

Optimal Audio and Video Reproduction at Home

Improving the Listening and Viewing Experience

Subwoofer Guide

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1 Introduction

The best way to obtain better bass, is to use one or several subwoofers to reproduce the lowest frequencies. By keeping the bass below 80 Hz out of your front and surround loudspeakers and directing it to your subwoofers, you gain a great amount of flexibility in loudspeaker placement: you can position the front and surround loudspeakers for optimal spatial reproduction and you can position the subwoofers for optimal bass reproduction. Contrary to popular belief, the principal determinant of low-frequency sound quality is not the loudspeaker itself, but the room and the positions of the loudspeakers and listeners in this room. Careful subwoofer positioning is crucial if you want to achieve the best-possible low-frequency sound.

The advice given in this subwoofer guide is a summary from my book *Optimal Audio and Video Reproduction: Improving the Listening and Viewing Experience*. Check it out if you want to find out more and want to understand the underlying principles of this summary.

Find out more at: vincentverdult.nl or routledge.com

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2 Buying Subwoofers

- Your subwoofers should be able to reproduce low frequencies down to 20 Hz when placed in your listening room. This usually means that the anechoic frequency response should extend to at least 30 Hz.
- Prefer subwoofers that have a closed-box enclosure over those with a bass-reflex enclosure.
- Your subwoofers should together be able to produce a peak SPL of at least 108 dB.
- Choose subwoofers with large drivers. In total you need at least four 9-inch drivers or two 13-inch drivers.
- Make sure that the amplifiers in your subwoofers are at least as powerful as indicated in figure 7.27 from *Optimal Audio and Video Reproduction at Home*.

3 Placing Subwoofers

- Keep the frequencies below 80 Hz out of your main loudspeakers and use one or more well-positioned subwoofers to reproduce these low frequencies.
- Use at least two subwoofers placed at two different positions in the room to get the smoothest bass response. Place the subwoofers at the wall midpoints or at a quarter distance from the sidewalls (See figure 4.45 from *Optimal Audio and Video Reproduction at Home*).
- If you have multiple rows of seats, consider using four subwoofers distributed around the room to minimize the variations from row to row. Place the subwoofers at the wall midpoints, at a quarter distance from the sidewalls, or in the corners of the room (See figure 4.46 from *Optimal Audio and Video Reproduction at Home*).
- If you only use a single subwoofer place it on the floor between the left and right loudspeakers close to the front wall and away from the sidewalls. Do not place it further than 60 cm (2 ft) away from the front wall, and do not place it at the pressure maximums and minimums of the room resonances that occur between the two sidewalls.

4 Setting Up Subwoofers

- Use the bass management setup menu in your A/V controller or receiver to set all the front and surround loudspeakers to 'small', set the subwoofer to 'on', and direct the LFE channel only to the subwoofers and not to the other loudspeakers.
- Set the subwoofer crossover frequency of your A/V controller or receiver between 80 and 120 Hz, such that the subwoofers and main loudspeakers sound well-integrated and the subwoofers cannot be audibly localized as separate sound sources.
- Disable the low-pass filter built into your subwoofer, or set it to the highest cutoff frequency.
- Set the phase controls of your subwoofer and the delay/distance controls in your A/V controller or receiver such that the sound from the subwoofers and the sound from the front loudspeakers arrive in phase at the prime listening position.
- Use an SPL meter to roughly set the subwoofer level, then play some music and watch some movies to fine-tune it. The subwoofer should blend seamlessly with the rest of the sound and never draw attention to itself.

5 Calibrating Subwoofers

- Improve the low-frequency response of your subwoofers using a combined approach in which you first select the best positions for your subwoofers and then apply parametric equalization. Use your own acoustical measurements to make informed decisions on where to put the subwoofers and how to tune the parametric equalizer.
- Only use high-resolution acoustic measurements (accurate to at least 1/20 of an octave) to analyze the low-frequency response of your room and subwoofers.
- To analyze the reproduction of low frequencies in your room, measure the combined response of the subwoofers and the left and right front loudspeakers from 20 Hz to 200 Hz.
- To measure the low-frequency response in the room mount the measurement microphone on a tripod, point it at the ceiling, and place it at one of the listening positions. Do not stand between the subwoofers and the microphone and make the room as quiet as possible.
- Experiment with different positions of the subwoofers and listeners in the room. Measure the frequency response at each listening position and try to move your subwoofers and listeners such that these frequency responses are as similar as possible and have the least number of dips.
- Manipulate the excitation of an offending room mode by placing a subwoofer at or near a pressure minimum, or by placing two subwoofers on opposing sides of a pressure minimum.
- Use a parametric equalizer to reduce the peaks in the in-room frequency response of the subwoofers. Focus on the peaks that are common among the frequency responses for the different seats. Do not attempt to correct narrow dips in the response. Broad depressions may be boosted if the gain is limited to about 6 dB.
- Do not attempt to use electronic equalization to correct dips in the frequency response that are nonminimum phase.
- Use acoustic measurements to set the subwoofer level. The average sound level for the frequencies below the subwoofer crossover frequency should closely match the average level above the crossover frequency.
- Use acoustic measurements to improve the integration between the main loudspeakers and the subwoofers in the crossover region. Play around with the subwoofer's time-delay, phase, and crossover frequency.

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Improving the Listening and Viewing Experience

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Optimal Audio and Video Reproduction at Home is a comprehensive guide that will help you set up a modern audio-video system in a small room such as a home theatre or studio control room.

This book covers everything you need to know to optimize the reproduction of multichannel audio and high-resolution video. It provides concrete advice on equipment set up, display calibration, loudspeaker positioning, room acoustics, and much more.

Detailed, easy-to-grasp explanations of the underlying principles ensure you will make the right choices, find alternatives, and separate the rigid from the more flexible requirements to achieve the best possible results.

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