How to Adjust the Bandpass Gains in Crown Power Amplifiers with Built-in DSP

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In a standard sound system, the full audio spectrum is filtered into two, three or four bands by stand-alone signal processors (bandpass filters). The band-limited audio is sent to several power amplifiers. Each amplifier receives a pre-filtered signal, amplifies it, and sends it to the speakers. The signal processors (bandpass filters) are external to the power amps.

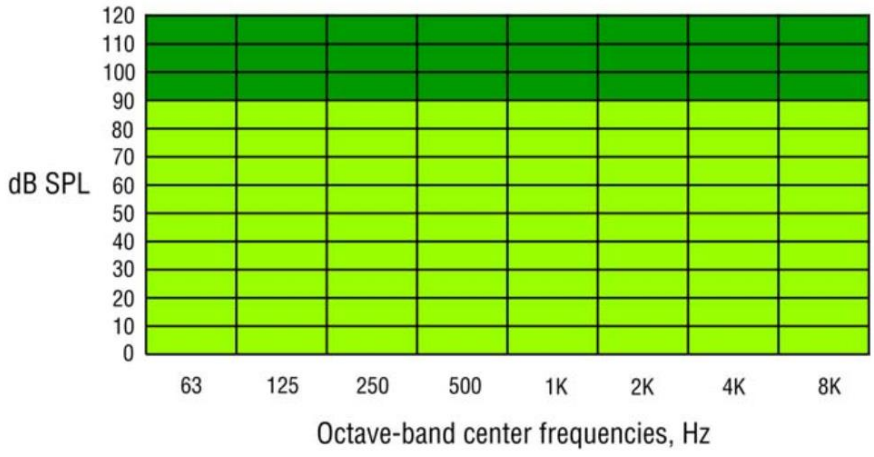
In contrast, some Crown products have DSP filtering inside the amplifier. These products are the I-Tech power amplifiers and CTs amplifiers with PIP-USP3 and PIP-USP3/CN cards installed.

Amplifiers with built-in DSP require different bandpass gain settings than systems with external signal processors. This article will explain how to adjust the bandpass gains on power amps with integrated DSP.

First, we need to review the difference between octave-band levels and full-spectrum (broadband) levels.

Octave Band vs. Broadband Levels

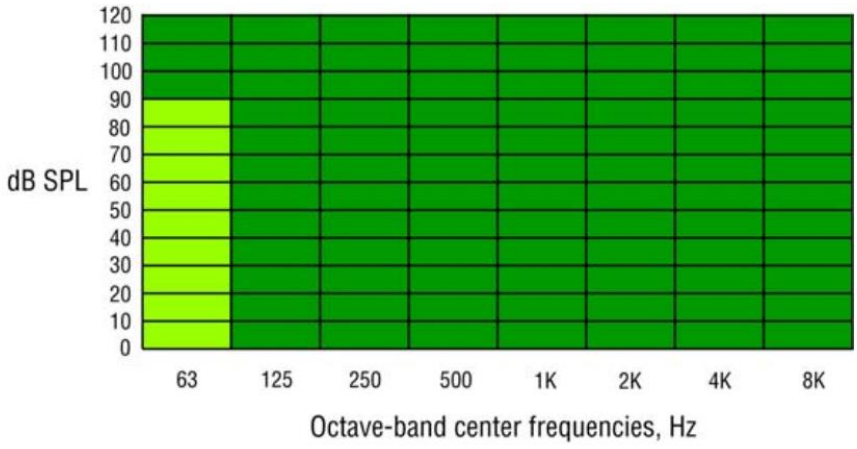
Consider this RTA display of pink noise. There are eight bands in the display, and the level in each octave band is 90 dB SPL.



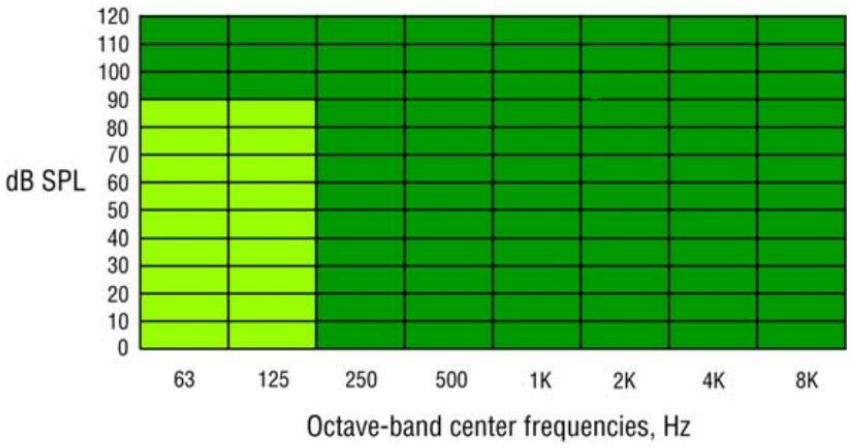
With the same pink-noise source, what would a broadband sound level meter read in dB (unweighted, linear)? The answer is not 90 dB, but 99 dB. Let's explain how we got that figure.

Each octave band, measured alone with a broadband sound level meter, gives a 90 dB measurement. Every time we double the number of octave bands that are switched on (at the same level), the level on the meter increases 3 dB.

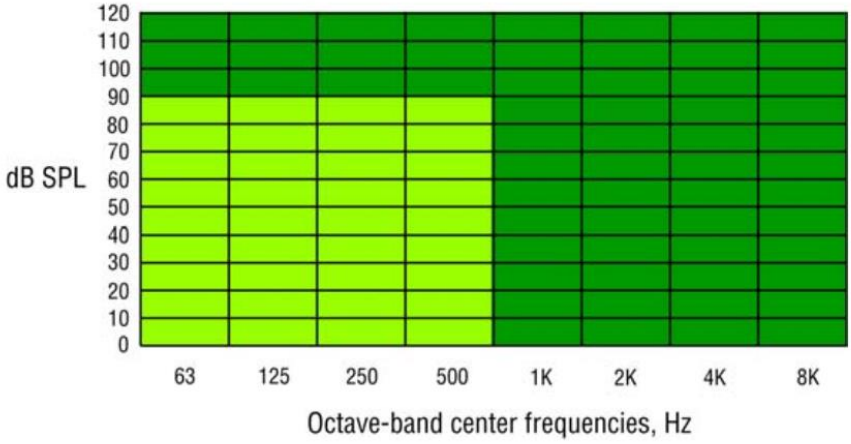
The single band shown below reads 90 dB on a sound level meter:



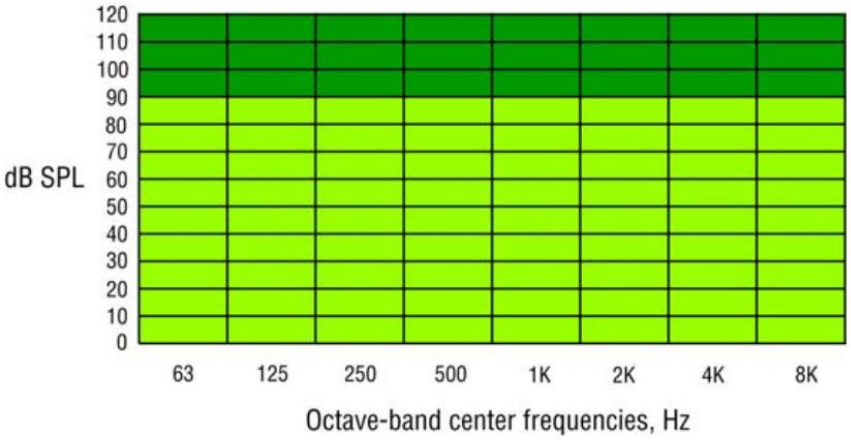
The two bands shown below read 93 dB on a sound level meter:



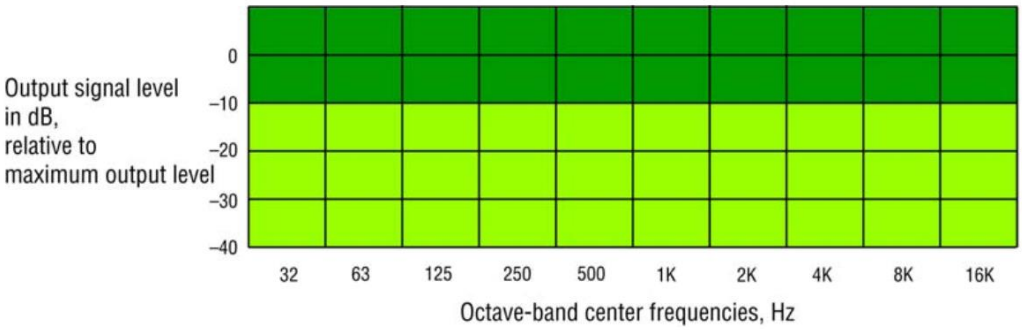
The four bands shown below read 96 dB on a sound level meter:



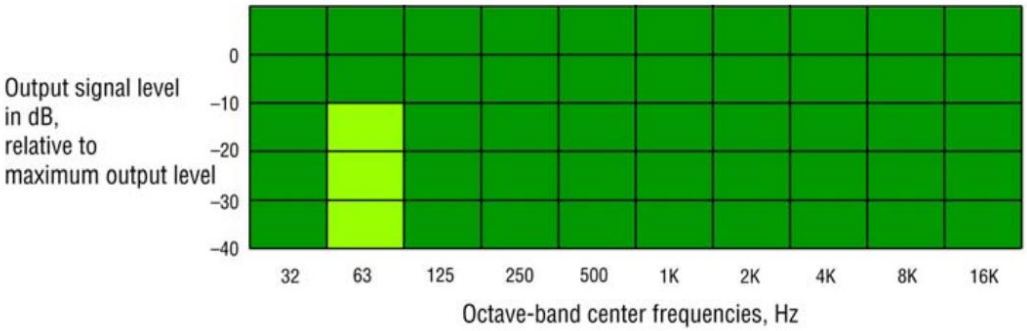
The eight bands shown below read 99 dB on a sound level meter:



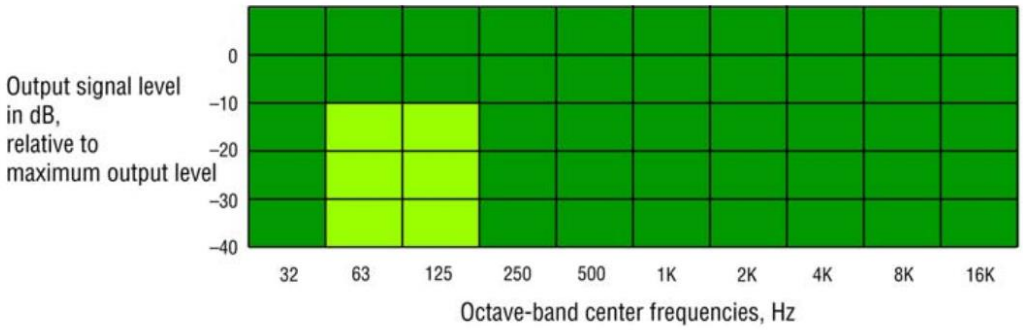
Adjusting bandpass levels in an amplifier with integral DSP With this background, we're ready to give an example of setting bandpass levels. Let's feed an I-Tech a full-range pink-noise signal, 10 octaves wide. We'll turn up the signal until the I-Tech produces a signal 10 dB below maximum output power (shown below). Let's say that this signal produces 100 dB SPL on a sound level meter.



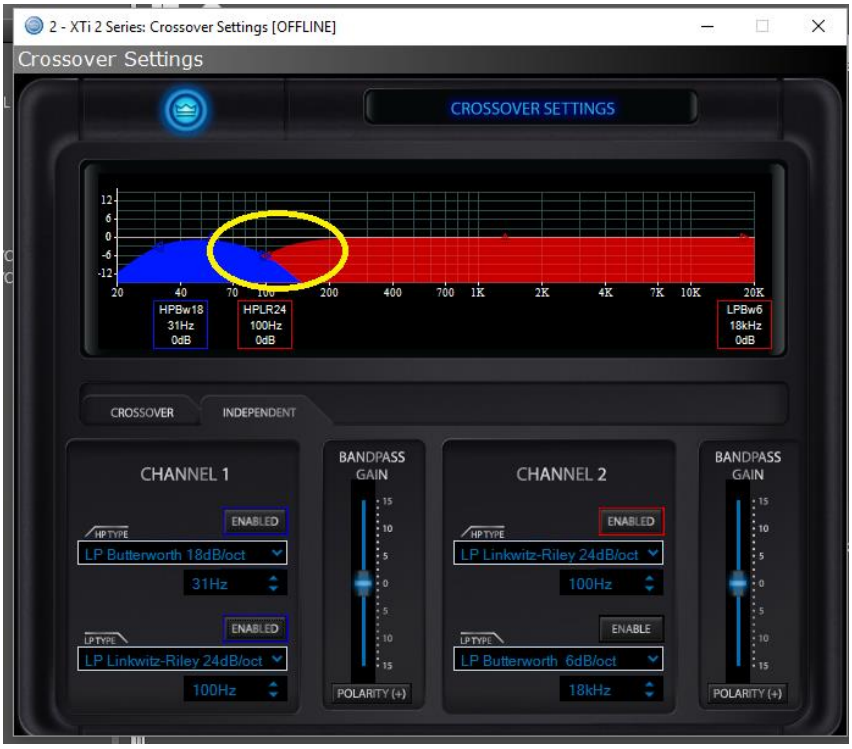
Now suppose we use the I-Tech's DSP to filter out everything except the 63Hz octave band as shown below (for use with a subwoofer). The sound level meter will read 90 dB. Did we lose 10 dB of amplifier level? No. The amplifier produces the same wattage in the 63Hz band before and after filtering, but the sound level meter is reading lower because the audio covers a narrower bandwidth. To get 100 dB SPL from the subwoofer, we need to raise the 63Hz band's level by 10 dB in the I-Tech's DSP software.



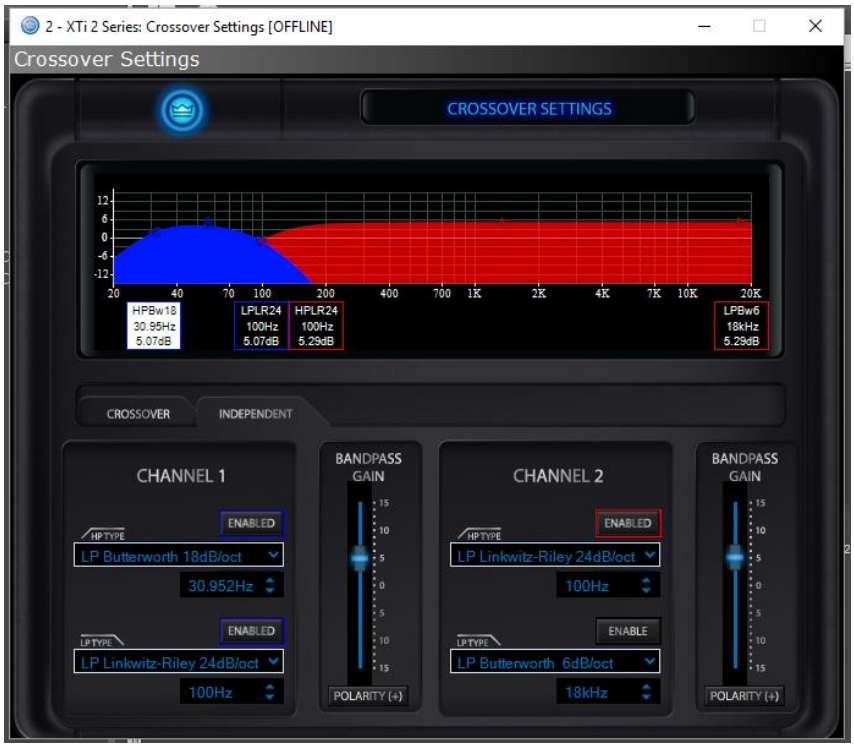
If the subwoofer used two octaves (as shown below), then the sound level meter would read 93 dB SPL. That is 7 dB lower than the meter reading before filtering was applied. We would need to add 7 dB of gain to those two octaves to get the subwoofer level up to 100 dB SPL.



Audio Architect software lets you compensate for the filtering loss in the DSP section of the amplifier. As shown below, you can do this in Audio Architect's filter section with the high-pass controls (top figure) and low-pass controls (bottom figure).



In the examples above and below, the high-pass/low-pass filter responses are circled in black, and the bandpass gains are circled in red. A total of 10 dB gain was added to the pass band (5 dB per filter).



Important: To increase the gain of the pass band, you need to make half the gain change with each filter. For example, to increase the level 4 dB overall, add 2 dB to the high-pass filter level and 2 dB to the low-pass filter level.

Important: After applying gain to the bandpass filters, you might need to reduce the input signal level to prevent clipping the amplifier output signal.

Listed below is the increase in filter gain to compensate for filtering the input signal. These figures assume that there is no EQ in use (other than bandpass filtering). If you apply any EQ cuts, you will need more gain than shown below. If you apply any EQ boosts, you will need less gain than shown below.

2-way system (HF/LF): 3 dB (1.5 dB per high-pass and low-pass) 3-way system (HF/MF/LF): 5 dB (2.5 dB per high-pass and low-pass) Subwoofer (VLF): 8 dB (4 dB per high-pass and low-pass)

These dB values vary in use, and they are provided only as a guide.

When using amplifiers with internal DSP, set the bandpass filter levels as described in this article. Then you'll get the best results every time.

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