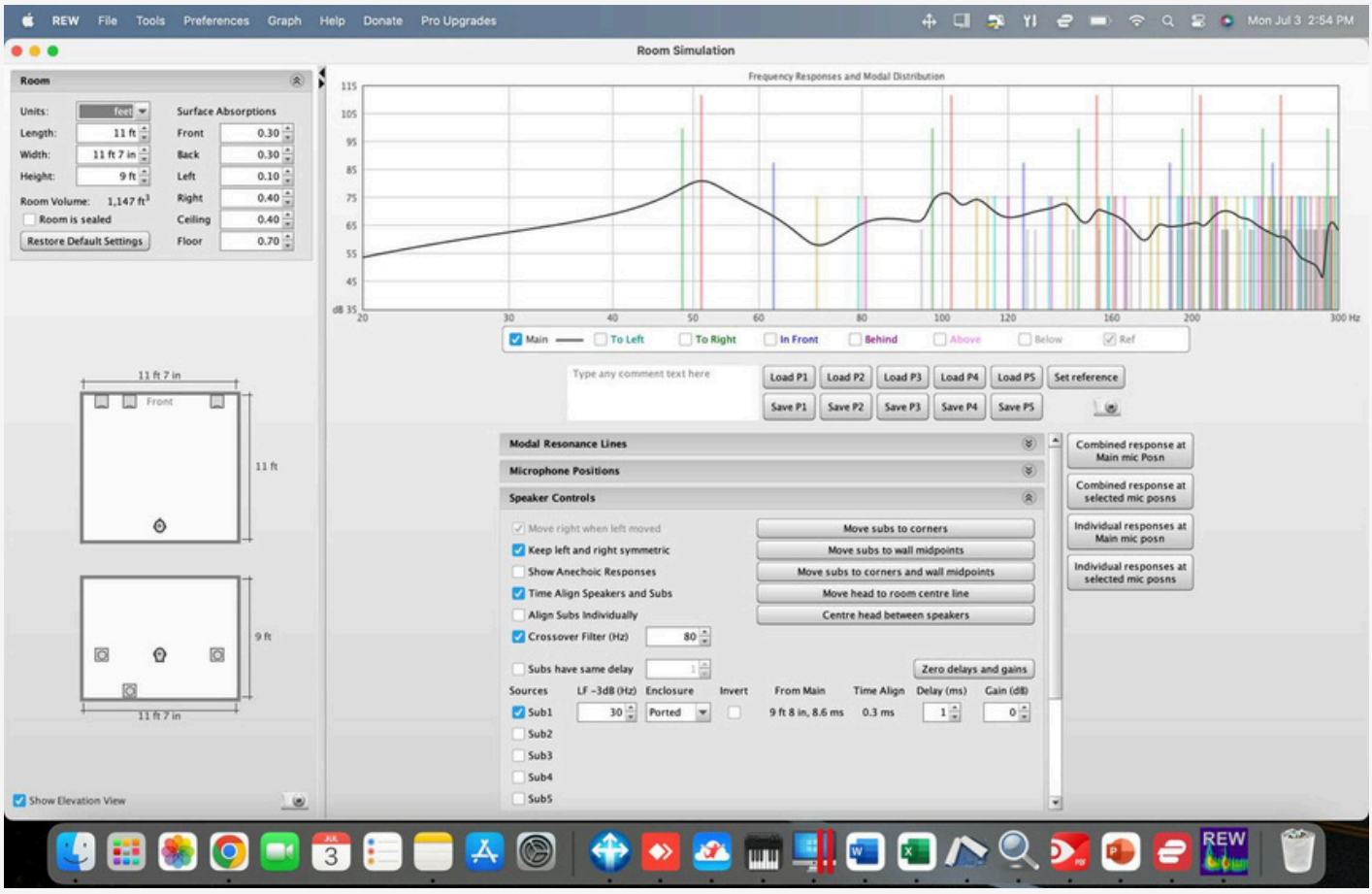
AVENUE SOUND AUDIO CALIBRATION STEPS

Step 1

Design the Room in REW Room Sim. Place the speakers and subwoofers in the best positions to achieve a 45 to 60 degree listening angle and the best frequency response for the main listening positions.



Step 2

Place your speakers according to the REW Room Sim in the room. Plan your seating position based on the Room Sim Design as well. Listen to some of your favorite content which you are very familiar with. Both movies and music. This will give you an understanding of the system before calibration and will give you a good comparison to see if any differences have been achieved after calibration.

Step 3

Turn off any automatic features in your AVR or processor. We don't want the AVR doing any unnecessary processing or filtering which may affect the sound quality. Also turn your subwoofer crossover knob on the back of the subwoofer to the maximum frequency allowable. We do this because we want the AVR or Processor to set the crossover. If we apply it from the AVR or Processor and then again apply it on that signal from the subwoofer, it will get applied twice and severely affect the response.

Place your measurement microphone where the listener's head would be in the master listening position at ear level. Place the microphone in the tripod so that it is facing 90 degrees upward if measuring a surround sound system. Place the microphone in the tripod so that it is facing straight forward pointing to the front speakers if measuring a stereo setup. Connect your microphone to your laptop and configure it in REW. Load the appropriate calibration file for your microphone if you have one. Connect the HDMI out from your laptop to any input on the AVR or processor and set the AVR or processor to that input. Take a look at Austin Jerry's guide on getting started with REW for a more detailed explanation on how to get started with REW, link provided below, or watch Jeff Mery's video on a great introduction to getting started with REW on MacOS.

https://www.dropbox.com/s/51jpnxet3bvew2k/REW%20101%20HTS%20Current%20Version.pdf?dl=0

https://www.youtube.com/watch?v=Z9YDRyfrdCw

Step 4

Time Align all speakers except for the subwoofer. Take a measure tape and manually measure the distance from the middle of the speaker driver to where the center of the head would be located at ear level at the listening position. Insert the distance into the distances section of the AVR or Processor. Enter the distance for the respective speaker into the AVR for that speaker.

Repeat these steps for all speakers except for the subwoofer. Leave the Subwoofer Distance at 0 feet for now. Once this is complete all speakers except for the subwoofer have been time aligned.

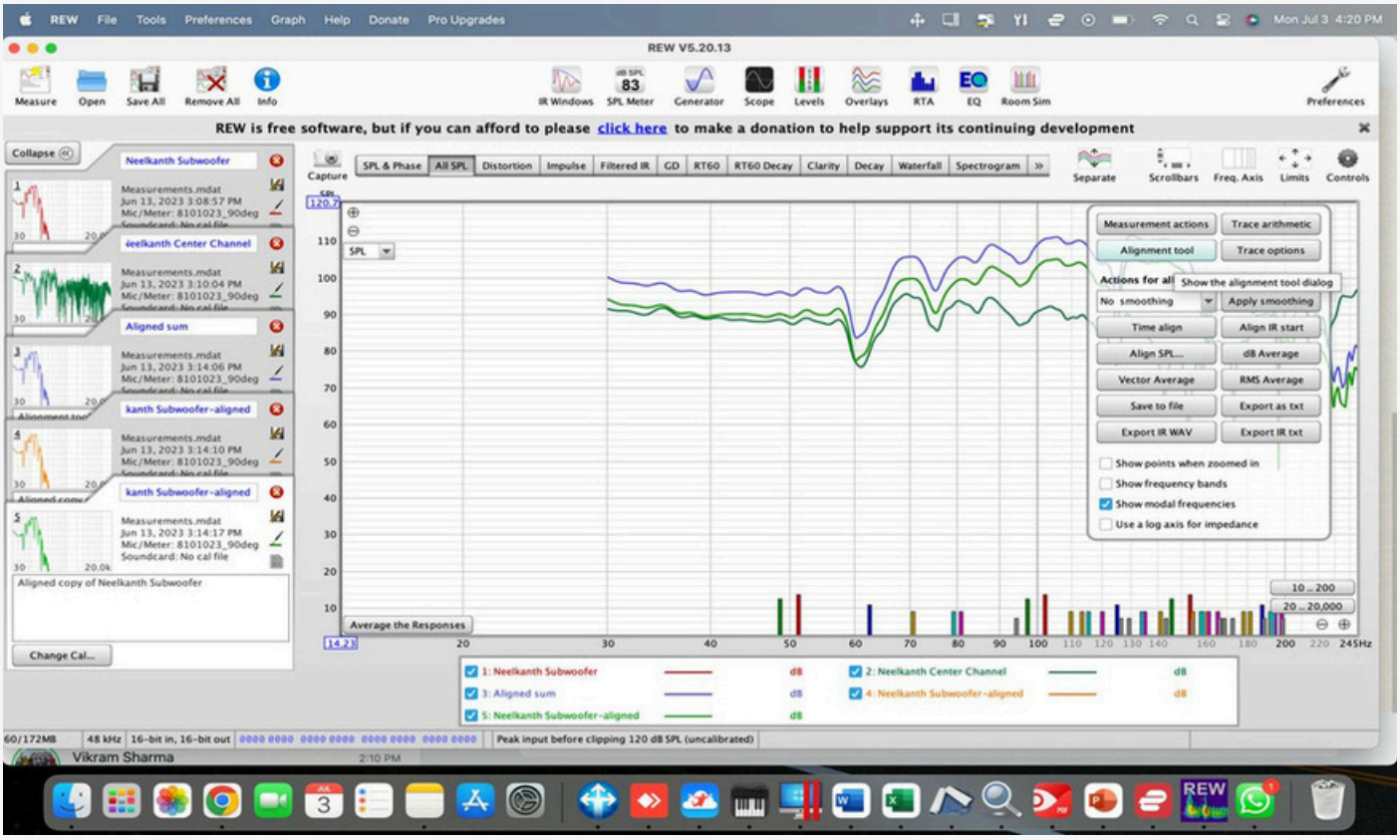
Step 5

Gain Align your speakers. Play a test tone at 75db level from the AVR or Processor. Start the SPL Meter in REW and check what level your test tone for each respective speaker is being output at. If the test tone is showing 73db and the AVR or Processor volume is set to 75 db, then the gain for that speaker in the levels section of the AVR or processor needs to be increased by 2 db. If the test tone is showing 78 db and your AVR or Processor's volume is set to 75 db, then the gain for that speaker in the levels section of the AVR needs to be lowered by 3 db to ensure that speaker is playing at a level of 75 db. Repeat these steps for all speakers including the subwoofer. Once this is complete all speakers have been gain aligned.

Step 6

Time align your subwoofers if you have multiple subwoofers. For a single sub you can skip down to Step 6. Make sure all your preferences are properly setup in REW and hit the Measure button. If you have Multiple Subwoofers follow the following steps. Do a frequency sweep of the LFE Channel from 20Hz to 300Hz. To ensure you are only measuring one subwoofer at a time, you can turn off the power to the other subwoofers, or if you are using a MiniDSP eq device such as a 2x4HD or equivalent you can mute any of the channels which you do not want to measure and measure only one output channel at a time.

Once all subwoofers are measured give each a proper description in the left side next to the details of each measurement. Set the tap at the top to “All SPL”. Click the Controls button on the top right and then select the Alignment Tool button. Picture of the same provided below.



In the alignment select the two measurements you want to align. If using more than two subwoofers, first align your front subwoofers and rear subwoofers with each other and then align the aligned front subs to the aligned rear subs. Try to invert the polarity first of the second measurement to see if it helps improve the combined measurement. If it helps leave the inversed polarity checked and try adding delay to the second measurement to try and further improve the measurement. Incase inverting the polarity does not help uncheck the invert polarity box and add delay to the second measurement to see if any delay provides a higher gain and flatter combined response. The delay can be applied on the back of the individual subwoofer in the phase or delay knob, or using the exact delay in millseconds attained from REW the delay can be applied to a MiniDSP 2x4, 2x4HD or similar hardware for that individual output. You can then remeasure after applying the delay to see the effect on the response after applying the delay.

If no amount of delay improves the response, then do not add delay to any of the speakers. If delay does improve the response then add the necessary delay to the respective speaker. If the invert polarity box is checked then make sure to invert the polarity of that particular speaker either through a MiniDSP EQ device or on the physical speaker itself if the option is available.

Save the predicted combined response in REW by selected the aligned sum button in the alignment tool. This will save a measurement of the combined time aligned measurement for you to compare with the actual measurement we are about to take.

Ensure both speakers are on and take a combined measurement of from 20hz to 300hz. Now compare this actual measurement with the predicted combined measurement in the overlays tab.

Repeat these steps for additional subwoofers as required till all subwoofers are time aligned with each other.

Measure

For more information on this time aligning your subwoofers please watch the video by Jeff Mery below:

https://www.youtube.com/watch?v=8bwpLfbLiZ4

Step 7

Time align your subwoofer to you center channel. Now that are subwoofers are time aligned to each other and all of our main channels are time aligned to each other, we need to time align our subwoofers to our main channels. This can be accomplished by time aligning the subwoofers combined response to a single speaker in the main channels. We generally prefer to choose the center channel speaker, but you can choose any of the LCR channels.

Take a measurement from 20hz to 300hz of the Center Channel Speaker. Label the measurement accordingly.

Using the alignment tool and the method described in Step 6, time align your combined subwoofer response to your center channel speaker. If you have only a single subwoofer use the measurement of your single sub from 20hz to 300hz and time align that to your center channel. Once the best aligned esponse has been calculated add the necessary delays and/or changes in polarity to the subwoofer/s to ensure the same response can be maintained. Please note whatever changes you make to one subwoofer needs to be applied to all the subwoofers. For adding delay the best option would be to add delay in your distance measurement for the subwoofer in the AVR or processor and that will get applied to all the subwoofer pre-out channels.

****The following steps require the use of a EQ hardware such as the MiniDSP 2x4, 2x4HD, Flex or others.**

Step 8

Once your subwoofers have been time aligned with your main channels, the next step would be to apply EQ to the subwoofer/s and save them on an EQ hardware such as the MiniDSP 2x4, 2x4HD, Flex or others if you choose to use one. Choose the combined time aligned final response for all subwoofers and then select the EQ button on the top in REW.

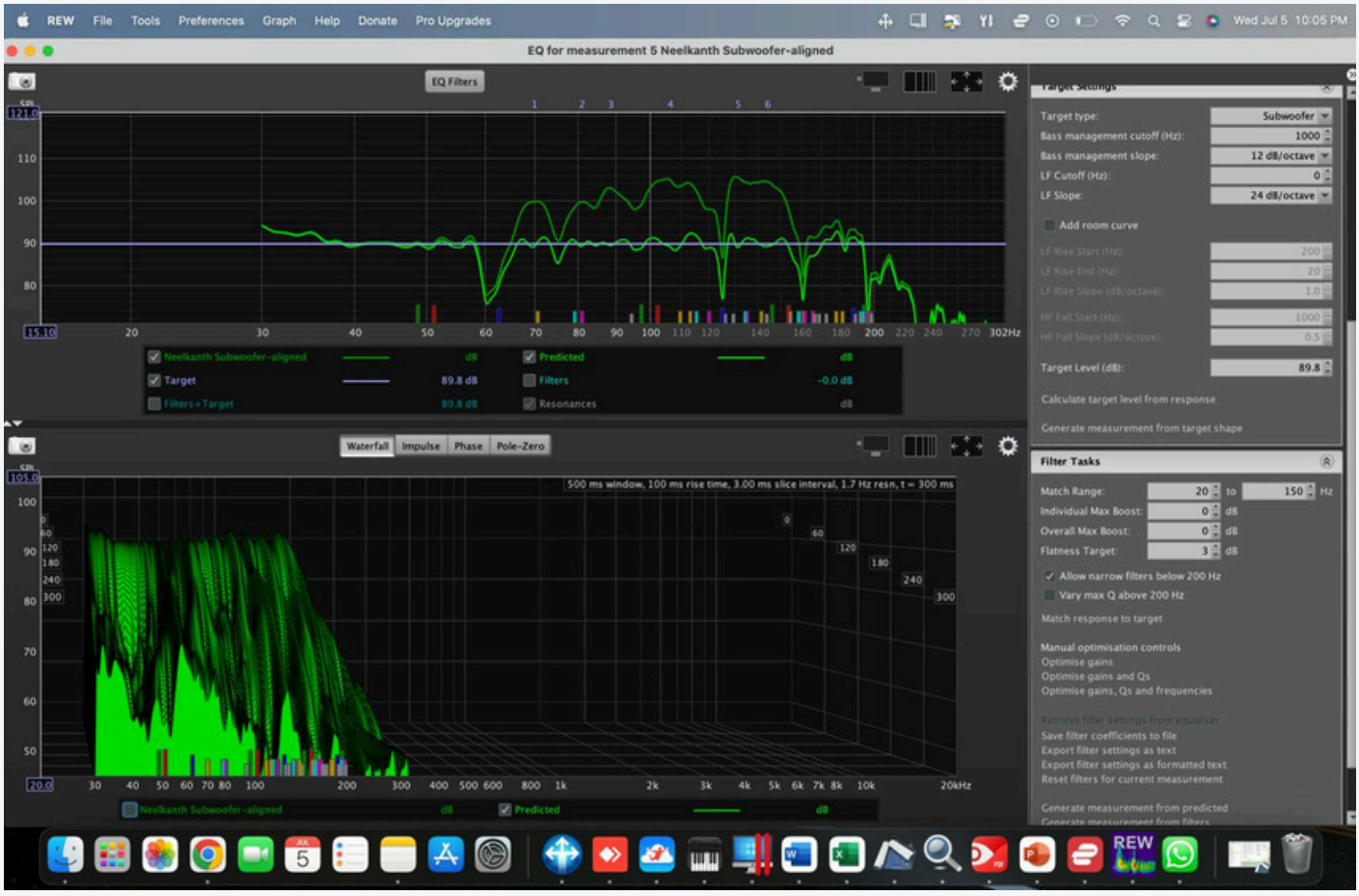
This opens a new window for EQ of this particular response. On the right side you have several drop downs which need to be completed to apply eq to this response. First choose your equalizer. If you have a MiniDSP 2x4HD you can choose that as the option. If you have a MiniDSP 2x4 you can choose MiniDSP. If you have a SHD or SHD Studio you can choose MiniDSP 96hz. Your equalizer hardware will have instructions which can guide you as to which option can be selected in REW. Incase you are not able to figure out which hardware should be chosen you can choose generic.

Next we need to choose the Target Settings. If this is a Subwoofer we are going to EQ please choose accordingly. If this is a full range speaker then choose that accordingly as well. We highly recommend only applying EQ till 300Hz or the transition frequency. Many are tempted to EQ beyond the transition frequency for the room but for the mid and high range frequencies EQ will not make an audible difference and actually affect the natural timbre of the speaker. For better response in the mid and high range frequencies it is always recommended to add acoustic treatment to control the response in that range.

After choosing the target type set the Bass Management cutoff to 1000hz. Set the bass management slope to 12db/octave and the LF cutoff to 0hz. Also set the LF Slope to 24db/octave

Uncheck the room curve box. A room curve can be applied and we will be sharing a link below to a video by Jeff Mery which further explains how to add a room curve to your target response. For our purposes we will be explaining how to EQ the response as flat as possible and further applying Dirac room correction to that flat response

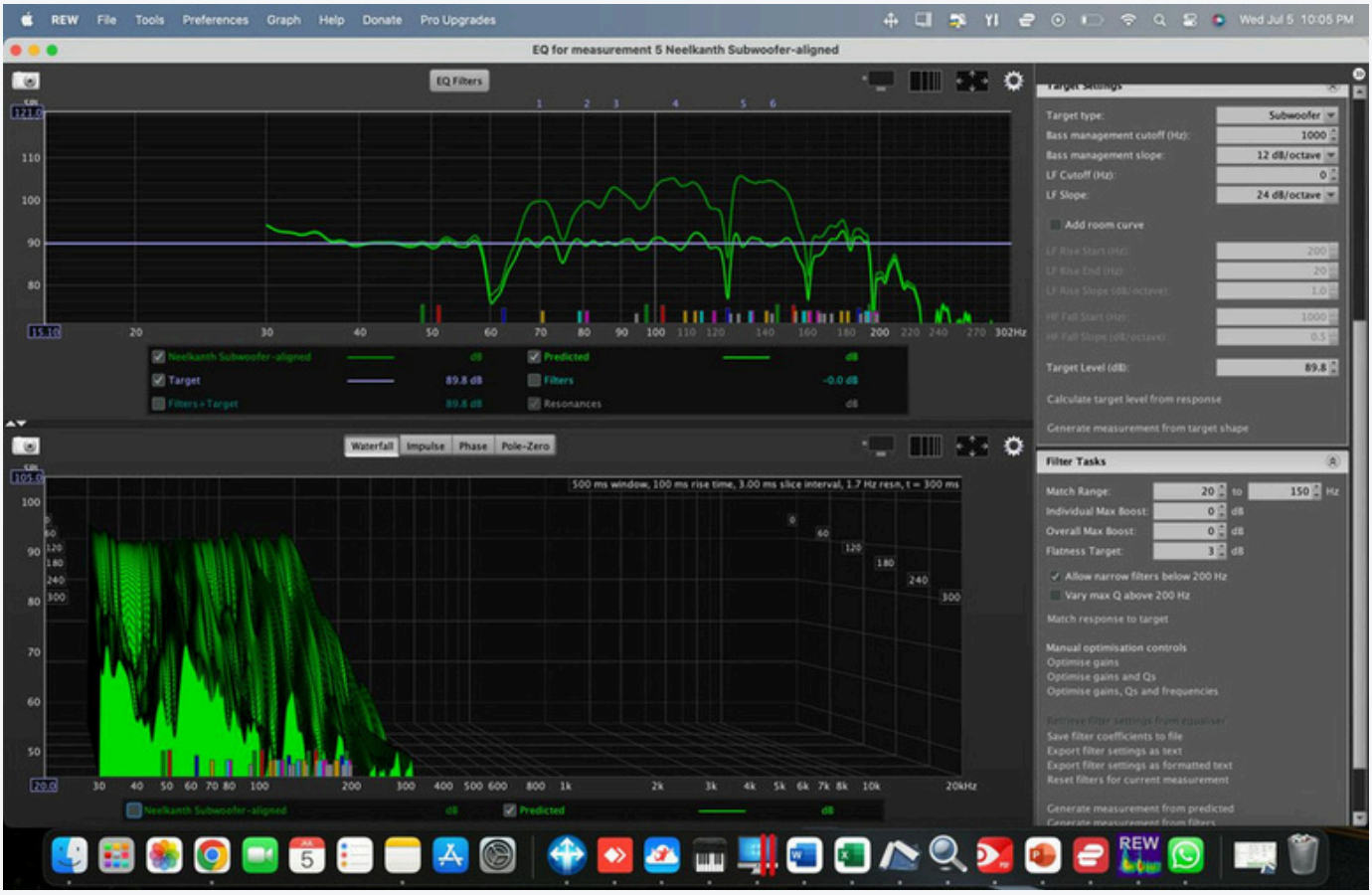
Lastly press the calculate the target level from response button. This will auto calculate what level of the frequency response we want to EQ. More often than not this will try and EQ more of the frequency response then we want to EQ. The goal when setting the target curve is to set it to a level which will correct most of the large peaks in the response. We cannot add gain to a null and try because it puts too much strain on the amplifier and does not do an effective job of compensating for the null. Quite a few nulls may be due to room modes and can be corrected naturally by moving the seating position, moving the subwoofer, or adding multiple subwoofers. Before we integrate the room we can plan for nulls in our response by using the Room Sim feature in REW or many other software which can help predict room modes. A picture of the target curve and target settings is shown below.



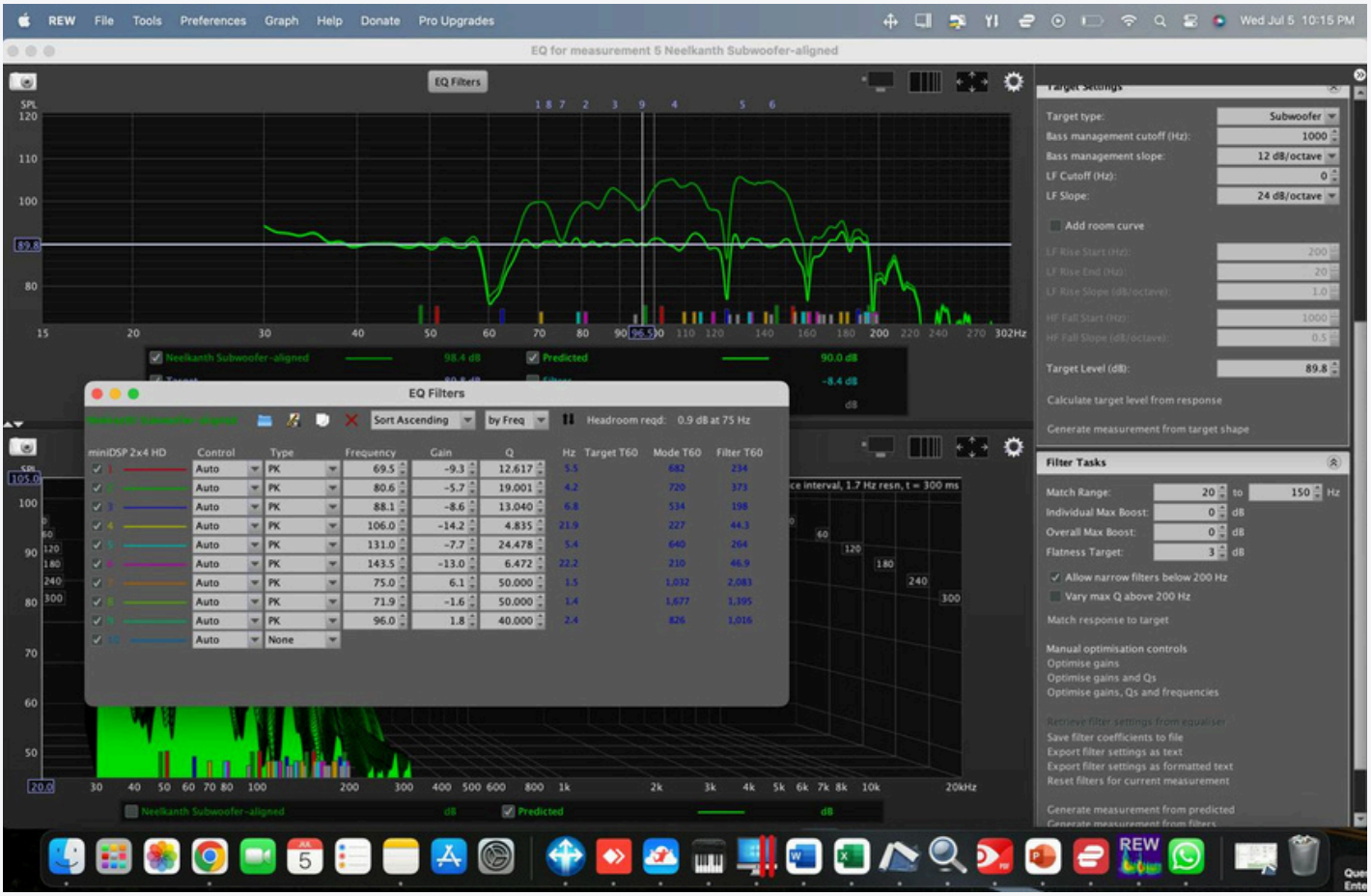
For the next section, filter tasks. The match range area deals with what areas we want to apply the EQ filter to. If you know your subwoofer can reach down to 20hz then that is a good starting point. If it can go down into the teens then you may want to even start at 15 hz. For the purposes of our training we are going to keep the starting range at 20hz and apply EQ till 100hz.

The individual max boost we are going to set to 0 because we don't want REW to boost any peak filters because it puts unnecessary strain on the amplifier when trying to boost a frequency. For the overall max boost same rule applies, we set that to 0 as well. For the flatness target, we can start with a target of 3 and see how the response turns out after asking REW to apply the automatic EQ. This basically means that we want all frequencies in the match range of the response to remain within plus or minus 3db of the target curve. Please note these are preliminary numbers and we will be experimenting with other figures to see how the response shapes in relation to the target curve. Allow narrow filters below 200hz can remain checked and vary Max Q above 200hz remains unchecked. Next you can click Match Response to Target and lets see how the response shapes in comparison to our target curve.

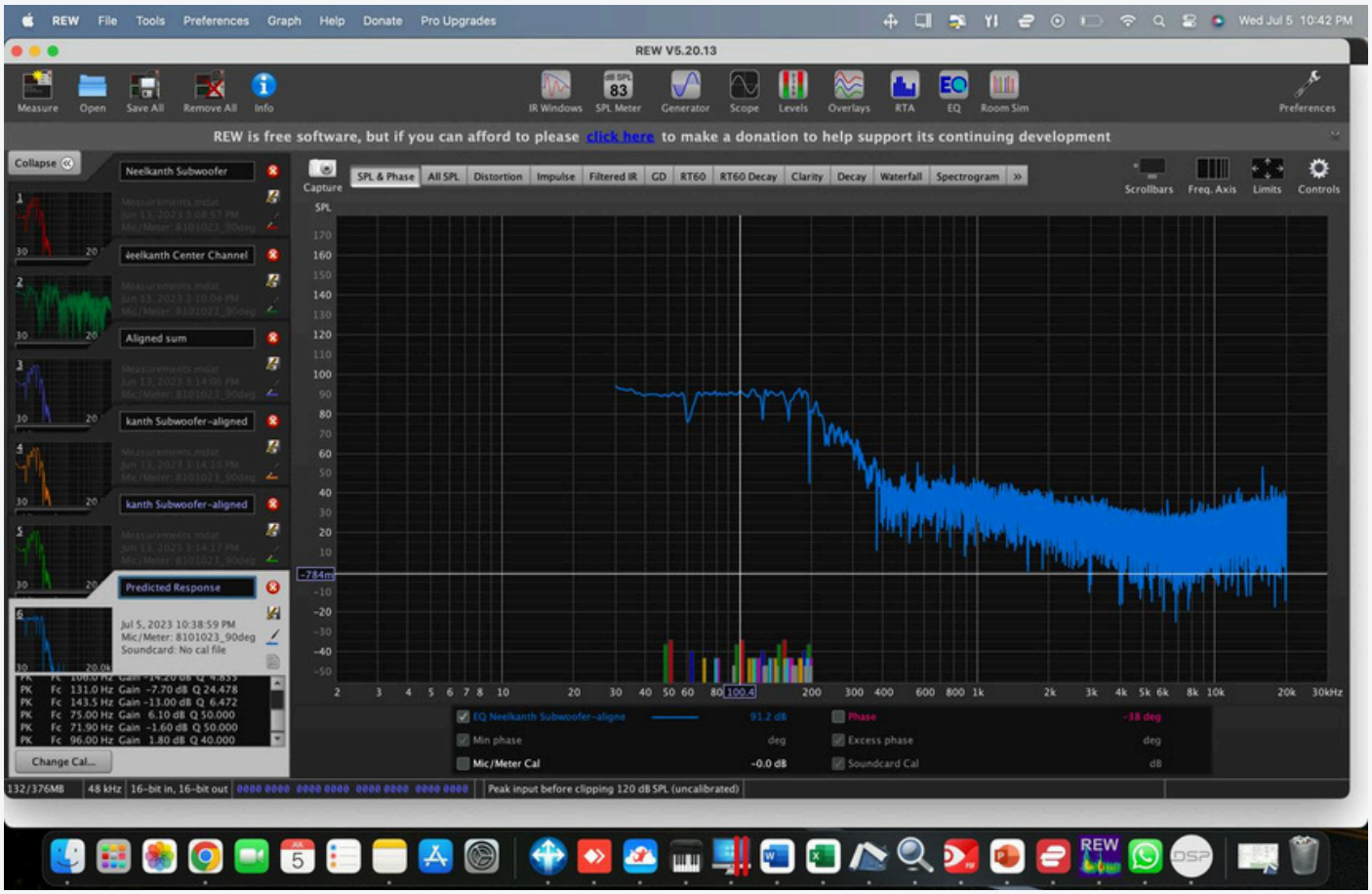
**You may get a pop indicating that the target level is more then 10db away from REW's estimate of where it should be. Please click okay because we don't want to EQ the entire response and would prefer to try and tame most of the peaks rather than boost the nulls to try and get a flat response.



Now after allowing REW to auto eq the response we get a much smoother response as we can see from the predicted response provided. There are those nulls still which can be attributed to room modes, but the majority of the response stays within plus or minus 3db of each other from the range of 20hz to 100hz. If we want to smoothen the response even further, we can manually add our own EQ incase some small boosts or cuts need to be given for an even flatter response. A screen shot of the same can be seen below.



If you find your response is not very smooth, you can try adjusting some of the figures in the flatness target or even the individual max boost to see if this helps bring a smoother response. You can also look at the predicted waterfall graph and impulse response to see that there is no modal ringing taking place in the predicted response. Also click on the Generate Measurement from Predicted Button located at the bottom right of the EQ page to generate a measurement which can be founded in the main REW section along with your other measurements. We will use this measurement later to compare with a measurement of the speaker once EQ has been applied.



Once we are satisfied with predicted response we can press the save the filter coefficients to file button and save the file in a known folder in our computer which can be easily accessed for the next step. Please take a look at Jeff Mery's video which does an excellent job of explaining this process in much more detail.

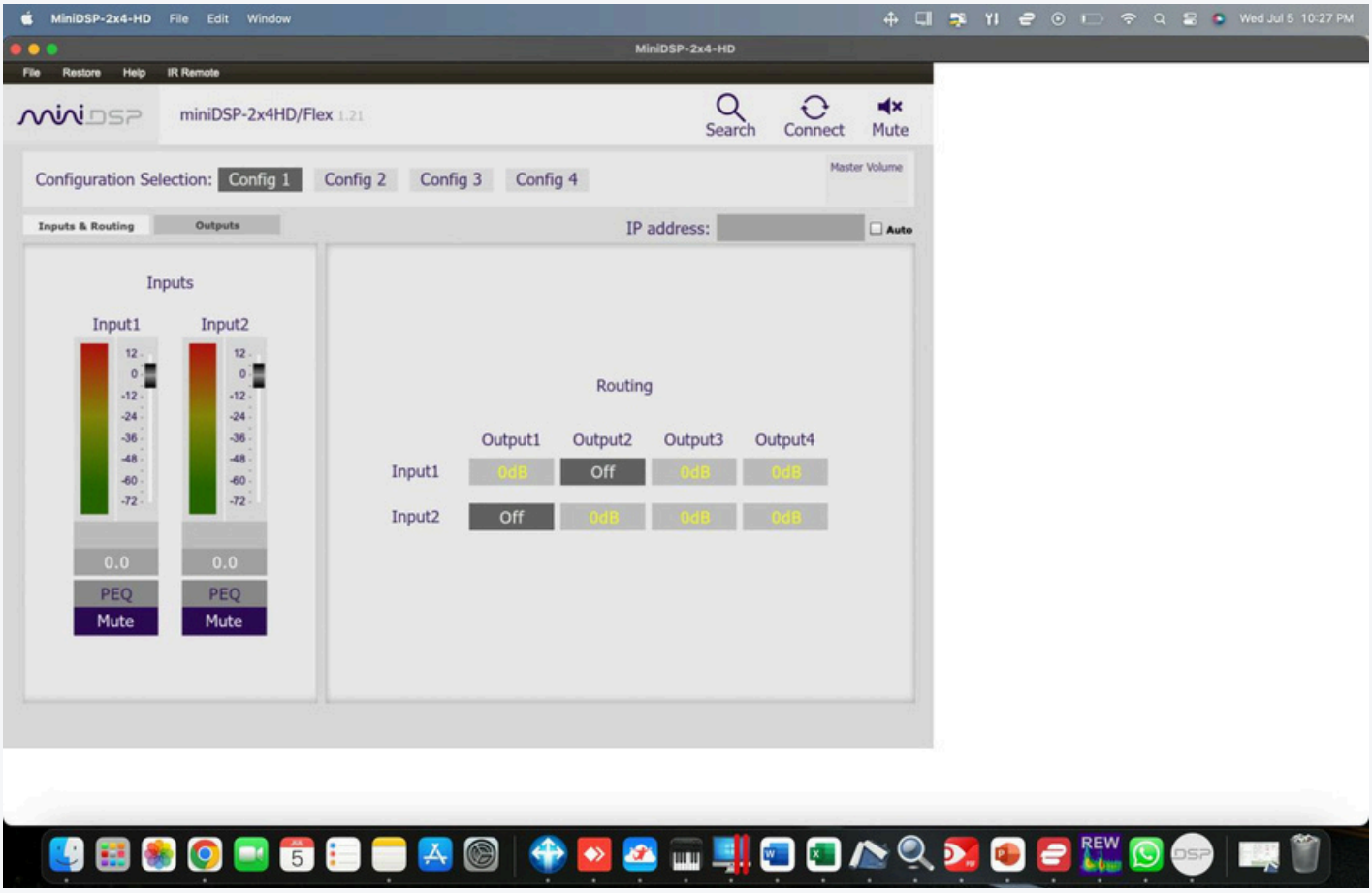
https://youtu.be/ARztXSmoQbE

Step 9

Once we have a coefficients file saved in our computer, it is now time to apply those filters to our subwoofer/s. This can be loaded into a MiniDSP 2x4, 2x4HD, SHD, SHD Studio or similar device which will allow equalization filters to be inserted which have been generated in REW. Let's look at saving this to a 2x4HD by MiniDSP in this example. We can open the 2x4HD DSP software which can be downloaded from MiniDSP's website with the purchase of a MiniDSP 2x4HD.

In here the first step is to configure our routing. If you have a subwoofer connected to a particular output, then keep both Input 1 and Input 2 selected for that output. If you have a speaker connected with a subwoofer also then you can select Input 1 or Input 2 depending on

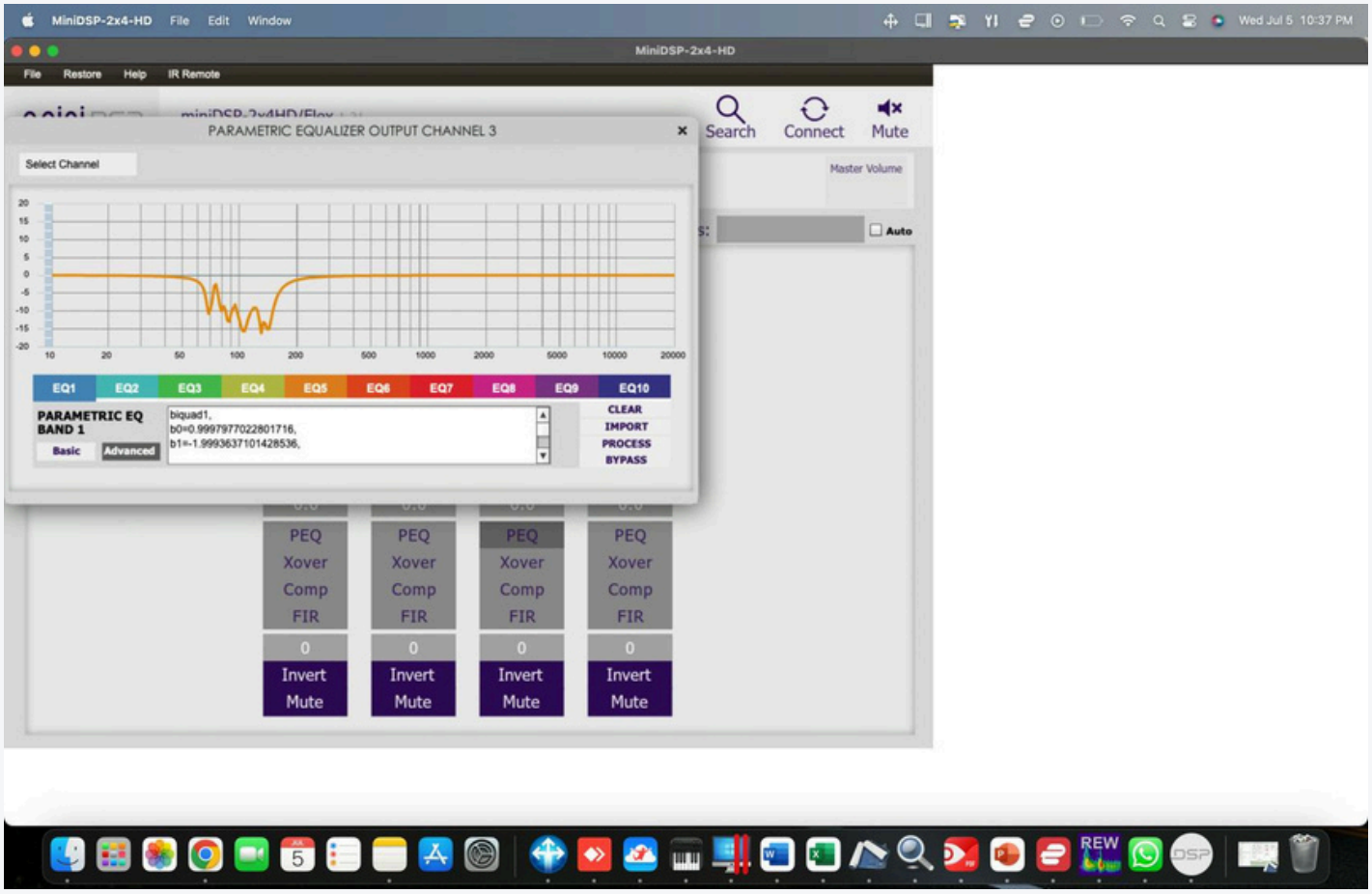
which signal should be passed to that speaker. A screen shot is provided below in which we have a full range signal coming into our MiniDSP 2x4 HD into input 1 and input 2. Input 1 would be the left channel and Input 2 the right channel. Thus we have routed Input 1 to Output 1 which is our Left Speaker, Input 2 to Output 2 which is our right speaker, and both inputs to our two subwoofers attached to outputs 3 and 4. Similarly if you had 4 subwoofers and only one input signal, we would select only that input for all 4 outputs.



Next we proceed to the outputs section. Here is where we can import our saved eq filters file from REW and apply it to the subwoofer/s which require EQ. If you have EQ'd the combined response of all subs in the room, then this same file would need to be applied to all outputs which have subwoofers connected to them. If this is an individual eq per subwoofer, or for a specific speaker then you would need to import that eq file only for the output which passes the signal to that particular speaker.

If you have set any delays or crossovers in the AVR or Processor, be sure to bypass all crossover in the MiniDSP and set all time alignment to 0. Vice versa applies if you have set any delays or crossovers in the MiniDSP or done any time alignment for any of the output channels, be sure to set everything to zero in the processor or AVR and set all crossovers to the maximum frequency possible. This is a crucial step because we want only one device to set the crossover and do the time alignment. If two devices are set to do it then the same is applied twice and severely affects the final response.

Click on the PEQ button for that output. This opens a new window in which you should see a completely flat target response. Incase the response is not flat, please press the clear button. Then proceed to press the import button and upload the coefficients file which you saved in Step 8. Once the file has been applied you should see the target response in the window changed and no longer flat with the eq filters applied which were saved from REW in Step 8. A screenshot of the same is provided below.



Apply the necessary coefficients file to the necessary outputs and re-measure your speaker. You can compare your new response with the measurement which we generated from the predicted response on the EQ page at the end of Step 8 to see if the filters have been applied successfully and we are getting the response which was predicted by REW.

If you feel some changes are still required, you can once again click on the time aligned response from Step 7 and click the EQ tab. Make the necessary changes till you are satisfied with the final response. Once you are satisfied with the final measured responses after applying EQ listen to some familiar content in both movies and music. Try and listen to the same content which you listened to before completing the calibration. This will give you a good understanding of what differences have taken place post calibration.

DIRAC AUDIO CALIBRATION STEPS

Step 1

Download the latest version of Dirac from **https://www.dirac.com/live/downloads/** Once installed, open Dirac. Create an account and sign in. Make sure your Dirac enabled device is on the network and so is your laptop and Dirac will automatically locate the Dirac enabled device. Click on the device once it is found

Step 2

Place your microphone at the main listening position in between where the listener's ears would be. The Dirac software will prompt you to select your recording device. In this case, depending on which calibration microphone you have connected to your laptop, select that microphone as the recording device. If you have a calibration file for that microphone, you can upload that as well below the recording device selection. Please ensure to use the calibration file for 90 degree measurements.

Step 3

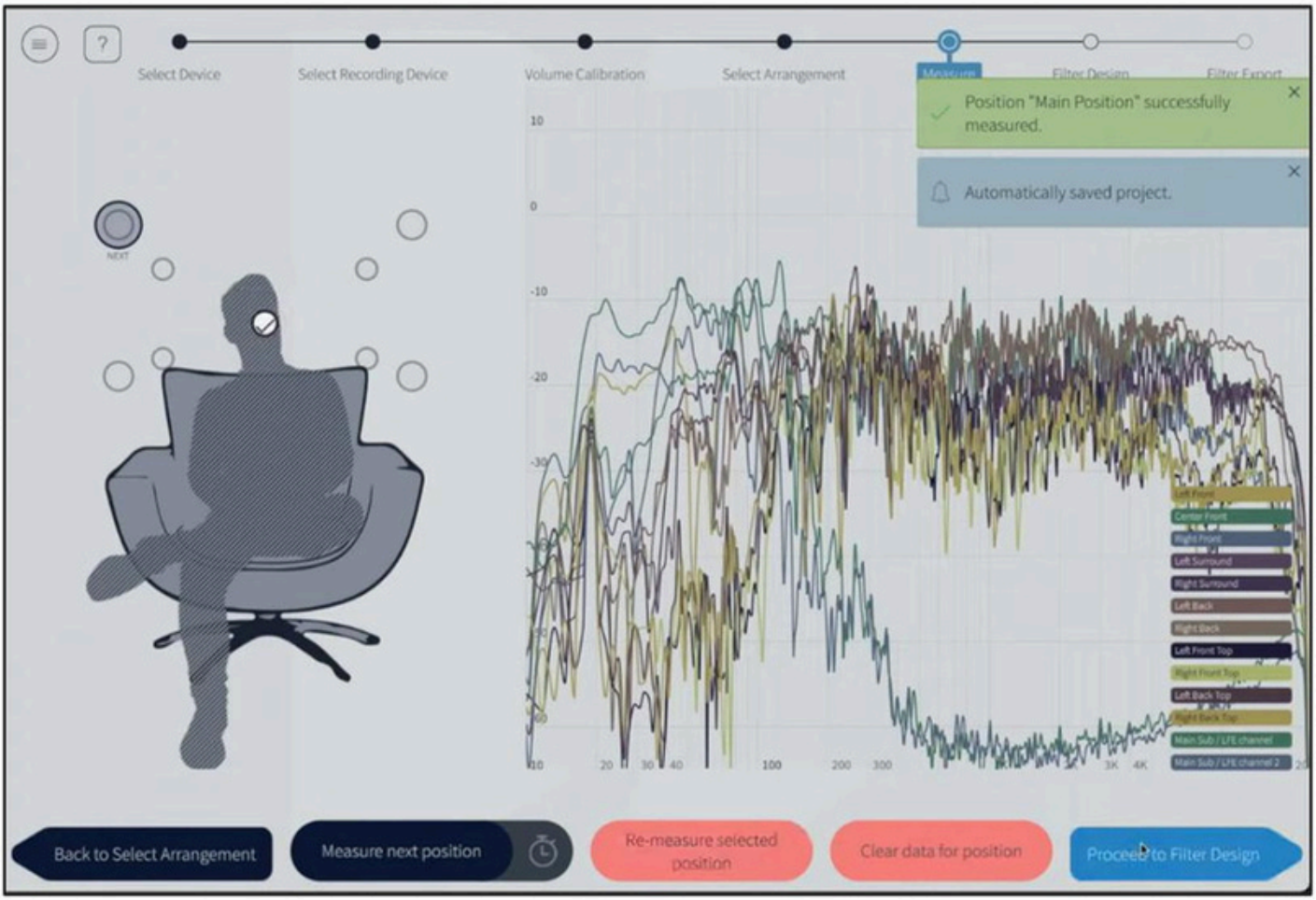
Click the Proceed to Volume Calibration button. Follow steps in the following link to complete the Volume Calibration:
https://mehlau.net/audio/dirac-live-2-mic-speaker-levels/

Step 4

Choose an arrangement which best matches the layout of your room. The larger the arrangement you choose, the more measurements will be taken throughout the Dirac Calibration. Tightly Focused Imaging (9 Points), Focused Imaging (13 Points), or Wide Imaging (17 Points).

Step 5

Dirac will show an illustrated guide of microphone placement positions where it would like to take measurements based on the seating arrangement selected. Example picture provided below.



Place your microphone in each position and then click the "Measure Selected Position" button. While taking the measurement be sure that your microphone has a clear line of sight to the speaker and there are no obstructions in the way. Also try and ensure you are completely still and not in a position which may affect the measurement. Dirac will do a series of sweeps across each speaker at each measurement position. Complete all measurement positions and proceed forward to the next step.

Step 6

Dirac will show an illustrated guide of microphone placement positions where it would like to take measurements. Be sure to measure the sweet spot as the first measurement. Then proceed to measure the remaining positions. Click the "Proceed to Filter Design" button once all the recommended positions have been measured.

Step 7

In this section Dirac allows you to create a custom target curve or load a predefined target curve to create the individualized response you feel most appropriate for each speaker. If you want to download and try Harman's pre-defined target curves with some extra bass boost you can do so from the following URL:

https://mehlau.net/audio/dirac-live-2/

We highly recommend loading different target curves and exporting that saved response as a Dirac filter in your device to see which sounds best. Compare the target curves from Harman as well as any you have designed on your own just based on what you hear. This will be a good comparison and let you narrow in on the best response for each speaker.

Speakers with similar attributes are automatically grouped, and we generally recommend keeping them that way. If you use a different response for your front left and a different response for your front right, it may cause issues in ensuring the same timbre response from both speakers. Remember that Dirac has already measured each individual speaker in multiple positions and will now try and shape its response to an ideal target response for the best possible results. Therefore, multiple target responses for speakers with the same attributes or type will not be beneficial.

Step 8

If you have Dirac Live with Bass Management, you also get the option for Dirac to automatically calculate the best crossover for each speaker. Mehlau.net has an excellent write up on how to properly set the crossovers with Dirac and does an amazing job of explaining the best way to set the correct crossover through Dirac for each speaker.

https://mehlau.net/audio/dirac-live-2-avr-crossover/

As with the target curve, setting the crossover will require a certain amount of trial and error. You need to export the Dirac filter, listen to it on our device, and compare different filters. This will help you determine which crossover is delivering the best response for your space.

Step 9

Once you have finished designing your filter, export it to your Dirac enabled device. You may have a single slot or multiple slots to save Dirac filters, depending on which device you are using. If you have multiple slots, you can save different filters and easily toggle from one slot to another in your device to listen and compare the filter designs. Be sure to save your project once you are finished in case you want to make any future changes or adjustments. You will not need to repeat the measurements if you have saved the Dirac file. You can go directly to the filter design and make the necessary adjustments.

Step 10

Take post calibration measurements in REW to see the frequency response you have achieved for each speaker and how close has Dirac been able to match the target curve which you set in the filter design.

References Used:

Jeff Mery, Professional Integrator and Calibrator and Owner at Bison HTA

Markus Mehlau, Multimedia Consultant and Developer