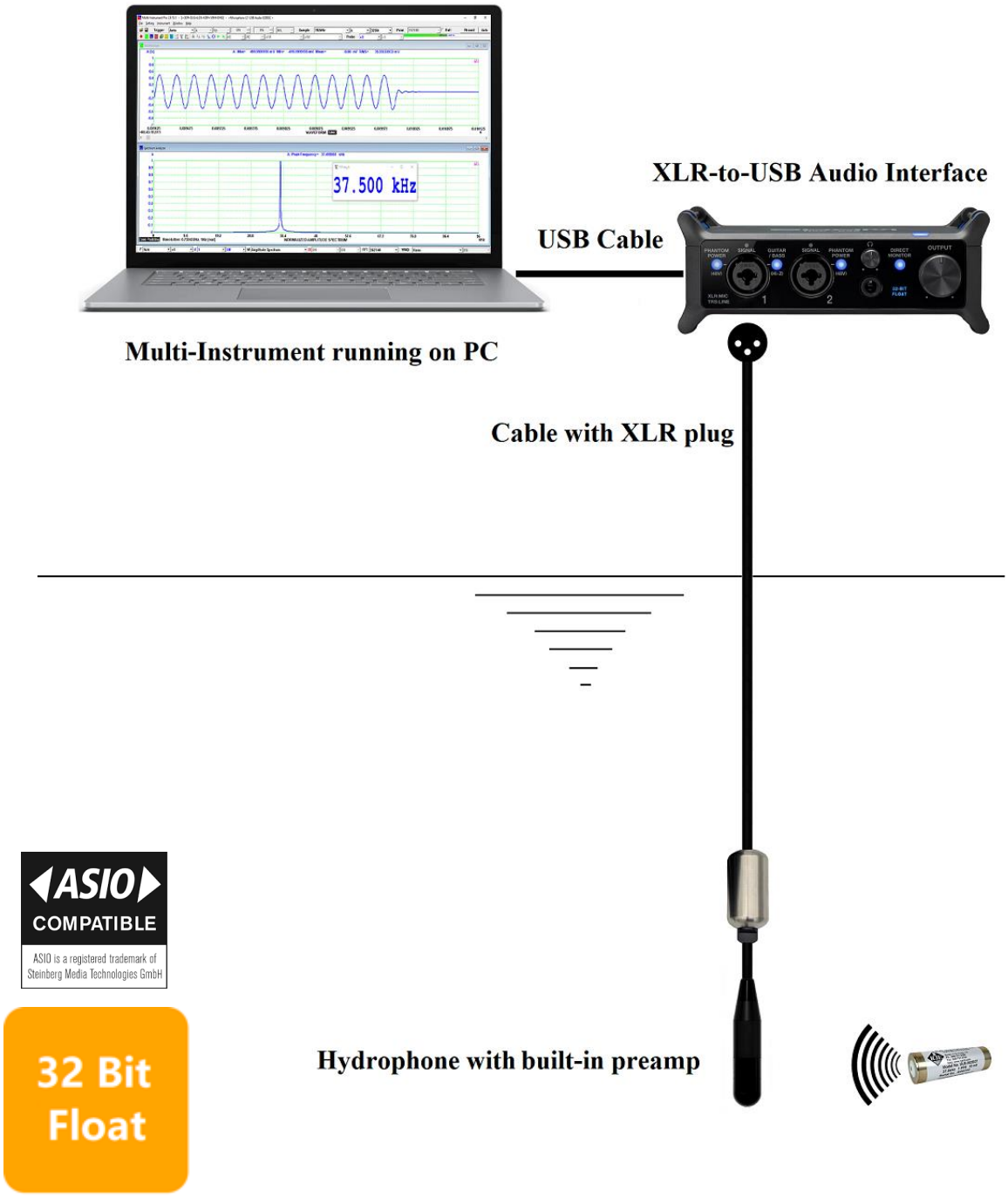
VT USA-268A/B Real Time Underwater Sound Analyzer Manual



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 USA-268A and VT USA-268B are PC-based real-time underwater sound analyzers with ultra-low noise and a huge dynamic range, covering 9 Hz to 92 kHz (-3 dB), powered by the comprehensive virtual instrument software Multi-Instrument®. Each analyzer includes a high-sensitivity hydrophone with a built-in preamp and an XLR output connector, plus an XLR-to-USB audio interface. The hydrophones can withstand a static water pressure up to 350 m and drive cables up to 250 m with negligible signal degradation.

The hydrophones in the two analyzers are manufactured with the same industrial-grade sensors under strict quality control, making them well-suited for absolute underwater sound level measurements in marine and industrial environments. The hydrophone of VT USA-268A is assembled with a 150g sliding stainless steel weight on its cable to provide negative buoyancy and stable positioning in mild wind and current conditions. The hydrophone of VT USA-268B features a standard panel-mount design, making it well suited for integration into systems, such as autonomous recording units, autonomous or remotely operated vehicles, and dive camera enclosures.

The XLR-to-USB audio interface used in the analyzers has two ADCs working in tandem to create a single output data stream in 32-bit float format. One “low gain” ADC is optimized for high-level signals, and the other “high gain” ADC is optimized for low-level signals. This state of the art dual-ADC architecture provides an unmatchable dynamic range compared with the conventional single ADC approach. It is possible to capture underwater sounds at low levels with high fidelity and at high levels without clipping, all without the hassle of manual analog gain adjustment.

1.1 Package Contents

1.1.1 Standard Package

A standard VT USA-268A/B Package contains the following items:

1) Hydrophone with a built-in preamp, integrated cable, and XLR output

(USA-268A)
(default cable length: 10 m)

(USA-268B)
(default cable length: 10 m)
(including Nylon retaining nut & nitrile o-ring for panel mounting)

2) XLR-to-USB Audio Interface

3) USB Cable (1 m)

4) CD (containing the copy-protected Multi-Instrument software)

The latest software can always be downloaded from www.virtins.com/MIsetup.exe.

5) USB hardkey (containing a Multi-Instrument Pro license)

6) Carrying Case

1.1.2 Optional Items

1) An additional XLR hydrophone and its accessories

2) Software license upgrade

1.2 Hardware Connection

Sound Measurement

Connect the XLR hydrophone to the input jack 1 of the audio interface.

Connect the corresponding ends of the USB cable to the XLR-to-USB Audio interface and a PC's USB port. When this is complete, the blue LED at the top right corner of the front panel lights up, indicating that it is receiving power.

Then switch on the 48V phantom power of input jack 1. This is required by the hydrophone used here, meanwhile, the Guitar/Bass switch for HiZ support MUST be turned off.

Software Activation

The USB hardkey needs to be plugged into any USB port of the PC in order to activate the Multi-Instrument software. Otherwise the software will run under the 21-day fully functional free trial mode before the trial period expires.

Test Signal Generation

You can generate the test signals from the Signal Generator of Multi-Instrument. The XLR-to-USB audio interface has two ¼-inch TRS jacks on its back panel, respectively for left and right balanced line-level outputs, and a ¼-inch TRS stereo headphone jack on its front panel. The test signals output from these jacks can be fed into an audio system and eventually played through underwater speakers/emitters.

1.3 Hardware Driver Installation

The device driver installer RTA268ABC_DriverInstaller.exe is located in the Drivers\VTRTA268ABC directory in the CD. When you install the Multi-Instrument software, a copy of the device driver installer will also be installed in the software installation directory\Drivers\VTRTA268ABC. Run it to install the driver. After driver installation, the device will be supported by both Sound Card MME and ASIO drivers in Multi-Instrument.

1.4 Multi-Instrument Software Installation and Configuration

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 DSOs and so on. It consists of multiple test instruments such Oscilloscope, Spectrum Analyzer, and Multimeter, etc.

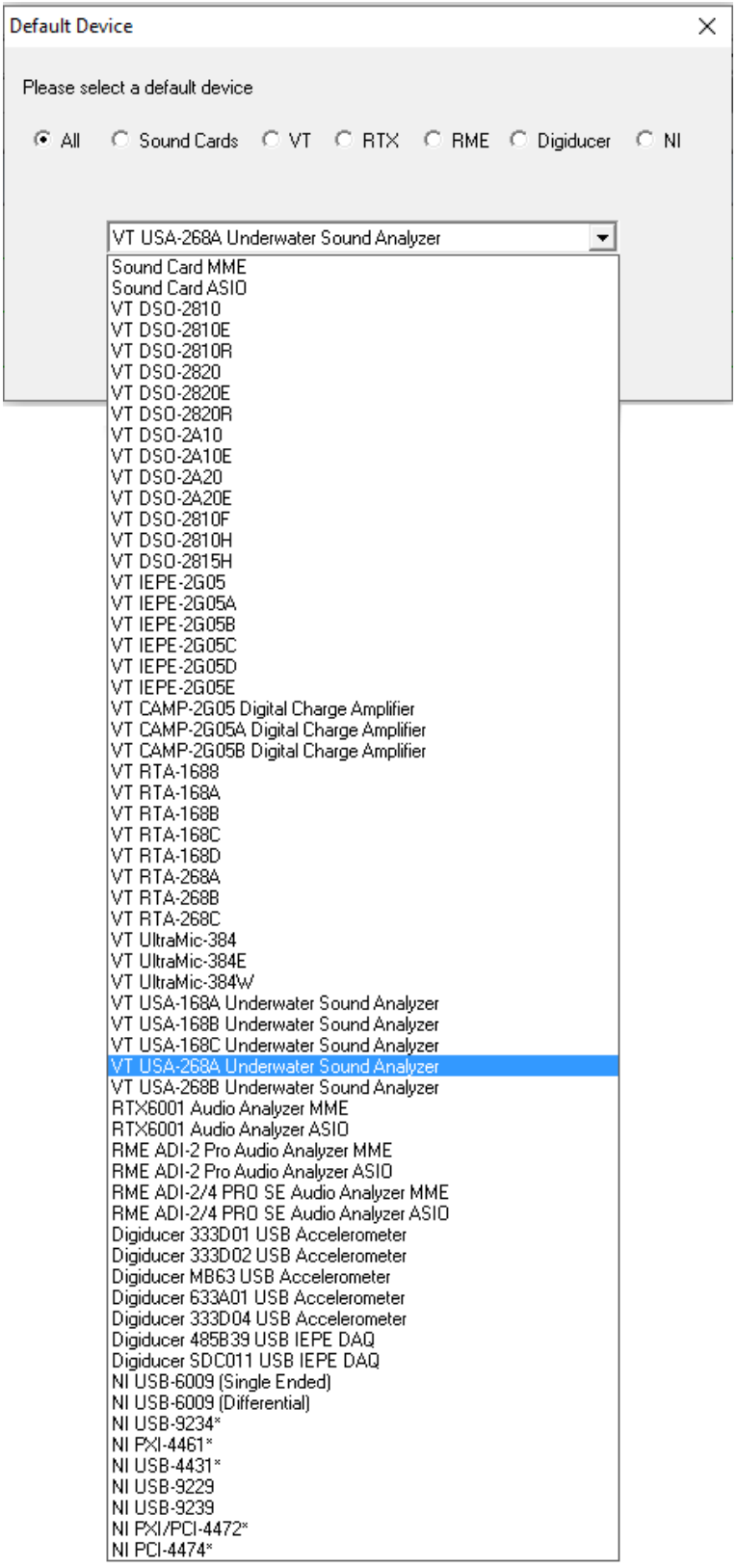
1.4.1 Install Multi-Instrument

Insert the Multi-Instrument installation CD into your computer's CD-ROM drive and follow the instruction on the screen to install the Multi-Instrument software. The installation file can also be downloaded from www.virtins.com/MIsetup.exe.

1.4.2 Start Multi-Instrument

To start Multi-Instrument, on the Windows desktop, select [Start]>[All Programs]>[Multi-Instrument]>[VIRTINS Multi-Instrument], or simply double click the MI icon.

If the software is started for the very first time after installation, it will prompt the user to select a default device (see figure below). Select VT USA-268A/B according to the hardware device to be used.



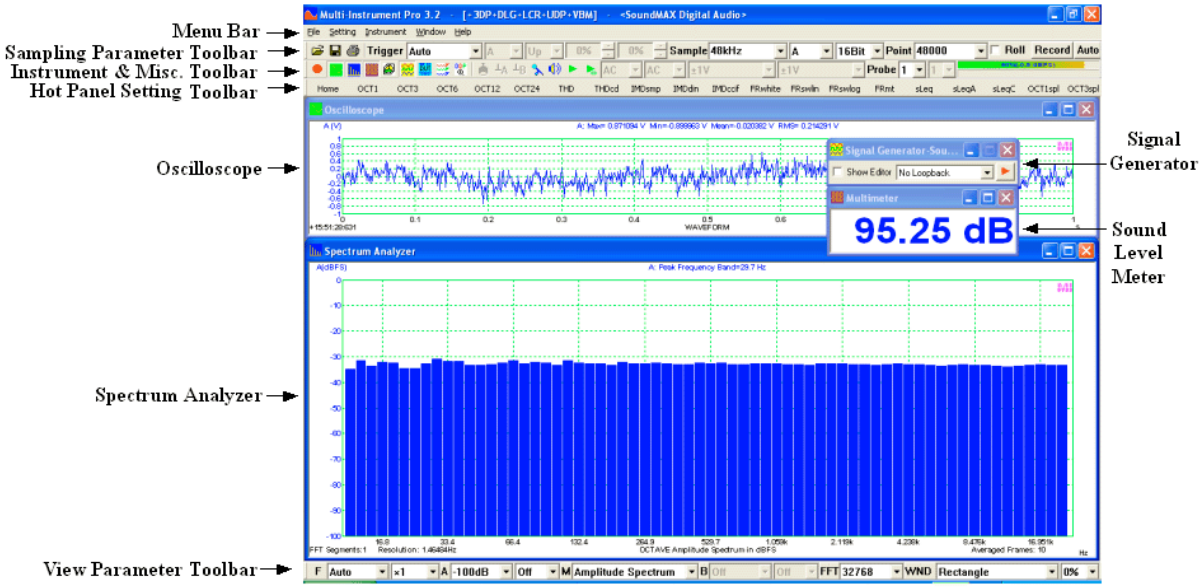
The default device can also be changed later via [Setting]>[ADC Device], [Setting]>[DAC Device], and [Setting]>[Configure Hot Panel Setting Toolbar], or simply [Setting]>[Restore to Factory Default]. **However, if [Restore to Factory Default] command is executed, all calibration data entered manually via [Setting]>[Calibration] after software installation will be reset to the default values of the selected product. To avoid losing the manually**

entered calibration data, you can save them as a calibration file first. Otherwise, you will have to enter the unique calibration data that come with the product package again.

If the driver has not yet been installed, the software will prompt the user to install the driver. Restarting program is required after that.

After the default device is selected, the software will prompt the user to select a default color scheme (Skin). The default skin can also be changed later via [Setting]>[Display].

The main window of the software will open after the above skin selection. The following figure shows a typical screen layout, please refer to the software manual for detailed functions of the software. The software manual can be accessed via [Start]>[All Programs]>[Multi-Instrument]>[VIRTINS Multi-Instrument Manual] (in PDF format) or [VIRTINS Multi-Instrument Help] (in HTML format) on Windows Start menu, or [Help]>[Software Manual] or F1 inside the software.



1.4.3 Configure Multi-Instrument

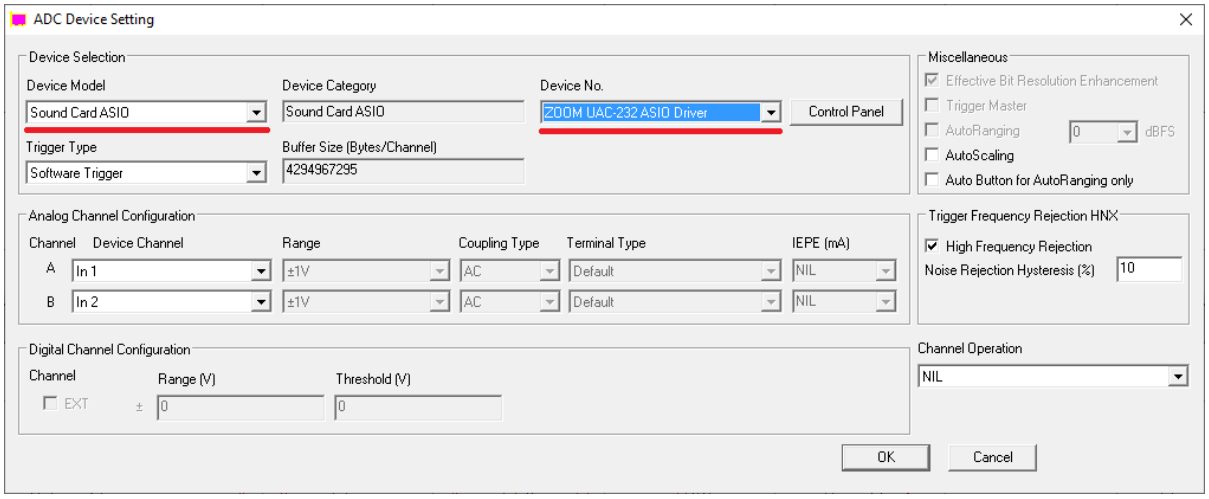
In Multi-Instrument, the menu items are enabled / disabled based on context. Many menu items are disabled when the Oscilloscope or the Signal Generator is running. To do the configuration, stop the oscilloscope first by pressing the green button at the upper left corner of the screen (see figure below). The button will turn red once the Oscilloscope is stopped.

1.4.3.1 Configure Sound Recording Devices for Multi-Instrument

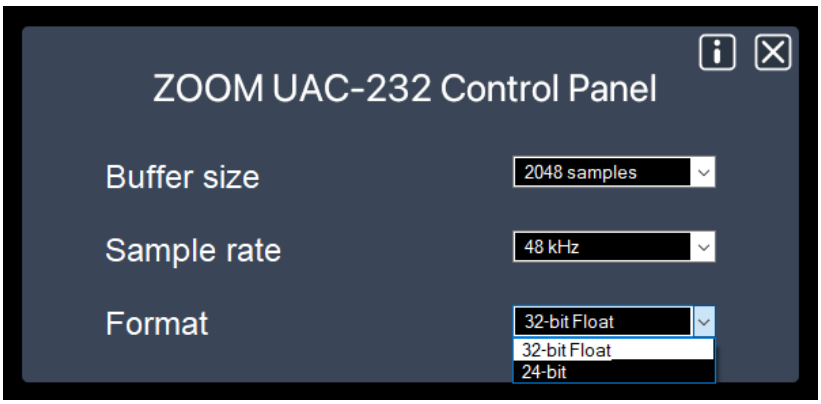
The audio interface can be used with either MME or ASIO driver. ASIO driver is recommended as it uses the sampling rate selected in Multi-Instrument directly and bypasses the possible sampling rate conversion and audio signal enhancement by Windows, which may otherwise alter the original samples and lead to measurement inaccuracies.

1.4.3.1.1 Using ASIO Driver

Go to [Setting]>[ADC Device], and select "Sound Card ASIO" in the "Device Model" field. Then choose "ZOOM UAC-232 ASIO Driver" in the "Device No." field (see figure below). This is to configure the audio interface as the sound recording device for the software.



Click the "Control Panel" button to bring up the control panel for the audio interface (see figure below).



1.4.3.1.1.1 Buffer Size

There is generally no need to change the default Buffer Size for test and measurement applications. A large buffer size is preferred, though.

1.4.3.1.1.2 Sampling Rate

Under ASIO, the Sampling Rate will be set directly in Multi-Instrument and thus changing it here will have no effect. Instead, the Sampling Rate here will passively follow what is set in Multi-Instrument.

On the other hand, if MME is used instead, you can only change the actual sampling rate of the audio interface here. The change here will be reflected in the sampling rate displayed in the Sound Recording Tab under the Windows Control Panel. When the sampling rate set in Multi-Instrument differs from the one here, Windows will conduct sampling rate conversion automatically.

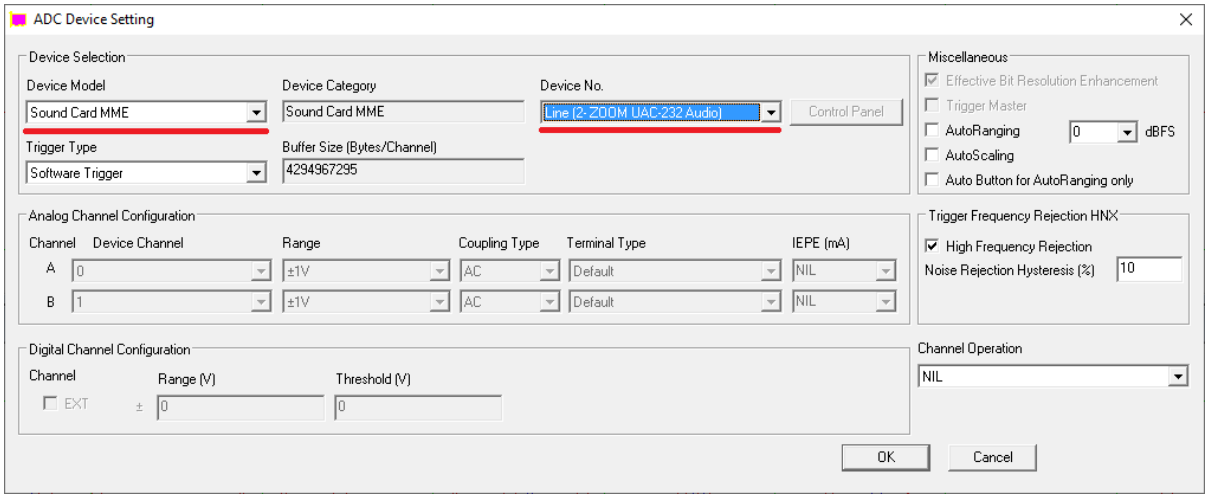
1.4.3.1.1.3 Format

Two formats are supported by the audio interface: 24-bit (Integer) or 32-bit Float. One unique feature of the audio interface is its support for 32-bit float format. This format provides much finer resolution than the 24-bit (Integer) format when the signal is weak, thanks to the audio interface's state-of-the-art dual-ADC architecture, with one optimized for weak signals and the other optimized for strong ones. Both formats have the same resolution when the signal is strong. It is thus recommended to use the 32-bit float format for sound recording (ADC). However, currently its ASIO driver does not support 32-bit float format for signal output (DAC). Hence, MME should be used for sound playback (DAC) instead. When the 32-bit float format is used, the Sampling Bit Resolution in Multi-Instrument must be set to 32-bit, otherwise, an error message will pop up. When the ADC is running in the 32-bit float mode, the "32-Bit FLOAT" sign on the front panel of the audio interface will be lit up, and "Float32" will be displayed at the middle bottom of the Oscilloscope window in Multi-Instrument.

Now, if you start the oscilloscope by pressing the red button at the upper left corner of the screen, and then talk LOUDLY in front of the hydrophone, you should be able to see your "voices" in the Oscilloscope and Spectrum Analyzer.

1.4.3.1.2 Using MME Driver

Go to [Setting]>[ADC Device], and select "Sound Card MME" in the "Device Model" field. Then choose "Line (ZOOM UAC-232 Audio)" in the "Device No." field (see figure below). This is to configure the audio interface as the sound recording device for the software.

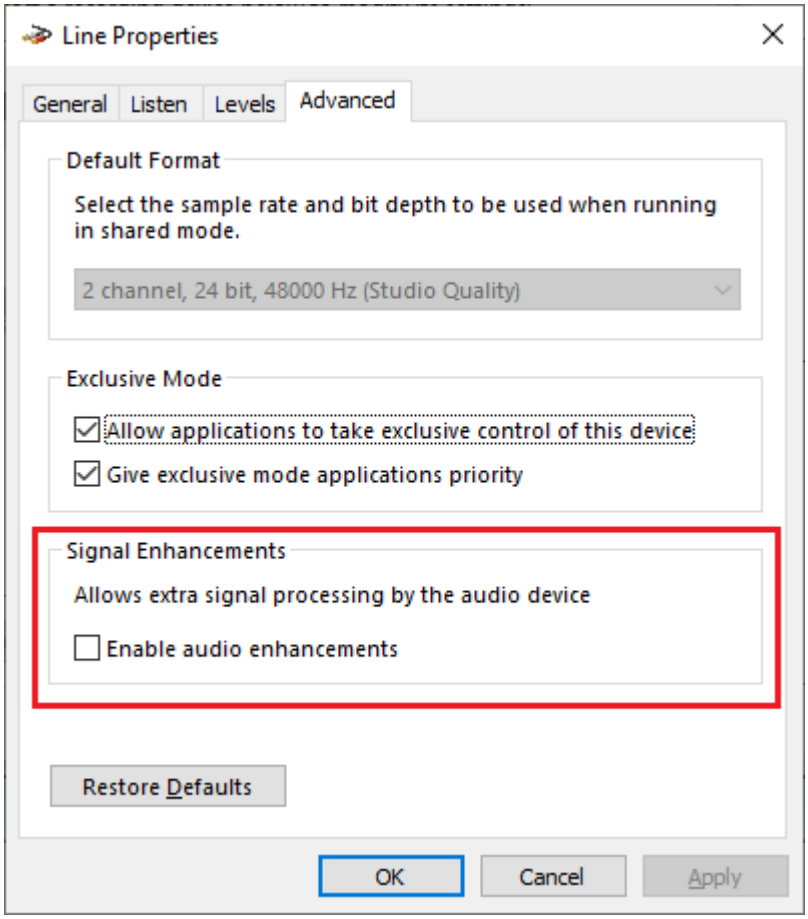


Note that the displayed name of the audio interface may vary a bit under different Windows versions or with different USB ports.

Now, if you start the oscilloscope by pressing the red button at the upper left corner of the screen, and then talk LOUDLY in front of the hydrophone, you should be able to see your "voices" in the Oscilloscope and Spectrum Analyzer.

Note that MME does not support 32-bit float format.

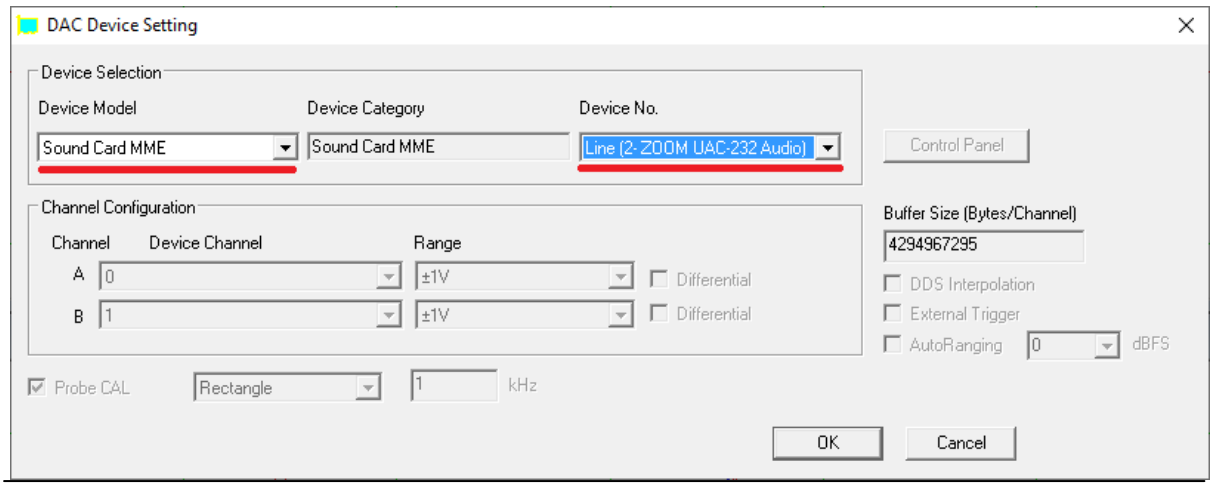
Some Windows versions / editions come with some audio signal enhancement features which are enabled by default. These features must be disabled through the Sound Recording Control under Windows Control Panel to prevent them from altering the originally sampled data, as shown below. One of the possible problems caused by these features is the unwanted alteration of the frequency response of the setup. Using ASIO driver instead of MME driver can avoid these problems.



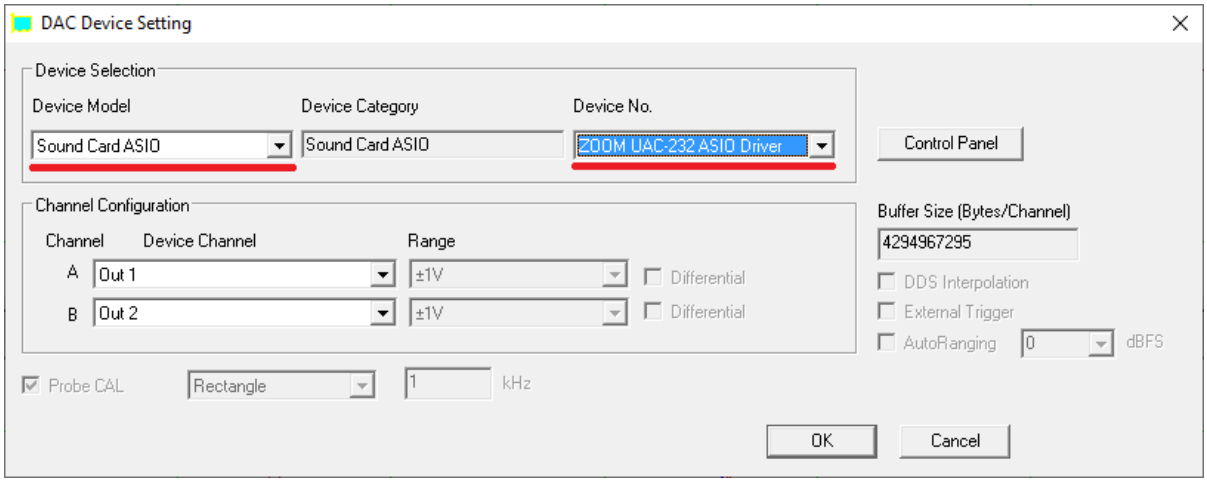
1.4.3.2 Configure Sound Playback Devices for Multi-Instrument

The audio interface has left and right balanced line-level outputs and a stereo headphone output. You can use the Signal Generator in Multi-Instrument to generate the test signals through them.

If ASIO with 32-bit float format (recommended) is used for sound recording (ADC), MME must be chosen for sound playback (DAC). To do that, go to [Setting]>[DAC Device], and select “Sound Card MME” in the “Device Model” field and “Line (ZOOM UAC-232 Audio)” in the “Device No.” field (see figure below).

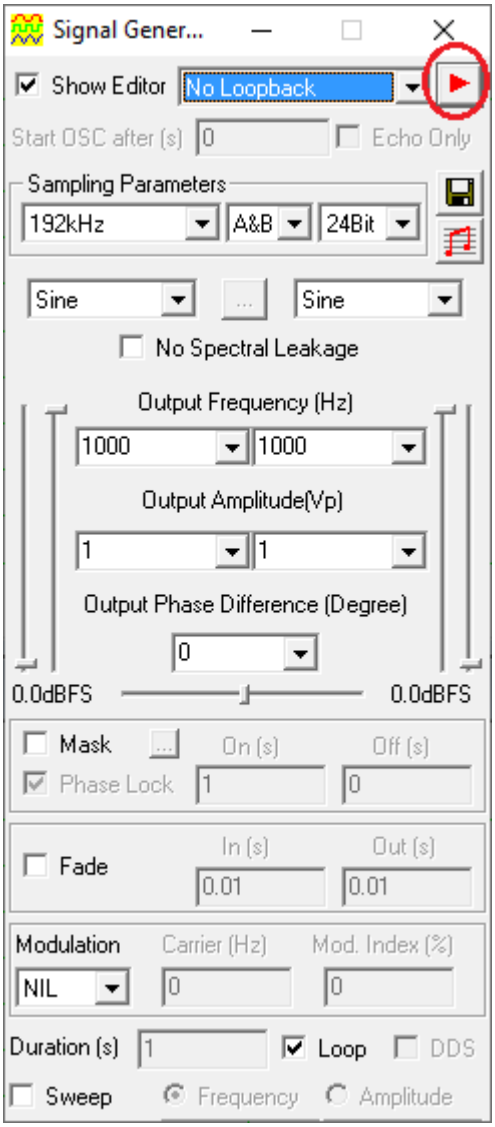


If ASIO with 24-bit format is used for sound recording (ADC), ASIO must be chosen for sound playback (DAC). To do that, go to [Setting]>[DAC Device], and select "Sound Card ASIO" in the "Device Model" field and "ZOOM UAC-232 ASIO Driver" in the "Device No." field (see figure below).



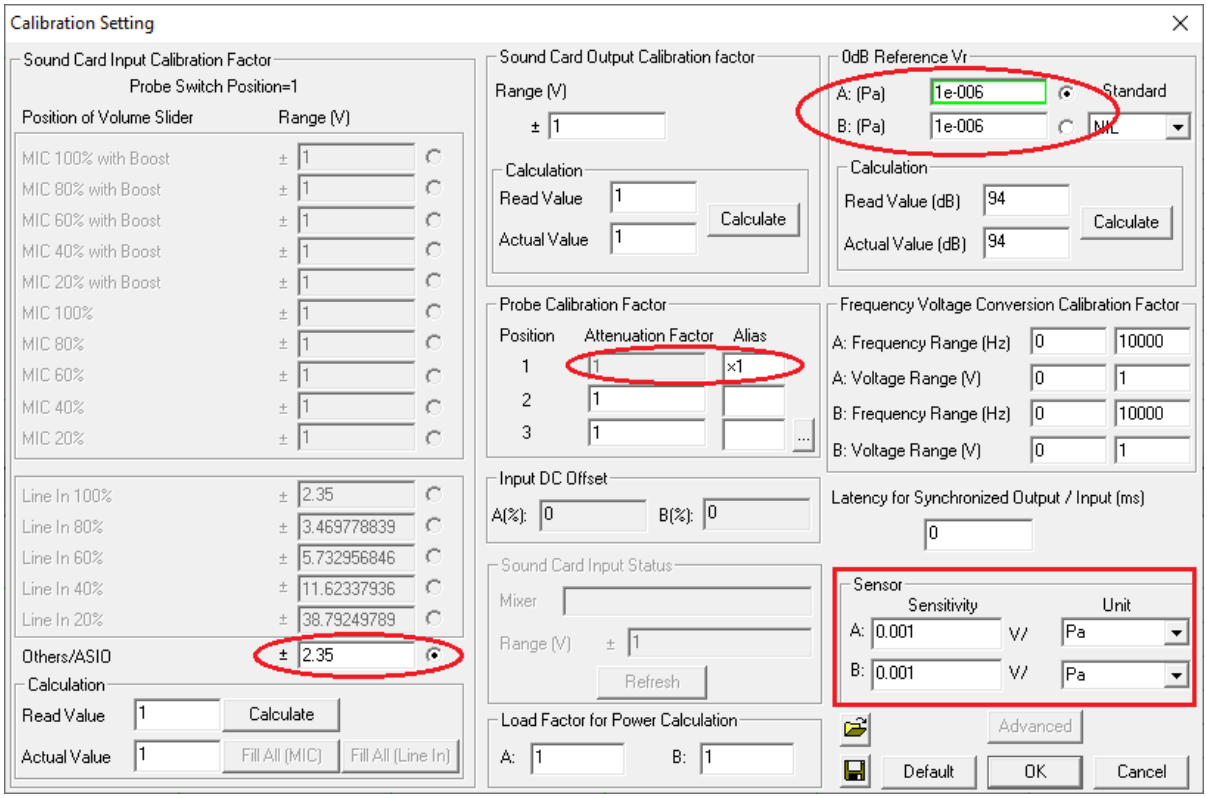
If MME is used for sound recording (ADC), then MME must be chosen for sound playback (DAC).

Now, if you press the Signal Generator button (see figure above), the Signal Generator panel will be opened (see figure below). Press the red triangle button at the upper right corner of the Signal Generator panel, you should hear a 1kHz test tone from the speaker or earphone connected to the audio interface. Press it again to stop the sound.



1.5 Input of Sound Level Calibration Data

Sound level calibration is required if you want to measure the absolute sound level. Please refer to the calibration data sheet provided in the product package and enter the calibration data in the respective highlighted fields in the Calibration Setting dialog box (see figures below). The Calibration Setting dialog box can be opened via [Setting]>[Calibration] in Multi-Instrument. Note that the "Sensor"> "Sensitivity" values in the following figure are examples only. You should enter the actual calibration data provided inside the product package.



The audio interface has an ultra-low noise level and offers a huge dynamic range of about 135dB, owing to its state-of-the-art dual-ADC architecture. Consequently, the absence of analog gain adjustment knobs on the audio interface panel is a deliberate design choice, as the exceptional dynamic range eliminates the need for such adjustments.

The audio interface also comes with a piece of utility software called UAC-232 Mix Control (see Section 1.12), where the digital gain of the input channels 1 & 2 can be adjusted from 0dB to 60dB. **Please note that the calibration data are valid only when the digital gains are set at 0dB.** The digital gain should always be kept at 0dB in order not to invalidate the calibration. Under the 32-bit float mode, the quality of the acquired data will not be affected by the digital gain settings.

1.5.1 0dB Reference Vr

The "0dB Reference Vr" in the Calibration Setting dialog box is used to finally calibrate the input voltage to dBSPL. The input voltage here should be considered as a relative value as the actual input is not a voltage but a sound pressure. The "0dB Reference Vr" is the parameter to be recalibrated if a sound level recalibration is necessary. To do the recalibration, simply enter the actual sound level value into the "Actual Value" edit box and the measured sound level value into the "Read Value" edit box, and then press the "Calculate" button ONCE. It should be noted that the Sensor Sensitivity is kept at 1V/V in this method.

In case you want to display the measured raw data in Pa rather than Volt, then you should enter the "actual" Sensor Sensitivity in V/Pa, which can be calculated using the following formula:

Sensitivity = ["0dB Reference Vr" (in Volt)] / [Standard 0dB Reference (in Pa)]

where the Standard 0dB Reference for sound pressure level in air is 20 µPa (i.e. 2e-005 Pa) and that in water is 1 µPa (i.e. 1e-006 Pa). If the "actual" Sensor Sensitivity is used, then the standard 0dB reference should be entered into the "0dB Reference Vr" edit box. For example, the following two methods are equivalent.

Method 1: [0dB Reference Vr] = 1e-009 (V) and [Sensor Sensitivity] = 1 V/V
Method 2: [0dB Reference Vr] = 1e-006 (Pa) and [Sensor Sensitivity] = 0.001 V/Pa

Method 2 is used by default for VT USA-268A/B.

The sensitivity of a hydrophone is usually specified in dB with reference to 1V/µPa, it can be converted to V/Pa as follows:

$$\text{Sensitivity (V/Pa)} = \text{power}(10, \text{Sensitivity (dB)}/20) \times 10^6$$

For example, the nominal sensitivity of the hydrophone in VT USA-268A/B is -180dB, i.e. 0.001 V/Pa.

1.6 Most Frequently Used Measurement Settings

Multi-Instrument bundled with VT USA-268A/B comes with many pre-configured panel setting files. This saves you time in configuring various parameters for some frequently performed measurements by yourself. You can load these panel setting files via [Setting]>[Load Panel Setting]. Furthermore, up to 20 most frequently used panel setting files can be configured in the Hot Panel Setting Toolbar (The third toolbar from the top) via [Setting]>[Configure Hot Panel Setting Toolbar]. You can load one of them by a single mouse click. Two panel setting files are preconfigured in this toolbar. They are:

(1) Home: Default Setting
The factory default panel setting. It is equivalent to the [File]>[New] command.

(2) OCT3: 1/3 Octave Analysis
1/3 octave band spectrum analysis instead of narrow band FFT spectrum analysis will be perform on the sampled data.

1.7 Using Hydrophone with an External Power Supply without a Computer

The XLR-to-USB audio interface can be powered by an external DC 5V power supply (e.g. a mobile USB battery) through a USB type C port. The underwater sound captured by the hydrophone can be directly monitored from the phone jack if the "DIRECT MONITOR" switch is set to "ON" even without a computer.

1.8 Hydrophone Maintenance

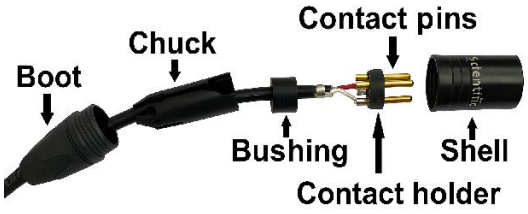
No special care is required for the hydrophone. It is designed to withstand corrosion from seawater and the impact of accidental drops. Although it is quite tough for what it is, but note that it is a sensitive instrument. Avoid throwing it into the water, or any other activity that may result with an impact to the hydrophone. Try to keep the output plug clean and dry and avoid unnecessarily rough handling to ensure the long-term stability of the product. It is best NOT to store the hydrophone in a waterproof enclosure. Doing so will trap moisture, salts and minerals that are left on the hydrophone and cable after deployment and prematurely corrode the output plug. Making an extra effort to coil the cable neatly when retrieving the hydrophone will help avoid problems with tangles as the cable ages. Most importantly, protect the cable from cuts and abrasions! The hydrophone uses a custom-made cable with a very durable PU jacket. However, it is also designed to be compact and flexible. Kinking the cable, walking on it, or dragging it over a sharp or abrasive surface may damage the cable sheath and eventually cause the hydrophone to fail. Both aquatic and terrestrial animals may attack the cable in an unattended application. Using some kind of cable conduit, such as plastic tubing, can help to protect the hydrophone in long-term installations.

1.9 Sliding Stainless Steel Weight on VT USA-268A

To maintaining negative buoyancy underwater, the hydrophone VT USA-268A is assembled with a 150g sliding stainless steel weight. There are several advantages to placing the weight on the cable rather than building it into the hydrophone. When the hydrophone is dropped, the cable flexes and absorbs any stress from impact, making the hydrophone more durable. The weight can be moved if need to allow insertion into a pipe. Both of these attributes are especially useful to the leak finding specialist. Moving the weight away from the hydrophone dampens acceleration noise that is transmitted down the cable from handling and it also minimizes response irregularities caused by material resonances and sound reflections. It can also be used for mounting a shroud tube to minimize flow noise over the hydrophone. To move the weight, turn the black plastic thumbscrew counter-clockwise to loosen the internal rubber compression sleeve and slide the weight where needed. Wet the cable if this is difficult. Secure again by turning the thumbscrew clockwise. **Be Advised: Finger-tighten thumbscrew only and always leave a minimum spacing of 5 cm between the hydrophone and the weight!**

1.10 VT USA-268B Hydrophone Panel Mounting Instructions

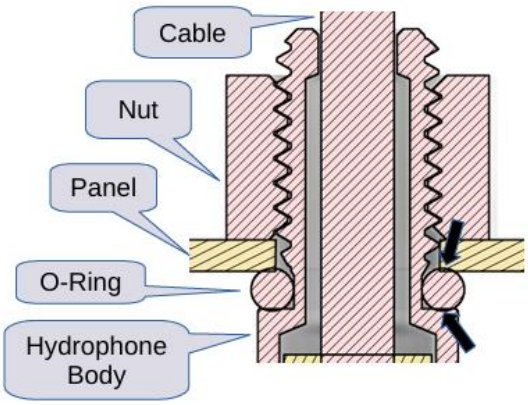
The XLR male connector of the VT USA-268B hydrophone cannot pass through an M10 mounting hole. However, the connector can be easily disassembled and reassembled without tools, requiring only the contact pins to be fed through any mounting fixture, conduit, or hardware.



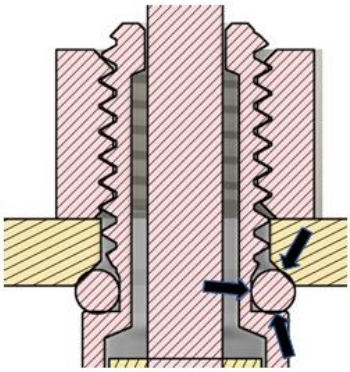
Exploded View

Fully Disassembled

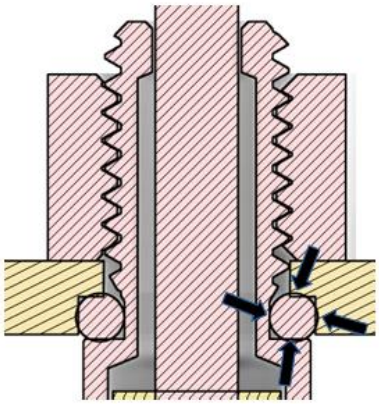
The VT USA-268B hydrophone comes with a size 109 (3/32" (2.6mm)) 70d Buna o-ring and an Essentra 04M100150HN nylon nut for panel mounting. The recommended dimensions for chamfer and counterbore are shown below.



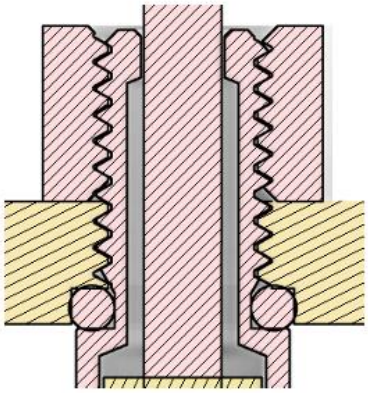
Straight 10mm hole through panel. Clamping force provides two points of contact for sealing (see arrows above). Positive pressure outside panel retains o-ring. Friction accommodates any common negative pressure. Sufficient for nearly all applications.



10mm hole with minimum 1mm chamfer provides three points of contact for sealing. O-ring fully retained against positive and negative pressure.



10mm hole with Ø12.5mm x 2mm deep counterbore provides four points of contact for sealing. O-ring fully retained against positive and negative pressure.



For high-pressure applications: Counterbore as at left, but panel is threaded with lock nut. Prevents crushing of o-ring under pressure and takes up play in thread for rigid mounting.

It is not recommended crushing the 0-ring to more than 65% of original diameter. For recommended o-ring, that would equate to ½ turn after first seating against panel. **Do not apply torque to rubber hydrophone encapsulation**. No liability for damage caused by failure of panel-mount seal will be accepted. Installer should verify clean, smooth contact surfaces. Use of silicone grease is recommended for critical and high-pressure applications.

1.11 UAC-232 Control Panel

UAC-232 Control Panel is installed during driver installation. Normally, there is no need to open it as the default settings will work perfectly. Please refer to Section 1.4.3.1.1 for details. Note that all the settings on the control panel are stored in the driver on the computer rather than the audio interface hardware.

1.12 UAC-232 Mix Control

UAC-232 Mix Control is an application designed to control the internal mixer settings of UAC-232. It can be installed manually if needed. Its installation file RTA268ABC_Mix_Control.msi is located in the Drivers\VTRTA268ABC directory in the CD. When you install the Multi-Instrument software, a copy of it will also be installed in the software installation directory\Drivers\VTRTA268ABC. Run it to manually install the utility program if necessary.

Normally, there is no need to use it as the default settings from Virtins Technology will work perfectly. As mentioned previously, the digital gain settings for input channels 1&2 should be kept at 0dB in order not to invalidate the entered calibration data. Under the 32-bit float mode, the recording quality will not be degraded by the digital gain settings. Please note that the digital gain settings for XLR condenser microphones (with 48V phantom power on), XLR dynamic microphones (with 48V phantom power off), TRS line-level input (with HiZ off), and TS Guitar/Bass input (with HiZ on) are kept separately in the hardware. The audio interface can recognize the input device connected automatically and set the corresponding digital gain. **For the hydrophone used here, 48V phantom power must be switched on and HiZ must be kept off, this will not only ensure the hydrophone to function correctly, but also set its correct digital gain settings (i.e. 0dB)**

The Loopback button is switched off by default. If it is turned on, the signals input through the input jacks 1 & 2 and the stereo signals output from the computer will be mixed and then input to the computer again (looped back). This function has its very particular use in time delay measurement.

Music mode will keep the two input channels separate while Streaming mode will merge them into a mono channel. Music mode is selected by default. It should be kept in that mode generally for test and measurement applications.

Note that all the settings on UAC-232 Mix Control are stored in the audio interface hardware rather than the software on the computer.

2 Specifications

2.1 VT USA-268A/B Overall Hardware Specifications

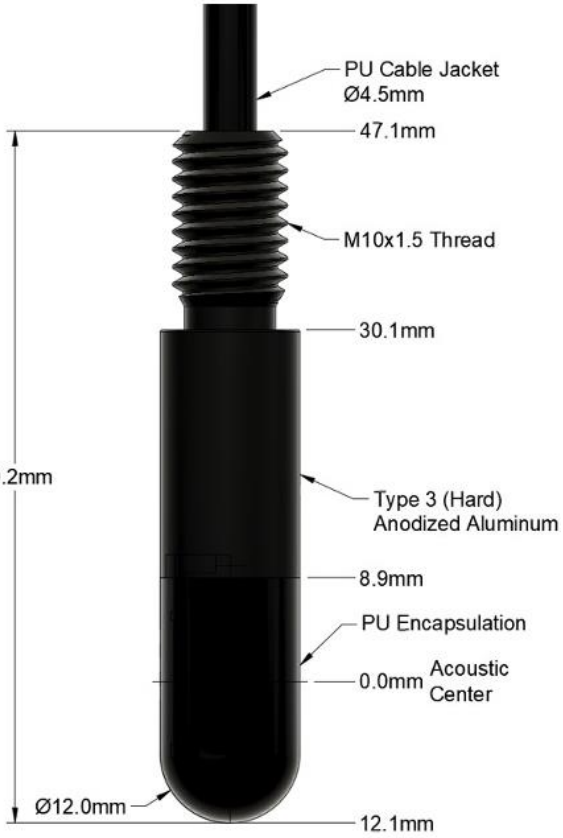
	USA-268A	USA-268B
Frequency Range (-3dB)	9Hz ~ 92kHz	
Sound Level Measurement Range	50dB~185dB (typical)	
Operating Depth	< 200m	
Sampling Rate	44.1kHz, 48kHz, 88.2kHz, 96kHz, 176.4kHz, 192kHz	
Bit Depth	32-bit Float / 24 bit	
Number of Input Channel	2	
Number of Output Channel	2	
Direct Monitoring without Passing Through Computer	Supported	
Frequency Accuracy	0.001%	
Frequency Weighting	Flat, A, B, C, ITU-R 468	
Time Weighting	Linear, Exponential (Equivalent continuous sound level (*Leq*) fully complies with IEC61672)	
Octave Analysis	1/1,1/3,1/6,1/12,1/24,1/48, 1/96 (Complies with IEC61260)	
Other Functions	Much more functions are described in the software manual.	
USB interface	USB 2.0, driver installation required	
Input Isolation	No (Isolation can be achieved through a USB high speed isolator)	
Power Source	USB bus power (Type C), DC 5V power supply (Type C)	
Power Consumption	Max. 2.5W	
System Requirements	Windows 10/11, 32 bit or 64 bit. Minimum Screen Resolution: 1024 × 600	
Calibration Accuracy	±2dB	

2.2 Hydrophone Specifications

	USA-268A	USA-268B
Transducer Type	Thin-wall PZT	
Frequency Range (-3dB)	4.3Hz ~ 110kHz	
Sensitivity	-180dB re: 1 V/μPa (i.e. 0.001V/Pa)	
Horizontal Directivity	+0.2/-1 dB @50kHz	
Vertical Directivity	+0/-5.9 dB @50kHz	
Survival Depth	350 m	
Operating Temperature Range	-10℃~+80℃	
Acoustic Overload Pressure	188 dB	
Size	Φ12mm × 43mm	
Weight (hydrophone only)	8 g	
Specific Gravity (hydrophone only)	1.4	
Wetted Materials	Polyurethane, anodized aluminum	
Added Weight	150g	No

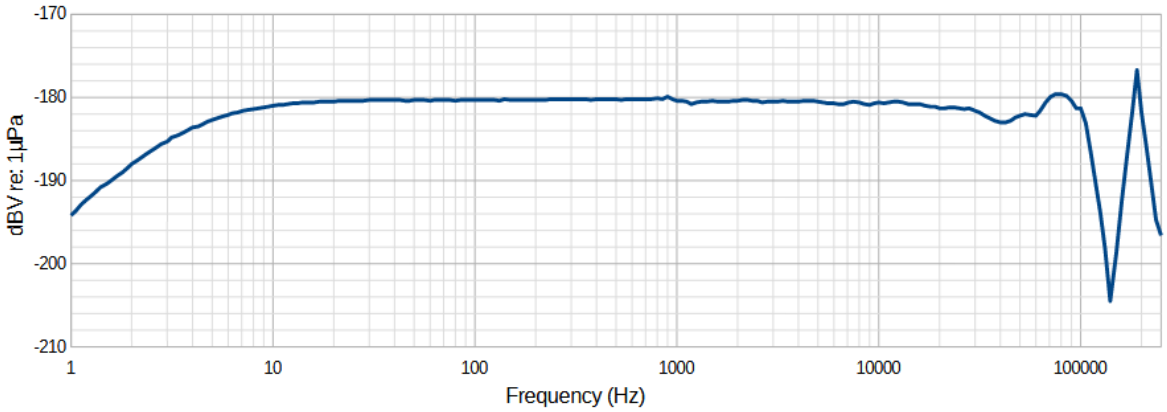
With Built-In Preamp	Yes
Connector	XLR (pin 1: ground, pin 2: hot, pin 3: cold)
Power Supply	48V Phantom

USA-268A Hydrophone

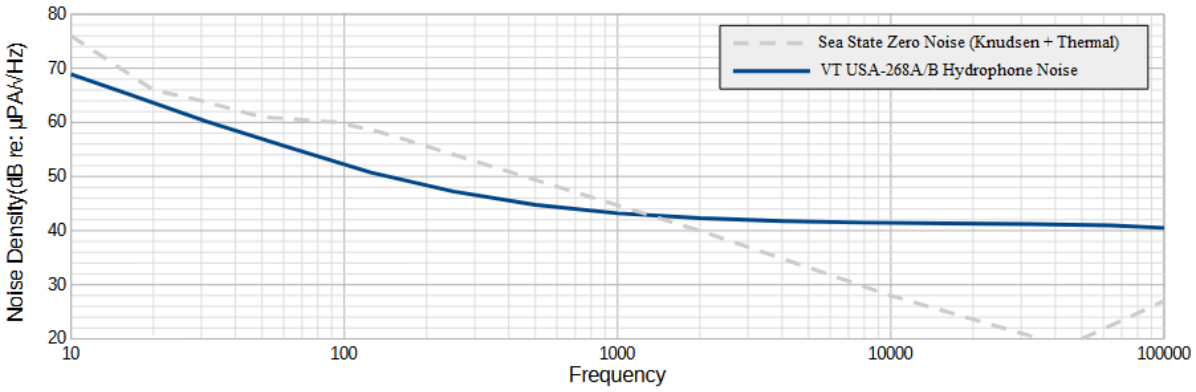


USA-268B Hydrophone

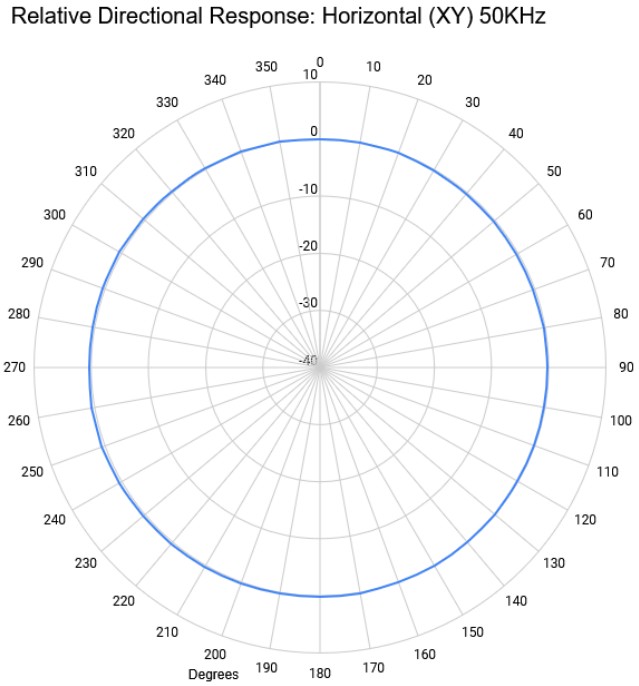
The following voltage sensitivity and directional response data were obtained from US Navy, Underwater Sound Reference Division Calibration Labs at Newport.



USA-268A/B Hydrophone Voltage Sensitivity (Typical)



USA-268A/B Hydrophone Equivalent Noise (Typical)



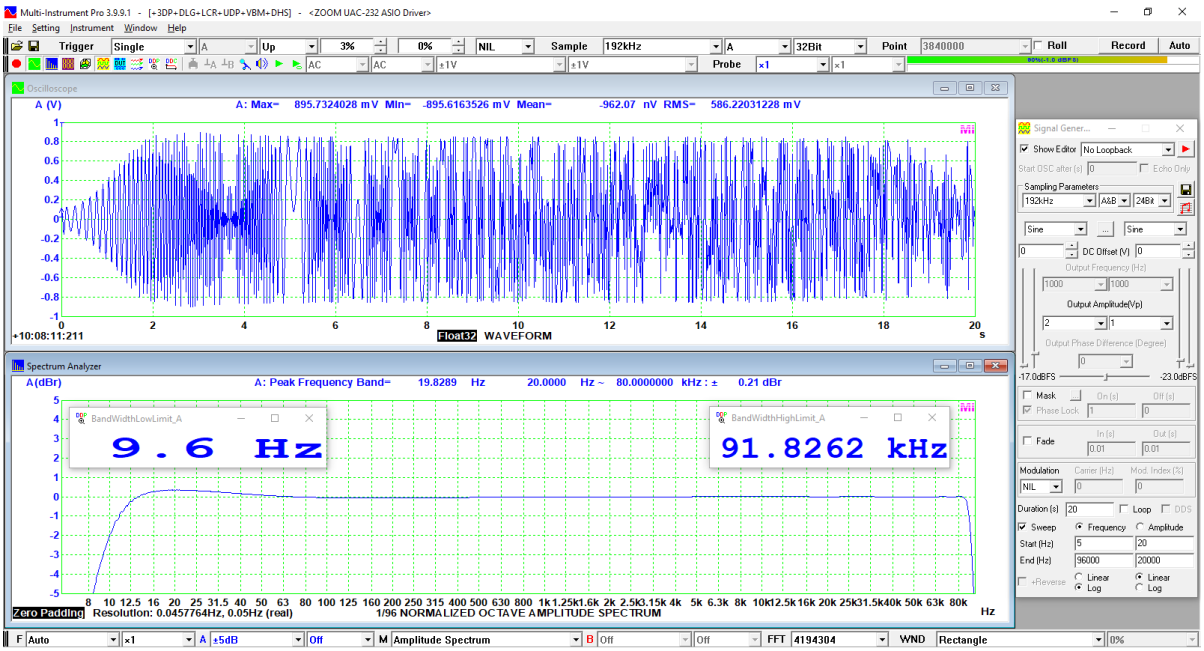
USA-268A/B Hydrophone Horizontal Directional Response (Typical)

2.3 XLR-to-USB Audio Interface Specifications

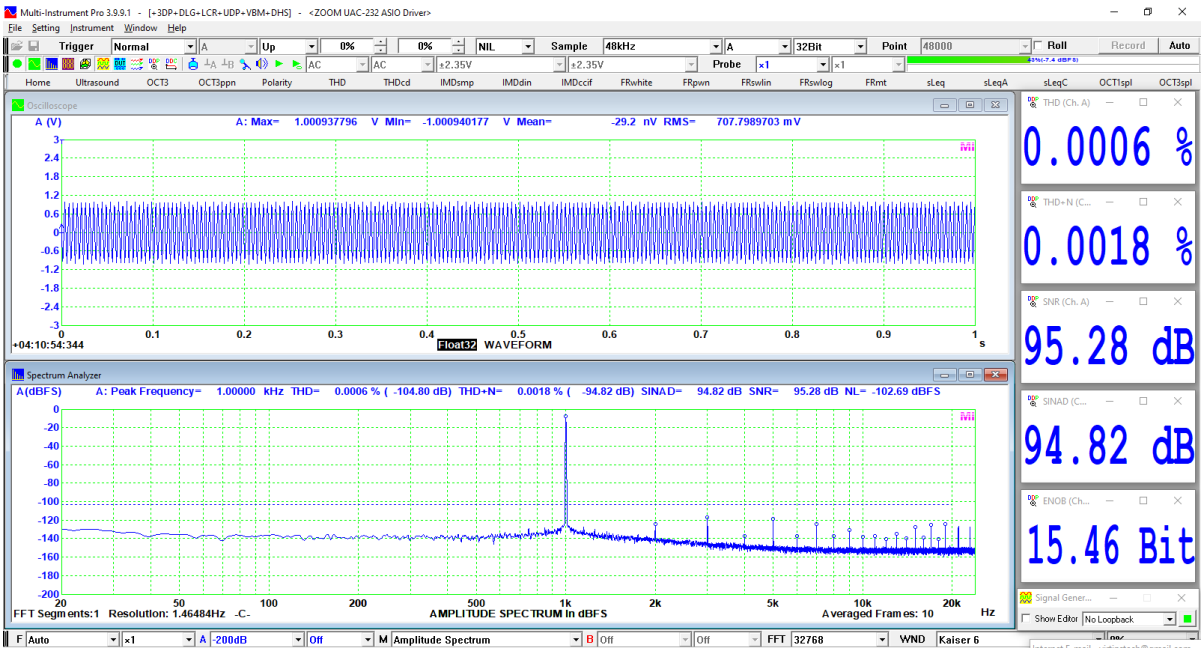
	Input Impedance	Max. Voltage	Dynamic Range	XLR Phantom Power
Left (Input 1): XLR/TRS/TS(HiZ) Combo Jack	XLR: 2.7 kΩ TRS: 4 kΩ / 1 MΩ (when HiZ on)	XLR: 2.35Vp TRS: 23.0Vp / 4.30Vp (when HiZ on)	XLR: 134 dB TRS: 129 dB TS(HiZ): 123 dB	48V
Right (Input 2): XLR/TRS Combo Jack				

	Output Impedance	Max. Voltage
Left (Output 1): TRS (balanced) Jack	100Ω	9.0Vp (adjustable through volume knob)
Right (Output 2): TRS (balanced) Jack		
Headphone	12Ω	4.4Vp (adjustable through volume knob)

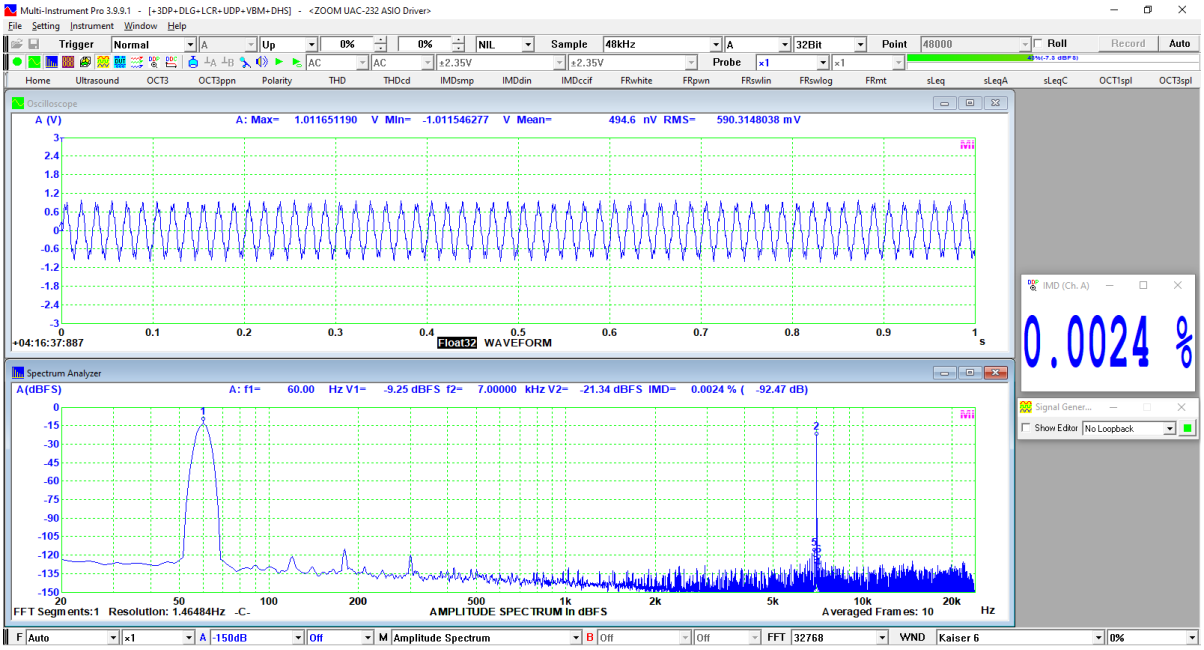
MIDI	IN/OUT (5-pin DIN connectors)
Input Frequency Response	44.1 kHz: 20Hz~20kHz, +0.1 dB / −0.2 dB -3dB: 9Hz~21.8kHz 48 kHz: 20Hz~20kHz, ±0.21dB -3dB: 9Hz~23.8kHz 96 kHz: 20Hz~40kHz, ±0.22dB -3dB: 9Hz~47.6kHz 192 kHz: 20Hz~80kHz, +0.1 dB / −0.2 dB -3dB: 9Hz~91.8kHz
TRS Output Frequency Response	44.1 kHz: 20Hz~20kHz, +0.0 dB / −0.1 dB -3dB: 1.9Hz~21.1kHz 48 kHz: 20Hz~20kHz, ±0.1dB -3dB: 1.9Hz~22.8kHz 96 kHz: 20Hz~40kHz, ±0.1dB -3dB: 2.1Hz~45.6kHz 192 kHz: 20Hz~80kHz, +0.0 dB / −1.0 dB -3dB: 2.1Hz~93.2kHz
Headphone Output Frequency Response	44.1 kHz: 20Hz~20kHz, +0.0 dB / −0.5 dB -3dB: 1.5Hz~20.9kHz 48 kHz: 20Hz~20kHz, ±0.3dB -3dB: 1.5Hz~22.8kHz 96 kHz: 20Hz~40kHz, ±0.1dB -3dB: 1.6Hz~45.6kHz 192 kHz: 20Hz~80kHz, +0.0 dB / −1.0 dB -3dB: 1.7Hz~95.2kHz
USB Connector	Type C
Power Consumption	Max. 2.5W
Dimension	164 mm (W) × 105.5 mm (D) × 65 mm (H)
Weight	355g



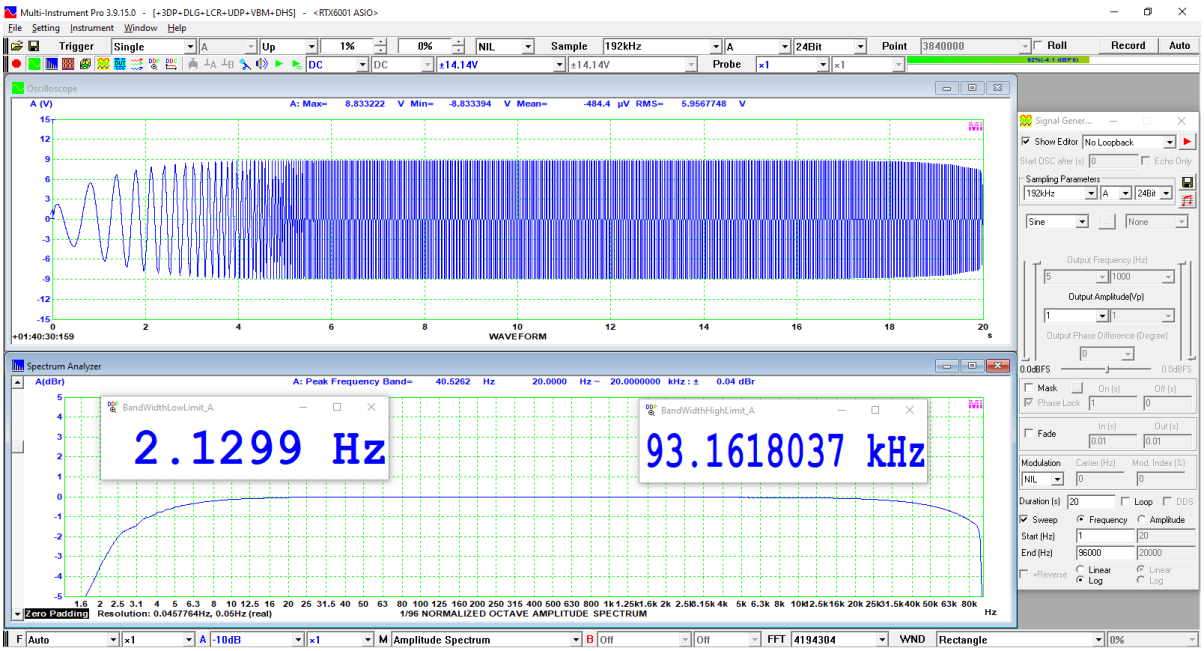
Typical Magnitude Frequency Response of XLR Input @ Sampling Rate 192kHz



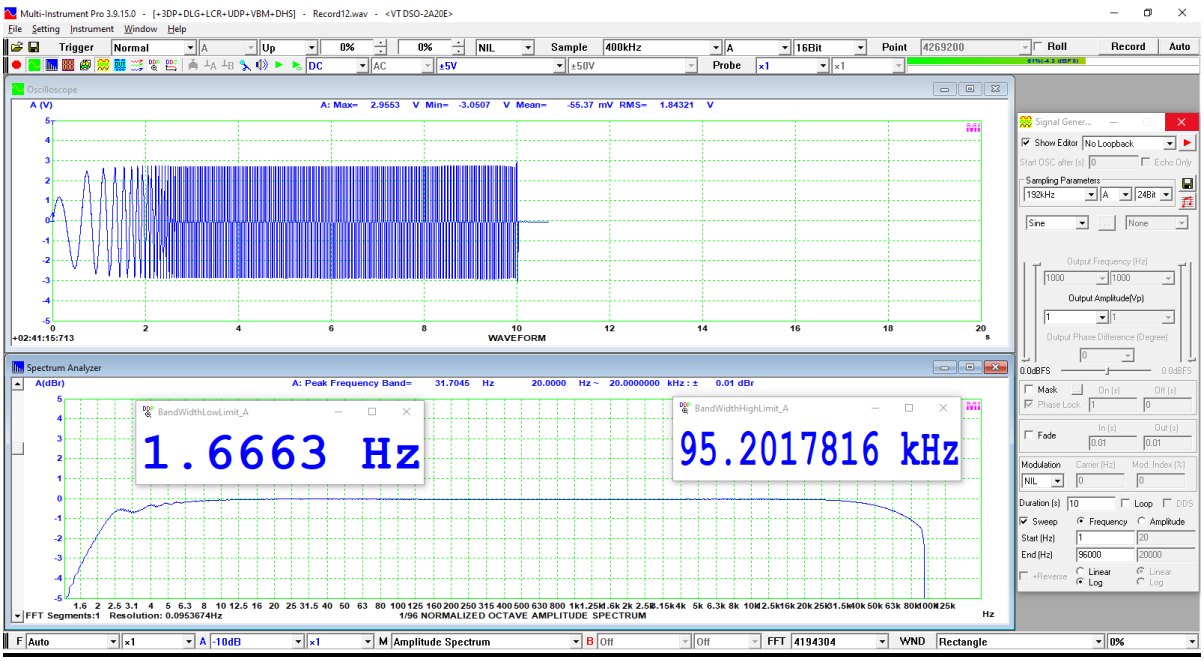
THD, THD+N, SNR, SNAD, ENOB of XLR Input @ 1kHz, 1Vp



SMPTE IMD of XLR Input @ 1Vp



Typical Magnitude Frequency Response of Balanced Line Output @ Sampling Rate 192kHz



Typical Magnitude Frequency Response of Stereo Headphone Output @ Sampling Rate 192kHz

2.4 Multi-Instrument Software Specifications

A complete Multi-Instrument software package consists of basic and add-on modules with all features in each of them. The basic modules include Oscilloscope, Spectrum Analyzer, Signal Generator, Multimeter, Derived Data Point Viewer, Derived Data Curve, and General Functions. The add-on modules include Spectrum 3D Plot, Data Logger, LCR Meter, Device Test Plan, Vibrometer, and Dedicated Hardware Support.

There are six license levels to access the basic modules: Sound Card Oscilloscope, Sound Card Spectrum Analyzer, Sound Card Signal Generator, Multi-Instrument Lite, Multi-Instrument Standard, and Multi-Instrument Pro. The add-on modules need to be purchased separately. They can only run with Multi-Instrument Lite, Standard, or Pro, except that Vibrometer can only run with Multi-Instrument Standard or Pro. The following table shows the function allocation among different license levels. Please note that a license of Multi-Instrument Full Package contains Multi-Instrument Pro and all add-on modules.

*Legend: √ - Function available * - Function available in Multi-Instrument Full Package 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	√	√	√	√	√	√
	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	√	√	√	√	√	√

		Sound Card Oscilloscope	Sound Card Spectrum Analyzer	Sound Card Signal Generator	Multi-Instrument Lite	Multi-Instrument Standard	Multi-Instrument Pro
	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	√	√	√	√	√	√
	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					√	√

		Sound Card Oscilloscope	Sound Card Spectrum Analyzer	Sound Card Signal Generator	Multi-Instrument Lite	Multi-Instrument Standard	Multi-Instrument Pro
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 Measurement	Reverberation / Speech Intelligibility						√
	Discontinuity						√
	Step Response						√
	Echo						*
	Damping Ratio						*
Others	Max, Min, Mean, RMS, Skewness, Kurtosis	√	√	√ (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) (Original /Generalized)		√		√	√	√
	Coherence/Non-Coherence						√
	Transfer Function / Impedance Analyzer						√
	Impulse Response						√
Intra-Frame	Frequency Compensation		√		√	√	√
	Frequency Weighting		√		√	√	√
	Remove DC		√		√	√	√

		Sound Card Oscilloscope	Sound Card Spectrum Analyzer	Sound Card Signal Generator	Multi-Instrument Lite	Multi-Instrument Standard	Multi-Instrument Pro
	Smoothing via Moving Average (Linear/Octave)		√		√	√	√
Inter-Frame Processing	Peak Hold		√		√	√	√
	Linear Average		√		√	√	√
	Exponential Average		√		√	√	√
	Cross Correlation Average (Cross Power Spectrum Vector 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 Loudness Level						√
	Sound Sharpness						√
	Sound Articulation Index						√
	Noise Rating & Criterion						√
	Total Non-Coherent Distortion + Noise						√
	GedLee Metric						√
	Sound Intensity						*
FFT	FFT Size 128~32768		√		√	√	√
	FFT Size 65536~4194304						√
	Intra-Frame Average		√		√	√	√
	Window function		√		√	√	√
	Window Overlap		√		√	√	√
Others	Octave Analysis (1/1, 1/3, 1/6, 1/12, 1/24, 1/48, 1/96)		√		√	√	√
	Linear / Log Scale for X and Y		√		√	√	√
	Peak Marker / Label		√		√	√	√
Signal Generator							
Waveform	Sine			√	√	√	√
	Rectangle			√	√	√	√
	Triangle			√	√	√	√
	Saw Tooth			√	√	√	√
	White Noise			√	√	√	√

		Sound Card Oscilloscope	Sound Card Spectrum Analyzer	Sound Card Signal Generator	Multi-Instrument Lite	Multi-Instrument Standard	Multi-Instrument Pro
	Pink Noise			√	√	√	√
	MultiTones			√	√	√	√
	Arbitrary Waveform			√	√	√	√
	MLS			√	√	√	√
	DTMF			√	√	√	√
	Musical Scale			√	√	√	√
	Wave File					√	√
	Play Waveform in Oscilloscope	√	√	√	√	√	√
	Cyclic Play Waveform in Oscilloscope	√	√	√	√	√	√
Sweep	Frequency Sweep (Linear/Log)			√	√	√	√
	Amplitude Sweep (Linear/Log)			√	√	√	√
	Forward + Reverse Sweep			√	√	√	√
Burst (Mask)	Normal Phase			√	√	√	√
	Locked Phase			√	√	√	√
	Window-Shaped Burst			√	√	√	√
	On/Off Amplitude Ratio			√	√	√	√
Fade	Fade In			√	√	√	√
	Fade Out			√	√	√	√
Modulation	AM			√	√	√	√
	FM			√	√	√	√
	PM			√	√	√	√
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(Z)					√	√
	dB(C)					√	√
	Frequency Counter				√	√	√
	RPM					√	√
	Counter					√	√
	Duty Cycle					√	√
	Frequency/Voltage					√	√
	Cycle RMS					√	√
	Cycle Mean					√	√
	Pulse Width					√	√

		Sound Card Oscilloscope	Sound Card Spectrum Analyzer	Sound Card Signal Generator	Multi-Instrument Lite	Multi-Instrument Standard	Multi-Instrument Pro
	Jitter Statistics						√
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						√
	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 (Demodulated)						√
	X-Y Plot						√

		Sound Card Oscilloscope	Sound Card Spectrum Analyzer	Sound Card Signal Generator	Multi-Instrument Lite	Multi-Instrument Standard	Multi-Instrument Pro
	Shock Response Spectrum						√
	Frequency Time Curve (Timed)						√
	RPM Time Curve						√
	Spectrum Analysis on Selection						√

Legend: Blank - Function available if purchased Shaded Blank - Function NOT available in 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)						
	Spectrogram Smoothing						
Data Logger							
Real Time Logging							
Load Historical Log File							
Three logging methods (Fastest, Time Interval, Update Threshold)							
270 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)							

	Sound Card Oscilloscope	Sound Card Spectrum Analyzer	Sound Card Signal Generator	Multi-Instrument Lite	Multi-Instrument	Multi-Instrument Pro
Device Test Plan						
30 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						

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, and Dedicated Hardware Support.

The license contained in the standard VT USA-268 package is a hardkey activated Multi-Instrument Pro license, without any add-on modules/functions. No softkey (activation code) is provided. The software will run under the licensed mode as long as the USB hardkey (dongle) is connected to your computer before you launch the Multi-Instrument software.

Note: If the software is launched without the USB hardkey connected to the computer, it will enter into 21-day fully functional trial mode, unless the software is activated by a softkey (activation code), which is NOT included in the standard VT USA-268 package and should be purchased separately as a brand-new license if needed.

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 information inside the USB hardkey by selecting [Start]>[All Programs]>[Multi-Instrument]>[VIRTINS Hardware Upgrading Tool] on your Windows desktop.

3.3 Software Upgrade in the Same License Level

Software upgrade in the same license level (if the hardkey 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 check frequently with our website to see if a new version or build is available.

4 Warranty

Virtins Technology guarantees this product against defective materials and manufacutring 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 unauthorised 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.

5 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.

