

Application Note

LFE Channel Management Daisy-Chaining Subwoofers in Stand-Alone Mode

September 2016



LFE Channel Management

Daisy-Chaining Subwoofers in Stand-Alone Mode

The purpose of this Application Note is to provide further insights into the LFE Channel management and the use of the +10 dB setting when daisy-chaining multiple subwoofers together.

Note: the configurations below concerning Genelec SAM subwoofers only describe their use in **stand-alone mode** – meaning without the use of the GLM 2.0 network and software for the 7200 and 7300 SAM subwoofers.

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A. The LFE (.1) Channel

The LFE channel is the space on the medium for a (.1) encoded (and usually band limited) audio channel. The subwoofer reproduces the LFE channel and / or the low frequencies of the main channels depending on whether bass management is used and how the system is setup.

In a 5.1 and 7.1 audio productions, all main channels (*Left, Center, Right, Surrounds Left* and *Surrounds Right*) have full bandwidth, i.e. 20 Hz to 20 kHz. Before encoding, the LFE channel is **not** band limited, i.e. it is just another full bandwidth channel. Figure 1 illustrates the audio bandwidth of each channel in a 5.1 production.



Figure 1 - Audio bandwidths of encoded 5.1 channel materials

After the *LFE* channel is being encoded it usually has a limited bandwidth (hence the label '.1'). This encoded bandwidth will range from 20 Hz up to various upper cut-off frequencies depending on the encoding formats

Headroom in the LFE channel

The LFE channel is recorded at the same nominal level as all main channels, however the monitor chain inserts a +10 dB boost to give the LFE channel a perceptual advantage since it does not include the higher frequency content of the main channels. The result is often “less level” going to the recording media, but occasionally the mixer may take advantage of the 10 dB differential and push the LFE content to the attention of the listener. Subwoofers are challenged as they are now asked to perform additional SPL requirements.

To deal with this issue some encoding systems – namely Dolby Digital & DTS Digital - require the LFE channel to be monitored at a level +10 dB higher than the nominal level of the main channels. In doing so, the audio level recorded to the media will have an additional 10 dB of available headroom as the engineer will naturally reduce the LFE channel level by 10 dB on the mixing desk output to maintain the sound level balance between the channels. Note that this increase in headroom is at the expense of 10 dB of signal-to-noise ratio, but as the LFE channel is eventually band limited in the encoder, it is a price worth paying.

How is this achieved in practice?

In Dolby Digital and DTS Digital formats, between the LFE channel monitor section fader and the acoustic output of the monitoring system, there must be a +10 dB level change - see Figure 3. This can happen in various places in the audio chain, but it must be implemented during the production stage.

Note that there are **no** level changes between the console outputs and the inputs to the recording media. The net effect is that there is a 10 dB additional headroom on the LFE channel level recorded to the media compared to the main channel levels.

All tracks are then encoded into a single bit-stream and replayed accordingly, including a +10 dB boost on the decoded output for the LFE channel - see Figure 2.

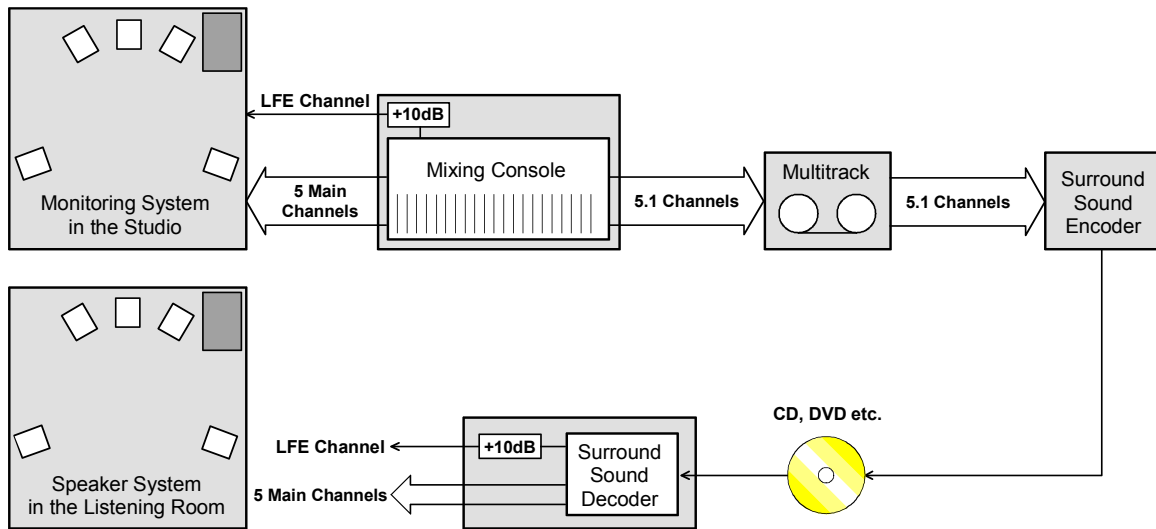


Figure 2 - Complete Multichannel Audio Production Chain for Dolby Digital and DTS Digital formats

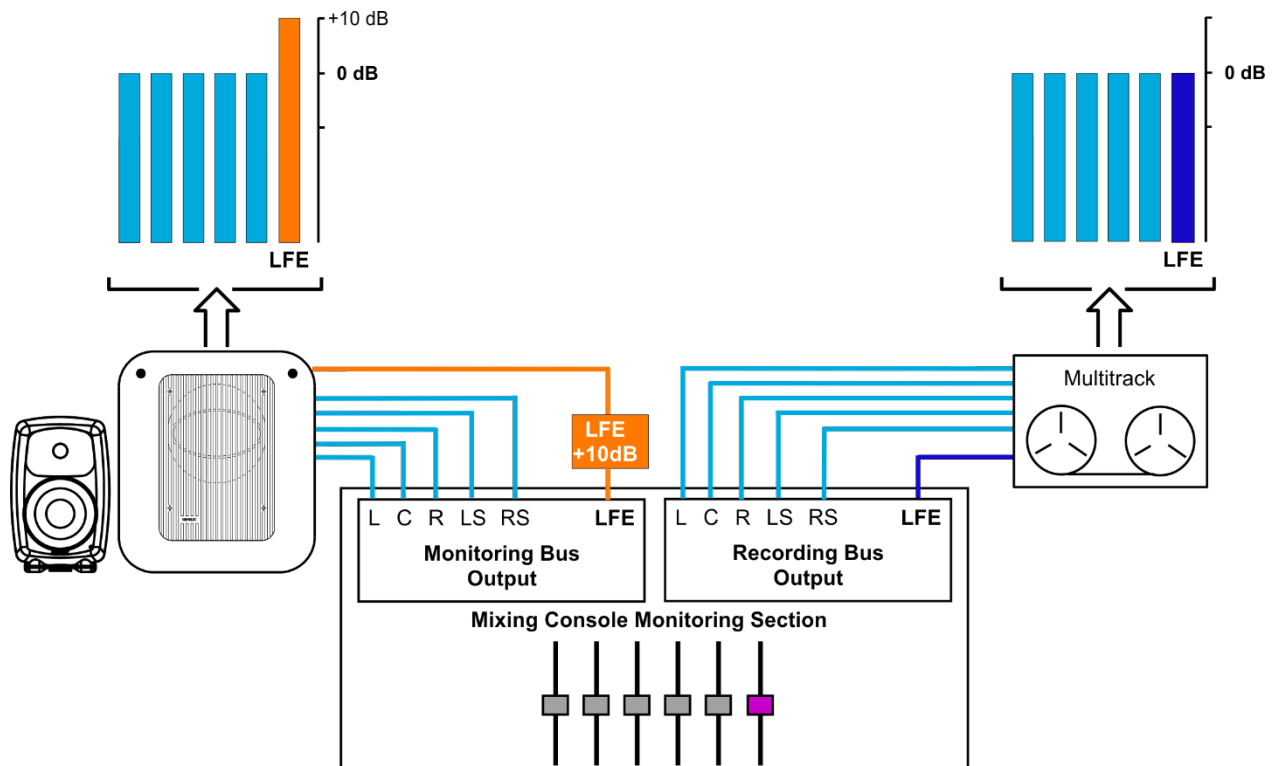


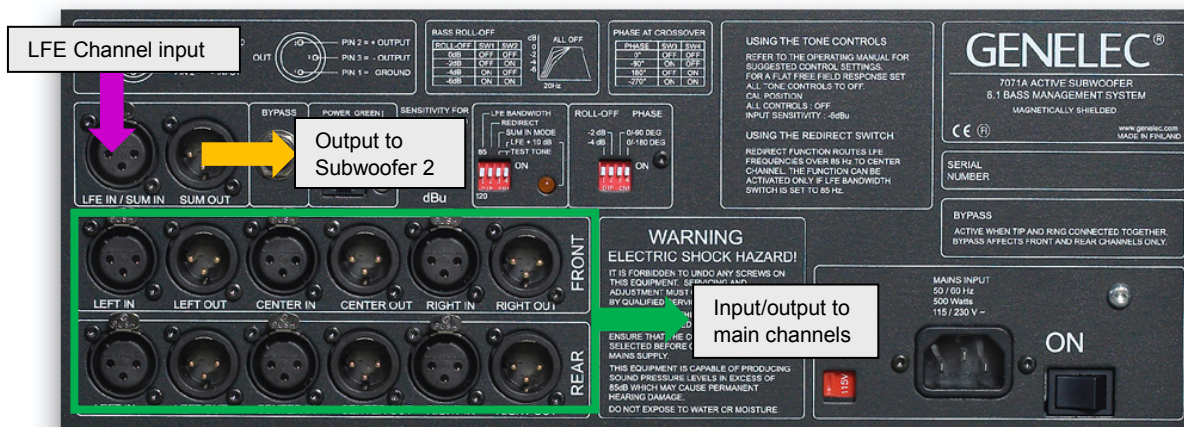
Figure 3 – Mixing console 5.1 monitoring section with LFE channel initial gain structure for both the monitoring and the recording output busses.

B. 7000 Series Subwoofers

Analogue 7000 Series subwoofers cannot be used with the Genelec Loudspeaker Manager (GLM) control network and software management system. Hence, they are always used in so-called stand-alone mode – meaning without possible computer control.

Subwoofer 1

- **LFE +10dB: ON or OFF.** Note that if the +10 dB is selected, it will be carried on the cable going to subwoofer 2.
- **Sensitivity:** note that the input sensitivity should be reduced by -6 dB on each subwoofer as a first action in order to take into account the mutual SPL coupling of multiple subwoofers. Additional attenuation may be required depending on the level balance to the main monitors, but at least -6 dB needs consideration.



Subwoofer 2

- The **SUM IN** DIP switch must be set to ON. It disables at the same time all other DIP switches in the same switch group, including the LFE +10dB.

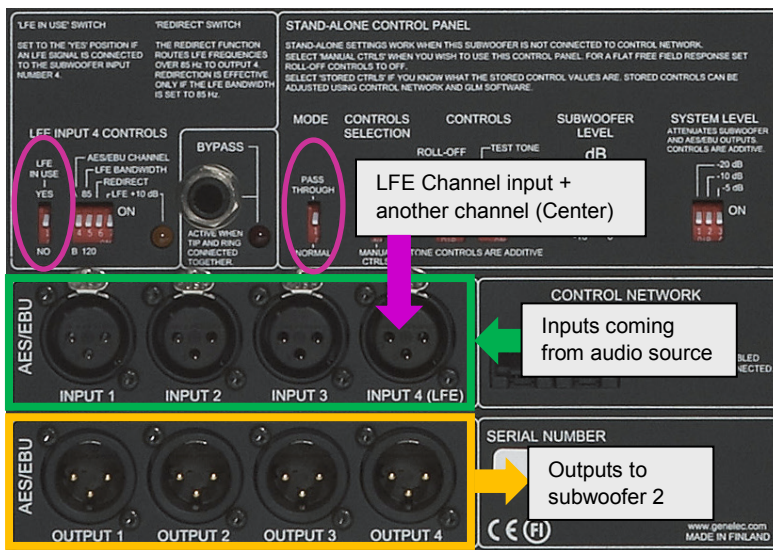


C. 7200 Series Subwoofers

7200 SAM Series subwoofers only feature **digital AES/EBU** inputs and outputs. They can be controlled using the GLM control network and software management system. The application below documents their use **without GLM control** in the so-called stand-alone mode.

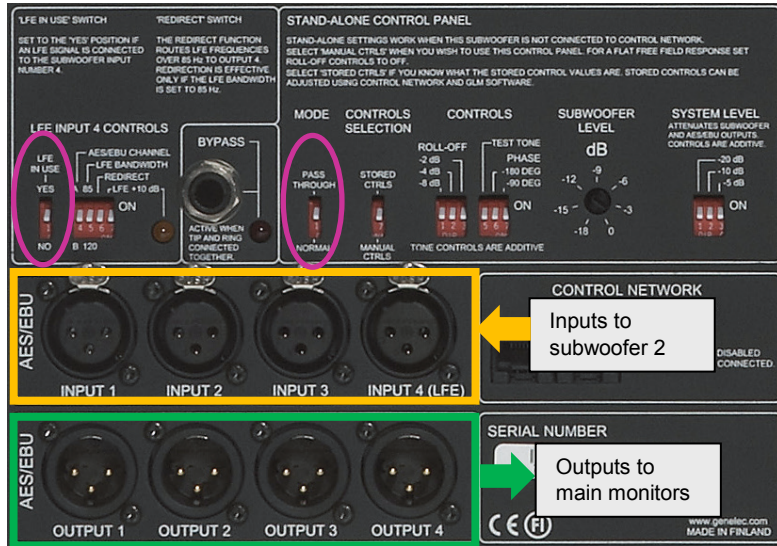
Subwoofer 1

- LFE IN USE: **YES**. States that there is a digital LFE channel on the input 4.
- LFE +10dB: **ON** or **OFF**.
- **PASS THROUGH**: selected. This allows all channels including the LFE channel to be sent to their respective outputs in order to feed the second subwoofer adequately.
- **Sensitivity**: note that the input sensitivity should be reduced by -6 dB on each subwoofer as a first action in order to take into account the mutual SPL coupling of multiple subwoofers. Additional attenuation may be required depending on the level balance to the main monitors, but at least -6 dB needs consideration. This can be done via the Acoustic Editor in GLM 2.0.



Subwoofer 2

- LFE IN USE: **YES**. States that there is a digital LFE channel on the input 4.
- LFE +10dB: **ON** or **OFF**
- **NORMAL**: selected. This allows all channels including the LFE channel to be bass managed and sent to their respective main monitors' outputs.



D. 7300 Series Subwoofers

7300 SAM Series subwoofers feature **analogue** and **digital** AES/EBU connections. They can be controlled using the GLM control network and software management system. The application below documents their use without GLM control in the so-called stand-alone mode.

D.1 Using Analogue Signals

Sensitivity: note that the input sensitivity should be reduced by -6 dB on each subwoofer as a first action in order to take into account the mutual SPL coupling of multiple subwoofers. Additional attenuation may be required depending on the level balance to the main monitors, but at least -6 dB needs consideration. This can be done via the Acoustic Editor in GLM 2.0.

Subwoofer 1 – Analogue Signals

- LFE +10dB: **ON** or **OFF**.
- LFE OUT: the output is an unaltered copy of the LFE IN input.



Subwoofer 2 – Analogue Signals

- LFE +10dB: ON or OFF.



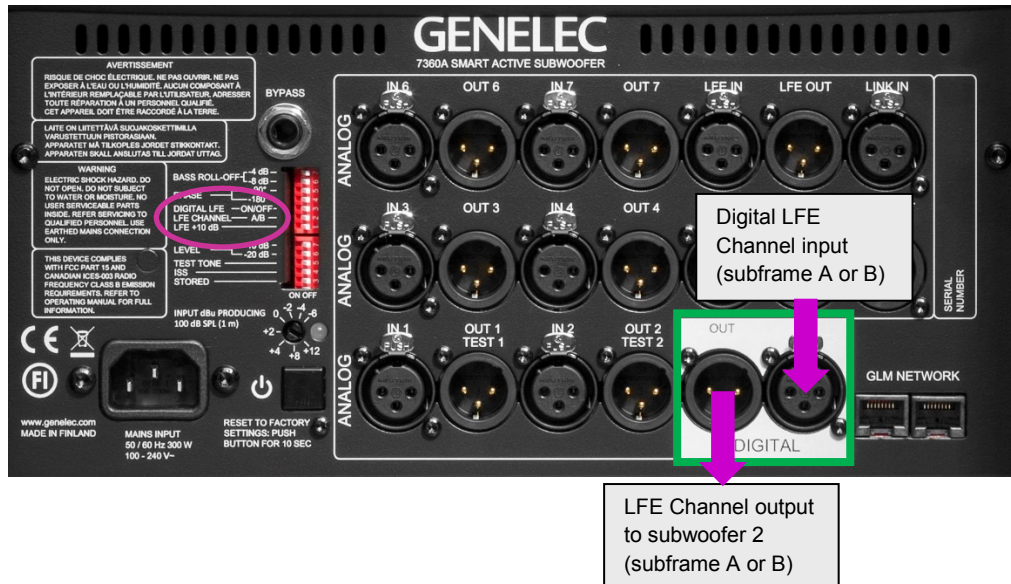
D.2 Using Digital Signals

The application detailed below documents the use of daisy-chained subwoofers receiving only the LFE channel.

Sensitivity: note that the input sensitivity should be reduced by -6 dB on each subwoofer as a first action in order to take into account the mutual SPL coupling of multiple subwoofers. Additional attenuation may be required depending on the level balance to the main monitors, but at least -6 dB needs consideration. This can be done via the Acoustic Editor in GLM 2.0.

Subwoofer 1 – Digital Signals

- LFE +10dB: **ON** or **OFF**.
- DIGITAL LFE: **ON**. Indicates that subwoofer 1 is receiving a digital LFE channel.
- LFE CHANNEL: the subframe A or B containing the digital LFE channel has to be selected.



Subwoofer 2 – Digital Signals

- LFE +10dB: **ON** or **OFF**.
- DIGITAL LFE: **ON**. Indicates that subwoofer 1 is receiving a digital LFE channel.
- LFE CHANNEL: the subframe A or B containing the digital LFE channel has to be selected.





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