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# Professional Studio Monitoring System Calibration

May 9, 2008

## The Instructions:

*Instructions for electro-acoustic calibration of a professional stereo, 2.1 and 5.1 studio monitoring systems (speakers) using a SPL meter and ADL's test files. If you are interested in calibrating a home theater system, we recommend using the test signals and procedures included with your home theater receiver.*

Before starting, download the [ADLTestFiles.zip](#) (15 MB). To download the zip file, "Right Click" and select "Save Target As" and the file will begin downloading.

Once downloaded, either burn the test files on to a CD or import them directly into your DAW and follow the instructions below.

Additional Required Items

- Stereo, 2.1 or 5.1 Monitoring System
- SPL Meter – such as the SPL meter sold by [RadioShack](#) in the U.S.



ADLTestFiles.zip Includes 4 files:

- 1000Hz SINEWAVE -20dBFS.wav – a 1kHz file recorded at -20dBFS for electrical calibration
- 40-80Hz PINK NOISE -20dBFS.wav – a 40Hz to 80Hz bandwidth limited pink-noise file recorded at -20dBFS
- 500-2.5kHz PINK NOISE -20dBFS.wav – a 500Hz to 2500Hz bandwidth limited pink-noise file recorded at -20dBFS
- Pink Noise full bw -20dBFS.wav – a full-bandwidth pink-noise file recorded at – 20dBFS

*All the test signals were created and measured on the [Prism Sound dScope III](#) and conform to the AES 17 guidelines for digital audio measurements. Because pink noise has a high crest factor, the levels of the pink noise signals were made using a time averaging technique, where multiple time samples are captured and averaged over a ten second interval to calculate the RMS level. These test files are all mono files. Please make sure you hard assign them to the left and then the right, not both channels at the same time. If you are using a CD / CD player, use only one channel of the CD player.*

Theory

The purpose of calibration is to adjust the overall electro-acoustic system gain so that 0dBVU of electrical signal level equals a certain acoustic level at the listening position. Since most recording media is now digital, the reference electrical signal level is usually –20dBFS with 20dB of headroom. The reference SPL however can vary based on the delivery media and speaker type.

***Please note** that the bandwidth limited signals that have been provided, limit many of the room interaction affects often associated with measuring SPL and broadband pink noise.*

***\*Also note** that the LFE channel gain in 5.1 formats varies from 0 to +10 dB depending on the encoding format used. This level is referenced to the bass-managed subwoofer level, which is listed as “SUB” in the chart below. Since the LFE channel is not calibrated as a separate entity, the LFE gain will not affect system calibration. It is important not to confuse the bass-managed subwoofer calibration level with the LFE channel. For more information about bass-management and the LFE channel, [please follow this link](#).*

The common calibration levels are listed below:

	L	C	R	LS	RS	SUB*
Movie Theatrical release	85dB	85dB	85dB	82dB	82dB	85dB
Movie DVD release	85dB	85dB	85dB	85dB	85dB	85dB
Broadcast / 85dBC or	78dB	78dB	78dB	78dB	78dB	78dB
Music (Stereo)**	85dB		85dB			85dB
Music (5.1)**	85dB	85dB	85dB	85dB	85dB	85dB

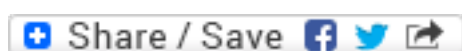
***\*\*IMPORTANT:** When compared to movie soundtracks, music tends to be much more compressed, with reduced dynamics and greater overall level. Because of this, music mixes may seem too loud when played back on a system calibrated for an 85dBc reference level. If this is the case, we recommend calibrating for a lower reference level, such as 78dBc.*

All test signals are recorded at -20dBFS including the 1 kHz sine wave tone. The sine wave tone is used to set the electrical output level throughout the signal path, right up to the point you get to the speakers. While the various pink noise signals are used for acoustic measurements and calibration.

The following procedure assumes you are calibrating the system to 85dBc SPL. If you are calibrating to TV, etc. substitute the appropriate level from the above chart.

1. **TURN OFF THE MONITORING SYSTEM (until step 4)**
  2. **Remove all eq and dynamics from the signal path and set all controls to zero / unity gain.** Play the 1kHz Sine Wave, hard assign it to the left channel only, and adjust the output fader so the so the output meter reads -20dBFS. If you are using an analog console or measuring the output of your D to A, set the output level to 0dB VU (typically 0dB VU is equal to +4dBu / 185 nanoWebers per meter / 1.23 Volts RMS – using a true RMS volt meter). Then hard pan the signal to the right channel output and repeat for the right channel. For a 5.1 system assign the channel to each output and repeat the adjustment procedure. Once calibrated do not move the output faders.
  3. Mute everything and make sure the 1kHz tone is OFF.
  4. Now that the system has been electrically calibrated, turn ON the SUB and SATs.
  5. Assign the 500-2.5kHz pink noise signal to the left channel only. Make sure there is nothing coming from the right channel (or any other channels). Because this signal is bandwidth limited, you don't have to worry about turning the sub off. There are two methods of setting the levels.
    1. If you have a master monitor controller, with individual channel calibration adjustments (such as [Blue Sky's BMC](#)), you can set the monitor gain controls on each speaker at the reference / max gain position and then adjust the master level control for 85 dBc. Then mark that master monitor level as your 'reference position' and use the individual channel calibration adjustment on your controller, to calibrate the rest of the channels, as outlined below. This method may not always be practical and if your monitors have too much gain, may result in a in poor signal to noise ratio.
    2. The other method is to set master monitor level to the position you want as a reference level and then use the individual monitor gain controls, until you measure 85 dBc. If you use this method you should mark the knob position, on each monitor, with a grease pencil so you can always go back to the reference level if the knob gets moved.
- For either method:**  
*SPL should be measured at the mix position, with the SPL meter at arms length, with the microphone at seated ear height, angled at approximately 45 degrees, and pointed at the center point between the left and right speakers.* Once the left channel is set to 85dBc, repeat this step for the right channel (and C, LS & RS in a 5.1 system).
6. Feed 40-80Hz pink noise signal to the left channel only. Adjust the subwoofer level control until the subwoofer reads 85dBc (slow) at the mix position. The meter will bounce around a little, so you will need to do a mental average (I tend to filter out the peaks in my mind, so I don't set the sub too hot). The right channel should measure about the same and no additional adjustments need to be made.
  7. You can play the full-bandwidth pink noise, assigning it to the left and then the right channel (not at the same time). You should measure about 85dBc. It may be a little higher, because below 30Hz the room may have a little extra gain. *No adjustments should be made with Full Bandwidth pink noise, unless you have an RTA (real time analyzer).*
  8. You are finished and the calibration process has been completed – **enjoy!**

If you have any questions, please don't hesitate to [contact us](#), or [leave a comment to this topic](#).



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