Ultimate Equalizer V7.0 Supplemental User Manual

April 2015

New Features Implemented in Ultimate Equalizer 7.0 – Digital

1. Implemented 2.1 and 2.2 loudspeaker system design screens. The 2.2 screen runs BBM mode as well.

2. Added 24bit/96kHz 2.0 stereo and 24bit/96kHz 5.1 Surround WAVE Player options to the existing 16bit/44.1kHz 2.0 stereo playback.

3. Data buffering option 2/3/4/5 buffers.

4. Subtle process timing adjustments for capture and playback.

5. Added "Clear Playlist" button in WAVE Player.

6. 512 bin data buffer implemented to reduce latency (72ms in linear-phase and 36ms in minimum-phase). This is perfect for audio-video playback. There is now a significant number of latency options to choose from.

7. In the MLS measurement system - windowing and scrolling improvements in Impulse Response processing.

8. Removed max frequency limit for filters. Allows you to mimic broad, gentle filtering slope (-6dB @ 20kHz) as per H. Moller, from B&K application Note 17-197.

9. Fixed "buffer size" bug affecting performance and automatic memory allocation when switching project files.

10. LED bar-graph display extinguishes when any player stops.

11. WAVE Player Mode will load speaker system configuration files (Project Files) via keyboard numeric command. Playback of wave files from valid playlist will start by pressing "Play" button.

12. Added 10-channel output (specifically for Delta1010LT 8outputs+SPDIF) selection from Preferences screen

This User Manual is intended to provide information about new features in version 7, and should be read in conjunction with the full User Manual for version 5 and 6, and available from Bodzio Software Pty. Ltd. website.

2.2 System Design Screen

Augmented stereo 2.1 and 2.2 system configurations seem to become quite popular. An example of such augmentation with two separate subwoofers, one for left channel and one for right channel is shown below. Please note, that input to Subwoofer 1 is assigned to be "In1" – which is the left stereo channel. Input to Subwoofer 2 is assigned to be "In3" – which is the right stereo channel.
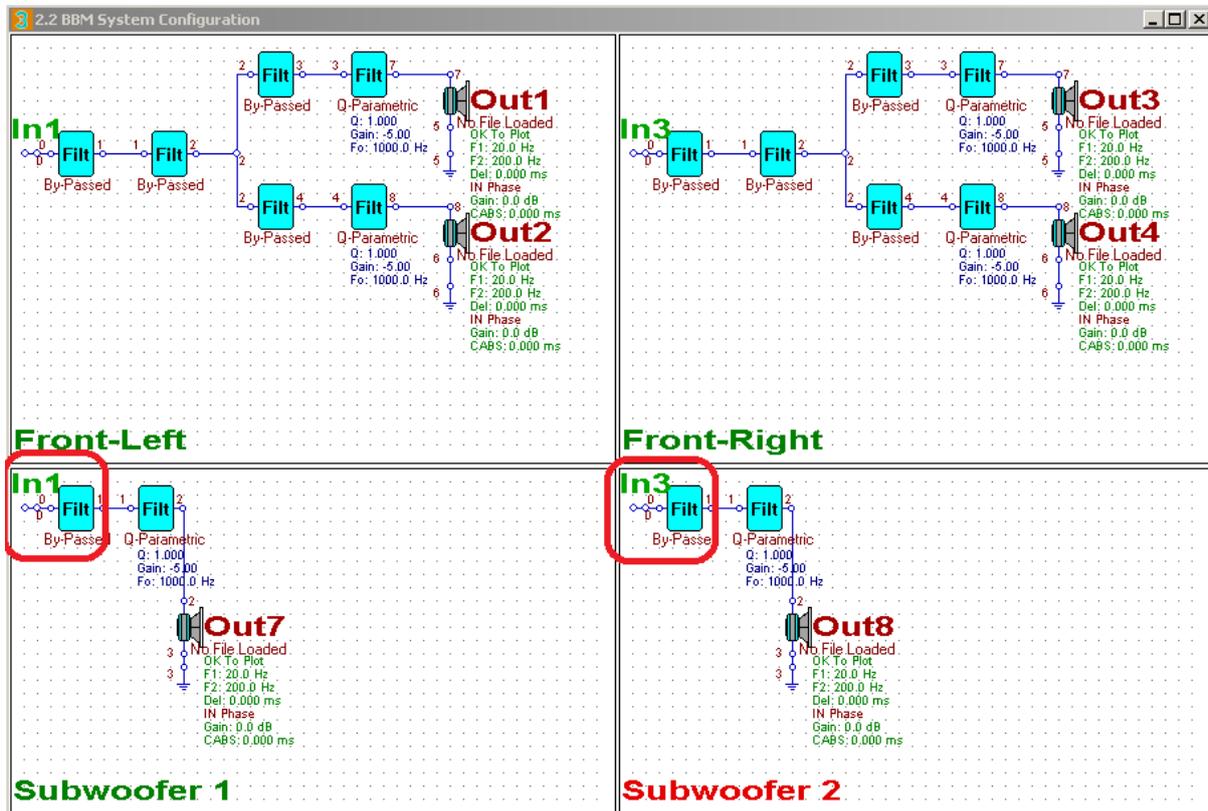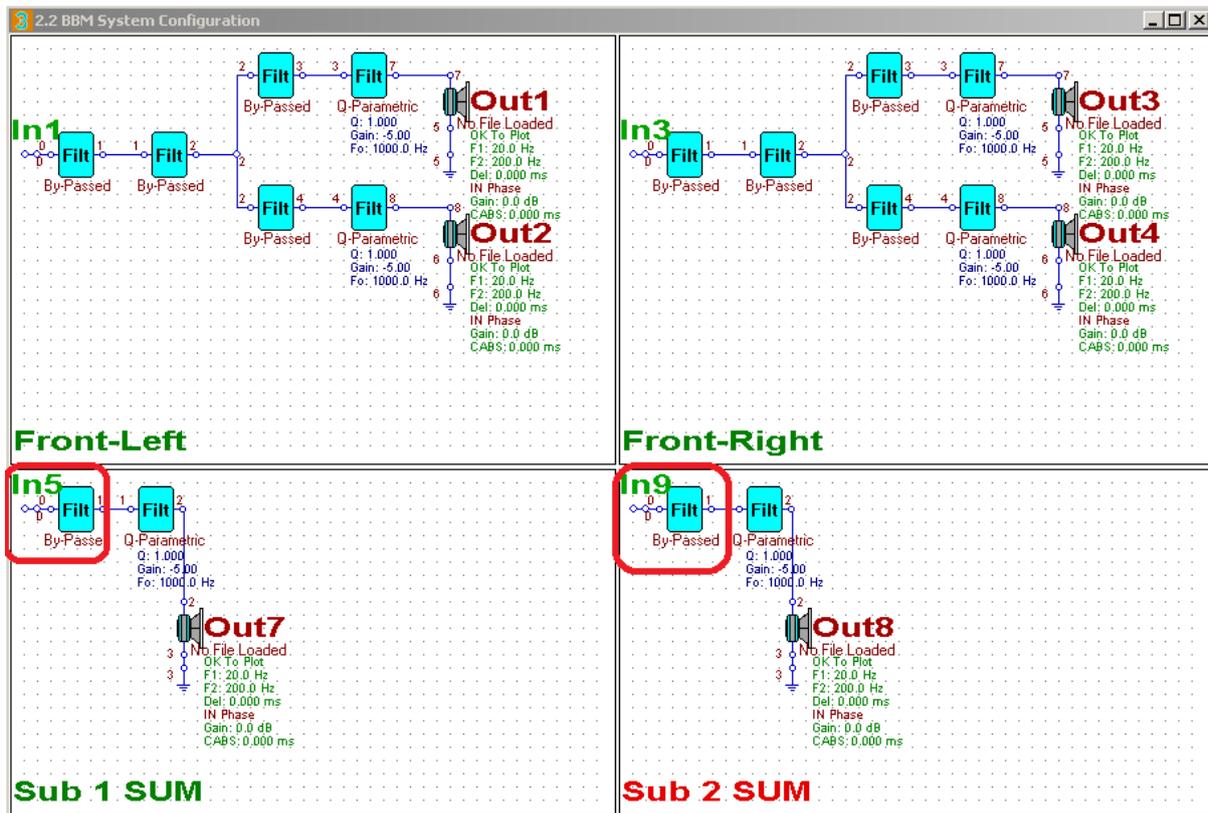

Figure 1. Typical 2-way system set-up as 2.2 with left/right subwoofer augmentation.

Testing for correctness of signal flaw is quite obvious – simply play music through left channel only, and you should see "Output" bars 1,2 and 7 going up. When you feed only the right channel, the "Output" bars 3,4 and 8 are active – see Figure 2 below.
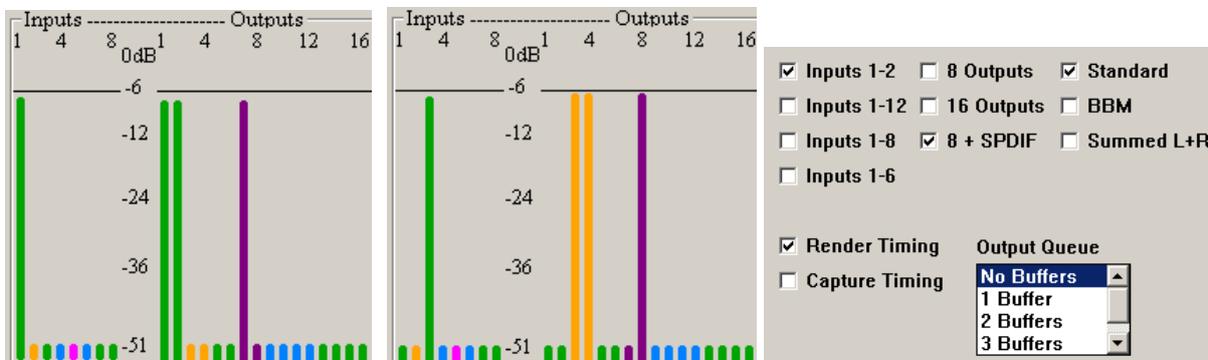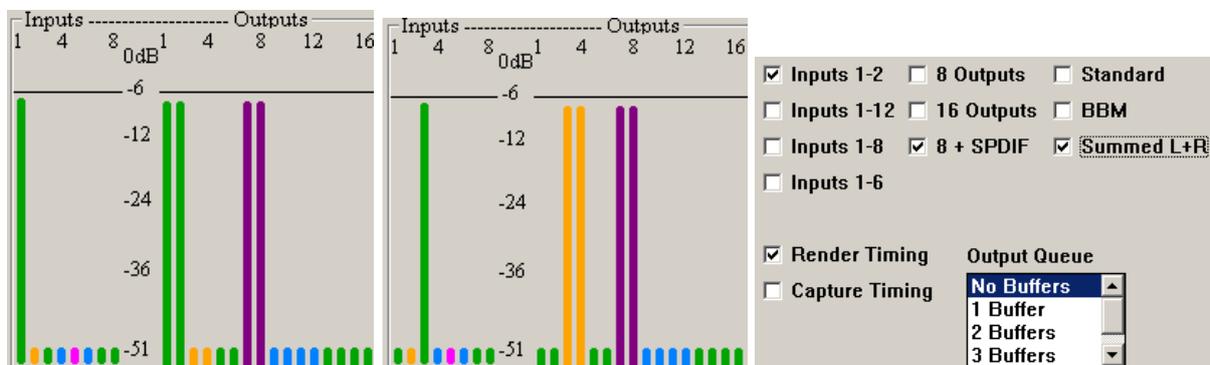

Figure 2. Signal flow when only left/right channel is active, and Preferences settings.

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2.1 System Design Screen

Another option is 2.1 Stereo System with single subwoofer. This would imply, that you need to extract low-frequency output from both: left and right channels, add them up, and allow to play via single output. This configuration is shown on Figure 3 below. Please note, that inputs to subwoofers are "phantom input" numbers – input signal in not connected to In5 and In9, but only to In1 and In3. This arrangement allows the summation (Summed L+R selected in Preferences screen) to function correctly.

Figure 3. Typical 2-way system set-up as 2.1 with single subwoofer augmentation.

Testing for correctness of signal flaw is quite obvious – simply play music through left channel only, and you should see "Output" bars 1,2 and 7,8 going up. When you feed only the right channel, the "Output" bars 3,4 and 7,8 are active – see Figure 4 below.

Figure 4. Signal flow when only left/right channel is active, and Preferences settings.

Low-frequency accuracy for different buffer sizes

Selecting various buffer sizes (512 / 1024 / 2048 / 4096) from Preferences screen affects two major parameters:

1. Low-frequency resolution. This will vary from 1.47Hz for largest buffers and 16-partition version to 11.2Hz for 512 buffer and 8-partition version. The low-frequency accuracy for several buffer sizes is shown on figures below.
2. System latency. This will vary from 36ms (Minimum-Phase, 8-partitions, and 512 buffer) to 460ms (Linear-Phase, 16-partitions, and 2048 buffer).

Obviously, the major factor impacting on system latency is the Linear-Phase Mode of operation. The table below, shows an example of various latency times for i7 960 CPU, depending on buffer size, sampling frequency and number of partitions.

7.2 HT Hybrid System				Delta1010LT + Lunx AES16			
UE Buffer Size	**48kHz Sampling**				**96kHz Sampling**		
	8 Partitions		**16 Partitions**		**8 Partitions**		**16 Partitions**
	8in - 16out		8in - 16out		8in - 16out		8in - 16out
512	Pt = 3.1ms Lt = 10.69ms LF-Res = 10.7Hz Delta buffer = 64 Lynx buffer = 128 **Latency: LP=75ms, MP=36ms**	D1=6.45 D2=7.7	Pt = 6.8 Lt = 10.69 LF-Res = 5.86Hz Delta buffer = 64 Lynx buffer = 128 **Latency: LP=120ms, MP=36ms**	D1=3.0 D2=4.3	Not Allowed		
1024	Pt = 5.9ms LT = 21.4ms LF-Res = 5.86Hz Delta buffer = 128 Lynx buffer = 128 **Latency: LP=147ms, MP=65ms**	D1=11.0 D2=13.7	Pt = 13.5ms LT = 21.4ms LF-Res = 2.93Hz Delta buffer =128 Lynx buffer = 256 **Latency: LP=235ms, MP=65ms**	D1=4.0 D2=6.7	Pt = 5.86 Lt = 10.69 LF-Res = 10.7Hz Delta buffer = 128 Lynx buffer = 256 **Latency: LP=76ms, MP=36ms**	D1=4.5 D2=5.9 (border line)	Needs faster PC
2048	Pt = 11.5ms LT = 42.7ms LF-Res = 2.93Hz Delta buffer = 128/256 Lynx buffer = 128/256 **Latency: LP=295ms, MP=130ms**	D1=19 D2=24.2	Pt = 26.1ms LT = 42.7ms LF-Res = 1.47Hz Delta buffer = 256 Lynx buffer = 256 **Latency: LP=465ms, MP=130ms**	D1=10.3 D2=15.6	Pt = 12.0ms LT = 21.37ms LF-Res = 5.86Hz Delta buffer = 128/256/512 Lynx buffer = 256/512 **Latency: LP=150ms, MP=69ms**	D1=11.6 D2=14.3	Needs faster PC
4096	Not Allowed				Pt = 25.0ms LT = 42.7ms LF-Res = 2.93Hz Delta buffer = 128 Lynx buffer = 256 **Latency: LP=295ms, MP=130ms**	D1=22.6 D2=28.0	Needs faster PC

Figure 5. Example performance numbers for i7 960 CPU with Windows7/64 Professional.

Low-frequency resolution will obviously deteriorate as the data buffers get smaller, and smaller. This may require additional re-testing effort to confirm, that the desired equalization is taking place, otherwise, you will need to modify the equalization and re-test again, until you are satisfied with the final result. For instance, if you run 11.2Hz bass resolution, and you determined, that the required notches/peaks of the measured equalization curve are too shallow, you may need to add an extra peak/notch into the system filtering (on the top of inverted HBT filtering) to achieve the overall frequency response.

Such approach will allow you to achieve very low latencies and still maintain adequate equalization of your subwoofers. This would be very desirable when using you DVD player with UE7. Latencies below 185ms are deemed acceptable for audio-video experience. **The lowest Linear-Phase latency is 75ms and Minimum-Phase latency is 36ms. These figures are excellent and do not require your DVD player to delay video.**

In general there are following latency options:

1. 36ms – MP, UE Buffer = 512, Delta Buffer = 64, Lynx Buffer = 128, UE = 8P
2. 36ms – MP, UE Buffer = 512, Delta Buffer = 64, Lynx Buffer = 128, UE = 16P
3. 75ms – LP, UE Buffer = 512, Delta Buffer = 64, Lynx Buffer = 128, UE = 8P
4. 120ms – MP, UE Buffer = 512, Delta Buffer = 64, Lynx Buffer = 128, UE = 16P
5. 65ms – MP, UE Buffer = 1024, Delta Buffer = 128, Lynx Buffer = 128, UE = 8P
6. 65ms – MP, UE Buffer = 1024, Delta Buffer = 128, Lynx Buffer = 256, UE = 16P
7. 147ms – LP, UE Buffer = 1024, Delta Buffer = 128, Lynx Buffer = 128, UE = 8P
8. 235ms – LP, UE Buffer = 1024, Delta Buffer = 128, Lynx Buffer = 128, UE = 16P
9. 130ms – MP, UE Buffer = 2048, Delta Buffer = 128, Lynx Buffer = 256, UE = 8P
10. 130ms – MP, UE Buffer = 2048, Delta Buffer = 128, Lynx Buffer = 256, UE = 16P
11. 295ms – LP, UE Buffer = 2048, Delta Buffer = 128, Lynx Buffer = 256, UE = 8P
12. 465ms – LP, UE Buffer = 2048, Delta Buffer = 256, Lynx Buffer = 256, UE = 16P

When equalizing 5.1HT or 7.1HT system, one needs to observe maximum tolerable audio-video latency, which is 185ms. It is therefore observable, that a number of system configurations listed above, will lead to a significantly lower latency than the 185ms threshold.

How does the buffering option affect low-frequency accuracy?.
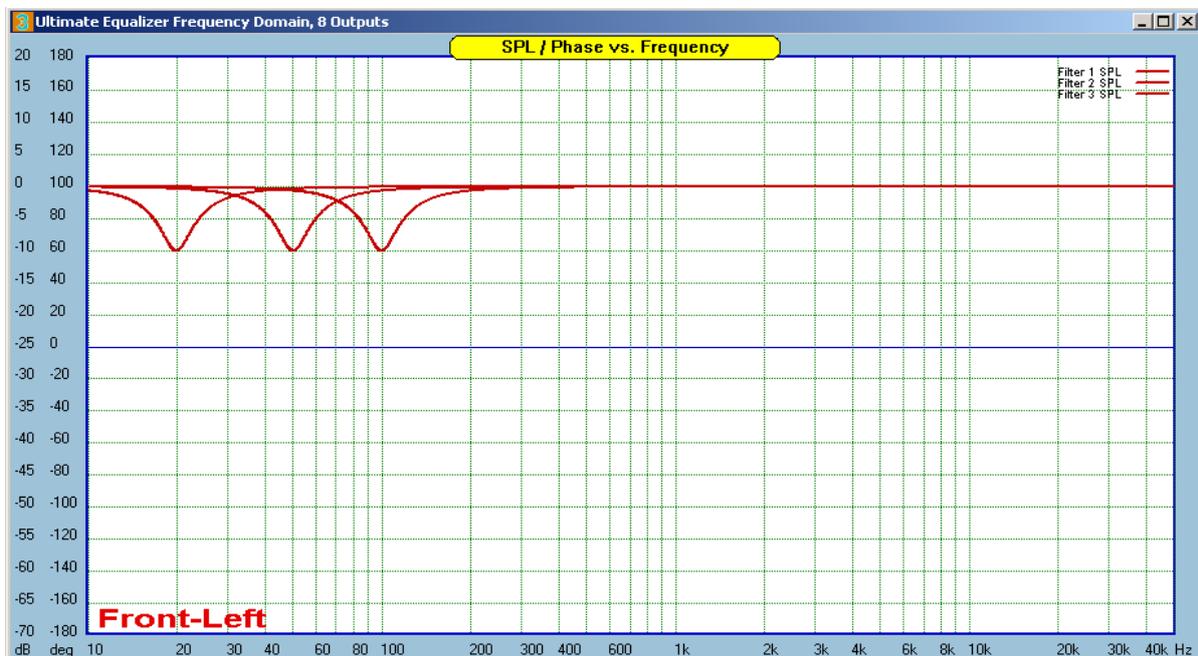
Figure 6. -10dB notch at 100Hz, 50Hz and 20Hz designed in System Design screen
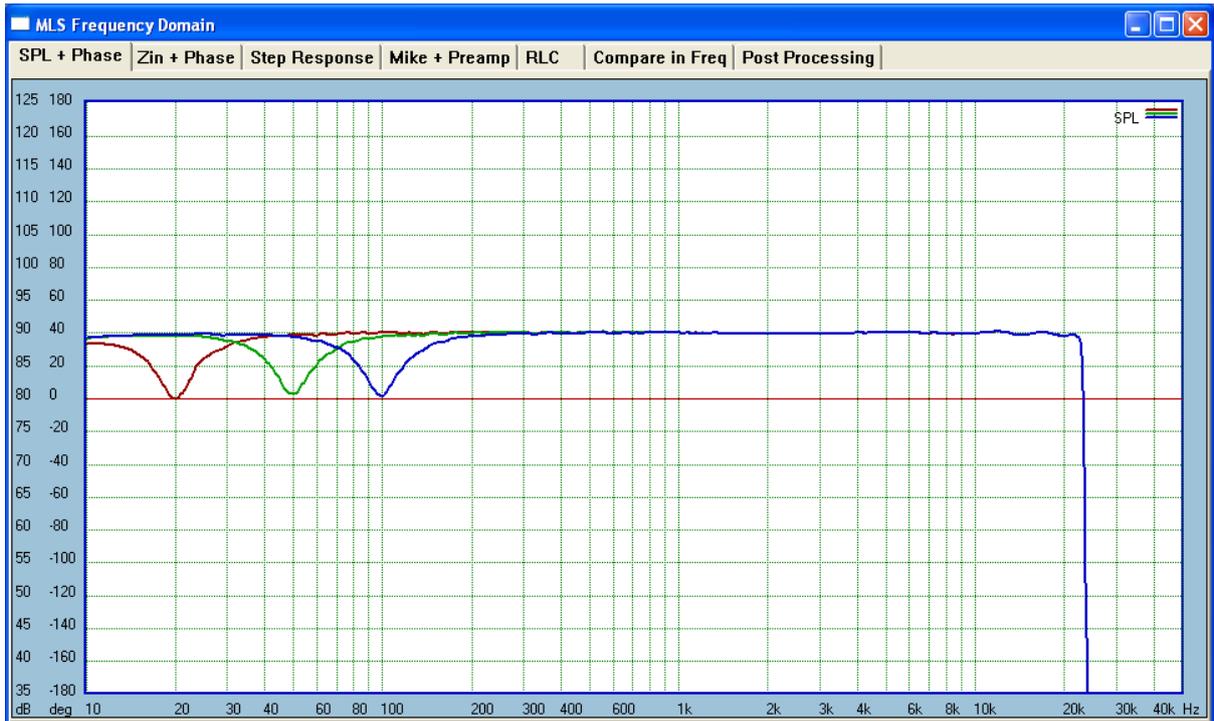
Figure 7. The same -10dB notch at 100Hz, 50Hz and 20Hz played through 16P version with 1024 buffer.
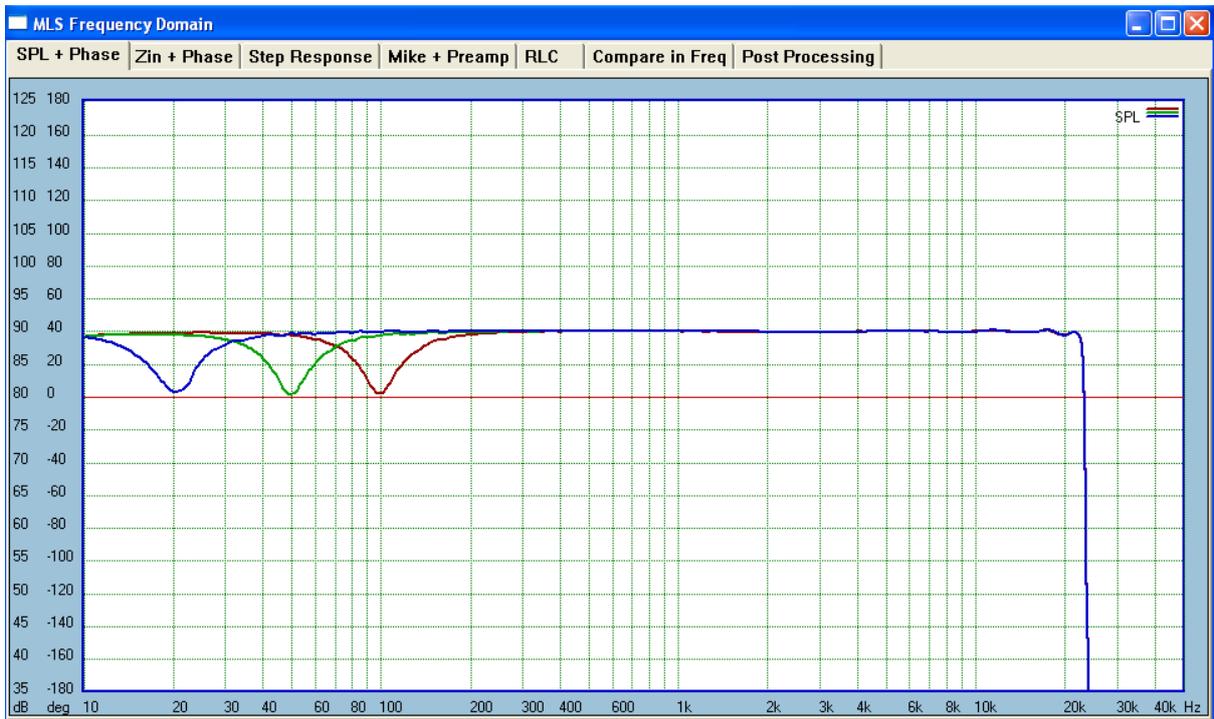
Figure 8. The same -10dB notch at 100Hz, 50Hz and 20Hz played through 16P version with 512 buffer.
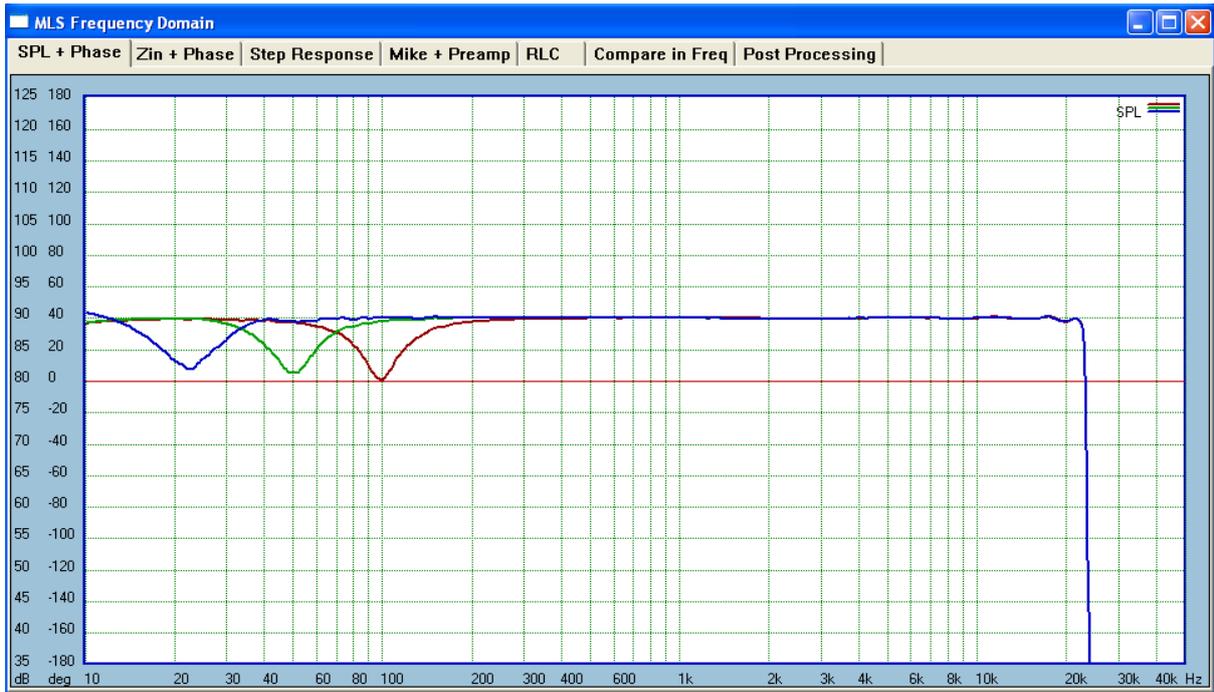
Figure 9. The same -10dB notch at 100/50/20Hz played through 8P version with 512buffer

Introduction of 512 size UE buffer pretty much solves the latency issue. Latency summary presented on page 7 shows, that there are seven latency options below 185ms. I have been running Option 7 for several years now, but with UE7, I decided to switch to Option 4, which offers the same bass resolution as Option 7, but cuts the latency by 27ms. Obviously Option 1 and Option 3 reduce the latency even further. The **i7-4770K** CPU handles UE7-16P option quite well.

Removal of max frequency limit for filters.

The main reason for this change is to enable implementation of Moller's correction.
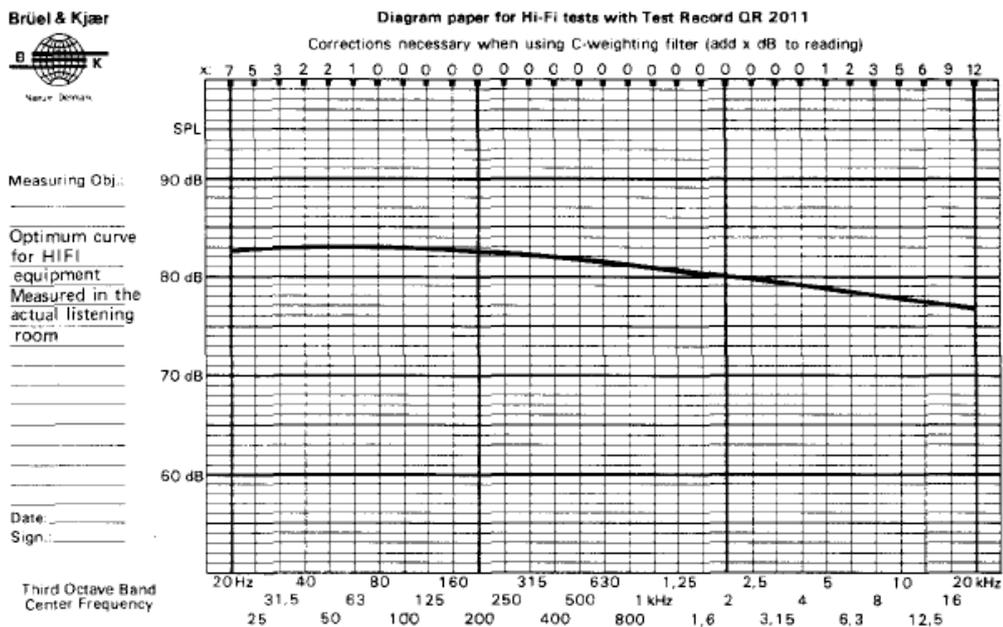
Most recordings are made as a combination of near-field and far-field information. Therefore the broad frequency response of the audio system should boost a little at low frequencies and roll off a little at high frequencies for most commercial recordings (H. Moller, from B&K application Note 17-197)- see Figure above.
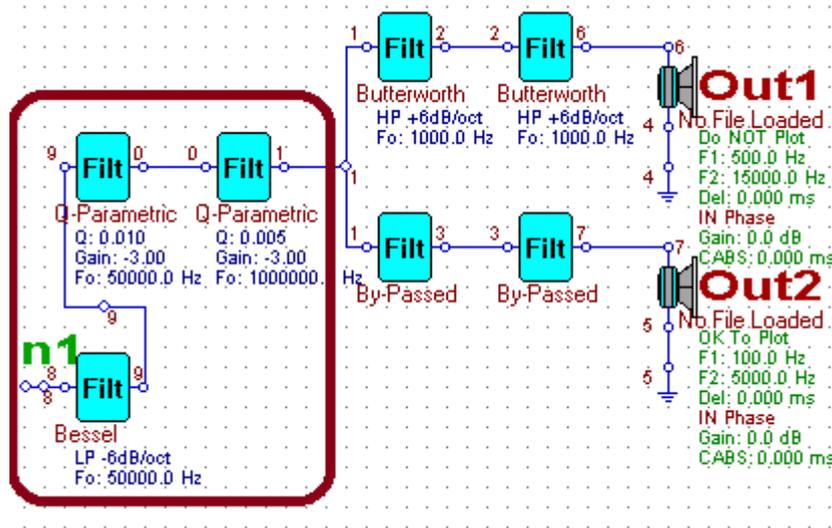
Figure 10. Introduction of 3-segment Q-Parametric filters to approximate Moller's correction
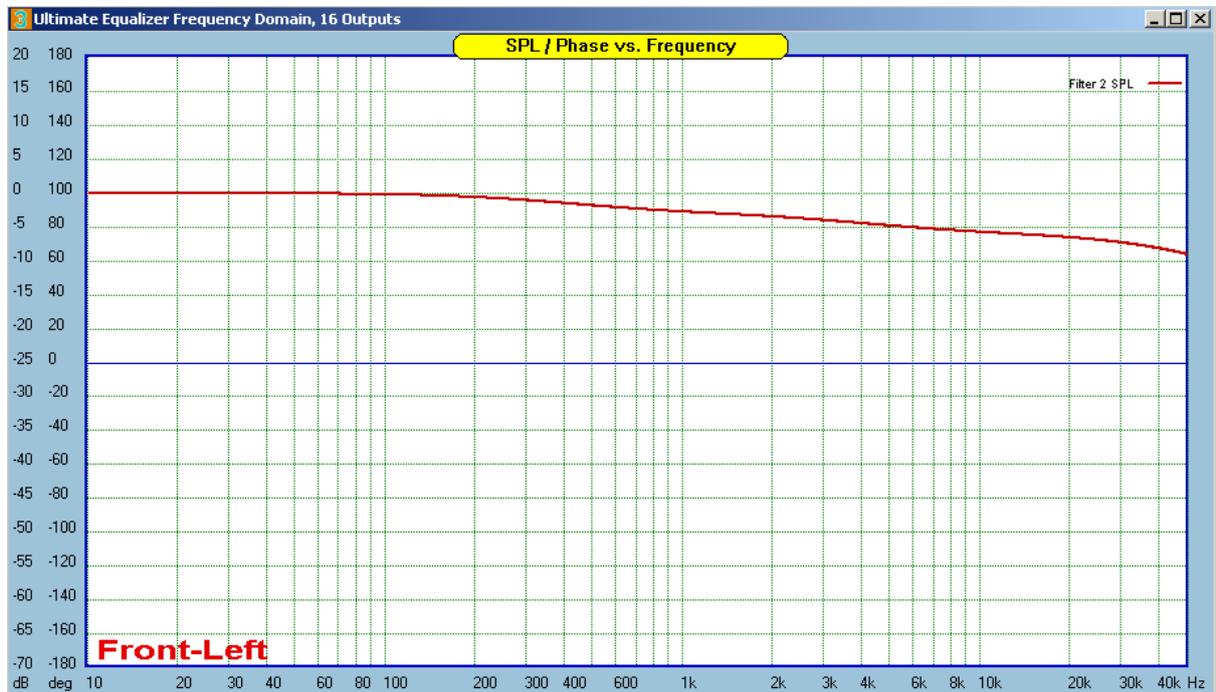
Figure 11. Correction curve based on 3-segment Q-Parametric filters to approximate Moller's correction

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Process timing adjustments and data buffers

One of the critical objectives required from audio-video software is minimization of latency, and obviously stable, reliable run. UE7 introduces subtle timing adjustments: "Render Timing" and "Capture Timing" options, that may help your particular PC+sound card combination run the program more efficiently. There is no general rule for selecting either of the options. You will have to determine the best combination, while also taking into account your sound card buffers – selected via sound card monitoring software.

For instance, when Delta1010LT is used, the sound card buffer selection varies from 64 to 512, depending on UE partition option and sampling frequency. Similarly, the sound card buffer in LynxAES16e is typically selected as 128 to 512 - again, depending on UE partition option and sampling frequency.

You will be guided by Pt, Lt, D1 figures, with correct examples are shown on page 10-12.

Additionally, processing of input data blocks can be isolated from outputting data blocks by selecting "Output Queue" with 1/2/3/4/5 buffers. These circular buffers provide additional smoothing in data transport within the program, the penalty will be increased latency. Each buffer will add latency depending on sampling frequency and UE buffer size. For instance for 48kHz and 1024 UE buffer - this will add 21.37ms latency per "Output Queue" buffer.

Windowing and scrolling improvements in MLS Impulse Response processing

In this software release, we have added "**Page" and "Line" scroll** ability to MLS impulse response window. This offers the user much better positioning of the impulse response for the purpose of selecting time window.

Also, mouse cursor centres the symmetrical windows, rather than points to start of the symmetrical window – see example below.
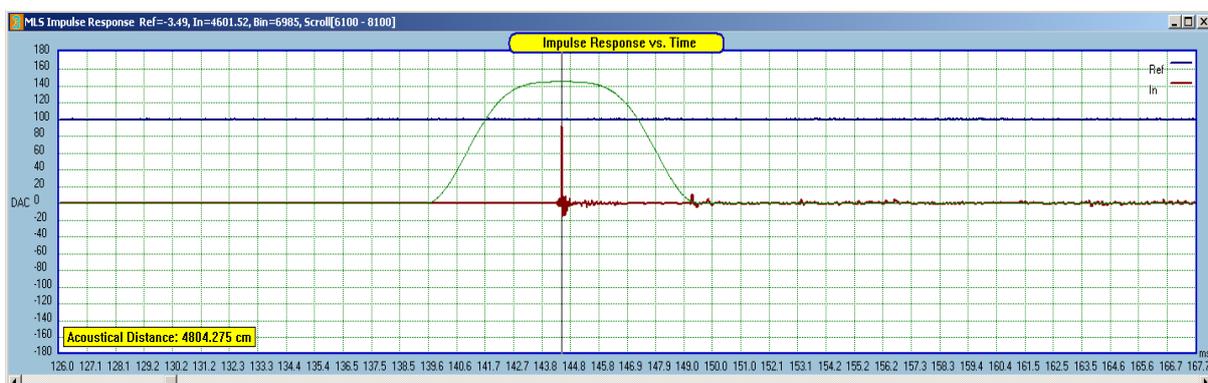
Examples of Pt, Lt, D1 figures

All examples shown below are generated with i7 960 CPU, Windows7/64bit operating system and Delta1010LT and LynxAES16e sound cards. The figures are typical examples, but show at what values you should be aiming for when selecting number of buffers and Render/Capture Timing options for your individual sound cards.

Ultimate Equalizer V7 – 8 partitions
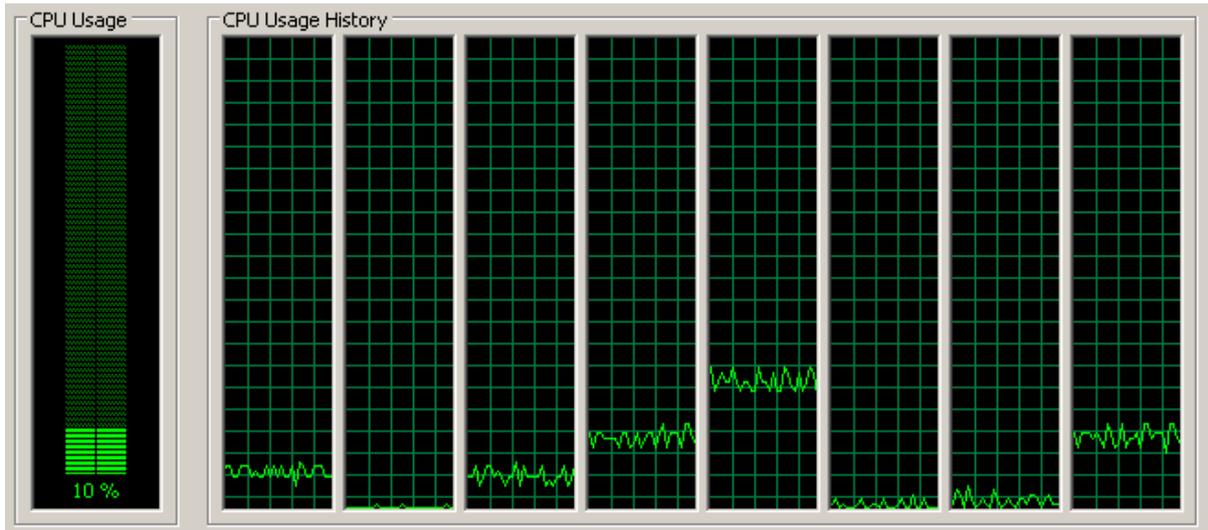
CPU Core Loading
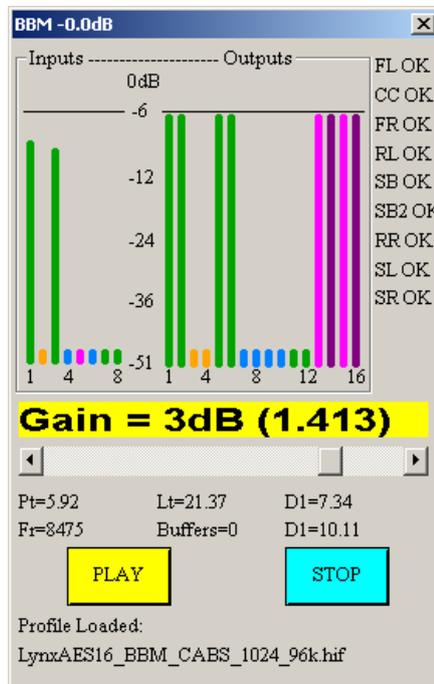
UE Buffer Size = 1024 bins

Ultimate Equalizer V7 – 16 partitions
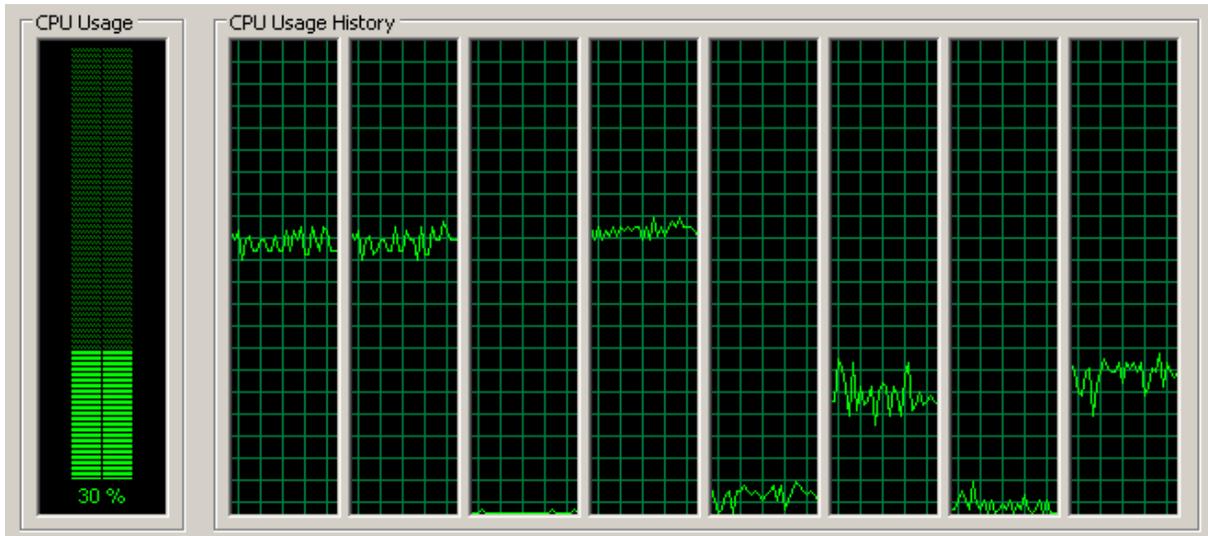
CPU Core Loading
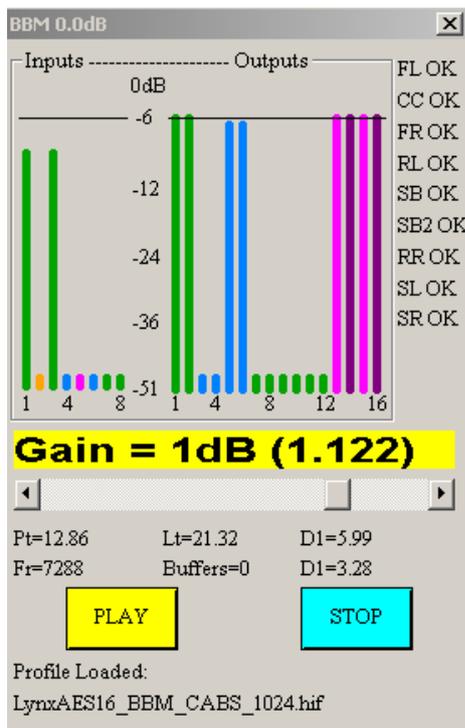
UE Buffer Size = 1024 bins
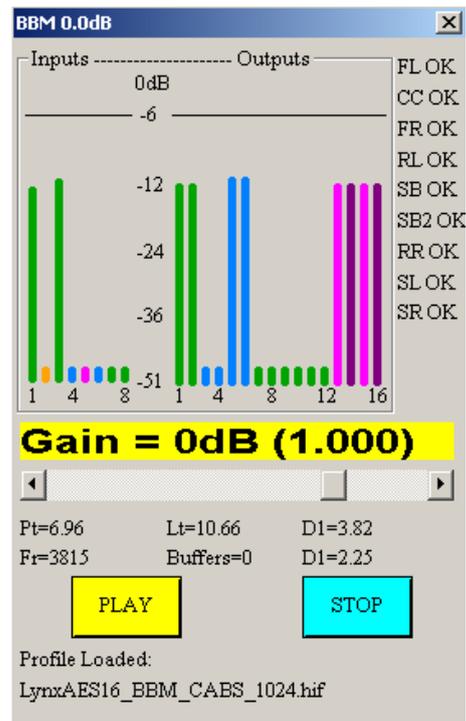
UE Buffer Size = 512 bins

WAVE Player (44.1kHz/16bit) and 1024 bins UE buffer.

CPU Core Loading

UE Buffer Size = 1024 bins

Added "Clear Playlist" button in WAVE Player

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