2. Taking Initial Measurements with REW

By David Das

Contents

Overview

In the previous article you have learned how to set up your ROON Server.

This article will show you how to take initial measurements of your speakers using the Room EQ Wizard (REW).

The following article will explain how to generate the FIR Filters using the Acourate Digital Room Correction Software.

The 3 Essential Items you need to buy

Item #1: Dayton Audio EMM-6 Omnidirectional Condenser Microphone

https://www.amazon.com/Dayton-Audio-EMM-6-Measurement-Microphone/dp/B002KI8X40

$69.95

Note: A USB Microphone is not suitable for taking measurements with Acourate.

Item #2: Microphone Stand

Auray MS-65HD Professional Mic Stand with Telescoping Boom Arm

https://www.bhphotovideo.com/c/product/1447612-REG/auray_ms_65hd_pro_hd_microphone_stand.html

$69.99

Item #3: USB Audio Interface

Focusrite Scarlett 2i2 3rd Generation 2-in, 2-out USB Audio Interface Bundle with XLR Cable.

https://www.amazon.com/Focusrite-Scarlett-Interface-Bundle-Polishing/dp/B09WJFHJZY

$220

Alternatively, you can buy the TOPPING E2x2 OTG USB Audio Interface.

https://www.amazon.com/TOPPING-E2x2-OTG-Audio-Interface/dp/B0DBPQWPPB

$199

This does not come with an XLR cable to connect your microphone. So, you would need to buy this cable.

Monoprice XLR Male to XLR Female Cable, 16AWG, 10 Feet.

https://www.amazon.com/Monoprice-104752-Premier-Male-Female/dp/B001URFZKM

$14.99

Download and Install the Room EQ Wizard

It is best to run the Room EQ Wizard on a laptop running Windows 10 Professional.

While REW is compatible with Windows 7, the Focusrite Scarlett 2i2 3rd Gen no longer supports USB drivers for Windows 7. You need Windows 10 or higher.

https://www.roomeqwizard.com/

Downloads

The current version is V5.31.3, 25th July 2024. Previous builds are here.
V5.19 cannot open V5.20 or later mdat files

Beta version downloads are hosted at AV Nirvana, home of the REW support forum. To view the REW revision history click here.

OS	Downloads
Win 11/10/8/7 Vista XP Pro x64	Windows 64-bit installer (51.3 MB, includes private 64-bit Java 8 runtime)
	Windows 32-bit installer (51.3 MB, includes private 32-bit Java 8 runtime)
10.15 - 14	macOS DMG (61.1 MB, includes private Java 8 runtime) Notarized universal binary for Intel and ARM Macs. Mic access is included in the code signature and will be requested if necessary. A mic access prompt for REW can be forced using `tccutil reset Microphone` from a terminal before starting REW then using a feature that requires mic access, such as the SPL meter. You may need to use the mac's Privacy settings to grant REW access to the folders where measurements are to be saved, particularly if they are on the desktop.
AMD64	Linux AMD64 installer (50.3 MB, includes private Java 8 AMD64 runtime)
	Linux installer (30.4 MB, requires a Java 8 runtime)

REW_windows-x64_5_31_3.exe Application 52,557 KB

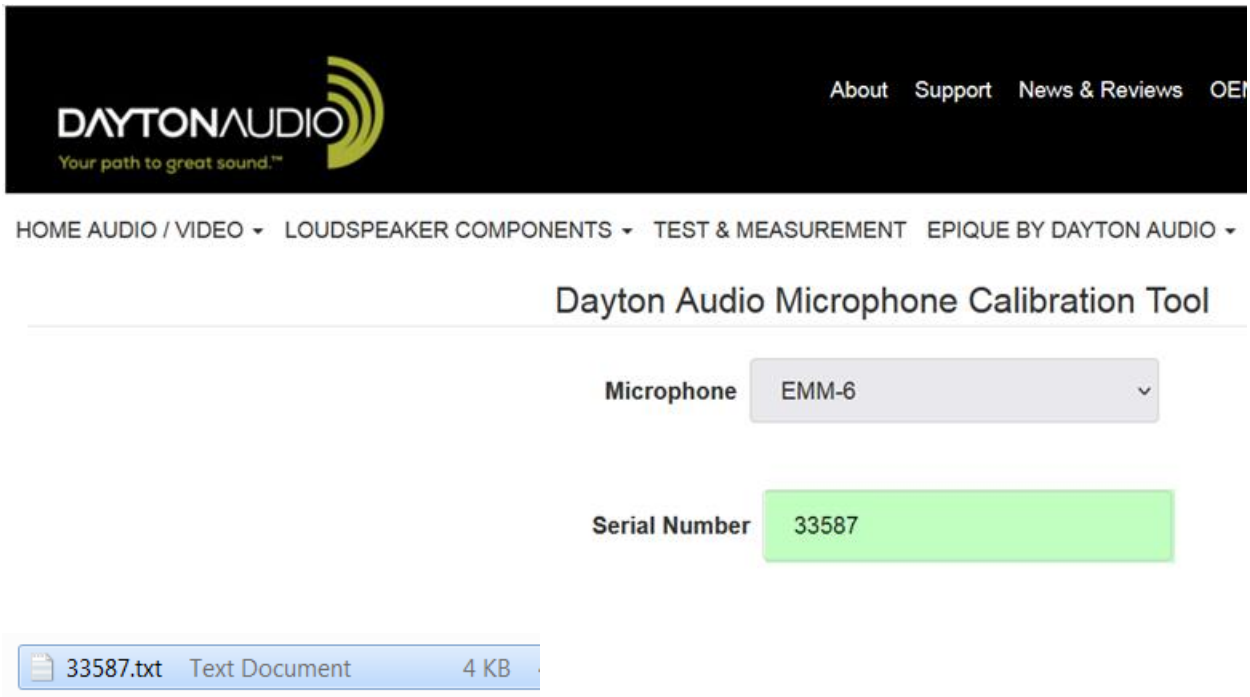
Download the Microphone Calibration File

Your Dayton Audio EMM-6 Calibration Mic will come in a sturdy padded carrying case.

Take a note of the Serial Number

Download the Calibration File that corresponds to your unique Serial Number.

https://support.daytonaudio.com/MicrophoneCalibrationTool



This file will contain the corrections at several frequencies like so:

*1000Hz -39.5

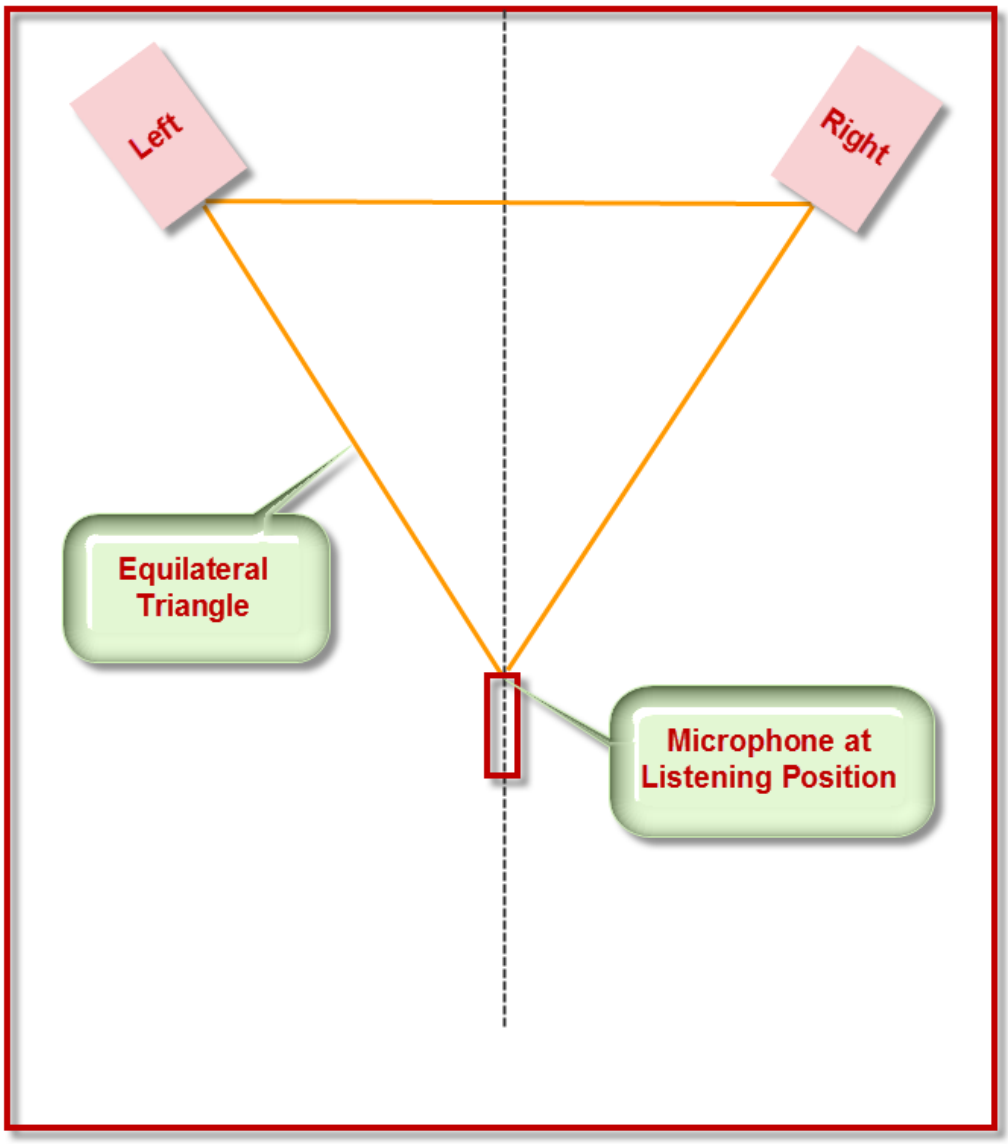
20.00 -1.2
20.55 -0.9
21.11 -0.5
21.69 -0.2
22.29 0.2
22.90 0.5
23.53 0.7
24.18 0.9
24.84 1.1
25.52 1.2
26.22 1.3
26.94 1.3
27.68 1.3
28.44 1.3

You will need to specify this Mic Calibration File in REW.

Position the Calibration Microphone

Orient the Microphone horizontally at the listening position at ear height.

It should *not* be pointed to the Left or the Right speaker but rather straight ahead on axis as shown in this diagram. The microphone should remain fixed at this position throughout the duration of this Project.



Ideally, the listening position should form an equilateral triangle for best imaging.

At the very least, the listening position should be equidistant from the Left and Right speakers.

First, turn off your Power Amp before making any connections.

Connect the Stereo Line Outputs from the Focusrite to the Stereo Line Inputs on your power amp.

Connect the USB Out of the Focusrite to a USB Input on your Laptop.

Connect the EMM-6 Microphone to Input-1 on the Focusrite using the XLR Microphone cable.

Turn on your Laptop. The green power LED with turn on. The Focusrite is USB powered.

Turn on the 48V Phantom Power. Your Condenser Mic needs Phantom Power.

Set the Input 1 Gain Switch to Instrument (INST)

Turn up the Input-1 Gain Knob to its Max position. If the Input-1 Gain setting is too high, you will see a red ring around the dial. Turn down the dial a bit from its Max position till the ring turns green.

Turn up the Output Volume dial to around 11 O'clock.

These are good initial settings.

After you have made all the connections, turn on your Power Amp.

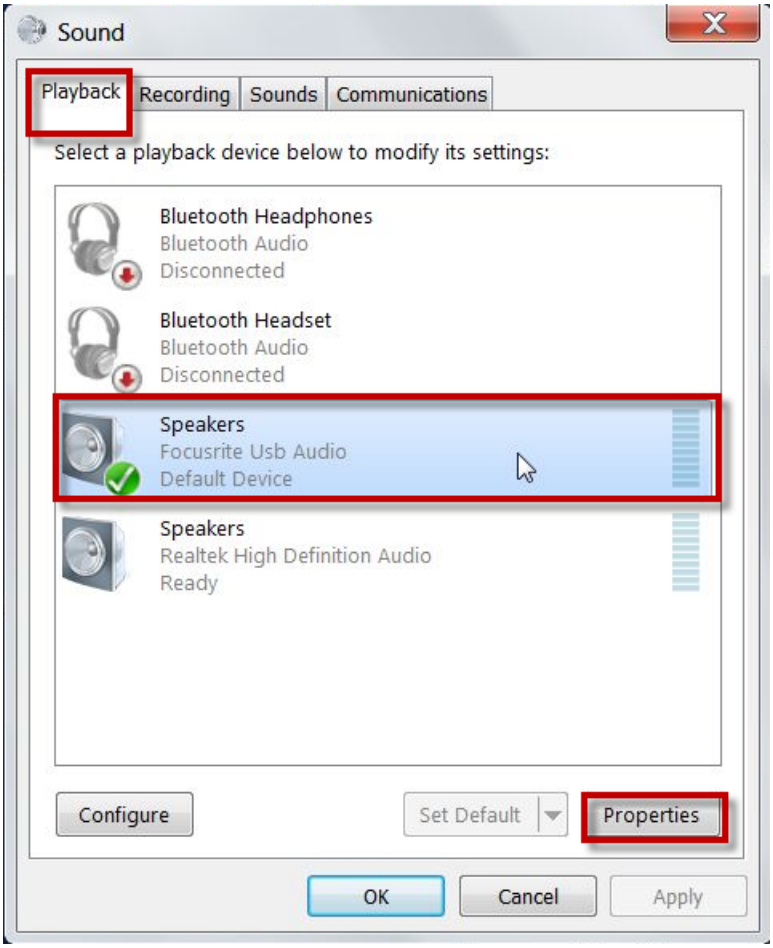
You are ready to take the Initial Measurements with REW.

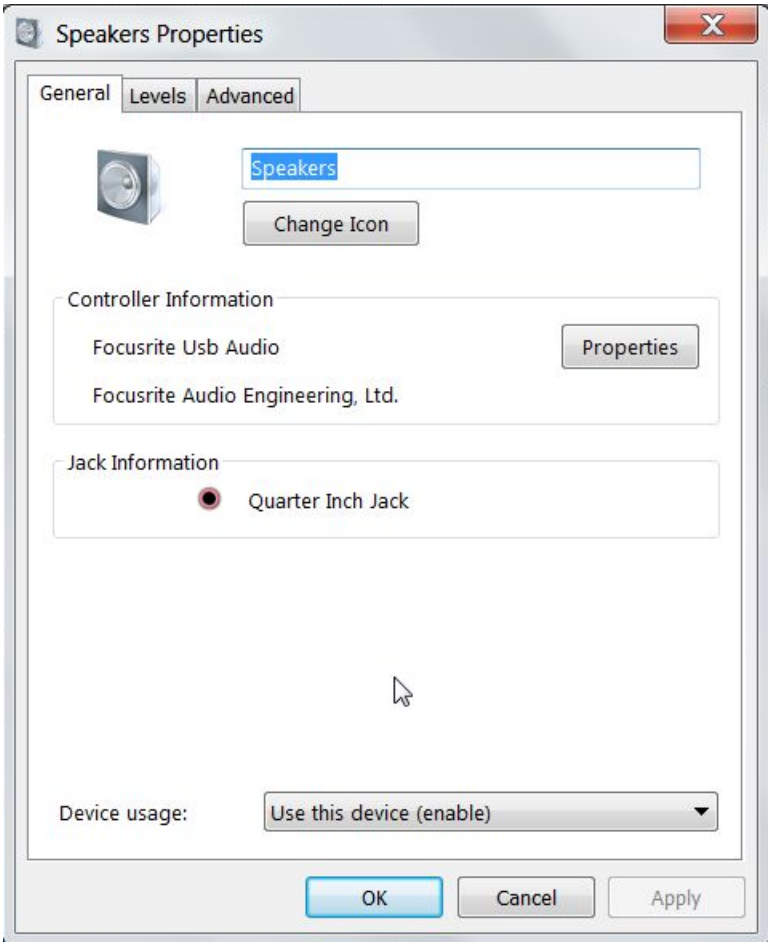
Note: A Focusrite Scarlett 2i2 Gen 1 USB Audio Interface is shown in this example.

Sound Settings on your Laptop

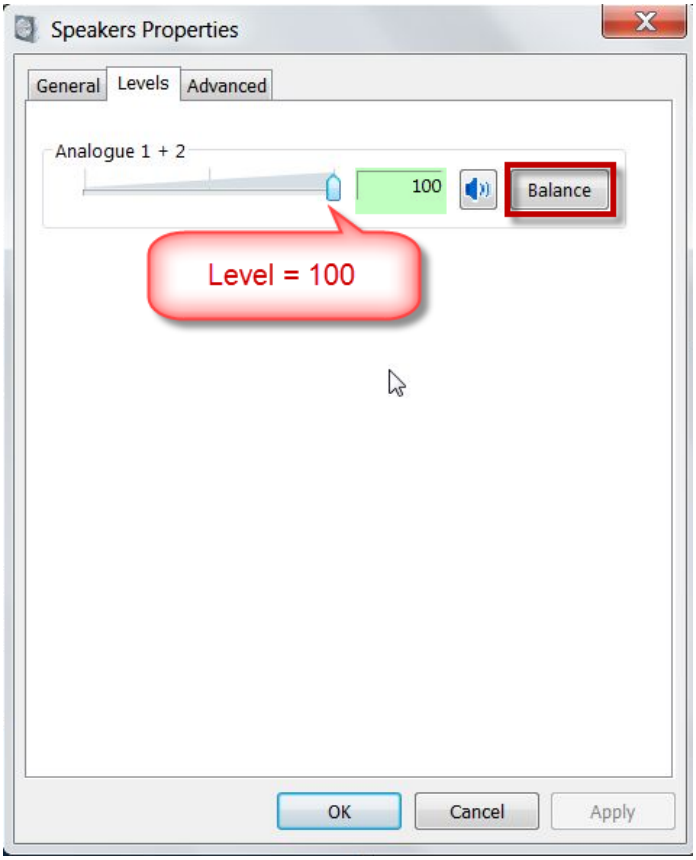
From the **Control Panel**, select **Sound** and make these adjustments for Playback and Recording.

Playback Settings



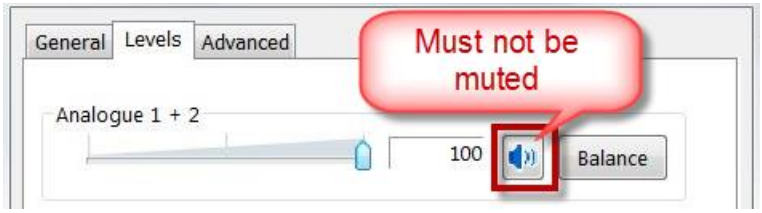

Speakers Properties
General
Levels
Advanced
Speakers
Change Icon
Controller Information
Focusrite Usb Audio
Properties
Focusrite Audio Engineering, Ltd.
Jack Information
Quarter Inch Jack
Device usage:
Use this device (enable)
OK
Cancel
Apply

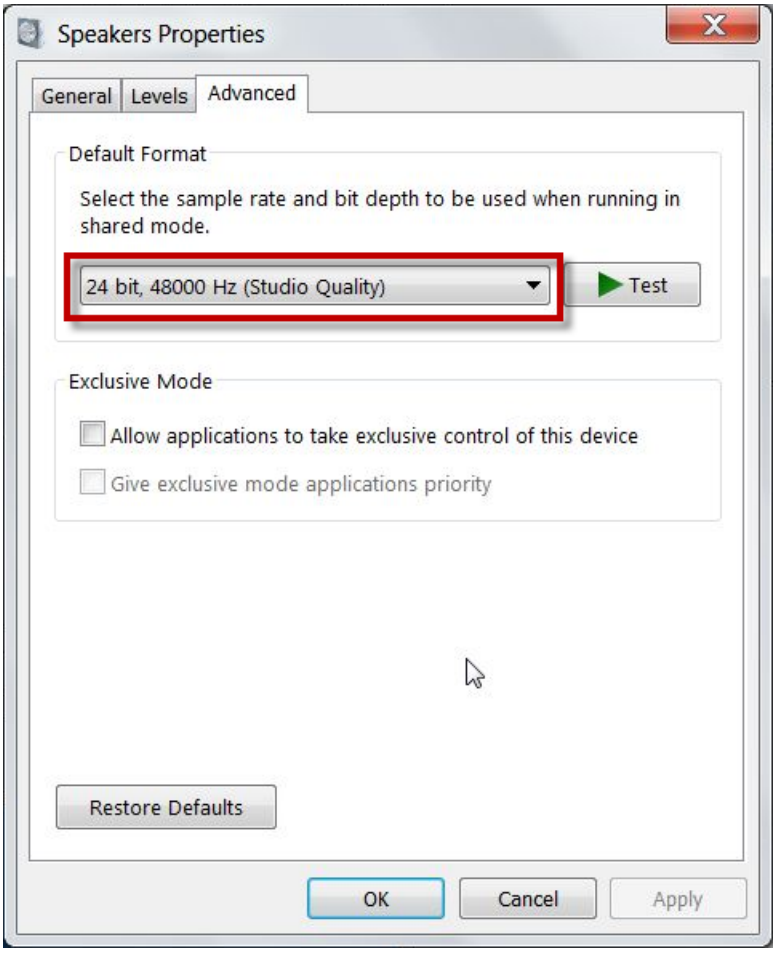
Set the Recording Level to 100. You will be controlling the output volume via the Focusrite.



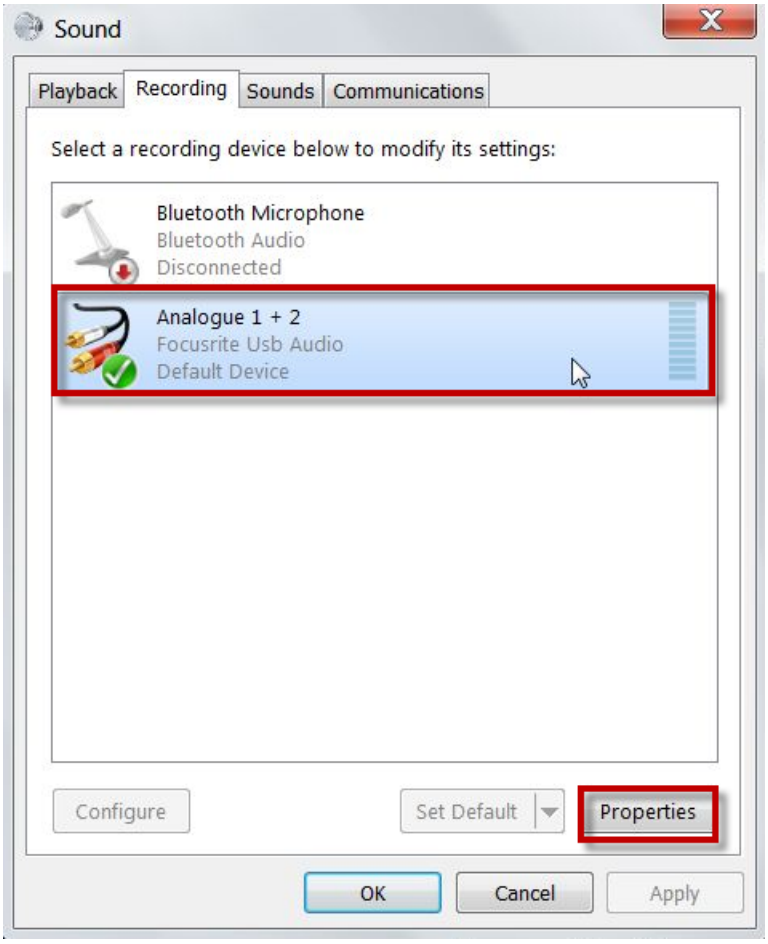
Balance

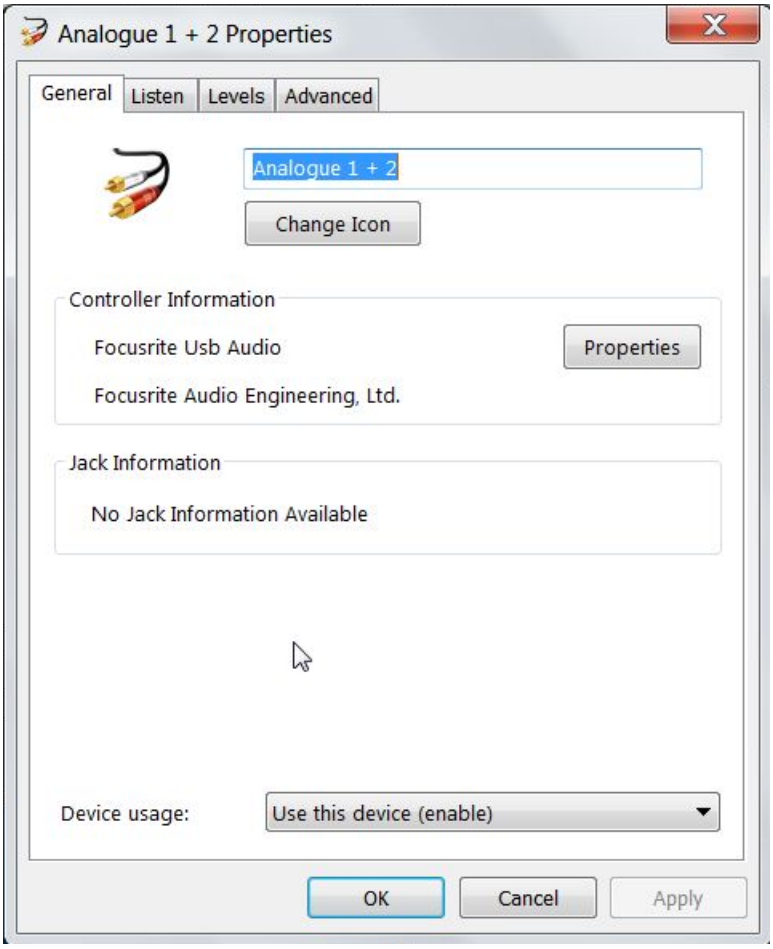
Note: If you are not getting any Sound check the speaker icon. Make sure it is not muted.

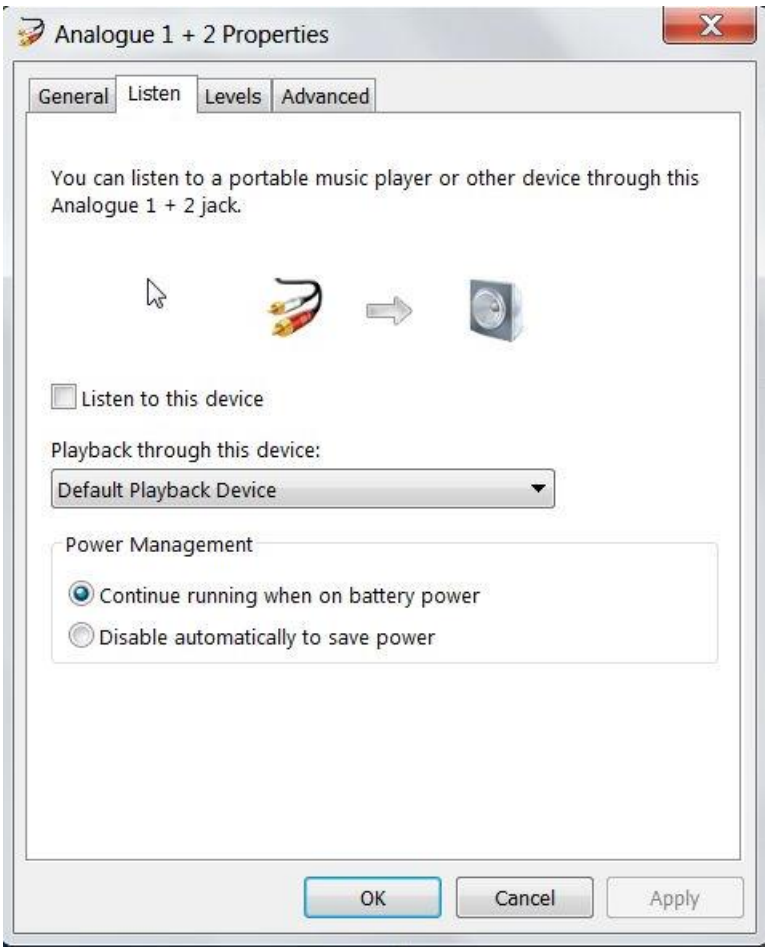



Speakers Properties
General
Levels
Advanced
Default Format
Select the sample rate and bit depth to be used when running in shared mode.
24 bit, 48000 Hz (Studio Quality)
Test
Exclusive Mode
Allow applications to take exclusive control of this device
Give exclusive mode applications priority
Restore Defaults
OK
Cancel
Apply

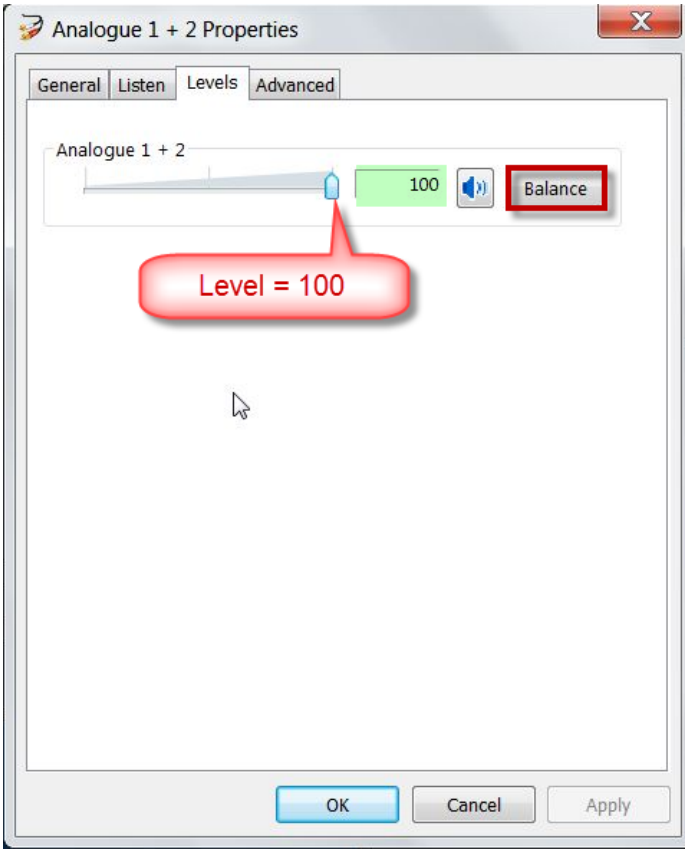
Recording Settings




Analogue 1 + 2 Properties
General
Listen
Levels
Advanced
Analogue 1 + 2
Change Icon
Controller Information
Focusrite Usb Audio
Properties
Focusrite Audio Engineering, Ltd.
Jack Information
No Jack Information Available
Device usage:
Use this device (enable)
OK
Cancel
Apply

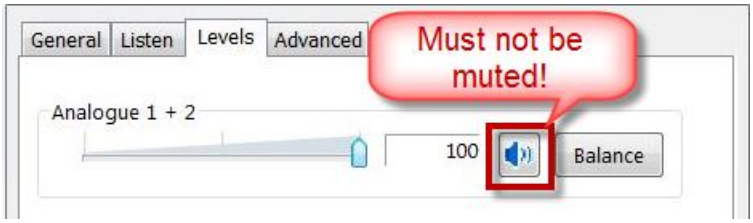

Analogue 1 + 2 Properties
General
Listen
Levels
Advanced
You can listen to a portable music player or other device through this Analogue 1 + 2 jack.
Listen to this device
Playback through this device:
Default Playback Device
Power Management
Continue running when on battery power
Disable automatically to save power
OK
Cancel
Apply

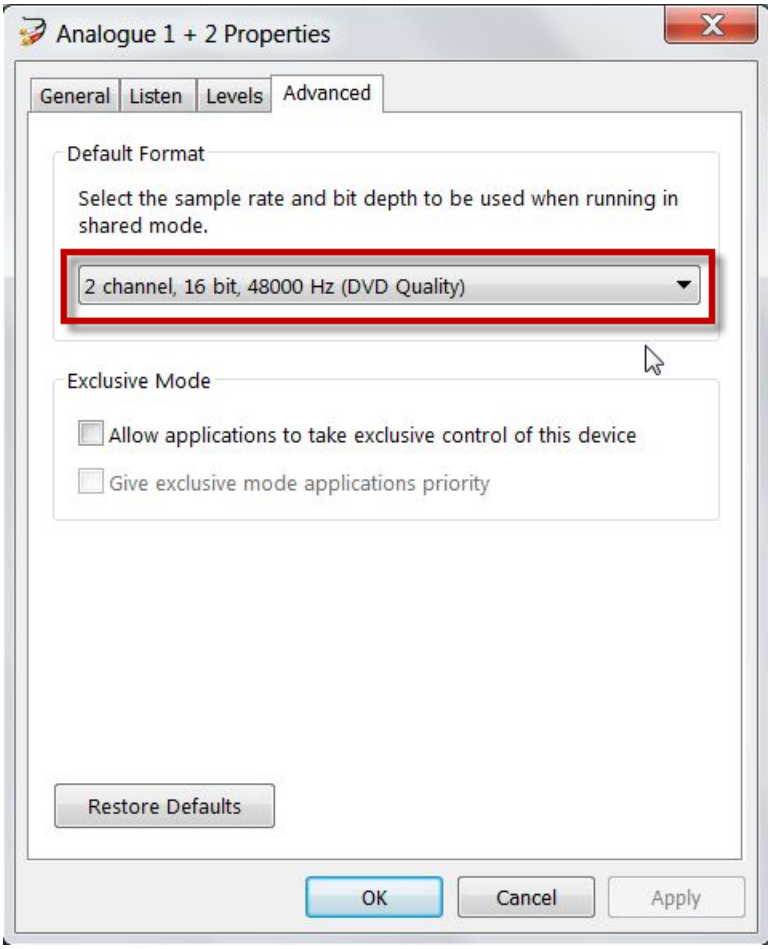
Set the Recording Level to 100. You will be controlling the Mic Input Gain via the Focusrite.



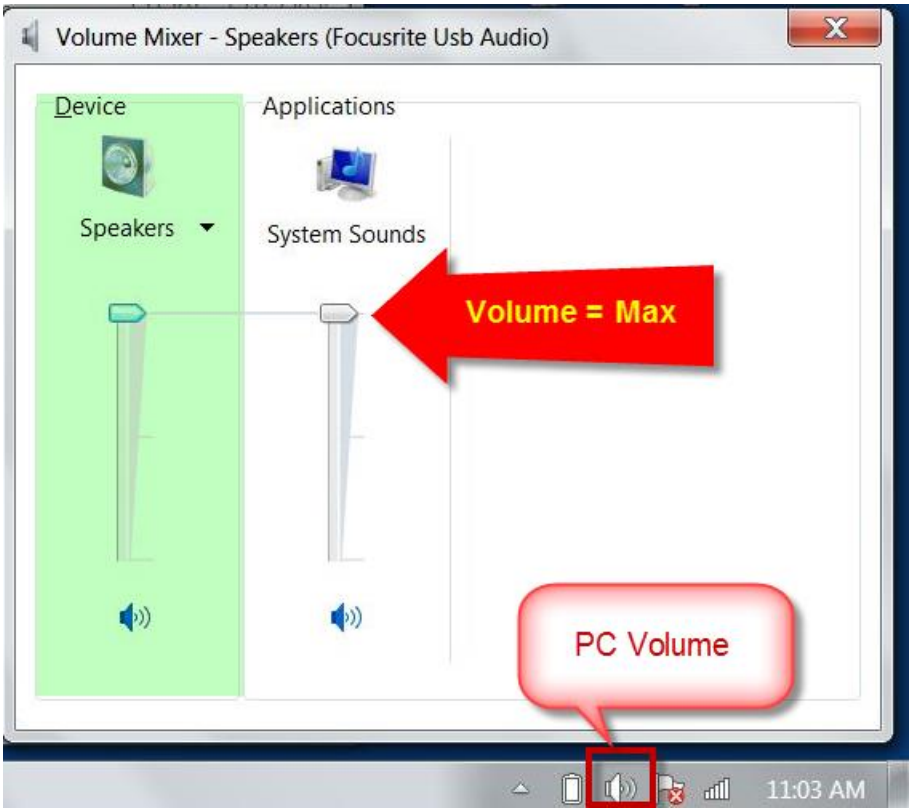
Balance

Note: If your Microphone is not receiving any signal, check the speaker icon. Make sure it is not muted.




Analogue 1 + 2 Properties
General
Listen
Levels
Advanced
Default Format
Select the sample rate and bit depth to be used when running in shared mode.
2 channel, 16 bit, 48000 Hz (DVD Quality)
Exclusive Mode
Allow applications to take exclusive control of this device
Give exclusive mode applications priority
Restore Defaults
OK
Cancel
Apply

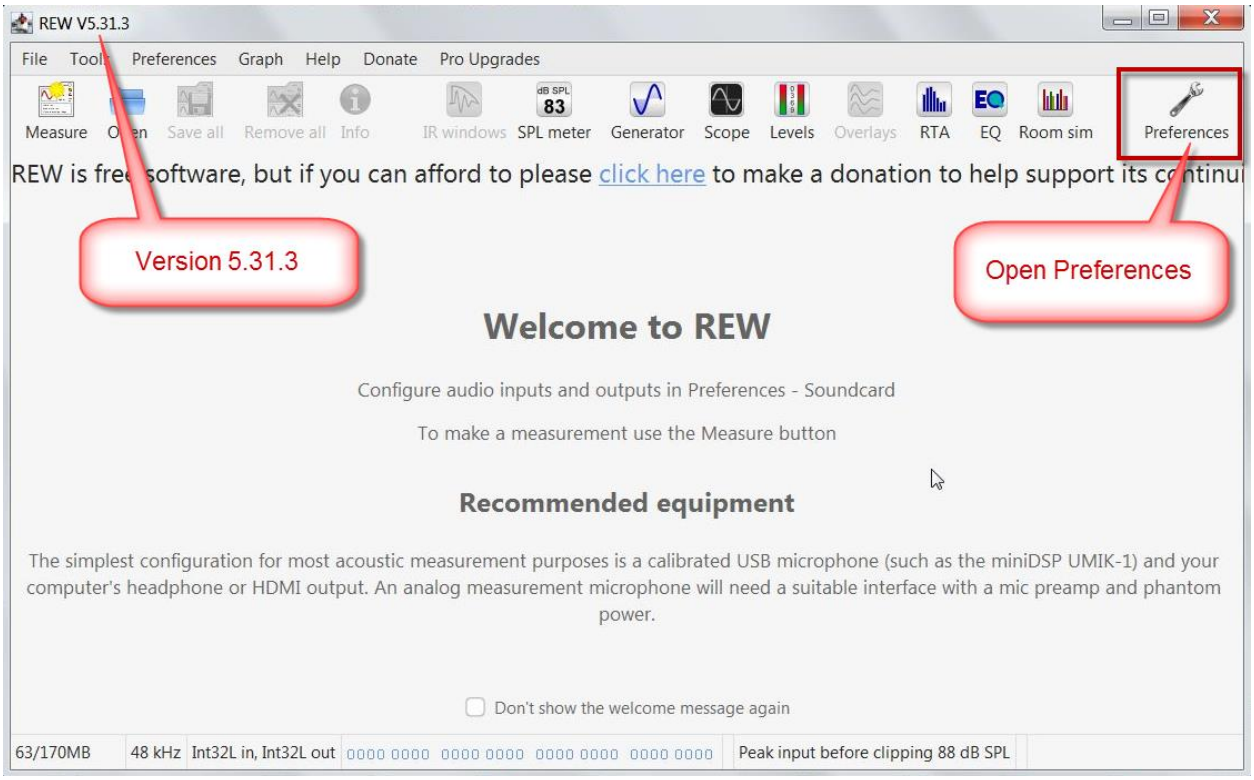
Set your PC Speaker Volume to Max.



You will be controlling the Output Volume using the Focusrite Output Volume Knob.

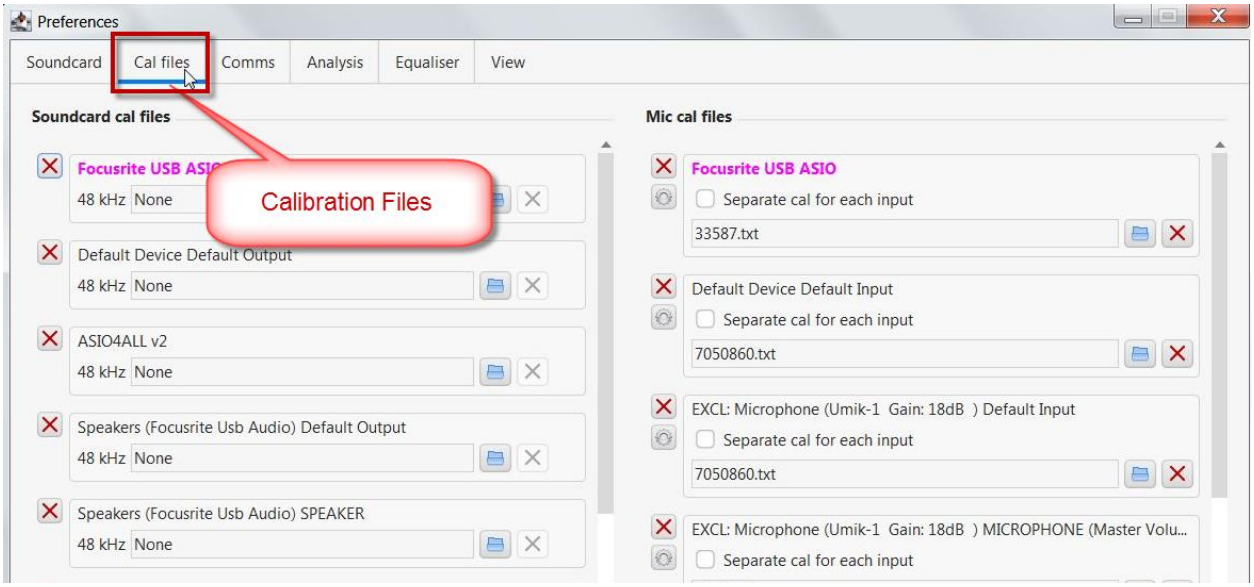
Set Preferences in REW

Launch REW Version 5.31.3

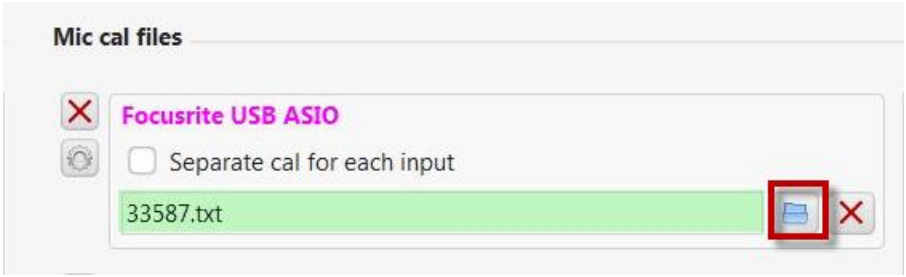


Open **Preferences**

Open the **Calibration Files** Tab



Browse and select the Dayton Audio EMM-6 Mic Calibration File = 33587.txt for Focusrite USB Audio.



Make the following settings to the **Soundcard** Tab.

ASIO Device = **Focusrite USB Audio**

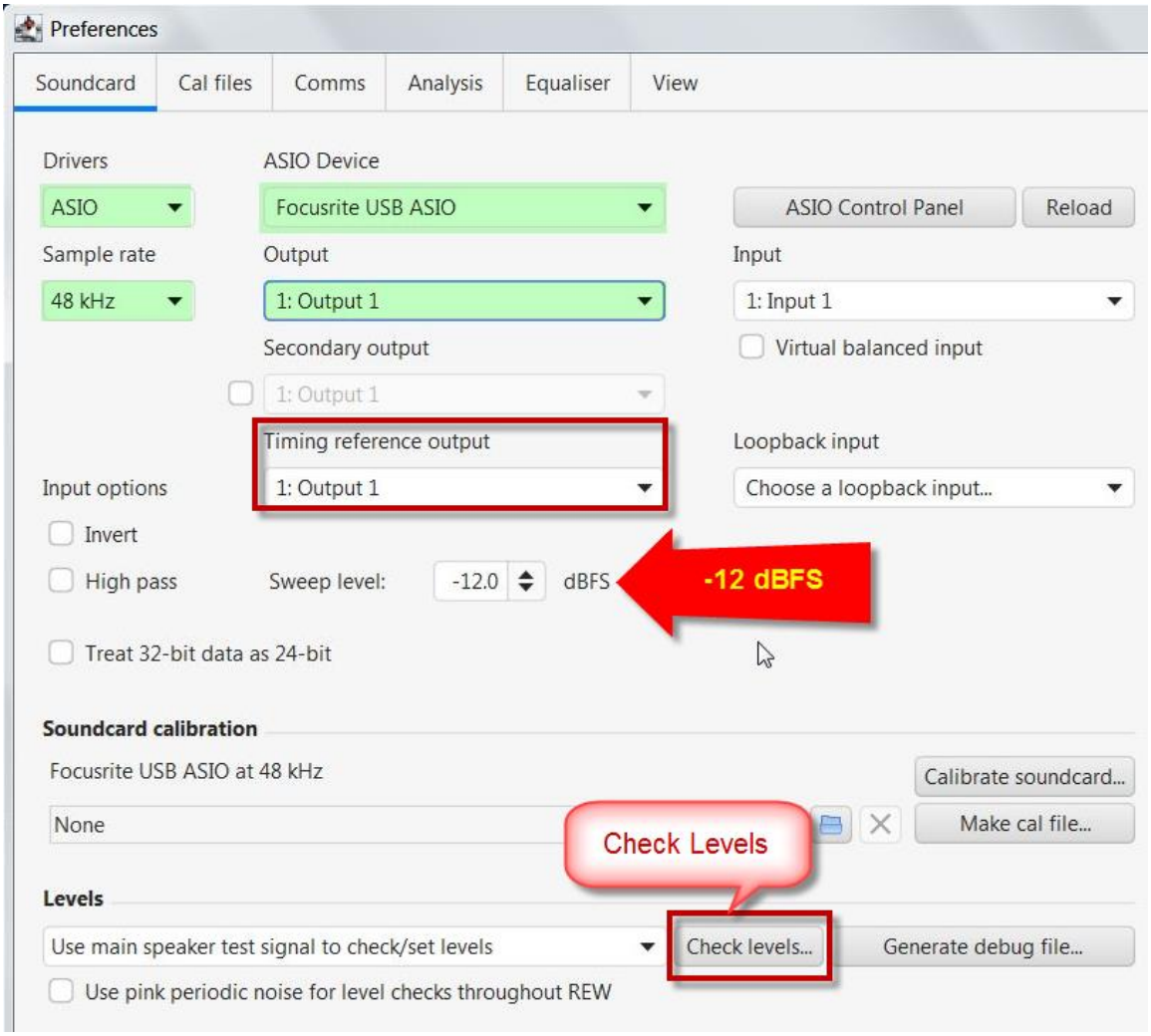
Output = **Output 1** (Left Channel)

Drivers = **ASIO**

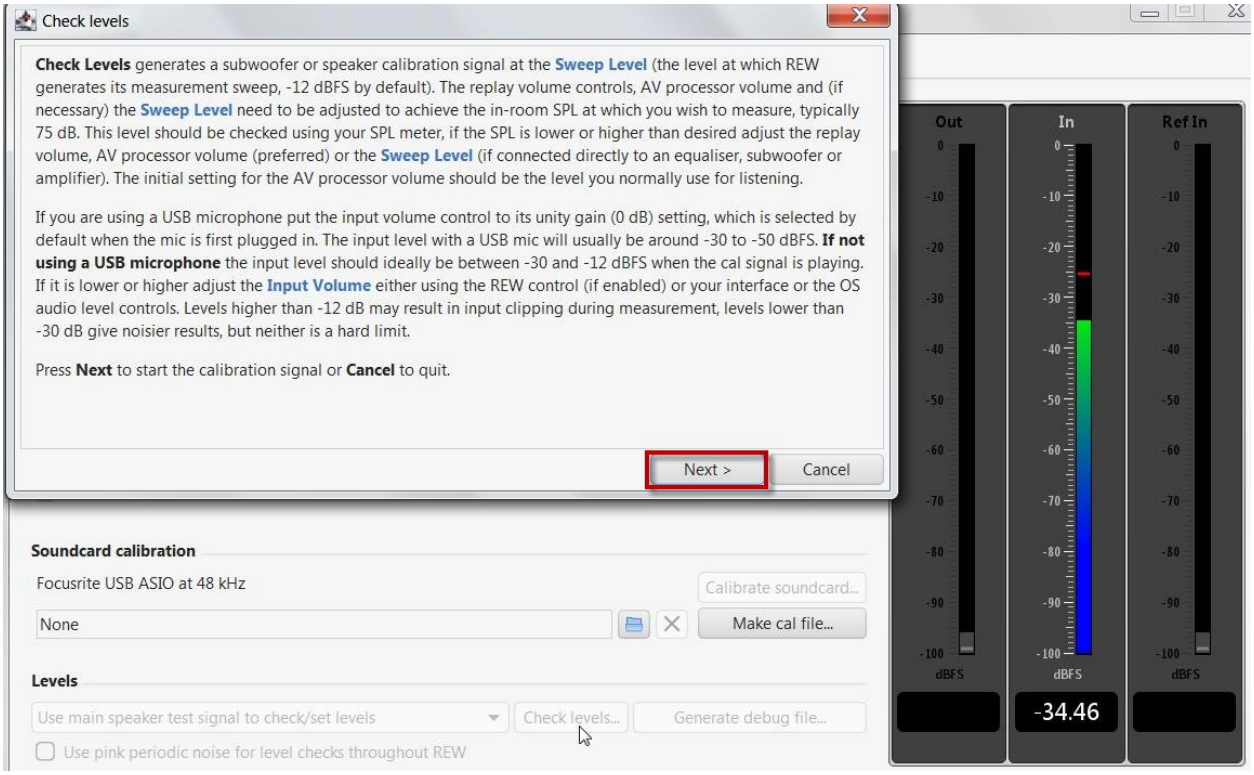
Sample Rate = **48kHz**

Timing reference output = **Output 1**
Note: You will keep the same Timing Reference throughout this exercise.

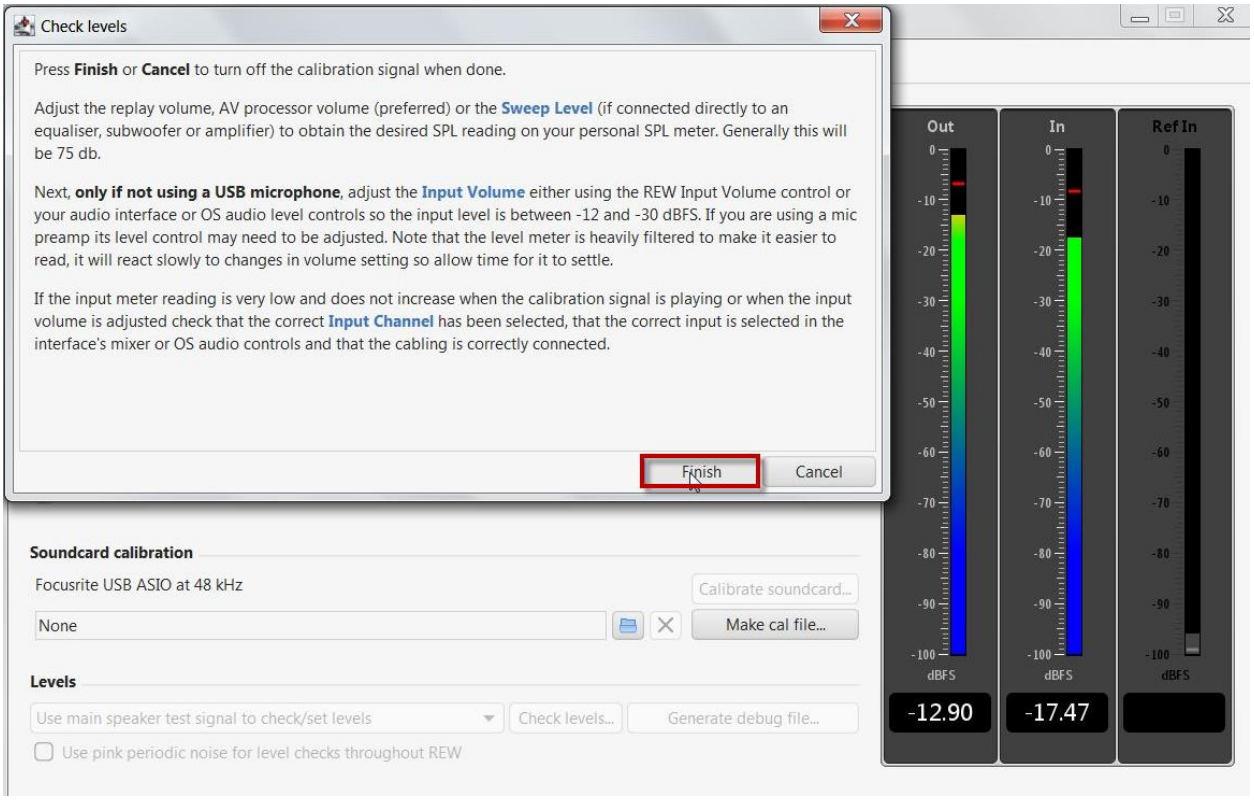
Sweep Level = -12dBFS



Check Levels

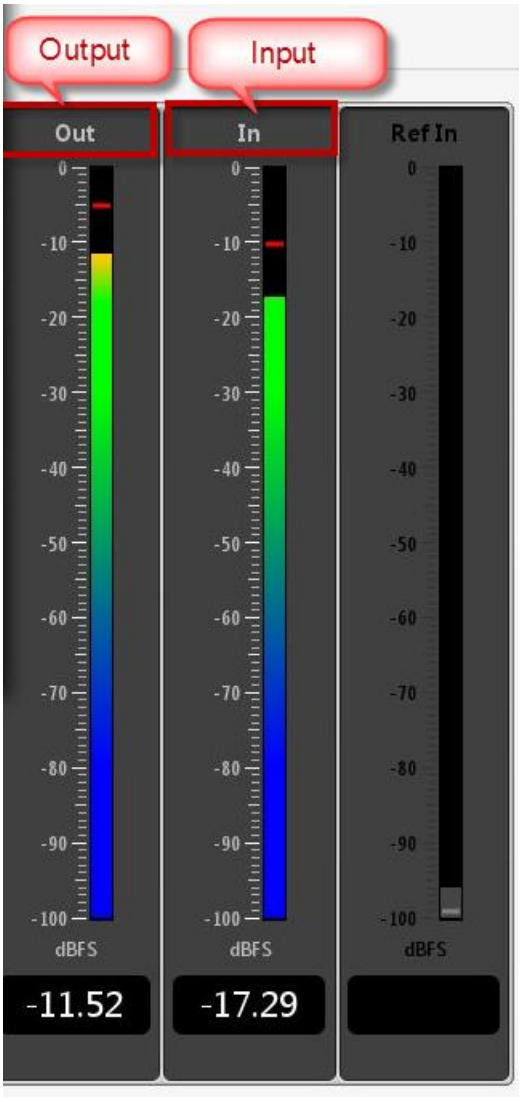

Check levels
Check Levels generates a subwoofer or speaker calibration signal at the Sweep Level (the level at which REW generates its measurement sweep, -12 dBFS by default). The replay volume controls, AV processor volume and (if necessary) the Sweep Level need to be adjusted to achieve the in-room SPL at which you wish to measure, typically 75 dB. This level should be checked using your SPL meter, if the SPL is lower or higher than desired adjust the replay volume, AV processor volume (preferred) or the Sweep Level (if connected directly to an equaliser, subwoofer or amplifier). The initial setting for the AV processor volume should be the level you normally use for listening.
If you are using a USB microphone put the input volume control to its unity gain (0 dB) setting, which is selected by default when the mic is first plugged in. The input level with a USB mic will usually be around -30 to -50 dBFS. If not using a USB microphone the input level should ideally be between -30 and -12 dBFS when the cal signal is playing. If it is lower or higher adjust the Input Volume either using the REW control (if enabled) or your interface or the OS audio level controls. Levels higher than -12 dB may result in input clipping during measurement, levels lower than -30 dB give noisier results, but neither is a hard limit.
Press Next to start the calibration signal or Cancel to quit.
Next >
Cancel
Soundcard calibration
Focusrite USB ASIO at 48 kHz
Calibrate soundcard...
None
Make cal file...
Levels
Use main speaker test signal to check/set levels
Check levels...
Generate debug file...
Use pink periodic noise for level checks throughout REW
Out
In
Ref In
dBFS
-34.46

Next


Check levels
Press Finish or Cancel to turn off the calibration signal when done.
Adjust the replay volume, AV processor volume (preferred) or the Sweep Level (if connected directly to an equaliser, subwoofer or amplifier) to obtain the desired SPL reading on your personal SPL meter. Generally this will be 75 db.
Next, only if not using a USB microphone, adjust the Input Volume either using the REW Input Volume control or your audio interface or OS audio level controls so the input level is between -12 and -30 dBFS. If you are using a mic preamp its level control may need to be adjusted. Note that the level meter is heavily filtered to make it easier to read, it will react slowly to changes in volume setting so allow time for it to settle.
If the input meter reading is very low and does not increase when the calibration signal is playing or when the input volume is adjusted check that the correct Input Channel has been selected, that the correct input is selected in the interface's mixer or OS audio controls and that the cabling is correctly connected.
Finish
Cancel
Soundcard calibration
Focusrite USB ASIO at 48 kHz
Calibrate soundcard...
None
Make cal file...
Levels
Use main speaker test signal to check/set levels
Check levels...
Generate debug file...
Use pink periodic noise for level checks throughout REW
Out
In
Ref In
dBFS
-12.90
-17.47

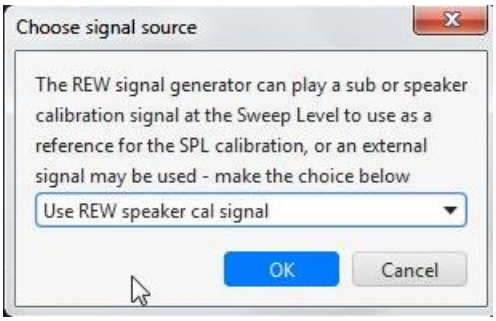
Finish

Note: You typically want the Input Level to be about 12dB lower than the Output Level.



Open the SPL Meter

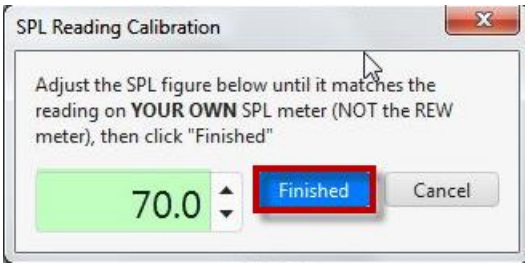
Press the **Calibrate** Button



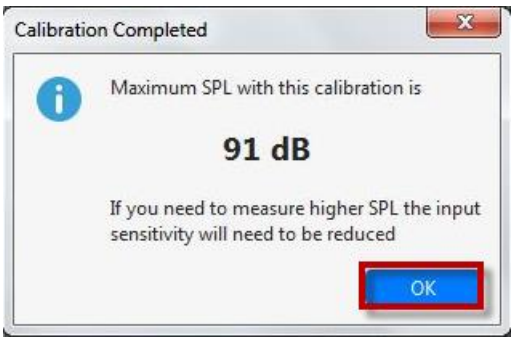
Hold an external Sound Pressure Level Meter next to your Dayton Audio EMM-6 microphone and take a note of the SPL reading.

In this example, I am using a Radio Shack 33-2050 Analog SPL Meter.

Adjust the display on REW SPL meter up or down until it matches the reading on your external SPL meter.

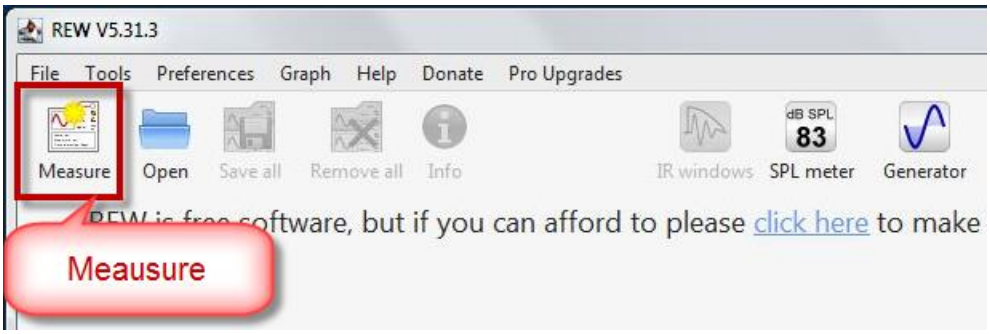


This completes your SPL calibration.



Measure your Left Speaker

Open the **Measure** Tool.



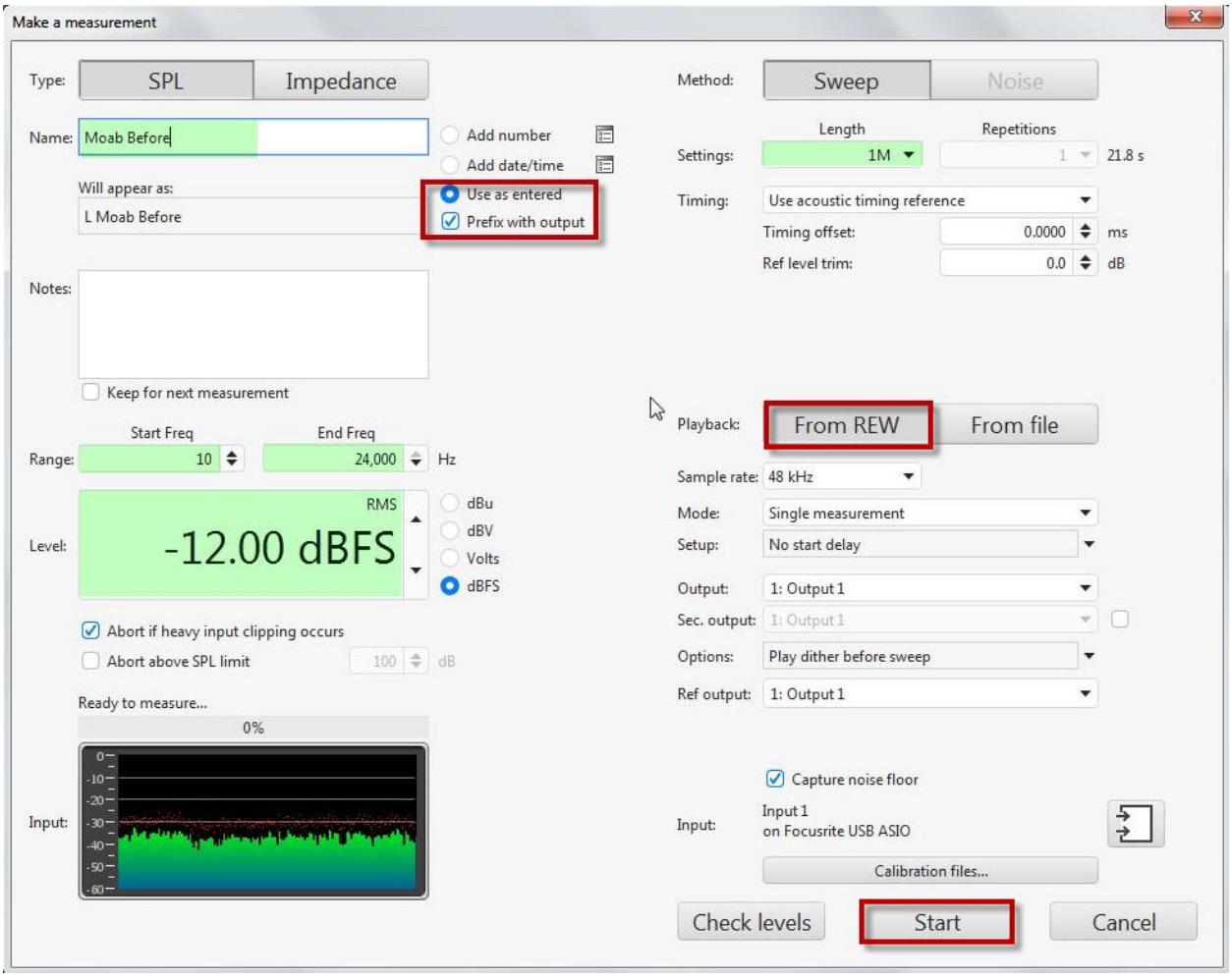
Type = **SPL**
Name = Moab Before

Select **Use as entered**
Check **Prefix with output**

Method = Sweep
Length = **1M**
Timing = Use acoustic timing reference

Start Freq = 10Hz
End Freq = 24,000Hz

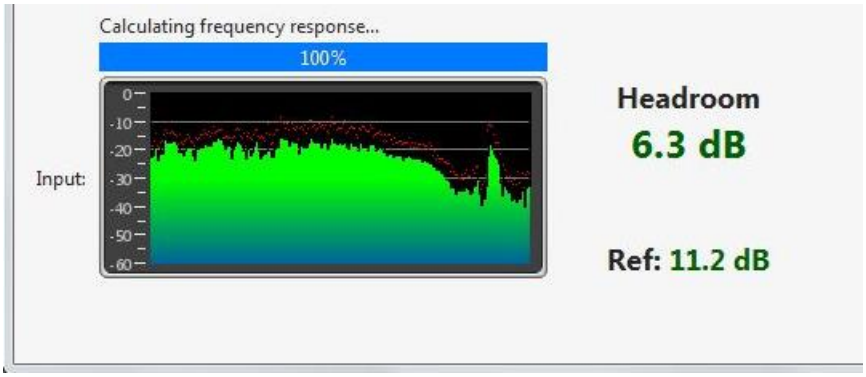
Level = **-12.00dBFS**

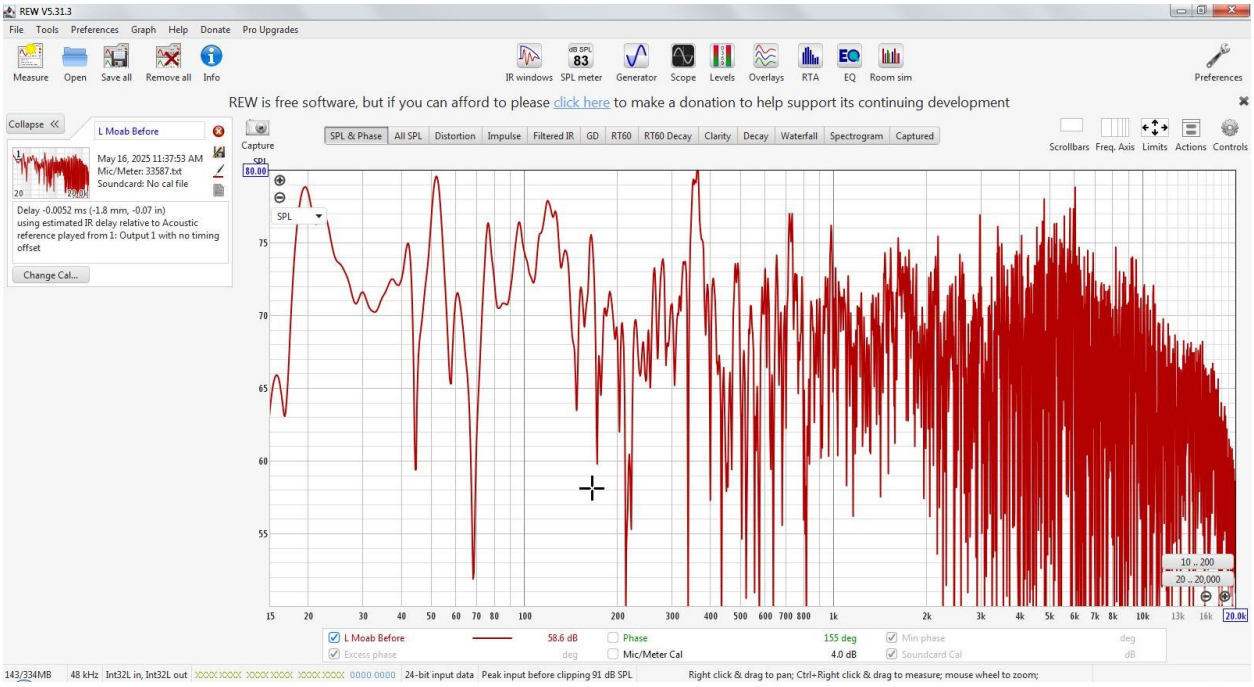


Start

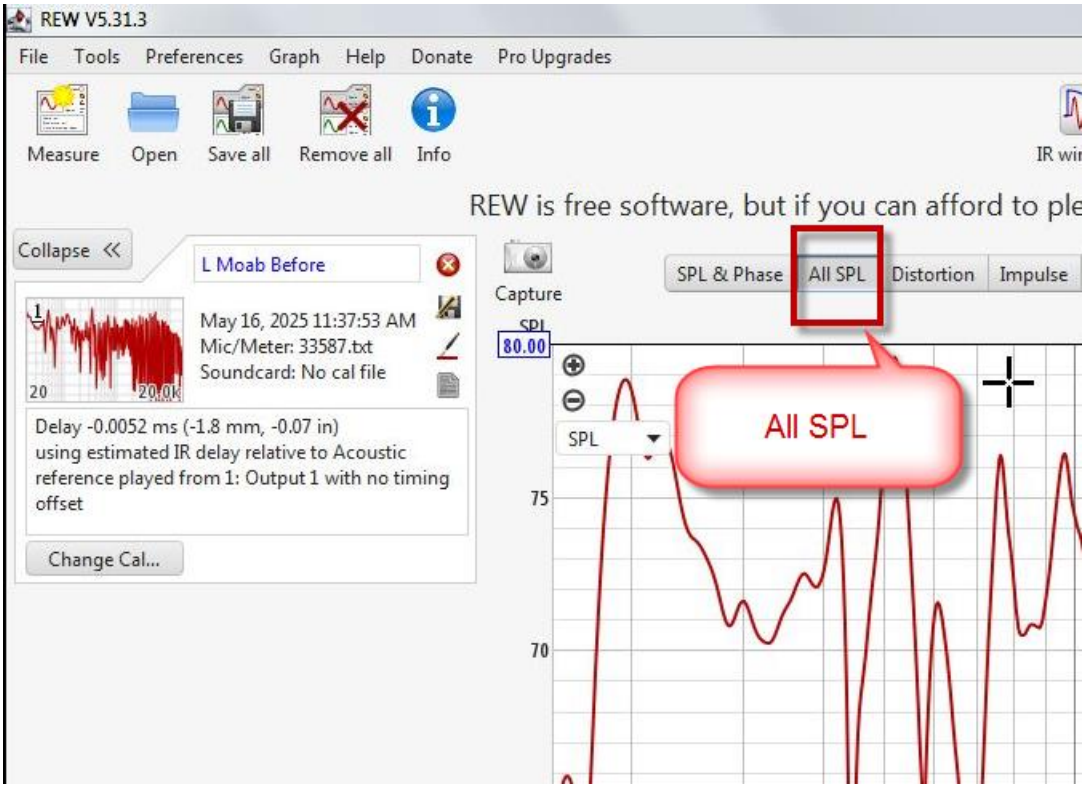
Stay absolutely quiet during the Sweep.
Turn off the Air Conditioner. Make sure there is no background noise.

Make sure there is no clipping .

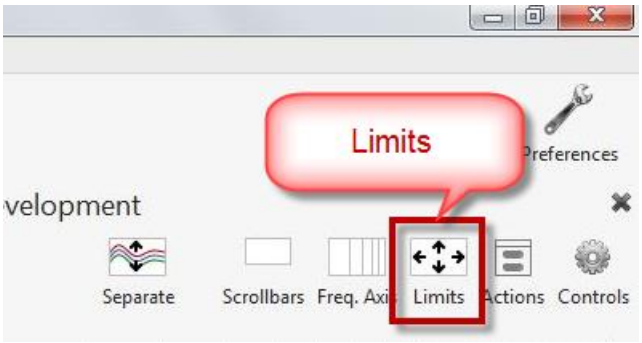




Open the **All SPL** Tab



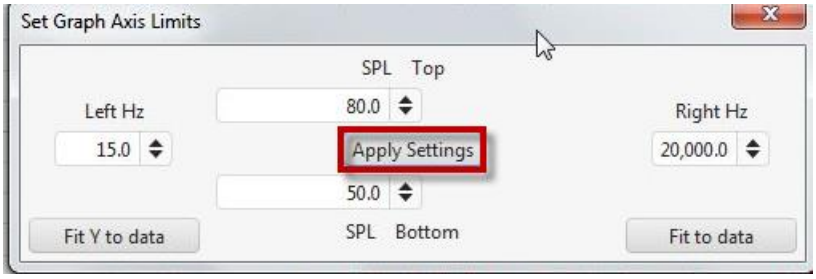
Open the **Limits** Tool.



Set these Graph Axis Limits

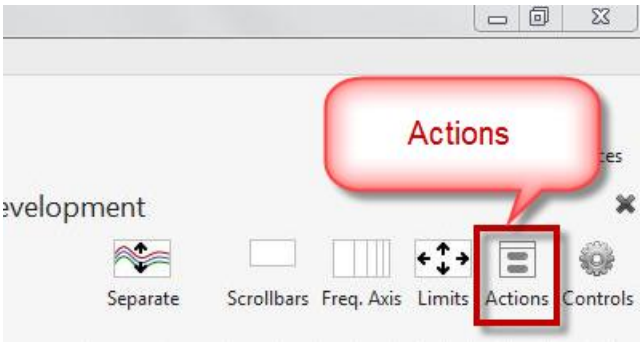
Left = 15Hz
Right = 20,000Hz

Top = 80Hz
Bottom = 50Hz

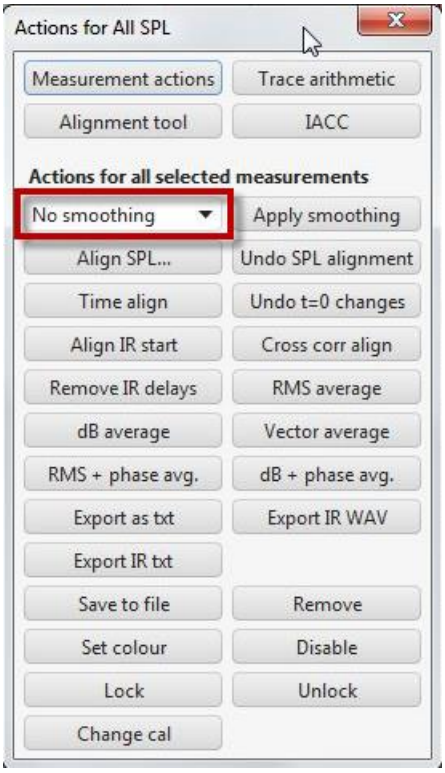


Apply Settings

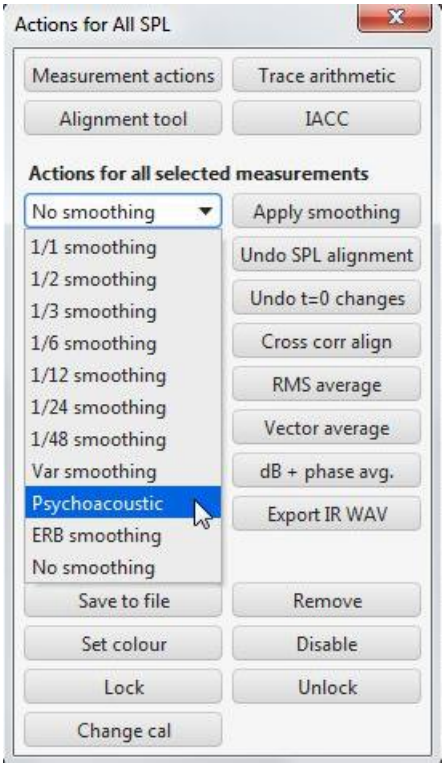
Open the **Actions** Tab



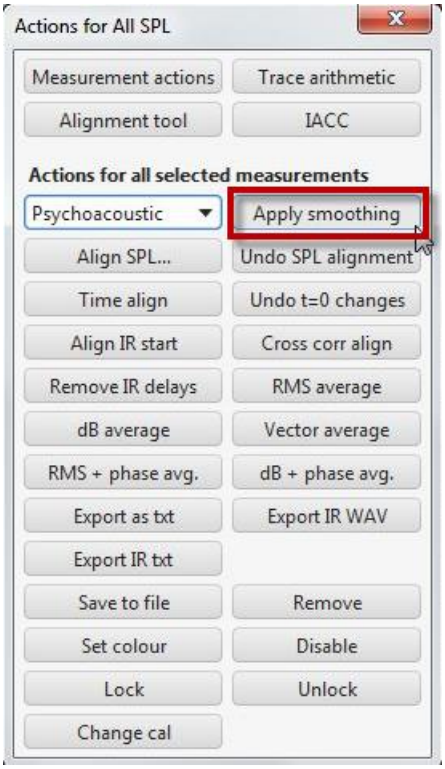
Expand the list of Smoothing Options.

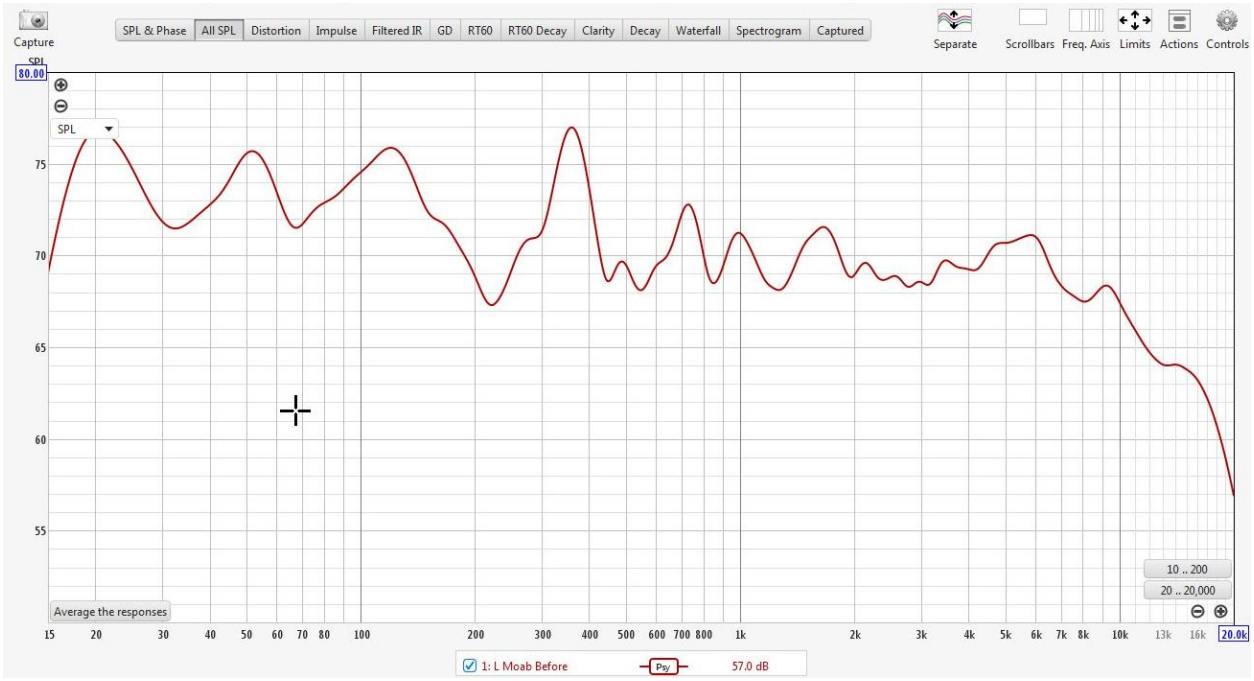


Select **Psychoacoustic**



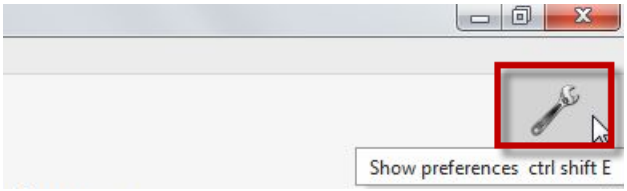
Apply Smoothing





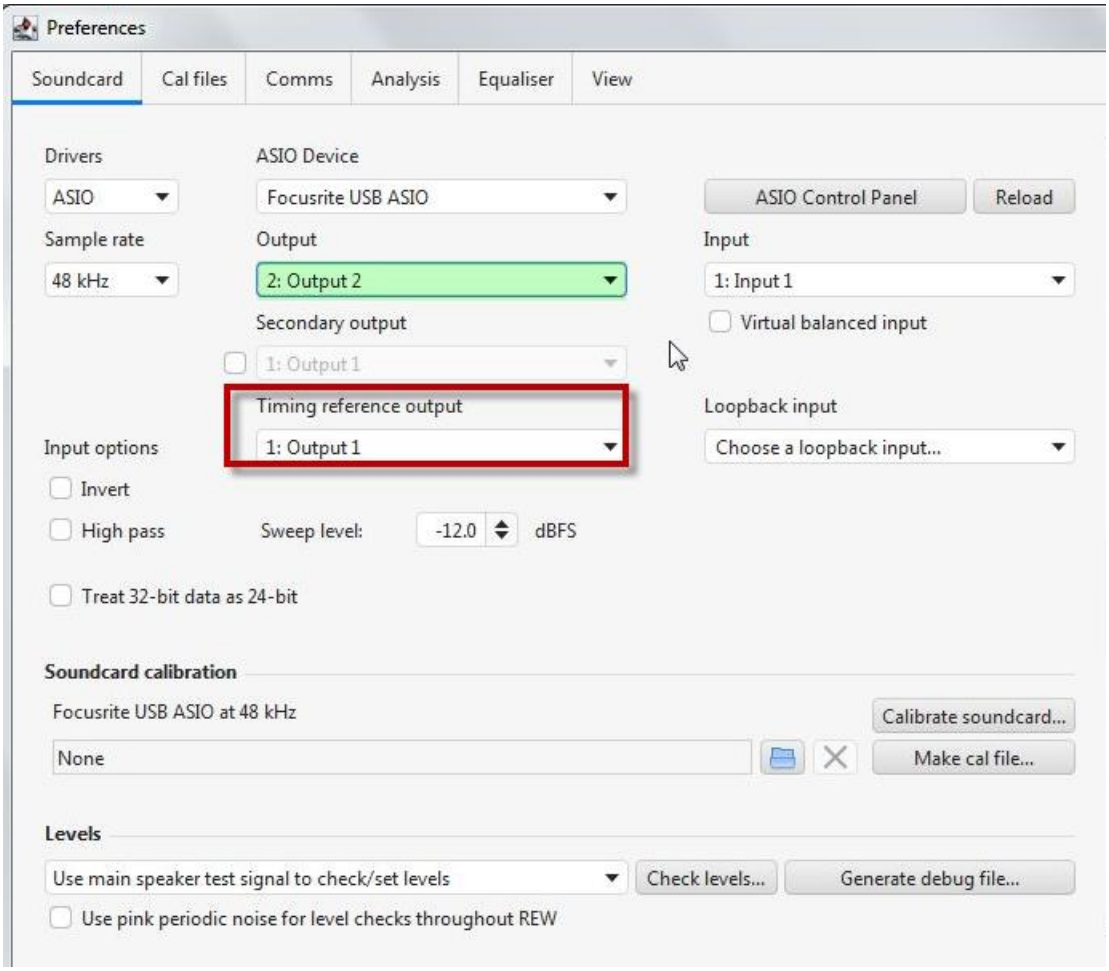
Measure your Right Speaker

Show **Preferences**



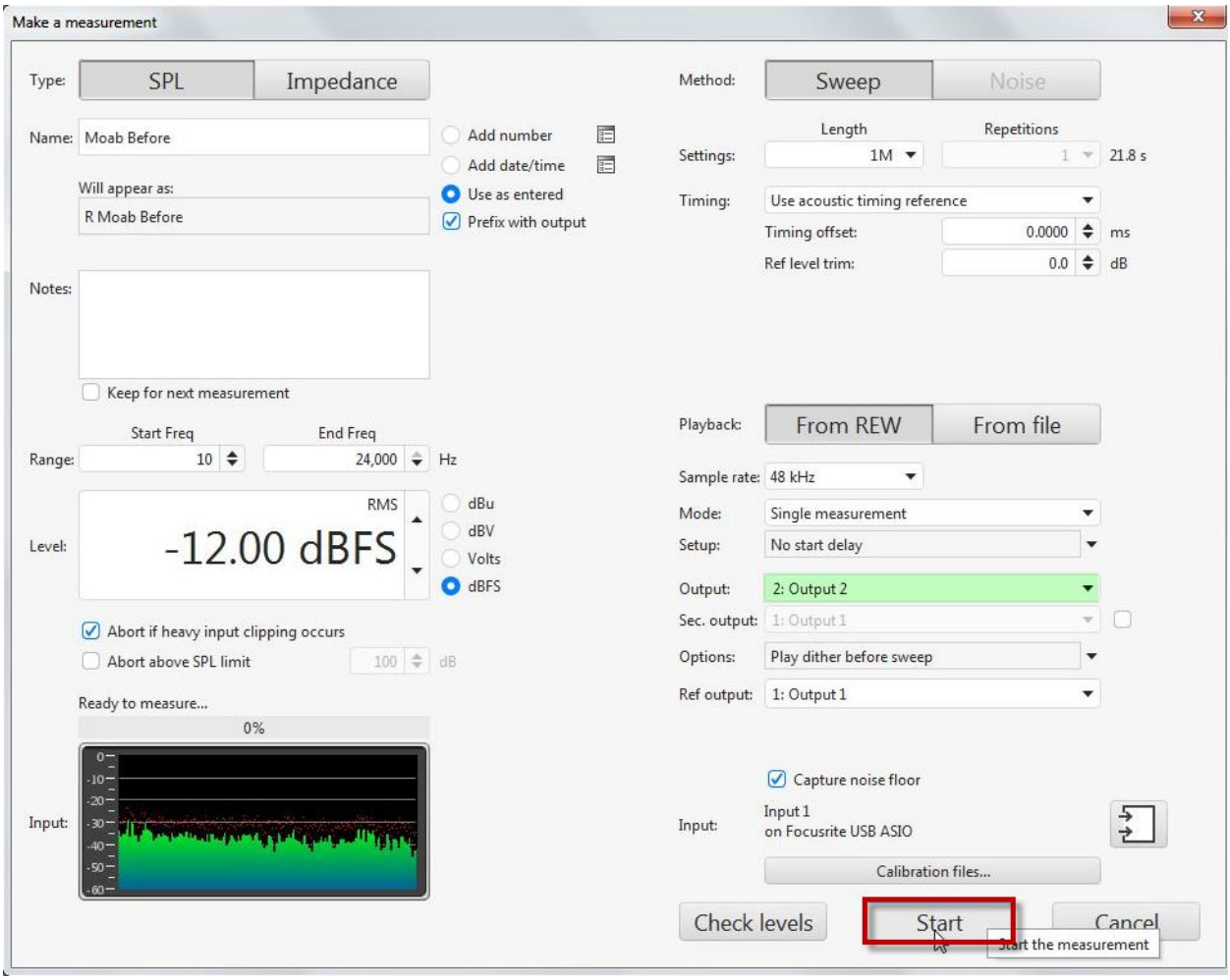
Open the **Soundcard** Tab and change Output to **Output 2** (This is your Right Channel)

Keep the Timing Reference to Output 1. Do not change the Timing Reference.



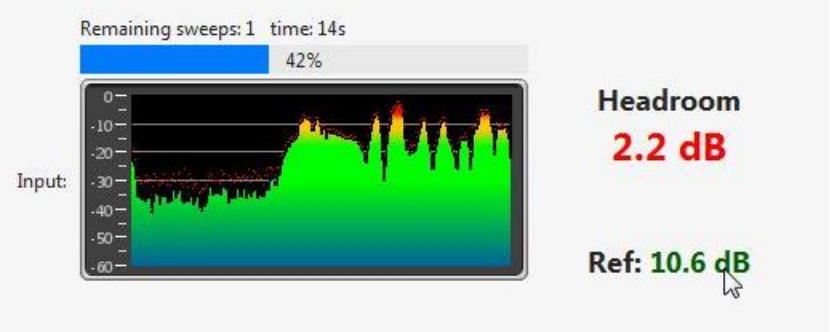
Open the **Measure** Tool.

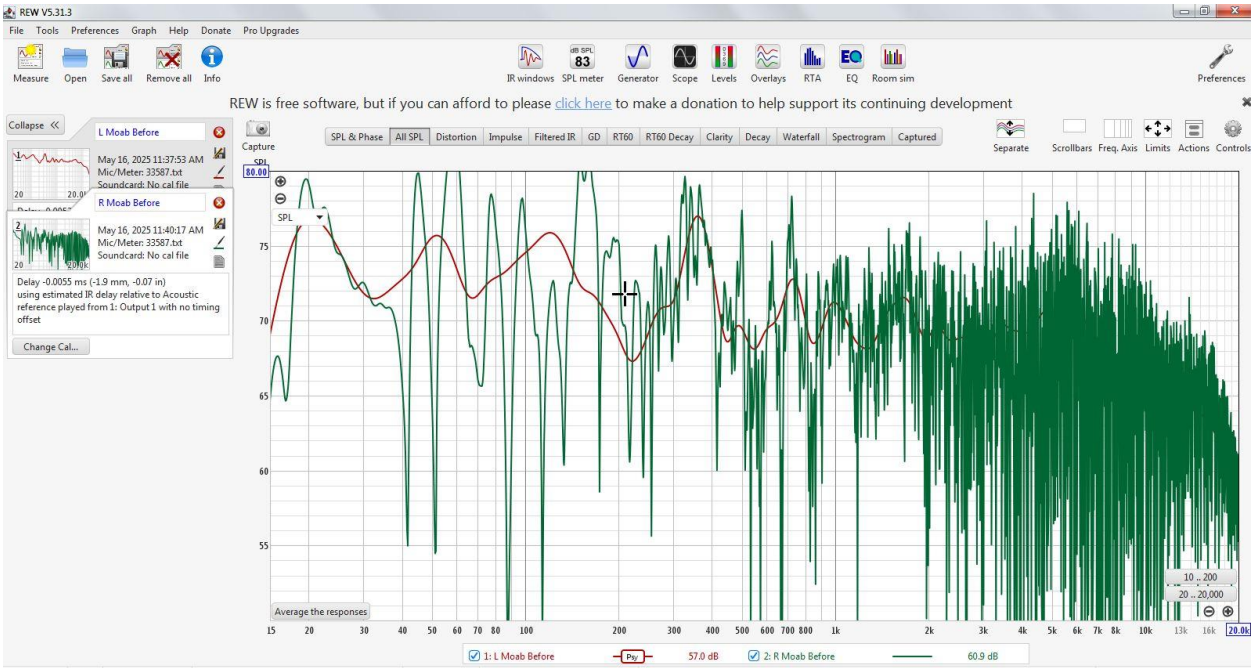
Make sure Output = **Output 2**



Start

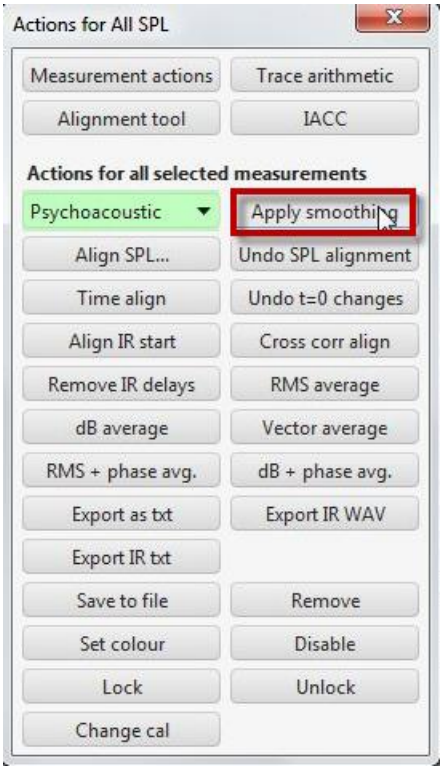
Make sure there is no clipping.

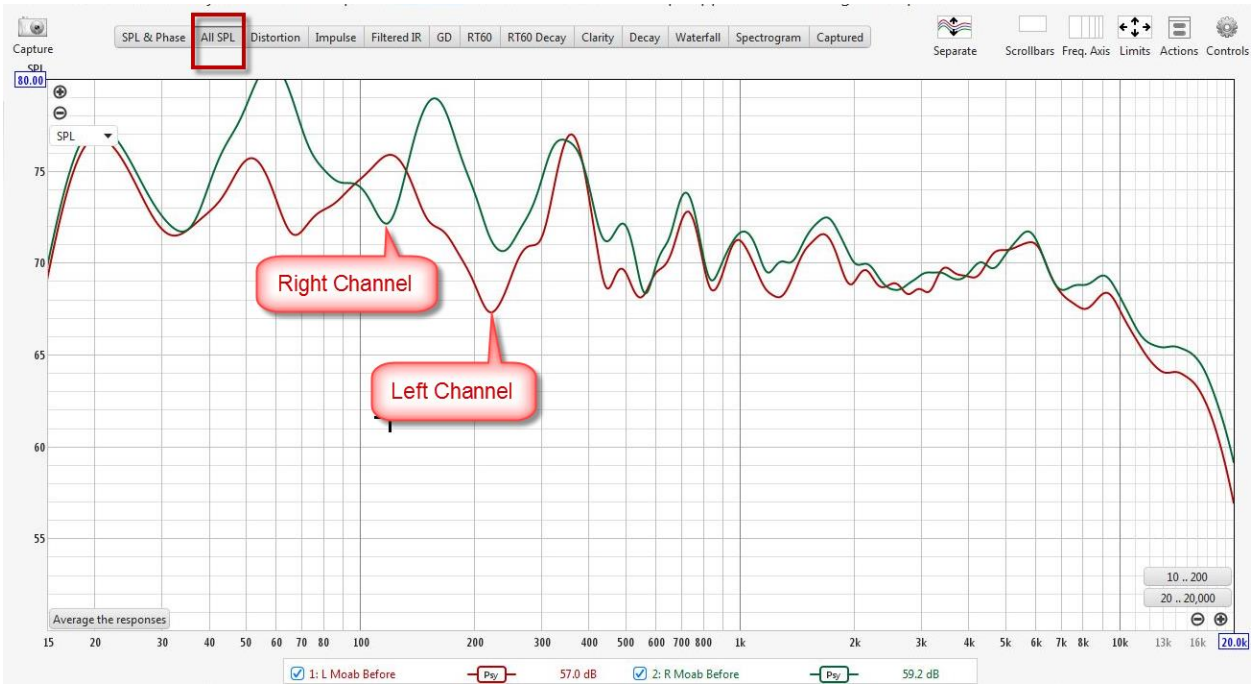




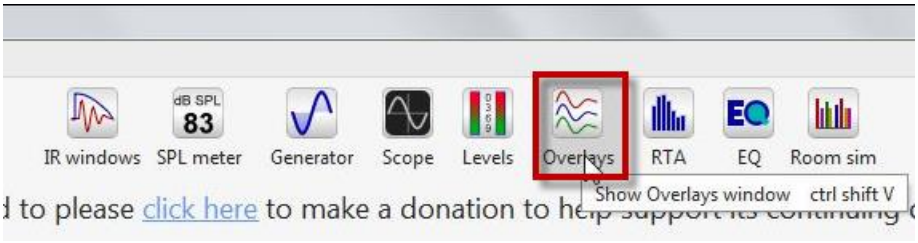
Open the **Actions** Tool.

Apply a Psychoacoustic Smoothing





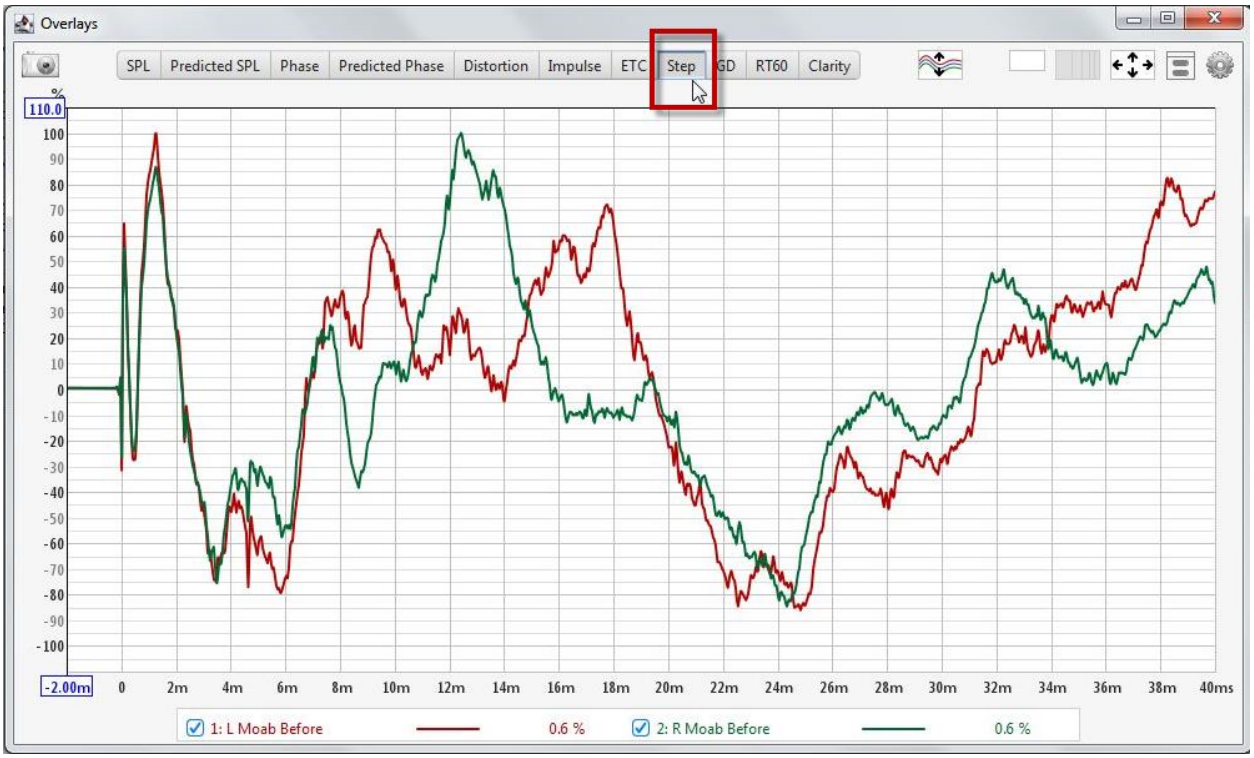
Show the **Overlays** Window.



You are viewing the SPL curves of the Left and Right Channels.

Open the **Step** Tab.

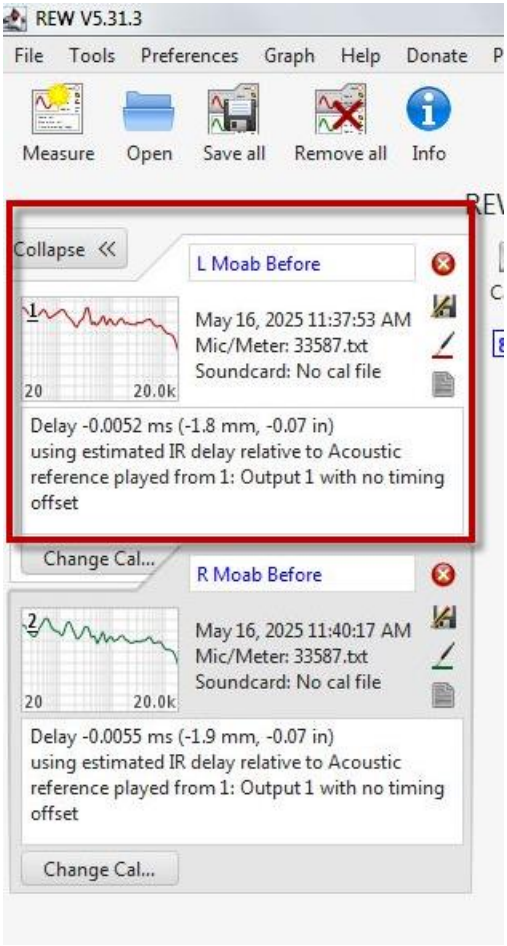
You are viewing the Step Responses of the Left and Right Channels.



Open the **RT60** Tab

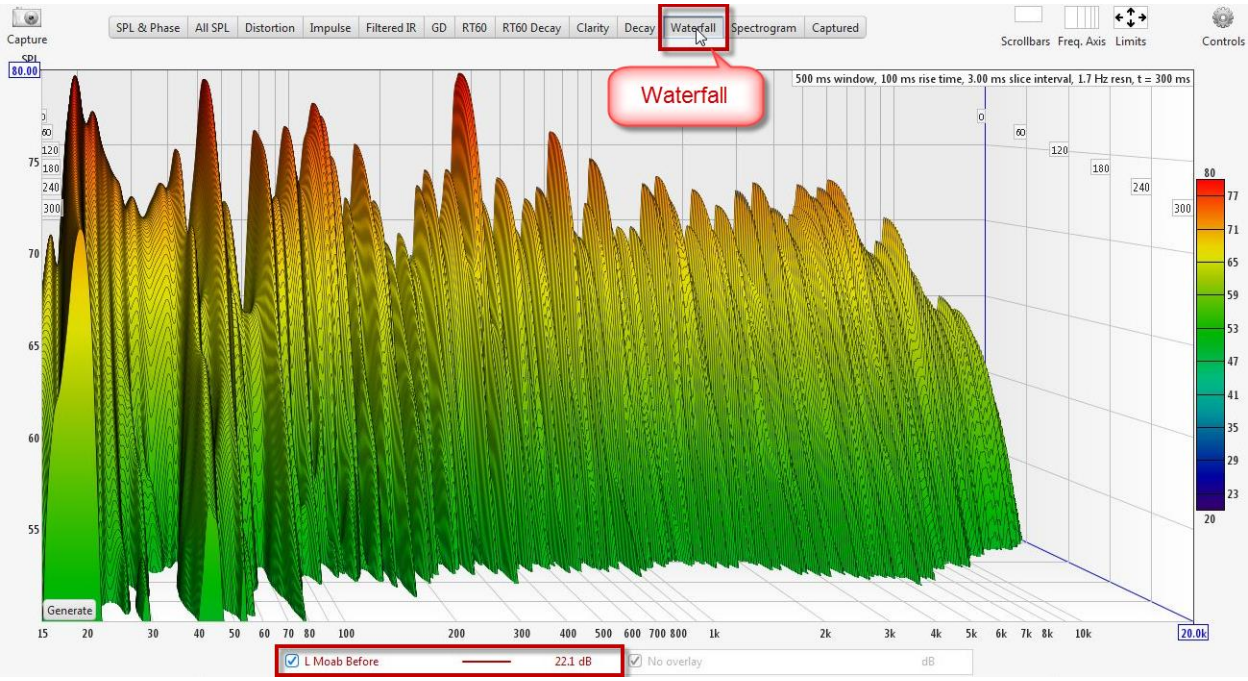
View the Waterfall charts

Select the **Left** Speaker Measurement.

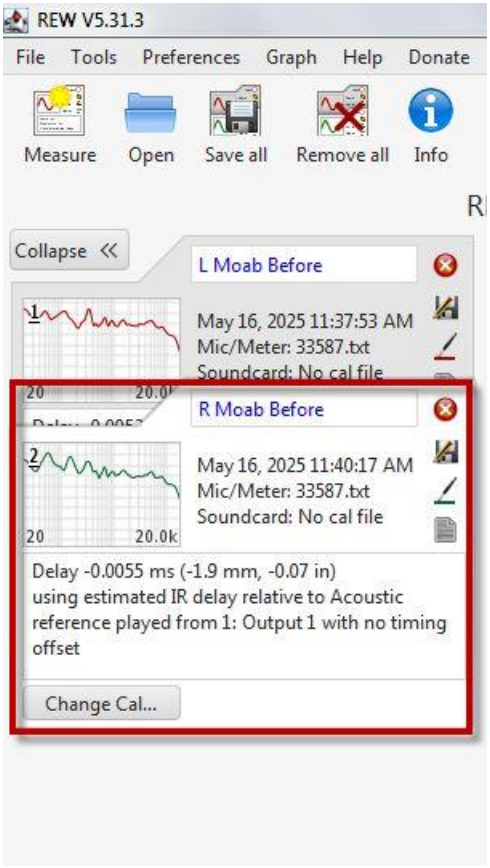


Open the **Waterfall** Tab.

This is the Waterfall chart of your Left Speaker before correction.

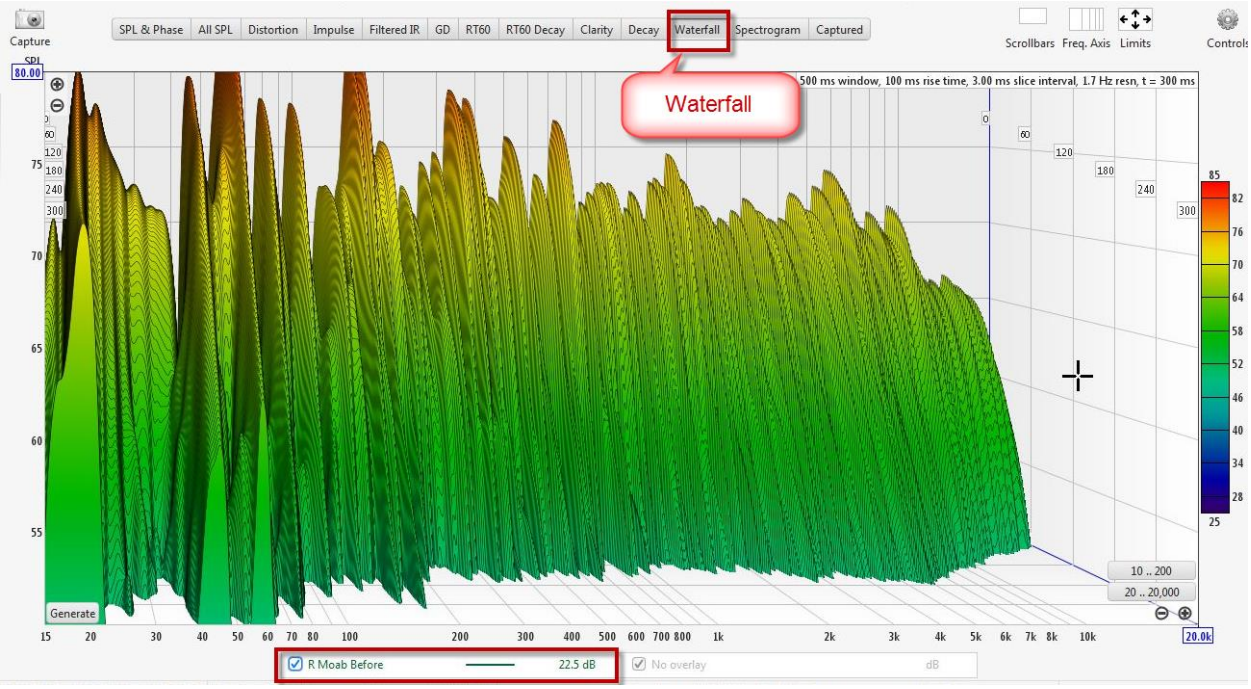


Select the **Right** Speaker Measurement.

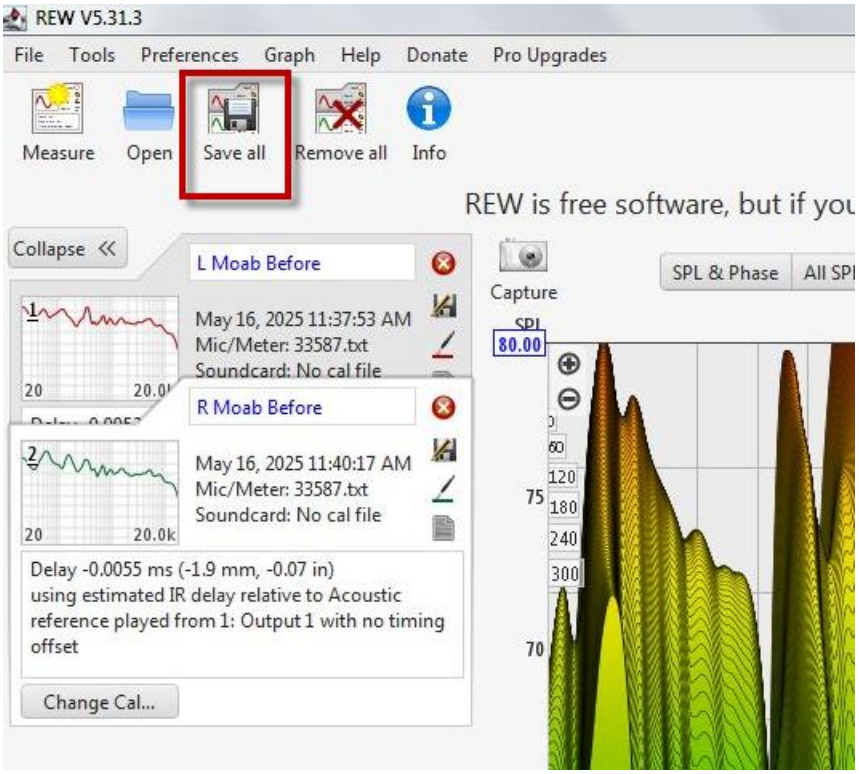


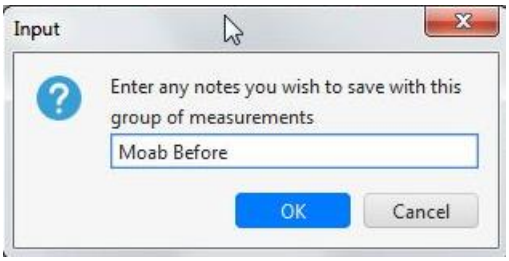
Open the **Waterfall** Tab.

This is the Waterfall chart of your Right Speaker before correction.



Save all your measurements

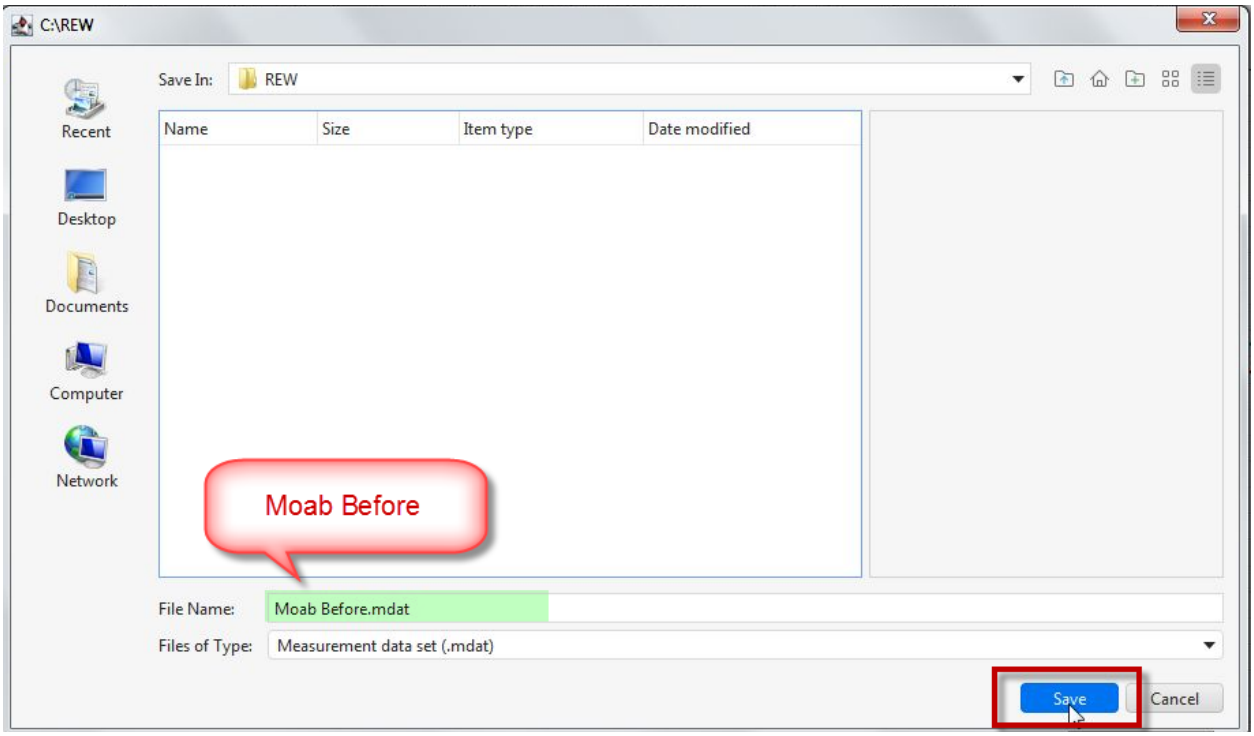




Save the REW Measurement File under:

C:\REW

File Name: **Moab Before**



Save

This saves your initial readings of your speakers before correction.

You will revisit this file later to compare the before and after values.

In the next article you will learn how to generate the FIR Filters using the Acourate Digital Room Correction Software.