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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
	<u>Caution or Warning</u> – 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.
	<u>Danger</u> – This information MUST be followed if not you may damage the equipment permanently or bodily injury may occur.
1	<u>Tip or Information</u> – Provides advice and suggestions that may be useful when installing Beanair Wireless Sensor Networks.

#### 3. ACRONYMS AND ABBREVIATIONS

AES	Advanced Encryption Standard
ССА	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
МАС	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<sup>®</sup>.

#### 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 – 2.4C	GHz		
Low consumption			<u>.</u>			
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 Monitoring measurement on remote with sleeping sites mode (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		<b>SSS</b>	3	<b>@@@</b> @	<b>I</b>	

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)	Ø		$\bigotimes$	$\bigotimes$	$\bigotimes$		$\bigotimes$
Survey	Ø						
Streaming			$\bigotimes$				$\bigotimes$
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<sup>®</sup>.

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



Figure 1: LDCDA mode Timeline

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

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

**G**o to the <u>LDCDA Flowchart diagram section</u> 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**<sup>®</sup>, 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 <sup>®</sup> is operating with "Sleep power mode"	4s
	The BeanDevice <sup>®</sup> 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<sup>®</sup>, please read the following technical note <u>TN\_RF\_010 - « BeanDevice<sup>®</sup> Power Management »</u>

#### 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*<sup>®</sup>);
- ✓ Data transmission is done with a duty cycle of *Ct* = *N*\**Cm*, N is configurable from the *BeanScape*<sup>®</sup> supervision software;
- ✓ Whenever an alarm threshold (user-configurable) is reached (4 alarm threshold levels High/Low), an alarm notification is transmitted to the *BeanGateway*<sup>®</sup>;



Figure 2: Survey mode Timeline

In survey mode, the BeanDevice® operates as follows:

- ✓ <u>Step 1</u>: The BeanDevice<sup>®</sup> wakes up (if sleep mode is selected), all the sensors connected to the BeanDevice<sup>®</sup> are also activated;
- <u>Step 2</u>: A Data acquisition is performed;
- ✓ <u>Step3</u>: If the Data logger function is enabled: the Data acquisition is registered on the BeanDevice<sup>®</sup> Data logger if an alarm threshold is reached <sup>®</sup> or a measurement cycle is reached;
- ✓ <u>Step 4:</u> If "Wireless transmission" option is enabled: The Data acquisition is transmitted to the BeanGateway <sup>®</sup> if an alarm threshold is reached or a transmission cycle is reached;
- <u>Step 5:</u> A Network diagnostic is performed and transmitted to the BeanGateway<sup>®</sup> (depending on diagnostic cycle defined by the user);
- ✓ <u>Step 6:</u> The BeanDevice<sup>®</sup> 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®".** 

**G**o to the <u>Alarm Flowchart diagram section</u> 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 <sup>®</sup> in a
   continuous flow rate. This mode is adapted for continuous monitoring on machines.
- « Burst » option: Data acquisition is transmitted to the BeanGateway<sup>®</sup> in a burst flow rate
- « One Shot » option: Data acquisition is transmitted to the BeanGateway <sup>®</sup> 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

- ✓ **<u>Step 1</u>**: A Data acquisition is performed with a high sampling rate, and buffered ;
- <u>Step 2</u>: If Data logger function is enabled: The Data acquisition is backed up on the BeanDevice<sup>®</sup> Data logger;
- <u>Step 3:</u> If "Wireless transmission" option is enabled: If Data buffer is full, a Data packet is transmitted to the BeanGateway <sup>®</sup>;
- ✓ <u>Step 4</u>: 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

- ✓ <u>Step 1</u>: A Data acquisition is performed with a high sampling rate, and buffered ;
- ✓ <u>Step 2</u>: If "Datalogger" option is enabled: the Data acquisition is backed up on the BeanDevice<sup>®</sup> Data logger;
- <u>Step 3:</u> If "Wireless transmission" option is enabled: If Data buffer is full, a Data packet is transmitted to the BeanGateway <sup>®</sup>;
- Step 4: Step 1 to Step 3 are repeated until the sampling duration is completed;
- <u>Step 5</u>: A Network diagnostic is performed and transmitted to the BeanGateway<sup>®</sup> (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

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

BeanDevi	ce® Model	BeanDevice <sup>®</sup> AX-3D	BeanDevice® AX-3D XRange	BeanDevice <sup>®</sup> HI- INC & INC & HI- INC XRange	BeanDevice® AX-3DS	BeanDevice® AN-V/AN-mV/AN-420
Number of	1 Channel	3 KSPS	3 KSPS	60 SPS	1 KSPS	400 SPS
enabled DAQ	2 Channels	1,5 KSPS	1,5 KSPS	60 SPS	1 KSPS	400 SPS
channel	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<sup>®</sup> settles a margin of 10s between these two parameters.



<u>Streaming mode</u>: PER (Packet Error Rate) will increase proportionately with the sampling rate, mainly if several BeanDevice<sup>®</sup> 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: <u>RF TN 003- "Aggregation capacity of wireless sensor networks"</u>



Go to the <u>Streaming Flowchart diagram section</u> 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<sup>®</sup> 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<sup>®</sup>), the operation is the same than streaming with continuous monitoring;
- ✓ The notification cycle is a cyclic period when the BeanDevice<sup>®</sup> 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<sup>®</sup> 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<sup>®</sup> 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<sup>®</sup> transmits data measurement during Δt1.



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

#### 7.6.1 Description



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

#### The BeanDevice® wakes up on two conditions:

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





#### Figure 7: SSD Mode timeline

 $\Delta t1 = 12.5 \text{ ms}$ , Latency time between the BeanDevice<sup>®</sup> wakes up and the first Data acquisition

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

- ✓ <u>Step 1</u>: A shock threshold is reached (user-configurable), the BeanDevice<sup>®</sup> wakes up;
- ✓ <u>Step 2</u>: A Data acquisition is performed with a high sampling rate, and buffered ;
- <u>Step3</u>: If Datalogger feature is enabled: the Data acquisition is registered on the BeanDevice<sup>®</sup> Datalogger;
- <u>Step 4:</u> If a Data Transmission function is enabled: The Data acquisition is transmitted to the BeanGateway <sup>®</sup>;
- $\checkmark$  <u>Step 5</u>: Step 2 to Step 4 are repeated until the sampling duration ( $\Delta$ t2) is completed;
- Step 6: A Network diagnostic is automatically performed and transmitted to the BeanGateway <sup>®</sup>

✓ <u>Step 7:</u> The BeanDevice<sup>®</sup> goes to sleep

#### 7.6.3 During a Survey

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

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

#### The Datalogger is not activated during a survey

••• <u>•</u> •	SD SSD - Sr (du	nart Shock detection ıring a self-test)	
Data Acquisition & Data Logging Wireless TX	<ul> <li>Network Diagnostic transmission</li> <li>BeanDevice wakes up (a shock threshold is reached)</li> </ul>	Start sleeping	
	Sleep		
٠			t,

Figure 8: SSD Mode timeline during s self test



See "Diagnostic Status" YouTube video

Beanair GmbH

#### 8. SYNCHRONUOUS MULTICASTING

#### 8.1 BEANDEVICE® COMPATBILITY

Synchronous multicasting is only available on the following BeanDevice®:

- Beandevice<sup>®</sup> AX-3D
- Beandevice<sup>®</sup> AX-3D Xrange
- Beandevice<sup>®</sup> INC (not available on the Xtend version)
- Beandevice<sup>®</sup> HI-INC (not available on the Xtend version)
- Beandevice<sup>®</sup> HI-INC Xrange (not available on the Xtend version)
- Beandevice<sup>®</sup> 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<sup>®</sup> that have been configured as members of a multicast group within the WSN.

<u>Step1</u>: The BeanScape<sup>®</sup> transmits to the BeanGateway <sup>®</sup> 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<sup>®</sup> belonging to the same multicast group. The BeanDevice<sup>®</sup> sends an ACK (acknowledgment) if the OTAC request is accepted.



Figure 10: OTAC exchanging in Multicast Group

<u>Step 3</u>: If the OTAC request is linked to a Data acquisition mode, it will start at the same time for all the BeanDevice<sup>®</sup> belonging to the same multicast group. The user can configure a <u>starting delay</u> (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<sup>®</sup> in the multicasting group, the download starts with the next BeanDevice<sup>®</sup>. If a download process is interrupted on a BeanDevice<sup>®</sup>, it restarts for several trials.

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

- Your BeanDevice<sup>®</sup> are not out of range of your BeanGateway<sup>®</sup>.
- You have enough power on your BeanDevice<sup>®</sup>

#### **8.3 DESCRIPTION**

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





Field	Parameters	Description								
Multicast Group management (1)	/	<ul> <li>Displays the list of BeanDevice<sup>®</sup> linked to the Multicast Group</li> <li>✓ BeanDevice<sup>®</sup>: BeanDevice<sup>®</sup> MAC ID</li> <li>✓ DAQ Mode : Current Data acquisition mode</li> <li>✓ DAQ Status : Current Data acquisition mode status</li> <li>✓ Power Status: Current Power mode status</li> <li>✓ Multicast Ability: OK or NOK. If NOK, you have to Stop acquisition in your BeanDevice<sup>®</sup>.</li> </ul>								
Add BeanDevice® (2)	Select	Select the BeanDevice® from the scroll list								
	Add BeanDevice®	Add a BeanDevice <sup>®</sup> to your Multicast group								
	Add all	Add all the BeanDevice <sup>®</sup> to your Multicast group								
	Remove	Remove a BeanDevice <sup>®</sup> from your Multicast group								
Configuration Manager (3)	/	Same setting than "Data acquisition mode" configuration Tab available on the BeanDevice® profile <u>Click here for more information</u> 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								
	Stop	These parameters are dispatched to the Multicast group.								
	Erase	Your BeanDevice <sup>®</sup> don't need to be in stopped condition.								
	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:

Site	Labellin	9	Notes	Radio Config	System Conf	ig Multicasting	Modbus		Upload device p	profile			
	Aulticas	st Group	Mgnt		Multicas	t Group vie	w Access	5		Configuration mar	hager		
	Multicast Group view 📑 💽									Data Acq. r Data Acq. c	node: LowDutyCyc ycle :	cle v (9 : (ddd,hh:mm:ss)	Start Stop
		Pan	ld Beand	evice	DAQ Mo	de DAQ Status	Power State	us Mult Abili	icast ty	Sampling	Rate:		
	<u>۱</u>	391A	MAC_IE	: 0 x 00158D00000E1049	NA	Stopped	Bat Saver Di	sa OK		Data Acq. dura	tion : (:	: ddd,hh:mm:ss	
	1	391A	MAC_ID	: 0 x 00158D00000E06BB	NA	Stopped	Bat Saver Di	sa OK		Start data	aco.:	es-mm-dd bb	
	2	391A	MAC_IE	: 0 x 00158D00000E0C37	NA	Stopped	Bat Saver Di	sa OK					
	dd Doo						Data acquisition	mode options		_			
Ĺ	iuu bea	IDEVICE								• Tx Only	O Log Only	O Tx & Log	
	< Selec	:t>		~ (	Add BeanDevice	Add all		Remove		Streaming Packe	t options		_
<b>%</b> ⊉ B	eandevio	e Group	Management	/iew(Pan Id:391A)									×
	Panid	NetId	Platform	Beandevice	PowerStatus	MulticastStatus	DownloadStatus	LoggerStatus	UsedMemory	LogOption	Data acquisition Status		
<b>▶</b> 0	391A	0001	AX 3D	MAC_ID : 0 x 00158D00000E1049	Bat Saver Disabled	Data acquisition finished	NA	Ready	0%	"Stop DAQ" recording	Stopped		
1	391A	0002	Hi Inc	MAC_ID : 0 x 00158D00000E06BB	Bat Saver Disabled	Data acquisition finished	NA	Ready	0%	"Stop DAQ" recording	Stopped		
2	391A	0003	AX 3D Xrange	MAC_ID : 0 x 00158D00000E0C37	Bat Saver Disabled	Data acquisition finished	NA	Ready	0%	"Stop DAQ" recording	Stopped		

#### Figure 12: Multicast Group view

Parameters	Description
NetID	BeanDevice <sup>®</sup> Network Address
Platform	BeanDevice <sup>®</sup> product version
BeanDevice <sup>®</sup>	BeanDevice <sup>®</sup> MAC Address
Power Status	BeanDevice <sup>®</sup> 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<sup>®</sup> 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<sup>®</sup> clock without any physical intervention, you can restart your BeanDevice<sup>®</sup> from your BeanScape<sup>®</sup> software.
- The maximum number of BeanDevice<sup>®</sup> is 6;
- Log only mode is used in "<u>Data Acquisition mode options</u>", data loss can be avoided by selecting this option;

Data acquisition	mode options		
⊙ Tx Only	🔿 Log Only	⊖ Tx & Log	

#### 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<sup>®</sup> 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<sup>®</sup> on different fields, before to start to deploy your wireless sensors, only the PAN ID should be different between the BeanGateway<sup>®</sup>.

Beanscape 2.4	IGHz	
	Desk period         View         Help           Server         Started         Started           MAC_ID:0x0015800000060688         MAC_ID:0x001580000006137         Started           MAC_ID:0x0015800000061091         MAC_ID:0x0015800000061091         Started           MAC_ID:0x0015800000061091         MAC_ID:0x0015800000061091         Started	BeanGateway system profile         Identity       Radio Configuration         Mac Id:       CeltS000000000000000000000000000000000000
PAN RF cha	I ID Configuration	Battery level:       Good         Module:       Ethemet Modbus         Soft. Vers:       VSRI         Ste Labelling       Notes         Radio Config       System Config         Multicasting       Modbus         Uplead device profile         Authorized RF Channels config.         New Pan Id (Hex.):       0x38LL C         Validate         Tit 2: 3: 14: 15: 16: 17: 18: 19: 28: 21: 22: 23: 24: 25: 26         Radio channel configuration         Channel List         Validate         Network Configuration         Scan duration         Validate
	Component List Sort Access to different sites Ste : 0x 391A	Minifees Sensor Network dag tool Energy Scan <selection> Request Max. network depth : Validate Validate</selection>

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

Beanscape 2.4	IGHz			
File BeanSca	pe® App Tools BeanGateway View Help			
	Server	BeanGateway system profile		
	🔲 Started 🔵	Identity	Radio Configuration	
	MAC ID : 0 x 00158D00000E06BB	Mac Id: 00158D00000E0EA0	Radio Channel : 26	
	MAC_ID : 0 x 00158D00000E0C37	Site ID: Site : 0 x 391A	Used RF channels : 11-26	
	MAC_ID : 0 x 00158D00000E10F1	Pan Id: 391A		System
		Net Id: 0000	Power Supply Diagnostic	Disapartia curla . 00-01-00 d bb-mm-ss
Ŕ		Version	Diag. Date: 12/3/2020 10:32:57 AM	Reen sound funct - Disabled
			Internal Temp : 34 000	Network Status : Disabled
× 🗐		Hard. vers. V3R4	Rever events	
		Soft. vers. V5R8	Potters: Voltage: 4 101	Additional Module
			Dattery voltage: 4.161	Module : Ethernet Modbus
				Soft. Vers : V5R1
		Site Labelling Notes Radio	Config System Config Multicasting	Modbus Upload device profile
		Panld Configuration	Authorized RF Cl	hannels config.
		New Pan Id (Hex.) : 0x39	11 12 13 14	15 16 17 18 19 20 21 22 23 24 25 26
4		Radio channel configuration		Validate
		Channel List	Vetwork Configu	
1 Stell		Scan duration Ch_Auto	Validate	
0		Ch_11 Ch_12		
		Wireless Sensor Network diag.1 Ch_13		
		Energy Scan Ch_15	Request	Validate
12	Component List	Ch_16		
	Sort	Ch_17		
~~	Access to different sites	Ch_19		
	Site : 0 x 391A	Ch_20		
		Ch_22		
~ ~		Ch_23		
₹````````````````````````````````````		Ch_25		
****		01_20		

Figure 15: Manual Radio Channel selection

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



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<sup>®</sup> user manual for more information about the BeanGateway<sup>®</sup> configuration.

Go to <u>Appendices 4</u> 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"

Seanscape 2.4GHz					
File BeanSca	Grit         Cools         Advanced func.         Off.Data Analysis         Vie           Server         Started         Started         Started <ul> <li>MAC_ID: 0 x 00159D000000008088</li> <li>On.Y</li> <li>MAC_ID: 0 x 00159 00000000037</li> <li>Gn.Y</li> <li>MAC_ID: 0 x 00159 00000001049</li> <li>On.Y</li> <li>MAC_ID: 0 x 00158 00000001049</li> <li>On.Y</li> <li>MAC_ID: 0 x 00158 00000001049</li> <li>On.Y</li> <li>MAC_ID: 0 x 00158 00000001051</li> <li>Gn_Temp_0</li> <li>Gn_Temp_1</li> <li>Gn_Temp_0</li> <li>Gn_Temp_0</li></ul>	W Help           BeanDevice system profile           Identity           Mac Id:         00155000000000000000000000000000000000	Network Diagnostic Network quality: PE8: 30.30 Power Supply Diagnostic Diag. Date: 12/3/2020 10:48:18 AM Internal Temp.: 22.125 Power supply: Mains Power mode: Bat Saver Disabled Battery Voltage: 4.177	System Diagnostic cycle: 00:00:10 hh.mm.ss Hicryklus: 00:00:01 hh.mm.ss Sensor Info Meas.Range: -15 / -15 Sensitivity: 0.0010 Cut off frequency: 1000 (kz	
Click o	on the BeanDevice profile	Batalogger Status: Ready Tatening Mode Status Waiting Sent Deleted Config. frame is: Deleted Config. frame is: Deleted	Battery level: Good Memory option: "Stop DAQ" recording Memory option: "Stop DAQ" recording Datalogger System cont Custum display Notes	Memory used: 0 (%) re Scanner Configuration fig. Power mode managt Online Data Analysis Data Acq. config. Sensor Config	L
	Component List	DAQ Status : Stopped Data Acq. mode: NA Data Acq. cycel : NA ddd.h Sampling rate : NA ddd.h Data Acq. duration : NA ddd.hh	Usta acquisition mode configuration Data Acq. mode: LosOutyQi Data Acq. cycle : LosOutyQi Data Acq. cycle : LosOutyQi Data acquisition mode options ktz mmn:ss	Cla V Start Stop Tx & Log	
	Sort Access to different sites	Tx Log	Click o	n the Data Acq tab	

Figure 16: BeanDevice® profile

## 9.1 TAB: DATA ACQUISITION CONFIGURATION

#### 9.1.1 Overview

Datalogger	System config.	Power mode managt	Online Data Analysis			
Custum display	Notes	Data Acq. config.	Sensor Config			
Data acquisition mode	configuration					
Data Acq. mode:	Streaming	· ) [	Start			
Data Acq. cycle :	;;;	ddd,hh:mm:ss	Stop			
Sampling rate :	10 ~ (	Hz				
Data Acq. duration :	;;	ddd,hh:mm:ss				
Data acquisition mode o	Data acquisition mode options					
⊙ Tx Only C	) Log Only 🛛 🔿 T	x & Log				
Streaming Packet options						
O Continuous Monitori	ns 🔿 Burst	🔿 One Shot				

Figure 17: Data Acquisition Configuration Tab

Stop button is available on the following BeanDevice®:

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

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

Stop button is not available on the following BeanDevice®:

- BeanDevice<sup>®</sup> INC Xtend
- BeanDevice<sup>®</sup> 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: <b>Started</b> or <b>Stopped</b> If <b>Started</b> , there is an ongoing data acquisition. If <b>Stopped</b> , 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 <sup>®</sup> . 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:
	<ul> <li>Whenever an alarm threshold (user-configurable) is reached (4 alarm threshold levels High/Low).</li> <li>A transmission cycle is reached; the transmission cycle is configurable through the BeanScape<sup>®</sup> 1s to 24h;</li> </ul>
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
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 <sup>®</sup> 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

Current data acq. mode	
DAQ Status :	Started
Data Acq. mode:	LowDutyCycle
Data Acq. cycle :	00:00:20 ddd,hh:mm:ss
Sampling rate :	NA Hz
Data Acq. duration :	NA ddd,hh:mm:ss
Б	< Log

Figure 20 : Low Duty Cycle status window

Par	ameters	Desc	riptions
• Select the Data acquisition cycle between 1s and 24hours.		lect the Data acquisition cycle between 1s and 24hours.	
Dati	acqui on Cy	• Th	e format is: Day: Hour: Minute: Second
E	S	TX on	ly: The BeanDevice <sup>®</sup> transmits the Data acquisition <u>without</u> Data logging
acquisitic e options		Log o	nly: The BeanDevice <sup>®</sup> logs the Data acquisition <u>without</u> wireless transmission
		TX & I	Log: The BeanDevice <sup>®</sup> transmits <u>and</u> logs the Data acquisition;
Data a	mod	For fu – <u>TN</u>	rther information about the Data logger function, read the technical note TN_RF_007 <u>RF_007 – "BeanDevice® Datalogger User Guide "</u>

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

Datalogger	System config.	Power mode managt	Online Data Analysis				
Custum display	Notes	Data Acq. config.	Sensor Config				
Data acquisition mode	Data acquisition mode configuration						
Data Acq. mode:	Alarm	~ ) (	Start				
Data Acq. cycle :		ddd,hh:mm:ss	Stop				
Sampling Rate:		Hz					
Transmission ratio : 1							
Data acquisition mode options							
Ty Only C		v £ Lon					

Figure 21 : Alarm Data acquisition configuration tab

Current data acq. mode	
DAQ Status :	Started
Data Acq. mode:	Alarm
Data Acq. cycle :	00:00:05 ddd,hh:mm:ss
Sampling rate :	NA Hz
Transmission cycle :	00:00:05 ddd,hh:mm:ss
Б	< Log

Figure 22 :Alarm status window

# RF-TN-008

Parameters	Description
ata iisition ycle	Select the Data acquisition cycle between 1s and 24hours. The format is: Day: Hour: Minute: Second
Ú acdn D	
NO	Select the transmission ratio
smissi Ratio	Transmission cycle is calculated as follow:
Tran. F	Transmission Cycle = "Transmission Ratio" * "Data Acquisition Cycle"
a	<b>TX only</b> : The BeanDevice <sup>®</sup> transmits the Data acquisition without Data logging
pou	Log only: The BeanDevice <sup>®</sup> logs the Data acquisition <u>without</u> wireless transmission
isition r tions	<b>TX &amp; Log</b> : The BeanDevice <sup>®</sup> transmits <b>and</b> logs the Data acquisition;
Jata acqu op	For further information about the Data logger function, read the technical note TN_RF_007 – <u>TN_RF_007 – "BeanDevice® DataLogger User Guide"</u>



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

Datalogger	System config.	Power mode managt	Online Data Analysis				
Custum display	Notes	Data Acq. config.	Sensor Config				
Data acquisition mode	Data acquisition mode configuration						
Data Acq. mode:	Streaming	~ ) (	Start				
Data Acq. cycle :	;;;	ddd,hh:mm:ss	Stop				
Sampling rate :	10 ~	Hz					
Data Acq. duration :	;;;	ddd,hh:mm:ss					
Data acquisition mode	Data acquisition mode options						
⊙ Tx Only O Log Only O Tx & Log							
Streaming Packet options							
⊙ Continuous Monitorin≬ ○ Burst ○ One Shot							

Figure 23: Streaming Data acquisition configuration tab

Current data acq. mode	
DAQ Status :	Started
Data Acq. mode:	Streaming
Data Acq. cycle :	NA ddd,hh:mm:ss
Sampling rate :	100 Hz
Data Acq. duration :	Continue ddd,hh:mm:ss
D	< Log

Figure 24 :Streaming status window

Parameters	Description
2	Select the Data acquisition cycle between 1s and 24hours.
Data quisitio Cycle	The format is: Day: Hour: Minute: Second
ασσ	This parameter is enabled if the " <b>Burst</b> " option is selected
rate	Select the sampling rate of your BeanDevice <sup>®</sup> between 1 sample per second and 3000 samples/s maximum (depending on the BeanDevice <sup>®</sup> product used). The resolution is 1 sample per second. Choose carefully the sampling rate value:
Sampling	<ul> <li>The PER (Packet Error Rate) may increase if a high sampling rate value is settled on your BeanDevice<sup>®</sup>. For further information, read the technical note <u><i>RF_TN_003-"Aggregation capacity of wireless sensor networks"</i></u></li> <li>Power consumption increases with the sampling rate</li> </ul>
c	Defines the duration of the streaming Data acquisition.
sitio	The format is Day: Hour: Minute: Second
acqui	"Data acquisition duration" value should be lower than "Data acquisition cycle".
Data du	This parameter is enabled if the " <i>Burst</i> " or " <i>One Shot</i> " options are selected.
uo si	<i>TX only</i> : The BeanDevice <sup>®</sup> transmits the Data acquisition <u>without</u> Data logging
uisiti ptior	Log only: The BeanDevice <sup>®</sup> logs the Data acquisition <u>without</u> wireless transmission
acq de o	<b>TX &amp; Log</b> : The BeanDevice <sup>®</sup> transmits <u>and</u> logs the Data acquisition;
Data	For further information about the Data logger function, read the technical note TN_RF_007 – <u>TN_RF_007 – "BeanDevice® DataLogger User Guide "</u>
suo	<ul> <li><i>« Continuous monitoring » option</i>: Data acquisition is transmitted to the <i>BeanGateway</i> <sup>®</sup> in a continuous flow rate.</li> </ul>
ning Opti	<i>« Burst » option</i> : Data acquisition is transmitted to the <i>BeanGateway</i> <sup>®</sup> in a burst flow rate
Strean	<b>« One Shot » option</b> : Data acquisition is transmitted to the <b>BeanGateway</b> <sup>®</sup> during a period time, and then the acquisition will be Stopped.



When starting the Streaming mode, BeanScape<sup>®</sup> 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<sup>®</sup> Smart Sensors AX-3D, AX-3D Xrange, Inc, Hi-Inc and Hi-Inc Xrange also for the BeanDevice<sup>®</sup> Process Sensors AN-XX (AN-V/AN-mV/AN-420).

Datalogger	System config.	Power mode managt	Online Data Analysis				
Custum display	Notes	Data Acq. config.	Sensor Config				
Data acquisition mode	configuration		^				
Data Acq. mode:	S.E.T	~ ) (	Start				
Notif Cycle :	:25:	ddd,hh:mm:ss	Stop				
Sampling rate :	125 ~ (	Hz					
Data Acq. duration :	;;60						
Pre-trigger.duration: 100 🗢 ddd,hh:mm:ss							
Data acquisition mode options							
Ty Only C	Log Oply 💦 🔿 T	v £ Lon					

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	<ul> <li>Select the sampling rate of your BeanDevice<sup>®</sup> between 1 sample per second and 1000 samples/s maximum. The resolution is 1 sample per second.</li> <li>Choose carefully the sampling rate value:</li> <li>✓ The PER (Packet Error Rate) may increase if a high sampling rate value is settled on your BeanDevice<sup>®</sup>. For further information, read the technical note <u>RF TN 003- "Aggregation capacity of wireless sensor networks"</u></li> <li>✓ Power consumption increases with the sampling rate</li> </ul>
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 acquisiti on mode options	<i>TX only</i> : The BeanDevice <sup>®</sup> transmits the Data acquisition <u>without</u> Data logging <i>Log only</i> : NA for S.E.T mode <i>TX &amp; Log:</i> NA for S.E.T mode
Streaming Packet Options	<ul> <li><i>« Continuous monitoring » option</i>: Data acquisition is transmitted to the <i>BeanGateway</i> <sup>®</sup> in a continuous flow rate (by Default)</li> <li><i>« Burst » option</i>: NA for S.E.T mode</li> <li><i>« One Shot » option</i>: NA for S.E.T mode</li> </ul>



When starting the S.E.T mode, BeanScape<sup>®</sup> 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<sup>®</sup> 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<sup>®</sup>.

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





#### 9.2.3 How to set an alarm threshold for the Alarm mode

From the BeanDevice<sup>®</sup> 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<sup>®</sup> software



## Figure 28: Alarm mode Alarm setting



## Figure 29: Alarm mode Alarm threshold configuration

## 9.2.4 Alarm Thresholds description

## 9.2.4.1 <u>Alarm Thresholds on AX-3D/Hi-Inc/AX-3DS/AN-XX Bipolar</u>

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<sup>®</sup> 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<sup>®</sup> 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:

📾 Sensor Alarms	- 🗆 X
Sensors	Alarms
Mac: 00158D00000E06BB, Id: 0, Ch_X	Date: 12/3/2020 1:42:29 PM, Value: 17.911 (Alarm)
Mac: 00158D00000E06BB, Id: 1, Ch_Y	Date: 12/3/2020 1:42:23 PM, Value: 17.91 (Alarm)
	Date: 12/3/2020 1:42:17 PM, Value: 18.186 (Alarm)
	Date: 12/3/2020 1:42:05 PM, Value: 16.226 (Alarm)
	Date: 12/3/2020 12:04:51 PM, Value: 7.202 (Alarm)
	Date: 12/3/2020 12:04:50 PM, Value: 18.186 (Alarm)
	Date: 12/3/2020 12:04:49 PM, Value: 17.912 (Alarm)
	Date: 12/3/2020 12:04:44 PM, Value: 17.912 (Alarm)
	Date: 12/3/2020 12:04:43 PM, Value: 18.186 (Alarm)
	Date: 12/3/2020 12:04:42 PM, Value: 18.186 (Alarm)
	Date: 12/3/2020 12:04:41 PM, Value: 18.186 (Alarm)
	Date: 12/3/2020 12:04:40 PM, Value: 15.346 (Alarm)

## Figure 33: Sensors alarms window

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

📸 Sensor Alarms		_		×
Sensors	Alarms			
Mac: 00158D00000E06BB, Id: 0, Ch_X Mac: 00158D00000E06BB, Id: 1, Ch_Y Alarm Date & Time Alarm Date & Time	Date: 12/3/2020 1:42:29 PM Date: 12/3/2020 1:42:23 PM Date: 12/3/2020 1:42:17 PM, Date: 12/3/2020 1:42:05 PM Date: 12/3/2020 12:04:50 P Date: 12/3/2020 12:04:50 P Date: 12/3/2020 12:04:50 P Date: 12/3/2020 12:04:49 P Date: 12/3/2020 12:04:44 P Date: 12/3/2020 12:04:43 P Date: 12/3/2020 12:04:43 P Date: 12/3/2020 12:04:44 P Date: 12/3/2020 12:04:44 P	, Value: 17 , Value: 17 , Value: 18 M, Value: 1 M, Value: 1	7.911 (Alar 7.91 (Alar 7.91 (Alar 7.202 (Ala 7.202 (Ala 18.186 (A 17.912 (Al 17.912 (Al 18.186 (A 18.186 (A 8.186 (A 15.346 (A	m) m) arm) arm) arm) arm) arm) larm) larm) Arm)

Figure 34: Exceeded thresholds displayed on Sensors alarms window

## 9.2.4.4 Example

In this example we will use the BeanDevice<sup>®</sup> 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

Dashboard	Sensor Config
Sensor Channel Status	Custum display Notes Alarm level Config
Label: Ch_X Technology: (Inclinometer State: On Alarm level Status (deg) Alarm: 11 Alert: 6 Action: 8	Alarm DAQ mode  Alert < Action < Alarm Alarm: 11 Action: 8 Alert: 6 Validate

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<sup>2</sup>).

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

Custum display	Notes	Data Acq. config.	Sensor Config
Datalogger	System config.	Power mode managt	Online Data Analysis
Online FFT Configuration		Online Velocity configura	ation
Enable Online FFT Automatic FFT Report Enable FFT Log file	t(S.E.T)	Enable Online Veloci Automatic DIN Repo Enable Velocity Log Enable PPV Log file	ty 😥 ort(S.E.T) file
Number of Points (Strea	ming)		
Manual SR/0.1 Current Points Number:	>¢ 		
Online waveform configu	ration	Unit of acceleration	Ý
Automatic waveform Enable waveforms Lo	s Report(S.E.T) og file(S.E.T)	S.E.T threshold	cceleration ×
Software Filters Enable IIR Filter		Validate	

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

RF-TN-008	2.4GHz wireless sensors series
Dashboard         Sensor Channel Status         Label: Ch_Z         Iechnology: (AX-30)         State:         On         Alarm: 9         Alert: 4         Action: 8	Sensor Config         Sensor labelling       Notes       Alarm level Config       Sensor calibration       Log config.         Alarm DAQ mode       Image: Config and Con



Parameter	Description					
	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 <sup>®</sup> user manual for more info);					
Alarm threshold	<ul> <li>✓ If the sensor value is higher than Alert, an alarm notification is sent to the BeanGateway /BeanScape;</li> </ul>					
	<ul> <li>✓ If the sensor value is higher than Action, an alarm notification is sent to the BeanGateway /BeanScape;</li> </ul>					
	<ul> <li>✓ If the sensor value is higher than Alarm, an alarm notification is sent to the BeanGateway /BeanScape;</li> </ul>					

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

Same as the BeanDevice<sup>®</sup> 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.

Dashboard	Ser	nsor Config				
Sensor Channel Status	Custum display	Notes	Alarm level Config	Sensor calibration	Log config.	DAQ Calib. Bipolar
Label: Ch_V_1 Technology: AN V State: On Alarm: 3.516 Action: 3.043 Alert: 2.727	Alarm DAO mode (V)	Alarm	te			

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

#### **RF-TN-008**

2.4GHz wireless sensors series



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

📾 Beanscape 2.4GHz							
File	BeanScape® App	Tools	Advanced func.	Off.	.Data Analysis	View	
				Sec	FFT		
	Serve	er		•	Particle Veloci	ty	

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.

All time Start V End V Browse files to process	Browse View Reset	Show selected graph Number graph :	FFT Configuration          • Auto        Window Type:       Algorithm:       Algorithm:       Zero Padding:       Zero Padding:       Use All Measurement data       Adjust number of FFI points       SRVE.1	Current FFI Configuration Mode: FFT Auto FFT Shift: Disabled Window type: Restangular Algorithm: Estimate Zero padding: Enabled Points used: All measurement
N° Parts File Name	<u>Figure 4</u>	Start End	The following file are invalid	



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

Itime       Start       End	vse View Reset Number graph : FFT Configuration C Auto Window Type Auto Window Type Auto C Au	FFT Shift e: Rectangular m: Estimate g: ☑	Current FFT Configur Mode: FFT Shift: Window type: Algorithm:	ation FFT Auto Disabled Rectangular Estimate
Browse files to process N* Parts File Name	← → ← ↑ → This PC → Windows (C:) → log_beanscape → Folder 1049 → TX Folder	~	ල Search TX Folder	
Click on Browse to select Tx Files	Name         Date           Transmit, Allsensor, LowDutyCycle, MAC_ID0_x_00158D00000E1049_112,3,202         11/21           Transmit, Allsensor, LowDutyCycle, MAC_ID0_x_00158D00000E1049_112,8,2020         12/81           Transmit, Allsensor, LowDutyCycle, MAC_ID0_x_00158D00000E1049_112,8,2020         12/81           Transmit, Allsensor, LowDutyCycle, MAC_ID0_x_00158D00000E1049_112,8,2020         12/81           Transmit, Allsensor, LowDutyCycle, MAC_ID0_x_00158D00000E1049_12,8,2020         12/91           Transmit, Allsensor, LowDutyCycle, MAC_ID0_x_00158D00000E1049_12,9,2020         12/91           Transmit, Streaming, MacId_00158D00000E1049_12,8,2020_3,20,3,2 PM.txt         12/91           Transmit, Streaming, MacId_00158D00000E1049_12,8,2020_3,22,714,PM.txt         12/91           Transmit, Streaming, MacId_00158D00000E1049_12,8,2020_3,22,14,PM.txt         12/91           Transmit, Streaming, MacId_00158D00000E1049_12,8,2020_3,23,14,PM.txt         12/91           Transmit, Streaming, MacId_00158D00000E1049,12,8,2020_3,30,14,PM.txt         <	Imodified         Type           3/2020 4:57 PM         Text Do           /2020 2:45 PM         Text Do           /2020 1:46 AM         Text Do           /2020 1:46 AM         Text Do           /2020 1:45 PM         Text Do           /2020 2:35 PM         Text Do           /2020 2:35 PM         Text Do           /2020 4:25 PM         Text Do           /2020 4:25 PM         Text Do           /2020 3:20 PM         Text Do           /2020 3:30 PM         Text Do           /2020 3:31 PM         Text Do	Size Size	·
Select files then click on open	File name:		✓ Log files (*.txt) Open 2	Cancel

1: Click on Browse to choose files

Figure 46: Browsing TX files on FFT tool

## **2**: Overview of the selected files

🛸 FFT											-		×
In All Sta En Brows	time rt Tuesday d Tuesday	y, December y, December ocess	8, 2020 3:20:08 PV ↔ ↔ 8, 2020 3:31:33 PM ↔ ↔ Check to generate the corresponding FFT files	> 7 Files Selected Browse View Reset 3 ✓ Generate Log files Click on View to show the graphs		Show selected graph Number graph :		FFT Configuration C Auto Window Type : Algorithm : Zero Padding : FFT Points Use AII Measurement data Adjust number of FFT points	FFT Sh Rectangular Estimate SR/0.1	ft Y Validate	Current FFT Configuration Mode: FFT Auto FFT Shift: Disabled Window type: Rectangula Algorithm: Estimate Zero padding: Enabled Points used: All measure	ir and a second se	
N°	Parts	File Name				Start End		The following file are Invalid					
1	1	Transmit_Str	eaming_MacId_00158D00000E1049_12_	8_2020_3_20_08_PM		12/8/2020 3:20:08 12/8/2020 3 PM PM	:20:27						
2	1	Transmit_Str	earning_MacId_00158D00000E1049_12_	8_2020_3_20_32_PM		12/8/2020 3:20:32 12/8/2020 3 PM PM	:20:51						
3	1	Transmit_Str	earning_MacId_00158D00000E1049_12_	8_2020_3_27_14_PM		12/8/2020 3:27:14 12/8/2020 3 PM PM	:27:33						
4	4 1 Transmit_Streaming_MacId_00158D00000E1049_12_8_2020_3_28_14_PM			12/8/2020 3:28:14 12/8/2020 3 PM PM	:28:33								
5	5 1 Transmit_Streaming_MacId_00158D00000E1049_12_8_2020_3_29_14_PM			12/8/2020 3:29:14 12/8/2020 3 PM PM	:29:33								
6 1 Transmit_Streaming_MacId_00158D00000E1049_12_8_2020_3_30_14_PM			12/8/2020 3:30:14 12/8/2020 3 PM PM	:30:33									
7	1	Transmit_Str	eaming_MacId_00158D00000E1049_12_	8_2020_3_31_14_PM		12/8/2020 3:31:14 12/8/2020 3 PM PM	:31:33						

#### Figure 47: Overview: FFT window

#### 3: Loading

🐝 FFT						– – ×
All Sta En Proce	I time rt Tuesday d Wednes	y, December 8, 2020 9:27:06 AA 🔍 ❤ day, December 9, 2020 9:27:06 🔍 ❤	> 10 Files Selected Reset Generate Log files	Show selected graph Number graph :	FFT Configuration         Image: Auto         Window Type :         Algorithm :         Estimate         Zero Padding :         Image: PFT Points         Use All Measurement data         Algott number of FFT points         Algott Algorithm :	Current FFI Configuration         Mode:       FFI Auto         FFI Shift:       Disabled         Window type:       Rectangular         Algorithm:       Estimate         Zero padding:       Enabled         Points used:       All measurement
N°	Parts	File Name		Start End	The following file are Invalid	
1	1	Transmit_Streaming_MacId_00158D00000E1049_12	_8_2020_3_20_08_PM	12/8/2020 3:20:08 12/8/2020 3:20:21 PM PM		
2 1 Transmit_Streaming_MacId_00158D00000E1049_12_8_2020_3_20_32_PM				12/8/2020 3:20:32 PM PM		

#### Figure 48: FFT generation

### 4: FFT report generated with the following results:

- a. Frequency
- b. Amplitude

🐋 FFT Current FFT Configuration 🗸 All time FFT Configuration -> 10 Files Selected Show selected graph 🔘 Auto FFT Shift Mode: FFT Auto :day, December 8, 2020 9:27:06 AN 🐳 👻 Start Reset Number graph : 10 Window Type : Rectangular FFT Shift: Disabled nesday, December 9, 2020 9:27:06 🌧 🗸 Fnd Estimate Generate Log files 🌌 Off.Data Analysis FFT  $\times$ \_ Ch\_X(g)\_Transmit\_Streaming\_MacId\_00158D00000E1049\_12\_8\_2020\_3\_20\_08\_PM Part 1/1 , 1621 Samples Processing 10/10 File Name Parts 0.0500 Transmit\_Streaming\_MacId\_00158D00000E1049\_12\_8\_2020\_3\_20\_08\_PM - 0.0400 ransmit\_Streaming\_MacId\_00158D00000E1049\_12\_8\_2020\_3\_27\_14\_PM - 0.0200 ransmit\_Streaming\_MacId\_00158D00000E1049\_12\_8\_2020\_3\_29\_14\_PM 0.0000 Transmit\_Streaming\_MacId\_00158D00000E1049\_12\_8\_2020\_3\_30\_14\_PM 0.000 10.000 20.000 30.000 40.000 50.000 Frequency(Hz) Transmit\_Streaming\_MacId\_00158D00000E1049\_12\_8\_2020\_3\_31\_14\_PM ransmit\_Streaming\_MacId\_00158D00000E1049\_12\_8\_2020\_3\_32\_14\_PM



#### 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<sup>®</sup> will create separate folders for each BeanDevice<sup>®</sup>.

(C:) ► log_beanscape ► FFT FOLDER ►		
	25 // 0 / 20/ 0 / 2 25	
MAC_ID_00158D00000E02A9	25/10/2018 12:36	Dossier de fichier
MAC_ID_00158D00000E06A8	25/10/2018 12:36	Dossier de fichier
MAC_ID_00158D00000E0277	25/10/2018 12:36	Dossier de fichie
<pre>MAC_ID_00158D00000E0277 (C:) ▶ log_beanscape ▶ FFT FOLDER ▶ MAC_ID_0015</pre>	25/10/2018 12:36 8D00000E06A8	Dossier de fichier
MAC_ID_00158D00000E0277 (C:) > log_beanscape > FFT FOLDER > MAC_ID_0015 FFTspec 00158D00000E06A8_2018-10-25 12-36-19 .bt	25/10/2018 12:36 8D00000E06A8 25/10/2018 12:36	Dossier de fichier

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.

🛸 FFT	г					- 🗆 ×
Sta Er	l time nt Tuesda nd Wednes	y, December 8, 2020 9:27:06 Ah 🔍 👻 sday, December 9, 2020 9:27:06 😓 😒	> 10 Files Selected     Reset     Generate Log files	Show selected graph Number graph : 18	FFT Configuration  C Auto  Window Type : Rectangular  Algorithm : Estimate  Zero Padding : ✓  FFT Points	Current FFI Configuration Mode: FFT Auto FFT Shift: Disabled Window type: Rectangular Algorithm: Estimate
Proce	essing 10/10			Click on show selected graph	Use All Measurement data     Adjust number of FFI points SR/0.1	Zero padding: Enabled Points used: All measurement
N°	Parts	File Name		Start End	The following file are Invalid	
1	1	Transmit_Streaming_MacId_00158D00000E1049_1	2_8_2020_3_20_08_PM	12/8/2020 3:20:08 12/8/2020 3:20:27 PM PM	Colort the nemul	
2 1 Transmit_Streaming_MacId_00158D00000E1049_12_8_2020_3_20_32_PM			12_8_2020_3_20_32_PM	12/8/2020 3:20:32 12/8/2020 3:20:51	Select the requi	rea
3 1 Transmit_Streaming_MacId_00156D00000E1049_12_8_2020_3_27_14_PM			12_8_2020_3_27_14_PM	12/8/2020 3:27:14 12/8/2020 3:27:33 PM PM	File	
4	1	Transmit_Streaming_MacId_00158D00000E1049_1	12_8_2020_3_28_14_PM	12/8/2020 3:28:14 12/8/2020 3:28:33 PM PM		



## 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.



#### 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



#### 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

📾 Bear	nscape 2.40	GHz						
File	BeanScap	e® App	Tools	Advanced func.	Off	.Data Analysis	View	Help
	(	_			Ser	FFT		
	l	Serve	r			Particle Veloci	ity	beanbev





#### 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
- o DIN report generated
- Velocity files created

3: Velocity Advanced Configuration.

O By FFT	O By Filter	⊙ By Zero Cross	sing	
FFT Configuration Auto Window Type : Rectang Algorithm : Estimate Zero Padding :	ular v s v	Vise All Measurement data Adjust number of FFT points (Streaming mode)		Current Velocity Configuration Mode : Zero Crossing
Filter Configuration         Auto       Filter         Response Type         Highpass         Bandpass         Design Method         IIR       Chebyshev_type_I         FIR       Equiripple         Filter Order         Minimum Order         Specify Order         Filter Specification	rs Profile : Frequency Specific: Units : Hz Fs : Fs : Fstop : Fpass :	ation Magnitude Speci Units : ( Astop : Apass : Filter Name :	( U T ification dB	
0 Astop 0 Fstop	pass	Fs/2 f (Hz)		Validate

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 Filter	O By Zero Crossing
FFT Configuration		
O Auto		Current FFT Configuration
Window Type :	Rectangular v	• Use All Measurement data
Algorithm :	Estimate ~	O Adjust number of FFT points
Zero Padding :	✓	(Streaming mode)

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

⊙ By FFT	○ By Filter	O By Zero Crossing			
FFT Configuration Manual		Current FFT Configuration			
Window Type : Algorithm : Zero Padding :	Rectangular ~ Estimate ~	<ul> <li>Use All Measurement data</li> <li>Adjust number of FFT points (Streaming mode)</li> </ul>			
o Fl	FT Points: Current FFT Configuration © Use All Measurement da O Adjust number of FFT po (Streaming mod	ints 128 v xC			

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.



o 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

<u>The Frequency Specification and The Magnitude Specification</u> 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.



✤ <u>Filter Profile:</u> 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.

#### **RF-TN-008**

2.4GHz wireless sensors series



4: Click on browse button to choose TX Files.

Particle Velocity		- 🗆 ×
Select Log Files  Browse View Reset VPV Report  F Browse files Browse	O By FFT     O By Filter     O By Zero Crossing       FFT Configuration     Image: Strangular     Image: Strangular       Window Type :     Rectangular     Image: Strangular       Algorithm :     Estimate     Image: Strangular       Zero Padding :     Image: Strangular     Image: Strangular       Filter Configuration     Image: Strangular     Image: Strangular	Current Velocity Configuration Mode : Zero Crossing
N° Parts File Name	Open	×
	· · · · · · · · · · · · · · · · · · ·	Search TX Folder
Click on Browse to select Tx Files	Instrum         New folder           Image: Streaming Anded 00158000000E1049_128_0200_3.20_14PM.txt         Date modified         Type           Image: Transmit_Allsensor_LowDutyCycle_MAC_ID0_x_00158000000E1049_12_10_020         I2/10/2020 11:18         Text Docur           Image: Transmit_Allsensor_LowDutyCycle_MAC_ID0_x_00158000000E1049_12_10_020         I2/10/2020 11:18         Text Docur           Image: Transmit_Allsensor_LowDutyCycle_MAC_ID0_x_0015800000E1049_12_10_020         I2/10/2020 11:18         Text Docur           Image: Transmit_Allsensor_LowDutyCycle_MAC_ID0_x_0015800000E1049_12_10_020         I2/10/2020 12:25         Text Docur           Image: Transmit_Allsensor_LowDutyCycle_MAC_ID0_x_0015800000E1049_12_10_020         I2/10/2020 4:43 PM         Text Docur           Image: Transmit_Allsensor_LowDutyCycle_MAC_ID0_x_0015800000E1049_12_11_20.20         I2/10/2020 4:20 PM         Text Docur           Image: Transmit_Allsensor_LowDutyCycle_MAC_ID0_x_0015800000E1049_12_8_2020_3.20_0.PM.txt         I2/10/2020 4:32 PM         Text Docur           Image: Transmit_Streaming_Macid_0015800000E1049_12_8_2020_3.20_0.2.9 PM.txt         I2/10/2020 3:22 PM         Text Docur           Image: Transmit_Streaming_Macid_0015800000E1049_12_8_2020_3.32_14.PM.txt         I2/10/2020 3:22 PM         Text Docur           Image: Transmit_Streaming_Macid_0015800000E1049_12_8_2020_3.32_14.PM.txt         I2/10/2020 3:32 PM         Text Docur <t< th=""><th>Bize ↓ I ∧ 0 ment 1 KB ment 2 KB ment 2 KB ment 8 KB ment 40 KB ment 49 KB ment 48 KB ment 49 KB ment 49 KB ment 49 KB</th></t<>	Bize ↓ I ∧ 0 ment 1 KB ment 2 KB ment 2 KB ment 8 KB ment 40 KB ment 49 KB ment 48 KB ment 49 KB ment 49 KB ment 49 KB
The following file are Invalid	Image: Streaming_Macld_00158D00000E1049_12_9_2020_2_37_08_PM.txt         12/9/2020 2:37 PM         Text Docur	ment 199 KB V
Select files then click on open	File name: Transmit_Streaming_MacId_00158D00000E1049_12_8_2020_3_29_14_PM.txt	✓ Log files (*.txt) ✓ ✓ Open 2 Cancel

Figure 59: Browsing TX files into Particle Velocity tool

#### 5: Loading.

🔂 F	article Veloo	city				
Seleo	ct Log Files					
ſ	> 10 Files	Selected Show selected graph				
		Reset VPPV Report				
	Generate L	og files DIN 4150-3 Report				
	Processing					
N°	Parts	File Name				
1	1	Transmit_Streaming_MacId_00158D00000E1049_12_8_2020_3_20_08_PM				
2	1	Transmit_Streaming_MacId_00158D00000E1049_12_8_2020_3_20_32_PM				
0	4	Transmit_Streaming_MacId_00158D00000E1049_12_8_2020_3_27_14_PM				
3	1	Transmit_Streaming_MacId_00158D00000E1049_12_8_2020_3_27_14_PM				
3 4	1	Transmit_Streaming_MacId_00158D00000E1049_12_8_2020_3_27_14_PM Transmit_Streaming_MacId_00158D00000E1049_12_8_2020_3_28_14_PM				

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

> 10 Files Selected		Show selected graph
	Reset	VPPV Report
✔ Generate Log files		DIN 4150-3 Report
Successful operation Velocity log files are located	at C:\logbeanscape\DIN FO	LDER



n PPV					– 🗆 🗙
	•	Find   Next			
BeanAir	VF	PPV 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_ID0_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_ID0_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



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	1-Find the maximum velocity values over the Time
effect	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	1-Find the maximum velocity values over the Time
pipework	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	1-Find the maximum velocity values over the Time
ріремогк	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	1-find the maximum velocity value over the time.
evaluation	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.

<ul> <li>✓ Enable Online FFT</li> <li>▲ Automatic FFT Report(S.E.T)</li> <li>✓ Enable FFT Log file</li> </ul>	Online FFT Configuration	
✓ Automatic FFT Report(S.E.T) ✓ Enable FFT Log file	✓ Enable Online FFT	
✓ Enable FFT Log file	Automatic FFT Report(S.E.T)	
	🖌 Enable FFT Log file	

Figure 67: Online FFT Configuration frame

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

(C:) ► log_beanscape ► Folder 06A8 ►		
🕌 FFT	26/10/2018 08:51	
Je GeneratedDisplay	26/10/2018 08:49	
🎉 Report Folder	26/10/2018 08:49	
🕌 TX Folder	26/10/2018 08:51	
00158D00000E06A8_WirelessNetwkInfo.txt	26/10/2018 08:53	435 Ko

#### I (C:) I log\_beanscape I Folder 06A8 I FFT

FFT_RealTime_MAC_ID0_x_00158D00000E06A8_2018-10-26_08-51-44.bxt	26/10/2018 08:54	619 Ko
FFT_SET_MACID_00158D00000E06A8_2018-10-26_08-25-58.txt	26/10/2018 08:26	10 Ko
FFT_SET_MACID_00158D00000E06A8_2018-10-26_08-26-20.txt	26/10/2018 08:26	10 Ko
FFT_SET_MACID_00158D00000E06A8_2018-10-26_08-27-23.txt	26/10/2018 08:27	11 Ko
FFT_SET_MACID_00158D00000E06A8_2018-10-26_08-28-24.txt	26/10/2018 08:28	11 Ko
FFT_SET_MACID_00158D00000E06A8_2018-10-26_08-29-25.txt	26/10/2018 08:29	11 Ko
FFT_SET_MACID_00158D00000E06A8_2018-10-26_08-30-26.txt	26/10/2018 08:30	11 Ko
FFT_SET_MACID_00158D00000E06A8_2018-10-26_08-31-27.txt	26/10/2018 08:31	11 Ko
FFT_SET_MACID_00158D00000E06A8_2018-10-26_08-32-29.txt	26/10/2018 08:32	11 Ko
FFT_SET_MACID_00158D00000E06A8_2018-10-26_08-33-30.txt	26/10/2018 08:33	11 Ko
EFT SET MACID 00158D00000F0648 2018-10-26 08-34-31.txt	26/10/2018 08:34	11 Ko

Figure 68: FFT log files folder



Figure 70: Report Folder

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

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

BeanAir	FFT	Report	[Logo]
This email is sent by the BeanSc	ape® software – Acceleration : Ad	event occurred on "Ch_Z Axis	" at Time: 11:04:59.150, Level
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 3 MAC ID : 00158D00000 Label : MAC_ID : 0 x 001 Range(g) : -2 / +2 Thresholds type for SET	BD E1049 ISBD00000E1049 mode : Acceleration
User Name : 3 Location : 3 Monitoring sites :	Related notes t	o monitoring site	
	Sensor Ir	formation	
	<u>Ch X</u>	<u>Ch Y</u>	Ch Z
Offset Zeroing value	NA	NA	NA 5
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
zero Pauding . Enabled		Algorithm : Estimate	
	HT Display		
••••			

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
З	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 <sup>®</sup> 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 <u>8</u>: <u>Alarm management.</u>

# • FFT Advanced Configuration

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

📾 FFT Configurat	tion		_	$\times$
🔘 Auto	FFT Shift			
Window Type :	Rectangular ~	Current FFT Configuratio	n	
Algorithm :	Estimate ~	Mode :	By FFT_Auto	
Zero Padding :	<b>√</b>	FFT Shift :	Disabled	
Number of Points	SR/0.1	Window type :	Rectangular	
(Streaming mode)		Algorithm :	Estimate	
	Validate	Zero padding :	Enabled	
·				

- Auto/Manual

🔵 Manual	C	FFT Shift
Window Type :	Rectangular	v
Algorithm :	Estimate	v
Zero Padding :	~	

- 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.



FFT Spectrum								
Electric Y	Actions Y	Extents Zoom 🗸 🗸	None 👻					
					EET Socotrum			
					FFT Spectrum			
								1.8000
								1.6000
								1 4000
								1.4000
								1.2000
								1.0000
								0.8000 🚽
								0.6000 🛒
								0.4000
								0 2000
								0,0000
								0.0000
		-40 000		-20 000	0 000	20.000	40 000	
					Eroguonar(H-)	201000	101000	
Frequency(Hz)								

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.

Custum display	Notes	Data Acq. config.	Sensor Config
Datalogger	System config.	Power mode managt	Online Data Analysis
Online FFT Configuration		Online Velocity configu	ration
Enable Online FFT Automatic FFT Repo Enable FFT Log file	rt(S.E.T)	<ul> <li>Enable Online Velo</li> <li>Automatic DIN Rep</li> <li>Enable Velocity Lo</li> <li>Enable PPV Log file</li> </ul>	city 😥 port(S.E.T) g file
Number of Points (Strea	ming)		
Manual SR/0.1 Current Points Number	℃\$ 		
Online waveform configu	ration	Unit of acceleration	g Ý
Automatic waveform Enable waveforms Lo	s Report(S.E.T) Ig file(S.E.T)	S.E.T threshold	Acceleration Y
Software Filters			
Enable IIR Filter		Validate	



**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

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	ОК
LTEBP	ОК
Velocity Frequency(hz)	0
PCPV(mm/s)	2.4892
STEBP	ОК
STVEE	NOK

## **DIN 4150-3 REPORT**

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	1-Find the maximum velocity values over the Time
effect	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	1-Find the maximum velocity values over the Time
pipework	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	1-Find the maximum velocity values over the Time
pipework	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	1-find the maximum velocity value over the time.
evaluation	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.

				open
> This	PC > Local Disk (C:) > log_beanscape > Fol	der 5C313E06A9A7000	00	
	Name	Date modified	Туре	Size
	FFT	13-Feb-19 14:43	File folder	
7	TX Folder	13-Feb-19 14:58	File folder	
*		13-Feb-19 14:58	File folder	
NIS 🖈	5C313E06A9A70000 WirelessNetwkInfo	13-Feb-19 14:58	Text Document	

Velocity\_RealTime\_Ch\_Y\_MAC\_ID\_\_\_0\_x\_F4B85E00A14B0000\_6\_12\_2019\_10\_48\_00\_AM

Uelocity\_RealTime\_Ch\_Z\_MAC\_ID\_\_\_0\_x\_F4B85E00A14B0000\_6\_12\_2019\_10\_48\_00\_AM

Figure 78: Velocity Log Folder/Files

#### **Enable PPV Log file**

poourd		Organize	146.44		(pen
<mark>}</mark> → Th	is PC → Local Disk (C:) ⇒	log_beanscape > Fe	older 5C313E06A9A7000	0	
	Name	^	Date modified	Туре	Size
	FFT		13-Feb-19 14:43	File folder	
ж.	TX Folder		13-Feb-19 14:58	File folder	
Ŕ	Velocity		13-Feb-19 14:58	File folder	
INIS 🖈	5C313F06A9A7000	) WirelessNetwkInfo	13-Feb-19 14:58	Text Document	
PPV	_RealTime_Ch_X_M	1AC_ID0_x_F4	B85E00A14B0000_	6_12_2019_10_4	8_00_AM
PPV	_RealTime_Ch_Y_M	1AC_ID0_x_F4	B85E00A14B0000_	6_12_2019_10_4	8_00_AM
PPV	_RealTime_Ch_Z_M	1AC_ID0_x_F4	B85E00A14B0000_	6_12_2019_10_4	8_00_AM

Figure 79: PPV Log Folder/Files

# Velocity Advanced Configuration

📾 Velocity Configuration			- 🗆 X
○ By FFT	○ By Filter	© By Z	ero Crossing
FFI	Streaming Mode SET	Mode	
	O Auto	Filters Profile : 🗸 🗸	1 🚽 🕁 🗊
Vindow lype : Hectangular Import			
Augurum : Estimate	O Highpass	Units: (Hz)	Units: (B)
	Bandpass	Fs:	
		Fstop 1 :	
Points Used	IIR Chebyshev_ty	rpe_l Y Fpass 1 :	
Number of points() SR/0.1	HIR Equiripple	Fpass 2	
Mode : Zero Crossing	Minimum Order     Specify Order		Filer name
			Close Validate
<u>Figure 80: Ve</u>	<u>locity Advance</u>	ed Configuration	

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

🗠 Velocity Configuration			-	×
⊖ By FFT	○ By Filter	● By Zero Crossing		

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

📾 Velocity Config	uration				
⊙ By FFT					
FFT					
🔘 Auto					
Window Type :	Rectangular	~ [S	Import		
Algorithm :	Estimate	~			
Zero Padding :	<b>V</b>				

 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.

📾 Velocity Configu	iration				
⊙ By FFT					
FFT					
🔘 Manual					
Window Type :	Rectangular	<u> </u>	Import	]	
Algorithm :	Estimate	~			
Zero Padding :					

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

By FFT	○ By Filter	0	By Zero Crossing	
FT	Streaming Mode SE	T Mode		
Manual	Auto	Filters Profile : 🗸 🗸		
Window Type : Rectangular Vindow Type :	Response Type	Frequency Specification	Magnitude Specification	
Algorithm : Estimate ~	O Highpass			
Zero Padding :	O Bandpass	Units: (Hz)	Units: (dB)	
Current Velocity Configuration		Fs:	Vstop1:	
Points Used	IIB Chebyshey	Fstop 1:	Wpass :	
	O FIR Equiripple	Fpass 1:	Wstop2	
(Streaming mode)	Filter Order	Feton 2		
Mada DuffT Magual	Minimum Arder			
	O Specify Order		Filer name	
Algorithm : Estimate				
Zero Padding : Disabled				
	Velocity Configurati	an X		
	Velocity Co	onfiguration saved Successfully		
		ОК		

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





 $\circ$   $\;$  Auto: If Auto is selected, Velocity Automatic filter will be configured

⊙ By Filter				
Streaming Mode SET Mode				
O Auto Filters Profil	e: 🗸 🗸	1	( ↓ 1	ົ
Response Type	Frequency Specification	Magnitu	de Specification	
<ul><li>Highpass</li><li>Bandpass</li></ul>	Units: Hz	Ur	nits: dB	
Design Method	Fs: 2000 V	Astr	opi: 60 iss: 0.1	
O IIR         Chebyshev_type_I ∨           O FIR         Equiripple ∨	Fpass1 :         2.5           Fpass 2         800	Wsta	op2: 60	
Filter Order	Fstop 2: 999			
Minimum Order     Specify Order		Filer nan	ne : 🗌	
Filer Specification				
Mag. (dB)				
0 - L	Astop2			
0 F <sub>stop1</sub> F <sub>pass1</sub>	Fpass2 Fstop2 Fs/2	f (Hz)		
			Close	Validate

- 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.
- ◆ <u>Filter Profile:</u> 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.



ly FFT		• By Filter	⊖ Bv	Zero Crossing
			-,	
🔵 Manual		Streaming Mode SET Mode	Diana Dadia	
Window Type : Rectangular 🗸 📔	Import		Finters Profile :	Heasitude Constituenties
Algorithm : Estimate ~		Response Type	Frequency Specification	Magnitude Specification
Zero Padding :		Highpass     Bandnass	Units: Hz	Units: dB
rrent Velocity Configuration			Fs: 100 Y	Astop : 1
		Design Method	Fstop : 20	Apass : 1
Ints Used		IIR Chebyshev_type_I     Ell Fauitionic	Fpass : 40	
Number of points(: SR/	/0.1			
Streaming	S.E.T	Minimum Order     Velocity	Configuration	X Filer name Filter_Name
Mode : By Filter	Mode : By Filter_Auto	Specify Urder	-	
ampling Hate : IVU (Hz)	Sampling Hate : UVU (Hz)	Filer Specification	Velocity Configuration saved Successfully	
lesion Method: Cheb. type II	Design Method: Cheb. type 1	Mag. (dB)		
Filter Order: Min order	Filter Order: Min order		ОК	
Fstop : 20 (Hz)	Fstop : 0.1 Hz	o	L Apass	
Fpass : 40 Hz	Fpass : 2.5 Hz			
Fpass2 : NA Hz	Fpass2 : NA Hz			
Fstop2 : NA Hz	Fstop1 : NA Hz			
Astop : 1 dB	Astop : 60 dB	0	Fpass	Fs/2 f (Hz)
Apass: 1 dB	Apass: 0.1 dB			
Wstop2: NA OB	Astop2: NA OB			
				Close Validate
				Close Validate
				Close Validate
10.2.2 UP Softwa	ro Filtor			Close Validate
10.2.3 IIR Softwa	re Filter			Close Validate
10.2.3 IIR Softwar	re Filter	2 filter		Close Validate
10.2.3 IIR Softwar	<b>re Filter</b> <b>r</b> : Check to enable IIF	R filter		Ciose Validate
10.2.3 IIR Softwar	re Filter r: Check to enable IIF	R filter		Close Validate
10.2.3 IIR Softwar	re Filter r: Check to enable IIF Softwar	R filter e Filters		Close Validate
10.2.3 IIR Softwar	re Filter r: Check to enable IIF Softwar	R filter e Filters ble IIR Filter		Close Validate
10.2.3 IIR Softwar	re Filter r: Check to enable IIF Softwar	R filter e Filters ble IIR Filter		Close Validate
10.2.3 IIR Softwar	re Filter r: Check to enable IIF Softwar	R filter e Filters ble IIR Filter		Close Validate
10.2.3 IIR Softwar	re Filter r: Check to enable IIF Softwar	R filter e Filters ble IIR Filter		Close Validate
10.2.3 IIR Softwar Enable IIR Filter	re Filter r: Check to enable IIF Softwar I Ena	R filter e Filters ble IIR Filter		Close Validate
10.2.3 IIR Softwar	re Filter r: Check to enable IIF Softwar I Ena	R filter e Filters ble IIR Filter		Close Validate
10.2.3 IIR Softwar	re Filter r: Check to enable IIF Softwar I Ena f Points	R filter e Filters ble IIR Filter Points (Streaming)		Close Validate
10.2.3 IIR Softwar Enable IIR Filter	re Filter r: Check to enable IIF Softwar I Ena f Points	R filter e Filters ble IIR Filter Points (Streaming)		Close Validate
10.2.3 IIR Softwar Enable IIR Filter	re Filter r: Check to enable IIF Softwar I Ena f Points	R filter e Filters ble IIR Filter Points (Streaming)		Close Validate
10.2.3 IIR Softwar	re Filter r: Check to enable IIF Softwar Tena f Points Number of Manual	R filter e Filters ble IIR Filter Points (Streaming) SR/0.1)		Close Validate
10.2.3 IIR Softwar	re Filter r: Check to enable IIF Softwar The founts Number of Manual Current Po	R filter e Filters ble IIR Filter Points (Streaming) SR/0.1) ints Number: SR		Close Validate
10.2.3 IIR Softwar Enable IIR Filter	re Filter r: Check to enable IIF Softwar The formula f Points Number of Manual Current Po	R filter e Filters ble IIR Filter Points (Streaming) SR/0.1) ints Number: SR	×¢.	Ciose Validate



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



It is important to notice

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/s<sup>2</sup>

Unit of acceleration	g 🗸
	g í
S.E.T threshold	mm/s <sup>2</sup>

#### 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/s<sup>2</sup>, 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.

Unit of acceleration	g	¥
S.E.T threshold	Acceleration	~
	Acceleration	T
	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<sup>®</sup> should be configured in Low Duty Cycle Acquisition Mode with a Data acquisition cycle of 20s.

#### Proceed as follows:

Waiting Sent Deleted	Datalogger		System config.	Power mode managt	Online Data Analysis
Config. frame is: 🤍 🤤 💭	Custum display	у	Notes	Data Acq. config.	Sensor Config
Current data acq. mode	Data acquisitio	on mode c	onfiguration		<u> </u>
DAQ Status : Started	1 Data Acq	ı. mode:	LowDutyCycle	· · · · ·	Start 4
Data Acq. mode: LowDutyCycle	Data Acq.	. cycle :	::20	ddd,hh:mm:ss	Stop
Data Acq. cycle : 00:00:20 ddd,hh:mm:ss	Data acquisitio	on mode o	ptions		
Sampling rate : NA Hz	O Tx Only	0	Log Only O T	x & Log	
Data Acq. duration : NA ddd,hh:mm:ss	3	DAQ co	nfiguration		×
6 Tx Log		1	Request sent : - Data acquisition : - Data acquisition (	mode : Mode LowDutyC cycle : 00:00:20	ycle
		5		0	к

Figure 81: Overview: Low Duty Cycle Configuration

#### **RF-TN-008**



#### 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

Datalogger	System config.	Power mode managt	Online Data Analysis	
Custum display	Notes	Data Acq. config.	Sensor Config	
Data acquisition mode	configuration			^
1 Data Acq. mode:	Alarm	v (	Start 5	
Data Acq. cycle :	::	ddd,hh:mm:ss	Stop	
Sampling Rate:		Hz DAG	Q configuration	×
Transmission ratio : 3 Data acquisition mode o	1 pptions		Request sent : - Data acquisi - Data acquisi - Survey transi	tion mode : Mode Alarm tion cycle : 00:00:02 mission cycle : 00:00:02
Tx Only 4 C	) Log Only O	Tx & Log a acq. mode		ОК
	D/	AQ Status : Started		
	Data A	Acq. mode: (Alarm		
	Data A	cq. cycle : NA ?	ddd,hh:mm:ss	
	Samp	oling rate : NA ?	Hz	
	Transmiss	ion cycle : NA ?	ddd,hh:mm:ss	
		Tx Log		
	Figure 83: C	Overview: Survey mo	de Configuration	



#### 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<sup>®</sup> is configured in streaming mode with a sampling rate of 100 Hz. "Continuous monitoring" and "TX" options are enabled.

Proceed as follows:



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<sup>®</sup> is configured in streaming Data acquisition mode with a sampling rate of 100 Hz. "One shot" and "TX" options are enabled.

Datalogger	System config.	Power mode ma	nagt	Online Data Analysis	
Custum display	Notes	Data Acq. con	ıfig.	Sensor Config	
Data acquisition mode	configuration			6	
1 Data Acq. mode:	Streaming	v		Start	
Data Acq. cycle :	;;;	ddd,hh:mm:ss		Stop	
2 Sampling Rate:	100 ~	Hz	DAQ co	nfiguration	×
Data Acq. duration :	3:20	ddd,hh:mm:ss	1	Request sent : - Data acquisition mo - Streaming options : - Sampling rate : 100	ode : Mode Streaming : One Shot
Data acquisition mode	options		6	- Data acquisition du	cle : NA iration : 00:00:20
💿 Tx Only 👍 🔾	) Log Only 🛛 🔿 1	ix & Log			
Streaming Packet optio	ns				ОК
O Continuous Monitori	n: 🔿 Burst	5 O One	Shot		



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

Beanair GmbH



### 11.3.3 Streaming Mode configuration (with "burst" option)

*Ex*: The BeanDevice<sup>®</sup> 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

100

Τx

00:00:20

Log

Sampling rate :

Data Acq. duration :

(Hz)

ddd,hh:mm:ss



# 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**:



### **RF-TN-008**

### 11.4.1 Step 1: configure the measurement range of your accelerometer



Figure 89: Sensor measurement range configuration



### 11.4.2 Step 2: Configure the SSD profile



1	Changes the accelerometer bandwidth du	ring the sleep period of the BeanDevice <sup>®</sup> : accelerometer during the sleep period	l, the					
	Accelerometer sampling rate during sleep period	BeanDevice <sup>®</sup> Current consumption						
	0,5 Hz	21 μA						
	1 Hz	<u>31 μ</u> Α						
	2 Hz	50 μA						
	5 Hz 78 μA							
	10 Hz 130 µA							
	50 Hz 302 μA							
	100 Hz 308 μA							
	400 Hz	343μΑ						
	1000 Hz	413 μΑ						
2	The user can select two events profile <i>Eve</i>	<i>nt 1</i> and <i>Event 2.</i>						
3	<i>Event combination</i> The user can use two logical combinations selection.	:: <b>AND</b> and <b>OR</b> combination on the axis ev	rent					
4	Set the shock detection threshold Unit value: g The threshold resolution depends highly c On the axis event selection frame, if the h positive. If the Low axis is selected, the threshold value Example: For a threshold value settled at For all the values upper than 2g on the X A	on the acceleration range. igh axis is selected, the threshold value wi alue will be negative. 2g, if X High Axis <u>OR</u> X Low Axis is selected axis, a shock event is detected	ill be I.					



	+ Range_MAX
	+TH_VAL Shock Detection Area
	- TH_VAL
	Shock Detection Area
	<ul> <li>Range_MIN</li> <li>The user selects a high event on the axis (+TH_VALUE), a shock is detected if the threshold value +TH_VALUE is reached:</li> </ul>
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	<b>RESET</b> 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:

Listening Mode Status					Temperature Sc	canner Configuration			
Waiting	g Sent	Deleted		Datalogger	Syst	em config.	Power mode	managt	
Config. frame is: 🕖				Custum display	Notes	Data Acq. con	fig. Se	ensor Config	
Current data acq. mode				Vata acquisition mode c	onfiguration			^	
DAQ Status :	Started			1 Data Acq. mode:	Shock Detectio	n v	<u> </u>	Start 🕖	
Data Acq. mode:	Shock Detect	tion		Survey Acq. cycle :	2:_1:00	ddd,hh:mm:ss	DAQ conf	iguration	×
Survey Acq. cycle :	00:01:00	ddd,hh:	mm:ss	3 Sampling Rate:	500	Hz		Dequest cent :	
Sampling rate :	500			Event acq. duration :	::10			- Data acquisition	mode : Mode Shock Detection
Event acq. duration :	00:00:10	ddd,hh:r	nm:ss					- Sampling rate : 5 - Data acquisition	00 Hz cycle : 00:01:00
9				Data acquisition mode o	ptions			- Data acquisition	duration : 00:00:10
	x Log			O Tx Only O	Log Only 5	⊙ Tx & Log			
									ОК

Figure 91: Overview: Shock Detection mode configuration

### **RF-TN-008**



### 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<sup>®</sup> 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.

Custum display	Notes	Data Acq. config.	Sens	or Config		
Datalogger	System config.	Power mode managt	Online	Online Data Analysis		
Number of Points (Strea	ming)				/ ^	
Manual SR/0.1	<b>x</b> ‡					
Current Points Number	: SR/0.1					
Online waveform configu	uration	Unit of acceleration		v I		
			9			
Enable waveforms L	og file(S.E.T)	S.E.T threshold	Accelerati	on 👻		
Coffigure Filters			Accelerati	on		
Software Filters			Velocity			
		1				

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.

Label: (Ch_Z) Alarm level Status [g]	
Technology: (AX-3D Alarm: (0 Alert:	
State: On Action: 0	

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.

Label: Ch_Z Alarm level Status (mm/s) Technology: (AX-3D Alarm: O Alert: O Alert: O Action: O	Sensor Channel Status		
	Label: (Ch_Z Technology: (AX-3D State: On	Alarm level Status (mm/s) Alarm: 0 Action: 0	Alert: Ø

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.



RF-TN-008	2.4GHz wireless sensors series
Dashboard       Sensor Channel Status       Label: Ch. Z       Iechnology: (AX-30)       State:       On	Sensor Config       Sensor labelling     Notes       Alarm DAQ mode       Image: Alarm Alarm: Alarm: Alarm: Alarm: Action: Mode

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.

Custum display	Notes	Data Acq. config.	Sensor Config
Datalogger	System config.	Power mode managt	Online Data Analysis
Online FFT Configuration		Online Velocity configura	ation
<ul> <li>Enable Online FFT</li> <li>Automatic FFT Repo</li> <li>Enable FFT Log file</li> <li>Number of Points (Stream</li> </ul>	rt(S.E.T)	Enable Online Veloci Automatic DIN Repo Enable Velocity Log Enable PPV Log file	ty 😰 ort(S.E.T) file
Manual SR/0.1 Current Points Number:	>: SR/0.1		
Online waveform configu	uration	Unit of acceleration	; ×
Automatic waveform Enable waveforms L	ns Report(S.E.T) og file(S.E.T)	S.E.T threshold	Acceleration Y
Software Filters Enable IIR Filter		Validate	

Figure 97: FFT setting

Now the BeanDevice<sup>®</sup> can be configured in S.E.T mode



Figure 98: S.E.T mode configuration



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 <sup>®</sup> profile
- 2. Click on Multicasting Tab
- 3. Click on the scroll list and select the BeanDevice<sup>®</sup> 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<sup>®</sup> in your multicast Group.

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

Labelling	Notes	Radio Config	System Config	Multicasting	Modbus	Upload dev	ice profile		
Multicast Grou	o Mgnt						Configuration manager		
Multicast Gro	up view 🕒						Data Acq. mode:	LowDutyCycle	<b>~</b> (s
							Data Acq. cycle :	LowDutyCycle Streaming	<b></b>
Par	Id Beandevice		DAQ Mode	DAQ Status	Power Status	Multicast Ability	Sampling Rate:	S.E.T	
▶ 0 391/	MAC_ID : 0 x 00	158D00000E1049	NA	Stopped	Bat Saver Disa	ОК	Data Acq. duration :	ii	ddd,hh:mm:ss
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### Figure 102: Overview: Multicast Group Management

# 11.6.3 Step 3: Click on Start to run your multicast

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2						Diag. Da	te: 12/8/2020	1:04:18 AM	Beep sound fu	inct.: Disabled						
						Internal Terr	p.: 32.625	<u></u>	Network Sta	itus : Disabled	าี เ					
<b>*</b>			Hard. v	ers. V3R4		Power supr	iv: Mains									
			Soft. v	ers. V5R8		Battery Volt	age: 4,196		Additional Mode							
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şh.			Site Labellin	g Notes		Radio Config	System Config	Multicasting	Modbus	Upload devic	e profile					
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Figure 103: Overview : Active Multicast Group



See "Synchronizing Acquisition with the Multicasting" YouTube video

- If you are using several BeanGateway<sup>®</sup> on the same field:
- The distance between each BeanGateway<sup>®</sup> should be at least 5 meters
- PAN ID should be different between the BeanGateway®
- RF Channel between each BeanGateway<sup>®</sup> 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<sup>®</sup> AX-3D Xrange 3 axis Accelerometer on our structure, and we begin to receive Vibration data, FFT and Velocity.

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

Listening Mode Status		Temperature Scanne	er Configuration	
Waiting Sent Deleted	Datalogger	System config.	Power mode managt	Online Data Analysis
Config. frame is: 🤍 🔍 🔍	Custum display	Notes	Data Acq. config.	Sensor Config
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Data Acq. cycle : NA ddd,hh:mm:ss	Sampling rate :	100 ~ (	Hz	
Sampling rate : 100 Hz	Data Acq. duration :	;;;	ddd,hh:mm:ss	
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	⊙ Tx Only (	O Log Only O 1	Tx & Log	$\overline{)}$

Figure 104: Wrong sampling rate value for resonance frequency monitoring

### **RF-TN-008**

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<sup>®</sup> 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<sup>®</sup> 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 <sup>®</sup>
- ✓ 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<sup>®</sup> and BeanGateway <sup>®</sup> 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 <sup>®</sup> profile and click on **Tools**, then click on **BeanGateway** <sup>®</sup> **config**.
- 2. A new window will open called "BeanGateway <sup>®</sup> configuration"
- 3. Disable the Keep alive available on your BeanGateway®

# BeanGateway Ethernet/LAN configuration Localize BeanGateway Localize v < Empty > Configuration Keep Alive App Config **TCP/IP Configuration** DHCP Enabled enabled : 🗸 BeanGateway TCP/IP KAA timeout (m/): 15000 🗢 IP address : 4000 🗢 KAA interva/(ms): Sub network mask : 7≎ Max/retry nbr : Default gateway IP : Validate DNS Enabled DNS IP AUTO Configuration via Ethernet (UDP) DNS Unlock the Keep enabled : 🗸 Alive function on Udp port : 53130 🗢 your BeanGateway BeanScape Validate 5315 🔶 "Port : IP address : Domain name : Validate Close

Figure 108: BeanGateway configuration panel on BeanScape

Disable the Keep alive on your BeanScape®

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

📾 Beanscape 2.4GHz

File BeanScape® App	Tools	Advanced func.	Off.Data Analysis	Vie
<u> </u>	BeanScape® configuration			Ь
Serve	Alarm Window			
	BeanGateway Ethernet/LAN Config.			5
	Import/Export user settings			2
A 🖌 🖌 🗖 🗛	A	larm Management		
	Notification Management			
	🙆 O	ffline graph		
	A	dvanced Settings		

Figure 109: BeanScape Tools menu

# You will see the following window:

BeanScape Configuration	×
Log	
Keep Alive App	Log directory : C:\log_beanscape
TCP/UDP	Stop loggin when disc space is 2048 😴 MB
Sustem	Main Log filename : LOG
System D i i	Main log max. size : 200 😴
Data cache	Sensor Log enabled : 🗹
Data Logger	Sensor log max. size (KB) : 1024 😴
StartUp	Network log info, enabled : 🗹
Date and Time Format	Network info log max. size (KB) : 1024 😴
Language	BGw Module Log enabled : 🗹
	BGw Module log max. size (KB) : 1024 🔽
	Syst. Maint. Status Log enabled : 🔽
	Syst. Maint. Status log max size (NB):
	Ctrooming log may size (KP) . 2048 🚔
	Reload Apply Save Reset

Figure 110: BeanScape configuration Window

### BeanScape Configuration



Figure 111: KeepAlive option on BeanScape configuration window

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

All the BeanDevice<sup>®</sup> 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<sup>®</sup>.



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 ( $\Delta t$ ), 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.



# 15.1 TIME-SYNCHRONIZATION OVER THE WIRELESS SENSOR NETWORKS

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

Accuracy @25°C

±2.5ms

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



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


## **15.2 CRYSTAL SPECIFICATIONS**

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