VT IEPE-2G05/A/B/C/D/E Manual

24-bit Dual-Channel 48 kSPS 0.03Hz~23kHz
USB IEPE Data Acquisition Interface

This product is designed to be used by those who have some basic electronics and electrical knowledge. It is absolutely dangerous to connect an unknown external voltage to the VT IEPE-2G05 unit. Generally only IEPE sensors can be connected to the BNC connectors of this product.

Note: VIRTINS TECHNOLOGY reserves the right to make modifications to this manual at any time without notice. This manual may contain typographical errors.

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1 Installation and Quick Start Guide

VT IEPE-2G05 is a 24-bit, dual-channel, USB data acquisition interface specially designed for use with IEPE sensors such as IEPE accelerometers, IEPE microphones and IEPE hydrophones. Each channel has six calibrated voltage measurement ranges for easy calibration to sensor sensitivity: ± 250 mV, ± 500 mV, ± 1 V, ± 2.5 V, ± 5 V, ± 10 V, and a built-in 24V 4mA current source to drive an IEPE sensor directly. It contains a hardware high pass filter with 5 selectable -3dB corner frequencies: None (0.03Hz), 1.8 Hz, 119 Hz, 236 Hz and 464 Hz. The signals sensed by the IEPE sensors can be amplified and output directly from its stereo headphone jack even without running the PC software. When used in conjunction with the Multi-Instrument® software, the setup allows you to take reliable and quality vibration and noise measurements as simply as plug & play. No external power supply and driver installation is required. It is a truly hassle-free portable vibration and noise test & measurement solution.

VT IEPE-2G05A has the same specifications as VT IEPE-2G05, except that its Channel B has a 20 dB higher analog gain, with its voltage measurement ranges changed to: ± 25 mV, ± 50 mV, ± 100 mV, ± 250 mV, ± 500 mV, ± 1 V. The increased gain makes it more capable of measuring low level signals such as a low-dBSPL sound.

VT IEPE-2G05B has the same specifications as VT IEPE-2G05, except that its two input channels A & B have a 20 dB higher analog gain, with their voltage measurement ranges changed to: ± 25 mV, ± 50 mV, ± 100 mV, ± 250 mV, ± 500 mV, ± 1 V. The increased gain makes it more capable of measuring low level signals such as a low-dBSPL sound.

VT IEPE-2G05C/D/E have the same specifications as VT IEPE-2G05, except that their Channels B have a 40 dB higher analog gain, with their voltage measurement ranges changed to: ± 2.5 mV, ± 5 mV, ± 10 mV, ± 25 mV, ± 50 mV, ± 100 mV. The increased gain makes them more capable of measuring extra low-dBSPL sound. Their Channels A have a 0dB /20dB / 40dB higher analog gain respectively than that of VT IEPE-2G05.

All the above models can be switched to a voltage measurement mode (e.g. for the purpose of accepting the voltage pulses output by a tachometer) by cutting off the 24V 4mA constant current supply through an internal DIP switch in each channel. The 4mA constant driving current can be modified as well (e.g. for the purpose of driving a very long cable). These customizations are recommended to be done in the factory upon request before shipping.

It is possible to run multiple VT IEPE-2G05/A/B/C/D/E using multiple instances of the software on the same computer.

1.1 Package Contents

1.1.1 Standard Package

A standard VT IEPE-2G05 Package contains the following items:

1) VT IEPE-2G05 unit with a hardware activated Multi-Instrument Standard software license

2) USB cable (1.5 m)

3) CD (contains the copy-protected Multi-Instrument software)

4) Carrying case

1.1.2 Optional Items

1) IEPE Accelerometers / IEPE Force Sensors
2) IEPE measurement microphones
3) IEPE measurement hydrophones
4) Magnetic mounting base
5) BNC-to-M5/L5 low-noise cable
6) USB Isolator
7) Software license upgrade

1.2 Multi-Instrument Software Installation

Multi-Instrument is a powerful multi-function virtual instrument software. It is a professional tool for time, frequency and time-frequency domain analyses. It supports a variety of hardware ranging from sound cards which are available in almost all computers to proprietary ADC and DAC hardware such as NI DAQmx cards, VT DSO, VT RTA, VT IEPE, VT CAMP and so on. It consists of an oscilloscope, a spectrum analyzer, a multimeter, a spectrum 3D plot, a vibrometer, a data logger, a LCR meter and a Device Test Plan, all of which can run simultaneously. Please refer to the Multi-Instrument software manual for details.

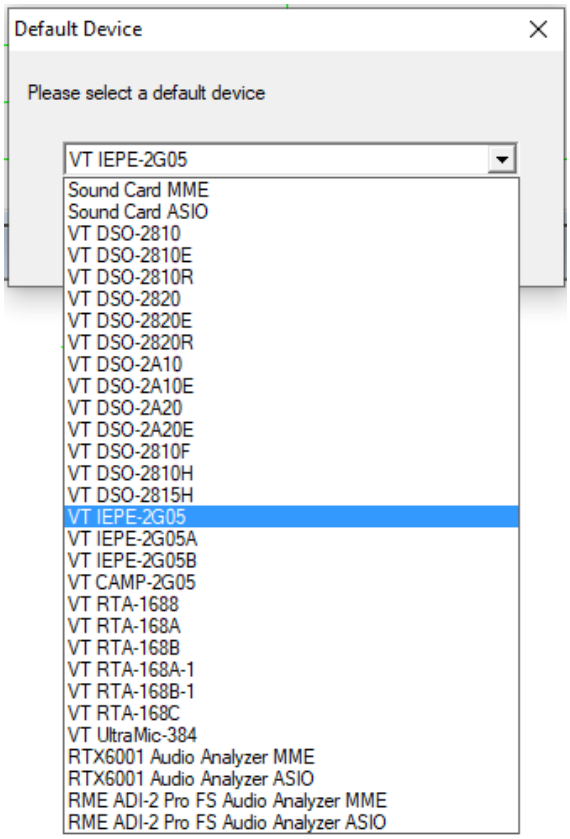
Insert the installation CD into your computer's CD-ROM drive and follow the instruction on the screen to install the Multi-Instrument software. Alternatively, you can always download the latest software from: www.virtins.com/MIsetup.exe.

By default, VT IEPE-2G05/A/B/C/D/E uses sound card MME driver which comes natively with all Windows versions. Thus no driver installation is required.

1.3 Start Multi-Instrument Software

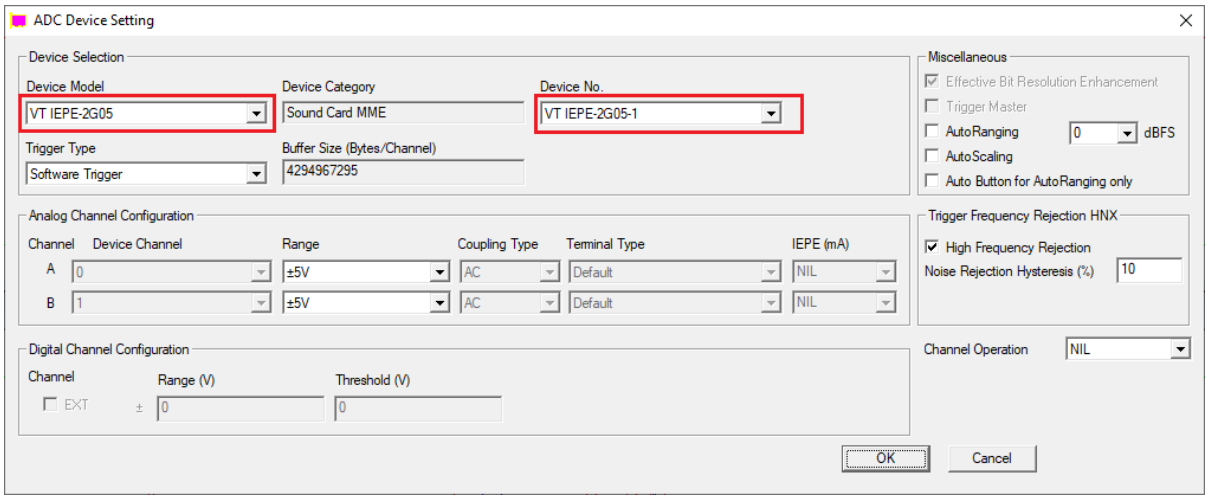
With the hardware activated Multi-Instrument license, the hardware (i.e. VT IEPE-2G05/A/B/C/D/E) must be connected to the computer first before the software can be launched. The LED on the front panel will turn steady red once connected.

To start the Multi-Instrument software, on Windows desktop, click the MI icon directly, or select [Start]>[All Programs]>[Multi-Instrument]>[VIRTINS Multi-Instrument]. If the software is started for the very first time, the following dialog box will pop up. Select "VT IEPE-2G05" (or "VT IEPE-2G05A", or "VT IEPE-2G05B"…) to make it the default data acquisition device. This dialog box can also be accessed via [Setting]>[Restore to Factory Default].



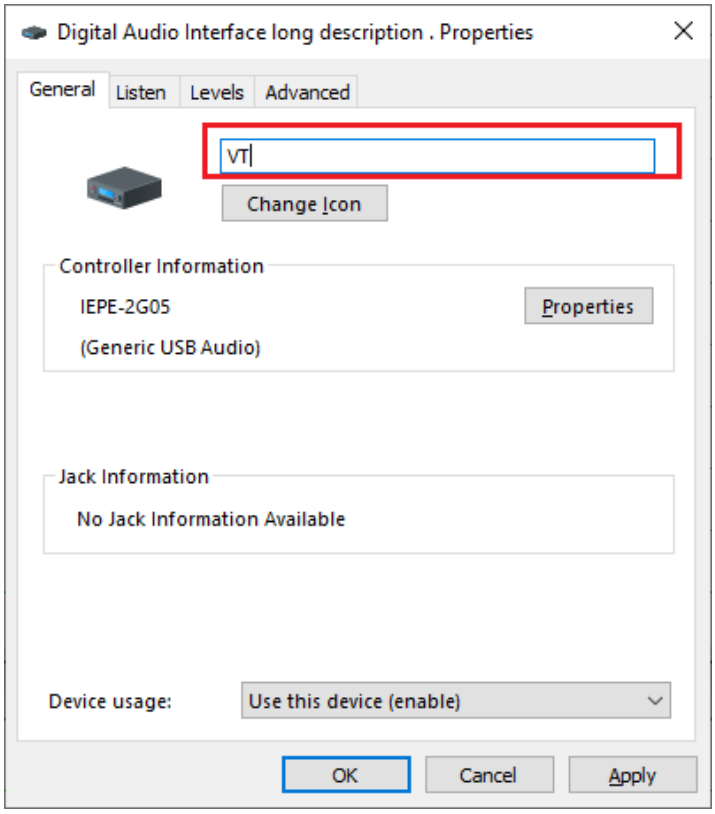
Click the round button at the upper left corner of the screen, or simply press the ENTER key, to start or stop data acquisition. When the data acquisition is running, the LED will turn greenish.

VT IEPE-2G05 can also be selected via [Setting]>[ADC Device]> "Device Model" and “Device No.”, as shown below.



When the system language of Windows is not English, depending on the actual language used, an error message such as “DAQ device not found!” or “Fail to start DAQ!” might pop up when you launch the software or start sampling. In this case, you can go to [Windows Control Panel]>[Sound]> “Recording” and find VT IEPE-2G05 there. Then right click it and

select “Property”> “General” to open the following page. Changing the highlighted long textual description to simply “VT” will solve the issue.

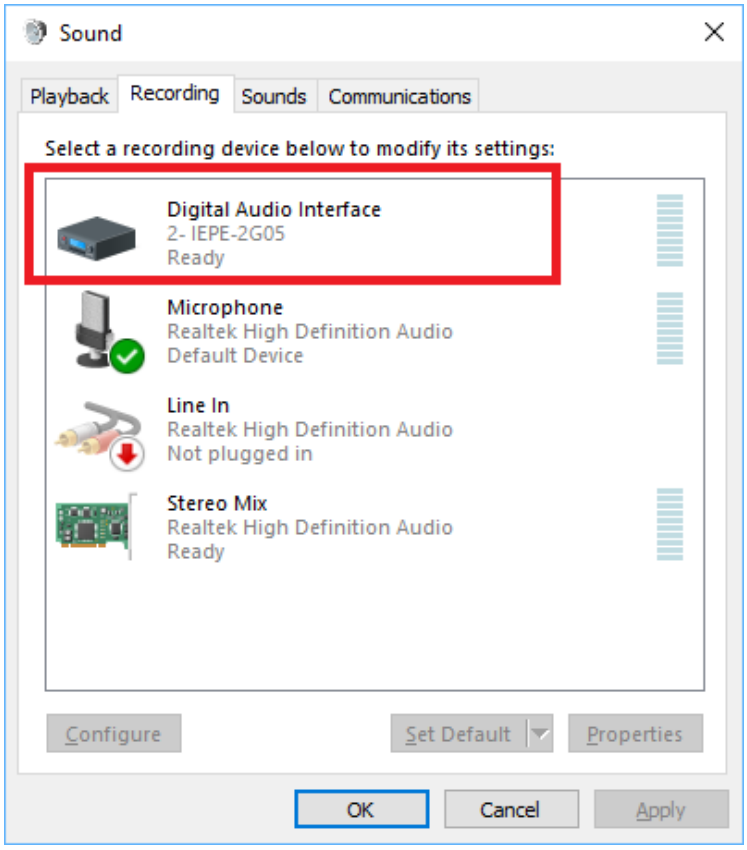


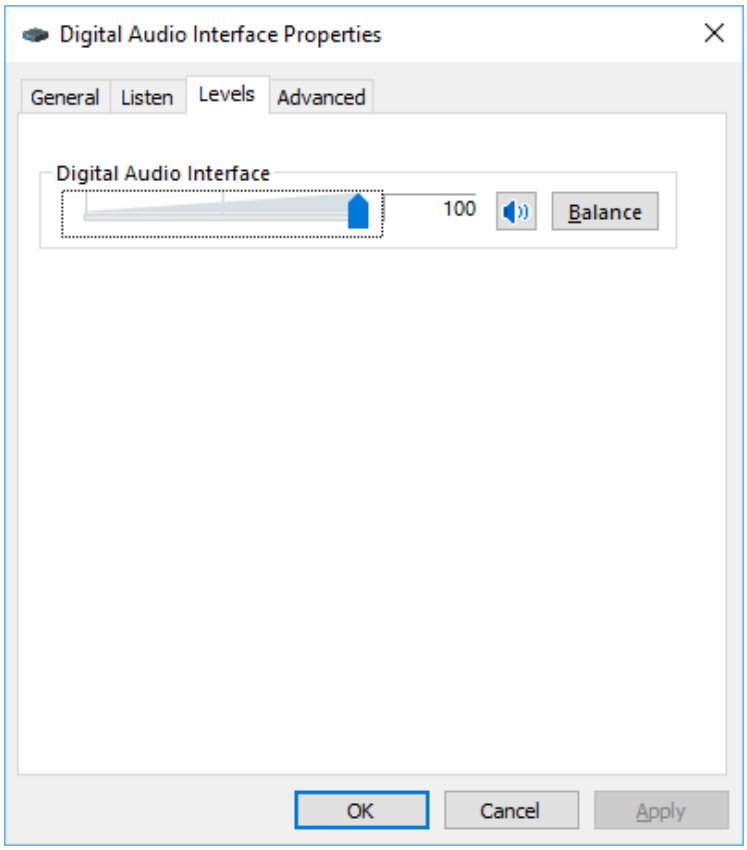
1.4 Voltage Measurement Range Selection

The voltage measurement range can be selected in the second toolbar from the top as follows. Six options are available (VT IEPE-2G05): ± 250 mV, ± 500 mV, ± 1 V, ± 2.5 V, ± 5 V, ± 10 V.

Please make sure that the “Probe” switch position is always at “×1” (the default selection) if there is no external attenuation switch in the IEPE sensors, which is usually the case.

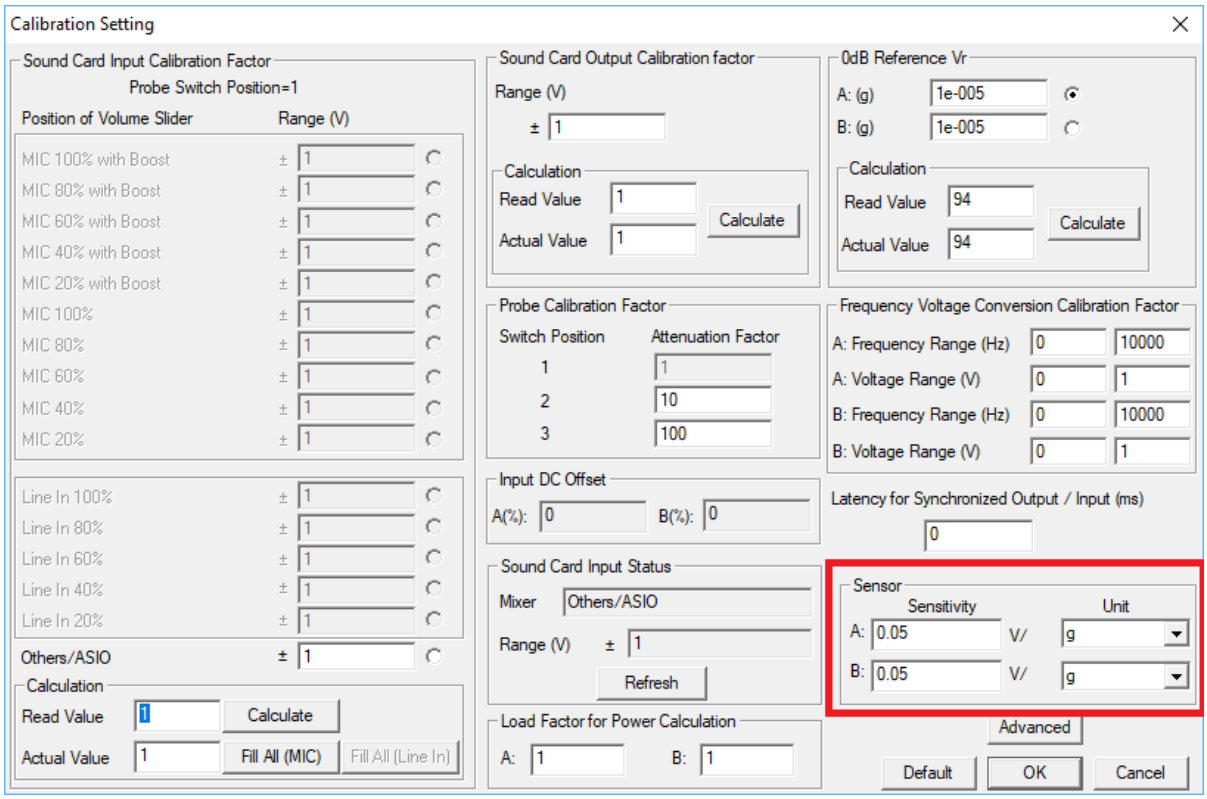
It should be noted that VT IEPE-2G05 will also be listed in the Recording Control under Windows Control Panel as follows. Thus it is possible to change the gain digitally by right clicking “Digital Audio Interface - IEPE 2G05” and select [Properties]>“Levels”. However, this change will not be compensated in the software and thus you should NEVER change the gain from there. By default, the “Levels” is at 100%. It should remain as 100% in order for VT IEPE-2G05 to scale the measurement data correctly.





1.5 Sensor Sensitivity Input

To scale the input voltage to the physical quantity it measures, the sensor sensitivity needs to be entered manually via [Setting]>[Calibration]> "Sensor". For example, a ±100g ±5V IEPE accelerometer has a sensitivity of 0.05V/g. You can select or enter an engineering unit of any physical quantity that the IEPE sensor measures.

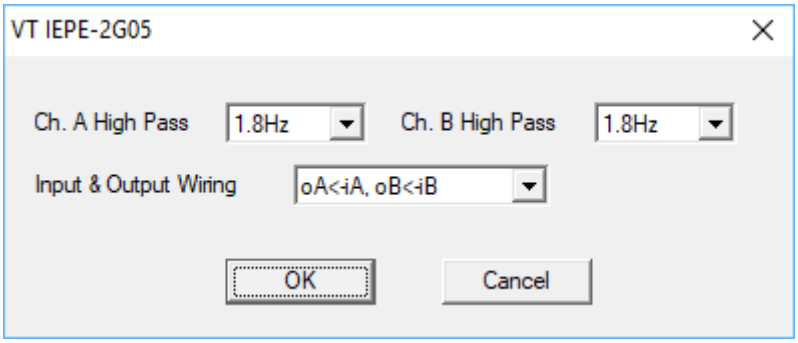


Note that in the above dialog box, the values in "Range (V)" column under Sound Card Input Calibration Factor do not affect the scaling of VT IEPE-2G05 at all.

1.6 High Pass Filter

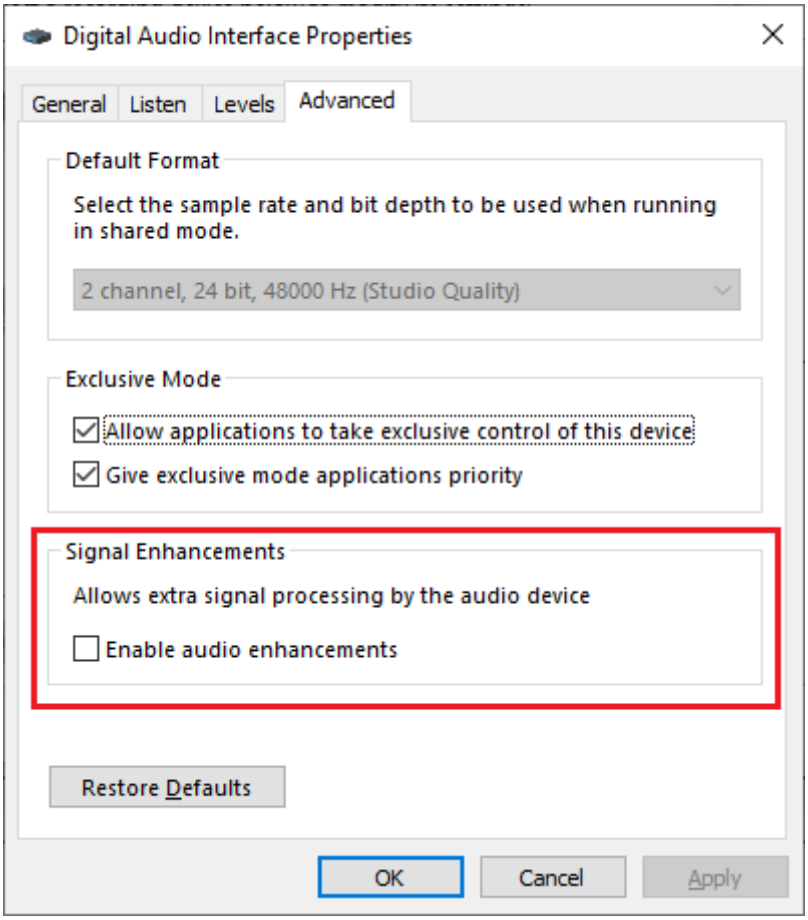
VT IEPE-2G05 is AC coupled and thus high pass filtered at about 0.03 Hz (-3 dB). On the top of that, it is also equipped with a built-in adjustable high pass filter with five options: None, 1.8 Hz, 119 Hz, 236 Hz, 464 Hz. To check or change the high pass filter setting, click the microphone button in the second toolbar from the top, as shown below.

The following dialog box will pop up. This high pass filter is set to 1.8 Hz by default after the unit is powered on. The settings in this dialog box can be saved together with a Panel Setting File in Multi-Instrument. In other words, if you load a preconfigured Panel Setting File, these settings may change.



If “None” is selected for the high pass filter, the input will still be high pass filtered at 0.03 Hz due to the AC input coupling. For the lower three voltage ranges, e.g. ± 250 mV, ± 500 mV and ± 1 V of VT IEPE-2G05, it is recommended to use a high pass filter with a cutoff frequency equal to or above 1.8 Hz, in order to remove any discernible DC offset.

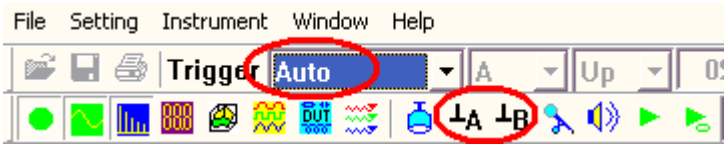
Some Windows versions / editions come with some audio signal enhancement features which are enabled by default. These features must be disabled through the Sound Recording Control under Windows Control Panel to prevent them from altering the originally sampled data, as shown below. One of the possible problems caused by these features is the removal of the frequencies below about 20Hz.



1.7 Zeroing

VT IEPE-2G05 exhibits extremely small DC offset and thus zeroing is generally not needed. Zeroing may be needed only under the lower three voltage ranges, e.g. ± 250 mV, ± 500 mV, ± 1 V of VT IEPE-2G05, with the high pass filter set to "None" (not recommended).

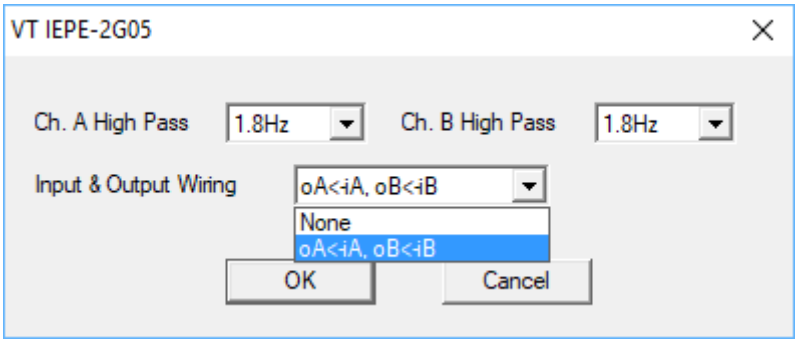
To perform software zeroing, disconnect all IEPE sensors from the BNC connectors of VT IEPE-2G05, switch the Trigger Mode to "Auto" (see the figure below). With the oscilloscope running, you should see a horizontal line at 0V in the oscilloscope. If not, you should click "⊥A " and "⊥B "in the toolbar and choose "Yes" to compensate the ground levels of both channels to zero. If "No" is chosen instead, the software DC compensation will be removed. Be sure to remove the software DC compensation if the voltage ranges are put back to the higher three, e.g. ± 2.5 V, ± 5 V, ± 10 V of VT IEPE-2G05, or a high pass filter is selected. To make sure that the software DC compensation is inactive, go to [Setting]>[Calibration] and check the "Input DC Offset", make sure that the values are zeros for both channels.



1.8 Direct Monitoring (Stethoscope)

VT IEPE-2G05 has a ϕ3.5 stereo headphone jack in it back panel for direct monitoring of the input signal. Direct monitoring means that the input signals from the IEPE sensors are attenuated / amplified / impedance converted and sent directly to the headphone jack without going through ADC and DAC hardware as well as the computer. This direct path can be on and off from Multi-Instrument through the aforementioned high pass filter setting dialog box as shown below. If "oA<-iA, oB<-iB" is selected in the "Input & Output Wiring" selection box, the path is established. If "None" is selected instead, the path is disconnected. The path is on by default when the unit is powered on. Thus it is possible to monitor the input signal through this jack without even running the Multi-Instrument software. The output signal from this jack is able to drive a headphone or an audio power amplifier. If the IEPE sensor is an accelerometer, then this function, in effect, converts the vibration which can only be felt by touching to an audible sound which can be heard.

Again, the settings on this dialog box can be saved together with a Panel Setting File in Multi-Instrument. In other words, if you load a preconfigured Panel Setting File, these settings may change.



Please note that measurement range selection will affect the gain of the direct monitoring function, as shown in the following table. For example, a 1V input signal under ±10V, ±5V, ±2.5V, ±1V, ±500mV and ±250mV measurement ranges will generate an output signal of 0.05V, 0.1V, 0.2V, 0.05V, 0.1V and 0.2V, respectively. The measurement range ±10V is selected by default upon power on.

Input Voltage (For Direct Monitoring only)	Voltage Measurement Range Selection	Gain (Typical)	Output Voltage Range
±10V	±10V	1/20	±0.5V
±5V	±5V	1/10	±0.5V
±2.5V	±2.5V	1/5	±0.5V
±10V	±1V	1/20	±0.5V
±5V	±500mV	1/10	±0.5V
±2.5V	±250mV	1/5	±0.5V

(VT IEPE-2G05)

In VT IEPE-2G05A/B/C/D/E, for those channels with a 20dB (i.e. ±1V, ±500mV, ±250mV, ±100mV, ±50mV, ±25mV) or 40dB (i.e. ±100mV, ±50mV, ±25mV, ±10mV, ±5mV, ±2.5mV) higher gain, the gain values (typical) here are 0.5, 1, 2, 0.5, 1, 2, and 5, 10, 20, 5, 10, 20 respectively.

1.9 Hard Reset

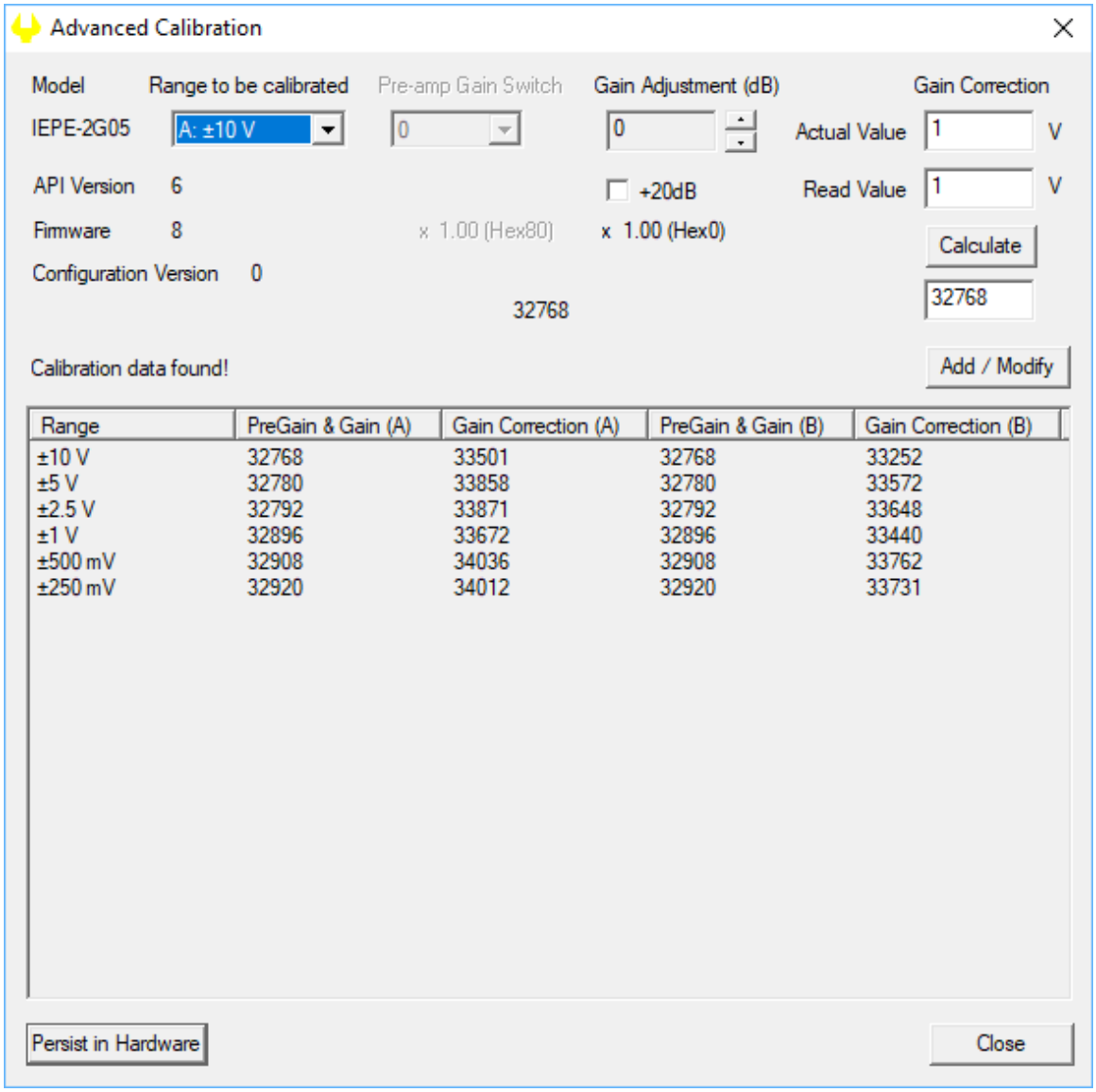
A hard reset can be done by disconnecting the unit from your computer and then re-connecting it to the computer again. You can only do this with the Multi-Instrument software closed.

1.10 Calibration and Recalibration

VT IEPE-2G05 is individually calibrated in factory. Re-calibration is generally not required.

A signal generator and an IEPE simulator are required to generate an IEPE compatible voltage signal during re-calibration. It is also possible to switch the unit to the voltage measurement mode through its internal DIP switches, and then employ only a signal generator to do the re-calibration. However, this will invalidate the warranty.

To overwrite the existing calibration data, go to [Setting]>[Calibration]> “Advanced”. The following “Advanced Calibration” dialog will pop up.



Detailed calibration procedure will be described separately from this document. Please contact Virtins Technology for details.

1.11 Sound Pressure Level Measurement Ranges and Calibration

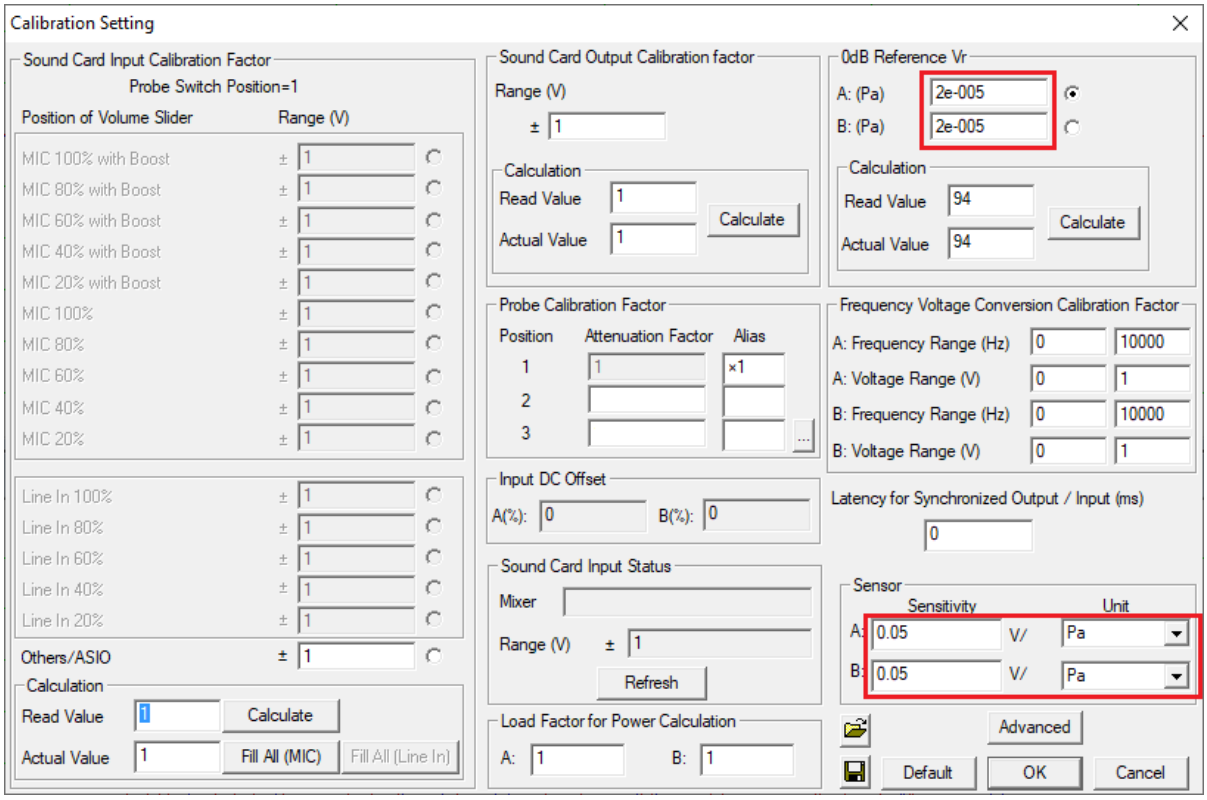
If an IEPE microphone is connected to VT IEPE-2G05/A/B/C/D/E to measure a sound pressure level in dBSPL, the maximum dBSPL measureable can be estimated by:

$$20 \times \log_{10}(([\text{Max. Measurable Voltage}] / 1.414) / [\text{IEPE Mic Sensitivity}] / (20\times10^{-6}))$$

where 1.414 is used to convert the peak value to the RMS value, and 20×10^{-6} Pa is the 0 dBSPL reference in air.

For an IEPE microphone with a sensitivity of 50 mV/Pa, such as IEPE-MIC-14604A, the voltage measurement ranges ±2.5mV, ±5mV, ±10mV, ±25mV, ±50mV, ±100mV, ±250mV,

±500mV, ±1V, ±2.5V, ±5V and ±10V can be used to measure a maximum dBSPL of 65dB, 71dB, 77dB, 85dB, 91dB, 97dB, 105dB, 111dB, 117dB, 125dB, 131dB and 137dB, respectively. This information can be used to decide which model VT IEPE-2G05/A/B/C/D/E to be used for dBSPL measurement. The following figure shows the calibration configuration for two such microphones.



IEPE-2G05/A/B/C/D/E are voltage-calibrated. If the sensitivity of the IEPE microphone is entered in the above figure, the measured data will be calibrated to sound pressure in Pa. Then 0.00002 or 2e-005 Pa (i.e. 20 µPa) should be entered in the "0dB Reference Vr" edit box in the above figure to convert sound pressure (in air) to sound pressure level in dBSPL. For sound pressure in water, 0.000001 or 1e-006 Pa (1 µPa) should be used instead. It is also acceptable to calibrate "0dB Reference Vr" directly without converting the measurement data to sound pressure in Pa first if the sensor sensitivity is unknown. In this case, just let the sensor sensitivity to be 1 V/V.

1.12 Constant Driving Current, Low-Pass Cutoff Frequency and Cable Length

With the constant 4 mA driving current of VT IEPE-2G05/A/B/C/D/E, there is generally no need to be concerned about the attenuation of high frequencies when the cable length is less than 100 m. The -3dB cutoff frequency due to cable length can be estimated by:

[-3dB cutoff frequency] = ([Constant Driving Current]-0.001] / (2 × 3.1415926 × [Max. Voltage] × [Cable Length] × [Capacitance per Unit Length]) (Hz)

where 0.001 A is the estimated current consumed by the circuit inside the IEPE sensor and the rest is available to drive the long cable. [Capacitance per Unit Length] is cable-type dependent and generally 100 pF/m can be used for estimation. If [Max. Voltage] is 5V and [Cable Length] is 100m, then [-3dB cutoff frequency] is 9549 Hz. If the constant current is 20 mA instead, then [-3dB cutoff frequency] becomes 60479 Hz.

Constant driving current is customizable upon request.

1.13 Non-routine Applications

The non-routine applications refer to those applications that are not considered as routine tasks of VT IEPE-2G05/A/B/C/D/E. With Multi-Instrument's capability of simultaneous input and output, you can generate a stimulus to a Device Under Test (DUT) and acquire the response from it at the same time. Different stimuli can be generated and the responses can be analyzed in different ways. The characteristics of the DUT, such as frequency response and distortion, can then be obtained. You can even configure and then perform a sequence of automated test steps to evaluate a DUT using the Device Test Plan software module.

You can configure the output device via [Setting]>[DAC Device]. For example, the computer sound card can be used to generate vibration stimulus to some external devices which then generate mechanical vibration.

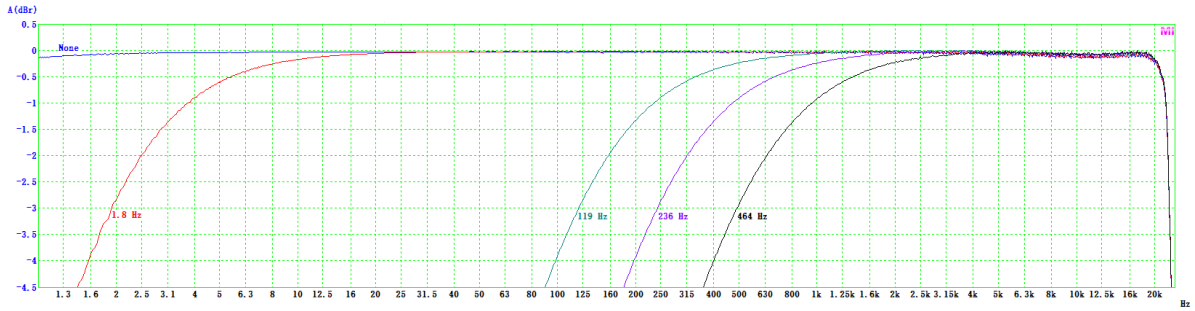
2 Specifications

2.1 VT IEPE-2G05/A/B/C/D/E Hardware Specifications

Number of Input Channels	2
Sampling Frequency	48 kHz (original), 44.1 kHz, 32 kHz, 22.05 kHz, 16 kHz, 11.025 kHz, 8 kHz, 4 kHz, 2 kHz …
ADC Bit Resolution	24 Bits (can be reduced to 16 bits or 8 bits)
Input Voltage Ranges	IEPE-2G05: ±250 mV, ±500 mV, ±1 V, ±2.5 V, ±5 V, ±10 V IEPE-2G05A: Ch.A: ±250 mV, ±500 mV, ±1 V, ±2.5 V, ±5 V, ±10 V Ch.B: ±25 mV, ±50 mV, ±100 mV, ±250 mV, ±500 mV, ±1 V IEPE-2G05B: ±25 mV, ±50 mV, ±100 mV, ±250 mV, ±500 mV, ±1 V IEPE-2G05C: Ch.A: ±250 mV, ±500 mV, ±1 V, ±2.5 V, ±5 V, ±10 V Ch.B: ±2.5 mV, ±5 mV, ±10 mV, ±25 mV, ±50 mV, ±100 mV IEPE-2G05D: Ch.A: ±25 mV, ±50 mV, ±100 mV, ±250 mV, ±500 mV, ±1V Ch.B: ±2.5 mV, ±5 mV, ±10 mV, ±25 mV, ±50 mV, ±100 mV IEPE-2G05E: ±2.5 mV, ±5 mV, ±10 mV, ±25 mV, ±50 mV, ±100 mV
Input Connectors & Interface	BNC, Single Ended, IEPE, 24V 4mA
Input Coupling Type	IEPE-2G05: AC (High pass filtered at 0.03 Hz) IEPE-2G05A: Ch.A: AC (High pass filtered at 0.03 Hz) Ch.B: AC (High pass filtered at 0.3 Hz) IEPE-2G05B: AC (High pass filtered at 0.3 Hz) IEPE-2G05C: Ch.A: AC (High pass filtered at 0.03 Hz) Ch.B: AC (High pass filtered at 3 Hz) IEPE-2G05D: Ch.A: AC (High pass filtered at 0.3 Hz)

	Ch.B: AC (High pass filtered at 3 Hz) IEPE-2G05E: AC (High pass filtered at 3 Hz)
Input Isolation	No (Isolation can be achieved through a USB isolator)
Input Impedance	IEPE-2G05: 510 kΩ IEPE-2G05A: Ch.A: 510 kΩ Ch.B: 51 kΩ IEPE-2G05B: 51 kΩ IEPE-2G05C: Ch.A: 510 kΩ Ch.B: 5.1 kΩ IEPE-2G05D: Ch.A: 51 kΩ Ch.B: 5.1 kΩ IEPE-2G05E: 5.1 kΩ
Input High Pass Filter	None, 1.8 Hz, 119 Hz, 236 Hz, 464 Hz
Frequency Response	IEPE-2G05: 0.03 Hz ~ 22.8 kHz IEPE-2G05A: Ch.A: 0.03 Hz~22.8kHz Ch.B: 0.3 Hz~22.8kHz IEPE-2G05B: 0.3 Hz~22.8kHz IEPE-2G05C: Ch.A: 0.03 Hz~22.8kHz Ch.B: 3 Hz~22.8kHz IEPE-2G05D: Ch.A: 0.3 Hz~22.8kHz Ch.B: 3 Hz~22.8kHz IEPE-2G05E: 3 Hz~22.8kHz
Frequency Accuracy	50 PPM
Anti-aliasing Filter	22.8 kHz at Sampling Rate 48 kHz, proportionally adaptive to Sampling Rate Chosen
Buffer Size	Virtually unlimited (streaming mode)
Voltage Accuracy	±0.5% at 1kHz
Output Connector & Interface	ϕ3.5 mm Stereo Audio Jack
Output Voltage Range	±0.5V
Digital Input / Output Standard	USB Audio Class 1
Calibration	Individually done at factory, user re-calibratable

PC Interface	USB 2.0 Full Speed / USB 1.1	
Device Category in Multi-Instrument	ADC Device	Sound Card MME
	DAC Device	Not Applicable
Power	Bus powered by USB port, no external power source required	
Power Consumption	Max. 0.5W	
Dimensions	128 mm (L) × 57 mm (W) × 24 mm (H), anodized aluminum case	
System Requirement	Windows XP, Vista, 7, 8, 10 or above, 32 bit or 64 bit	
Operating Temperature	0°C ~50°C	



Frequency Response of Built-in High Pass Filter (sampled at 48 kHz)

2.2 Multi-Instrument Software Specifications

Please refer to Multi-Instrument software manual for detail. The following table shows the function allocation matrix for Multi-Instrument series. The Spectrum 3D Plot, Data Logger, LCR Meter, Device Test Plan, Vibrometer, Dedicated Hardware Support are add-on modules/functions and should be purchased separately, and they are only available for Multi-Instrument Lite, Standard, and Pro editions, except that the Vibrometer is only available for Multi-Instrument Standard and Pro editions.

Legend: √ - Function available *√* - Function available in Full version only*

		Sound Card Oscilloscope	Sound Card Spectrum Analyzer	Sound Card Signal Generator	Multi-Instrument Lite	Multi-Instrument Standard	Multi-Instrument Pro
General Functions							
ADC / DAC Hardware	Sound Card MME	√	√	√	√	√	√
	Sound Card ASIO						√
	Other Hardware				√	√	√
	vtDAQ, vtDAO software development kit	License automatically activated with the presence of the corresponding hardware, e.g. a USB hardkey or a VT DSO.					
File Operation	Load WAV File	√	√	√	√	√	√
	Load TXT File					√	√
	Load WAV File Frame by Frame (fore Long WAV File)					√	√
	Combine WAV Files	√	√	√	√	√	√
	Extract Data and save them into a new WAV File	√	√	√	√	√	√

		Sound Card Oscilloscope	Sound Card Spectrum Analyzer	Sound Card Signal Generator	Multi-Instrument Lite	Multi-Instrument Standard	Multi-Instrument Pro
	Save/Load Panel Setting	√	√	√	√	√	√
Data Export	Copy Text to Clipboard	√	√	√	√	√	√
	Copy BMP to Clipboard	√	√	√	√	√	√
	Print Preview	√	√	√	√	√	√
	Print	√	√	√	√	√	√
	Export as TXT File	√	√	√	√	√	√
	Export as BMP File	√	√	√	√	√	√
Trigger Settings	Trigger Mode	√	√		√	√	√
	Trigger Source	√	√		√	√	√
	Trigger Edge	√	√		√	√	√
	Trigger Level	√	√		√	√	√
	Trigger Delay	√	√		√	√	√
	High Frequency Rejection	√	√		√	√	√
	Noise Rejection	√	√		√	√	√
Sampling Settings	Sampling Rate	√	√	√	√	√	√
	Sampling Channels	√	√	√	√	√	√
	Sampling Bit Resolution	√	√	√	√	√	√
	Record Length	√	√		√	√	√
Calibration	Input	√	√		√	√	√
	Output			√	√	√	√
	Probe	√	√		√	√	√
	Sound Pressure Level	√	√		√	√	√
	F/V Conversion					√	√
	Latency for Sync. Output/Input						√
	Sensor Sensitivity	√	√		√	√	√
	Load Factor for Power Calculation	√	√		√	√	√
Graph Operation	Zoom	√	√	√	√	√	√
	Scroll	√	√	√	√	√	√
	Cursor Reader	√	√	√	√	√	√
	Marker	√	√	√	√	√	√
	Chart Type	√	√	√	√	√	√
	Line Width	√	√	√	√	√	√
	Color	√	√	√	√	√	√
	Fast/Slow Display Mode	√	√	√	√	√	√
	Refresh Delay	√	√	√	√	√	√
	Font Size	√	√	√	√	√	√
	Roll Mode					√	√
	Reference Curves & Limits					√	√
Others	Gain Adjustment	√	√	√	√	√	√
	Input Peak Indicator	√	√	√	√	√	√
	Sound Card Selection	√	√	√	√	√	√
	Sampling Parameter Auto Setting	√	√	√	√	√	√
	Multilingual GUIs	√	√	√	√	√	√
	Show/Hide Toolbar	√	√	√	√	√	√
	Lock/Unlock Panel Setting	√	√	√	√	√	√

		Sound Card Oscilloscope	Sound Card Spectrum Analyzer	Sound Card Signal Generator	Multi-Instrument Lite	Multi-Instrument Standard	Multi-Instrument Pro
	Hot Panel Setting Toolbar	√	√	√	√	√	√
	ActiveX Automation Server	√	√	√	√	√	√
	AutoRanging	√	√	√	√	√	√
	AutoScaling	√	√		√	√	√
	Input Channel Operation	√	√		√	√	√
Oscilloscope							
Type	Individual Waveform	√	√	√ (offline)	√	√	√
	Waveform Addition	√	√	√ (offline)	√	√	√
	Waveform Subtraction	√	√	√ (offline)	√	√	√
	Waveform Multiplication	√	√	√ (offline)	√	√	√
	Lissajous Pattern	√	√	√ (offline)	√	√	√
Inter-Frame Processing	Linear Average					√	√
	Exponential Average					√	√
Intra-Frame	Time Delay Removal					√	√
Demodulation (Intra-Frame)	AM					√	√
	FM					√	√
	PM					√	√
Digital Filtering (Intra-Frame Processing)	Remove DC					√	√
	Rectification					√	√
	FFT Low Pass					√	√
	FFT High Pass					√	√
	FFT Band Pass					√	√
	FFT Band Stop					√	√
	FFT Frequency Response					√	√
	FIR Low Pass					√	√
	FIR High Pass					√	√
	FIR Band Pass					√	√
	FIR Band Stop					√	√
	FIR Frequency Response					√	√
	IIR Coefficients					√	√
Parameter	Reverberation / Speech Intelligibility						√
	Discontinuity						√

		Sound Card Oscilloscope	Sound Card Spectrum Analyzer	Sound Card Signal Generator	Multi-Instrument Lite	Multi-Instrument Standard	Multi-Instrument Pro
	Step Response						√
Others	Max, Min, Mean, RMS	√	√	√ (offline)	√	√	√
	Record Mode					√	√
	Persistence Display Mode	√	√		√	√	√
	Equivalent Time Sampling Mode	√	√		√	√	√
	Analog & Digital Signal Mixed Display				√	√	√
	SINC Interpolation	√	√	√	√	√	√
Spectrum Analyzer							
Type	Amplitude Spectrum / Power Spectrum Density / Impedance Spectrum		√		√	√	√
	Phase Spectrum		√		√	√	√
	Auto-correlation (Linear/Circular)		√		√	√	√
	Cross-correlation (Linear/Circular)		√		√	√	√
	Coherence/Non-Coherence						√
	Transfer Function / Impedance Analyzer						√
	Impulse Response						√
Intra-Frame Processing	Frequency Compensation		√		√	√	√
	Frequency Weighting		√		√	√	√
	Remove DC		√		√	√	√
	Smoothing via Moving Average (Linear/Octave)		√		√	√	√
Inter-Frame Processing	Peak Hold		√		√	√	√
	Linear Average		√		√	√	√
	Exponential Average		√		√	√	√
Parameter Measurement	THD,THD+N,SNR, SINAD,Noise Level, ENOB		√		√	√	√
	IMD/DIM		√		√	√	√
	Bandwidth		√		√	√	√
	Crosstalk		√		√	√	√
	Harmonics & Phase		√		√	√	√
	Energy in User Defined Frequency Band		√		√	√	√
	Peak Detection, SFDR, TD+N		√		√	√	√
	Wow & Flutter						√*
	Sound Loudness						√

		Sound Card Oscilloscope	Sound Card Spectrum Analyzer	Sound Card Signal Generator	Multi-Instrument Lite	Multi-Instrument Standard	Multi-Instrument Pro
	Sound Loudness Level						√
	Sound Sharpness						√
	Total Non-Coherent Distortion + Noise						√
	GedLee Metric						√
FFT	FFT Size 128~32768		√		√	√	√
FFT	FFT Size 65536~4194304						√
FFT	Intra-Frame Average		√		√	√	√
FFT	Window function		√		√	√	√
FFT	Window Overlap		√		√	√	√
Others	Octave Analysis (1/1, 1/3, 1/6, 1/12, 1/24, 1/48, 1/96)		√		√	√	√
Others	Linear / Log Scale for X and Y		√		√	√	√
Others	Peak Marker / Label		√		√	√	√
Signal Generator							
Waveform	Sine			√	√	√	√
Waveform	Rectangle			√	√	√	√
Waveform	Triangle			√	√	√	√
Waveform	Saw Tooth			√	√	√	√
Waveform	White Noise			√	√	√	√
Waveform	Pink Noise			√	√	√	√
Waveform	MultiTones			√	√	√	√
Waveform	Arbitrary Waveform			√	√	√	√
Waveform	MLS			√	√	√	√
Waveform	DTMF			√	√	√	√
Waveform	Musical Scale			√	√	√	√
Waveform	Wave File					√	√
Waveform	Play Waveform in Oscilloscope	√	√	√	√	√	√
Waveform	Cyclic Play Waveform in Oscilloscope	√	√	√	√	√	√
Sweep	Frequency Sweep (Linear/Log)			√	√	√	√
Sweep	Amplitude Sweep (Linear/Log)			√	√	√	√
Sweep	Forward + Reverse Sweep			√	√	√	√
Burst (Mask)	Normal Phase			√	√	√	√
Burst (Mask)	Locked Phase			√	√	√	√
Burst (Mask)	Window-Shaped Burst			√	√	√	√
Burst (Mask)	On/Off Amplitude Ratio			√	√	√	√
Fade	Fade In			√	√	√	√
Fade	Fade Out			√	√	√	√
Modulation	AM			√	√	√	√
Modulation	FM			√	√	√	√
Modulation	PM			√	√	√	√

		Sound Card Oscilloscope	Sound Card Spectrum Analyzer	Sound Card Signal Generator	Multi-Instrument Lite	Multi-Instrument Standard	Multi-Instrument Pro
Others	Software Loopback (all channels)			√	√	√	√
	Software Loopback (1 channel)				√	√	√
	Sync. with Oscilloscope						√
	Save as WAV file			√	√	√	√
	Save as TXT file			√	√	√	√
	DDS				√	√	√
	DC Offset				√	√	√
Multimeter							
Type	RMS					√	√
	dBV					√	√
	dBu					√	√
	dB					√	√
	dB(A)					√	√
	dB(B)					√	√
	dB(C)					√	√
	Frequency Counter				√	√	√
	RPM					√	√
	Counter					√	√
	Duty Cycle					√	√
	Frequency/Voltage					√	√
	Cycle RMS					√	√
	Cycle Mean					√	√
	Pulse Width					√	√
Settings	Counter Trigger Hysteresis				√	√	√
	Counter Trigger Level				√	√	√
	Frequency Divider				√	√	√
DDP (Derived Data Point) Viewer							
Function	DDP & UDDP display						√
	HH, H, L, LL Alarm						√
	Set Display Precision						√
	Define UDDP						√
	Alarm Sound						√
	Alarm Acknowledge						√
	Inter-frame Linear / Exponential Average						√
DDP Array Viewer	Harmonic Frequencies, RMS, Phases Report						√
	Octave Bands, RMS Report						√
	Peak Frequencies, RMS, Phases Report						√
	Frequency Bands, RMS Report						√

		Sound Card Oscilloscope	Sound Card Spectrum Analyzer	Sound Card Signal Generator	Multi-Instrument Lite	Multi-Instrument Standard	Multi-Instrument Pro
	Reverberation / Speech Intelligibility Report (1/1 Octave)						√
	Reverberation / Speech Intelligibility (1/3 Octave)						√
Derived Data Curve (DDC)							
Function	Energy Time Curve (Log-Squared)						√
	Energy Time Curve (Envelop)						√
	Energy Time Curve (dBSPL)						√
	Impulse Response Schroeder Integration Curve						√
	Step Response Curve (via Impulse Response Integration)						√
	Frequency Time Curve						√
	X-Y Plot						√

Legend: Blank - Function available if purchased Shaded Blank - Function NOT available for that license level

		Sound Card Oscilloscope	Sound Card Spectrum Analyzer	Sound Card Signal Generator	Multi-Instrument Lite	Multi-Instrument	Multi-Instrument Pro
Spectrum 3D Plot							
Type	Waterfall Plot (Inter-frame, STFT)						
	Waterfall Plot (Intra-frame, STFT)						
	Waterfall Plot (Intra-frame, CSD)						
	Spectrogram (Inter-frame, STFT)						
	Spectrogram (Intra-frame, STFT)						
	Spectrogram (Intra-frame, CSD)						
Settings	Spectrogram Color Palette						
	Waterfall Color Palette						
	Waterfall Tilt Angle						
	Waterfall / Spectrogram Height						
	Linear / Log Scale for X and Y						
	Number of Spectral Profiles (10~200)						
Others	3D Cursor Reader						
	Octave Analysis (1/1, 1/3, 1/6, 1/12, 1/24, 1/48, 1/96)						

	Sound Card Oscilloscope	Sound Card Spectrum Analyzer	Sound Card Signal Generator	Multi-Instrument Lite	Multi-Instrument	Multi-Instrument Pro
Spectrogram Smoothing	■	■	■			
Data Logger						
Real Time Logging	■	■	■			
Load Historical Log File	■	■	■			
Three logging methods (Fastest, Time Interval, Update Threshold)	■	■	■			
246 derived data points available for logging	■	■	■			
Up to 8 × 8 = 64 variables can be logged simultaneously	■	■	■			
LCR Meter						
High Impedance Measurement	■	■	■			
Low Impedance Measurement	■	■	■			
Up to 8 X-Y Plots (Linear/Log)	■	■	■			
Device Test Plan						
25 Instructions	■	■	■			
Create/Edit/Lock/Execute/Load/Save a Device Test Plan	■	■	■			
Up to 8 X-Y Plots (Linear/Log)	■	■	■			
Device Test Plan Log	■	■	■			
Automatic Mutli-Step Generation						
User Log In / Out						
Volatile & Non-volatile Variables						
Vibrometer						
RMS, Peak/PP, Crest Factor for acceleration, velocity, displacement (in Multimeter)	■	■	■	■		
Waveform conversion among acceleration, velocity and displacement (in Oscilloscope)	■	■	■	■		
SI / English units	■	■	■	■		
Dedicated Hardware Support						
RTX6001 Remote /Local Control	■	■	■			

2.3 Software Development Interface Specifications

Multi-Instrument provides the following secondary development features:

1. Multi-Instrument can work as an ActiveX automation server so that an external program can access the data and functions that Multi-Instrument exposes. You can integrate Multi-Instrument into your own software seamlessly via the ActiveX automation server interfaces exposed by Multi-Instrument.

Please refer to: *Multi-Instrument Automation Server Interfaces*

Download link:
http://www.virtins.com/Multi-Instrument-Automation-Server-Interfaces.pdf

The above document and the sample automation client programs in Visual C++, Visual Basic, Visual C# and Python can be found in the AutomationAPIs directory of the software.

2. You can use the vtDAQ and vtDAO interface DLLs supplied in this software to allow your own back-end software to interface to sound cards, NI DAQmx cards, VT DSOs, VT RTAs, VT IEPE, VT CAMP, etc.. You can also develop your own vtDAQ and vtDAO compatible DLLs to allow Multi-Instrument to interface to your own hardware.

   Please refer to: *vtDAQ and vtDAO_Interfaces*

   Download link:
   http://www.virtins.com/vtDAQ-and-vtDAO-Interfaces.pdf

   The above document and the sample DAQ and DAO back-end programs and sample vtDAQ compatible DLL in Visual C++, Visual C# and Labview can be found in the DAQDAOAPIs directory of the software.

3. Virtins Technology's Signal Processing and Analysis (vtSPA) Application Programming Interfaces (APIs) provides a suite of generic APIs for data processing and analysis. It contains some unique features / algorithms originated and only available from Virtins Technology.

   Please refer to: *Signal Processing and Analysis (vtSPA) Interfaces*

   Download link:
   http://www.virtins.com/Signal-Processing-and-Analysis-APIs.pdf

   The above document and the sample programs in Visual C++ and Visual C# can be found in the DAQDAOAPIs directory of the software.

Furthermore, Multi-Instrument is well prepared to be rebranded for OEM services. Its look and feel can be readily changed through configuration without even reprogramming. Contact Virtins Technology if interested.

3 Multi-Instrument Software License Information

3.1 License Types

The License of Multi-Instrument software has six levels and six add-on modules/functions. The six levels are: Sound Card Oscilloscope, Sound Card Spectrum Analyzer, Sound Card Signal Generator, Multi-Instrument Lite, Multi-Instrument Standard, Multi-Instrument Pro. The six add-on modules/functions are: Spectrum 3D Plot, Data Logger, LCR Meter, Device Test Plan, Vibrometer, Dedicated Hardware Support.

The license contained in the standard VT IEPE package is a hardware activated Multi-Instrument Standard license, without any add-on modules/functions. No softkey (activation code) and USB hardkey (USB dongle) are provided in this type of license. The software will run under the licensed mode as long as the VT IEPE unit is connected to your computer before you start the Multi-Instrument software.

Note: If the software is started without the VT IEPE unit connected to the computer, it will enter into 21-day fully functional trial mode, unless the software is activated by a softkey (activation code) or a hardkey (USB dongle), which are NOT included in the standard VT IEPE package and should be purchased separately as a brand-new license if needed. In other words, the VT IEPE hardware should always be connected to the computer in order for the Multi-Instrument software to work under the licensed mode, even though you might just want to use your computer sound card for ADC and DAC.

3.2 License Upgrade from one level to another

You can purchase an upgrade of the license, e.g. from Multi-instrument Standard to Multi-Instrument Pro + Data Logger, at any time if necessary. After you purchase the upgrade, a small upgrade package file will be sent to you via email. You can then use it to upgrade the license bundled within the VT IEPE unit by selecting [Start]>[All Programs]>[Multi-Instrument]>[VIRTINS Hardware Upgrading Tool] on your Windows desktop.

3.3 Software Upgrade in the same level

Software upgrade in the same level (if the hardware is still supported by the new version), e.g. from Multi-Instrument 3.0 Standard to Multi-Instrument 3.1 Standard, is always FREE. You just need to download the new version from our website and install it on any computer.

Thus, please do visit frequently our website to see if a new version or build is available.

4 Extended Use of Multi-Instrument Software

Multi-Instrument is a powerful multi-function virtual instrument software. It supports a variety of hardware ranging from sound cards which are available in almost all computers to proprietary ADC and DAC hardware such as NI DAQmx cards, VT DSO units, and so on. Furthermore, the ADC and DAC device can be chosen independently in Multi-Instrument. For example, you can use VT IEPE for data acquisition and use your computer's sound card for signal generation simultaneously.

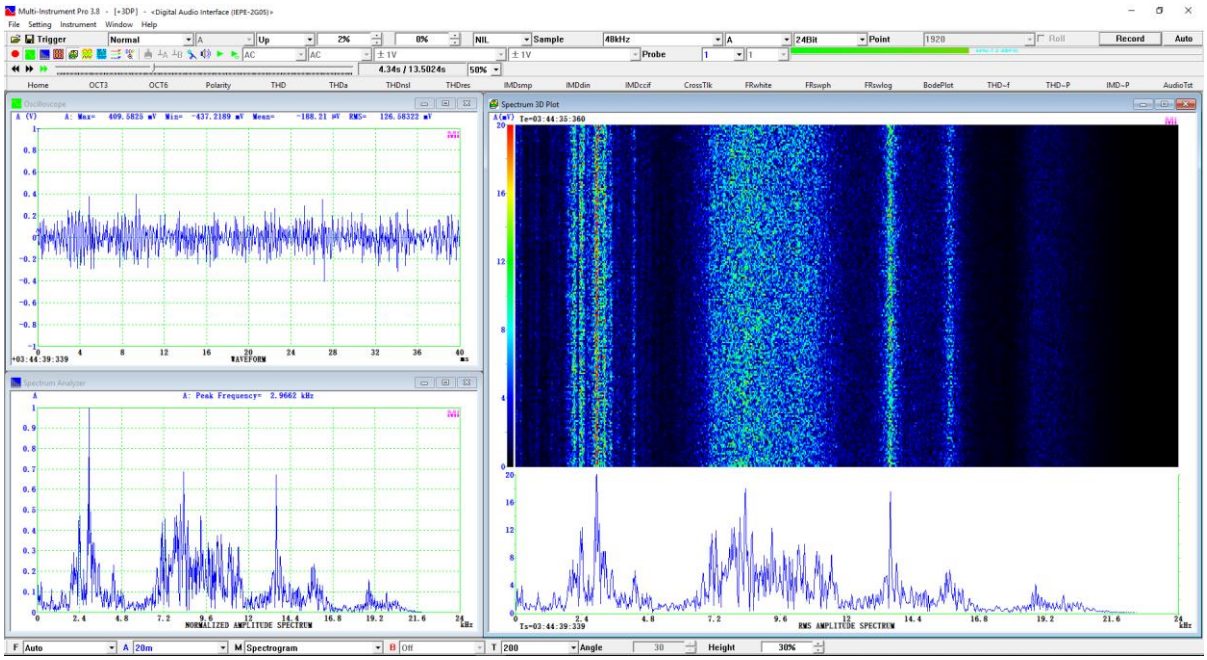
You can change the ADC device via [Setting]>[ADC Device]>[Device Model]. For example you can also use your computer's sound card as the ADC device.

You can choose a DAC device via [Setting]>[DAC Device]>[Device Model]. For example, you can use your computer's sound card as the DAC device and thus make full use of the signal generator function of Multi-Instrument.

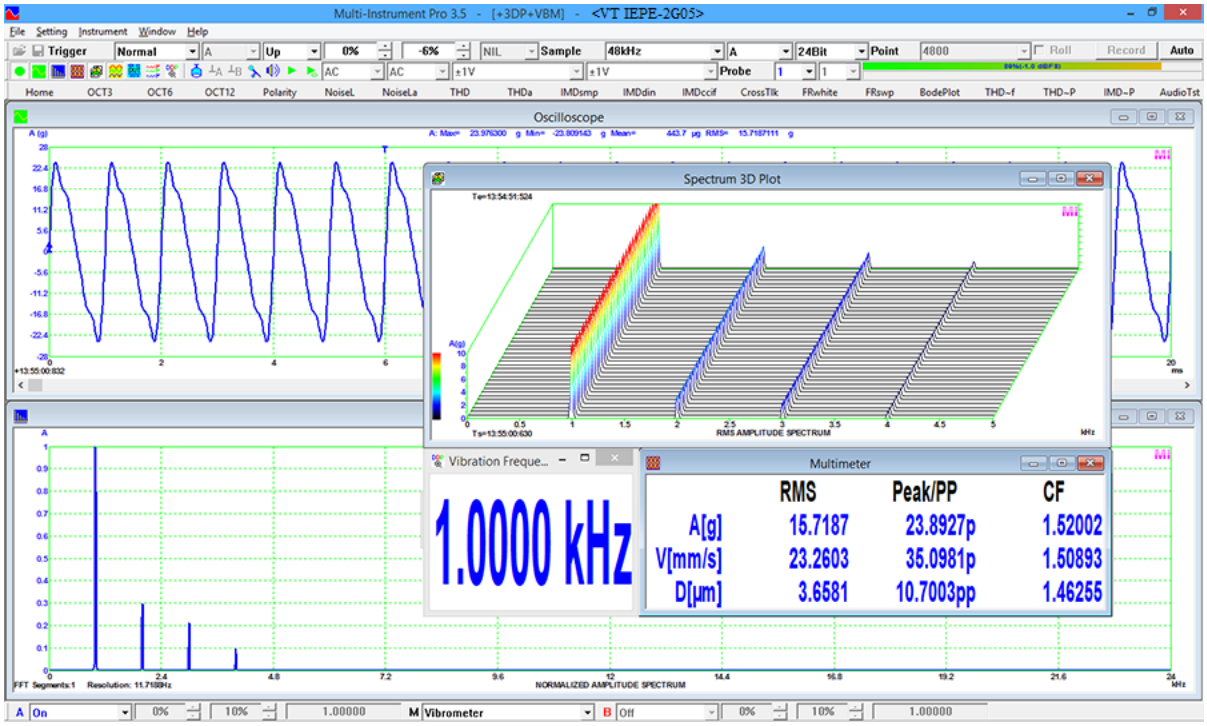
If you want to use the sound card as the ADC/DAC device, you may need to purchase the dedicated sound card oscilloscope probe kit from Virtins Technology separately, or you may make the connection by yourself.

5 Measurement Examples

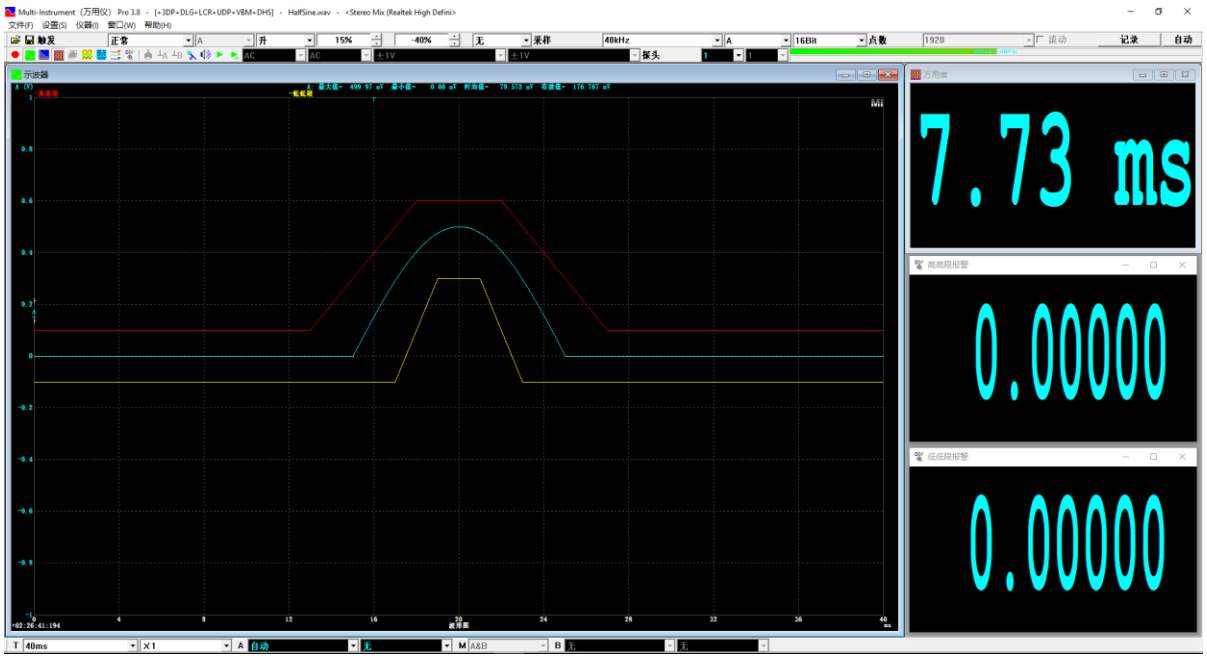
5.1 VT IEPE-2G05 with Multi-Instrument Pro + Spectrum 3D Plot



5.2 VT IEPE-2G05 with Multi-Instrument Pro + Spectrum 3D Plot + Vibrometer



5.3 Half-sine Shock Test



6 Safety Instructions

- Always keep in mind that the input of VT IEPE is NOT galvanically isolated from the computer connected.
- Under IEPE mode, connect to passive IEPE sensors only, never connect to an active signal.
- It should be noted that for many computers (typically desktop PCs or laptop PCs with a built-in AC power supply adapter), the ground of the BNC is connected to mains earth. This is not a problem if the IEPE sensors connected are floating (i.e. isolated from earth). Otherwise, you MUST make sure that the ground of the BNC is connected to a point that is also at earth potential.

7 Warranty

Virtins Technology guarantees this product against defective materials and manufacturing defects for a period of 12 months. During this period of warranty, a replacement of the faulty part will be shipped to the buyer's address free of charge upon receiving and verifying the returned faulty part. The Warranty is only applicable to the original buyer and shall not be transferable. The warranty shall exclude malfunctions or damages resulting from acts of God, fire, civil unrest and/or accidents, and defects from using wrong electrical supply/voltage and/or consequential damage by negligence and/or abuse, as well as use other than in accordance with the instructions for operation. The Warranty shall immediately cease and become void if the hardware is found to have been tampered, modified, repaired by any unauthorized person(s). Decisions by Virtins Technology on all questions relating to complaints as to defects either of workmanship or materials shall be deemed conclusive and the buyer shall agree to abide by such decisions.

8 Disclaimer

This document has been carefully prepared and checked. No responsibility can be assumed for inaccuracies. Virtins Technology reserves the right to make changes without prior notice to any products herein to improve functionality, reliability or other design aspects. Virtins Technology does not assume any liability for loses arising out of the use of any product described herein; neither does its use convey any license under its patent rights or the rights of others. Virtins Technology does not guarantee the compatibility or fitness for purpose of any product listed herein. Virtins Technology’s products herein are not authorized for use as components in life support services or systems. Virtins Technology should be informed of any such intended use to determine suitability of the products.

