



DIRAC SERIES

HIGH-RESOLUTION AUDIO PROCESSORS

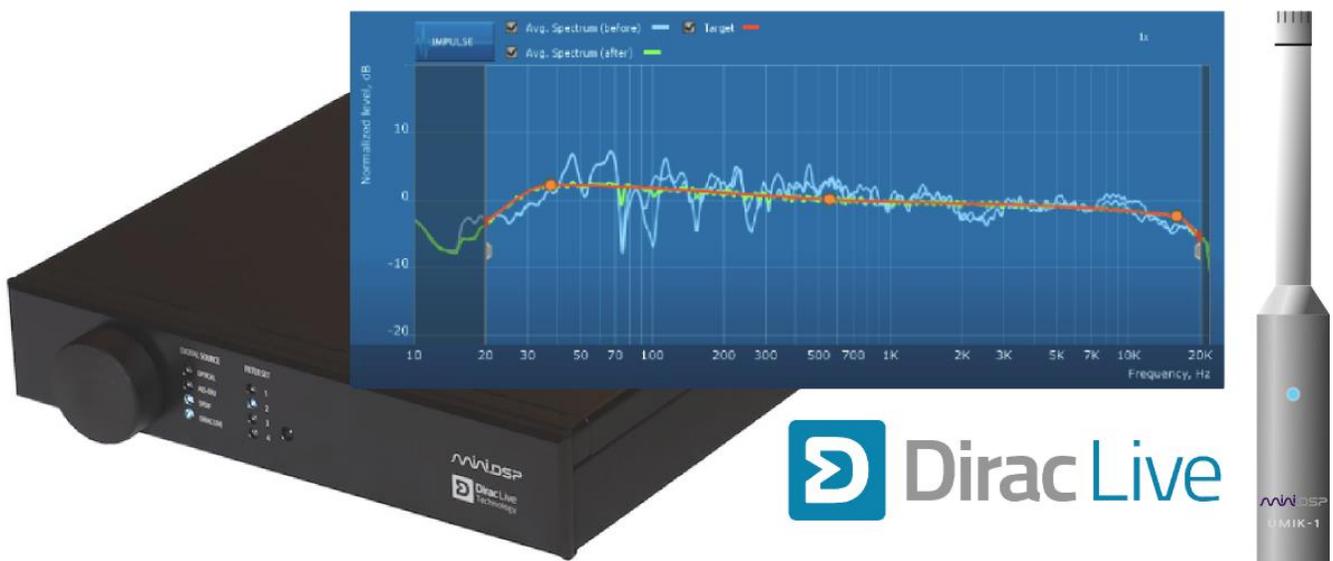
WITH DIRAC LIVE[®] TECHNOLOGY

DDRC-22A

DDRC-22D

DDRC-22DA

User Manual





Revision history

Revision	Description	Date
0.9	Initial public release	26 Mar 2014
1.0	First production version	4 April 2014
1.1	Added DDRC-22DA	18 May 2015
1.2	Updated firmware upgrade procedure	20 May 2015
1.3	Updated for Mac version of software	11 July 2015
1.4	Update for Dirac license removal	10 Sept 2015
1.5	Simplified installation and activation procedure	17 October 2016
1.6	Updated installation procedure	20 October 2016

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IMPORTANT INFORMATION

Please read the following information before use. In case of any questions, please contact miniDSP via the support portal at minidsp.desk.com.

SYSTEM REQUIREMENTS

To configure your *Dirac Series* audio processor, you will require a Windows or Apple Mac computer with the following minimum specification:

Windows

- Intel Pentium III or later, AMD Athlon XP or later
- 2 Gigabytes (GB) of RAM or higher
- Keyboard and mouse or compatible pointing device
- Microsoft® Windows® Vista® SP1/Win7/Win8/Win10
- Two free USB 2.0 ports

Mac OS X

- Intel-based Mac with 1 GHz or higher processor clock speed
- 2 Gigabytes (GB) of RAM or higher
- Keyboard and mouse or compatible pointing device
- OS X 10.9 (Mavericks) to macOS 10.12 (Sierra)
- Two free USB 2.0 ports

DISCLAIMER/WARNING

miniDSP cannot be held responsible for any damage that may result from the improper use or incorrect configuration of this product. Please read this manual carefully to ensure that you fully understand how to operate and use this product, as incorrect use or use beyond the parameters and ways recommended in this manual have the potential to cause damage to your audio system.

Please also note that many of the questions we receive at the technical support department are already answered in this User Manual and in the online [application notes](#) on the miniDSP.com website. So please take the time to carefully read this user manual and the online technical documentation. And if an issue arises with your unit, please read through the [Troubleshooting](#) section first. Thank you for your understanding!

WARRANTY TERMS

miniDSP Ltd warrants this product to be free from defects in materials and workmanship for a period of one year from the invoice date. Our warranty does not cover failure of the product due to incorrect connection or installation, improper or undocumented use, unauthorized servicing, modification or alteration of the unit in any way, or any usage outside of that recommended in this manual. If in doubt, contact miniDSP prior to use.

PACKAGE CONTENTS

Your *Dirac Series* package includes:

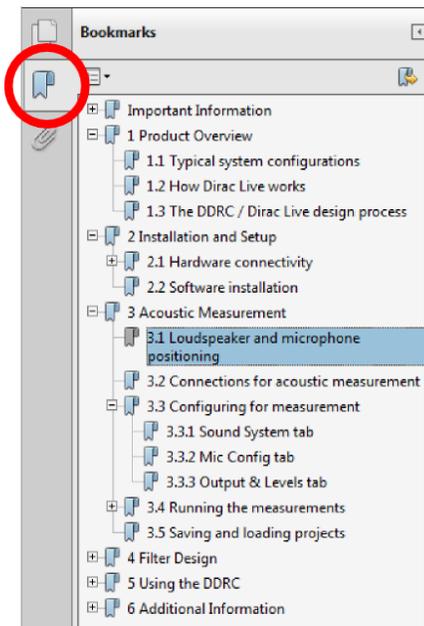
- One *Dirac Series* high-resolution audio processor
- One universal 5 VDC power supply with interchangeable power pins
- One USB cable for computer connectivity
- One UMIK-1 calibrated measurement microphone with USB cable
- One tripod microphone stand
- One license for **Dirac Live Calibration Tool Stereo for miniDSP**
- One printed Quick-start Guide

A NOTE ON THIS MANUAL

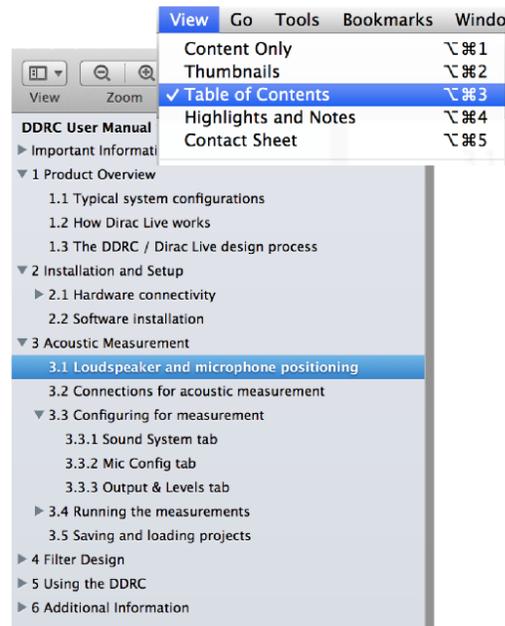
This User Manual is designed for reading in both print and on the computer. If printing the manual, please print double-sided. The embedded page size is 8 ½” x 11”. Printing on A4 paper will result in a slightly reduced size.

For reading on the computer, we have included hyperlinked cross-references throughout the manual. In addition, a table of contents is embedded in the PDF file. Displaying this table of contents will make navigation much easier:

- In Adobe Reader on Windows, click on the “bookmarks” icon at the left. The table of contents will appear on the left and can be unfolded at each level by clicking on the “+” icons.
- In Preview on the Mac, click on the **View** menu and select **Table of Contents**. The table of contents will appear on the left and can be unfolded at each level by clicking on the triangle icons.



Adobe Reader on Windows



Preview on Mac

1 PRODUCT OVERVIEW

Thank you for purchasing a *Dirac Series 24/96*¹ high-resolution audio processor powered by Dirac Live®, the world’s premier room correction solution. We are delighted to offer you this software and hardware combination, the fruit of extensive research and development and years of experience in sound system tuning.

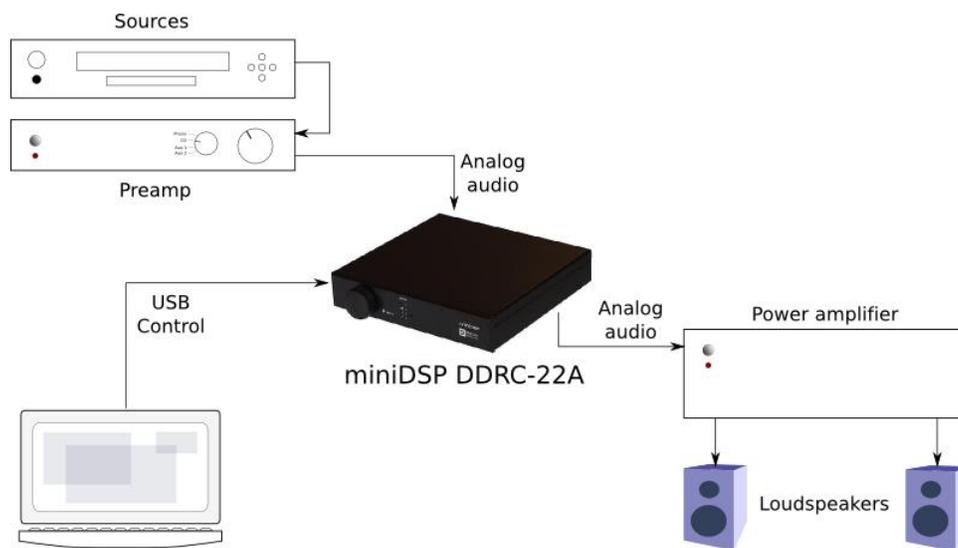
Deploying a miniDSP *Dirac Series 24/96* audio processor with Dirac Live® Technology will

- Improve the imaging of your sound system
- Improve the clarity of the music
- Produce a tighter bass
- Reduce listening fatigue
- Improve the timbre
- Remove resonances and room modes
- Reduce early reflections

Dirac Series processors are available in several versions. The *DDRC-22A* has analog inputs and outputs, while the *DDRC-22D* has digital inputs and outputs. The *DDRC-22DA* has digital inputs and analog outputs, thus eliminating the need for a separate DAC. Each is inserted into the signal chain in the appropriate location (examples follow).

1.1 TYPICAL SYSTEM CONFIGURATIONS

The *DDRC-22A* (analog input/output) is typically inserted into the analog signal chain just before power amplification, such as between a preamp or mixing/mastering console and power amp. Since it has on-board volume control, it can also be used in systems where there is no other volume control, such as between a CD player and a power amplifier.



¹ *Dirac Series* processors operate with 24-bit 96 kHz resolution.

The DDRC-22D (digital input/output) is typically inserted into the digital signal chain just before D/A conversion; for example, between one or more digital sources and a DAC. From there, a regular power amplifier or an integrated amplifier complete the system. Variations on this theme include the use of an integrated amplifier with a digital input or the use of a digital input of an A/V receiver, in which case a separate DAC is not required.



The DDRC-22DA (digital input/ analog output) is typically inserted between digital sources and a power amplifier, as illustrated below.



Computer connectivity is used to perform acoustic measurements and generate digital room correction filters. Up to four sets of correction filters can be stored on the *Dirac Series* processor and recalled from the front panel or via an infrared remote. Once the processor is fully configured, the computer is no longer needed.

1.2 HOW DIRAC LIVE[®] WORKS

Each miniDSP *Dirac Series* audio processor includes Dirac Live[®], a premium mixed-phase room correction technology. This technology is used not only in home stereo and home theater systems but also in cinemas, recording studios, and luxury cars.

As with any room correction system, Dirac Live[®] corrects the system's *magnitude response* (often referred to imprecisely as "frequency response"). In contrast to fully automated systems, Dirac Live[®] corrects the magnitude response towards a user-adjustable *target response*. The target response takes account of the natural frequency range of the loudspeaker system and the normal effects of loudspeaker dispersion on the measured *in-room* magnitude response.

In addition, Dirac Live[®] corrects the system's *impulse response*, which reflects how the system responds to a sharp transient such as a drumbeat. Reflections, diffraction, resonances, misaligned drivers, and so on, all combine to smear out the transient. An ideal loudspeaker has none of these, so correcting the impulse response makes the speaker in the room behave much more like that ideal loudspeaker. The impulse response is a critical factor for accurate sound-staging, clarity and bass reproduction. Dirac Live[®] employs a sophisticated analysis algorithm to make the optimal correction across the *whole* listening area, not just at a single point.

Dirac Live[®] accomplishes this using *mixed-phase filters* – filters that match a desired magnitude response *and* generate a customized impulse response. This contrasts with the *minimum-phase* and *linear-phase* filters that are commonly used in audio applications. While minimum-phase and linear-phase filters are relatively easy to design, they are tightly constrained in their impulse response characteristics – neither can make a desired change to the magnitude response independently of controlling the impulse response. In some cases, they may even make things worse.

Mixed-phase filters are more difficult to design, but the audible performance of Dirac Live[®] is due to its success in using mixed-phase filters to make the system response across the *whole* listening area more closely resemble that of an ideal speaker. The energy from the direct wave and from early reflections is optimally combined to arrive as a single wavefront to the listener. Late reflections are left largely untouched, being corrected only for their spectral coloration, as they contribute to a larger, more enveloping soundstage.

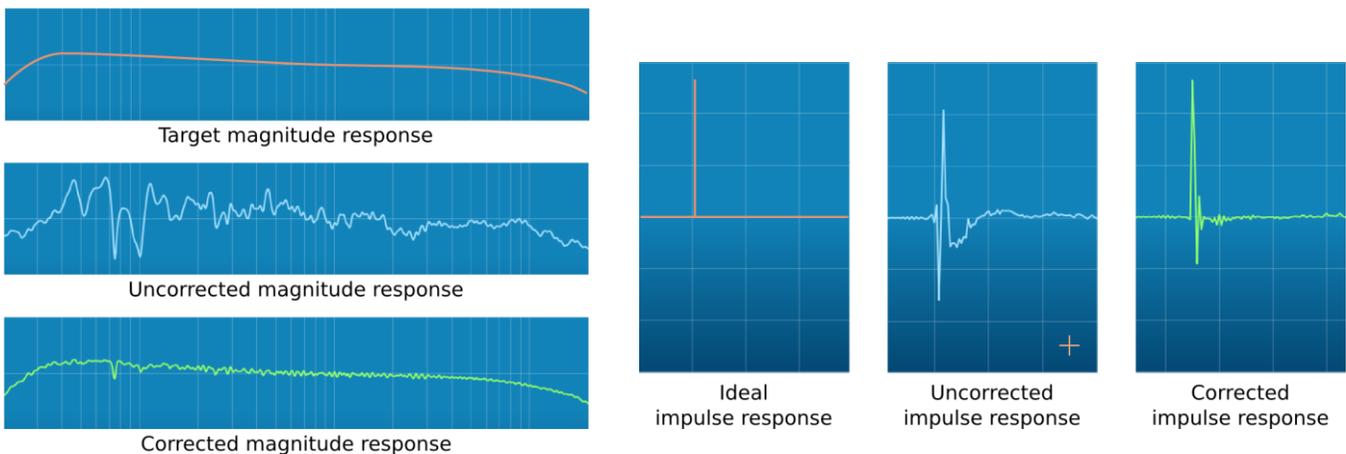
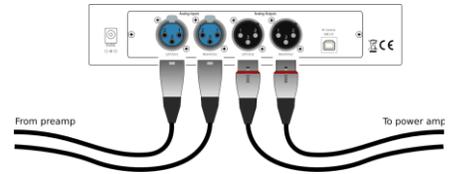


Illustration of Dirac Live[®] magnitude and impulse response correction

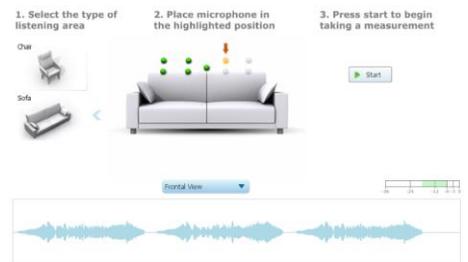
1.3 DIRAC SERIES / DIRAC LIVE[®] CONFIGURATION STEPS

The steps for configuring your *Dirac Series* audio processor with Dirac Live[®] are as follows:

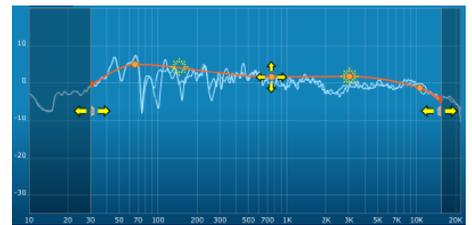
1. Connect the *Dirac Series* audio processor into your system and install software. See Section 2, [Hardware Connectivity](#) and Section 3, [Software Installation](#).



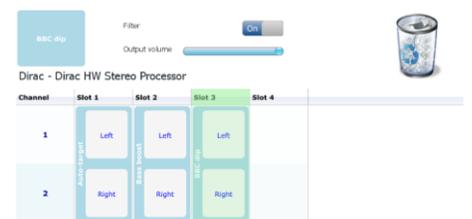
2. Run a series of acoustic measurements using the **Dirac Live Calibration Tool Stereo for miniDSP** program, to capture the acoustic behavior of your speakers and room. See Section 4, [Acoustic Measurement](#).



3. Generate digital room correction filters that will be executed by the *Dirac Series* processor. Up to four filter sets can be downloaded into the processor for easy real-time recall and auditioning. See Section 5, [Filter Design](#).



4. Once the digital room correction filters are designed and downloaded, the computer can be disconnected, as computer connectivity is not required for normal listening. See Section 6, [Using the Dirac Series Audio Processor](#).



2 HARDWARE CONNECTIVITY

All connections to the *Dirac Series* audio processors are made on the rear panel.

2.1 AUDIO INPUT AND OUTPUT CONNECTIONS

Digital inputs (DDRC-22D and DDRC-22DA)

Connect up to three digital sources: AES-EBU on XLR, S/PDIF on RCA, or optical (TOSLINK). These sources can be selected between by using the front panel or an infrared remote (not included). The digital inputs of the DDRC-22D and DDRC-22DA accept sample rates from 20 up to 216 kHz.

Note: the digital inputs accept a stereo PCM digital signal only. They do **not** accept encoded or multichannel digital audio (such as Dolby Digital or DTS).

Digital outputs (DDRC-22D)

Connect one of the digital outputs to your DAC or other device with a digital input. All digital outputs are simultaneously active, so multiple output connections can be made if necessary.

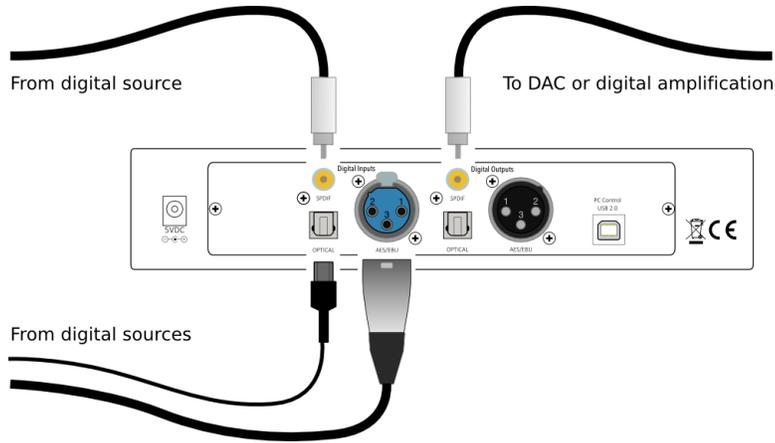
Note: the digital *outputs* of the DDRC-22D operate at 96 kHz sample rate. Any connected DAC must support this sample rate. (The digital inputs of the DDRC-22D and DDRC-22DA accept any sample rate up to 216 kHz.)

Analog inputs (DDRC-22A)

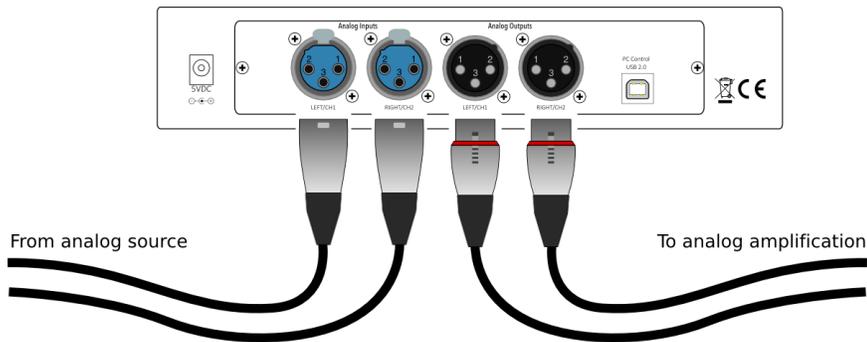
Connect the analog inputs to your preamp or other analog source. The inputs are balanced XLR connectors, so in the event that your other equipment has only single-ended (RCA) connections, use suitable RCA-XLR adapters or adapter cables.

Analog outputs (DDRC-22A and DDRC-22DA)

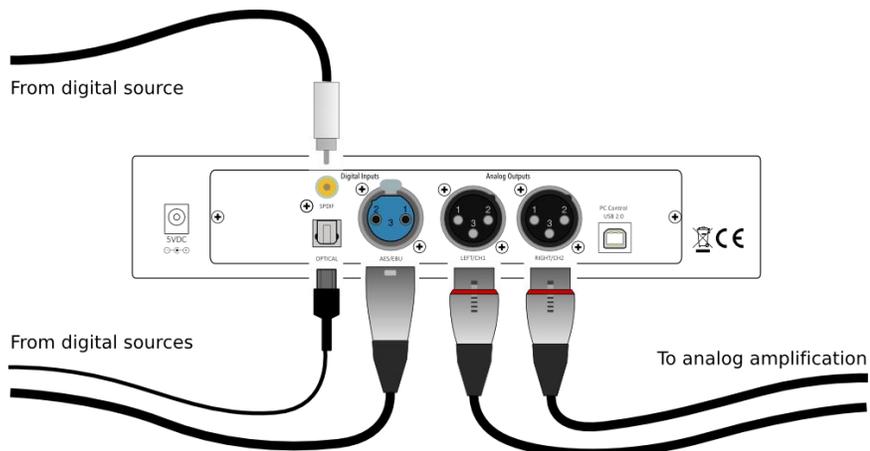
Connect the analog outputs directly to your amplification. The outputs are balanced XLR connectors, so in the event that your other equipment has only single-ended (RCA) connections, use suitable XLR-RCA adapters or adapter cables.



DDRC-22D connections



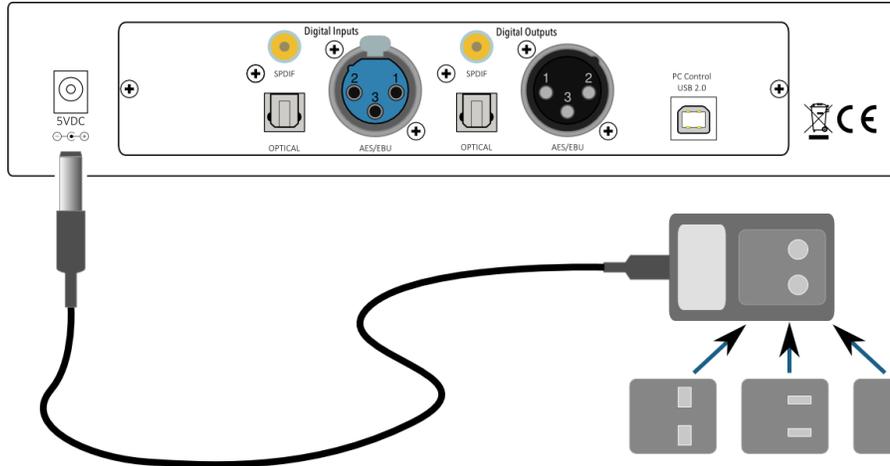
DDRC-22A connections



DDRC-22DA connections

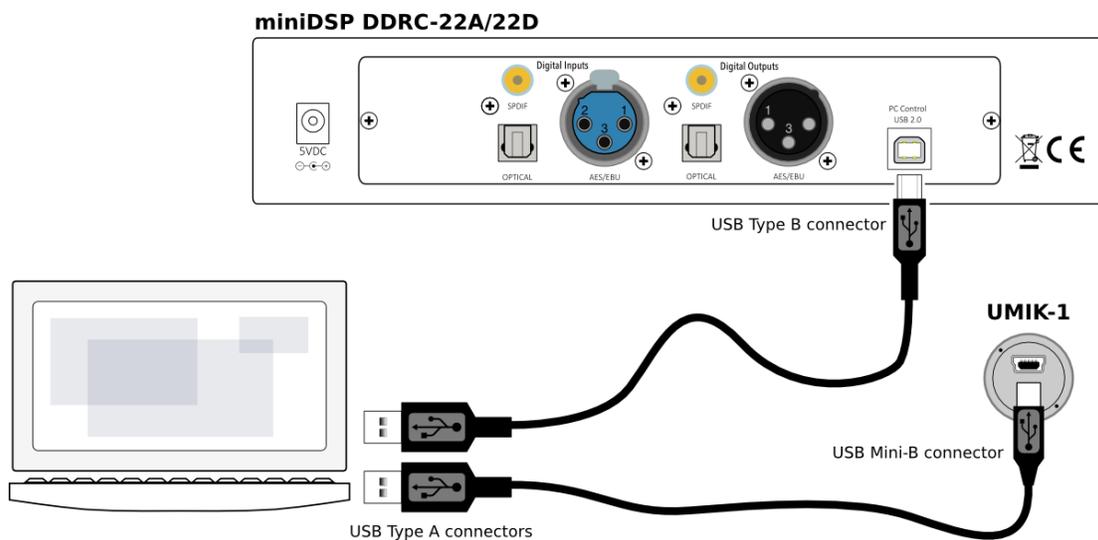
2.2 DC POWER

The supplied 5 VDC power supply includes a set of interchangeable power pins. Fit the correct pins for your country. Connect the DC plug to the 5 VDC power socket.



2.3 USB

Computer connectivity is required to perform acoustic measurements in your listening room and to generate and download the digital room correction filters to the *Dirac Series* processor. To configure the processor, connect the USB port of the processor to a USB 2.0 port on your computer using the supplied cable. For measurements, connect the UMIK-1 to a second USB port.



Once calibration and configuration is complete, the computer can be disconnected. The processor can then be controlled from the front panel or via remote control – see Section 6, [Using the Dirac Series Audio Processor](#).

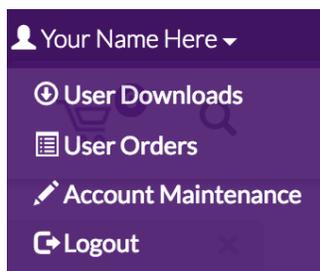
3 SOFTWARE INSTALLATION

If you purchased your product directly from miniDSP, your software will be available from the [User Downloads](#) section of the miniDSP website when your order ships. You will need to be logged into the website with the account you created when purchasing to access the download.

If you purchased your product from a miniDSP dealer, you will receive a coupon together with the product. Redeem this coupon and select the Plugin Group “Dirac Series” at the link below:

- <https://www.minidsp.com/support/redeem-coupon>

The User Downloads link is visible from the dropdown menu at the top right of the website page:



Navigate to the **Dirac Series** section and then to **DDRC-22 software**. There you will find the following zip files available for download:

DDRC-22 series configuration tool

This will install the **DDRC-22 Utility** program, used to configure remote control codes and perform various other maintenance operations on the processor. Download this file for both Windows and Mac.

Dirac Live Calibration Tools for DDRC-22 series

This will install **Dirac Live Calibration Tool for miniDSP**, which is used to perform measurements, generate correction filters, and load them into the processor. Download this file for both Windows and Mac.

After downloading, unzip the downloaded files (on Windows, right-click and select “Extract All...”; on Mac, double-click).

3.1 A NOTE ON DIRAC LIVE LICENSE ACTIVATION

As of version 1.2 of Dirac Live Calibration Tool, license activation is done automatically when DLCT recognizes a valid Dirac Live license code in the hardware unit itself. No separate manual activation step is required.

If you have previously used a miniDSP Dirac Live product and used the manual license activation process, be aware that this is no longer necessary. Note also that automatic license activation will apply to all miniDSP Dirac Live units in the field.

3.2 INSTALLATION — WINDOWS

3.2.1 Possible Windows installation issues

The miniDSP software requires that a number of other frameworks be installed for it to work. For Windows 7 and later, these packages should be installed automatically. For earlier versions of Windows, please download and install the following frameworks before attempting to install any miniDSP software. You can also manually install these if you receive an error message that required software is missing.

- [Microsoft .NET framework](#) (version 3.5 or later)
- Latest version of [Adobe Air](#)
- Microsoft Visual C++ 2010 Redistributable Package: for [x86](#) (32-bit operating system) or [x64](#) (64-bit operating system).

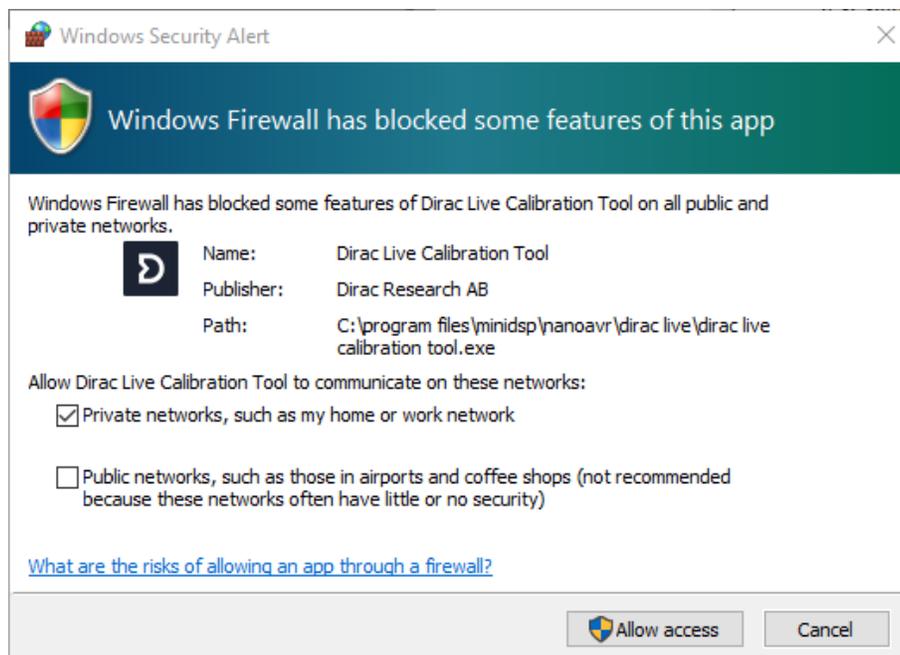
3.2.2 DDRC-22 Utility installation

1. Navigate to the **Windows** sub-folder of the unzipped utility program download.
2. Double-click on the **DDRC_22.exe** installer program to run it. We recommend that you accept the default installation settings.

3.2.3 DLCT installation

1. Navigate to the **Windows** sub-folder of the unzipped DLCT download.
2. Double-click on the installer program to run it. You may need to unzip it first (right-click, then select “Extract All”). The installer will have a name similar to **Dirac Live Calibration Tool for DDRC-2x v1.2.0.8344 Setup.exe** (the version number starting with v1.2... may be different). We recommend that you accept the default installation settings.

The first time you run DLCT, you may see a warning from Windows Firewall as shown below. If so, ensure that “Private networks...” is checked and “Public networks...” is not checked. Then click on “Allow access.”

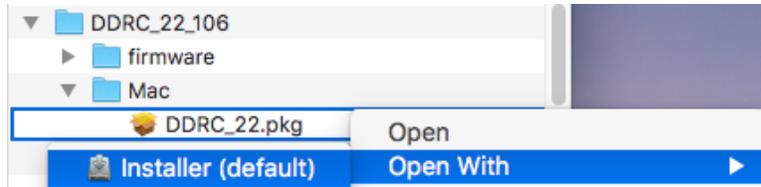


3.3 INSTALLATION — MAC OS X

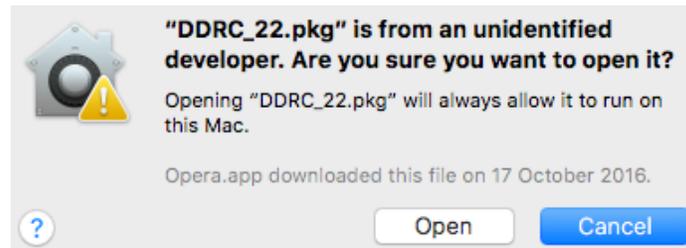
3.3.1 Possible Mac installation issues

If double-clicking on an installer brings up a message that the installer cannot run, use this alternate method:

1. Right-click on the installer (or click while holding the Control key).
2. On the menu that pops up, move the mouse over the “Open With” item and then click on “Installer (default).”



3. The following window will appear. Click on “Open.”



3.3.2 DDRC-22 Utility installation

1. Navigate to the **Mac** sub-folder of the unzipped utility program download.
2. The installer program is named **DDRC_22.pkg**. To run it, double-click on it, or right-click and open as described above. We recommend that you accept the default installation settings.
3. To run the DDRC-22 Utility, locate **DDRC-22.app** in the Applications -> miniDSP folder and double-click on it. To make it easier to run in future, right-click on its dock icon and select Options -> Keep in Dock.

3.3.3 DLCT installation

1. Navigate to the **Mac** sub-folder of the unzipped DLCT download.
2. The installer program will have a name similar to **Dirac Live Calibration Tool for DDRC-2x v1.2.0.8392.mpkg** (the version number starting with v1.2... may be different). To run it, double-click on it, or right-click and open as described above. You may need to double-click twice (the first time to unzip it, the second time to run it). We recommend that you accept the default installation settings.
3. To run DLCT, locate **Dirac Live Calibration Tool.app** in the Applications -> miniDSP folder and double-click on it. To make it easier to run in future, right-click on its dock icon and select Options -> Keep in Dock.

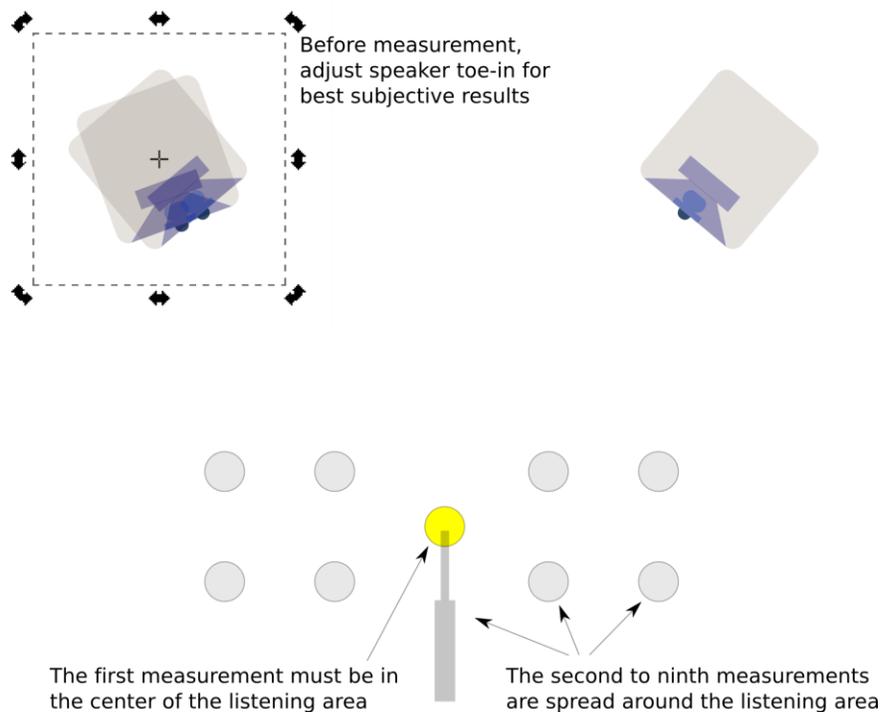
4 ACOUSTIC MEASUREMENT

The **Dirac Live Calibration Tool Stereo for miniDSP** uses a set of measurements made in your listening room to calculate correction filters for the left and right channels. The measurements are made using the *Dirac Series* audio processor and the supplied UMIK-1 measurement microphone. No additional hardware or connectivity is required.

4.1 LOUSPEAKER AND MICROPHONE POSITIONING

Prior to performing acoustic measurements, optimize your loudspeaker and listening positions. Start with the recommendations of the manufacturer of your loudspeakers. Loudspeakers designed for home hifi use typically perform best away from the walls, whereas speakers designed for studio use may be designed for use closer to walls or other surfaces. With Dirac Live®, you have more freedom with loudspeaker placement but the best result will still be achieved if optimal loudspeaker placement is used together with Dirac Live®.

You should also experiment with toe-in – many loudspeakers benefit from pointing directly at the listening position or even slightly in front. The listening position should be away from the rear wall, as placing the listening chair or sofa right against the wall will result in increased early reflections and changes in timbre.

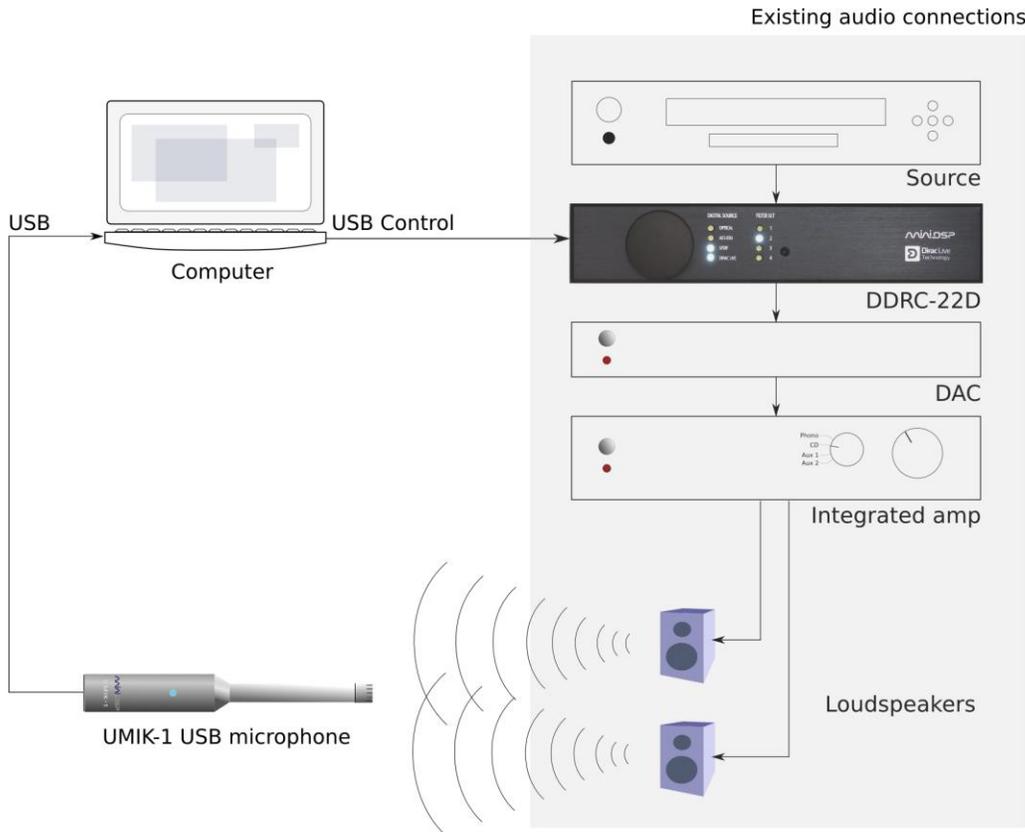


A total of nine measurements must be taken, with the microphone located in different positions in the room and pointed between the two speakers. The first measurement must be taken at the central location of the listening area, as this location sets the levels and delays of each speaker. While this location will usually be an equal distance from both speakers, Dirac Live® will adjust in cases where it is not. Eight more measurements are then taken at locations spread around the listening room and at different heights from the floor.

4.2 CONNECTIONS FOR ACOUSTIC MEASUREMENT

The figure below shows a typical connection diagram for performing acoustic measurement. (This example uses the DDRC-22D.) No changes to existing audio connections are needed. Simply:

1. Connect the supplied USB (type A to type B) cable from the processor to a USB port on the computer.
2. Connect the supplied USB (type A to mini type B) cable from the UMIK-1 to a USB port on the computer.



Place the UMIK-1 microphone into the microphone stand and point it between the speakers. Position the computer and cabling so that there is enough freedom of movement to move the microphone into the needed locations.

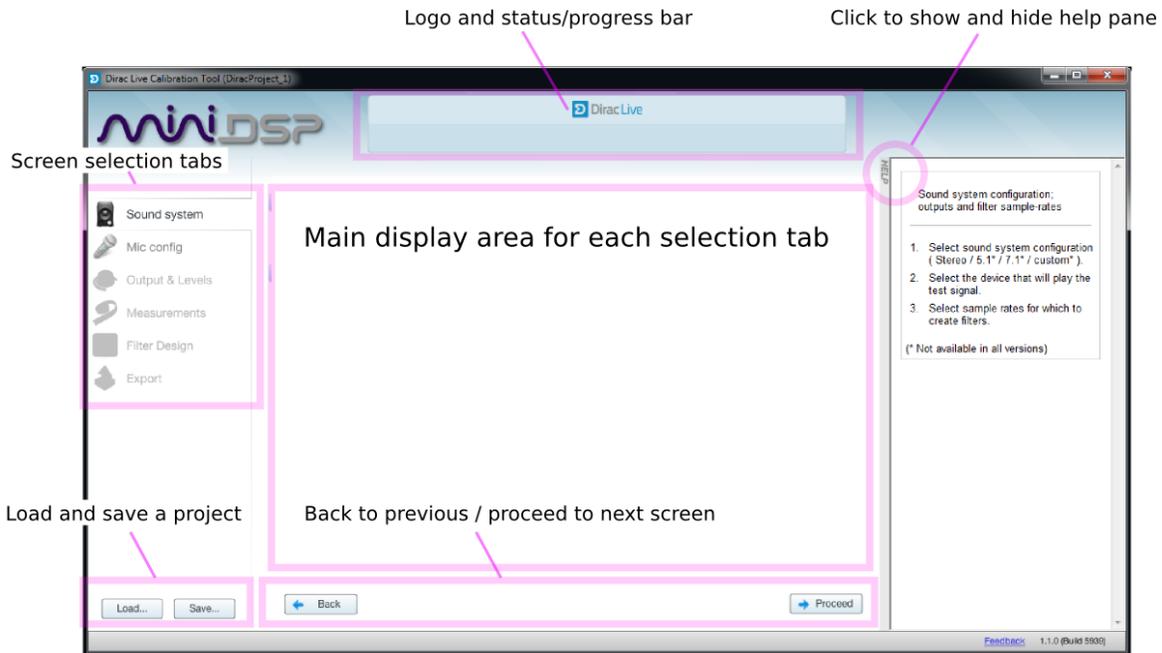


4.3 CONFIGURING FOR MEASUREMENT

Start **Dirac Live Calibration Tool Stereo for miniDSP** (if it is not already running).



Be sure to quit the **DDRC-2 Utility** program before starting **Dirac Live Calibration Tool for miniDSP**. Running the two programs at the same time may result in communication conflicts and odd behavior.



The main areas of the screen are:

Logo and status progress bar

This area shows a progress bar with current status when the program is performing calculations.

Screen selection tabs

Each tab selects a different step of the calibration process. These are generally worked through in order, from top to bottom. This section covers the first four tabs; the final two are covered in [Filter Design](#).

Load and save a project

Each measurement project can be saved to a file and reloaded at a later time. See [Saving and loading projects](#).

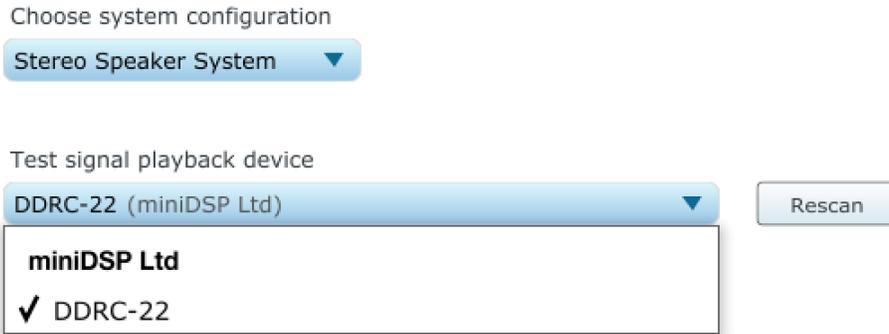
Back to previous / proceed to next

Use these two buttons to advance to the next tab when each is complete, or to go back to the previous tab to make alterations. The tabs at the left can also be clicked on directly.

Help open/close

Click on the small Help divider at the right of the screen to open a pane with help on the currently selected tab. Click on the divider again to close the help pane.

4.3.1 Sound System tab



The **Sound System** tab is preset for you, provided that you have your *Dirac Series* audio processor and UMIK-1 connected to the computer via USB.

Choose system configuration

Preset to **Stereo Speaker System**. This is the only configuration supported by stereo *Dirac Series* processors.

Test signal playback device

Preset to **DDRC-22 (miniDSP Ltd)**. This will ensure that test signals are sent into your audio system via the *Dirac Series* processor. (If this is not present, check that your processor is connected via USB and powered on, then click the **Rescan** button.)

Once you have verified that this tab is correct, click the **Proceed** button.

4.3.2 Mic Config tab



On the **Mic Config** tab, set the following parameters.

Recording device

Preset to the **UMIK-1**. (If this is not present, ensure that the UMIK-1 is connected securely to the computer via USB, then go back to the **Sound System** tab and click on **Rescan**. Then select the “Microphone” item underneath “UMIK-1”, as shown at right.)



Recording channel

Select **1** from the drop-down menu.

Microphone calibration file

Each UMIK-1 measurement microphone is individually calibrated to ensure accuracy. To download the unique calibration file for your microphone, go to the [UMIK-1 page](#) and enter your microphone's serial number. It is in the form xxx-yyyy and labelled on the microphone.

Then click on the **Load File** button and select the regular or “on axis” calibration file. Usually, it will be saved to the computer with a name that is the same as the serial number e.g. “7001870.txt”. (Do not use the calibration file with “_90deg” in the name e.g. “7001870_90deg.txt” unless you are pointing the microphone at the ceiling.)

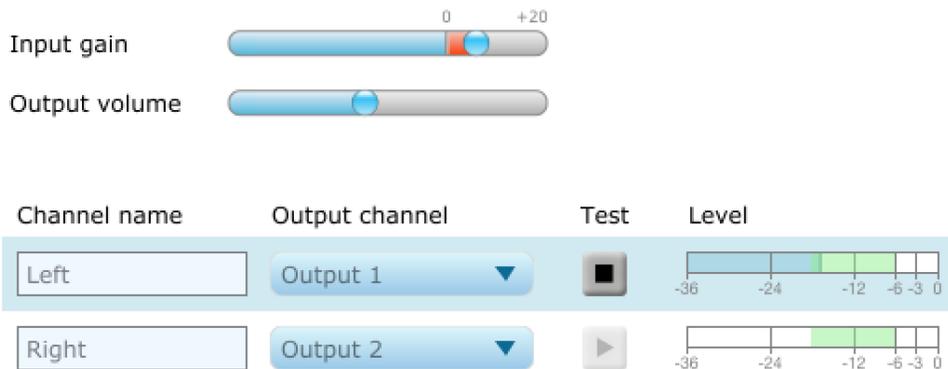
Once you have verified that this tab is correct, click the **Proceed** button.

4.3.3 Output & Levels tab

On the **Output & Levels** tab, set **Output volume** quite low. If you have another volume control “down-stream” of the DDRC, set it about halfway (or -20 dB if digital) and increase it later if needed.

Click on the **Test** button for the left channel and gradually increase the output volume until it is at a moderate level, such that your voice would have to be raised to converse with someone sitting next to you.

Now increase the **Input gain** slider until the blue bar on the level meter reaches up into the green section, as shown below.



Click again on the **Test** button for the left channel to stop the test signal. Then click on the **Test** button for the right channel. If necessary, adjust **Input gain** or **Output volume** so that both channels are in the green.

When done, click the **Proceed** button.

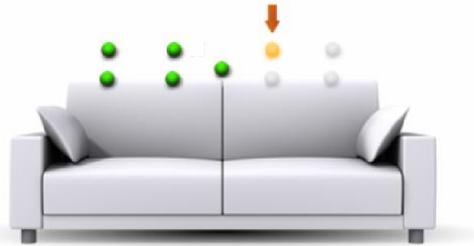
4.4 RUNNING THE MEASUREMENTS

Measurements are performed on the **Measurements** tab.

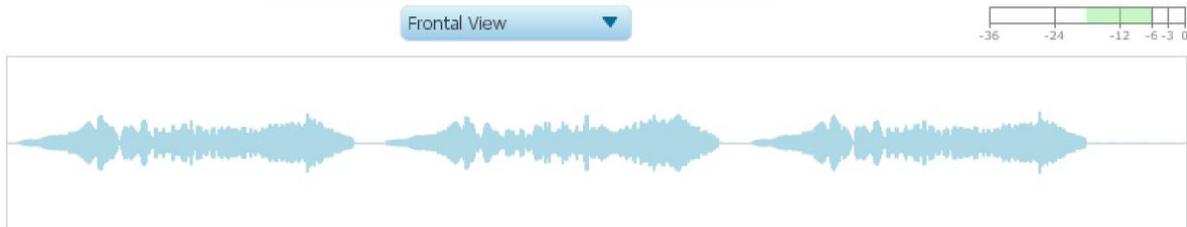
1. Select the type of listening area



2. Place microphone in the highlighted position



3. Press start to begin taking a measurement

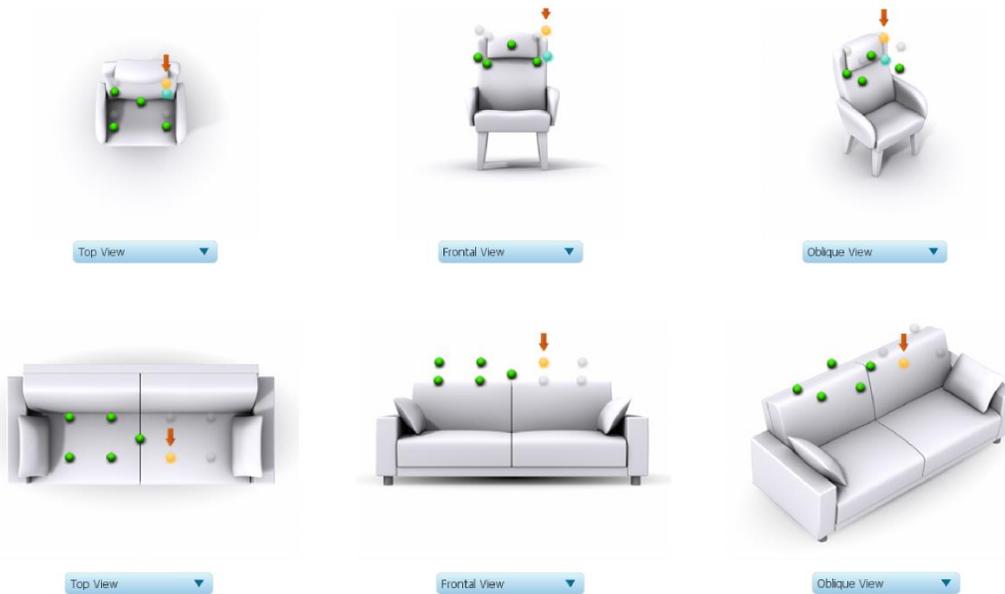


Measurements should be performed under good conditions. While the measurement technique used by Dirac Live is quite robust, low-frequency noise (traffic, machinery, aircraft, storms) in particular can adversely affect measurement accuracy. A high level of ambient noise can degrade signal to noise ratio and prevent the algorithm from analyzing the test sweep signal properly. Minimize the effect of any external noise, ensure that measurement signal levels are adequate, and/or choose a suitable time for performing measurements.

4.4.1 Listening environment

The **Dirac Live Calibration Tool Stereo for miniDSP** presents two different listening environments as a visual guide to positioning the microphone for each measurement: **Chair**, for a single listening seat, and **Sofa**, for multiple listening seats. Select a listening environment by clicking on the chosen icon.

The center of the screen contains a pictorial representation of the selected listening environment, with dots marking the microphone locations. Completed measurements are shown in green, while the next measurement to be done is highlighted in yellow and has a red arrow marker pointing to it. A drop-down menu underneath selects three different views, which should be used to help you place the microphone in the correct location.



While the visual guide indicates a suitable set of microphone locations, these locations can be varied to suit individual circumstances. It is, however, imperative that the first measurement is taken in the center of the listening area, as this measurement is used to set the levels and delays of each channel. The subsequent eight measurements should be well spread out over the entire listening area so that Dirac Live can acquire a good set of measurements that capture the acoustic behavior of the room. Placing all microphone locations too close to each other may result in “over-correction” that will sound dry and dull.

For example, if using the **Chair** listening area, spread the microphone positions over a circle with a diameter of at least a meter (three feet). The microphone should be varied in height from the central position by at least 30 cm (one foot) up and down. If using the **Sofa** listening environment, spread the measurement locations over the full listening area and vary the height up and down by at least 30 cm (one foot).

A different set of locations other than those indicated by the visual guide and the above guidelines can be used if necessary. The important thing is to ensure that the measurement locations are spread out over the whole listening area and that the microphone is moved a sufficient distance vertically as well as horizontally.

In some cases, such as when the listening area is very close to the loudspeakers or the loudspeakers have a very narrow dispersion pattern, the size and in particular the height of the measurement area can be reduced, to avoid discrepancies caused by varying output response from the speakers themselves.

4.4.2 Executing measurements

With the microphone in place at the central location and pointed between the two speakers, click on the **Start** button. The *Dirac Series* audio processor will generate a test signal, audible as a frequency sweep through the left speaker, then the right, and then the left again. While the measurement proceeds, the time-domain graph of the captured audio signal is displayed at the bottom of the measurement tab. (This graph is related to the magnitude response but is not the same display. Its purpose is to verify that the recorded signal level is in a suitable range.)



At the completion of the measurement, the status bar will update with a progress indicator as the program performs calculations on the measurement. If the measurement was successfully captured, the red arrow marker will advance to the next location to be measured.

If the program indicates that the measurement was not successful, you will need to take corrective action. The most common error is related to signal level:

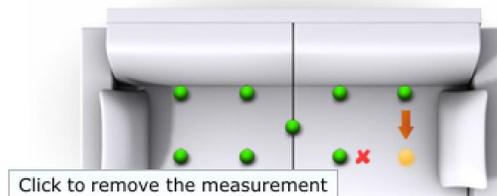
- The measurement signal is too low to ensure a clean capture.
- The measurement signal is too high and the audio signal has exceeded the maximum level (clipping). This is shown in red on the signal graph.

In either of the above cases, go back to the **Output & Levels** tab and adjust **Output volume** or **Input gain**. Then re-run the measurement. (You do not need to redo the measurements you have already successfully completed.)

4.4.3 Viewing and redoing measurements

Click on the green dot for any completed measurement to display its measured time-domain response graph.

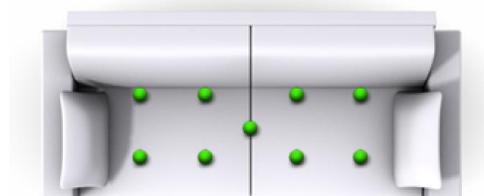
After clicking on a green dot, a small red “X” will appear next it. Click on the “X” to delete the measurement. The status bar will indicate that the program is recalculating parameters.



To redo a measurement, delete it, move the microphone to the appropriate location, and click on **Start**. Note: if more than one measurement is deleted, the marker will move to the lowest-numbered one.

4.4.4 Completing the measurements

After each successful measurement, the location marker (red arrow) will advance to the next location. Move the microphone to that location, using the three views (top, front, oblique) as a guide to positioning it in the correct location. Then click on **Start** again. Repeat this process until all nine locations have been successfully measured.



Note that it is good practice to save the project periodically while performing measurements (see [Saving and loading projects](#)). Once all nine measurements have been completed, you can advance to the **Filter Design** tab by clicking on the **Proceed** button or directly on the **Filter Design** tab at the left.



It is important that all nine measurements are completed in order to ensure best results from the optimization algorithm. Being patient and thorough will pay audible dividends!

4.5 SAVING AND LOADING PROJECTS

Each set of measurements and the associated configuration settings are a single *project*. The project should be saved at regular intervals. This is done by clicking on the **Save** button. The default location for project files is **My Documents\MiniDSP\Projects** (Windows) or **Documents/MiniDSP/Projects** (Mac).

A project can be reloaded at any time by clicking on the **Load** button. This enables you to generate new correction filters for different target curves at a later date (see [Filter Design](#)), or to redo any of the measurements. (Note: if you wish to change from the **Chair** to the **Sofa** listening environment, or vice versa, you will need to start a new project.)

5 FILTER DESIGN

Once the full set of measurements has successfully been taken, **Dirac Live Calibration Tool Stereo for miniDSP** has the acoustical information it needs about your loudspeakers and listening room to create the correction filters.

5.1 WORKING WITH GRAPHS

The **Filter Design** tab shows a number of plots that can individually be turned on and off with the checkboxes near the top of the screen.



Avg. spectrum (before)

The average of the measured magnitude responses. These plots are shown in light blue.

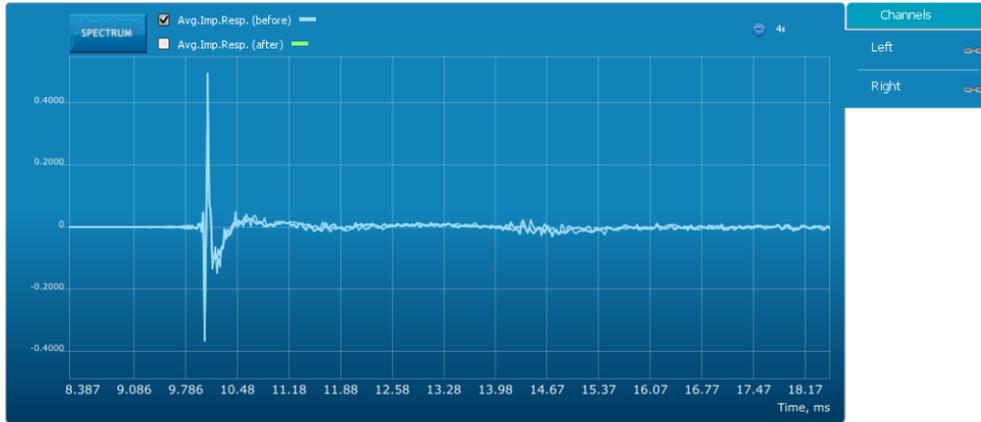
Avg. spectrum (after)

The predicted average magnitude response after correction. These plots are shown in green, and can only be viewed after filters have been generated with the **Optimize** button.

Target

The target curve – that is, the desired in-room magnitude response. This curve is user-adjustable so you can fine-tune it to best suit your speakers, room, and preferences. See [Designing your target curve](#).

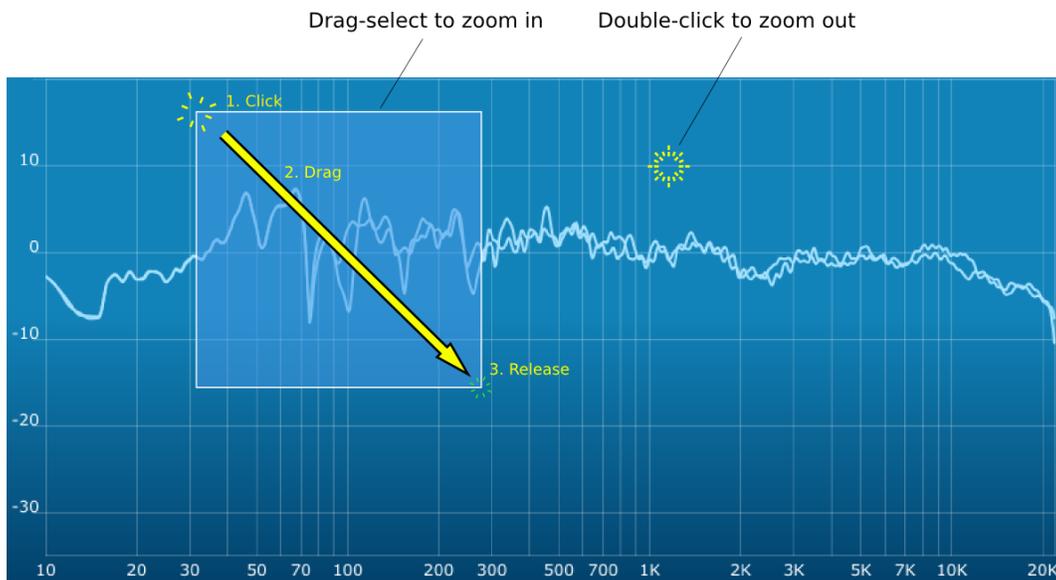
To display the impulse response instead of the magnitude response, click on the **Impulse** button at the top left of the display. There are two graphs that can be turned on and off with the checkboxes at the top: the measured impulse response (shown in light blue), and the predicted impulse response after correction (shown in light green).



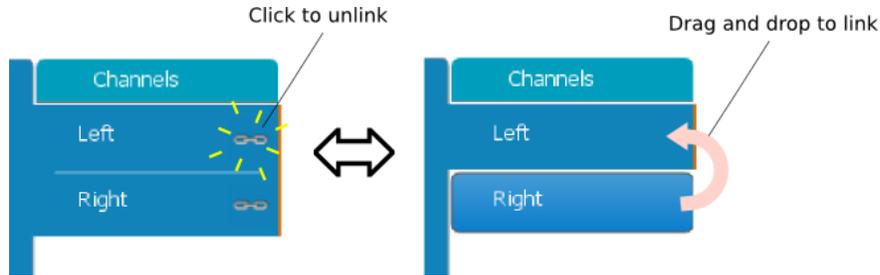
To return to the magnitude response, click on the **Spectrum** button.

The magnitude and impulse response graphs can be viewed at a larger scale. To zoom in and out on the response graphs:

- Drag-select a region of the graph to zoom in on it. (Click the left button, move the mouse while holding the button, release the button.) You can then drag-select a region again to zoom in further.
- Double-click on the graph to zoom back out to the previous zoom level, or click on the small “-” sign next to the zoom indicator at the top right of the display.



By default, graphs of both left and right channels are shown together. The left and right channels can be unlinked by clicking on the small “chain” icon next to the channel name, at the right of the graphs. Then the graphs of each channel can be viewed separately, by click on the “Left” or “Right” tab. To relink the two channels, drag the “disconnected” channel tab over the top of the selected channel.

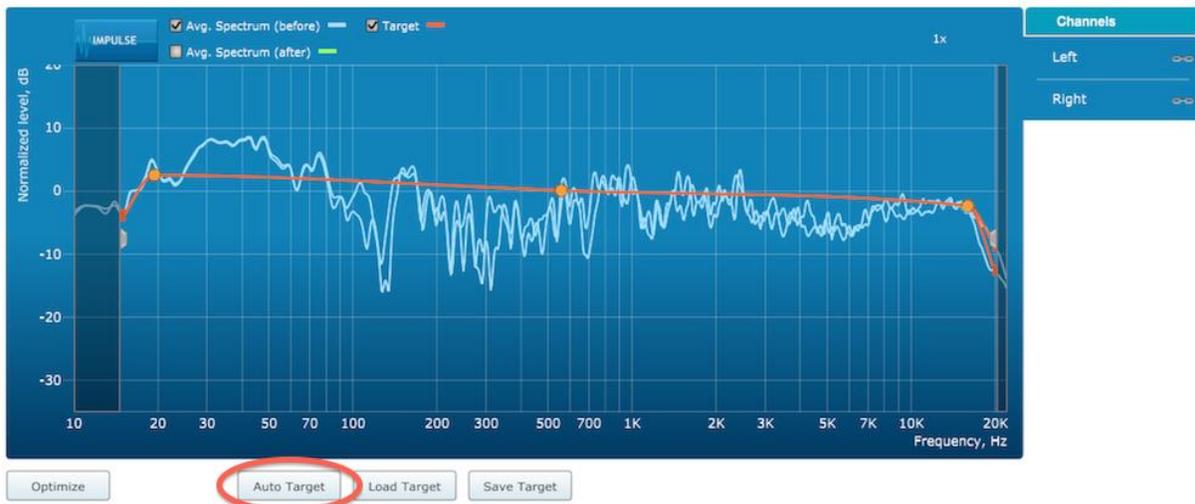


5.2 DESIGNING YOUR TARGET CURVE

The *target curve* is the desired in-room frequency response with the *Dirac Series* processor performing digital room correction.

5.2.1 The Auto Target

When first viewing the **Filter Design** tab, an estimated target curve suitable for your speakers is shown as the red curve. This calculated target curve can be restored at any time by clicking on the **Auto Target** button.



Note: restoring the auto target will erase the current target curve. If you wish to keep it, you can save it to a file – see [Saving and loading target curves](#).

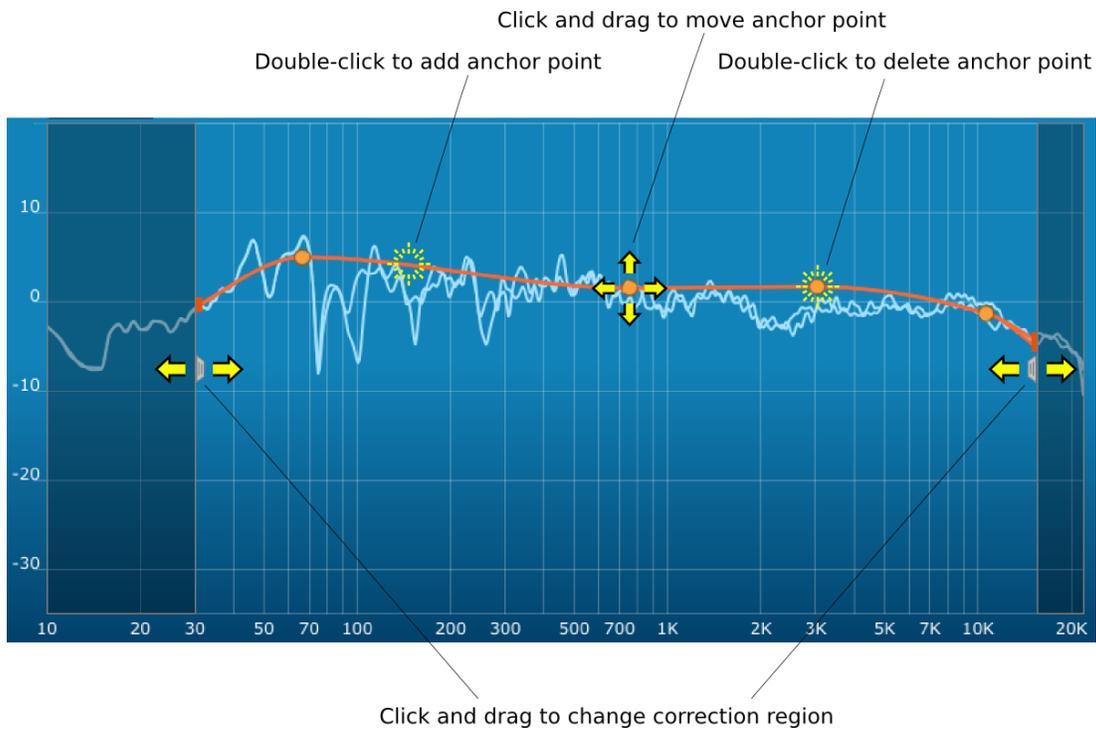
5.2.2 Editing the target curve

You can edit the target curve to set any desired magnitude response (see [Guidelines for target curve design](#)). This is done with the use of *anchor points*, shown as orange dots on the curve:

- Drag an anchor point to move it.
- Double-click on the target curve to add an anchor point.
- Double-click on an anchor point to delete it.

The regions to the left and right of the response graphs that are shaded in a darker color are excluded from correction. You can adjust the range of frequency correction for your system and environment. For example, low-frequency noise (traffic, machinery) may be present in some environments, so it is best to adjust the frequency range to exclude these frequencies from the correction. Or, you may be happy with the in-room response at higher frequencies, so you can set the frequency region to limit correction to the modal region (up to 300 Hz, in a typical room).

To alter the frequency region, drag the grey handles on either side of the graph. Note that you can't drag these handles over an anchor point, so you may need to move or delete an anchor point that is "in the way."



If the left and right channels are linked, the same target curve is used for both channels. To create separate target curves for the left and right channels, unlink the two channels as described in [Working with graphs](#).

5.2.3 Guidelines for target curve design

Care should be taken to create a target curve that works well with your speakers and room, as well as suiting your personal preferences. Small changes to the target curve can have significant effects on the tonal quality of the system, so it is important that you experiment with different target curves to find the optimum.

If you initially don't achieve a satisfactory result, please ensure that you have spread your measurements over a sufficiently large area and with sufficient variation in height. The following guidelines will help you understand how to adjust your target curve.

Low-frequency extension and boost

All loudspeakers have a natural low-frequency roll off. Setting the target curve to boost the region below the speaker's natural roll off frequency *may* result in overdriving the speakers, especially with smaller home loudspeakers and depending on your listening habits. A system with capable subwoofers integrated into it, however, will support much more low-frequency output.

The auto-target estimates the low-frequency roll-off and curve, and in some cases may include some amount of boost if it estimates that the speakers are capable of handling it. You should determine by *listening* whether this estimate is suitable for your speakers, and adjust the target curve accordingly.

High-frequency "tilt"

The target curve is the desired measured response of loudspeakers *in a room*, in contrast to measurements made of a loudspeaker during its design under anechoic (measured in free space) conditions. While high-quality loudspeakers are usually designed for a flat on-axis anechoic response, these same speakers when placed into a listening room will tend to have a downward-sloping or "tilting" response at high frequencies, due to the effects of limited dispersion at high frequencies and greater acoustic absorption.

A completely flat in-room response is therefore usually not desirable and will tend to sound thin or bright. Start with a target curve that follows the natural behavior of your speakers in your room, and then experiment with greater or lesser degrees of tilt in the treble region to obtain the most natural timbral balance.

Low-frequency adjustment

A completely flat response at low frequencies, with complete elimination of peaks due to room modes, may sound light in the bass. Often, a slight increase in the target curve below 100 Hz will give a more balanced sound, yet without introducing audible irregularities in bass response.

Magnitude response dips

In some cases, it may be helpful to adjust the target curve to follow dips in the magnitude response. This can occur where, for example, the listening area is very close to the speakers and the measurements exhibit a dip caused by the vertical response of the speakers themselves. In such a case, adjusting the magnitude response to follow the dip will avoid making the speakers sound worse elsewhere in the room. (You may also wish to try a different set of measurement locations.)

Unlinking channels

In almost all cases, the left and right channels should remain linked for target curve adjustment, to ensure that both speakers produce the same response across the listening area. In certain unusual circumstances, such as where the magnitude response dip discussed in the previous point shows up in only one speaker, you can try unlinking the left and right channels and making separate adjustments.

5.2.4 Saving and loading target curves

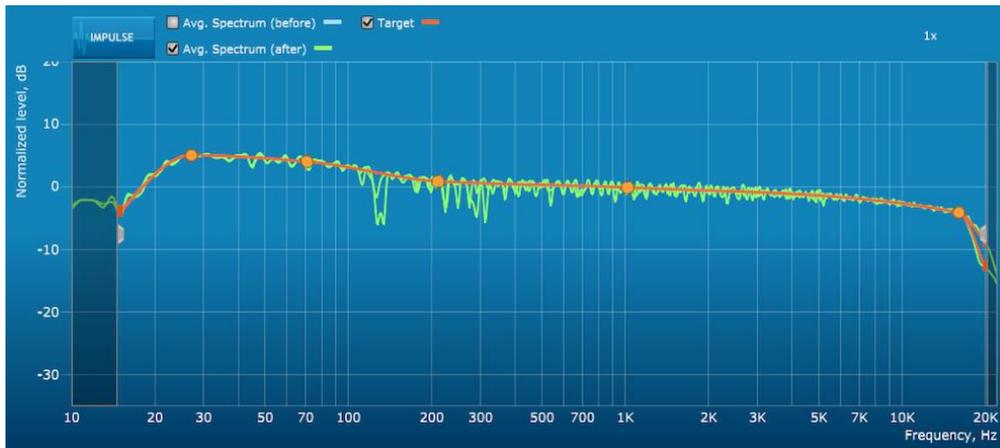
To allow you to experiment with different target curves, you can save a target curve to a file and reload it at a later time. To save a target curve, click on the **Save Target** button. If the left and right channels are linked, then the shared target curve will be saved to the file. If the channels are not linked, then the currently visible target is saved to the file.

To load a target curve, click on **Load Target**. Note that loading a target will erase the current target, so be sure to save it first if needed. If the channels are linked, then the target curve will be loaded to both channels. If the channels are not linked, then the target will be loaded to the currently visible channel.

5.3 GENERATING CORRECTION FILTERS

Once you have a target curve set to your satisfaction, click on the **Optimize** button. The **Dirac Live Calibration Tool Stereo for miniDSP** may at this time contact the Dirac license server to verify its license, so you will need to be connected to the Internet. If a firewall is in place, it must allow HTTP (normal web traffic) to pass.

The status bar will update with progress of the algorithm. Execution may take some time, depending on the speed of your computer. When the algorithm completes, the predicted average magnitude response will be shown in green. (The predicted impulse response can be viewed by clicking on the **Impulse** button.)



To download the generated filters into the *Dirac Series* audio processor, click the **Proceed** button or on the **Export** tab on the left.

5.4 LOADING FILTER SETS

The **Export** tab initially shows four empty “slots” for filter sets (a filter set is one filter for the left channel and one filter for the right channel). Filter sets are managed with a “drag and drop” metaphor:

- To load the most recently generated filter set into the processor, drag the box at the top left (labeled “More Bass” in the example) and drop it onto an empty slot.
- To remove a filter set, click on its name (oriented vertically), drag it from the slot and drop it on the trashcan icon at the top right.
- To load a filter set into a slot that already has filters loaded, first delete the loaded filter set by dragging it onto the trashcan icon. Then drag and drop the current filter set onto the now-empty slot.

The name displayed on the filter slot after dragging and dropping is the name of the project. This example shows three slots loaded:

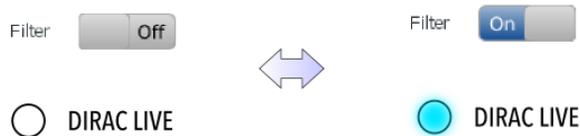
The screenshot shows the software interface with a 'More bass' filter set box, a 'Filter' toggle set to 'On', and an 'Output volume' slider. Below these is a trash can icon and the text 'miniDSP Ltd - DDRC-22'. A table below shows the filter sets loaded in the processor:

Channel	Slot 1	Slot 2	Slot 3	Slot 4
1	nine measure... Left	Single point... Left	More bass Left	
2	Right	Right	Right	

The two additional controls on this tab are:

Filter

Turn this on to enable the Dirac Live® correction filters. The indicator on the front panel of your *Dirac Series* processor will light when filtering is enabled.



Output volume

Adjust the slider to adjust the output volume of the processor. Once the computer is disconnected, output volume can also be adjusted from the front panel or by remote control.

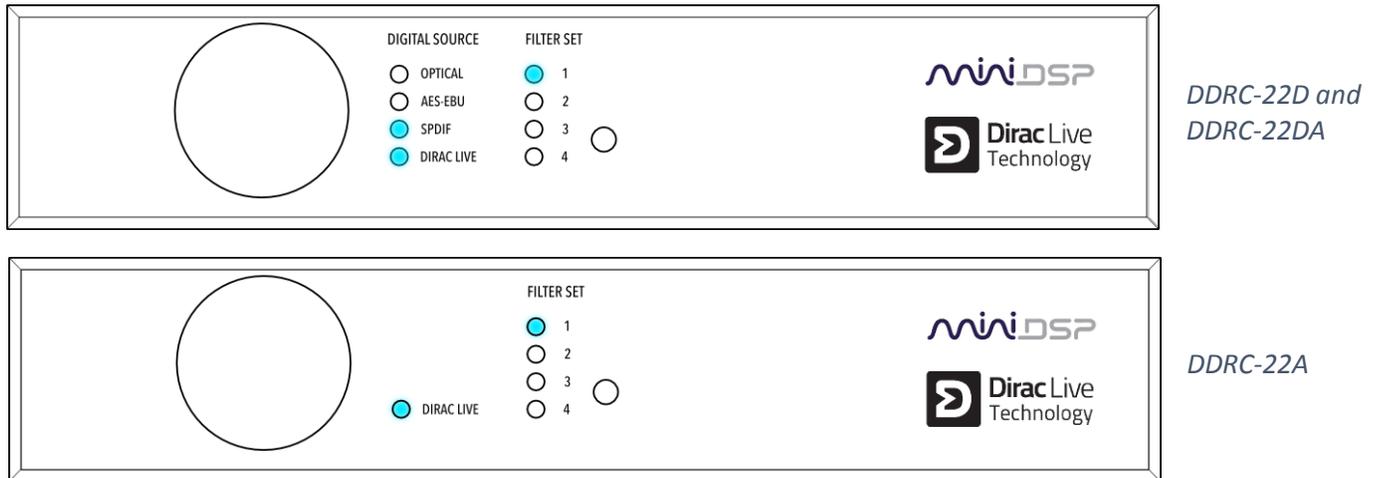


There are two ways of generating different filter sets to load into the processor:

- Return to the **Filter Design** tab, change your target curve, and click on **Optimize** again. Then proceed to the **Export** tab and drag and drop the new filter set onto an empty slot.
- Load another project. Its most recently generated filter set can then be dropped onto an empty slot.

6 USING THE DIRAC SERIES AUDIO PROCESSOR

Once the desired correction filters have been downloaded into the *Dirac Series* audio processor, the computer is not required and can be disconnected. The front panel and/or an infrared remote can be used to control master volume, preset selection, mute (remote only), input source (DDRC-22D and DDRC-22DA), and Dirac Live filtering.



6.1 STATUS INDICATORS

The current status of the processor is indicated by a set of LEDs:

- Filter Set** Indicates the currently selected filter set (1 through 4).
- Digital Source** Indicates the currently selected digital input (DDRC-22D and DDRC-22DA only).
- Dirac Live** Indicates that Dirac Live® filtering is turned on.

6.2 FRONT PANEL CONTROLS

The *Dirac Series* audio processors use a minimalist physical control design with a single control knob.

To change the volume

Rotate the control knob clockwise to increase the volume, and counter-clockwise to decrease it.

To change the selected filter set

Briefly press the control knob. The **Filter Set** LED blinks quickly. Rotate the control knob until the desired filter set LED is blinking. Press the control knob again, and the selected LED will remain steady. (For the DDRC-22D and DDRC-22DA, this will advance to digital input selection.)

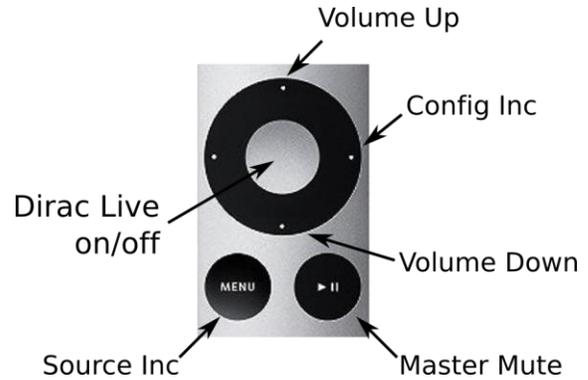
To change the selected digital input (DDRC-22D and DDRC-22DA only)

Briefly press the control button twice. The **Digital Source** LED blinks quickly. Rotate the control knob until the desired source LED is blinking. Press the control knob again, and the selected LED will remain steady.

6.3 INFRARED REMOTE CONTROL

Many standard and programmable remote control units can be used with the *Dirac Series* processor. By default, the processor recognizes the Apple Remote, with the key assignments shown at right.

(The commands **Config Inc** and **Source Inc** cycle through the presets and input sources. For example, if the currently selected preset is **1**, pressing **Config Inc** changes it to **2**. Note that switching between presets takes a few seconds.)



In addition, the processor can “learn” the control codes of your current remote if it supports one of the following remote control codes:

- NEC
- Sony
- Philips RC6

To initiate the learning process, run the DDRC-22 utility and click **Connect**. Click on the **Learn** button for an operation, and then press the desired button on the remote control. If the code is accepted, a dialog will appear to show that the code was recognized the status will change to show a tick. If the processor does not recognize the remote control code, then it will time out and display a message saying that IR learning failed.

Once programmed, check that the programmed buttons perform the expected function.



- To “unlearn” a command, press the **Learn** button and wait for the plugin to time out.
- To restore the default Apple remote commands, “unlearn” those commands.

7 ADDITIONAL INFORMATION

7.1 THE DDRC-22 UTILITY PROGRAM

The **DDRC-22 Utility** program is used to configure certain functions of the *Dirac Series* processors. It is not used for measurement or calibration.

Master volume

Displays the current master volume setting. Click and type here to change the master volume.

Mute

Mutes all audio output.

Connect/Connected

Click on the **Connect** icon to connect to the *Dirac Series* processor. To disconnect, quit from the **DDRC-22 Utility**.



You will need to connect to the processor with this button in order to use most of the functionality of this utility.

Attenuation

By default, the DDRC-22 introduces 10 dB of attenuation in order to provide headroom for the EQ boost that Dirac Live may introduce. If this is too much attenuation, you can change it with the dropdown menu.

(Please Select)
(Please Select)
0 dB
-3 dB
-6 dB
-10 dB

Refresh DSP Program

Updates the internal DSP program with the version contained in the **DDRC-22 Utility**. Use this after installing a new version of **DDRC-22 Utility**.

Restore All to Default

Clears all four loaded filter presets.

About

Provides the current version of DSP firmware.

Upgrade Firmware

Starts the MCU firmware upgrade process. See [MCU firmware upgrade](#) on page 37.

IR Learning

Buttons used to learn infrared remote control codes. See [Infrared remote control](#) on page 34.



Be sure to quit **Dirac Live Calibration Tool For miniDSP** before starting the **DDRC-22 Utility** program. Running both programs at the same time may result in communication conflicts and odd behavior.





7.2 SPECIFICATIONS

Computer connectivity	Driverless USB 2.0 control interface for Windows
Digital Audio Inputs (DDRC-22D and DDRC-22DA)	<p>Digital audio source selectable from IR remote or front panel:</p> <ul style="list-style-type: none">• AES-EBU on Neutrik 3-pin female XLR / Isolated with digital audio transformer• SPDIF on RCA connector / Isolated with digital audio transformer• Toslink on Optical connector <p>The input signal is processed by a high quality onboard Asynchronous Sample Rate Converter for compatibility with most common sample rates (20-216kHz)</p>
Digital Audio Outputs (DDRC-22D)	<p>Processed digital audio is available on all three outputs:</p> <ul style="list-style-type: none">• AES-EBU on Neutrik 3-pin male XLR / Isolated with digital audio transformer• SPDIF on RCA connector / Isolated with digital audio transformer• Toslink on Optical connector <p>Digital audio is always output at a sample rate of 96 kHz.</p>
Analog Audio Inputs (DDRC-22A)	Balanced audio inputs on XLR Neutrik connector; ADC SNR: 114 dB; maximum input signal level: 2 VRMS or 8 VRMS (jumper-selectable); input impedance: 47 k Ω .
Analog Audio Outputs (DDRC-22A and DDRC-22DA)	Balanced Audio outputs on XLR Neutrik connector; DAC SNR: 114 dB; maximum output signal level: 2 VRMS; output impedance: 1.12k Ω (560 Ω each signal pin).
Audio sample rate / Resolution	<p>Input/output resolution: 24-bit integer</p> <p>DSP internal processing path: 96 kHz</p>
Audio processing	32-bit floating-point processor
Storage/Presets	4 filter sets stored, selectable from front panel or IR remote
Infrared remote	<p>“Learning remote” capabilities (NEC, Philips, Sony, Apple)</p> <p>Controls master volume, mute, digital input selection, filter set selection, Dirac Live® filtering on/off</p>
Power supply	5 VDC single supply @ 600mA, 2.1 mm center-positive
Dimensions (H x W x D)	41.5 x 214.5 x 206 mm

7.3 MCU FIRMWARE UPGRADE

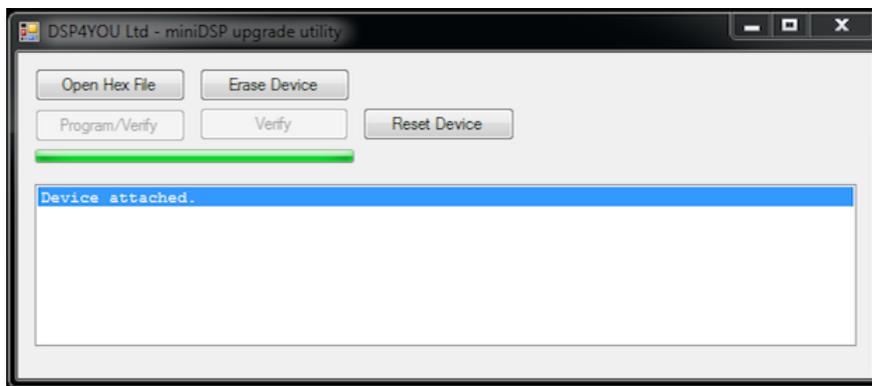
miniDSP may occasionally provide an update to the *Dirac Series* processor MCU firmware to enable new features. To update the MCU firmware, first download **and install** the latest version of the **DDRC-22 Utility** program from the **User Downloads** section of the miniDSP website. Then follow the instructions below for your platform.



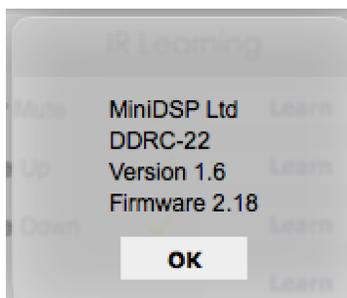
DO NOT DISCONNECT THE USB CABLE OR POWER FROM THE DIRAC SERIES PROCESSOR WHILE FIRMWARE UPDATE IS IN PROGRESS. DOING SO MAY “BRICK” YOUR PROCESSOR.

7.3.1 Windows

1. Connect the processor to your computer via USB (if not already connected) and power it on.
2. Start the **DDRC-22 utility** program.
3. Click on the **Connect** button. The button will display a green tick if connection is successful.
4. Click on the **Upgrade Firmware** button. The *Dirac Series* processor will be put into boot loader mode and the miniDSP upgrade utility will start. The status line should display “Device attached”.

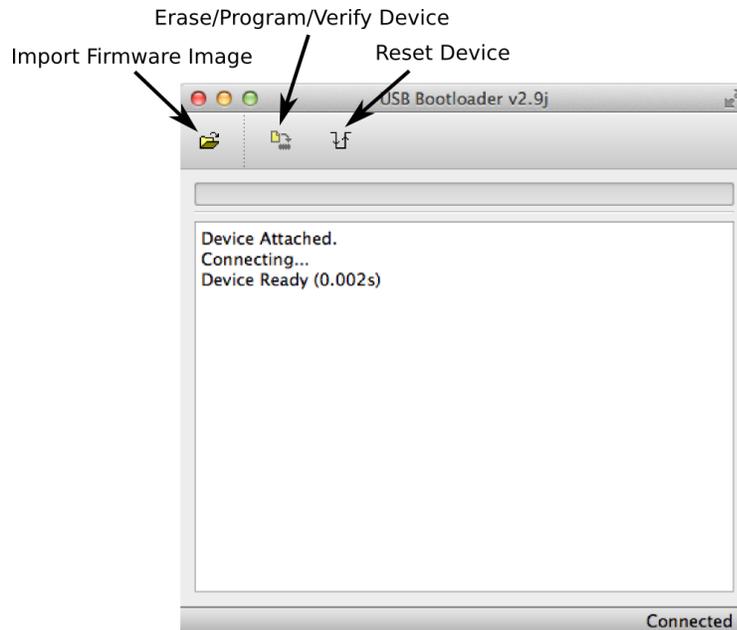


5. Click on the **Open Hex File** button and select the .hex file located in the **firmware** folder of the download. It will have a name like **ENC_DDRC22_Ver2.18_SS.hex**.
6. Click on the **Program/Verify** button. The status bar will indicate progress. **Do not disconnect the USB cable or remove power** from the processor while this runs!
7. After the status indicates that the verify has completed successfully, click on the **Reset Device** button, and then quit the upgrade utility.
8. Return to the **DDRC-22 Utility** program. (If there is a dialog informing "Connection to DSP closed," click on **OK**.) Click on the **Connect** button, and then on **About** to verify the new firmware version.

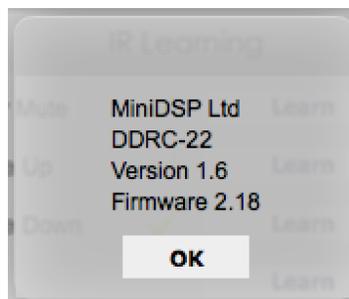


7.3.2 Mac OS X

1. Connect the processor to your computer via USB (if not already connected) and power it on.
2. Start the **DDRC-22 utility** program.
3. Click on the **Connect** button. The button will display a green tick if connection is successful.
4. Click on the **Upgrade Firmware** button. The *Dirac Series* processor will be put into boot loader mode and the miniDSP bootloader program will start. The status display should show “Device attached”.



5. Click on the **Import Firmware Image** button and select the .hex file located in the **firmware** folder of the download. It will have a name like **ENC_DDRC22_Ver2.18_SS.hex**.
6. Click on the **Erase/Program/Verify Device** button. The status display will indicate progress. **Do not disconnect the USB cable or remove power** from the processor while this runs!
7. After the status indicates that the verify has completed successfully, click on the **Reset Device** button, and then quit the bootloader program.
8. Return to the **DDRC-22 Utility** program. (If there is a dialog informing "Connection to DSP closed," click on **OK**.) Click on the **Connect** button, and then on **About** to verify the new firmware version.



7.4 TROUBLESHOOTING

The following table lists the most common causes of issues with the DDRC-22. If following this table does not provide a solution, see [Obtaining Support](#).

Item#	Symptoms	Troubleshooting recommendation
1	DDRC-22 doesn't appear in the Sound System tab	<ul style="list-style-type: none"> a. Check that the USB cable is firmly connected. b. Check that you have the miniDSP version of the software installed, called Dirac Live Calibration Tool Stereo for miniDSP. c. On the Sound System tab, click the Rescan button
2	The measurement test signal produces no output	<ul style="list-style-type: none"> a. Check the Output volume slider. b. Ensure that the <i>Dirac Series</i> processor is connected correctly into the audio system. c. (DDRC-22D only) Confirm that the connected DAC accepts 96 kHz sample rate. d. Check that the downstream device has the <i>Dirac Series</i> processor selected for input. e. Check that any downstream volume control is not set to zero. f. Check that no downstream device is muted or powered off.
3	No input from measurement microphone	<ul style="list-style-type: none"> a. Check that the USB cable to the UMIK-1 is securely seated. b. Check that the UMIK-1 is selected in the Mic config tab.
4	Insufficient recording level	<ul style="list-style-type: none"> a. Increase Input gain on the Output & Levels tab. b. Go to the Control Panel and view the Recording tab of the Sound pane. Select the UMIK-1 and view its Properties. In Levels, set the gain to 100. c. Increase system output volume.
5	No audio when playing music	<ul style="list-style-type: none"> a. Check that the <i>Dirac Series</i> processor is not muted. b. Check that the processor master volume control is not turned down. c. Check that the downstream device has the <i>Dirac Series</i> processor selected for input. d. Check that any downstream volume control is not set to zero. e. Check that no downstream device is muted or powered off.
6	Cannot install software	<ul style="list-style-type: none"> a. Confirm that you downloaded and installed the required frameworks first (see Software Installation).



7.5 OBTAINING SUPPORT

1. Check the forums on minidsp.com to see if this issue has already been raised and a solution or solutions provided.
2. Contact miniDSP via the support portal at minidsp.desk.com with:
 - a. The product information obtained from **DDRC-22 Utility (About** button) and **Dirac Live Calibration Tool Stereo for miniDSP (Sound System** tab).
 - b. A clear explanation of the symptoms you are seeing.
 - c. A description of the troubleshooting steps (see [Troubleshooting](#)) you performed and the results obtained.