



Welcome

Thank you for purchasing Onix R-DES, a 6 band digital parametric equalizer designed for your subwoofer(s). The R-DES product is composed of two pieces: a stereo digital parametric equalizer which we will call the *Device*, and an application that runs on your personal computer to control it which we will call the *Interface*.

You might ask why we broke the product up into two parts. This way we can leverage the power of your personal computer to give you a simple, powerful, cost effective solution for room correction. We can also offer easy upgrades to the product as the core technology advances.

This help manual is not just a reference, but a working tutorial on speaker and room interaction and their effect on your listening enjoyment. I would encourage you to read the manual before attempting to use R-DES as there is a lot of valuable information contained in the following sections. Enjoy!

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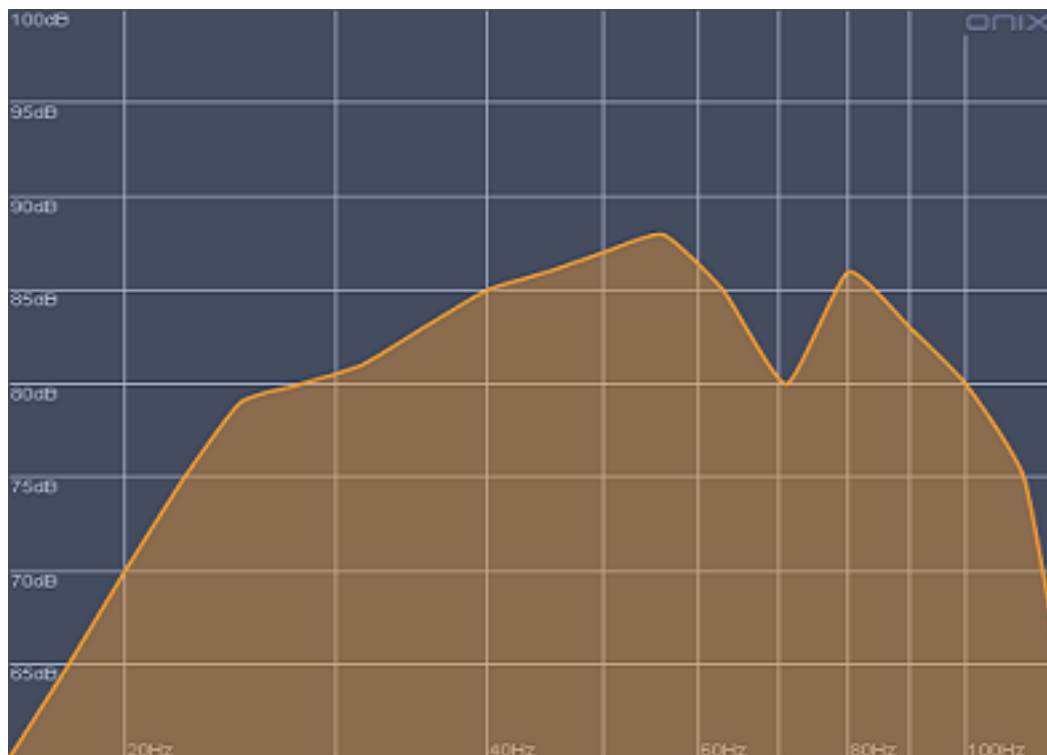
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What is Frequency Response?



To really understand how to use R-DES to its fullest potential you really need to understand the concept of Frequency Response. Music does not sound like a lot of individual tones, but that is in fact what music is made up of. All music can be seen as a combination of tones of specific frequencies that occur at specific times. For instance an acoustic bass note may have a fundamental pitch of 100Hz, or 100 cycles per second (it also has additional harmonics that are multiples of that fundamental pitch). When a piano hits a middle C note on top of that, that music contains all of its tones as well. These simply add up to create music.

Now, when music is played back over speakers in a room, the speakers and the room can't play every frequency, or tone, at exactly the same level. This can be seen in its Frequency Response. It is a measure of how a system plays back different tones at slightly different levels.

A non-uniform Frequency Response is a flaw in the playback system. Some notes will sound louder than others. Some will resonate more than others. None of this was in the original music, it is created by your speakers and your room. Now, most speakers do a pretty good job of playing things at similar levels. +/- 3dB is a very common target for speakers because this change in level is not very noticeable. But rooms can cause enormous aberrations in the Frequency Response for reasons that will be explained in the next

chapter. These variations can be up to 20dB! This is very noticeable and is commonly referred to as one note, flabby, or weak bass. That is because certain tones can be so much louder than everything else. By compensating for those extra loud tones, you can bring your system's Frequency Response back to nearly uniform, which will significantly increase your listening pleasure.

Frequency Response is most often shown in the form of a graph with frequency on the horizontal axis and level on the vertical axis. What you would like to see in a system is a perfectly flat line, but this is not realistic. What you will most often see is some small variation in the curve across the frequency range. You can see an example Frequency Response graph at the top of this page.

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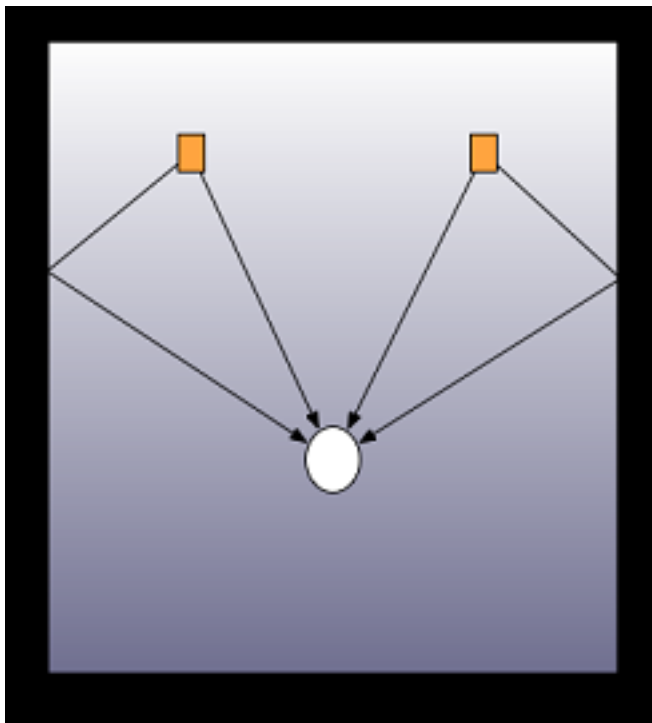
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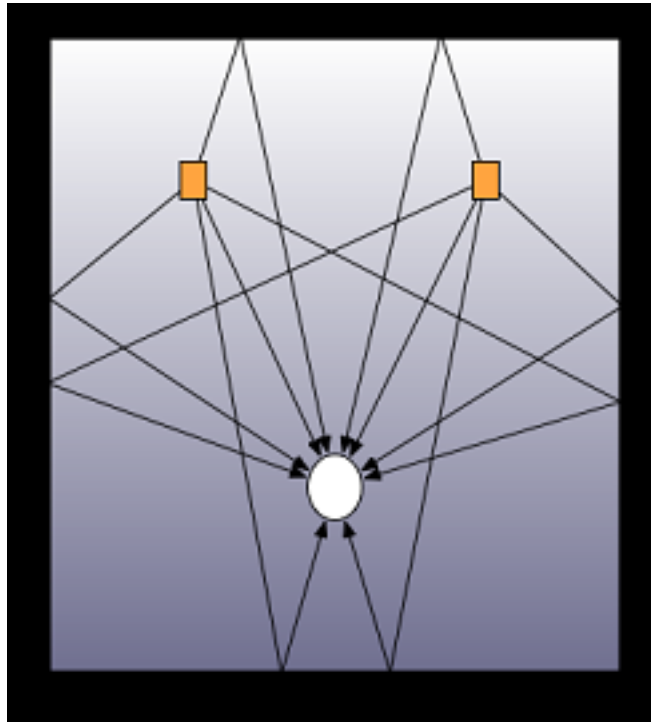
What is Room Interaction?

Before we go into the interaction of speakers and rooms, it is important to understand a little bit about sound and how it behaves in different environments. Sound is a pressure wave moving through air at about 1130 feet per second. This wave contains a combination of different frequencies, or tones, that combine to make the music we hear. For the most part, this sound bounces around a room like rays of light would. It reflects off walls and creates what is called a reverberant sound field. It is also absorbed to some extent when it hits objects, with higher frequencies being more easily absorbed. It is this absorption that can dictate the "character" of the sound in your room. If your listening room is made of glass, the sound will be very bright because very little of the high frequencies will be absorbed. If your room has heavy curtains covering the walls it will sound very dark because all the high frequency energy being sent into the room by your speakers will be absorbed very quickly leaving only the low frequencies to reverberate.

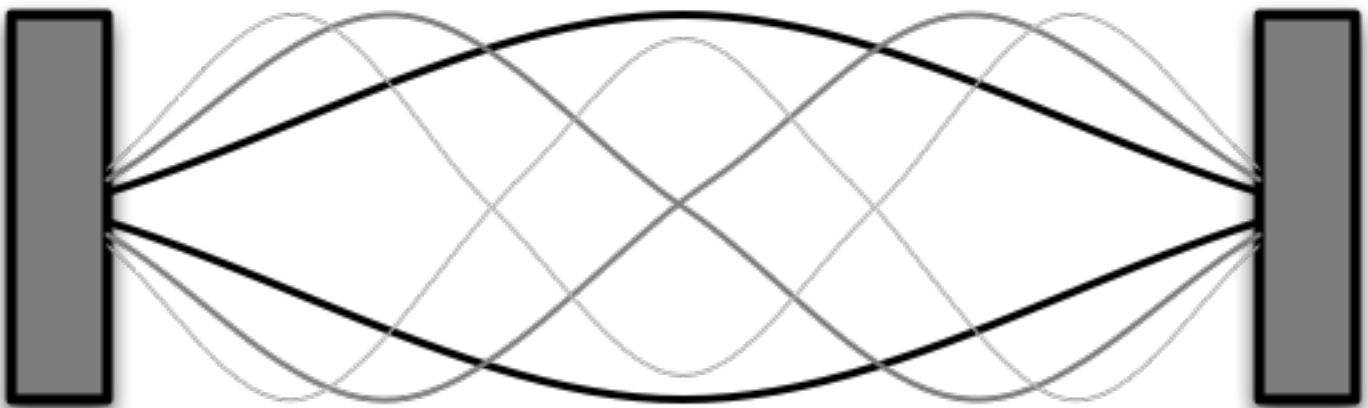


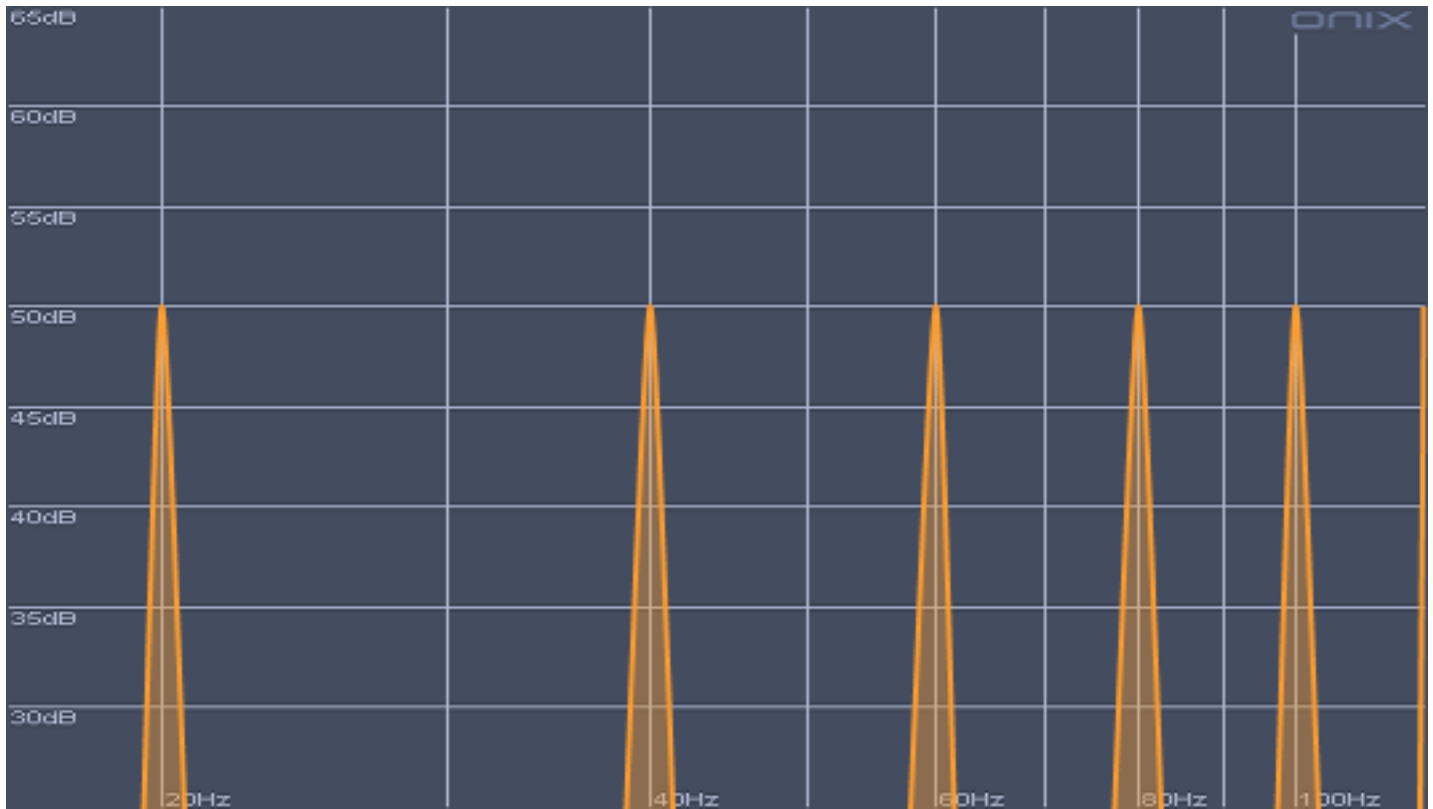
Everything sounds fine so far, but there is a pretty big problem with these reflections. You might guess that most of the sound you are hearing is directly from your speakers, but in truth, you probably hear more reflected sound than direct sound. This is why larger rooms require larger speakers to play at reasonable levels. They retain less sound due to the larger space. Whereas smaller rooms retain much more of the sound that is put into them. Now it should be apparent that those reflections are critical to

take into account in any listening space.



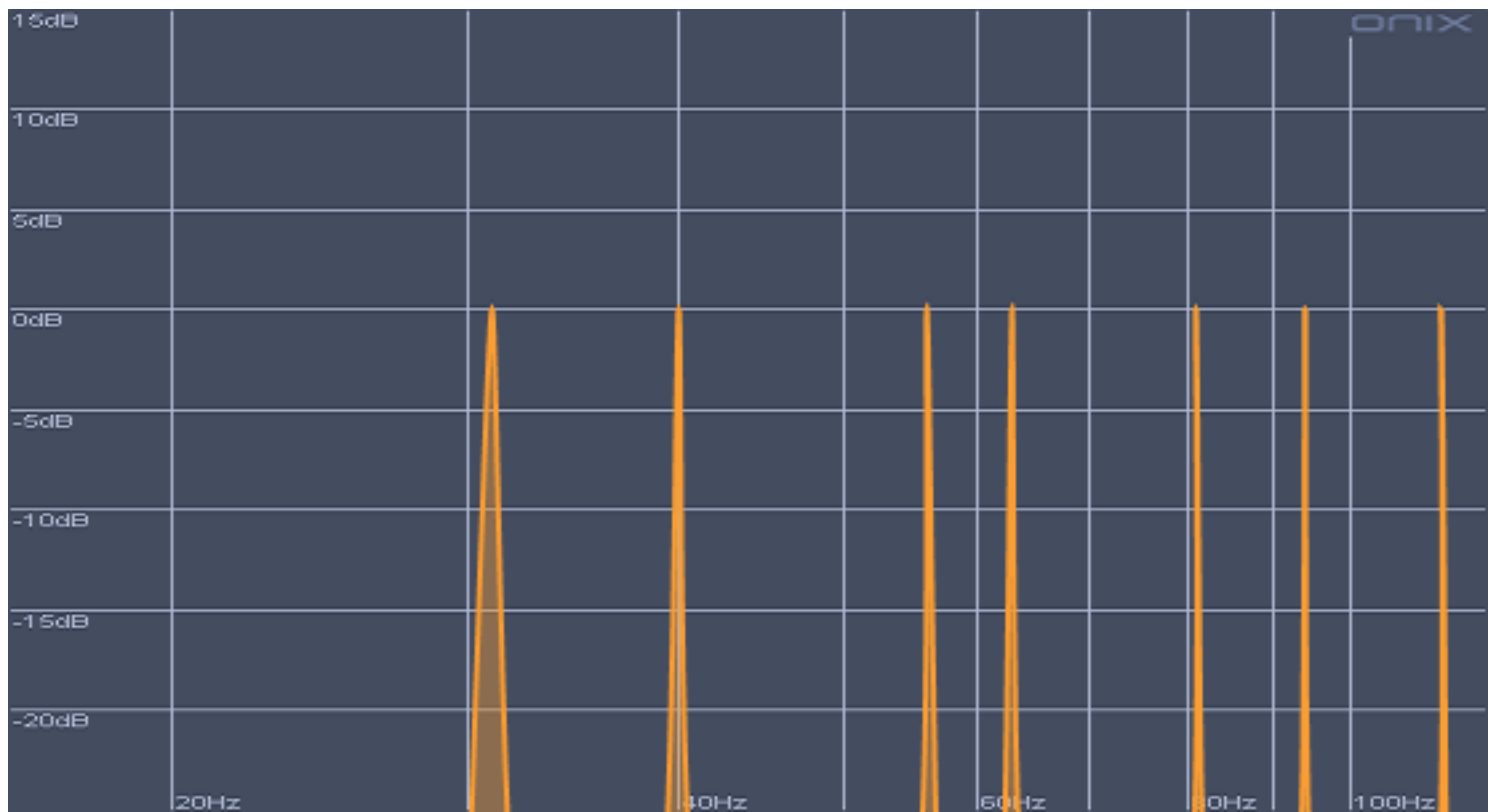
What do those reflections mean to your room response? To understand that, let's look at the case of a vibrating string. A vibrating string is nothing more than an acoustical type wave traveling back and forth and reflecting off a hard surface at both ends. These reflections interact with each other to create the resonance that you hear from a plucked string. The reflections constructively add up and resonate where the wavelength of the acoustical wave is equal to 2 times the string length. This is called its fundamental frequency. The string will also resonate at all multiples of that frequency. At every other frequency, the reflections will essentially cancel each other out resulting in very little volume. The fundamental and its harmonic frequencies, we will call modes. Check out the string diagram below and its resulting frequency response below. The fundamental frequency of this string was arbitrarily set to 20Hz for this example.



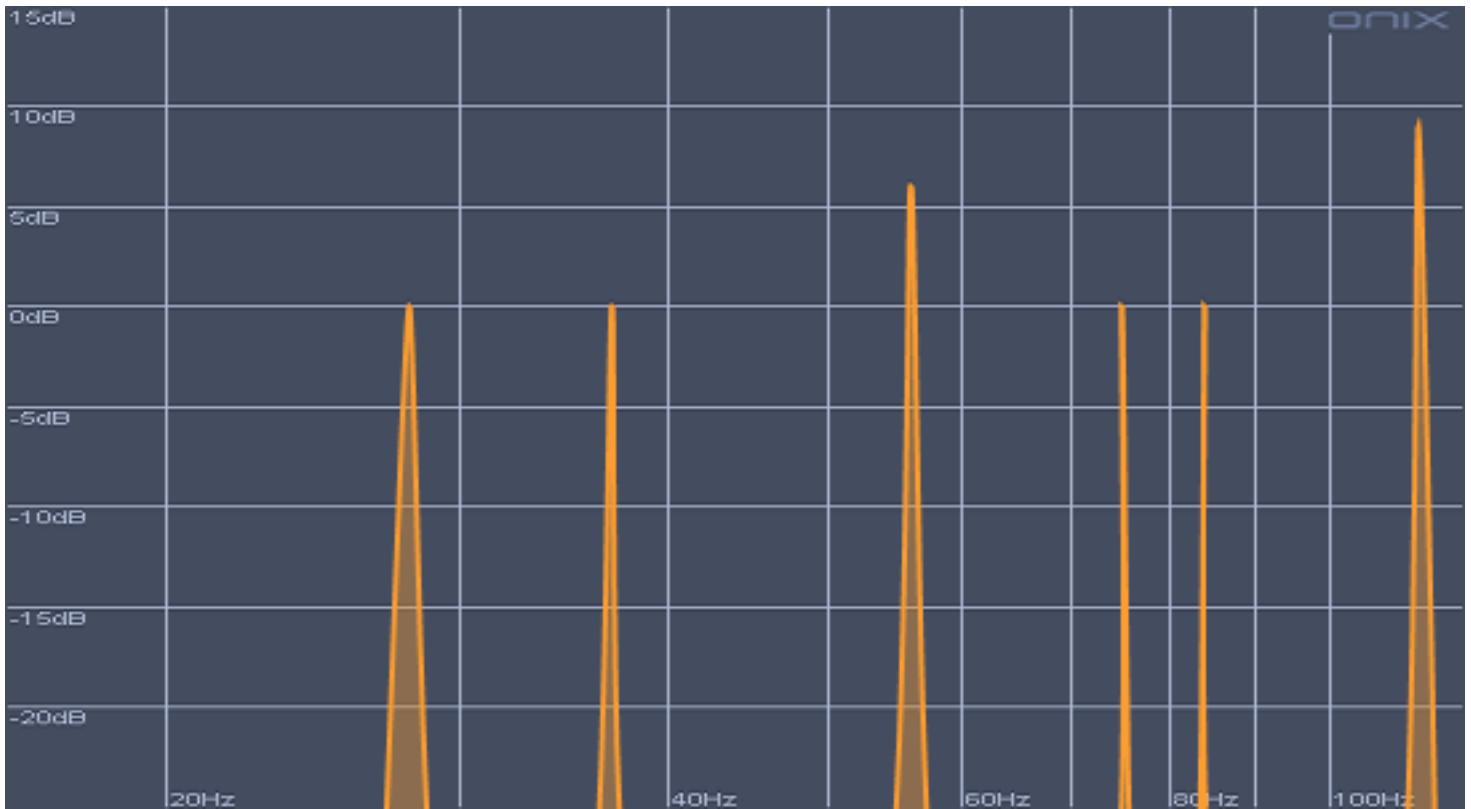


We are now ready to bring all this together. A room isn't that different from a string. A room has three dimension that each have a set of modes. When the speaker produces a signal, that sound bounces around for a while and causes the room's modes to resonate. For example, lets look at a room that is 10' tall, 14' wide, and 19' long. To calculate the fundamental frequency of each dimension, take the speed of sound (1130ft/sec) and divide it by 2 times the length of your room in that dimension. For example, the fundamental frequency of the height of the room is $1130/(2*10) = 56\text{Hz}$. Of course there are harmonic modes along this dimension at multiples of this frequency, so 112Hz, 169Hz, 225Hz, ...

While we're at it, lets calculate the modes of the other dimensions and put them on a graph. The fundamental mode along the width is $1130/(2*14) = 40\text{Hz}$. And the fundamental mode along the length is $1130/(2*19) = 30\text{Hz}$. Check out the graph below to see all the axial room modes. This graph will show the overall shape of your room's frequency response. In reality, things aren't this simple, but you would definitely see these features if you measured the real frequency response.



You can see in the graph that this is actually a pretty good room since the modes are spaced pretty evenly. The more evenly your room modes are spread out, the fewer problems you will have in your room's frequency response. You especially want to watch out for room modes piling up on one another. Lets look at a room that is a little more problematic, say 10'x15'x20'. You can see right away the the height and length modes will have some modes that pile up on each other, but also think about what that height means. Lets just plot it. You can see the stacking of the modes as an increase in level. Two modes stacking would result in 6dB and three modes stacking results in 9dB.



This room response is going to be anything but subtle. In fact, the owner of this room should probably consider moving a wall or two. Even acoustical treatment and EQ has its limits.

In a perfect world, we would all design our rooms to keep the modes as even as possible, but in reality, we have to deal with the rooms we already have. Please read the next sections on how to measure your room response and compensate for some of the problems using EQ.

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EQ to the Rescue

So, how does R-DES and its powerful EQ fit into all of this? Looking at the mode graphs you might think that these resonances are perfectly narrow spikes, but this is where rooms are a little different. The boundaries of a room are not all that solid and differing absorption in the room broadens the width of these peaks quite a bit. There are also a lot of modes in your room that are not described by the simple equations in the previous section. All of these things combine to make the room response a lot smoother than the string example. There are still large peaks and troughs to deal with though and EQ can really help.

The modes in the room response can be approximated as filters that have a specific frequency, boost, and Q (width). You can find the most offensive peaks in your room response and determine their frequency, boost, and Q, you can effectively cancel out these peaks by using a filter in R-DES with the same frequency and Q, but an opposite amount of boost. For example, if you have a peak that looks like a boost=6dB, frequency=40Hz, and Q=3, you can setup a counteractive filter in R-DES with a frequency=40Hz, Q=3, and a boost of -6dB. It is important to note that you should not correct major nulls in your room response. Trying to correct for them will decrease your woofers headroom and increase distortion. Don't do it! Fortunately, nulls are not nearly as offensive as peaks. And also be careful not to mis-identify a null as a flat spot surround by two peaks, because this does effectively the same thing as trying to boost the peak. You can conceptually think of it like the image below.



Once you correct for your biggest offensive room modes, you might be surprised by how much you can bring up the level of your subwoofer to match the rest of the system.

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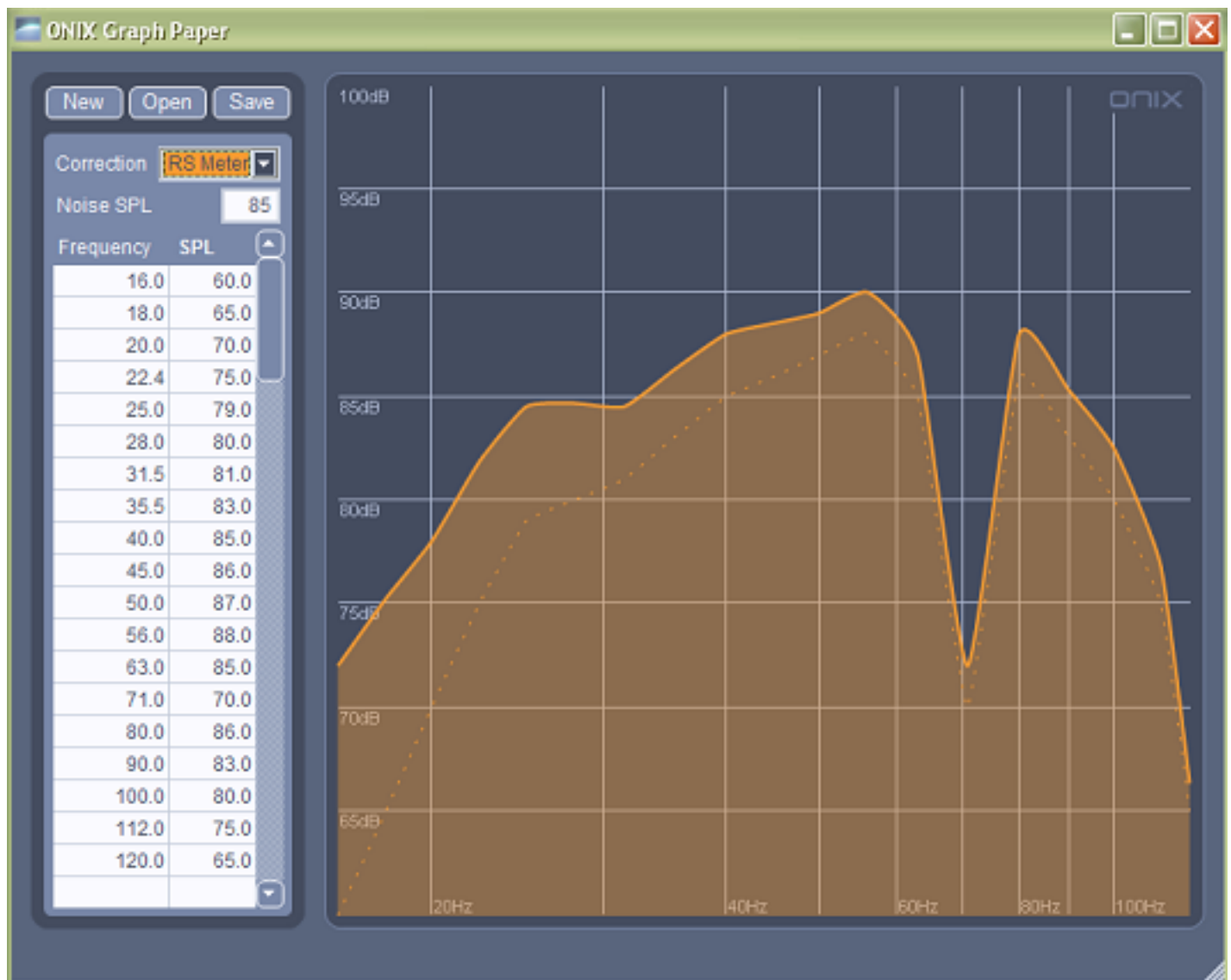
Measuring Your Room

Now that you have some idea of what to expect, let's measure the response in your actual room. It is important to measure, because there are levels of complexity that I left out in the previous section. Things like tangential modes, speaker position, and listener position significantly affect your room response as well.

The CD included with this product not only installs the R-DES software on your PC, it is also a test tone disc and a graphing application to measure and plot your room response. There are two different sequences of test tones on the CD for plotting at different accuracy. For the sake of simplicity in this tutorial, we will only cover the Long Sweep, which gives you more precision in the measurement.

Graph Paper

Before we actually go into the measurement, here's a quick tour of ONIX Graph Paper. ONIX Graph Paper does not automatically take measurements of your room, it is simply a nice plotting program to get a good graph after you have manually recorded the SPL of the test tones.



On the left hand side of the interface is the document manager. At the top are some buttons that allow you to create new measurements, open saved measurements, or save your current measurement. These should be pretty self explanatory, so I won't really cover them in detail here.

Below that is what really counts. For the current measurement, you can select SPL Meter Correction, the average SPL level of the measurement, and the recorded SPL of each individual test tone. As you enter data into these fields, the graph will be updated automatically.

It is important to set the Noise SPL field correctly as this is what zooms the graph to the correct frequency range. You can change this value to zoom to a different range if you want, but the measurement sequence should get you to the right range.

On the right hand side of the interface is the Frequency Response Graph. It simply plots the data in a nice way. You can grab the plot and drag it to your desktop or directly into an email if you want to save this graph as a PNG image. The only caveat here is that you should rename the image as soon as you drag it somewhere to store. By default the files are always named FrequencyResponse.png and will

overwrite each other if not renamed.

One last thing to remember is the onscreen help. In all Onix applications, you can just mouse over different controls to get a description and extra tips displayed at the bottom of the window.

Setup

Open the ONIX Graph Paper application by going to StartMenu->Onix->Graph Paper. This will launch the application with a template for the Long Sweep all setup and ready to go.

For now, you only want to measure whatever speaker you are going to correct with R-DES. Unplug your full range speakers from your system so you only hear the subwoofers. Since the test tone disc is only in stereo, you will have to configure your preamp processor to send a signal to the sub. Please consult the manual of your processor to find out how to do this.

I also recommend turning the crossover knob on the back of your subwoofer all the way up to get the room response without the subwoofer crossover. This is not strictly necessary, but it will give you a better idea of what is happening on the high end of the sub range. It also give you the option to use the crossover already built into the R-DES Curves, which are more configurable.



Before you start, turn the volume down on your preamp/processor. The test tones are recorded at a very high level.

Insert the R-DES CD into your CD player. There is a track listing of the test tones included in the R-DES package. You might want to keep that handy, so you don't forget where you are.

Sit in your listening position with your SPL meter at ear level. Set the meter to "Slow" response time and a "C" weighting. Please consult the owner's manual of your SPL meter to make sure that the test tone levels are in the correct range. You are now ready to measure your response curve.

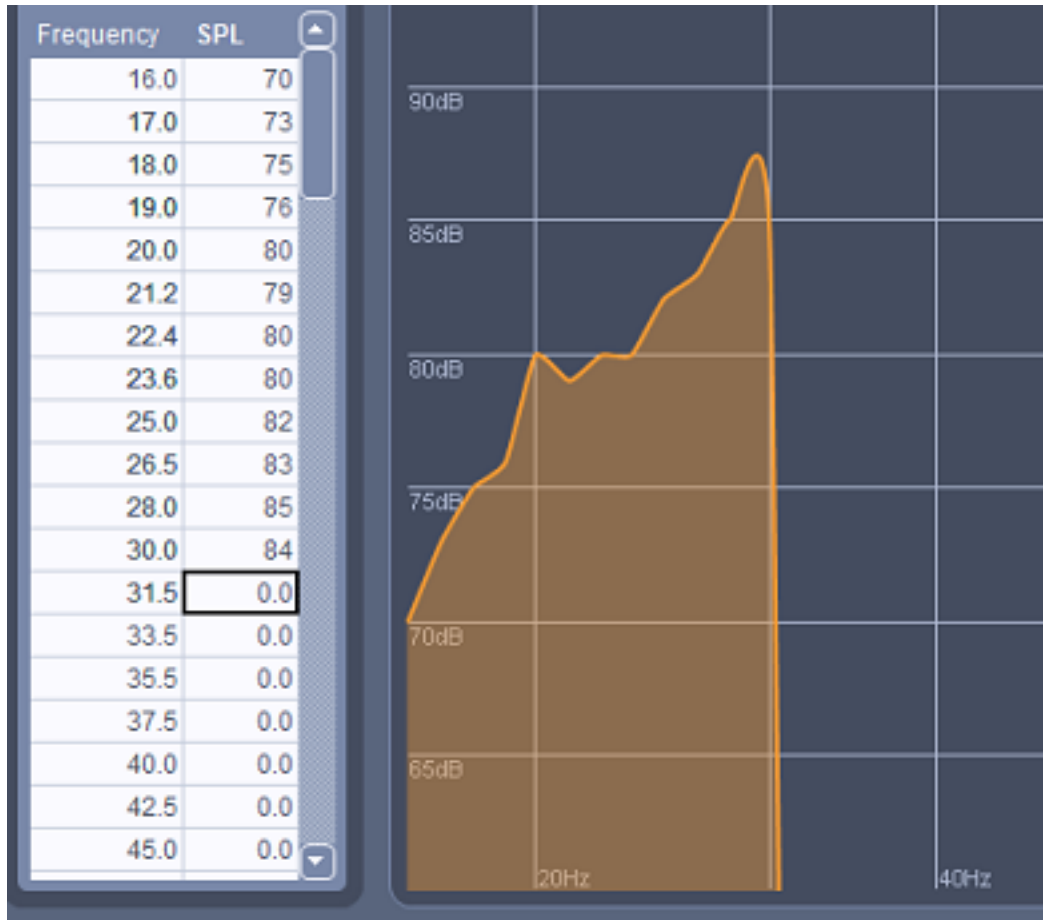
The measurement sequence starts with a Pink Noise sample to help you set your system volume to a reasonable level. It also gives you an average level to enter into the Noise SPL section in ONIX Graph Paper. The higher level you test at, the more accurate your testing will be, but don't turn it up to harmful levels. Go ahead and complete this step.

Noise SPL

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Now, the test tone tracks on the disc start at 16Hz and go up to 120Hz. While you go through the 5

second tones, record the SPL for each frequency into Graph Paper. You should see the plot changing as you enter each new SPL.



If are using the Radio Shack SPL meter, you can convert its C weighted response to an unweighted response by selecting RS Meter in the Correction box. The main plot will adjust to this conversion, but you can still see your actual measurement data with the dotted line in the plot.

Correction

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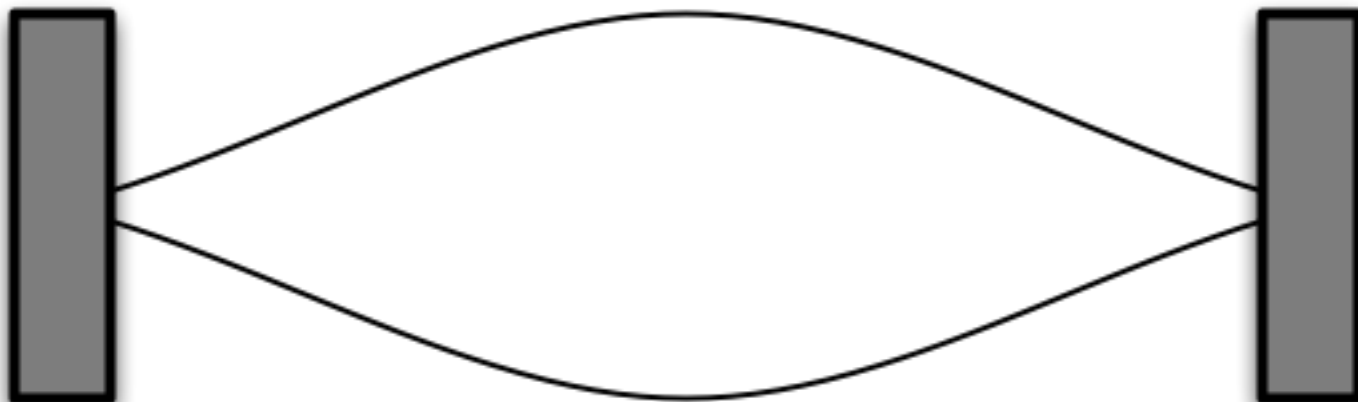
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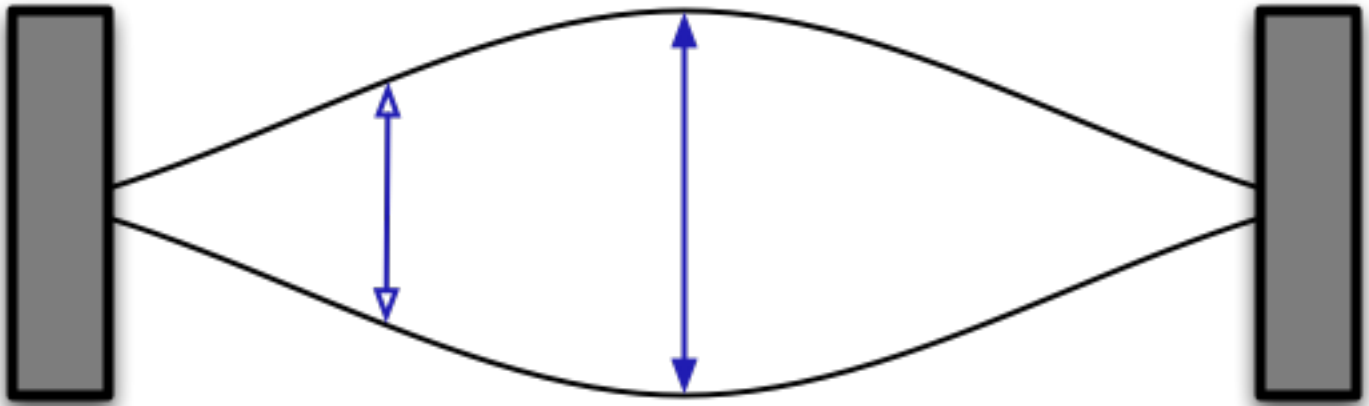
Interpreting Your Room

You should have a graph of your room response in front of you at this point. Looking at that graph, are there any really bad problem? Can you relate any of them to a dimension of your room following the calculations in the "Room Frequency Response" section? If so, you might want to consider moving some things around in your room. Why does this matter? Well, lets show some examples of what is happening.

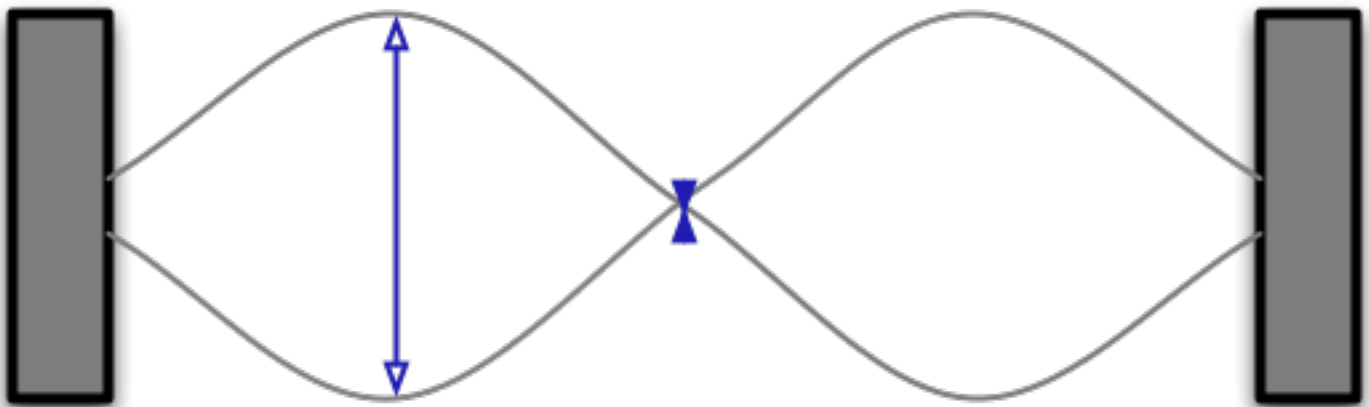
Remember those vibrating string graphs from the "Room Frequency Response" section? We know that these show which frequencies are going to resonate, but there is some more information there as well. Consider the following vibrating string image below with its fundamental resonant frequency. You can see that the the complete string swings back and forth with the vibration.



However, lets imagine that it is showing the sound wave in your room along its length. If you sit in the middle of the stringlength-wise, you will get the maximum amount of swing at that frequency. The level of the sound wave there is going to be very high. If you sit at one quarter or three quarters of the room length-wise, you will hear that resonance at a lower volume because the wave doesn't swing as much there. This is why the bass in your room can sound so radically different as you walk around! Your room determines the frequencies at which it will resonate, but your listening position will ultimately determine how loud or quiet those resonances are.



That looks simple for the fundamental, but what about the all important harmonics? Let's take a look at what happens for the second harmonic mode along the length of your room. Notice that the wave in the middle of the string doesn't move at all! This is called a null. They happen where the standing waves along the string always cancel each other out. No matter how much you turn up your sub, you will never strongly hear this frequency in that null. You obviously don't want to sit here, you can't correct for this at all. Move your couch up a foot or two and you will hear that frequency again.



So, that pretty much covers what causes the peaks and nulls in your response.

There is also this issue of subwoofer placement. I don't want to go too much into that here as we already have a lot to think about, but it is important. Common practice is to locate your subwoofer in the corner to optimally excite all the modes in your room, but playing around with sub placement can yield some really good results. Primarily because you can reduce the excitation of problematic modes.

Moving your listening position and sub position(s) is definitely something you should do. Keep working with the measurements to see what is effective in your room. You can use the Quick Sweep template in Onix Graph Paper to cut your measurement time in half if you are just looking at the big picture.

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Managing Presets and Curves

Before going into the details of how to use the R-DES Interface, let's quickly define a few terms that we are going to use often.

Curve: A Curve is a complete EQ setting. It represents the sum of the Subsonic, Crossover, and EQ filters. You can only listen to one Curve at a time, but you can switch between the 4 curves stored in the Device.

Preset: A Preset is a group of four Curves that can be stored in the R-DES Device. Only one Preset can be stored in the Device at any one time, but all of your Presets can be stored on your computer for future upload.

Preset Manager

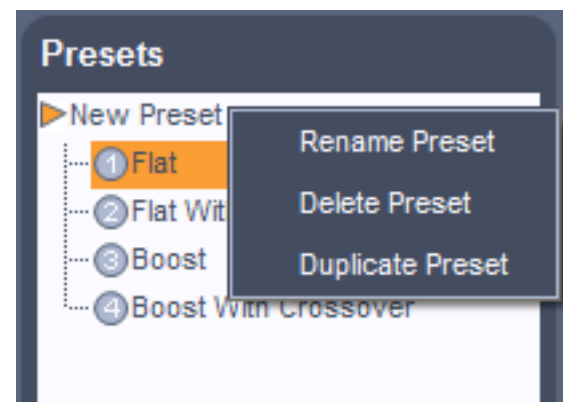
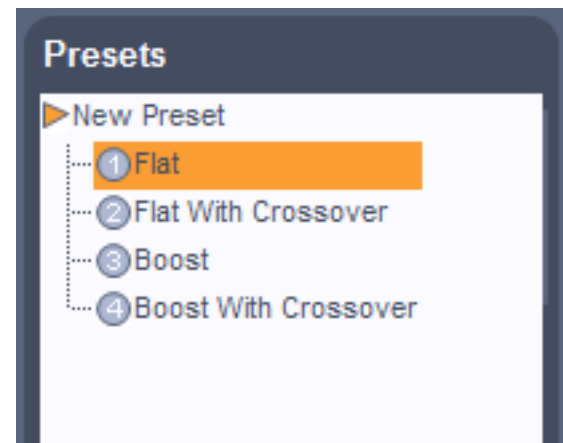
Now that you understand our terminology, let's talk about how Presets are created and deleted as well as how to edit Curves within any Preset. If you look at the left most portion of the Interface, you will see the Preset Manager (labeled **Presets**). This is simply a list of Presets stored on your computer. When you first run the application, there should only be one Preset in the list called **New Preset**.

Naming Presets

Why don't we rename this Preset "First Curves" or anything else you like. You can do this by **right clicking** on Preset name and choosing Rename Preset. Type anything you like for a name and hit the Enter key on your keyboard.

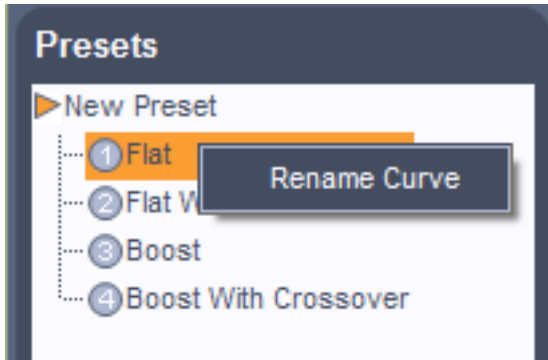
Other Preset Options

There are a couple other options in that menu that you saw a moment ago, so let's quickly talk about them. Delete Preset will permanently remove that Preset from your computer. You can not undo this operation, so be careful when deleting Presets. You can also Duplicate Preset, which creates a perfect copy of that Preset and



adds it to the top of the Preset Manager. This is very useful when you want to experiment with slightly different curves.

Naming the Curves



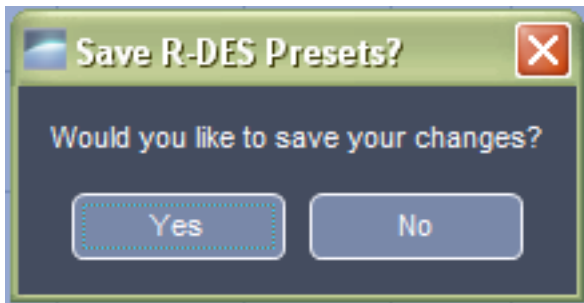
Notice that the currently selected Preset (denoted by a little triangle next to the name) is open and it contains four items. These represent the four Curves in the Preset. You can select one of the four Curves and see its shape and settings in the Curve editor portion of the Interface. This is the large section on the right of the screen. We'll cover this big portion of the Interface later, but for now just notice that it changes. You can rename any of the four Curves by right clicking on the Curve name and selecting Rename

Curve. Again, type anything you like and hit the Enter key.

Creating New Presets

You can create new Presets by pressing the **New** button at the bottom of the Preset Manager. This will create a new preset at the top of the list that contains the factory default curves. It will open this Preset for you, so you can start editing. For convenience, it also closes your other Presets. If you would like to see those curves again, just click on the desired Preset to open it up.

Saving Your Presets



Finally, to save your presets, all you have to do is quit the application and it will ask you to save them. This way you don't have to remember which file you saved which Preset to, we take care of all that for you. If you really screwed up your presets and you don't want to save them, answer No to this question and the next time you launch the R-DES interface it will show the last Presets you had saved.

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Introducing the Curve Editor

The Curve Editor is the section of the Interface show below. It can look intimidating with the graph and all of the dials, but it is pretty simple to explain if we break it up into sections.



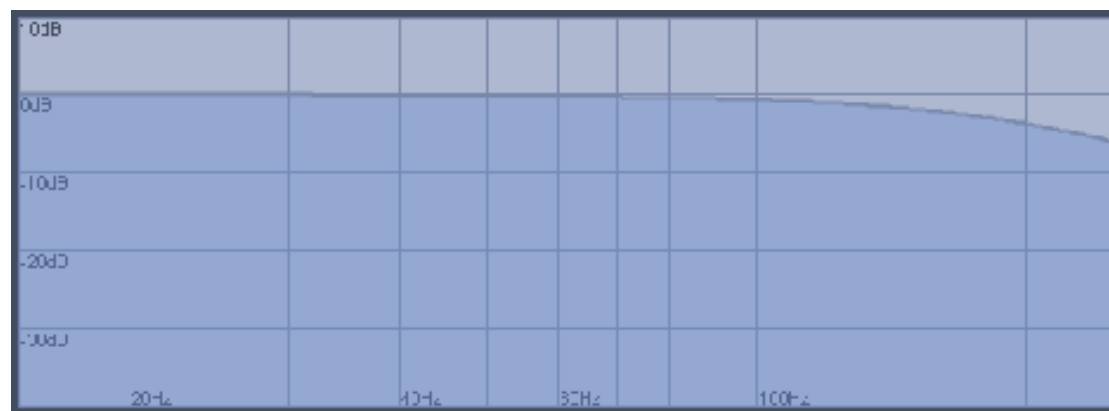
Title

The title bar at the top of the Curve Editor simply shows the name of the Curve you are editing along with the Preset it is part of. It will always correspond to the selected Curve in the Preset Manager. If you want to edit a different Curve, you need to select that curve in the Preset Manager.

New Preset - Flat

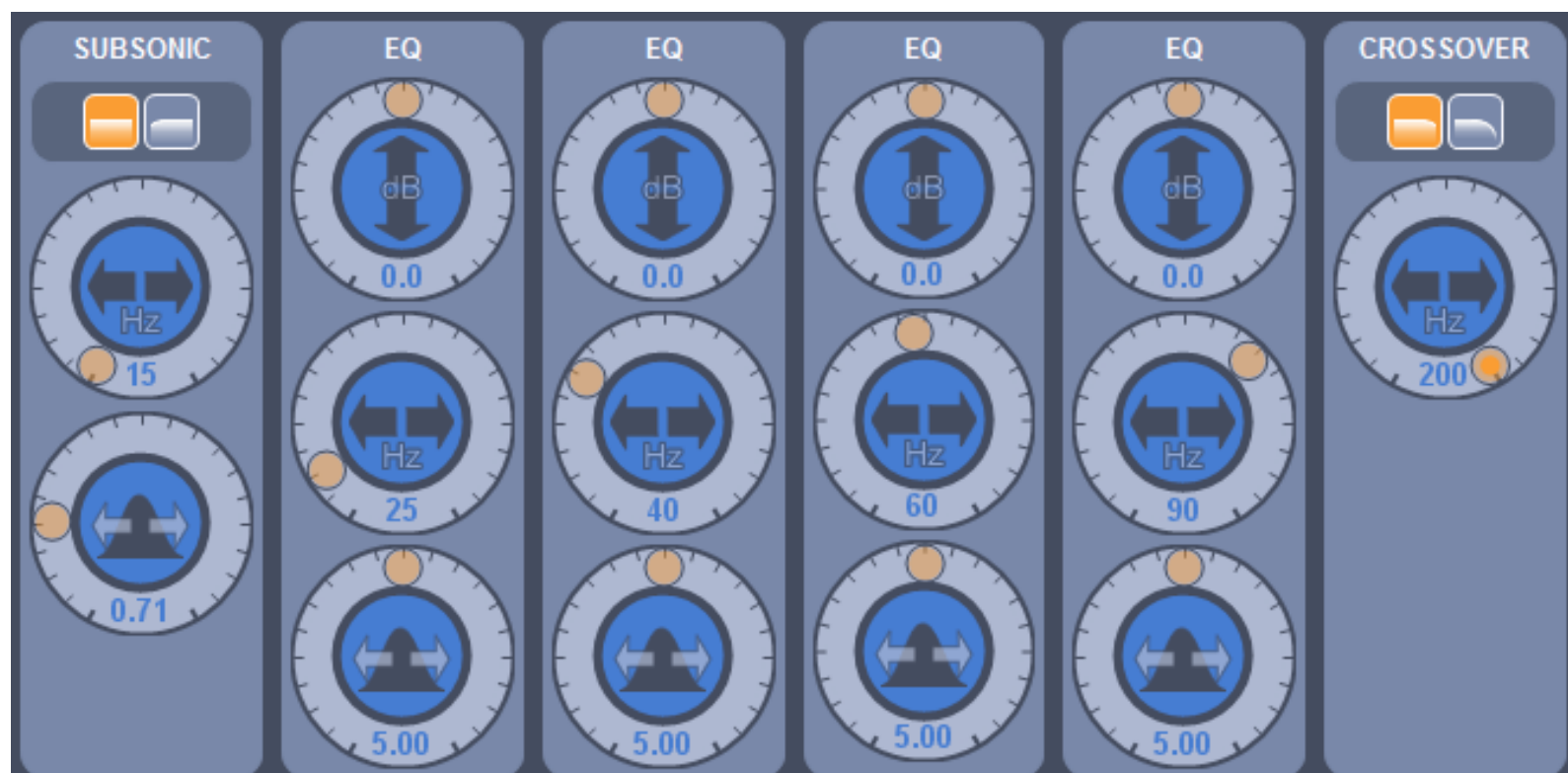
Graph

The large graph in the Curve Editor shows the frequency response of the selected Curve. You probably remember us talking about what Frequency Response means in the introduction. This Frequency Response does not show the response of your speaker or your room, it simply shows the response of a specific curve when loaded into the R-DES device. A flat response would mean that the signal going through the Device would be unaltered. If you want to compensate for some room modes, this graph should look like the opposite of your room response around those frequencies.



Filters

Before talking about the sections and all those dials, let's define what a filter is. A filter is simply an object that alters the frequency response of a signal. There are a bunch of different types of filters in the world, but R-DES really only needs 3: Subsonic, EQ, and Crossover. Each Curve contains 1 Subsonic, 4 EQ, and 1 Crossover filter. The Subsonic filter allows you to decide how much signal gets sent to your subwoofer at VERY low frequencies, EQ filters allow you to finely tune the response at an arbitrary frequency, and the Crossover filter prevents high frequencies from being sent through. The specifics of these different filters will be covered in the next section, so don't worry about that for now. Notice that each filter has its own vertical section with the dials and buttons that control it.



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Subsonic Filter

As mentioned in the previous section, the Subsonic filter allows you to reduce the amount of damaging low frequency signal sent to your subwoofer. As the frequency of sound decreases, your subwoofer has to work harder and harder to try to push that much air. You can relieve the stress on your subwoofer and potentially gain some headroom by cutting the very lowest frequencies. The Subsonic filter has three controls; Slope, Frequency, and Q.



Slope

Slope is controlled by the two buttons at the top of the Subsonic filter section. The left button is flat and functionally bypasses the subsonic filter altogether. The right button turns on the filter with a 12dB/octave slope.

Frequency

The Frequency Dial gives you the ability to adjust the corner frequency of the subsonic filter. You can set this to low frequencies for larger subs and higher frequencies for smaller subs.

Q

Q is really an engineering type parameter, but it is very useful in custom EQ. You can think of Q in different ways for different filters. For the Subsonic filter, Q represents the level of flatness at the corner frequency. A higher Q will give you some boost before rolling off the low frequencies. You can use this boost to your advantage if you want more low end kick in a home theater setting, but be careful of using too high of a Q as this can cause a boomy sounding response.

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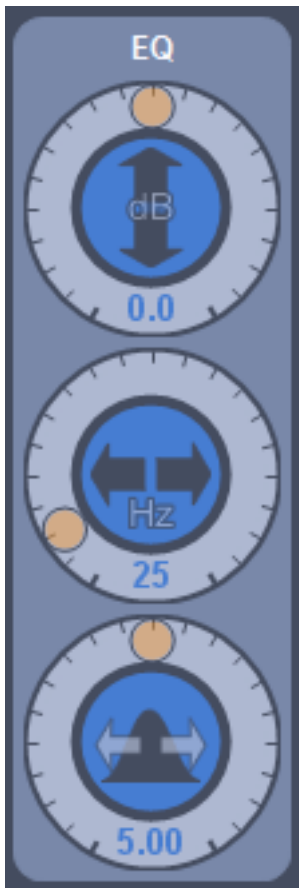
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EQ Filters

There are 4 EQ filters for each curve. You can use these filters to adjust the frequency response across a smaller range of frequencies. These EQ filters can create a peak or a dip in the frequency response to counteract some of your room problems. The EQ filters have three controls: Gain, Frequency, and Q.



Gain

Gain is simply the height or depth of the EQ in dB. You can boost or cut by up to 10dB with this knob. When using this control, it is important to remember that you should try to correct peaks in your room response more than nulls. So, try to use positive gain sparingly. Using negative gain to correct for a peak is more benign on total system performance.

Frequency

The Frequency control sets the center of the EQ filter.

Q

The Q of an EQ filter controls the width of the peak. A higher Q will make a narrower filter, whereas a lower Q will make a broad filter.

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Crossover Filter

The Crossover Filter is used to remove high frequencies from the signal before it reaches your subwoofer. If you already have a crossover filter going to your sub, either in your surround processor, or on the sub itself, you can essentially bypass the crossover by turning its frequency all the way up. You can also turn your other crossover filters (processor and/or sub) off and use this one instead. The Crossover filter in R-DES is very accurate and configurable on a per curve basis which probably makes it the best one to use. The Crossover filter has only two controls.



Slope

The Crossover Slope can be set with the two buttons in the upper portion of the Crossover section. The left hand buttons selects a 2nd order Butterworth filter which rolls off at 12dB per octave. The right hand button selects a 4th order Linkwitz-Riley filter which rolls off at 24dB/octave. You can try the different slopes to figure out which sounds best with your main speakers.

Frequency

The Frequency dial sets the corner frequency of the crossover filter.

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Uploading a Preset

Uploading is the process of storing a Preset into the R-DES Device. You can Upload as many times as you like, but the Preset you upload will replace the previously stored Preset. Of course your old Preset is still probably stored in the R-DES Interface Preset Manager.

First, make sure the hardware is plugged in to your computer via USB. If the R-DES Interface recognizes the device it will light up the Upload Button near the top of the window. If there is no R-DES device plugged in, this button will look grayed out and you won't be able to press it.



To upload a preset you like, select it in the Preset Manager and press the Upload Button. If the upload was successful, all of the LEDs on your R-DES device should momentarily light up and decay to the curve you have selected. If the upload fails for any reason, please try unplugging and replugging in the USB cable. This helps reset the USB sub-system before trying future uploads.

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Advanced Features

This section is really for random tips and tricks that will turn you into an R-DES power user.

Trick 1: Keyboard Focus

All of the dials in the R-DES interface can be targeted by the arrow keys on your keyboard. Select a dial by clicking the middle area. It should turn orange, which means it is the selected knob for keyboard control. Use your arrow keys or PageUp/PageDown to finely control the dial.

Trick 2: Shifting Focus

You can also switch the which dial you would like to focus on by pressing Tab or Shift-Tab to step through them. Once the proper dial turns orange, you can use those nifty keyboard controls mentioned in Trick 1 to control the knob. Using this trick, you can completely control your Curve editing from your keyboard.

Trick 3: Backup Your Presets

All of your Presets are automatically saved when you instruct the applicaiton to save when quitting. They are stored in xml format in MyPresets.xml. This file can be found in the application installation directory. By default this is C:\Program Files\Onix\R-DES, but it won't be the same if you changed the installation directory when you installed the software. Backing up all of your Presets is as simple as saving a copy of this xml file. If you ever want to restore your Presets, simply drop the saved copy back into the installation directory.

That is all for now, but this section will likely grow in the next software update!

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