Readme – Vibration Event Analyzer

1. INSTALL THE SOFTWARE FIRST

The software installs the necessary drivers for Microsoft Windows to recognize your National Instruments (NI) data acquisition device.

2. ACCELEROMETER TYPES SUPPORTED

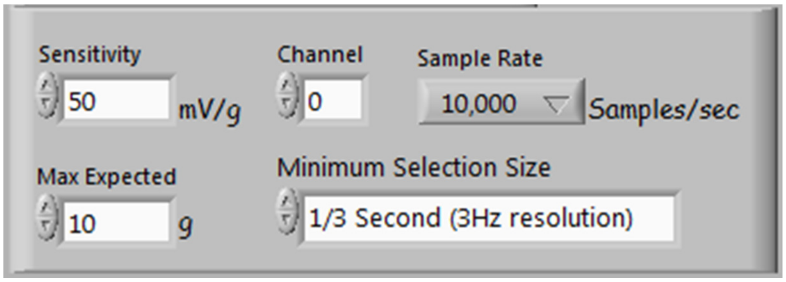
This software will work with IEPE single axis accelerometers. IEPE accelerometers are also called ICP™, ISOTRON, CCLD, or Deltatron. These are names that vary by manufacturer, but they all mean the same thing: electronics are built into the accelerometer and a DC excitation current along the signal wire from 2mA to 20mA is required to power the accelerometer. Some instruments have the current excitation built-in, and others require an external device between the accelerometer and the instrument. This current powers the electronics inside the accelerometer. The accelerometer should have a specification of "mV/g".

3. MOUNTING THE SENSOR

Proper sensor mounting is very important in reading the appropriate vibration signal. The best way possible is to drill a small hole into the device and screw the accelerometer onto the vibrating device. There are 2 common types of threading: ¼-28 and 10-32 threads. Smaller accelerometers may not have built-in threads for screw mounting. In this case, using a little beeswax or a very small dab of cyanoacrylic (superglue) on the mounting surface will work. Finally – it's important that the mounting is very clean and very flat. Special mounting options are available for mounting the sensor to a surface with a curvature. E-mail support@justmeasure.net if you need more information about mounting.

4. OPERATION OF SOFTWARE

You can double click the "Vibration Spectrum Capture" link on your desktop or from Start Menu -> Programs -> JustMeasure. Once the software is launched, the next step is to provide a few parameters for the software to operate properly in this section:



"Sensitivity"
You can input the sensitivity of the sensor (in mV/g), which will be providing on the calibration sheet from the manufacturer.

"Max Expected"
Input the maximum vibration levels you will need to measure in g's. If you don't know what kind of g force to expect, try a test run using the maximum range of the accelerometer you've chosen. You can do this by calculating what g force it would take to output 5 volts from the accelerometer:

Max Expected = 5 Volts / (x mV/g / 1000)

Where "x mV/g" represents the stated sensitivity from the accelerometer manufacturer.

"Channel"
This specifies which hardware channel on the National Instruments devices is being utilized. For more information, see section 7 below on proper wiring of the sensor to the data acquisition device.

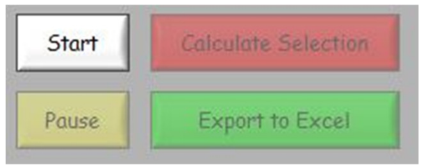
"Minimum Selection Size"
This is where you control the frequency resolution (in parentheses) and the minimum amount of time you're sure that the device under test will vibrate. There are 4 options: 1/10 of a second, 1/3 second, ½ second, and 1 second. If you can choose a longer minimum vibration time, you'll get better frequency resolution. Frequency resolution is simply the spacing (in Hz) between values in the results. Additionally, highlighting as much vibration as possible will result in more accurate results.

"Sample Rate"
This sets the data acquisition rate. The options are 1000, 5000, 10000, and 25000 Samples / sec. The highest frequency in the results will be slightly less than half of the sample rate you choose.

"Set Defaults"

This writes a small text file to your hard disk to permanently store your selections for the next time you run the software. For your convenience, you will not see any confirmation or response from hitting this button unless there are any problems or errors to report.

The next step in the software is to start the measurement. Controlling the measurement operation and analysis is done in this section of the software:



You'll notice the "start" button is the only active option at first. Once you start, you'll see along the top graph the data start collecting and the "Pause" option becomes available. The graph will auto-zoom as the vibration level changes from a very low background level to the level when the device under test is actuated. Once the vibration is complete, click the "pause" button and highlight the area that you wish to analyze by doing a click-and-drag over the vibration area of interest in the graph. If you are not satisfied with the selection, you can click the "Zoom Back Out" and try again. The "Zoom Back Out" button is only visible after the data has been paused. The graph records the most recent 10 seconds of data from the accelerometer.

Clicking the "Calculate Selection" will do the frequency analysis on all the data in the top graph. This data could be many times longer than the minimum required vibration time specified in the setup. If, for example, you selected 1.5 seconds worth of vibration data and you have chosen "1/3 second (3 Hz)" in the setup field, the software will average 4 consecutive frequency analyses between 0 and 1.2 seconds. The data remaining in a fraction of the time period (in the example, 0.3 seconds) will be ignored. You won't know exactly how much data you've selected in seconds, but you will get a message specifying if you haven't selected enough of the graph.

If you are satisfied with the selection, click "Export to Excel". Excel will open automatically and pre-format all of the cells and data for you.

5. DATA RESULTS:

In Excel, you'll get a time/date stamp, then 5 columns of data:

a) Time (s): The time stamps for each data point are the inverse of the sampling rate
b) Level (g's): This represents the G force from that accelerometer. You'll notice that, regardless of the length of your selection, you'll only get time domain data equal to your minimum selection size: 1 second, ½ second,

1/3 second, or 1/10 second. This is because the results only populate the last averaged segment of data in the FFT calculation.

NOTE: Your Time data results (in columns A and B) represent the last segment of time domain slices averaged together to create your frequency results. Consequently, if you did an FFT on this time segment, it will not be equivalent to the FFT results published in the Excel file.

c) This column is left blank
d) Freq (Hz): You'll notice the frequency is spaced in 1, 2, 3, or 10Hz increments dependent upon the "Minimum Selection Size" option in the software application.
e) Accel (g rms): This is the rms vibration level (in g's) calculated from a linear averaged FFT explained in the middle of Page 3 (above).
f) Vel (in/s rms): This is the calculated velocity data based on the vibration levels in inches / sec
g) Displ (mm rms): This is the displacement at each frequency calculated from the g levels.

6. SUGGESTIONS FOR NATIONAL INSTRUMENTS HARDWARE

Precision Suggestion: The National Instruments PCI-4462:

- Plugs inside a desktop PC into the "PCI slot" (in almost all desktop computers)
- Built in IEPE power to produce the DC excitation current so that you can hook it directly up to the accelerometer
- Features BNC jacks on the front for simple connection to the accelerometer
- 118dB of dynamic range from 24-bit A/D converters to see background vibration levels even with large device vibration
- 6 gains built into device to zoom in on small vibration
- See the user's manual of this device at sine.ni.com/manuals for more information on measurement accuracy.

Low Cost Suggestion: The National Instruments USB-6210:

- Plugs into any USB port of a laptop or desktop and does not require batteries or a separate power cord
- Features small screw terminals on the sides
- 16-bit A/D converter with no gain options
- See the user's manual of this device at sine.ni.com/manuals for more information on measurement accuracy
- Requires an extra device to supply the excitation current to the accelerometer: suggested model 5114 from Kistler – http://www.kistler.com) and a few extra cables (all included in this low-cost suggestion when purchased from our website)
- See Section 7 below for the proper wiring configuration for the sensor, excitation device, and National instruments device

NOTE: If you purchase the low-cost or precision bundle from our website, all cables and the device that provides excitation current (if necessary) will be supplied to you by JustMeasure.

7. ALL NATIONAL INSTRUMENTS DEVICES SUPPORTED

Table 1: All National Instruments Data Acquisition Devices Supported

Device	# of Ch's	Resolution / Gains	Current Excitation?	Example NI Cable	Example NI Connector Box	Wire Connections
PCI (goes inside Desktop PC)						
PCI-4462	4	24-bit / 6	Y	N/A	Built into Device	Group D
PCI-4472	8	24-bit / 1	Y	N/A	Built into Device	Group D
PCI-4474	4	24-bit / 1	Y	N/A	Built into Device	Group D
PCI-6110	4	12-bit / 8	N	SH68-68-EP	SCB-68	Group M
PCI-6111	2	12-bit / 8	N	SH68-68-EP	SCB-68	Group M
PCI-6115	4	12-bit / 8	N	SH68-68-EP	SCB-68	Group M
PCI-6120	4	16-bit / 8	N	SH68-68-EP	SCB-68	Group M
PCI-6122	4	16-bit / 4	N	SH68-68-EP	SCB-68	Group M
PCI-6123	8	16-bit / 4	N	SH68-68-EP	SCB-68	Group M
PCI-6133	8	14-bit / 4	N	SH68-68-EP	SCB-68	Group M
PCI-6143	8	16-bit / 1	N	SH68-68-EP	SCB-68	Group M
PCI-6010 (37-pin)	8	16-bit / 3	N	SH37F-37M-1	CB-37F-LP	Group C
PCI-6220	8	16-bit / 4	N	RC68-68	CB-68LP	Group M
PCI-6221 (68-pin)	8	16-bit / 4	N	RC68-68	CB-68LP	Group M
PCI-6221 (37-pin)	8	16-bit / 4	N	SH37F-37M-1	CB-37F-LP	Group C
PCI-6250	8	16-bit / 7	N	SHC68-68-EPM	SCB-68	Group M
PCI-6251	8	16-bit / 7	N	SHC68-68-EPM	SCB-68	Group M
PCI-6280	8	18-bit / 7	N	SHC68-68-EPM	SCB-68	Group M
PCI-6281	8	18-bit / 7	N	SHC68-68-EPM	SCB-68	Group M
PCI-6224	16	16-bit / 4	N	RC68-68, qty 2	CB-68LPR, qty 2	Group M2
PCI-6229	16	16-bit / 4	N	RC68-68, qty 2	CB-68LPR, qty 2	Group M2
PCI-6254	16	16-bit / 7	N	SHC68-68-EPM & SHC68-68	SCB-68, qty 2	Group M2
PCI-6259	16	16-bit / 7	N	SHC68-68-EPM & SHC68-68	SCB-68, qty 2	Group M2
PCI-6284	16	18-bit / 7	N	SHC68-68-EPM & SHC68-68	SCB-68, qty 2	Group M2
PCI-6289	16	18-bit / 7	N	SHC68-68-EPM & SHC68-68	SCB-68, qty 2	Group M2
PCI-6225	40	16-bit / 4	N	RC68-68, qty 2	CB-68LP, qty 2	Group H
PCI-6255	40	16-bit / 7	N	RC68-68, qty 2	CB-68LP, qty 2	Group H
PCI-6013	8	16-bit / 4	N	R6868	CB-68LPR	Group M
PCI-6014	8	16-bit / 4	N	R6868	CB-68LPR	Group M
PCI-6023E	8	12-bit / 4	N	R6868	CB-68LPR	Group M
PCI-6024E	8	12-bit / 4	N	R6868	CB-68LPR	Group M
PCI-6036E	8	16-bit / 4	N	R6868	CB-68LPR	Group M

PCI-6030E	8	16-bit / 14	N	SH68-68-EP	SCB-68	Group M
PCI-6032E	8	16-bit / 14	N	SH68-68-EP	SCB-68	Group M
PCI-MIO-16XE-50	8	16-bit / 8	N	SH68-68-EP	SCB-68	Group M
PCI-6040E	8	12-bit / 15	N	R6868	CB-68LP	Group M
PCI-6052E	8	16-bit / 15	N	SH68-68-EP	CB-68LPR	Group M
PCI-6070E	8	12-bit / 15	N	SH68-68-EP	SCB-68	Group M
PCI-6031E	32	16-bit / 14	N	SH1006868	SCB-68, qty 2	Group H
PCI-6033E	32	16-bit / 14	N	SH1006868	SCB-68, qty 2	Group H
PCI-6071E	32	12-bit / 15	N	SH1006868	CB-68LP	Group H
PCMCIA Devices (for Laptop PC):						
DAQCard-6024E	8	12-bit / 4	N	RC68-68	CB-68LPR	Group M
DAQCard-6036E	8	16-bit / 4	N	RC68-68	CB-68LPR	Group M
DAQCard-6062E	8	12-bit / 4	N	RC68-68	CB-68LPR	Group M
USB-Powered Devices:						
USB-6210	8	16-bit / 4	N	None Required	Built into Device	Group U
USB-6211	8	16-bit / 4	N	None Required	Built into Device	Group U
USB-6221	8	16-bit / 4	N	None Required	Built into Device	Group UM
USB-6229	16	16-bit / 4	N	None Required	Built into Device	Group UM
USB-6251	8	16-bit / 7	N	None Required	Built into Device	Group UM
USB-6259	16	16-bit / 7	N	None Required	Built into Device	Group UM
USB-9215A	4	16-bit / 1	N	None Required	Built into Device	Group UQ
USB-9215A (USB)	4	16-bit / 1	N	None Required	Built into Device	Group D
USB-9233	4	24-bit / 1	Y	None Required	Built into Device	Group D

NOTE: **For more information on the specific devices, visit http://sine.ni.com/manuals and type in the exact model from the first column of Table 1 (above) into the search field on that website.**

8. CABLES / WIRING FOR NATIONAL INSTRUMENTS DEVICES

STEP 1: DETERMINE HOW EXCITATION IS PROVIDED
The column in Table 1 labeled “Excitation Current?” indicates whether or not the NI Device supplies the required current between 2mA and 20mA to the accelerometer automatically.

If “Y”: The excitation is provided automatically and only a single cable is required (typically provided by the accelerometer manufacturer) from the sensor direct to the National instruments device. The BNC or SMB connectors on the front of the National Instruments device are clearly marked with channel numbers and correspond to the channels in your JustMeasure software application.

If “N”: You have to supply a separate device that provides the excitation current. The Model 5114 from Kistler is the recommended device. This device is included in the low-cost bundle from the JustMeasure website. It has 2 BNC jacks: One for the sensor input and one for the output to the National Instruments device. The manufacturer of the accelerometer can provide the proper cable from the accelerometer to the “Sensor” input BNC jack. The “Output” BNC jack on this device will need a cable from the BNC jack to 2 bare wires: one for “signal”, and one for “ground”. These bare wires will be secured into screw terminals. The one exception is if you’ve purchased the USB-9215A, in which case you just need a cable with BNC plugs on both sides to connect the excitation device (model 480C02) to the National Instruments device.

NOTE: If you purchase the low-cost or precision bundle from our website, all cables and the device that provides excitation current (if necessary) will be supplied to you.

STEP 2: DETERMINE THE PROPER NI CABLE AND SCREW TERMINAL BOX
You will need a cable from National Instruments that matches that device and a screw terminal box with the screw terminals inside (see suggestions for each device in Table 1 above). The screw terminals in the connector box will be assigned numbers. These numbers DO NOT correspond to the “channel” input in the software!

STEP 3: DETERMINE WHICH SCREW TERMINALS TO USE
Use table 1 (above) to find the correct group for you your National Instruments device. Then, use Table 2 below to determine the appropriate screw terminals for the “signal” and “ground” wires coming out of the current excitation device.

NOTE: If your device is in Group D, you’ll only need the cable provided by the accelerometer manufacturer. The device has the current excitation source built-in to it, with the exception of the USB-9125 which still requires the external current excitation source between it and the accelerometer.

Table 2: Wire Connections for NI Devices

Group M		
Software Channel	Signal	Ground
0	68	34
1	33	66
2	65	31
3	30	63
4	28	61
5	60	26
6	25	58
7	57	23

Group U		
Software Channel	Signal	Ground
0	15	16
1	17	18
2	19	20
3	21	22
4	24	25
5	26	27
6	29	30
7	31	32

Group UM		
Software Channel	Signal	Ground
0	1	2
1	4	5
2	7	8
3	10	11
4	17	18
5	20	21
6	23	24
7	26	27
8	33	34
9	36	37
10	39	40
11	42	43
12	49	50
13	52	53
14	55	56
15	58	59

Group C		
Software Channel	Signal	Ground
0	1	20
1	21	2
2	22	4
3	5	23
4	6	25
5	26	7
6	27	9
7	28	10

Group UQ		
Software Channel	Signal	Ground
0	0	1
1	2	3
2	4	5
3	6	7

Group M2		
Software Channel	Signal	Ground
Connector 0		
0	68	34
1	33	66
2	65	31
3	30	63
4	28	61
5	60	26
6	25	58
7	57	23
Connector 1		
8	68	34
9	33	66
10	65	31
11	30	63
12	28	61
13	60	26
14	25	58
15	57	23

Group H		
Software Channel	Signal	Ground
Connector 0		
0	68	34
1	33	66
2	65	31
3	30	63
4	28	61
5	60	26
6	25	58
7	57	23
Connector 1		
8	68	34
9	33	67
10	32	66
11	65	31
12	30	64
13	29	63
14	62	28
15	27	61
16	26	60
17	59	25
18	24	58
19	23	57
20	55	21
21	20	54
22	19	53
23	52	18
24	17	51
25	16	50
26	49	15
27	14	48
28	13	47
29	46	12
30	11	45
31	10	44
32	42	8
33	7	41
34	6	40
35	39	5
36	4	38
37	3	37
38	36	2
39	1	35

9. PC REQUIREMENTS:

Software:

- Windows 2000/XP/Vista
- Microsoft Excel 2000 or later
- Adobe Acrobat Reader Ver. 6.0 or later

Hardware:

- 256MB RAM
- Pentium III / Celeron 600MHz or equivalent/faster

This document serves as a repository for all the technical information we've published about this application. If we've left something out or you need more information, all e-mail is answered within 24 hours:

Support@JustMeasure.net