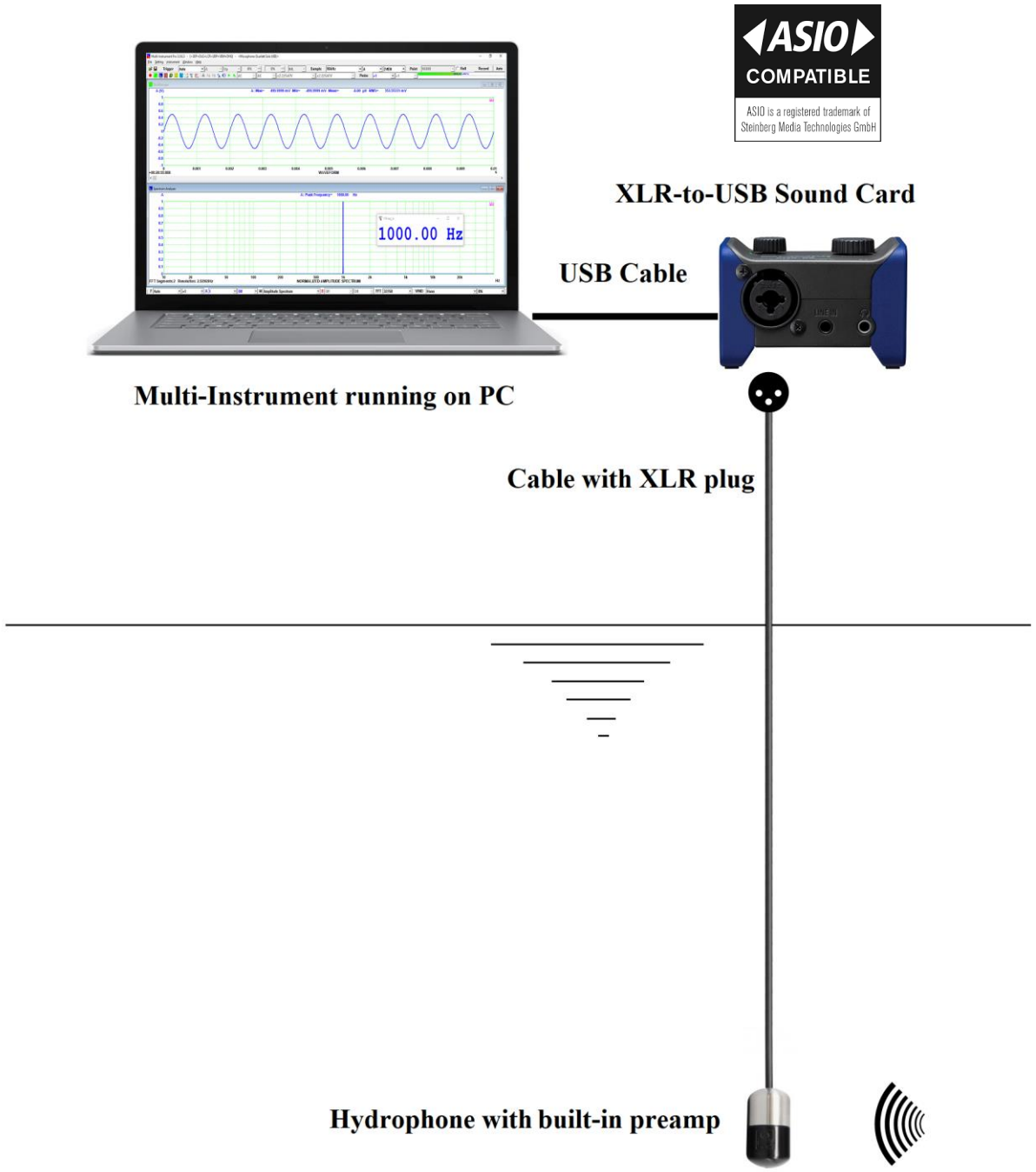
VT USA-168A/B/C Real Time Underwater Sound Analyzer Manual



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-168A, VT USA-168B and VT USA-168C are high-sensitivity low-noise real-time underwater sound analyzers in the human auditory range. They are equipped with high-sensitivity hydrophones with built-in preamps and XLR output connectors, which are compatible with common phantom powered XLR interfaces. The hydrophones can withstand a static water pressure up to 100m and drive a cable up to 250 m with negligible signal degradation.

The hydrophone of VT USA-168A is rugged and compact. Its small, streamlined shape and high specific gravity will help it to maintain a low working depth in mild wind and currents. Its compact size and flexible cable make it very portable and simple to use.

The hydrophone of VT USA-168B uses a unique high-sensitivity, dual-sensor, mechanically-balanced transducer assembly that offers exceptional signal-to-noise performance. Compared with the hydrophone of VT USA-168A, it has a smaller size and much lower specific gravity and thus can be inserted into pipes and other tight spaces, making it excellent for leak finding. Its low mass and full polyurethane rubber encapsulant make it highly resistant to damage caused by impact. To maintaining negative buoyancy underwater, it is assembled with a 150g sliding stainless steel weight on the cable. Though designed primarily for underwater listening and leak finding, it is also useful as a waterproof microphone for tool room applications, such as monitoring cutting in waterjet and other CNC tooling.

The hydrophone of VT USA-168C is very small and has a standard panel-mount design with a low-profile 3.5mm TRS output plug, making it very useful for integrated systems, such as autonomous recording units, autonomous or remote-operated vehicles, and dive camera enclosures. When fitted with the supplied weight and a long cable, it will be equally useful for typical deep-water and field recording applications. The compact and rugged sensor design is especially useful for leak finding and other industrial sensing operations. This hydrophone is designed to connect directly to a standard 3.5mm mic jack that supplies plug-in power (PIP). With the supplied PIP-to-XLR adapter, it can also be connected to a standard XLR mic jack that provides phantom power.

All the three underwater sound analyzers above have not been individually calibrated. Only the nominal values are provided. Their use in absolute sound level measurement is thus not recommended (Please check our other products such as the underwater sound analyzer consisting of a digital charge amplifier VT CAMP-2G05/A/B and a hydrophone HDP-AS1 instead).

There are two versions of hardware in this series: those purchased before June 1, 2024 are V1 and those purchased after that are V2. This manual is for V2 only. For V1, please refer to the software's installation directory/HardwareManuals/ VT-USA-168-Manual-V1.pdf or https://www.virtins.com/documents/VT-USA-168-Manual-V1.pdf

1.1 Package Contents

A standard VT USA-168A/B/C Package contains the following items:

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

(USA-168A)
(default cable length: 9 m)

or

(USA-168B)
(default cable length: 6 m)

or

(USA-168C)
(default cable length: 6m)
(with PIP-to-XLR adapter & Weight)

2) XLR-to-USB Sound Card

3) USB 2.0 Cable (1.5m)

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

1.2 Hardware Connection

Connect the hydrophone to the MIC/GUITAR jack of the XLR-to-USB sound card.

Then connect the XLR-to-USB sound card to the PC's USB port using the supplied USB cable.

The red POWER LED should light up indicating that it is receiving power. Then switch on the 48V phantom power to supply power to the built-in preamp of the hydrophone.

The LOOPBACK switch allows the signal output from the computer to mix with the input signal and then return to the computer. It should be kept OFF for ordinary use.

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.

1.3 Hardware Driver Installation

The device driver installer USA168_DriverInstallerV2.exe (for hardware version V2 purchased after June 1, 2024) is located in the Drivers\VTUSA168 directory on 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\VTUSA168. 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.

If you are using hardware version V1 (purchased before June 1, 2024), run USA168_DriverInstaller.exe instead.

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.

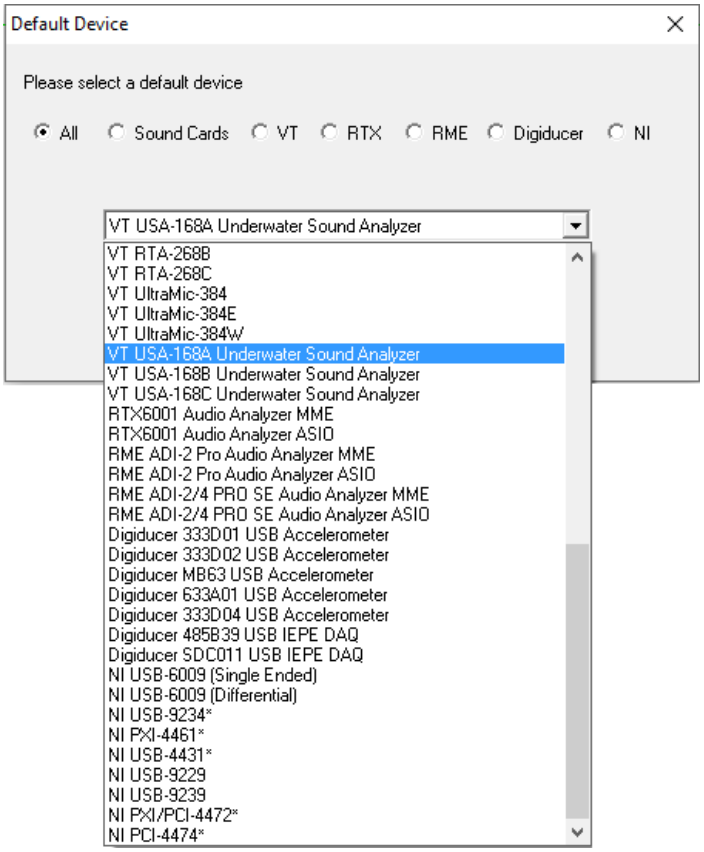
1.4.1 Install Multi-Instrument

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-168A, VT USA-168B, or VT USA-168C according to the hardware device to be used.



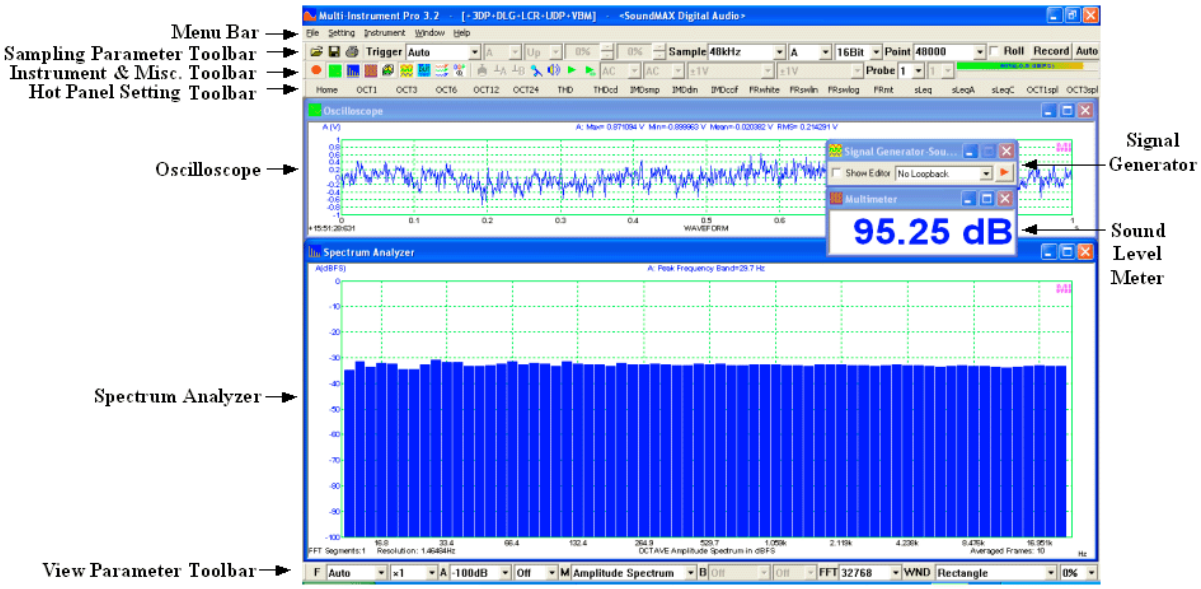
The default device can also be changed later via [Setting]>[ADC Device], [Setting]>[DAC Device], and [Setting]>[Configure Hot Panel Setting Toolbar], or simply [Setting]>[Restore to Factory Default]. **However, if [Restore to Factory Default] command is executed, all calibration data entered manually 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**.

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

For VT USA-168A and VT USA-168B, the software will also prompt the user to select between hardware Versions V1 and V2.

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

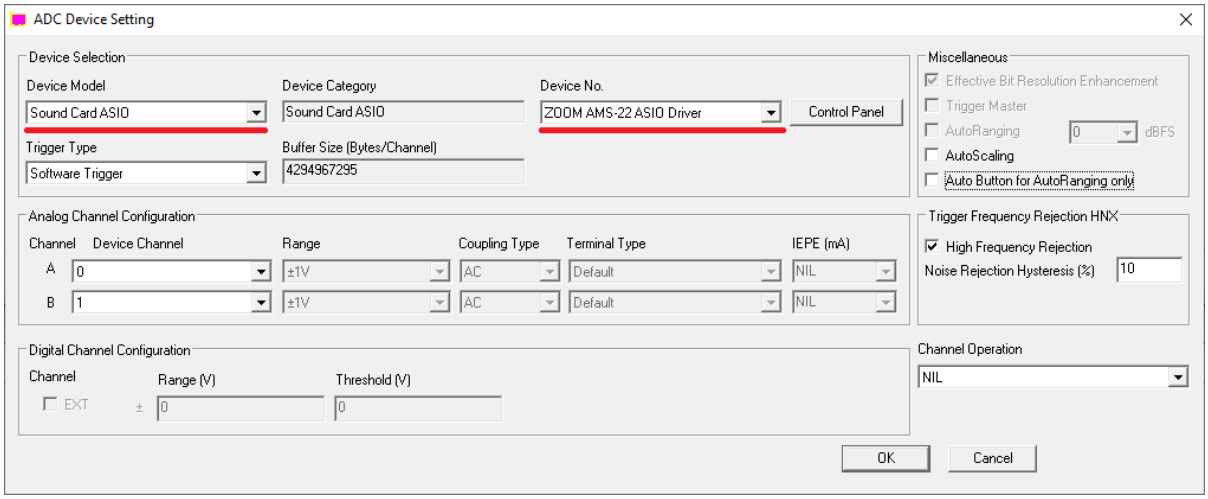
In Multi-Instrument, the menu items are enabled / disabled based on context. Many menu items are disabled when the Oscilloscope or the Signal Generator is running. To do the configuration, stop the oscilloscope first by pressing the green button at the upper left corner of the screen (see figure below).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

1.4.3.1 Configure Sound Recording Devices for Multi-Instrument

The XLR-to-USB sound card 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

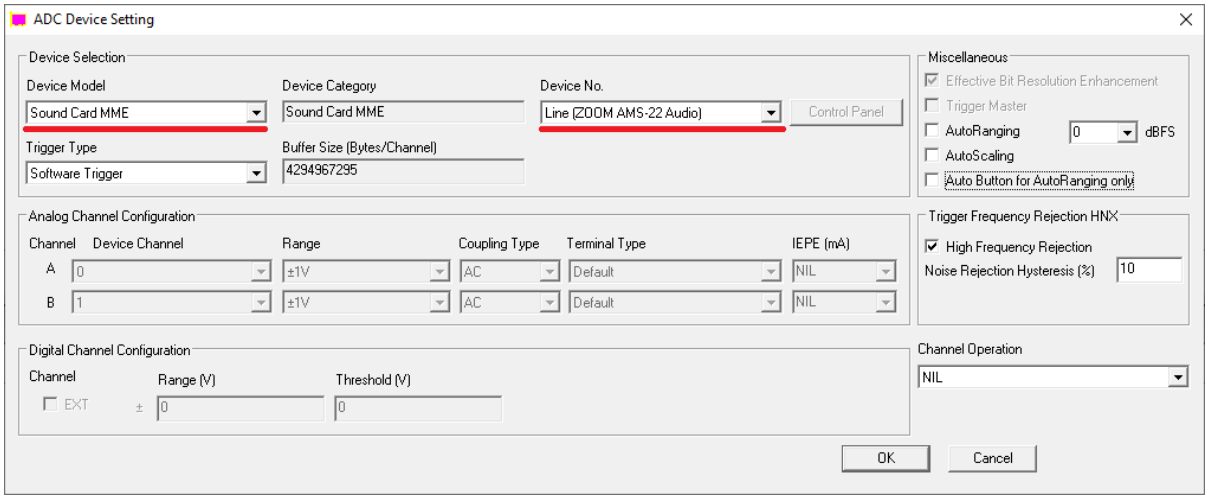
Go to [Setting]>[ADC Device], and select “Sound Card ASIO” in the “Device Model” field. Then choose “Zoom AMS-22 ASIO Driver” (for V2) or “Zoom U-22 ASIO Driver” (for V1) in the “Device No.” field (see figure below). This is to configure the XLR-to-USB sound card as the sound recording device for the software.



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 AMS-22 Audio)" (for V2) or "Line (ZOOM U-22 Audio)" (for V1) in the "Device No." field (see figure below). This is to configure the XLR-to-USB sound card as the sound recording device for the software.

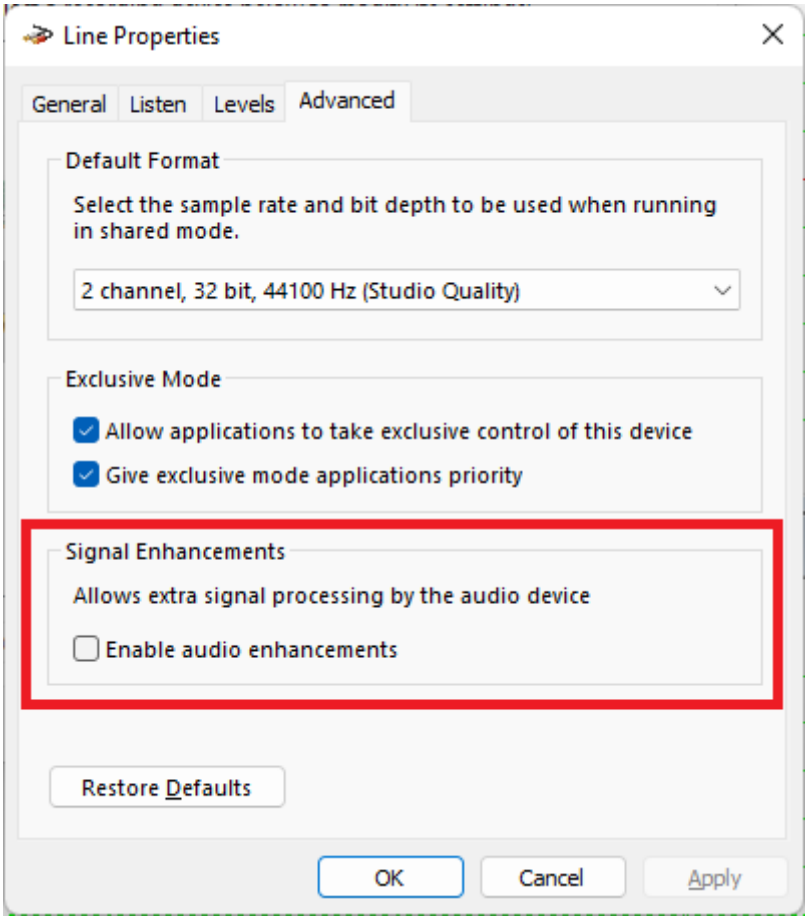


Note that the displayed name of the sound card may vary a bit under different Windows versions or with different USB ports.

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.

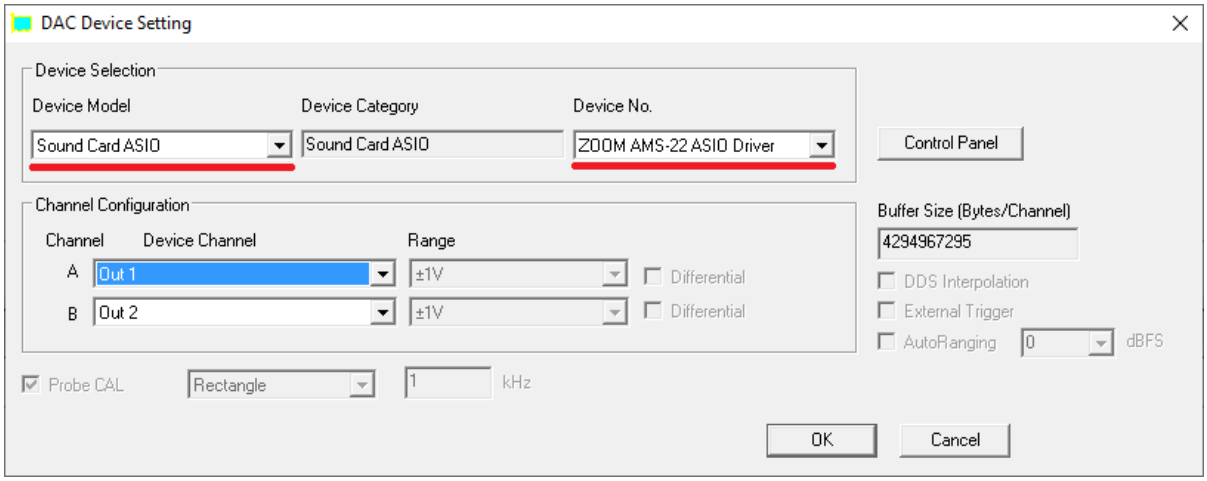
Some Windows versions / editions come with some audio signal enhancement features which are enabled by default. These features must be disabled through the Sound Recording Control under Windows Control Panel to prevent them from altering the originally sampled data, as

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. It should also be noted that when MME driver is used, the actual sampling rate is determined by the sampling rate configured in the Sound Recording Control Panel (see figure below). If the sampling rate selected in Multi-Instrument differs from the actual one, then sampling rate conversion will be performed automatically by Windows and this will alter the original data unwantedly.

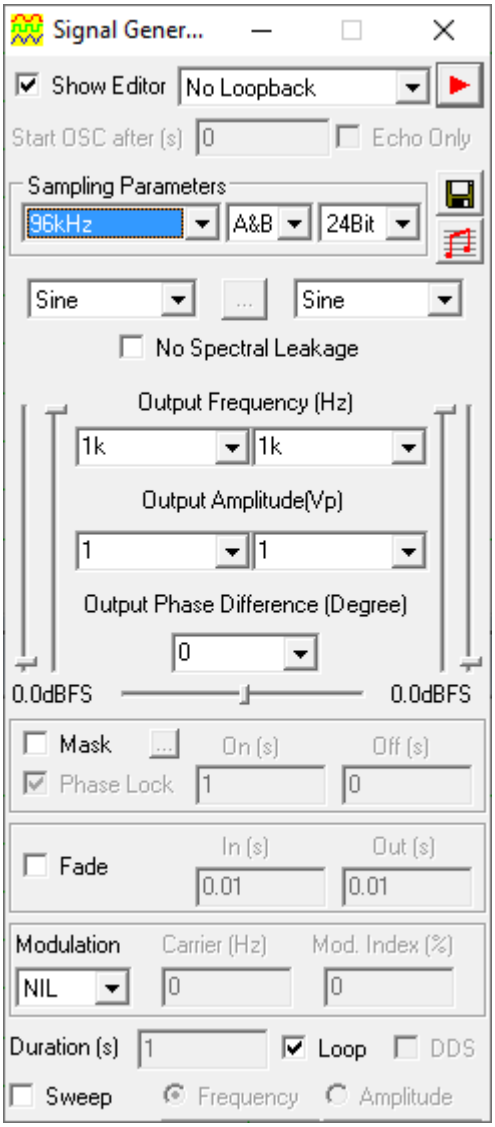


1.4.3.2 Configure Sound Playback Devices for Multi-Instrument

The Signal Generator of Multi-Instrument can be used for sound playback and generation. You can use it to playback a recorded underwater sound, or generate an underwater test sound if you have an underwater sound emitter attached. To configure the sound card for the Signal Generator, go to [Setting]>[DAC Device]. Either “Sound Card MME” or “Sound Card ASIO” can be chosen in the “Device Model” field. Choose the corresponding sound card’s name in the “Device No.” field. By default, the XLR-to-USB sound card with its ASIO driver is selected for signal output.



Now, if you press the Signal Generator button, the Signal Generator panel will be opened. 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 selected playback sound card. Press it again to stop the sound.



1.5 Input of Sound Level Calibration Data and Adjustment of Input Gain

Both the hydrophone and XLR-to-USB sound card are not calibrated individually. The combined setup is not calibrated individually either. **Therefore VT USA-168A, VT USA-168B and VT USA-168C are not recommended for absolute underwater sound level measurement (please check our other products instead).** However, Multi-Instrument will still show the measured underwater sound level based on the nominal sensitivity of the hydrophone and the gain of the XLR-to-USB sound card. Please consider the value as indicative only.

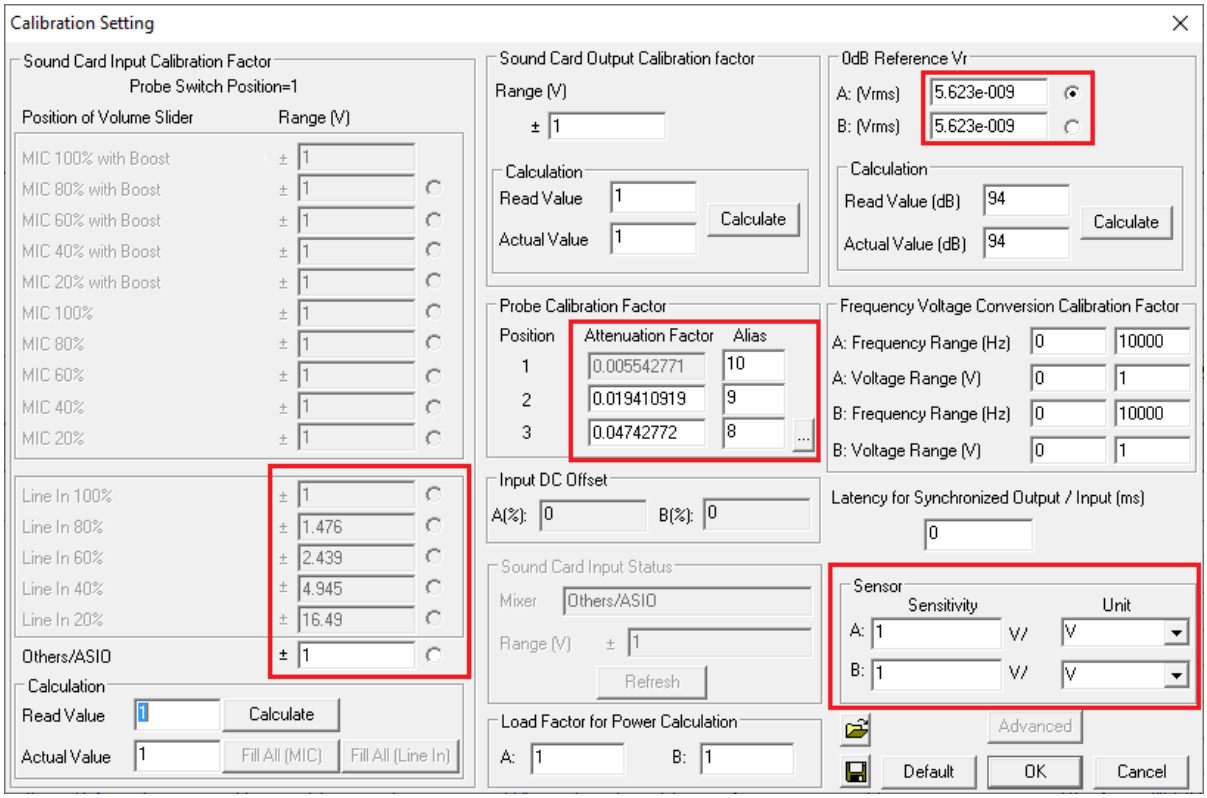
Sound level calibration data can be entered / viewed via [Setting]>[Calibration] in Multi-Instrument (see highlighted fields in the figure below). Note that different calibration data may be required for different Windows versions.

You can adjust the sound level measurement range by turning the gain knob of the XLR-to-USB sound card.

1.5.1 Under Windows 10/11

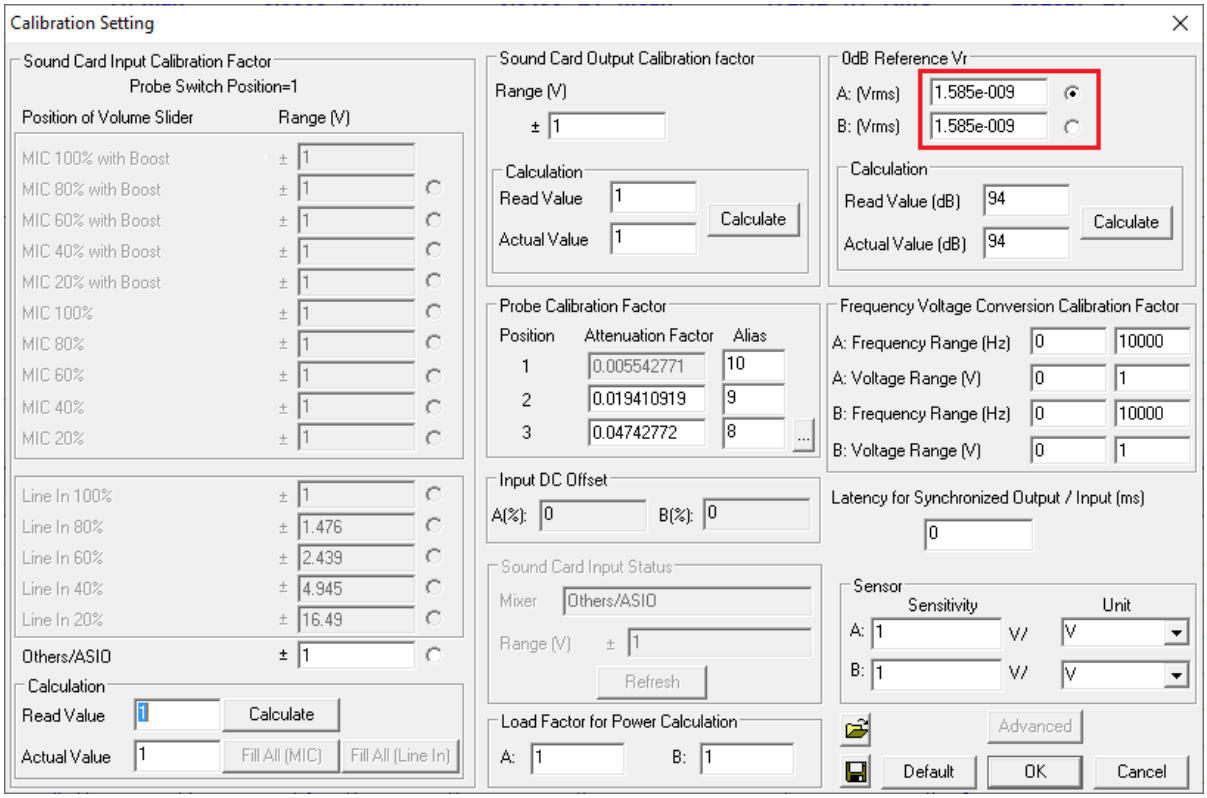
Input of the Sound Level Calibration Data

The following calibration data will be filled automatically after VT USA-168A is selected as the default device when the software is launched for the very first time or via [Setting] > [Restore to Factory Default].



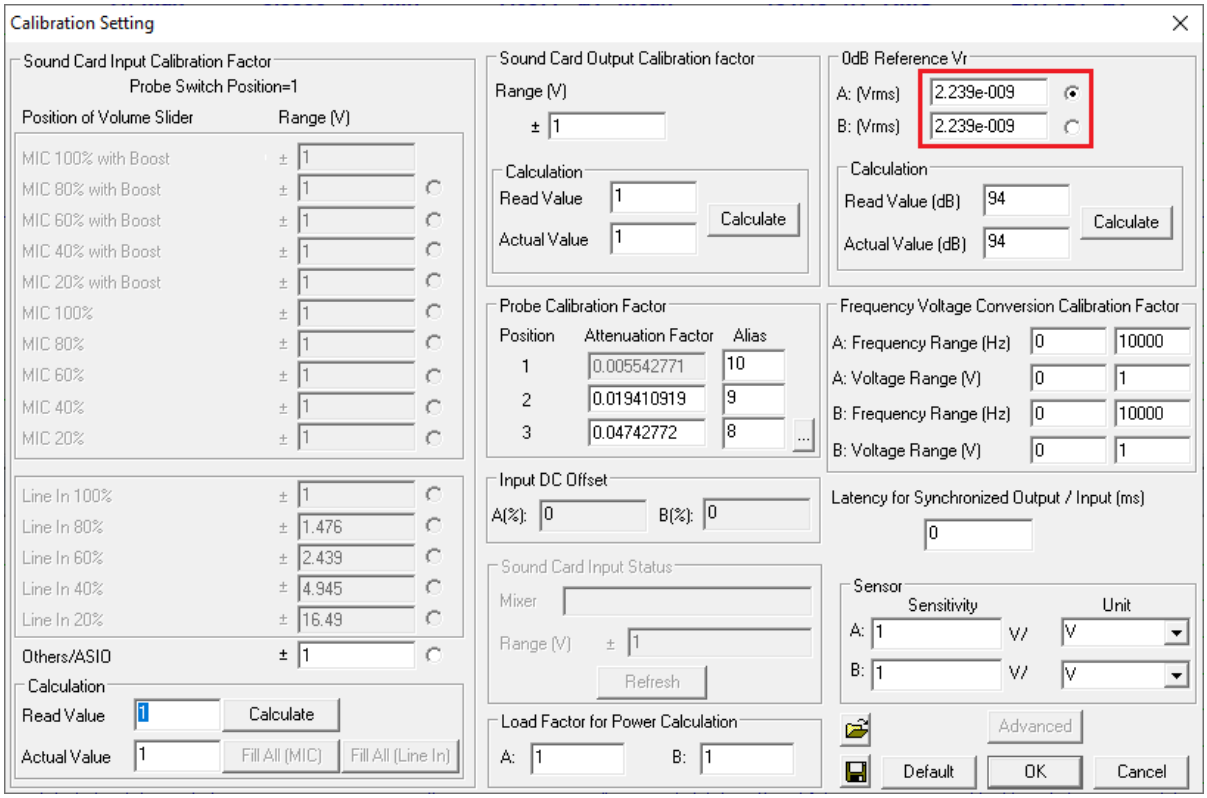
VT USA-168A

The following figure shows the calibration data for VT USA-168B. The difference is only at 0dB reference Vr.



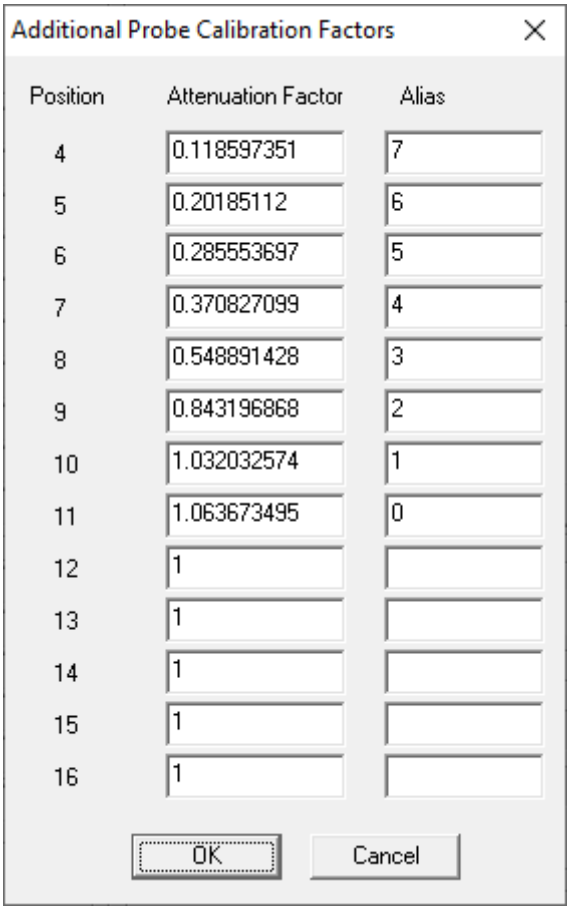
VT USA-168B

The following figure shows the calibration data for VT USA-168C. Again, the difference is only at 0dB reference Vr.



VT USA-168C

Clicking the button "…" in the above figures will show additional calibration data for the gain knob.

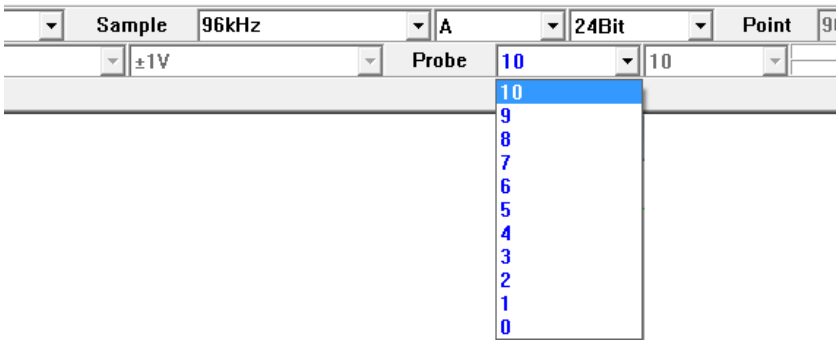


Adjustment of Input Digital Gain

Only when MME driver is used can the input digital gain be adjusted by clicking the respective radio buttons beside the "Line In 100%", "Line In 80%", "Line In 60%", "Line In 40%" and "Line In 20%" in the above figures. It should be generally kept at "Line In 100%". These input digital gain settings have no impact when ASIO driver is used.

1.5.2 Adjustment of Input Gain via Hardware Gain Knob

You can adjust the input gain by turning the gain knob on the XLR-to-USB sound card (see figure above). To account for this gain adjustment, you will have to update the "Probe" switch position (see figure below) accordingly in Multi-Instrument's toolbar.



If the "SIG" LED lights up red, reduce the gain.

1.5.3 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 his 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.

VT USA-168A
Method 1: [0dB Reference Vr] = 5.623e-009 (V) and [Sensor Sensitivity] = 1 V/V
Method 2: [0dB Reference Vr] = 1e-006 (Pa) and [Sensor Sensitivity] = 0.005623 V/Pa

VT USA-168B
Method 1: [0dB Reference Vr] = 1.585e-009 (V) and [Sensor Sensitivity] = 1 V/V
Method 2: [0dB Reference Vr] = 1e-006 (Pa) and [Sensor Sensitivity] = 0.001585 V/Pa

VT USA-168C
Method 1: [0dB Reference Vr] = 2.239e-009 (V) and [Sensor Sensitivity] = 1 V/V
Method 2: [0dB Reference Vr] = 1e-006 (Pa) and [Sensor Sensitivity] = 0.002239 V/Pa

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

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

For example, the nominal sensitivity of the hydrophone in VT USA-168A is -165dB, i.e. 0.005623 V/Pa. The nominal sensitivity of the hydrophone in VT USA-168B is -176dB, i.e. 0.001585 V/Pa. The nominal sensitivity of the hydrophone in VT USA-168C is -173dB, i.e. 0.002239 V/Pa.

1.6 Most Frequently Used Measurement Settings

Multi-Instrument bundled with VT USA-168A/B/C 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 sound card 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-168B

To maintaining negative buoyancy underwater, the hydrophone VT USA-168B 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 hydrophone and weight!**

1.10 Using VT USA-168A as a Contact Mic Analyzer in Air

A contact mic adapter (see picture below) can be purchased separately to convert the VT USA-168A into a contact mic analyzer in air. The adapter is made from the same acoustically-transparent rubber used to encapsulate the transducer assembly of the hydrophone. The inside is molded to the same size as the hydrophone. Simply place the hydrophone inside, bed with water for maximum efficiency, and set the flat surface of the cup on the media to which you want to listen. This will create a very sensitive contact microphone, outperforming most contact mics at very low frequencies. It can be used for sound effects, leak detection, surveillance, terrestrial studies, sporting events, or general phonography.

1.11 Connecting VT USA-168A/B Hydrophones to 3.5mm TRS Mic Input of Other Audio Devices

It is possible to connect the hydrophones of VT USA-168A/B to the 3.5mm TRS mic input of other audio devices using a XLR-to-PIP adapter shown below. The adapter needs to be purchased separately. It will allow you to use the hydrophone with any preamp designed to work with electret-condenser microphones (i.e. with plug-in-power). The 3.5mm TRS plug is wired for dual-mono output, which will drive both left and right stereo channels and is also compatible with mono computer sound cards.

1.12 Modular Design and Assembly of VT USA-168C Hydrophone

1.12.1 Modules

The hydrophone of VT USA-168C features a modular design, consisting of the following items:

(1) Hydrophone with a 6m (default length) integrated cable terminated with a 3.5mm TRS plug.

The 3.5mm TRS plug can be connected directly to a standard 3.5mm mic jack that supplies plug-in power (PIP) (2.4V, min. 400μA). It is wired dual mono: tip and ring (output), sleeve (ground). The outside diameter is 5.5mm.

(2) PIP-to-XLR adapter

With the help of this adapter, the hydrophone can be connected to a standard XLR mic jack that provides phantom power (48V, max. 10mA).

(3) 115g Stainless steel weight for free-hanging applications

(4) Nylon M10×1.5 nut and o-ring for panel-mount applications

1.12.2 Weight installation

Push the TRS plug of the hydrophone through the weight. Slide it down the length of the cable and thread it onto the hydrophone. You will feel some resistance as the rubber end of the weight stretches over the plug and cable. When tightening the weight onto the hydrophone, hold the hydrophone by the aluminum shell. Applying excessive force to the rubber encapsulation may damage the hydrophone. Tighten firmly by hand. No tools are required.

The TRS plug has a slightly larger diameter than the cable. The top of the weight is made from a flexible rubber that will stretch over the plug while the hard black plastic requires a channel that is large enough for the plug. This leaves a small air void inside of the weight after assembly. This should not cause a problem in any common application of the hydrophone. However, if the hydrophone is to be used at higher static pressures, or you are getting any noise from escaping air bubbles when deployed, you can flood the inside of the weight with water. While keeping the output plug dry, thread the weight onto the hydrophone while underwater, with the rubber end of the weight facing downward (see picture below).

1.12.3 Connection of PIP-to-XLR Adapter

Simply push the hydrophone TRS plug into the adapter until you feel it click into place, then tighten the boot to secure the installation.

The boot compresses a plastic chuck that holds the hydrophone TRS plug in place. When open, you will see a gap of approximately 3mm between the boot and shell of the XLR connector. Hold the hydrophone cable approximately 1 cm behind the crimp ferrule on the TRS plug.

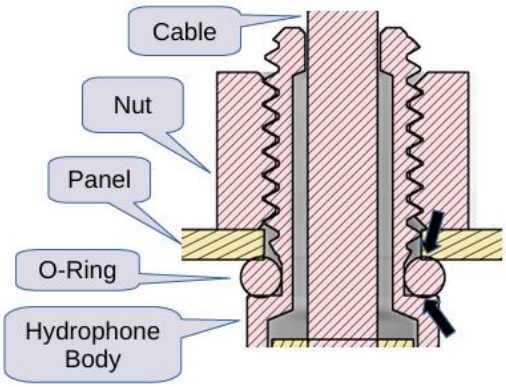
When the hydrophone's TRS plug is fully inserted into its mating connector, your fingers should be nearly touching the boot. To paraphrase, the back of the TRS plug should be approximately 1 cm inside of the boot when the adapter is in the open position.

Tighten the chuck by turning the boot clockwise until snug. Hand tighten only. Note that there should be no gap between boot and XLR connector shell when tight. Test by gently pulling on the hydrophone cable.

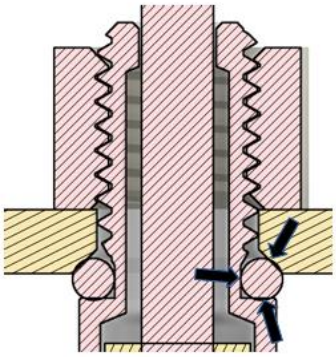
Use the reverse procedure to remove adapter.

1.12.4 Panel Mounting Instructions

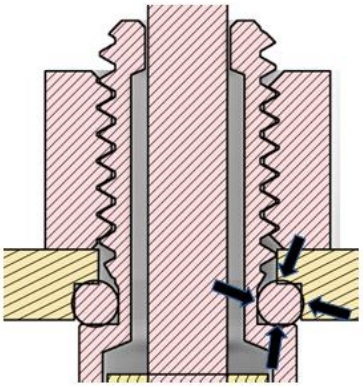
The VT USA-168C hydrophone comes with a size 109 (3/32" (2.6mm)) 70d Buna o-ring and an Essentra 04M100150HN nylon nut for panel mounting. The recommended dimensions for chamfer and counterbore are shown below.



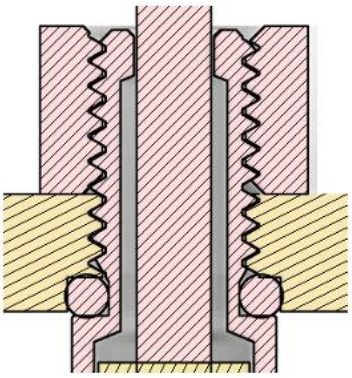
Straight 10mm hole through panel. Clamping force provides two points of contact for sealing (see arrows above). Positive pressure outside panel retains o-ring. Friction accommodates any common negative pressure. Sufficient for nearly all applications.



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 the 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.

2 Specifications

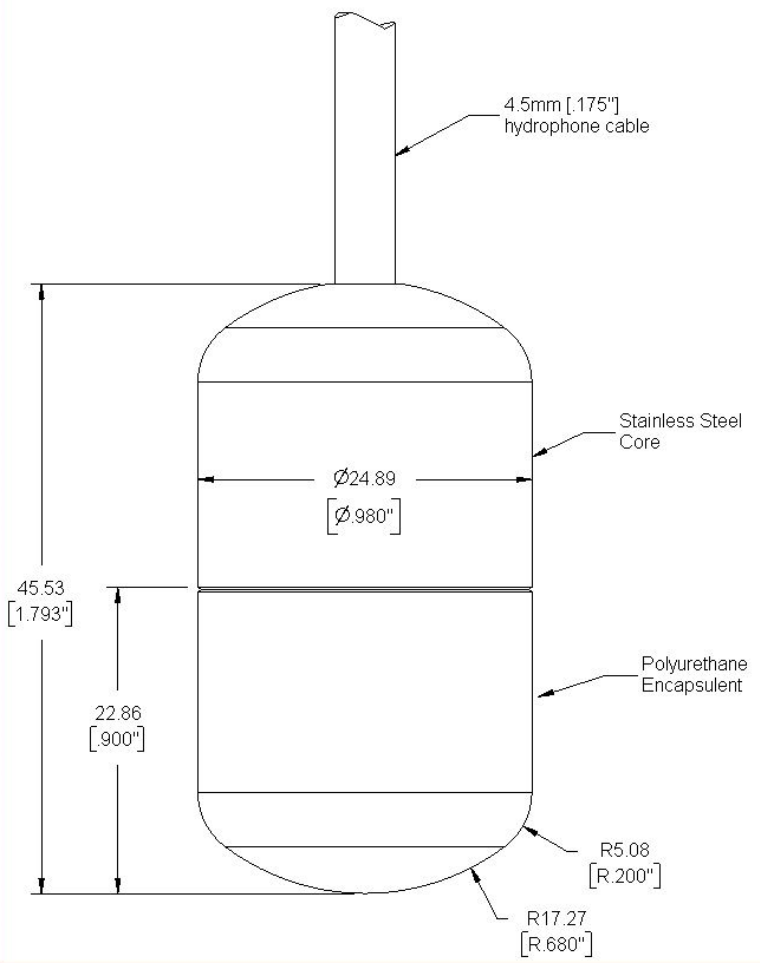
2.1 VT USA-168A/B/C Overall Hardware Specifications

	USA-168A	USA-168B	USA-168C
Frequency Range	20Hz ~ 4kHz (± 4dB)	20Hz~10kHz (± 5dB)	20Hz~10kHz (± 4dB)
Sound Level Measurement Range	47dB~165dB (typical)	58dB~176dB (typical)	55dB~173dB (typical)
Useful Frequency Range	(<10Hz) ~ (>100kHz) (Sensitivity drops about 45dB @100kHz)	(<10Hz) ~ (>100kHz) (Sensitivity drops about 44dB @100kHz)	(<10Hz) ~ (>100kHz) (Sensitivity drops about 44dB @100kHz)
Operating Depth	< 80m	< 80m	< 100m
Sampling Rate	44.1kHz, 48kHz, 88.2kHz, 96kHz		
Bit Depth	24 bit		
Number of Input Channel	1		
Direct Monitoring without Passing Through Computer	Supported		
Frequency Accuracy	0.01%		
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. 1W		
System Requirements	Windows 10/11, 32 bit or 64 bit. Minimum Screen Resolution: 1024 × 600		
Calibration	Not calibrated individually. Nominal value is used instead. Not recommended for absolute sound level measurement.		

2.2 Hydrophone Specifications

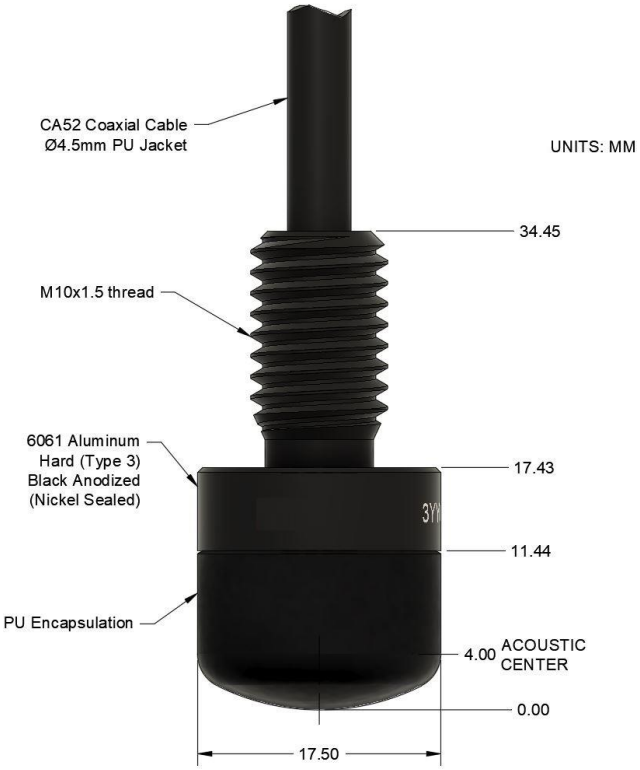
	USA-168A	USA-168B	USA-168C
Transducer Type	Plate bender	Dual plate benders, mechanically balanced	Dual plate benders, mechanically balanced
Frequency Range	20Hz ~ 4kHz (± 4dB)	20Hz ~ 10kHz (± 5dB)	20Hz ~ 10kHz (± 4dB)

Sensitivity	-165dB re: 1 V/μPa (Typical)	-176dB re: 1 V/μPa (Typical)	-173dB re: 1 V/μPa (Typical)
Useful Frequency Range	(<10Hz) ~ (>100kHz) (Sensitivity drops about 45dB @100kHz)	(<10Hz) ~ (>100kHz) (Sensitivity drops about 44dB @100kHz)	(<10Hz) ~ (>100kHz) (Sensitivity drops about 44dB @100kHz)
Size	ϕ25mm × 46mm	ϕ17mm × 32mm	ϕ18mm × 35mm
Weight	105g	10g	15g
Specific Gravity	5.3	1.3	5.7
Added Weight	Not required	150g	115g
With Built-In Preamp	Yes		
Polar Response	Omnidirectional (horizontal)		
Connector	XLR (pin 1: ground, pin 2: hot, pin 3: unused, impedance balanced output)		
Power Supply	48V Phantom		
Power Consumption	1.2 mA (Typical)		

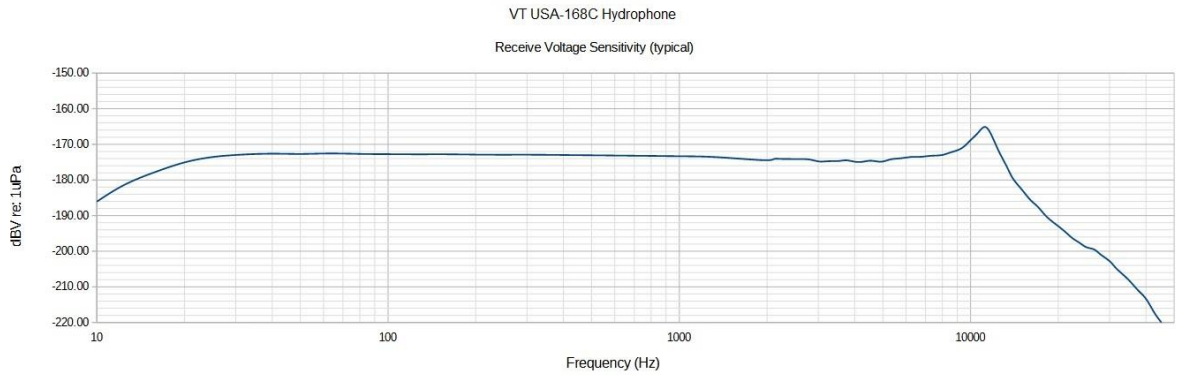


USA-168A Hydrophone

USA-168B Hydrophone



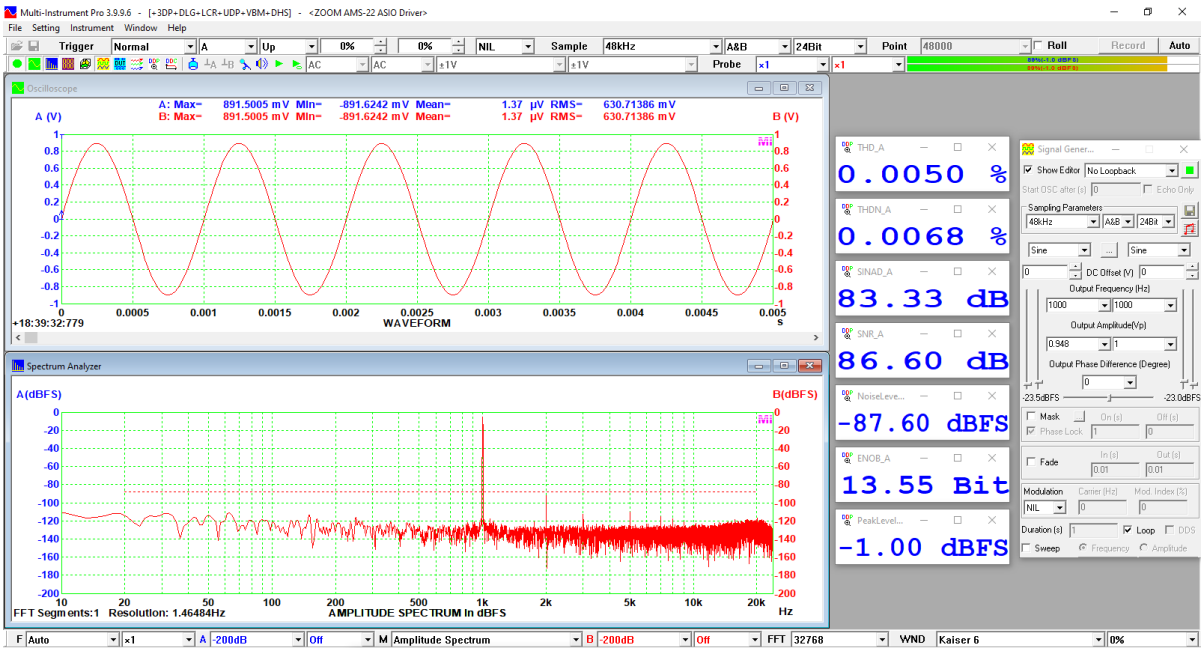
USA-168C Hydrophone



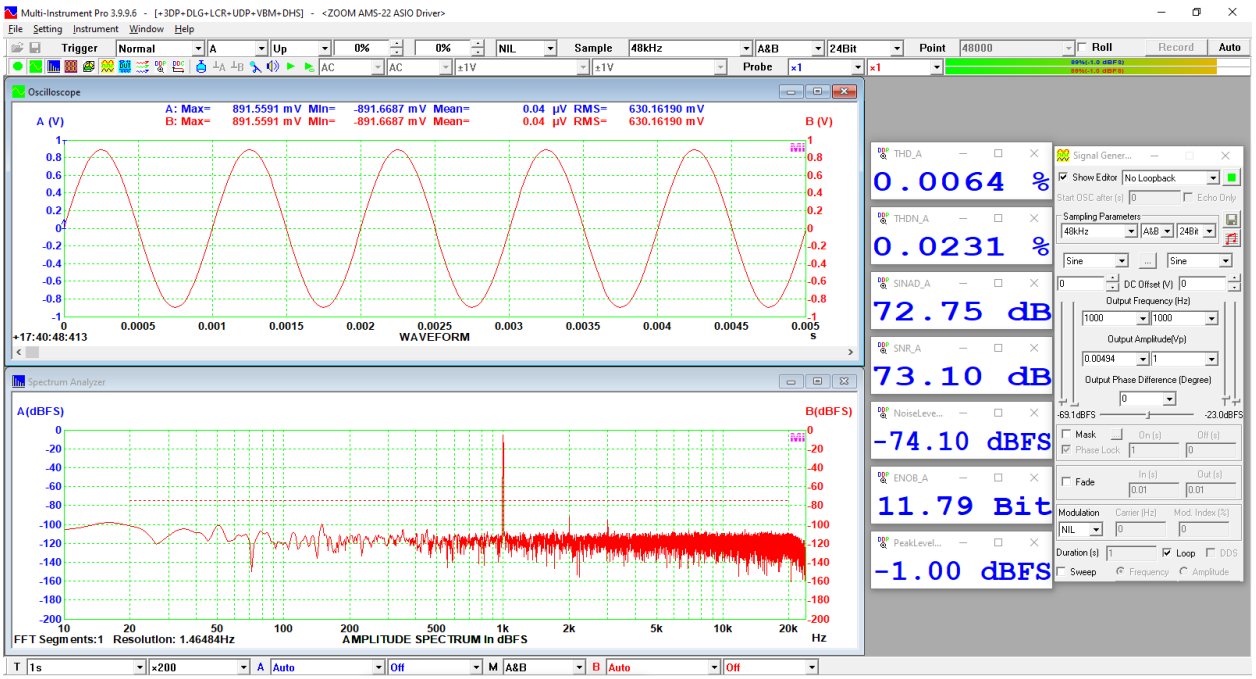
Typical Frequency Response of USA-168C Hydrophone

2.3 XLR-to-USB Sound Card

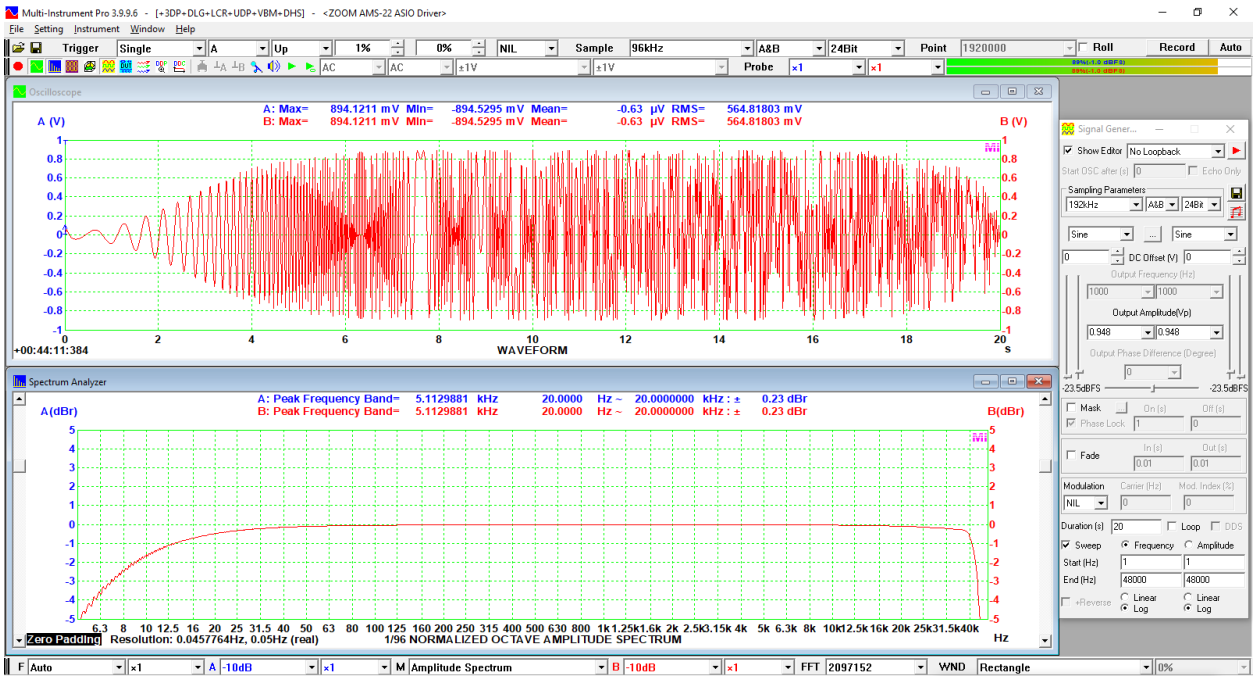
MIC/GUITAR	
Connector	XLR/TS combo jack
Full-Scale Input Voltage Range	Mic: ±0.006V ~ ±1.1V; Hi-Z: ±0.035V ~ ±3.9V Adjustable through the GAIN knob
Input Impedance	Mic: 1.8kΩ (unbalanced), 3.6kΩ (balanced) Hi-Z: 1MΩ
Analog Line In	
Connector	ϕ3.5mm stereo jack
Full-Scale Input Voltage Range	±1.3V
Input Impedance	20kΩ
Analog Output L/R	
Connector	TRS (impedance balanced output)
Full-Scale Output Voltage Range	±0.87V, adjustable through the OUTPUT knob
Output Impedance	100Ω
Phones	
Connector	ϕ3.5mm stereo jack
Full-Scale Output Voltage Range	±1.6V, adjustable through the OUTPUT knob
Output Impedance	10Ω
Other Specifications	
Frequency Response	10Hz~40kHz, ±2dB
Size	68.0 mm (L) × 57.7 mm (W) × 46.0 mm (H)
Weight	85g



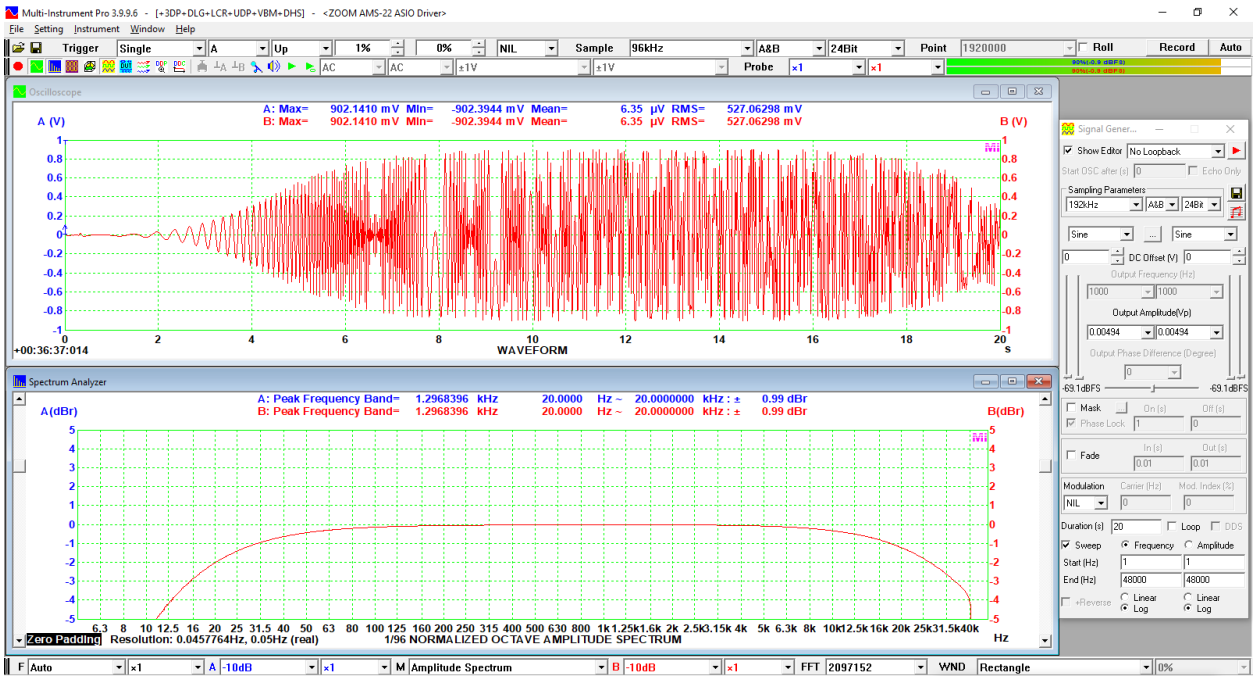
Typical THD, THD+N, SNR with Gain Knob at 0



Typical THD, THD+N, SNR with Gain Knob at 10



Typical Frequency Response with Gain Knob at 0 (Sampling Rate = 96kHz)



Typical Frequency Response with Gain Knob at 10 (Sampling Rate = 96kHz)

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					√	√

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

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

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

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

		Sound Card Oscilloscope	Sound Card Spectrum Analyzer	Sound Card Signal Generator	Multi-Instrument Lite	Multi-Instrument Standard	Multi-Instrument Pro
	dB					√	√
	dB(A)					√	√
	dB(Z)					√	√
	dB(C)					√	√
	Frequency Counter				√	√	√
	RPM					√	√
	Counter					√	√
	Duty Cycle					√	√
	Frequency/Voltage					√	√
	Cycle RMS					√	√
	Cycle Mean					√	√
	Pulse Width					√	√
	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)						√

		Sound Card Oscilloscope	Sound Card Spectrum Analyzer	Sound Card Signal Generator	Multi-Instrument Lite	Multi-Instrument Standard	Multi-Instrument Pro
	Energy Time Curve (dBSPL)						√
	Impulse Response Schroeder Integration Curve						√
	Step Response Curve (via Impulse Response Integration)						√
	Frequency Time Curve (Demodulated)						√
	X-Y Plot						√
	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)							
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							

	Sound Card Oscilloscope	Sound Card Spectrum Analyzer	Sound Card Signal Generator	Multi-Instrument Lite	Multi-Instrument	Multi-Instrument Pro
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-168 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-168 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

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