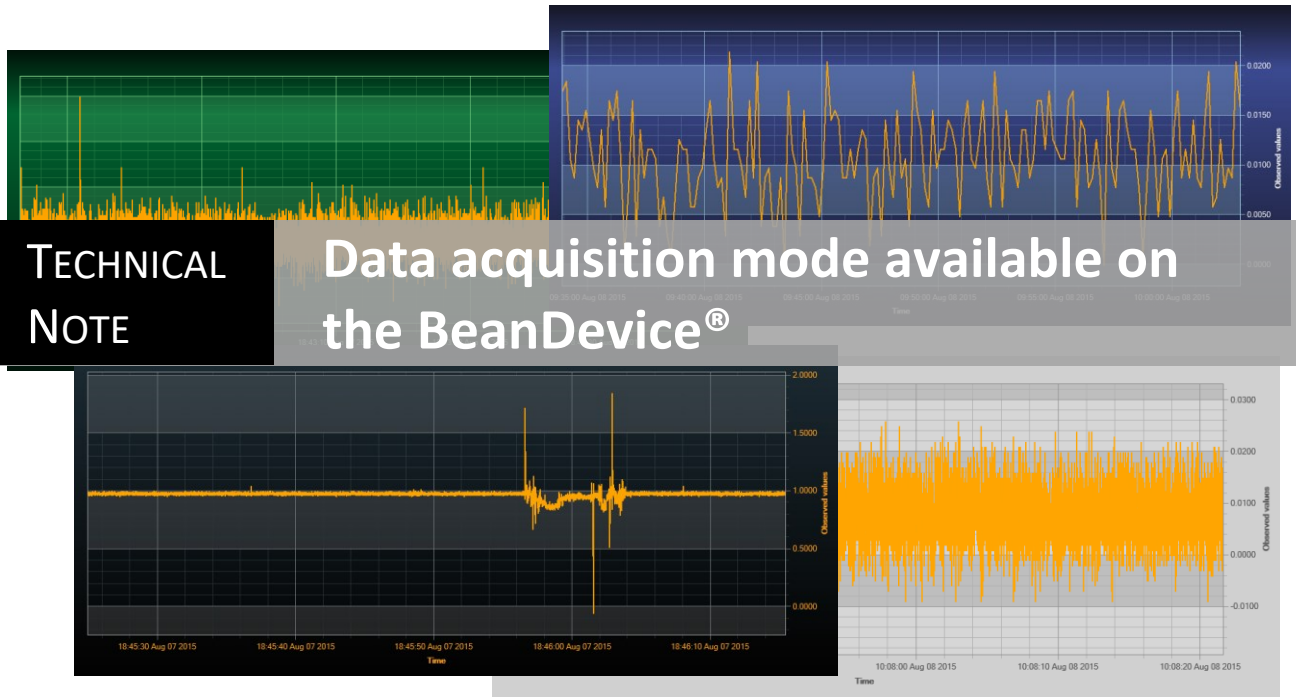
BeanDevice®

Version 3.0



TECHNICAL NOTE

Data acquisition mode available on the BeanDevice®

BeanAir

Rethinking Sensing Technology

2.4 GHz

DOCUMENT			
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Author	Fahd ESSID, Application/Support Engineer		
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Writer	Aymen Jegham	✓	
Reader	Mohamed-Yosri Jaou.	✓	
Validation	Antje Jacob		✓

DIFFUSION			
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Reader n°1	Maxime Obr., Embedded software engineer	✓	
Reader n°2	Mohamed-Yosri Jaouadi., Embedded software engineer	✓	

UPDATES			
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V1.5	17/09/2014	Maxime Obr.	**Commissioning mode & Multicasting process added**
V1.6	24/03/2016	Rasha FRIJI	**Time synchronization process** **Multicasting and commissioning details** **Data acquisition modes videos**
V1.7	04/08/2016	Salah Riahi	**Standalone operation updated + examples** **Streaming Mode suppressed** **Timeout commissioning suppressed**
V1.8	22/12/2016	Salah Riahi	**Multicasting video added** **Diagnostic Status video added**
V1.9	17/05/2018	Aymen Jegham	**S.E.T mode description added**
V2.0	16/06/2018	Aymen Jegham	**More info added about SET mode** - **SET operation mode** - **Flowchart Diagram** - **Example**

UPDATES			
V2.1	25/07/2018	Aymen Jegham	• **Screenshot update** • **SET mode thresholds**
V2.2	23/09/2018	Youssef Shahine	• **Start and Stop function added**
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V2.4.1	10/05/2019	Mohamed Bechir Besbes	• **Weblinks Update**
V2.5	03/07/2019	Fahd ESSID	• **Online/Offline Data Analysis Update**
V2.6	28/08/2019	Seddik ATTIG	• **Pictures update for the BeanDevice AX-3D** • **S.E.T mode on the BeanDevice Hi-Inc & Hi-Inc Xrange** • **S.E.T mode on the BeanDevice process sensors AN-XX**
V2.7	29/01/2020	Seddik ATTIG	• **Update the SET mode section** • **Update screen shots**
V2.8	29/06/2020	Seddik ATTIG	• **PPV Restrictions**
V2.9	23/10/2020	Seddik ATTIG	• **Triple AAA configuration**
V3.0	09/12/2020	Seddik ATTIG	• **Update the document with the new skin interface**

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1. TECHNICAL SUPPORT

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

tech-support@Beanair.com

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

www.Beanair.com

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

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

2. VISUAL SYMBOLS DEFINITION

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

3. ACRONYMS AND ABBREVIATIONS

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

4. AIM OF THIS DOCUMENT

The aim of this document is to describe closely all the parameters related to the LAN configuration of your BeanGateway®.

5. PROS/CONS OF EACH DATA ACQUISITION MODE

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

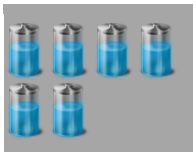
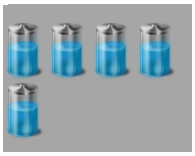
	Low Duty Cycle	Alarm	Streaming	Survey	Smart Shock Detection	S.E.T
Wireless Stack compatibility	*IEEE 802.15.4E – 2.4GHz*					
Low consumption						
Low Duty Cycle	*1s to 1day*					
Data sampling (sample per second)	*N.A.*		*1 Sps to 3 Ksps maximum(per channel)*	*N.A.*	*1 Sps to 1 Ksps maximum*	*1 Sps to 1 Ksps maximum (per channel)*
Data acquisition type	*Static*	*Static*	*Dynamic*	*Static*	*Dynamic / static*	*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 and impact detection (BeanDevice® AX-3DS only)*	*Land survey /monitoring remote sites with high sampling rate*
Network Size						

Table 1: Pros/Cons of each data acquisition configuration

6. DATA ACQUISITION MODE AVAILABLE ON THE BEANDEVICE®

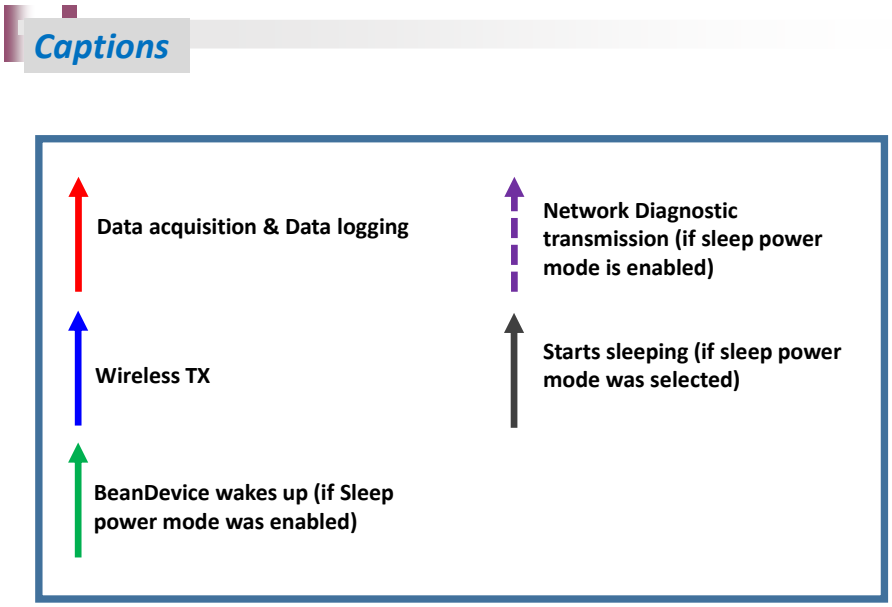
The following table presents the different Data acquisition mode available on the BeanDevice®:

Data acquisition Mode	BeanDevice® ONE-T/ ONE-TH/ONE-TIR (Ecosensor products)	BeanDevice® AX-3D/AX-3D Xrange	BeanDevice® INC/HI-INC/HI-INC Xrange (Xtend version not included)	BeanDevice® INC/HI-INC/HI-INC Xrange (Xtend version)	BeanDevice® AN-420/AN-V/AN-mV (Xtender version not included)	BeanDevice® AN-420/AN-V/AN-mV (Xtender version)	BeanDevice® AX-3DS
Low Duty Cycle Data Acquisition (LDCDA)	✓	✓	✓	✓	✓	✓	✓
Survey	✓		✓	✓	✓	✓	
Streaming		✓	✓		✓		✓
Smart shock detection							✓
S.E.T		✓	✓	✓	✓	✓	

Table 2: Data Acquisition mode available on the BeanDevice®

7. SYSTEM OVERVIEW

7.1 CAPTIONS



7.2 LOW DUTY CYCLE DATA ACQUISITION (LDCDA)

7.2.1 Operation Mode

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

Measurement duty cycle can be configured between one Data acquisition & transmission per second to 1 Data acquisition & transmission per day.

Low Duty Cycle Data Acquisition Mode

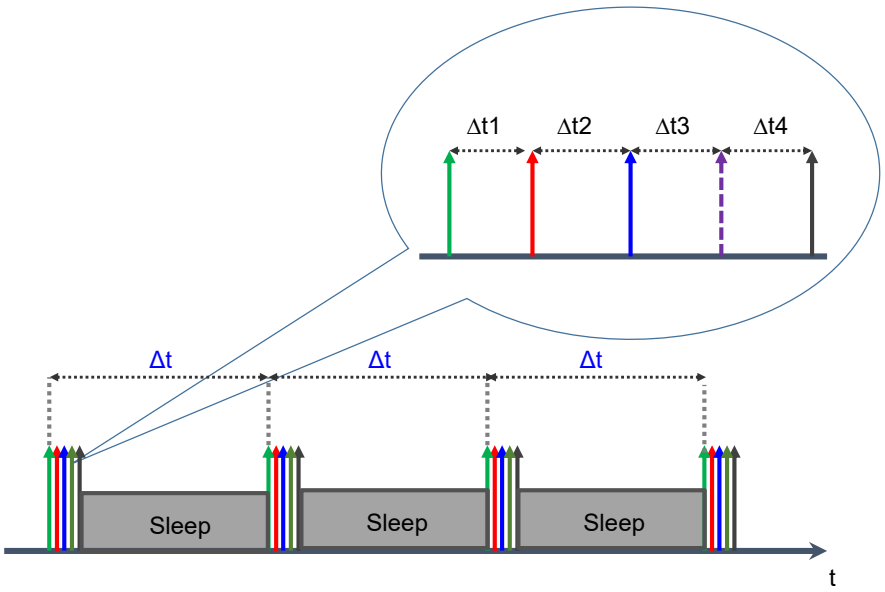


Figure 1: LDCDA mode Timeline

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

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

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

See "Diagnostic Status" YouTube video

7.2.2 Data acquisition cycle

Data acquisition cycle is user-definable from the ***BeanScape®***, 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	The BeanDevice® is operating with "Sleep power mode"	*4s*
	The BeanDevice® 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" or "sleep mode

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

7.3 « SURVEY » MODE

7.3.1 Operation mode

Same operation mode than alarm mode with beacon transmission informing its status:

- ✓ 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;
- ✓ Whenever an alarm threshold (user-configurable) is reached (4 alarm threshold levels High/Low), an alarm notification is transmitted to the ***BeanGateway®***;

Survey/Alarm Mode

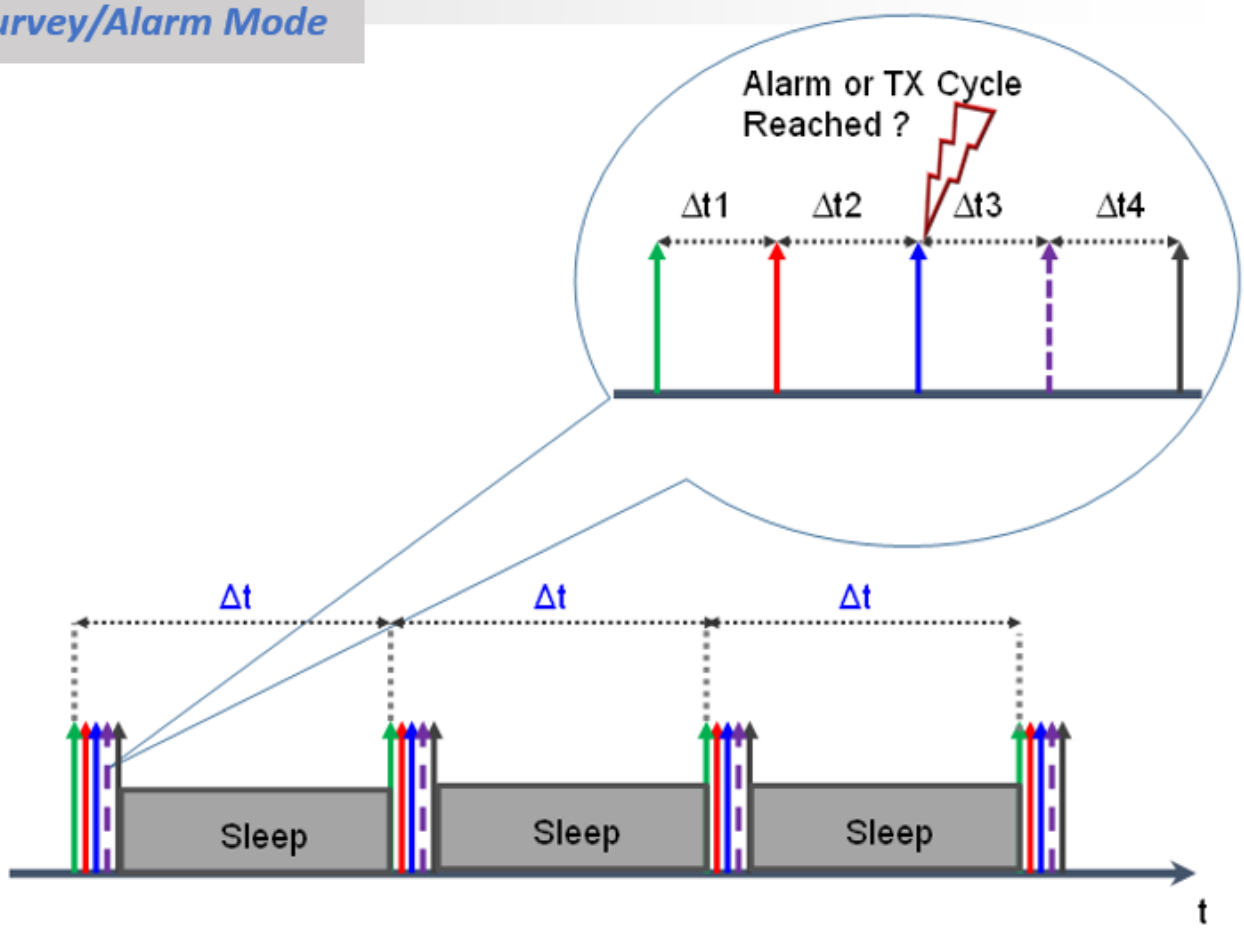


Figure 2: Survey mode Timeline

In survey mode, the BeanDevice® operates as follows:

- ✓ ***Step 1:*** *The* ***BeanDevice®*** *wakes up (if sleep mode 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® Data logger if an alarm threshold is reached ®* or a measurement cycle is reached;
- ✓ ***Step 4:*** *If "Wireless transmission" option is enabled: The Data acquisition is transmitted to the* ***BeanGateway ®*** *if an alarm threshold is reached* or a transmission cycle is reached*;*
- ✓ ***Step 5:*** *A Network diagnostic is performed and transmitted to the* ***BeanGateway ®*** *(depending on diagnostic cycle defined by the user);*
- ✓ ***Step 6:*** *The* ***BeanDevice®*** goes to sleep *(if sleep mode is selected);*

If the alarms thresholds are not defined correctly, *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®".***

Go to the Alarm Flowchart diagram section for a flowchart representation of the Alarm measurement mode.

See "Diagnostic Status" YouTube video

7.3.2 Data acquisition cycle

Same process than LDCDA mode

7.4 STREAMING MODE

7.4.1 Operation mode

Streaming mode is dedicated to dynamic Data acquisition (vibration, strain gage, deformation, acceleration…); it's suitable for users requiring a high Data sampling rate (maximum sampling rate is 3 KSps).

For completing this type of Data acquisition, the BeanDevice® provides others options:

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

See "Diagnostic Status" YouTube video

7.4.1.1 Streaming with "**continuous monitoring**" option

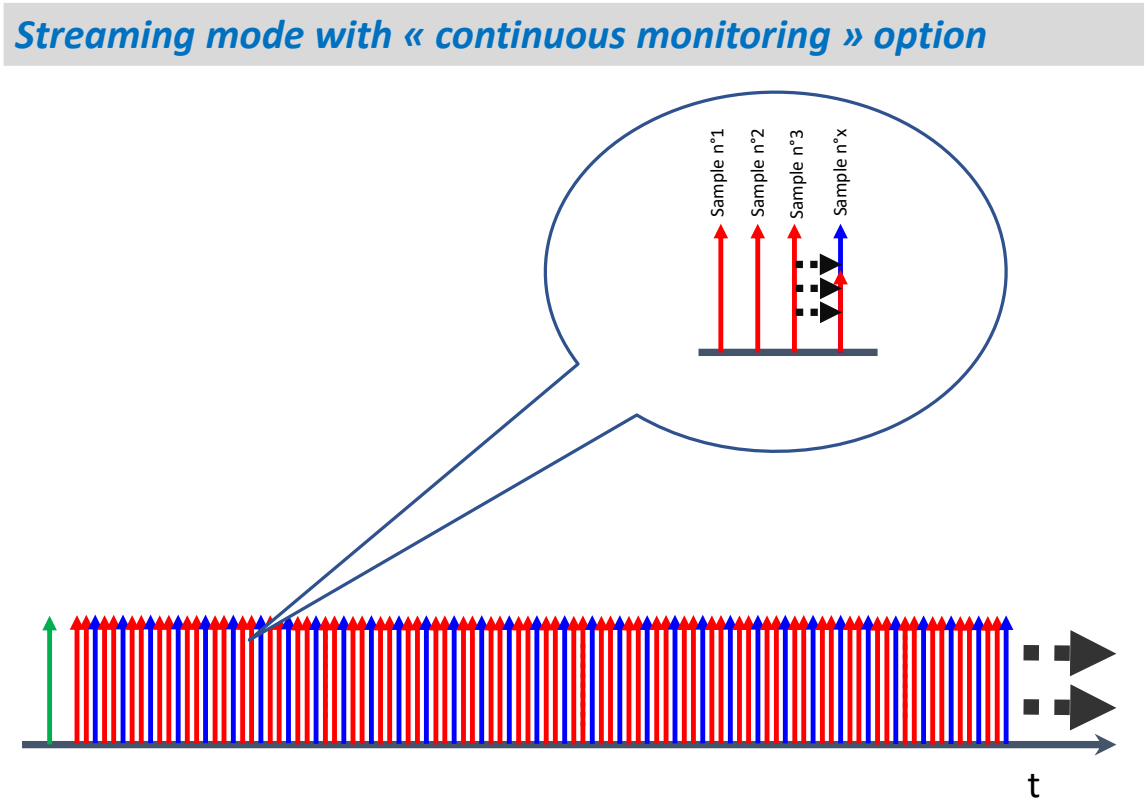


Figure 3: Streaming mode timeline

The BeanDevice® operates as follows:

- ✓ ***Step 1** : A Data acquisition is performed with a high sampling rate, and buffered ;*
- ✓ ***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**:* If Data buffer is full, a Data packet is transmitted to the ***BeanGateway ®**;*
- ✓ ***Step 4**:* Step 1 to Step 3 are repeated without stopping;

7.4.1.2 Streaming mode with “One shot” option

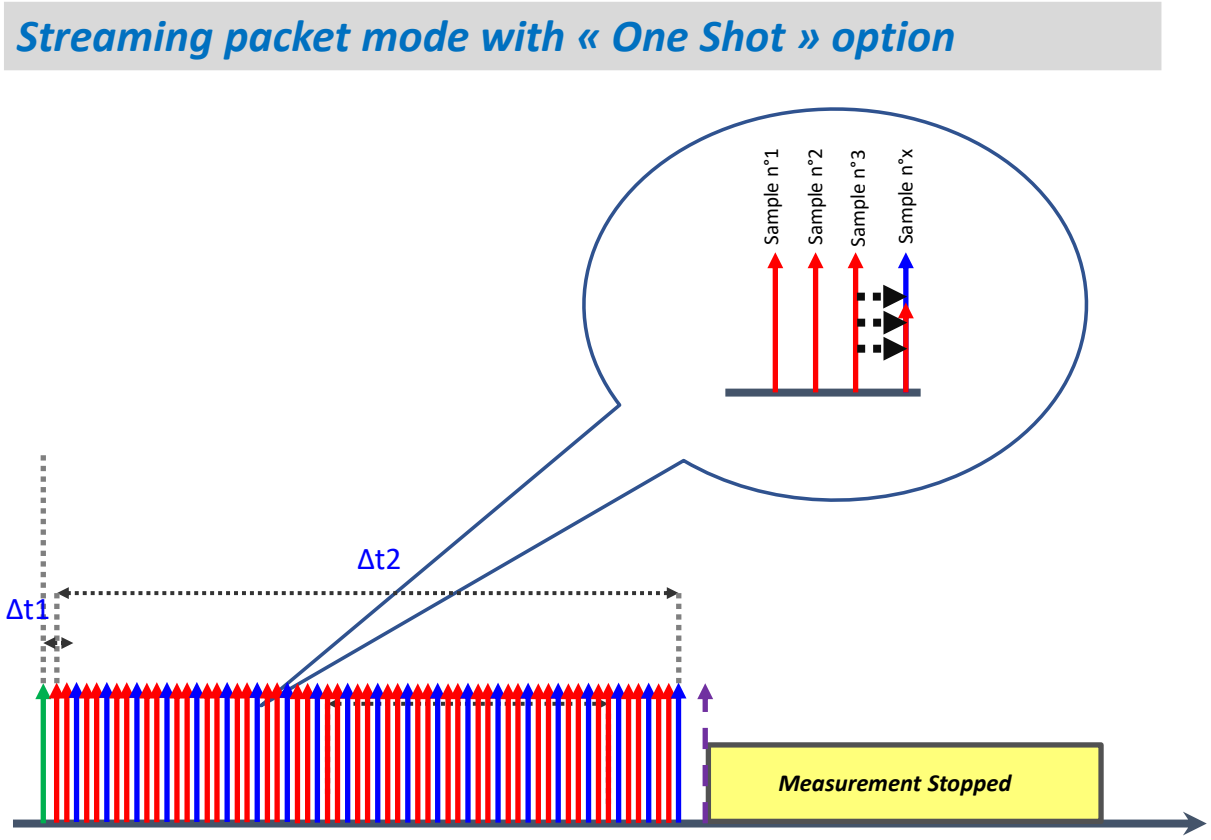


Figure 4: Streaming mode with “one shot” option timeline

The BeanDevice® operates as follows:

- ✓ ***Step 1** : A Data acquisition is performed with a high sampling rate, and buffered ;*
- ✓ ***Step 2**: If “Datalogger” option is enabled: the Data acquisition is backed up on the BeanDevice® Data logger;*
- ✓ ***Step 3:** If “Wireless transmission” option is enabled:* If Data buffer is full, a Data packet is transmitted to the ***BeanGateway ®**;*
- ✓ ***Step 4**: **Step 1** to **Step 3** are repeated until the sampling duration is completed;*
- ✓ ***Step 5** : A Network diagnostic is performed and transmitted to the **BeanGateway ®** (depending on diagnostic cycle defined by the user)*
- ✓ ***Step 6**: The Data acquisition will be Stopped*, and will wait for a new OTAC request;

7.4.1.3 Streaming mode with "Burst" option

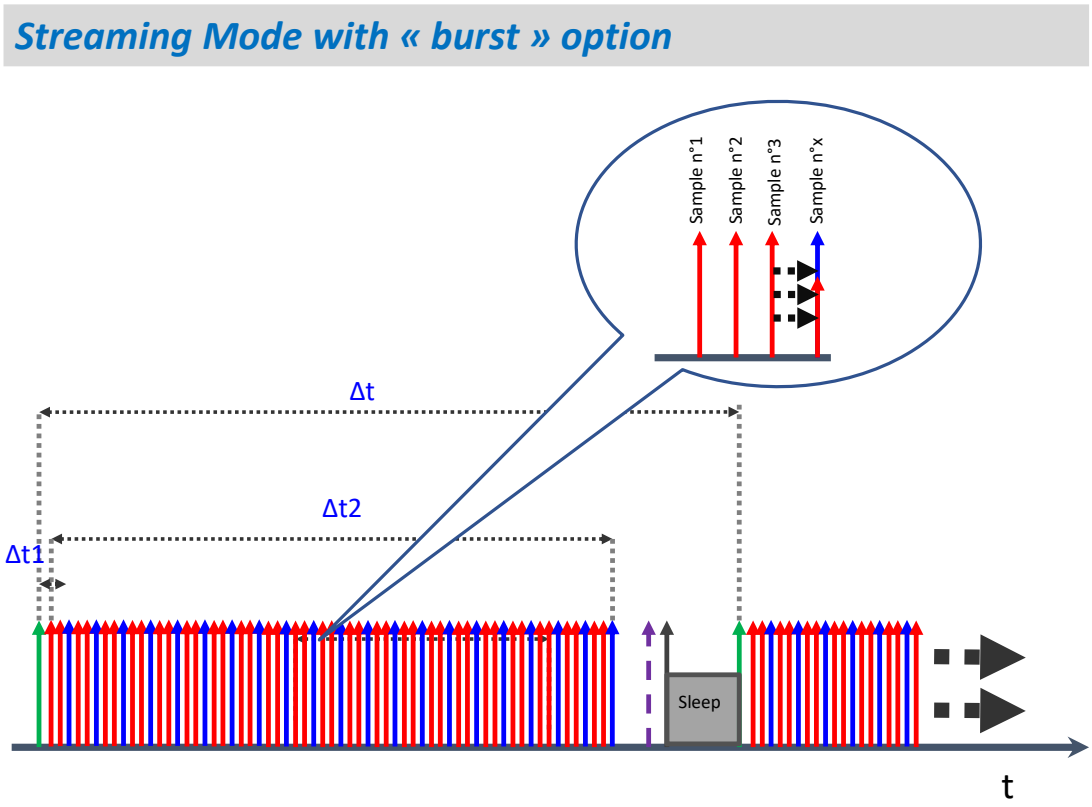


Figure 5: Streaming mode with "Burst" option timeline

The BeanDevice® operates as follows:

- ✓ ***Step 1*** *: A Data acquisition is performed with a high sampling rate, and then buffered ;*
- ✓ ***Step 2****: If Data logger option is enabled: the Data acquisition is backed up on the BeanDevice® Data logger*;
- ✓ ***Step 3:*** *If "Wireless transmission" option is enabled:* If Data buffer is full, a Data packet is transmitted to the ***BeanGateway ®***;
- ✓ ***Step 4****:* ***Step 1*** to ***Step 3*** are repeated until the sampling duration is completed;
- ✓ ***Step 5*** *: A Network diagnostic is performed and transmitted to the* ***BeanGateway ®*** *(depending on diagnostic cycle defined by the user);*
- ✓ ***Step 6*** *: The* ***BeanDevice®*** goes to sleep power mode *(if sleep mode power mode is enabled);*

7.4.2 Maximum sampling rate

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

BeanDevice® Model		BeanDevice® AX-3D	BeanDevice® AX-3D XRange	BeanDevice® HI-INC & INC & HI-INC XRange	BeanDevice® AX-3DS	BeanDevice® AN-V/AN-mV/AN-420
Number of enabled DAQ /Sensor channel	*1 Channel*	3 KSPS	3 KSPS	60 SPS	1 KSPS	400 SPS
	2 Channels	1,5 KSPS	1,5 KSPS	60 SPS	1 KSPS	400 SPS
	3 Channels	1 KSPS	1 KSPS	60 SPS	1 KSPS	400 SPS
	4 Channels	N.A.	N.A.	N.A.	N.A.	400 SPS

Take notice: 1 KSPS == 1Ksamples per second with a resolution of 16-bits

The WSN comes with the following restrictions:

- ✓ *Data acquisition duration must be lower than Data acquisition cycle. The BeanDevice® settles a margin of 10s between these two parameters.*

Streaming mode: PER (Packet Error Rate) will increase proportionately with the sampling rate, mainly if several BeanDevice® 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. For further information, read the technical note: RF_TN_003- "Aggregation capacity of wireless sensor networks"

Go to the Streaming Flowchart diagram section for a flowchart representation of the Streaming measurement mode.

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

7.5.1 Operating mode

The streaming with event trigger mode allows user to receive notification on BeanScape® software also via email when the measurement reaches the preconfigured thresholds, the measurement is in streaming mode with high sampling rates (up to 1Ksps) unlike in the alarm mode.

- ✓ Data acquisition is done with a high sampling rate up to 1 Ksps (configurable with the BeanScape®), the operation is the same than streaming with continuous monitoring;
- ✓ The notification cycle is a cyclic period when the BeanDevice® wakes up from sleep, performs acquisition, and sends notification even if an alarm threshold is not reached.
- ✓ Whenever an alarm threshold (user-configurable) is reached (three levels of alarm threshold are available action/alert/alarm), an alarm notification is transmitted to the *BeanScape®*;
- ✓ Data acquisition duration represents the measurement duration after a threshold is reached.
- ✓ Pre-trigger duration is corresponding to the period before the threshold is reached

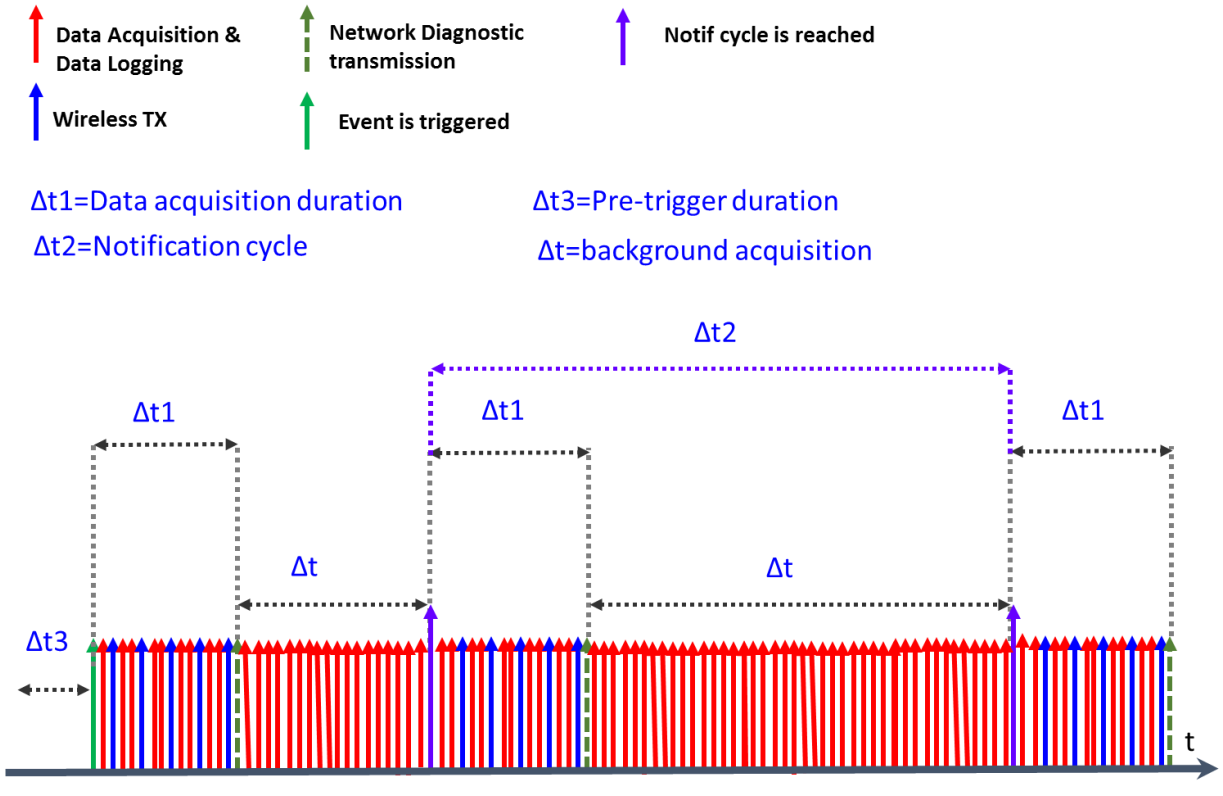


Figure 6: Streaming with event trigger (S.E.T.) mode timeline

- **Δt :** Exactly like the streaming mode, the BeanDevice® is in continuous acquisition mode & wireless transmission. When the measurement threshold is reached, data acquisition will be recorded on the local PC and displayed on the BeanScape® software;
- **Δt3 (Pre-trigger duration):** Up to 10s of data acquisition before the threshold can be recorded ;
- **Δt1 (Data Acquisition duration) :** The maximum data acquisition duration is 1 minute(60 seconds)
- **Δt2:** User can receive a notification about the good operation of the wireless sensor on the monitoring site. When a notification cycle occurs, the BeanDevice® transmits data measurement during **Δt1**.

Δt2 > Δt1 : Notification cycle should be higher than Data acquisition duration**.**

7.6 SMART SHOCK DETECTION (AVAILABLE ONLY ON THE BEANDEVICE® AX-3DS)

7.6.1 Description

The BeanDevice® AX-3DS integrates ***Smart Shock Detection*** technology which permits to detect & recognize a shock event during the sleeping mode of the ***BeanDevice® AX-3DS.***

The BeanDevice® wakes up on two conditions:

- ***Survey Cycle***: A survey frame is transmitted; the transmission cycle is configurable from the BeanScape®. The user can choose to enable or disable this option;
- Whenever a shock event is detected, all the measurement Data are transmitted instantly;

7.6.2 During a shock detection

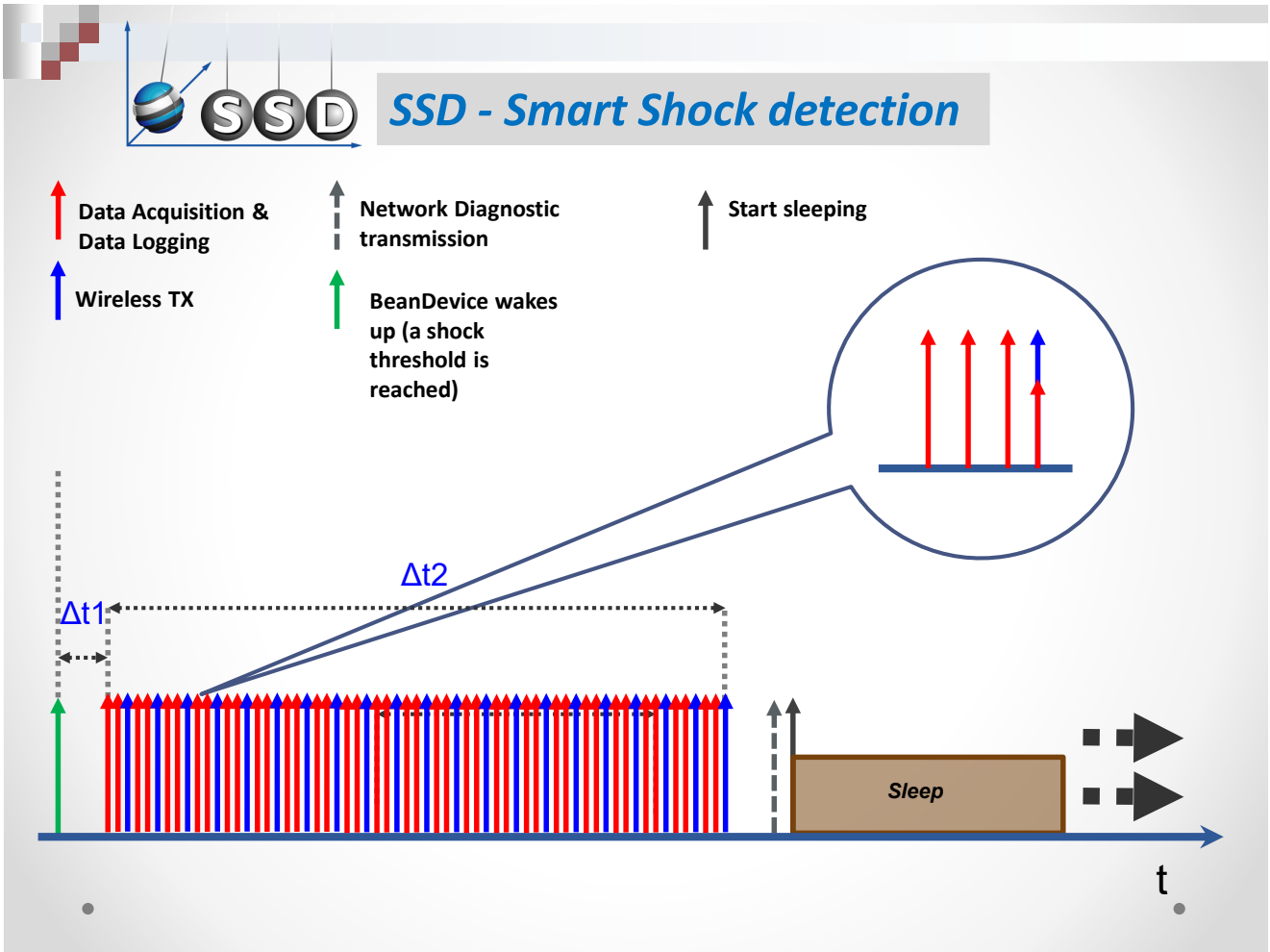


Figure 7: SSD Mode timeline

Δt1 = 12.5 ms, Latency time between the BeanDevice® wakes up and the first Data acquisition

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

The BeanDevice® operates as follows:

- ✓ ***Step 1*** *: A shock threshold is reached (user-configurable), the* ***BeanDevice®*** *wakes up;*
- ✓ ***Step 2*** *: A Data acquisition is performed with a high sampling rate, and buffered ;*
- ✓ ***Step3*****: If Datalogger feature is enabled**: the Data acquisition is registered on the BeanDevice® Datalogger;
- ✓ ***Step 4: If a Data Transmission function is enabled:*** The Data acquisition is transmitted to the ***BeanGateway ®****;*
- ✓ ***Step 5***: Step 2 to Step 4 are repeated until the sampling duration (**Δt2**) is completed;
- ✓ ***Step 6****: A Network diagnostic is automatically performed and transmitted to the* ***BeanGateway ®***

- ✓ ***Step 7:*** *The* ***BeanDevice®*** goes to sleep

7.6.3 During a Survey

If survey function is activated, the BeanDevice® wakes up on a duty cycle:

- ✓ ***Step 1:*** The ***BeanDevice®*** wakes up;
- ✓ ***Step 2:*** *A* Data acquisition is performed;
- ✓ ***Step 4:*** ***If a Data Transmission function is enabled****:* The Data acquisition is transmitted to the ***BeanGateway ®****;*
- ✓ ***Step 5****: A Network diagnostic is automatically performed and transmitted to the* ***BeanGateway ®***
- ✓ ***Step 6*** *: The* ***BeanDevice®*** goes to sleep

The Datalogger is not activated during a survey

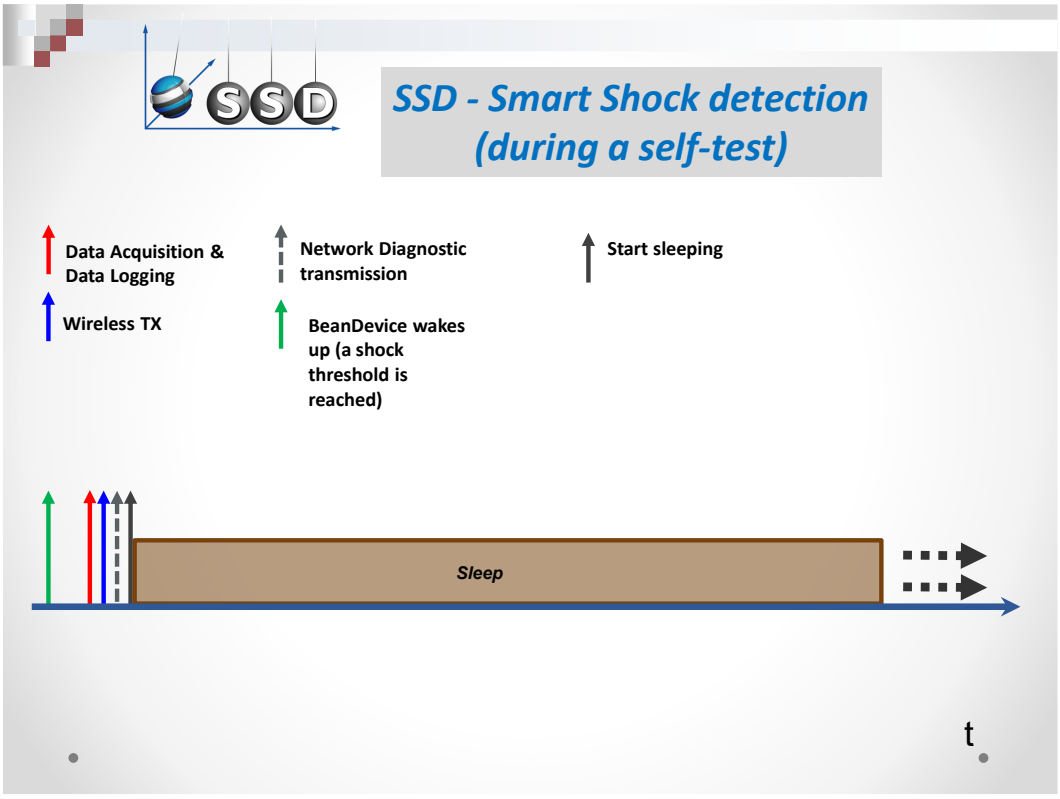


Figure 8: SSD Mode timeline during s self test

See "Diagnostic Status" YouTube video

8. SYNCHRONUOUS MULTICASTING

8.1 BEANDEVICE® COMPATBILITY

Synchronous multicasting is only available on the following BeanDevice®:

- **Beandevice® AX-3D**
- **Beandevice® AX-3D Xrange**
- **Beandevice® INC (not available on the Xtend version)**
- **Beandevice® HI-INC (not available on the Xtend version)**
- **Beandevice® HI-INC Xrange (not available on the Xtend version)**
- **Beandevice® AN-V/AN-mV/AN-420**

8.2 SYSTEM OVERVIEW

A synchronous multicast routing enables the delivery of an OTAC request to a set of BeanDevice® that have been configured as members of a multicast group within the WSN.

Step1: The BeanScape® transmits to the BeanGateway ® a message containing the OTAC request followed by the multicast group;

Figure 9: OTAC Requests + Multicast Group

Step2: OTAC request is distributed to each BeanDevice® belonging to the same multicast group. The BeanDevice® sends an ACK (acknowledgment) if the OTAC request is accepted.

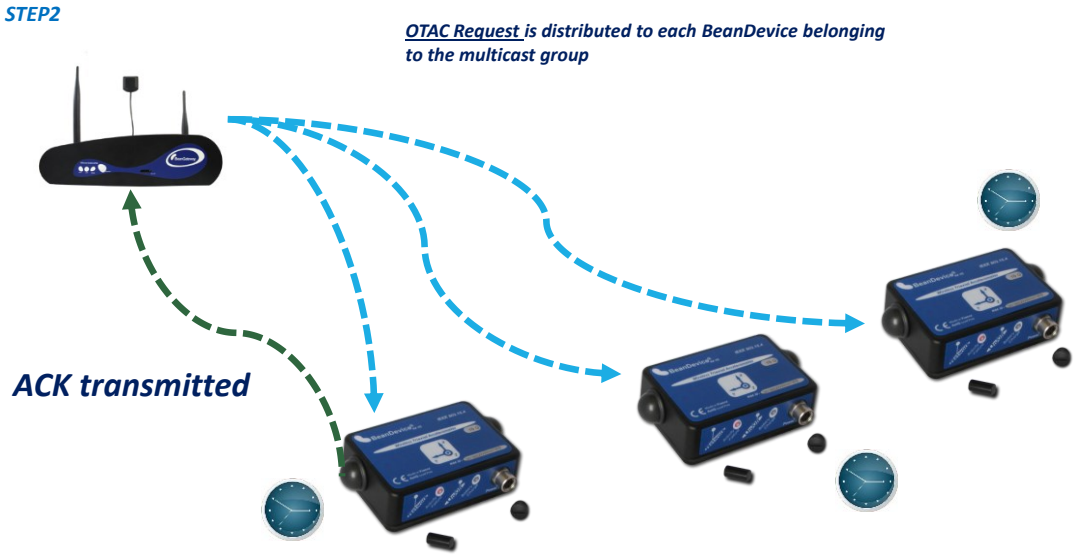


Figure 10: OTAC exchanging in Multicast Group

Step 3: If the OTAC request is linked to a Data acquisition mode, it will start at the same time for all the BeanDevice® belonging to the same multicast group. The user can configure a **starting delay** (minimum value 10s).

Multicasting function is not suitable for:

- **Sensors operating at very high sampling rate ,**
- **Large number of sensors (more than 6 sensors);**

Due to its synchronous data transmission, too many collision will occur during data transmission. We suggest you to use Multicasting with limited sensors 4-6 maximum operating at 5-40Hz sampling rate maximum. However if you need to work with higher sampling rate, we suggest you to use Tx+Log option, when the sensors are in stopped condition you can download data logs from sensors itself without facing problems.

If the OTAC request is linked to data download, it will be executed sequentially. Once the download is finished from one BeanDevice® in the multicasting group, the download starts with the next BeanDevice®. If a download process is interrupted on a BeanDevice®, it restarts for several trials.

To avoid a download interruption, before to send the Download request make sure that:

- **Your BeanDevice® are not out of range of your BeanGateway®.**
- **You have enough power on your BeanDevice®**

8.3 DESCRIPTION

1. Click on the BeanGateway® profile
2. Select « Multicasting » tab

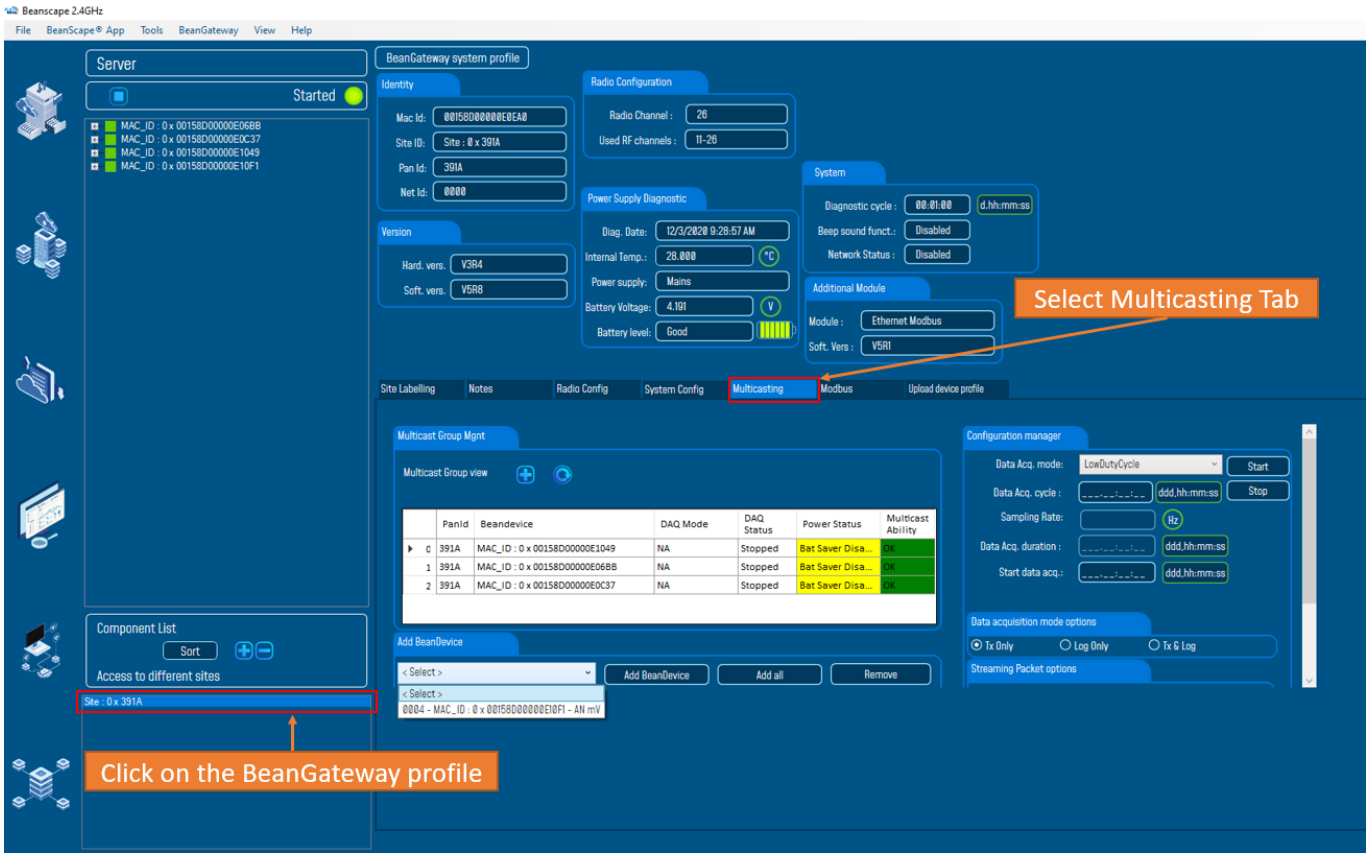


Figure 11: Multicasting tab overview

Field	Parameters	Description
Multicast Group management (1)	/	Displays the list of BeanDevice® linked to the Multicast Group ✓ ***BeanDevice®***: BeanDevice® MAC ID ✓ ***DAQ Mode*** : Current Data acquisition mode ✓ ***DAQ Status*** : Current Data acquisition mode status ✓ ***Power Status***: Current Power mode status ✓ ***Multicast Ability***: OK or NOK. If NOK, you have to Stop acquisition in your BeanDevice®.
Add BeanDevice® (2)	***Select***	Select the BeanDevice® from the scroll list
	Add BeanDevice®	Add a BeanDevice® to your Multicast group
	Add all	Add all the BeanDevice® to your Multicast group
	Remove	Remove a BeanDevice® from your Multicast group
Configuration Manager (3)	/	Same setting than "Data acquisition mode" configuration Tab available on the BeanDevice® profile Click here for more information These parameters are dispatched to the Multicast group. **Before to Multicast a new data acquisition mode, make sure that your BeanDevice® is in stopped condition.**
Download manager (5)	***Download***	Same setting than "Datalogger" configuration Tab available on the BeanDevice® profile. These parameters are dispatched to the Multicast group. Your BeanDevice® don't need to be in stopped condition.
	Stop	
	Erase	
	Cancel	
	Download, Erase and Stop	
	Stop DAQ, Download then erase	
	Datalogger memory configuration	

By clicking on "***Multicast group view***", a second window will open. It will display the following information:

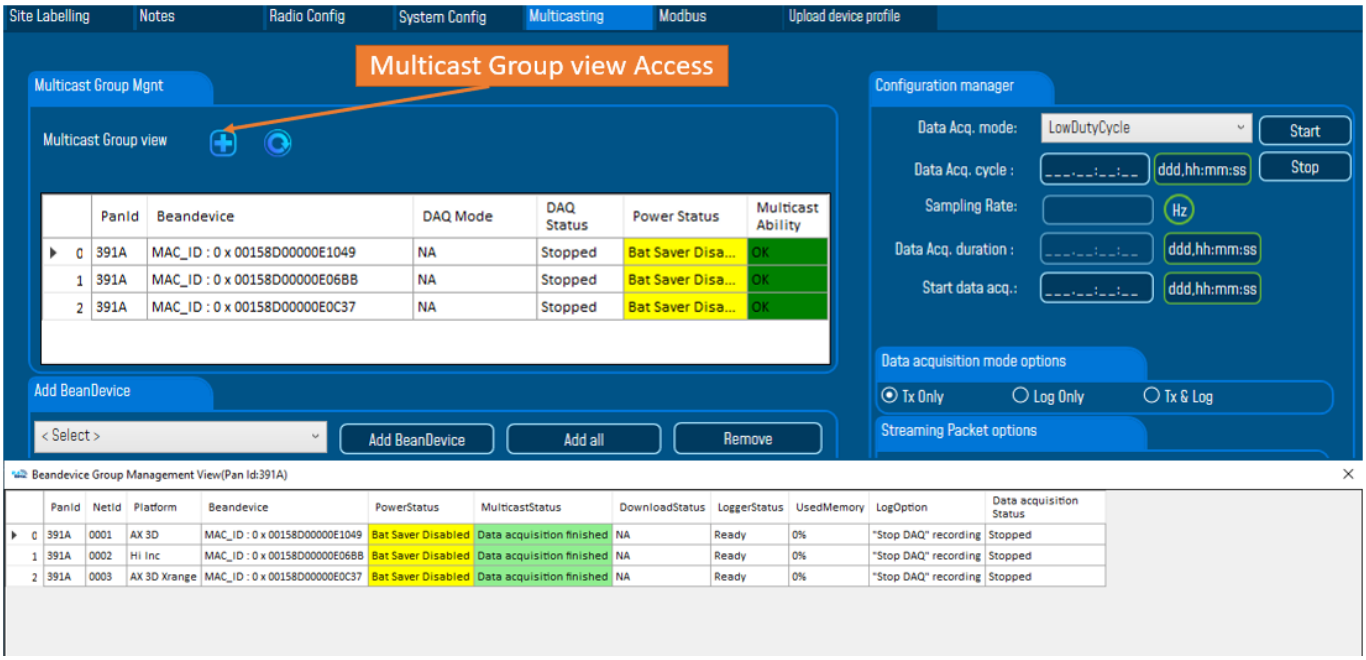


Figure 12: Multicast Group view

Parameters	Description
NetID	BeanDevice® Network Address
Platform	BeanDevice® product version
BeanDevice®	BeanDevice® MAC Address
Power Status	BeanDevice® power mode status (Active, Sleep, Standby….)
Multicast Status	Several Multicast statuses are available (MSG Sent….)
Download Status	Datalogger download status (N.A., Successful)
Logger Status	Datalogger status (Ready….)
Used Memory	% of used memory on the datalogger
LogOption	Datalogger options when the flash memory is full (SC recording,)
Data acquisition status	Data acquisition options

See “Synchronizing Acquisition with the Multicasting” YouTube video

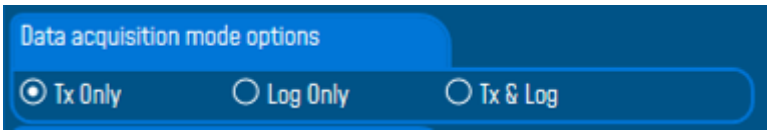
8.4 STARTING DATA ACQUISITION AT THE SAME TIME

When using multi-casting function, BeanDevice® starts data acquisition at the same time when the following data acquisition mode are used:

- In low duty cycle mode;
- In streaming mode with one-shot option;
- In streaming with burst mode: only during the first data acquisition cycle;

A synchronization accuracy of ***±2.5ms*** is reached over the WSN:

- Clock-drift is ±10 ppm at 25°C, to resynchronize your BeanDevice® clock without any physical intervention, you can restart your BeanDevice® from your BeanScape® software.
- The maximum number of BeanDevice® is 6;
- Log only mode is used in "Data Acquisition mode options", data loss can be avoided by selecting this option;



8.5 MULTICASTING WITH SEVERAL BEANGATEWAY® ON THE FIELD

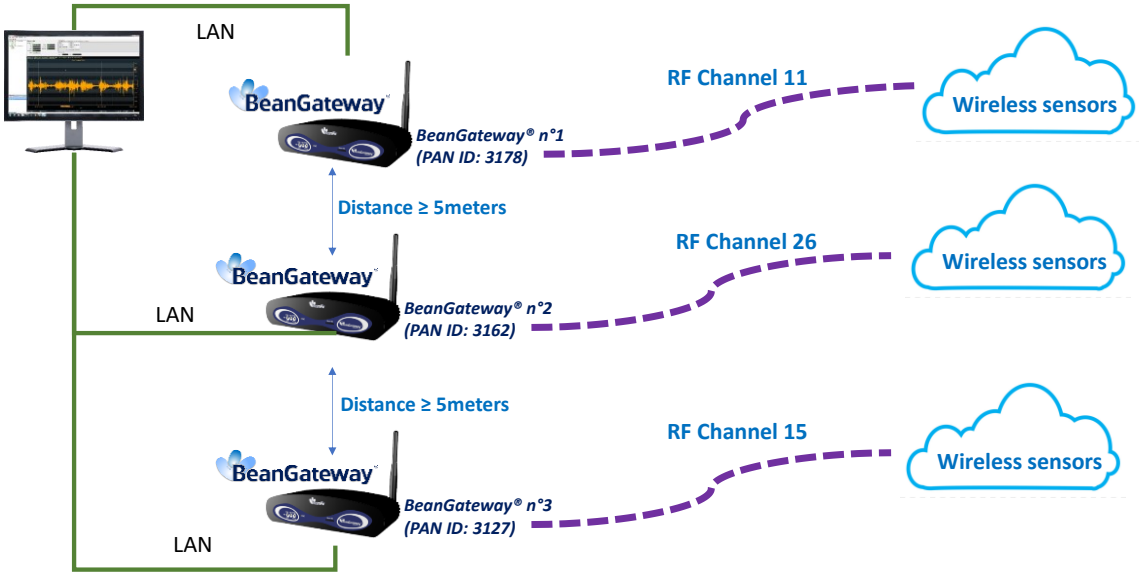


Figure 13: Multicasting with several BeanGateway® on the same field

If you are using several BeanGateway® on the same field, before to start to deploy your wireless sensors, the following network configuration is highly recommended to avoid network conflicts:

1. The distance between each BeanGateway® should be at least 5-10 meters;
2. PAN ID should be different between the BeanGateway®;
3. RF Channel between each BeanGateway® should be spaced by two RF channels;

If you are using several BeanGateway® on different fields, before to start to deploy your wireless sensors, only the PAN ID should be different between the BeanGateway®.

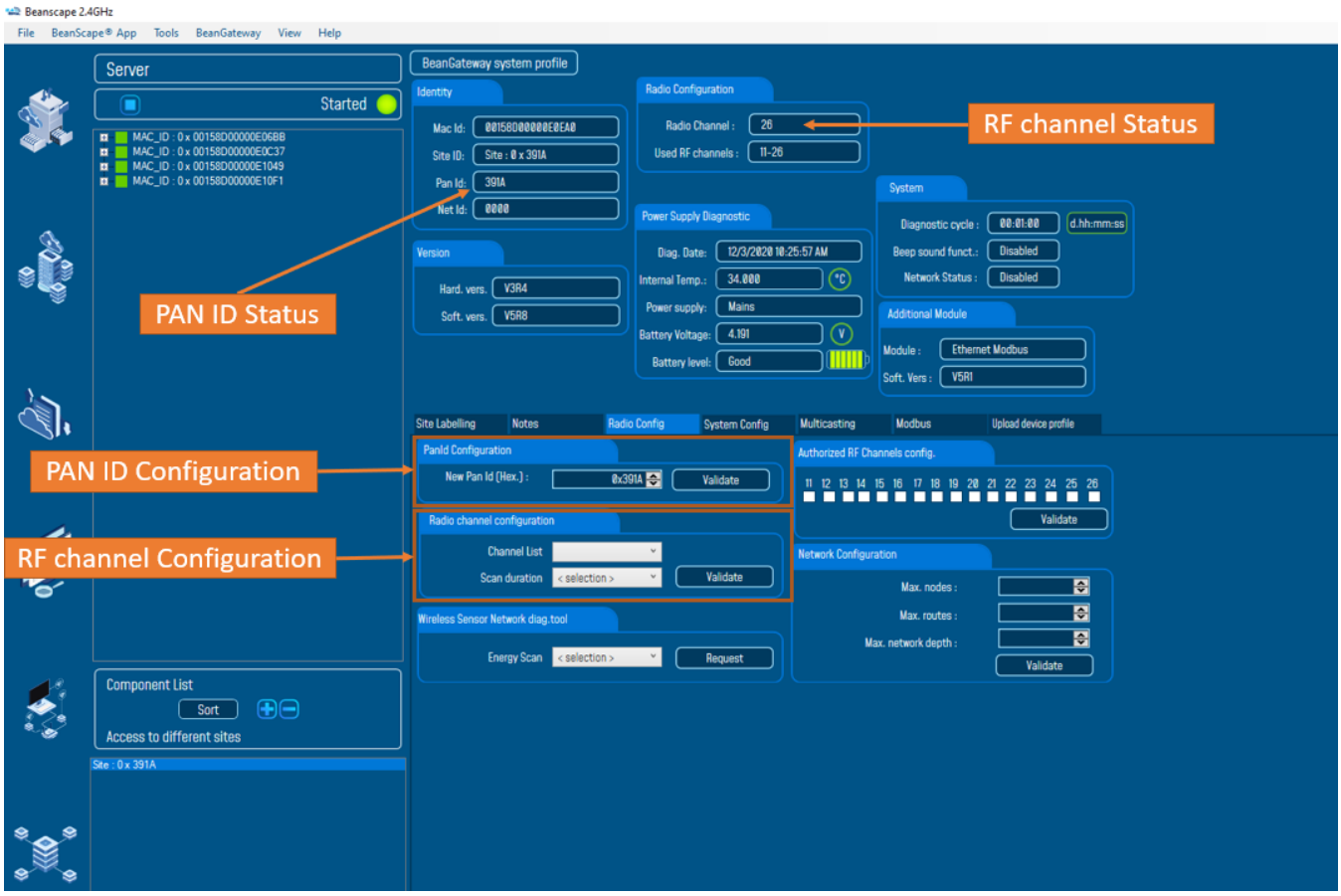


Figure 14: RF Channel and PAN ID configuration on the BeanGateway®

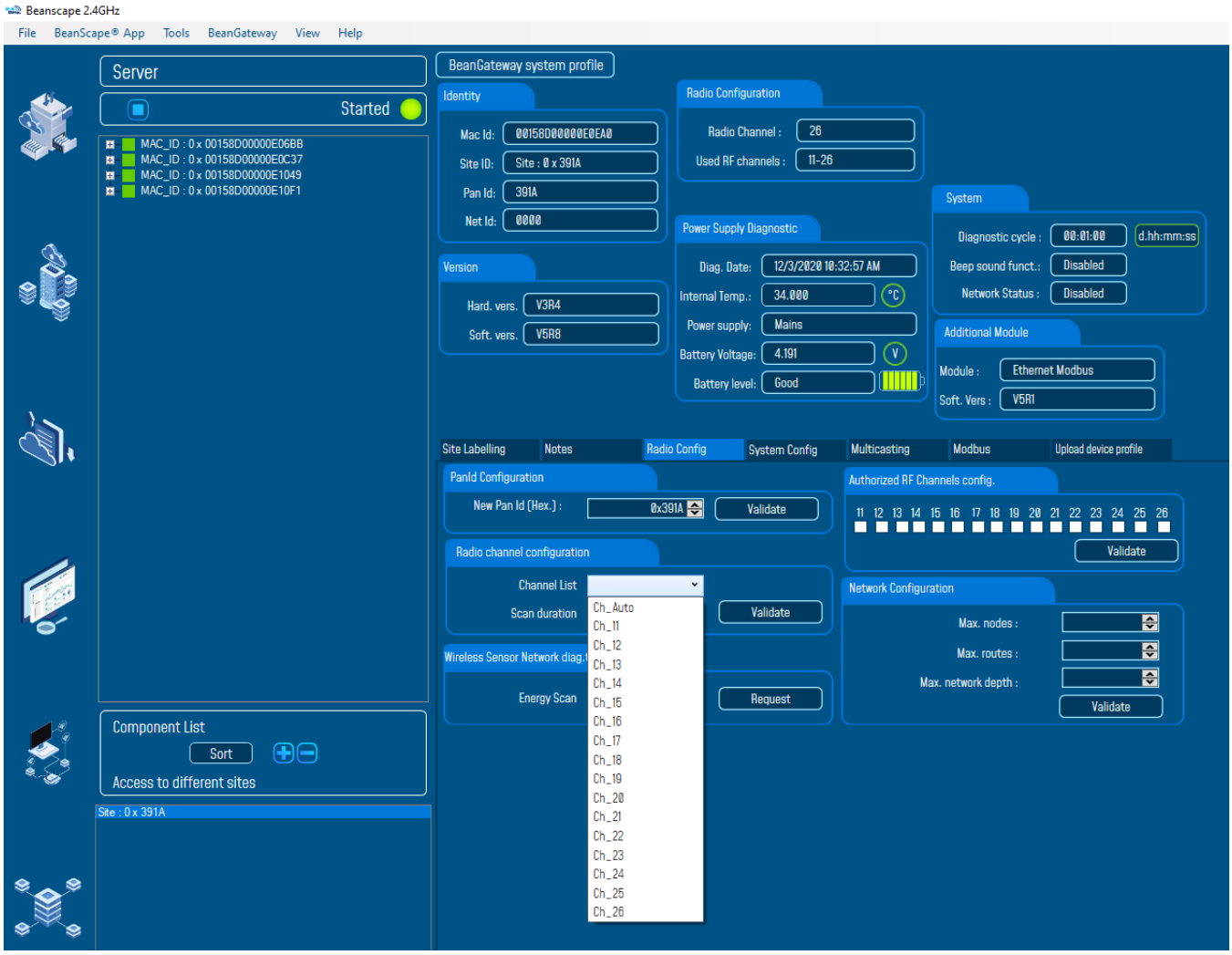


Figure 15: Manual Radio Channel selection

PAN ID and RF channels must be changed before to deploy your wireless sensors (before connect the BeanDevice® to the BeanGateway®), otherwise you will lose the wireless links to your BeanDevice®.

Firstly, change the PAN ID then the RF Channel. By changing the PAN ID, the RF channel will automatically switch to the Channel 26

Please consult the BeanGateway® user manual for more information about the BeanGateway® configuration.

Go to Appendices 4 for further information about clock management and clock-drift.

9. DATA ACQUISITION MODE CONFIGURATION FROM THE BEANSCAPE®

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

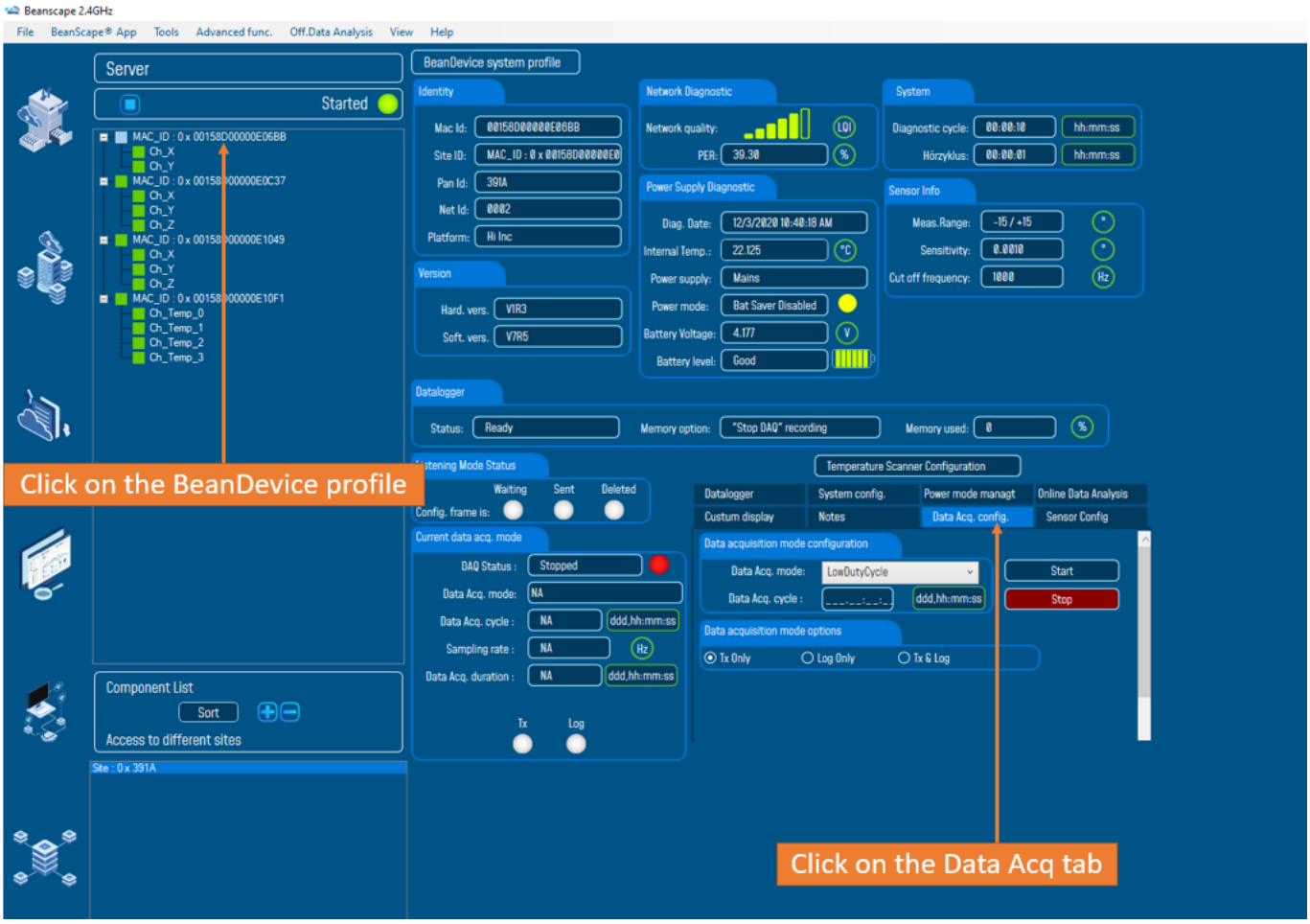


Figure 16: BeanDevice® profile

9.1 TAB: DATA ACQUISITION CONFIGURATION

9.1.1 Overview

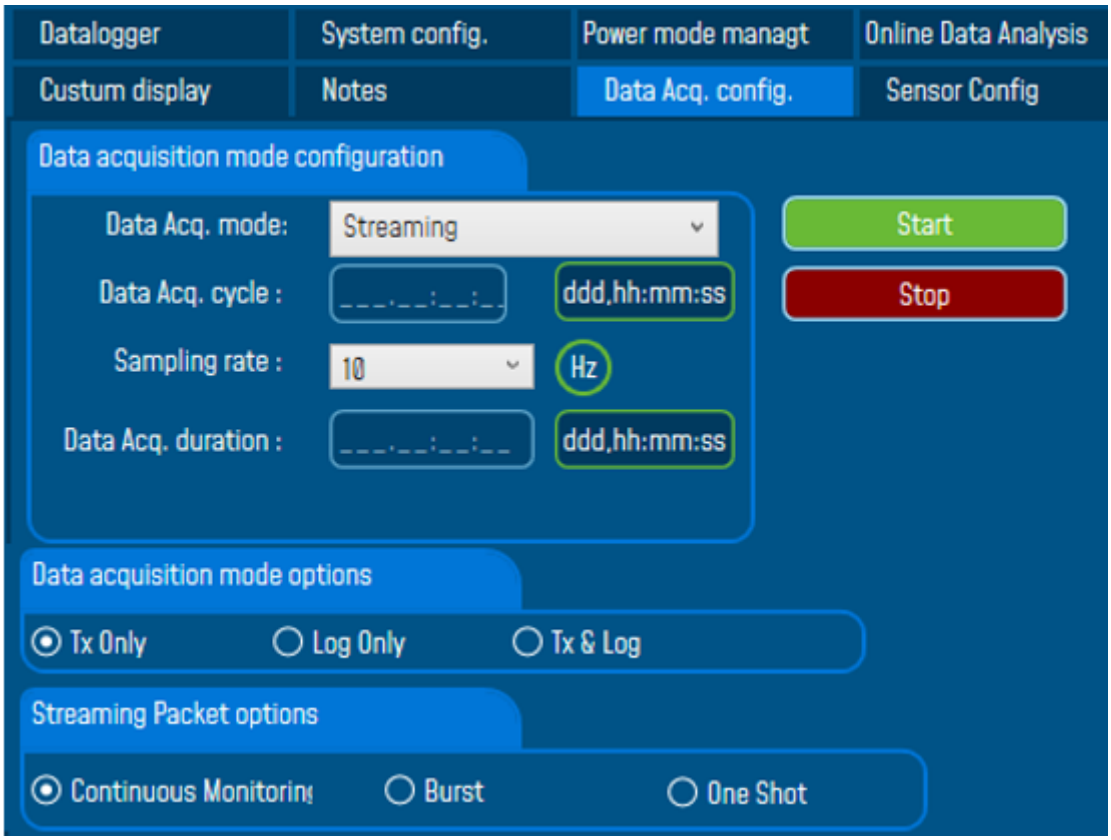


Figure 17: Data Acquisition Configuration Tab

Stop button is available on the following BeanDevice®:

- BeanDevice® INC/HI-INC/HI-INC Xrange
- BeanDevice® AN-420/AN-V/AN-mV
- BeanDevice® AX-3D/AX-3D Xrange

By clicking on **Stop** button, you will stop data acquisition and data recording, the BeanDevice® will operate in active power mode and will wait for a new data acquisition.

Stop button is not available on the following BeanDevice®:

- BeanDevice® INC Xtend
- BeanDevice® ONE-T/ONE-TH/ONE-TIR/ONE-TIR-MED

Current Data acquisition is displayed on "***Current Data acquisition mode***" frame:

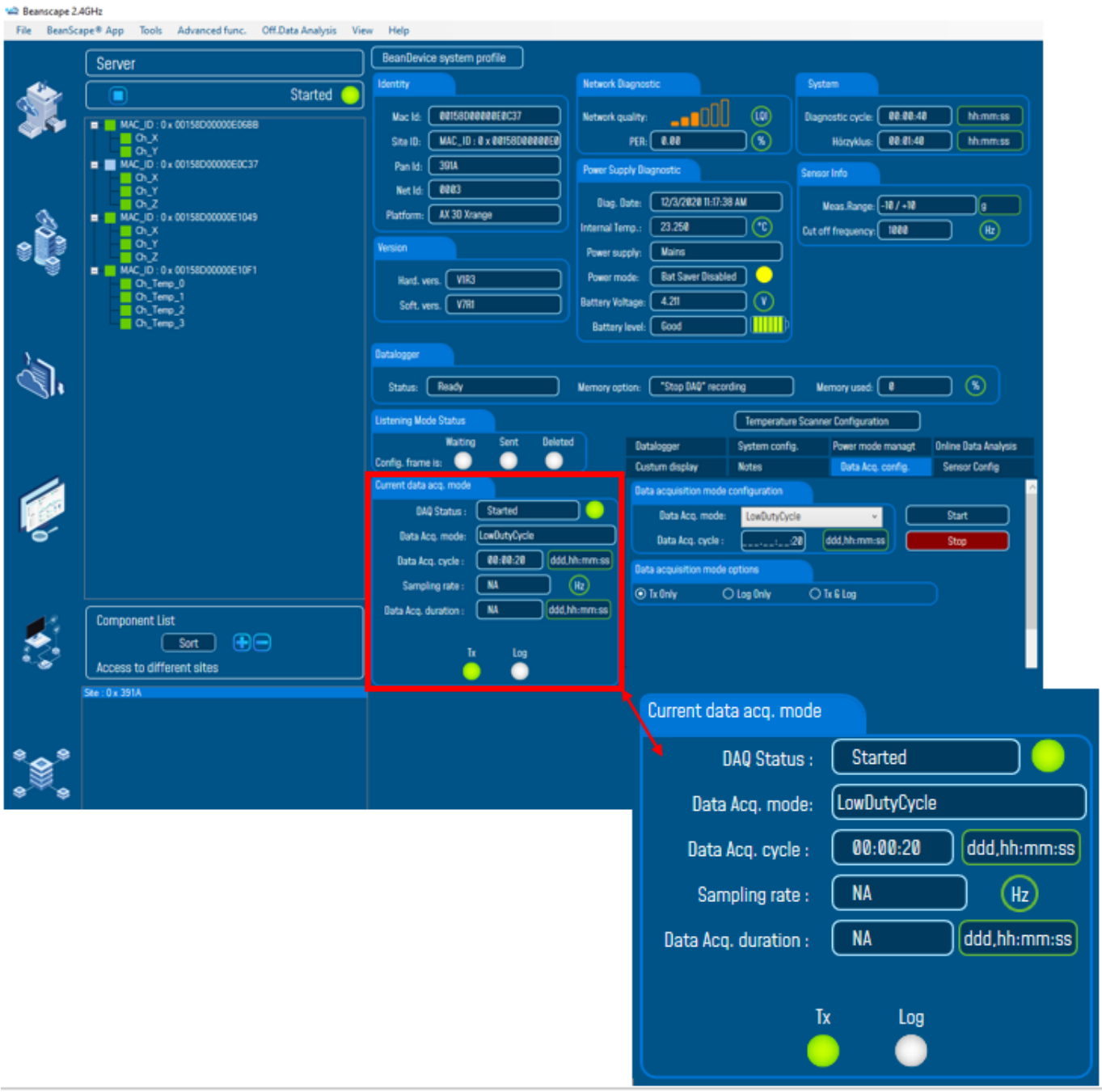


Figure 18: Current data acquisition mode tab

9.1.2 Data acquisition mode

Data acquisition mode	*Description*
DAQ Status	Displays current DAQ Status: **Started** or **Stopped** If **Started**, there is an ongoing data acquisition. If **Stopped**, data acquisition is not performed.
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®. The duty cycle can be configured between 1 Data acquisition & transmission per second to 1 Data acquisition & transmission per day.
Alarm	Survey mode is a mix between the LDCDA mode and Alarm mode. A Data acquisition is transmitted: • Whenever an alarm threshold (user-configurable) is reached (4 alarm threshold levels High/Low). ▪ A transmission cycle is reached; the transmission cycle is configurable through the BeanScape® 1s to 24h;
Streaming	Streaming is suitable for users requiring a high Data sampling rate. To achieve these performances, data sampling is transmitted by packet;
SSD (Smart Shock Detection)	Smart shock detection mode is only available on the BeanDevice® AX-3DS. If a shock threshold is detected, the BeanDevice® starts to transmit all the data acquisition to the BeanGateway ®.
S.E.T(streaming with event trigger)	Streaming with event trigger mode operates like Streaming mode (high sampling rate), but data acquisition is displayed on the BeanScape® software if a threshold is reached. User can enable a notification by email when the measurement reaches the preconfigured thresholds.

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

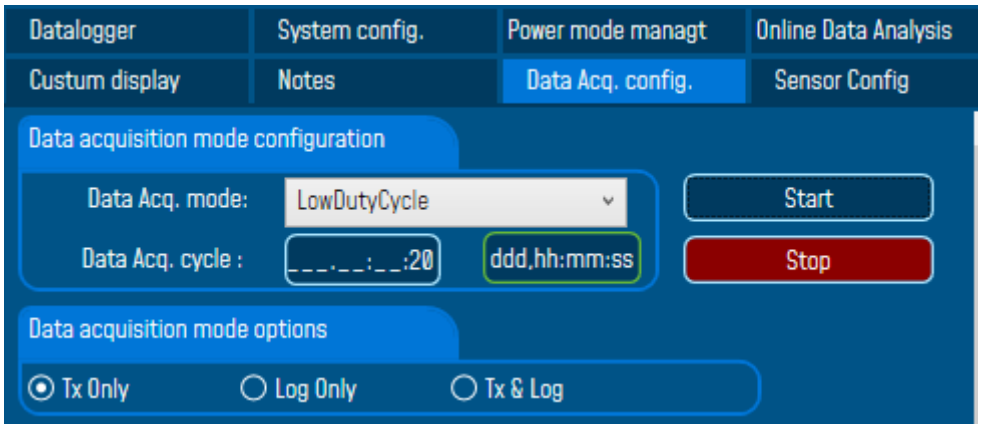


Figure 19 : Low Duty cycle Data acquisition configuration Tab

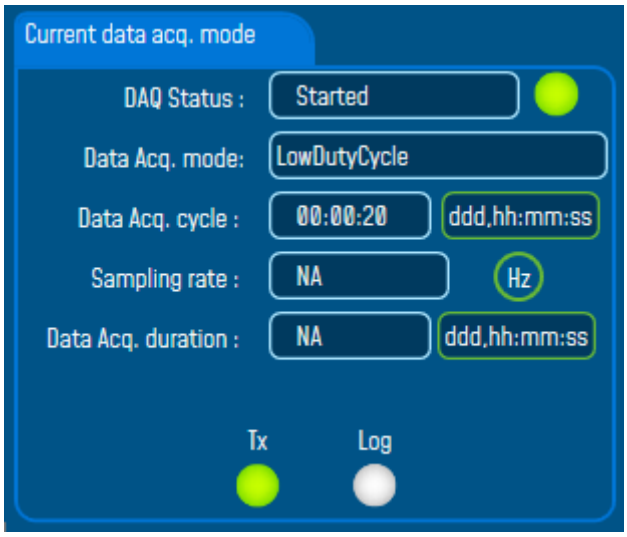


Figure 20 : Low Duty Cycle status window

Parameters	Descriptions
Data acquisition Cycle	• Select the Data acquisition cycle between 1s and 24hours. • The format is: Day: Hour: Minute: Second
Data acquisition mode options	*TX only*: The BeanDevice® transmits the Data acquisition **without** Data logging *Log only*: The BeanDevice® logs the Data acquisition **without** wireless transmission *TX & Log*: The BeanDevice® transmits **and** logs the Data acquisition; For further information about the Data logger function, read the technical note TN_RF_007 – *TN_RF_007 – "BeanDevice® Datalogger User Guide "*

Data acquisition duration and Sampling rate parameters are not available for low duty cycle data acquisition.

9.1.4 Parameters related to “Alarm” Data acquisition mode

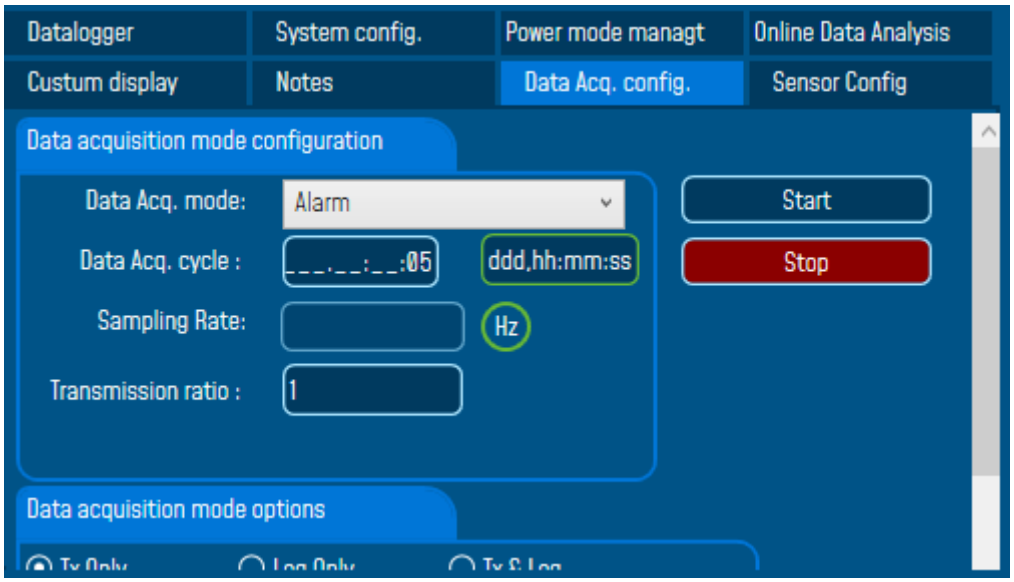


Figure 21 : Alarm Data acquisition configuration tab

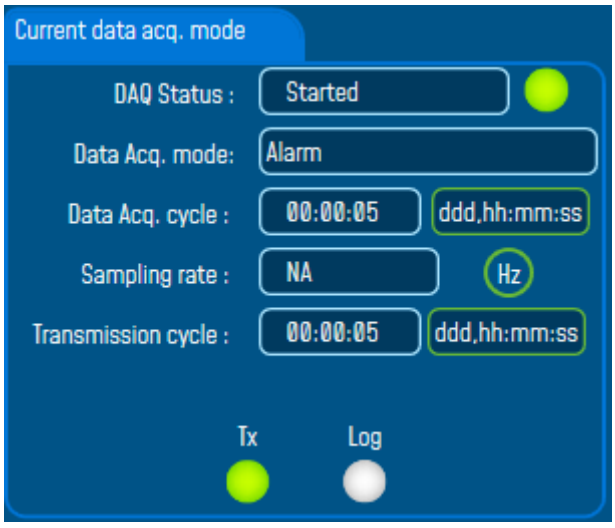


Figure 22 :Alarm status window

Parameters	Description
Data acquisition Cycle	Select the Data acquisition cycle between 1s and 24hours. The format is: Day: Hour: Minute: Second
Transmission Ratio	Select the transmission ratio Transmission cycle is calculated as follow: Transmission Cycle = "Transmission Ratio" * "Data Acquisition Cycle"
Data acquisition mode options	***TX only***: The BeanDevice® transmits the Data acquisition **without** Data logging ***Log only***: The BeanDevice® logs the Data acquisition **without** wireless transmission ***TX & Log***: The BeanDevice® transmits **and** logs the Data acquisition; For further information about the Data logger function, read the technical note TN_RF_007 – ***TN_RF_007 – "BeanDevice® DataLogger User Guide"***

Sampling rate parameter is not available for the Alarm Data acquisition mode.

9.1.5 Parameters related to “Streaming mode“

Watch our streaming acquisition mode video on our YouTube channel

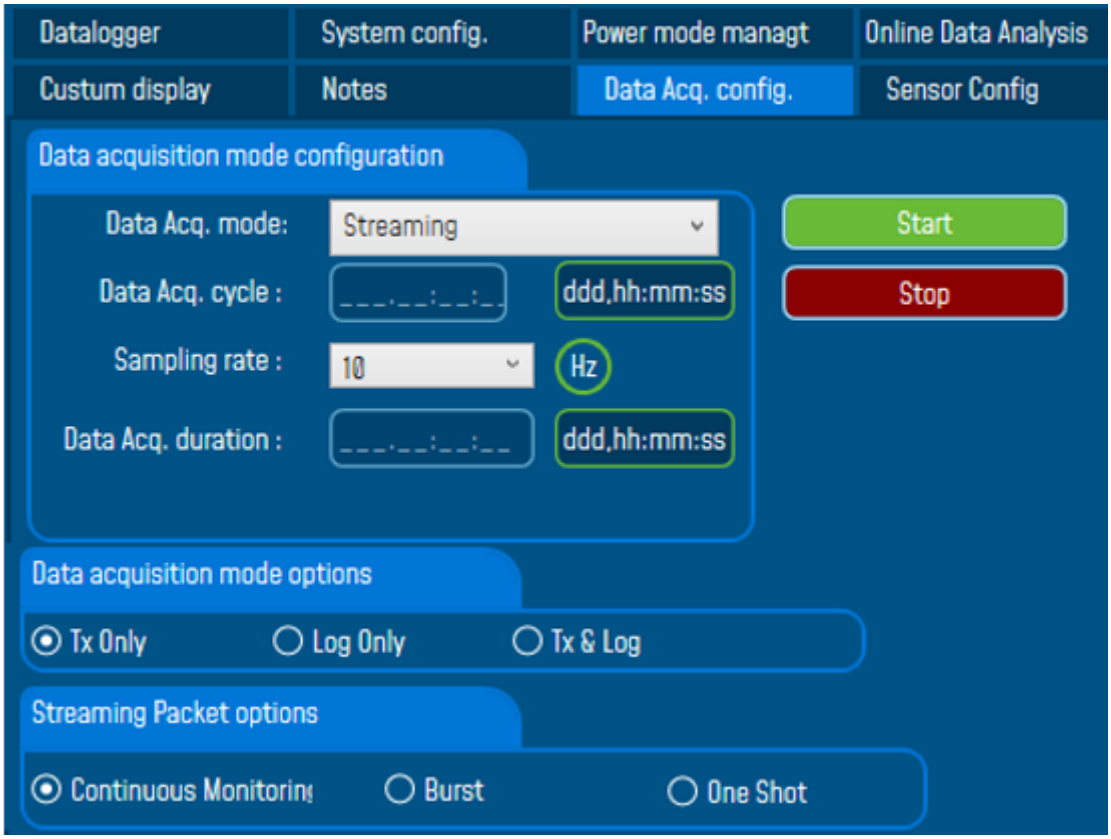


Figure 23: Streaming Data acquisition configuration tab

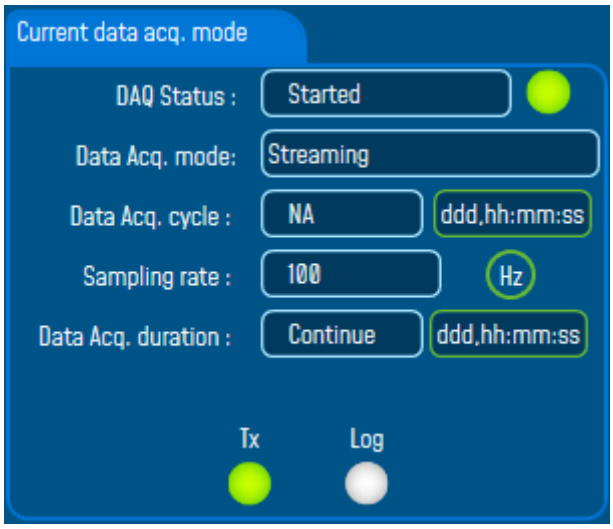


Figure 24 :Streaming status window

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® between 1 sample per second and 3000 samples/s maximum (depending on the BeanDevice® product used). The resolution is 1 sample per second. Choose carefully the sampling rate value: ✓ The PER (Packet Error Rate) may increase if a high sampling rate value is settled on your BeanDevice®. For further information, read the technical note ***RF_TN_003- "Aggregation capacity of wireless sensor networks"*** ✓ 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® transmits the Data acquisition **without** Data logging ***Log only***: The BeanDevice® logs the Data acquisition **without** wireless transmission ***TX & Log***: The BeanDevice® transmits **and** logs the Data acquisition; For further information about the Data logger function, read the technical note TN_RF_007 – ***TN_RF_007 – "BeanDevice® DataLogger User Guide "***
Streaming Options	***« Continuous monitoring » option***: Data acquisition is transmitted to the ***BeanGateway ®*** in a continuous flow rate. ***« Burst » option***: Data acquisition is transmitted to the ***BeanGateway ®*** in a burst flow rate ***« One Shot » option***: Data acquisition is transmitted to the ***BeanGateway ®*** during a period time, and then the acquisition will be Stopped.

When starting the Streaming mode, BeanScape® stops to display the full Battery health status information on the Power Supply Diagnostic frame until stopping the Streaming.

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

S.E.T. mode is now available for the BeanDevice® Smart Sensors AX-3D, AX-3D Xrange, Inc, Hi-Inc and Hi-Inc Xrange also for the BeanDevice® Process Sensors AN-XX (AN-V/AN-mV/AN-420).

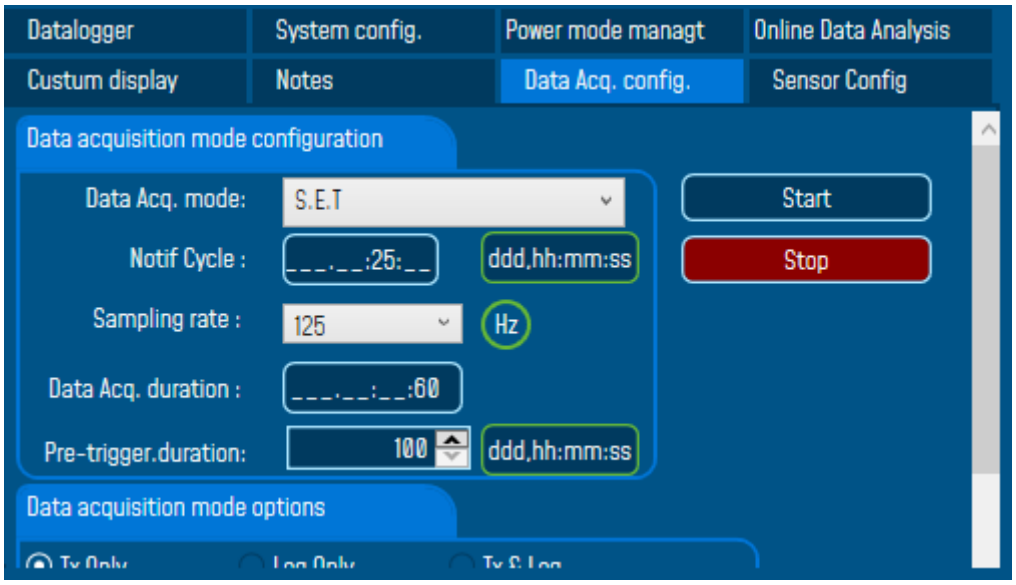


Figure 25 :SET mode configuration tab

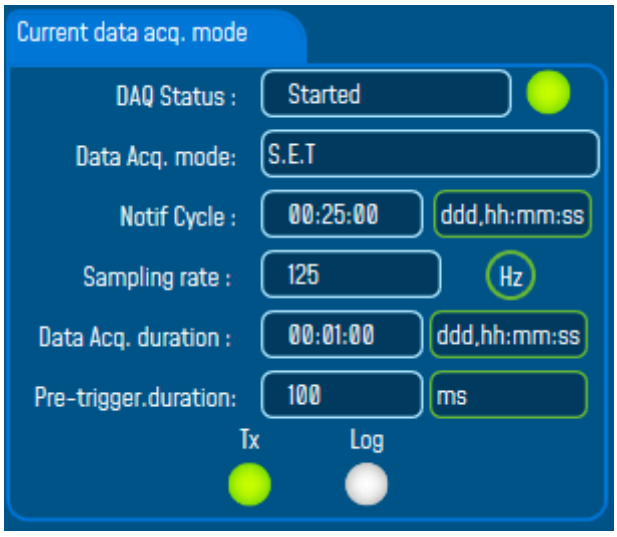


Figure 26: Set mode status window

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® between 1 sample per second and 1000 samples/s maximum. The resolution is 1 sample per second. Choose carefully the sampling rate value: ✓ The PER (Packet Error Rate) may increase if a high sampling rate value is settled on your BeanDevice®. For further information, read the technical note ***RF_TN_003- "Aggregation capacity of wireless sensor networks"*** ✓ 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 "Notif cycle" and also less than 1 minute (60 seconds)
Data acquisition mode options	***TX only***: The BeanDevice® transmits the Data acquisition **without** Data logging ***Log only***: NA for S.E.T mode ***TX & Log:*** NA for S.E.T mode
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

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

When S.E.T mode is enabled, Data Logger is not available, that implies that the data acquisition mode options will be disabled except Tx only.

9.2 ALARM THRESHOLD CONFIGURATION FROM THE BEANSCAPE®

9.2.1 Overview

You can configure each channel of your BeanDevice® separately by selecting the channel and then going to the **Alarm config** tab in the configuration panel.

Two systems of thresholds are available, AAA (Alert Action Alarm) for S.E.T mode and (Alert/Alarm) for survey mode. For more info please review the examples below

Figure 27: Alarm & S.E.T mode Alarm window

9.2.2 How to set an alarm threshold (survey mode)

9.2.2.1 Relation between alarm threshold

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

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

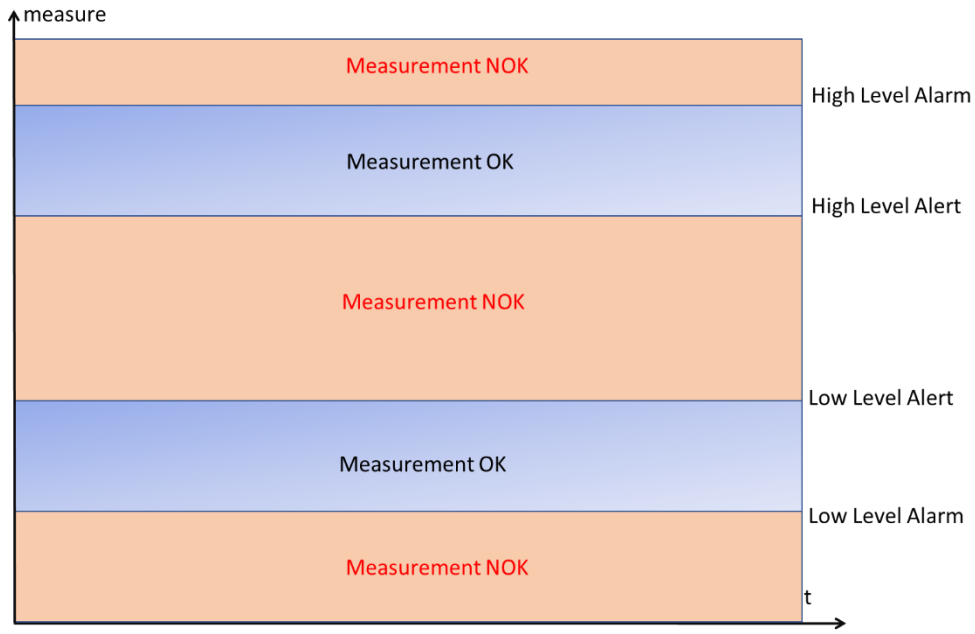
- **2 high level thresholds: High Level Alarm>= High Level Alert**
- **2 low level thresholds: Low level alert>= Low Level Alarm**

Alarms threshold are organized as follows:

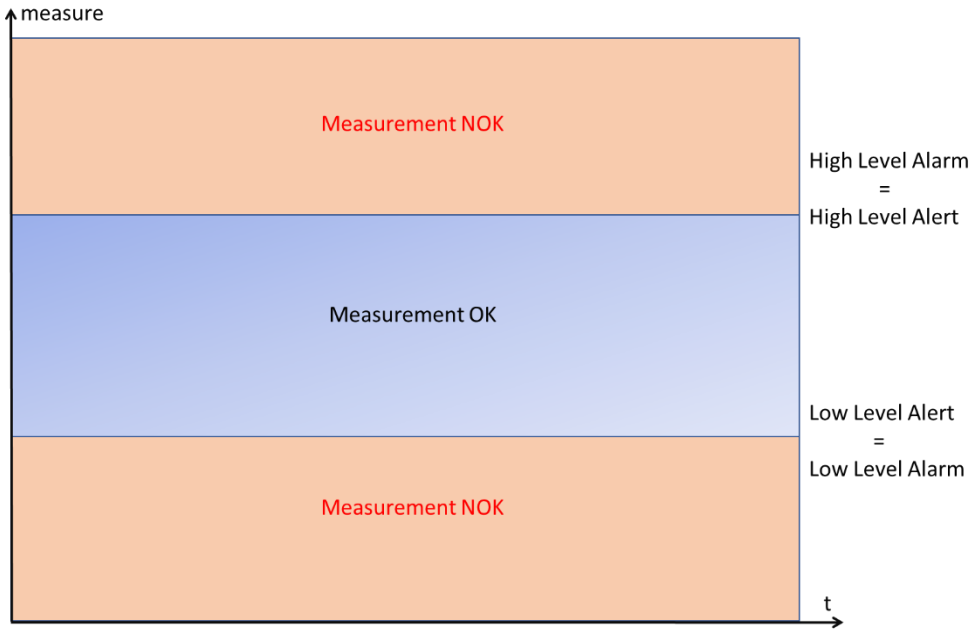
High Level Alarm>= High Level Alert> Low Level Alert>= Low Level Alarm

Several configurations are possible:

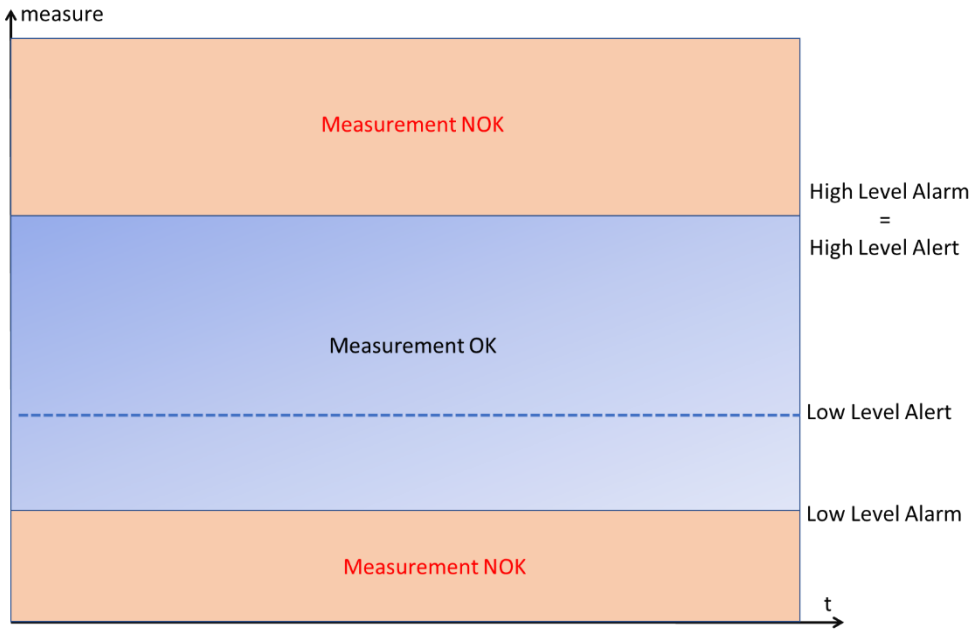
High Level Alarm> High Level Alert and Low-Level Alert > Low Level Alarm



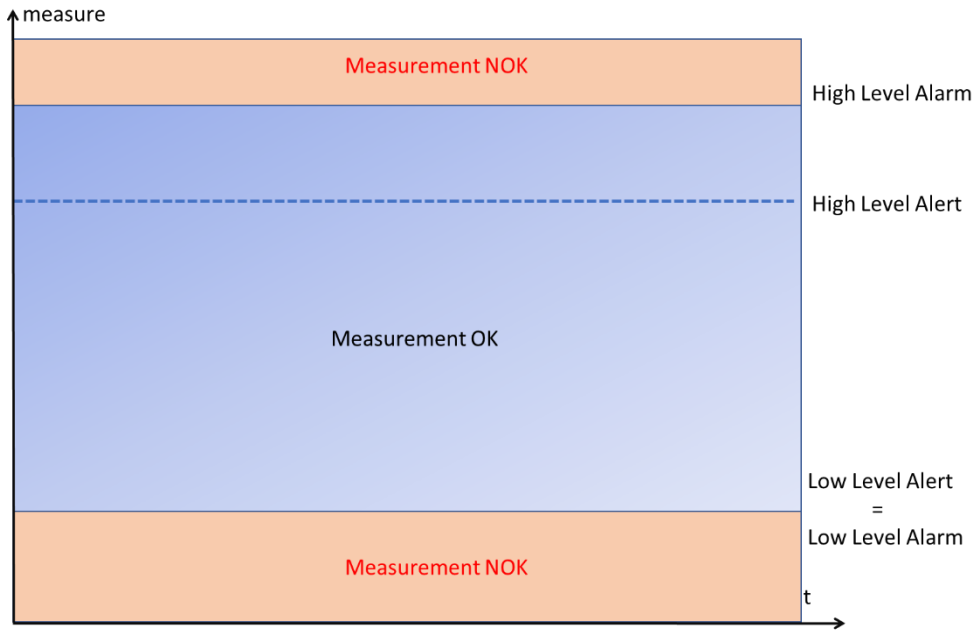
High Level Alarm = High Level Alert & Low Level Alert = Low Level Alarm



High Level Alarm = High Level Alert and Low-Level Alert > Low Level Alarm



High Level Alarm> High Level Alert and Low Level Alert= Low Level Alarm



If the alarms thresholds are not well configured, **you can end up with spurious and untimely alarms. Do not forget to properly configure the alarms thresholds before starting the alarm mode.**

9.2.3 How to set an alarm threshold for the Alarm mode

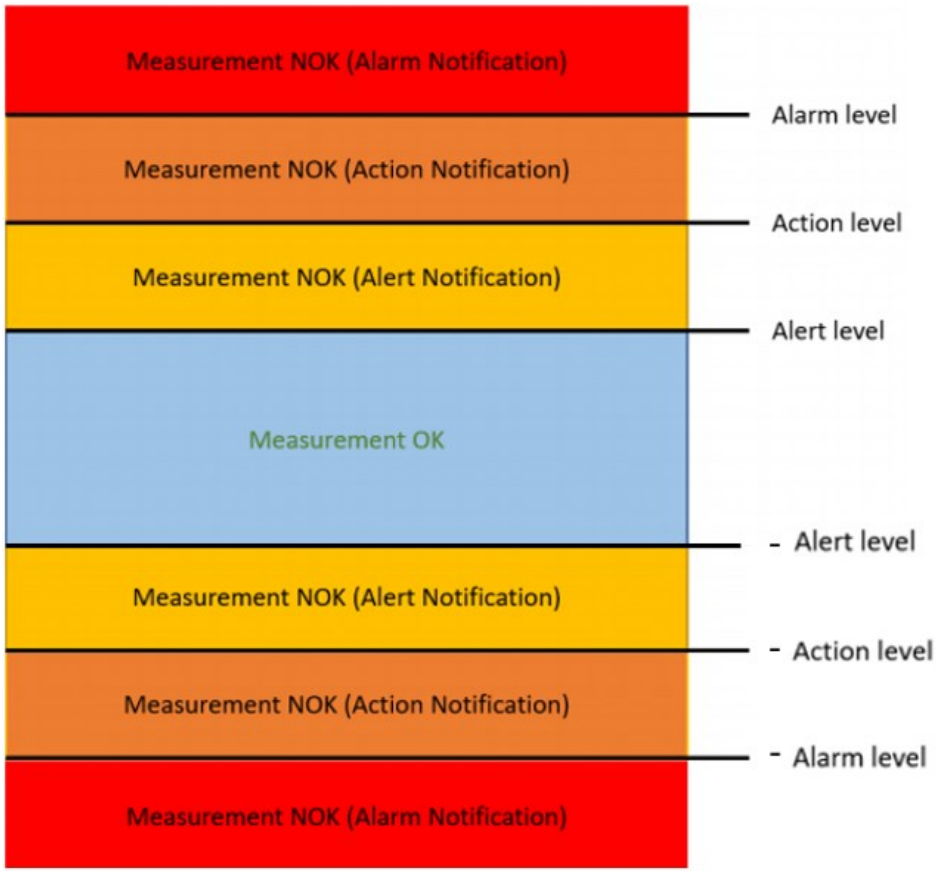
From the BeanDevice® 2.4GHz firmware version V7R5 the Alarm threshold architecture was improved and changed from 4 levels of Alarm to 3 Alarm levels for both Alarm mode and also SET mode.

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.



9.2.3.1 Configuration from the BeanScape® software

Figure 28: Alarm mode Alarm setting

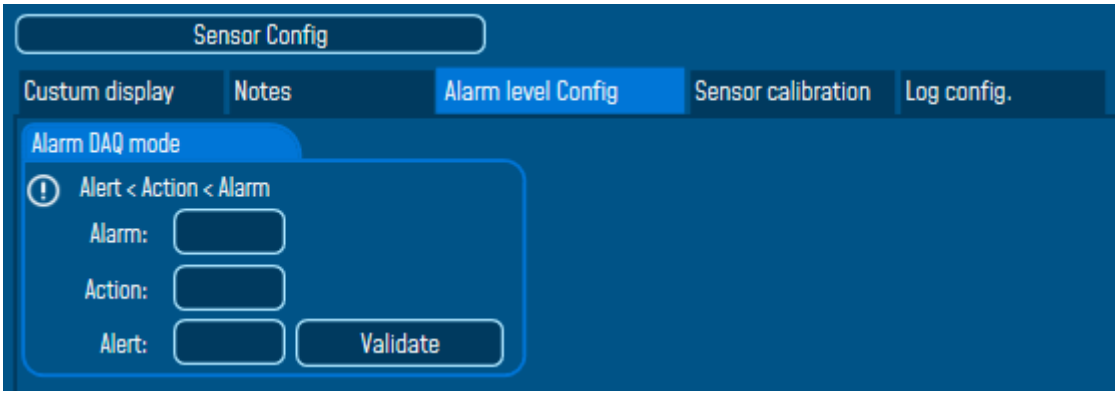


Figure 29: Alarm mode Alarm threshold configuration

9.2.4 Alarm Thresholds description

9.2.4.1 Alarm Thresholds on AX-3D/Hi-Inc/AX-3DS/AN-XX Bipolar

The triple AAA are operating as an absolute value, user enter just the absolute value and an alarm notification will occur if a value reaches the positive or the negative value.

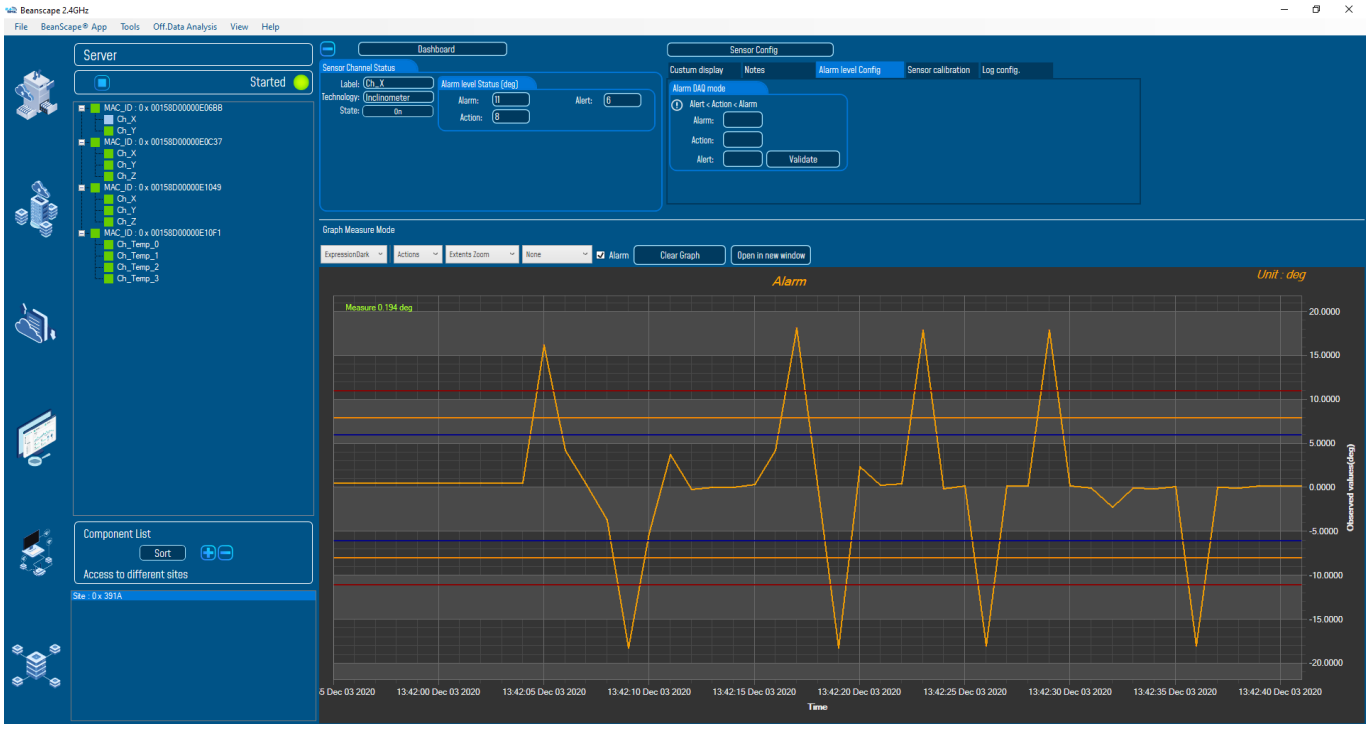


Figure 30: Alarm measurement

9.2.4.2 Alarm Thresholds on AN-XX Unipolar/ Eco sensors

The triple AAA are working only with the positive values which are higher than the thresholds.

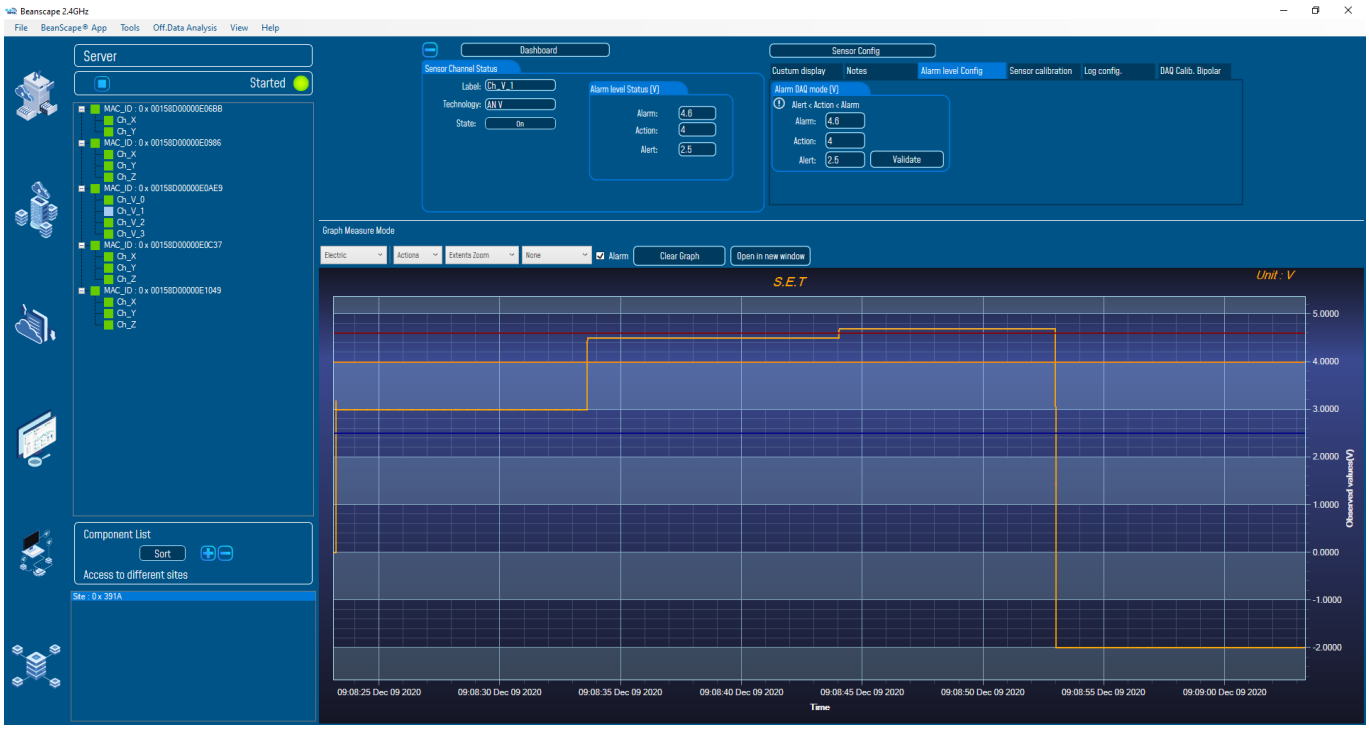


Figure 31: Alarm measurements with unipolar configuration

9.2.4.3 Sensor alarms window

The BeanScape® 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:

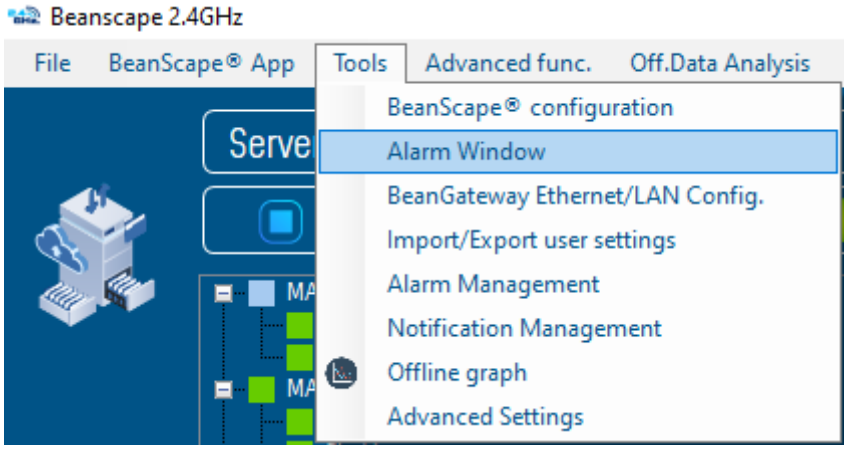


Figure 32: Sensors alarm window on BeanScape Tools menu

- You will see the following screen:

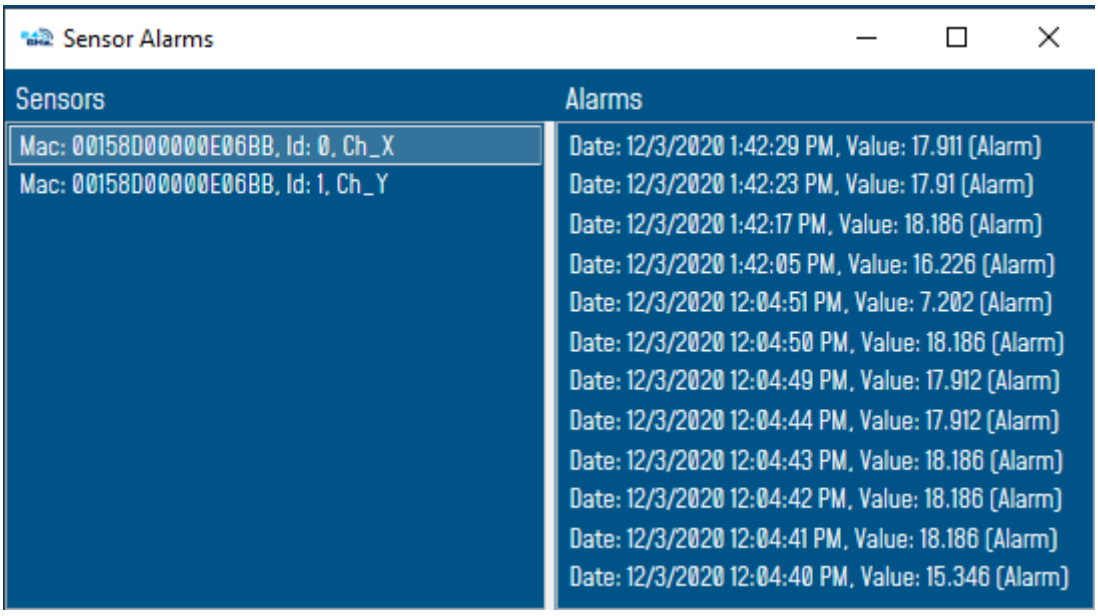


Figure 33: Sensors alarms window

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

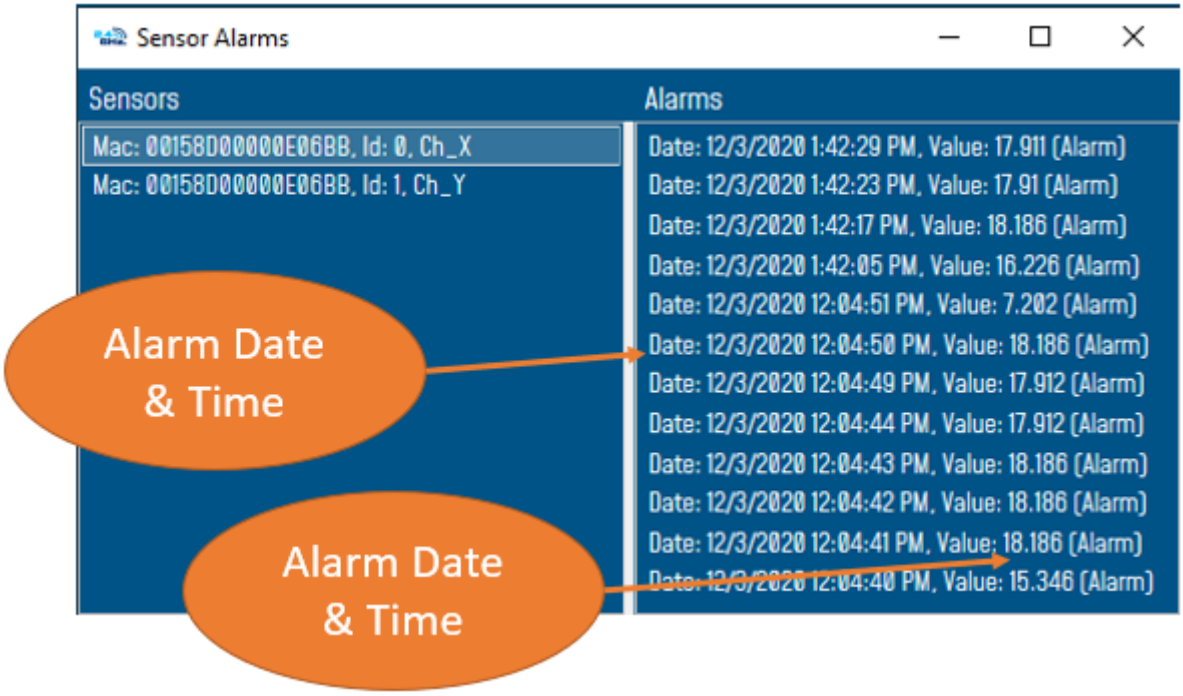


Figure 34: Exceeded thresholds displayed on Sensors alarms window

9.2.4.4 Example

In this example we will use the BeanDevice® Hi Inc Xrange in Survey mode and we will set the alarm threshold as the following:

Alarm = 11 deg
Action = 8 deg
Alert = 6 deg

Figure 35: Alarm thresholds (Survey mode)

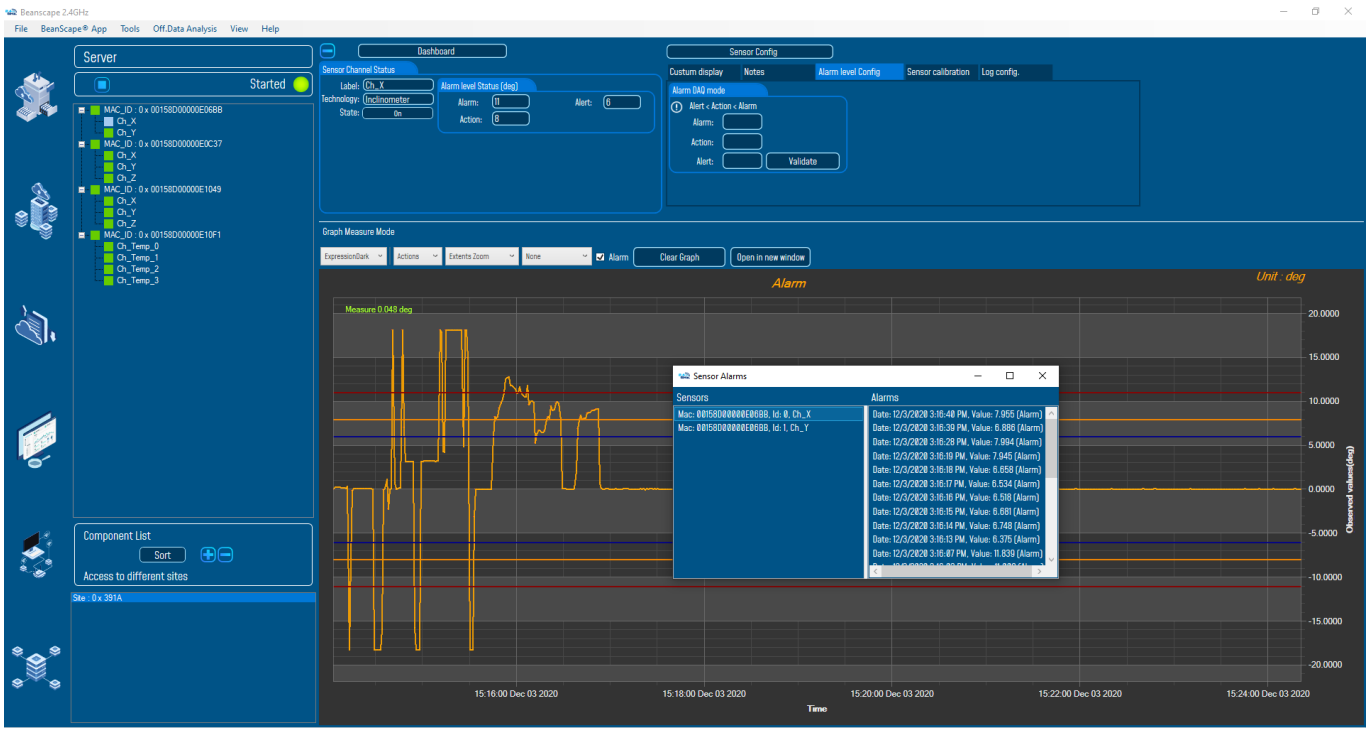


Figure 36: Overview: Alarm window (Survey mode)

9.2.5 How to set an alarm threshold (S.E.T mode)

For users working with the BeanDevice® AX-3D/AX-3D Xrange (Wireless vibration sensor):

Before to configure the threshold values, user can select a Velocity threshold (mm/s) or Acceleration Threshold (g or mm/s^2).

To configure the threshold type, you need to go to **Online Data Analysis** Tab from the BeanDevice® main profile and change S.E.T threshold from the scroll list.

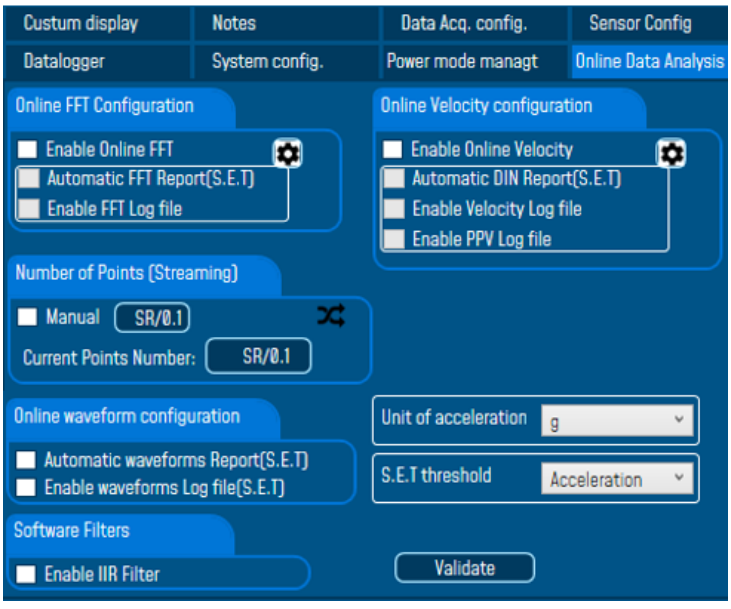


Figure 37: Acceleration/Velocity S.E.T mode thresholds configuration

In S.E.T mode (Streaming with event triggering) 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 Alarms S.E.T Config tab after selecting the related measurement channel.

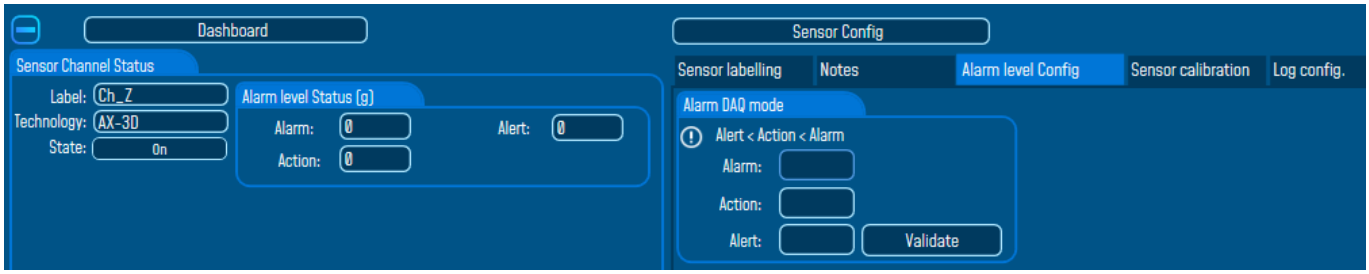


Figure 38: Overview: Alarm thresholds (S.E.T mode)

Figure 39: S.E.T mode setting

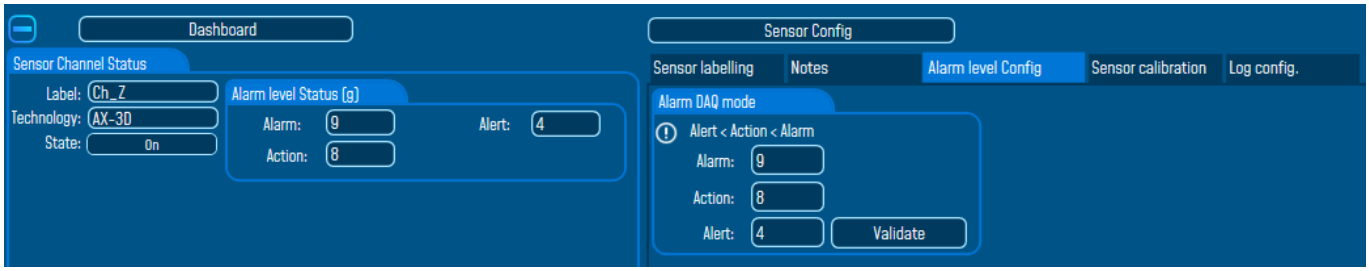


Figure 40: S.E.T mode Alarm threshold configuration

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;

For users working with the BeanDevice® Hi-Inc/Hi-Inc Xrange (Wireless inclinometer sensor):

Same as the BeanDevice® AX-3D, the S.E.T mode is available on the BeanDevice Hi-Inc and Hi-Inc Xrange.

To set a S.E.T mode configuration click on the sensor channel, then click on **Alarm level Config** tab.

Enter your thresholds values in the corresponding frame, then start the BeanDevice with a S.E.T mode.

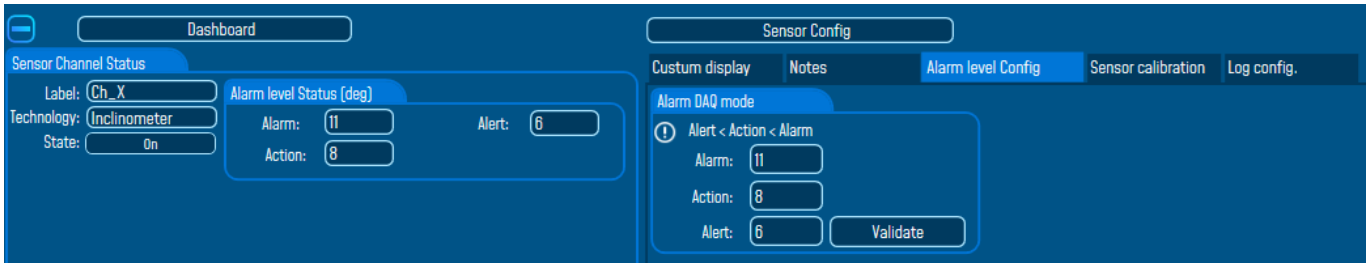


Figure 41: Overview Alarm thresholds (S.E.T mode)

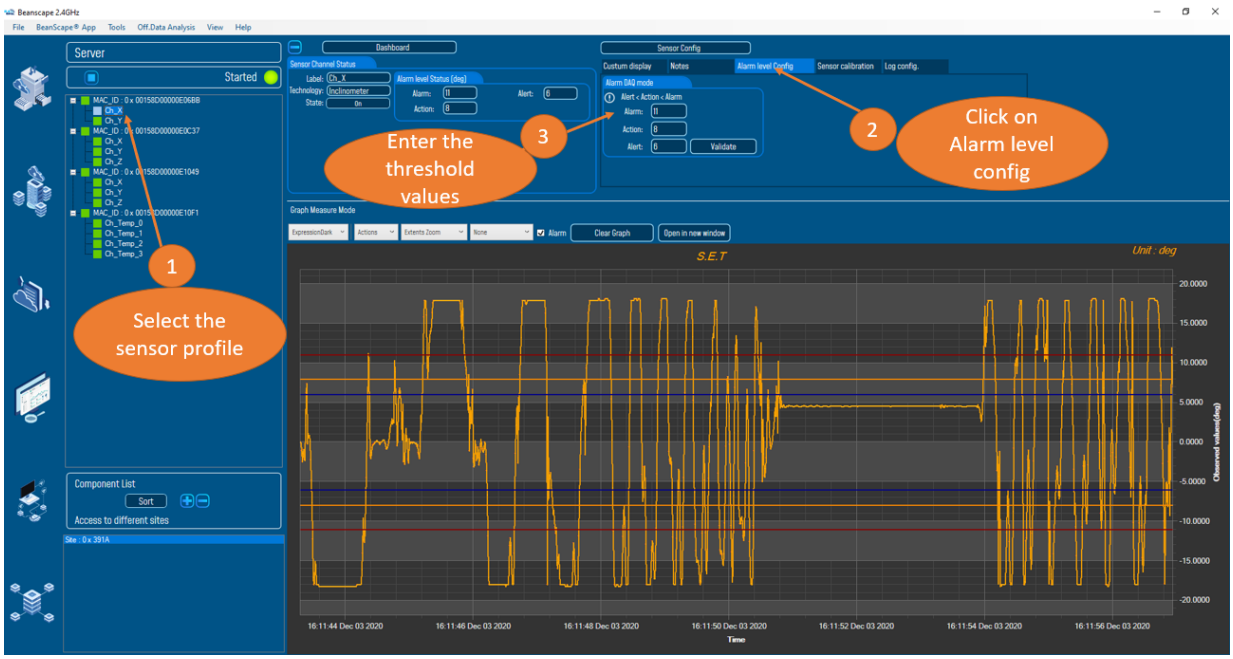


Figure 41: S.E.T mode setting

For users working with the BeanDevice® AN-XX (Wireless Process sensors):

Users can use S.E.T mode on the BeanDevices process sensors AN-V, AN-mV and AN420.

To configure the BeanDevice AN-XX just follow the same steps as the configuration on the BeanDevice Hi-Inc.

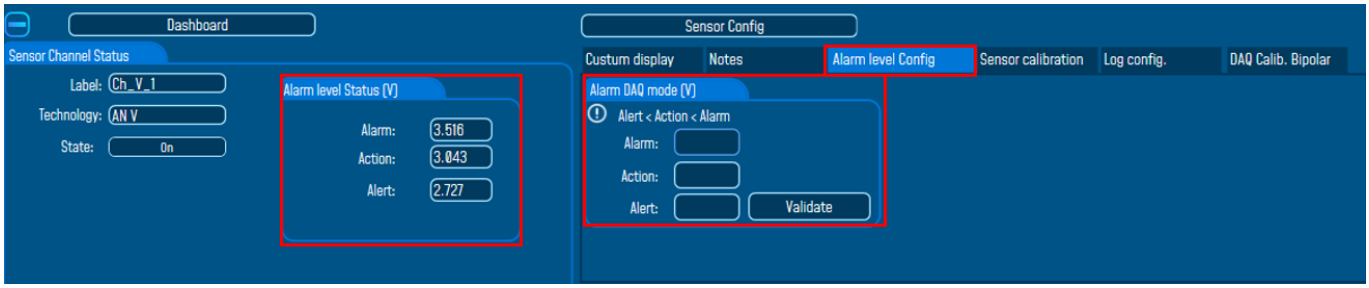


Figure 42: Overview Alarm thresholds (S.E.T mode)

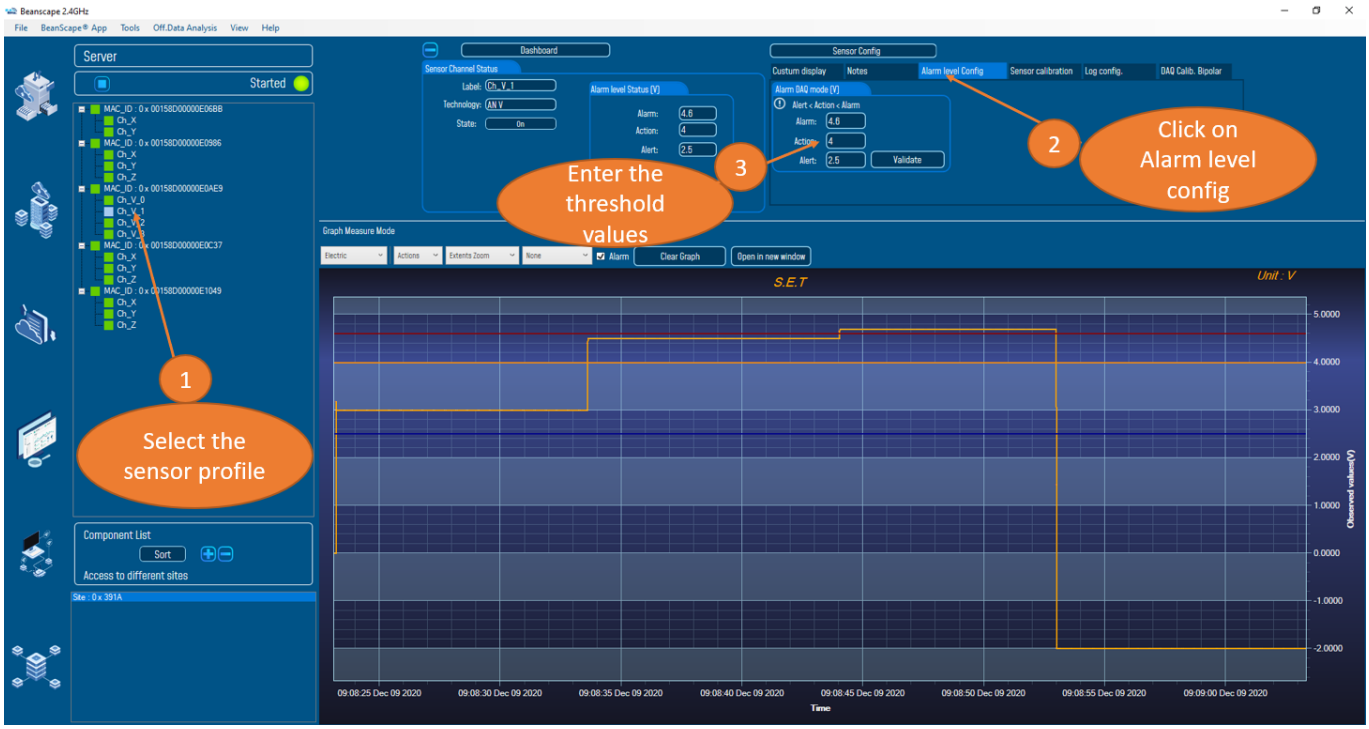


Figure 43: Overview S.E.T mode settings

10. ONLINE AND OFFLINE DATA ANALYSIS TOOL

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

10.1 OFFLINE DATA ANALYSIS TOOL

10.1.1 FFT (Fast Fourier Transform) waveform analysis module

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

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

10.1.1.1 FFT generation

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

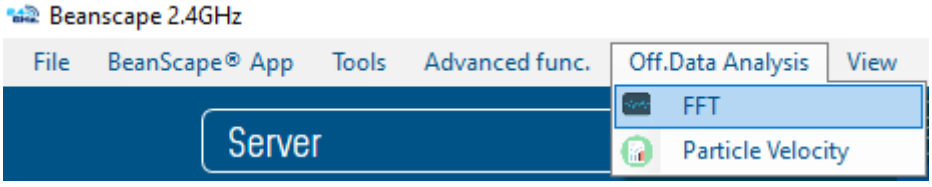


Figure 44: FFT offline data analysis on BeanScape® top menu

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

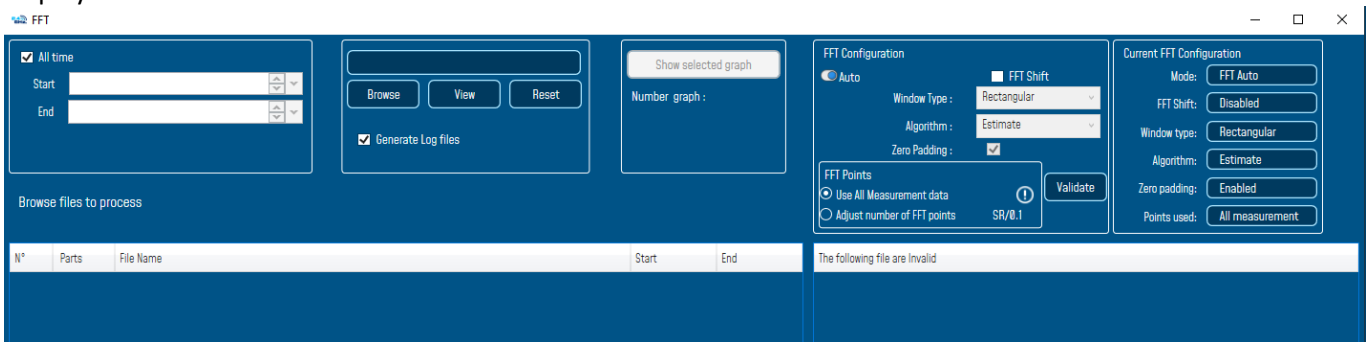


Figure 44: FFT tool window

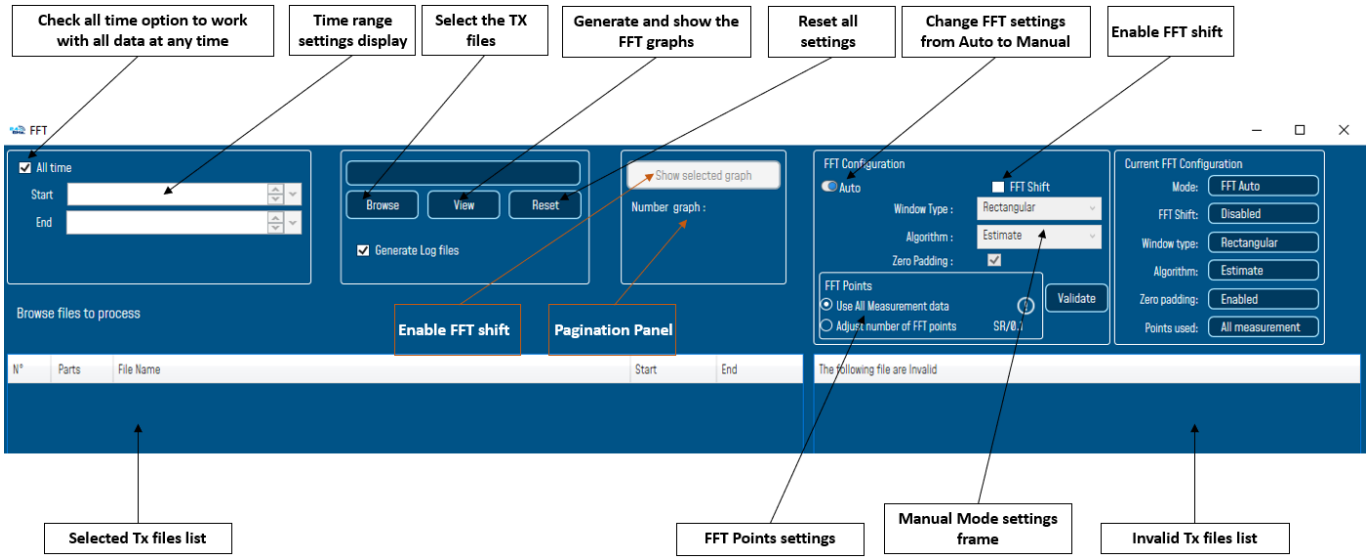


Figure 45:FFT tool options

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

The FFT tool will generate as a result:

- Power spectral density and a new window displays

1: Click on Browse to choose files

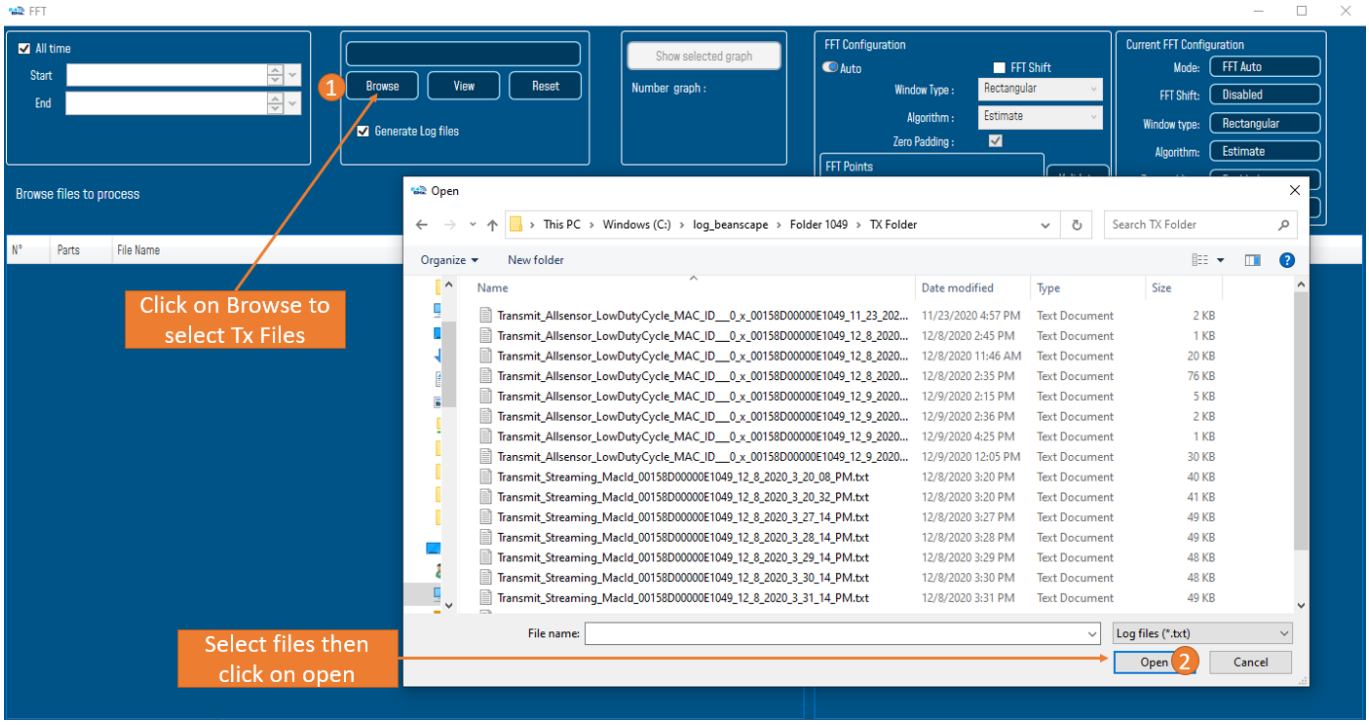


Figure 46: Browsing TX files on FFT tool

2: Overview of the selected files

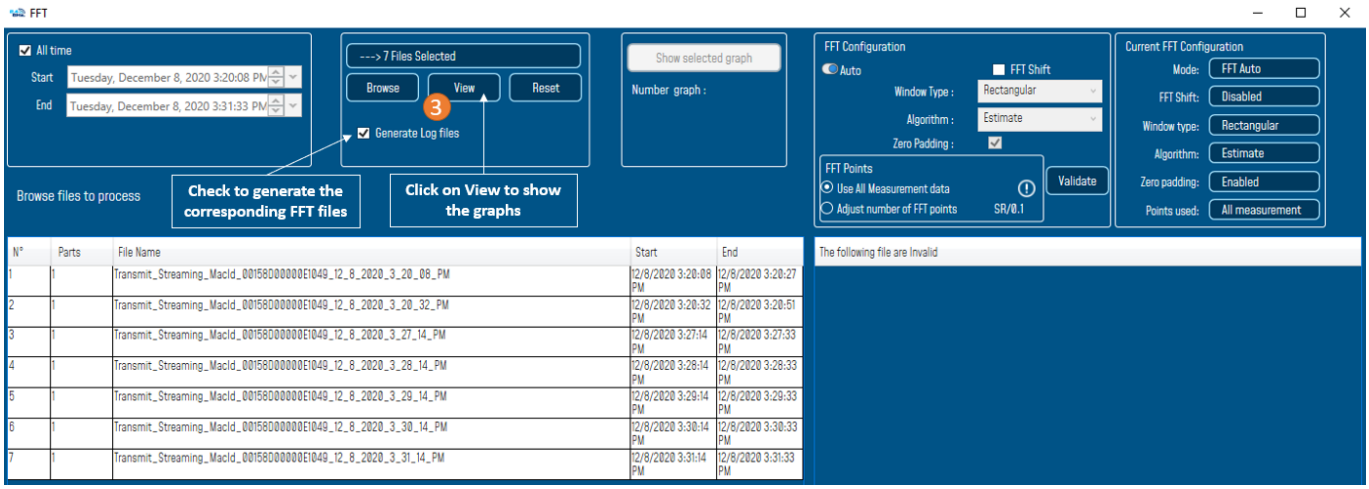


Figure 47: Overview: FFT window

3: Loading

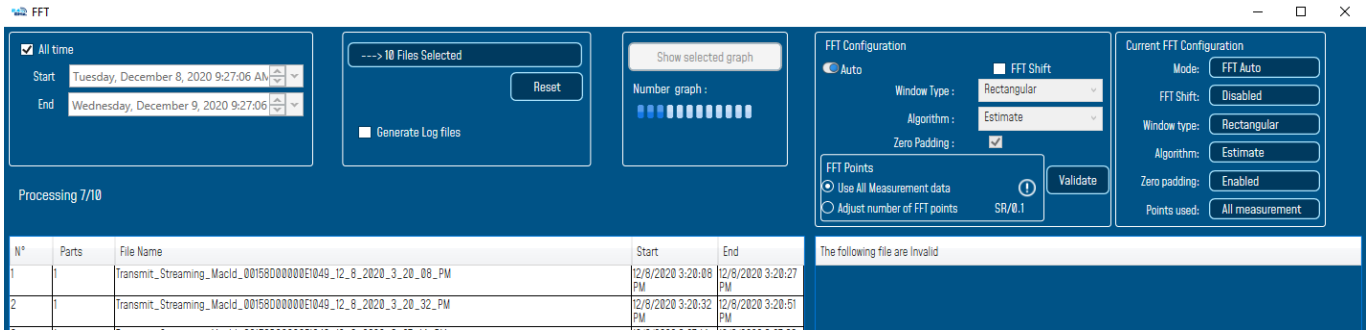


Figure 48: FFT generation

4: FFT report generated with the following results:

a. Frequency
b. Amplitude

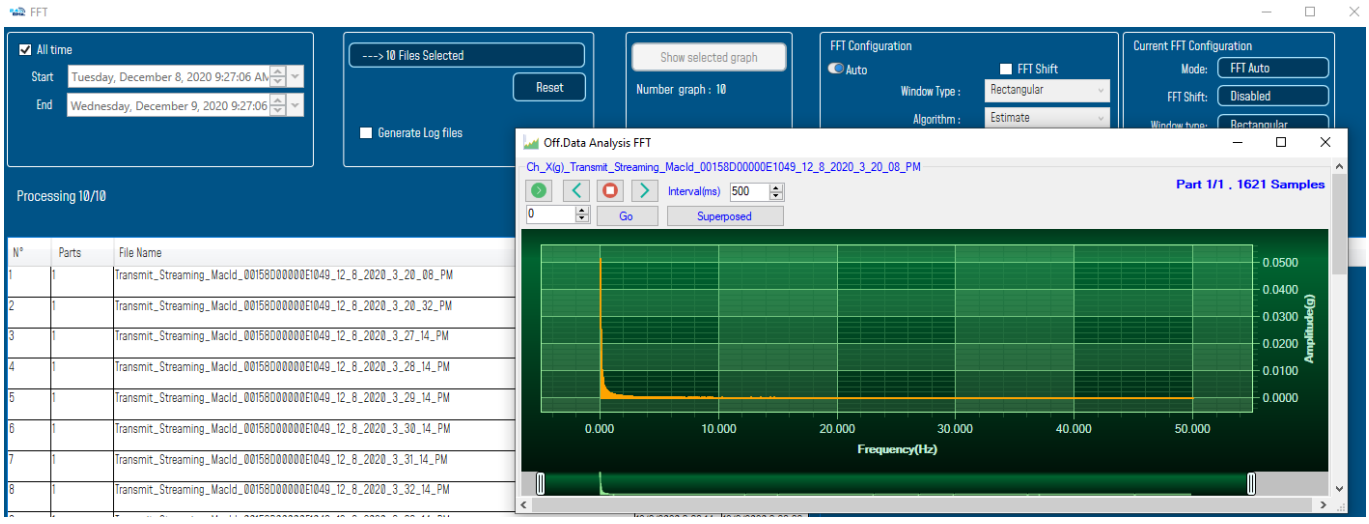


Figure 49: FFT generated View

5: FFT LOG files generated

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

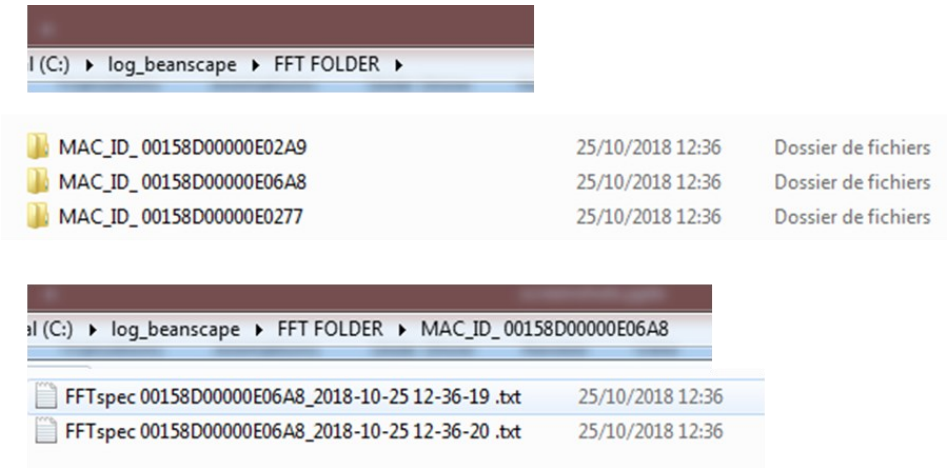


Figure 50: Generated FFT Log files

6: The graphs will be displayed automatically when VPPV Report is generated via a pop-up window, that can be formatted to select the number of graphs to display simultaneously in this window.
An easy navigation bar on the top of the window, allow to the user to navigate between the graphs and select the page size.

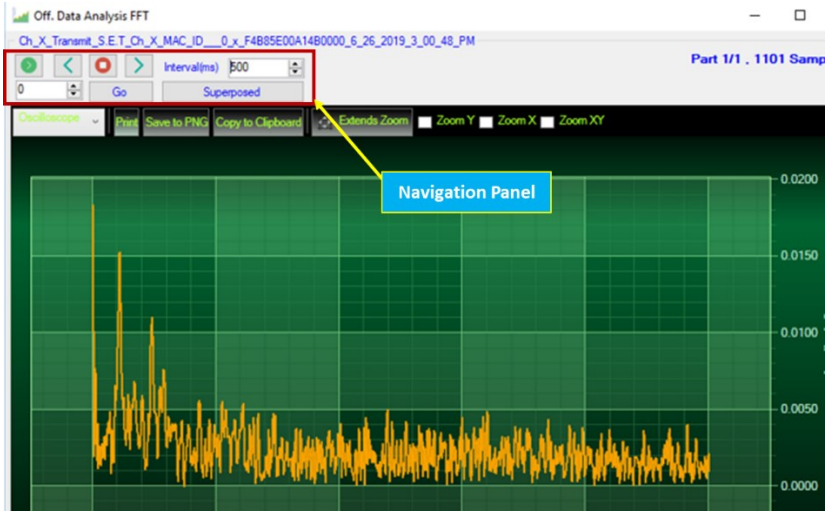


Figure 51: Graph display (Offline Data Analysis)

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

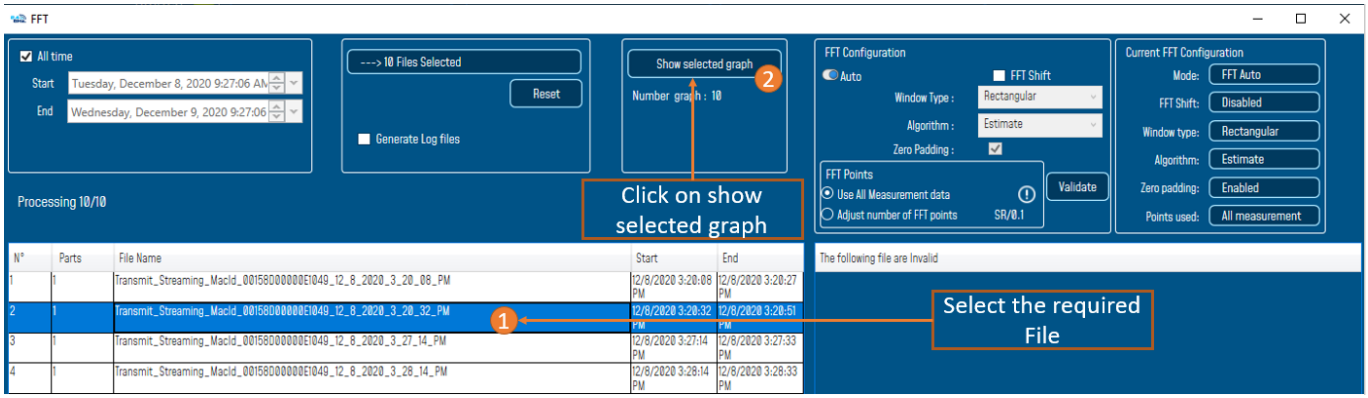


Figure 52: Selecting a graph to display

8: The selected graph is displayed

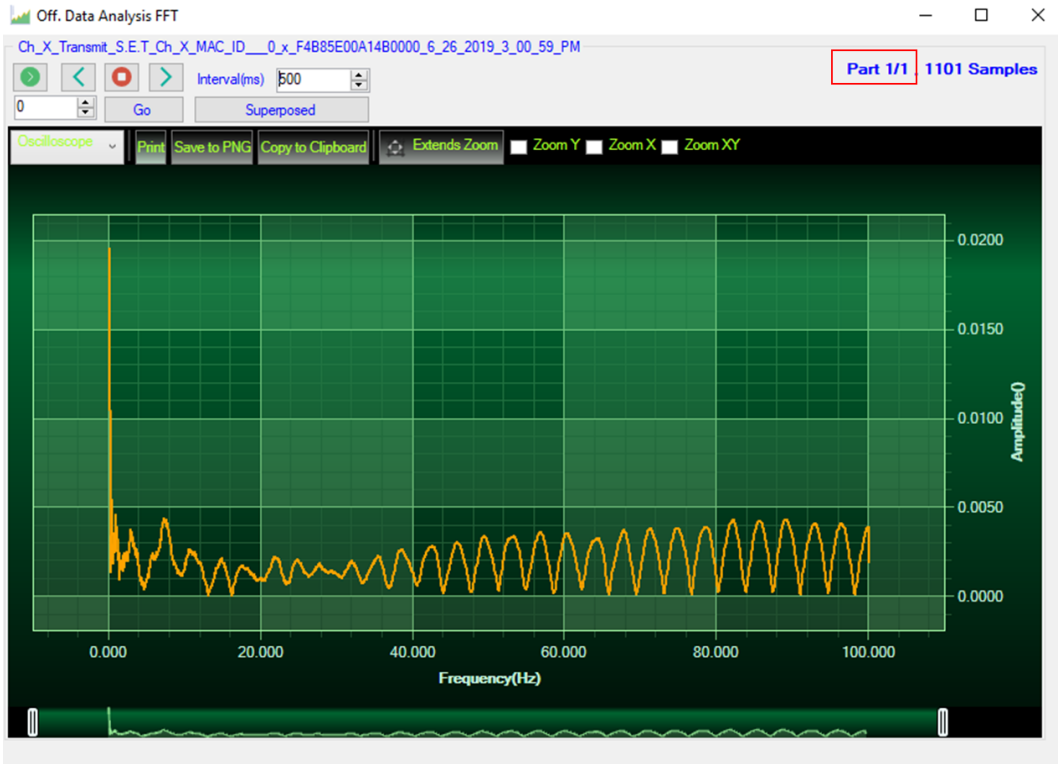


Figure 53: Selected graph display

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

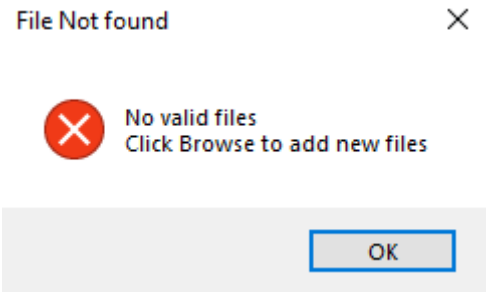


Figure 54: FFT offline data analysis time errors

10.1.1.2 FFT shift

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

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

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

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

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

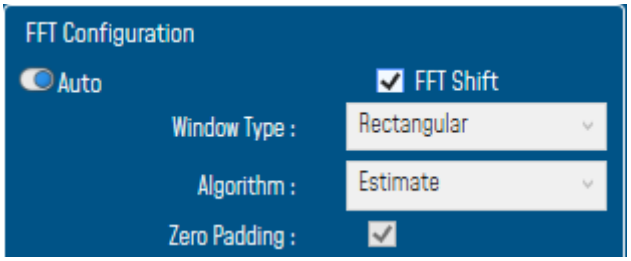


Figure 55: FFT Shift activation

2: Grid of FFT Spectrum with FFT Shift option enabled

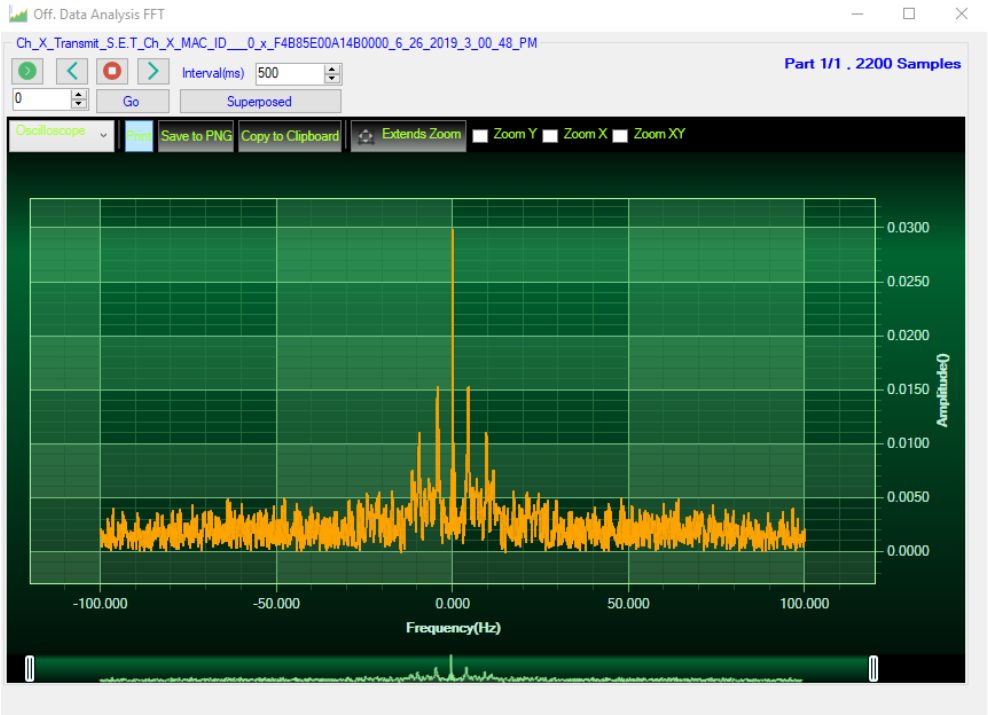


Figure 56: Gird of FFT Shift spectra

FFT and FFT shift video

10.1.2 **Particle Velocity**

According to the DIN4150-3, the BeanScape software DIN option acts as follow:

1-Display the 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 DIN

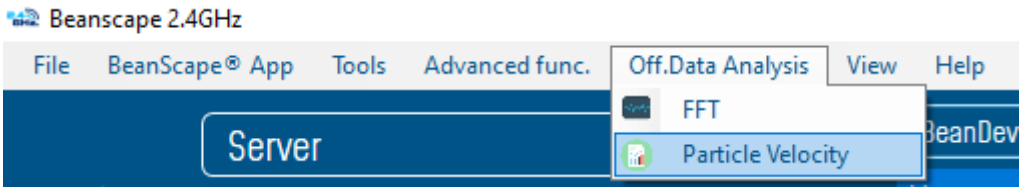


Figure 57: DIN on BeanScape® top menu

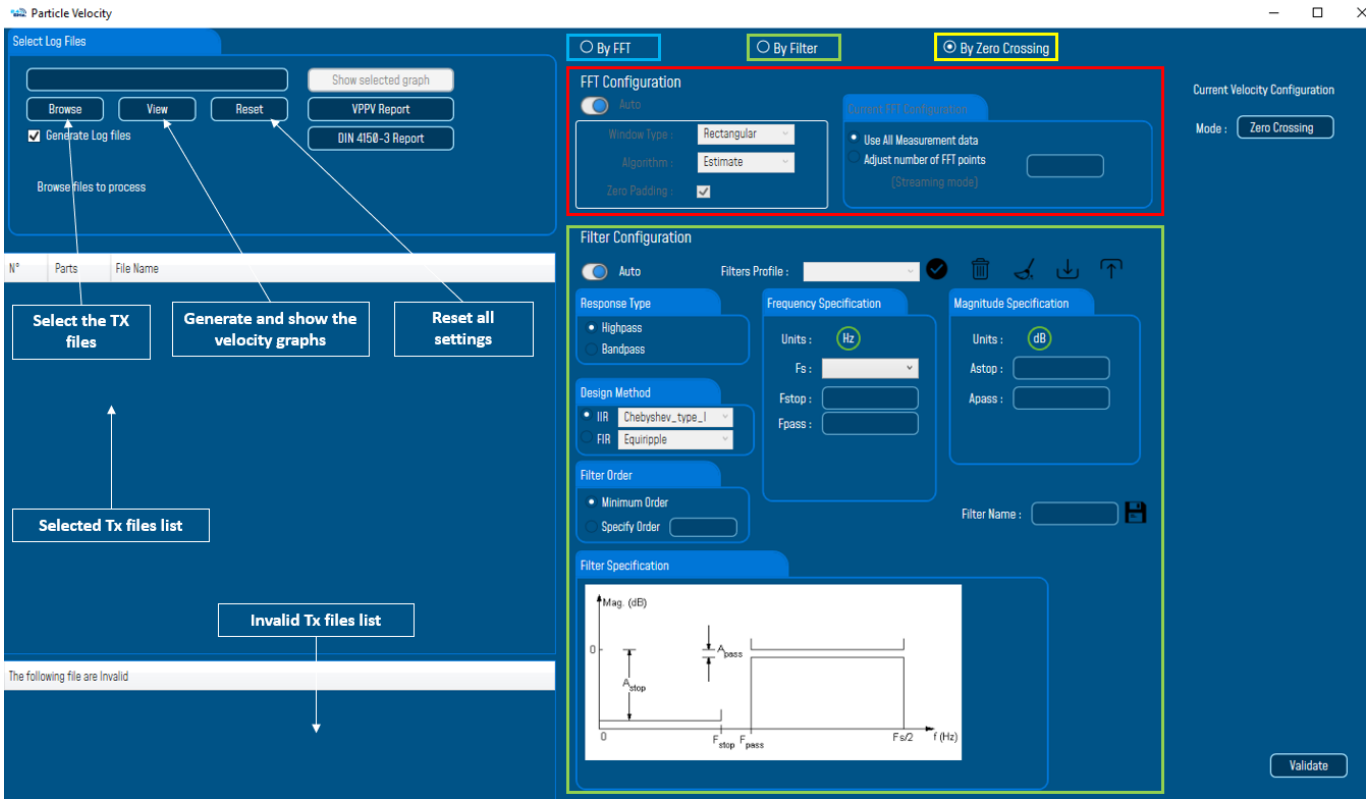
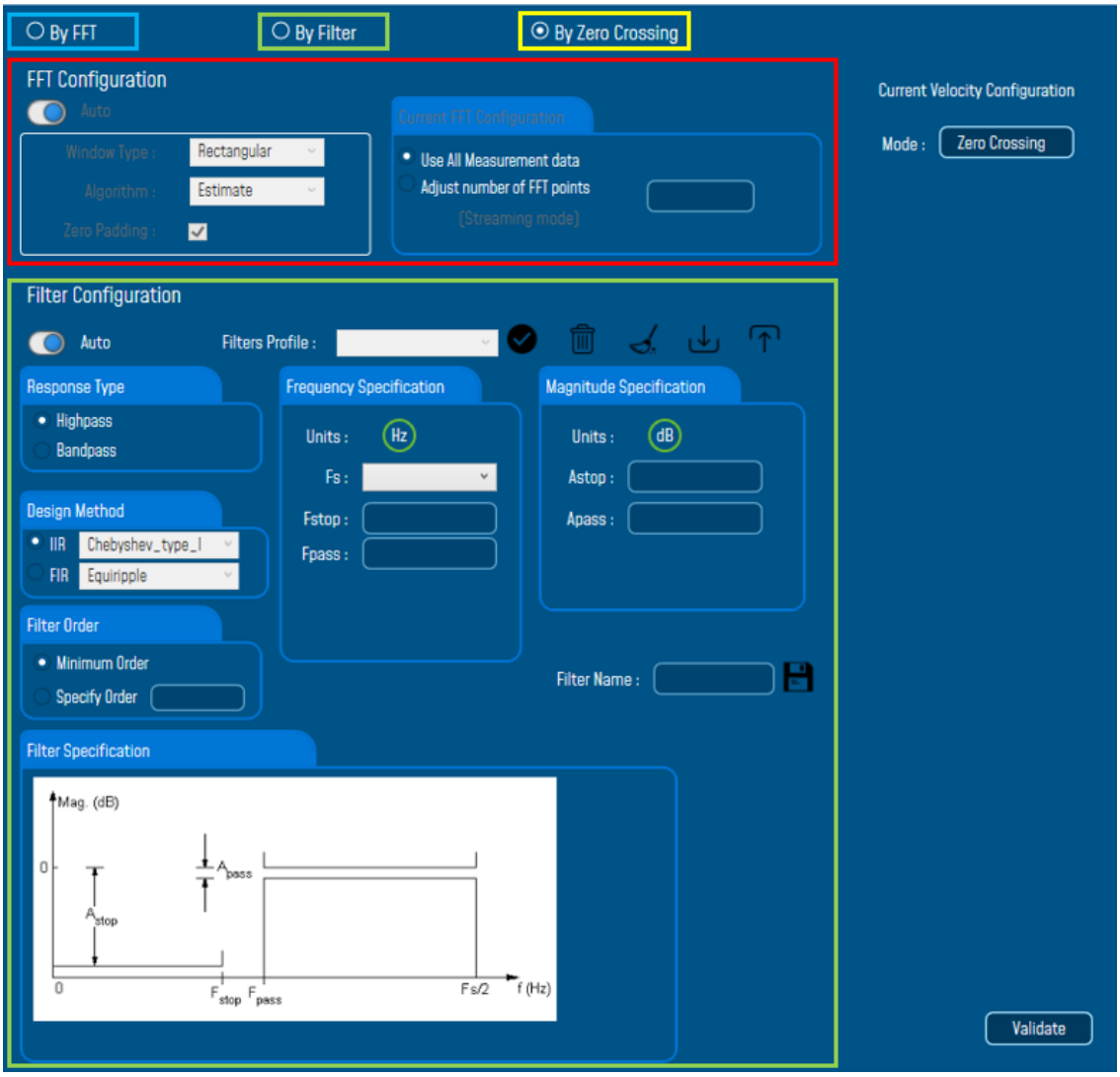


Figure 58: DIN window

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

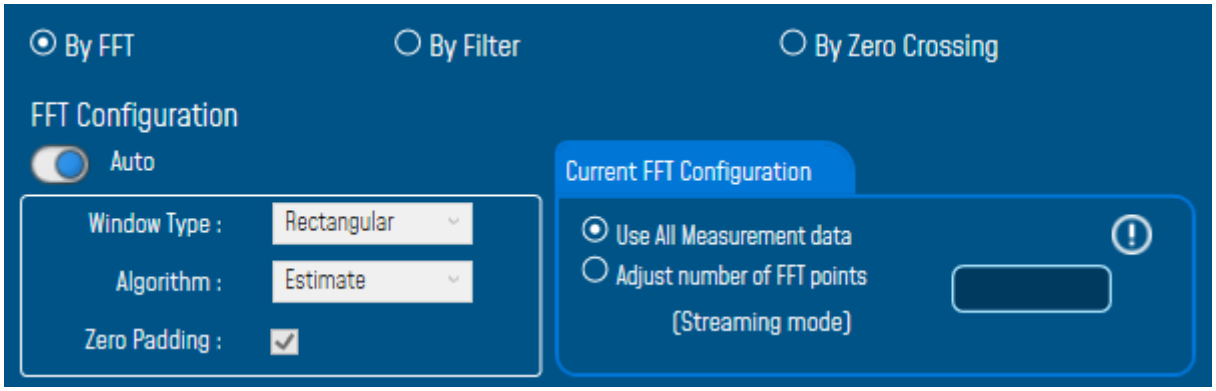
- Velocity display window
- DIN report generated
- Velocity files created

3: Velocity Advanced Configuration.

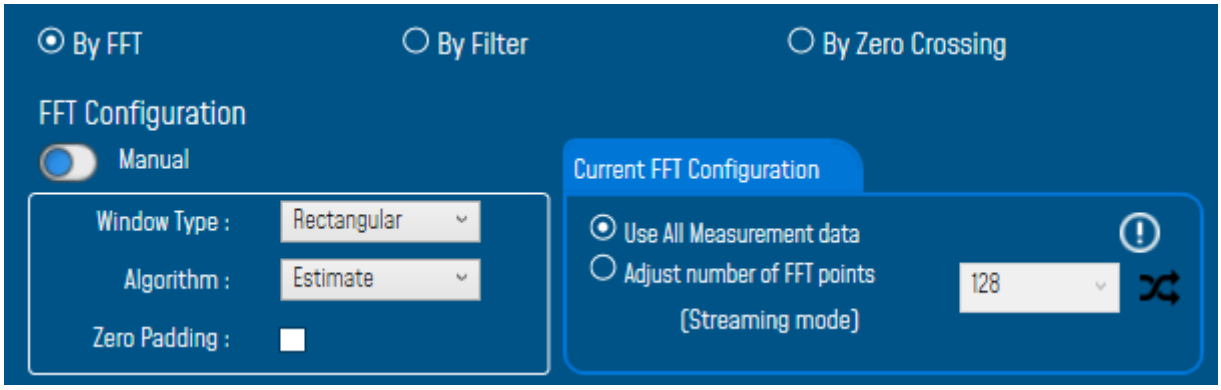


By default, the Velocity is configured “By Zero Crossing”, to edit the Velocity settings user must select “By FFT” or “By Filter”.

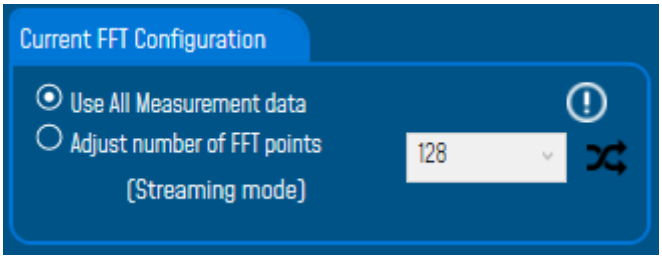
- **By FFT:** By selecting this option, the user will setup the Velocity basing on customized FFT settings.
    - Auto: If Auto is selected, The Velocity calculation will activate FFT Auto mode Settings



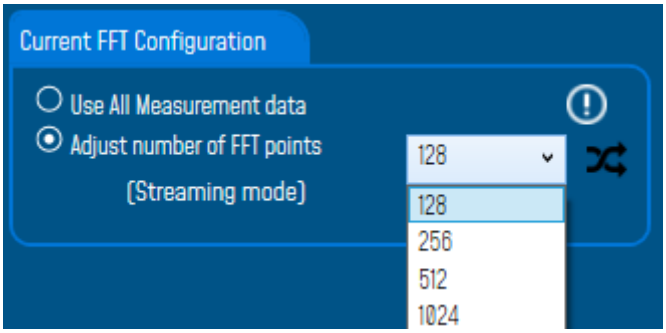
- Manual: Once switched to Manual, the user must configure the FFT settings manually (Window Type, Algorithm & Zero Padding).



- FFT Points:



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



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

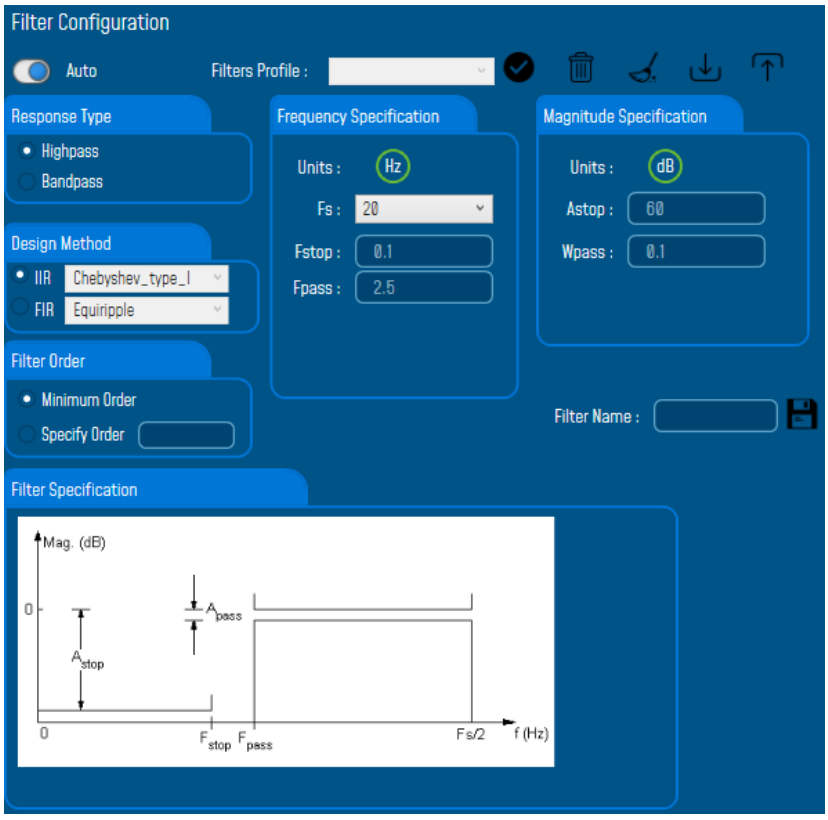
The frequency resolution of each spectral line is equal to the Sampling Rate divided by the Number of Points. For instance, for example, if the Number of Points is 4096 and the Sampling Rate is 2000, the resolution of each spectral line will be:

2000/4096 = 0.48828125

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

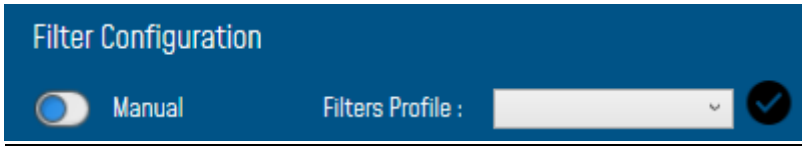
It is important to notice that larger Number of Points provide higher spectral resolution but take longer to compute.

- **By Filter:** By selecting this option, the user will setup the Velocity basing on the Software Filter.
    - Auto: If Auto is selected, Velocity Automatic filter will be configured



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

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



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

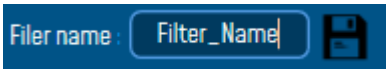
The Frequency Specification and The Magnitude Specification will be modified according the selected Design Method

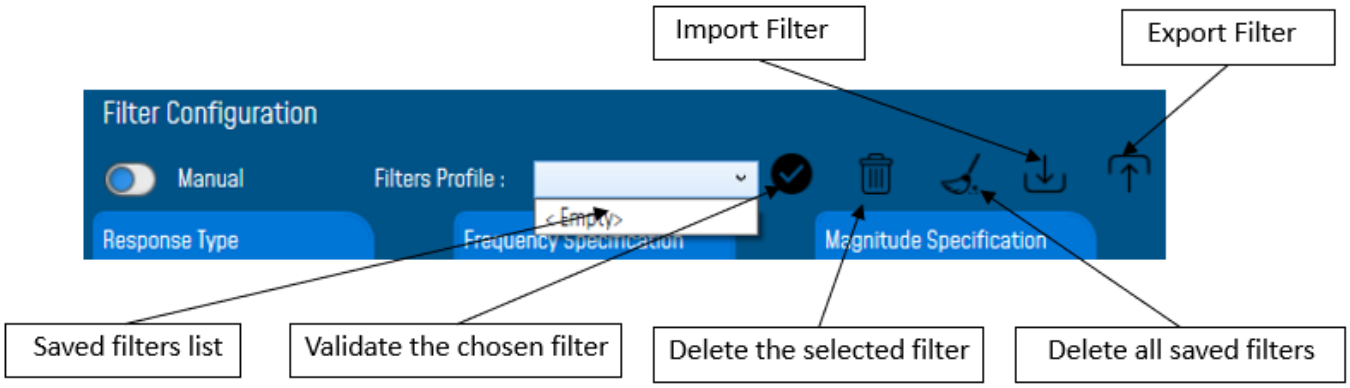
  - ❖ Filter Order: If the user is using IIR Design Method, Minimum Order will be selected automatically.
    If the FIR Design Method is selected, user must Specify Order.

  - ❖ Frequency Specification: Is a customizable frame according to the Design Method.

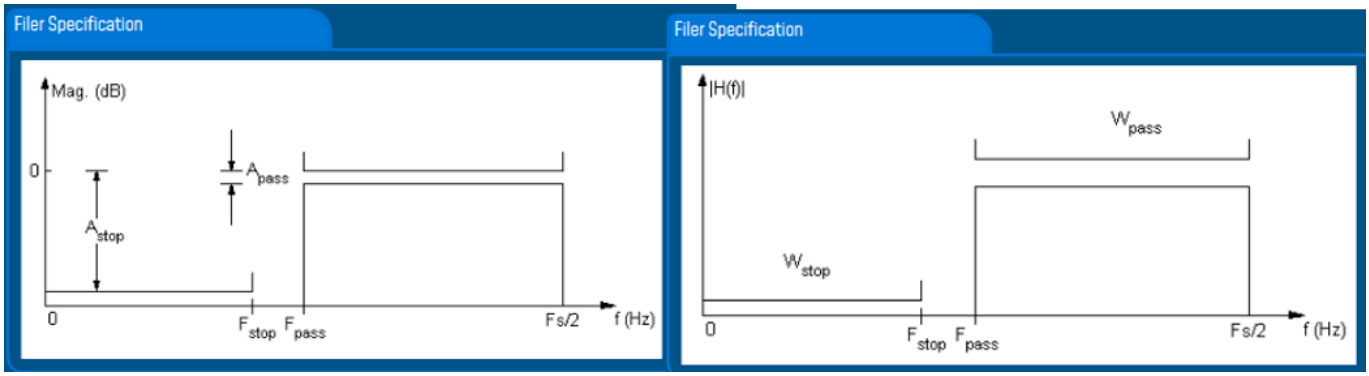
  - ❖ Magnitude Specification: Is a customizable frame according to the Design Method.

  - ❖ Filter Profile: User can save a specific Configuration and re-use it later.





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



4: Click on browse button to choose TX Files.

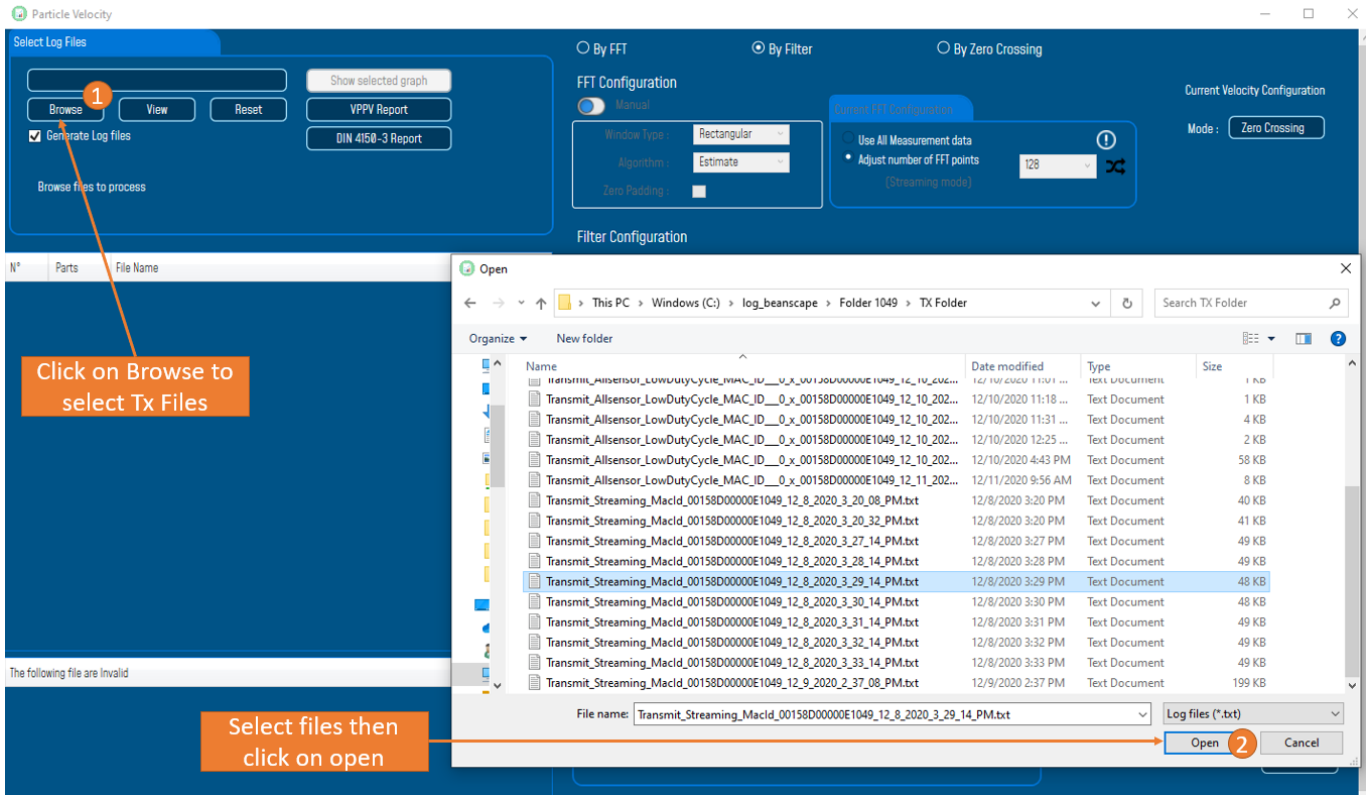


Figure 59: Browsing TX files into Particle Velocity tool

5: Loading.

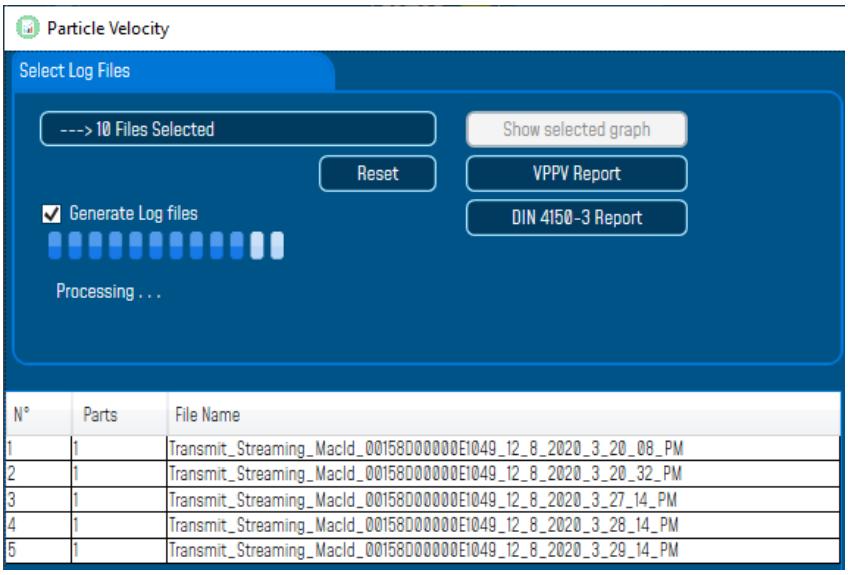


Figure 60: Particle Velocity result generation

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

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

Figure 61: Particle Velocity Display Window

6: The VPPV and DIN Report:

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

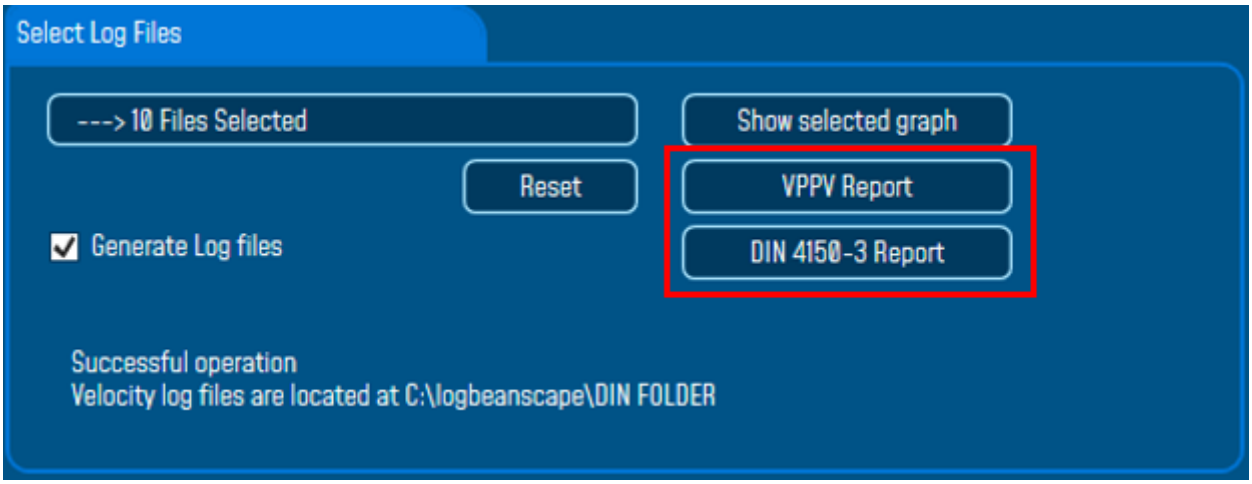
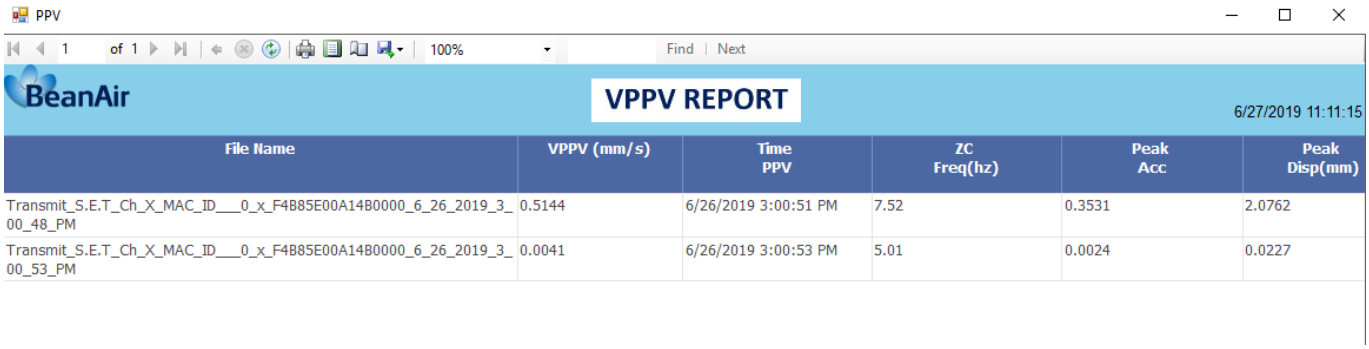


Figure 62: VPPV & DIN buttons



PPV

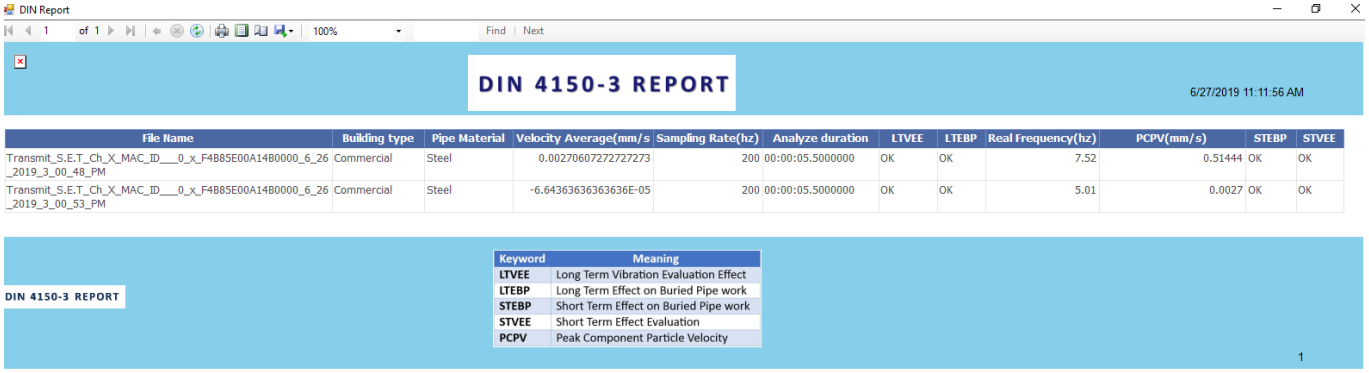
BeanAir

VPPV REPORT

6/27/2019 11:11:15

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

Figure 63: VPPV Report



DIN Report

DIN 4150-3 REPORT

6/27/2019 11:11:56 AM

File Name	Building type	Pipe Material	Velocity Average(mm/s	Sampling Rate(hz)	Analyze duration	LTVEE	LTEBP	Real Frequency(hz)	PCPV(mm/s)	STEBP	STVEE
Transmit_S.E.T_Ch_X_MAC_ID___0_x_F4B85E00A14B0000_6_26_2019_3_00_48_PM	Commercial	Steel	0.00270607272727273	200	00:00:05.5000000	OK	OK	7.52	0.51444	OK	OK
Transmit_S.E.T_Ch_X_MAC_ID___0_x_F4B85E00A14B0000_6_26_2019_3_00_53_PM	Commercial	Steel	-6.643636363636E-05	200	00:00:05.5000000	OK	OK	5.01	0.0027	OK	OK

DIN 4150-3 REPORT

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

1

Figure 64: DIN Report

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

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

DIN 4150-3 Interpretation video

10.2 ONLINE DATA ANALYSIS TOOL

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

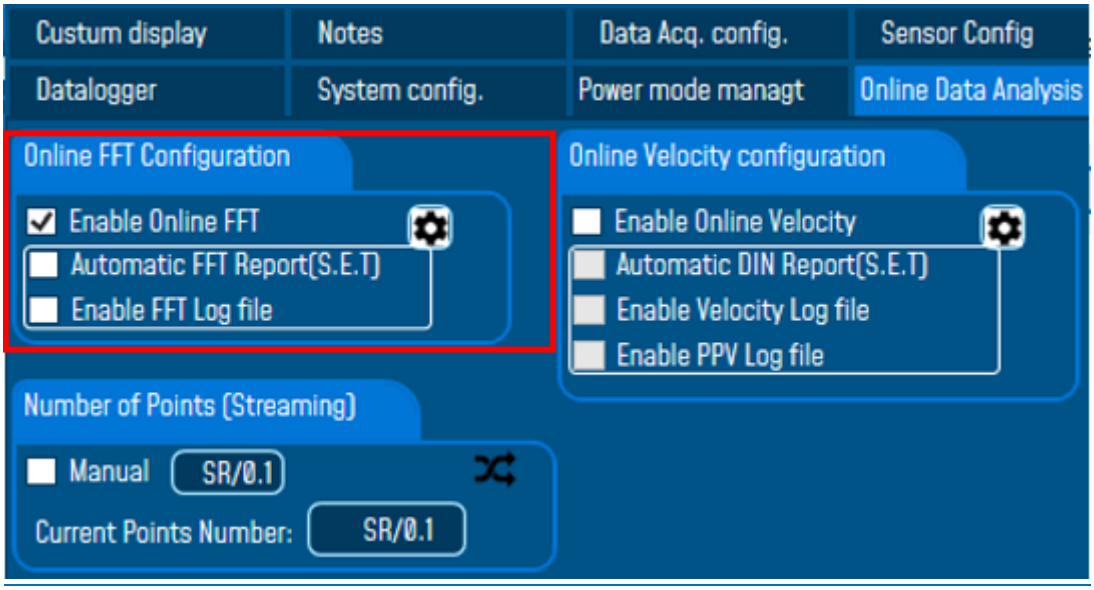


Figure 65: Online FFT Configuration frame

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

Figure 66: FFT Spectrum

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

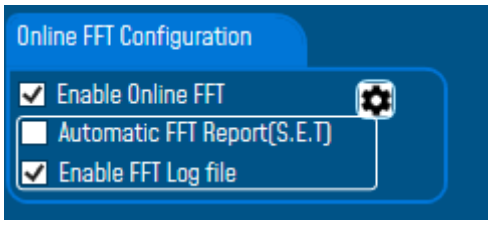


Figure 67: Online FFT Configuration frame

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

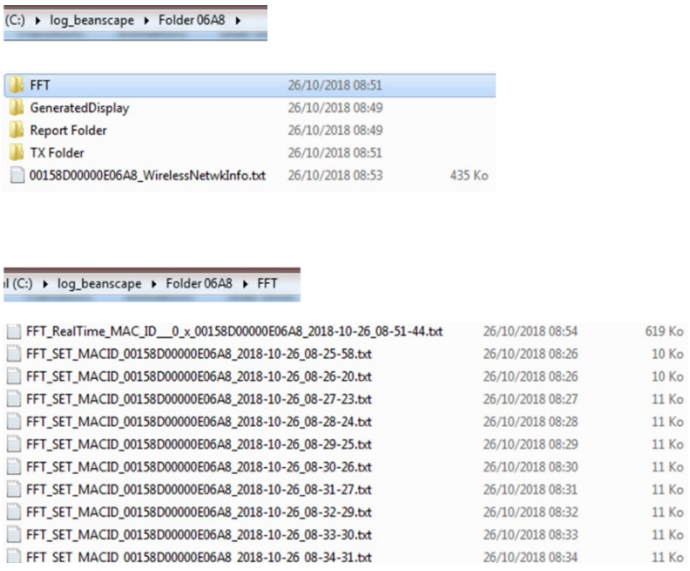


Figure 68: FFT log files folder

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

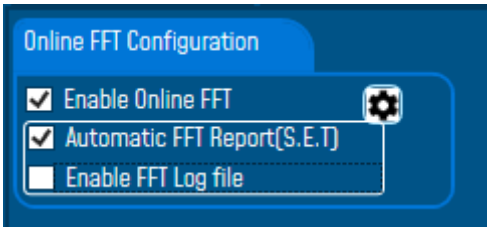


Figure 69:Enabling Automatic FFT Report

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

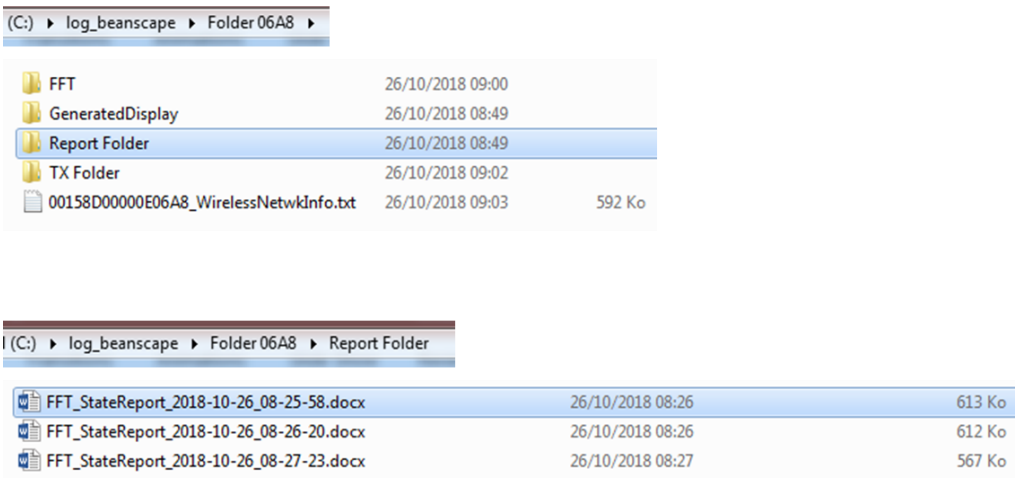


Figure 70: Report Folder

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

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

BeanAir FFT Report [Logo] 1

This email is sent by the BeanScape® software – Acceleration event occurred on "Ch_Z Axis" at Time : 11:04:59.150 , Level : Action

Date : 2020-12-11 11:04:59.150
Measure Duration : 15 sec
Sampling Rate : 100 (hz)
Pre-Trigger Duration : 100 (ms)
IIRFilter : Disabled
Axis where trigger occured : Ch_Z
2

Beandevice® Type : AX 3D
MAC ID : 00158D00000E1049
Label : MAC_ID : 0 x 00158D00000E1049
Range(g) : -2 / +2
Thresholds type for SET mode : Acceleration
4

Related notes to monitoring site

User Name :
Location :
Monitoring sites :
3

Sensor Information

	Ch_X	Ch_Y	Ch_Z
Offset Zeroing value	NA	NA	NA
Threshold Alarm	1.052 g	1.052 g	1.052 g
Threshold Action	0.747 g	0.747 g	0.747 g
Threshold-Alert	0.441 g	0.441 g	0.441 g

5

FFT Configuration

Mode : AUTO
Zero Padding : Enabled
Window Type : Rectangular
Algorithm : Estimate
6

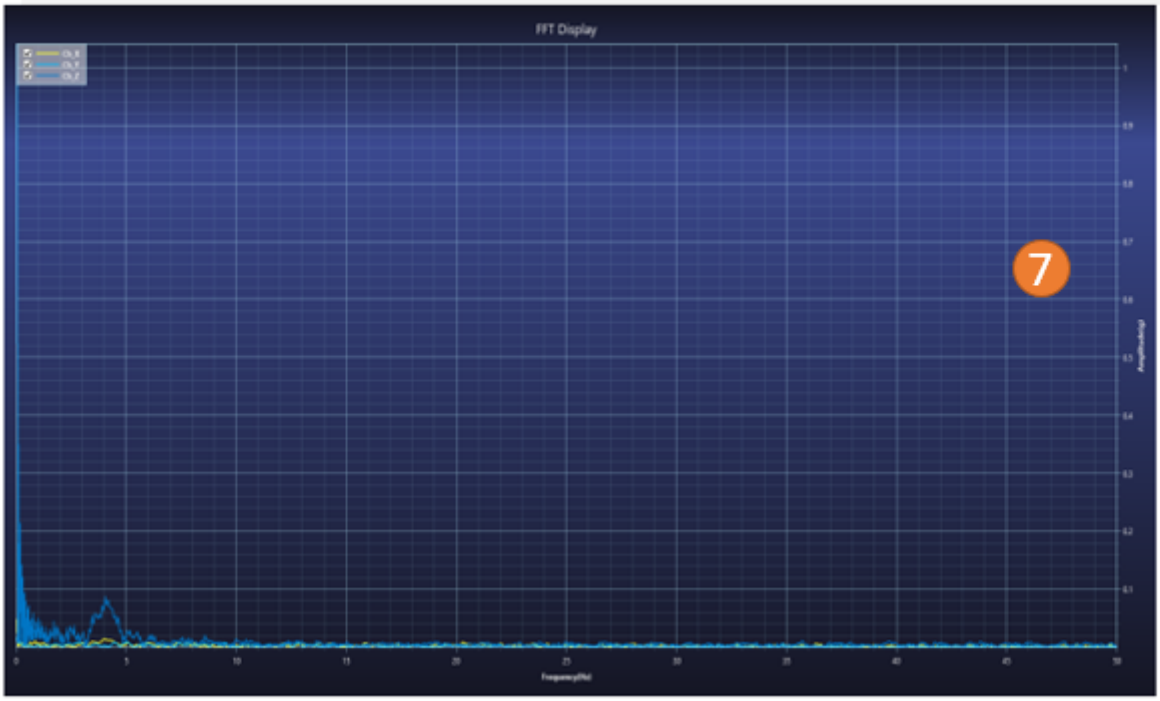


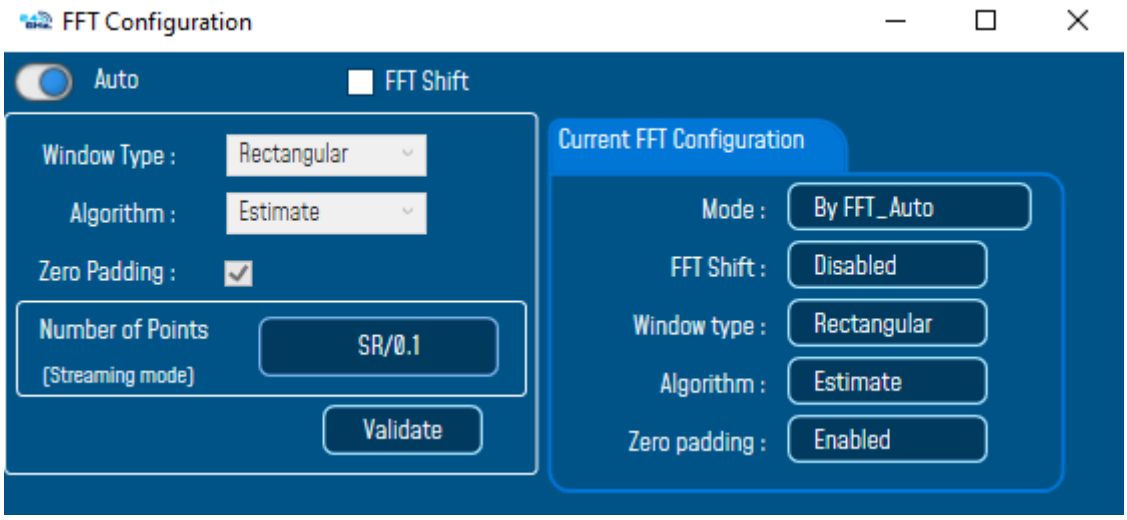
Figure 71: FFT Report (S.E.T mode)

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

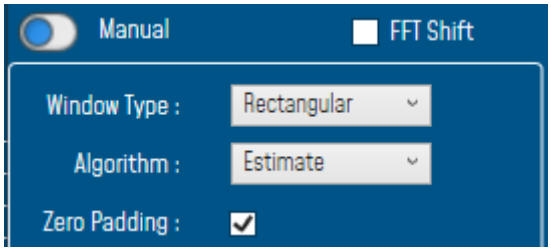
For further information about managing your notification and reports email please refer to section 8: Alarm management.

- : FFT Advanced Configuration

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



- Auto/Manual



- Window type:

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

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

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

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

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

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

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

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

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

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

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

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

- Algorithm

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

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

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

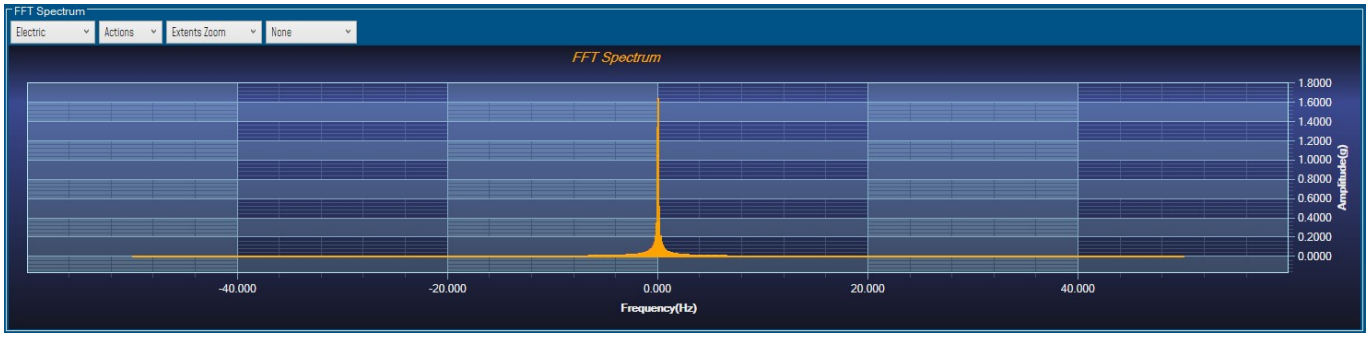


Figure 72: FFT Shift Spectrum

10.2.2 Online Velocity and Velocity report

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

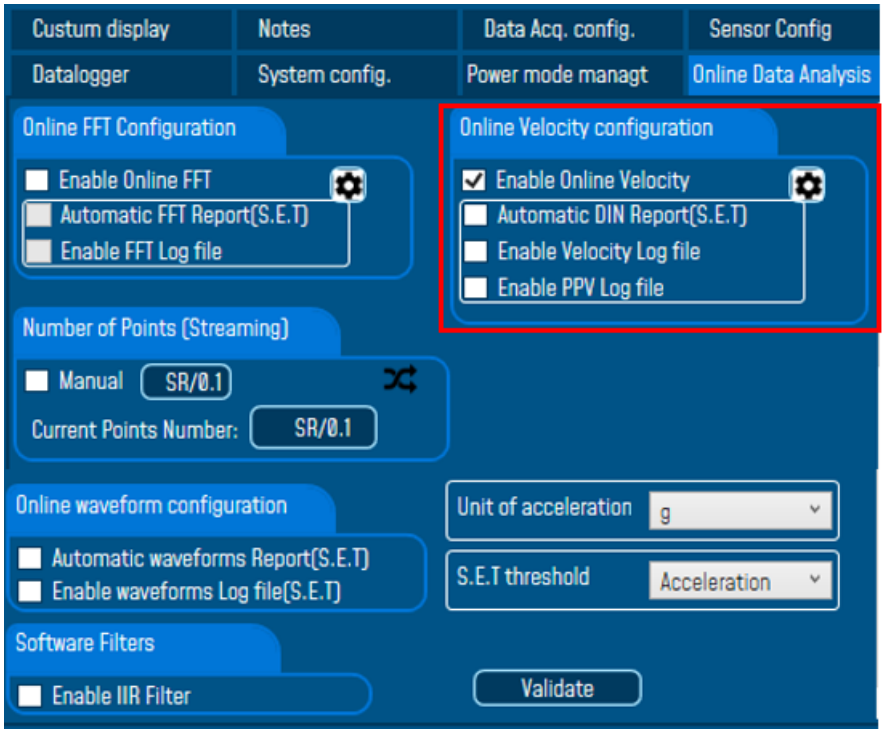


Figure 73: Online Velocity configuration tab

- ***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

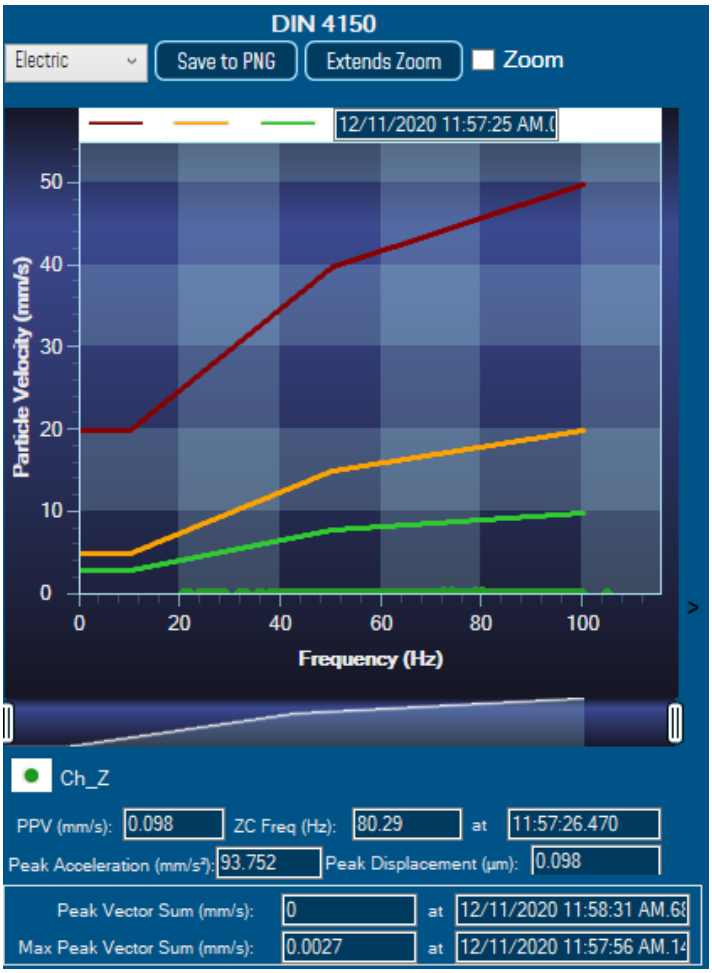
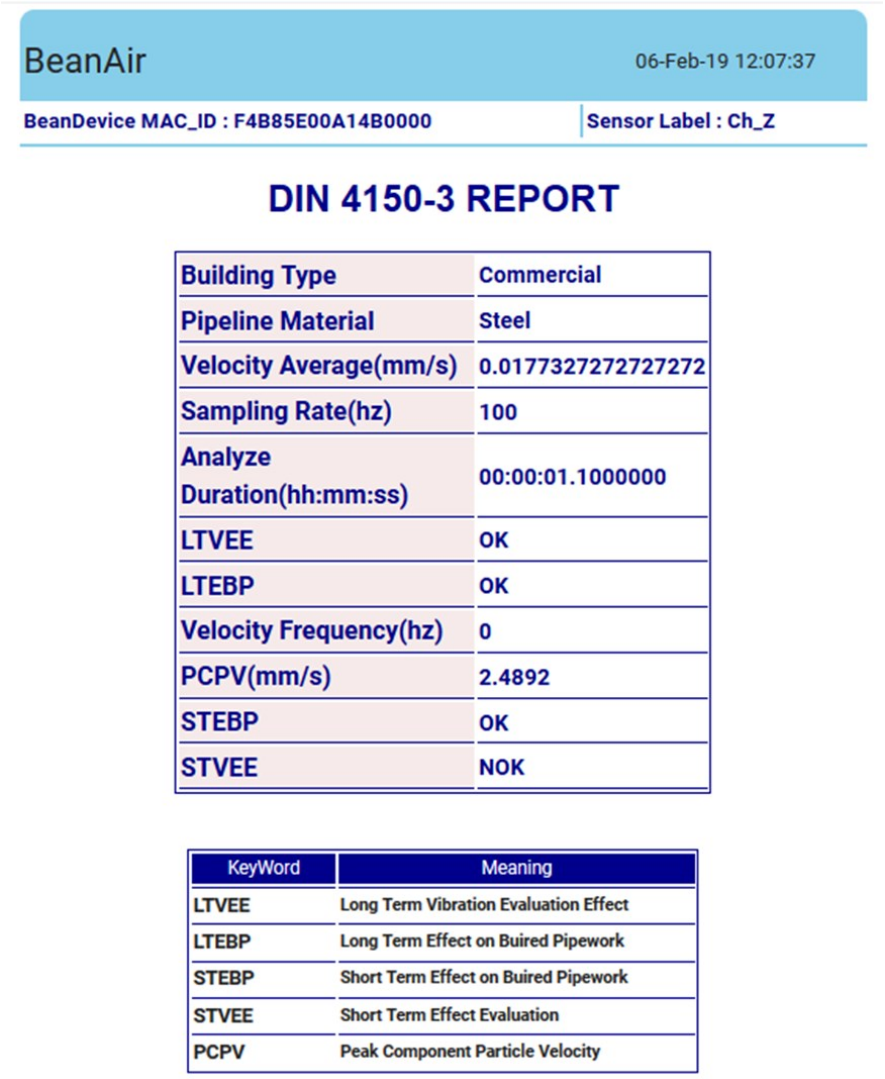


Figure 76: DIN 4150 Real Time Graph, PPV & PVS

- ***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.

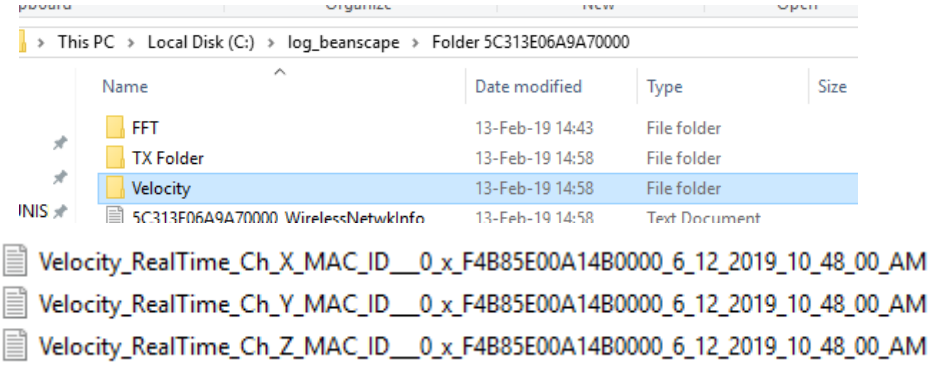


Figure 78: Velocity Log Folder/Files

- ***Enable PPV Log file***

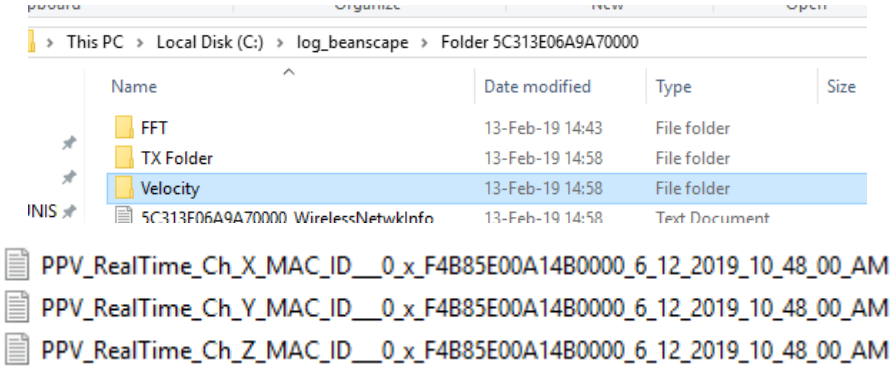


Figure 79: PPV Log Folder/Files

: Velocity Advanced Configuration

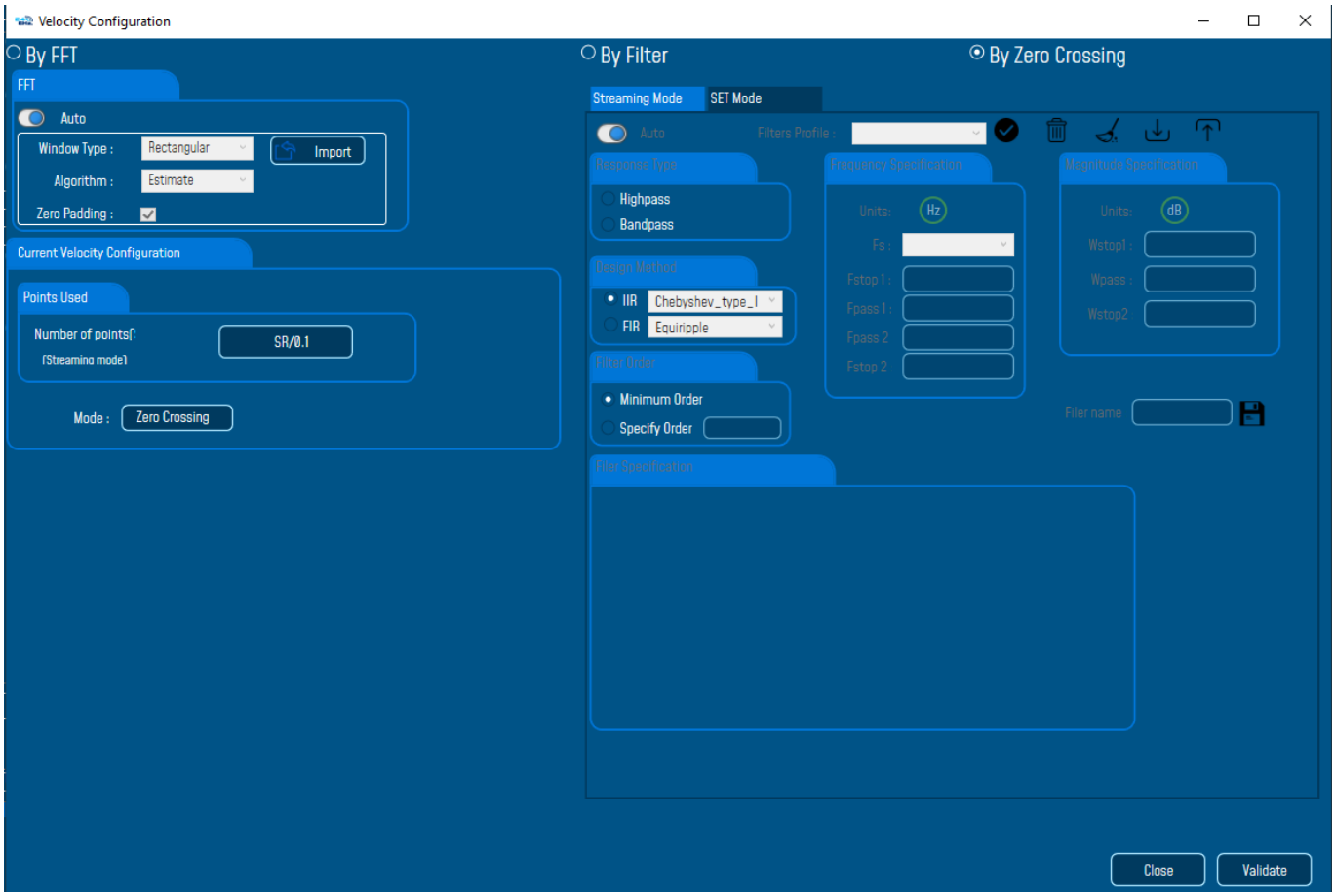
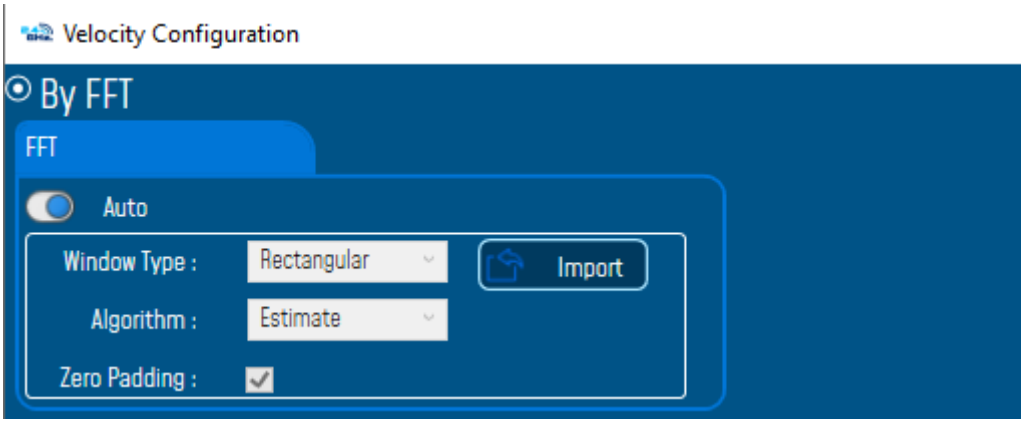


Figure 80: Velocity Advanced Configuration

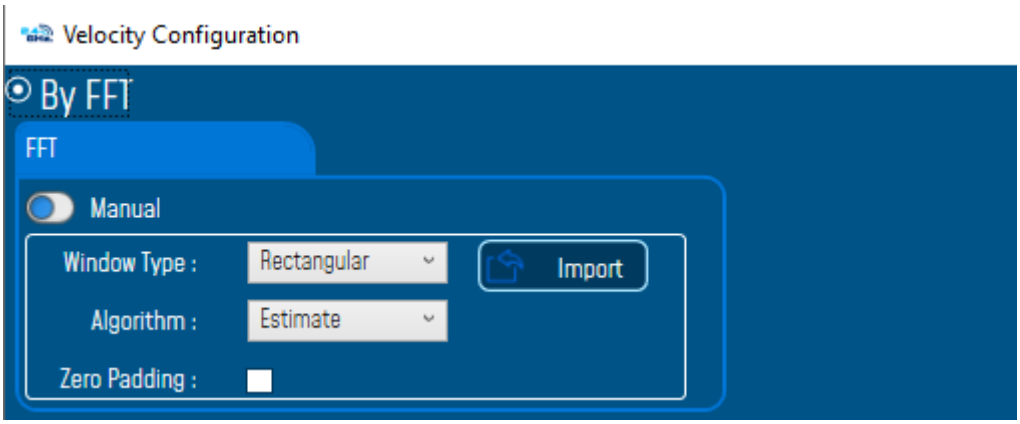
By default, the Velocity is configured “By Zero Crossing”, to edit the Velocity settings user must select “By FFT” or “By Filter”.

- **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

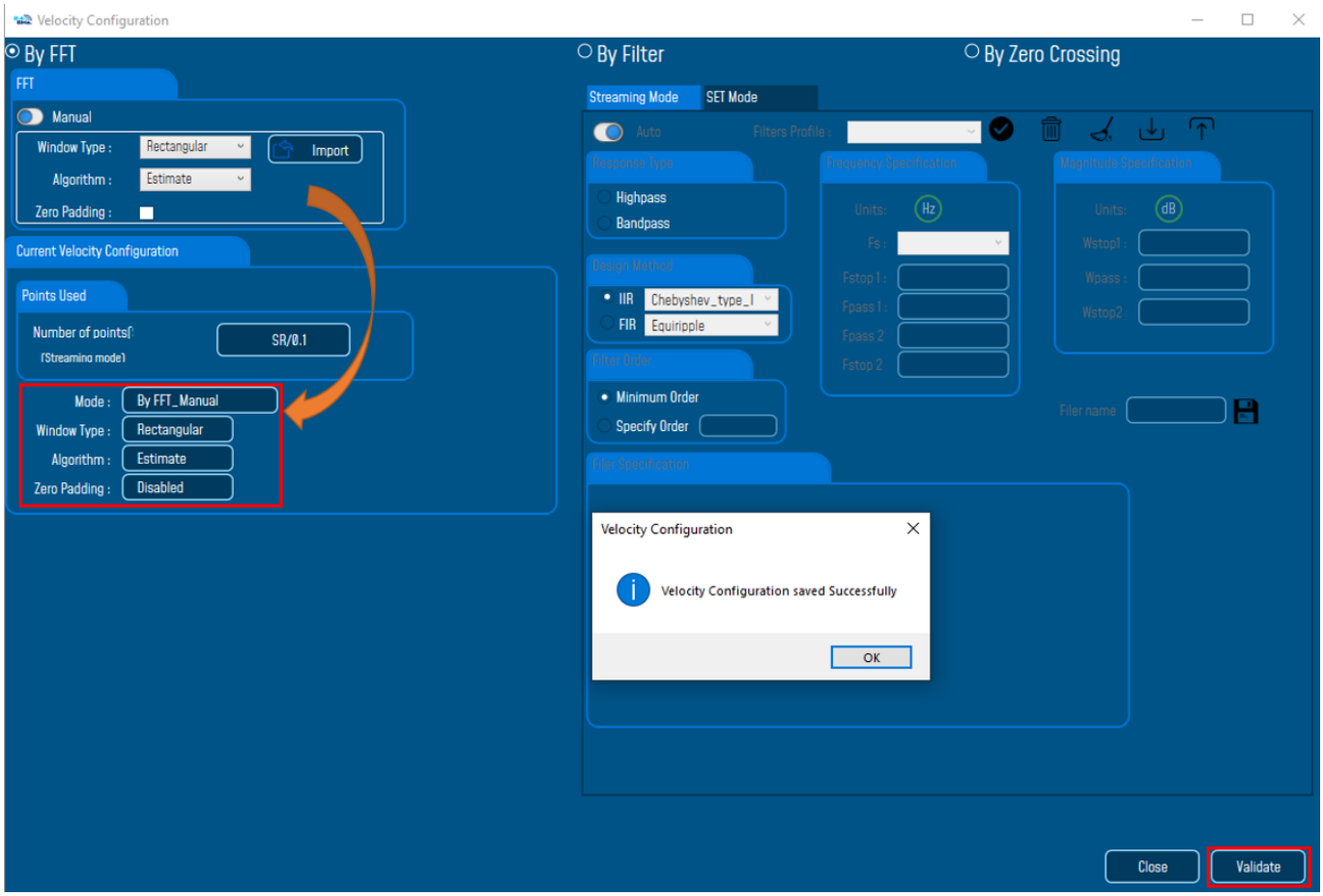


- Manual: Once switched to Manual, the user must configure the FFT settings manually (Window Type, Algorithm & Zero Padding).

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



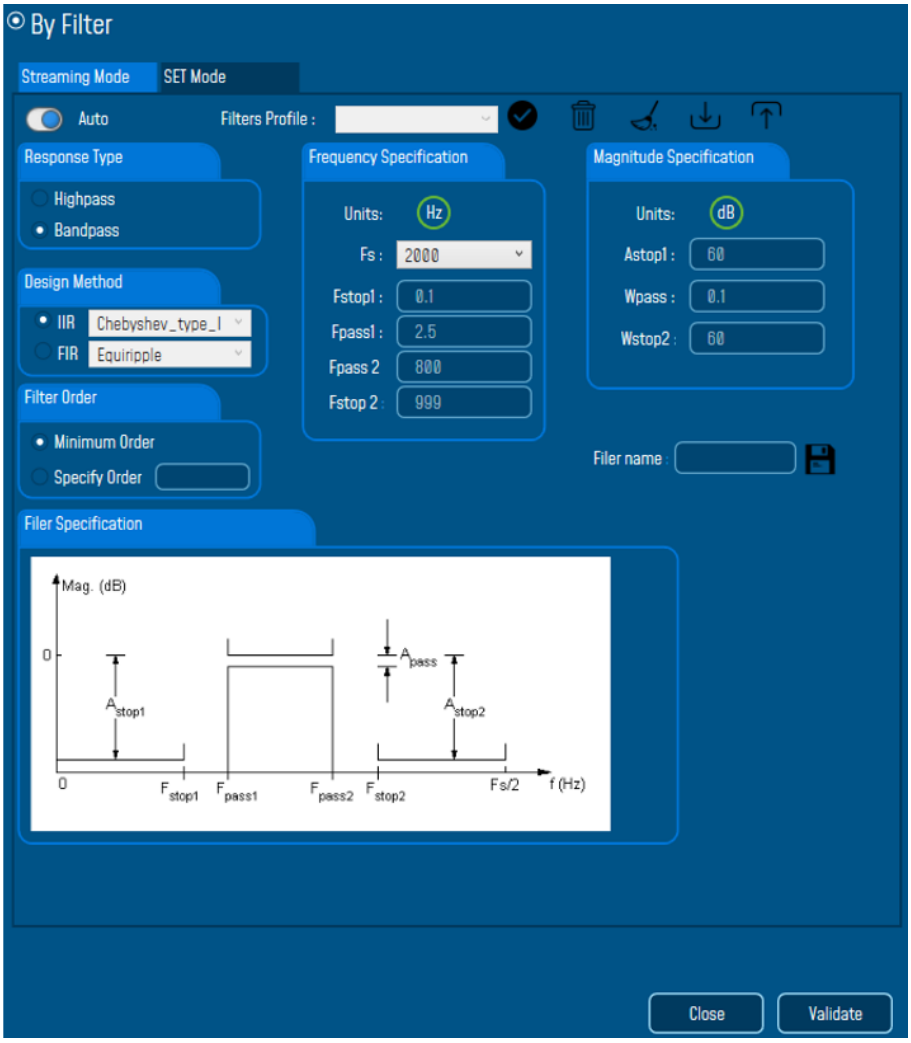
To save all settings Press Validate. The new settings should be displayed on the Left side of the Window.



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

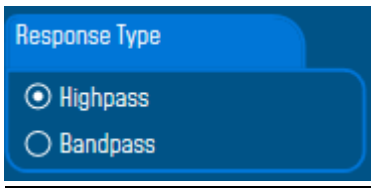
The Software filter is available for Streaming and S.E.T Mode.

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



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

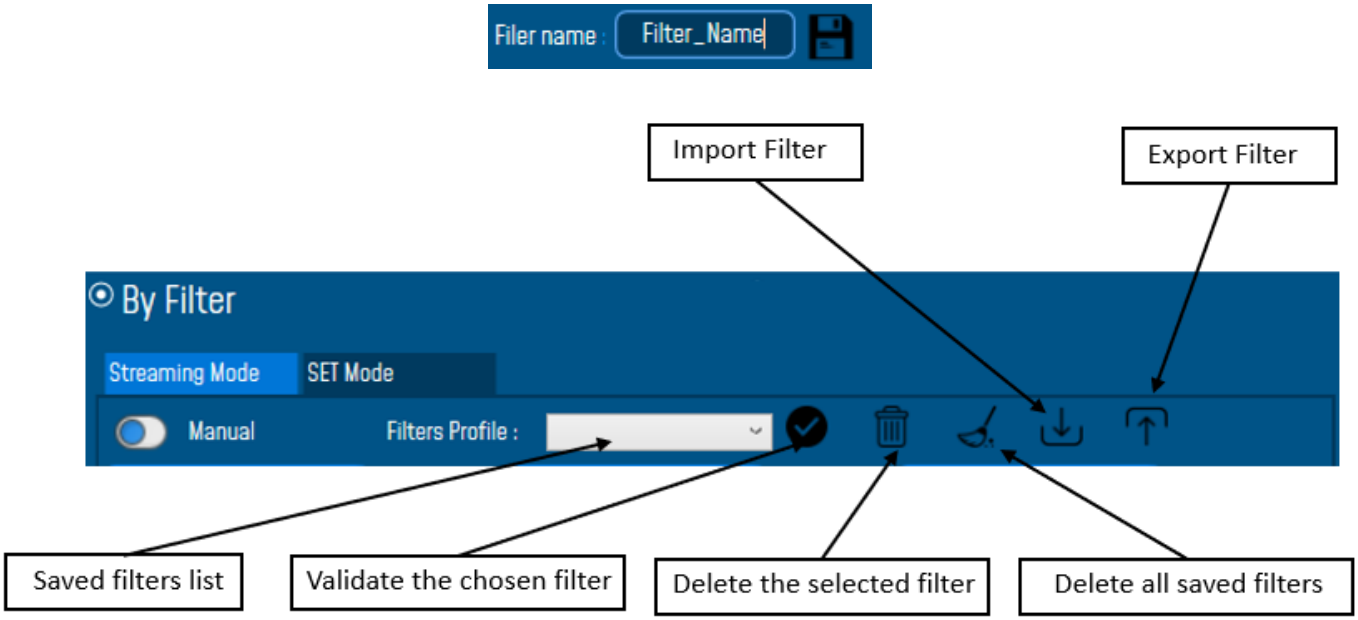
  - ❖ Response Type: User should specify if the Response is **Highpass** or **Bandpass**



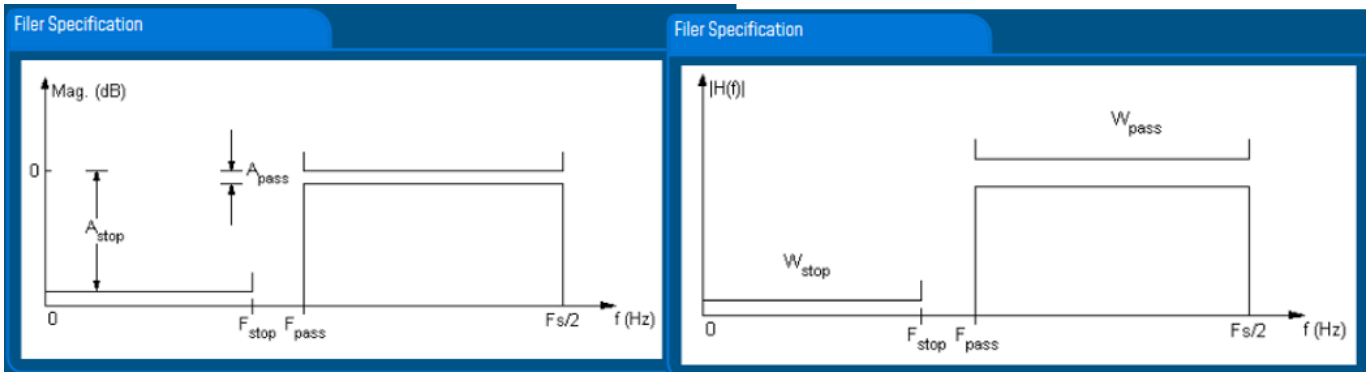
  - ❖ Design Method: User should Select the nature of the Filter between **IIR** or **FIR**
    From the List of every filter, user have to specify the method of the Filter:
    IIR: Chebyshev_type_I, Chebyshev_type_II or Butterworth
    FIR: Equiripple, Generalized_Equiripple or Kaiser_Window

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

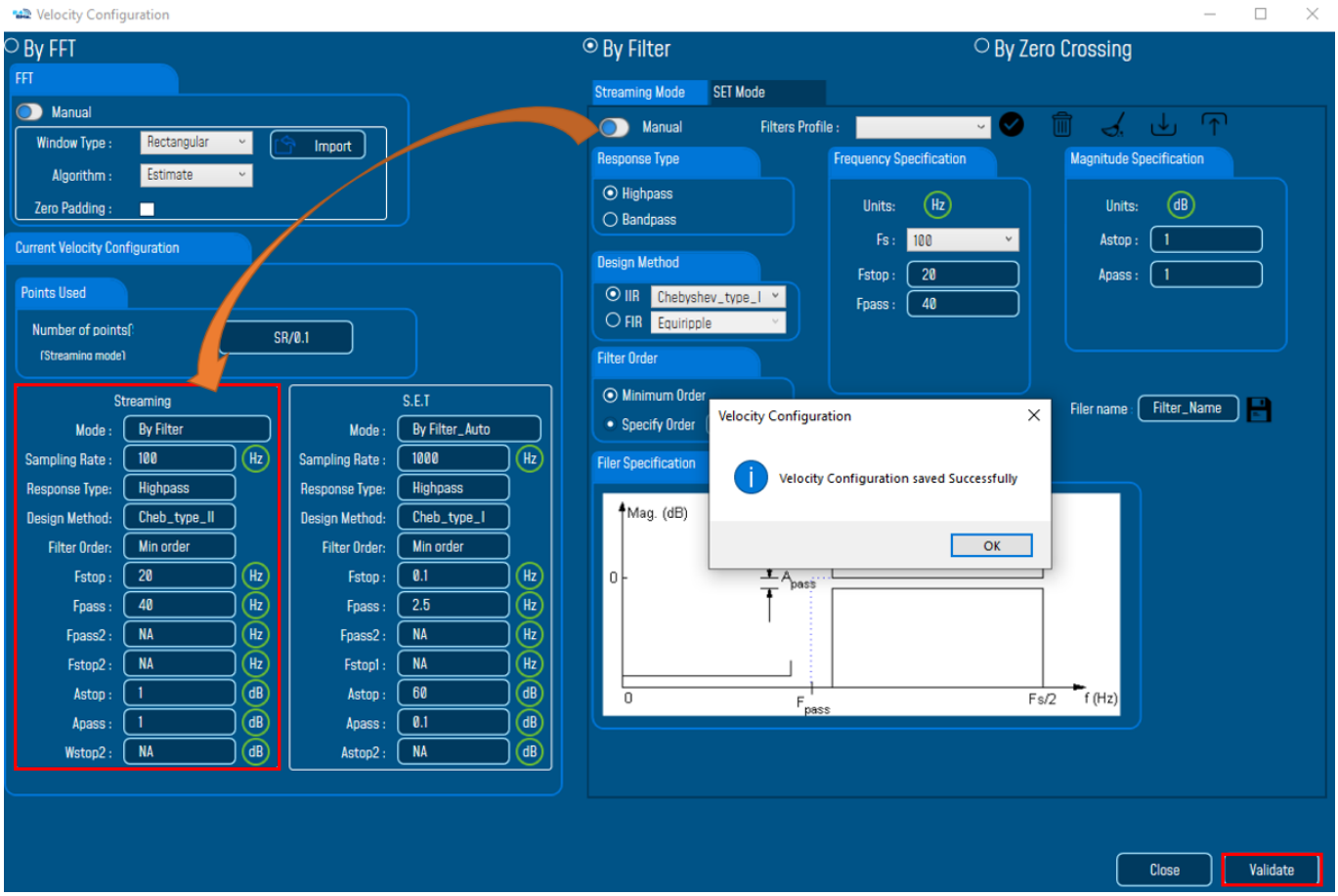
- Filter Order: If the user is using IIR Design Method, Minimum Order will be selected automatically.
  If the FIR Design Method is selected, user must Specify Order.
- Frequency Specification: Is a customizable frame according to the Design Method.
- Magnitude Specification: Is a customizable frame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



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

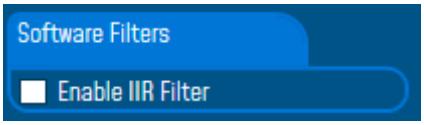


To save all settings Press Validate. The new settings should be displayed on the Left side of the Window.

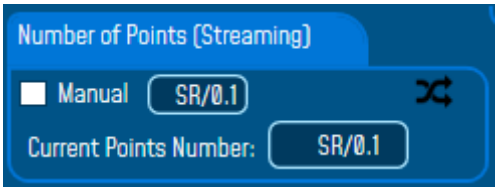


10.2.3 IIR Software Filter

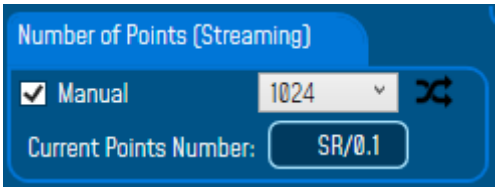
- ***Enable IIR Filter***: Check to enable IIR filter



10.2.4 Number of Points

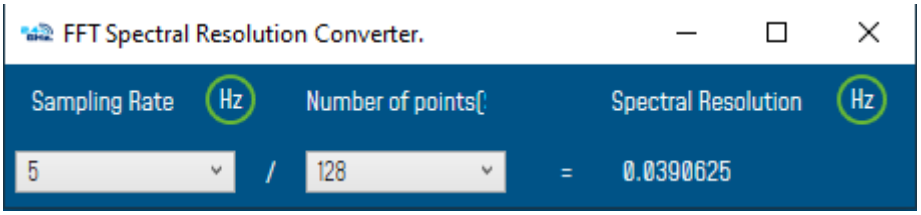


By default, the Number of Points is configured to be set automatically as Sampling Rate / 0.1 (SR/0.1). By moving to the Manual settings, user must choose a value between 128 and 32768.



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

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



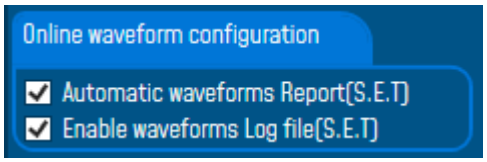
The frequency resolution of each spectral line is equal to the Sampling Rate divided by the Number of Points. For instance, for example, if the Number of Points is 4096 and the Sampling Rate is 2000, the resolution of each spectral line will be:

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.

10.2.5 Online Waveform Configuration

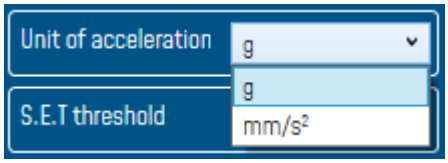


- ***Automatic Wave Report (S.E.T)***: Check to enable waveform reports, this is only available for S.E.T mode
- ***Enable Wave Log file:*** check to enable logging wave form for real-time data (only S.E.T mode)

10.2.6 Acceleration Unit

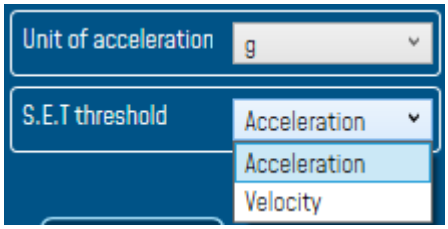
Select which unit to be used for acceleration measurement.

- G
- mm/s²



10.2.7 S.E.T Threshold

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



11. APPENDICE 1: CONFIGURATION EXAMPLES

11.1 LOW DUTY CYCLE ACQUISITION MODE

Watch our LowDutyCycle Data Acquisition mode video on YouTube

11.1.1 Configuration

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

Proceed as follows:

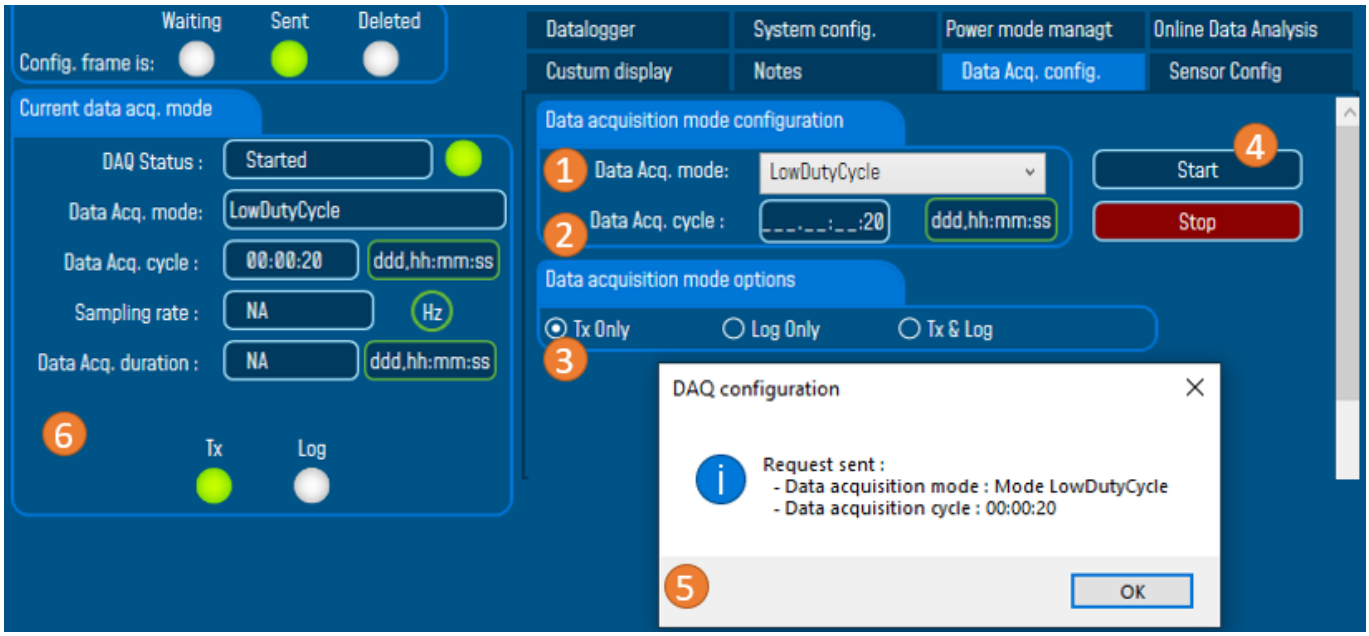


Figure 81: Overview: Low Duty Cycle Configuration

1	*Choose "LowDutyCycle "in Data acquisition mode*
2	*Enter a Data acquisition cycle of 20s*
3	*In this example, we configure the BeanDevice® in TX only*
4	*Click on Start to validate your new configuration*
5	*A Pop-up window displays the new configuration*
6	*If the new Data acquisition mode configuration is accepted by the BeanDevice®, all the parameters are displayed in the frame "Current Data acquisition mode" and DAQ Status change to "Started" with a green indicator*

11.1.2 Graph visualization

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

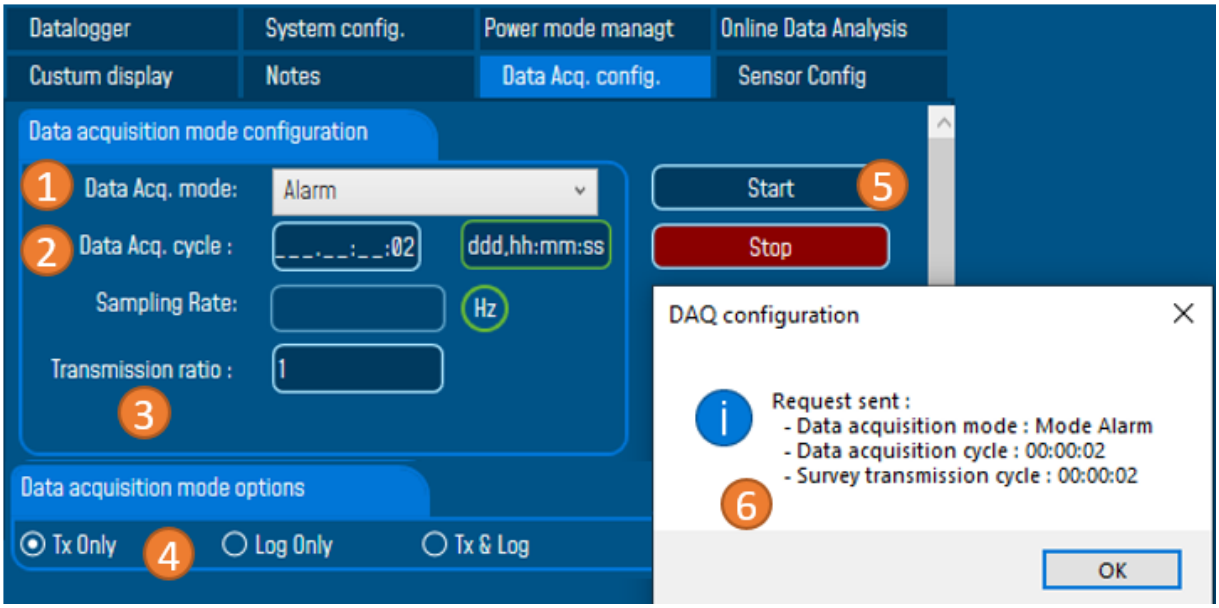
Figure 82: Low Duty Cycle Graph visualization

11.2 SURVEY MODE

[Watch Survey mode video on our YouTube channel]

If the alarms thresholds H1/H2/L1/L2 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®".***

11.2.1 Alarm mode configuration



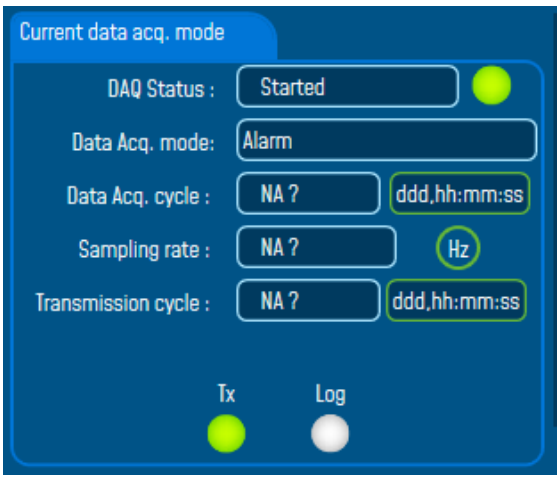


Figure 83: Overview: Survey mode Configuration

1	*Choose "Alarm "*
2	*Enter a Data acquisition cycle of 2s*
3	*Enter a transmission ratio of 1*
4	*In this example, we configure BeanScape in Tx*
5	*Click on Start to enable your new configuration*
6	*A Pop-up window displays the new configuration*
7	*If the new Data acquisition mode configuration is accepted by the BeanDevice®, all the parameters are displayed in the frame "Current Data acquisition mode" and DAQ Status change to "Started" with a green indicator*

11.2.2 Graph visualization

Example of Alarm mode on the BeanDevice® Hi-Inc (wireless Inclinometer sensor):

Figure 84: Alarm mode Graph visualization

11.3 STREAMING MODE

Watch Streaming Mode video on our YouTube channel

11.3.1 Streaming mode configuration (with "continuous monitoring" option)

Example: The BeanDevice® is configured in streaming mode with a sampling rate of 100 Hz. "Continuous monitoring" and "TX" options are enabled.

Proceed as follows:

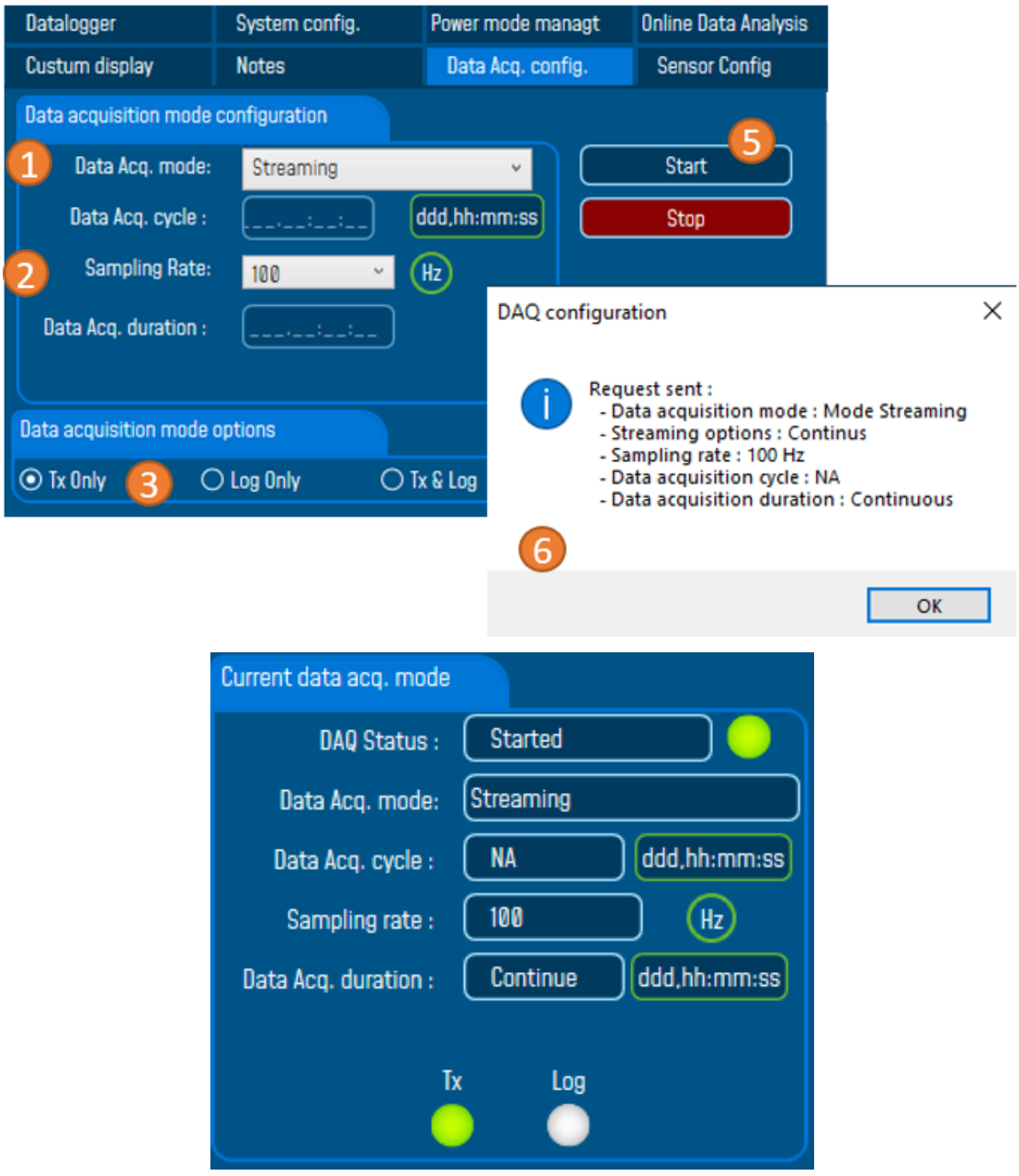


Figure 85: Overview: Streaming mode Configuration with Continuous Monitoring option

1	*Choose "Streaming "*
2	*Enter a sampling rate of 100 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*
7	*If the new Data acquisition mode configuration is accepted by the BeanDevice®, all the parameters are displayed in the frame "Current Data acquisition mode" and DAQ Status change to "Started" with a green indicator.*

11.3.2 Streaming Mode configuration (with “one shot” option)

Ex: The BeanDevice® is configured in streaming Data acquisition mode with a sampling rate of 100 Hz. “One shot” and “TX” options are enabled.

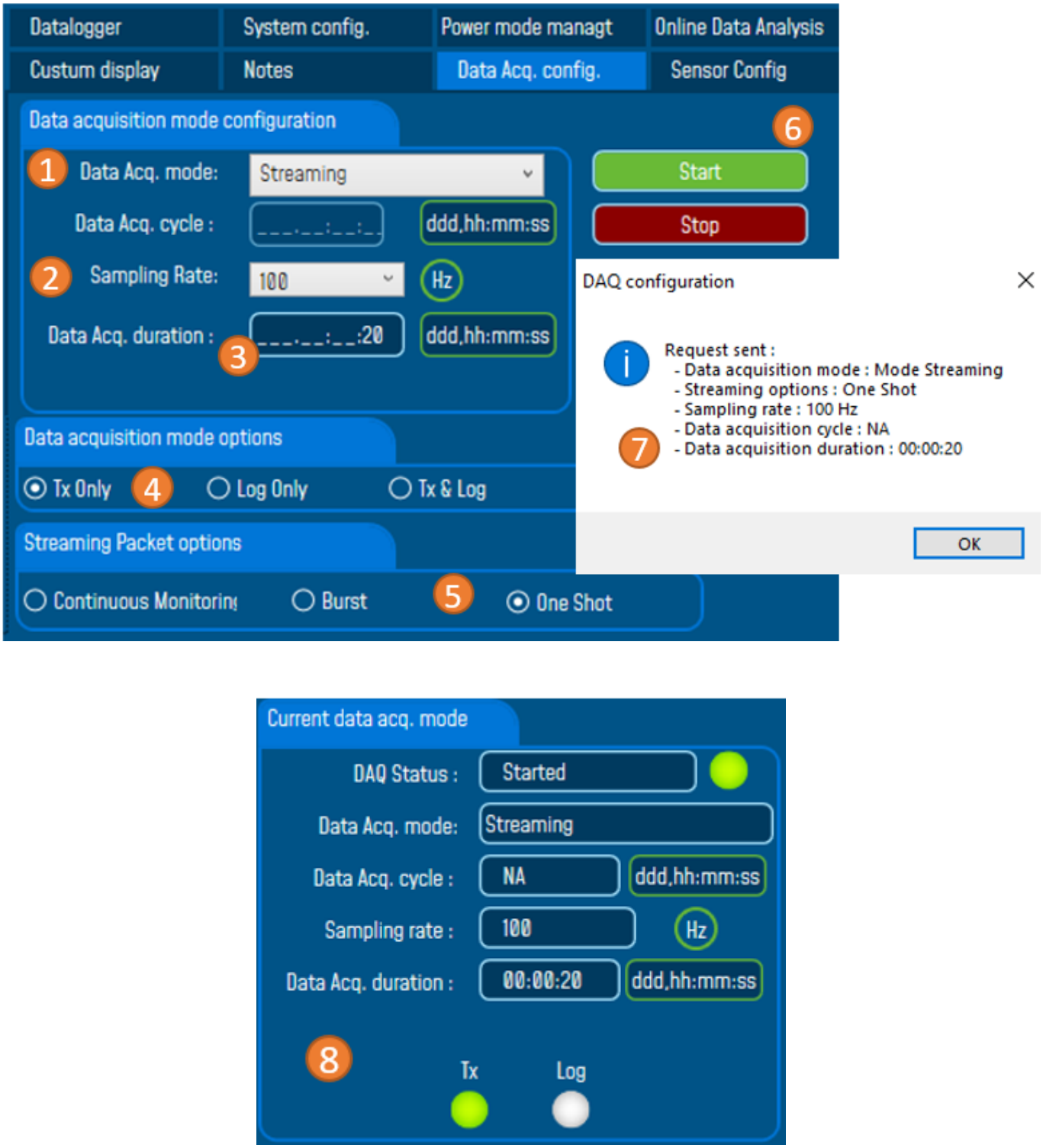


Figure 86: Overview: Streaming mode Configuration with One Shot option

1	*Choose "Streaming "*
2	*Enter a sampling rate of 100 Hz*
3	*Enter a Data acquisition duration of 20s*
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®, all the parameters are displayed in the frame "Current Data acquisition mode" and DAQ Status change to "Started" with a green indicator.*

11.3.3 Streaming Mode configuration (with "burst" option)

Ex: The BeanDevice® is configured in streaming Data acquisition mode with a sampling rate of 100Hz. "Burst" and "TX" options are enabled.

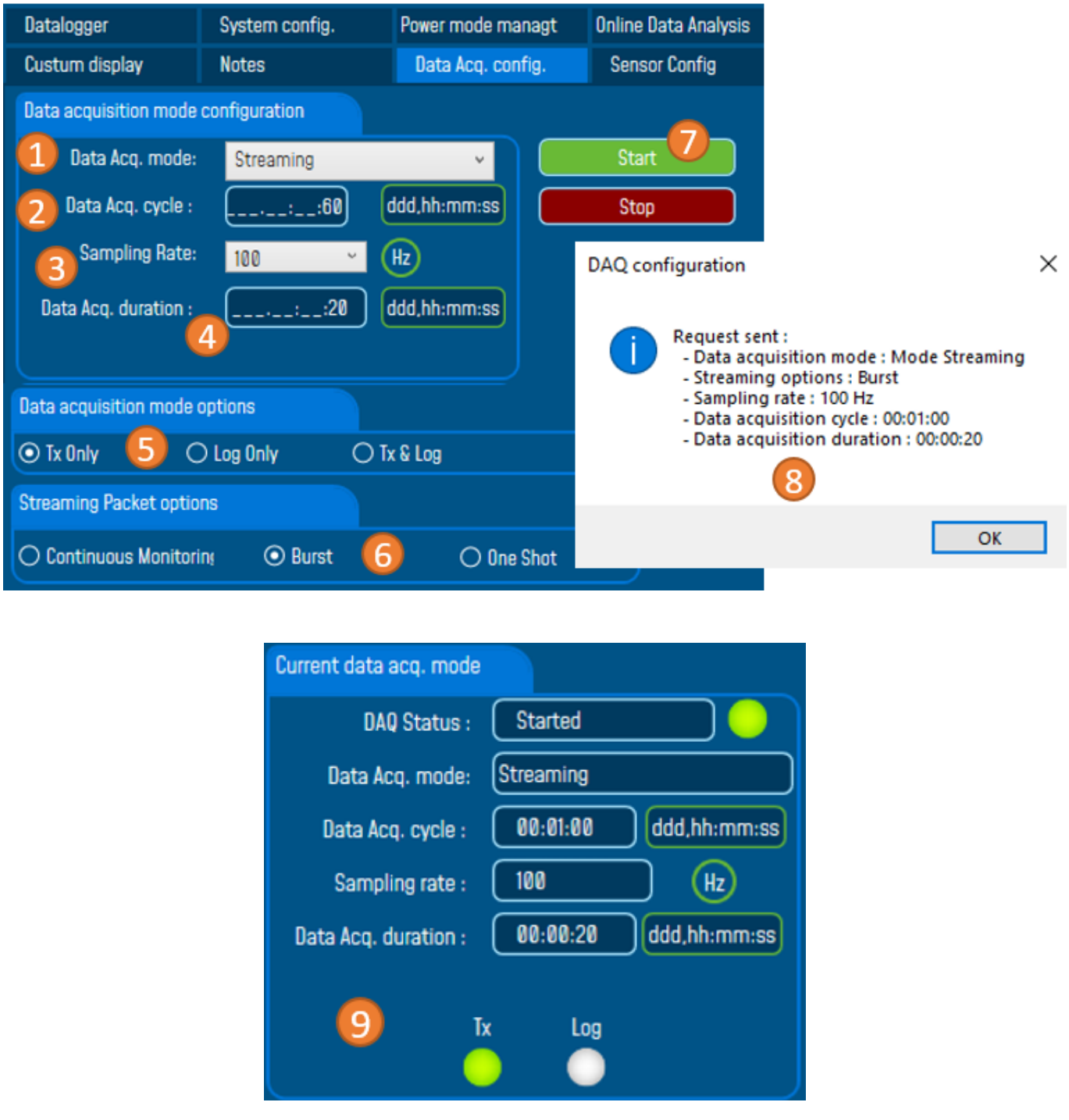


Figure 87: Overview: Streaming mode Configuration with Burst option

1	*Choose "Streaming "*
2	*Enter a duty cycle of 30s*
3	*Enter a sampling rate of 100 Hz*
4	*Enter a Data acquisition duration of 20s*
5	*Check "TX and Log" option*
6	*Check "Burst"*
7	*Click on Start 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®, all the parameters are displayed in the frame "Current Data acquisition mode" and DAQ Status change to "Started" with a green indicator.*

11.3.4 Graph visualization

Example of streaming mode on the BeanDevice® AX-3D (wireless accelerometer):

Figure 88: Streaming mode Graph visualization

11.4 SSD (SMART SHOCK DETECTION)

Watch SSD (SMART SHOCK DETECTION) video on our YouTube channel

SSD function is only available on the ***BeanDevice® AX-3DS***:

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

11.4.1 Step 1: configure the measurement range of your accelerometer

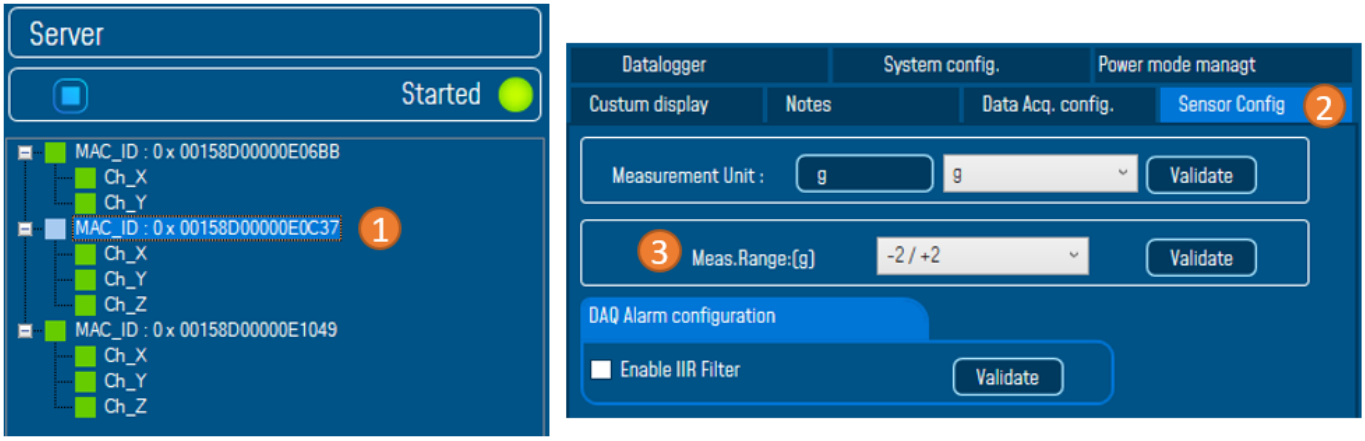


Figure 89: Sensor measurement range configuration

1. **Select your sensor from your sensor list**
2. **Click on the Sensor Config**
3. **Choose your accelerometer range and click on validate**

11.4.2 Step 2: Configure the SSD profile

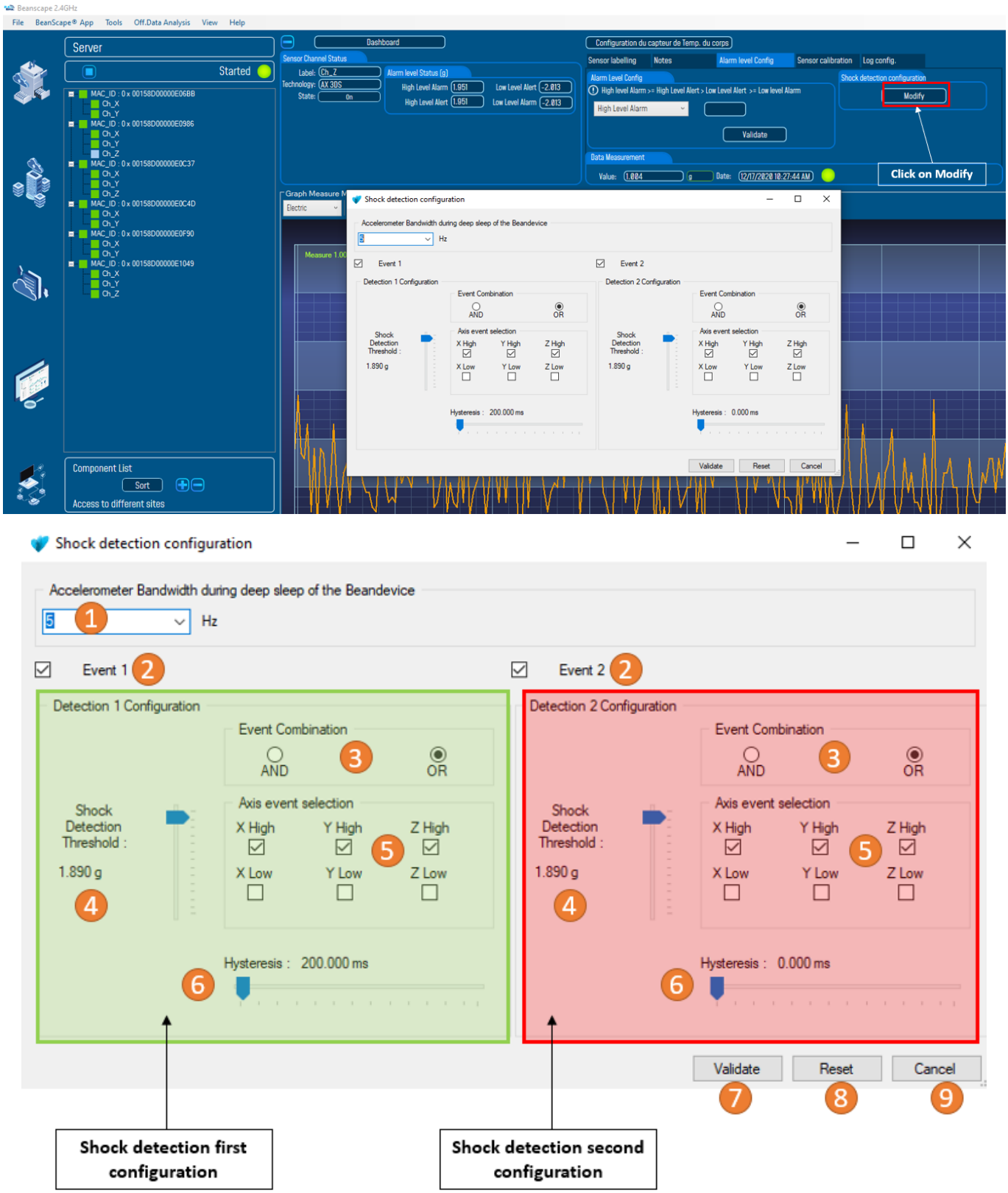
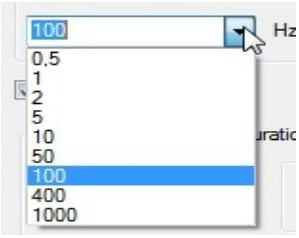


Figure 90: SSD profile configuration

1

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



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

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

2

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

3

Event combination

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

4

Set the shock detection threshold

Unit value: g

The threshold resolution depends highly on the acceleration range.

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

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

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

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

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

5

Axis event selection

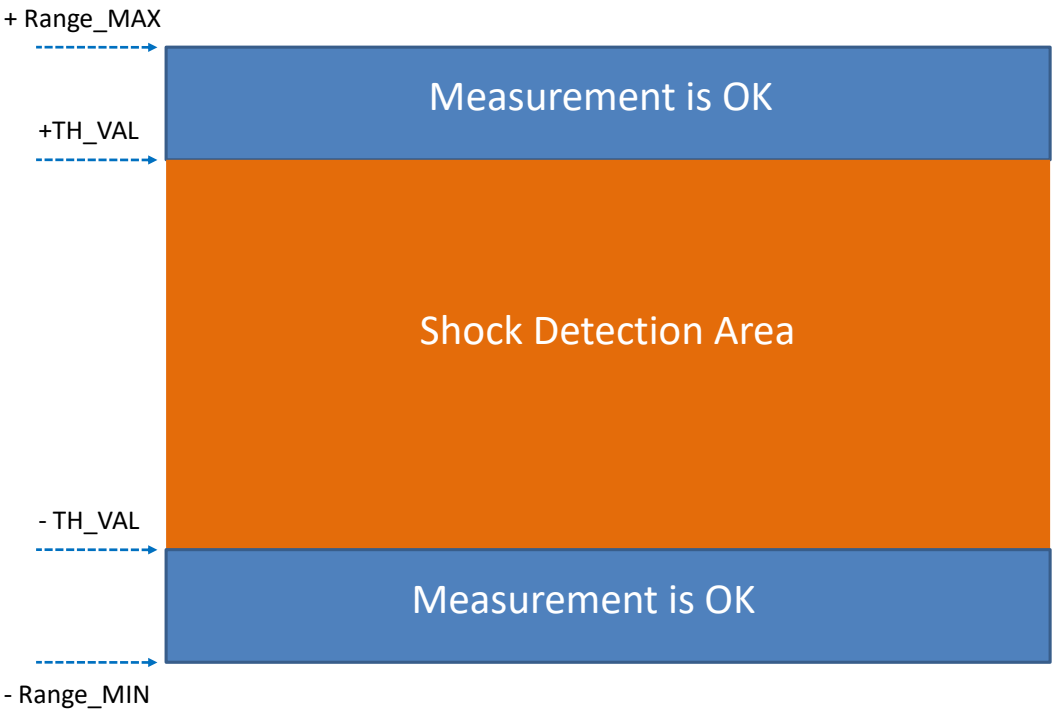
The user can associate a shock event with an axis: X Axis High, X Axis Low, Y Axis High, Y axis Low, Z Axis High, Z Axis Low.

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

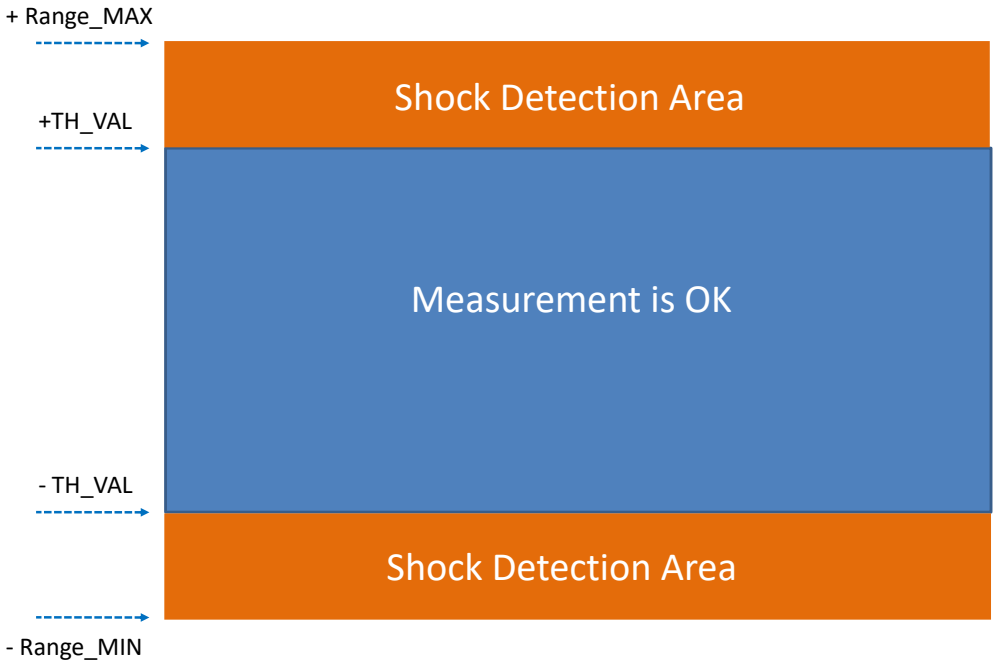
- ***TH_VALUE*** is the shock detection threshold settled by the user
- ***Range_MAX*** is the maximum measurement of the wireless accelerometer

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

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



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



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

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

11.4.3 Step 3: Set SSD Data acquisition mode

Example: The ***BeanDevice® AX-3DS*** should be configured as follow:

- SSD Data acquisition mode,
- A sampling rate of 500 Hz after a shock detection,
- Survey cycle of 1 minute
- A Data acquisition duration of 10s after a shock detection

Proceed as follows:

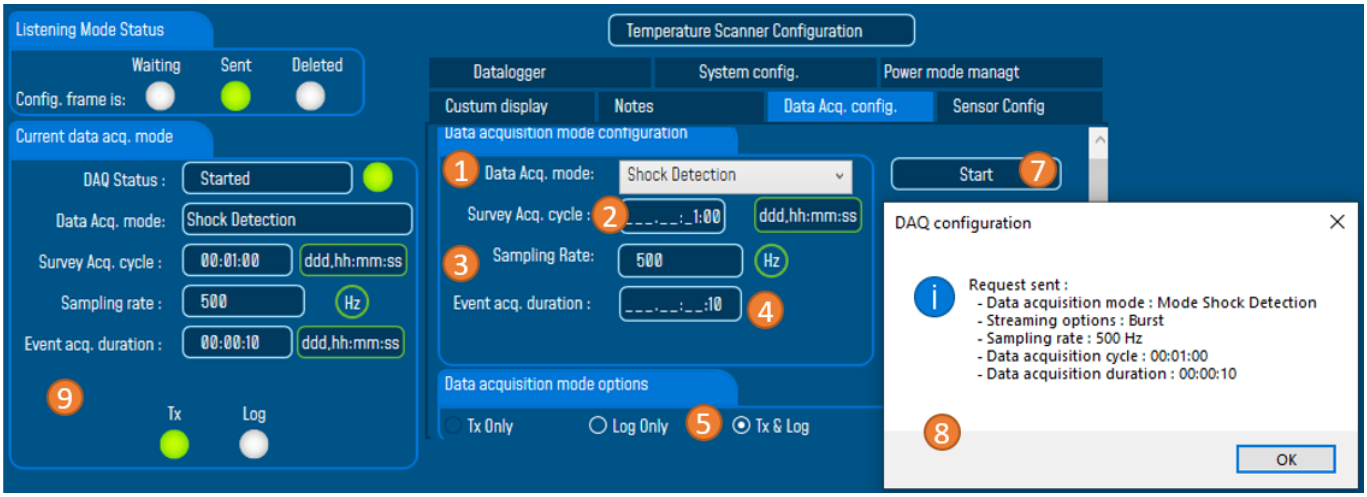


Figure 91: Overview: Shock Detection mode configuration

1	*Choose "SSD "(Smart shock detection)*
2	*Enter a Survey Acq. Cycle of 1 minute*
3	*Enter a sampling rate of 500Hz during a shock event acquisition*
4	*Event acquisition duration: 10s*
5	*In this example, we use TX and Log*
6	*Choose "survey cycle"*
7	*Click on Start 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®, all the parameters are displayed in the frame "Current Data acquisition mode" and DAQ Status change to "Started" with a green indicator.*

11.4.4 Graph display

SSD Data acquisition mode on the ***BeanDevice AX-3DS*** :

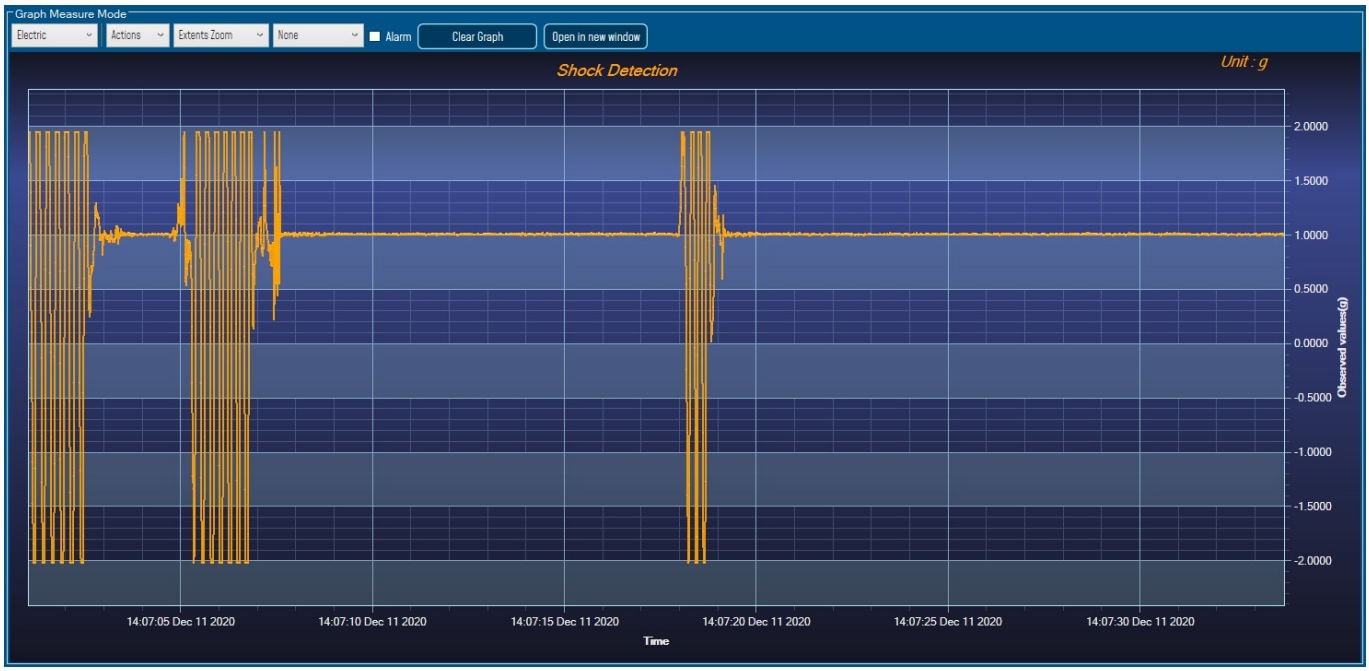


Figure 92: Shock Detection mode Graph visualization

11.5 STREAMING WITH EVENT TRIGGER (SET MODE)

Watch Set mode video on our YouTube channel

Example: The BeanDevice® is configured in SET mode with a sampling rate of 500 Hz, Notification cycle of 1 minute, Data acquisition duration of 30 seconds and pre-trigger duration of 100 ms.

Before beginning the acquisition, the Alarm thresholds should be set. To configure the Alarm thresholds, it is important to set the type of threshold for S.E.T mode. To do that, user should go to **the Online Data Analysis** tab and select Acceleration or Velocity from the option **S.E.T threshold**.

This option is available only in the BeanDevice AX-3D.

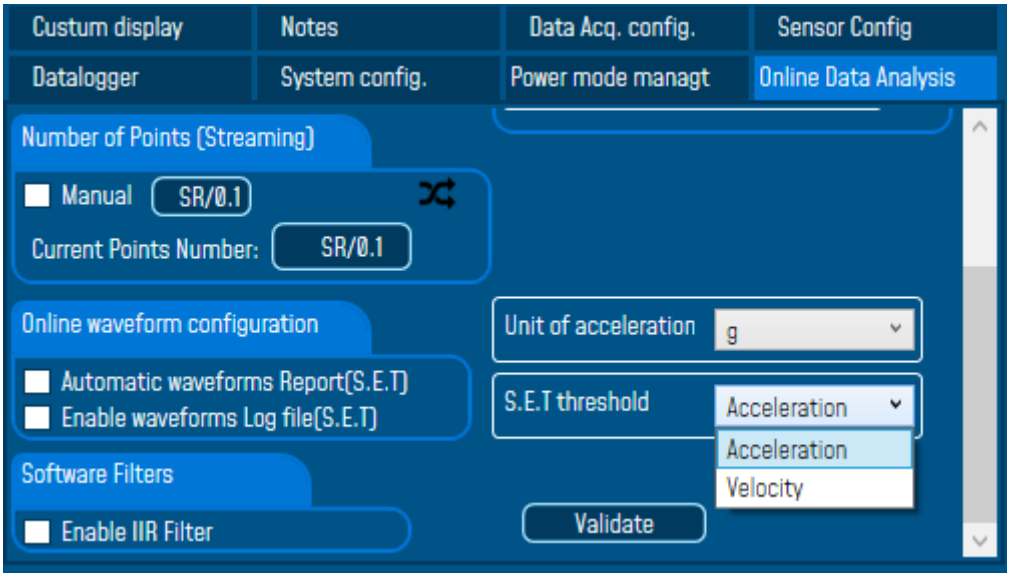


Figure 93: Setting the type of threshold (S.E.T mode)

By choosing **Acceleration** S.E.T thresholds the Unit of the Alarm thresholds for the S.E.T mode will be in **g**.

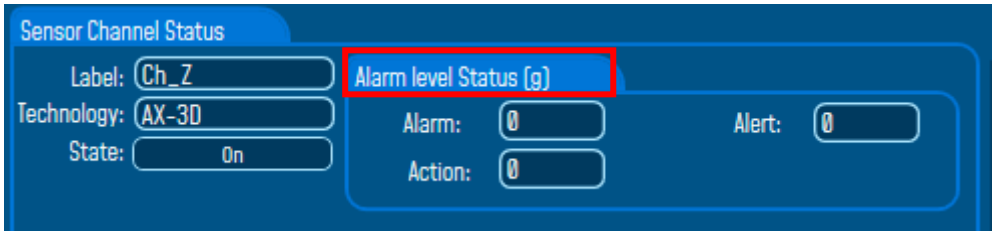


Figure 94: Acceleration Alarm thresholds for the S.E.T mode

And if user want to choose the **Velocity** S.E.T thresholds then the unit of the Alarm will be in **mm/s**.

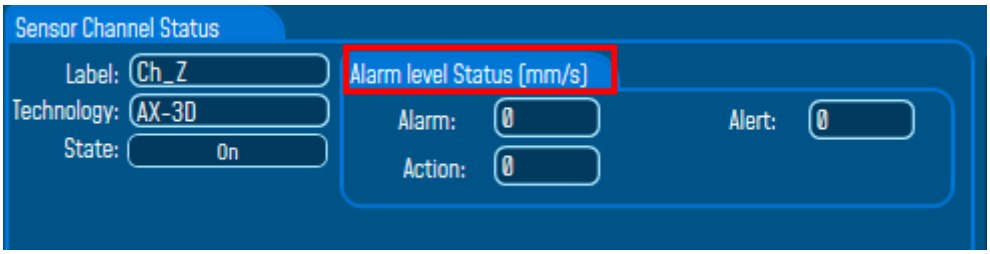
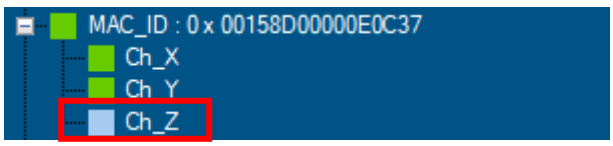


Figure 95: Velocity Alarm thresholds

it is important to notice that for each type of BeanDevice® we configure threshold differently.

User should select the sensor profile and configure the AAA based thresholds respecting the rule: **Alert value < Action value < Alarm value.**



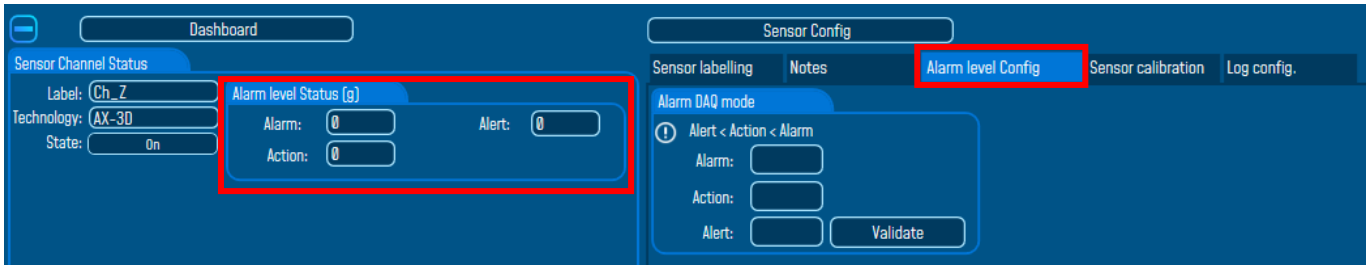


Figure 96 : AAA Alarm configuration

The AAA values should not exceed the BeanDevice Maximum range.

- FFT can be configured also before running our measurement, by going to the **Online Data Analysis** tab and enabling the suitable option and validate.

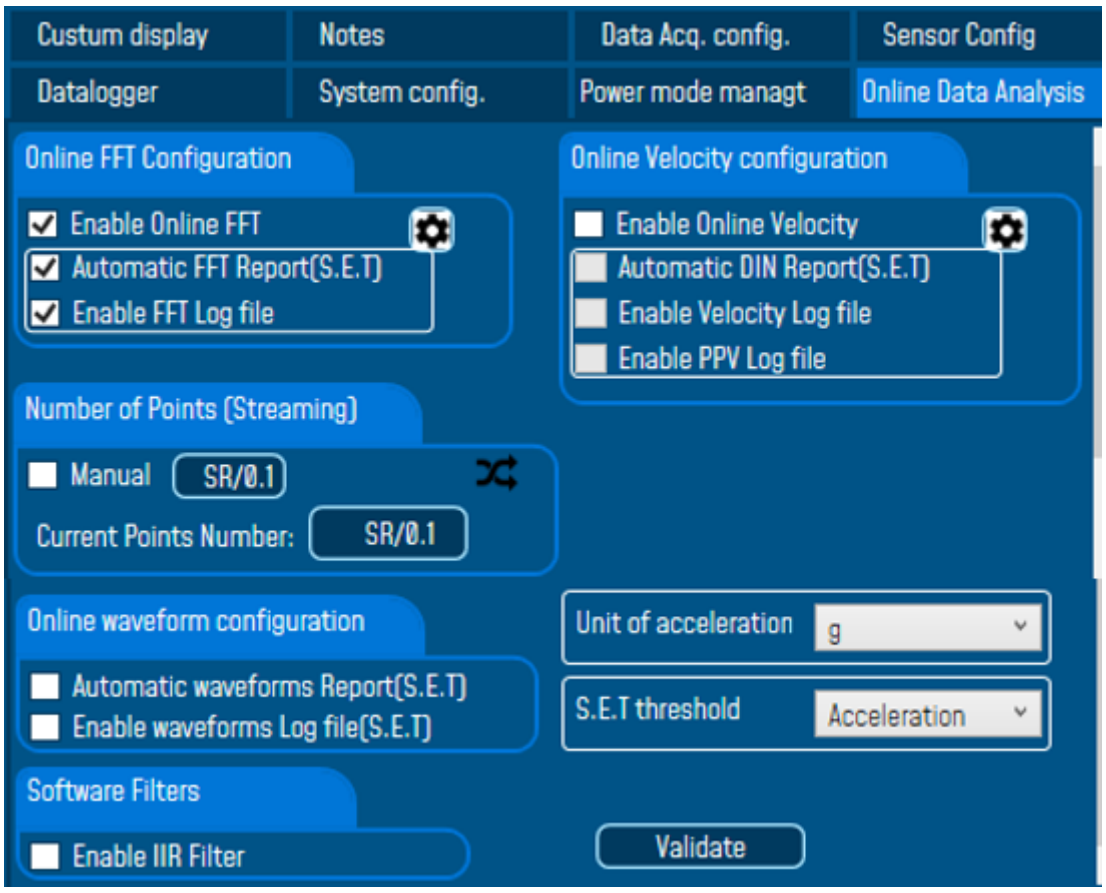


Figure 97: FFT setting

- Now the BeanDevice® can be configured in S.E.T mode

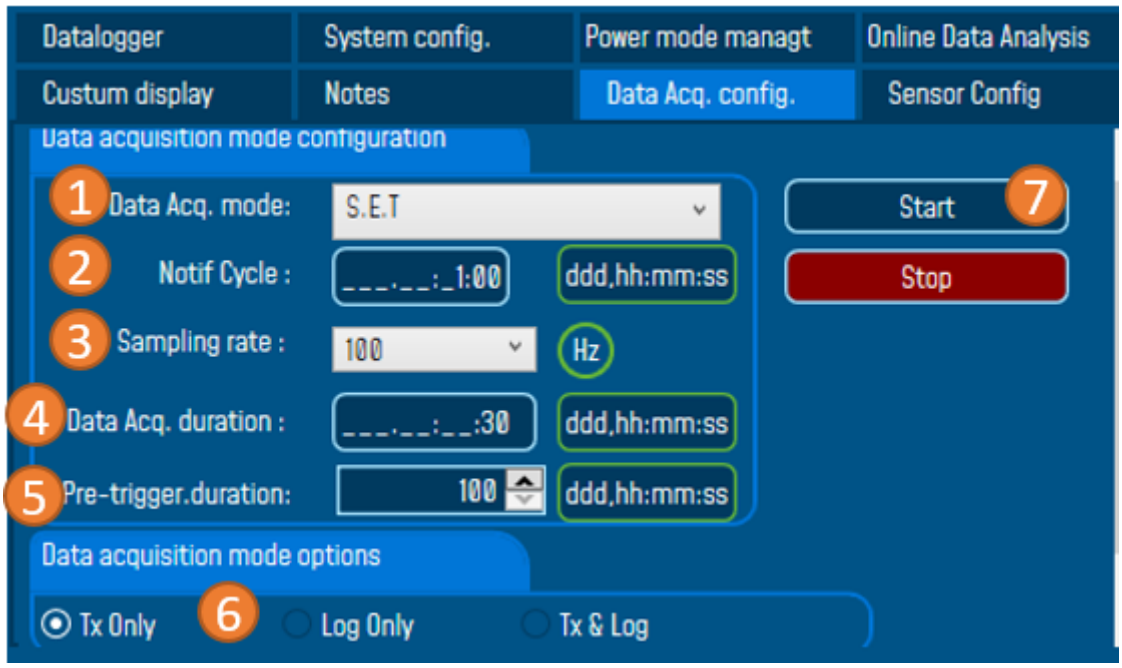


Figure 98: S.E.T mode configuration

1	*Choose "SET mode "(streaming with event trigger) as a DAQ mode*
2	*Enter Notification Cycle for the monitoring*
3	*Enter sampling rate (500Hz)*
4	*Enter Data acquisition duration: 30s*
5	*Set pre-trigger duration to 100 ms*
6	*TX only is selected by default*
7	*Start*

By clicking on start button the BeanDevice start to work with the S.E.T mode and here there is two possibilities:

- If an event occurred (a measurement value that exceed one of the thresholds values) the BeanDevice start to record the measurements until the DAQ duration finishes and a notification message will be displayed on the bottom right screen saying that the measurements recording was finished.

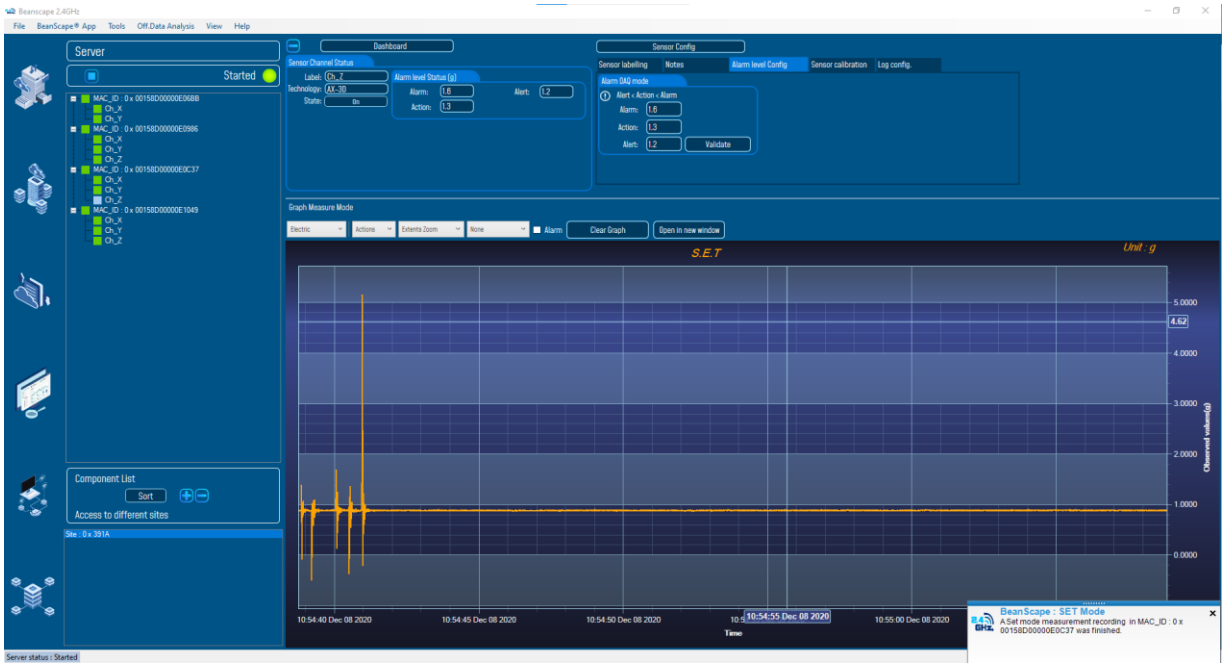


Figure 99: The S.E.T mode recording

- If there is no event occurred and the notification cycle is reached then, all the measurements data though out this duration will be displayed on the graph and a notification message will be displayed saying that the monitoring was OK and there is no event recorded.

Figure 100: The Monitoring is OK

11.6 SYNCHRONUOUS MULTICASTING

11.6.1 Step 1: Build your multicast group

1. Click on your BeanGateway ® profile
2. Click on Multicasting Tab
3. Click on the scroll list and select the BeanDevice® which should be added to the Multicast group

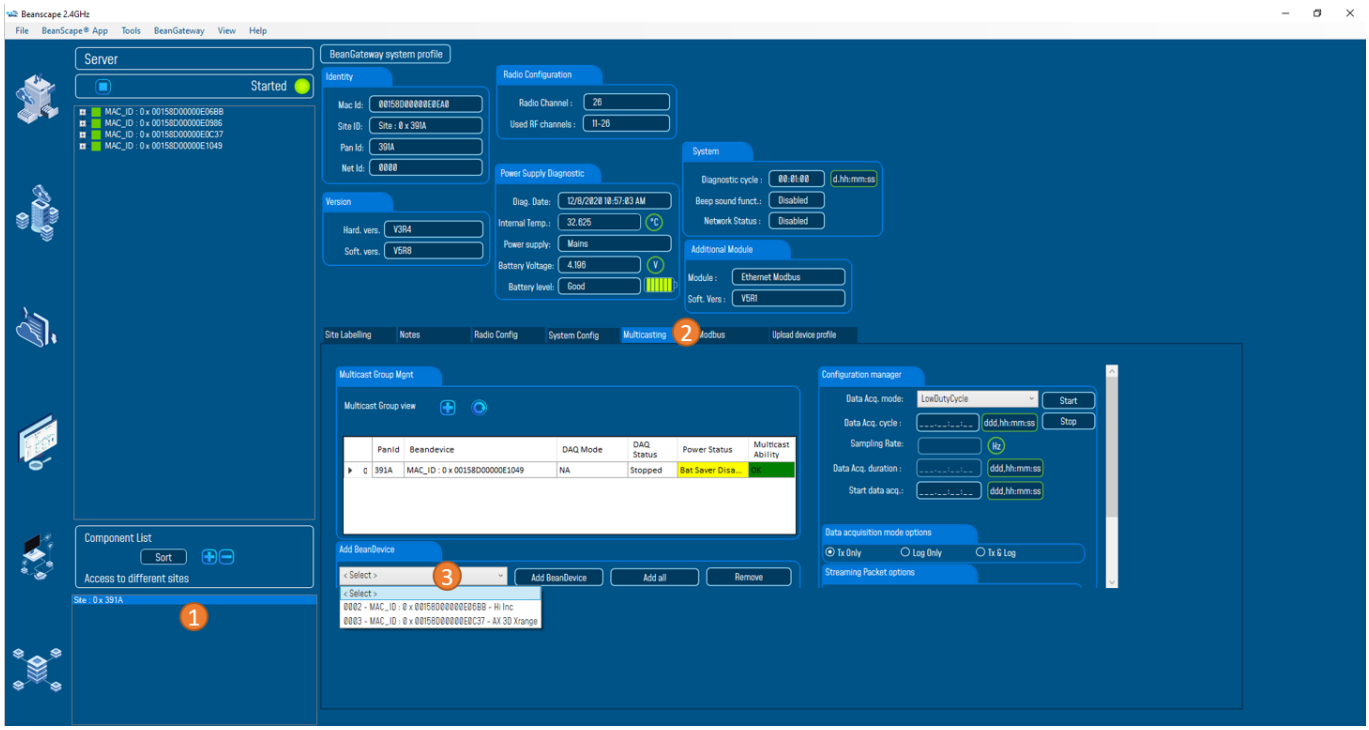


Figure 101: Overview: Multicasting interface

11.6.2 Step 2: Select the Data Acquisition mode

It's very important to know, before selecting the suitable acquisition mode, that the multicast configuration manager display only the common acquisition modes used by the different types of BeanDevices® in your multicast Group.

If you have, for example, AX-3D BeanDevices® and Hi-Inc BeanDevices®, The S.E.T mode and The Survey mode will not be displayed.

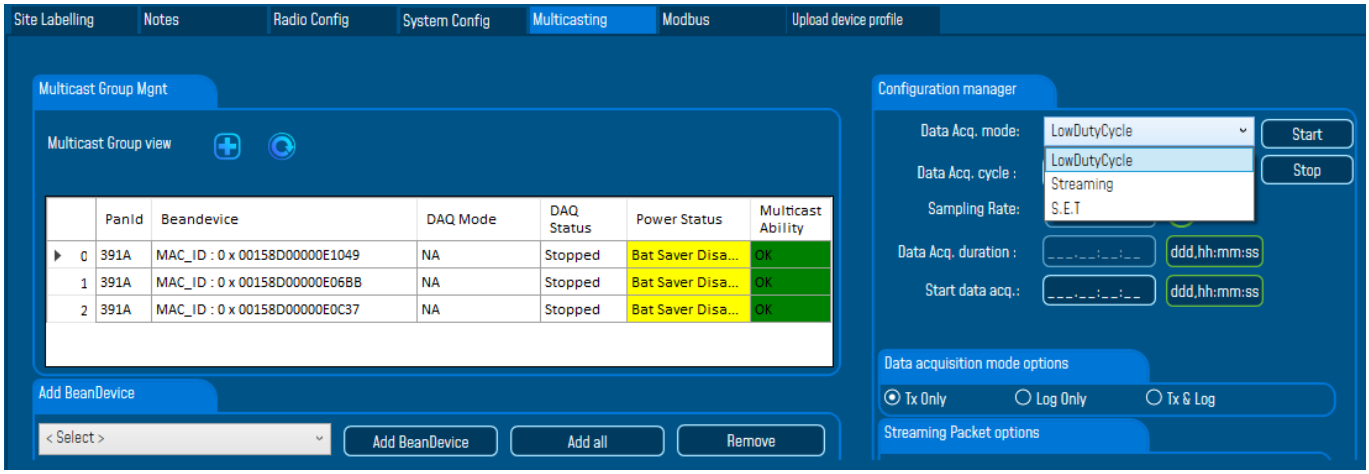


Figure 102: Overview: Multicast Group Management

11.6.3 Step 3: Click on Start to run your multicast

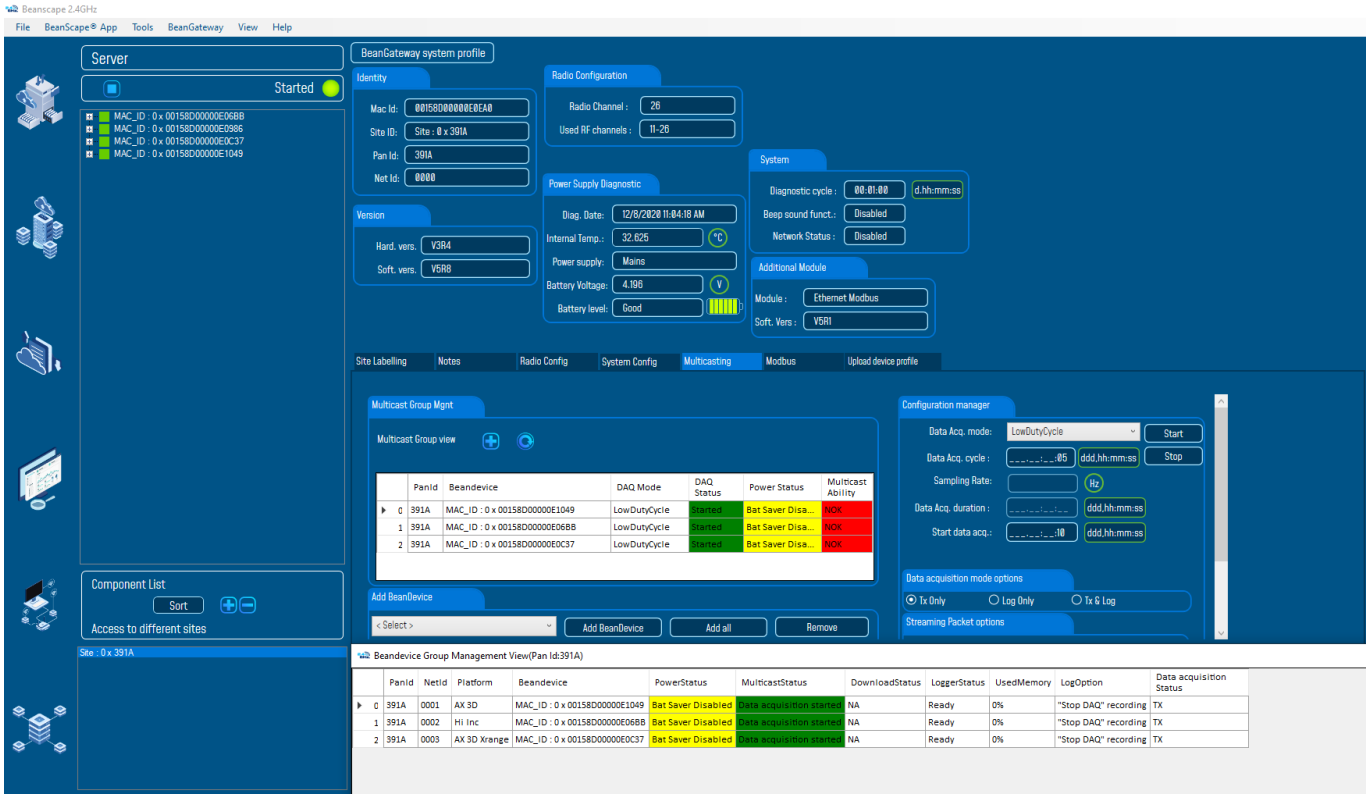


Figure 103: Overview : Active Multicast Group

See “Synchronizing Acquisition with the Multicasting” YouTube video

If you are using several BeanGateway® on the same field:

- The distance between each BeanGateway® should be at least 5 meters
- PAN ID should be different between the BeanGateway®
- RF Channel between each BeanGateway® should be spaced by two RF channels

12. APPENDICE2: HOW TO SET UP THE RIGHT SAMPLING RATE TO GET THE RIGHT STRUCTURE RESONANCE VALUE

In many cases, the parameters set by the user can reflect wrong measurement values. The most important case to mention is the wrong setting of the **Sampling Rate** value related to your measurement.

12.1 THE RIGHT SAMPLING RATE SETTING

For example, we will install a BeanDevice® AX-3D Xrange 3 axis Accelerometer on our structure, and we begin to receive Vibration data, FFT and Velocity.

The BeanDevice® is sampling with **100 Hz** using a Streaming data acquisition mode.

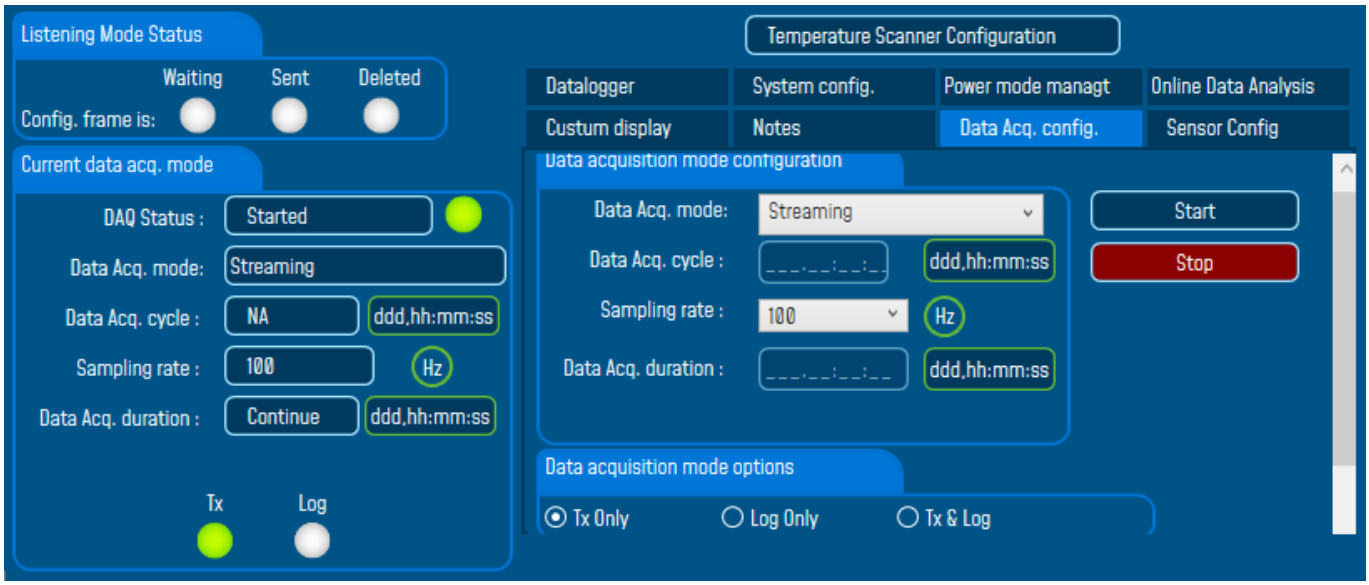


Figure 104: Wrong sampling rate value for resonance frequency monitoring

On the graph, we can observe on the FFT Spectrum a doom representing the Resonance frequency calculated. 32.05 Hz is not a logical value of the Resonance frequency of our structure, this is a wrong measurement.

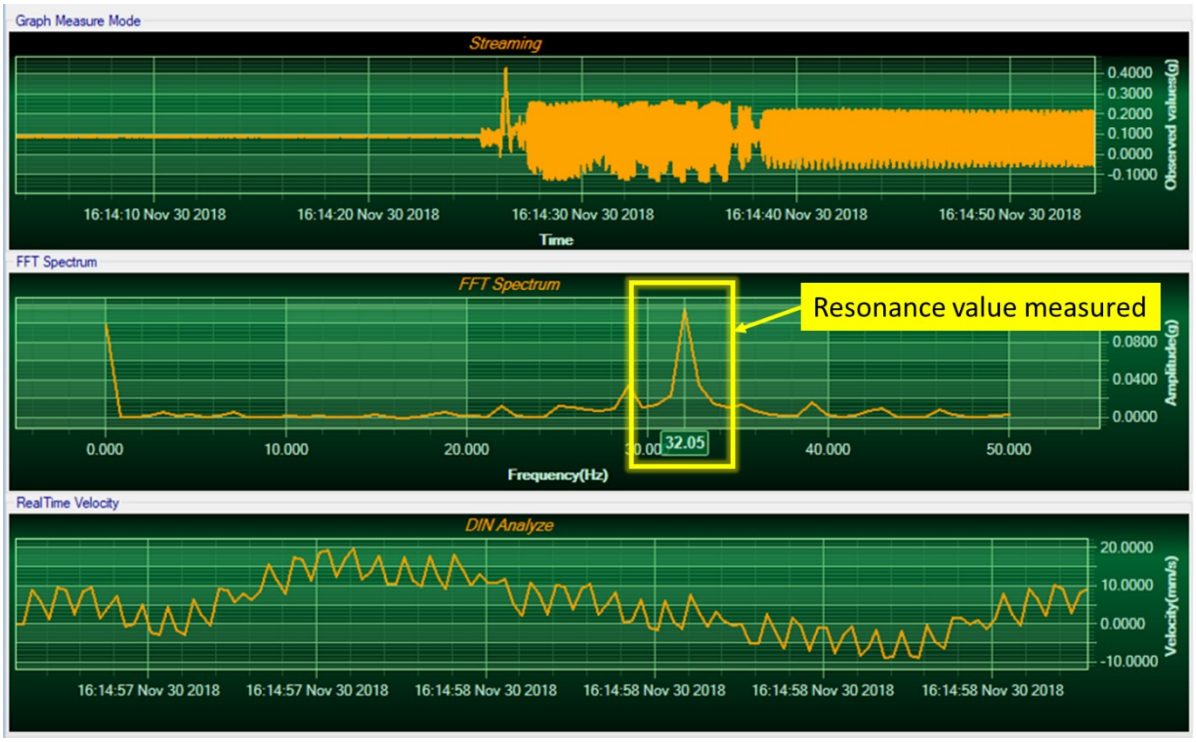


Figure 105: Wrong resonance frequency value

To monitor your structure and receive right measurement values, you have to configure your BeanDevice® to sample with more than the double of the estimated resonance frequency value.

Sampling Rate > 2 x Resonance frequency of the structure

In our case, the estimated resonance frequency of our structure should be between 220 Hz and 280 Hz, so the Sampling rate of our BeanDevice® should be upper than the average of our estimation (> 2 x 250).

In our example we used 600 Hz as sampling rate.

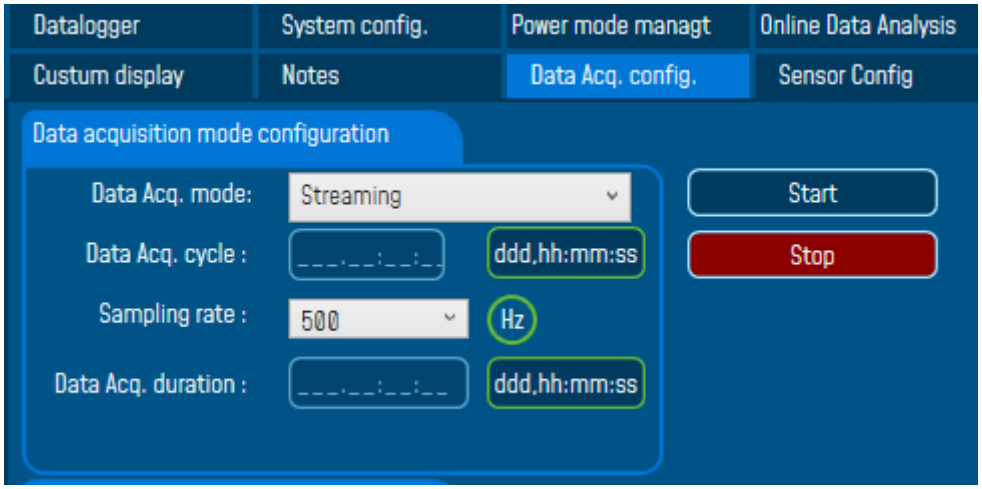


Figure 106: Right sampling rate for good resonance frequency monitoring

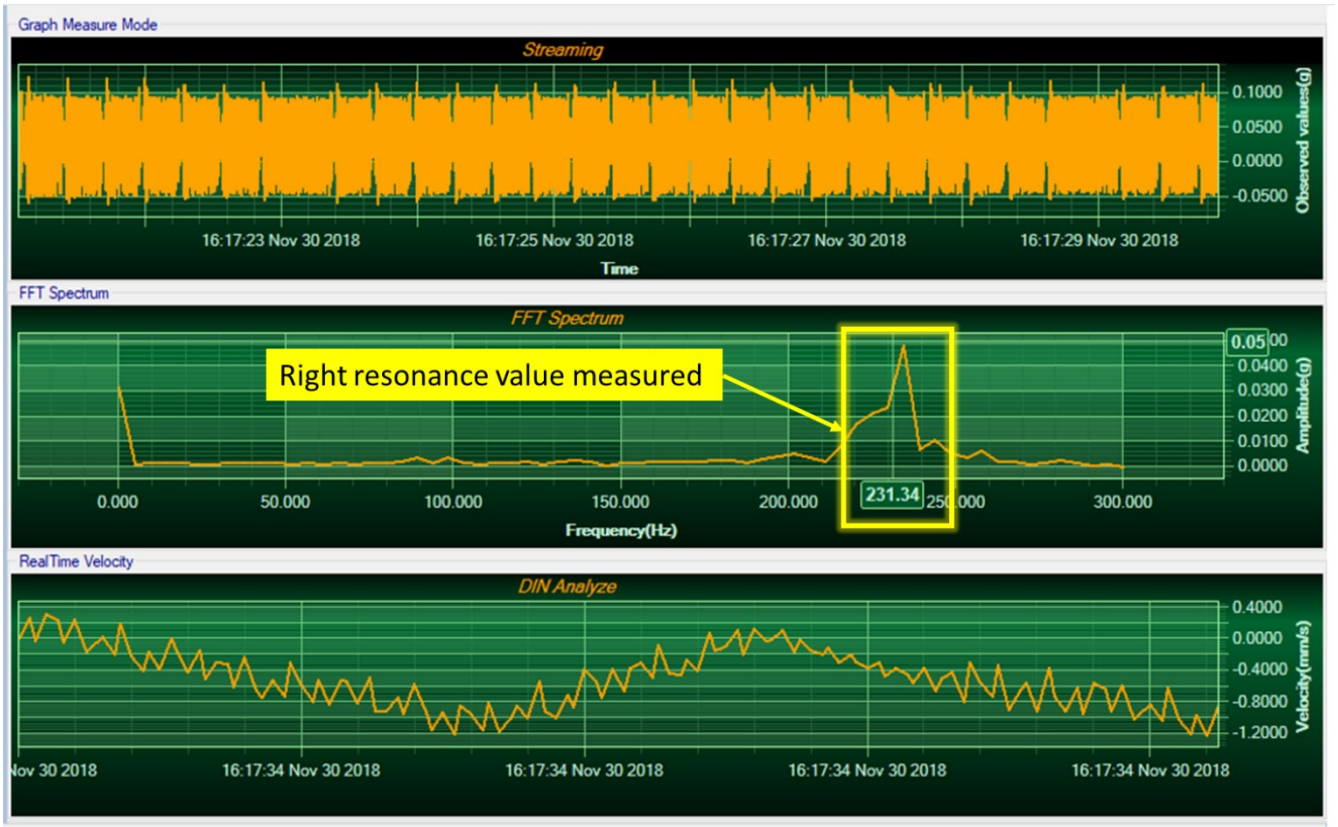
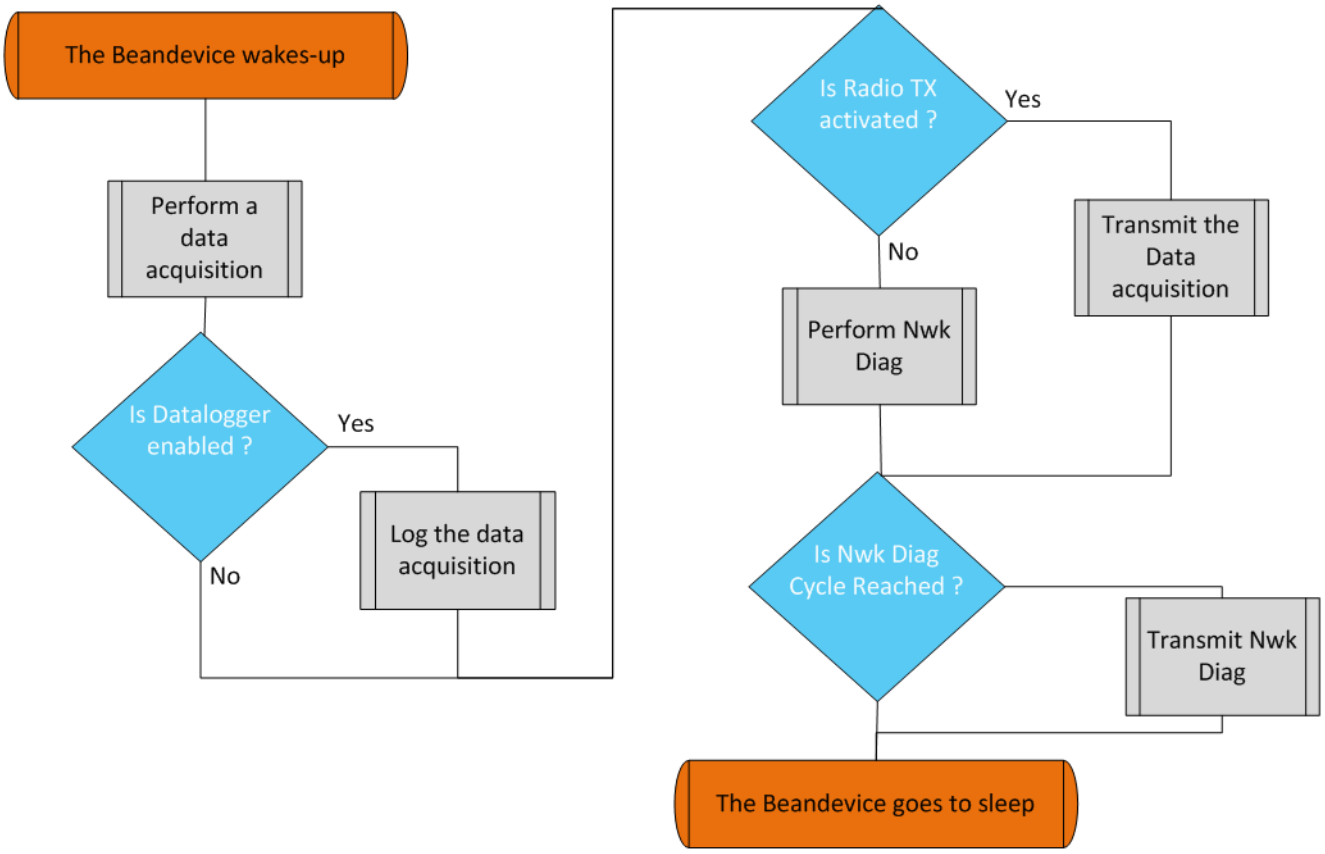


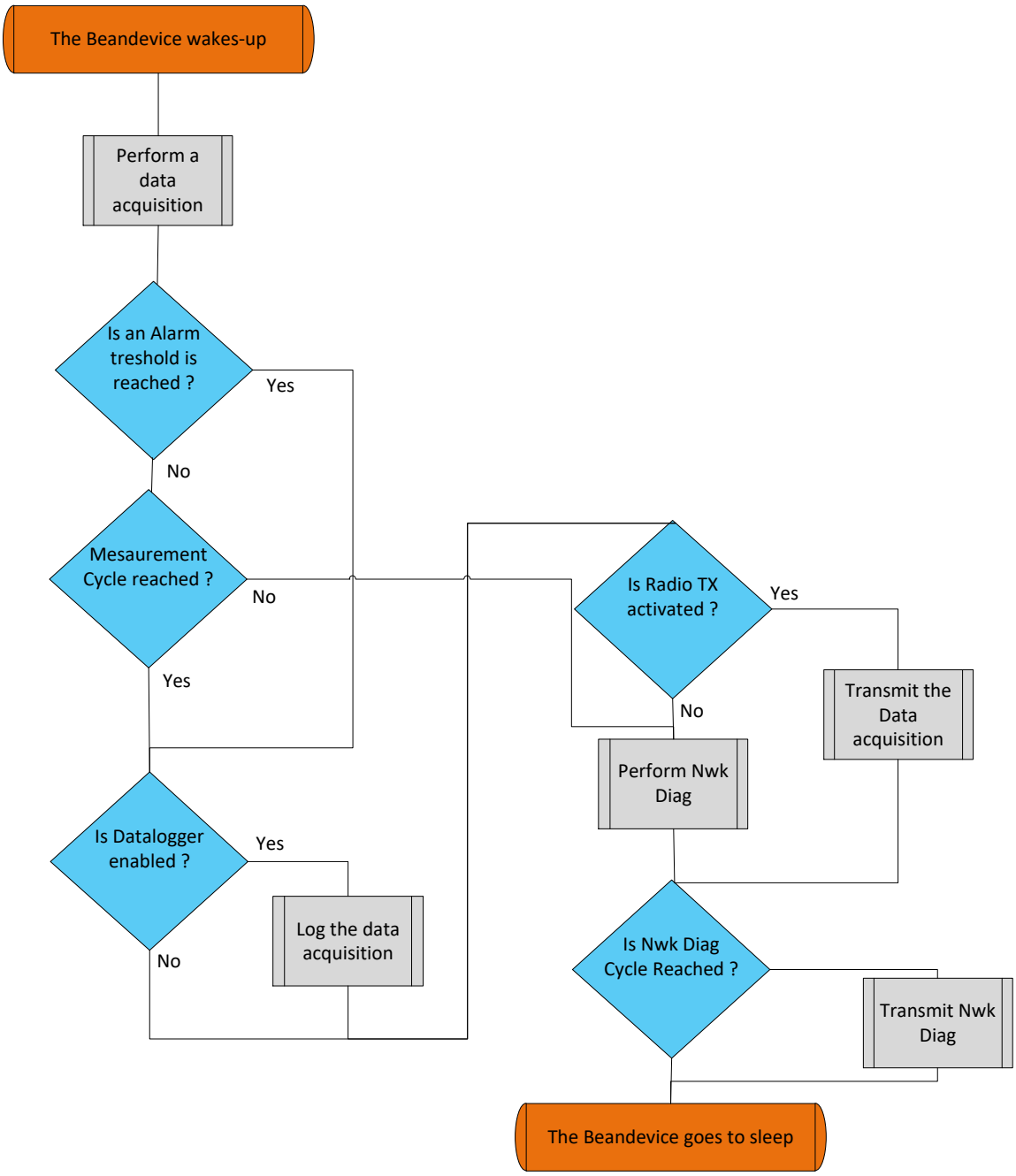
Figure 107: Right resonance frequency value

13. APPENDICE 3: FLOWCHART DIAGRAM (FOR EXPERT USER ONLY)

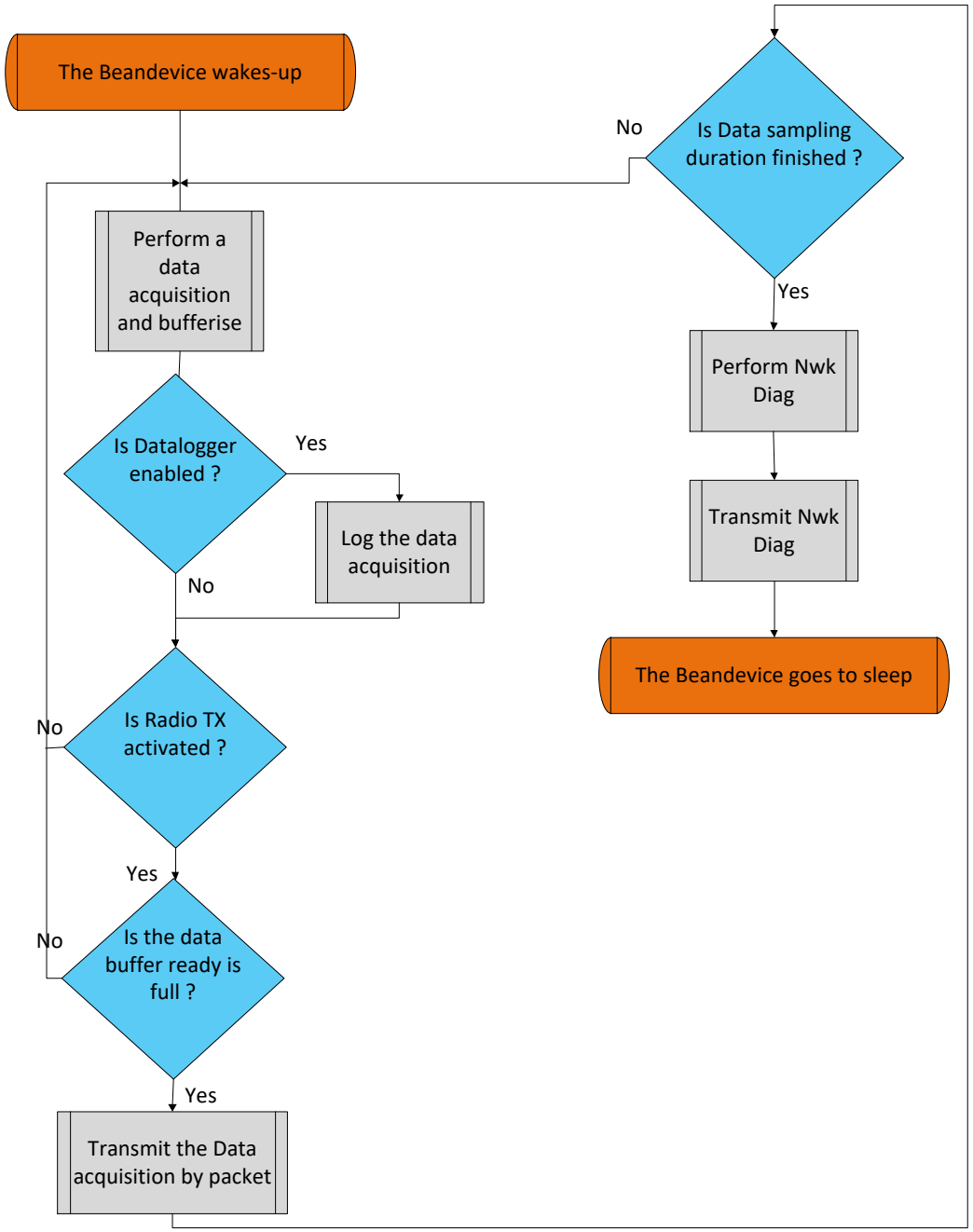
13.1 "LDCDA" DATA ACQUISITION MODE WITH SLEEPING POWER MANAGEMENT



13.2 « SURVEY » DATA ACQUISITION MODE WITH SLEEPING POWER MANAGEMENT

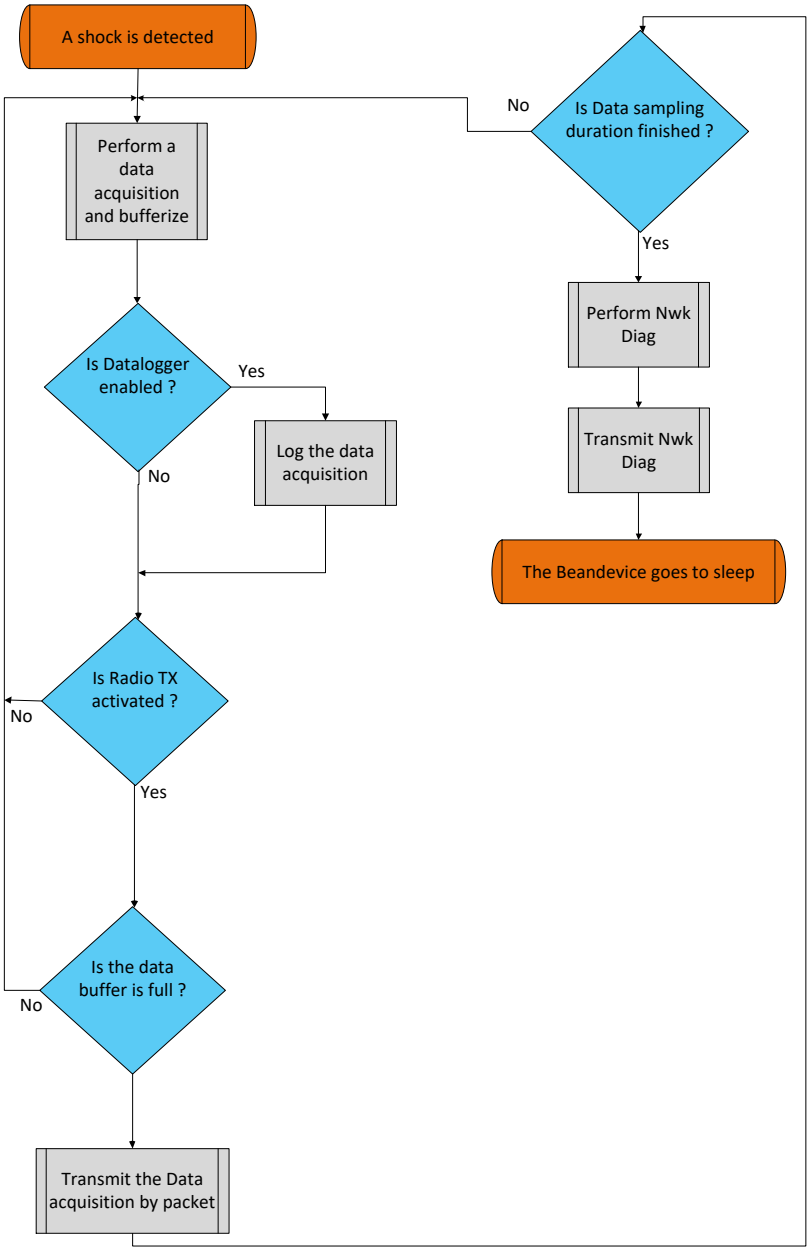


13.3 « STREAMING » DATA ACQUISITION MODE WITH SLEEPING POWER MANAGEMENT

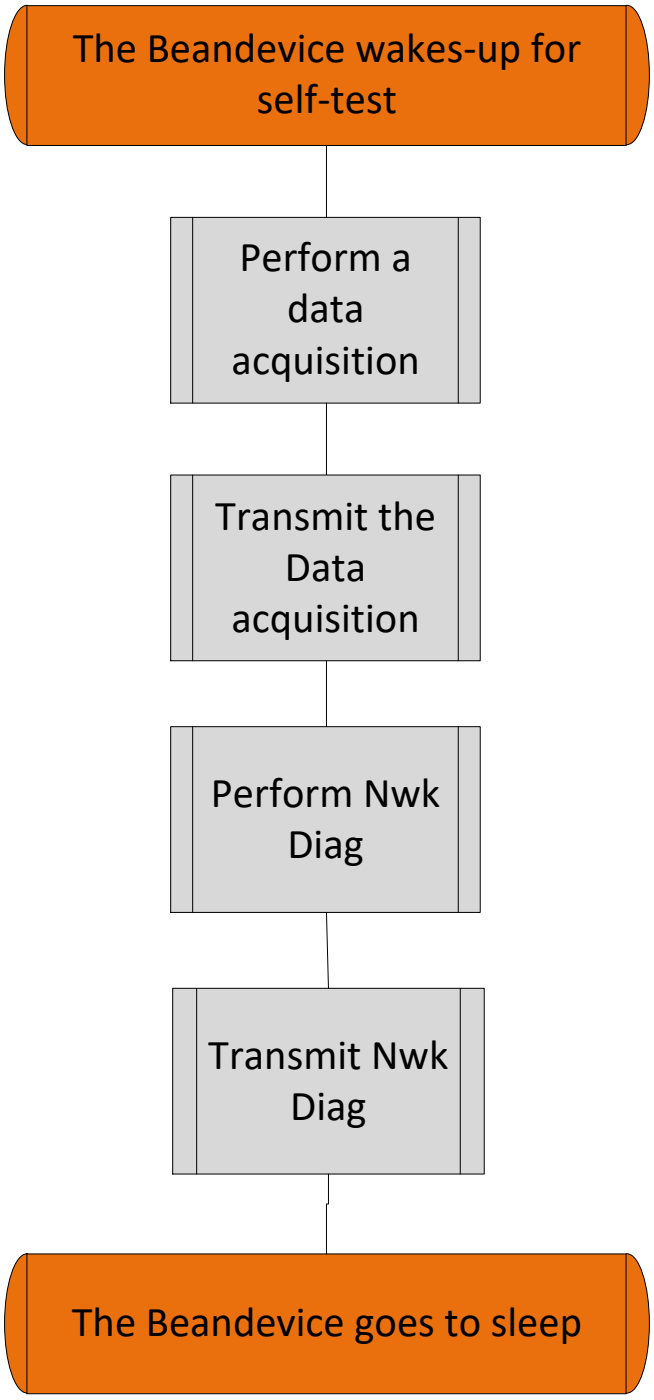


13.4 SSD (SMART SHOCK DETECTION)

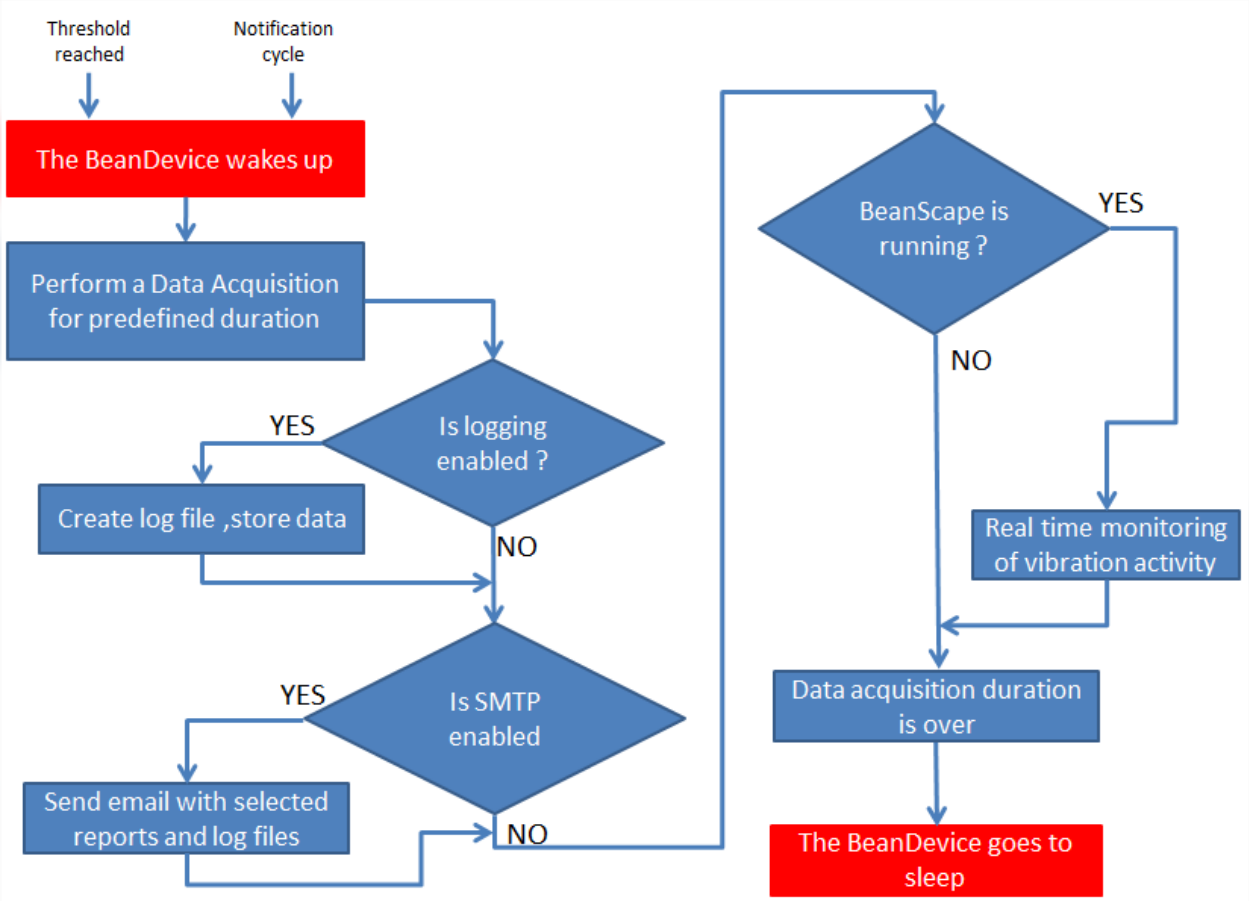
13.4.1 Shock Detection Flowchart



13.4.2 Self-test Flowchart



13.5 SET MODE (STREAMING WITH EVENT TRIGGER)



14. APPENDICE 4: HOW TO PREVENT A BEANSCAPE® CRASH

During a streaming or streaming Data acquisition mode, your computer resources will be intensively used.

For avoiding a PC crash, the following steps should be followed:

- ✓ Disable Keep alive function on your computer and the BeanGateway ®
- ✓ Disable the sleep mode of your computer & Ethernet board. For further information, please read the user manual of your computer.

14.1 DISABLE KEEP ALIVE FUNCTION

Keep alive message is exchanged between the BeanScape® and BeanGateway ® to check that the link between the two is operating, or to prevent this link from being broken.

During a streaming mode, keep alive message uses a low priority compared to the Data acquisition message.

This link can be disconnected due to a high network activity.

14.1.1 Disable the Keep Alive on your BeanGateway ®

1. Go on your BeanGateway ® profile and click on **Tools**, then click on **BeanGateway ® config**.
2. A new window will open called "**BeanGateway ® configuration**"
3. Disable the Keep alive available on your **BeanGateway ®**

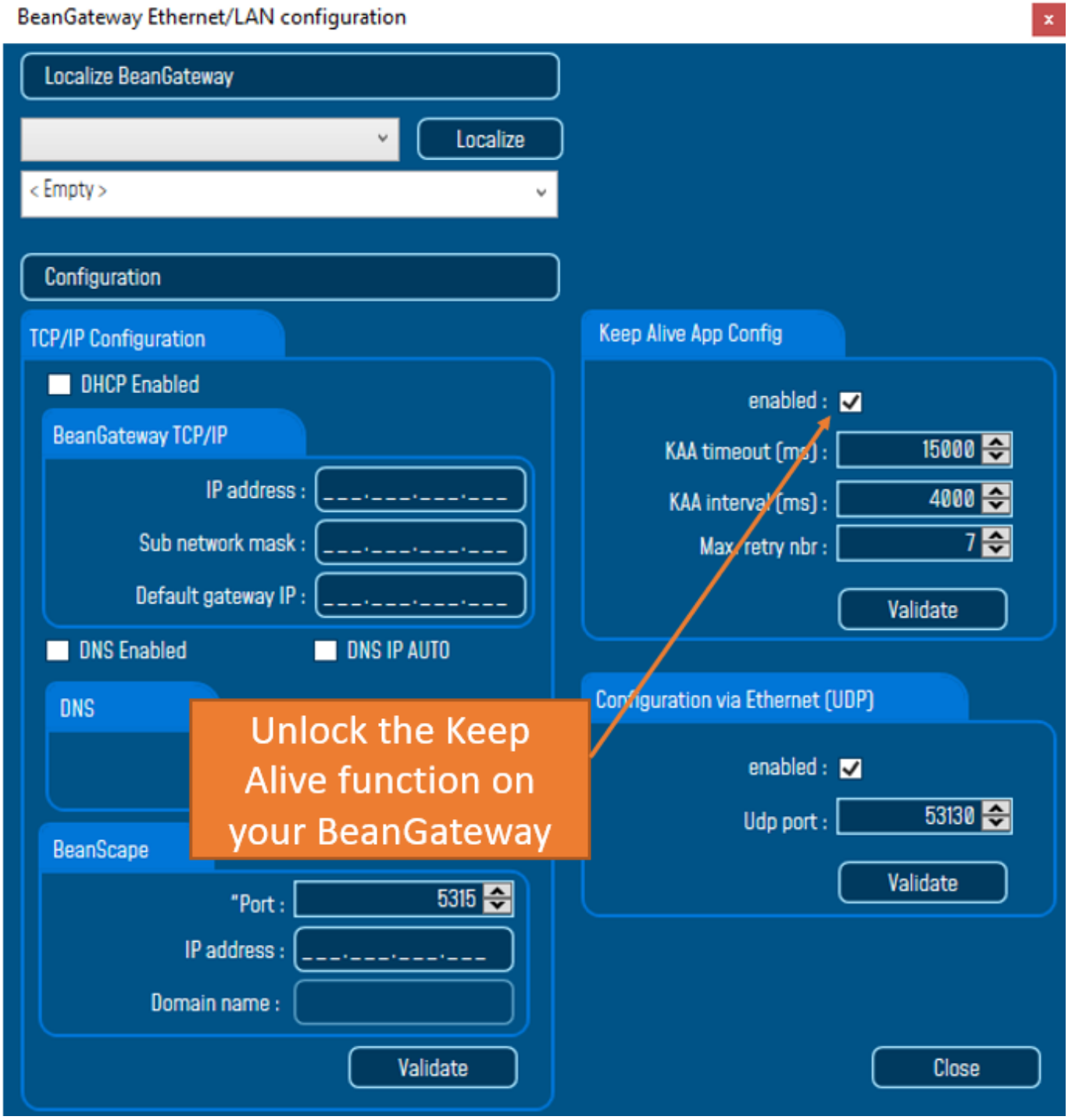


Figure 108: BeanGateway configuration panel on BeanScape

Disable the Keep alive on your BeanScape®

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

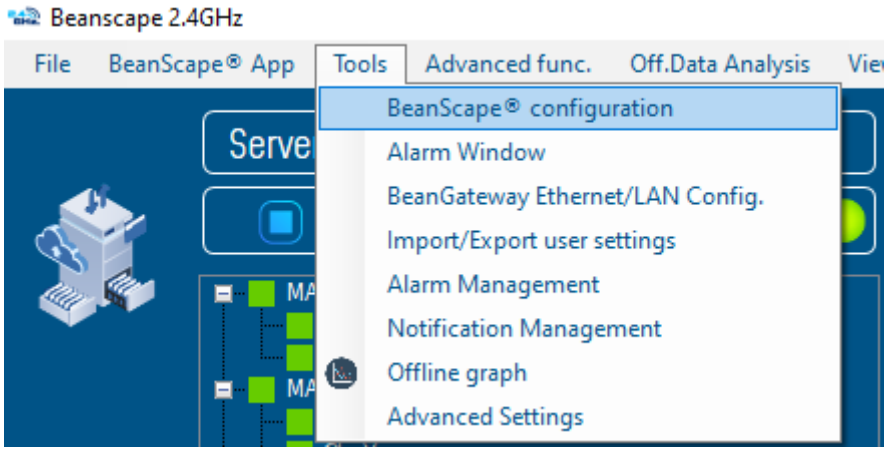


Figure 109: BeanScape Tools menu

You will see the following window:

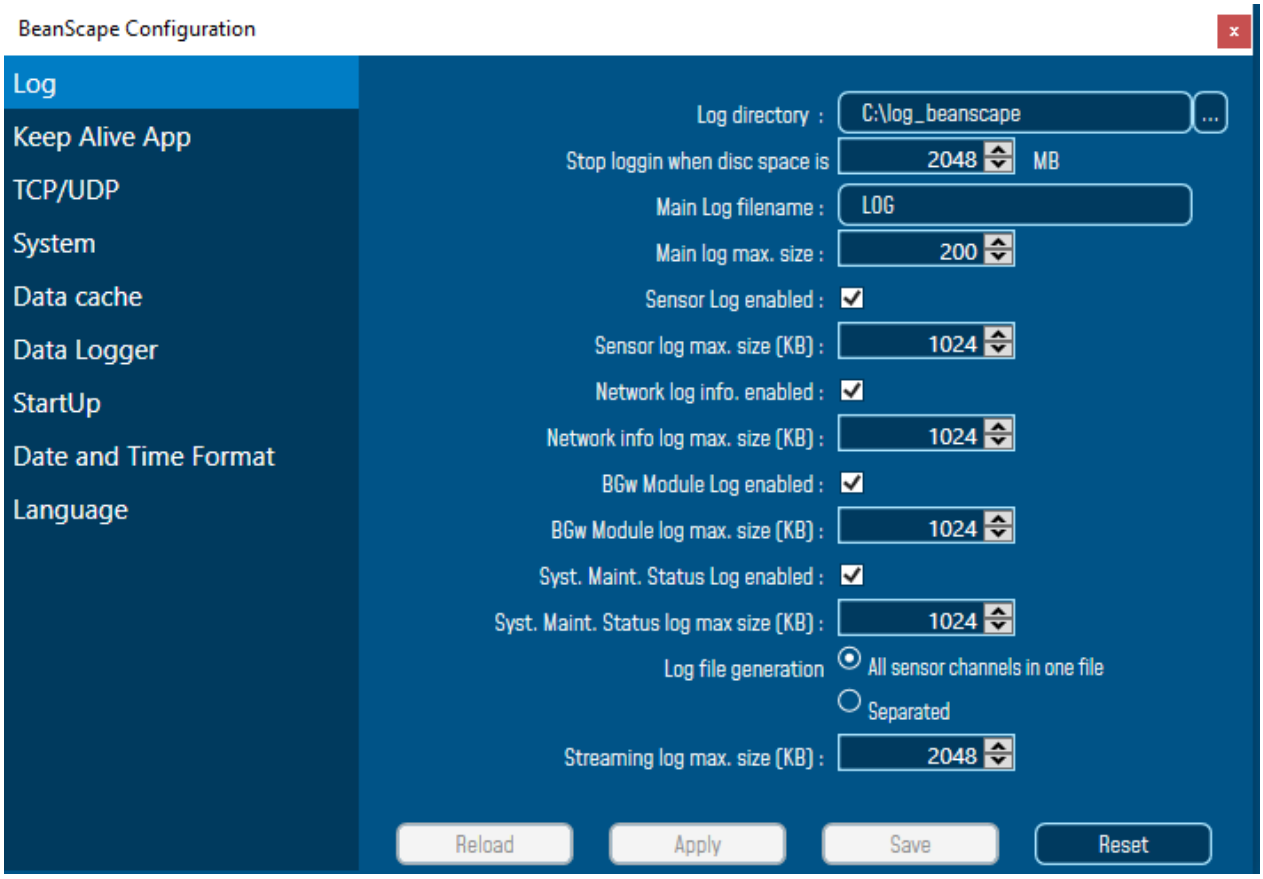


Figure 110: BeanScape configuration Window

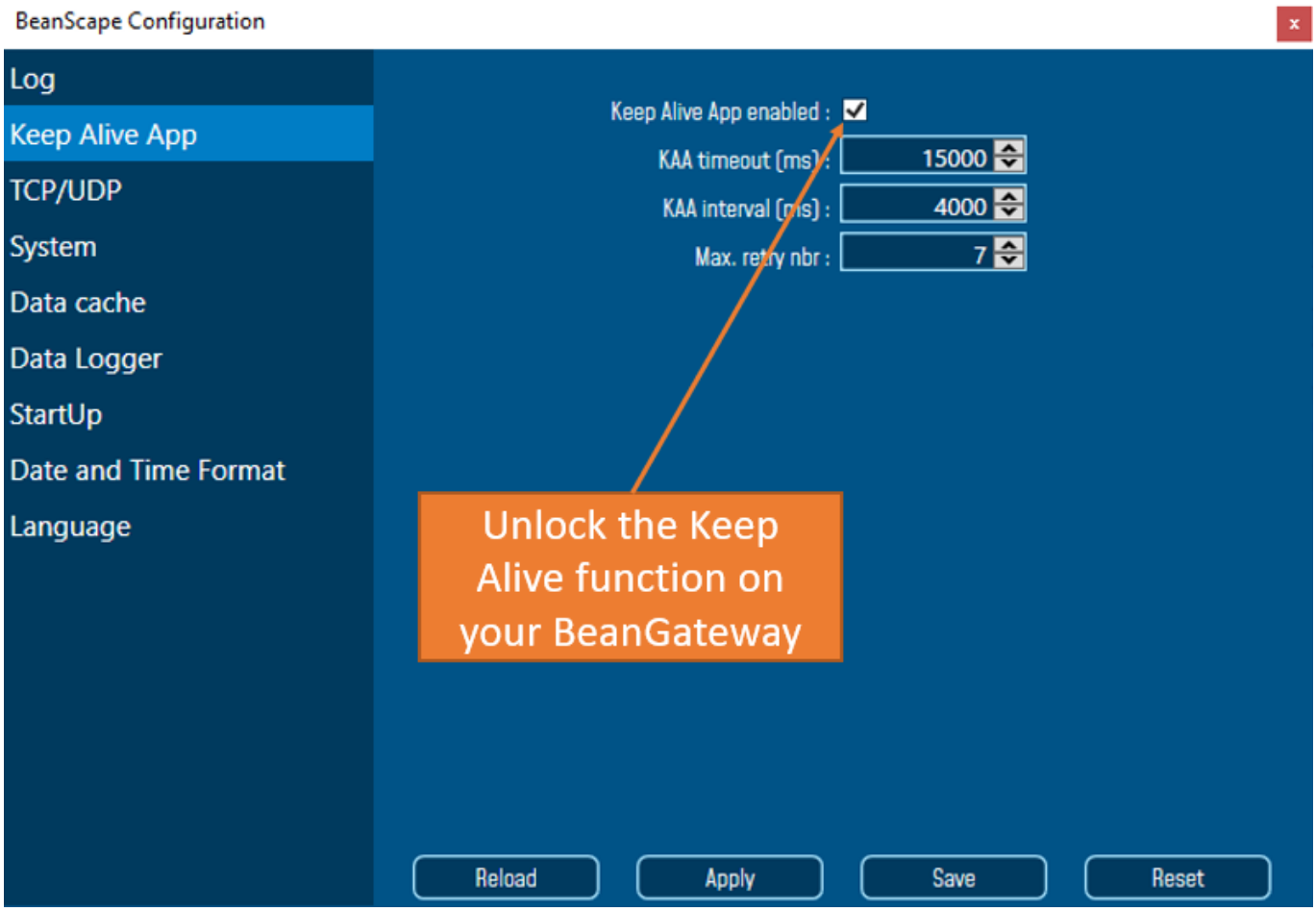


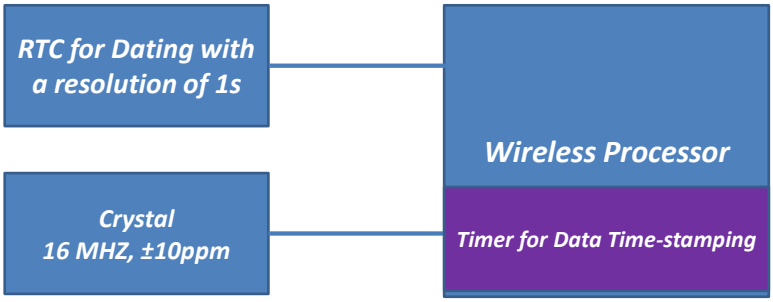
Figure 111: KeepAlive option on BeanScape configuration window

15. APPENDICE 5: DATA SAMPLING ACCURACY IN STREAMING MODE (FOR ADVANCED USERS)

All the BeanDevice® integrates a RTC (Real-Time-clock) and a high accuracy timer for Data sampling.

The RTC is a computer clock in the form of an integrated circuit that keeps track of the current time. It is used by the BeanDevice®.

Architecture of Real-Time-Clock & Timer on the BeanDevice®



A RTC (Real-Time-Clock) is used for starting the Data sampling on a date (Year, Month, Hours, Minute and seconds).
A Timer is used for Data Sampling (Δt), the Timer source is a 16 MHz Crystal with a frequency stability of ±10 ppm at 25°C. Data transmission does not affect Data sampling process.

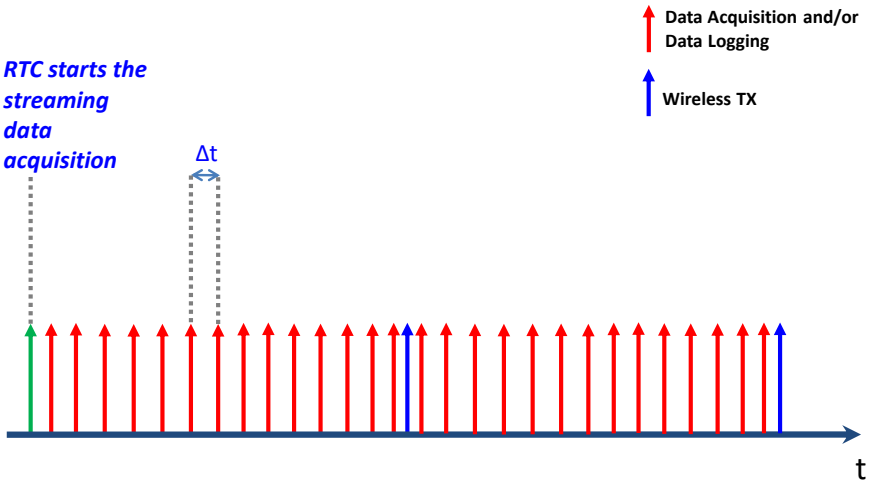


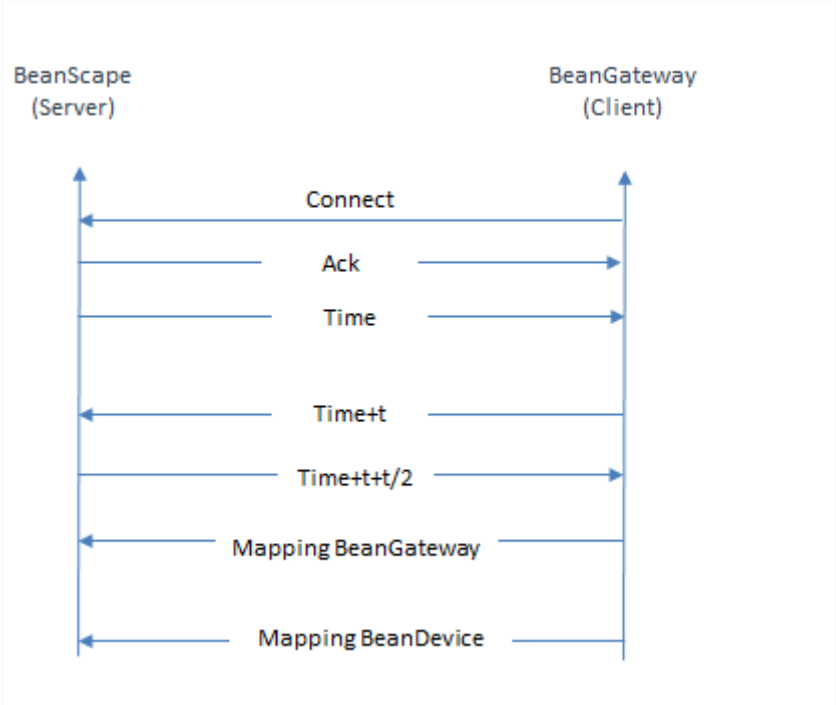
Figure 112: RTC timeline

15.1 TIME-SYNCHRONIZATION OVER THE WIRELESS SENSOR NETWORKS

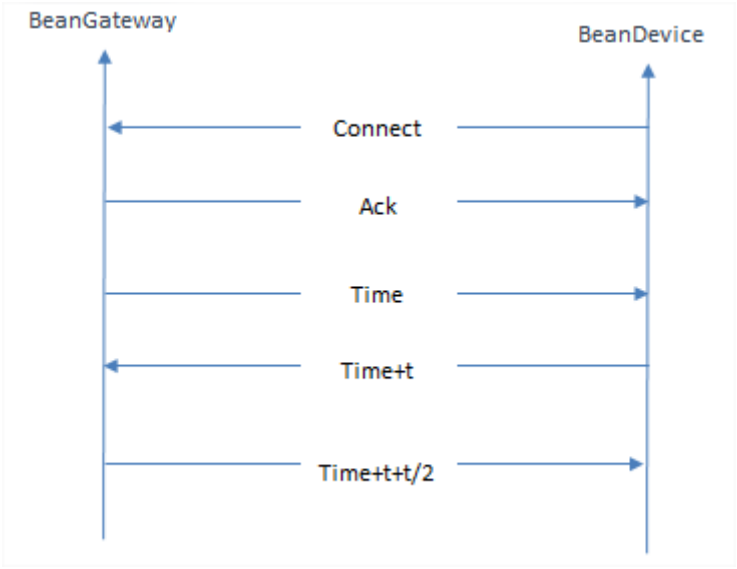
The time synchronization period between the BeanScape® and the BeanGateway® does not exceed ±2.5ms at 25°C.

Accuracy @25°C	***±2.5ms***

The time synchronization process between BeanScape® and the BeanGateway® is described in the following flowchart:



The time synchronization process between the BeanGateway® and the BeanDevice® is described in the following flowchart.



15.2 CRYSTAL SPECIFICATIONS

Nominal frequency	***16 Mz***
Frequency tolerance (at 25±3 ℃)	***± 10 ppm***
Frequency Stability (vs. 25 ℃)	***± 10 ppm***
Aging Rate	***± 3 ppm/year***