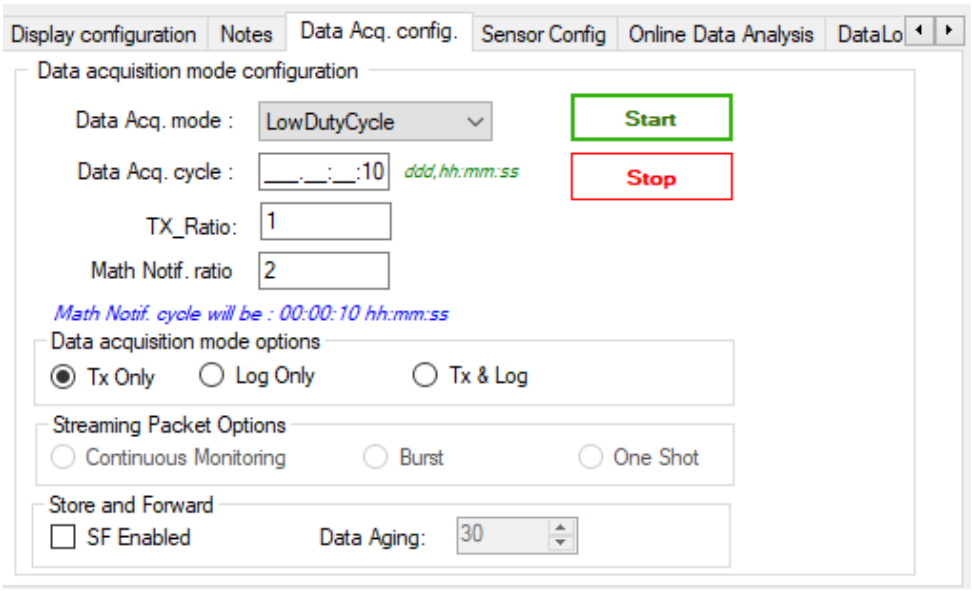


Figure 9: LowDutyCycle configuration tab

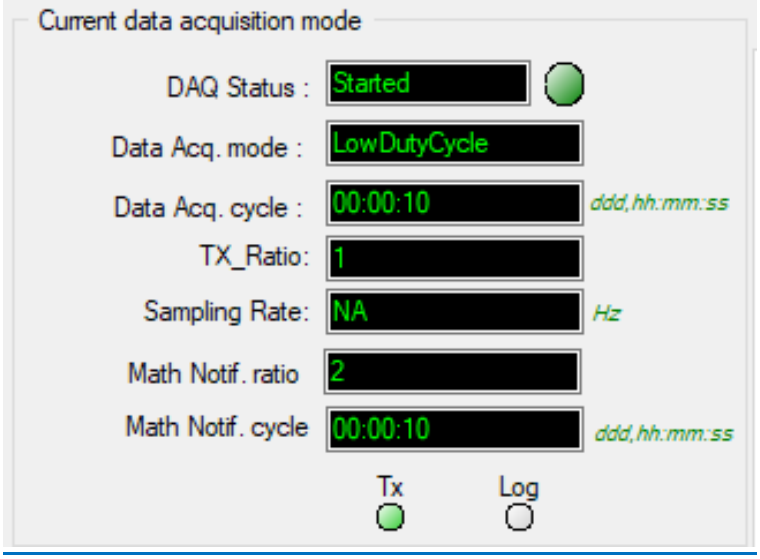


Figure 10: Low Duty cycle status window

Parameters	Descriptions
Data acquisition Cycle	• Select the Data acquisition cycle between one and twenty-four hours. • The format is: Day: Hour: Minute: Second
Data acquisition mode options	*TX only*: The BeanDevice® Wilow® transmits the Data acquisition **without** Data logging *Log only*: The BeanDevice® Wilow® logs the Data acquisition **without** wireless transmission *TX & Log*: The BeanDevice® Wilow® transmits **and** logs the Data acquisition; *SA*: The BeanDevice® Wilow® logs the Data acquisition **without** wireless transmission. The BeanDevice® stores all the measurement on its embedded Datalogger.
Transmission Ratio (TX Ratio)	Select the transmission ratio (TX Ratio) Transmission cycle is calculated as follow: Transmission Cycle = "Transmission Ratio" * "Data Acquisition Cycle"
Math Notification Ratio	Select the Math Notification Ratio (min value = 2s) Math Notif Cycle is calculated as follow: Math Notif Cycle Cycle = ("Transmission Ratio" * "Data Acquisition Cycle" * "Math Notif Ratio") – "Data Acquisition Cycle"

Data acquisition duration and Sampling rate parameters are not available for Low Duty Cycle Data acquisition.

4.1.1.1 Math Result Feature

Math RESULT is a new feature integrated in Beanscape, it offers a better user experience and a better data handling by:

- ❑ Receiving information about the maximum, minimum & average data values as well as the corresponding dates of their acquisition.
- ❑ Receiving information, the average value.
- ❑ The user can control the period that he wishes for these data to be updated

Math RESULT is included in all Beanscape versions starting from:

- Device firmware V3R6
- Beanscape Wilow Basic 3.0.2.10
- Beanscape Wilow Lite 3.0.2.10
- Beanscape Wilow Manager 3.0.1.11
- Beanscape Wilow Premium 3.1.0.9
- Beanscape Wilow RA 3.2.0.12

It's important to know that currently math Result is currently available only in LowDutyCycle mode

Math Result Configuration

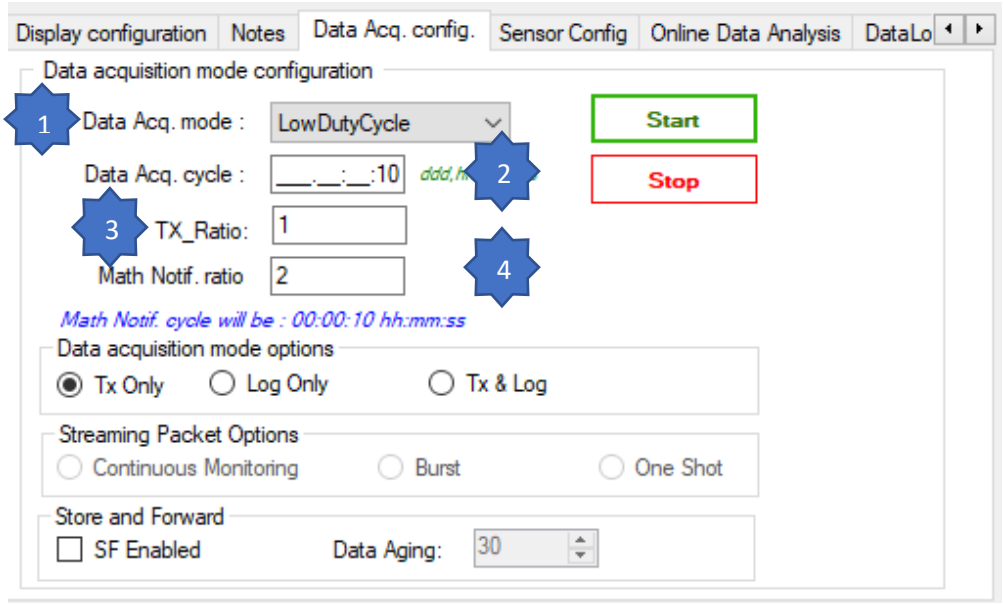


Figure 11: LowDutyCycle Configuration

- 1/ choose Low Duty Cycle as DAQ mode
- 2/ time needed to acquire one date in second
- 3/ number of data to be sent
- 4/ Number of cycles required to start calculation

Math Notif Cycle = (Data Acq Cycle × Tx_Ratio × Math.NotifRation) – Data Acq.cycle

= (10 ×1 ×2) – 10 = 20 –10 =10

Math Notif Cycle in this case is 10

- **Math Configuration Example**

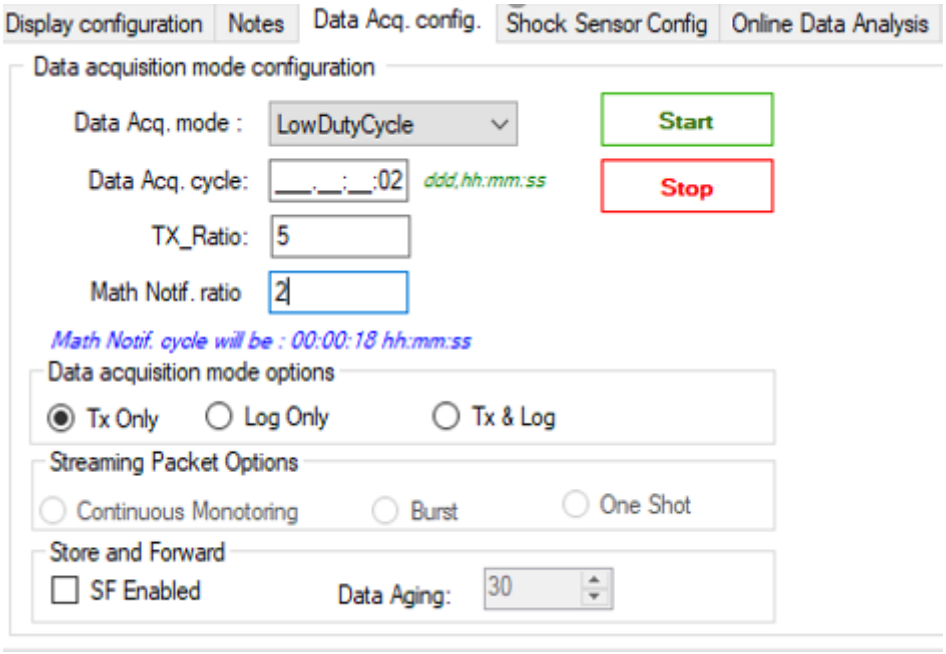
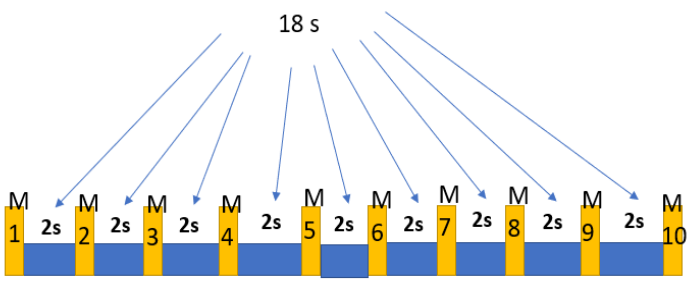


Figure 12:LowDutyCycle Configurations Exp 2

Data Acq cycle =2 seconds: so every two seconds we will receive a measurement

TX =5 so we will need 5 data to be sent

Math not ration =2 so Tx_Ration will be multiplied by 2 = 10 Measurements



Math Notif Cycle =(Data Acq Cycle × Tx_Ratio × Math.NotifRation) − Data Acq.cycle

Math Notif Cycle=(2*5*2) − 2=18

All the information related to the Math Result calculation are displayed on the sensor profile.

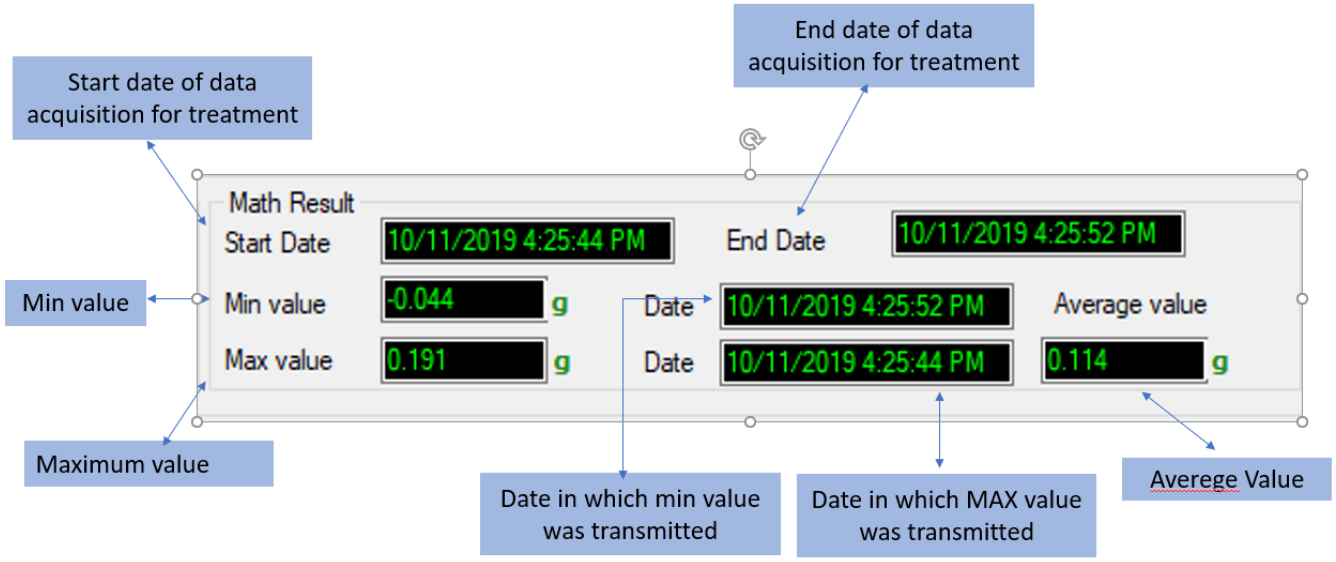


Figure 13:Math Result display

- **Math Result Log File**

Math Result file is created besides the Tx file

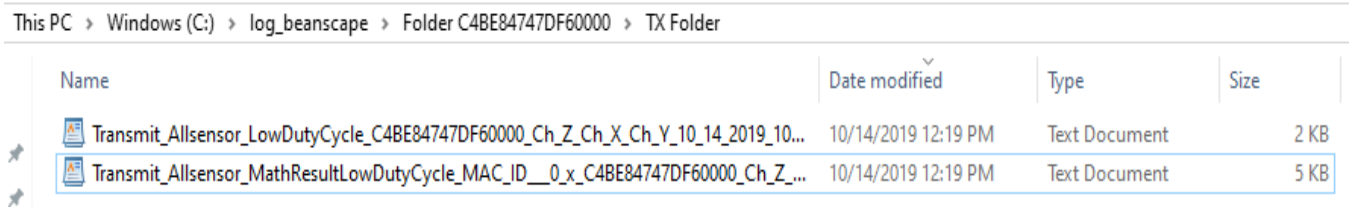


Figure 14: Math Result repository

The header of the MathRESULT file contains the details about the sensor as well as the :
Math Notif ration & calculated Math Notif cycle

The body of the file contains the period of acquisition:
The Max, Min values with their corresponding dates & the average Value on each channel X Y Z

```
BeanDevice : AX 3D
PAN_ID : FFFE
MAC_ID : C4BE84747DF60000
Network Id : 0129
Measure mode : LowDutyCycle
DATE_FORMAT : M/d/yyyy h:mm:ss tt
Date : 10/14/2019 12:16:35 PM
Unit for accelerometer : g
Math Notif. ratio : 2
Math Notif. cycle 00:00:05 ddd,hh:mm:ss
-----------------------------------------------------------------
------------------------------


Date_start;Date_end  | Ch_Z(g)
Date_Min;Value_Min;Date_Max;Value_Max;Average | Ch_X(g)
Date_Min;Value_Min;Date_Max;Value_Max;Average | Ch_Y(g)
Date_Min;Value_Min;Date_Max;Value_Max;Average

10/14/2019 10:16:30 AM;10/14/2019 10:16:35 AM  | 10/14/2019
10:16:30 AM;0.8;10/14/2019 10:16:35 AM;0.802;0.801 | 10/14/2019
10:16:30 AM;0.02;10/14/2019 10:16:35 AM;0.021;0.02 | 10/14/2019
10:16:35 AM;-0.005;10/14/2019 10:16:30 AM;-0.003;-0.004
10/14/2019 10:16:40 AM;10/14/2019 10:16:45 AM  | 10/14/2019
10:16:45 AM;0.802;10/14/2019 10:16:40 AM;0.809;0.805 |
10/14/2019 10:16:40 AM;0.013;10/14/2019 10:16:45 AM;0.014;0.013
| 10/14/2019 10:16:40 AM;-0.01;10/14/2019 10:16:45
AM;-0.006;-0.008
10/14/2019 10:16:50 AM;10/14/2019 10:16:55 AM  | 10/14/2019
10:16:55 AM;0.794;10/14/2019 10:16:50 AM;0.802;0.798 |
10/14/2019 10:16:55 AM;0.015;10/14/2019 10:16:50 AM;0.017;0.016
| 10/14/2019 10:16:55 AM;-0.008;10/14/2019 10:16:50
AM;-0.006;-0.007
10/14/2019 10:17:00 AM;10/14/2019 10:17:05 AM  | 10/14/2019
10:17:05 AM;0.804;10/14/2019 10:17:00 AM;0.808;0.806 |
10/14/2019 10:17:05 AM;0.016;10/14/2019 10:17:00 AM;0.017;0.016
| 10/14/2019 10:17:05 AM;-0.01;10/14/2019 10:17:00
AM;-0.005;-0.007
10/14/2019 10:17:10 AM;10/14/2019 10:17:15 AM  | 10/14/2019
10:17:15 AM;0.802;10/14/2019 10:17:10 AM;0.803;0.802 |
10/14/2019 10:17:10 AM;0.01;10/14/2019 10:17:15 AM;0.015;0.012 |
10/14/2019 10:17:15 AM;-0.011;10/14/2019 10:17:10
AM;-0.009;-0.01
10/14/2019 10:17:20 AM;10/14/2019 10:17:25 AM  | 10/14/2019
10:17:25 AM;0.801;10/14/2019 10:17:20 AM;0.802;0.801 |
10/14/2019 10:17:25 AM;0.011;10/14/2019 10:17:20 AM;0.013;0.012
| 10/14/2019 10:17:25 AM;-0.008;10/14/2019 10:17:20
```

Figure 15: Math Result Log file

See our technical video "Overview of Math Result Feature for Wilow IOT Sensors." on YouTube

4.1.3 Parameters related to "Alarm" Data acquisition mode

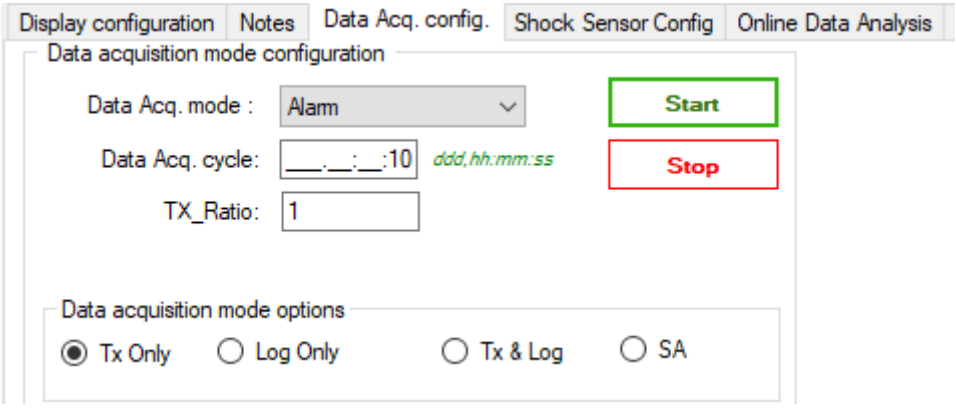


Figure 16: Alarm Data acquisition configuration tab

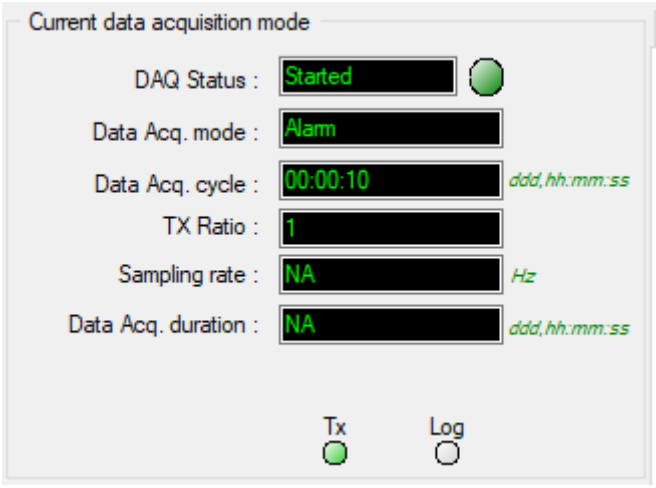


Figure 17: Alarm status window

Parameters	Description
Data acquisition Cycle	Select the Data acquisition cycle between one second and twenty-four hours. The format is: Day: Hour: Minute: Second
Transmission Ratio (TX Ratio)	Select the transmission ratio (TX Ratio) Transmission cycle is calculated as follow: Transmission Cycle = "Transmission Ratio" * "Data Acquisition Cycle"
Alarm Notif Delay	Alarm Notif delay represents the measurement in seconds duration for every cycle.
Data acquisition mode options	***TX only***: The BeanDevice® Wilow® transmits the Data acquisition **without** Data logging ***Log only***: The BeanDevice® Wilow® logs the Data acquisition **without** wireless transmission ***TX & Log***: The BeanDevice® Wilow® transmits **and** logs the Data acquisition; ***SA***: The BeanDevice® Wilow® logs the Data acquisition **without** wireless transmission. The BeanDevice® stores all the measurement on its embedded Datalogger.

4.1.4 Parameters related to “Streaming “mode

Streaming Mode

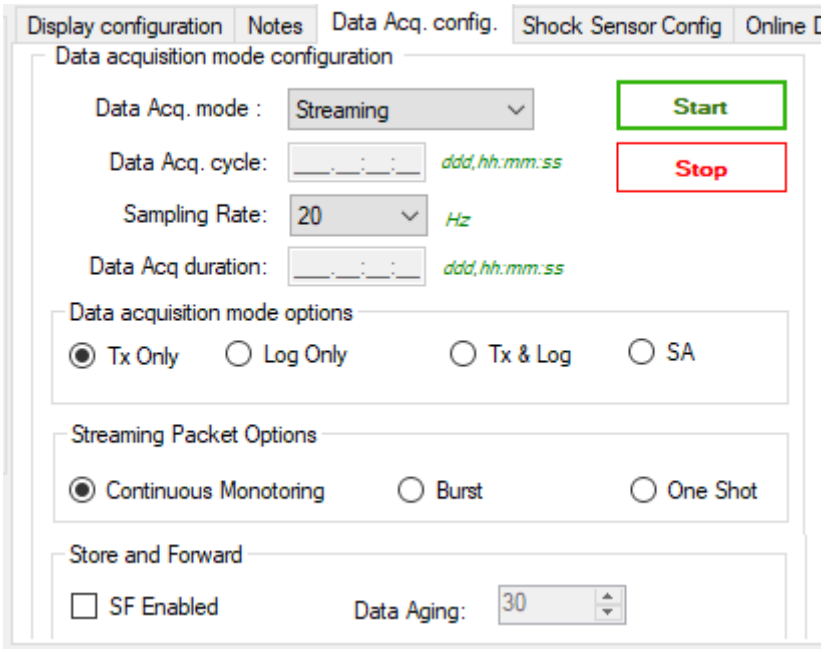


Figure 18: Streaming Mode Data acquisition configuration tab

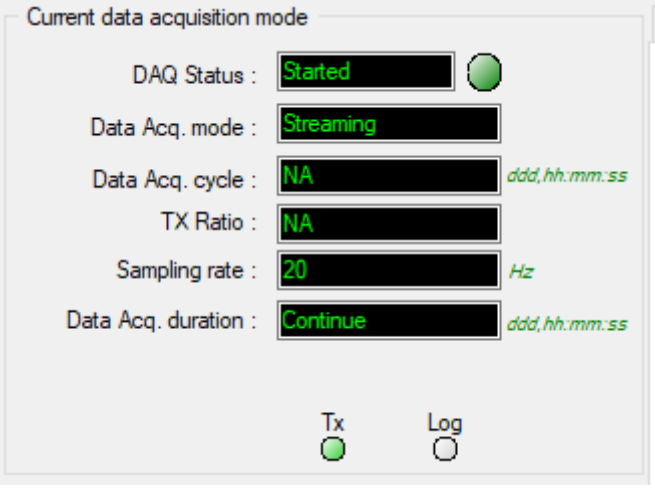


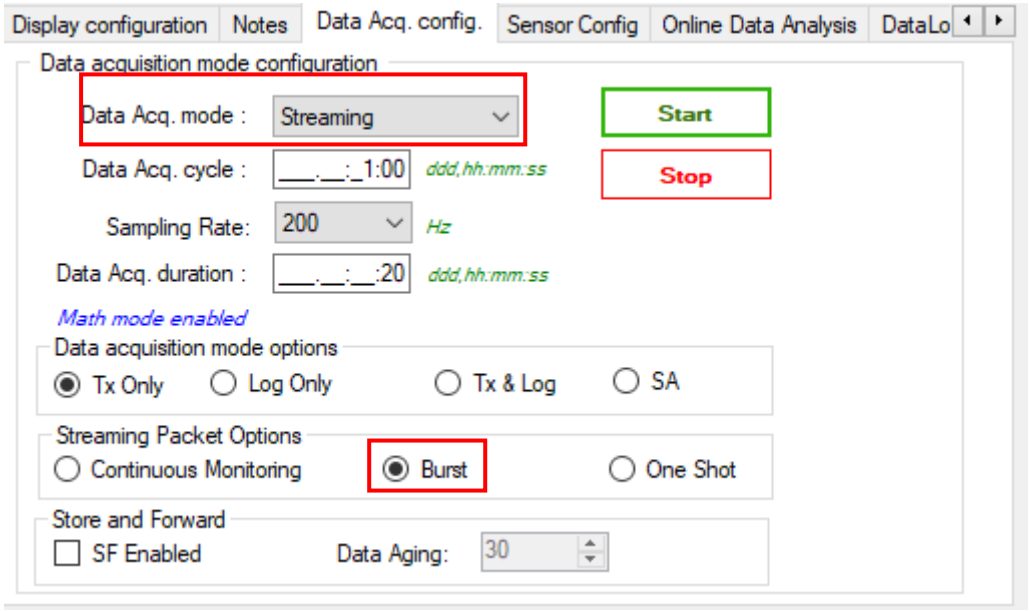
Figure 19: Streaming status window

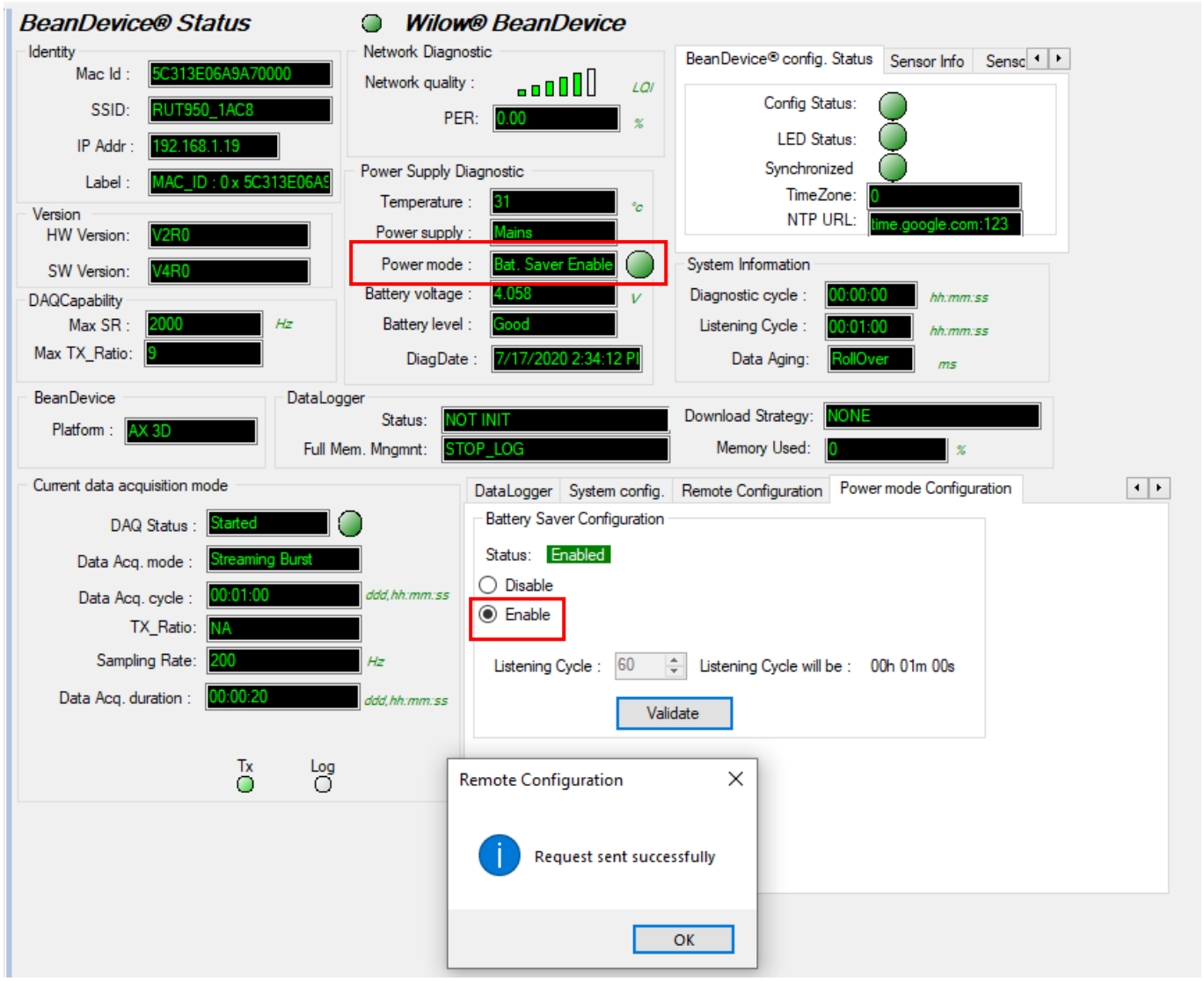
Parameters	Description
Data acquisition Cycle	Select the Data acquisition cycle between 1s and 24hours. The format is: Day: Hour: Minute: Second This parameter is enabled if the "***Burst***" option is selected
Sampling rate	Select the sampling rate of your BeanDevice® Wilow® between one sample per second and 2000 samples per second maximum (depending on the BeanDevice® Wilow® product used). Choose carefully the sampling rate value: ✓ The PER (Packet Error Rate) may increase if a high sampling rate value is settled on your BeanDevice® Wilow® ✓ Power consumption increases with the sampling rate
Data acquisition duration	Defines the duration of the streaming Data acquisition. The format is Day: Hour: Minute: Second "Data acquisition duration" value should be lower than "Data acquisition cycle". This parameter is enabled if the "***Burst***" or "***One Shot***" options are selected.
Data acquisition mode options	***TX only***: The BeanDevice® Wilow® transmits the Data acquisition **without** Data logging ***Log only***: The BeanDevice® Wilow® logs the Data acquisition **without** wireless transmission ***TX & Log***: The BeanDevice® Wilow® transmits **and** logs the Data acquisition; ***SA***: The BeanDevice® Wilow® logs the Data acquisition **without** wireless transmission. The BeanDevice® stores all the measurement on its embedded Datalogger.
Streaming Packet Options	***« Continuous monitoring » option***: Data acquisition is transmitted to *BeanScape ® Wilow®* in a continuous flow rate. ***« Burst » option***: Data acquisition is transmitted to the *BeanScape ® Wilow®* in a burst flow rate ***« One Shot » option***: Data acquisition is transmitted to the *BeanScape ® Wilow®* during a period time, then the *BeanDevice® Wilow®* will be stoped

Store and Forward+

SF Enabled: enable Store and forward option

From the BeanDevice® Wilow firmware version 4.0, users have the possibility to use the battery saver mode (sleep mode) with the *streaming burst option.*




BeanDevice® Status
Wilow® BeanDevice
Identity
Mac Id : 5C313E06A9A70000
SSID: RUT950_1AC8
IP Addr : 192.168.1.19
Label : MAC_ID : 0 x 5C313E06A9
Version
HW Version: V2R0
SW Version: V4R0
DAQCapability
Max SR : 2000 Hz
Max TX_Ratio: 9
Network Diagnostic
Network quality : LQI
PER: 0.00 %
Power Supply Diagnostic
Temperature : 31 °c
Power supply : Mains
Power mode : Bat. Saver Enable
Battery voltage : 4.058 V
Battery level : Good
DiagDate : 7/17/2020 2:34:12 PI
BeanDevice® config. Status
Sensor Info
Config Status:
LED Status:
Synchronized
TimeZone: 0
NTP URL: time.google.com:123
System Information
Diagnostic cycle : 00:00:00 hh:mm:ss
Listening Cycle : 00:01:00 hh:mm:ss
Data Aging: RollOver ms
BeanDevice
Platform : AX 3D
DataLogger
Status: NOT INIT
Full Mem. Mngmnt: STOP_LOG
Download Strategy: NONE
Memory Used: 0 %
Current data acquisition mode
DAQ Status : Started
Data Acq. mode : Streaming Burst
Data Acq. cycle : 00:01:00 ddd,hh:mm:ss
TX_Ratio: NA
Sampling Rate: 200 Hz
Data Acq. duration : 00:00:20 ddd,hh:mm:ss
Tx
Log
DataLogger
System config.
Remote Configuration
Power mode Configuration
Battery Saver Configuration
Status: Enabled
Disable
Enable
Listening Cycle : 60
Listening Cycle will be : 00h 01m 00s
Validate
Remote Configuration
Request sent successfully
OK

4.1.6 Parameters related to S.E.T mode (Streaming with Event Trigger)

Soft SET mode

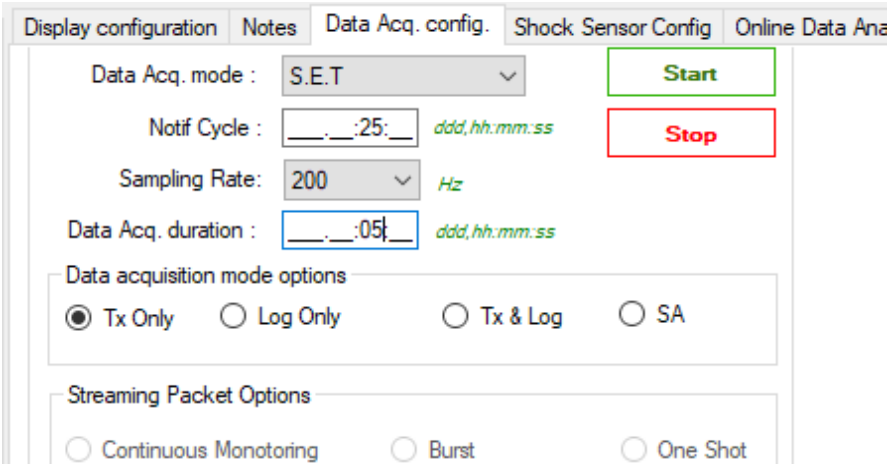


Figure 20 : S.E.T Mode Data acquisition configuration tab

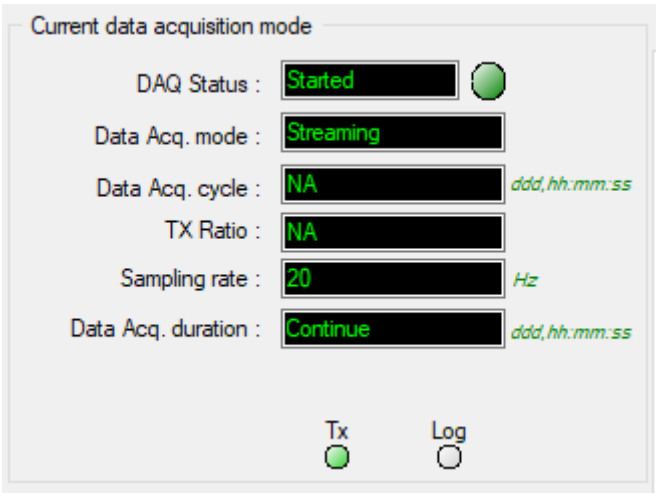


Figure 21 :S.E.T mode status window

Parameters	*Description*
Notif Cycle	Select the Notif cycle between 1s and 24hours. The format is: Day: Hour: Minute: Second Data acquisition will be performed every cycle and reports will be sent using SMTP
Sampling rate	Select the sampling rate of your BeanDevice® Wilow® between 1 sample per second and 200 samples/s maximum.
Data acquisition duration	Defines the duration of the streaming Data acquisition. The format is Day: Hour: Minute: Second "Data acquisition duration" value should be lower than "Notif cycle".
Data acquisition mode options	***TX only***: The BeanDevice® Wilow® transmits the Data acquisition **without** Data logging ***Log only***: The BeanDevice® Wilow® will store all data in the embedded Datalogger ***TX & Log:*** The BeanDevice® Wilow® transmits the Data acquisition ***and*** stores it in the embedded Datalogger at the same time. ***SA***: The BeanDevice® Wilow® logs the Data acquisition **without** wireless transmission. The BeanDevice® stores all the measurement on its embedded Datalogger.
Streaming Packet Options	***« Continuous monitoring » option***: Data acquisition is transmitted to the ***BeanGateway ®*** in a continuous flow rate (by Default) ***« Burst » option***: NA for S.E.T mode ***« One Shot » option***: NA for S.E.T mode

4.1.7 Parameters related to Soft S.E.T mode (Software Streaming with Event Trigger)

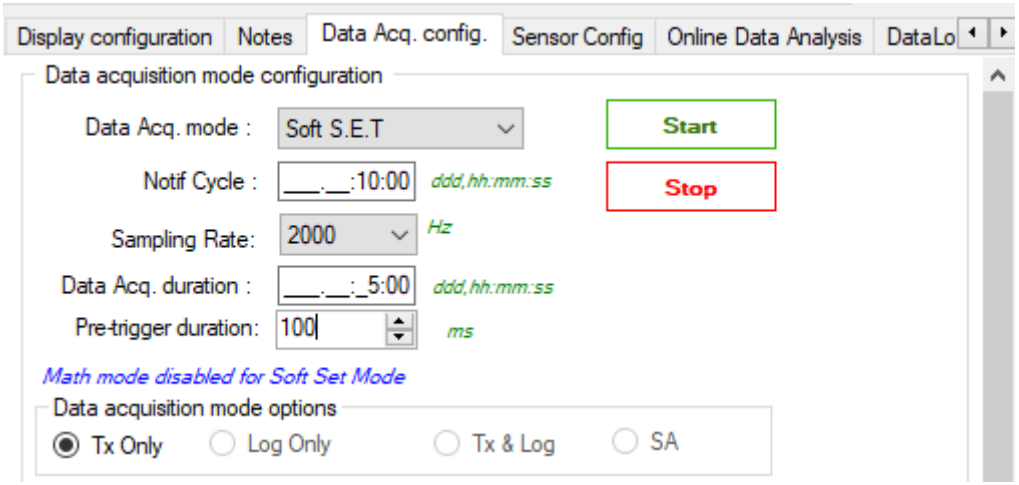


Figure 22:Soft S.E.T Mode Data acquisition configuration tab

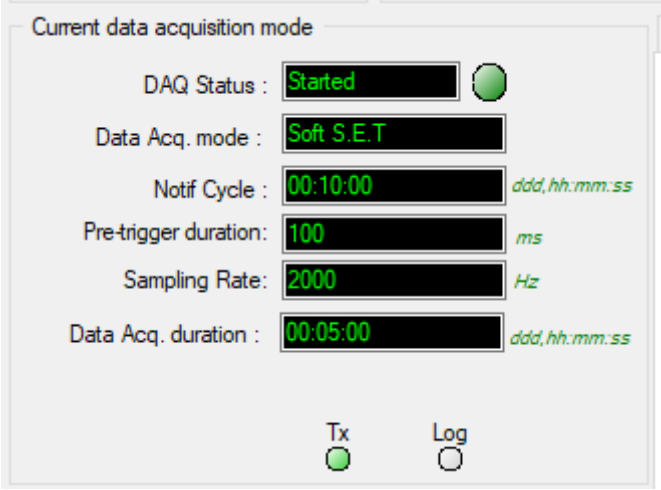
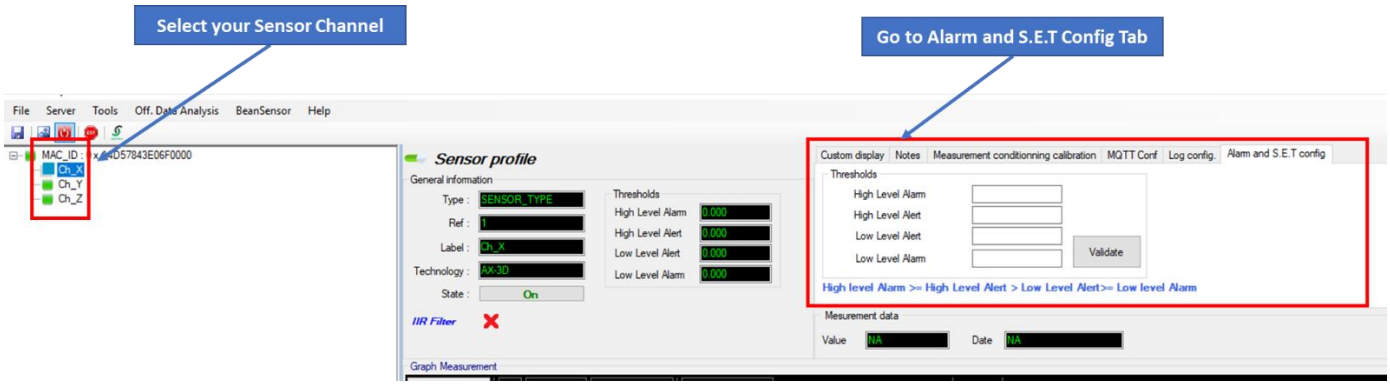


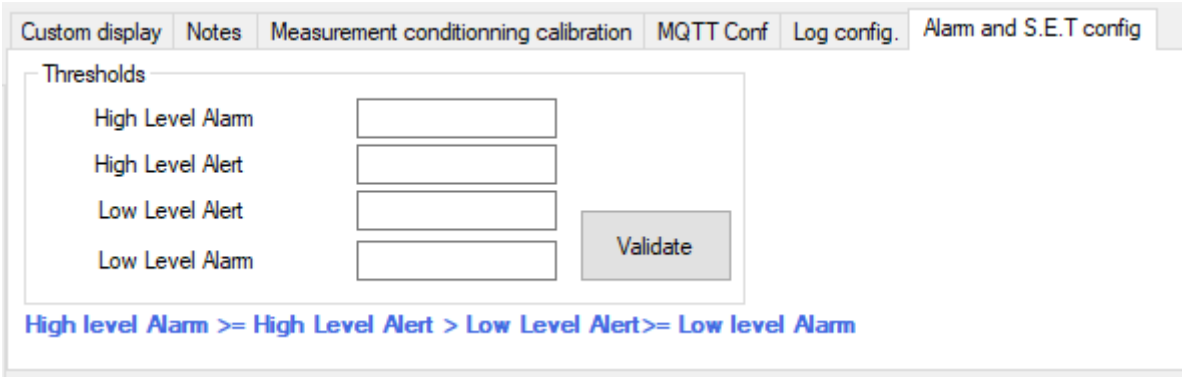
Figure 23 :S.E.T mode status window

Parameters	*Description*
Notif Cycle	Select the Notif cycle between 1s and 24hours. The format is: Day: Hour: Minute: Second Data acquisition will be performed every cycle and reports will be sent using SMTP
Sampling rate	Select the sampling rate of your BeanDevice® Wilow® between 32 sample per second and 2000 samples/s maximum.
Data acquisition duration	Defines the duration of the streaming Data acquisition. The format is Day: Hour: Minute: Second "Data acquisition duration" value should be lower than "Notif cycle".
Data acquisition mode options	***TX only***: The BeanDevice® Wilow® transmits the Data acquisition **without** Data logging ***Log only***: The BeanDevice® Wilow® will store all data in the embedded Datalogger ***TX & Log:*** The BeanDevice® Wilow® transmits the Data acquisition ***and*** stores it in the embedded Datalogger at the same time. ***SA***: The BeanDevice® Wilow® logs the Data acquisition **without** wireless transmission. The BeanDevice® stores all the measurement on its embedded Datalogger.
Pre-trigger duration	The BeanDevice® will record data just before the event which is the pre-trigger duration.
Streaming Packet Options	***« Continuous monitoring » option***: Data acquisition is transmitted to the ***BeanGateway ®*** in a continuous flow rate (by Default) ***« Burst » option***: NA for S.E.T mode ***« One Shot » option***: NA for S.E.T mode

4.2 ALARM THRESHOLDS CONFIGURATION FROM THE BEANSCAPE® WILOW®

4.2.1 How to set an alarm threshold based on 4 alarm levels





Parameter	*Description*
Alarm threshold	You can configure threshold high values (High Level Alarm, High Level Alert) and low values (Low Level Alert, Low Level Alarm). In alarm mode, when a higher low threshold value is reached, an alarm notification is transmitted: ✓ If the sensor value is higher than High Level Alarm / High Level Alert, an alarm notification is send to the BeanScape If the sensor value is lower than Low Level Alert / Low Level Alarm, an alarm notification is send to the BeanScape ✓ Threshold values must be organized in this manner: High Level Alarm>= High Level Alert > Low Level Alert>=Low Level Alarm

4.2.2 How to set an alarm threshold based on 3 alarm levels

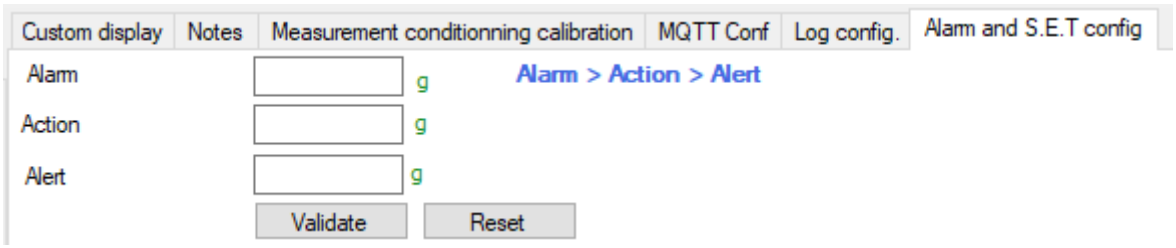
From the BeanDevice® Wilow firmware version 4.0 the Alarm threshold architecture was improved and changed from 4 levels of Alarm to 3 Alarm levels for both Alarm mode and also SET mode.

The threshold is based on AAA (Alert/Action/Alarm) with:

Alert value < Action value < Alarm value

Measurement exceeding each threshold will result in notification sent with the appropriate reports and info via email and audio notification on the computer will take place.

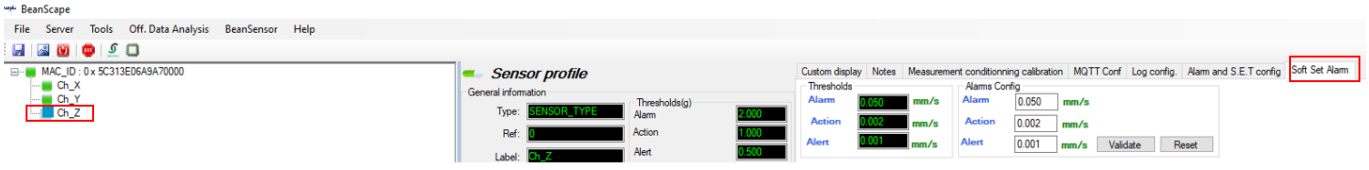
To configure your thresholds, click on Alarm and S.E.T Config tab after selecting the related measurement channel.



Parameter	*Description*
Alarm threshold	You can configure threshold using AAA (Alert Action Alarm) system. every time one of these values is reached, an alarm notification is transmitted to the BeanGateway and then report is generated and sent using SMTP (refer to alarm management in the BeanDevice® user manual for more info); ✓ If the sensor value is higher than Alert, an alarm notification is sent to the BeanGateway /BeanScape; ✓ If the sensor value is higher than Action, an alarm notification is sent to the BeanGateway /BeanScape; ✓ If the sensor value is higher than Alarm, an alarm notification is sent to the BeanGateway /BeanScape;

4.2.3 How to set an alarm threshold based on 3 alarm levels for Soft SET mode

The Soft SET alarm thresholds are based on the velocity unit



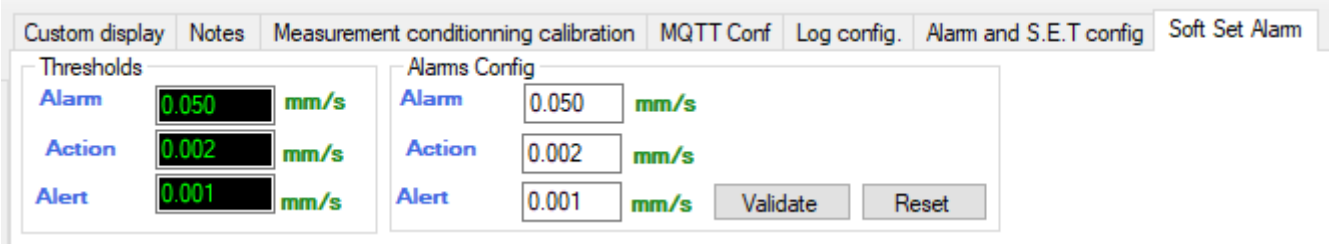


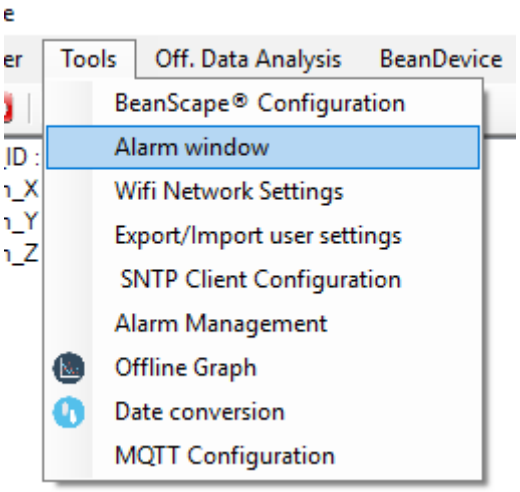
Figure 24: Soft SET alarm thresholds

For each sensor (X,Y,Z), the three alarm levels should not have 0 value at the same time, you should enter a value different from zero in one level at least, otherwise you cannot perform a soft SET DAQ.

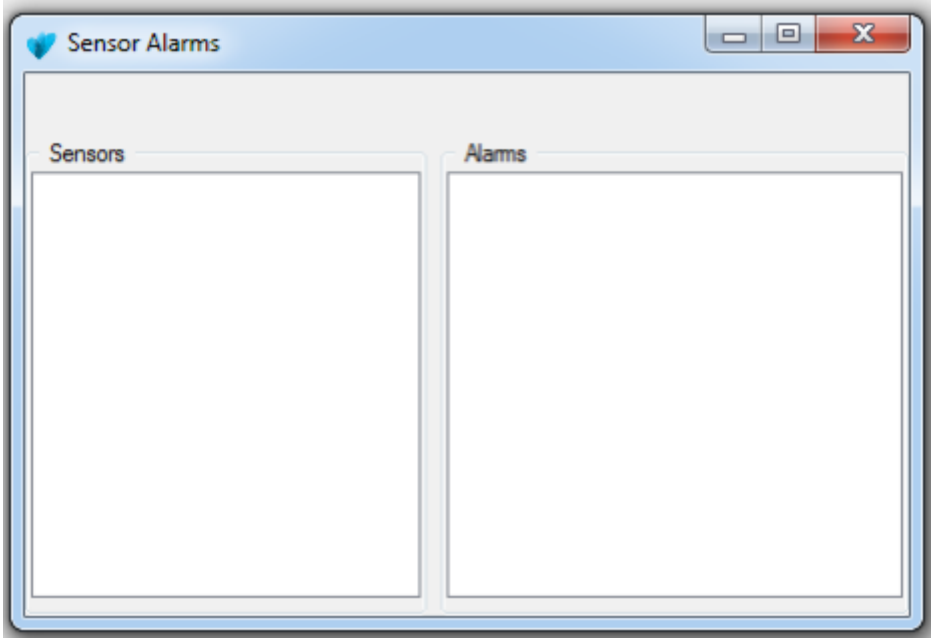
4.2.4 Sensor alarms window

The BeanScape® Wilow® provides user a detailed and neatly viewed alarm list (four user configurable alarms Up/Down). A real time diagnostic alarm is generated by the Beanair® expert system.

- Select the desired platform by clicking on “Tools” scrolling menu available on the left side pane.
- Then Click:



- You will see the following screen:



- Please note that this window automatically opens when the alarm threshold is exceeded when alarm mode is configured

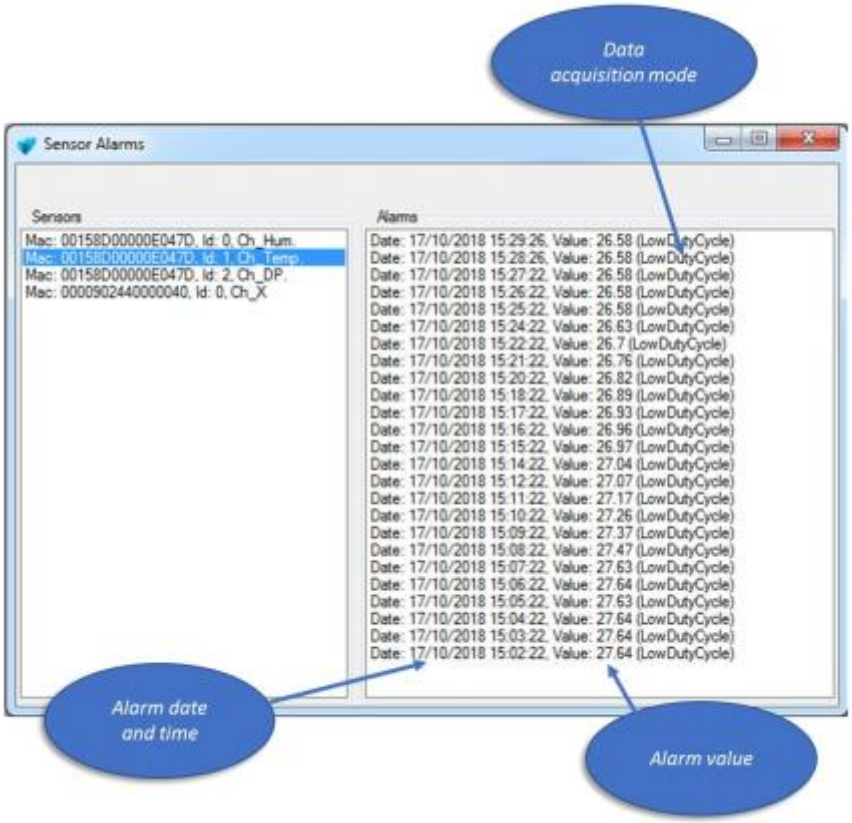


Figure 25: sensors alarm alert window

5. SEVERAL EXAMPLES OF DATA ACQUISITION

5.1 LOW DUTY CYCLE ACQUISITION MODE

Low Duty Cycle Data Acquisition mode

5.1.1 Configuration

Example: The BeanDevice® Wilow® should be configured in Low Duty Cycle Acquisition Mode with a Data acquisition cycle of 20s.

Proceed as follows:

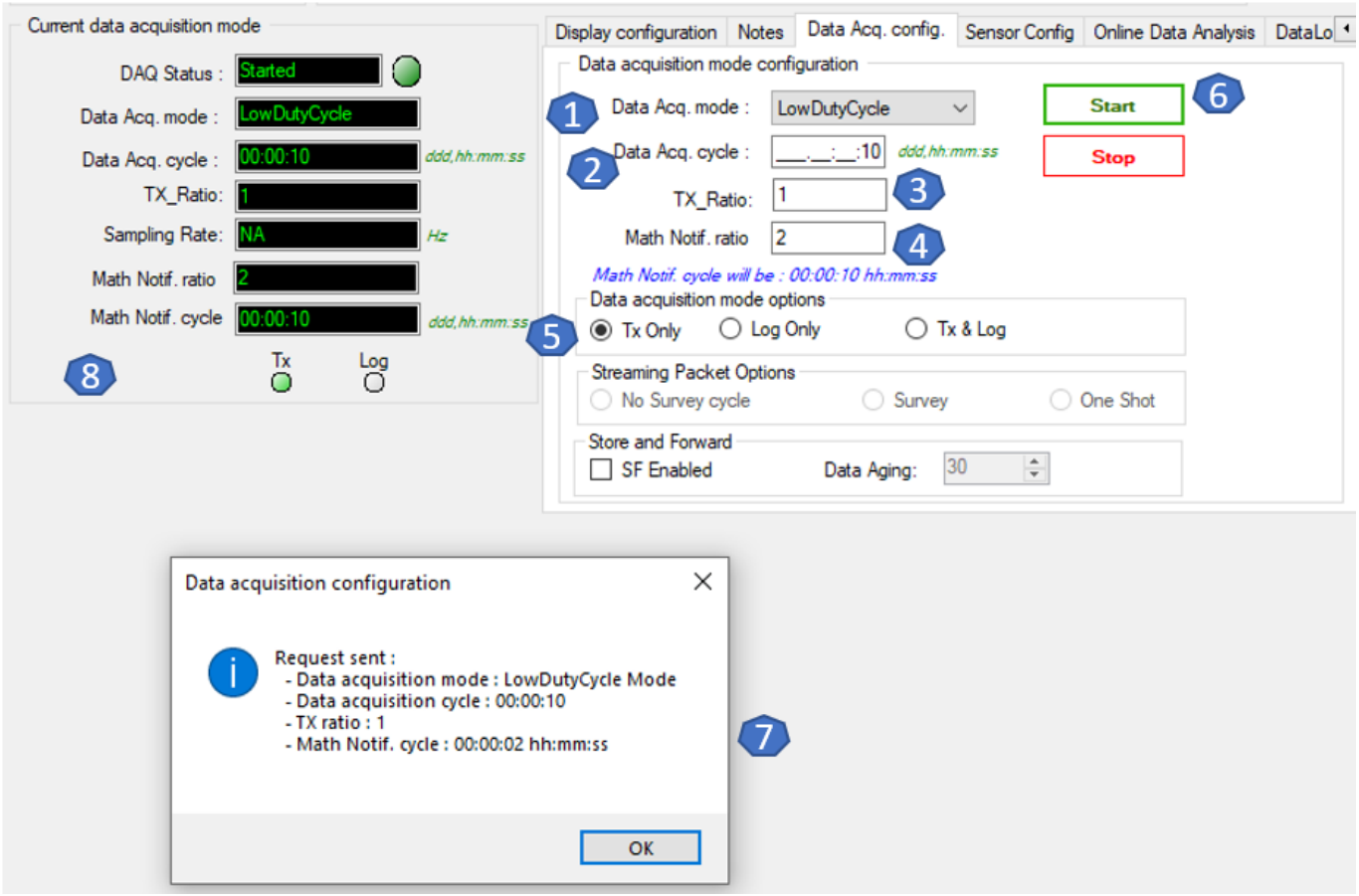


Figure 26:DAQ Configuration

1	*Choose "LowDutyCycle "in Data acquisition mode*
2	*Enter a Data acquisition cycle of 10s*
3	*Enter TX ratio from 1 to 9*
4	*Enter Math Notif. Ratio of 2s*
5	*In this example, we configure the BeanDevice® Wilow® in TX only*
6	*Click on validate to validate your new configuration*
7	*A Pop-up window displays the new configuration*
8	*If the new Data acquisition mode configuration is accepted by the BeanDevice® Wilow®, all the parameters are displayed in the frame "Current Data acquisition mode"*

- **Only on the BeanDevice® Hi-Inc and X-Inc**

From Firmware version 4.1 and above the Tx ratio was fixed to 1 as default and the minimum Data acquisition cycle is 2s.

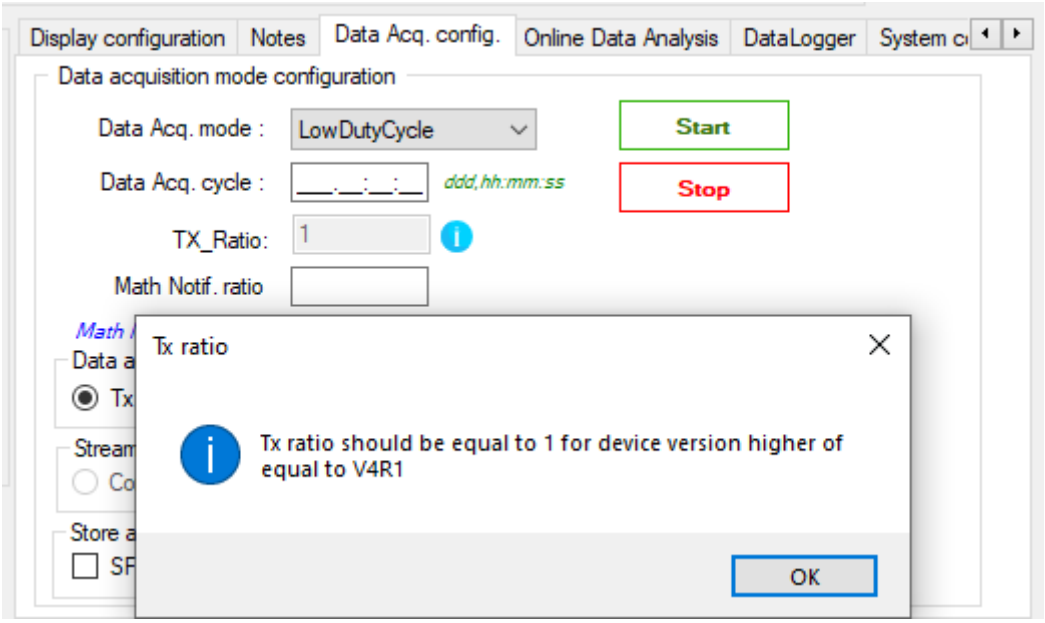


Figure 27: TX ratio

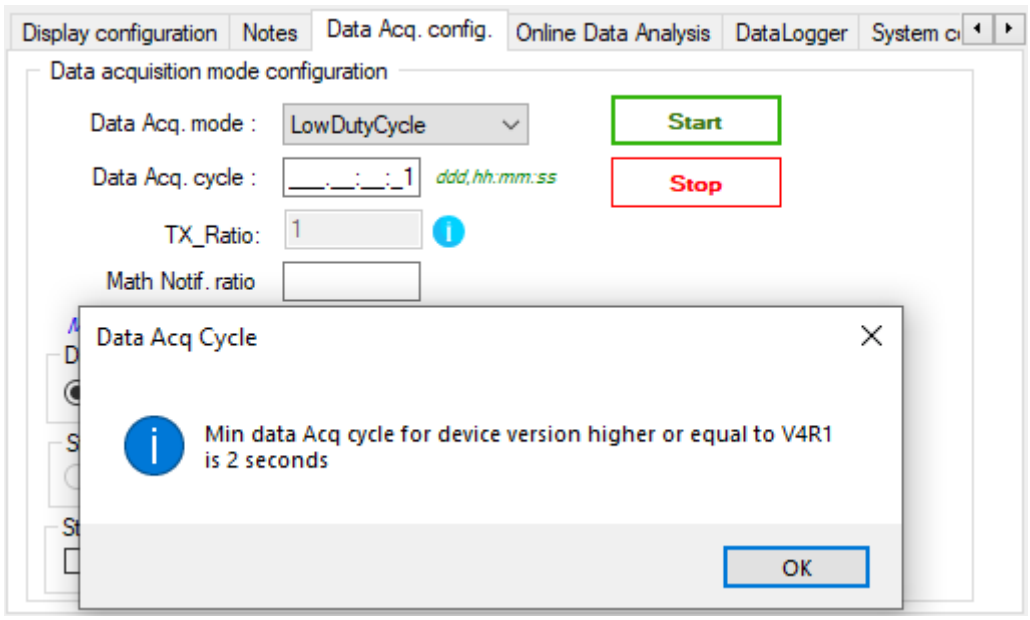


Figure 28: Minimum DAQ cycle on LDC

You can disable the Tilt sensors on the BeanDevice® X-Inc then you can manage the TX Ratio.

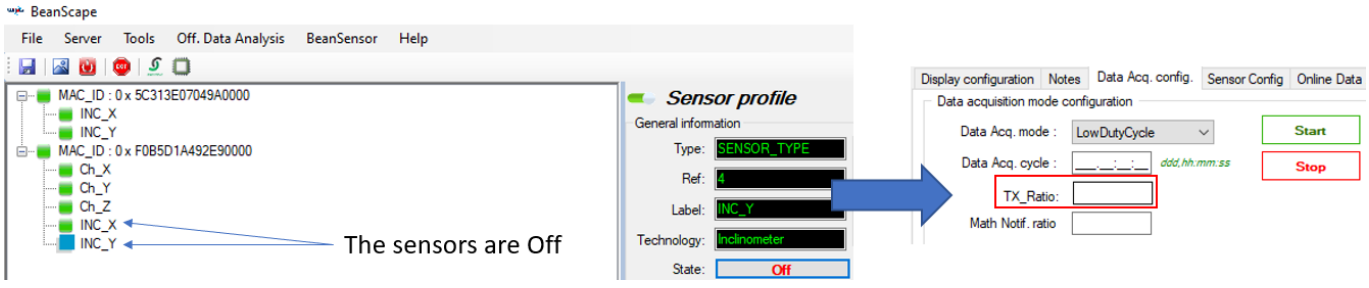


Figure 29: Tx Ratio on the X-Inc

5.1.2 Graph visualization

The graph displays all the Data acquisition in Low Duty cycle:

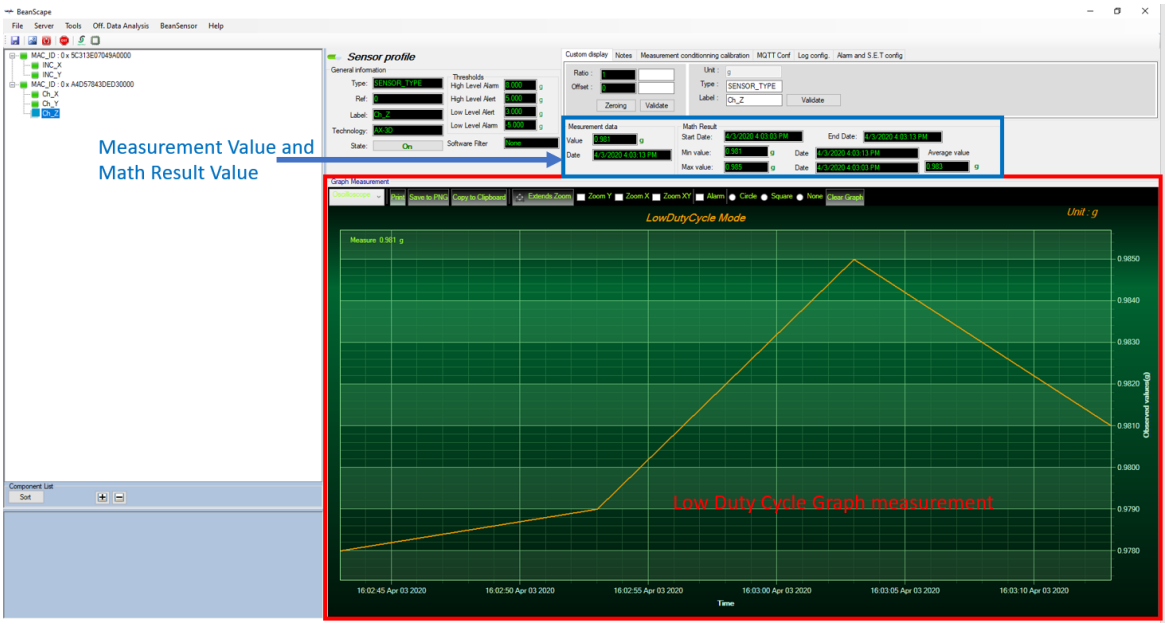


Figure 30: Low Duty Cycle Measurement graph

5.2 ALARM MODE

Alarm mode

If the alarms thresholds are not well defined, *you can end up with spurious and untimely alarms. Do not forget to properly configure the alarms thresholds before starting the alarm mode.* ***Read the section "Alarm threshold configuration from the BeanScape®".***

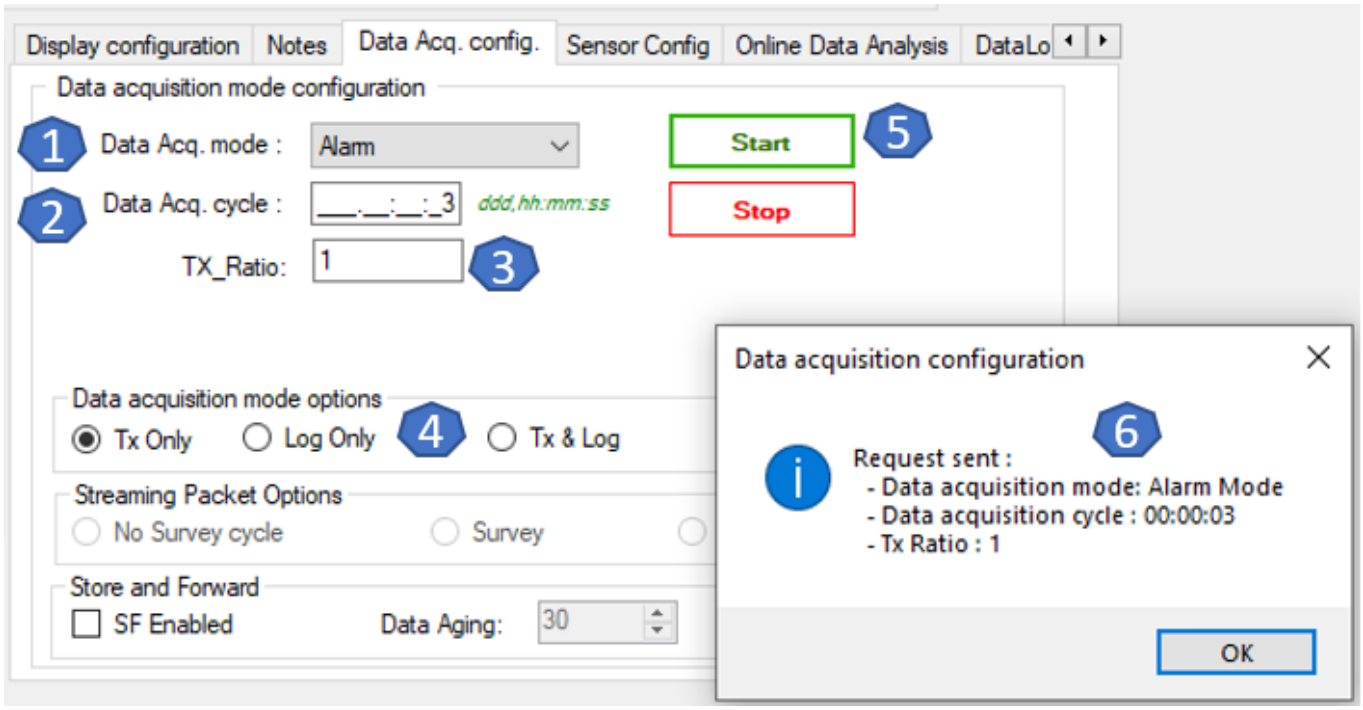


Figure 31: alarm mode configuration

1	*Choose "Alarm" mode*
2	*Enter a Data acquisition cycle of 3s*
3	*Enter a transmission ratio of 1*
4	*In this example, we configure BeanScape in TX Only*
5	*Click on Start to enable your new configuration*
6	*A Pop-up window displays the new configuration*

5.2.1 Graph visualization

Example of Alarm mode on the BeanDevice® Wilow® AX-3D (wireless vibration sensor):

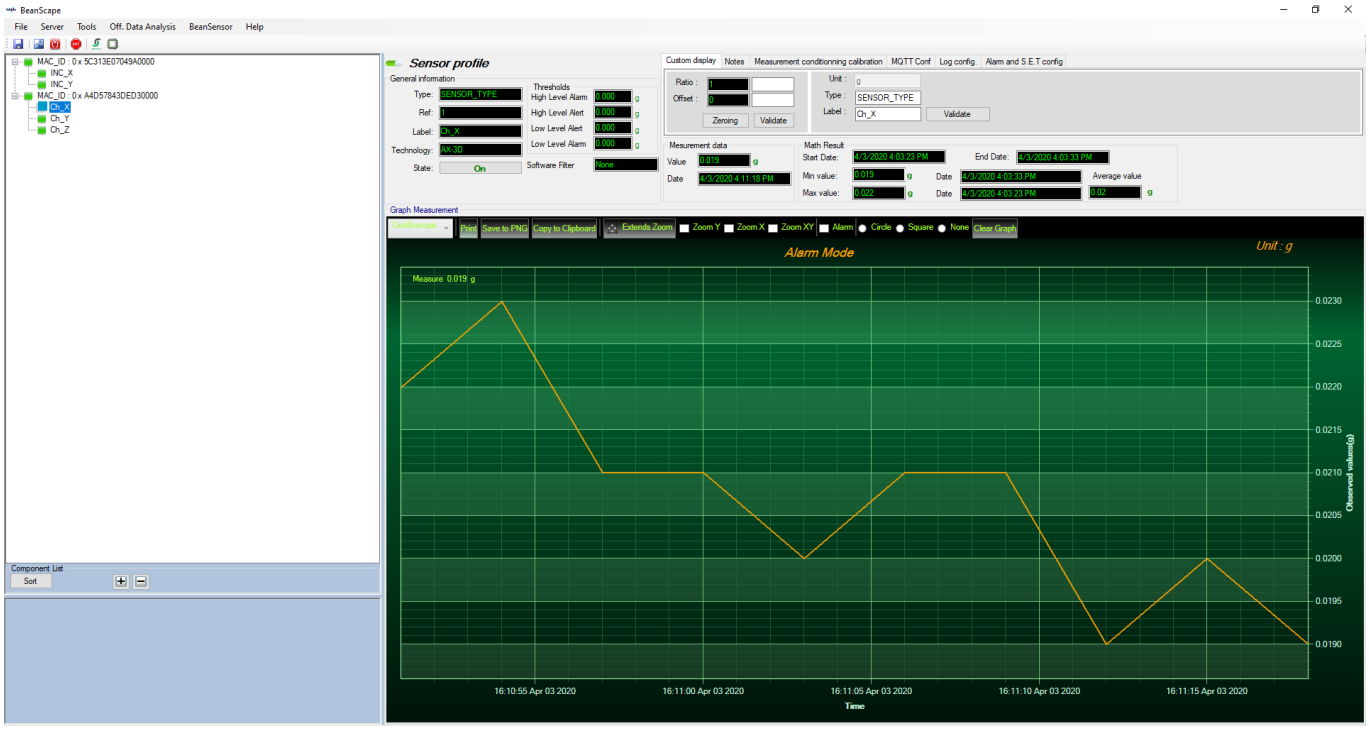


Figure 32:Alarm Mode Graph

Streaming Mode

5.3 STREAMING MODE

5.3.1 Streaming mode configuration (with “continuous monitoring” option)

Example: The BeanDevice® Wilow® is configured in streaming mode with a sampling rate of 1500 Hz. “Continuous monitoring” and “TX” options are enabled.

Proceed as follows*:*

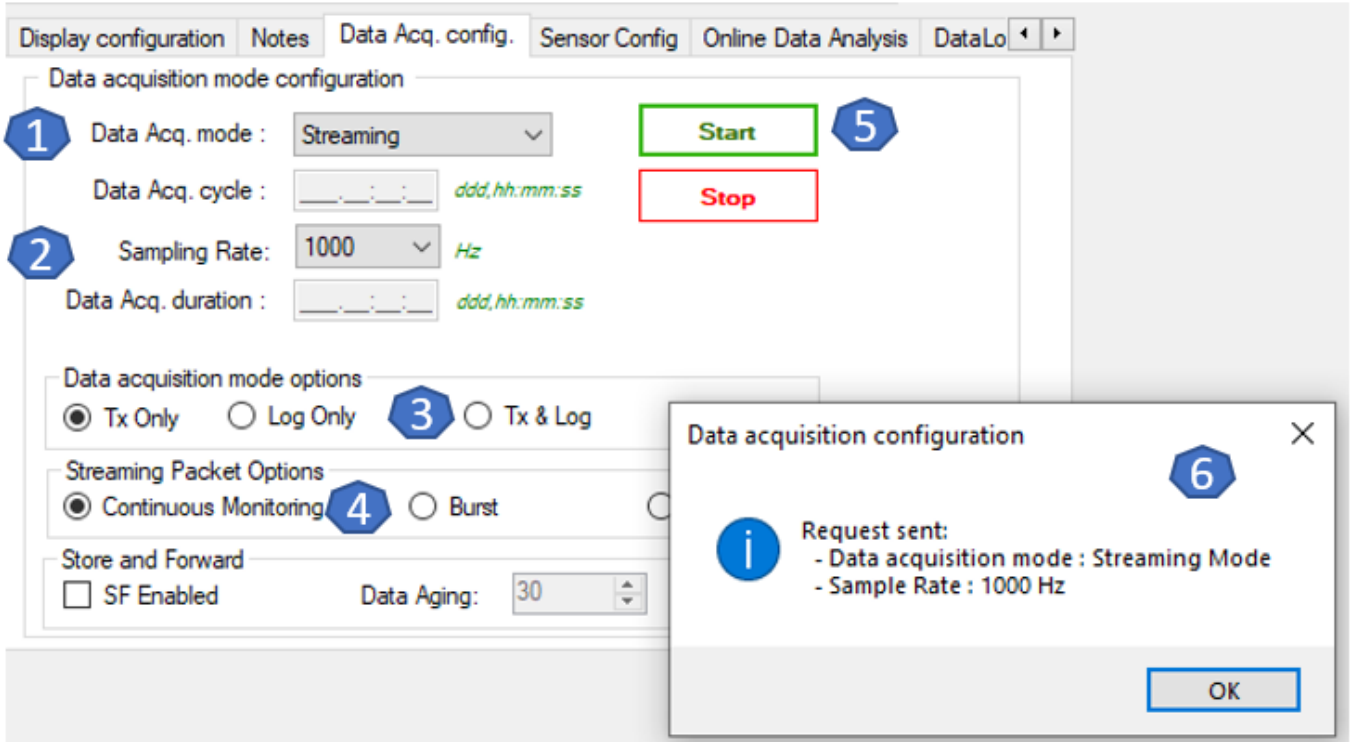


Figure 33: Streaming mode configuration

1	*Choose "Streaming" mode*
2	*Enter a sampling rate of 1000 Hz*
3	*In this example we choose TX option*
4	*Check "Continuous monitoring"*
5	*Click on Start to enable your new configuration*
6	*A Pop-up window displays the new configuration*

5.3.2 Streaming Mode configuration (with "one shot" option)

Ex: The BeanDevice® is configured in streaming Data acquisition mode with a sampling rate of 1000 Hz. "One shot" and "TX" options are enabled.

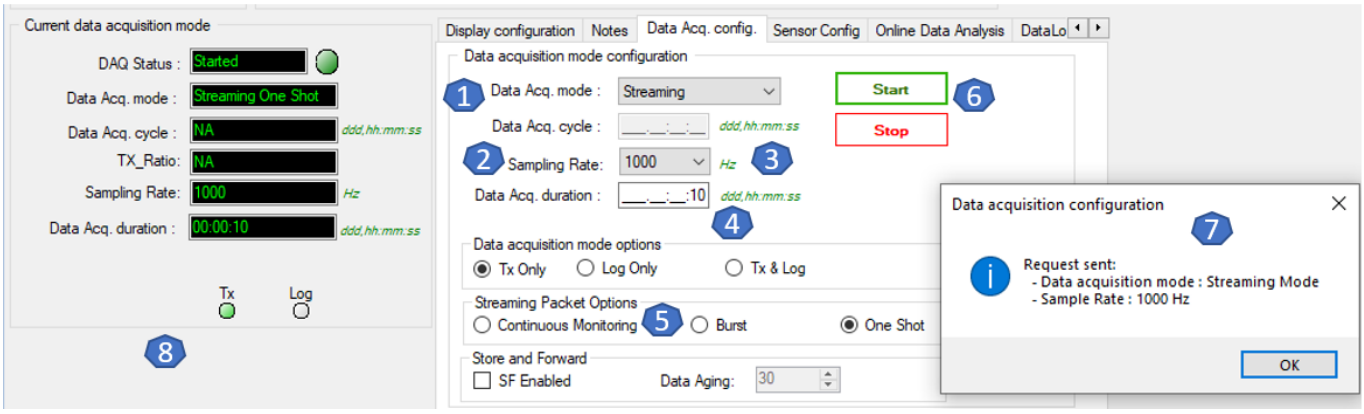


Figure 34: Streaming mode configuration (one option)

1	*Choose "Streaming "*
2	*Enter a sampling rate of 1000 Hz*
3	*Enter a Data acquisition duration of 10s*
4	*Check "TX" option*
5	*Check "One shot"*
6	*Click on Start to enable your new configuration*
7	*A Pop-up window displays the new configuration*
8	*If the new Data acquisition mode configuration is accepted by the BeanDevice® Wilow® , all the parameters are displayed in the frame "Current Data acquisition mode"*

5.3.3 Streaming Mode configuration (with "burst" option)

Ex: The BeanDevice® Wilow® is configured in streaming Data acquisition mode with a sampling rate of 1000Hz. "Burst" and "TX" options are enabled.

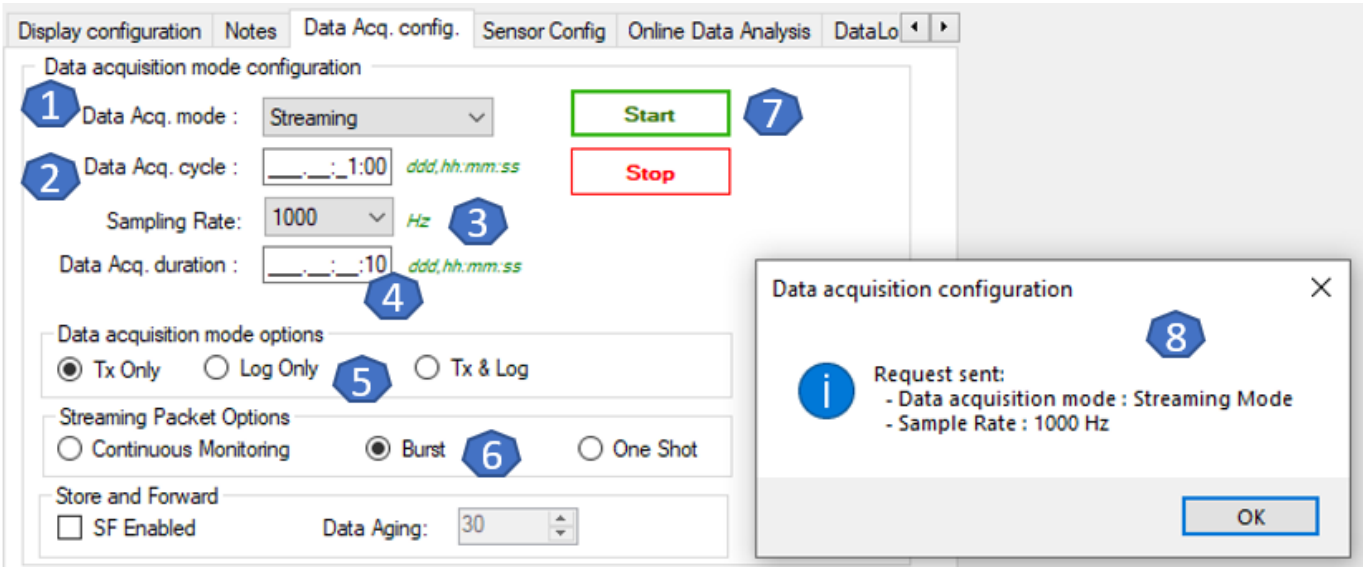


Figure 35: streaming mode with burst option configuration

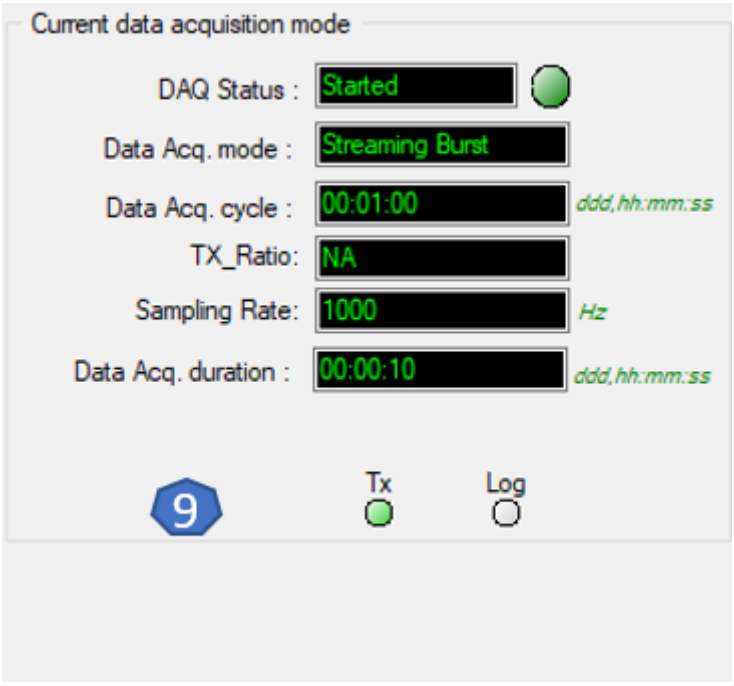


Figure 36: Current DAQ mode

1	*Choose "Streaming "*
2	*Enter a duty cycle of 60s*
3	*Enter a sampling rate of 1000 Hz*
4	*Enter a Data acquisition duration of 10s*
5	*Check "TX" option*
6	*Check "Burst"*
7	*Click on validate to enable your new configuration*
8	*A Pop-up window displays the new configuration*
9	*If the new Data acquisition mode configuration is accepted by the BeanDevice® Wilow® , all the parameters are displayed in the frame "Current Data acquisition mode"*

5.3.4 Graph visualization

Example of streaming mode on the **BeanDevice® Wilow®** (wireless accelerometer):

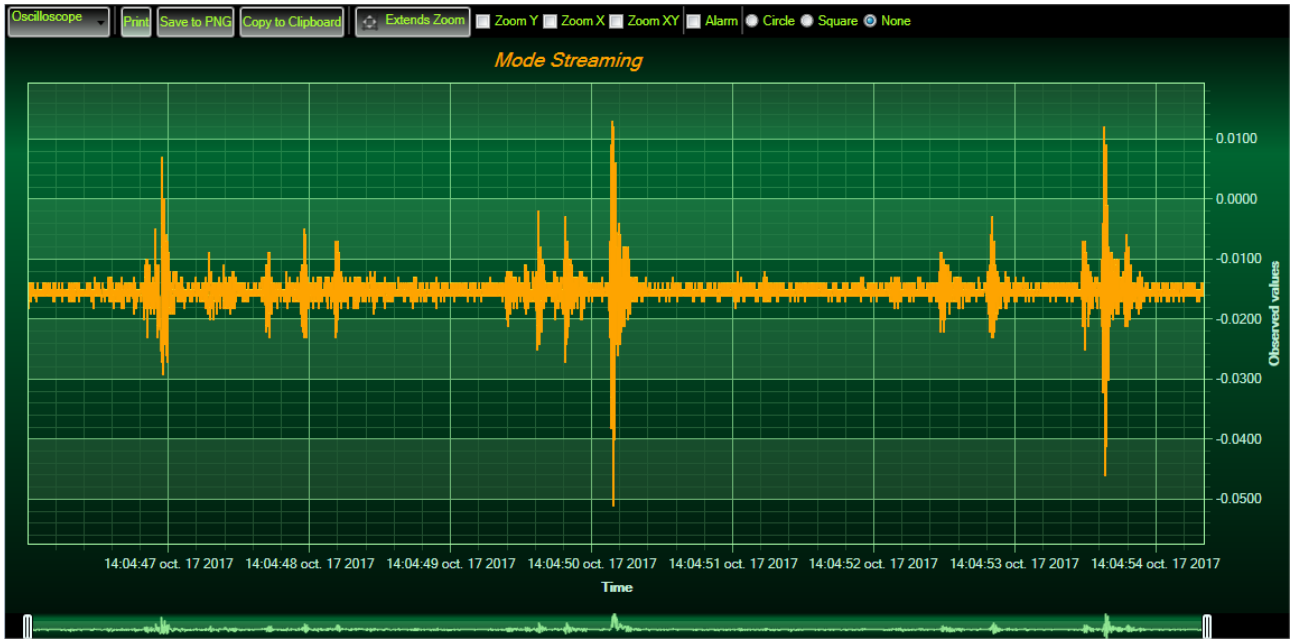


Figure 37: Graph Measurement

5.4 SSD (SMART SHOCK DETECTION) (ONLY AVAILABLE ON HARDWARE VERSION 2.0)

SSD (SMART SHOCK DETECTION)

SSD function is only available on the ***BeanDevice® Wilow AX-3DS, BeanDevice® Wilow AX-3D & BeanDevice® Wilow X-Inc*** *with a hardware version 2.0, however the SSD function is not available on the* ***BeanDevice® Wilow X-Inc & BeanDevice® Wilow AX-3D*** *with the hardware version 2.1:*

Step 1

- Configure the measurement range of your accelerometer

Step 2

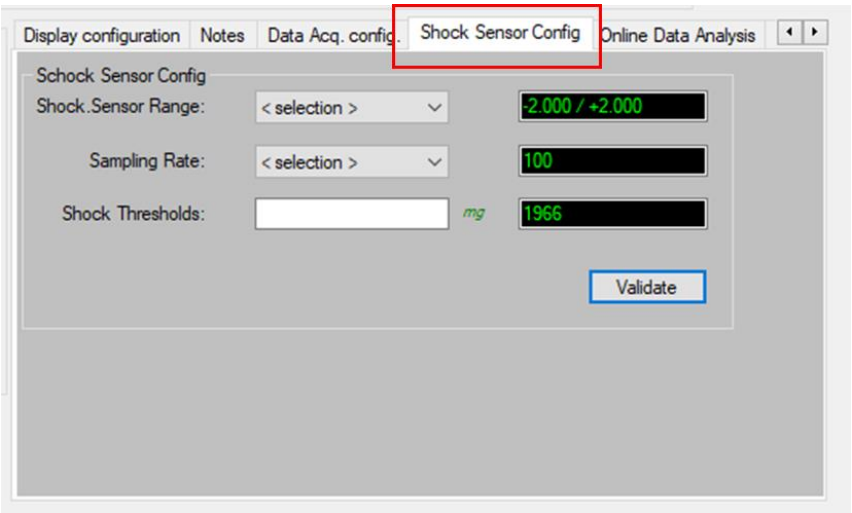
- Configure the SSD (Smart Shock Detection) Profile

Step 3

- Configure SSD (Smart shock detection) measurement mode

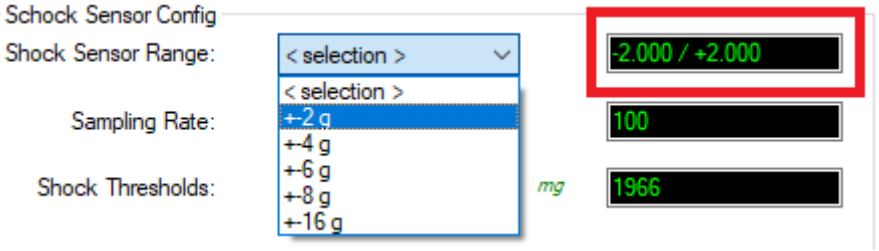
5.4.1 Step 1: configure the shock detection sensor

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



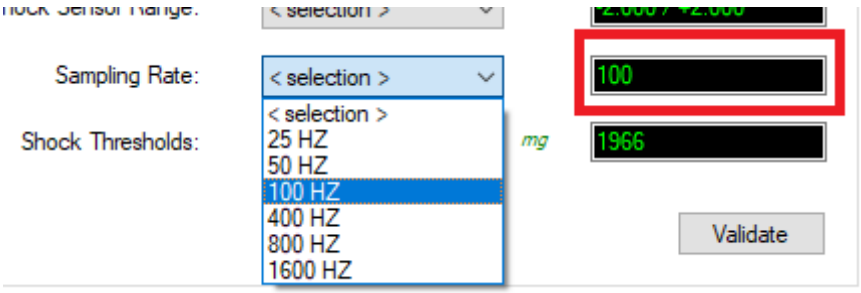
- ***Shock Sensor Range:*** This option allows the user to change the Shock sensor range from the list, as displayed below. The available Shock Ranges are +/-2g, +/-4g, +/-6g, +/-8g or +/-16g.

  The selected value will be displayed on the black case.



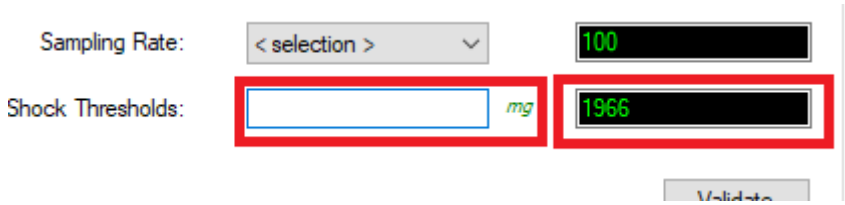
- ***Sampling Rate:*** This option allows to change the Sampling Rate of the Shock Senor from the listed values: 25Hz, 50Hz, 100Hz, 400Hz, 800Hz or 1600Hz.

The selected value will be displayed on the black case.



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

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



5.4.2 Graph display

SSD Data acquisition mode on the ***BeanDevice® Wilow® AX-3DS*** when shock is detected

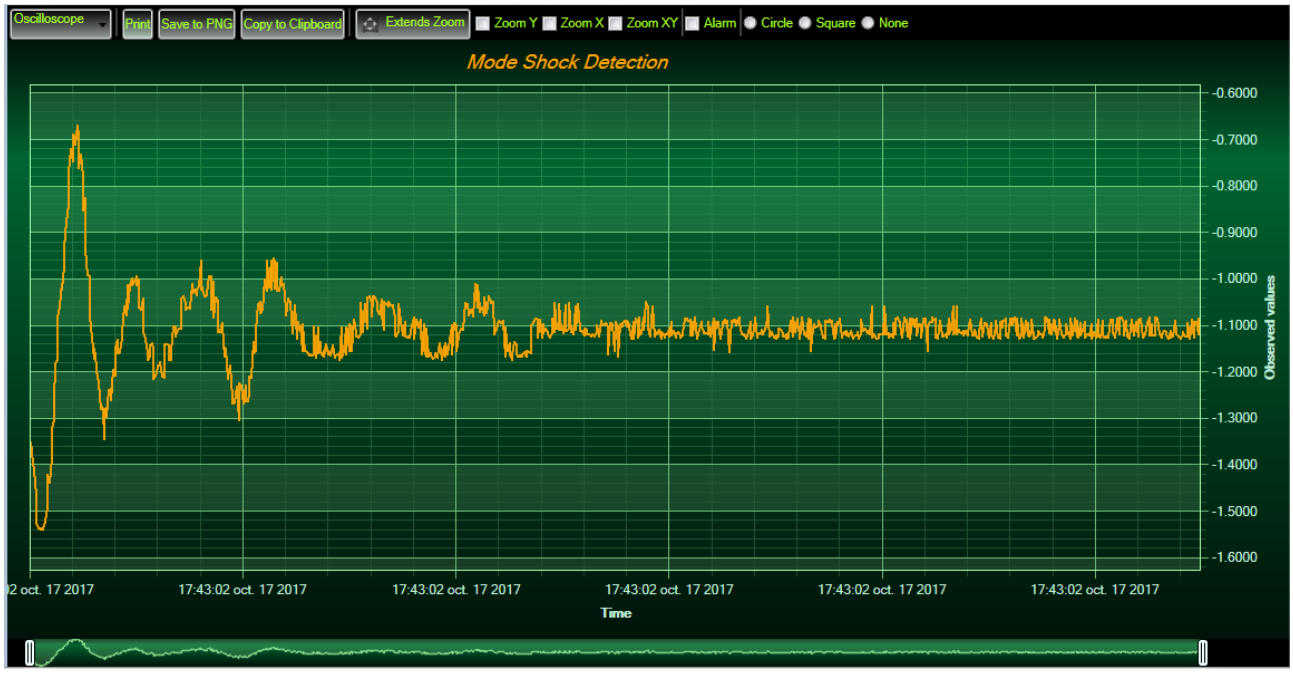


Figure 38: Graph display corresponding to a shock detection

5.5 STREAMING WITH EVENT TRIGGER (S.E.T)

Streaming with event trigger YouTube video

5.5.1 Configuration

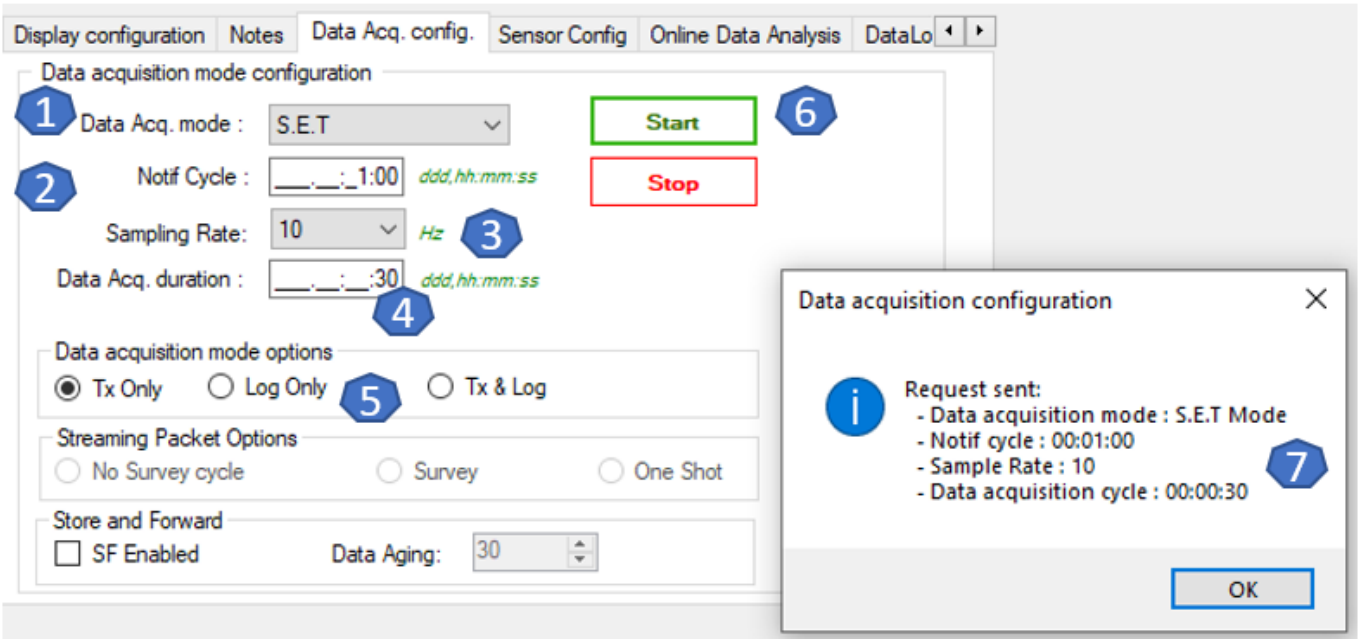


Figure 39: SET mode Configuration

1	*Chose "S.E.T" mode*
2	*Enter 10 hours for Notif cycle*
3	*Enter a sampling rate of 200 Hz*
4	*Enter 50 seconds for Data Acq. duration*
5	*In this example we choose TX option*
6	*Click on validate to enable your new configuration*
7	*A Pop-up window displays the new configuration*

5.6 STREAMING WITH EVENT TRIGGER (S.E.T)

5.6.1 Configuration

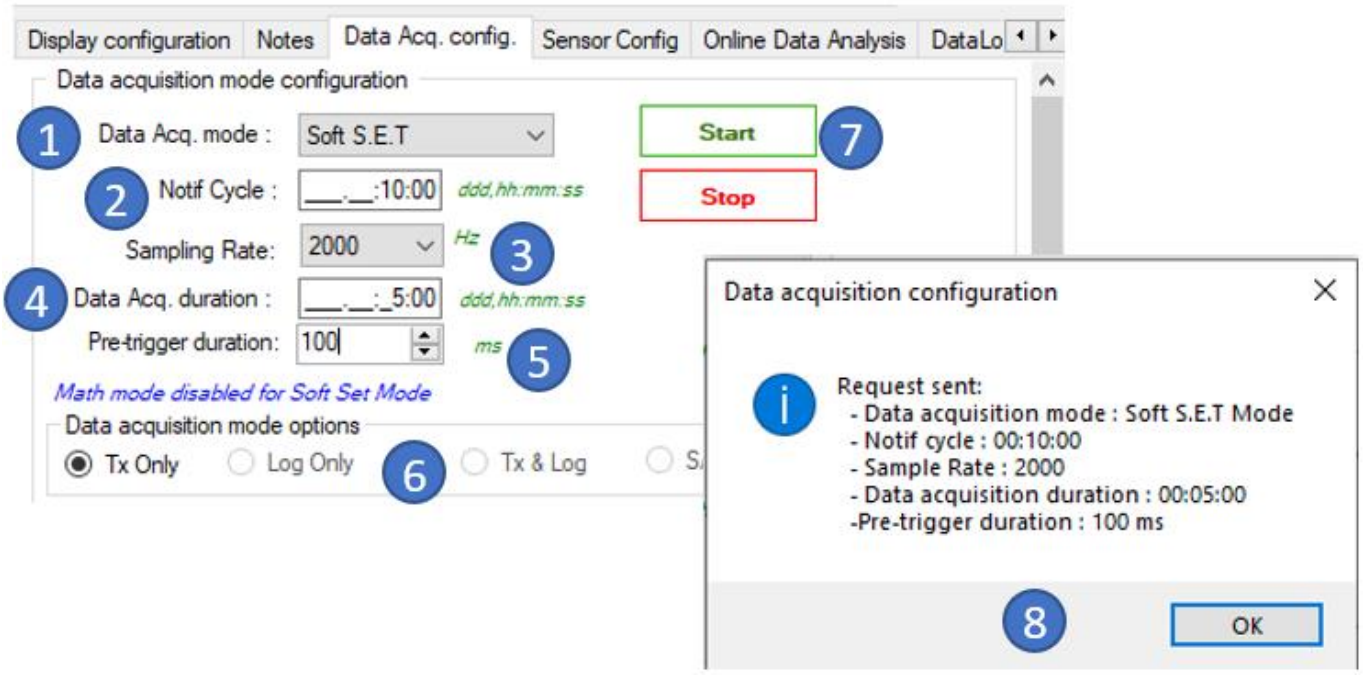


Figure 40: Soft SET DAQ mode

1	*Chose "Soft S.E.T" mode*
2	*Enter 10 minutes for Notif cycle*
3	*Enter a sampling rate of 2000 Hz*
4	*Enter 5 minutes for Data Acq. duration*
5	*Enter a pre-trigger duration of 100 milli-seconds*
6	*In this example we choose TX option*

7	***Click on validate to enable your new configuration***
5	***A Pop-up window displays the new configuration***

5.6.2 Graph display

Soft SET Data acquisition mode on the ***BeanDevice® Wilow® AX-3D*** when an event was trigged.

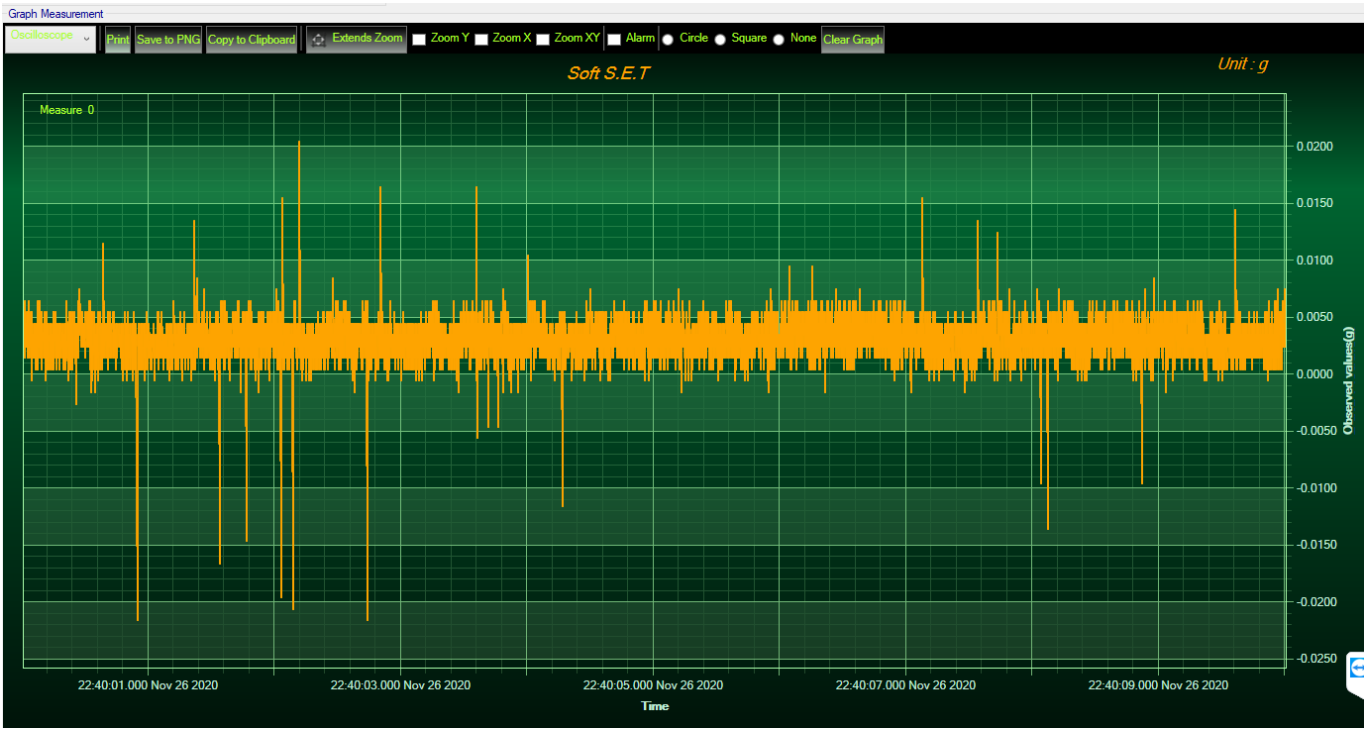


Figure 41: Soft SET graph display

The graph will be refreshed every 10 seconds

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

6.1 OFFLINE DATA ANALYSIS TOOL

6.1.1 FFT (Fast Fourier Transform) waveform analysis module (available only on BeanDevice® Wilow® AX-3D)

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

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

6.1.1.1 FFT File Generation

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

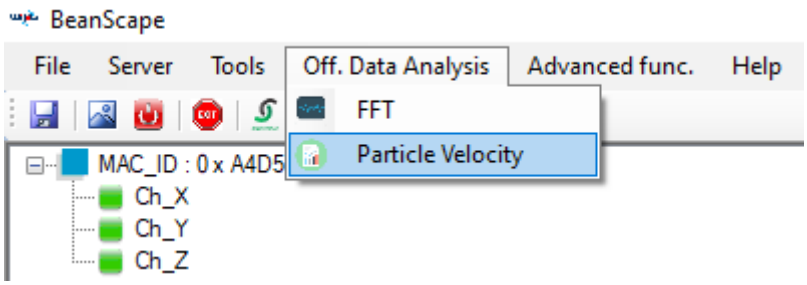


Figure 42: FFT offline data analysis on BeanScape® top menu

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

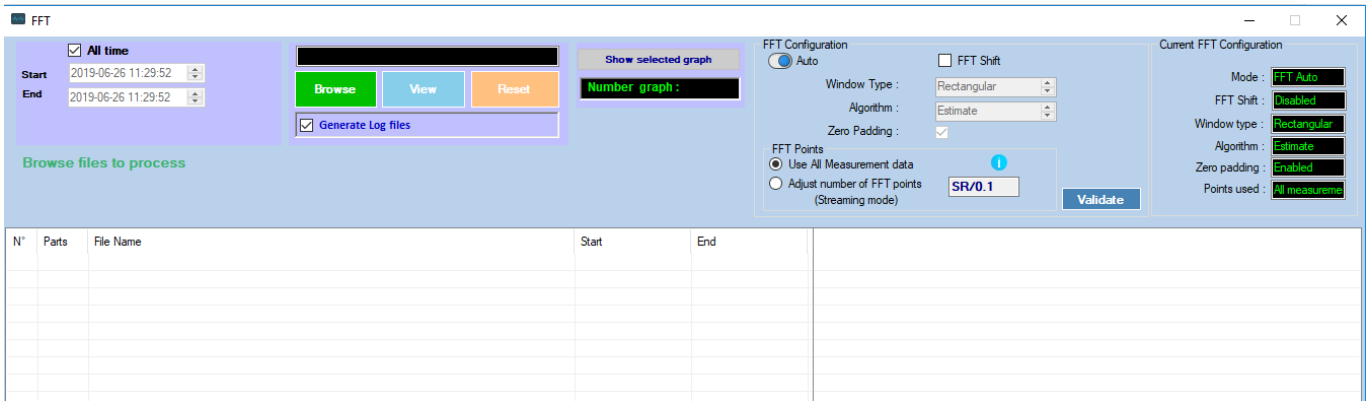


Figure 43: FFT tool window

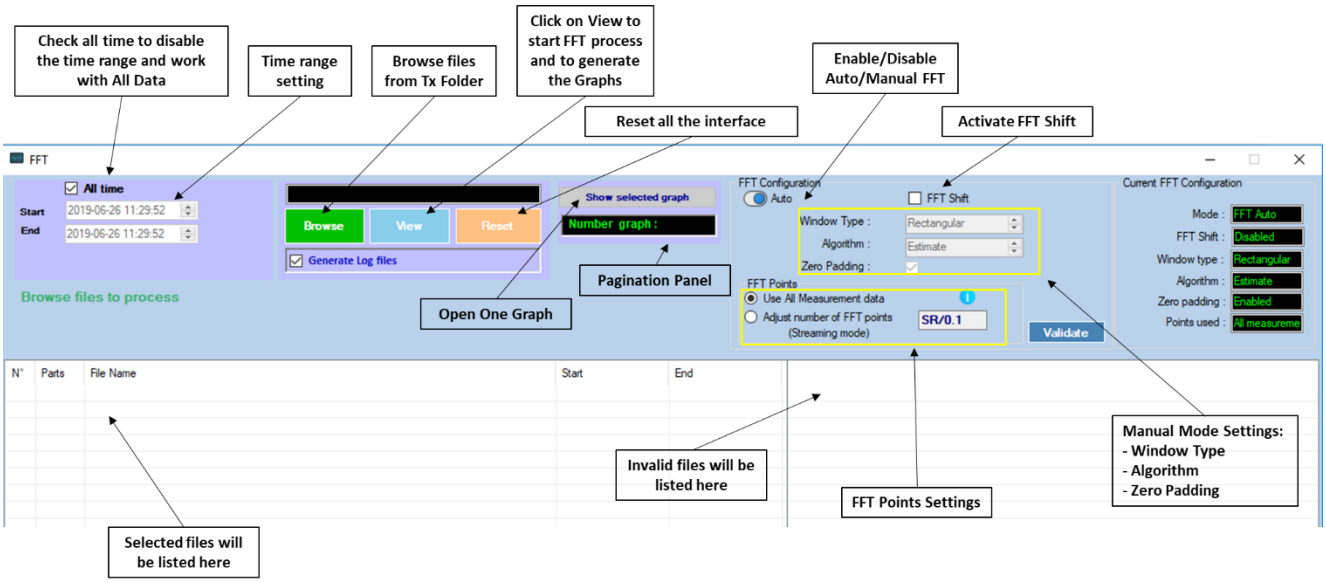


Figure 44: FFT window options

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

The FFT tool will generate as a result:

o Power spectral density and a new window displays

1: Click on Browse to choose files

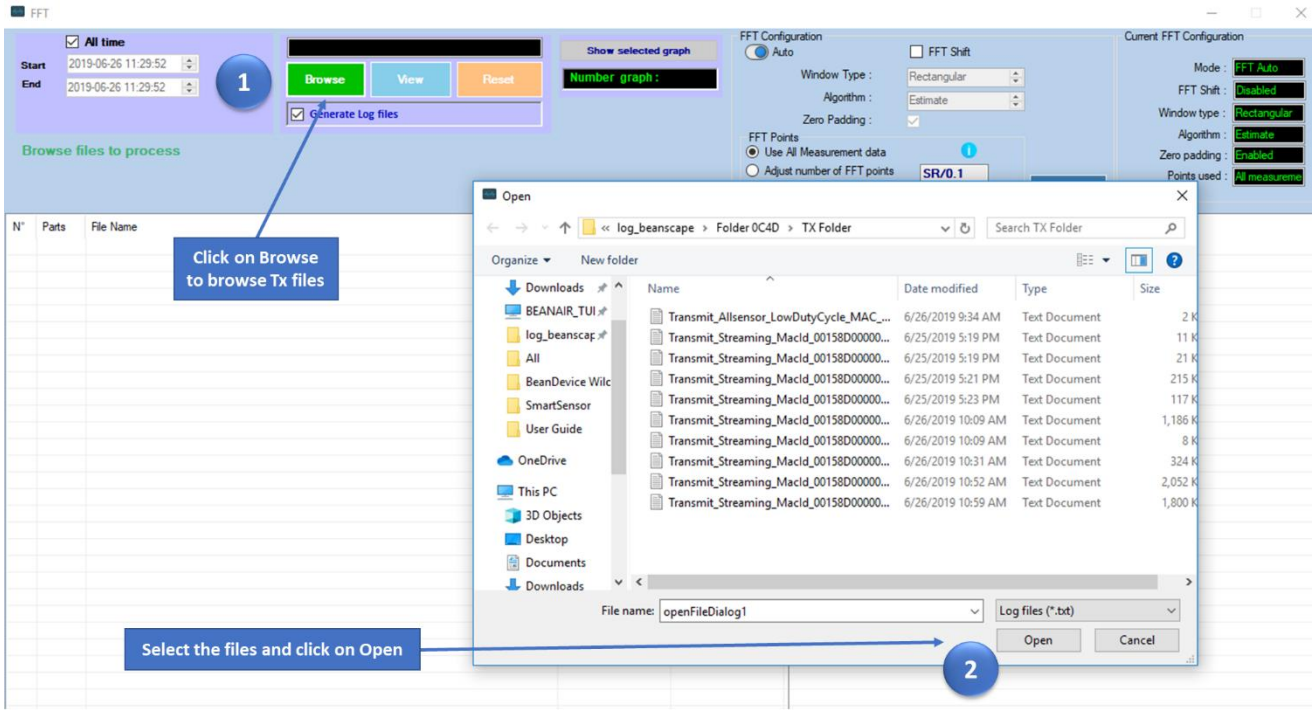


Figure 45: Browsing TX files on FFT window

2: Overview of the selected files

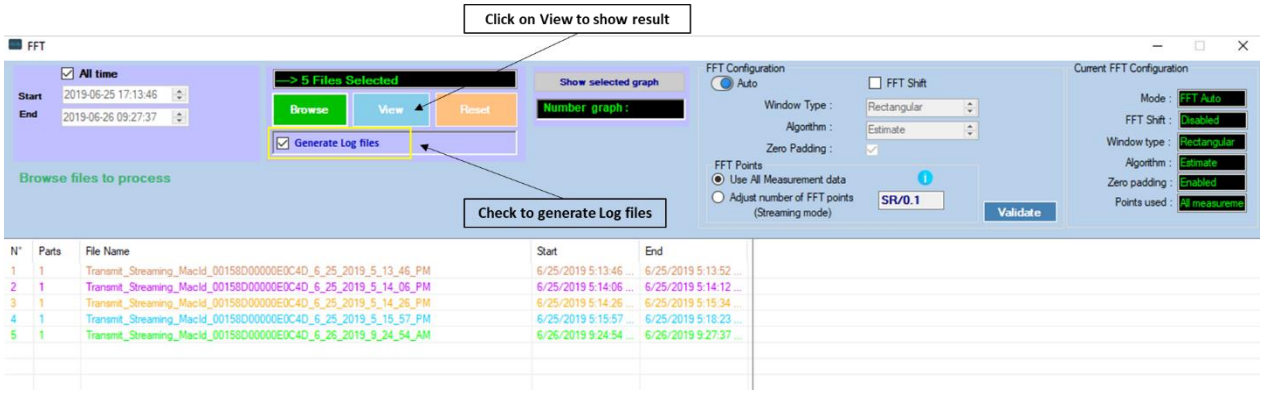


Figure 46: Overview: FFT window

3:Loading

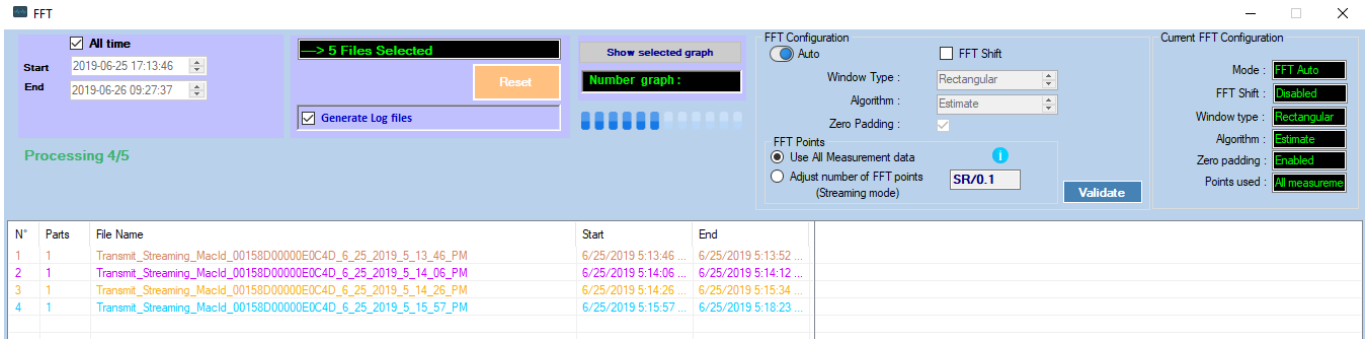


Figure 47: FFT features generation

4: FFT report generated with the following results:

a. Frequency

b. Amplitude

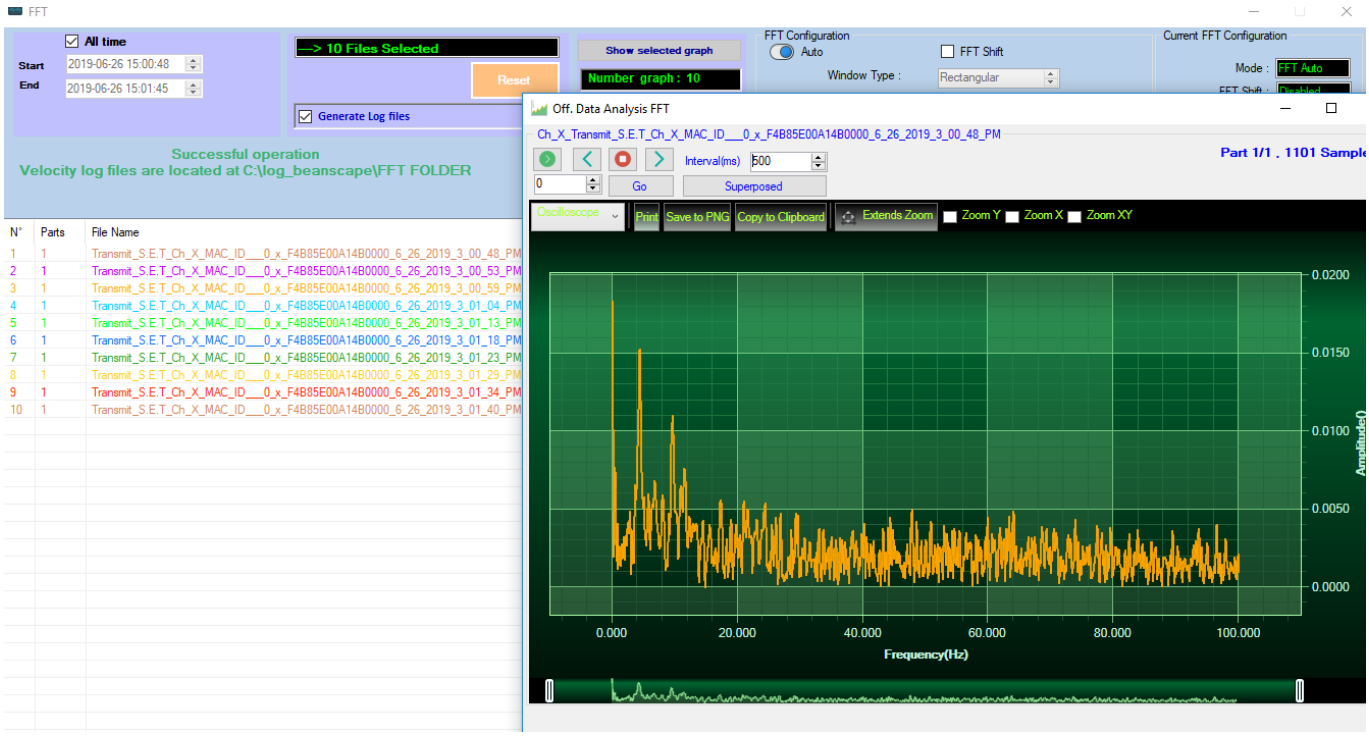


Figure 48: FFT genrated view

5: FFT LOG files generated

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

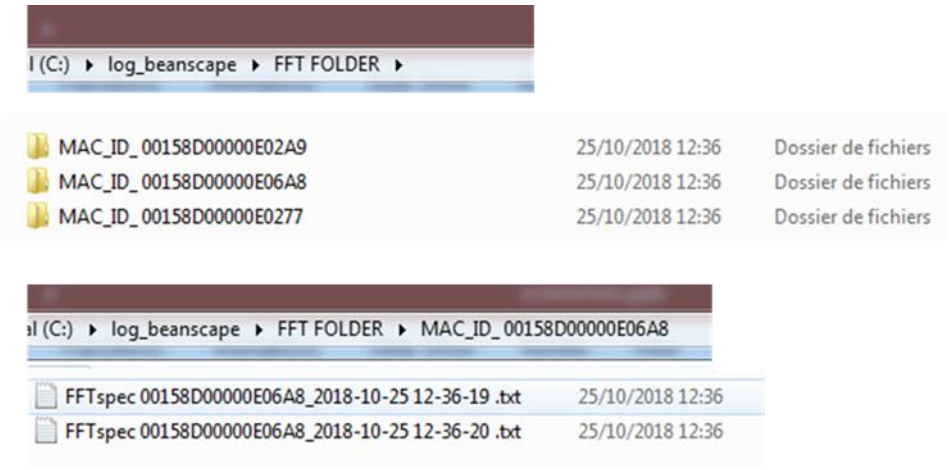


Figure 49: Generated FFT Log files

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

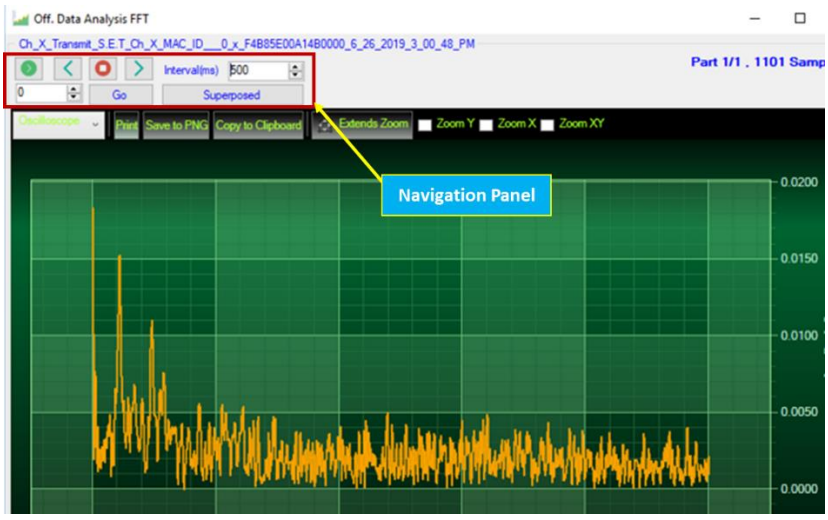


Figure 50: Graph display (Offline Data analysis)

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

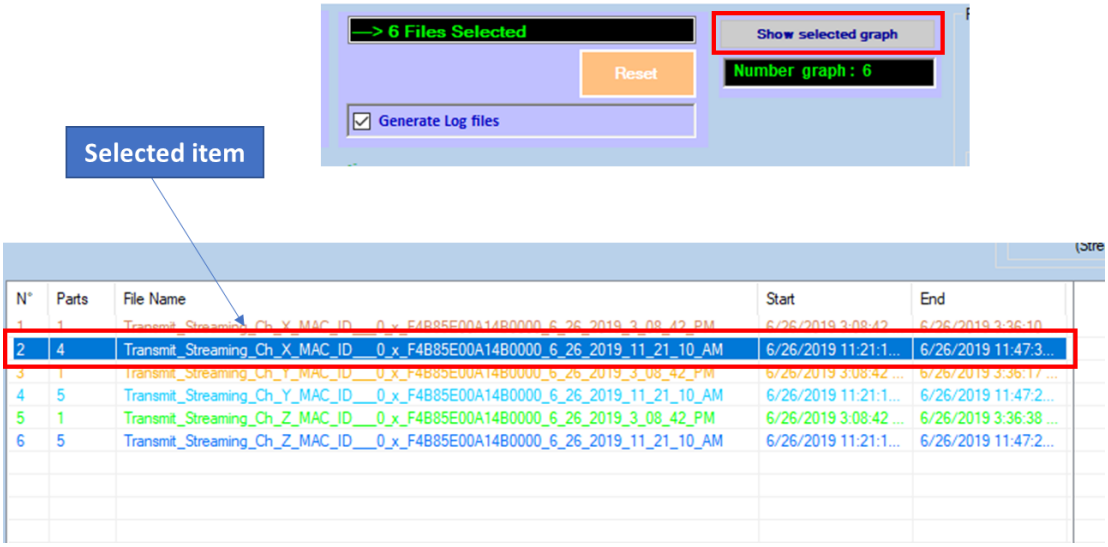


Figure 51: Selecting a graph to display

8: The selected graph is displayed

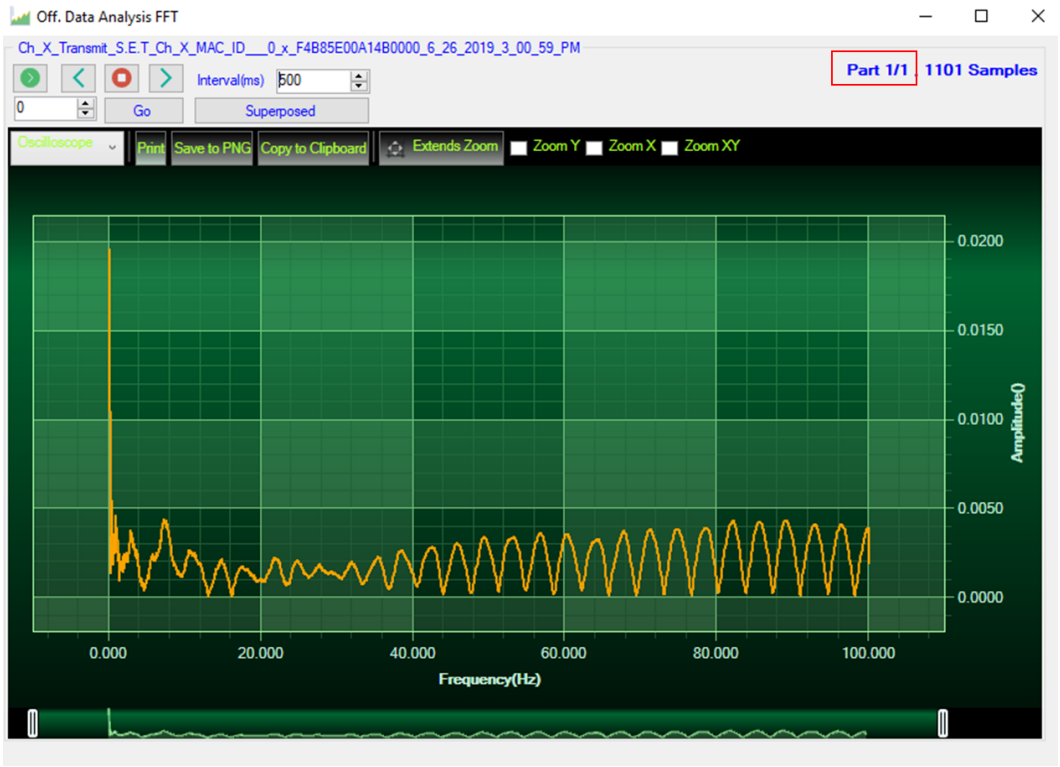


Figure 52: Selected graph display

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

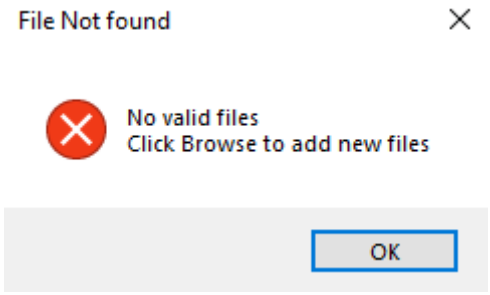


Figure 53: FFT invalid files

6.1.1.2 FFT shift

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

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

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

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

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

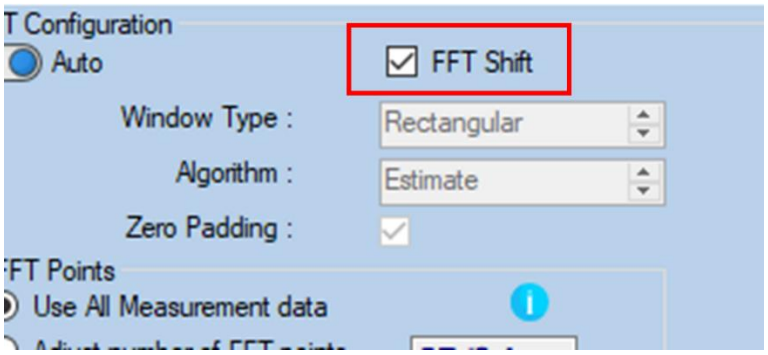


Figure 54: Offline FFT shift activation

2. FFT Spectrum with FFT Shift option enabled

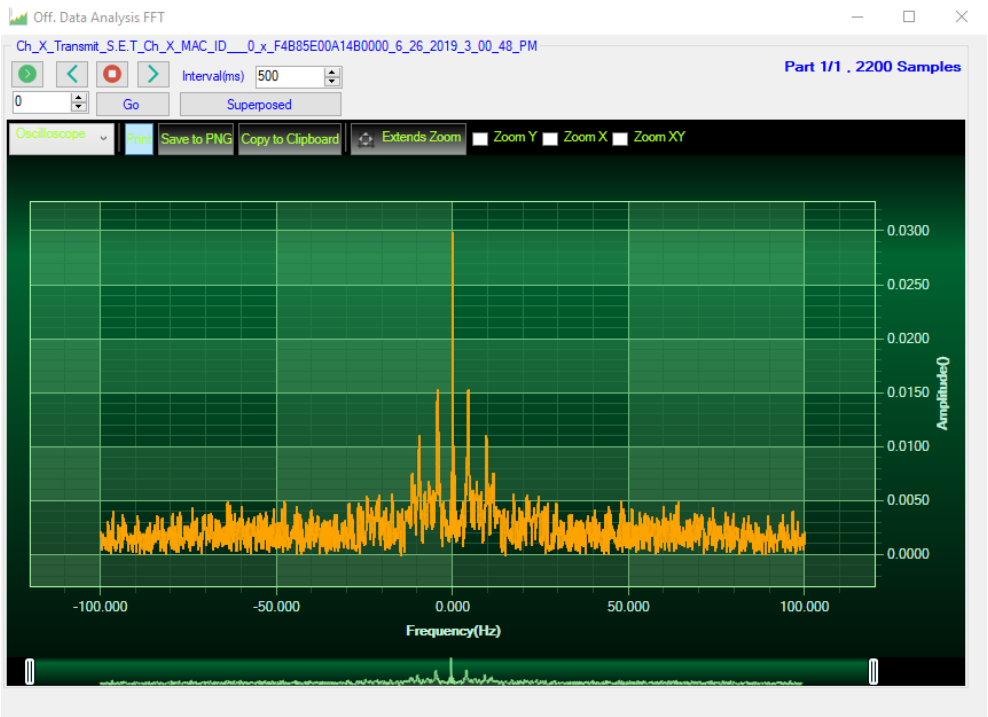


Figure 55: FFT shift spectrum

FFT and FFT shift video

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

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

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

2-Implement an analysis report.

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

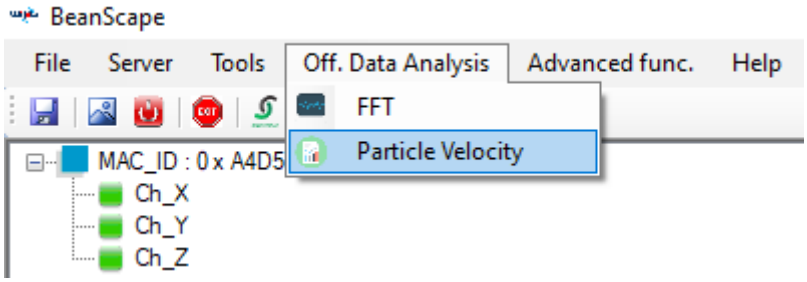


Figure 56: Particle Velocity on BeanScape® top menu

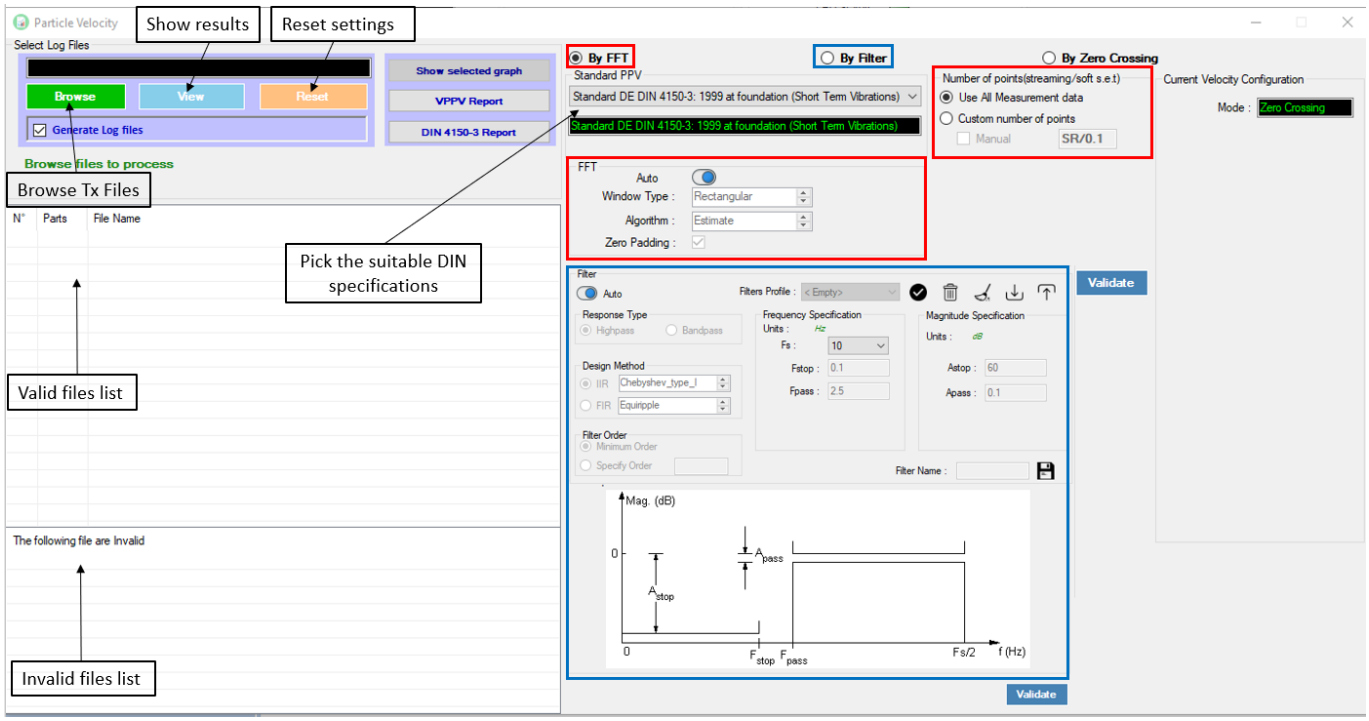


Figure 57: Particle Velocity window

The second step is to select the DIN norm specification from the Standard PV drop down list:

- Standard DE DIN 4150-3: 1999 at foundation (Short Term Vibration)
- Standard DE DIN 4150-3: 1999 Uppermost Floor (Short Term Vibration)

- Standard DE DIN 4150-3: 1999 at Buried Pipework (Short Term Vibration)
- Standard DE DIN 4150-3: 1999 Uppermost Floor (Long Term Vibration)
- BS Standard BS 7385-2:1993
- Standard USBM RI8507 and OSMRE

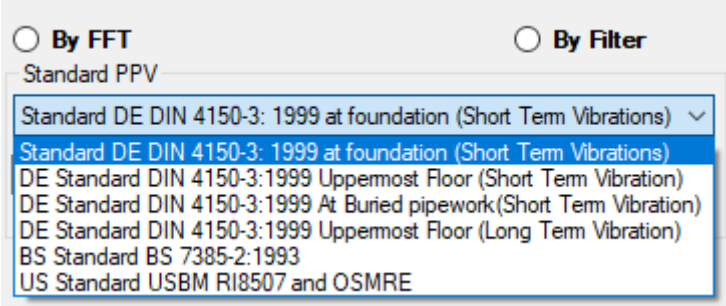


Figure 58: Available Standards

The PPV Results will be based on the select Standard.

From more information about the DIN Standard please read Wilow vibration sensors for ground vibration technical note TN-RF-23.

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

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

Figure 59:Log file management

3: Velocity Advanced Configuration.

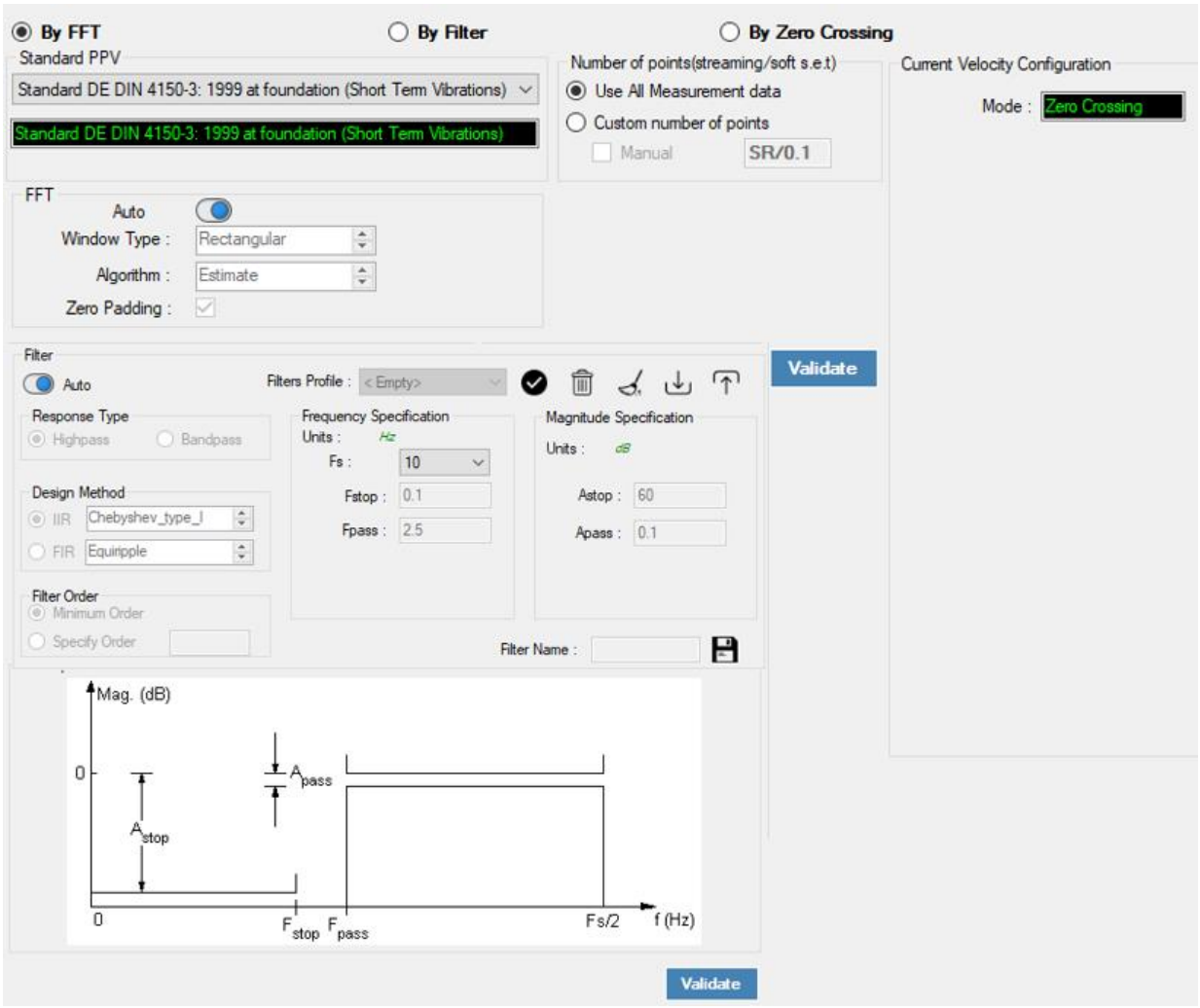
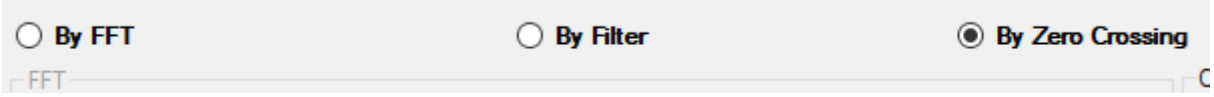
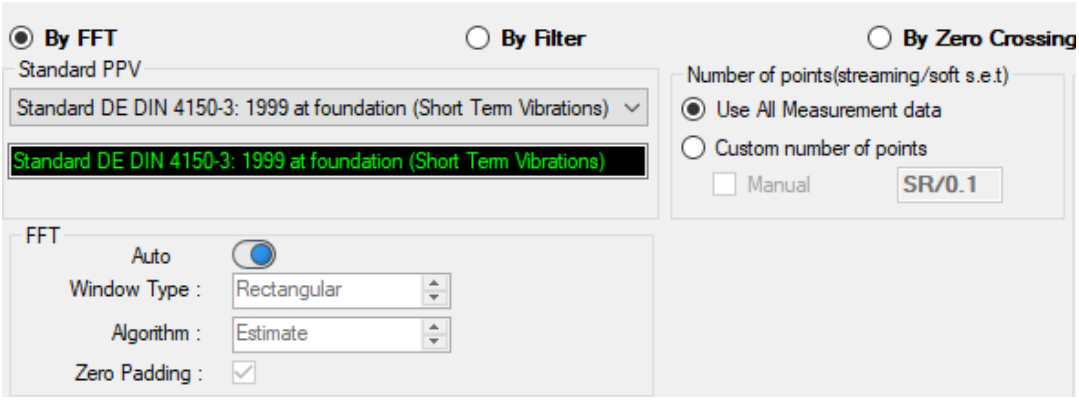


Figure 60: Velocity Advanced Configuration

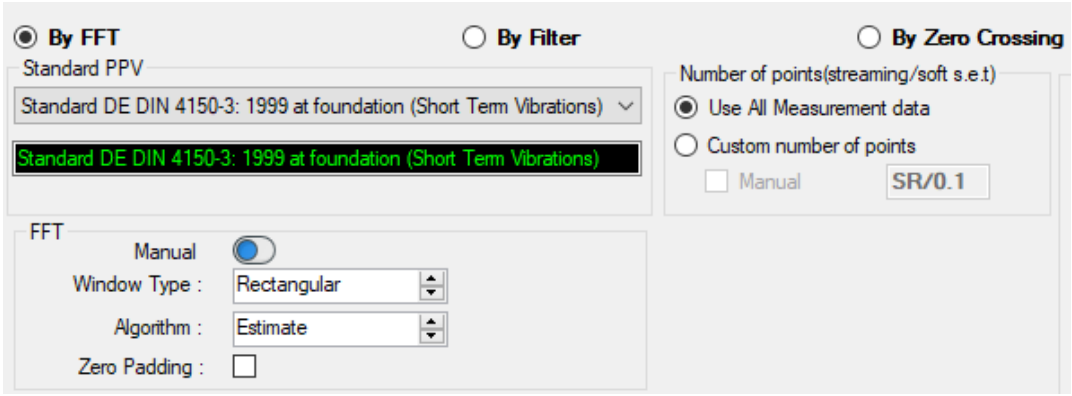
By default, the Velocity is configured “By Zero Crossing”, to edit the Velocity settings user must select “By FFT” or “By Filter”.



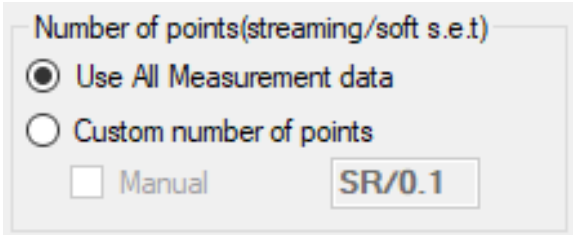
- **By FFT:** By selecting this option, the user will setup the Velocity basing on customized FFT settings.
    - Auto: If Auto is selected, The Velocity calculation will activate FFT Auto mode Settings



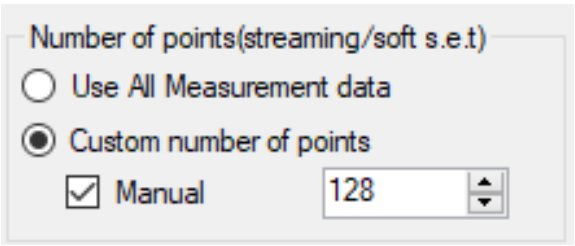
- Manual: Once switched to Manual, the user must configure the FFT settings manually (Window Type, Algorithm & Zero Padding).



- 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.



The Number of points configurations is only related to Streaming and Soft SET DAQ modes

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

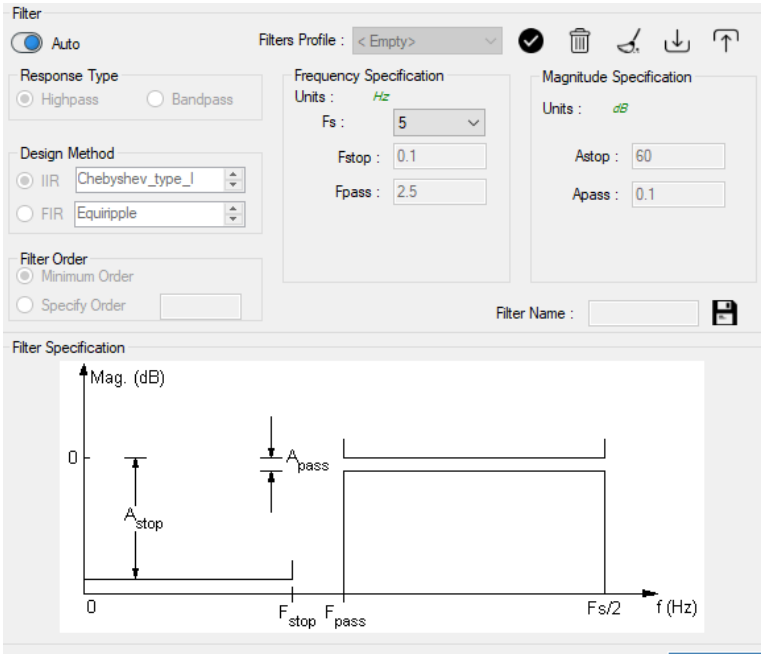
The frequency resolution of each spectral line is equal to the Sampling Rate divided by the Number of Points. For instance, for example, if the Number of Points is 4096 and the Sampling Rate is 2000, the resolution of each spectral line will be:

2000/4096 = 0.48828125

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

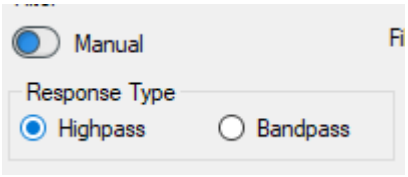
It is important to notice that larger Number of Points provide higher spectral resolution but take longer to compute.

- **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**

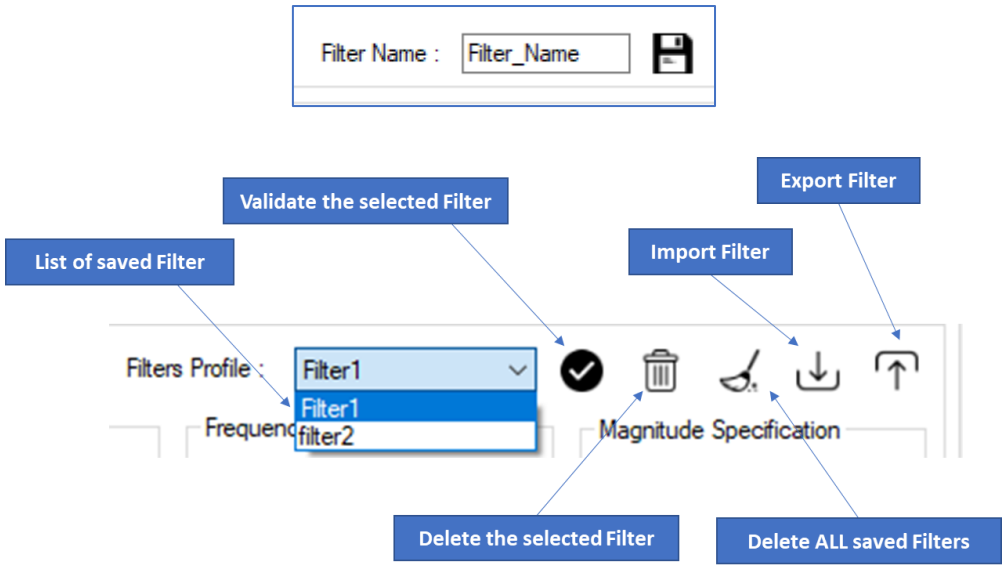


- Design Method: User should Select the nature of the Filter between **IIR** or **FIR**
  From the List of every filter, user have to specify the method of the Filter:
  IIR: Chebyshev_type_I, Chebyshev_type_II or Butterworth
  FIR: Equiripple, Generalized_Equiripple or Kaiser_Window

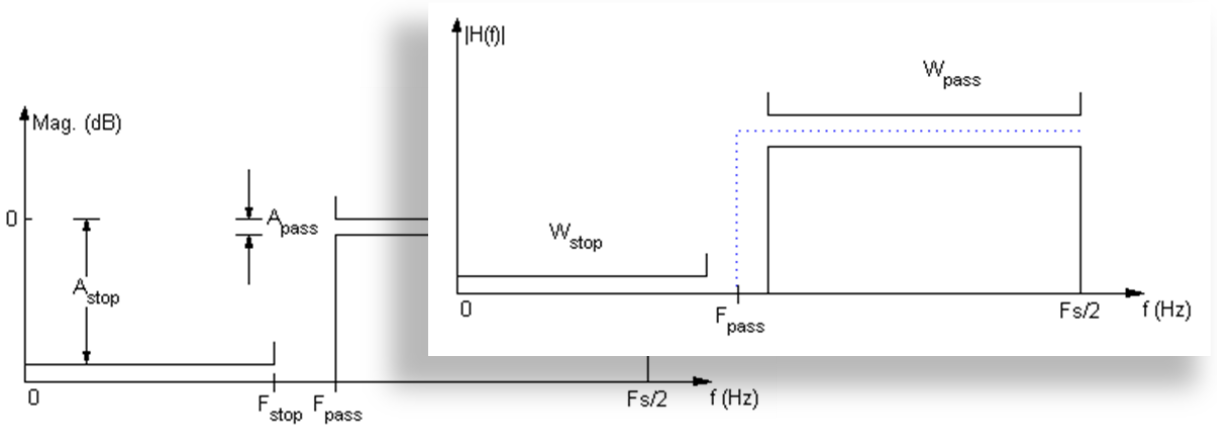
The Frequency Specification and The Magnitude Specification will be modified according the selected Design Method

- 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.

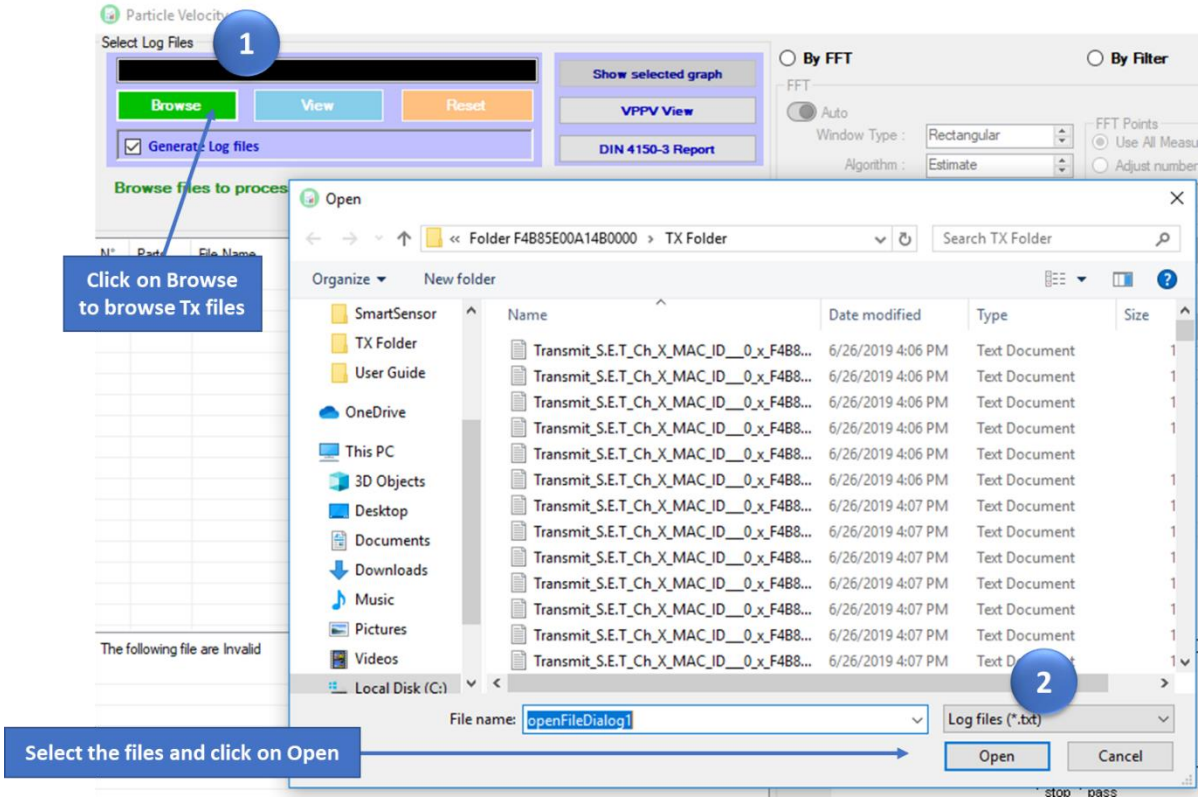


Figure 61: Browsing TX files into Particle Velocity tool

5: Loading.

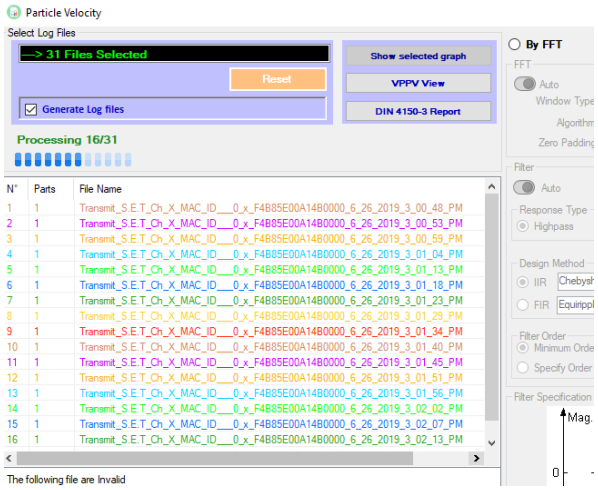


Figure 62: Generation of the Particle Velocity Calculation Result

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

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

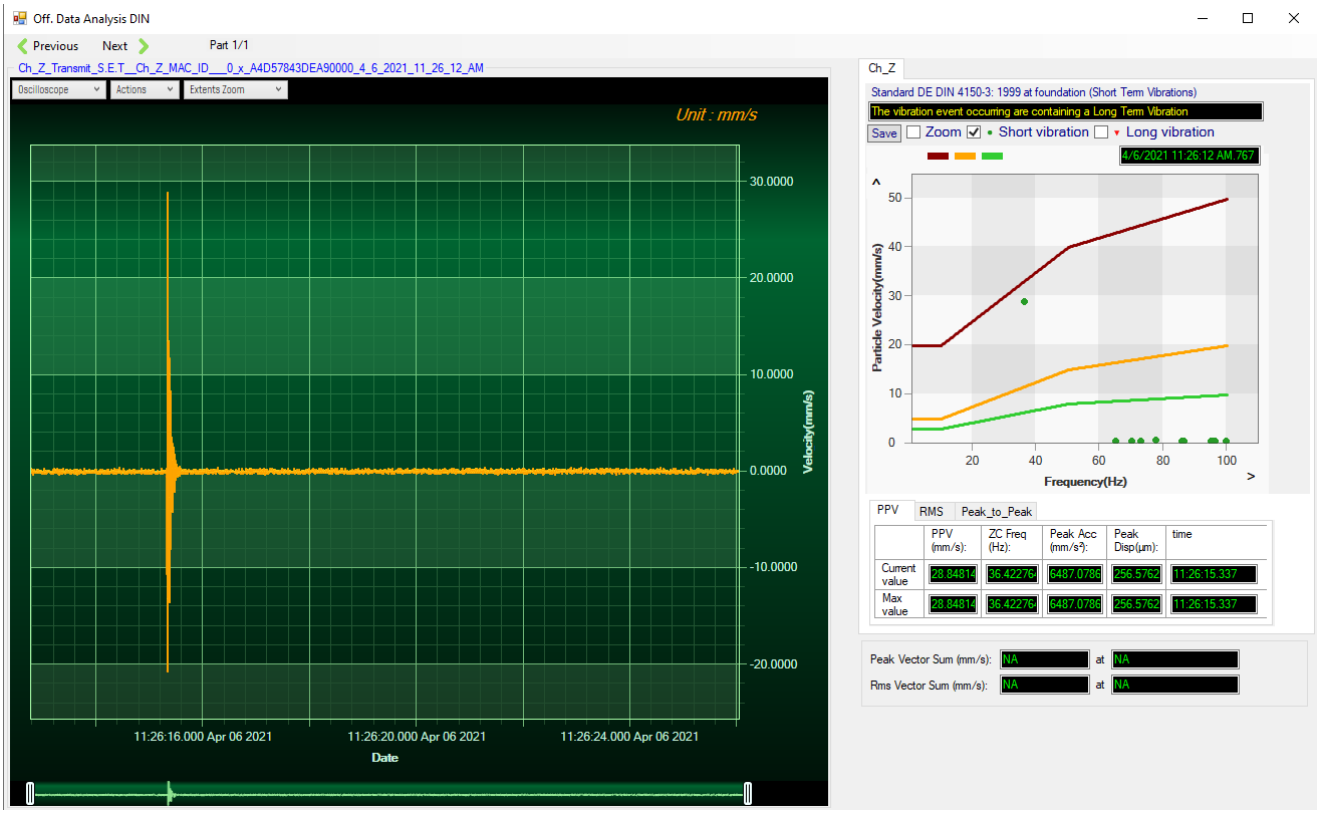


Figure 63: Particle Velocity Display Window

7: The VPPV and DIN Report:

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

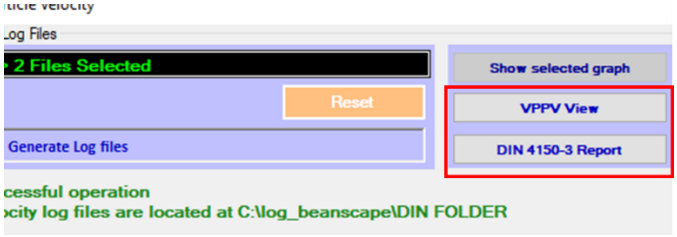


Figure 64: VPPV & DIN buttons

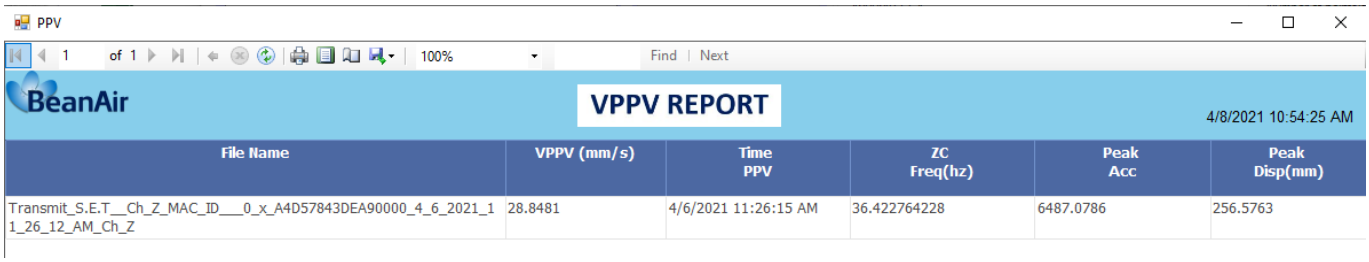


Figure 65: VPPV Report

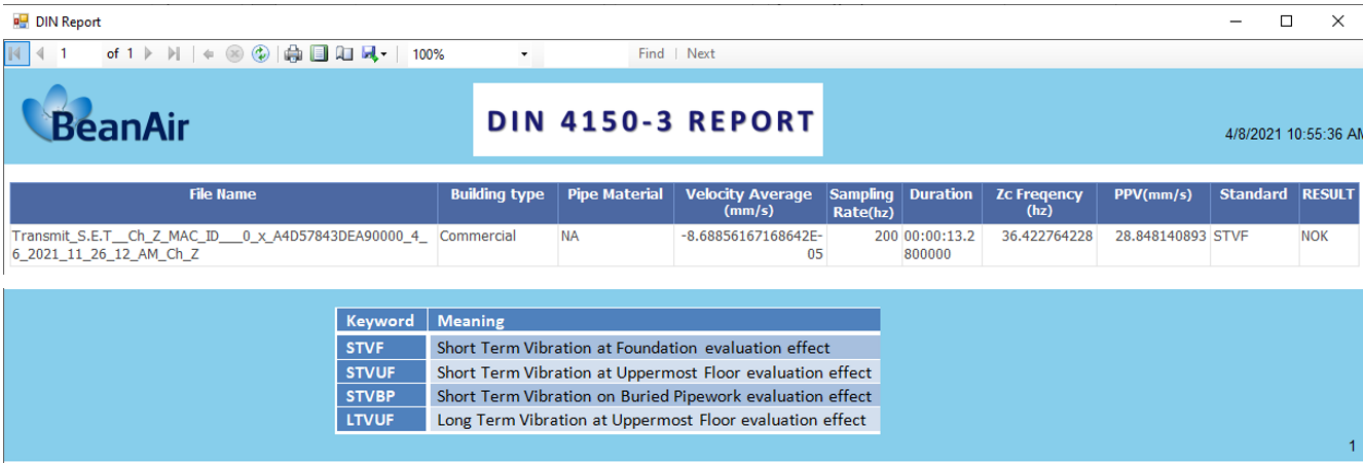


Figure 66: DIN Report

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
Analyze duration	BeanScape property
Long term vibration at Uppermost Floor 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 (Long term vibration criteria).

	3-Display if the result is OK or not (guideline respected or not)
Short term vibration at foundation evaluating 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 (Short term vibration at foundation criteria). 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 vibration at Uppermost Floor evaluating 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 (Short term vibration at uppermost floor criteria). 3-Display if the result is OK or not (guideline respected or not)
Short term vibration at Buried Pipework evaluating Effect	1-find the maximum velocity value over the time. 2-compare the maximum velocity to the guideline value described on the Norm DIN 4150 (Short term vibration at Buried Pipework criteria). 3-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

6.3 ONLINE DATA ANALYSIS TOOL (AVAILABLE ONLY ON BEANDEVICE® WILOW® AX-3D)

6.3.1 Online FFT and FFT report

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

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

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

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

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

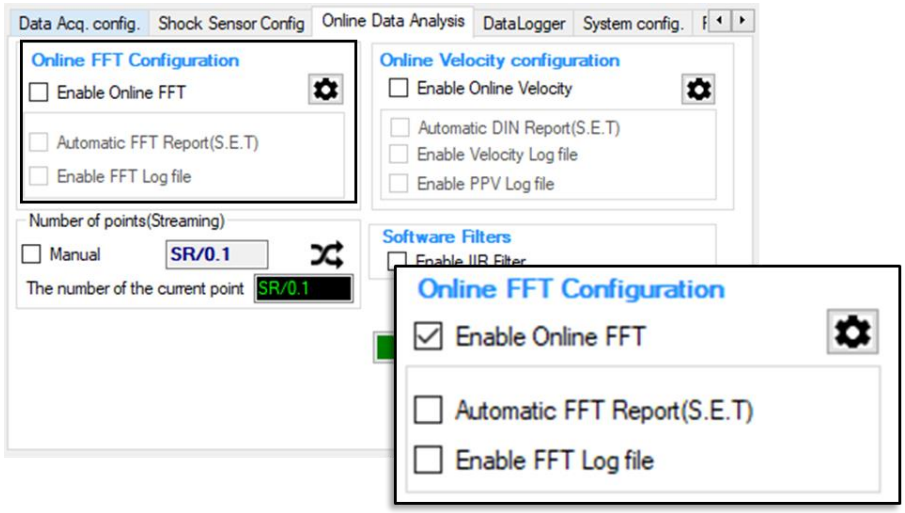


Figure 67: Online FFT configuration frame

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

	• **Automatic DIN Report (Set Mode):** check for automatically sending the DIN 4150-3 report by email when alarm occurs on streaming with event-trigger(set) mode • **Enable Velocity Log file :** check to create Velocity folder and log all real time Velocity • **Enable PPV Log file:** check to create PPV Log file •  : check to modify the Velocity Advanced Configuration settings
Software filters	• **Enable IIR Filter**: check to enable the IIR (infinite impulse response) filter for the High sampling rate acquisition modes.
Number of points(Streaming)	• **Manual:** check to configure the number of points related to the Sreaming manually. •  **:** check to modify the FFT Spectral Resolution Converter

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

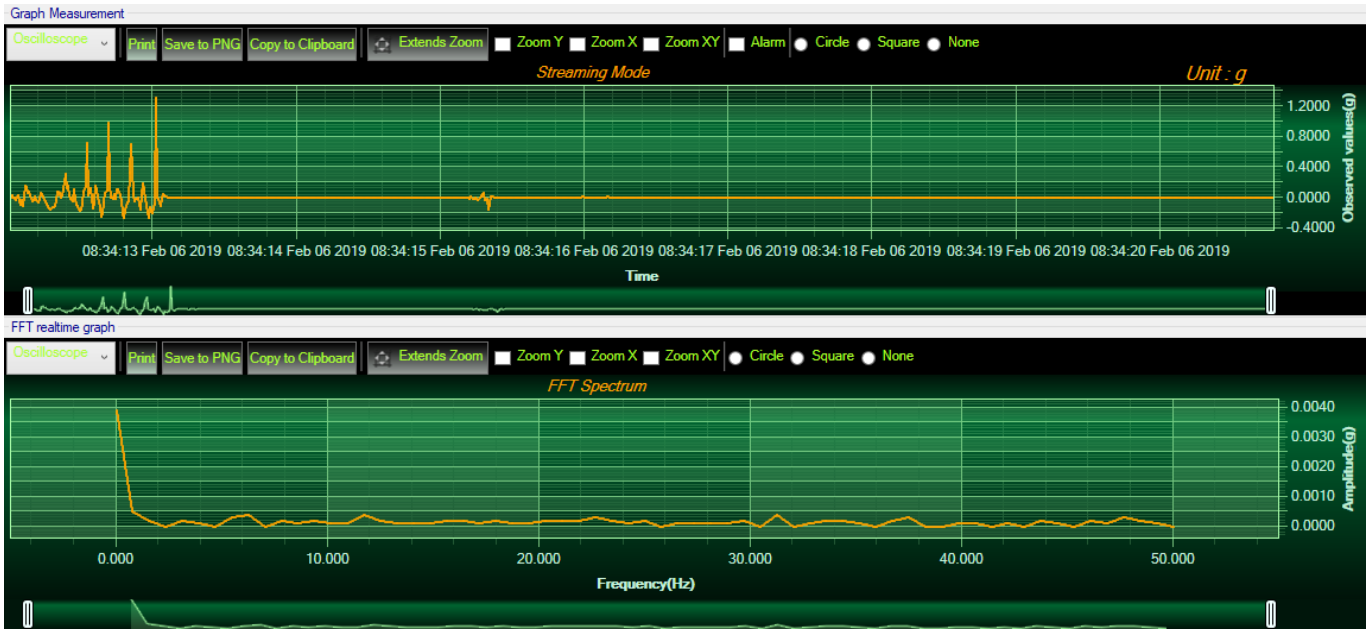
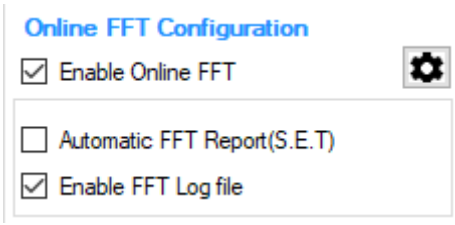


Figure 68: FFT spectrum

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



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

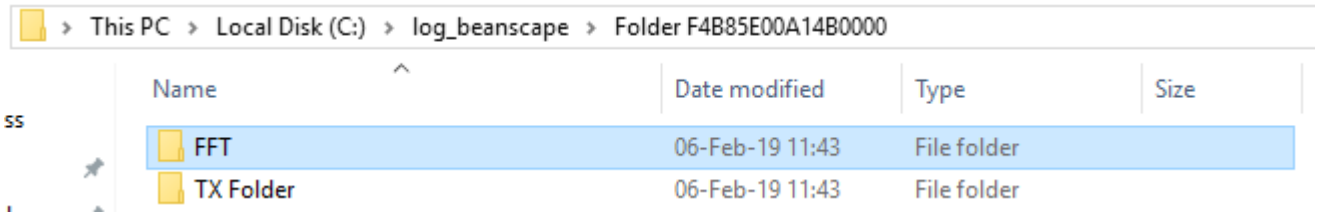


Figure 69: FFT log files folder

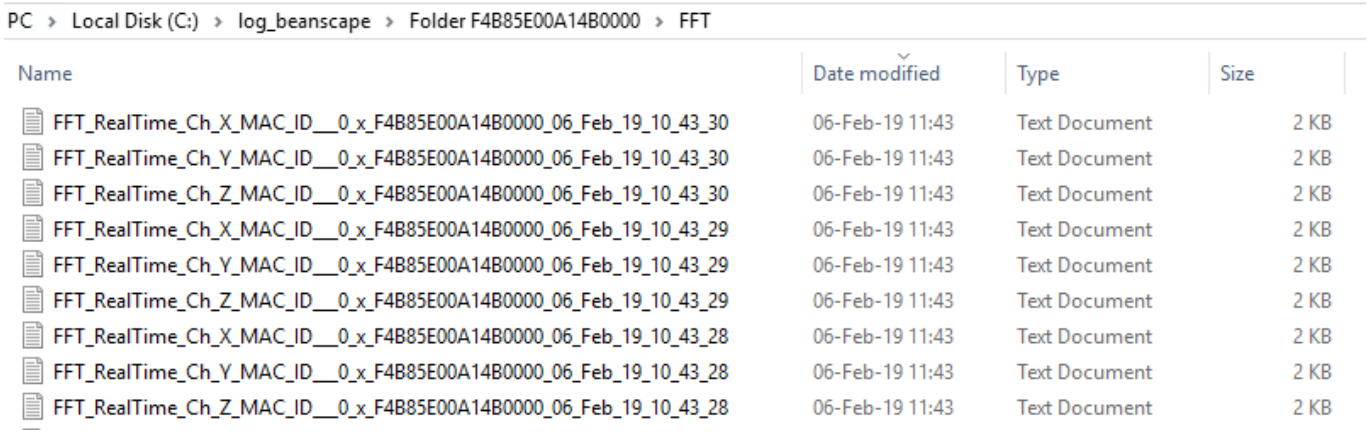
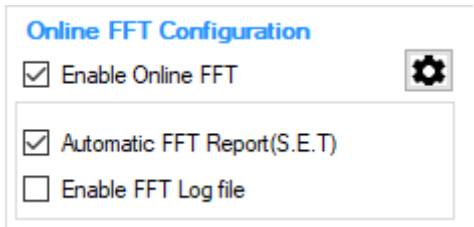


Figure 70: FFT log files folder

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



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

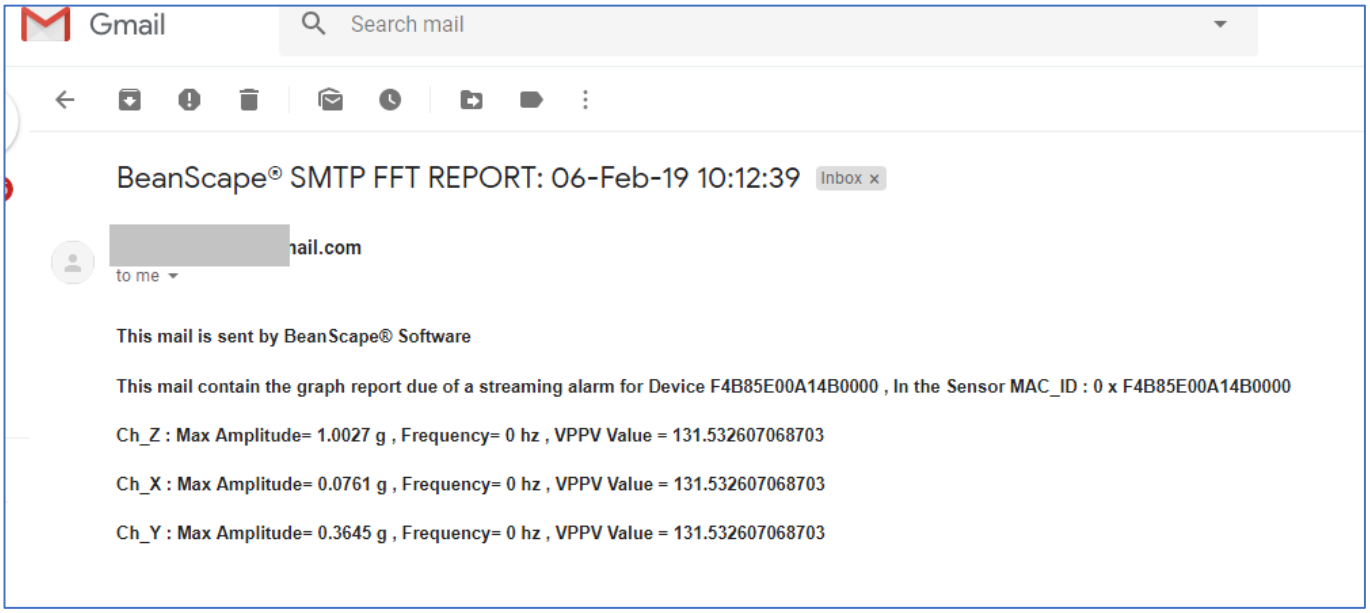
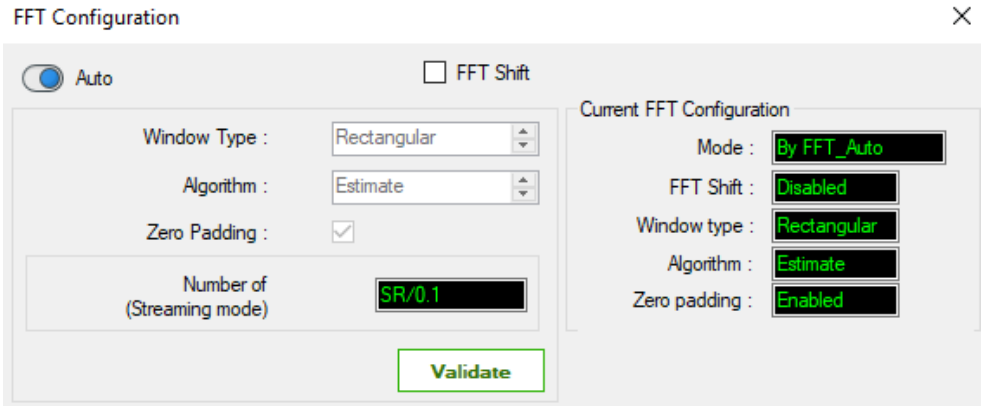


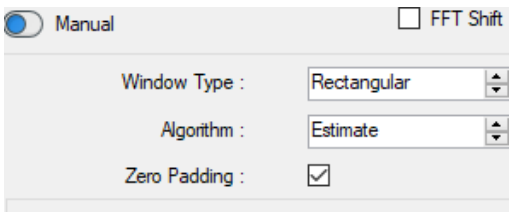
Figure 71: FFT report sent by email

-  : FFT Advanced Configuration

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



  - Auto/Manual



  - Window type:

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

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

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

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

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

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

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

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

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

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

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

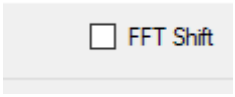
In general, the Hanning (Hann) window is satisfactory in 95 percent of cases. It has good frequency resolution and reduced spectral leakage. If you do not know the nature of the signal but you want to apply a smoothing window, start with the Hann window.

- Algorithm

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

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

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



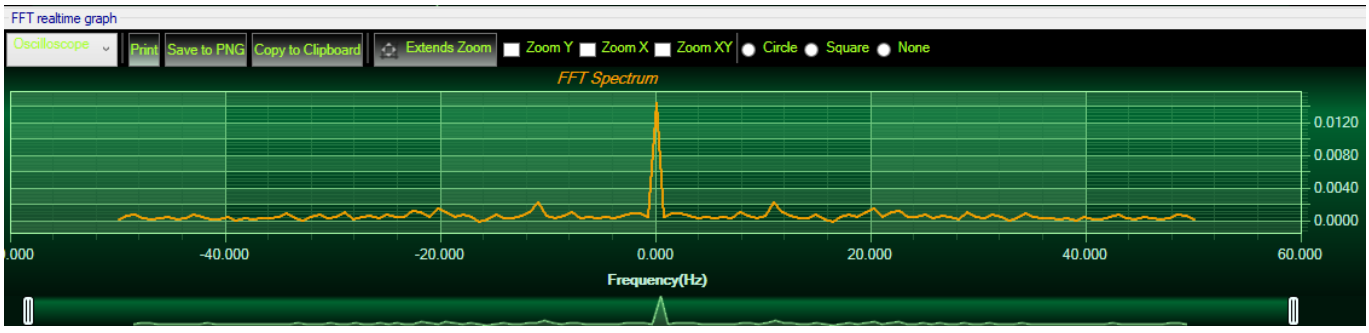


Figure 72: FFT Shift Spectrum

6.3.2 Online Velocity and Velocity report (available only on BeanDevice® WiLow® AX-3D ±2g version)

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

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

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

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

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

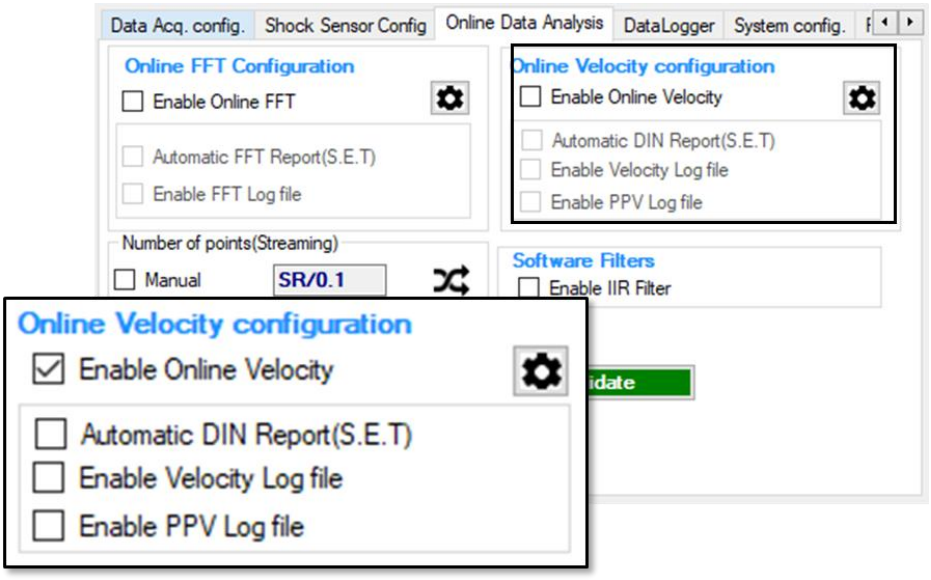


Figure 73: Online Velocity configuration tab

- ***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.

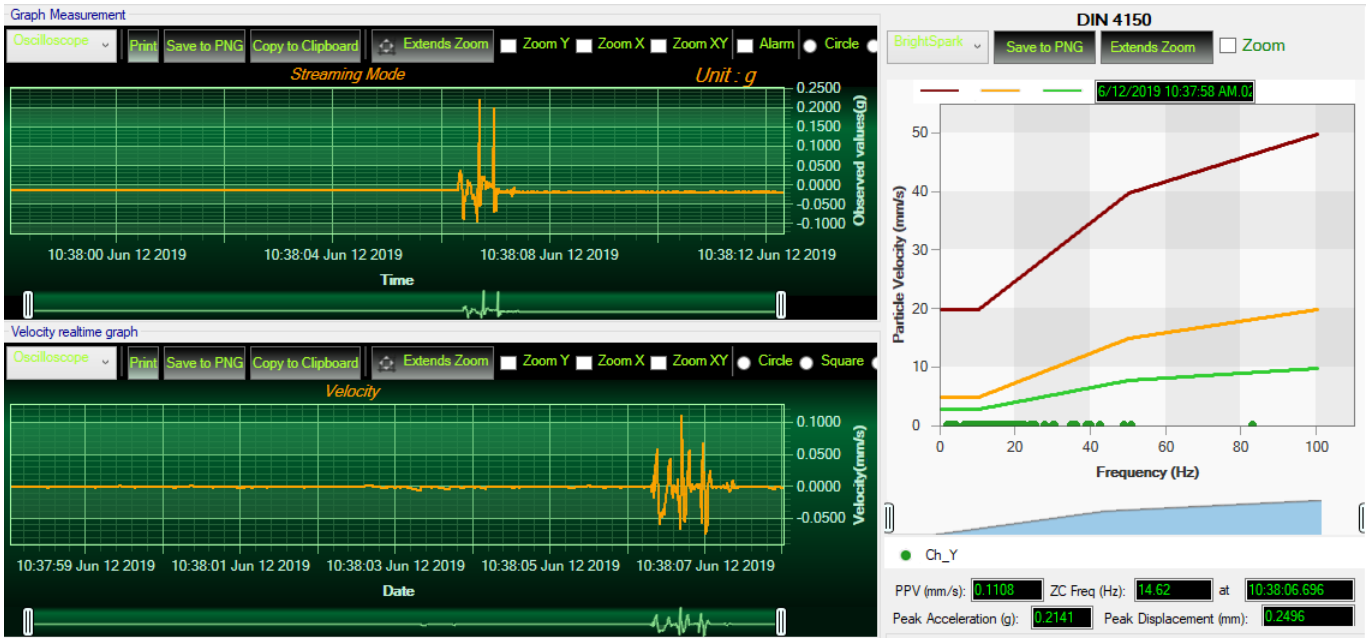


Figure 74: Velocity Graph

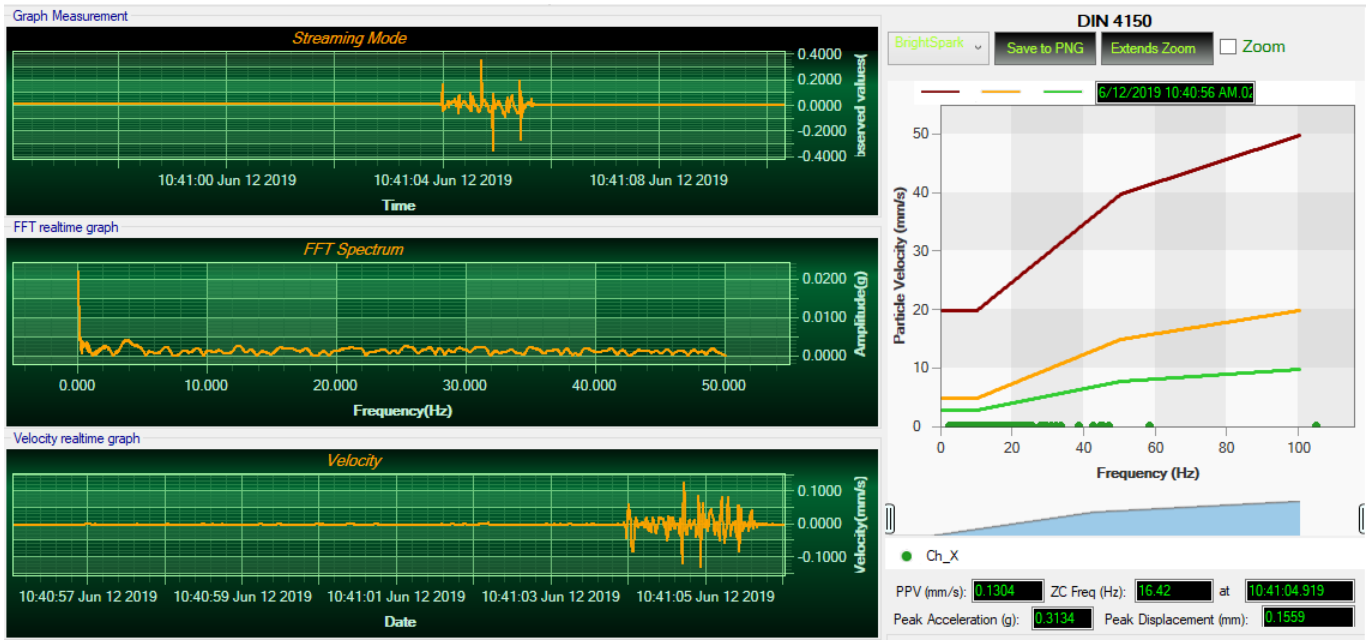


Figure 75: Velocity and FFT Graph, PPV and PVS

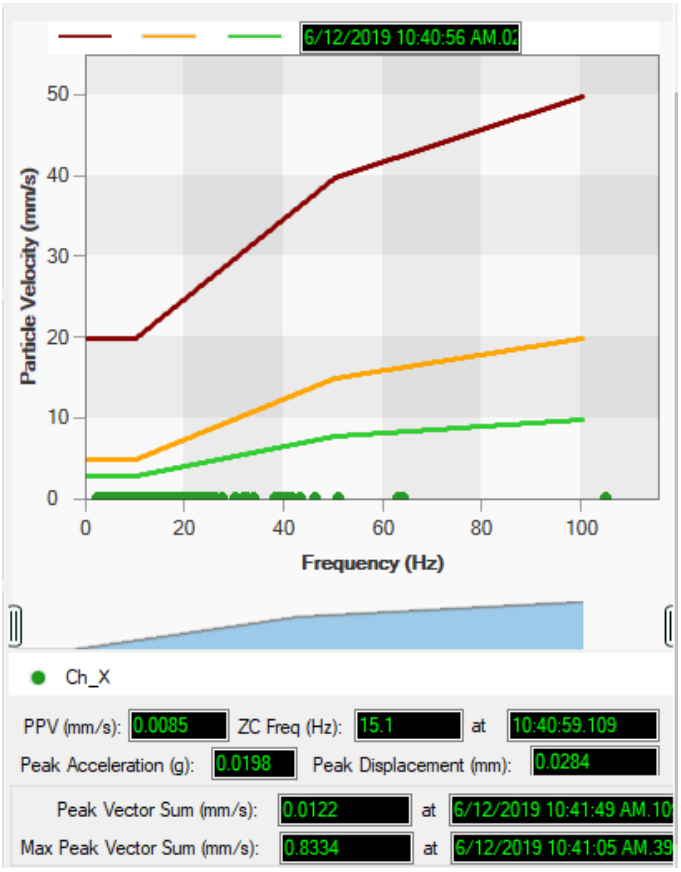
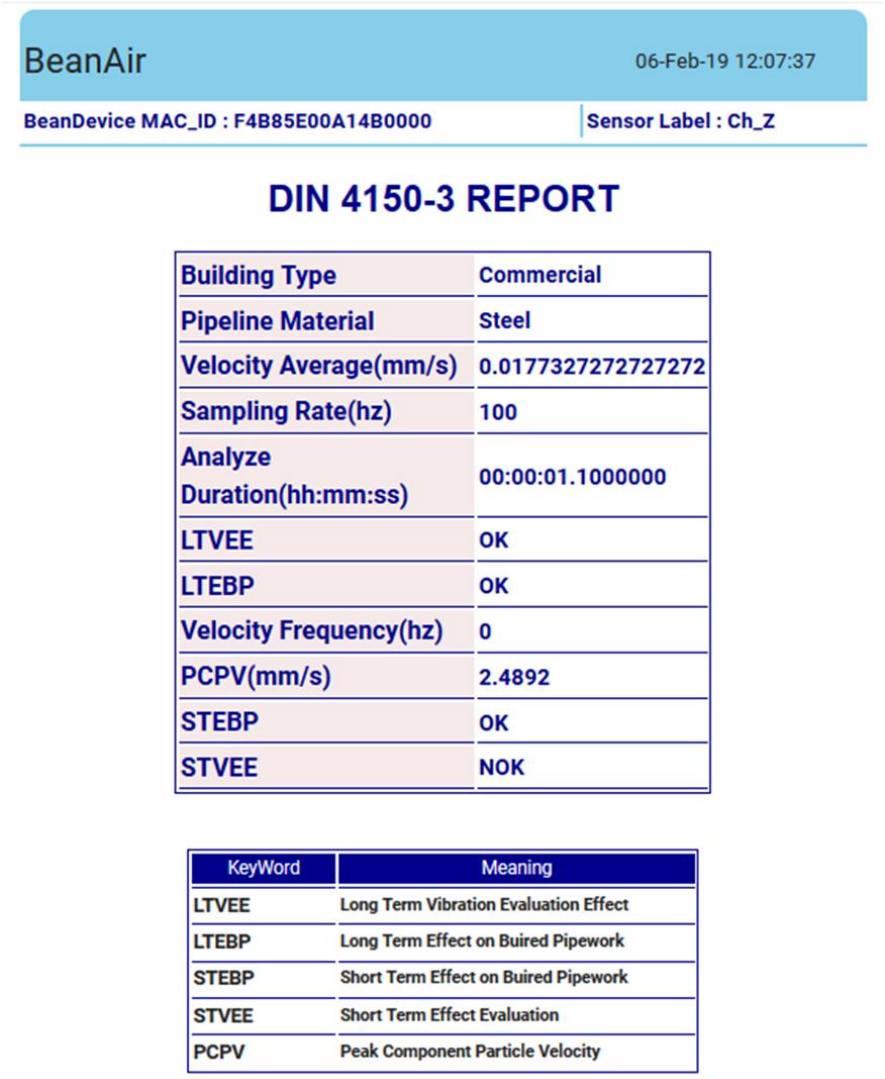


Figure 76: DIN 4150 Real Time Graph, PPV & PVS

- ***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 77: 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.

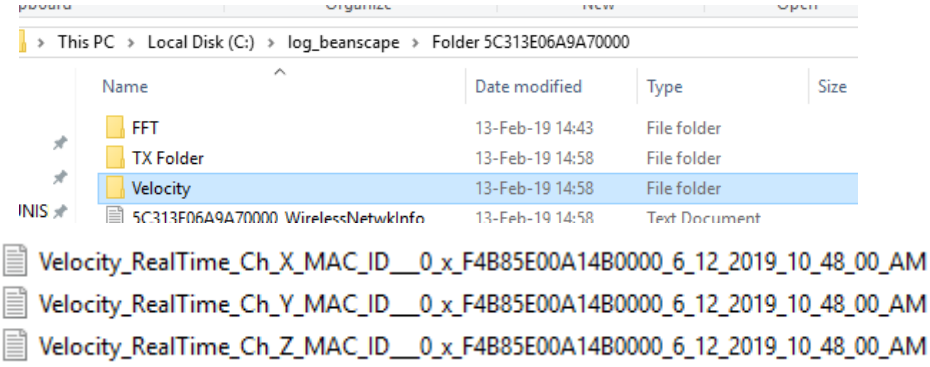


Figure 78: Velocity Log Folder/Files

- ***Enable PPV Log file***

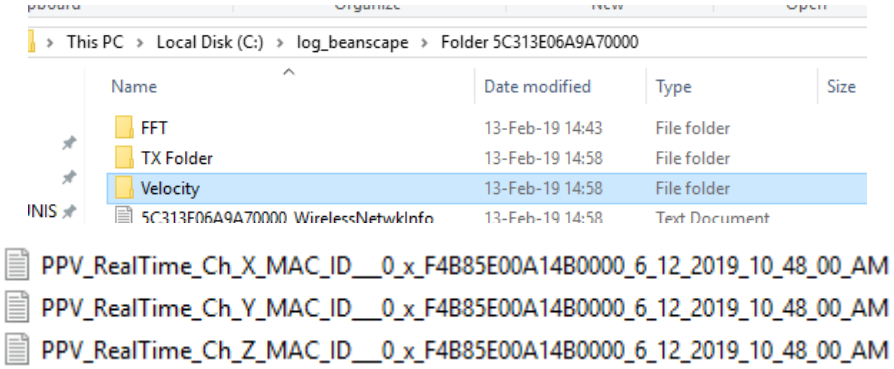


Figure 79: PPV Log Folder/Files

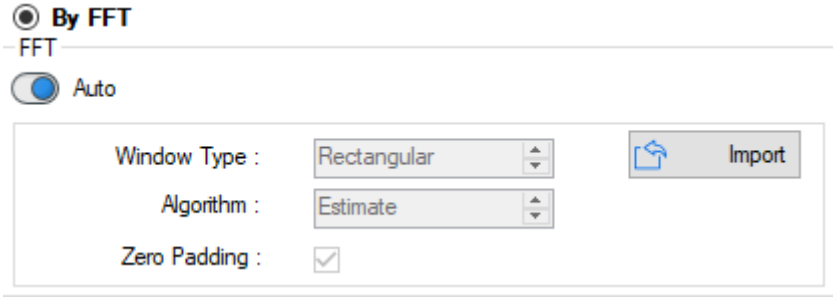
: Velocity Advanced Configuration

Figure 80: 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”.

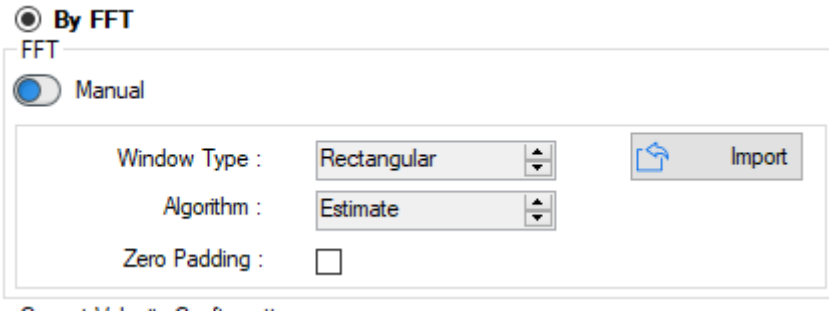
- **By FFT:** By selecting this option, the user will setup the Velocity basing on customized FFT settings.

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

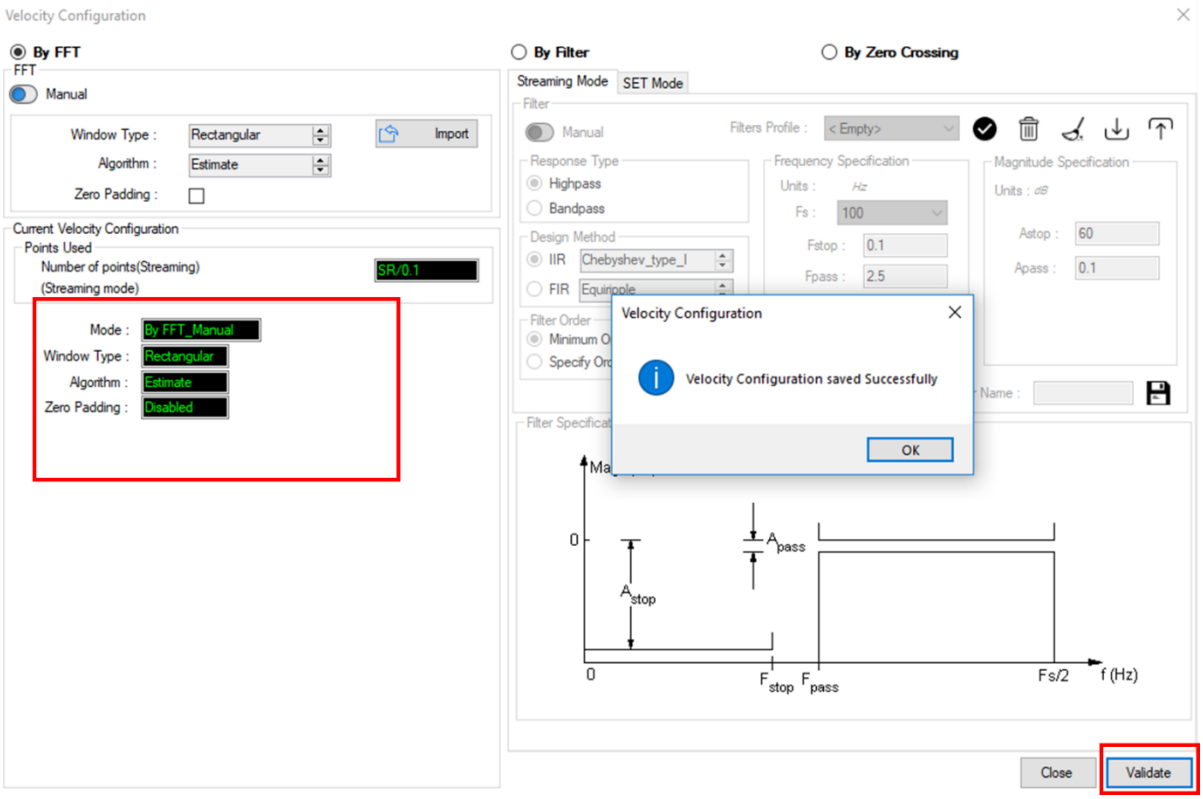


- Manual: Once switched to Manual, the user must configure the FFT settings manually (Window Type, Algorithm & Zero Padding).

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

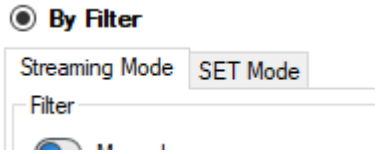


To save all settings Press Validate. The new settings should be displayed on the Left side of the Window.

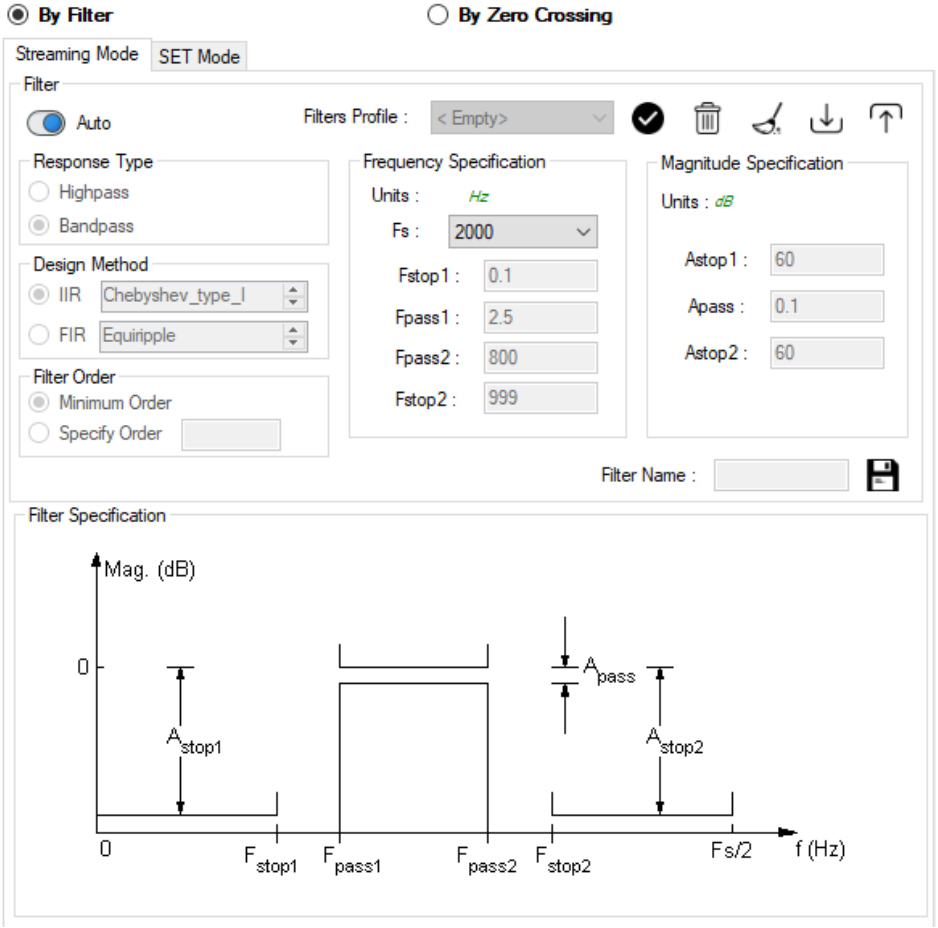


- **By Filter:** By selecting this option, the user will setup the Velocity basing on the Software Filter.

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

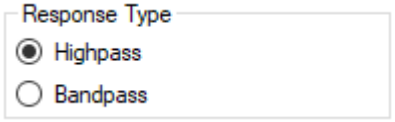


  - Auto: If Auto is selected, Velocity Automatic filter will be configured



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

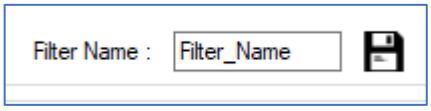
    - <u>Response Type:</u> User should specify if the Response is **Highpass** or **Bandpass**

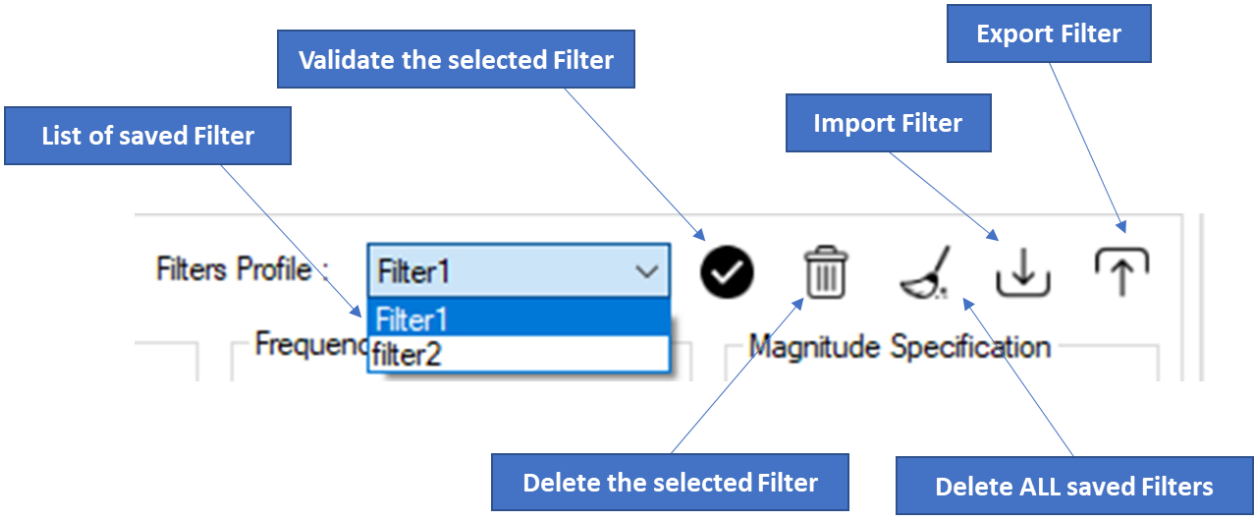


- Design Method: User should Select the nature of the Filter between **IIR** or **FIR**
  From the List of every filter, user have to specify the method of the Filter:
  IIR: Chebyshev_type_I, Chebyshev_type_II or Butterworth
  FIR: Equiripple, Generalized_Equiripple or Kaiser_Window

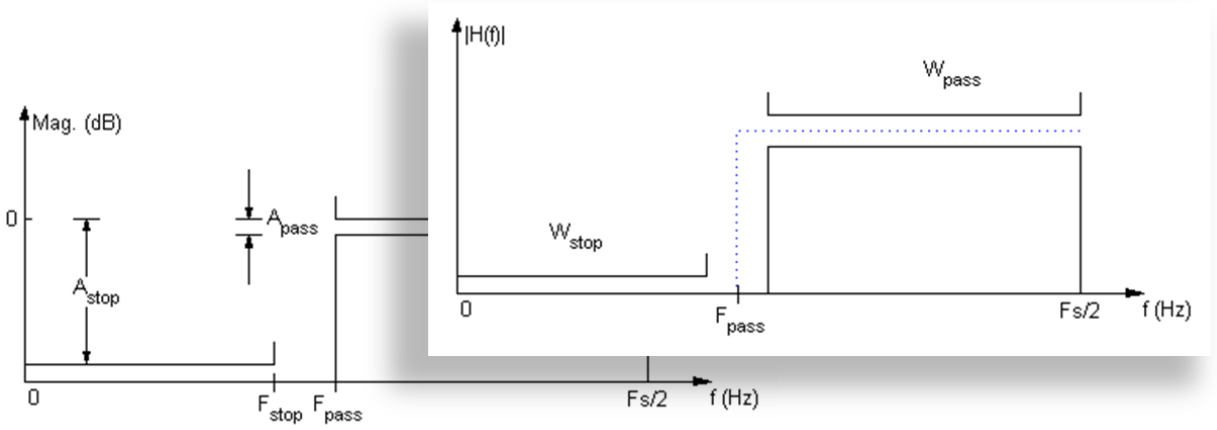
The Frequency Specification and The Magnitude Specification will be modified according the selected Design Method

- 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.

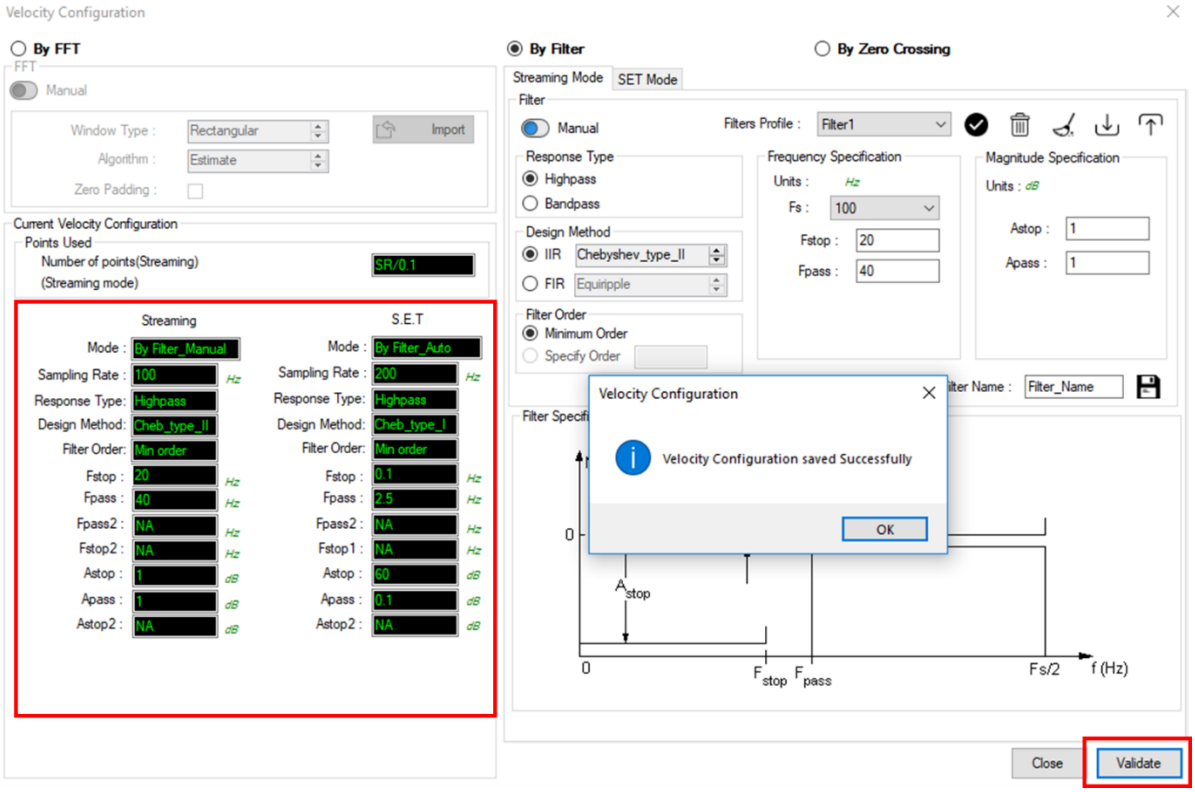




- Filter Specification: Is a Graphical Display of the Filter Specification depends on the user settings.

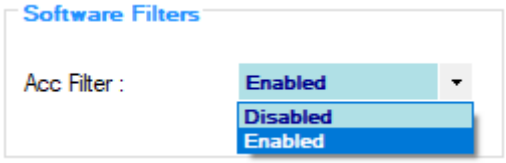


To save all settings Press Validate. The new settings should be displayed on the Left side of the Window.



6.3.3 Software Filters

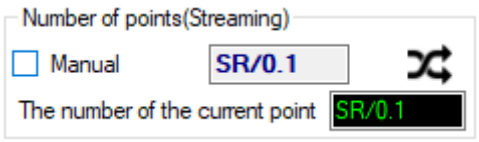
- ***Enable Acceleration Filter***: Check to enable acceleration filter



The acceleration filter is used to reduce the noise and makes the signal smooth.

The acceleration filter is working only with the dynamic modes (Streaming, Shock Detection and S.E.T mode)

6.3.4 Number of Points (Streaming)



By default, the Number of Points is configured to be set automatically as Sampling Rate / 0.1 (SR/0.1).

Then the signal graph will be displayed after 10s.

When enable the ACC filter with an automatic number of points, on Shock detection mode, SET mode and Streaming mode (Burst & One-shot options), you should enter a DAQ duration multiple of 10 (10s, 20s, 40s etc.)

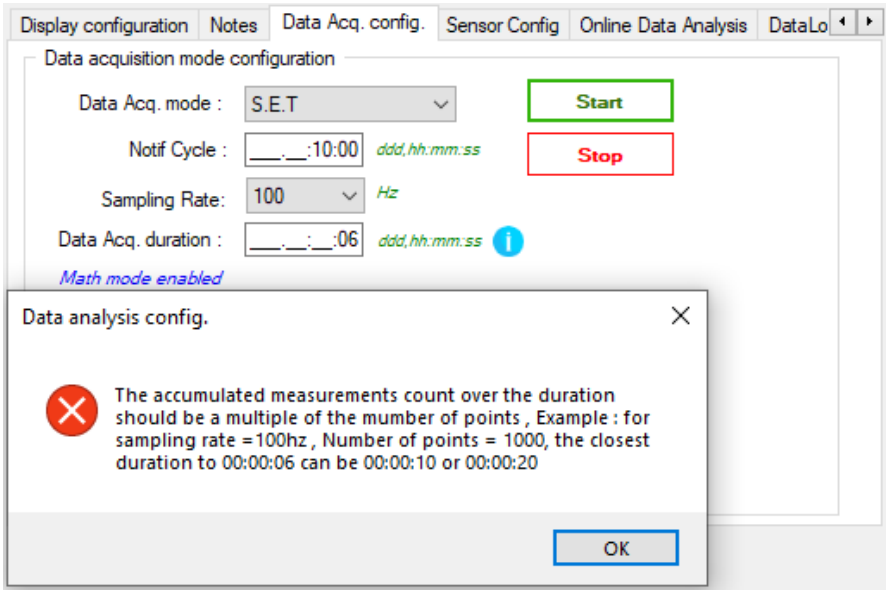
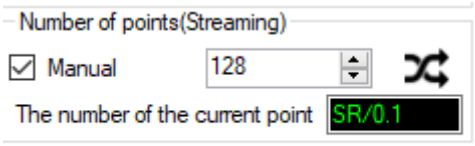


Figure 81: DAQ duration restriction

By switching to Manual settings, user must choose a value between 256 and 32768.



When the user chooses to select a manual buffer seize with the acceleration filter is enabled, the minimum DAQ duration should be calculated before performing a SET/Shock Detection or Streaming (burst, one shot)

- **How to calculate the minimum DAQ duration:**

The minimum DAQ duration is equal to the number of points divided by the sampling rate.

Example:

Sampling rate = 100 Hz; Number of points = 256;

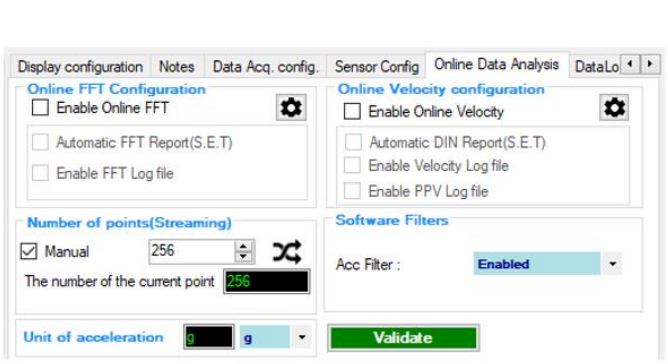
Min_duration = $\frac{Number\ of\ points}{Sampling\ rate} = \frac{256}{100}$ = 2.56 s ≅ 3s

The DAQ duration should be a multiple of the minimum duration already calculated.

- **DAQ duration calculation:**

DAQ duration = min_duration * X with X should be an integer (1,2,3 ... etc.)

= 3 * 5 = 15s



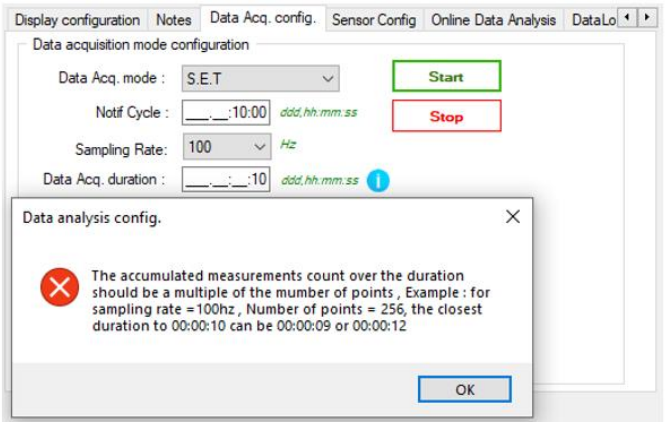
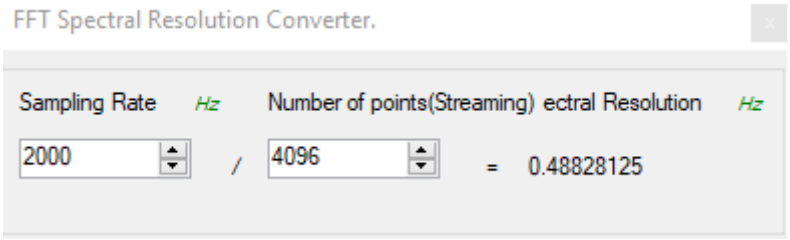


Figure 82: DAQ duration with manual buffer seize settings

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 Sampling Rate (Acquisition time at least = 1 second)

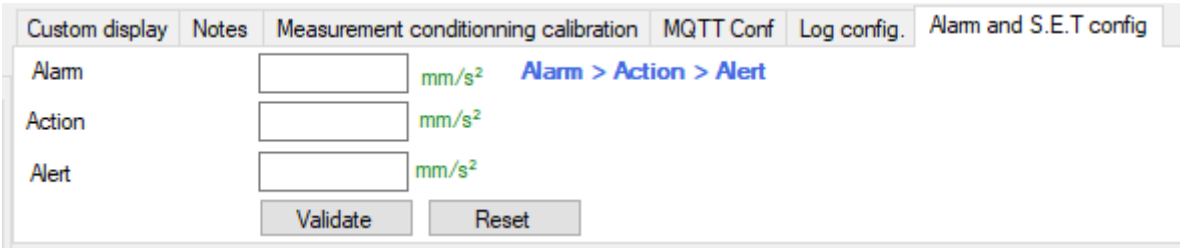
It is important to notice that larger Number of Points provide higher spectral resolution but take longer to compute.

6.3.5 Unit of acceleration

User have the possibility to choose the acceleration unit between g and mm/s2.

Don't forget to click on validate before to proceed 

Notice also that the Alarm thresholds unit will be affected with this change of acceleration unit.



6.4 ONLINE DATA ANALYSIS (AVAILABLE ONLY FOR BEANDEVICE® HI-INC)

The Software filters for vibration-tolerant tilt measurement are related only to the Inclinometer.

The Software filters for vibration-tolerant tilt measurement are implemented on the BeanScape® software and they are used for Dynamic Measurement.

The following software filters for vibration-tolerant tilt measurement are used to reduce the noise in the signal due to the use of high sampling rate, reduce shock peaks and also absorb vibration on the inclinometer.

- ***Average Filter***: select the average filter in order to reduce the noise.

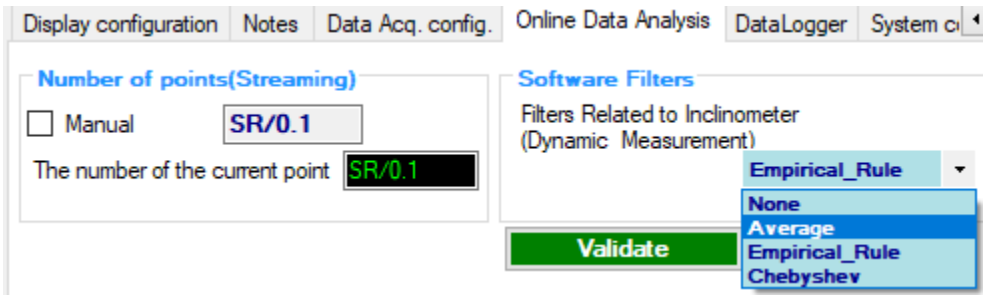


Figure 83: The Average filter

By activating the Average filter, the chosen filter will be displayed in the sensor profile under software filter frame.

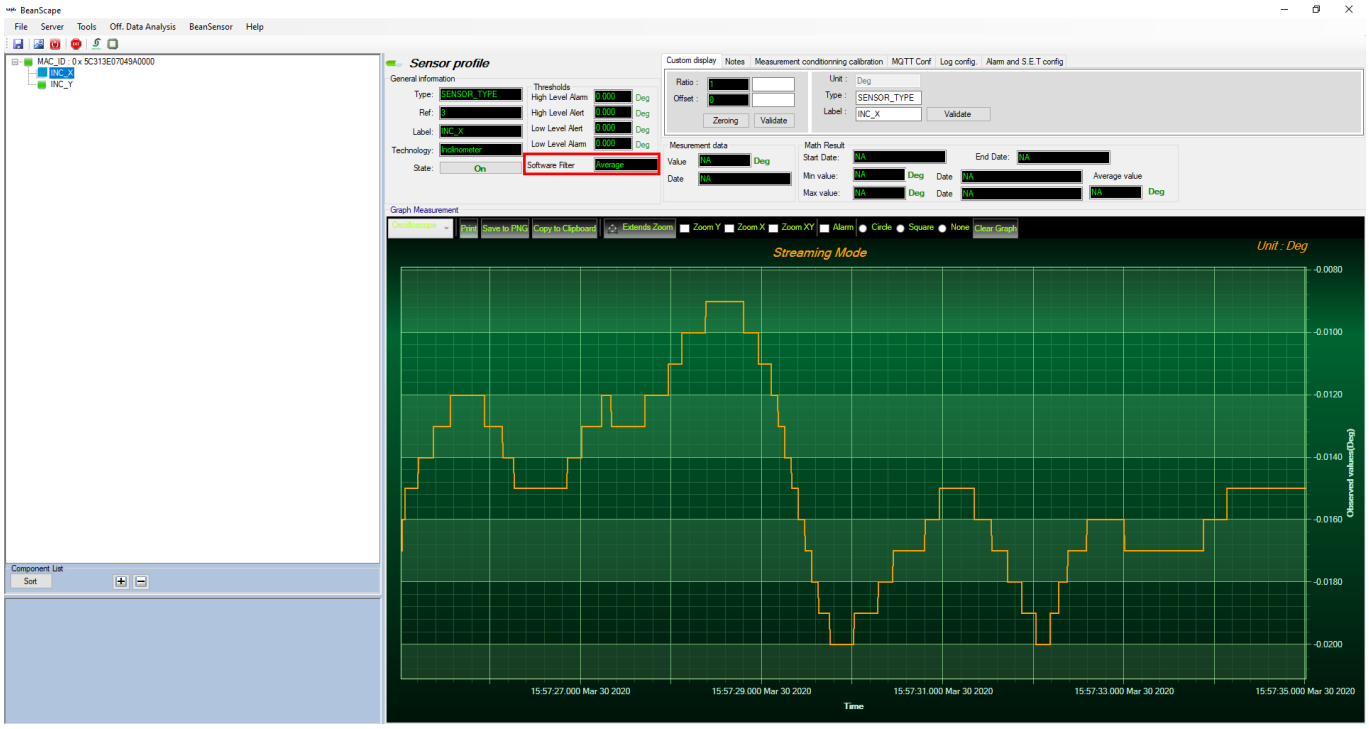


Figure 84: Graph Measurement using Average filter

- ***Empirical Rule Filter***: The Empirical Rule filter is suitable for vibration absorption

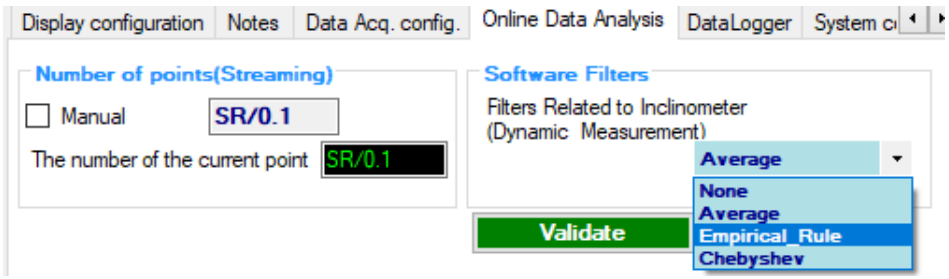


Figure 85: Empirical Rule filter

This filter is accurate and have a repeatability of ±0.001% even while using a high sampling rate.

It eliminates the vibration that may disturb the measurement process and may cause a noisy signal.

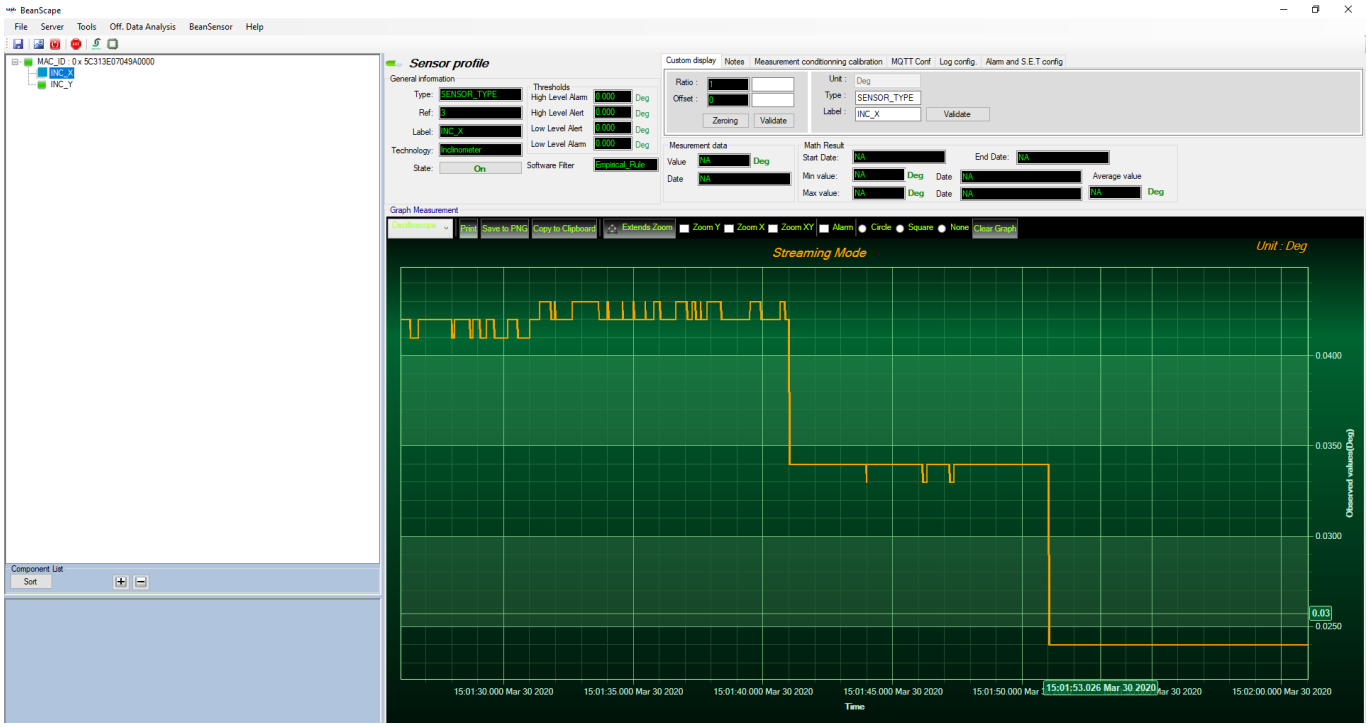


Figure 86: Graph Measurement using the Empirical Rule filter

- ***Chebyshev Filter***: The Chebyshev filter is used to eliminate shock peaks from the signal

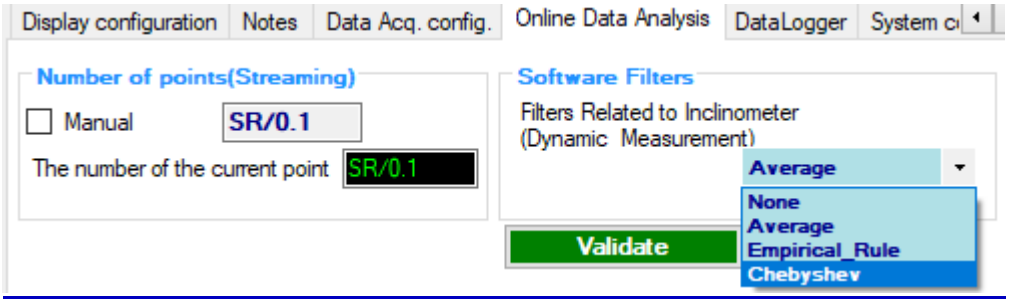


Figure 87: Chebyshev filter

Also, the Chebyshev filter has a good repeatability about ±0.001% with high sampling rate.

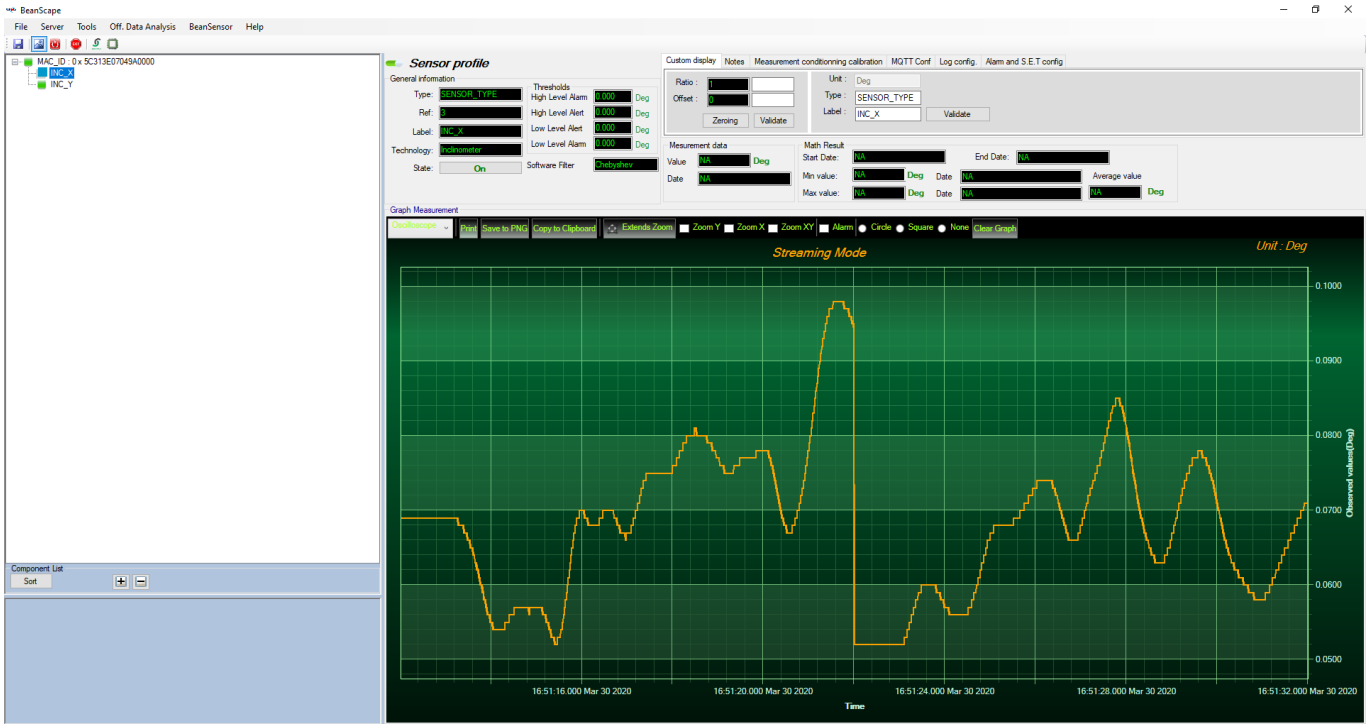


Figure 88: Graph Measurement using Chebyshev filter

You can use any of the available filter to reduce the vibration or peak shocks.

Notice that the Math Mode will be disabled automatically once user use the software filter.

If the number of streaming points was setup as Auto, the Graph Measurement will be displayed after 10s and refreshed every 10s.

In order to see the Graph Measurement in continuous flow, just setup the number of streaming points the closest possible as the sampling rate.

Software filters for Vibration-tolerant tilt measurement

6.5 DATE CONVERSION

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

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

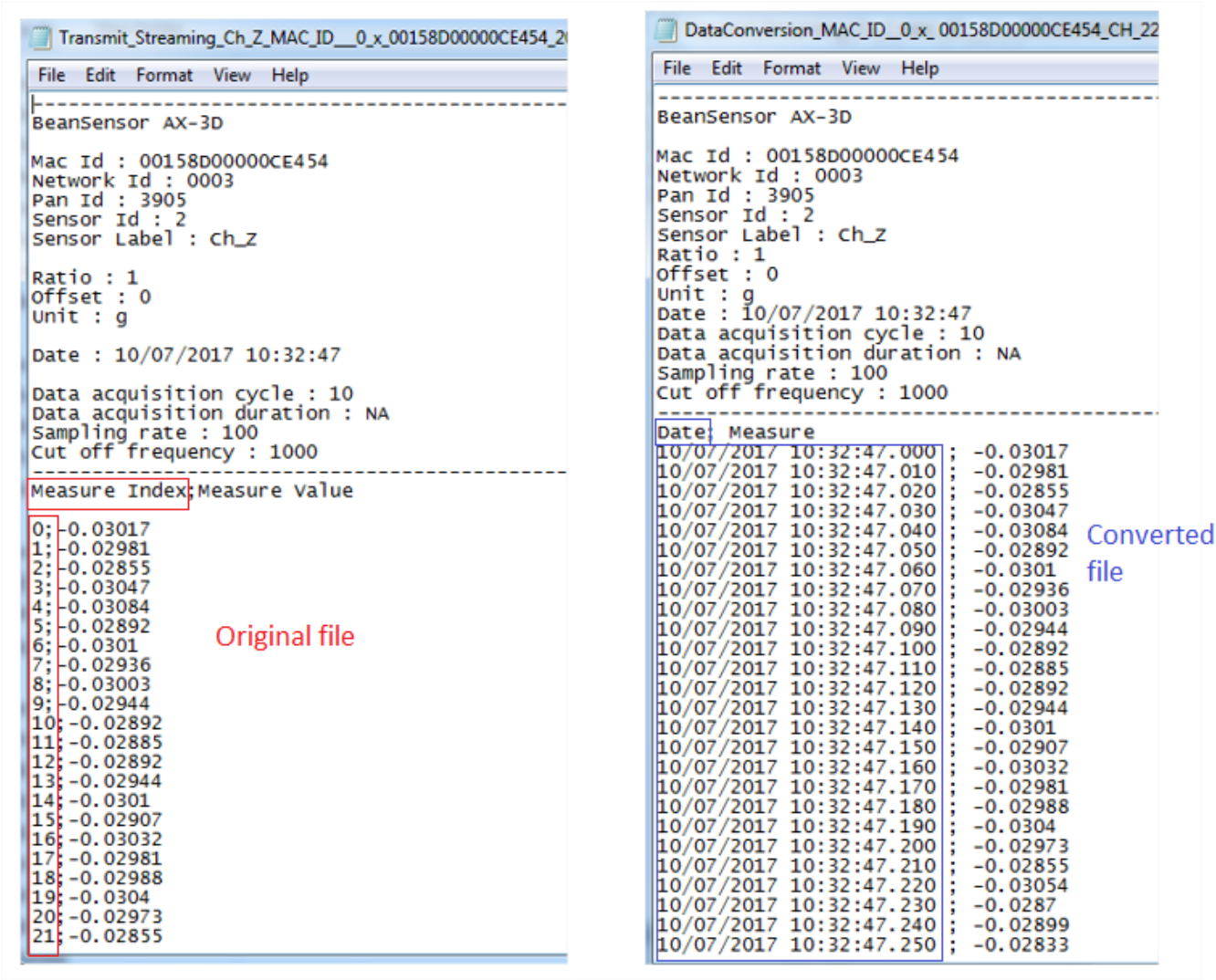


Figure 89: Date Conversion

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

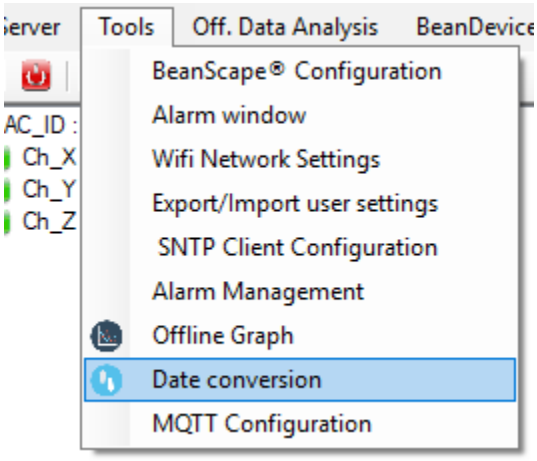


Figure 90: Date conversion option on BeanScape®

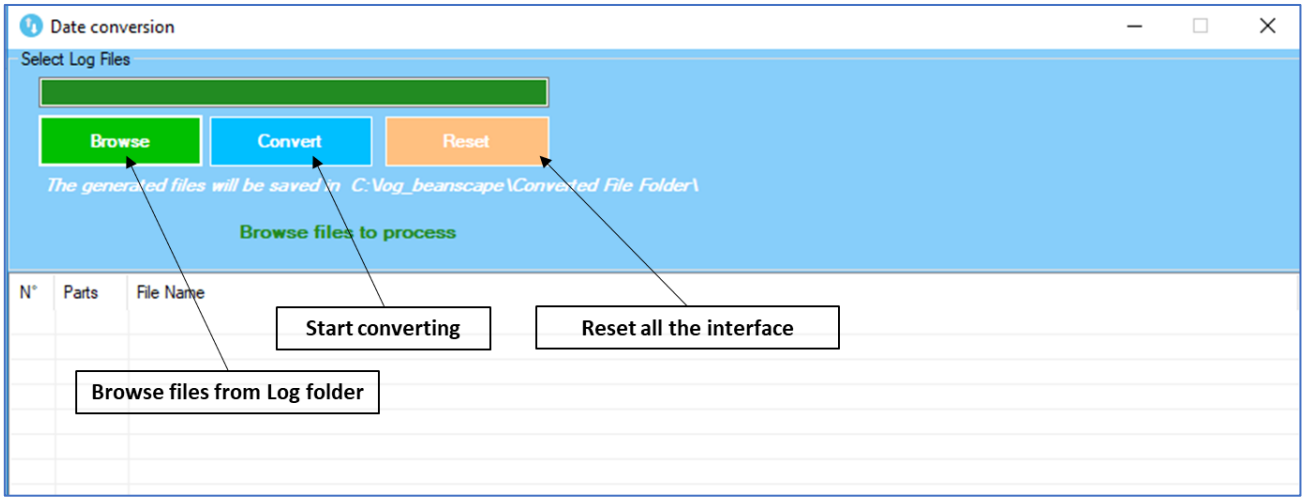


Figure 91: Date conversion window

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

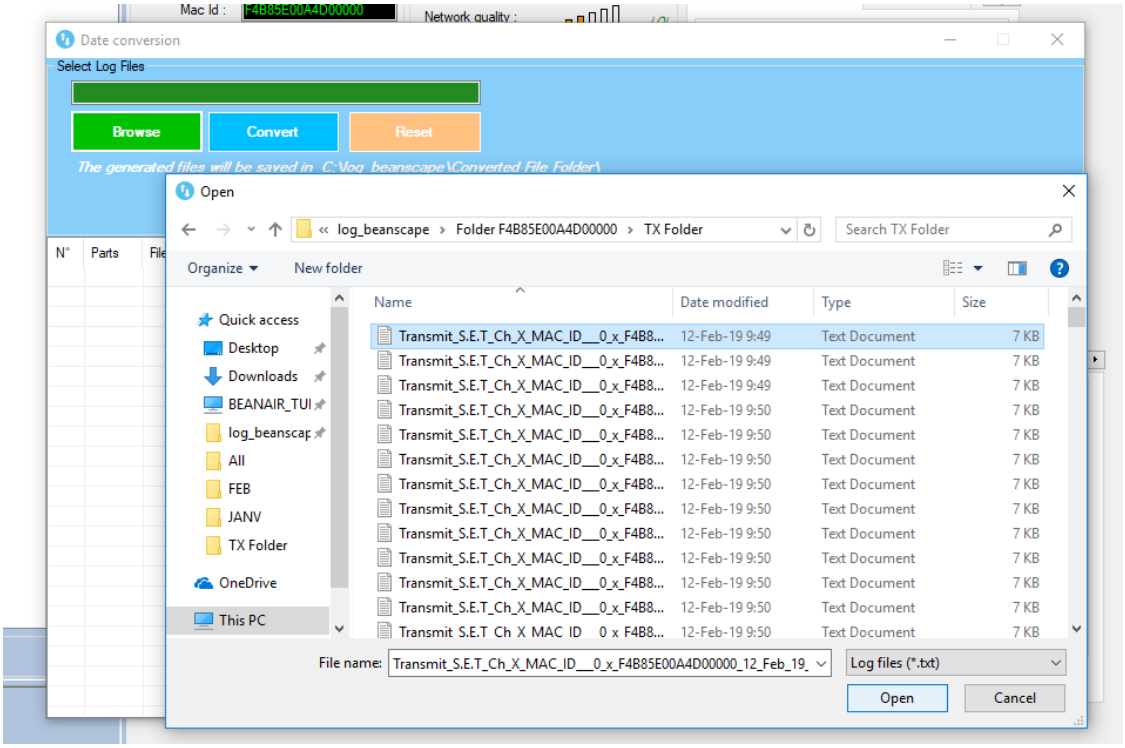


Figure 92: Importing files into data conversion window

- Overview of the selected files

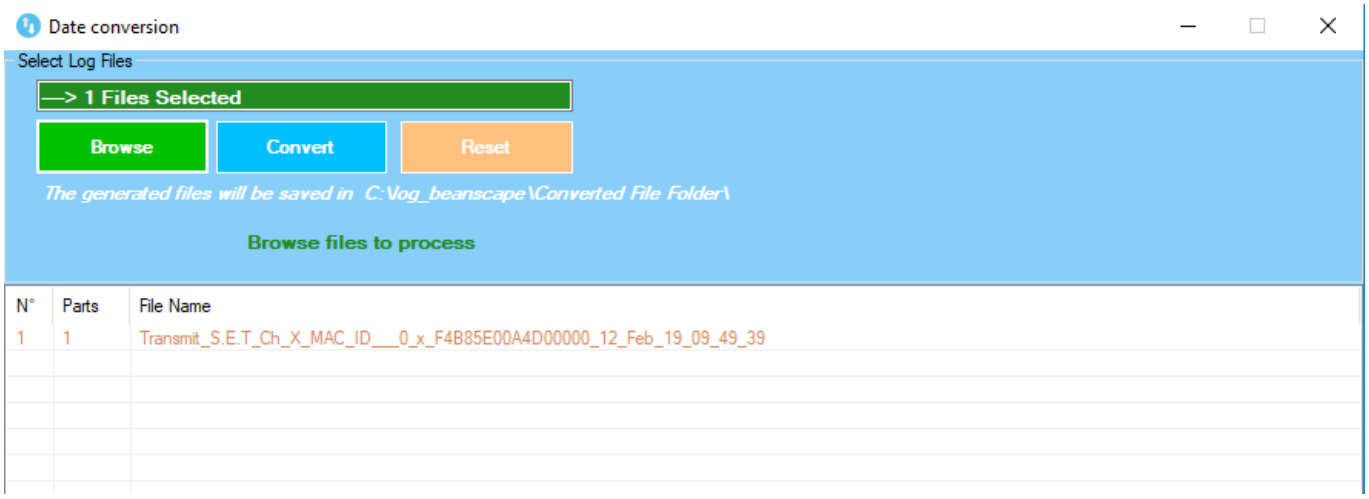


Figure 93: Overview of a selected file on Data conversion window

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

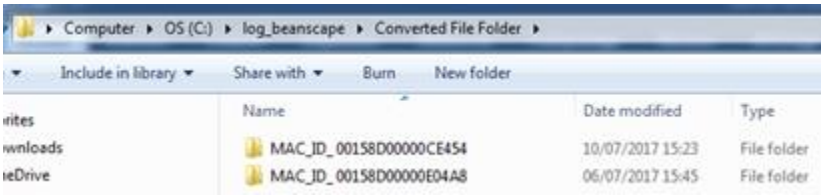


Figure 94: Converted file folder

6.6 OFFLINE GRAPH

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

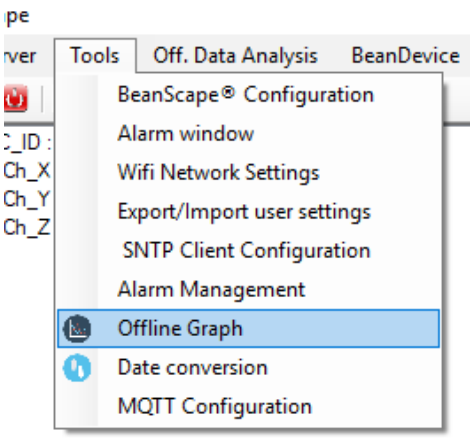


Figure 95: Offline graph option on BeanScape®

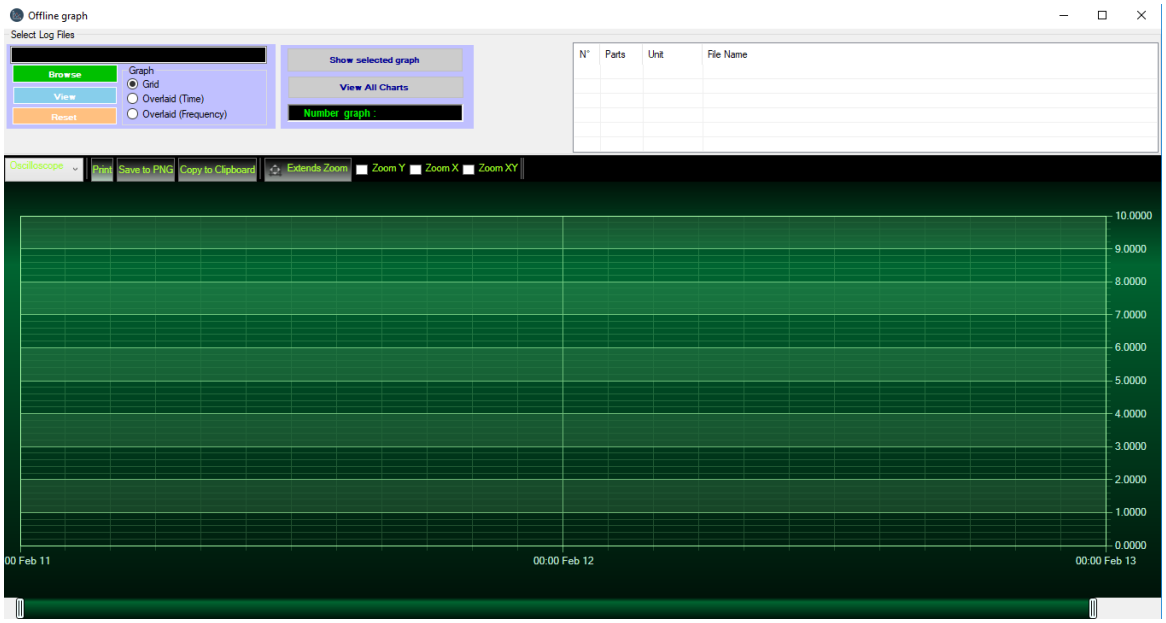


Figure 96: Offline graph window

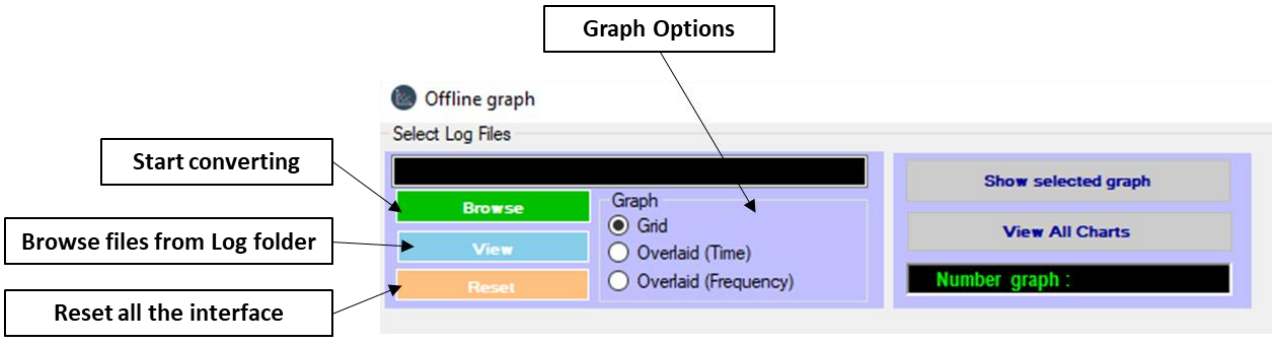


Figure 97: Offline graph window's options

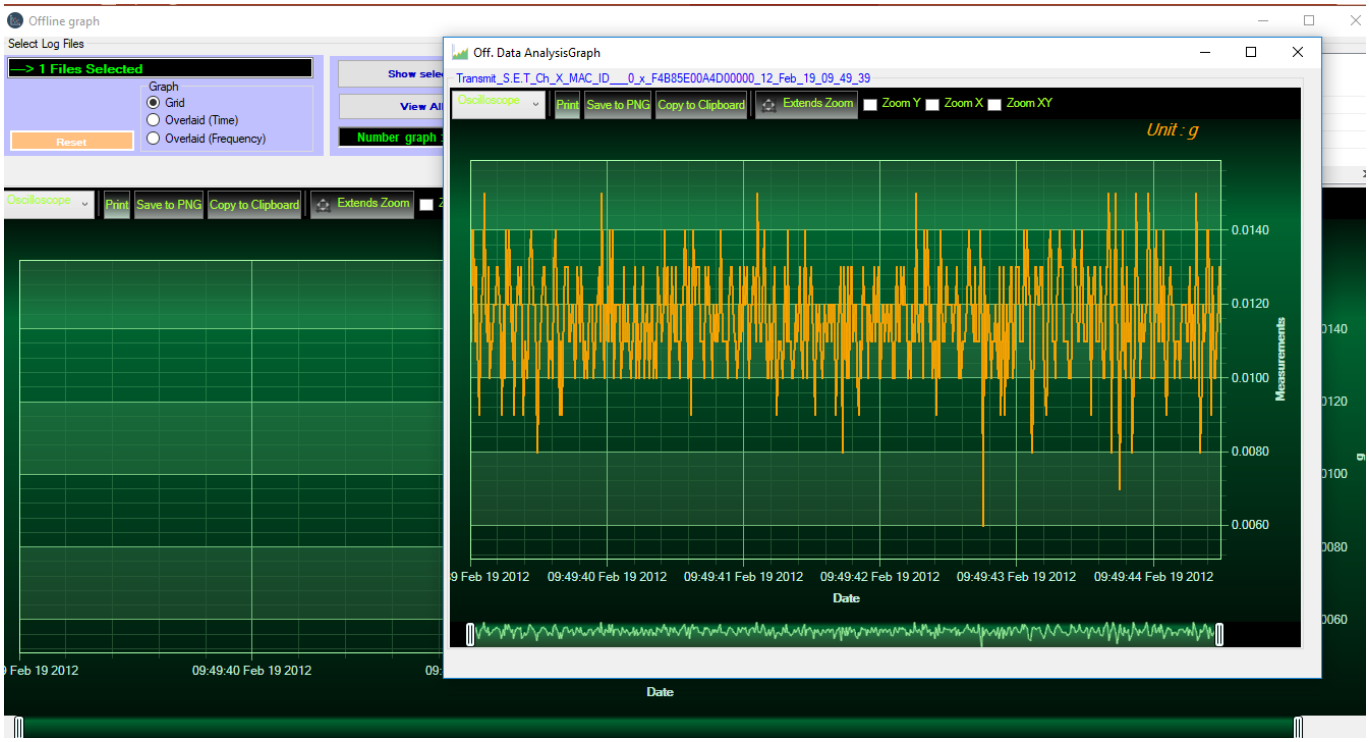


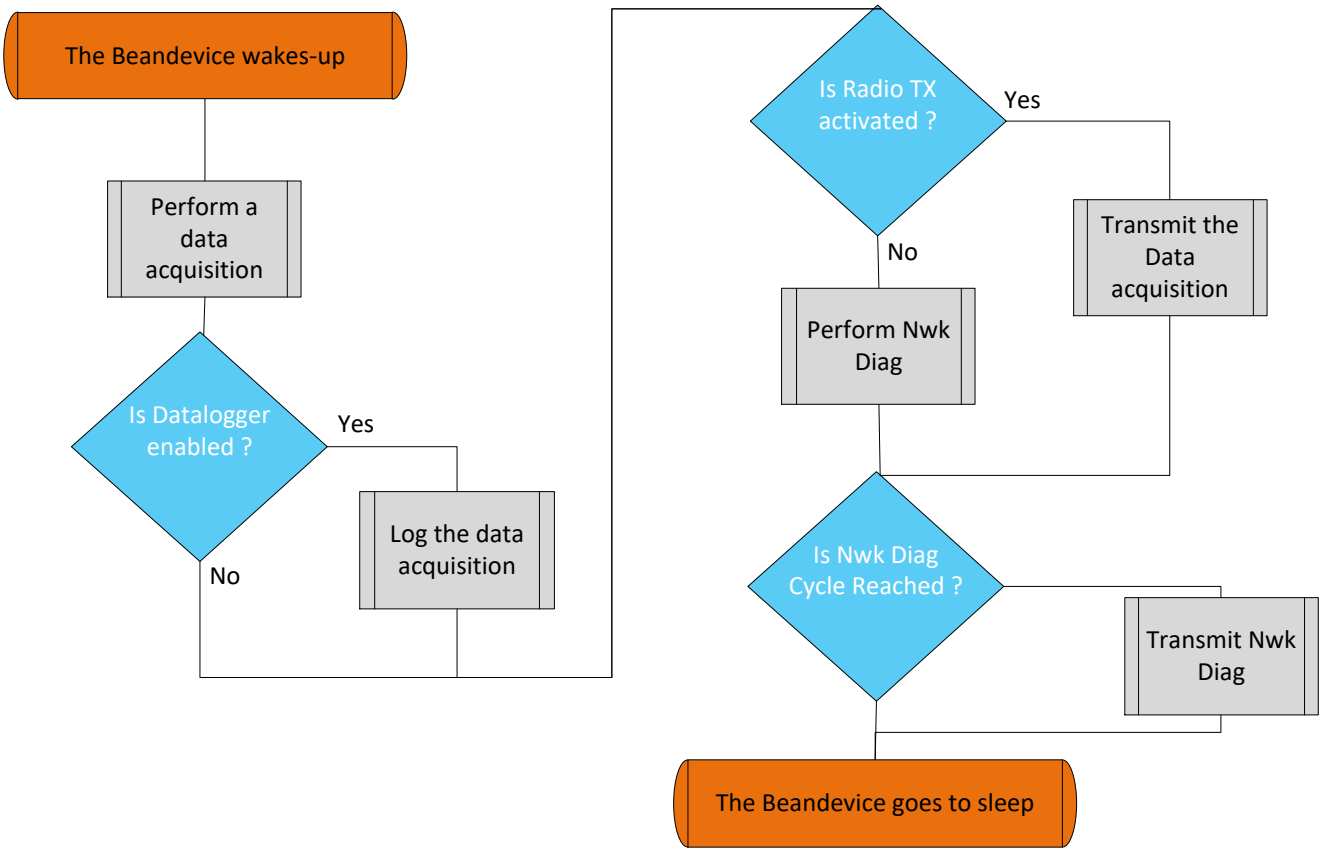
Figure 98: Offline displayed graph

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

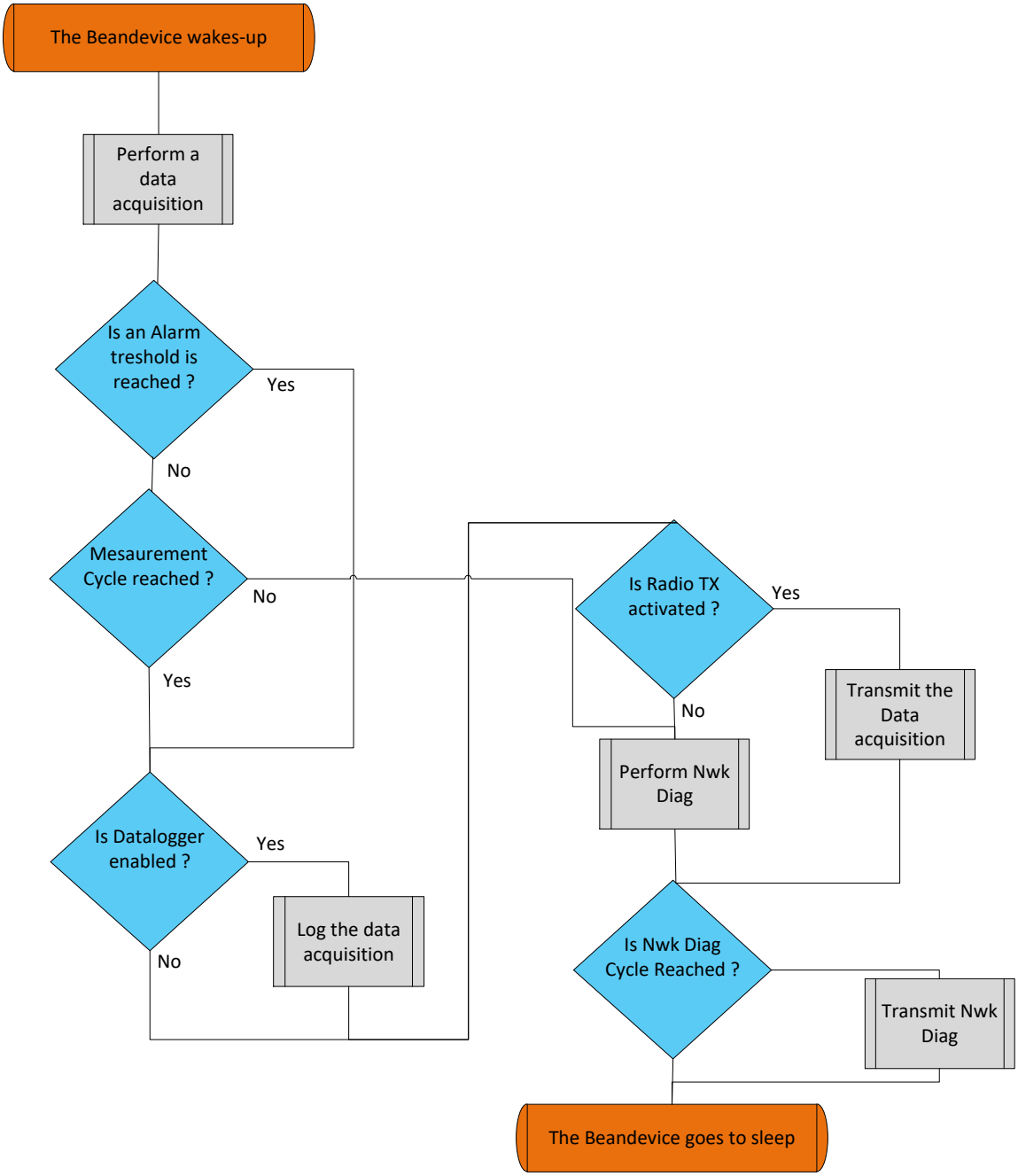
Figure 99: Gird display of graphs

7. APPENDIX 1: FLOWCHART DIAGRAM (FOR ADVANCED USERS)

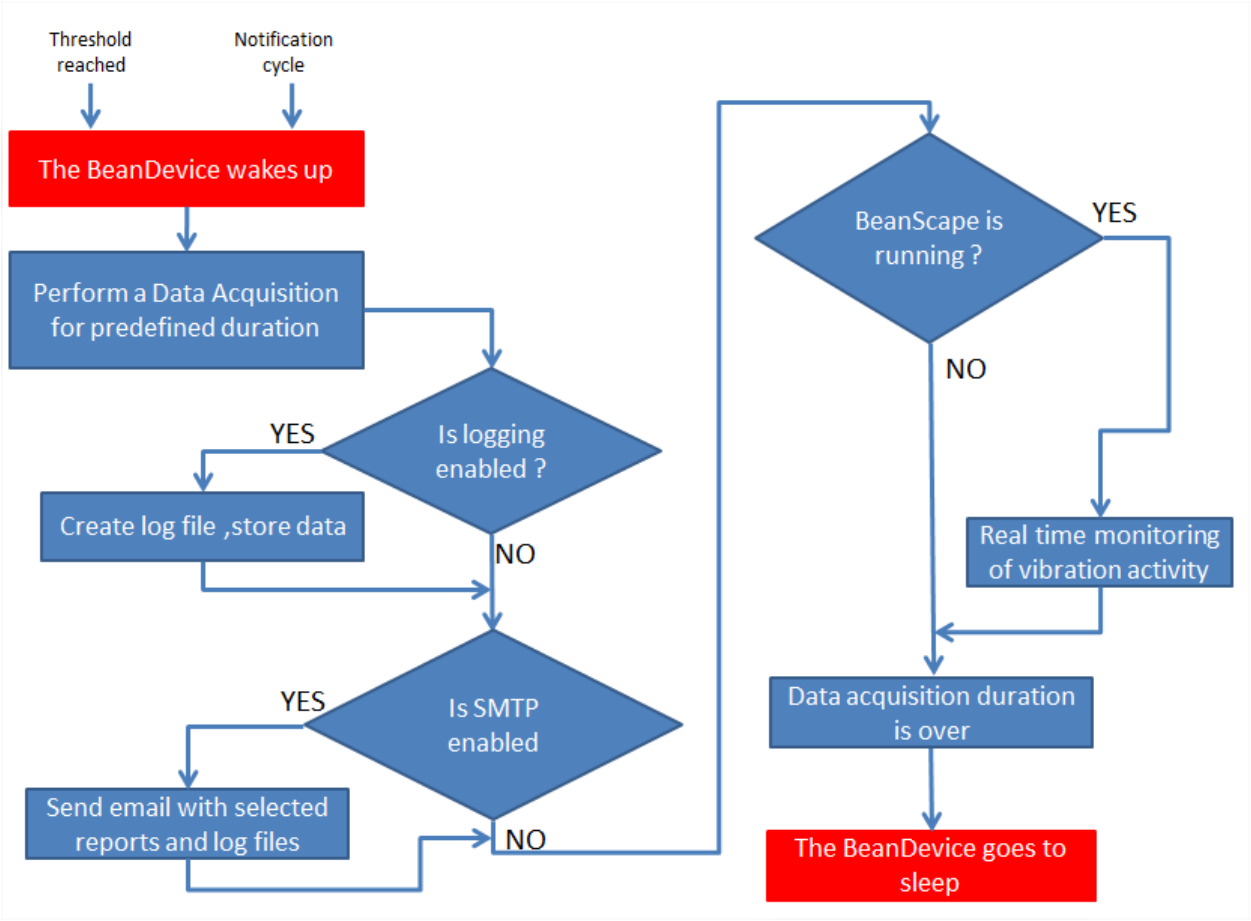
7.1 "LDCDA" DATA ACQUISITION MODE WITH SLEEP WITH NETWORK LISTENNING POWER MODE CONFIGURATION



7.2 « ALARM » DATA ACQUISITION MODE WITH SLEEP WITH NETWORK LISTENNING POWER MODE CONFIGURATION

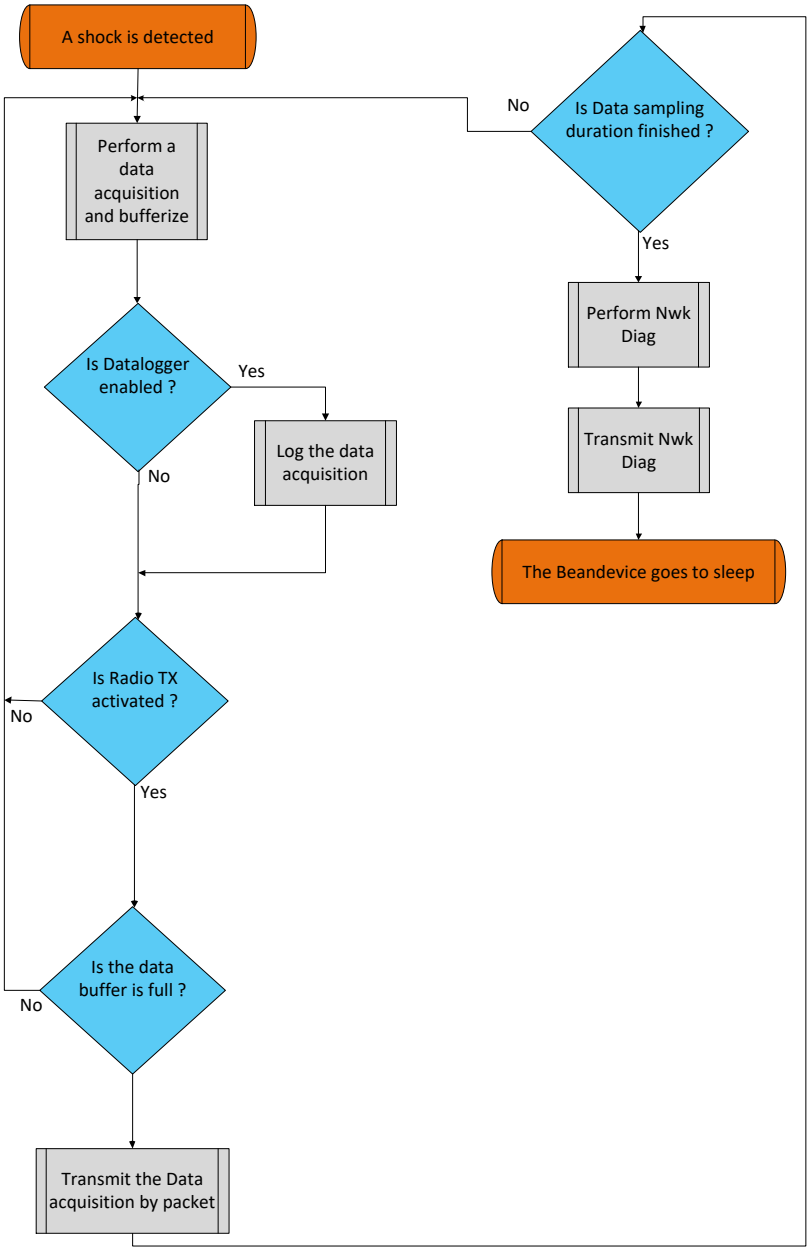


7.3 S.E.T MODE (STREAMING WITH EVENT TRIGGER)



7.4 SSD (SMART SHOCK DETECTION)

7.4.1 Shock Detection Flowchart



7.4.2 Self-test Flowchart