350W Subwoofer Amplifier—Special Edition

From Rythmik Audio www.rythmikaudio.com

Thanks for purchasing this 350W Subwoofer Amplifier. The amplifier is designed to make the integration of your subwoofer to the rest of the system as seamless as possible. It features a linear phase shift control that is effective in the crossover frequency range. It also features an extension filter that can be used to correct the bass roll-off of the subwoofer and/or to adjust for room response in the bass range. In addition, the amplifier is packed with other standard features such as both high and low level inputs, high-pass line output (12db/oct) for the satellite speakers, continuously adjustable crossover frequency (40-160hz) for the subwoofer output, automatic on/off switch (activated by input signal), and a subwoofer level control. Mated with a high quality subwoofer driver, its 350W@4ohm output is enough to shake your room. Thermal protection and short circuit protection circuitry ensure long-last durability.

Technical specs

Crossover frequency control	Continuously variable for the subwoofer from 40hz to 160hz, 2nd order characteristic (12db/oct).
Phase control	Continuously adjustable phase lag control on the subwoofer from 0 to 180 degrees. This control helps to align the phase shift of subwoofer and satellite for a smooth blending.
Power switch (Auto ON/OFF)	When the switch is in the auto position, the amplifier will turn on when the input signal is present. There are also ON and OFF positions that can override this function.
Volume control	Adjust the output level of subwoofer.
Line in	These are line level RCA inputs. Use to connect pre-out or preamplifier outputs. These inputs are summed as mono. It the preferred method of connecting the subwoofer. For a mono line level signal, one can connect it to either channel input. See setup section for more explanation.
Line out	This line level RCA outputs is high-pass at 100hz for satellite output if the amplifier(s) driving the satellite has a line level direct inputs.
High Level in	Speaker level input. Use these inputs when the line level inputs and outputs are not used. Connects directly to the speaker output of the satellites (or front channels).

High Level out	Speaker level outputs (high passed at 100hz of the speaker level input). It can be used only when the speaker level inputs are used. It is not a recommended method because the impedance of satellite (or front channel) speakers may interfere with the crossover network used for this output. If one needs to use these outputs, connect these outputs to satellite speakers. Do not connect satellite speakers from the amplifier outputs.
Extension Filter (frequency control)	This controls the frequency of the extension filter. Three positions are available 14hz, 20hz, and 28hz. The damping factor (or Q value) can be controlled separately (see below).
Extension Filter (damping control)	This controls the damping factor of the extension filter. Three positions are available (low, medium, and high). Combined with 3 positions in the frequency control, there are a total of 9 combinations available.

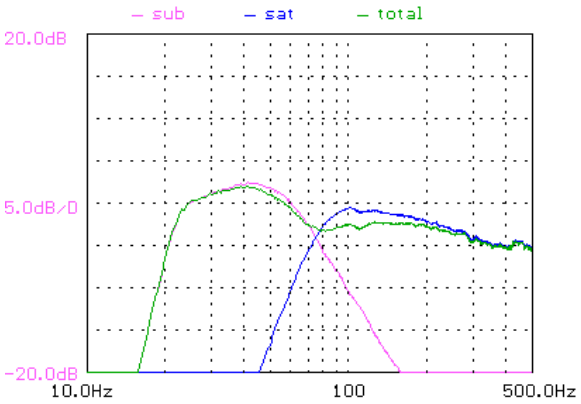

Fig 1 Response of no phase adjustment

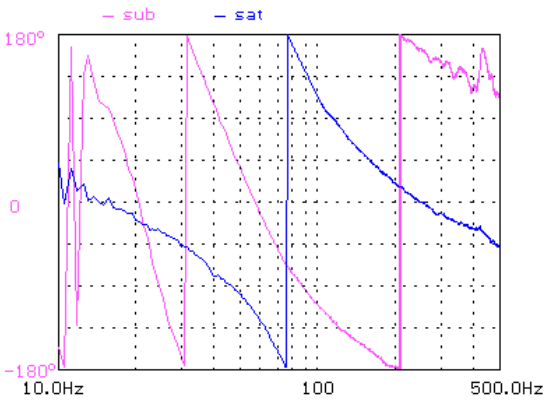

Fig 2 Relative phase (no phase adjustment)

Control adjustment Tips

Crossover and phase controls

To get a smooth blending from a subwoofer to the satellites, we need to achieve two objectives at the crossover point: 1) 3db to 6db down in terms of output, and 2) close to 0 relative phase shift (subwoofer vs. satellite, or vice versa). Both of them are equally important. Objective 1) is achieved by crossover control knob and objective 2) is achieved by phase control knob. Very often, users have overlooked the importance of the latter. Figure 1 shows and an example response of poor integration because of failure to achieve objective 2). Figure 2 shows the phases of the sub and satellite. Note that in this case, the crossover control knob is at 12 o'clock. The phase control knob is at 0 degree (or 7 o'clock) position so no phase shift is added. At the crossover point (70hz), the phase difference between the two is about 125 degrees, which accounts for the dip in the frequency response around 80hz of Figure 1. Sonically, the upper bass will sound hollow and lean. After we set the phase adjustment to 11 o'clock to add a phase lag of 125 degree to the sub at 70hz, the new amplitude response and relative phase are shown in Figure 3 and 4, respectively. The previous dip is filled so that frequency response is smoother.

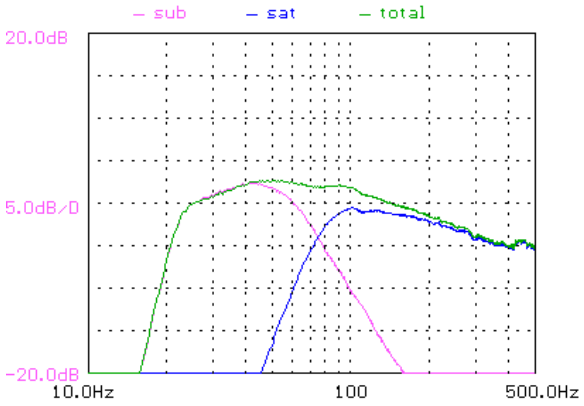

Fig 3 Response after phase adjustment

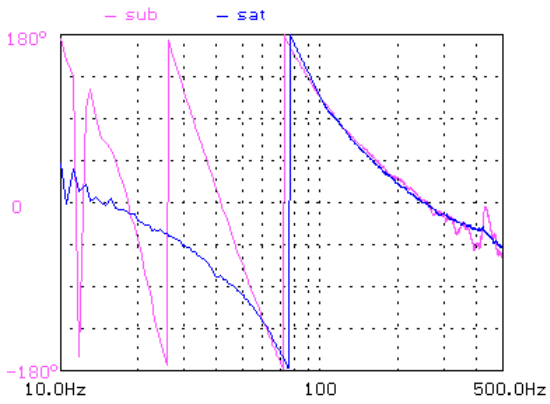

Fig 4 relative phase (after phase adjustment)

Now the question is how one can effectively adjust these controls without the help of a microphone or other tools. Fortunately, it is relatively easy to come up with a first cut educated guess and gradually fine-tune it until good result is obtained.

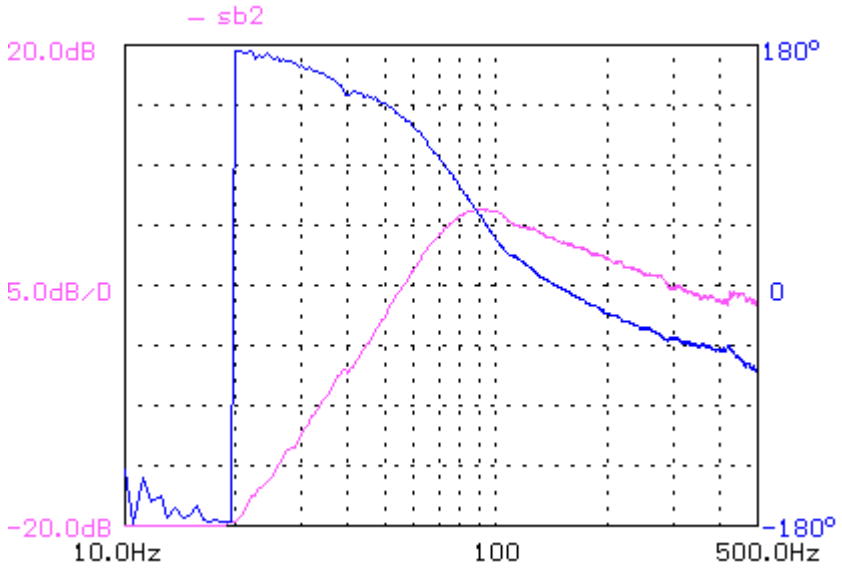

Fig 5 Response of a sealed box speaker

Phase: Keep in mind that for each order in a high-pass filter, there is a 45-degree phase lead at the crossover point. Our amplifier uses a 2nd order high pass filter for satellites. So there is a 90-degree phase lead. In addition, the satellite has its own high pass filter characteristic already: for sealed box design it'2nd order, and for vented box design, it is 4th order. In Figure 5, the satellite is a sealed box design. That means the total phase lead at the crossover point is about 90+90=180. As for the subwoofer crossover, our low pass is 2nd order, that means there is a 45x2=90 phase lag at the crossover point. Note that 180 degee phase lead is same as 180 degree phase lag. Therefore, we need to add a 90-degree phase lag to the sub to achieve close-to-0 phase difference. It is time to check how far we are in reality. Not too bad. Figure 2 shows that we need about 110 degrees.

Crossover: One may notice that in Figure 1 the actual crossover point is about 70hz. But this is different from the –3db@100hz that we stated in this manual earlier. This is the result from a technique that I referred to as "***delayed roll-off***" that intends to give an impression of higher bass output. The way it works is that the Q value of low-end roll-off is purposely made higher so that the response will have a bump before it rolls off. This high Q roll-off interferes with crossover and actually shifts the crossover point lower. This result is evident in Figure 5, which is a commercial speaker. The shelf-down characteristic

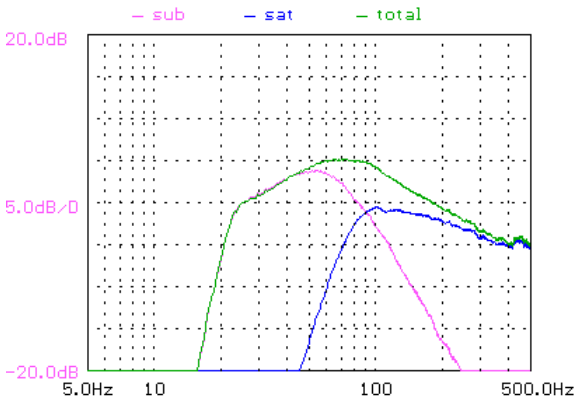

Fig 6 Sub crossover is too high

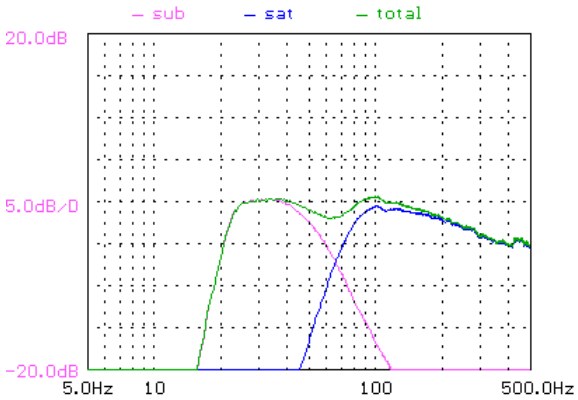

Fig 7 Sub crossover is too low

above 100hz implies that it is designed to be placed well off the wall. If we had not considered this "delayed roll-off", we would have set the crossover control to 2 o'clock, which will give us –3db points at 90hz. Figure 6 is the result. On the other hand, if we set the crossover point too low, the response will not blend well either. Figure 7 shows the result when the crossover control is set to 10 o'clock (which sets to –3db point to 35hz). Both Figure 6 and 7 have phase corrected.

Extension Filter

Two toggle switches below the binding posts constitute the extension filter. One switch controls the frequency (14,20,and 28) and the other controls the damping (or Q value). Note that Q value is the inverse of damping. That is, low (high) damping means high (low) Q. These switches control the response contour of the lower bass. They serves two purposes: 1) limit the excursion when excessive rumble signal is present in the playback and reduce the interference from so called "room gain" at lower bass range, and 2) correct minor imperfection in the subwoofer response. "Room gain" is a phenomenon that the lower bass signal gets significantly "louder" because of the wall reflection. Excessive room gain can blur the sound of low frequency instrument. The high damping setting is designed to this purpose. It is a Bessel filter. Small or acoustically lively room has higher room gain, therefore one may want to set the extension frequency higher on the panel.

On the other hand, for small size vented box, it has a tendency of premature roll-off. To compensate that, we provide med damping (1.5db boost) and low damping (3db boost).

Overall speaking, set the extension frequency lower will make the sound stage sound deeper and wider. At the same time, damping of the extension filter affects the perception of bass instrument body, pace of the music, and tightness of bass instrument. High damping setting makes the bass instrument sound quicker

Graphs

In the following, graphs are provided to illustrate the characteristics of controls. It serves the purpose of helping users to achieve better integration.

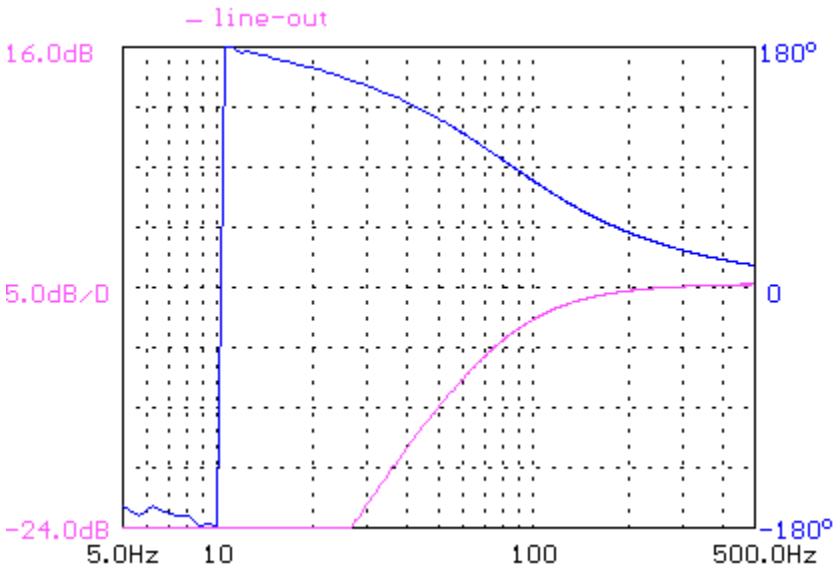

Fig 8 Line-out

Line out: Line out is essentially a 2nd order high-pass filter as shown in Figure 8.

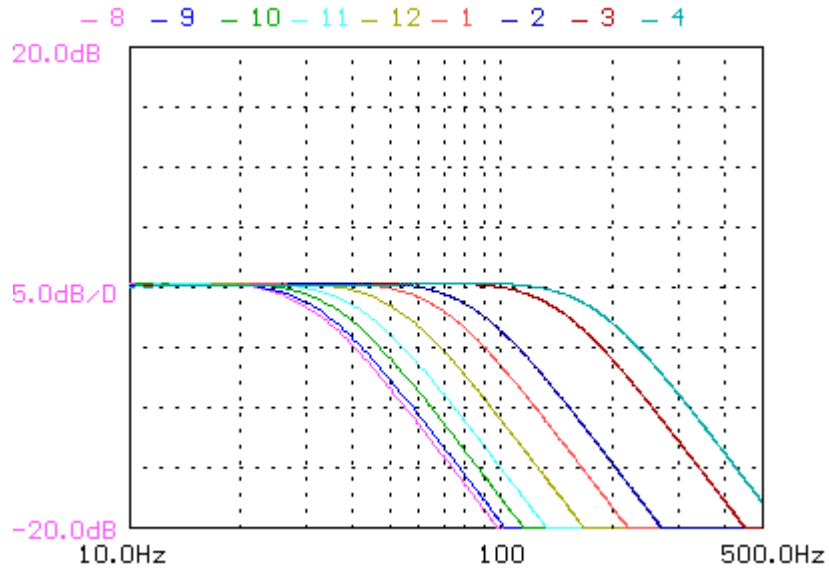

Fig 9 Sub crossover

Crossover: the crossover controls the crossover frequency of the subwoofer. Figure 9 shows, from left to right, amplitude responses from 8 o'clock to 4 o'clock position, in one o'clock increment. The control is fairly linear. 7 o'clock setting has almost same effect as 8 o'clock. Similarly 4 o'clock has similar effect as 5 o'clock.

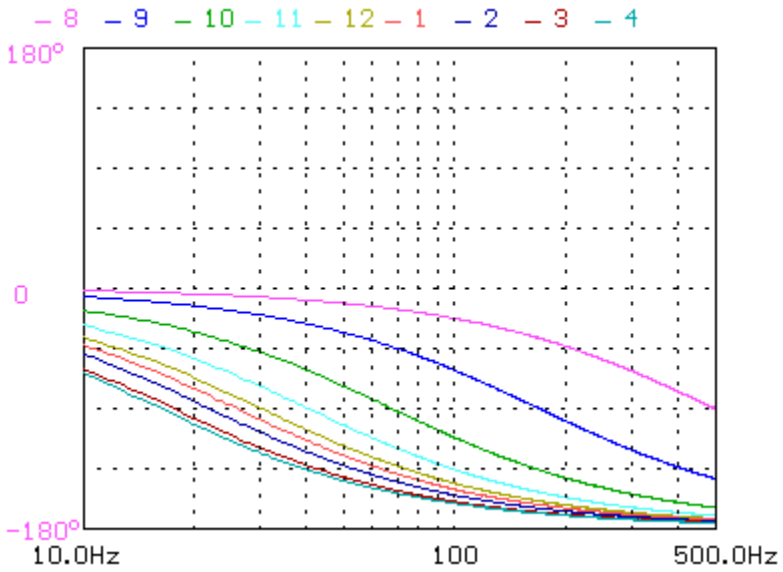

Fig 10 Sub phase control

Phase: Figure 10 Shows the phase shift from 8 o'clock to 4 o'clock position, in one o'clock increment (from top to bottom). The control is also fairly linear up to one point and afterwards changes slowly. The exact point where this happens depends on frequency. Also the maximum shift depends on frequency.

Extension filter: The frequency response when the frequency setting is at 20hz is shown in Figure 11 for 3

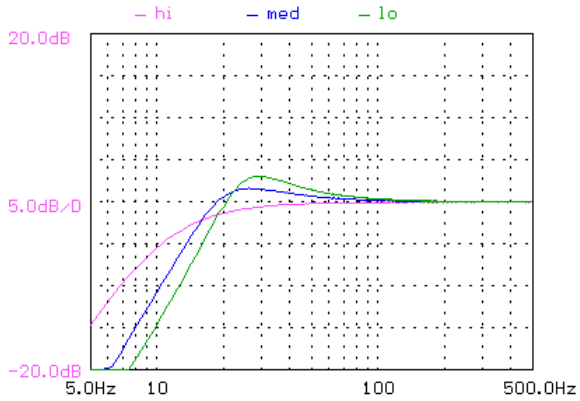

Fig 11 3 damping settings at 20hz

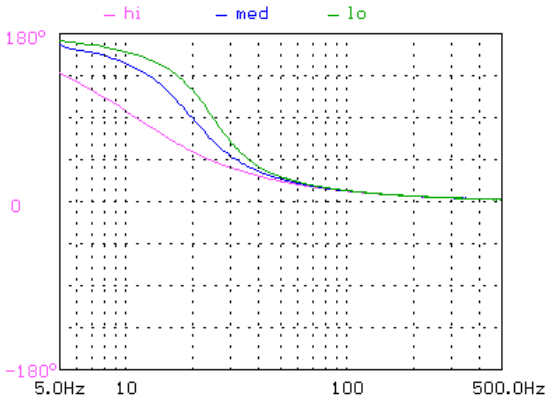

Fig 12 Phase response of Fig 11

different damping settings. From top to bottom are low damping, medium damping, and high damping. The Q values are approximately 0.60, 1.07, 1.33, for high, med, and low damping, respectively. The boost for med (low) damping is about 1.3db (3db). The true –3db points is somewhat lower than 20hz. Therefore one should think of this frequency setting as where the roll-off starts, and where –3db point is. We design the extension filter this way so that we can have more usable settings. Figure 12 is the phase response. Figure 13 and 14 are the response when the setting is at 14hz and 28hz, respectively. Finally, to bypass this filter, one can set the frequency to 14hz and damping to high.

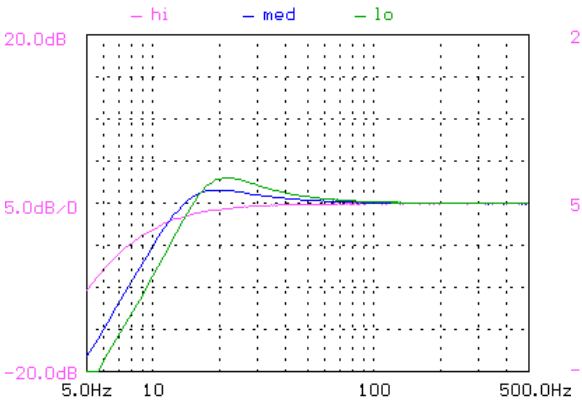

Fig 13 Response of 3 damping settings at 14hz

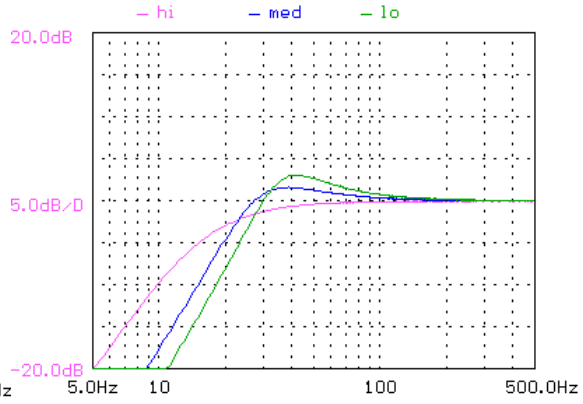

Fig 14 Response of 3 damping settings at 28hz

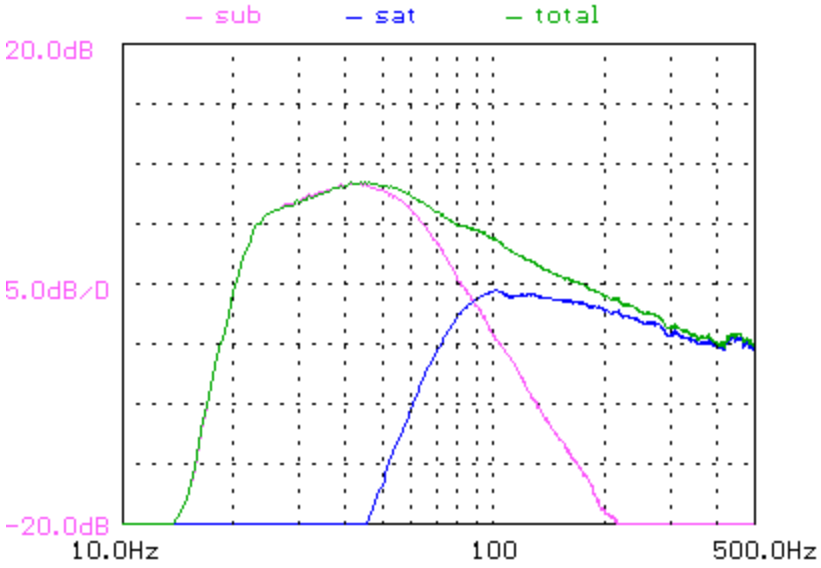

Fig 15 Subwoofer volume is increased by 6db

System hookup

Separate Preamp and power amp(s)

In this configuration one needs to connect the output from the preamp to Line input of on this subwoofer amp. Then connect the line output to the power amplifier that drives the satellite/front speakers. Follow the steps outlined earlier in this manual and gradually fine-tune it until you are happy with the results. A good starting point is set the crossover to 12 o'clock position and phase to 11 o'clock position. Try rock music with good recording of bass drums. The sound the bass drum should be solid and tight yet not forward. If the sound is sometime hollowed and recessed in the mid bass region (50-100hz), most likely a dip has occurred in the crossover region. If the bass drum sounds forward or tends to be one note, then too much overlap in the crossover region has occurred, similar to what Figure 6 has shown.

To add a bit of excitement, one may turn up the subwoofer volume a bit higher. As long as the phase is correctly aligned between sub and satellite, the blending should be smooth – a smooth tilt-up in the bass region, as shown in Figure 15.

Home Theater Receiver

Three aspects of home theater receiver that makes the setup different from the above case: 1) while there are preamp outputs, there are no power amp inputs. That means one cannot use the Lineout outputs from this subwoofer amp. 2) The build-in crossover for sub and satellite most likely will follow Lucusfilm's recommendation of 24db/12db Linkwitz/Riley. That is, 24db/oct for the sub and 12db/oct for the satellite. The anticipation is that the 12db/oct roll-off of the satellite's natural frequency response will make the overall response as 24db/24db, an intended setup for Linkwitz/Riley filter. This immediately rules out vented/ported speakers as front/satellite speakers because the setup will become 24db/36db. 3) There are simply too many options in the menu and too easy to make unwary mistakes. For instance, the delay time adjustment, if not adjusted correctly, can affect the blending when you play music.

Make sure the subwoofer is enable in the speaker configuration manual. Front speaker is set to small so that the low frequency signal is redirected to subwoofer. Connect the subwoofer output in the preamp outputs to the right channel line input. Set the phase to 0 and crossover to max (5 o'clock position) as a starting point. Gradually fine-tune the crossover and phase controls to get the best result. It is recommended to keep the phase control between 7 to 9 o'clock range and crossover control between 1 to 5 o'clock range. Whenever possible, use crossover control instead of phase control. The main reason is that Linkwitz/Riley setup theoretically will have phase alignment between the subwoofer and satellite at the crossover point.

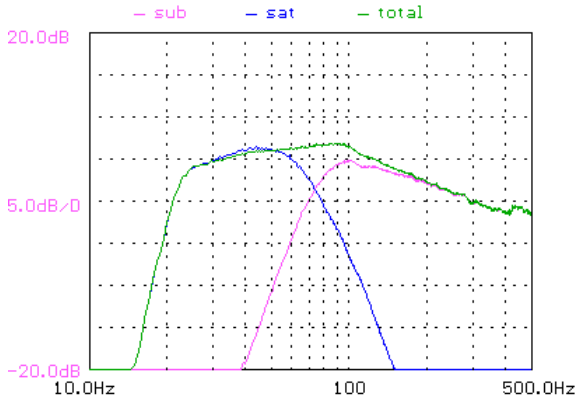

Fig 15 Response when crossover is at 5 o'clock

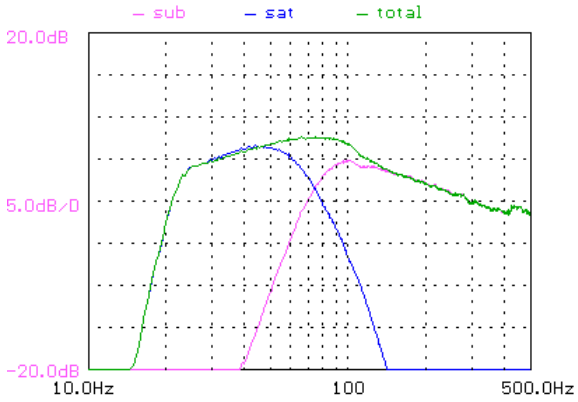

Fig 16 Response when crossover is at 3 o'clock

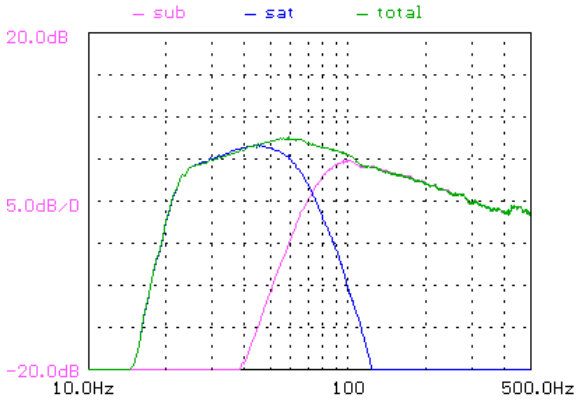

Fig 17 Response when crossover is at 2 o'clock

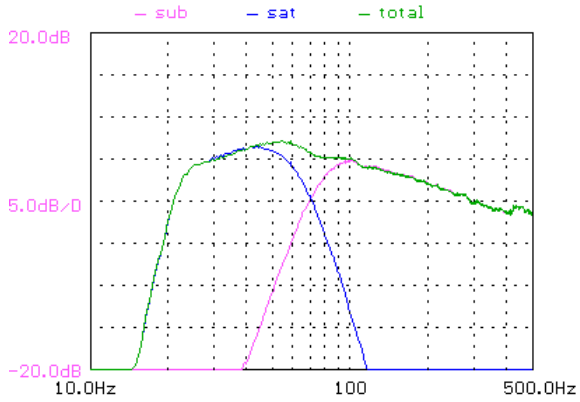

Fig 18 Response when crossover is at 1 o'clock

For comparative purpose, Figure 15-18 (taken from a Denon AVR-4800 receiver) shows the result when crossover control is at different setting (5, 3, 2 , and 1 o'clock respectively) while phase control is set at 0 (or 7 o'clock). Note that in Figure 18, a dip is about to form at the crossover point.

What I have seen from the Denon AVR-4800 may not be typical of other receivers. However, I have seen the distance difference between

Other Recommendations

This subwoofer amplifier is **NOT** recommended for sealed box speakers with DC voice coil resistance of less than 2.5 ohm, nor for vented box (passive radiator) speakers with DC voice coil resistance of less than 3.0 ohm. Otherwise, the thermal protection circuitry will be activated more often.

Support

Your satisfaction is paramount to us. Please feel free to ask us questions or give us feedback.