

Bass Management in Emotiva RMC-1, RMC-1L, and XMC-2 Processors

Most audio content that comes from a surround sound disc or streaming source includes a separate channel called the Low Frequency Effects (LFE) channel. This channel contains low frequency special effects sounds and very low bass notes which are usually intended to be played through a subwoofer. Many people may refer to this as “the subwoofer channel”, even though in systems without a subwoofer it may be routed to your regular large speakers. In systems where some of the other speakers are small and a subwoofer is present, low bass from other channels may also be sent to the subwoofer in addition to the LFE track.

Just to clarify the terminology: When we refer to a 5.1 or 7.1 channel *system*, we are referring to a system that has a subwoofer, where the subwoofer is “the .1 speaker channel”. However, when we refer to 5.1 or 7.1 channel *audio content*, “the .1 channel” refers to this LFE audio channel. This is the case even though the LFE channel from the content may not be the only audio being sent to the subwoofer.

In a system with a subwoofer, where all of the other speakers are full-range, the LFE channel is usually routed directly to the subwoofer, while the other audio channels are simply sent to their respective speakers. However, in a system where some or all of the other speakers, or other amplifier channels, aren’t capable of handling sufficient amounts of low bass, the low bass from those channels is often also redirected to the subwoofer. Some systems are designed specifically this way, with a subwoofer for the low bass, and smaller speakers sometimes referred to as “satellites” for the other channels. In some systems, where the front speakers are very large, or have built-in subwoofers, a separate subwoofer may not be included, and the LFE channel may be routed to those Large speakers instead.

The part of the processor or AVR that handles how these low bass signals are routed is called the Bass Management system. With most home theater gear, there is no specific option to enable Bass Management, and it is simply invoked by setting one or more of your sets of speakers to “Small” rather than “Large”. When you set any speakers to Small, low bass from those channels is routed away from those speakers, and sent to the subwoofer instead. At this point you may also be presented with a variety of other options, which may be slightly different with different brands and models of processors. In this document we’re going to describe how this works on our Emotiva RMC-1, RMC-1L, and XMC-2 processors.

From now we’re going to be referring to the low frequency content coming into the system on the LFE channel as “LFE bass” and to the audio signal being sent out to the subwoofer by the Bass Management system as “summed bass content”.

Very Basic Bass Management

In a system which includes a subwoofer, and a full set of full range speakers, the full range audio signal from each incoming channel is sent directly to its respective speaker, and the LFE channel is sent directly to the subwoofer.

However, in a system which includes a subwoofer, but some or all of the other speakers are NOT full range, a “crossover frequency” is configured for each of the speakers that is not full range. All of the audio above the crossover frequency for a given channel is routed to the respective speaker, but audio content below the crossover frequency is diverted away from the speaker. This low frequency content from each channel is all summed together, along with the content from the LFE channel, and this summed bass content is sent to the subwoofer.

In a system which lacks a separate subwoofer, but has some Large speakers, or even Front speakers with built-in subwoofers, both the LFE bass and the summed bass from the Small speakers will be routed to the Large speakers.

In standard Bass Management terminology, any full range speaker is described as “Large”, meaning it will be sent the full frequency range of audio for its channel. Any speaker for which a crossover frequency has been set is described as “Small”, regardless of the physical size of the speakers involved. There is also a widely accepted industry standard crossover frequency of 80 Hz for Small speakers.

It’s worth mentioning that, in some systems, we may designate physically large speakers as “Small”, and configure them with a crossover frequency lower than 80 Hz, in order to limit the low frequency content they receive, because this may enable them to do a better job of handling the rest of the audible frequency range.

A Few Things To Keep In Mind

When you configure Bass Management on your processor you must have at least one subwoofer or other set of speakers configured to handle LFE content and at least one set or subwoofer configured to handle the low bass from your other channels. (For example, you cannot configure all of your speakers to Small if you don’t have at least one sub to handle both the LFE and summed bass information. In most cases the processor will not allow you to choose combinations of settings that don’t work.)

On our processors both the summed bass and the bass from the LFE channel are treated as Mono. Each subwoofer output may be individually adjusted using manual EQ, and will be calibrated individually by Dirac Live, but the same monaural bass signal is routed to all of them.

Connecting Your Subwoofers

Our processors support up to three subwoofers. If you have a single subwoofer, we generally recommend connecting it to the Center Sub output for the most flexibility, but you may connect it to the Left Sub output if you prefer. (If you only connect one subwoofer to the Left / Right sub outputs then you MUST use the Left Sub output.) If you have two or three subs you may connect them to the Left / Right sub outputs, or you may connect one to the Center Sub output and one to the Left Sub output. (This will enable you to “split the subs” as described below.)

Configuring Bass Management On Your Emotiva RMC-1, RMC-1L, or XMC-2 Processor

Our processors allow you to configure up to three subs, defined as a Center Sub and a pair of Left / Right subs. In addition to that, each set of regular speakers that you have can be configured as Large or Small. (Most speakers, like Fronts or Surrounds, are configured in pairs or sets; the only exception is the Center Channel, which is a set all by itself.)

For each set of speakers configured as Small you will have the opportunity to set a Bass Management crossover point. (The default crossover for Main and Surround Speakers is 80 Hz; the default crossover for Height Speakers is 250 Hz.)

IF YOU HAVE NO SUBWOOFERS – You MUST have at least one set of speakers configured as Large. In this situation, the LFE channel and the Bass Managed bass from all of your Small speakers will be combined into a single summed bass channel, which is then sent to all of your Large speakers.

IF YOU HAVE ONE OR MORE SUBWOOFERS – If you have one or more subwoofers, and all are equally able to handle both sound effects and musical content, you will probably want to configure all subwoofers as Mono. When configured this way, any speakers configured as Large will be treated as full range, the LFE channel and the Bass Managed bass from all of your Small speakers will be combined into a single summed bass channel, and this summed bass channel will then be sent to your sub, or divided among your multiple subs.

ASSIGNING THE CENTER SUB AS LFE – Some systems may include one or two subwoofers that sound good with music and another that works great at delivering thunderous special effects but really doesn't sound good when playing music. Others may include Large Front speakers with built-in subs, or multiple full range speakers set as Large, but also a subwoofer that works well for special effects. In this situation you may configure the Center Sub output as LFE rather than Mono. (You will only have this option if you have at least one Left / Right Sub or at least one set of speakers set to Large.)

When configured this way, the LFE channel will be routed to the Center Sub, while summed bass from the other channels will not.

- If you also have Left / Right Subs, and some speakers set to Small, then the speakers you have set to Large will be treated as full range, and the summed bass from your Small speakers will be routed to the Left / Right subs.
- If you DO NOT have one or two Left / Right subs, and you have some speakers set to Small, but you also have some Large speakers, then the speakers you have set to Large will be treated as full range, and the summed bass from your Small speakers will be routed to your Large speakers.
- If you DO NOT have any Left / Right subs, then you MUST configure at least some of your speakers to Large (otherwise, since all of your speakers are set to Small, the summed bass from the Bass Management system will have no place to go).

In general, we do not recommend this option unless you have subwoofers of widely varying capabilities or sound quality. However, it may offer benefits in some situations, so you should feel free to experiment. One benefit is that, by assigning the LFE and summed bass from the Bass Management system to separate output channels and physical speakers, you will have the option of adjusting the levels of each separately (whether by using the channel trim on the processor or by physically changing the level on the subwoofers themselves.) You may also find that even similar subwoofers may perform differently in different locations. For example, a given subwoofer might sound quite musical when located in the center of a wall but deliver louder but less well-defined bass when located in a corner. This option would allow you to use the center-wall sub for music and the corner-located one for sound effects.

Enhanced Bass

There is another Bass Management feature called Enhanced Bass that will ONLY be available in the Size menu when your Fronts are set to Large. Enhanced Bass is specifically intended to allow the subwoofer channels to "play along" with your Front Large speakers when you are listening to stereo or 2.0 formatted content. (Normally, if your Fronts are set to Large, since 2.0 channel content doesn't have an LFE channel, nothing would be routed to your subs. Enhanced Bass configures the subwoofer to play along with the Front speakers in this situation even if no bass content that would normally be routed to the subwoofer is present. NOTE that this setting is essentially overriding the normal operation of Bass Management and so is musically less accurate.)

You can alter the frequency setting at which the subwoofer will begin to play when Enhanced Bass is enabled by temporarily disabling Enhanced Bass, setting your Fronts to Small, setting the crossover point on the Fronts to the desired value, then setting the Fronts back to Large and re-enabling Enhanced Bass. (The Enhanced Bass option uses the "Small" crossover setting from the Fronts to determine the crossover point it uses for mixing in the subwoofer.)

Crossover Frequency and Filter Slope Settings

The choice of whether to set a speaker as Small or Large is NOT necessarily based on the physical size of the speaker. Setting a speaker to Large simply means that it will be treated as a full range speaker. Setting a speaker to Small means that Bass management will be enabled for that speaker, and a crossover frequency can be set. All content above that crossover frequency will be routed to the speaker while the Bass Management system will route the frequencies below that crossover point wherever it has been configured to route the summed bass.

Most speakers are really not fully capable of reproducing all frequencies from 20 Hz to 20 kHz. Asking them to do may result in increased distortion or may require excessive amplifier power. Therefore, in some cases, you may choose to set even physically large speakers as Small, in order to route very low bass frequencies from those channels to the subwoofer.

Once you set a speaker to Small in the Size menu of the processor, you will have an additional option to set the specific crossover frequency at which Bass Management system will start routing the bass away from that speaker. There are default values in the processor for each channel, which generally work well with physically Small speakers, but the user should be encouraged to adjust these based on their setup. For example, if you have physically large Front speakers, you may wish to set them to Small, but try a lower crossover frequency setting like 50 Hz.

There is no one correct crossover setting for any particular speaker or system, but there are some rules of thumb that can help you get started with your crossover settings. It is helpful to look at the specifications of the speakers that are attached to each channel, noting the lowest value specified in the frequency response of that speaker, and setting the crossover about an octave above that. For example, the frequency response of the Emotiva T1+ is specified as 37 Hz – 28 kHz, so you might consider trying a crossover frequency of 50 or 60 Hz. (This setting would enable the T1+ to “work a little less hard”, and continue to play cleanly at slightly higher levels, while allowing your sub to handle some of the “heavy lifting”.)

There is also an option in the Size menu for the Crossover Slope - either 12 or 24 dB per octave. This setting applies only to the low-pass crossover applied to the summed bass that is sent to the subwoofers, as the crossover slopes for the high-pass filters are fixed at 12 dB per octave. This setting determines the sharpness of the crossover filter – with a 24 dB per octave filter being sharper. While the sharper setting is arguably “better” there is no specific correct setting here and you may find that one or the other enables you to achieve a smoother transition between the speaker and your sub in a particular system and room.

Bass Management, Crossover Settings, and Dirac Live

There are a few things we should keep in mind when considering how the processor interacts with Dirac Live regarding bass management and crossovers. In short, the processor handles ALL Bass Management duties, including crossover settings, while Dirac Live measures and calibrates each individual speaker output channel separately.

Dirac Live treats each speaker as if it is full range. Dirac Live analyzes the response of each speaker, determines the range of frequencies that speaker is capable of reproducing, sets its “curtains” accordingly, and then calibrates the speaker. Frequencies “outside the curtains” are not blocked or filtered out but are simply passed uncorrected by the Dirac Live filter. When running Dirac Live you can adjust the curtains to widen or narrow the range of frequencies that Dirac Live will attempt to correct.

The size and crossover setting you make in the processor do not affect how Dirac Live calibrates each speaker. However, Dirac Live will not calibrate speakers that are set to None in the Speaker Preset you are currently using.

This separation of duties between the processor and Dirac Live allows you to change your speaker assignments between Large and Small, or change your crossover frequencies, without having to create a new Dirac filter. Dirac corrects each speaker individually across the entire frequency range when filters are created, so no matter if the speaker is set to Large or Small, or at what frequency the crossover point is set, the Dirac adjustments from the filter will be applied to whatever part of the frequency range is being used for that channel by the processor.

Final Note

Bass Management is both an art and a science. We urge each user to feel free to experiment and to choose the settings and configuration that work best in your system, and your room, with your subs. There are lots of theories about how your subwoofers should be positioned, how Bass Management should be configured, what you need to do to make your system sound good, and even what and how many subwoofers you need. None of them works well, all of the time, for every system, and there is no single magic measurement or graph that will ensure that you will get the sound you want. You should treat all information you may find on this subject as suggestions or guidelines, and try different options to find out what works best for you in your system.