- [ ] 2700 Series
- [ ] ATS-2
- [x] APx500 Series

Testing USB Headsets

By Steve Peterson

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Introduction

This Technote discusses techniques for testing the audio performance of USB headsets using an Audio Precision APx analyzer. While a regular headset consists of a standard analog microphone and earphone, a USB headset adds an adapter module containing A/D and D/A converters and a USB plug. The analog I/O on the USB adapter of our sample headset is easily accessible through two 3.5mm phone jacks. If the device you are testing is instead hard-wired to its USB module, you can just cut the wires and proceed from there.

Microphone and headset transducer tests aren't addressed here. Once the headset itself is detached from the USB module, it can be tested like any other acoustic device. APx500's acoustic response measurement is well suited for this purpose. You'll need acoustic coupling fixtures or a head (and torso) simulator to properly do acoustic tests on the headset.

See the related Technote 108: PC Audio Testing for general information about performing the "Basic Six" audio measurements on consumer-level PC audio devices.

Requirements

APx projects are included, and require APx500 measurement software version 2.6 or later to run. The text explains the procedures involved when running the Windows 7 operating system on the control/testbed PC. Windows XP or Vista may also be used, although the steps and settings may differ somewhat. The headset uses the default Windows USB audio device driver.

Windows 7

Testing audio devices connected to a personal computer through a USB connection is simplified by the Windows 7 Unified Audio Architecture (UAA). USB audio device drivers must comply with the UAA, and drivers must comply with the Windows Logo requirements in order to receive the Windows Logo. If the USB audio device is compliant, it will appear much the same as any other Windows audio device and can be tested in a similar fashion. This Technote applies to any USB audio device that exposes Sound properties through the standard Windows UAA architecture.

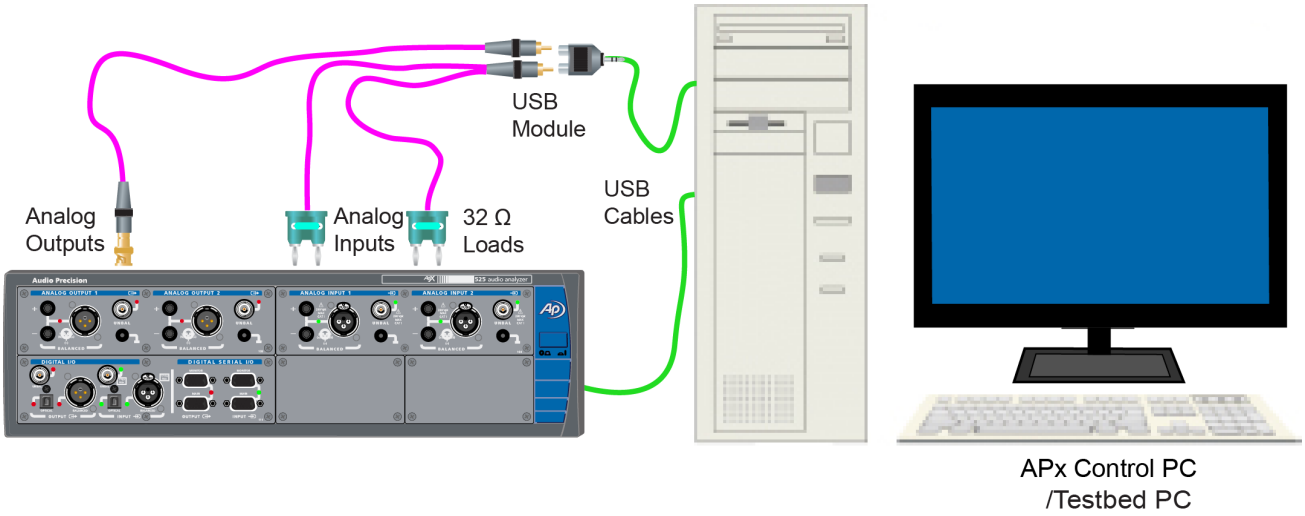

Figure 1. Record/playback connections.

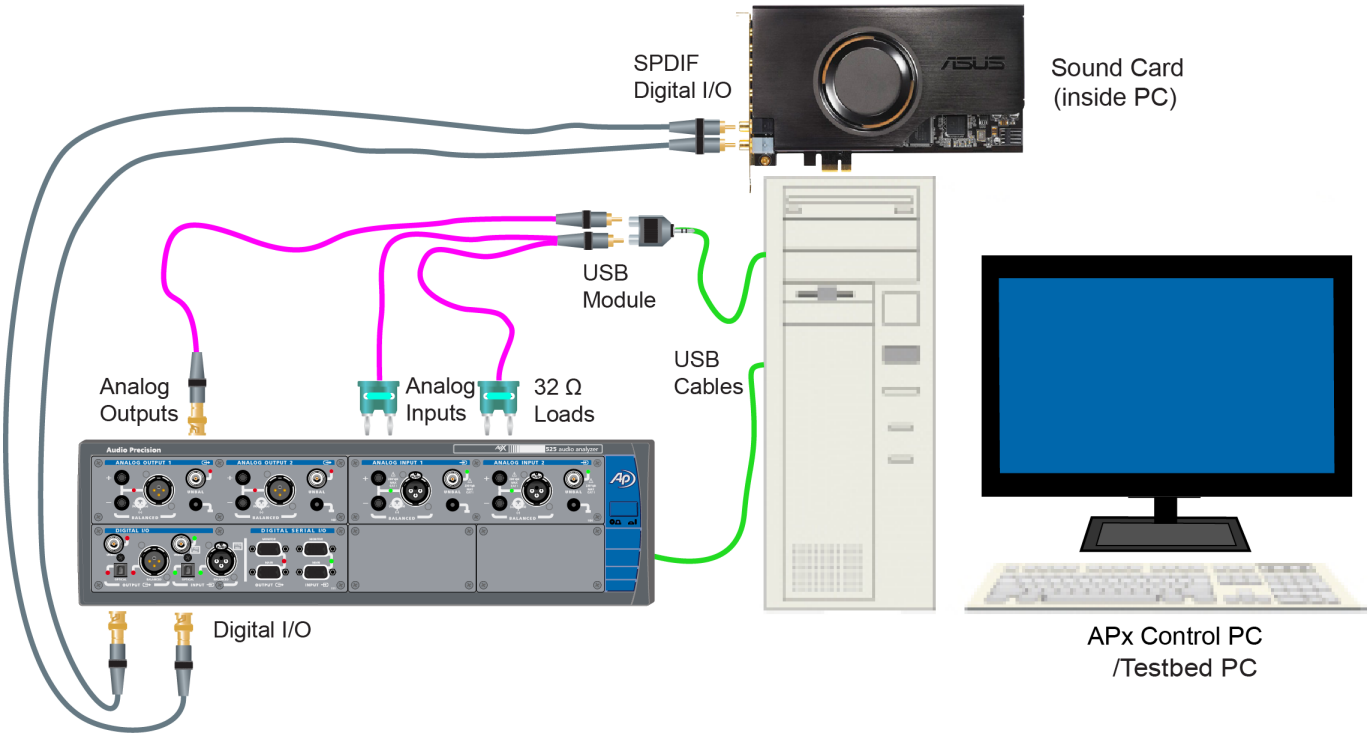

Figure 2. Real-time connections.

Test Methods

Two methods are suitable for testing the audio performance of a USB device: Record/Playback, and Real-time. Both methods require correct configuration of the Windows audio Playback and Recording device properties.

Record/Playback

The Record/Playback audio test method requires an audio record and playback application running on the test PC, and direct file access to the recorded files by the APx500 software. This test method does not require an APx with a digital audio interface. Recorded files may be analyzed using the APx500 File Analysis measurement if the test PC can provide a direct connection to recorded files, or if the recorded files can be copied to the PC running APx500. The connections are shown in Figure 1.

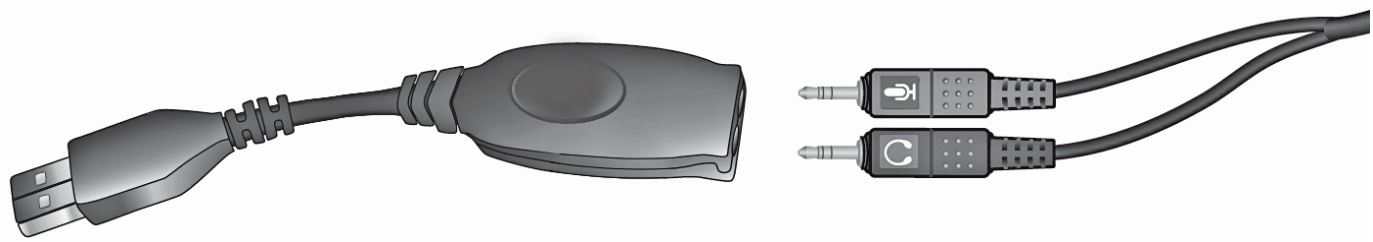

Figure 3. USB-Headset-Adapter-with-Headphone-plugs

Real-Time

The Real-time audio test method involves a direct analog connection to the USB audio device, and an indirect digital audio input/output connection to the device via the SPDIF or Optical connection on a PC.

A real-time connection to the device under test permits closed loop testing that is difficult or impossible to implement with the Record/Playback method. Tests of maximum input or output level, gain and linearity, and delay or latency become much easier to perform. Real-time tests avoid the necessity of playback with a sound file editor, and are able to perform live measurements on input devices without the need to record a file and then analyze the recording.

This method requires an audio analyzer with digital audio interfaces. Proper Windows Sound configuration of the digital connection is vital to success. This Technote will utilize an ASUS Xonar D2X audio card for the SPDIF I/O on the PC. Figure 2 illustrates a real-time test system with analog audio connections between the APx analyzer and the USB device, and digital audio connections between the APx analyzer and the Xonar D2X audio card.

Preparation for Testing

Microphone Connections

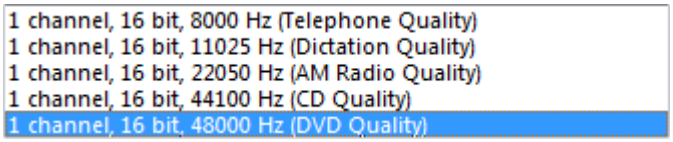

Figure 4. Windows 7 audio format selection.

The USB module's 3.5mm microphone input jack accepts audio on the tip and delivers DC bias for the electric microphone capsule on the ring. Connect the tip to the APx unbalanced analog output 1. The ring can be connected to the unbalanced analog input 2 if you wish to measure the DC bias voltage. The sleeve is ground.

The Windows 7 audio driver for the headset microphone supports many audio formats. The audio tests will be performed with 16-bit resolution at 48 kHz.

Earphone Connections

The 3.5mm stereo earphone outputs should be connected to a load fixture that shunts each output with a 1 Watt 32 Ω resistor, to simulate the speaker load. A resistor mounted on a dual banana plug makes a convenient fixture (see Figures 1 and 2). Connect the load fixture to the APx unbalanced analog inputs 1 (left) and 2 (right). If the sleeve contact is not ground-referenced, then use the balanced analog inputs instead.

The Windows 7 audio driver for the earphone output jack supports many audio formats as well. The audio tests will be performed at the highest 2-channel bit resolution and sample rate available: 16-bit at 48 kHz.

Measurements

Microphone Input

The microphone electrical measurements are described in the table below:

Microphone Test	Record	Real-time Streaming
Input Sensitivity	997 Hz @ 0 dBrG (100 mV)	997 Hz @ 0 dBrG (1% THD+N)
THD+N	997 Hz @ -3 dBrG	997 @ -3 dB dBrG*
Spectrum	997 Hz @ -3 dBrG	997 @ -3 dB dBrG*
DFD IMD	12.5 kHz mean, 80 Hz difference @ -3 dBrG	12.5 kHz mean, 80 Hz difference @ -3 dB dBrG*
Noise	Input terminated with 600 Ω (if possible)	Input terminated with 600 Ω (if possible)
THD+N vs. Frequency	20 Hz to 20 kHz @ -6 dBrG	20 Hz to 20 kHz @ -6 dB dBrG*
Frequency Response	20 Hz to 20 kHz @ -20 dBrG	20 Hz to 20 kHz @ -20 dB dBrG*
Dynamic Range	997 Hz @ -60 dBrG	997 @ -60 dB dBrG*

* Relative to the 1% THD+N reference level.

Record tests will be performed with a fixed analog input of 100 mV. The precise value will be different for other devices and must be determined in advance. A value is entered into the APx500 Reference Levels > Signal Generator dBrG field.

Microphone input real-time streaming tests will be performed with an input level that produces 1% THD+N on the digital output. This will be achieved by using the APx500 Auto Set Generator Level function in the *Reference Levels* measurement to set the dBrG value. A 1 Vrms limit will be set.

Earphone Output Measurements

The earphone electrical measurements are described in the following table:

Earphone Test	Playback	Real-time Streaming
Earphone Power 32 Ω Load	997 Hz @ 0 dBFS	997 Hz @ 0 dBrG (1% THD+N)
Inter-channel Phase	997 Hz @ 0 dBFS	20 Hz to 20 kHz @ -3 dB dBrG*
Crosstalk (L-R and R-L)	15 kHz @ -3 dBFS	15 kHz @ -3 dB dBrG*
THD+N	997 Hz @ -3 dBFS	997 @ -3 dB dBrG*
Spectrum	997 Hz @ -3 dBFS	997 @ -3 dB dBrG*
DFD IMD	12.5 kHz mean, 80 Hz difference @ 0 dBFS	12.5 kHz mean, 80 Hz difference @ -3 dB dBrG*
Frequency Response	20 Hz to 20 kHz @ -20 dBFS	20 Hz to 20 kHz @ -20 dB dBrG*
Channel Balance	997 Hz @ -20 dBFS	997 Hz @ -20 dB dBrG*
Dynamic Range	997 Hz @ -60 dBFS	997 @ -60 dB dBrG*

* Relative to full scale or the 1% THD+N reference level, whichever is lower.

Real-time Measurements

Real-time streaming tests will be performed with the output levels relative to the lesser of 0 dBFS or the digital output level that produces 1% THD+N at the analog output when terminated into 32 Ω. This will automatically be determined using the Auto Set Generator Level capability in the *Reference Levels* measurement to set dBrG. APx500 will also set the resultant analog output level as a reference for subsequent analog measurements as needed.

Microphone Record Tests

The APx Signal Path Paradigm

The APx500 software utilizes a “Signal Path” paradigm. The APx500 Measurement Navigator groups audio tests according to the type of inputs and outputs connectors on the analyzer that are utilized. The APx500 signal path is configured using the Signal Path Setup panel shown in Figure 5.

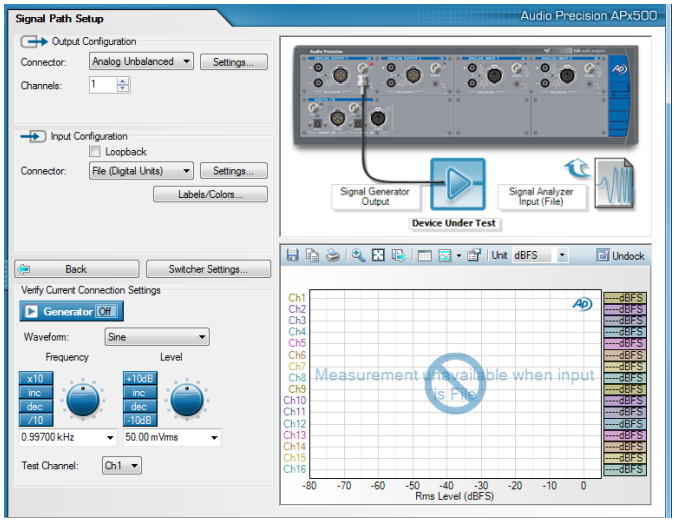

Figure 5. APx500 microphone record signal path.

In order to test a headset microphone with the file recording method, the APx500 output is configured for one unbalanced analog output channel, and the input is configured for digital audio file analysis.

APx500 File Analysis

With the APx500 signal path input set to "File (Digital Units)," each measurement in the test sequence will analyze a unique file. Figure 6 illustrates this for the microphone *Sensitivity @ 0 dB* test, which is a renamed instance of the *Level and Gain* test. To specify the filename, click the **File List…** button to open the *Input File List* dialog. Use the **Add Files…** button and browse or enter the complete path of the file to be analyzed.

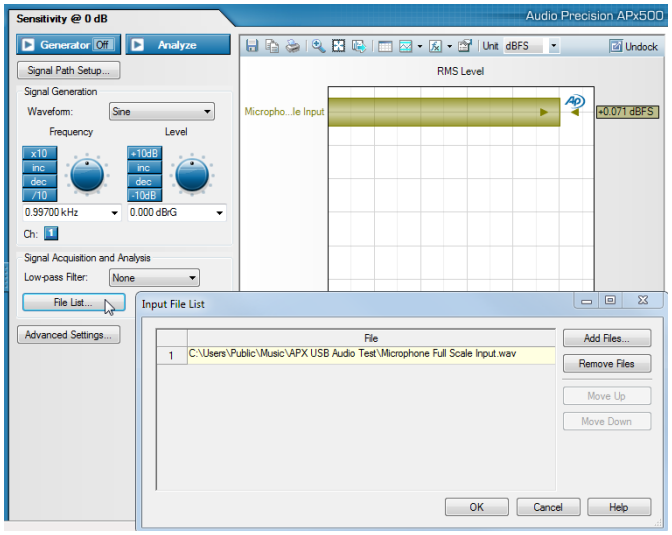

Figure 6. APx500 Input File List dialog.

The microphone measurements in this project have all the filenames entered for you in the public shared folder "C:\Users\Public\Music\APx USB Audio Test". Each measurement in the sequence has been configured to display a prompt which will instruct you to record the signal and save it using a specific filename. You'll be prompted when to stop recording, and when you click the OK button, the file measurement will be performed.

The file may be analyzed outside of the automated sequence by selecting the **Analyze** button in the measurement settings panel. This is useful if you wish to change measurement parameters and then re-analyze a file.

The recording file path may be located on your local machine or on a network drive. You may change the filename and path by editing the *Input File List* shown in Figure 6.

Record Files

Each measurement step in the APx500 sequence requires a recorded file to analyze. The table below lists them for your reference:

Microphone Test	Record Filename
Input Sensitivity	Microphone Full Scale Input.wav
THD+N	Microphone -3 dB Input.wav
Spectrum	Microphone -3 dB Input.wav
DFD IMD	Microphone -3 dB DFD Input.wav
Noise	Microphone Noise Input.wav
THD+N vs. Frequency	Microphone -6 dB Input Frequency Sweep.wav
Frequency Response	Microphone -20 dB Input Frequency Sweep.wav
Dynamic Range	Microphone -60 dB Input.wav

Record Test Sub-Steps

Measurement steps within an APx500 sequence may contain sub-steps. To view the sub-steps in the *Sensitivity @ 0 dB* measurement, right-click and select *Edit Prompts and Properties*.

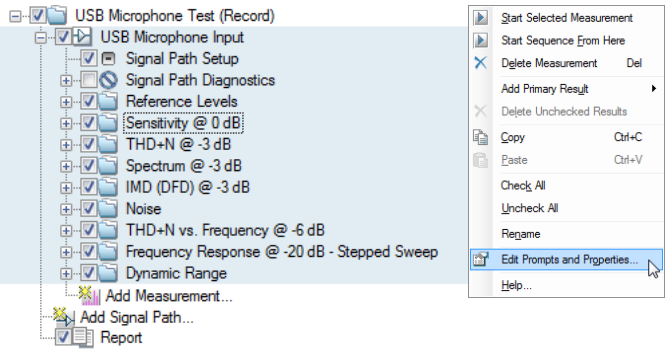

Figure 7. Measurement right-click menu with Edit Prompts and Properties selected.

Figure 8 shows the *Sequence Step Properties* dialog with the sub-steps for this measurement. It starts by turning the analog generator output on, and then provides numerous prompts to tell you how to configure the Windows 7 sound properties, how to connect the microphone, and when to start recording. A short *Delay* sub-step provides a 5 second interval for recording followed by a prompt to stop recording. The last step analyzes the recorded file. A sub-step can be skipped by unchecking it.

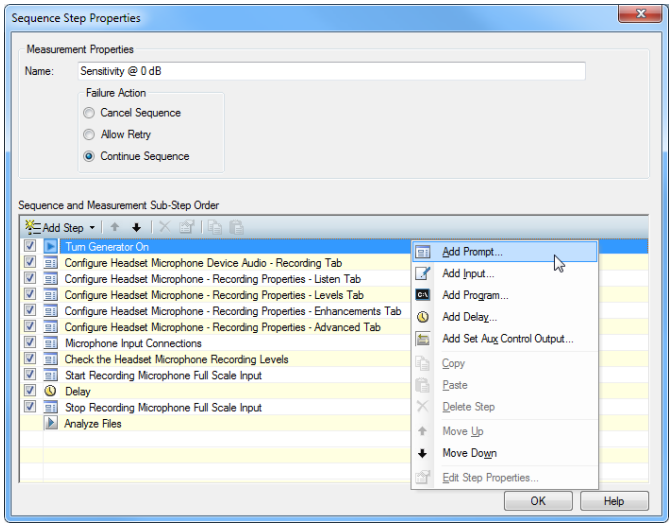

Figure 8. Sequence Step Properties dialog with Add Step menu.

Microphone Sound Configuration

Before you begin microphone testing, you must configure the Windows 7 sound properties for recording. The goal is to configure the microphone to operate as transparently as possible. The input gain must be set to 0 dB in order to test it at the highest possible analog input level without analog or digital clipping. No other input devices should be enabled—otherwise, their audio signals may be mixed with the microphone under test, producing erroneous results. The number of audio channels, digital bit depth, and sample rate should be set for optimum performance. Set the headset microphone to be the default recording device in the Windows Sound setup.

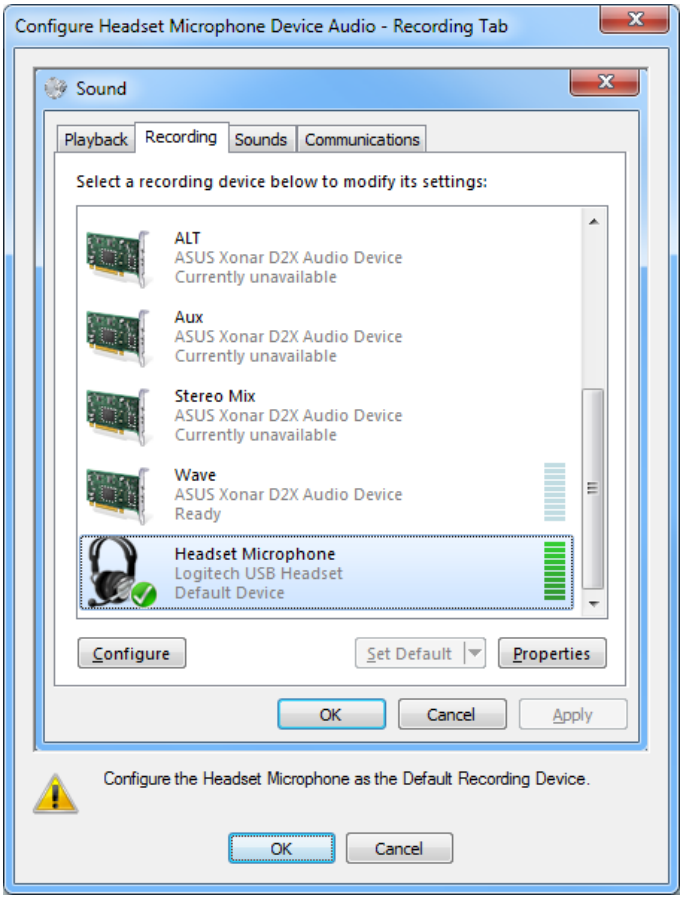

Figure 9. Windows Sound Recording setup tab.

Appendix A and B provide screen captures and details for setting the recording sound properties in Windows 7. The configuration settings shown are specific to the USB microphone selected for this Technote, but the principles apply in general to all recording input devices and are vital to achieving realistic microphone input audio performance measurements. The proper settings are also included in the operator prompts of the supplied APx project.

GoldWave Software Configuration

For these projects, we recommend using the inexpensive GoldWave recording software at www.goldwave.com. See Appendix D to set up GoldWave for audio recording.

Run the Microphone Measurements (Record) Project

Start APx500 and open the "USB Microphone Test (Record).approjx" project file. Start the measurement sequence with the **Start Sequence** button and follow the operator prompts as each measurement step displays them. Select the **OK** button for each prompt to continue or select the **Cancel** button to stop the measurement sequence.

Earphone Playback Tests

The earphone tests use the "USB Earphone Test (Playback).approjx" APx project. Figure 10 shows the Signal Path settings. The APx output is configured as **None (External)**, since the test signal will be provided by a playback file.

The APx input is configured for **Analog Unbalanced**, and the two earphone analog outputs are connected to APx input channels 1 and 2. Although only two channels are needed, the project will run fine on the APx585 family (8 and 16 channel) APx analyzers.

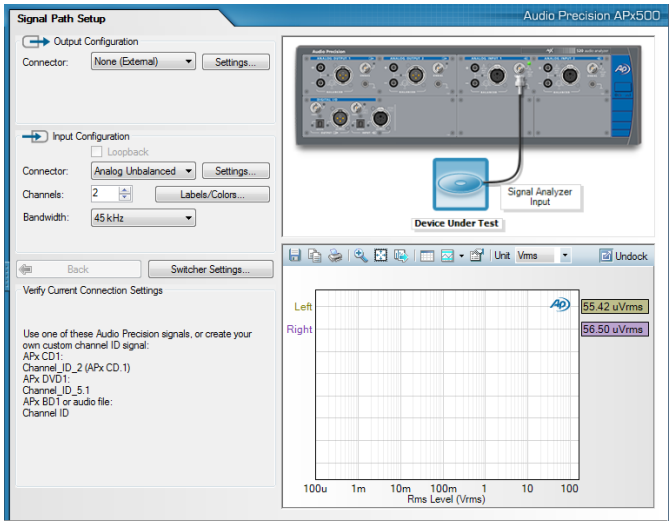

Figure 10. APx500 Signal Path Setup for earphone playback tests.

Each of the measurements in the earphone measurement sequence (Figure 11) has prompts to tell you what audio test file to play and when to start and stop playback.

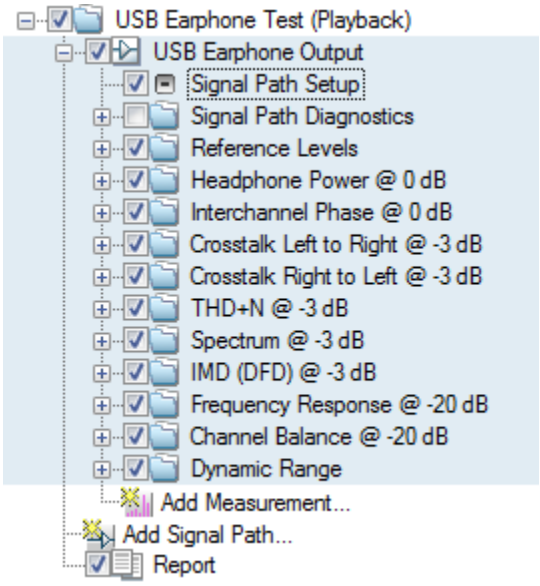

Figure 11. APx500 measurement sequence for the earphone playback tests.

Playback Files

Each measurement step in the APx500 sequence requires a playback file to drive the earphone output with the appropriate audio test signal. The table below lists the earphone measurements and the playback file required. These files are supplied with this Technote. Install them in any folder accessible to your audio playback software.

Earphone Test	Playback Filename
Earphone Power 32 Ω Load	Reference_Level_0dB_48.24.wav
Interchannel Phase	Reference_Level_0dB_48.24.wav
Crosstalk (L-R and R-L)	Crosstalk_left_only_-3dB_15k_48.24.wav
	Crosstalk_right_only_-3dB_15k_48.24.wav
THD+N	Reference_Level_-3dB_48.24.wav
Spectrum	Reference_Level_-3dB_48.24.wav
DFD IMD	DFD_-3dB_48.24.wav
Frequency Response and THD+N	Freq_sweep_61_-20dB_48.24.wav
Channel Balance	Reference_Level_-20dB_48.24.wav
Dynamic Range	Reference_Level_-60dB_48.24.wav

Earphone Sound Configuration

Before you begin earphone testing, you must configure the Windows 7 sound properties for playback. Gain should be set for maximum output, and audio processing effects should be disabled. Bit depth should be the highest possible at a nominal sample rate of 48 kHz. All input devices should have **Listen to this device** unchecked, otherwise their audio may be mixed with the playback signal and producing erroneous results.

Appendix A and B provide screen captures and details for setting the playback sound properties in Windows 7. The configuration settings shown are specific to the USB earphone selected for this Technote, but the principles apply in general to all playback devices and are vital to achieving realistic microphone input audio performance measurements. The proper settings are also included in the operator prompts of the supplied APx project.

GoldWave Software Configuration

For these projects, we recommend using the inexpensive GoldWave recording software at www.goldwave.com. See Appendix D to set up GoldWave for audio recording.

Run the Earphone Measurements (Playback) Project

Start the APx500 software and open the "USB Earphone Test (Playback).approjx" project file. Start the measurement sequence with the **Start Sequence** button and follow the operator prompts as each measurement step displays them. Select the **OK** button for each prompt to continue or select the **Cancel** button to stop the measurement sequence.

Real-time Tests

A physical audio streaming interface is required in order to perform real-time audio tests with the APx analyzer and the USB audio device. The APx will source digital audio signals to the computer to drive the headset stereo DAC, and will receive digital audio from the computer to measure output from the microphone ADC. This is easily accomplished using a "known good" digital SPDIF audio interface on the PC that the USB device is attached to.

The Computer Digital Audio Interface

Most computers are not equipped with a digital audio interface. If yours is not, then consider the ASUS Xonar D2X PCI Express audio card. The Xonar provides excellent digital audio connectivity via either coaxial or optical SPDIF, and is readily available at an economical price. It operates at sample rates up to 192 kHz at 24-bit resolution, and integrates well with Windows 7.

Figure 12. Asus Xonar D2X sound card.

Real-time Earphone Measurements

The APx project file "USB Earphone Test (Real-time). approjx" includes the measurements shown in Figure 13.

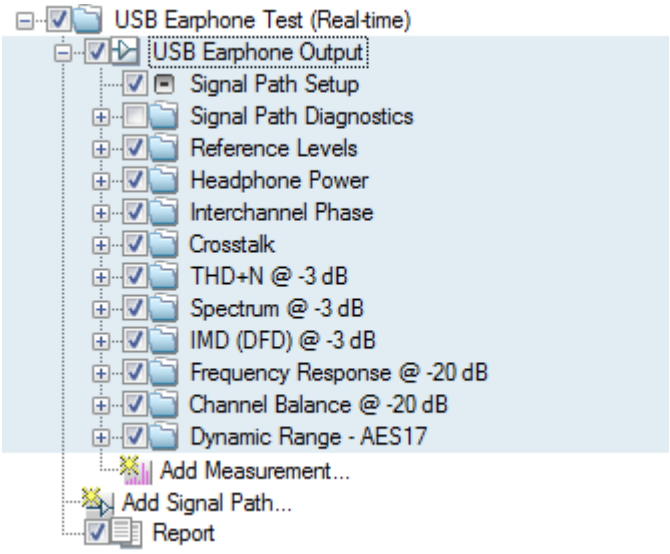

Figure 13. APx500 measurement sequence for the earphone real-time tests.

In *Signal Path Setup*, the APx output is set to **Digital Unbalanced** in order to feed the coaxial SPDIF input on the Xonar sound card. The input is set for stereo **Analog Unbalanced**, to connect to the headset earphone outputs.

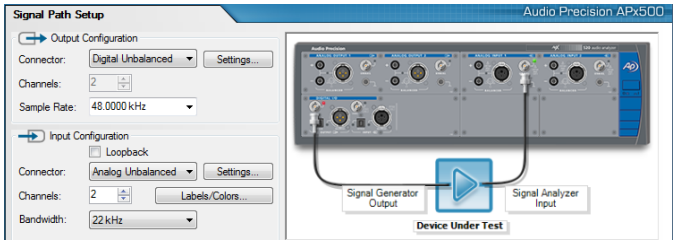

Figure 14. Real-time earphone tests signal path setup.

Auto Gen Level

The *Reference Levels* measurement is designed to automatically drive the APx digital unbalanced output to the highest level possible without exceeding 1% THD+N, as measured at the APx analog unbalanced inputs (fed by the earphone output). The generator starts at its current level and increments the output until the THD+N is 1%. If the THD+N is lower than 1% at 0.0 dBFS, then the process will stop and report a failure. This does not mean the earphone failed, but merely that the earphone does not clip at full scale output.

The dBrG reference level will be set to the digital audio output level that results from this process, and all measurements will be set relative to this value. Figure 15 shows the *Reference Levels* measurement window and the *Auto Gen Level* window starting conditions before the measurement is executed.

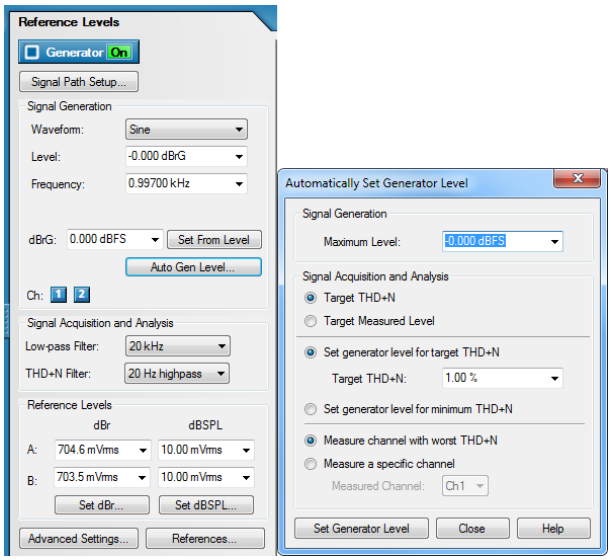

Figure 15. Reference Levels and Set Generator Level dialogs.

Windows Sound Configuration

The Windows 7 Sound properties for recording must be set for the SPDIF input on the Xonar sound card (or other suitable model). Set the Xonar SPDIF In as the default recording device, and check **Listen to this device** in its *SPDIF Properties* dialog (to play back thought the Headset Earphone Default Playback Device). Uncheck **Listen to this device** for all other recording devices.

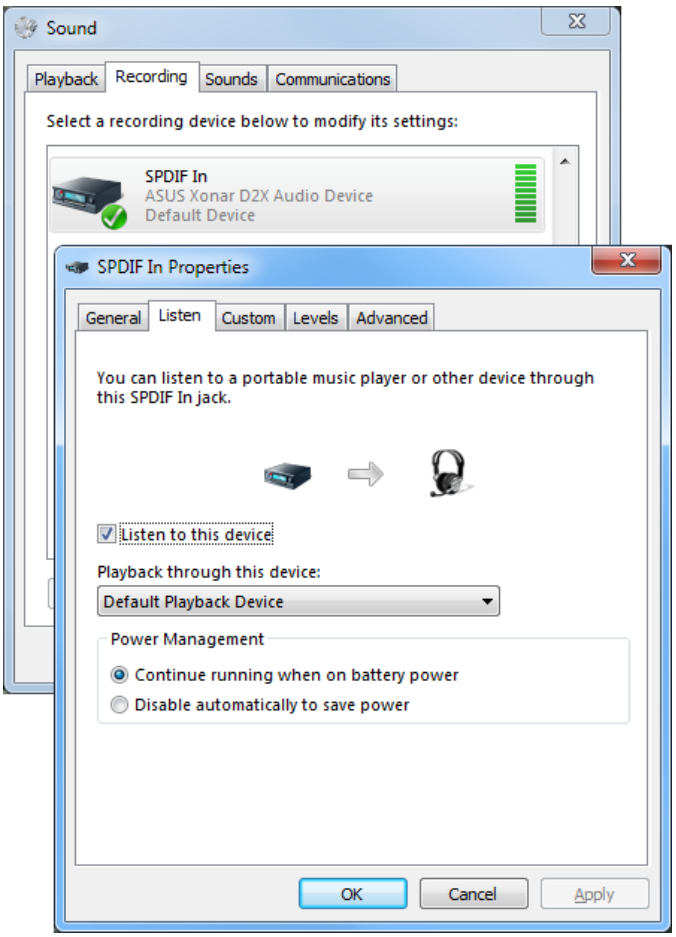

Figure 16. Asus Xonar sound card configuration: SPDIF In Recording Properties Listen tab.

Configure the Headset Earphone as the Windows 7 Default Playback Device.

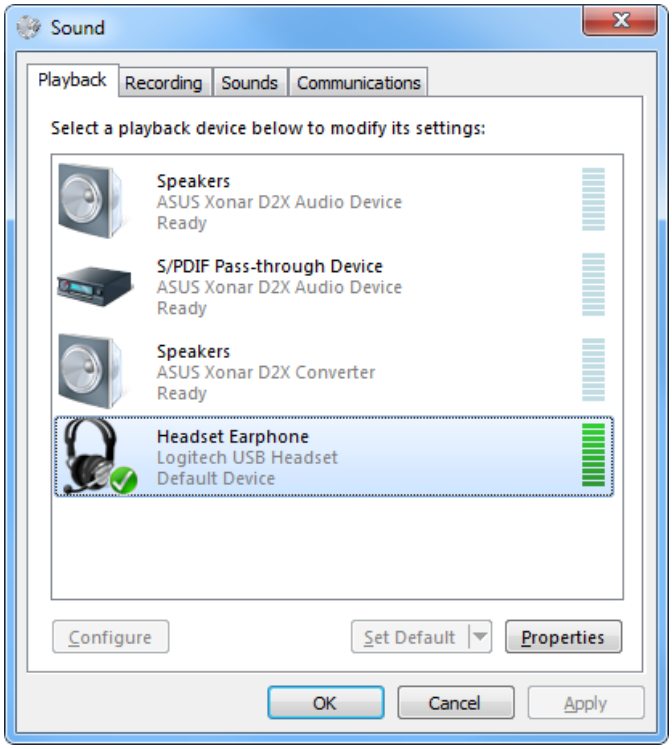

Figure 17. Headset Earphone Playback Properties set as Default Device.

See Appendix A and C for more details about configuring the Windows 7 Sound properties for headset earphone testing.

Run the Earphone Measurements (Real-time) Project

Start APx500 and open the "USB Earphone Test (Real-time).approjx" project file. Start the measurement sequence with the **Start Sequence** button, and follow the operator prompts as each measurement step displays them. Select the **OK** button on each prompt to continue, or select **Cancel** to stop the measurement sequence.

Real-time Microphone Measurements

The APx project file "USB Microphone Test (Real-time). approjx" includes the measurements shown in Figure 18.

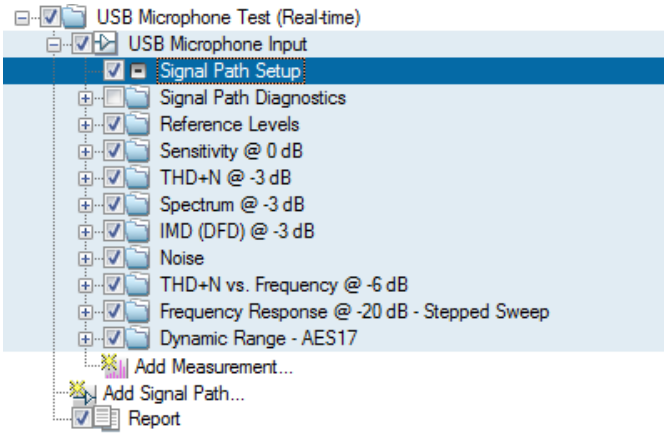

Figure 18. APx500 measurement sequence for the microphone real-time tests.

In *Signal Path Setup*, the APx output is set for **Analog Unbalanced** in order to feed the microphone input. The input is set for stereo **Digital Unbalanced**, to measure the signal via the Xonar coaxial SPDIF output.

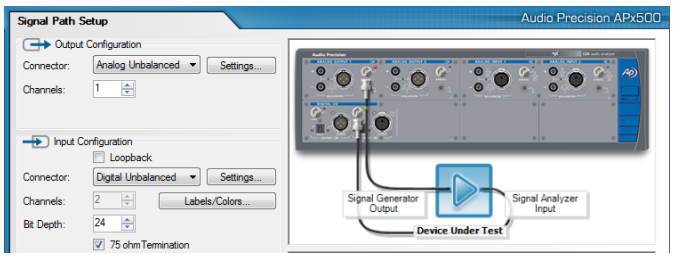

Figure 19. Real-time microphone tests Signal Path Setup.

Auto Gen Level

The *Reference Levels* measurement is designed to automatically drive the APx analog unbalanced output to the highest level possible without exceeding 1% THD+N, as measured at the APx digital unbalanced input. The generator starts at its current level and increments the output until the THD+N is 1%, or until the maximum limit of 1.0 Vrms is reached, whichever comes first.

The dBrG reference level will be set to the analog output level that results from this process, and all measurements will be set relative to this value. Figure 20 shows the *Reference Levels* measurement window and the *Auto Gen Level* window starting conditions before the measurement is executed.

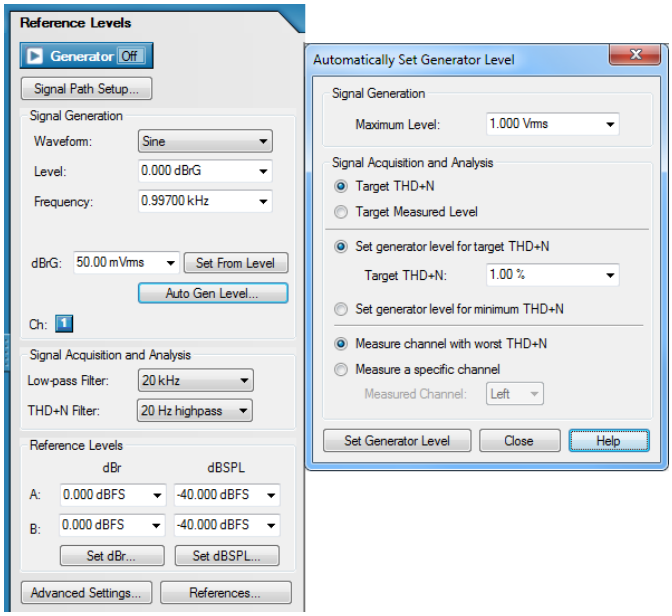

Figure 20. Reference Levels and Set Generator Level dialogs.

Windows Sound Configuration

The Windows 7 Sound properties must be set. Enable the microphone **Listen to this device** setting to play back through the default playback device (the Xonar SPDIF Pass-through Device). Uncheck the **Listen to this device** setting on all other recording devices.

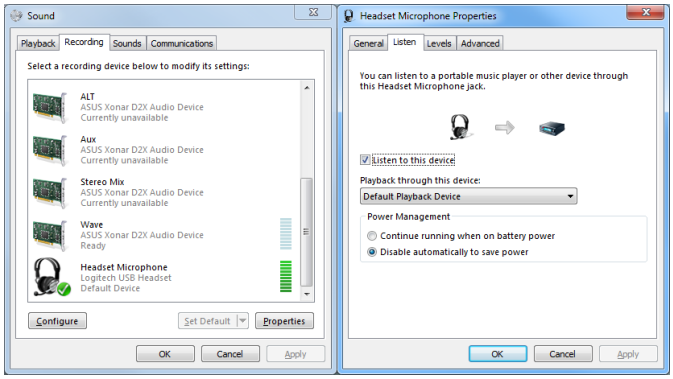

Figure 21. Headset Microphone recording sound properties set to Default Device, and Listen tab.

Configure the Xonar SPDIF Pass-through Device as the default playback device.

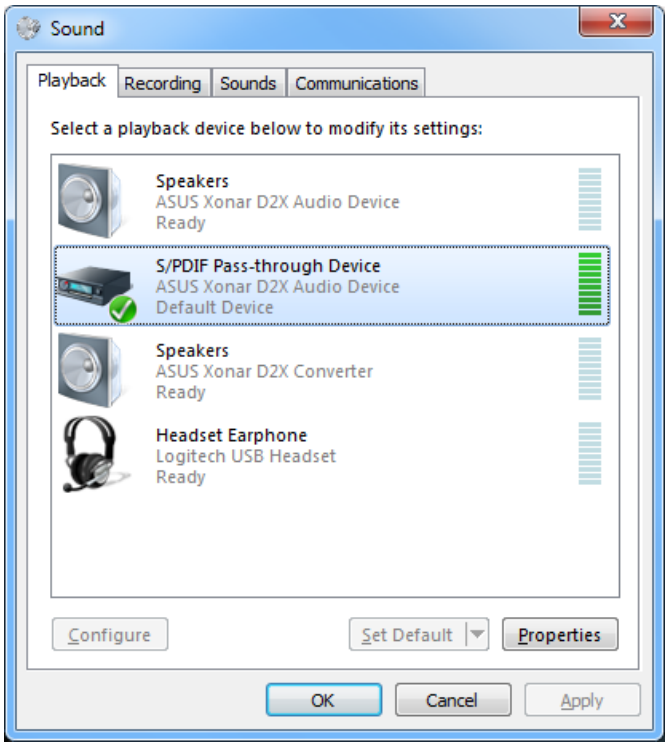

Figure 22. Asus Xonar D2X SPDIF Pass-through Device set to Default Device.

See Appendix A and C for more details about configuring the Windows 7 Sound properties for microphone testing.

Run the Microphone Measurements (Real-time) Project

Start APx500 and open the "USB Microphone Test (Real-time).approjx" project file. Start the measurement sequence with the **Start Sequence** button and follow the operator prompts as each measurement step displays them. Select the **OK** button for each prompt to continue, or select the **Cancel** button to stop the measurement sequence.

APPENDIX A – Windows 7 Volume Control Configuration

Volume Control Options

Set the Windows 7 *Volume Control Options* as shown below. Check the box for **All devices currently playing sound** to assure that all relevant volume controls are visible in the Volume Mixer window.

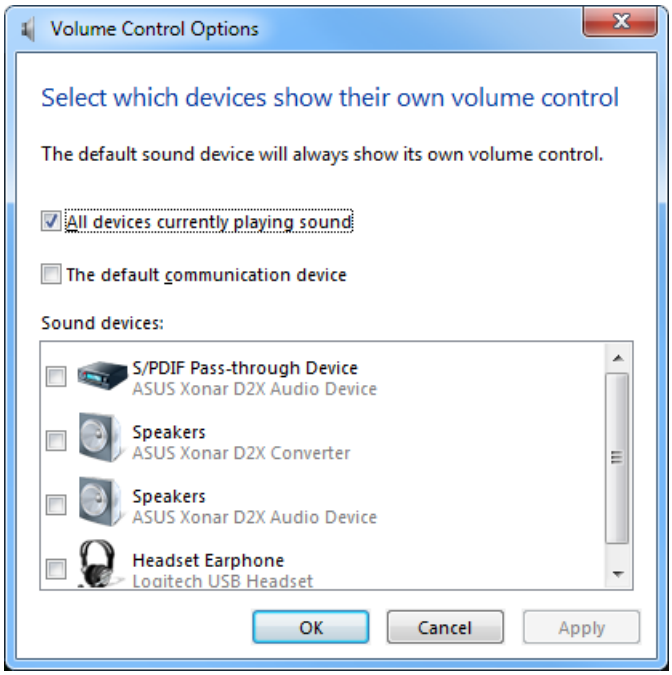

Figure 23. Volume Control Options dialog.

System Sounds

Open the Windows 7 *Volume Mixer*. Mute the System Sounds. Windows system sounds may occur as you manipulate applications and Windows system settings. These sounds must be muted to prevent them from mixing with real-time audio streams from the default playback device—otherwise the audio measurements at the output of the playback device will be corrupted. See Figure 24.

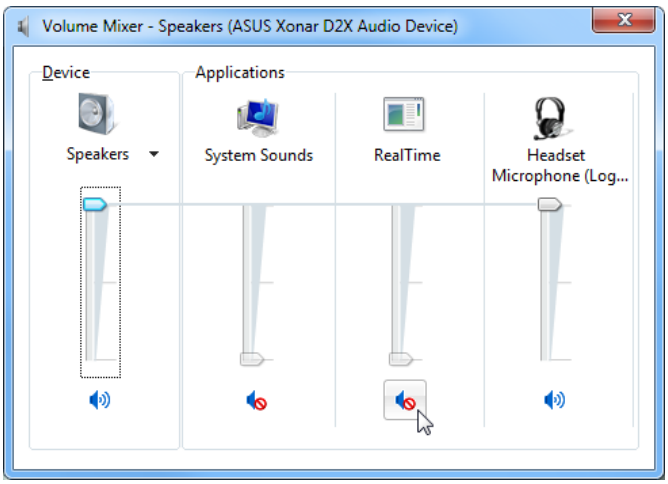

Figure 24. Volume Mixer configuration.

APx500 Audible Signal Monitor

On the Windows *Volume Mixer*, you must mute the RealTime application. RealTime is the APx500 Audible Signal Monitor that provides a real-time audible signal while testing. If you are testing audio on the same computer that is running APx500, then RealTime should be muted to prevent mixing the audible signal monitor with the real-time audio output of the device under test. If this is not muted, a feedback condition will occur which will corrupt all measurements of the audio stream from the default playback device.

APx500 automatically mutes the Audible Signal Monitor when an APx project file is loaded. The Audible Signal Monitor mute inside of APx500, and the RealTime mute in the Windows *Volume Mixer*, work independently of each other.

APPENDIX B - Windows 7 Audio Device Configuration for Record/Playback Tests

Earphone Playback Device

Follow these instructions to configure the Windows 7 sound recording and playback properties for the headset earphone playback audio tests.

Configure the Headset Earphone as the default playback device.

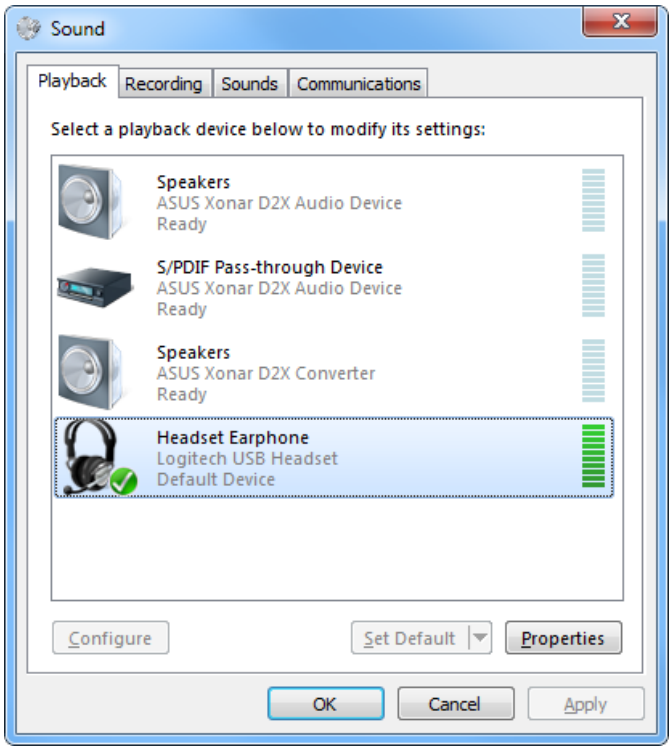

Figure 25. Headset Earphone configuration as Default Device.

Set the Headset Earphone level to maximum. If implemented, set the Headset Microphone level to minimum and mute.

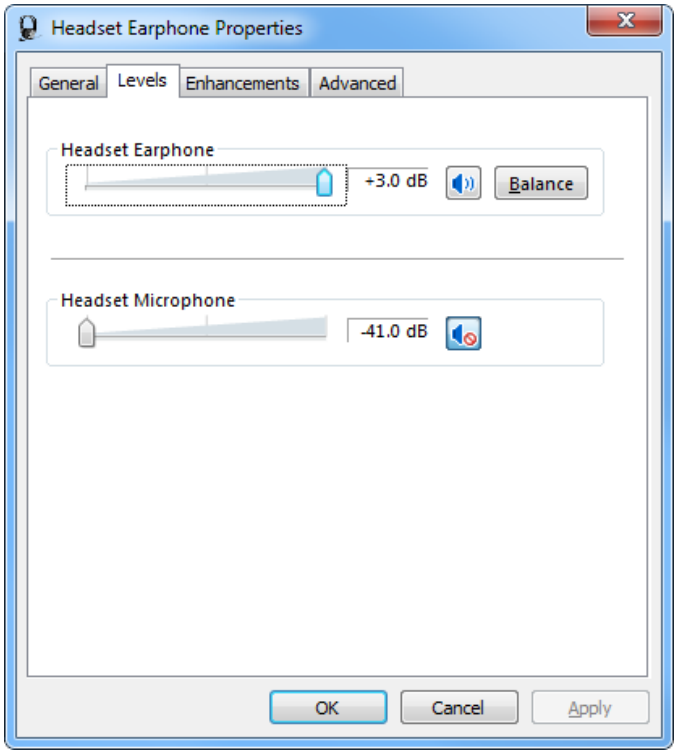

Figure 26. Levels tab.

Set the Headset Earphone **Balance** to maximum (both channels identical).

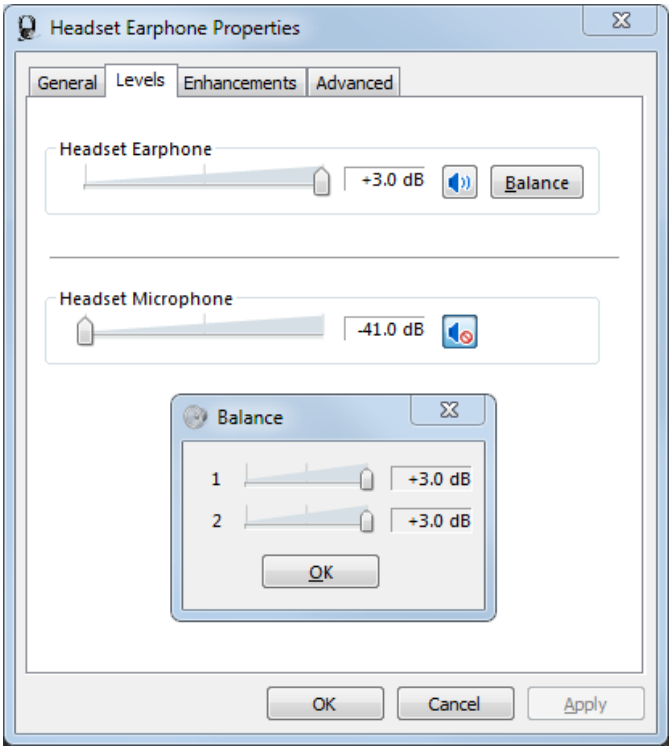

Figure 27. Levels Balance dialog.

Disable all Headset Earphone enhancements.

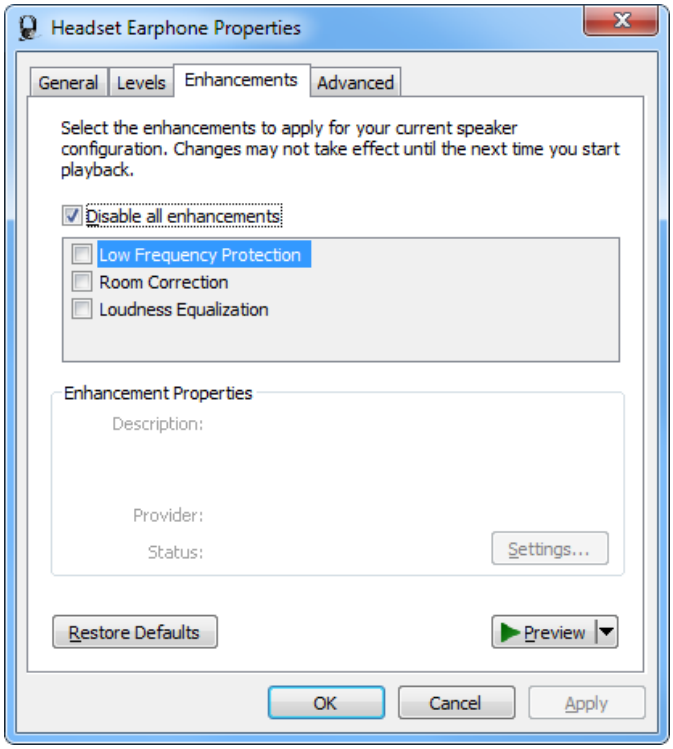

Figure 28. Enhancements.

Set the Headset Earphone **Default Format** to the 2 channel setting, with the highest bit resolution available at the 48000 Hz sample rate.

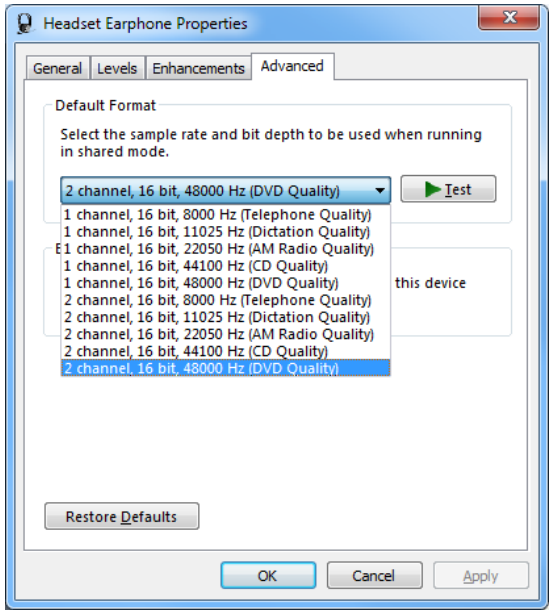

Figure 29. Advanced tab.

Uncheck **Listen to this device** on the Headset Microphone *Listen* tab.

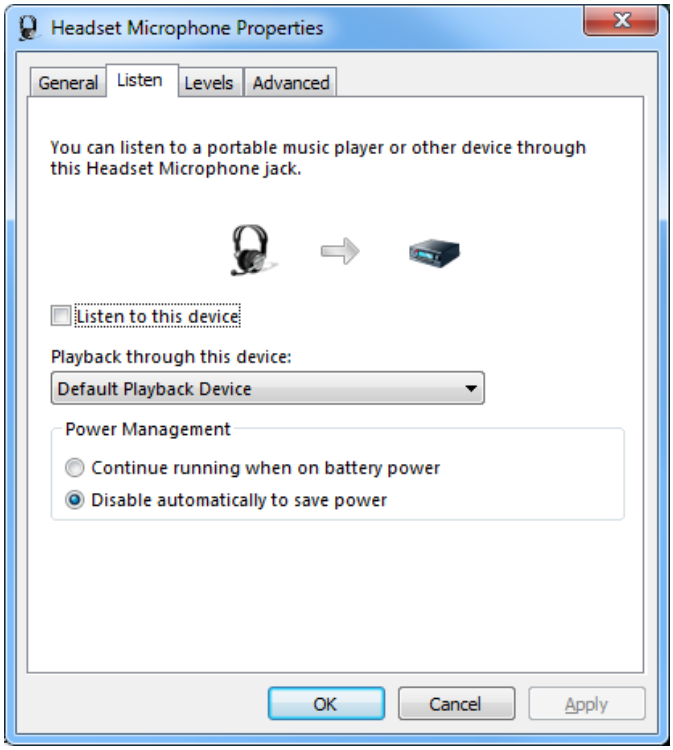

Figure 30. Listen tab.

Uncheck **Listen to this device** on all other recording devices to avoid mixing other input signals.

Microphone Recording Device

Follow these instructions to configure the Windows 7 Sound Recording and Playback properties for the microphone recording audio tests.

Configure the Headset Microphone as the default recording device.

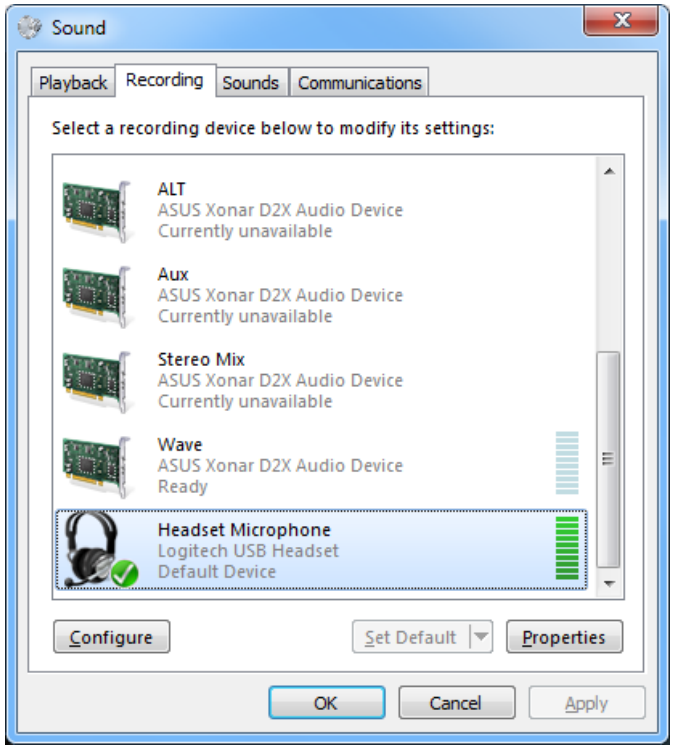

Figure 31. Headset Microphone set as Default Device.

Uncheck **Listen to this device** on the Headset Microphone *Listen* tab.

Uncheck **Listen to this device** on all other recording devices to avoid mixing other input signals.

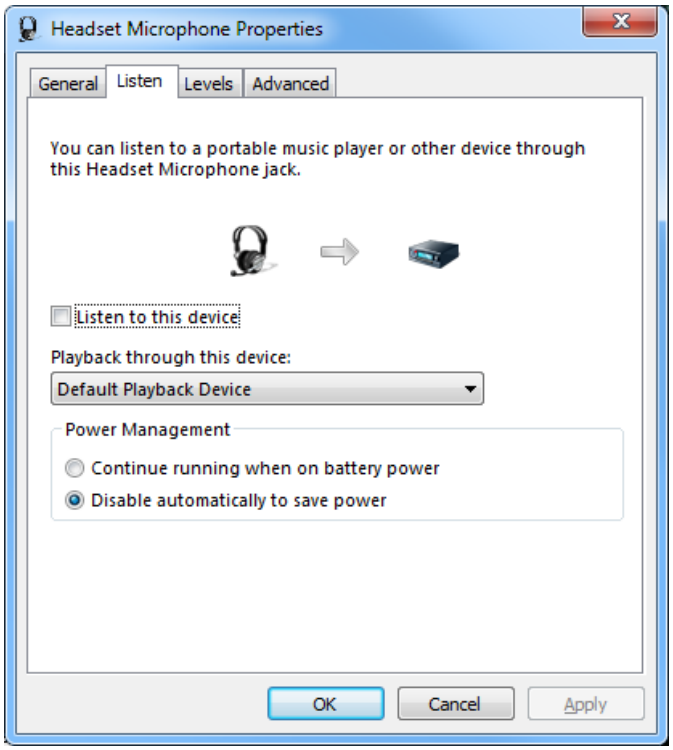

Figure 32. Headset Microphone Listen tab.

Set the Headset Microphone level to the lowest value available that does not mute the microphone.

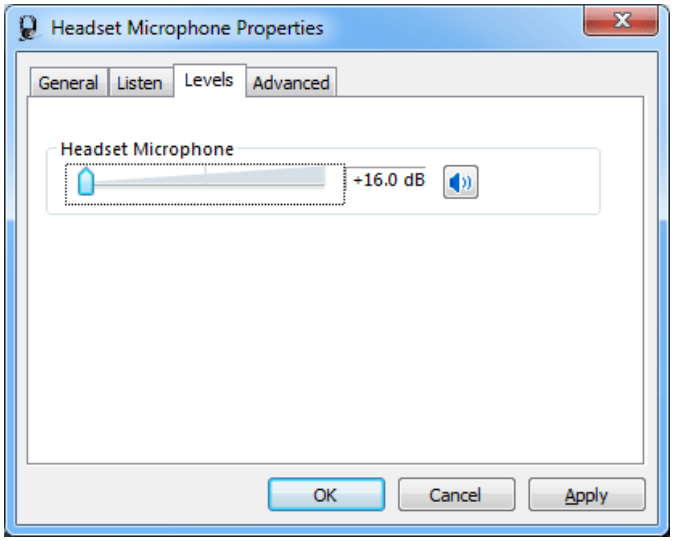

Figure 33. Headset Microphone Listen tab.

Disable all Microphone enhancements (if implemented). Set all microphone boost settings to 0.0 dB and disable boost (if implemented).

Set the Headset Microphone **Default Format** to the 1 channel setting with the highest bit resolution available at the 48000 Hz sample rate.

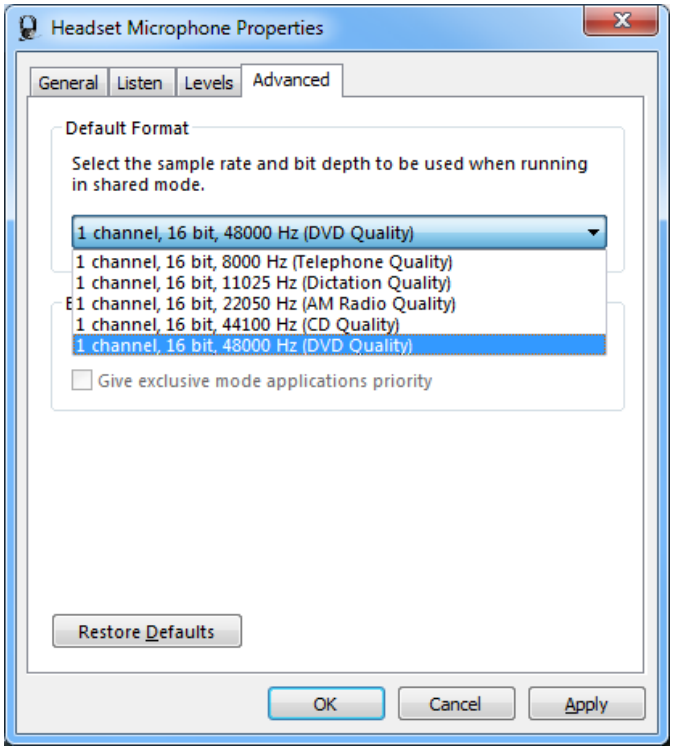

Figure 34. Headset Microphone Advanced tab.

APPENDIX C - Windows 7 Audio Device Configuration for Real-time Tests

Earphone Playback Device and Xonar Audio Card Recording Device

Follow these instructions to configure the Windows 7 Sound Recording and Playback properties for the headset earphone real-time audio tests.

Configure the Headset Earphone as the default playback device.

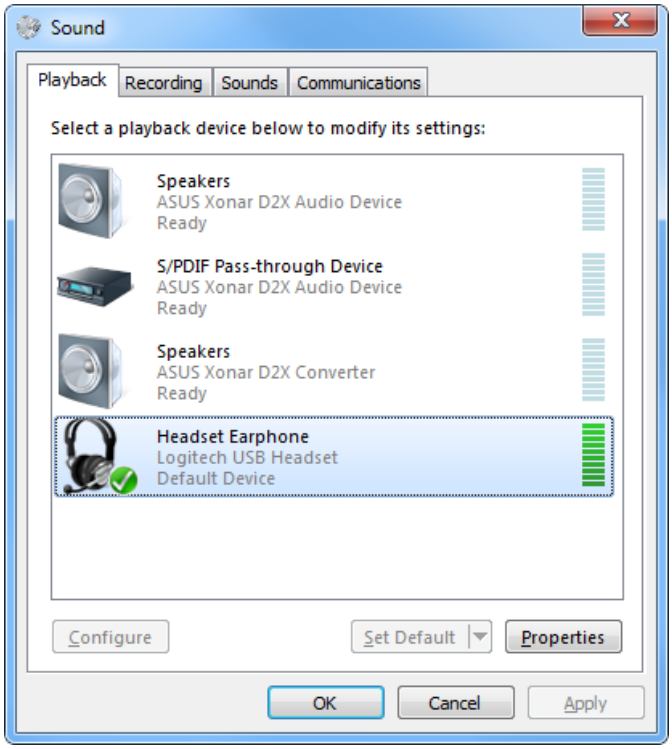

Figure 35. Default playback device.

Set the Headset Earphone level to maximum. If implemented, set the Headset Microphone level to minimum and mute.

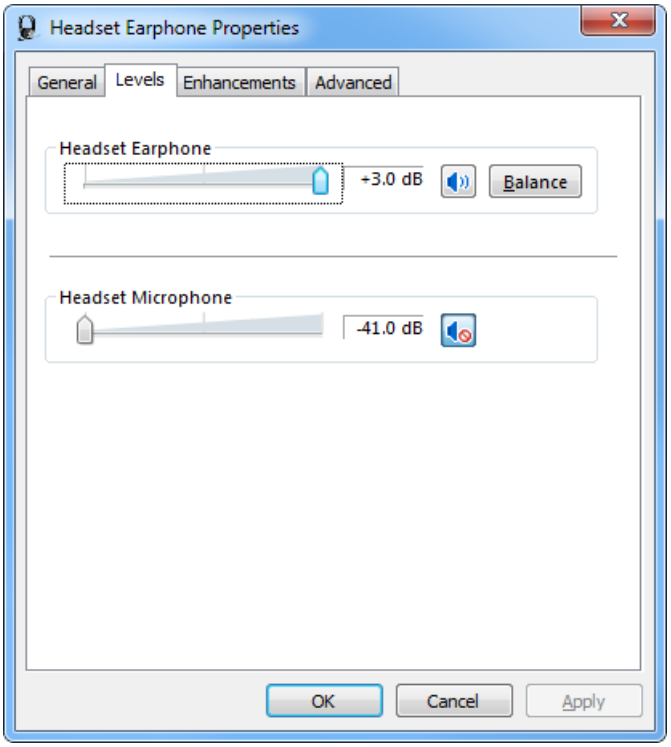

Figure 36. Headset Earphone Levels tab.

Set the Headset Earphone **Balance** to maximum (both channels identical).

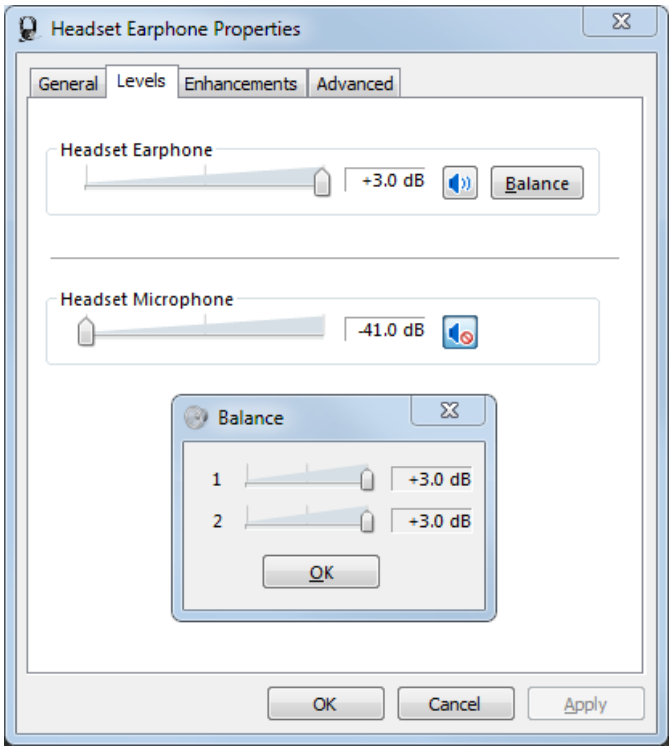

Figure 37. Headset Earphone Levels tab Balance dialog.

Disable all Headset Earphone enhancements.

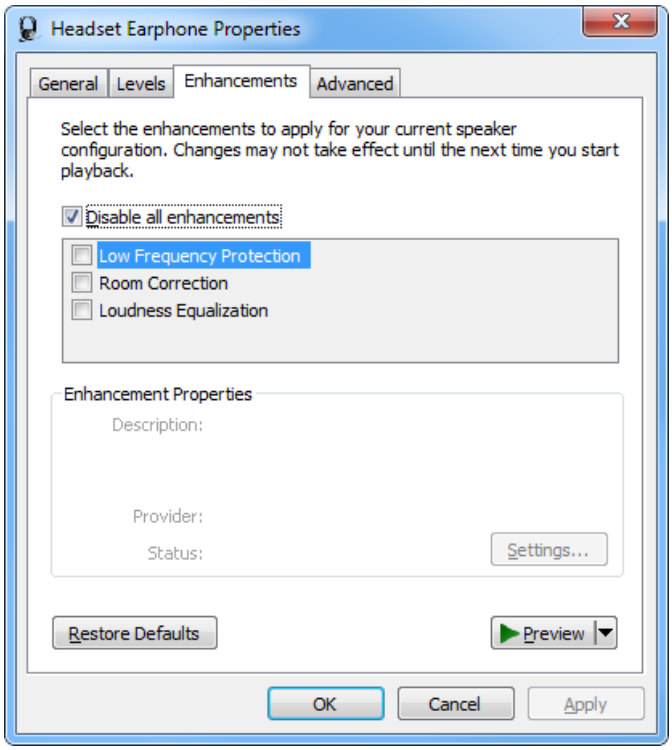

Figure 38. Headphone Earphone Enhancements tab.

Set the Headset Earphone **Default Format** to the 2 channel setting, with the highest bit resolution available at the 48000 Hz sample rate.

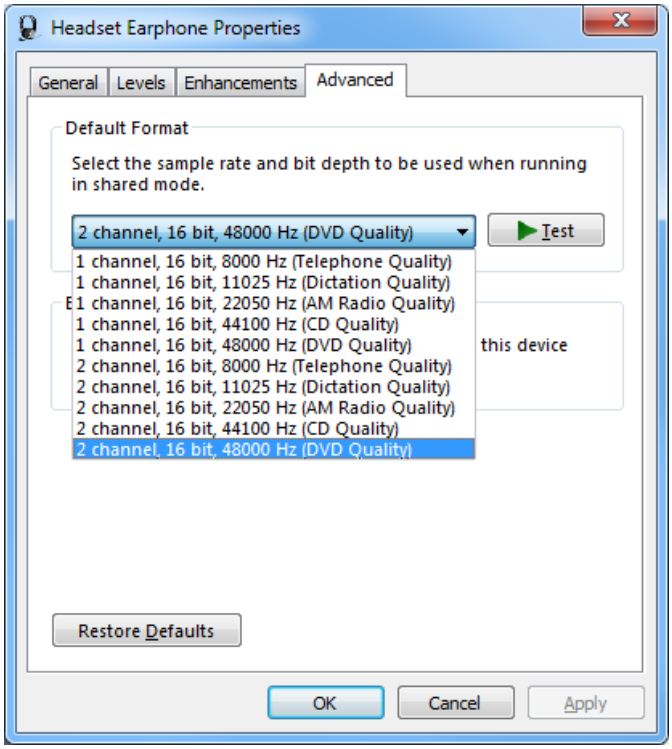

Figure 39. Headphone Earphone Advanced tab.

Configure the *SPDIF In* device as the default recording device.

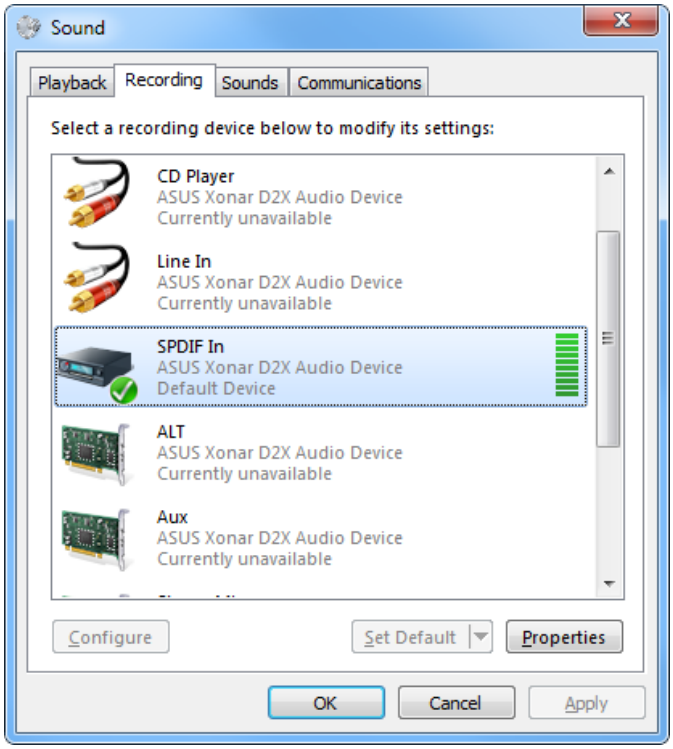

Figure 40. Sound Recording tab with SPDIF In set as Default Device.

Check **Listen to this device** on the *SPDIF In Listen* tab.

Uncheck **Listen to this device** on all other recording devices, to avoid mixing other input signals.

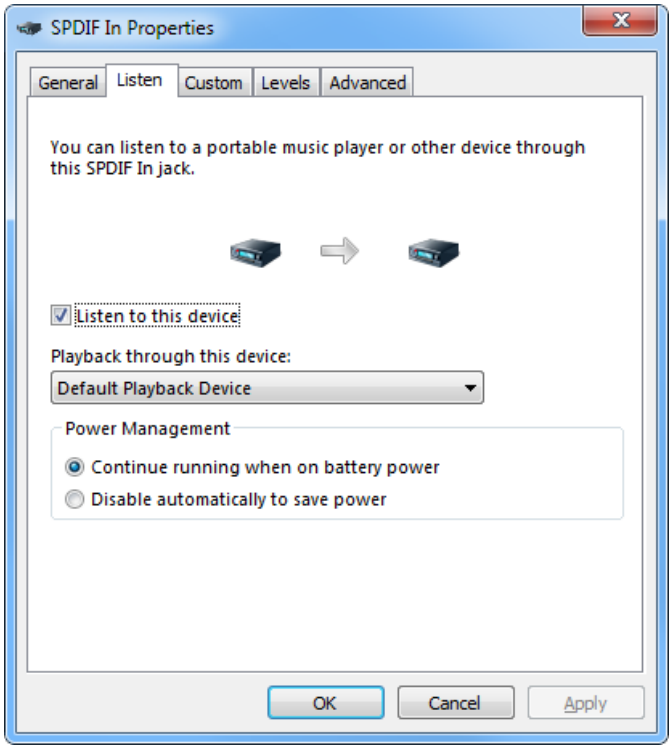

Figure 41. SPDIF In Properties Listen tab.

Set the *SPDIF In* level to 0.0 dB. Set the **Balance** to maximum and the same level for Left and Right channels.

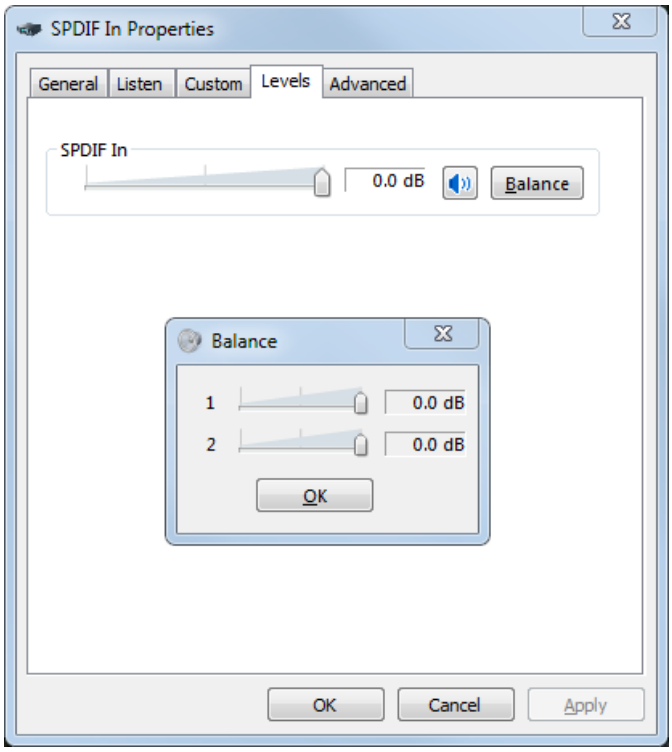

Figure 42. SPDIF In Properties Levels tab.

Set the SPDIF In Default Format to **2 channel, 24 bit, 48000 Hz**.

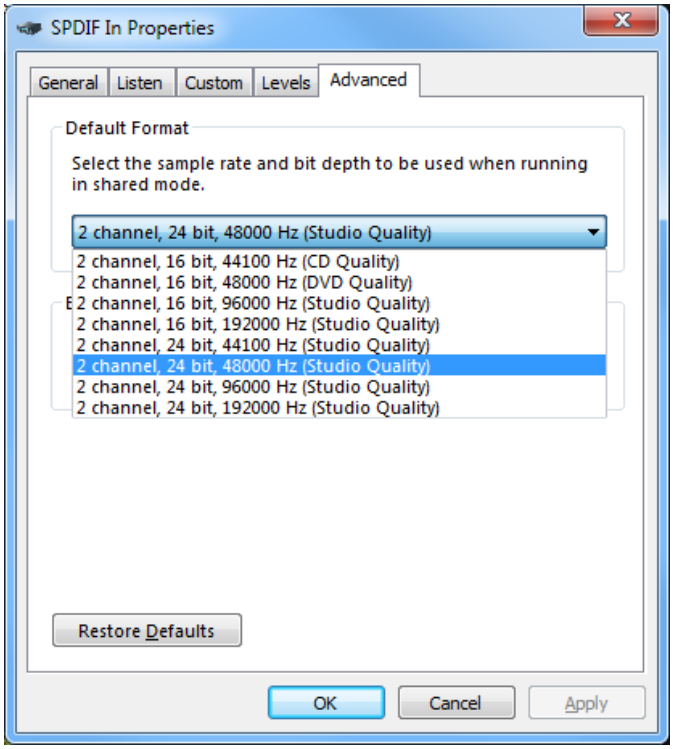

Figure 43. SPDIF In Properties Advanced tab.

Microphone Recording Device and Xonar Audio Card Playback Device

Follow these instructions to configure the Windows 7 Sound Recording and Playback properties for the headset microphone real-time audio tests.

Configure the Xonar D2X *S/PDIF Pass-through Device* as the default playback device.

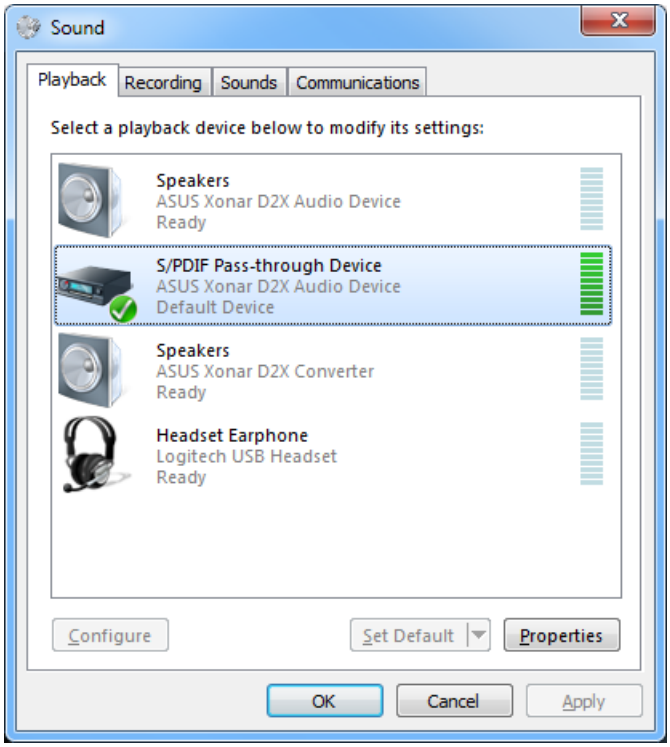

Figure 44. SPDIF Pass-through set as Default Device.

Set the *S/PDIF Pass-through Device* **Level** to maximum. Set **Balance** to maximum and the same settings for both Left and Right channels.

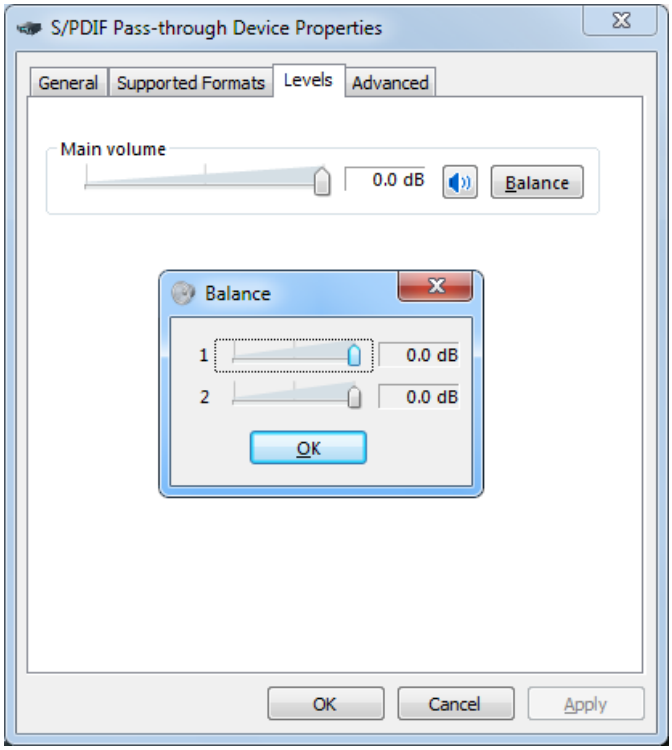

Figure 45. SPDIF Pass-through Device Levels and Balance.

Set the *S/PDIF Pass-through Device* **Default Format** to **2 channel, 24 bit, 48000 Hz**.

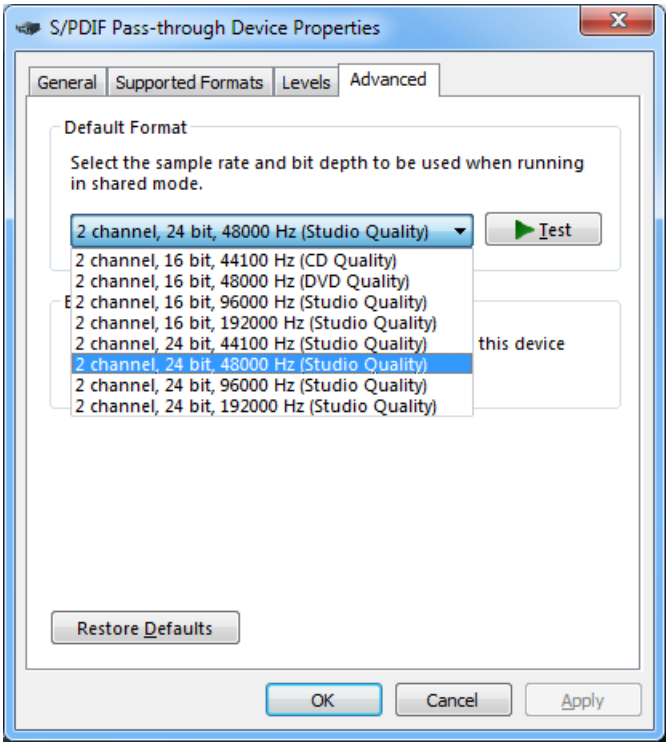

Figure 46. SPDIF Pass-through Device Advanced tab.

Configure the Headset Microphone as the default recording device.

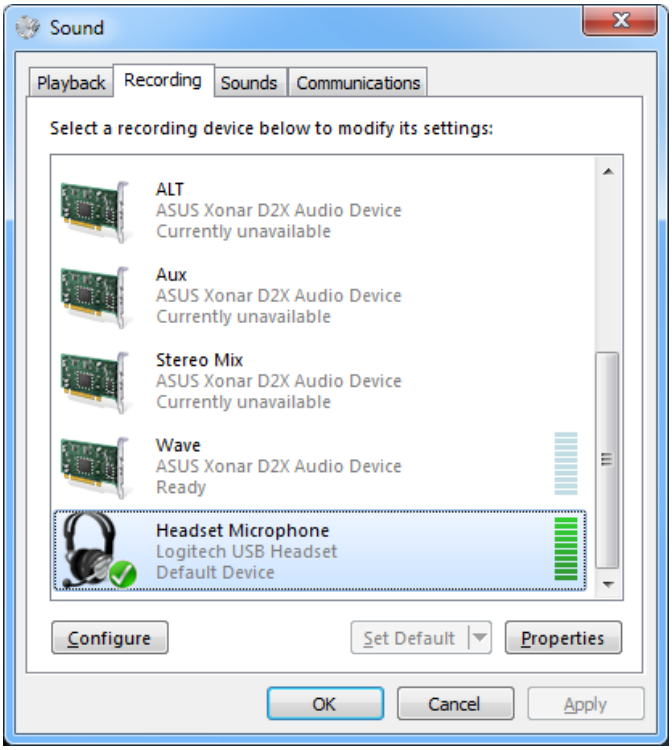

Figure 47. Headset Microphone set as Default Device.

Check **Listen to this device** on the Headset Microphone *Listen* tab.

Uncheck **Listen to this device** on all other recording devices to avoid mixing other input signals.

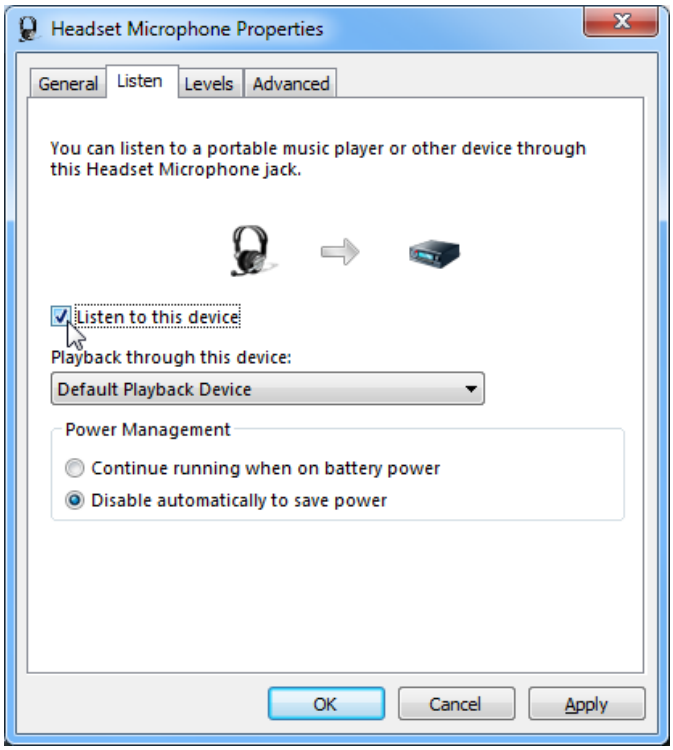

Figure 48. Headset Microphone Properties Listen tab.

Set the Headset Microphone level to the lowest value available that does not mute the microphone.

Disable all Microphone enhancements (if implemented). Set all Microphone boost settings to 0.0 dB and disable boost (if implemented).

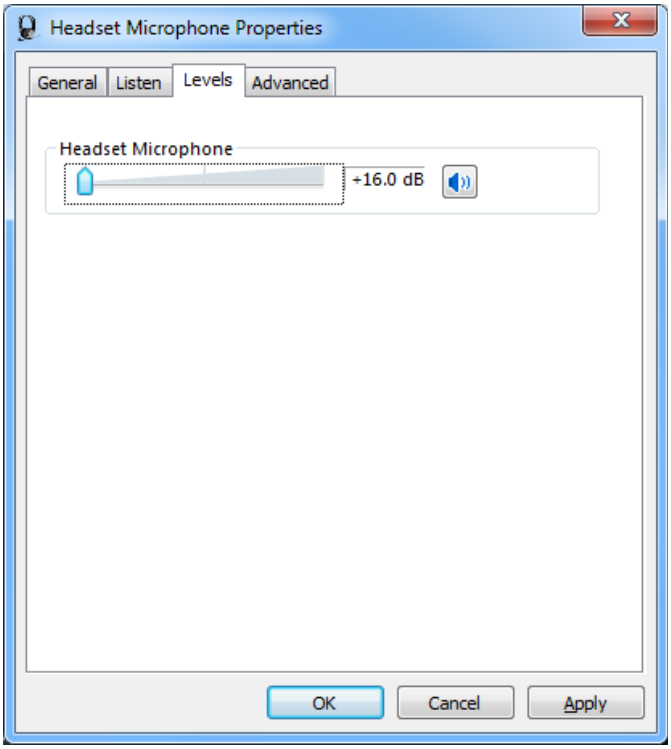

Figure 49. Headset Microphone Properties Levels tab.

Set the Headset Microphone **Default Format** to the 1 channel setting with the highest bit resolution available at 48000 Hz sample rate.

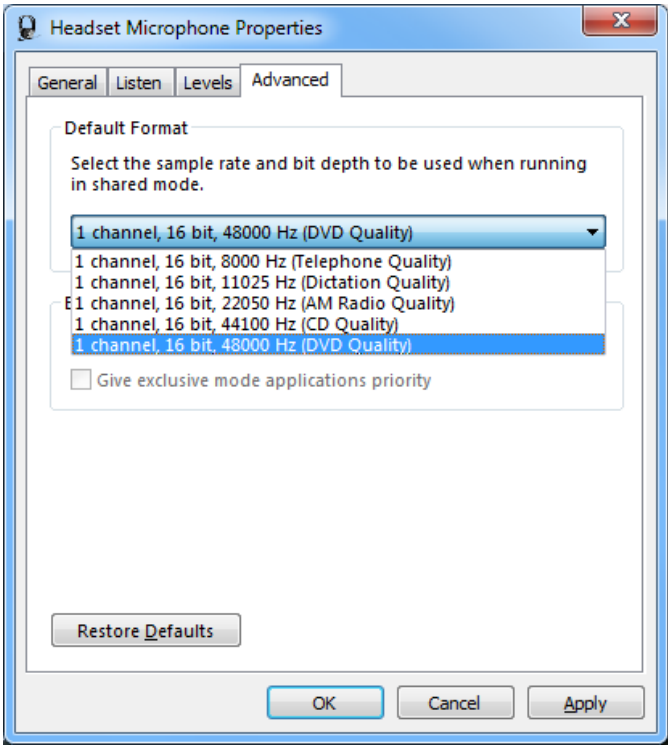

Figure 50. Headset Microphone Properties Advanced tab.

APPENDIX D - GoldWave Record/ Playback Configuration

GoldWave is an inexpensive digital audio editor application suitable for record and playback of audio test files. GoldWave is available for download and purchase at www.goldwave.com. Here are some configuration tips:

Start GoldWave and open the *Control Properties* dialog from the *Options* menu. On the *Device* tab, configure *Playback Device* as **Primary Sound Driver** and *Record Device* as **Primary Sound Capture Driver**. This will configure GoldWave to use the Windows 7 default playback and recording devices. Set *Quality* to **IEEE 32 bit**.

On the *Record* tab, check **Monitor input** in order to see the live recording level meters during a recording session.

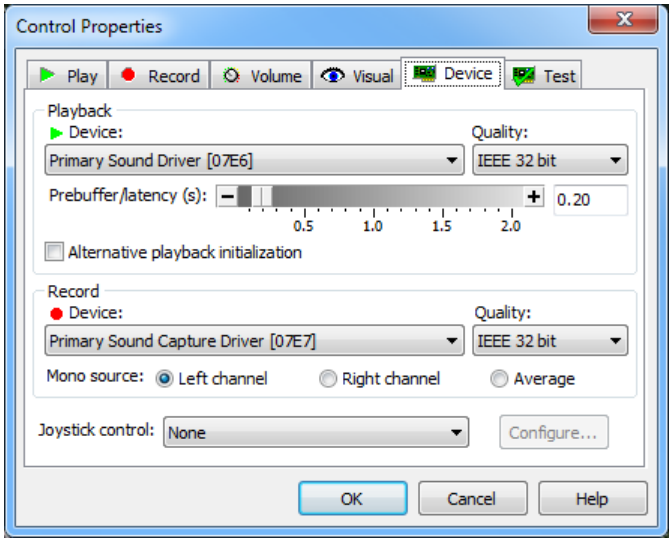

Figure 51. Control Properties Device tab.

Open the *File Format Options* dialog from the *Options* menu. Set **Save As type** to **Wave (*.wav)**. Set **Attributes** to **PCM signed 24 bit, mono** for a monophonic microphone input, or **PCM signed 24 bit, stereo** for a stereophonic microphone input.

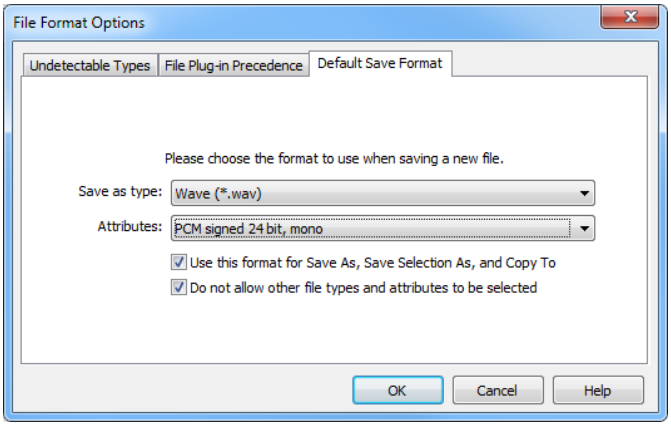

Figure 52. File Format Options Default Save tab.

To start recording audio from a microphone input, select the **New** button on the toolbar or select **New…** from the *File* menu. The *New Sound* dialog will appear as shown below. Set **Number of channels** to **1 (mono)** for a monophonic microphone input or **2 (stereo)** for a stereophonic microphone. Set **Sampling rate** to 48000. Select **OK** to complete the settings. A sound editor window will appear.

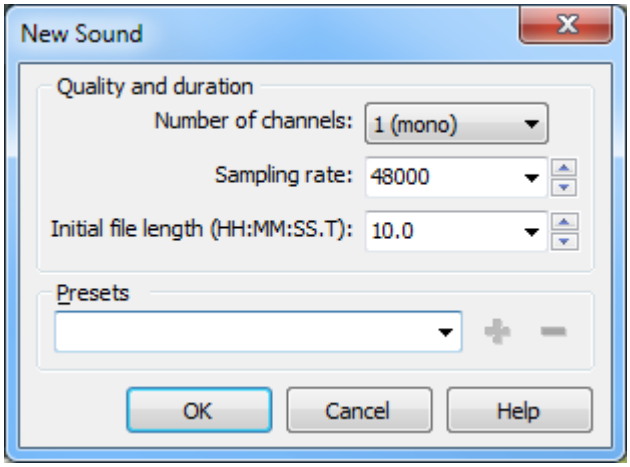

Figure 53. New Sound dialog.

To record or play back, use the control toolbar. See the GoldWave help for more information about recording.

Figure 54. Control toolbar.

To set up the VU meter, right-click and select *Properties*. Check **Show axis** to see audio level marks on the VU meter.

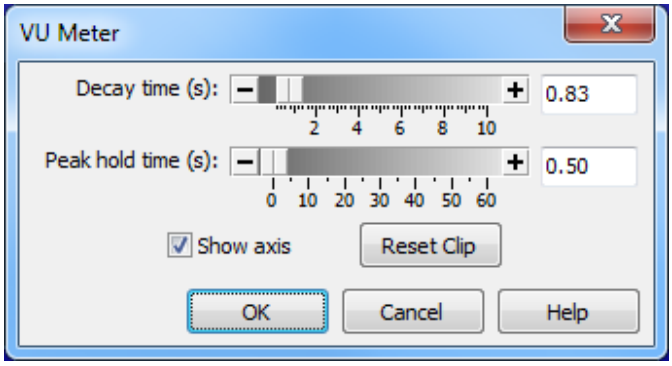

Figure 55. VU Meter properties dialog.

Use the VU meter to confirm that the APx analog output drives the microphone input near full scale but not clipping, preferably within 1 dB as shown below.

Figure 56. GoldWave VU meter.

After the recording is done, save the recording to the file specified by the APx500 measurement prompt during the microphone measurements sequence.

Navigate with the browser to the "C:\Users\Public\Music\APx USB Audio Test" folder, enter the filename, and select the **Save** button. The path and filename must match the path and filename expected by the APx500 measurement.

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