

Rethinking Sensing Technology

Beanair GmbH

DAQ modes on Wilow[®] devices

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DAQ modes on Wilow[®] devices

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1.	TECHNICAL SUPPORT	11
2.	VISUAL SYMBOLS DEFINITION	12
3.	ACRONYMS AND ABBREVIATIONS	13
4.	DOCUMENT ORGANIZATION	14
1.	ADVANTAGES & LIMITS OF EACH DATA ACQUISITION MODE	15
2.	AVAILABLE DATA ACQUISITION MODE	16
3.	SYSTEM OVERVIEW	17
	3.1 Captions	17
	3.2 Low duty cycle data Acquisition (LDCDA)	17
	3.2.1 Operation Mode	17
	3.2.2 Data acquisition cycle	19
	3.3 « Alarm»	19
	3.3.1 Operation mode	19
	4.1.1 Alarm threshold management (Alarm mode)	21
	3.4 Streaming	24
	3.4.1 Operation mode	24
	3.4.2 Maximum sampling rate	27
	3.5 Smart Shock detection (available only on the BeanDevice [®] Wilow [®] AX-3DS, AX-3D & X-INC)	28
	3.5.1 Operation mode	28
	3.5.2 During a shock detection	28
	3.6 Streaming with event trigger (S.E.T)	30
	3.6.1 Operation mode	30
	3.7 Software Streaming with event trigger (Soft S.E.T) (Available Only On The AX-3D)	31
	3.7.1 Operation mode	31
4.	DATA ACQUSITION MODE CONFIGURATION FROM THE BEANSCAPE® WILOW®	32
	4.1 Tab: Data Acquisition configuration	33
	4.1.1 Overview	33
	4.1.2 Parameters related to "Low duty cycle Data acquisition mode"	34
	4.1.3 Parameters related to "Alarm" Data acquisition mode	39

		4.1.4	Parameters related to "Streaming "mode	41
		4.1.6	Parameters related to S.E.T mode (Streaming with Event Trigger)	45
		4.1.7	Parameters related to Soft S.E.T mode (Software Streaming with Event Trigger)	47
	4.2	Alarn	n thresholds configuration from the BeanScape [®] Wilow [®]	49
		4.2.1	How to set an alarm threshold based on 4 alarm levels	49
		4.2.2	How to set an alarm threshold based on 3 alarm levels	50
		4.2.3	How to set an alarm threshold based on 3 alarm levels for Soft SET mode	50
		4.2.4	Sensor alarms window	51
5.	SE\	/ERAL E	XAMPLES OF DATA ACQUISITION	53
	5.1	Low	duty cycle acquisition mode	53
		5.1.1	Configuration	53
		5.1.2	Graph visualization	56
	5.2	Alarn	n Mode	56
		5.2.1	Graph visualization	58
	5.3	Strea	ming Mode	59
		5.3.1	Streaming mode configuration (with "continuous monitoring" option)	59
		5.3.2	Streaming Mode configuration (with "one shot" option)	60
		5.3.3	Streaming Mode configuration (with "burst" option)	62
		5.3.4	Graph visualization	64
	5.4	SSD (Smart Shock Detection)	65
		5.4.1	Step 1: configure the shock detection sensor	66
		5.4.2	Graph display	68
	5.5	Strea	ming with event trigger (S.E.T)	69
		5.5.1	Configuration	69
	5.6	Strea	ming with event trigger (S.E.T)	71
		5.6.1	Configuration	71
		5.6.2	Graph display	72
6.	ON	ILINE AI	ND OFFLINE DATA ANALYSIS TOOL (AVAILABLE ONLY ON BEANDEVICE® WILOW® AX-3D)	73
	6.1	Offlir	ne data analysis tool	73
		6.1.1 3D)	FFT (Fast Fourier Transform) waveform analysis module (available only on BeanDevice® Wil 73	ow® AX-
	6.2	Parti	cle Velocity (available only on BeanDevice [®] WiLow [®] AX-3D ±2g version)	81
	6.3	Onlin	e data analysis tool (available only on BeanDevice® WiLow® AX-3D)	91
		6.3.1	Online FFT and FFT report	91
		6.3.2	Online Velocity and Velocity report (available only on BeanDevice® WiLow® AX-3D ±2g ver	sion)96
		6.3.3	Software Filters	108
		6.3.4	Number of Points (Streaming)	108
		6.3.5	Unit of acceleration	110
	6.4	Onlin	e Data analysis (available only for Beandevice® Hi-inc)	111

	6.5	Date Conversion	115
	6.6	Offline Graph	118
7.	APP	ENDIX 1: FLOWCHART DIAGRAM (FOR ADVANCED USERS)	122
	7.1	"LDCDA" Data acquisition mode with Sleep with network LISTENNING POWER mode configuration	122
	7.2	« Alarm » Data acquisition mode with Sleep with network LISTENNING POWER mode configuration	123
	7.3	S.e.T moDe (streaming with event trigger)	124
	7.4	SSD (Smart Shock Detection)	125
		7.4.1 Shock Detection Flowchart	125
		7.4.2 Self-test Flowchart	126

List of Tables

Table 1: Maximum sampling rate	27
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List of Figures

Figure 1: LDCDA Mode	18
Figure 2: Alarm mode operation	20
Figure 3: Streaming with one shot option	25
Figure 4: Smart Shock Detection	28
Figure 5 : Streaming with Event Trigger	30
Figure 6: Data Acquisition frame	32
Figure 7: Data Acquisition configuration Tab	33
Figure 8: Current DAQ mode	33
Figure 9: LowDutyCycle configuration tab	34
Figure 10: Low Duty cycle status window	35
Figure 11: LowDutyCycle Configuration	36
Figure 12:LowDutyCycle Configurations Exp 2	37
Figure 13:Math Result display	
Figure 14: Math Result repository	
Figure 15: Math Result Log file	39
Figure 16: Alarm Data acquisition configuration tab	39
Figure 17: Alarm status window	40
Figure 18: Streaming Mode Data acquisition configuration tab	41
Figure 19: Streaming status window	41
Figure 20 : S.E.T Mode Data acquisition configuration tab	45
Figure 21 :S.E.T mode status window	45
Figure 22:Soft S.E.T Mode Data acquisition configuration tab	47
Figure 23 :S.E.T mode status window	47
Figure 24: Soft SET alarm thresholds	51
Figure 25: sensors alarm alert window	52
Figure 26:DAQ Configuration	53
Figure 27: TX ratio	55
Figure 28: Minimum DAQ cycle on LDC	55
Figure 29: Tx Ratio on the X-Inc	55
Figure 30: Low Duty Cycle Measurement graph	56
Figure 31: alarm mode configuration	57
Figure 32:Alarm Mode Graph	58
Figure 33: Streaming mode configuration	59
Figure 34: Streaming mode configuration (one option)	60
Figure 35: streaming mode with burst option configuration	62
Figure 36: Current DAQ mode	62
Figure 37: Graph Measurement	64
Figure 38: Graph display corresponding to a shock detection	68
Figure 39: SET mode Configuration	69
Figure 40: Soft SET DAQ mode	71
Figure 41: Soft SET graph display	72
Figure 42: FFT offline data analysis on BeanScape [®] top menu	73
Figure 43: FFT tool window	74
Figure 44: FFT window options	74
Figure 45: Browsing TX files on FFT window	75
Figure 46: Overview: FFT window	75

Figure 47: FFT features generation	76
Figure 48: FFT genrated view	76
Figure 49: Generated FFT Log files	77
Figure 50: Graph display (Offline Data analysis)	77
Figure 51: Selecting a graph to display	78
Figure 52: Selected graph display	78
Figure 53: FFT invalid files	79
Figure 54: Offline FFT shift activation	79
Figure 55: FFT shift spectrum	80
Figure 56: Particle Velocity on BeanScape® top menu	81
Figure 57: Particle Velocity window	81
Figure 58: Available Standards	82
Figure 59:Log file management	
Figure 60: Velocity Advanced Configuration	
Figure 61: Browsing TX files into Particle Velocity tool	
Figure 62: Generation of the Particle Velocity Calculation Result	
Figure 63: Particle Velocity Display Window	
Figure 64: VPPV & DIN buttons	
Figure 65: VPPV Report	
Figure 66: DIN Report	
Figure 67: Online FFT configuration frame	
Figure 68: FFT spectrum	
Figure 69: FFT log files folder	
Figure 70: FFT log files folder	
Figure 71: FFT report sent by email	
Figure 72: FFT Shift Spectrum	96
Figure 73: Online Velocity configuration tab	97
Figure 74: Velocity Graph	98
Figure 75: Velocity and FFT Graph, PPV and PVS	99
Figure 76: DIN 4150 Real Time Graph, PPV & PVS	99
Figure 77: DIN 4150-3 Report email	100
Figure 78: Velocity Log Folder/Files	102
Figure 79: PPV Log Folder/Files	102
Figure 80: Velocity Advanced Configuration	103
Figure 81: DAQ duration restriction	108
Figure 82: DAQ duration with manual buffer seize settings	109
Figure 83: The Average filter	111
Figure 84: Graph Measurement using Average filter	112
Figure 85: Empirical Rule filter	112
Figure 86: Graph Measurement using the Empirical Rule filter	113
Figure 87: Chebyshev filter	113
Figure 88: Graph Measurement using Chebyshev filter	114
Figure 89: Date Conversion	115
Figure 90: Date conversion option on BeanScape [®]	116
Figure 91: Date conversion window	116
Figure 92: Importing files into data conversion window	117
Figure 93: Overview of a selected file on Data conversion window	117
Figure 94: Converted file folder	118
Figure 95: Offline graph option on BeanScape [®]	118
Figure 96: Offline graph window	119

Figure 97: Offline graph window's options	
Figure 98: Offline displayed graph	120
Figure 99: Gird display of graphs	121

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.

DAQ modes on Wilow[®] devices

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. DOCUMENT ORGANIZATION

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

DAQ modes on Wilow[®] devices

1. ADVANTAGES & LIMITS OF EACH DATA ACQUISITION MODE

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

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

2. AVAILABLE DATA ACQUISITION MODE

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

Data acquisition Mode	BeanDevice® Wilow® AX3D	BeanDevice® Wilow® AX3DS	BeanDevice [®] Wilow [®] <i>HI-INC</i>	BeanDevice [®] Wilow [®] X-INC
Low Duty Cycle Data Acquisition(LDCDA)	Ø		Ø	Ø
Alarm	Ø	Ø	Ø	Ø
Streaming				
Shock detection	Ø			
Streaming with event-trigger (SET)	Ø	Ø		

3. SYSTEM OVERVIEW

3.1 CAPTIONS



3.2 LOW DUTY CYCLE DATA ACQUISITION (LDCDA)

3.2.1 Operation Mode

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

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



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

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

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



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

3.2.2 Data acquisition cycle

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

Data Acquisition cycle (depending on the power mode status)		Data acquisition duty cycle (in seconds)
Minimum values	BeanDevice® Wilow® is operating with "Sleep power mode"	1 5
	The BeanDevice Wilow [®] is operating with "Active" power mode	<i>1s</i>
Maximum value		1day (86400 seconds)

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

3.3 « ALARM»

3.3.1 Operation mode

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

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

DAQ modes on Wilow[®] devices



Figure 2: Alarm mode operation

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

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

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



See "Alarm mode on BeanDevice Wilow" YouTube video

4.1.1 Alarm threshold management (Alarm mode)

This section is related to the alarm thresholds management on the BeanDevice[®] Wilow[®]. Four alarms thresholds are available. The user can remotely configure the threshold values from the BeanScape[®]:

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

Alarms threshold are organized as follows:

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

Several configurations are possible:

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

↑ measure



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



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



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

Measurement NOK	
	High level alarm
	High level alert
Measurement OK	
	Low level alert = Low level alarm
Measurement NOK	

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

Alarm mode on firmware version 4.0 and above



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

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

Alert value < Action value < Alarm value

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

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





3.4 STREAMING

3.4.1 Operation mode

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

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

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

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

Streaming/Streaming Packet options			
Continuous Monitoring	Burst	One Shot	

See "Streaming mode on BeanDevice® Wilow" YouTube video

3.4.1.1 <u>Streaming with "continuous monitoring" option</u>

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

The BeanDevice® Wilow® operates as follows:

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

3.4.1.2 Streaming with "One shot" option



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

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

3.4.1.3 Streaming mode with "Burst" option

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

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

3.4.2 Maximum sampling rate

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

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

Table 1: Maximum sampling rate

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

The WSN comes with the following restrictions:

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

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

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

3.5.1 Operation mode

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



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

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

3.5.2 During a shock detection



∆t1 = **12.5** *ms*, Latency time between the device wake up and the first data acquisition

Δ*t2* - Data sampling duration. This value can be configured by the user from the BeanScape[®] software.

SSD mode operates as follow:

- ✓ <u>Step 1</u>: A shock threshold is reached (user-configurable), the **BeanDevice[®] Wilow[®]** wakes up
- ✓ <u>Step 2</u>: A data acquisition is performed with a high sampling rate
- ✓ <u>Step3</u>: The data acquisition is registered on the BeanDevice[®] Wilow[®] datalogger and transmitted to the BeanScape[®] in real time
- \checkmark <u>Step 4</u>: Step 2 to Step 3 are repeated until the sampling duration (Δ t2) is completed;
- Step 5: A Network diagnostic is automatically performed and transmitted to the BeanScape[®]
- ✓ <u>Step 7:</u> The BeanDevice[®] Wilow[®] goes to sleep



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

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

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



See "Smart Shock Detection (SSD) mode" YouTube video

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

3.6.1 Operation mode

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

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



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



See "Streaming with Event Trigger mode" YouTube video

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

3.7.1 Operation mode

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

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

The streaming with event trigger mode allows user to receive notification via email when the measurement reaches the preconfigured thresholds, the measurement is in streaming mode with high sampling rates (up to 2000 Sps) unlike in the alarm mode.

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

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DAQ modes on Wilow[®] devices

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

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





DAQ modes on Wilow[®] devices

4.1 TAB: DATA ACQUISITION CONFIGURATION

4.1.1 Overview

			0	
Data Acq. mode :	wDutyCycle \	/	Start	
Data Acq. cycle :	ddd, hh:m	nm:55	Stop	
TX_Ratio:				
Math Notif. ratio				
Math Notif. cycle will be : l	V4			
Data acquisition mode opt	ons O T			
() Ix Only) Log C		& Log		
0				
Streaming Packet Options				
Streaming Packet Options	🔘 Burst	\bigcirc	One Shot	
Streaming Packet Options Continuous Monitoring Store and Forward	Burst	0 (One Shot	

Figure 7: Data Acquisition configuration Tab

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



Data acquisition modes

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

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

Display configuration Notes	Data Acq. config.	Sensor Config	Online Data Analysis	DataLo 🔹
 Data acquisition mode confi 	guration			
Data Acq. mode : Lo	wDutyCycle	~	Start	
Data Acq. cycle :	::10 ddd, hh:i	mm:ss	Stop	
TX_Ratio: 1				
Math Notif. ratio 2				
Math Notif. cycle will be : 0 Data acquisition mode opt Tx Only Log C	00:00:10 hh:mm:ss ions Only OTx	« & Log		
Streaming Packet Options				
Continuous Monitoring	 Burst 	0	One Shot	
Store and Forward	Data Aging:	80 🚖		
Eige	ure 9: LowDuty(Sycle configu	uration tab	



Figure 10: Low Duty cycle status window

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

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

4.1.1.1 Math Result Feature

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

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

Math RESULT is included in all Beanscape versions starting from:

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

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

Math Result Configuration

Display configuration Notes Data Acq. confi	ig. Sensor Config Online Data Analysis Data Lo • •
Data acquisition mode configuration	
1 Data Acq. mode : LowDutyCycle	Start
Data Acq. cycle :::10 ddd,	5 Stop
3 TX_Ratio: 1	
Math Notif. ratio 2	4
Math Notif. cycle will be : 00:00:10 hh:mm:s. Data acquisition mode options	5
Tx Only C Log Only	Tx & Log
Streaming Packet Options Continuous Monitoring	t One Shot
Store and Forward	
SF Enabled Data Aging:	30 🜩

Figure 11: LowDutyCycle Configuration
- > 1/ choose Low Duty Cycle as DAQ mode
- > 2/ time needed to acquire one date in second
- > 3/ number of data to be sent
- > 4/ Number of cycles required to start calculation

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

Math Notif Cycle in this case is 10

• Math Configuration Example

Display configuration	Notes	Data Acq. config.	Shock Se	ensor Config	Online Data Analysis
Data acquisition mo	de confi	guration			
Data Acq. mod	e: Lo	wDutyCycle	\sim	Start	
Data Acq. cyc	de:	::02 ddd, hh	:mm:ss	Stop	
TX_Ra	tio: 5				
Math Notif. ra	tio 2				
Math Notif. cycle Data acquisition m	<i>vill be : (</i> iode opti	<i>00:00:18 hh:mm:ss</i> ions			
Tx Only) Log ()nly 🔿 1	īx & Log		
Streaming Packet	Options				
O Continuous Mo	notoring	Burst	0	One Shot	
Store and Forward	1	Data Aging:	30	k F	

Figure 12:LowDutyCycle Configurations Exp 2

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

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

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



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

Math Notif Cycle=(2*5*2) – 2=18

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



Math Result file is created besides the Tx file

This PC > Windows (C:) > log_beanscape > Folder C4BE84747DF60000 > TX Folder					
	Name	Date modified	Туре	Size	
	Transmit_Allsensor_LowDutyCycle_C4BE84747DF60000_Ch_Z_Ch_X_Ch_Y_10_14_2019_10	10/14/2019 12:19 PM	Text Document	2 KB	
3	Transmit_Allsensor_MathResultLowDutyCycle_MAC_ID0_x_C4BE84747DF60000_Ch_Z	10/14/2019 12:19 PM	Text Document	5 KB	

Figure 14: Math Result repository

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

The body of the file contains the period of acquisition: The Max, Min values with their corresponding dates & the average Value on each channel X Y Z BeanDevice : AX 3D

PAN ID : FFFE MAC ID : C4BE84747DF60000 Network Id : 0129 Measure mode : LowDutyCycle DATE_FORMAT : M/d/yyyy h:mm:ss tt Date : 10/14/2019 12:16:35 PM Unit for accelerometer : g Math Notif. ratio : 2 Math Notif. cycle 00:00:05 ddd,hh:mm:ss _____ _____ Date start; Date end | Ch Z(g) Date Min; Value Min; Date Max; Value Max; Average | Ch X(g) Date_Min;Value_Min;Date_Max;Value_Max;Average | Ch_Y(g) Date_Min; Value_Min; Date_Max; Value_Max; Average 10/14/2019 10:16:30 AM;10/14/2019 10:16:35 AM | 10/14/2019 10:16:30 AM;0.8;10/14/2019 10:16:35 AM;0.802;0.801 | 10/14/2019 10:16:30 AM;0.02;10/14/2019 10:16:35 AM;0.021;0.02 | 10/14/2019 10:16:35 AM;-0.005;10/14/2019 10:16:30 AM;-0.003;-0.004 10/14/2019 10:16:40 AM;10/14/2019 10:16:45 AM | 10/14/2019 10:16:45 AM;0.802;10/14/2019 10:16:40 AM;0.809;0.805 | 10/14/2019 10:16:40 AM;0.013;10/14/2019 10:16:45 AM;0.014;0.013 | 10/14/2019 10:16:40 AM;-0.01;10/14/2019 10:16:45 AM;-0.006;-0.008 10/14/2019 10:16:50 AM;10/14/2019 10:16:55 AM | 10/14/2019 10:16:55 AM;0.794;10/14/2019 10:16:50 AM;0.802;0.798 | 10/14/2019 10:16:55 AM;0.015;10/14/2019 10:16:50 AM;0.017;0.016 | 10/14/2019 10:16:55 AM;-0.008;10/14/2019 10:16:50 AM;-0.006;-0.007 10/14/2019 10:17:00 AM;10/14/2019 10:17:05 AM | 10/14/2019 10:17:05 AM;0.804;10/14/2019 10:17:00 AM;0.808;0.806 | 10/14/2019 10:17:05 AM;0.016;10/14/2019 10:17:00 AM;0.017;0.016 | 10/14/2019 10:17:05 AM;-0.01;10/14/2019 10:17:00 AM;-0.005;-0.007 10/14/2019 10:17:10 AM;10/14/2019 10:17:15 AM | 10/14/2019 10:17:15 AM;0.802;10/14/2019 10:17:10 AM;0.803;0.802 | 10/14/2019 10:17:10 AM;0.01;10/14/2019 10:17:15 AM;0.015;0.012 | 10/14/2019 10:17:15 AM;-0.011;10/14/2019 10:17:10 AM;-0.009;-0.01 10/14/2019 10:17:20 AM;10/14/2019 10:17:25 AM | 10/14/2019 10:17:25 AM;0.801;10/14/2019 10:17:20 AM;0.802;0.801 | 10/14/2019 10:17:25 AM;0.011;10/14/2019 10:17:20 AM;0.013;0.012 | 10/14/2019 10:17:25 AM;-0.008;10/14/2019 10:17:20



Figure 15: Math Result Log file

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

4.1.3 Parameters related to "Alarm" Data acquisition mode

Data acquisition mode configurat	on	ochaor coning johim	ic Data Analy
Data Acq. mode : Alarm	~	Start	
Data Acq. cycle::	:10 ddd, hh:mm:ss	Stop	
TX_Ratio: 1		,	
Data acquisition mode options -			
Tx Only C Log Only	🔿 Tx & Log	⊖ sa	

Figure 16: Alarm Data acquisition configuration tab

DAQ modes on Wilow[®] devices



Figure 17: Alarm status window

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

Streaming Mode

4.1.4 Parameters related to "Streaming "mode

Display configuration Notes Data Acq. config. Shock Se	nsor Config Online [
Data acquisition mode configuration	
Data Acq. mode : Streaming ~	Start
Data Acq. cycle: ddd, hh:mm:ss	Stop
Sampling Rate: 20 V Hz	
Data Acq duration: ddd, hh:mm:ss	
Data acquisition mode options	
● Tx Only ○ Log Only ○ Tx & Log	⊖ sa
Streaming Packet Options	
Continuous Monotoring O Burst	One Shot
Store and Forward	
□ SF Enabled Data Aging: 30 🚖	

Figure 18: Streaming Mode Data acquisition configuration tab



Figure 19: Streaming status window

Wilow[®] wireless sensors

DAQ modes on Wilow[®] devices

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

DAQ modes	on Wilow [®] devices	Wilow [®] wireless sensors
	SE Englied: enable Store and forward ontion	
÷	Si Endoled. enable store and forward option	
rwar		
d Fo		
ire ai		
Sto		

From the BeanDevice[®] Wilow firmware version 4.0, users have the possibility to use the battery saver mode (sleep mode) with the <u>streaming burst option.</u>

Display configuration Notes	Data Acq. config.	Sensor Config	Online Data Analysis	DataLo 🔹 🕨
 Data acquisition mode configu 	iration			
Data Acq. mode : Strea	aming	~	Start	
Data Acq. cycle :	_:_1:00 ddd, hh:n	nm:55	Stop	
Sampling Rate: 200	✓ Hz			
Data Acq. duration :	_::20 ddd, hh:n	nm:55		
Math mode enabled				
Data acquisition mode option Tx Only Log Only	y OTx	& Log O	SA	
Streaming Packet Options	Burst	0	One Shot	
Store and Forward	Data Aging: 3	0		

BeanDevice® Status	Wilow® BeanDevice
Identity	Network Diagnostic BeanDevice® config. Status Sensor Info Senso + +
Mac Id : 5C313E06A9A70000	
SSID: RUT950_1AC8	PER: 0.00 *
IP Addr : 192.168.1.19	LED Status:
Label : MAC ID : 0 x 5C313E06AS	Power Supply Diagnostic Synchronized
Version	Temperature : 31 ··································
HW Version: V2R0	Power supply : Mains Mine Source Mine Source State Sta
SW Version: V4R0	Power mode : Bat. Saver Enable System Information
DAQCapability	Battery voltage : 4.058 V Diagnostic cycle : 00:00:00 hh:mm:ss
Max SR : 2000 Hz	Battery level : Good Listening Cycle : 00:01:00 hh:mm:ss
Max TX_Ratio: 9	DiagDate : 7/17/2020 2:34:12 PI Data Aging: RollOver ms
BeanDevice DataLogo	Download Strategy: NONE
Platform : AX 3D Full Me	m. Mngmnt: STOP LOG Memory Used: 0 %
Current data acquisition mode	Datal order System config Remote Configuration Power mode Configuration
DAQ Status · Started	Battery Saver Configuration
Data Aca, mode : Streaming Burst	Status: Enabled
	ddd hh:mm:ss O Disable
TX Ratio: NA	Enable
Sampling Rate: 200	
Data Acq. duration .	ddd,m:mm.ss Validate
Tx Log	
0 0	Remote Configuration X
	Request sent successfully
	ОК

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



Soft SET mode

Display configuration Note	B Data Acq.	config.	Shock Se	nsor Config	Online	e Data Ana
Data Acq. mode :	S.E.T	`	<i>·</i>	Start		
Notif Cycle :	:25:	ddd, hh:n	nm:55	Stop		
Sampling Rate:	200 ~	Hz				
Data Acq. duration :	:05	ddd, hh:n	nm:ss			
Data acquisition mode of	options					
Tx Only Co	g Only	⊖ Tx	& Log	⊖ sa		
Streaming Packet Option	Ins					
Continuous Monoto	ring O Mode Date	Burst a acaui	sition co	One Sh	not on tab	

Current data acquisition m	node		
DAQ Status :	Started)
Data Acq. mode :	Streaming		
Data Acq. cycle :	NA		ddd,hh:mm:ss
TX Ratio :	NA		
Sampling rate :	20		Hz
Data Acq. duration :	Continue		ddd,hh:mm:ss
	Tx	Log	
	0	0	



DAQ modes on Wilow[®] devices

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

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

Display configuration Notes	Data Acq. config.	Sensor Config	Online Data	a Analysis	DataLo	•	Þ
Data acquisition mode cor	nfiguration					1	•
Data Acq. mode :	Soft S.E.T	~	Start				
Notif Cycle :	:10:00 ddd, hh:/	nm:ss	Stop				
Sampling Rate:	2000 ~ ^{Hz}						
Data Acq. duration :	:_5:00 ddd, hh:	mm:55					
Pre-trigger duration: 1	00 🚖 ms						
Math mode disabled for So	oft Set Mode						
Tx Only Log	Only OTx	& Log 💦 🔅	SA				

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

Current data acquisition m	node
DAQ Status :	Started
Data Acq. mode :	Soft S.E.T
Notif Cycle :	00:10:00 ddd,hh:mm:ss
Pre-trigger duration:	100 ms
Sampling Rate:	2000 Hz
Data Acq. duration :	00:05:00 ddd, hh:mm:ss
	0

Figure 23 :S.E.T mode status window

DAQ modes on Wilow[®] devices

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

DAQ modes on \	Wilow [®] devices
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4.2 ALARM THRESHOLDS CONFIGURATION FROM THE BEANSCAPE® WILOW®

Select your	Sensor Channel Go to Alarm and S.E.T Config Tab
File Server Tools Off. Data Analysis Be	<pre>indexion Help indexion Help indexion dealer information if if i</pre>
Alarm threshold	You can configure threshold high values (High Level Alarm, High Level Alert) and low values (Low Level Alert, Low Level Alarm). In alarm mode, when a higher low threshold

Wilow[®] wireless sensors

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

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

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

Alert value < Action value < Alarm value

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

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

Custom display	Notes	Measurement conditionning calibration	MQTT Conf	Log config.	Alarm and S.E.T config
Alarm	[g Alarm > Ac	tion > Alert		
Action	[g			
Alert	[g			
		Validate Reset			

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

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

The Soft SET alarm thresholds are based on the velocity unit

⊶ BeanScape File Server Tools Off.Data Analysis BeanSensor Help 🙀 🎯 🖤 🖉 🔲		
MAC_ID: 0x 5C313E06A9A70000 MAC_ID: 0x 5C313E06A9A70000 Gn_Y Gn_Z	Sensor profile General information Type: SelSOR_TYPE Airm Ref: Action Label: 10.2	Custom disalagi Notes Measurement conditioning calibration MQTT Corf. Log corfig. Alam and S E T corfig Soft Set Nam Thresholds Alam 0.050 mm/s Alam 0.050 mm/s Action 0.022 mm/s Action 0.002 mm/s Alam 0.001 mm/s Alert 0.001 mm/s Validate Reset Reset Reset

DAQ modes on whow aevice	S		whow [®] wireless	sensors
Custom display Notas Massuram	ont conditionning collibration MO	TT Conf Log config		Soft Set Alarm
Custom display Notes Measurem	en conditionning calibration Mg	Log coning.	Alarm and S.E. I Coning	Soft Set / Valim
Thresholds	Alams Config			
Alarm 0.050 mm/s	Alarm 0.050 mm/s	•		
Action 0.002 mm/s	Action 0.002 mm/s	1		
Alert 0.001 mm/s	Alert 0.001 mm/s	Validate Re	eset	

Figure 24: Soft SET alarm thresholds



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

4.2.4 Sensor alarms window

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

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



• You will see the following screen:



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



5. SEVERAL EXAMPLES OF DATA ACQUISITION

5.1 LOW DUTY CYCLE ACQUISITION MODE

Low Duty Cycle Data Acquisition mode

5.1.1 Configuration

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

Proceed as follows:





Only on the BeanDevice[®] Hi-Inc and X-Inc



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

Wilow[®] wireless sensors

DAQ mod	les on '	Wilow® c	levices

Display configuration Notes Data Acq. config. Online Data Analysis DataLogger System c
Data acquisition mode configuration
Data Acq. mode : LowDutyCycle ~ Start
Data Acq. cycle : ddd, hh:mm:ss Stop
TX_Ratio: 1
Math Notif. ratio
Math I Data a Tx ratio ×
Stream Co Store a
□ SF OK
Figure 27: TX ratio
Disclay and investing Nation Data App cooping Online Data Applying Data Language Contains a 1
Data acquisition mode configuration
Data Acq. mode : LowDutyCycle ~ Start
Data Acq. cycle :1 ddd, hh:mm:ss Stop
TX_Ratio: 1
Math Notif. ratio
Data Acq Cycle ×
S Min data Acq cycle for device version higher or equal to V4R1 is 2 seconds
ОК

Figure 28: Minimum DAQ cycle on LDC

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



5.1.2 Graph visualization

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



Figure 30: Low Duty Cycle Measurement graph

5.2 ALARM MODE



<u>Alarm mode</u>



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

DAQ modes on Wilow [®] devices	Wilow [®] wireless sensors
Display configuration Notes Data Acq. config. Sensor Config	Online Data Analysis DataLo
Data acquisition mode configuration	
1 Data Acq. mode : Alarm ~	Start 5
Data Acq. cycle :3 ddd, hh:mm:ss	Stop
TX_Ratio: 1	
	Data acquisition configuration X
Data acquisition mode options	
Tx Only O Log Only 4 O Tx & Log	Request sent :
Streaming Packet Options	- Data acquisition mode: Alarm Mode
O No Survey cycle O Survey O	- Tx Ratio : 1
Store and Forward	
SF Enabled Data Aging: 30 ≑	
	ОК

Figure 31: alarm mode configuration

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

5.2.1 Graph visualization

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



Figure 32:Alarm Mode Graph



Streaming Mode

5.3 STREAMING MODE

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

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

Proceed as follows:



Figure 33: Streaming mode configuration

DAQ modes on Wilow[®] devices



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

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

Current data acquisition mode	Display configuration Notes Data Acq. config. Sensor Config Online Da	ata Analysis Data Lo
DAQ Status : Started	Data acquisition mode configuration	
Data Acq. mode : Streaming One Shot	Data Acq. mode : Streaming V Start	
Data Acq. cycle : NA ddd, hh:mm:ss	Data Acq. cycle : ddd, hh:mm:ss Stop	
TX_Ratio: NA	Sampling Rate: 1000 V Hz 3	-
Sampling Rate: 1000 Hz	Data Acq. duration ::10 ddd, hh::mm:ss	Data acquisition configuration ×
Data Acq. duration : 00:00:10 ddd, hh:mm:ss	Data acquisition mode options	
	● Tx Only O Log Only O Tx & Log	Request sent: - Data acquisition mode : Streaming Mode
	Streaming Packet Options O Continuous Monitoring 5 O Burst O One Shot	- Sample Rate : 1000 Hz
8	Store and Forward Data Aging: 30 +	ОК

Figure 34: Streaming mode configuration (one option)

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

5.3.3 Streaming Mode configuration (with "burst" option)

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



Figure 35: streaming mode with burst option configuration



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

5.3.4 Graph visualization



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

Figure 37: Graph Measurement

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

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

Step 1

• Configure the measurement range of your accelerometer

Step 2

• Configure the SSD (Smart Shock Detection) Profile

Step 3

• Configure SSD (Smart shock detection) measurement mode



5.4.1 Step 1: configure the shock detection sensor

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

Display configuration Note	s Data Acq. config.	Shock Ser	nsor Config	Online Data Analysis	• •
Schock Sensor Config	L				
Shock.Sensor Range:	< selection >	~	-2.000 /	+2.000	
Sampling Rate:	< selection >	~	100		
Shock Thresholds:		mg	1966		
				Validate	

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

The selected value will be displayed on the black case.

Schock Sensor Config			
Shock Sensor Range:	< selection > ~ ~		-2.000 / +2.000
Sampling Rate:	< selection > +-2 g +-4 g		100
Shock Thresholds:	+-6g +-8g +-16g	mg	1966

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

The selected value will be displayed on the black case.

HUCK SCHOOL Mange.	< selection >	·	2.0007 +2.000
Sampling Rate:	< selection >	/	100
Shock Thresholds:	< selection > 25 HZ 50 HZ	mg	1966
	100 HZ 400 HZ		Validate
	1600 HZ		

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

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

Sampling Rate:	< selection > ~ ~	100
Shock Thresholds:	mg	1966
		Validate

5.4.2 Graph display

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



Figure 38: Graph display corresponding to a shock detection

Figure 39: SET mode Configuration



DAQ modes on Wilow [®] of	levices
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5.6 STREAMING WITH EVENT TRIGGER (S.E.T)

5.6.1 Configuration

Display configuration Notes Data Acq. config. Sensor Config Online Data Analysis Data Lo Data acquisition mode configuration Data Acq. mode : Soft S.E.T Start :10:00 ddd, hh:mm:ss Notif Cycle : Stop 2000 V Sampling Rate: 3 Data acquisition configuration × Data Acq. duration : :_5:00 ddd, hh:mm:ss Pre-trigger duration: 100 ÷ 5 Request sent: Math mode disabled for Soft Set Mode - Data acquisition mode : Soft S.E.T Mode Data acquisition mode options - Notif cycle : 00:10:00 () S/ Log Only Tx & Log Tx Only - Sample Rate : 2000 6 - Data acquisition duration : 00:05:00 -Pre-trigger duration : 100 ms 8 OK Figure 40: Soft SET DAQ mode 1 Chose "Soft S.E.T" mode 2 Enter 10 minutes for Notif cycle Enter a sampling rate of 2000 Hz 3 Enter 5 minutes for Data Acq. duration 4 Enter a pre-trigger duration of 100 milli-seconds 5 6 In this example we choose TX option

Wilow[®] wireless sensors



5.6.2 Graph display

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



Figure 41: Soft SET graph display



The graph will be refreshed every 10 seconds
6. ONLINE AND OFFLINE DATA ANALYSIS TOOL (AVAILABLE ONLY ON BEANDEVICE® WILOW® AX-3D)

6.1 OFFLINE DATA ANALYSIS TOOL

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

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



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

6.1.1.1 FFT File Generation

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



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

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

DAQ modes on Wilow[®] devices

Wilow[®] wireless sensors

🖬 FFT						- 🗆 X
All Start 2019- End 2019-	l time 06-26 11:29:52 ♀ 06-26 11:29:52 ♀	Browse View Reset	Show selected graph Number graph :	FFT Configuration Auto Window Type : Agorithm : Zero Padding : FFT Points	FFT Shift Rectangular Estimate	Current FFT Configuration Mode : FFT Auto FFT Shift : Disabled Window type : Bectangular Agonthm : Estimate
Browse file	s to process			 Use All Measurement data Adjust number of FFT points (Streaming mode) 	SR/0.1 Validate	Zero padding : Enabled Points used : All measureme
N° Parts F	ile Name		Start End			
FFT Start 20 Browse 1	All time to disable me range and work with All Data	Time range setting Browse files from Tx Folder	Reset all the in Reset all the in Show selected graph Number graph : Pagination Panel	Enable/Di Auto/Manu nterface FFT Configuration Window Type : Agonthm : Zero Padding : FFT Parks © Use Al Measurement data Adjust number of FFT ports (Streaming mode)	Sable Lal FFT Activate FFT Shift	Current FFT Configuration Mode : FFT Auto FFT Shift : Deabled Window type : Rectangular Algorithm : Extensite Zero padding : Enabled Points used : All measureme
N° Parts	File Name		Start End	-		
	×					Manual Mada Cattings:
						- Window Type
			Invalid files	will be		- Algorithm
			listed he	FFT Poi	nts Settings	- Zero Padding
		_				
	Selected files wil be listed here					

Figure 44: FFT window options

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

The FFT tool will generate as a result:

o Power spectral density and a new window displays

1: Click on Browse to choose files

FFT			
Start 2019/06/26 11:29:52 0 End 2019/06/26 11:29:52 0 Browse files to process	Show selected graph FFT Configuration Number graph: Window Type : Algorithm : Zero Padding : FFT Points Use All Measurement data	FFT Shit Rectangular ¢ Estimate ¢	Current FFT Configuration Mode : FFT Shift : Window type : Algorithm : Zero padding :
	Adjust number of FFT points	SR/0.1	Points used :
* Parts File Name	← → ✓ ↑	Search TX Folder	P
Click on Browse	Organize V New folder	B== •	
to browse Tx files	Downloads * Deventional * Devention	Date modified Type 6/26/2019 9:34 AM Text Document 6/25/2019 9:19 PM Text Document 6/25/2019 5:19 PM Text Document 6/25/2019 5:21 PM Text Document 6/25/2019 5:22 PM Text Document 6/25/2019 5:23 PM Text Document 6/26/2019 0:09 AM Text Document 6/26/2019 10:31 AM Text Document 6/26/2019 10:52 AM Text Document 6/26/2019 10:52 AM Text Document 6/26/2019 10:52 AM Text Document	Size 2 K 11 K 21 K 21 S 11 T 21 S 11 T 21 S 324 K 324 K 2,052 K 1,800 K
Select the files and click on Open	Desktop Documents Downloads File name: openFileDialog1	✓ Log files (*.txt) ✓ Open	Cancel

Figure 45: Browsing TX files on FFT window

2: Overview of the selected files Click on View to show result FFT _ Current FFT Configuration All time 2019-06-25 17:13:46 2019-06-26 09:27:37 FFT Configuration Auto FFT Shift Show selected graph Mode : Start View 🔺 er graph : Window Type Rectangular Estimate FFT Shift : Algorithm : Generate Log files • Window type Zero Padding : FFT Points Use AI Measurement data Adjust number of FFT points (Streaming mode) SR/0.1 Algorithm Browse files to process Zero padding Points used Check to generate Log files Validate N* Parts File Name Start End 6/25/2019 5:13:46 ... 6/25/2019 5:13:52 . 6/25/2019 5:14:06 ... 6/25/2019 5:14:12 . 6/25/2019 5:14:26 ... 6/25/2019 5:14:21 ... 6/25/2019 5:15:34 ... 6/25/2019 5:15:34 Transmit_Streaming_MacId_00158D00000E0C4D_6_25_2019_5_13_46_PM Transmit_Streaming_MacId_00158D00000E0C4D_6_25_2019_5_14_06_PM ming_Macld_00158D00000E0C4D_6_25_2019_5_14_26_PM ming_Macld_00158D00000E0C4D_6_25_2019_5_15_57_PM ming_Macld_00158D00000E0C4D_6_26_2019_9_24_54_AM 6/26/2019 5:15:57 ... 6/25/2019 5:18:23 6/26/2019 9:24:54 ... 6/26/2019 9:27:37 mit_Stre

Figure 46: Overview: FFT window

×

DAQ modes on Wilow[®] devices

3:Loading

-	FT					– 🗆 X
St: En	vant 20 d 20 rocess	All time -> 5 Files Selected 19:06:25 17:13:46 • 19:06:26 09:27:37 • Generate Log files ing 4/5	Show selected graph Number graph :	FFT Configuration	FFT Shit Rectangular \$ Estimate \$ T ts SRV0.1 Validate	Current FFT Configuration Mode : FFT Auto FFT Shift : Usabled Window type : Rectangular Agonthm : Estimate Zero padding : Enabled Points used : Al measureme
N°	Parts	File Name	Start End			
1	1	Transmit_Streaming_MacId_00158D00000E0C4D_6_25_2019_5_13_46_PM	6/25/2019 5:13:46 6/25/	2019 5:13:52		
2	1	Transmit_Streaming_MacId_00158D00000E0C4D_6_25_2019_5_14_06_PM	6/25/2019 5:14:06 6/25/	2019 5:14:12		
3	1	Transmit_Streaming_MacId_00158D00000E0C4D_6_25_2019_5_14_26_PM	6/25/2019 5:14:26 6/25/	2019 5:15:34		
4	1	Transmit_Streaming_MacId_00158D00000E0C4D_6_25_2019_5_15_57_PM	6/25/2019 5:15:57 6/25/	2019 5:18:23		

Figure 47: FFT features generation

- **4:** FFT report generated with the following results:
 - a. Frequency
 - b. Amplitude

···· FFT									- 🗆 X
Start End	20	All time 19-06-26 15:00:48	-> 10 Files Selected	Reset	Show selected graph Number graph : 10	FFT Configuration Auto Window Type :	FFT Shift Rectangular	Current FFT	Configuration Mode : FFT Auto
Velo	ocity	Successful operation of the state of the sta	Generate Log files	Ch_X	Data Analysis FFT Transmt_S.E.T_Ch_X_MAC_ID Transmt_S.E.T_Ch_X_MAC_ID Interval(ms)	0_x_F4B85E00A14B0000_6_26_20 500	19_3_00_48_PM		- D
N° P	arts	File Name		Oscillo	Go Sup scope - Print Save to PNG C	erposed	m Zoom Y Zoom X	Zoom XY	
1 1 2 1 3 1 4 1		Transmit_S.E.T_Ch_X_MAC_ID0_x Transmit_S.E.T_Ch_X_MAC_ID0_x Transmit_S.E.T_Ch_X_MAC_ID0_x Transmit_S.E.T_Ch_X_MAC_ID0_x	F4885E00A14B0000_6_26_2019_3_00 F4885E00A14B0000_6_26_2019_3_00 F4885E00A14B0000_6_26_2019_3_00 F4885E00A14B0000_6_26_2019_3_01	48_PM 53_PM 59_PM 04_PM					0.0200
5 1 6 1 7 1 8 1 9 1		Transmit_S.E.T_Ch_X_MAC_ID0_x_ Transmit_S.E.T_Ch_X_MAC_ID0_x_ Transmit_S.E.T_Ch_X_MAC_ID0_x_ Transmit_S.E.T_Ch_X_MAC_ID0_x_ Transmit_S.E.T_Ch_X_MAC_ID0_x_	F4B85E00A14B0000_6_26_2019_3_01 F4B85E00A14B0000_6_26_2019_3_01 F4B85E00A14B0000_6_26_2019_3_01 F4B85E00A14B0000_6_26_2019_3_01 F4B85E00A14B0000_6_26_2019_3_01	13_PM 18_PM 23_PM 29_PM 34_PM					0.0150
10 1		Transmit_S.E.T_Ch_X_MAC_ID0_x_	F4B85E00A14B0000_6_26_2019_3_01	40_PM					0.0100
					A Willow In	Wilds an etc. it. d	الدولاس ألتواج ويتقار		0.0050
								*//////////////////////////////////////	0.0000
				Π	0.000 20.0	00 40.000 Freque	60.000 ency(Hz)	80.000 1	00.000
					Berry have alway and	^{an} elos al al antisense and a second	มปัจจะสิรสุทธิ, การร่างที่สุท.การที่ประกอสรรมกำหว่า _ง มากไห	aanta Kidobhamaadaad maxadaan adamana milaa ka Aad	horse

Figure 48: FFT genrated view

5: FFT LOG files generated

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

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 fichier

Figure 49: Generated FFT Log files

6: The graphs will be displayed automatically, it can be formatted to select the number of graphs to display simultaneously in this window.

An easy navigation bar on the top of the window, allow to the user to navigate between the graphs and select the page size.



Figure 50: Graph display (Offline Data analysis)

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

	Se	elected item	Contract Co	Show selected graph Number graph : 6	
N°	Parts	File Name		Start	End
1	1	Transmit Streaming Ch X	MAC ID 0 x E4885E0041480000 6 26 2019 3 08 42 PM	6/26/2019 3:08:42	6/26/2019 3:36:10
2	4	Transmit_Streaming_Ch_X	MAC_ID0_x_F4B85E00A14B0000_6_26_2019_11_21_10_AM	6/26/2019 11:21:1	6/26/2019 11:47:3
3	1	Transmit_Streaming_Ch_Y	MAC_ID0_X_F4B85E00A14B0000_6_26_2019_3_08_42_PM	6/26/2019 3:08:42	6/26/2019 3:36:17
4	5	Transmit Streaming Ch Y	MAC ID 0 x F4B85E00A14B0000 6 26 2019 11 21 10 AM	6/26/2019 11:21:1	6/26/2019 11:47:2
5	1	Transmit Streaming Ch Z	MAC ID 0 x F4B85E00A14B0000 6 26 2019 3 08 42 PM	6/26/2019 3:08:42	6/26/2019 3:36:38
6	5	Transmit Streaming Ch Z	MAC_ID0 x F4B85E00A14B0000_6_26_2019_11_21_10_AM	6/26/2019 11:21:1	6/26/2019 11:47:2

Figure 51: Selecting a graph to display

8: The selected graph is displayed



Figure 52: Selected graph display

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



6.1.1.2 FFT shift

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

FFT shift option is activated when the checkbox "FFT shift" is checked.

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

- Power spectral density and a new window displays (with zero-frequency at the center)
- 1. To use FFT Shift: check FFT Shift, Select files and click the "View" button:

FFT Shift	
Rectangular	*
Estimate	*
0	
	FFT Shift Rectangular Estimate

Figure 54: Offline FFT shift activation

2. FFT Spectrum with FFT Shift option enabled



Figure 55: FFT shift spectrum



DAQ modes on Wilow[®] devices

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

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

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

👾 BeanScape

File Server

🚽 🚨 🚺 💿 🔊

🖃 📕 🔤 🖂 🖂 🖃

Tools

2-Implement an analysis report.

Particle Velocity

Select Log Files

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

Off. Data Analysis

Particle Velocity

FFT

Advanced func.

Help



Browse View Res	sct VPPV Report	Standard DE DIN 4150-3: 1999 at foundation (Short Term Vibrations) $ \smallsetminus $	 Use All Measurement data 	Made : Zero Crossing
Generate Log files	DIN 4150-3 Report	Standard DE DIN 4150-3: 1999 at foundation (Short Term Vibrations)	Custom number of points Manual SR/0.1	
Browse files to process Browse Tx Files N° Parts File Name Pi	ick the suitable DIN specifications	FFT Auto Window Type : Rectangular Agorithm : Estimate Zero Padding : Reponse Type Fitten Profile : <empty> Reponse Type Bandpass Highpass Bandpass Fitter 10 Fitter 10 Fi</empty>	Magnude Specification Unts : ad	J
Valid files list		Design Method Fitop: 0.1 © IIR [Onebythew_type_] © PIR Equipple © FiterOrder © Minimum Order	Astop : 60 Apass : 0.1	
		O Specify Order Filter N	ame :	
The following file are Invalid		0 Fatop Fpass	Fs/2 f (Hz)	
L			Validate	

Figure 57: Particle Velocity window

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

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

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



Figure 58: Available Standards

The PPV Results will be based on the select Standard.

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

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

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

			Show Selected graph
Browse	View	Reset	VPPV Report
Generate Log files	5		DIN 4150-3 Report
owse files to pro	ocess		
	Figure 59:	Log file management	<u>t</u>

3: Velocity Advanced Configuration.

Standard DE DIN 4150-3: 1999		Number of pointe/et	reaming (eaft e e t)	Current Valenty Configuration
Standard DE DIN 4150-3: 1999	at foundation (Short Term Vibrations)	Use All Measure O Custom number	ment data of points	Mode : Zero Crossing
	at roundation (onor: name vibrationay	Manual	SR/0.1	
FFT				
Window Type : Rectar	ngular 🔅			
Algorithm : Estima	te 🏠			
Zero Padding :				
-				
Filter	Filters Profile : CEmpty>	●	Validate	
Response Type	Frequency Specification	Magnitude Specification	·	
Highpass D Bandpass	Units : Hz	Units : dB		
	Fs: 10 ~			
IR Chebyshev_type_I	Fstop : 0.1	Astop : 60		
O FIR Equinpple	Fpass : 2.5	Apass : 0.1		
Elter Order				
Minimum Order				
O Specify Order	Filter	r Name :	8	
		Fs/2 f (Hz)		
0	「stop 「pass	Val	date	
0	^r stop ^r pass	Val	_{date} Configuration	
ault, the Velocity is o ter".	rstop rpass Figure 60: Velou configured "By Zero Cros	city Advanced C	date Configuration	ttings user must select "By
ault, the Velocity is o ter".	rstop rpass Figure 60: Veloc configured "By Zero Cros	city Advanced C ssing", to edit th By Filter	date	ttings user must select "By
ault, the Velocity is o ter".	rstop rpass	city Advanced C ssing", to edit th By Filter	date Configuration	ttings user must select "By
ault, the Velocity is o ter". By FFT FFT - By FFT : By se	electing this option, the u	city Advanced C ssing", to edit th By Filter user will setup th	date Configuration ne Velocity se	ttings user must select "By

DAQ modes	on Wi	low® d	levices
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By FFT Standard PPV	C	By Filter	Number of points(str	By Zero Crossing eaming/soft s.e.t)
Standard DE DIN 4150	-3: 1999 at foundation (Short Te	erm Vibrations) $$	Use All Measurer	ment data
Standard DE DIN 4150	3 1999 at foundation (Short Te	m Vibrations)	O Custom number of	of points
Standard DE Din 4155	5. 1999 at roundation (phote re	in volutions,	Manual	SR/0.1
FFT	_			
Auto				
Window Type :	Rectangular 🚖			
Algorithm :	Estimate 🜲			
Zero Padding :				

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

	By FFT Standard PPV Standard DE DIN 4150-3 Standard DE DIN 4150-3	By Filter 1999 at foundation (Short Term Vibrations) 1999 at foundation (Short Term Vibrations)	By Zero Crossing Number of points(streaming/soft s.e.t) Use All Measurement data Custom number of points Manual SR/0.1
	FFT Manual Window Type : Algorithm : Zero Padding :	Rectangular Stimate	
	○ FFT F	Points:	
		Number of points(streaming/soft Use All Measurement data Custom number of points Manual 	s.e.t) .1
By default, t By moving to	he Number of Po the Manual setting	ints is configured to be set auto s, user must choose a value betwee	omatically as Sampling Rate / 0.1 (SR/0.1) n 128 and 32768.

Number of points(streaming/soft s.e.t)		
O Use All Measurement data		
 Custom number of points 		
Manual	128 🜲	



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



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

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

2000/4096 = 0.48828125



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



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

- **By Filter:** By selecting this option, the user will setup the Velocity basing on the Software Filter.
 - Filter Filters Profile : < Empty> -∢. ↓ ↑ 🔵 Auto 俞 Frequency Specification Magnitude Specification Response Type Bandpass Units : Hz Highpass dB Units : Fs: 5 \sim Design Method Astop: 60 Fstop: 0.1 ● IIR Chebyshev_type_I 🔶 Fpass: 2.5 Apass: 0.1 FIR Equiripple * Filter Order Minimum Order Specify Order Filter Name : - **-**Filter Specification ₱Mag. (dB) 0 stop f (Hz) ī Fs/2 F_{stop} F_{pass}
 - \circ $\;$ 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



 <u>Design Method:</u> 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.



4: Click on browse button to choose TX Files.

		Show selected graph	FFT		O By Filt
Browse	View Rese	VPPV View	Auto Window Type : F	Rectangular 🜲	FFT Points
Generate Log nies		DIN 4150-3 Report	Algorithm :	Estimate 🔹	O Adjust
Browse files to proces	😡 Open				
NI ¹ Ded Die Neue		older F4B85E00A14B0000 > TX Folder	ٽ ~	Search TX Folder	
Click on Browse	Organize 🔻 New fold	der			- 🔳
to browse Tx files 📃	SmartSensor	Name	Date modified	Туре	Size
	TX Folder	Transmit S.E.T Ch X MAC ID 0 x F4B8	6/26/2019 4:06 P	M Text Document	
	User Guide	Transmit S.E.T Ch X MAC ID 0 x F4B8	6/26/2019 4:06 P	M Text Document	
		Transmit_S.E.T_Ch_X_MAC_ID0_x_F4B8	6/26/2019 4:06 P	M Text Document	
	 OneDrive 	Transmit_S.E.T_Ch_X_MAC_ID0_x_F4B8	6/26/2019 4:06 P	M Text Document	
	This PC	Transmit_S.E.T_Ch_X_MAC_ID0_x_F4B8	6/26/2019 4:06 P	M Text Document	
	3D Objects	Transmit_S.E.T_Ch_X_MAC_ID0_x_F4B8	6/26/2019 4:06 P	M Text Document	
	Desktop	Transmit_S.E.T_Ch_X_MAC_ID0_x_F4B8	6/26/2019 4:07 P	M Text Document	
		Transmit_S.E.T_Ch_X_MAC_ID0_x_F4B8	6/26/2019 4:07 P	M Text Document	
	Develoads	Transmit_S.E.T_Ch_X_MAC_ID0_x_F4B8	6/26/2019 4:07 P	M Text Document	
	Downloads	Transmit_S.E.T_Ch_X_MAC_ID0_x_F4B8	6/26/2019 4:07 P	M Text Document	
	J Music	Transmit_S.E.T_Ch_X_MAC_ID0_x_F4B8	6/26/2019 4:07 P	M Text Document	
The following file are lowalid	Pictures	Transmit_S.E.T_Ch_X_MAC_ID0_x_F4B8	6/26/2019 4:07 P	M Text Document	
The following nie are invalid	Videos	Transmit_S.E.T_Ch_X_MAC_ID0_x_F4B8	6/26/2019 4:07 P	M Text D	
	느 Local Disk (C:) 🗡	<		2	
	File	name: openFileDialog1	~	Log files (*.txt)	
t the files and click on	Onen			Open	Cancel

Figure 61: Browsing TX files into Particle Velocity tool

5: Loading.

Auto			Thes defected	-2.91	
	VPPV View	Reset			
Window Ty	DIN 4150-3 Report		rate Log files	Gene	F
Algorit Zero Padd Filter			ing 16/31	rocessi	Pr
Auto	^		File Name	Parts	N°.
	0 6 26 2019 3 00 48 PM	0 x F4B85E00A	Transmit S.E.T. Ch. X. MAC. ID	1	
Highnass	0 6 26 2019 3 00 53 PM	0 x F4B85E00A	Transmit S.E.T Ch X MAC ID	1	
C Tigripdaa	0_6_26_2019_3_00_59_PM	0_x_F4B85E00A	Transmit_S.E.T_Ch_X_MAC_ID_	1	
	0_6_26_2019_3_01_04_PM	0_x_F4B85E00A	Transmit_S.E.T_Ch_X_MAC_ID	1	
Design Method	0_6_26_2019_3_01_13_PM	0_x_F4B85E00A	Transmit_S.E.T_Ch_X_MAC_ID_	1	
IIR Cheb	0_6_26_2019_3_01_18_PM	0_x_F4B85E00A	Transmit_S.E.T_Ch_X_MAC_ID_	1	
O FIR Equiri	0_6_26_2019_3_01_23_PM	0_x_F4B85E00A	Transmit_S.E.T_Ch_X_MAC_ID_	1	
	0_6_26_2019_3_01_29_PM	0_x_F4B85E00A	Transmit_S.E.T_Ch_X_MAC_ID_		
Filter Order	0_6_26_2019_3_01_34_PM	0_x_F4B85E00A	Transmit_S.E.T_Ch_X_MAC_ID_	1	
Minimum Or	0_6_26_2019_3_01_40_PM	0_x_F4B85E00A	Transmit_S.E.T_Ch_X_MAC_ID_	1	0
Specify Ord	0_6_26_2019_3_01_45_PM	0_x_F4B85E00A	Transmit_S.E.T_Ch_X_MAC_ID_	1	1
	D_6_26_2019_3_01_51_PM	0_x_F4B85E00A	Transmit_S.E.T_Ch_X_MAC_ID_	1	2
Filter Specification	0_6_26_2019_3_01_56_PM	0_x_F4B85E00A	Iransmit_S.E.I_Ch_X_MAC_ID_	1	3
≜ Ma	0_6_26_2019_3_02_02_PM	0_x_F4B85E00A	Transmit_S.E.T_Ch_X_MAC_ID_	1	4 5
	0_6_26_2019_3_02_07_PM	0 x F4B85E00A	Transmit_S.E.T_Ch_X_MAC_ID_ Transmit_S.E.T_Ch_X_MAC_ID	1	э 6
	0.6.26.2019.3.01.40_PM 0.6.26.2019.3.01.45_PM 0.6.26.2019.3.01_55_PM 0.6.26.2019.3.01_55_PM 0.6.26.2019.3.02_02_PM 0.6.26.2019.3.02_07_PM 0.6.26.2019.3.02_07_PM	0_x_F4B85E00A F4B85E00A F4B85E00A F4B85E00A F4B85E00A F4B85E00A F4B85E00A	Transmit, S.E.T., Ch, X, MAC, JD Transmit, S.E.T., Ch, X, MAC, JD	1 1 1 1 1 1 1	10 11 12 13 14 15

Figure 62: Generation of the Particle Velocity Calculation Result

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

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



Figure 63: Particle Velocity Display Window

velocity Average	into velocity signal
Sampling Rate	In Hz
Analyze duration	BeanScape property
Long term vibration at Uppermost	1-Find the maximum velocity values over the Time
Floor evaluation effect	2- Compare the maximum velocity to the guideline value described on the Norm DIN 4150-3 (Long term vibration criteria).

	3-Display if the result is OK or not (guideline respected or not)
Short term vibration at foundation evaluating Effect	 1-Find the maximum velocity values over the Time 2- Compare the maximum velocity to the guideline value described on the Norm DIN 4150-3 (Short term vibration at foundation criteria). 3-Display if the result is OK or not (guideline respected or not)
Velocity Frequency	Get the signal frequency (FFT + windowing)
Maximum velocity (mm/s)	BeanScape Property
Short term vibration at Uppermost Floor evaluating Effect	 1-Find the maximum velocity values over the Time 2- Compare the maximum velocity to the guideline value described on the Norm DIN 4150 (Short term vibration at uppermost floor criteria). 3-Display if the result is OK or not (guideline respected or not)
Short term vibration at Buried Pipework evaluating Effect	 1-find the maximum velocity value over the time. 2-compare the maximum velocity to the guideline value described on the Norm DIN 4150 (Short term vibration at Buried Pipework criteria). 3-Display if the result is OK or not (guideline respected or not)



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



DIN 4150-3 Interpretation video

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

6.3.1 Online FFT and FFT report

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

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

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

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



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

Data Acq. config. Shock Sensor Config O	nline Data Analysis DataLogger System config.
Online FFT Configuration	Online Velocity configuration
Automatic FFT Report(S.E.T)	Automatic DIN Report(S.E.T) Enable Velocity Log file Enable PPV Log file
Number of points(Streaming) Manual SR/0.1 X The number of the current point SR/0.1	Software Filters Fnable IIR Filter Online FFT Configuration
	Enable Online FFT
	Automatic FFT Report(S.E.T) Enable FFT Log file

Figure 67: Online FFT configuration frame

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

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

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



Figure 68: FFT spectrum

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

Online FFT Configuration



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

> This PC > Local Disk (C:) > log_beanscape > Folder F4B85E	00A14B0000			
Name Date mo	dified Type	2	Size	
FFT 06-Feb-1	19 11:43 File f	folder		
TX Folder 06-Feb-1	19 11:43 File f	folder		
- Figure 69: FFT log file	es folder			
> Local Disk (C:) > log_beanscape > Folder F4B85E00A14B0000 > FFT				
lame	Date modified	Туре	Size	
FFT_RealTime_Ch_X_MAC_ID0_x_F4B85E00A14B0000_06_Feb_19_10_43_30	06-Feb-19 11:43	Text Documen	ıt	2 KB
FFT_RealTime_Ch_Y_MAC_ID0_x_F4B85E00A14B0000_06_Feb_19_10_43_30	06-Feb-19 11:43	Text Documen	ıt	2 KB
FFT_RealTime_Ch_Z_MAC_ID0_x_F4B85E00A14B0000_06_Feb_19_10_43_30	06-Feb-19 11:43	Text Documen	ıt	2 KB
FFT_RealTime_Ch_X_MAC_ID0_x_F4B85E00A14B0000_06_Feb_19_10_43_29	06-Feb-19 11:43	Text Documen	ıt	2 KB
FFT_RealTime_Ch_Y_MAC_ID0_x_F4B85E00A14B0000_06_Feb_19_10_43_29	06-Feb-19 11:43	Text Documen	ıt	2 KB
FFT_RealTime_Ch_Z_MAC_ID0_x_F4B85E00A14B0000_06_Feb_19_10_43_29	06-Feb-19 11:43	Text Documen	ıt	2 KB
FFT_RealTime_Ch_X_MAC_ID0_x_F4B85E00A14B0000_06_Feb_19_10_43_28	06-Feb-19 11:43	Text Documen	ıt	2 KB
FFT_RealTime_Ch_Y_MAC_ID0_x_F4B85E00A14B0000_06_Feb_19_10_43_28	06-Feb-19 11:43	Text Documen	ıt	2 KB
FFT_RealTime_Ch_Z_MAC_ID0_x_F4B85E00A14B0000_06_Feb_19_10_43_28	06-Feb-19 11:43	Text Documen	it	2 KB
Figure 70: FFT log file	es folder			
Enabling Automatic Papart: This functionality is available	vilable only in S	E T modo To	activato	
Enabling Automatic Report. This functionality is ava			activate	
automatic reports generation, check the option on	Online FFT con	figuration fran	ne	

Online FFT Configuration	
Enable Online FFT	*
Automatic FFT Report(S.E.T)	

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

DAQ modes on Wilow [®] devices Wilow [®] wireless set				
Gmail Q Search mail	v			
BeanScape® SMTP FFT REPORT: 06-Feb-19 10:12:39 Inbox ×				
to me -				
This mail is sent by BeanScape® Software				
This mail contain the graph report due of a streaming alarm for Device F4B85E00A14B0000 ,	In the Sensor MAC_ID : 0 x F4B85E00A14B0000			
Ch_Z : Max Amplitude= 1.0027 g , Frequency= 0 hz , VPPV Value = 131.532607068703				
Ch_X : Max Amplitude= 0.0761 g , Frequency= 0 hz , VPPV Value = 131.532607068703				
Ch_Y : Max Amplitude= 0.3645 g , Frequency= 0 hz , VPPV Value = 131.532607068703				
Figure 71: FFT report sent by emai	1			

• FFT Advanced Configuration

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

	FFT Configuration					×
	Auto		FFT Shift			
	Window Ty	pe: Re	ctangular 🚖	Curre	ent FFT Configural	lion
	Algorith	nm: Es	timate 🚖	1	FFT Shift :	By FFT_Auto
	Zero Paddii	ng: 🗹			Window type :	Rectangular
	Numbe	er of	SR/0.1		Algorithm : Zero padding :	Estimate
	(Streaming mo	de)			Zoro padaling .	
			Validate			
A+ - / D.A	I					
AUTO/IVI	lanual					
		Manual				
			Window Type :	Rectang	ular ≑	
			Algorithm :	Estimate	▲ ▼	
			Zero Padding :			
Window	v 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 Shift

Oscilloscope	Print Save to PNG Copy to Cli	pboard 🔄 Extends Zoom 🔤 Zoo	om Y 🔲 Zoom X 🔲 Zoom XY 🕥	Circle 🕥 Square 🕥 None		
			FFT Spectrum			
	~~~~~	~~~~~^		$\sim$	~~~~~	
000	-40.000	-20.000	0.000	20.000	40.000	

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



0120 0080 0040 You need to sample at 200Hz at least to provide good PPV values.



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



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

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

Data Acq. config. Shock Sensor Config	Online Data Analysis DataLogger System config.
Online FFT Configuration  Enable Online FFT	Dnline Velocity configuration  Enable Online Velocity
Automatic FFT Report(S.E.T) Enable FFT Log file	Automatic DIN Report(S.E.T) Enable Velocity Log file Enable PPV Log file
Number of points(Streaming)           Manual         SR/0.1	Software Filters
Online Velocity configuration	
Enable Online Velocity	idate
Automatic DIN Report(S.E.T) Enable Velocity Log file	
Enable PPV Log file	

Figure 73: Online Velocity configuration tab

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

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

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

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



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

<u>PPV:</u> 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

#### DAQ modes on Wilow[®] devices

#### Wilow[®] wireless sensors



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		
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)		

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

	organize	TACAA	00	
> This	s PC > Local Disk (C:) > log_beanscape > Fo	lder 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	
R		13-Feb-19 14:58	File folder	
S 🖈 🛛	5C313E06A9A70000 WirelessNetwkInfo	13-Eeb-19 14:58	Text Document	

Velocity_RealTime_Ch_Y_MAC_ID___0_x_F4B85E00A14B0000_6_12_2019_10_48_00_AM

Velocity_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	Organiz		140.00	Open	
⇒ Th	is PC → Local Disk (C:) → log_beansca	pe → Folder 5C313E	06A9A70000		
	Name	Date mo	dified Type	e :	Size
	FFT	13-Feb-1	19 14:43 File	folder	
7	TX Folder	13-Feb-1	19 14:58 File	folder	
Ŕ		13-Feb-1	19 14:58 File	folder	
INIS 🖈	5C313F06A9A70000 WirelessNetv	vklnfo 13-Eeb-1	19 14:58 Text	Document	
PPV	_RealTime_Ch_X_MAC_ID0	_x_F4B85E00A1	4B0000_6_12_	_2019_10_48_0	0_AM
PPV	_RealTime_Ch_Y_MAC_ID0	_x_F4B85E00A1	4B0000_6_12_	2019_10_48_0	0_AM
PPV	_RealTime_Ch_Z_MAC_ID0	_x_F4B85E00A1	4B0000_6_12_	2019_10_48_0	0_AM

Figure 79: PPV Log Folder/Files

### Velocity Advanced Configuration

) By FFI	U By Filter	By Zero Crossing	
Auto	Streaming Mode SET Mode		
	Filter Fi	iters Profile : < Emptys	
Window Type : Rectangular	Auto T	5 C	
Algorithm : Estimate	Highpage	Frequency Specification	Magnitude Specification
Zero Padding : 🔽	Bandnass	Units : HZ	Units : dB
urrent Velocity Configuration	- Design Mathed	rs : 2000 V	Astop 1 : 60
Points Used	IB Chebyshev type I	Fstop1: 0.1	
Number of points(Streaming) SR/0.1		Fpass1 : 2.5	Apass : 0.1
(Streaming mode)		Fpass2 : 800	Astop2 : 60
Mode : Zero Crossing	Filter Order	Estop 2 · 999	
	Specify Order		
		F	ter Name :
	Filter Specification		
	∮Maα. (dB)		
	0	± A _{na}	55 T
		T T T	
	A .		۵ ¹
	Mston1		Oston2
	Astop1		Cstop2
	Stop1		Tstop2
			Fs/2 f (Hz)
	0 F _{stop1}	F _{pass1} F _{pass2} F _{stop2}	Fs/2 f (Hz)
	0 F stop1	Fpass1 Fpass2 Fstop2	Fs/2 f (Hz)
	0 Fstop1	Fpass1 Fpass2 Fstop2	Fs/2 f (Hz)
	0 F _{stop1}	Fpess1 Fpess2 Fstop2	Fs/2 f (Hz)

Figure 80: Velocity Advanced Configuration

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

O By FFT		O By Filter		By Zero Crossing
- By FFT: B	y selecting this option,	the user will setup the Ve	locity basing on cu	stomized FFT settings.
	<ul> <li>Auto: If Auto is sel</li> <li>By FFT</li> </ul>	ected, The Velocity calcul	ation will activate F	FT Auto mode Settings
	Auto: If Auto is sel     By FFT FFT     Auto	ected, The Velocity calcul	ation will activate F	FT Auto mode Settings

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

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

Manual			
Window Type :	Rectangular	÷ In	nport
Algorithm :	Estimate	-	
Zero Padding :			

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

/elocity Configuration						
By FFT			O By Filter		O By Zero Cro	ossing
Manual			Streaming Mode	SET Mode		
Window Type : Algorithm : Zero Padding : Current Velocity Configuration Points Used Number of points(Stream (Streaming mode) Mode : <u>By FF</u> Window Type : <u>Recto</u> Algorithm : <u>Estim</u> Zero Padding : <u>Resto</u>	Rectangular	SR/0.1	Filter Manual Response Typ Highpass Bandpass Design Method FIR Equin Filter Order Minimum O Specify Ord Filter Specificat Maa 0 -	Fil vyshev_type_1 Velocity Configurat Velocity C	ters Profile : < Empty> Frequency Specification Units : Ac Fs : 100 Fstop : 0.1 Fpass : 2.5 ion Configuration saved Successfu	Magnitude Specification Units : dB Astop : 60 Apass : 0.1
			0	•	F _{stop} F _{pass}	Fs/2 f (Hz)
						Close Validate

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



By Filter	
Streaming Mode	SET Mode
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

Response Type	
Highpass	
O 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.



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

T
Manual
Manual       Rectangular       Import         Algorithm :       Estimate       Import         Zero Padding :

DAQ modes on Wilow[®] devices Wilow[®] wireless sensors 6.3.3 Software Filters Enable Acceleration Filter: Check to enable acceleration filter Software Filters Acc Filter : Enabled Disabled Enabled The acceleration filter is used to reduce the noise and makes the signal smooth. The acceleration filter is working only with the dynamic modes (Streaming, Shock Detection and S.E.T mode) 6.3.4 Number of Points (Streaming) Number of points(Streaming) Manual SR/0.1 The number of the current point SR/0.1

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

Then the signal graph will be displayed after 10s.



Display configuration Notes	Data Acq. config.	Sensor Config	Online Data Analysis	DataLo 🔹 🕨		
Data acquisition mode con	figuration					
Data Acq. mode : S	.E.T	~	Start			
Notif Cycle :	:10:00 ddd, hh:	mm:ss	Stop			
Sampling Rate: 1	00 v Hz					
Data Acq. duration :	::06 ddd, hh:	mm:ss 🚺				
Math mode enabled						
Data analysis config.			×			
The accumulated measurements count over the duration should be a multiple of the mumber of points, Example : for sampling rate = 100hz, Number of points = 1000, the closest duration to 00:00:06 can be 00:00:10 or 00:00:20						
			ОК			

Figure 81: DAQ duration restriction
Figure 82: DAQ duration with manual buffer seize settings

OK

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

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

FFT Spectral Resolution	Converter.	
Sampling Rate Hz 2000 - /	Number of points(Streaming) ectral Resolution 4096 = 0.48828125	Hz

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

2000/4096 = 0.48828125



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

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

#### 6.3.5 Unit of acceleration

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



Don't forget to click on validate before to proceed

Validate

DAQ modes on V	Vilow® c	levices
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unit.

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

Custom display	Notes	Measurement	condition	ning calibration	MQTT Conf	Log config.	Alarm and S.E.T config
Alarm	[		mm/s²	Alarm > Ac	tion > Alert		
Action	[		mm/s²				
Alert	[		mm/s²				
		Validate	Re	set			

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

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

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

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

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

Display configuration	Notes	Data Acq. config.	Online Data Analysis	DataLogger	System	CI 1
Number of points	(Stream	ing)	Software Filters			
Manual	SR/0.1		Filters Related to Incli (Dynamic Measureme	nometer ent)		
The number of the cu	urrent poi	nt SR/0.1		Empirical_	Rule	-
				None		
			17.15.1.5	Average		
			Validate	Empirical_ Chebyshev	Rule	

Figure 83: The Average filter

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



Figure 84: Graph Measurement using Average filter

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

Display configuration Notes Data Acq. config.	Online Data Analysis	DataLogger	System c 1
Number of points(Streaming)       Manual       SR/0.1	Software Filters Filters Related to Incli (Dynamic Measureme	nometer ent)	
The number of the current point SR/0.1		Average None	•
	Validate	Average Empirical_f Chebyshev	Rule

Figure 85: Empirical Rule filter

This filter is accurate and have a repeatability of  $\pm 0.001\%$  even while using a high sampling rate. It eliminates the vibration that may disturb the measurement process and may cause a noisy signal.

👐 BeanScape			- ø ×
File Server Tools Off. Data Analysis BeanSensor Help			
🖬 📓 🔘 😳 🔍 💭			
MAC_ID: 0 x 5C313E07049A0000	🥌 Sensor profile	Custom display Notes Measurement conditionning calibration MQTT Conf Log config. Alarm and S.E.T config	
	General information Transholds	Ratio: Unit: Deg	
	Type: SENSOR_TYPE High Level Alarm 0.000 Deg	Offset : DType : SENSOR_TYPE	
	Ref: B High Level Alert 0.000 Deg	Zeroing Validate Label : IINC_X Validate	
	Label: NC_X Low Level Alert 0.000 Deg		
	Technology: Indiamater	Mesurement data Math Hesuit End Date: MA	
	State: On Software Filter	Date Date Date Date Average value	
		Max value: MA Deg Date NA	
	Graph Measurement		
	Oscilloscope - Print Save to PNG Copy to Clipboard	Zoom Y Zoom X Zoom XY Alarm Circle Square None Clear Graph	
			Unit : Dea
		Streaming Mode	
			0.0400
			0.0100
			0.0350
			0.0350 8
			valt
			Part Part
			Ase
			Ű
			0.0300
0			
Sort + -			
			0.03
			- 0.0250
	15-01-20 000 M 20 2020 15-01-25 000 M-	20 2020 15 01 40 000 M- 20 2020 15 01 46 000 M- 20 2020 15 01 50 000 M- 15 01 53 026 Mar 30 2020 - 20 2020	15:02:00 000 M 20 2020
	15:01:30:000 Mar 30 2020 15:01:35:000 Ma	30 2020 15:01:40:000 Mar 50 2020 15:01:40:000 Mar 30 2020 15:01:50:000 Mar 100:2020 Mar 100:2020 Mar 30 2020	u 15:02:00.000 Mar 30 2020
		1 110	

Figure 86: Graph Measurement using the Empirical Rule filter

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

Display configuration Notes Data Acq. config.	Online Data Analysis	DataLogger System ci
Number of points(Streaming)     Manual       SR/0.1	Software Filters Filters Related to Incli (Dynamic Measureme	nometer ent)
The number of the current point SR/0.1		Average 🔹
	Validate	None Average Empirical_Rule Chebyshev

Figure 87: Chebyshev filter

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



Figure 88: Graph Measurement using Chebyshev filter

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

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

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

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

Software filters for Vibration-tolerant tilt measurement

# 6.5 DATE CONVERSION

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

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

Transmit_Streaming_Ch_Z_MAC_ID0_x_00158D00000CE454_2	DataConversion_MAC_ID_0_x_00158D00000CE454_CH_22
File Edit Format View Help	File Edit Format View Help
L	
BeanSensor AX-3D	BeanSensor AX-3D
Mac Id : 00158D00000CE454	Mac Id : 00158D00000CE454
Network Id : 0003	Network Id : 0003
Pan Id : 3905	Pan Id : 3905
Sensor Id : 2	Sensor Id : 2
Sensor Label : Ch Z	Sensor Label : Ch_Z
	Ratio : 1
Ratio : 1	offset : 0
Offset : 0	Unit : a
Unit : a	Date : 10/07/2017 10:32:47
onite i g	Data acquisition cycle : 10
Date : 10/07/2017 10:32:47	Data acquisition duration : NA
buce : 10/07/2017 10:52:47	Sampling rate : 100
Data acquisition cycle : 10	Cut off frequency : 1000
Data acquisition duration : NA	
Sampling rate : 100	Date: Measure
Cut off frequency : 1000	10/0//2017 10:32:47,000 : -0.03017
cut off frequency . 2000	10/07/2017 $10.32.47$ $010$ : -0.02981
Measure Index Measure Value	10/07/2017 10:32:47 020 : -0.02855
neasure index, neasure variae	10/07/2017 10:32:47 030 : -0.03047
00.03017	10/07/2017 $10:32:47.030$ ; $-0.03084$ Converted
1:-0.02981	10/07/2017 10:32:47.040 , -0.03004 Converted
2:-0.02855	10/07/2017 $10.32.47.050$ ; -0.02032
3-0.03047	10/07/2017 10:32:47.000 ; -0.0301 1110
4:-0.03084	10/07/2017 $10.32.47.070$ ; $-0.02930$
5:-0.02892	10/07/2017 $10.32.47.000$ ; $-0.03003$
6 - 0,0301 Original file	10/07/2017 $10.32.47.090$ , $-0.02944$
7:-0.02936	10/07/2017 10:32:47.100 , -0.02092
8-0.03003	
9-0 02944	
10: -0. 02892	10/07/2017 10:32:47.130 ; -0.02944
11 -0.02885	10/07/2017 10:32:47.140 ; -0.0301
12 -0 02892	
13 -0.02944	
14 -0.0301	
15 -0.02907	
16 -0.03032	
17 -0.02981	
18 -0.02988	
19 -0.0304	
201-0.02973	10/07/2017 10:32:47.230 ; -0.028/
21: -0. 02855	
	10/0//201/ 10:32:4/.250 ; -0.02833

Figure 89: Date Conversion

DAQ modes on Wilow[®] devices

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



Figure 90: Date conversion option on BeanScape®

O Date conversion	_	×
Select Log Files		
Browse Convert Reset		
The generated files will be saved in C: Vog_beanscape \Convexted File Folder\		
Browse files to process		
N° Parts File Name		
Start converting Reset all the interface		
Browse files from Log folder		

Figure 91: Date conversion window

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



Figure 92: Importing files into data conversion window

• Overview of the selected files

0	Date conv	ersion			_	×
Sele	ct Log Files	}				
E	—> 1 Fil	es Selected				
	Brow	rse Convert				
	The gener	rated files will be saved in C:V	log_beanscape\Con	, verted File Folder\		
		Browse files to	process			
N°	Parts	File Name				
1	1	Transmit_S.E.T_Ch_X_MAC_ID	0_x_F4B85E00A4D000	00_12_Feb_19_09_49_39		

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

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

▼ Include in library ▼	Share with  Burn New folder		
rites	Name	Date modified	Туре
wnloads	3 MAC_ID_00158D00000CE454	10/07/2017 15:23	File folde
eDrive	MAC_ID_00158D00000E04A8	05/07/2017 15:45	File folde

### 6.6 OFFLINE GRAPH

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



Figure 95: Offline graph option on BeanScape®

Reset all the interface

	10 9.0 8.0 7.0 6.0 5.0
	10 9.0 8.0 -7.0 -5.0
	10 9,0 8,0 7,0 6,0 5,0
	- 10 - 9,0 - 8,0 - 7,0 - 6,0 - 5,0
	9,0 8,0 7,0 6,0 5,0
	8. 7.0 6.0 5.0
	- 7.0 - 6.0 - 5.0
	6.0 5.0
	5.0
	4.0
	3.0
	2.0
	1.0
0 Feb 11 00:00 Feb 12 00:00	0.0 0:00 Feb
Figure 96: Offline graph window	
Graph Options	
Graph Options	
Graph Options     Offline graph	
Graph Options Offline graph Select Log Files	
Graph Options  Offline graph Select Log Files  Show selected graph Show selected graph	sh

Figure 97: Offline graph window's options

#### DAQ modes on Wilow[®] devices

Wilow[®] wireless sensors





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



Figure 99: Gird display of graphs



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



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



Beanair GmbH

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



Wilow[®] wireless sensors

# 7.4 SSD (SMART SHOCK DETECTION)

#### 7.4.1 Shock Detection Flowchart



## 7.4.2 Self-test Flowchart

