

VIRTINS® Sound Card Oscilloscope Probe (P601) Manual



This product is designed to be used by those who have some basic electronics and electrical knowledge. It is absolutely dangerous to connect an unknown external voltage to your PC's or Pocket PC's sound card. Be sure that the voltage to be measured is less than the maximum allowable input voltage.

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 Introduction

VIRTINS Sound Card Oscilloscope Probe (Model No. P601) is the world's first sound card based oscilloscope probe. It has an ordinary oscilloscope tip and ground lead at its front end, and a RCA plug (male) at its back end. It can be connected directly to a sound card with RCA input jacks (female), or connected to an ordinary sound card via a stereo-to-2RCA converter or a mono-to-1RCA converter. P601 has a 3-position switch which allows you to choose different attenuation settings. It has an input protection circuit which prevents the sound card and the computer from being damaged by accidental high input voltage within ± 24 V. With this probe, the measurement range of a sound card oscilloscope is broaden to from as low as $1 \mu\text{V}$ to up to 24 V.

P601 can also be used as the output leads for Sound Card Signal Generator. To reduce the output impedance, it is recommended to put the attenuation switch to Position 1.

There are two kits available at Virtins Technology.

1.1 Probe kit for VIRTINS Multi-Instrument series (1 channel, part number P601PC)

It contains: 1 Probe, 1 Stereo-to-2RCA converter, 1 Mono-to-1RCA converter and accessories.



Fig. 1 P601PC

You may need from 1~4 sets of this probe kit per license of the software, depending on your purpose of test. We recommend the standard configuration be 2 sets per license.

1.2 Probe kit for VIRTINS Pocket Multi-Instrument series (1 channel, part number P601PPC)

It contains: 1 Probe, 1 HeadsetJack-to-3RCA converter and accessories.



Fig. 2 P601PPC

You may need 1 set of this probe kit and 1~2 sets of the probe kit for VIRTINS Multi-Instrument series. We recommend the standard configuration be 1 set of this probe kit (P601PPC) and 1 set of the probe kit for VIRTINS Multi-Instrument series (P601PC).

2 Specification

- Maximum Allowable Input Voltage: **± 24 V**
- Built-in input protection circuit ensures its output to be less than 3V at all time, provided the input voltage is within the allowable range
- Three switchable attenuation positions: 1, 2, 3, with input impedance equal to $1\text{ k}\Omega + \text{sound card input impedance}$, $201\text{ k}\Omega + \text{sound card input impedance}$, $10.001\text{ M}\Omega + \text{sound card input impedance}$ respectively. Note that the sound card input impedance, either MIC IN or Line In, is card dependent and ranges from $600\ \Omega$ to $50\text{ k}\Omega$.
- Frequency range: 0~200 kHz
- Soft molded strain reliefs at all stress points assure long cable life.
- Accessories include sprung hook, 6" ground lead.

- Its back end is a RCA plug (male) and can be connected to an ordinary sound card through a stereo-to-2RCA converter or a mono-to-1RCA converter. No converter is required for those sound cards that have RCA jacks for input and output.
- Can be used in Signal Generator for signal output. The output impedance is about 1 k Ω , 201 k Ω and 10.001 M Ω for attenuation switch Positions 1, 2, 3, respectively.



3 Safety Instructions

- Always keep in mind that the input of the probe is NOT galvanically isolated from the sound card connected.
- Never connect to a signal with unknown amplitude.
- Never connect to a signal with voltage greater than 24V.
- If you are not very sure about the exact voltage under test, always start measurement by putting the attenuation switch to Position 3 which has the highest input impedance.
- Never plug in or plug out the probe from the sound card when the probe is already connected to powered external device.
- Be extremely careful when the voltage under test is greater than 5V.
- It should be noted that for many sound cards (typically the internal sound card of a desktop PC or a laptop PC with a built-in AC power supply adapter), the ground line of input and output is connected to mains earth. This is not a problem if the circuit under test is floating (i.e. isolated from earth). Otherwise, you MUST make sure that the ground lead of the probe is connected to a point on the circuit that is also at earth potential.

4 Equivalent Circuit

When the built-in input protection circuit of the probe is in inactive state, the probe impedance, Z_{probe} , and the sound card input impedance, Z_{sc} , form a voltage divider as follows:

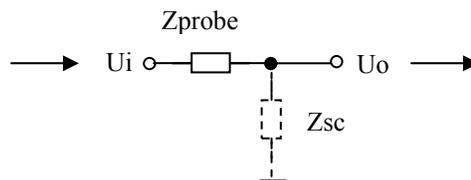


Fig. 3 Probe Equivalent Circuit

The ratio between the output voltage U_o and input voltage U_i is thus:

$$U_o/U_i=Z_{sc}/(Z_{probe}+Z_{sc})$$

where $Z_{probe} = 1 \text{ k}\Omega$, $201 \text{ k}\Omega$, $10.001 \text{ M}\Omega$ respectively for probe switch Positions 1, 2, 3, and Z_{sc} is in the range of $600 \text{ }\Omega \sim 50 \text{ k}\Omega$, depending on the sound card and channels (MIC In or Line In) used.

The built-in input protection circuit of the probe becomes active when the input voltage causes the output of the probe exceed 3V. When it is in active state, it clamps the voltage at 3V to ensure that no excess voltage is applied to the sound card. This protection works only if the input voltage is within the maximum allowable voltage.

When voltage clipping happens (you can see “flat top” or “flat bottom” if the input is a sine wave), you should put the probe switch to a position with higher attenuation factor until no voltage clipping occurs.

5 Detailed Calibration Procedure for VIRTINS Multi-Instrument

There are many ways to calibrate VIRTINS Multi-Instrument. The simplest ways is to use a multimeter. The following procedure assumes that you have purchased two VIRTINS Sound Card Oscilloscope Probe (P601) and has an ordinary multimeter with you.

5.1 Main Step 1 --- Initial State Check:

Step 1:

Open **Recording Control** panel for the sound card to be calibrated under **Windows Control Panel** (see Fig. 4), and select “Microphone” or “Line In” depending on which one you want to calibrate with. And then, put its slider to maximum.



Fig. 4 Recording Control under Windows Control Panel

If the slider selected has an **Advanced** button, click the button, the following dialog box will pop up. Un-tick the “Mic Boost”.

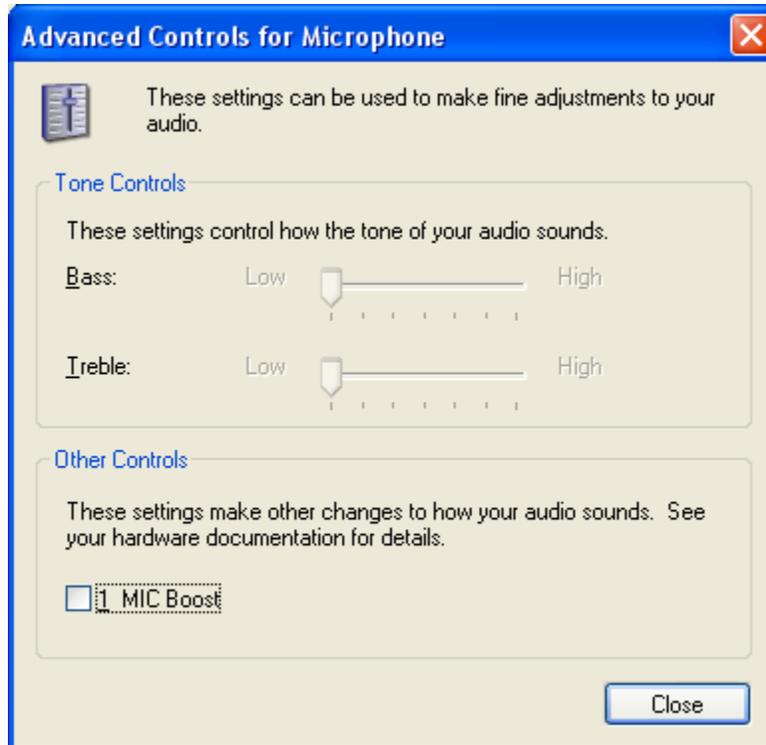


Fig. 5 Advanced Controls for Microphone under Windows Control Panel

Step 2:

Open **Volume Control** panel for the sound card to be calibrated under **Windows Control Panel** (See Fig. 6), put the “Volume Control” slider and “Wave” slider to minimum and mute the rest of signal sources.

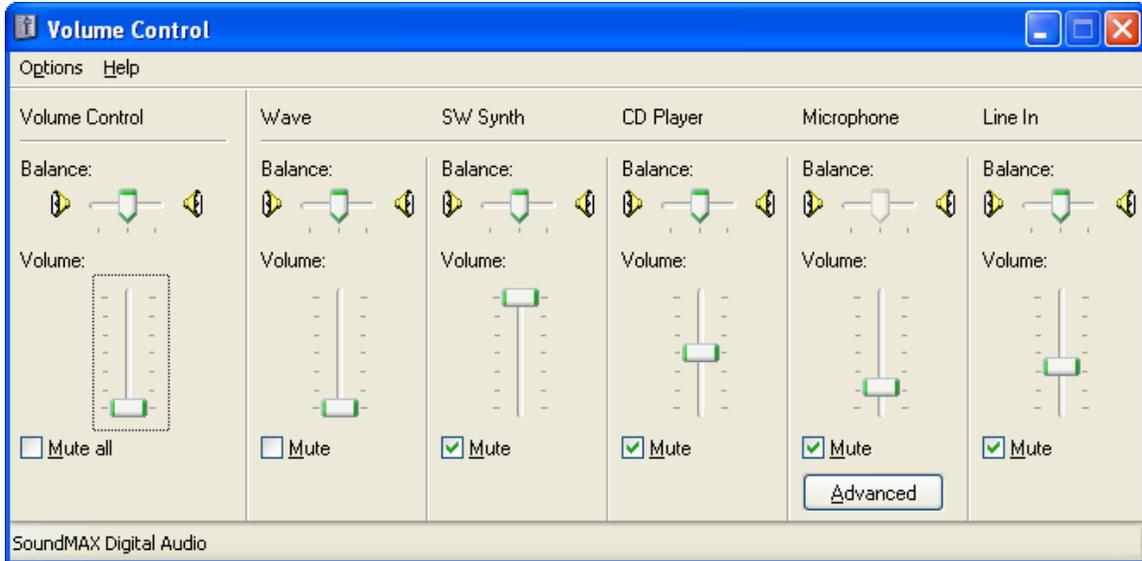


Fig. 6 Volume Control under Windows Control Panel

Step 3:

Launch the VIRTINS Multi-Instrument software, open the **Calibration Setting** dialog box by clicking [**Setting**]>[**Calibration**] (See Fig. 7). Make sure the calibration settings are at their default values by clicking **Default** button and then clicking **Apply** button.

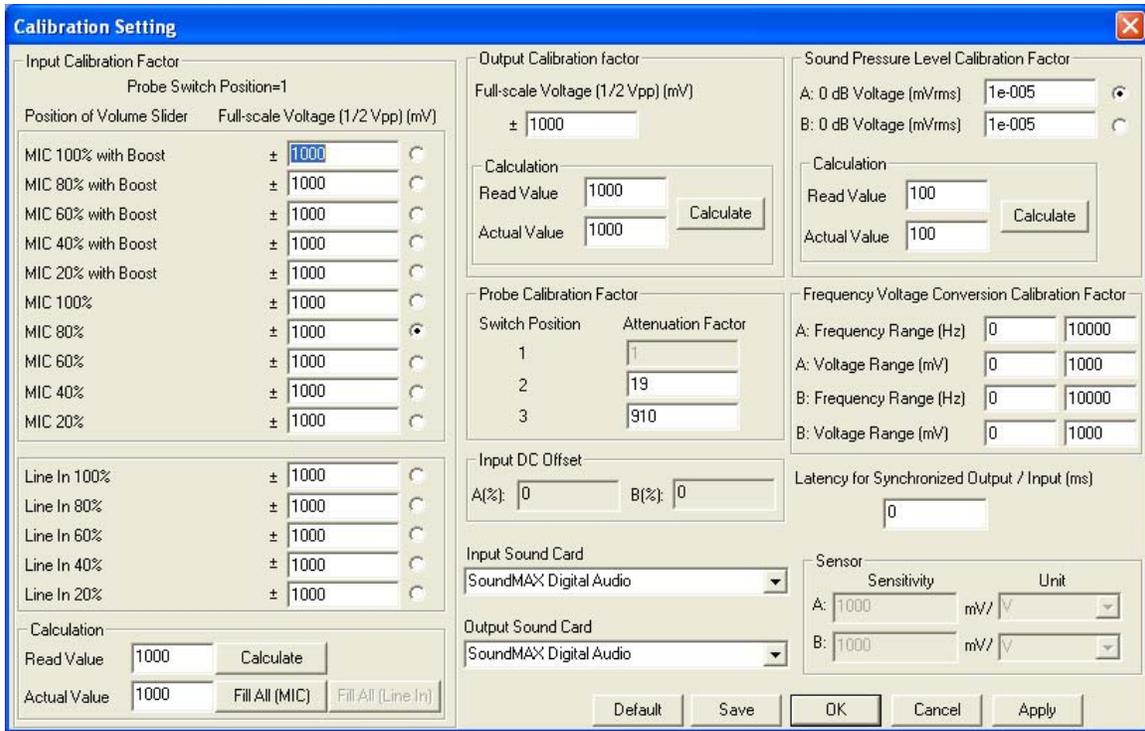


Fig. 7 Calibration Setting under VIRTINS Multi-Instrument

Step 4:

In the VIRTINS Multi-Instrument main window, make sure all parameters are set with their factory default values (see Fig. 8). E.g. On the **Instrument & Miscellaneous Toolbar**, the **Probe** is set to “1”, and on the **Sampling Parameter Toolbar**, the Sampling Bit Resolution is set to 16Bit, etc. Alternatively, you can simply select **[File]>[New]** to reset these parameters to their factory default values.

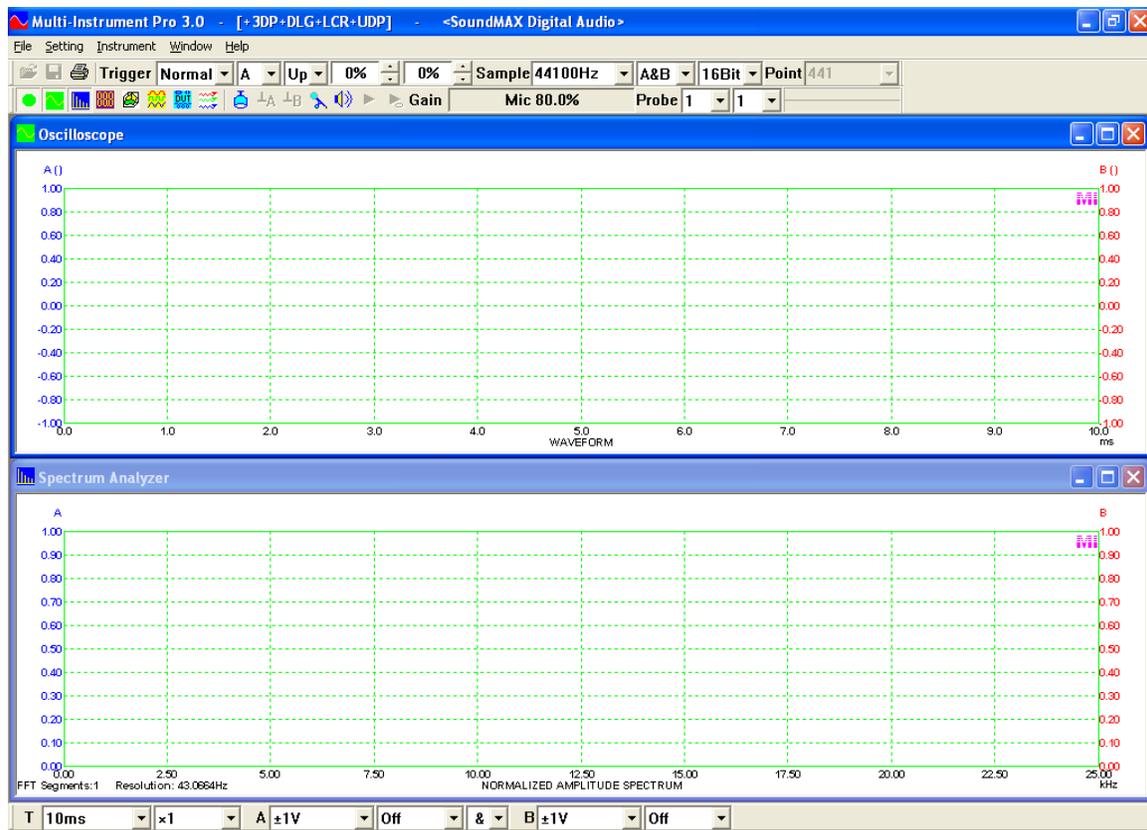


Fig. 8 Main Window of VIRTINS Multi-Instrument

5.2 Main Step 2 --- Ground Level Correction (Zeroing):

Step 1:

Connect the oscilloscope probe to the sound card channel to be calibrated, as shown in Fig. 9.

Step 2:

Put the Trigger Mode to **Auto** and start the Oscilloscope.

Step 3:

Connect the probe tip to the ground lead and then click ⊥ for the respective channel on the **Instrument & Miscellaneous Toolbar** to set its ground level to zero.

Note: Ground level correction (zeroing) should be performed whenever the sound card's input gain setting is changed for better accuracy.

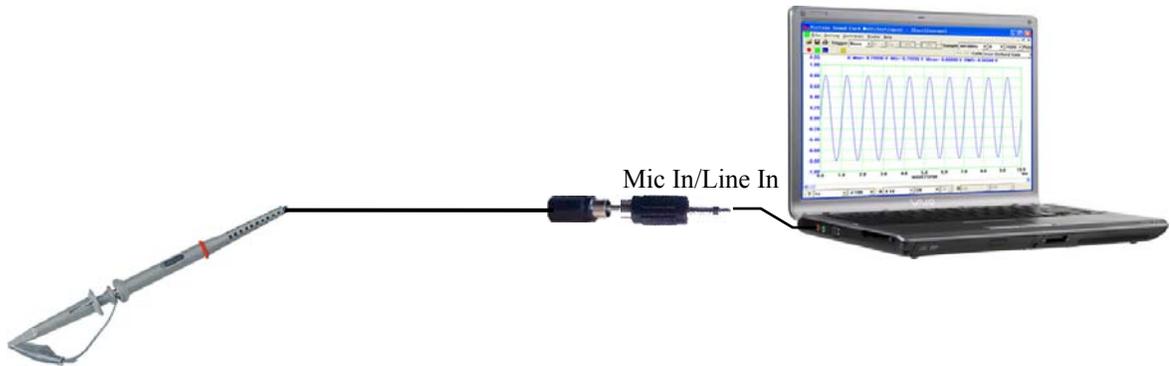


Fig. 9 Connection Diagram for Ground Level Correction (zeroing)

5.3 Main Step 3 --- Calibration of Attenuation Factors for Probe Switch Positions 1, 2, 3

The attenuation factor for each switch position needs to be calibrated together with the sound card channel to be connected with. In VIRTINS Multi-Instrument software, the probe attenuation factor for switch position 1 always has a value of 1, and you need to calibrate the attenuation factors for switch Positions 2 and 3 with reference to position 1. Note that this calibration does not require the sound card's input & output channels to be calibrated first.

Step 1:

Loop back the Signal Generator output to the Oscilloscope input using two oscilloscope probes fitted with two adapters, as shown in Fig. 10. Put the switches on both probes to Position 1. Use a multimeter to measure the voltage between the probe tips and the ground leads.

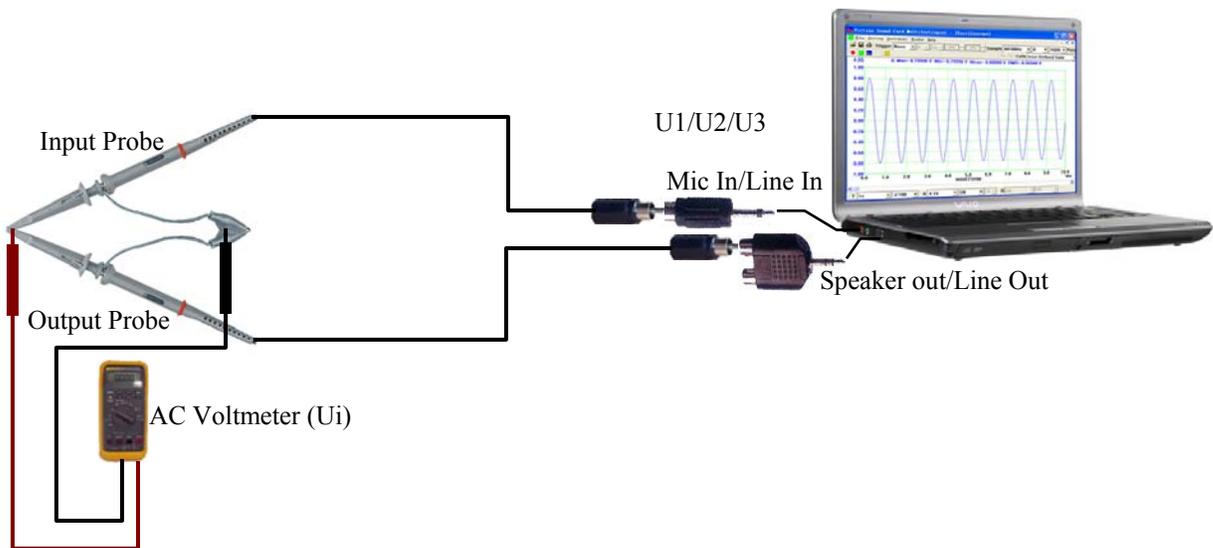


Fig. 10 Connection Diagram for Probe Attenuation Factor Calibration

Step 2:

Open the Signal Generator panel in VIRTINS Multi-Instrument. Use the Signal Generator to output a 1 kHz sine wave with output full-scale voltage (1000 mV by factory default, un-calibrated).

Slowly increase the output volume by adjusting the “Wave” and/or “Volume” sliders on the Volume Control Panel such that the Input Peak Level Indicator in VIRTINS Multi-Instrument shows a value in the range of 80%~95% to ensure sufficient calibration accuracy.

Write down the corresponding RMS voltage value $U1$ displayed on the Oscilloscope and the RMS voltage value U_i displayed on the multimeter.

Step 3:

Put the attenuation switch on the input probe to Position 2. Fine tune the output amplitude in the Signal Generator such that the RMS voltage displayed on the multimeter remains at U_i . Write down the corresponding RMS voltage value $U2$ displayed on the Oscilloscope. Thus, the probe attenuation factor for switch Position 2 would be $U1/U2$. Enter this value in the **Calibration Setting** dialog box and press the **Save** button.

Step 4:

The probe attenuation factor for switch Position 3 can be derived as follows. From the equivalent circuit shown previously, we have:

$$U1/U_i = Z_{sc} / (Z_{inputprobe1} + Z_{sc}) \quad (1)$$

$$U2/U_i = Z_{sc} / (Z_{inputprobe2} + Z_{sc}) \quad (2)$$

$$U3/U_i = Z_{sc} / (Z_{inputprobe3} + Z_{sc}) \quad (3)$$

where $Z_{inputprobe1}$, $Z_{inputprobe2}$, $Z_{inputprobe3}$ are the impedance of the input probe for switch Positions 1, 2, 3 respectively. And $U3$ is the RMS voltage displayed on the Oscilloscope when the same U_i is applied for switch Position 3.

Thus,

$$Z_{sc} = (U2 \times Z_{inputprobe2} - U1 \times Z_{inputprobe1}) / (U1 - U2) = (201U2 - U1) / (U1 - U2)$$

The probe attenuation factor for switch position 3 is then:

$$U1/U3 = (Z_{inputprobe3} + Z_{sc}) / (Z_{inputprobe1} + Z_{sc}) = 50 \times U1 / U2 - 49$$

Enter this value in the **Calibration Setting** dialog box and press the **Save** button.

5.4 Main Step 4 --- Calibration of Sound Card Input Channel

Please refer to the manual attached with VIRTINS Multi-Instrument software to perform the sound card input channel calibration. Please refer to Fig. 10 for the calibration setup. Note that the probe must be put to Position 1 during the calibration.

5.5 Main Step 5 --- Calibration of Sound Card Output Channel

Please refer to the manual attached with VIRTINS Multi-Instrument software to perform the sound card output channel calibration.

If the probe is used for output, it should be put to Position 1 to minimize the output impedance. Please refer to Fig. 11 for the calibration setup.

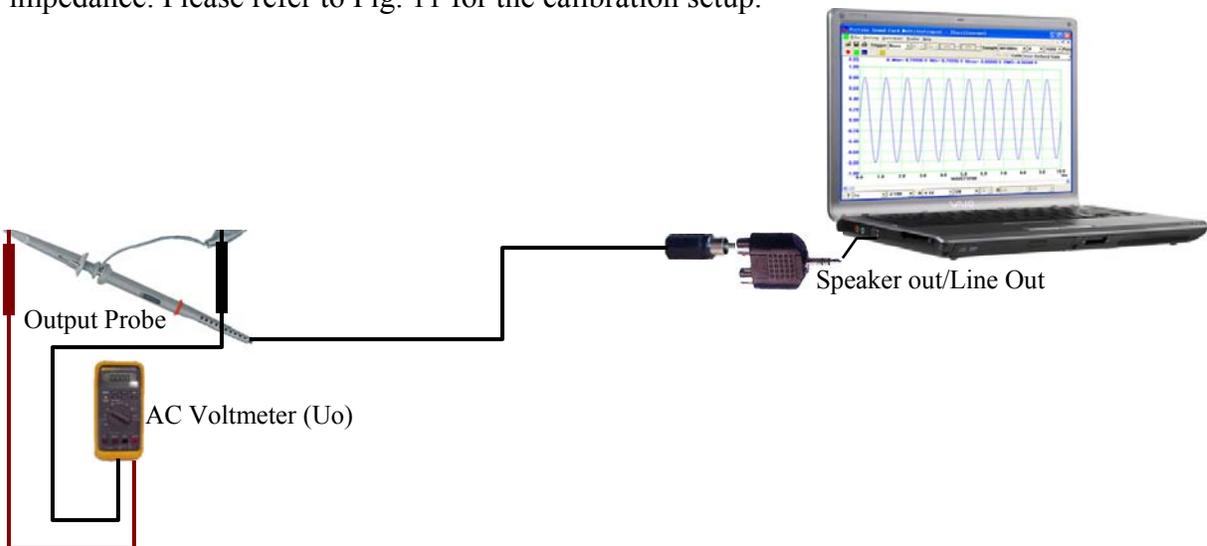


Fig. 11 Connection Diagram for Sound Card Output Channel Calibration

6 Detailed Calibration Procedure for VIRTINS Pocket Multi-Instrument

For VIRTINS Pocket Multi-Instrument, the calibration method for the input and output channels is similar to those for VIRTINS Multi-Instrument, with the connection diagrams as follows.

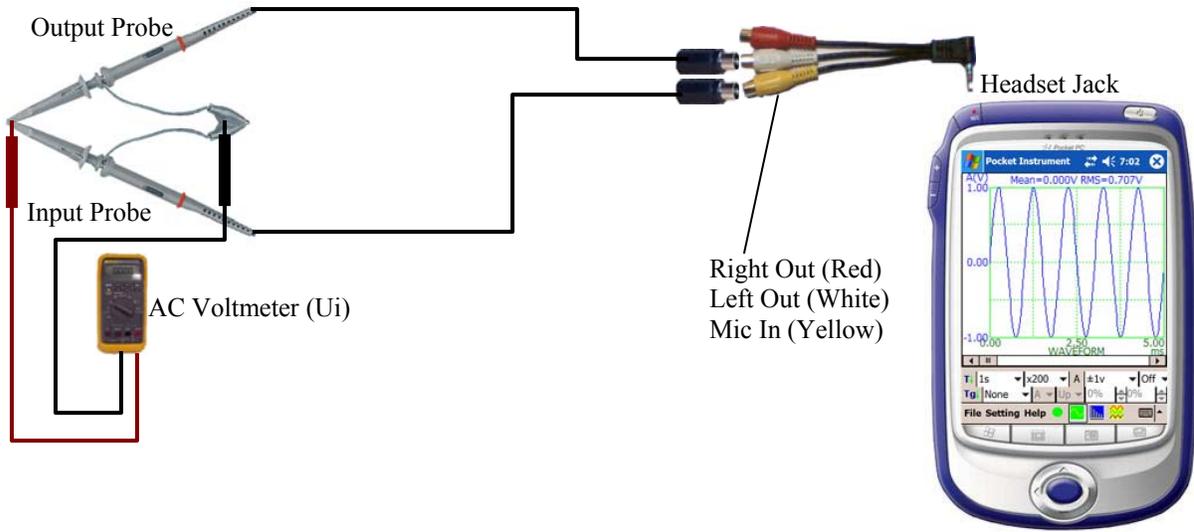


Fig. 12 Connection Diagram for Pocket PC Sound Card Input Channel Calibration

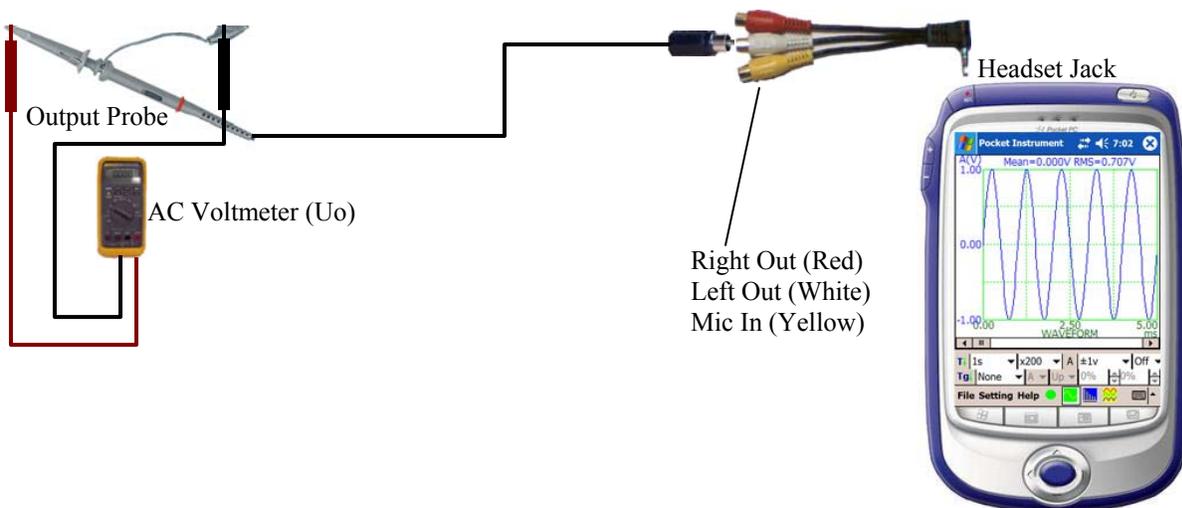


Fig. 13 Connection Diagram for Pocket PC Sound Card Output Channel Calibration

7 Warranty

VIRTINS TECHNOLOGY guarantees this product against defective materials and manufacturing defects for a period of 12 months. During this period of warranty, a replacement probe will be shipped to the buyer's address free of charge upon receiving and verifying the returned faulty probe. 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 probe 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.

8 Disclaimer

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