![miniDSP logo]

Home Theater Series

NANOAVR HD
NANOAVR HDA

HIGH-RESOLUTION HDMI AUDIO PROCESSOR

User Manual

Revision history

Revision	Description	Date
1.0	Initial version	26 Jan 2014
1.1	Corrected package contents and time delay; links to app notes	11 Feb 2014
1.2	Additional items added to Troubleshooting	12 Mar 2014
1.3	Ethernet connectivity.	30 June 2014
1.4	Bass management information added, support portal link added.	28 Jul 2014
1.5	Update for Home Theater series	28 August 2014
1.6	Added nanoAVR HDA, HDMI channel mode, smartphone app	17 March 2015
1.7	Updated firmware upgrade procedure, iOS app	20 May 2015

CONTENTS

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 the nanoAVR, you will require a Windows PC or Apple Mac OS X computer with the following minimum specification:

Windows

- PC with 1GHz or higher processor clock speed. Intel® Pentium®/Celeron® family, or AMD K6®/AMD Athlon®/AMD Duron® family, or compatible processor recommended.
- 512 megabytes (MB) of RAM or higher
- Keyboard and mouse or compatible pointing device
- Microsoft•® Windows® Vista® SP1/ XP pro SP2/Win7/Win8.1
- Microsoft•® .NET framework v3.5 or later
- Adobe AIR environment (latest version)
- Adobe Flash player (latest version)

Mac OS X

- Intel-based Mac with 1 GHz or higher processor clock speed
- 512 megabytes (MB) of RAM or higher
- Keyboard and mouse or compatible pointing device
- Mac OS X 10.4 or higher
- Adobe AIR environment (latest version)
- Adobe Flash player (latest version)

Both Platforms

For USB connectivity:

- USB 2.0 port

For Ethernet connectivity via LAN:

- Ethernet router with spare 100 Mbps port

For direct (ZeroConf) Ethernet connectivity:

- Ethernet port on computer with 100 Mbps capability. (Apple Macs: a Thunderbolt port with a Thunderbolt to Ethernet adapter.)

DISCLAIMER/WARNING

miniDSP cannot be held responsible for any damage that may result from the improper use of this product or incorrect configuration of its settings. As with any other product, we recommend that you carefully read this manual and other technical notes to ensure that you fully understand how to operate this product. The nanoAVR is a powerful tool, and misuse or misconfiguration, such as incorrectly set gains or excessive boost, can produce signals that may damage your audio system.

As a general guideline, you should perform the initial configuration of your nanoAVR before enabling audio through any connected output device or amplification. Doing so will help ensure that the software is correctly configured.

Finally, note that the nanoAVR is a very flexible device, and many of the questions we receive at the tech 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 support. Thanks 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.

FCC CLASS B STATEMENT

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions:

- This device may not cause harmful interference.
- This device must accept any interference received, including interference that may cause undesired operation.

Warning: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

Notice: Shielded interface cable must be used in order to comply with emission limits.

miniDSP

Notice: Changes or modification not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

CE MARK STATEMENT

The nanoAVR HD/HDA has passed the test performed according to European Standard EN 55022 Class B.

WHAT'S INCLUDED

Your nanoAVR package contains:

- One **nanoAVR HD** or **nanoAVR HDA** HDMI audio processor
- Universal 5 VDC power supply with interchangeable power pins
- One USB cable for computer connectivity
- One Ethernet cable
- One HDMI cable
- 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, which 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.

1 PRODUCT OVERVIEW

The **nanoAVR HD** and **nanoAVR HDA** HDMI audio processors provide a comprehensive and sophisticated set of digital audio processing functions for eight channels of high-resolution (24-bit, 96 kHz) HDMI audio. The functions include bass management, parametric equalization, level adjustment, mixing and routing, and time delay. All internal processing takes place at 96 kHz, with sample rates up to 192 kHz accepted over HDMI.

Two HDMI inputs are provided and can be switched from the front panel or by an infrared remote (not included). The accepted audio format is multichannel linear PCM (LPCM). Video from the selected HDMI input is switched directly to the output, with no video processing applied to the signal.

A user-friendly computer-based interface is used to configure the audio processing parameters of the nanoAVR in real time. Up to four complete configuration presets can be stored. Once configuration is complete, the computer is no longer needed and the presets can be recalled from the front panel, by an infrared remote, or with a smartphone app.

1.1 TYPICAL USAGE – NANOAVR HD

In its most typical application, the nanoAVR HD connects between an HDMI source such as a Blu-ray player and an A/V receiver, providing an unmatched level of audio tuning flexibility for home theater applications. The second HDMI input allows connection of a second device such as a media streamer or computer/HTPC.

The HDMI output is connected to an A/V receiver, which in turn drives the display (TV, monitor, or projector), powers a suite of loudspeakers and provides output to a subwoofer.
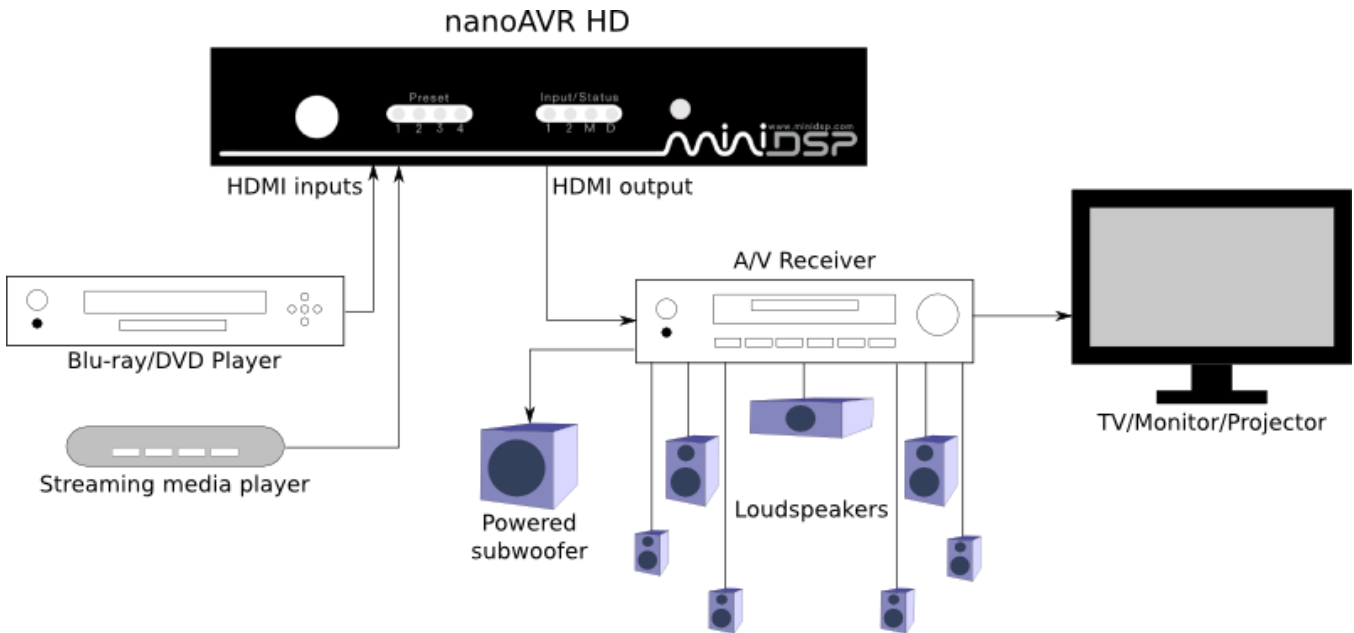
1.2 TYPICAL USAGE – NANOAVR HDA

The nanoAVR HDA negates the need for an A/V receiver to decode the audio component of the HDMI stream. For example, the analog outputs of the nanoAVR HDA can be connected directly to a multichannel power amplifier and a powered subwoofer, as illustrated in the diagram below. In this case, volume control is done digitally in the nanoAVR HDA itself, using a remote control or the miniDSP smartphone app.

The analog outputs of the nanoAVR HDA can also be connected to multichannel analog inputs of an A/V receiver, A/V preamp, or any other component with multichannel analog inputs.
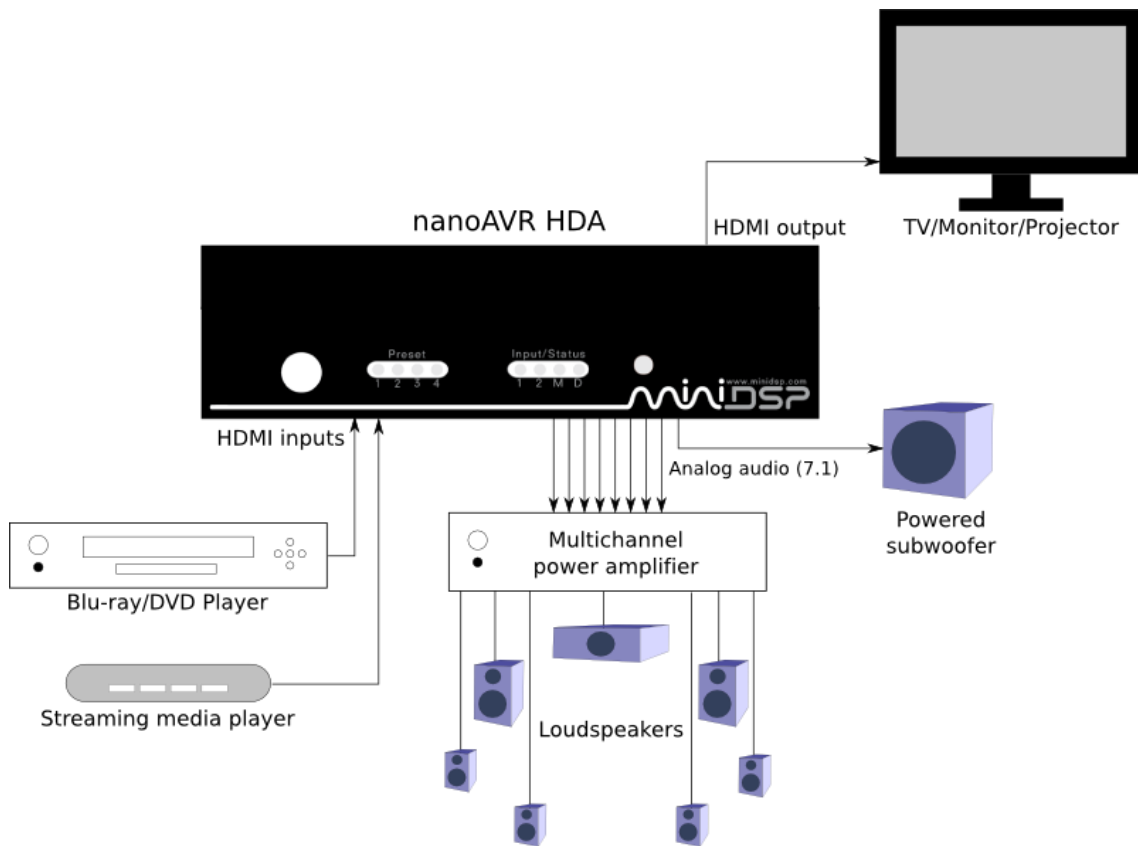
2   INSTALLATION AND SETUP

2.1   HARDWARE CONNECTIVITY

All connections to the nanoAVR are made on the rear panel.

2.1.1   HDMI input and output

Two HDMI connections are available for input, and one for output. The input connectors can be connected to any HDMI source such as a Blu-ray or DVD player. Other sources may include media streaming devices, gaming consoles, and computers with an HDMI port[†].

The HDMI output will need to be connected to an HDMI input on an A/V receiver (AVR) or A/V processor (AVP). In the case of the nanoAVR HDA, the HDMI output can be connected directly to the display device (TV, monitor, or projector).
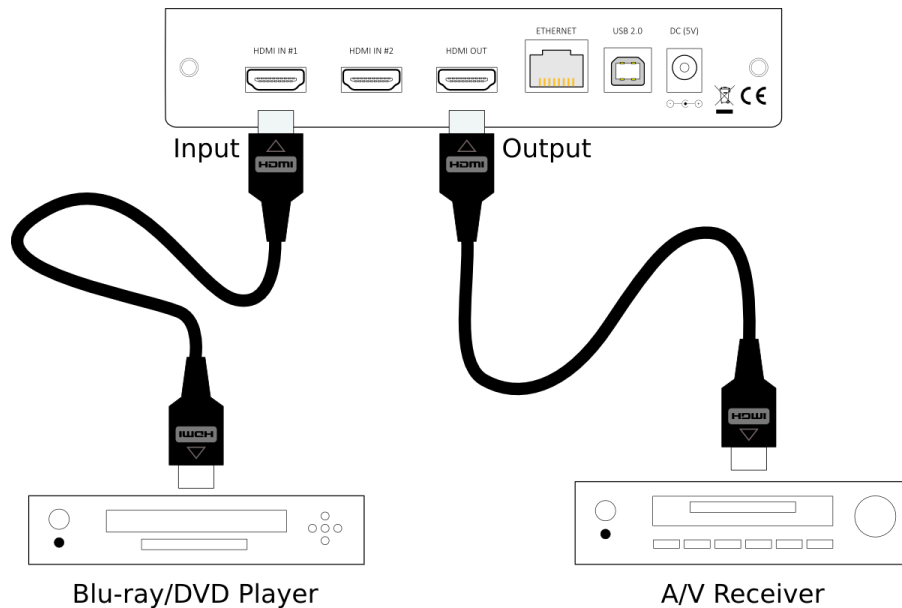
⚠ Ensure that your HDMI sources are set to produce linear PCM (also referred to as PCM, L-PCM, or LPCM) on their HDMI outputs. The nanoAVR does not decode compressed formats such as Dolby and DTS.

⚠ Some HDMI devices such as TVs only support basic HDMI Audio (up to 48 kHz), and will not respond to audio from the nanoAVR. Use an A/V receiver or preamp with 96 kHz support to decode HDMI audio.

[†] Apple Macs with a Thunderbolt port can be connected to the nanoAVR with the use of a Thunderbolt to HDMI adapter cable.

2.1.2 Analog outputs (nanoAVR HDA only)

The analog outputs of the nanoAVR HDA can be connected directly to power amplification and a powered subwoofer. They can also be connected to any other equipment with multichannel analog inputs such as an A/V receiver, multichannel preamp, or mixing desk.
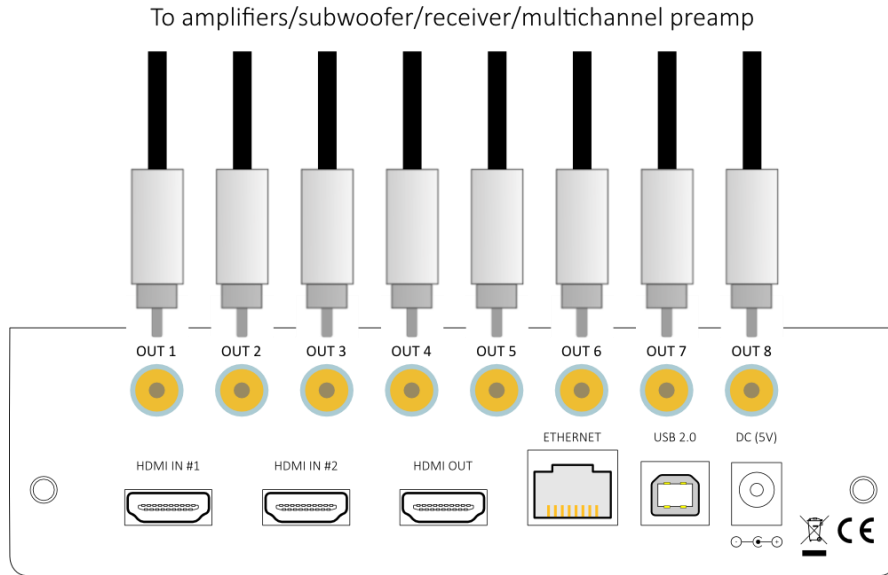
Note that HDMI audio and the analog outputs are simultaneously active.

⚠️ Always be sure to turn off all equipment before connecting or disconnecting audio signal cables.

2.1.3   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.
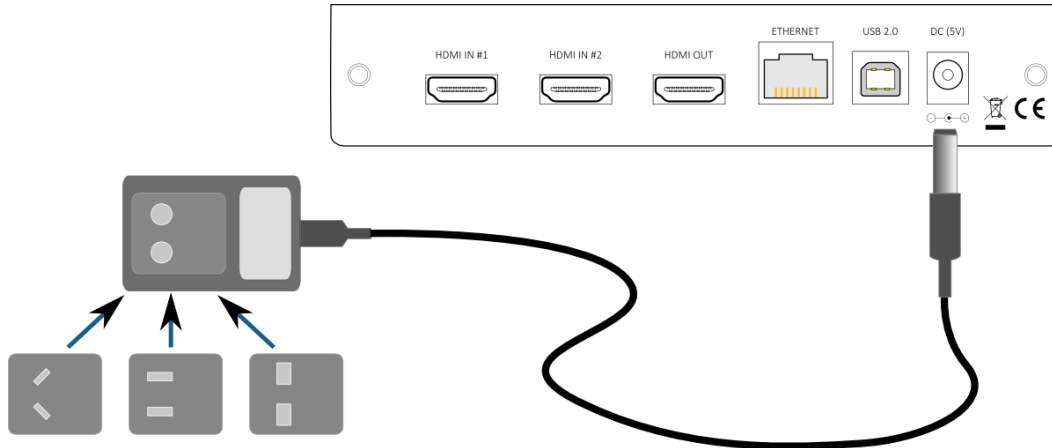
> ⚠️ HDMI units communicate with a set of "hand-shaking" signals in order to establish the capabilities of each device. It is recommended that for at least the first time the system is powered up with the nanoAVR connected, equipment is powered on in this order: TV, AVR, nanoAVR, source/player.

2.1.4   USB

To configure the nanoAVR via USB, connect the USB port of the nanoAVR to a USB 2.0 port on your computer using the supplied cable.
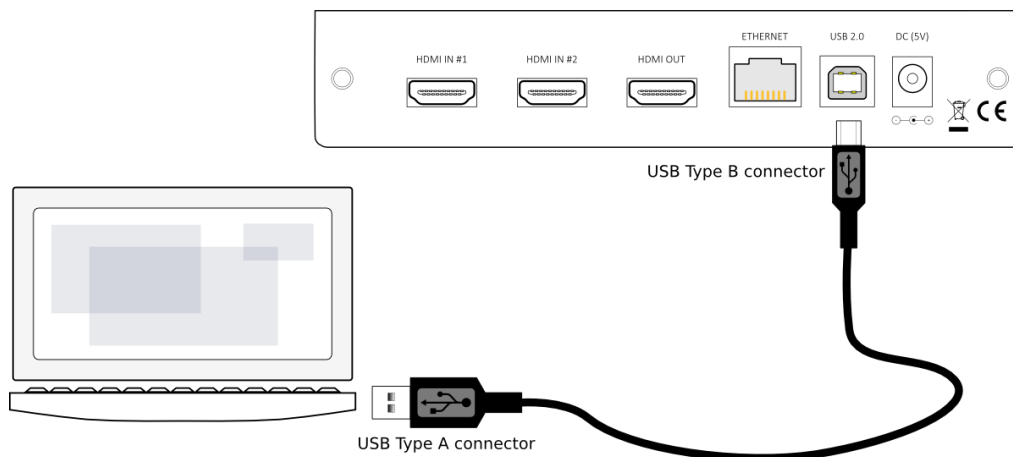
2.1.5   Ethernet

To configure and control the nanoAVR over Ethernet, connect an Ethernet cable from the nanoAVR's Ethernet port to a free port on your Ethernet router or switch. The diagram below illustrates a typical case where the Ethernet router also acts as a wireless base station, and is in turn connected to an ADSL/cable modem. It is also common for the ADSL/cable modem, Ethernet router, and wireless base station to be combined into a single unit.

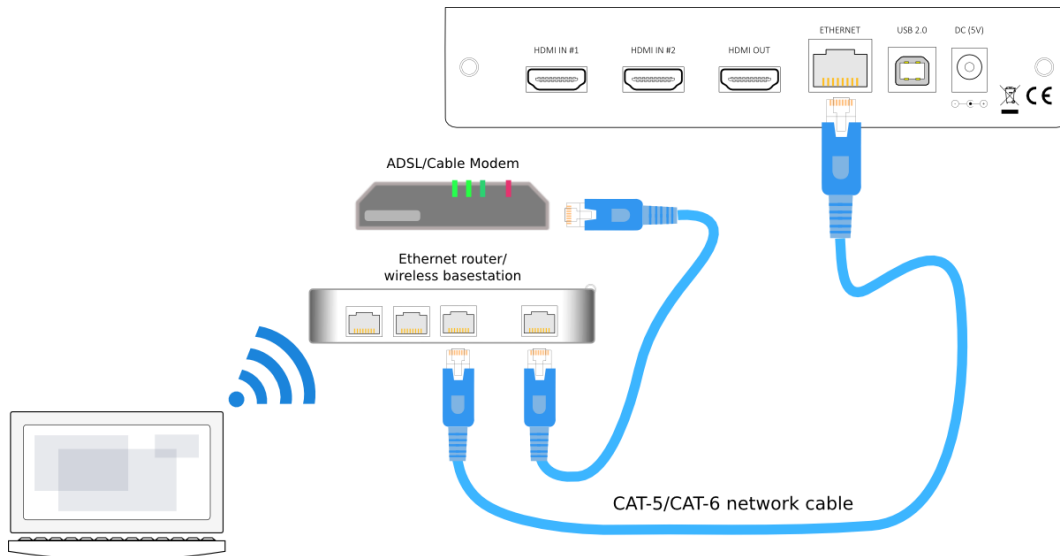In the setup illustrated, the nanoAVR is connected via an Ethernet cable to the Ethernet router, while the computer is connected to the LAN over Wi-Fi. The network must be capable of DHCP so that the nanoAVR will be given an IP (network) address.

If a local area network is not available, or the network does not support DHCP, it is still possible to communicate with the nanoAVR over Ethernet by connecting the two devices directly with an Ethernet cable. In this case, auto-IP (link-local) addresses will be assigned. For this to work correctly, your PC must be set to allow automatic IP addresses (that is, it must not be set to a static IP address).
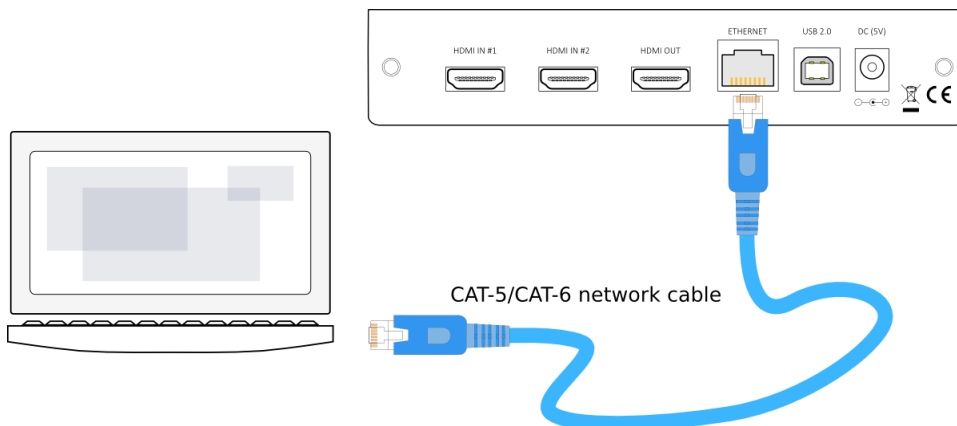
2.2   SOFTWARE INSTALLATION

Subsequent to your purchase of the nanoAVR, the software will be available from the User Downloads section of the miniDSP website. This link is visible when you have logged into the site with the account you created when purchasing.
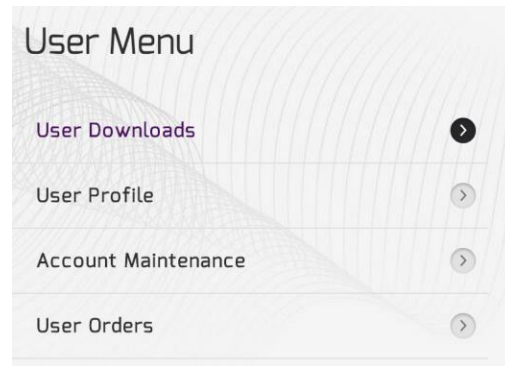

Navigate to the **nanoAVR** section of User Downloads, then to **nanoAVR HD/HDA downloads**. Download the zip file under the heading **nanoAVR HD/HDA plug-in**. Double-click on it to unzip it. Then follow the installation procedure below according to your computer type.

2.2.1   Windows

Prior to installing the miniDSP software, download and install the following programs. You will need to accept the license agreements in order to successfully complete the installation.

- Microsoft .NET framework (version 3.5 or later)
- Latest version of Adobe Flash
- Latest version of Adobe Air

If you haven't updated these recently, you should download and install the latest versions prior to running the miniDSP install program.

To install the miniDSP software, open the **Windows** folder of the download and double-click on the **nanoAVR_BM.exe** program. We recommend accepting the default installation settings. Once installation is complete, the nanoAVR user interface will automatically start. Since the nanoAVR checks for a network connection when starting up, a warning such as the following may appear. In this case, click on **Allow access**.

![miniDSP logo]
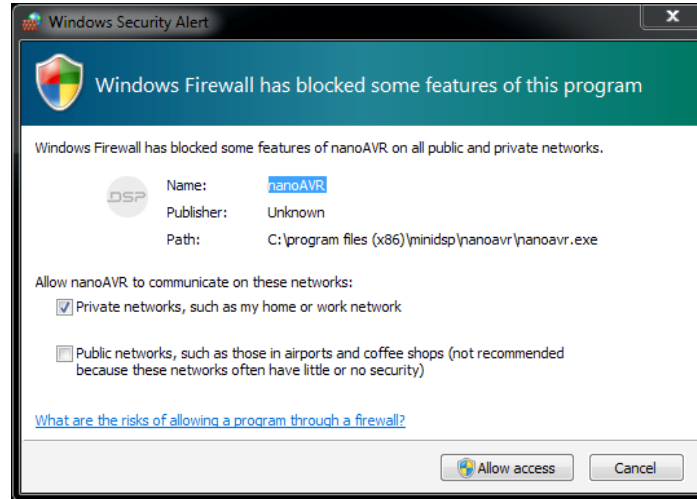
2.2.2   Mac OS X

On versions of OS X from 10.7 (Lion) and later, you will need to inform the GateKeeper program that it is OK to install and run this software. Go to System Preferences, then click on Security & Privacy and select the General tab:

1. Click on the padlock icon in the lower left corner and enter your password, in order that you can make changes to the settings.

2. Under the text "Allow Applications downloaded from:", click on "Anywhere."

Then, download and install the following programs. You will need to accept the license agreements in order to successfully complete the installation:

- Latest version of Adobe Flash
- Latest version of Adobe Air

If you haven't updated these recently, you should download and install the latest versions prior to running the miniDSP install program.
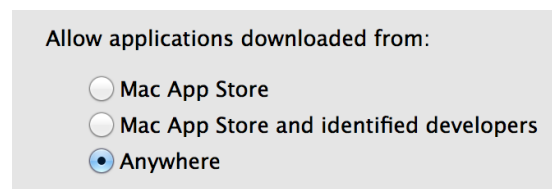
To install the miniDSP software, open the **Mac** folder of the download, and double-click on the **nanoAVR_BM.dmg** file to open it in a new window. Then double-click on the installer program, **Install nanoAVR_BM.app**. Once installation is complete, the nanoAVR plugin user interface will automatically start.

3 CONFIGURING THE NANOAVR

The nanoAVR is configured with the **nanoAVR_BM** plugin / user interface program. Once the nanoAVR is fully configured, the user interface is no longer required, as source and preset selection can be done with the front panel or a remote control – see Using the nanoAVR below. If desired, however, the user interface can remain connected during use for real-time ("live") control of all settings in the nanoAVR.

This screenshot shows the **nanoAVR_BM** plugin with the key areas highlighted:

Note: during initial configuration of the nanoAVR, it is recommended that the connected HDMI output device be muted.

3.1 CONNECTING TO THE NANOAVR

Communication with the nanoAVR can take place either over USB or Ethernet.

3.1.1 USB

Ensure that the computer is connected to the nanoAVR by a USB 2.0 port (see Hardware connectivity above). Then click on the Connect button:

3.1.2 Ethernet

Connect the nanoAVR to your local area network by plugging in the Ethernet cable. The following dialog will appear:
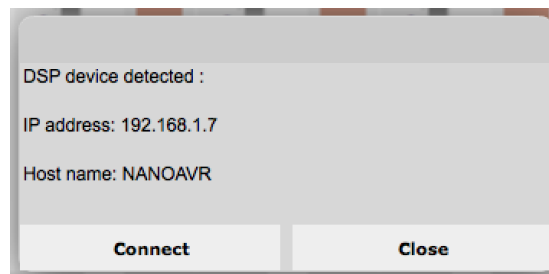
Click on **Connect** to proceed.

3.1.3 Options

The first time you connect, or if you have made any changes to any data in the user interface, the following dialog box will appear. It is recommended that the *first* time you connect, use **Restore Config** to ensure a known starting state. Thereafter, use **Synchronize Config**.
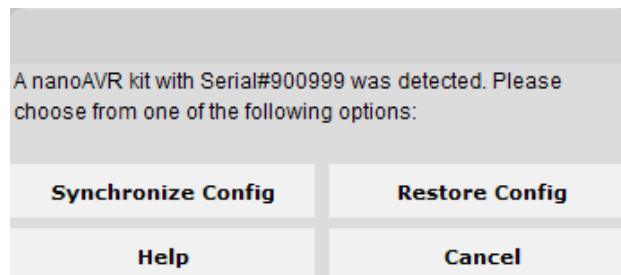
The options are:

Synchronize Config

> Download the currently selected configuration into the corresponding configuration preset of the nanoAVR. After downloading the configuration data, the user interface remains connected to the nanoAVR and any changes to processing parameters will be downloaded immediately in real time to the nanoAVR. That is, the nanoAVR is now "live."

Synchronize and Upgrade

> This is similar to Synchronize Config, but also upgrades the internal data of the nanoAVR. This option may appear when connecting to the nanoAVR after an update to the plugin.

Restore Config

> Restore the data in the currently selected configuration to the factory defaults. When using this option, the HDMI output device should be muted until you have set the configuration to a working state.

Help   This option brings up a help screen explaining the options.

Cancel   This option cancels the attempt to connect to the nanoAVR. The user interface will remain disconnected.

3.2   GLOBAL SETTINGS

The nanoAVR has four configuration presets stored in memory. The presets can be selected from the plugin, from the front panel, or via remote. For more information on using configurations, see Working with configurations below.

By default, configuration 1 is selected:

A drop-down menu allows either HDMI 1 or HDMI 2 to be selected as the input source:
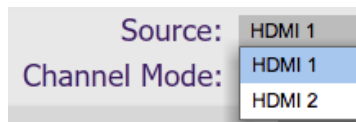
The **Mute** button disables all audio output:

The **Channel Mode** selector controls how the nanoAVR outputs audio over HDMI. See Channel mode below.

3.3 CONFIGURE SIGNAL ROUTING

Click on **Routing** in the Selection tabs. The input channels are labeled along the left, and the output channels along the top.

	FL Out	FR Out	SUB Out	CTR Out	SL Out	SR Out	RL Out	RR Out
FL In	0dB	Off	Off	Off	Off	Off	Off	Off
FR In	Off	0dB	Off	Off	Off	Off	Off	Off
LFE In	Off	Off	Off	Off	Off	Off	Off	Off
CTR In	Off	Off	Off	0dB	Off	Off	Off	Off
SL In	Off	Off	Off	Off	0dB	Off	Off	Off
SR In	Off	Off	Off	Off	Off	0dB	Off	Off
RL In	Off	Off	Off	Off	Off	Off	0dB	Off
RR In	Off	Off	Off	Off	Off	Off	Off	0dB
LFE Mgt	Off	Off	0dB	Off	Off	Off	Off	Off

(The **LFE Mgt** row is the output from the LFE Mgt screen. For information, see Bass Management below.)

Each cross-point represents a switch that can either be turned off, or turned on with a gain setting. By default, each input channel is switched to the corresponding output channel with 0 dB gain (i.e. no change in level), as shown in the above screenshot.

Any number of input channels can be mixed to each output channel. At each cross-point, the gain of the signal being mixed can be adjusted to a value between -72 and +12 dB. To adjust the gain, right-click on the cross-point and a gain control will appear. Adjust the gain with the slider, or by typing in the value directly. This screenshot shows the gain control, with two input channels mixed to one output channel, each at -6 dB:
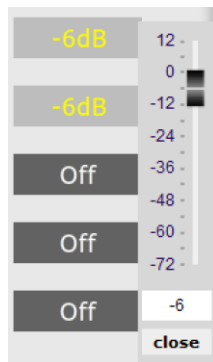
Note: To rename an input channel, click on its label and type in a new name (maximum of eight characters).

![miniDSP logo]

3.4   OUTPUT CHANNEL SETUP

Click on **Outputs** in the Selection tabs. The output control screen will appear, with each channel showing a "strip" of controls.
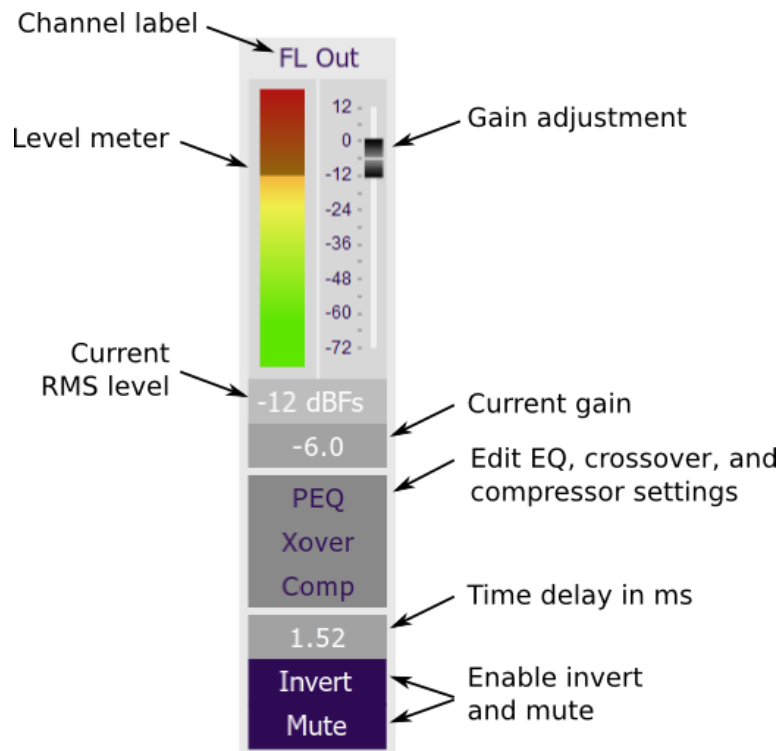
3.4.1   Channel label

The name of each output channel is shown at the top of the channel strip. To rename a channel, click on the channel label and type a new name (up to eight characters).

3.4.2   Gain control and level monitoring

The gain of each channel can be adjusted by moving the Gain Adjustment slider, or by typing the desired gain into the Current Gain text box. The maximum gain setting is 12 dB, and the minimum gain setting is –72 dB. (0 dB, the default, is unity gain or no change in level.)

The signal level on each output channel displays in two locations: on the bar-graph meter, and as a numeric value (in dB relative to full scale) in the RMS Level box. The RMS level displays only when the user interface is connected to the nanoAVR.

The level meters are useful in many situations. For example, when adding filters with boost, monitor the level meters with typical signals and maximum levels to ensure that there is no clipping. The meters can also be used during normal operation to monitor for or to help locate level or gain structure problems.

3.4.3 Parametric EQ

Parametric equalization (PEQ) is a flexible type of equalization filter. It can be used to correct for errors in loudspeaker output, to compensate for acoustic room effects, and to tailor the overall system response for best sound. Click on the PEQ button to open the parametric equalizer settings window:
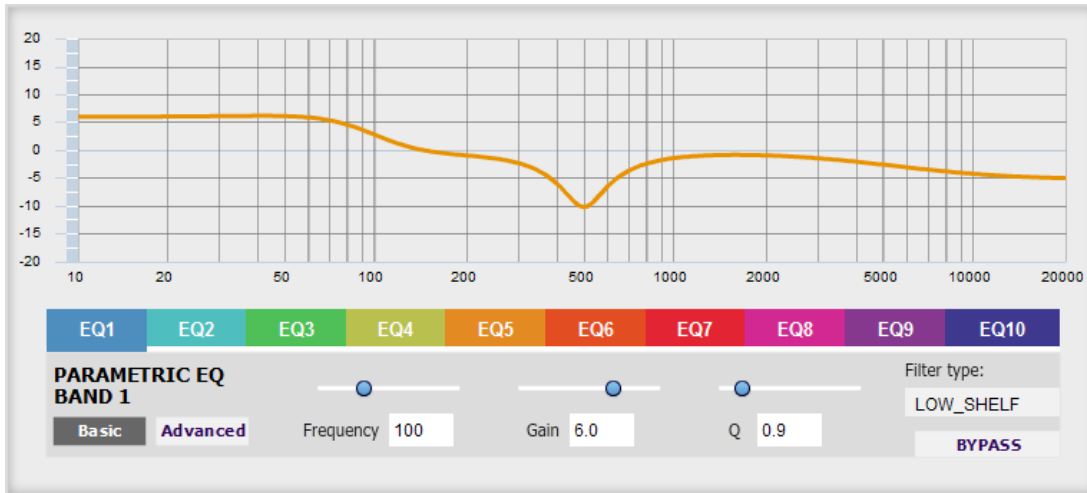
In the center of the window is a frequency response graph that illustrates the combined response of all enabled parametric filters on that channel. The screenshot above shows a response curve created with a low-shelf boost filter at 100 Hz, a dip at 500 Hz, and a high-shelf cut filter at 5000 Hz.

There are ten filters per channel, each of which is displayed by clicking on the buttons **EQ1**, **EQ2**, and so on. Each filter can be set to one of four types:

PEAK   Create a dip or a peak in the frequency response.

LOW_SHELF   Reduce or increase part of the frequency spectrum *below* a given frequency.

HIGH_SHELF   Reduce or increase part of the frequency spectrum *above* a given frequency.

SUB_EQ   Create a dip or a peak in the frequency response at low frequencies (10 to 50 Hz). This filter type is similar to PEAK but gives more accurate results for low frequencies. Note that activating any SUB_EQ filter reduces the number of available filters on that channel from ten to nine.

Each filter has three parameters that control its location and shape. These parameters can be entered directly as numerical values, or by using the sliders:

Frequency   For the PEAK and SUB_EQ filter types, this is the center frequency of the peak or dip. For the HIGH_SHELF and LOW_SHELF filter types, this is the frequency at which the gain is half of the set value.

Gain   For the PEAK and SUB_EQ filter types, this is the gain in dB at the center frequency. For the HIGH_SHELF and LOW_SHELF filter types, this is the gain in dB reached at high or low frequencies respectively.

Q
Q controls the "sharpness" of the filter. For the PEAK and SUB_EQ filter types, lower Q gives a shallower peak or dip, while higher Q gives a narrower peak or dip. For the HIGH_SHELF and LOW_SHELF filter types, Q controls how quickly the filter transitions from no gain to maximum gain.

To disable or enable a filter, click on the **Bypass** button. A filter will also have no effect if its gain is set to 0.0.

Other filter types can be created by switching to **Advanced** mode. In this mode, the coefficients of each filter "biquad" are entered individually. The coefficients will need to be calculated by a filter design program. A useful spreadsheet for a number of filter types is available on the miniDSP.com website – see the application note Advanced Biquad Programming.
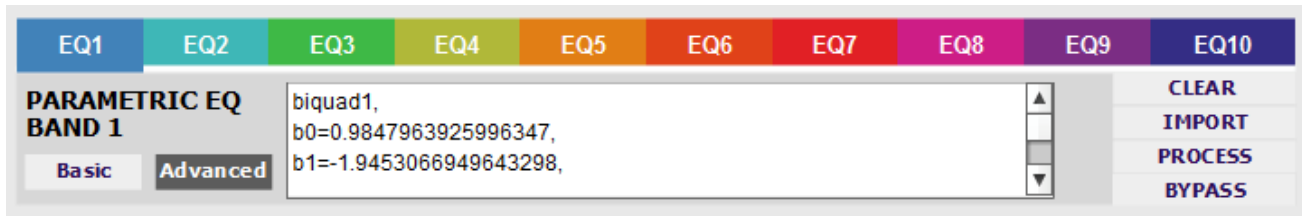
Each channel can be linked to one other channel. When a channel is linked to another, the PEQ settings of that channel are mirrored to the other. Typically, the corresponding left and right channels are linked: front left and right, surround left and right, and rear surround left and right. To link a channel, select the other channel from the drop-down menu at the top left of the PEQ screen, and click the Link checkbox.
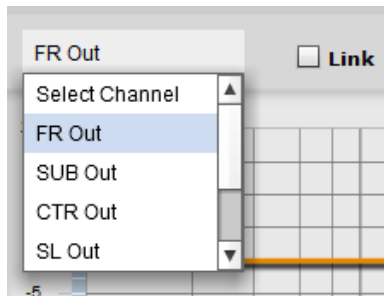
3.4.4 Crossover settings

Each output channel has independent high pass and low pass filters. Click on the **Xover** button to open the crossover settings window:
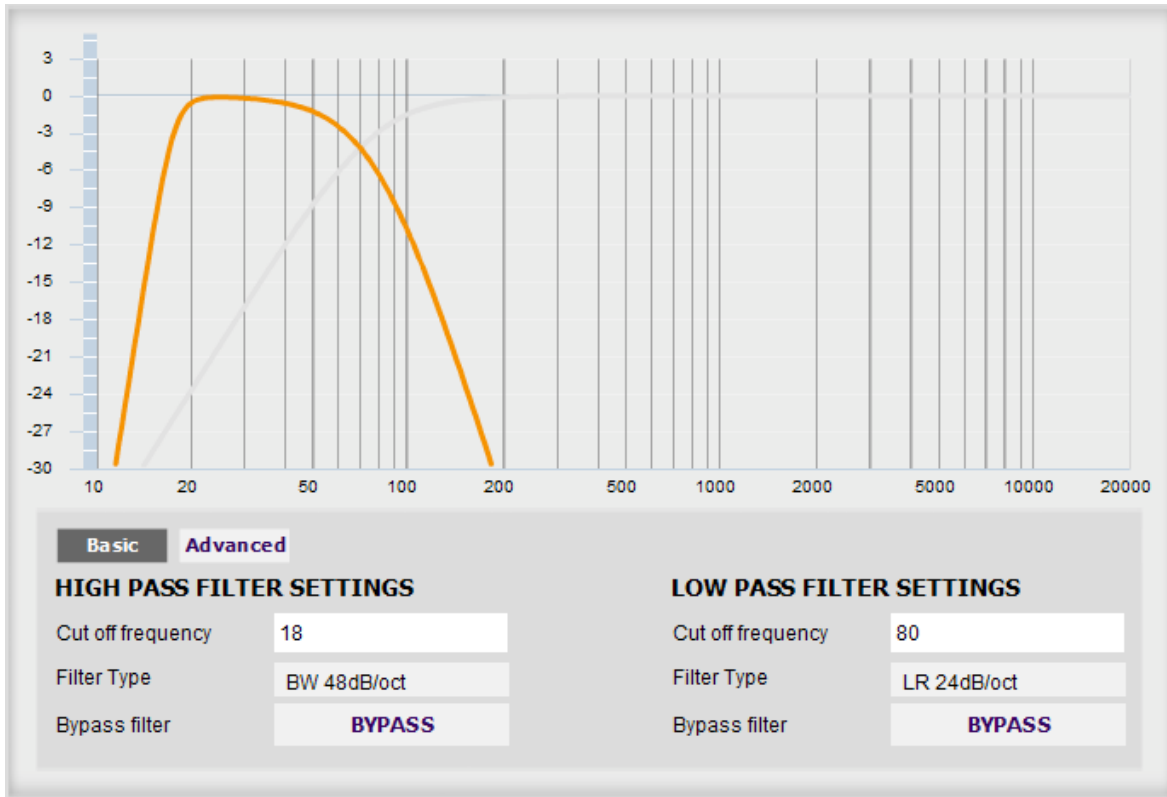
By default, the crossover filters are bypassed (disabled). Click on the **Bypass** button to enable and disable a crossover filter. There is one filter for high pass (low cut) and one for low pass (high cut). The above example shows a pair of filters for the subwoofer channel with an 18 Hz high pass filter and an 80 Hz low pass filter.

Each filter can be set to one of a range of filter types and slopes. The filter type determines the shape of the filter around the crossover point, and the filter slope (expressed in dB/octave) determines how steep the filter cutoff is. The available filter types and slopes are:

Butterworth (BW)

> Available in 6, 12, 18, 24, 30, 36, 42, and 48 dB/octave, Butterworth crossover filters are 3 dB down at the cutoff frequency.

Linkwitz-Riley (LR)

> Available in 12, 24, and 48 dB/octave, Linkwitz-Riley crossover filters are 6 dB down at the cutoff frequency.

Bessel

> Available in 12 dB/octave only, a Bessel filter gives a more gradual roll off through the crossover region.

For other types of filter and filter slopes, use **Advanced** mode. This mode allows you to enter the coefficients of eight biquads directly into the interface. The coefficients will need to be calculated by a filter design program. A useful spreadsheet for a number of filter types is available on the miniDSP.com website – see the application note Advanced Biquad programming.

biquad1,
b0=0.000027136608757459585,
b1=0.00005427321751491917,
b2=0.000027136608757459585,
a1=1.9795591346653545,
a2=-0.9796676811003843,

PROCESS

BYPASS
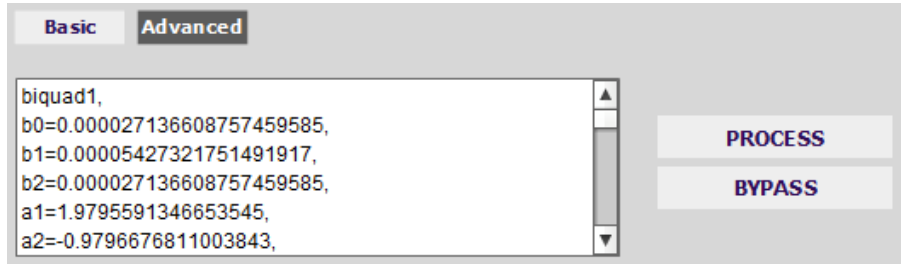
Each channel can be linked to one other channel. When a channel is linked to another, the crossover settings of that channel are mirrored to the other. Typically, the corresponding left and right channels are linked: front left and right, surround left and right, and rear surround left and right. To link a channel, select the other channel from the drop-down menu at the top left of the **Xover** screen, and click the Link checkbox.

FR Out
☐ **Link**

Select Channel
FR Out
SUB Out
CTR Out
SL Out
-5
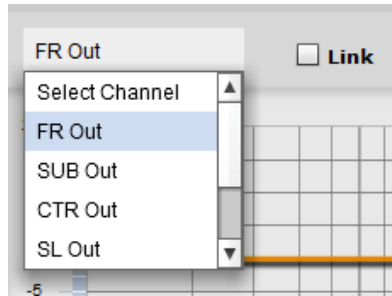
3.4.5 Compressor

The compressor reduces the gain of an output channel when the audio signal reaches a certain level as specified by the **Threshold** parameter. The gain of the channel will be progressively reduced as the signal increases above the threshold, according to the **Ratio** parameter. This can be used to limit the power delivered to speakers and thus reduce the risk of damage from overdriving.

This screenshot shows an example Compressor setting:
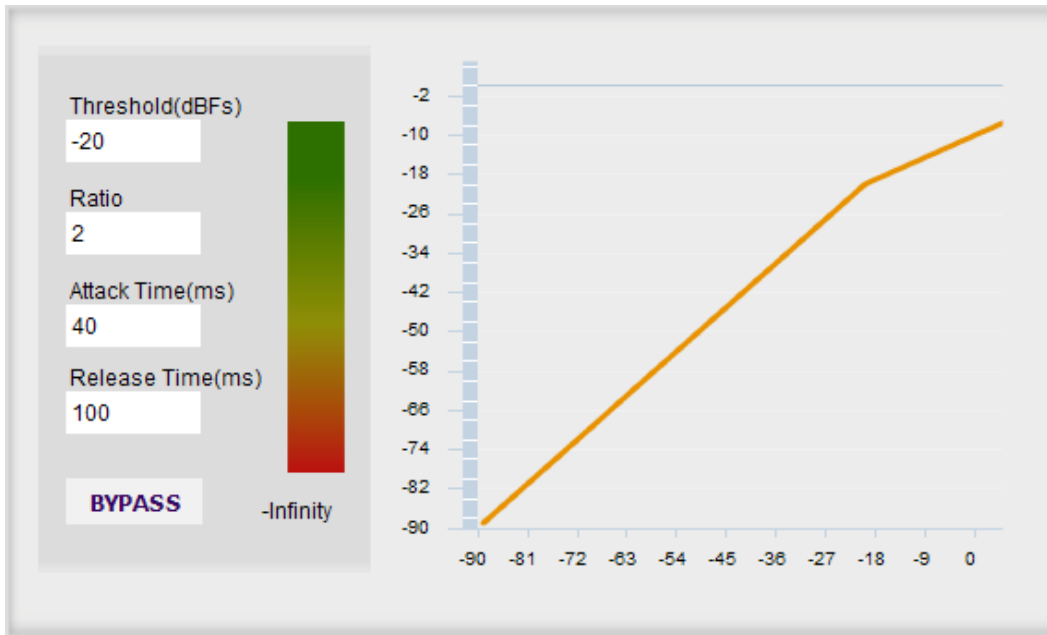
(Note that the compressor algorithm is bypassed by default, so click on the **Bypass** button to see the curve as shown here.)

In this example, the threshold is set to -20 dB, so the compressor will activate when the signal on that channel reaches -20 dB (relative to full output). The ratio is set to 2, so if the input signal level to the compressor then increases by 10 dB, the output level will increase by only 5 dB. If the input signal level to the compressor is at full scale (0 dB), then the output level will be limited to -10 dB.

Two additional parameters control the action of the compressor: the attack time and the release time. These two parameters govern how quickly the compressor activates when the signal level exceeds the threshold, and how quickly it deactivates when the signal level reduces. The optimum settings may need to be tuned by ear. For more information, see the Wikipedia article Dynamic range compression.

3.4.6 Time delay

A delay of up to 80 ms can be applied to each output channel. To set the delay, click in the delay entry box for a channel. The delay value can be entered numerically, and the up and down arrows can be used to change the delay in small (0.02 ms) increments.

The time delay corresponds to a distance. This distance is shown in cm when the cursor is hovered over the time delay box. The maximum time delay of 80 ms corresponds to a distance of approximately 27.5 meters (about 90 feet).

Time delay can be calculated from distance using one of the following formulae:

(Time delay in ms) = (Distance in cm) / 34.4

Or:

(Time delay in ms) = (Distance in inches) / 13.54
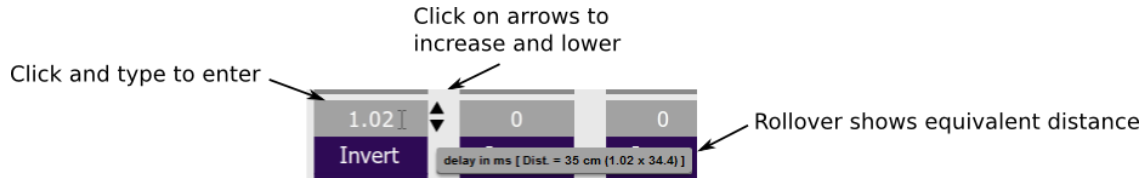
3.4.7 Invert and mute

Each channel can be inverted in polarity, and individually muted. When either of these options is selected, the display changes color and the label of the button reflects the current state.
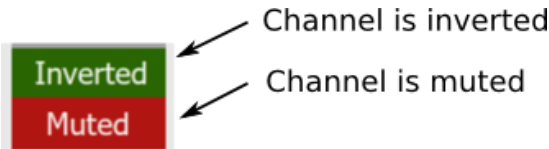
3.5 BASS MANAGEMENT

The **nanoAVR_BM** plugin includes a dedicated tab for bass management, named **LFE Mgt**:
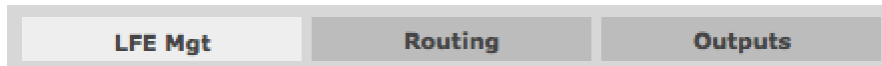
When movies are mixed for the cinema, each speaker is specified as a full bandwidth channel—that is, 20 Hz to 20 kHz, although 40 Hz to 18 kHz for the speakers is considered acceptable in cinema and the mixing studio (see the Grammy paper "Recommendations For Surround Sound Production"). The Low Frequency Effects (LFE) channel is used for high-level low-frequency content and is fed to dedicated subwoofers in order to avoid overloading the speakers.

In a typical home theatre system, some or all of the speakers are not capable of reproducing frequencies down to 40 Hz, let alone 20 Hz. The solution is *bass management*, where low frequencies are filtered out from the speaker channels and sent to the subwoofer instead. While 80 Hz is a common frequency used to separate content for the subwoofer and speaker channels, the bass management feature allows any frequency to be used, and any mix of frequencies to be used across different channels.

Above: LFE Management screen

Inset: setting mix levels
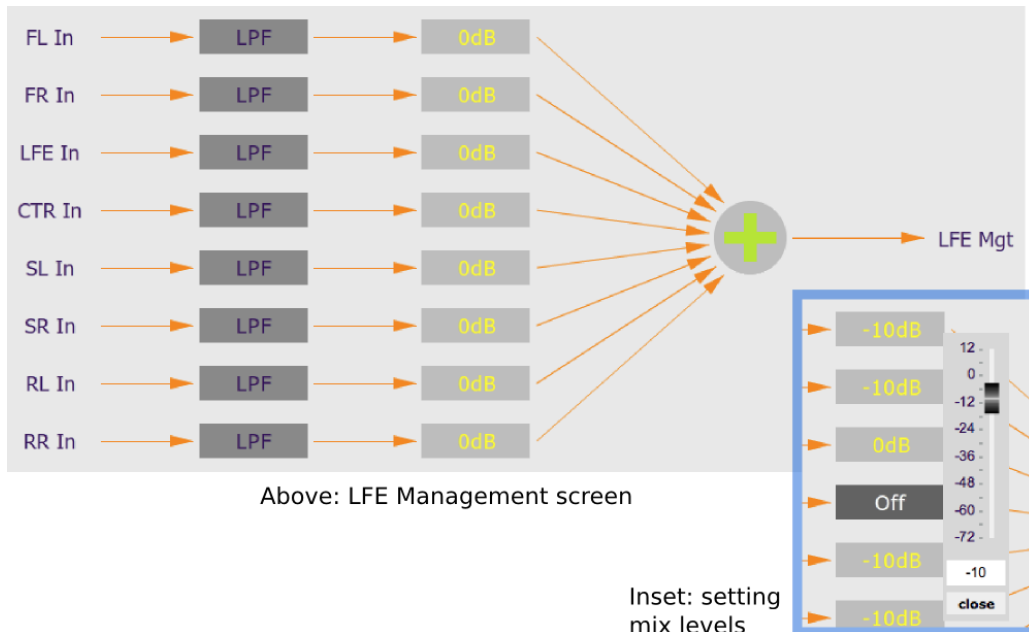
The input channels are low pass filtered in the **LPF** blocks, and then summed into a combined low-frequency signal. The controls for each **LPF** block are similar to those seen in the **Xover** blocks in the output channels, but only have a single low pass filter. (For details on the filter parameters, see Crossover settings above.)

Settings for 7 full-range channels:
Tiny 'satellite' speakers: 150-200 Hz.
Small center, surround, bookshelf speakers: 100-120 Hz.
Mid-size center, surround, bookshelf speakers: 80-100 Hz.
Large center, surround and bookshelf speakers: 60-80 Hz.
Very large center, surround, bookshelf speakers: 40-60 Hz.

Setting for .1 LFE channel: 120Hz

LOW PASS FILTER SETTINGS

Cut off frequency (Hz)	80
Filter Type	LR 48dB/oct
Bypass filter	**BYPASS**

The gain control blocks (labelled with the attenuation, such as "0 dB" or "-10 dB") set the levels at which the low pass filtered signals from each channel are mixed together. To set the gain, right-click on the box and use the slider, or type directly into the entry box. Then click **Close**. To turn off low frequency mixing for a channel, simply click on the gain control box to set it to **Off**.

Note that the mix levels for the speaker channels are normally set 10 dB lower than the LFE channel—see the application note Bass Management with the nanoAVR for full details.

The **Routing** screen provides the output from the LFE Mgt tab as the bottom row. By default, the summed, filtered bass signal will be sent to the subwoofer channel, as shown below. The direct LFE input signal is *not* sent to the subwoofer on this screen, as it has already been mixed into the **LFE Mgt** signal:

	FL Out	FR Out	SUB Out	CTR Out	SL Out	SR Out	RL Out	RR Out
FL In	0dB	Off	Off	Off	Off	Off	Off	Off
FR In	Off	0dB	Off	Off	Off	Off	Off	Off
LFE In	Off	Off	Off	Off	Off	Off	Off	Off
CTR In	Off	Off	Off	0dB	Off	Off	Off	Off
SL In	Off	Off	Off	Off	0dB	Off	Off	Off
SR In	Off	Off	Off	Off	Off	0dB	Off	Off
RL In	Off	Off	Off	Off	Off	Off	0dB	Off
RR In	Off	Off	Off	Off	Off	Off	Off	0dB
LFE Mgt	Off	Off	0dB	Off	Off	Off	Off	Off

The **Xover** blocks on the **Output** screen must also be used to create matching high pass filters for each speaker channel. For a full set of instructions on how to use bass management, see the application note Bass Management with the nanoAVR.

3.6 CHANNEL MODE

The number of audio channels that the nanoAVR signals on its HDMI output to the downstream HDMI device is selected by the **Channel Mode** dropdown selector:

Source: HDMI 1   Master Volume

Channel Mode: Auto   -1.5 dB

Auto
Stereo
4.0 ch
5.1 ch
7.1 ch
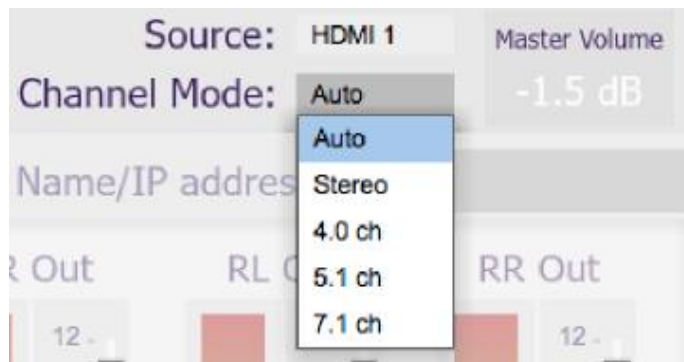
Auto	The number of output channels signaled is the same as receives on the selected. For example, if the selected source signals that HDMI audio is carrying a stereo signal, the nanoAVR passes this to its output. If the source signals that HDMI audio is carrying six channels (5.1), the nanoAVR passes this to its output. And so on.
Stereo	The nanoAVR always signals stereo output, regardless of the number of input channels.
4.0	The nanoAVR always signals four-channel output, regardless of the number of input channels.
5.1	The nanoAVR always signals six-channel output, regardless of the number of input channels.
7.1	The nanoAVR always signals eight-channel output, regardless of the number of input channels.

The setting of **Channel Mode** has no effect on the analog output channels (nanoAVR HDA only).

3.7 WORKING WITH CONFIGURATIONS

The complete set of data that controls the audio processing of the nanoAVR is called a *configuration*. The nanoAVR stores four configuration presets in its internal memory, which can then be selected from the plugin user interface, the front panel or via remote control.

The effect of changes made in the user interface fall into two categories:

The user interface is connected to the nanoAVR

> The user interface is "live" – that is, any changes made to the audio processing parameters in the user interface are downloaded immediately to the nanoAVR. The effect of these changes will thus be audible as the changes are made.

The user interface is *not* connected to the nanoAVR

> Changes made to the audio processing parameters will be made locally in the user interface only. The next time the user interface is connected to the nanoAVR, the audio processing parameters will be downloaded to the nanoAVR (as long as the **Synchronize Config** button is selected). Changes are not lost between quitting and restarting the user interface.

3.7.1 Selecting a configuration

The current configuration is selected by one of the four buttons in the Configuration Selection area. By default, configuration 1 is selected:

Configuration Selection: Config 1   Config 2   Config 3   Config 4

To switch to a different configuration, click on a different button. If the interface is live, real-time processing in the nanoAVR will be updated to the newly selected configuration, and audio processing will then continue. If, however, the selected configuration has changed in the user interface since the newly selected configuration was last synchronized to the nanoAVR, then a dialog will appear asking you if you want to synchronize the local configuration to the nanoAVR.

If the user interface is not connected, then the screen will update to show the parameters of the newly selected configuration. If this configuration is changed in the user interface, it will be downloaded to the nanoAVR next time it is synchronized.

Note: because of the potential for a selected configuration to be in an unknown state, we recommend that each configuration be selected and checked/initialized prior to connecting to the nanoAVR for the first time.

3.7.2 Saving and loading configurations

Configurations can be saved to and loaded from files. Each configuration is stored in a separate file. It is strongly recommended that each configuration programmed into the nanoAVR be saved to a file, to ensure that the configuration is not lost if the nanoAVR is inadvertently reset. A configuration file stores all of the audio processing parameters except for the master volume setting and the HDMI input selection.

To save the currently selected configuration to a file, drop down the File menu, then select **Save** and then **Save current configuration**. In the file box, select a location and name of the file, and save it.
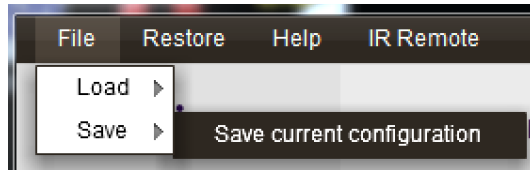
To load a configuration, first select the configuration preset that you wish to load the parameters into. Then drop down the File menu, select **Load**, and then **Load configuration to current slot**.
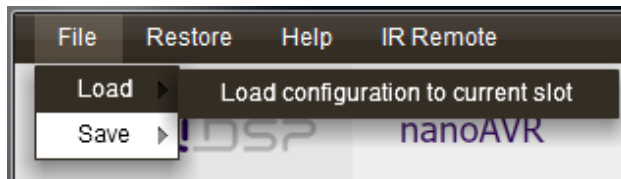
If the user interface is live, the loaded configuration data will be downloaded to the nanoAVR immediately, and audio processing will recommence with the new configuration. If it is not, the configuration will be loaded into the user interface only, and will be downloaded to the nanoAVR the next time it is synchronized.

Tip: To copy a configuration from one preset to another, simply save the configuration to a file, then select a different preset and load the file.

3.7.3   Restoring to defaults

Configurations can be reset to the factory defaults from the Restore menu. There are two options:

Factory Default

> This selection clears all configuration data and resets all four configuration presets to the factory default settings.

Current Configuration Only

> This selection clears only the currently selected configuration preset and resets its data to the factory default settings.

If the user interface is connected to the nanoAVR, the configuration data on the nanoAVR (all or just one configuration, as selected) will also be reset to factory defaults. Otherwise, the reset will take place in the user interface only. Any changes can then be made, and the configuration will be downloaded to the nanoAVR next time it is synchronized.

3.8   KEYBOARD SHORTCUTS

The nanoAVR user interface supports the use of the keyboard for many operations.

Tab   The Tab key moves the focus from the current user interface element to the next. A light blue surrounding box usually indicates the user interface element with the focus. For example, after changing the gain of an output channel, the Tab key moves the focus to the next channel, so that the arrow keys can be used to change that channel's gain. Shift-Tab moves the focus in the opposite direction.

Up/down arrows

> The up/down arrow keys (and in some cases, the left/right arrow keys) adjust the value of many parameters:
>
> - Output channel gain
> - Crossover frequency and filter type
> - PEQ filter frequency, gain, and Q

Space   The Space bar toggles buttons that have two states, such as **Bypass**, **Invert**, and **Mute**.
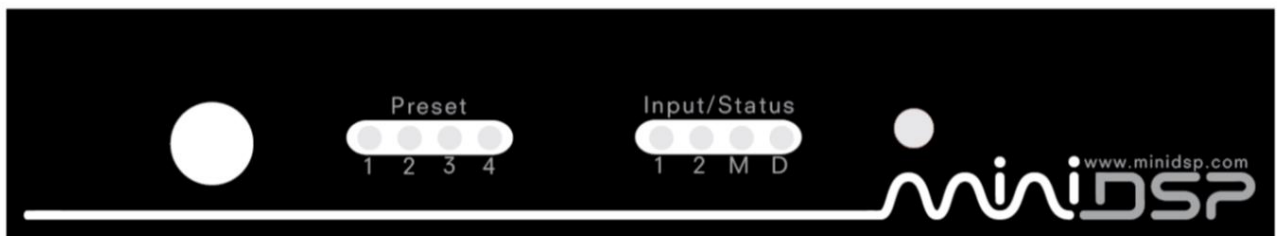
4 USING THE NANOAVR

Once configured, the computer is not required to operate the nanoAVR. The front panel, an infrared remote, or the miniDSP smartphone app can be used to control:

- Preset selection
- HDMI input selection
- Master volume (remote control and smartphone app only)
- Master mute (remote control and smartphone app only)

Note: changing the selected configuration preset from the front panel or remote control while the user interface is connected will disconnect the user interface.

4.1 STATUS INDICATORS

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

Preset   Indicates the currently selected configuration preset (1 through 4).

Input   Indicates the currently selected HDMI input (1 or 2).

M   Master mute is enabled.

D   Data communication between the user interface and the nanoAVR is active.

4.2 FRONT PANEL CONTROLS

The nanoAVR uses a minimalist physical control design with a single control button.

To change the selected configuration preset

Briefly press the control button. The selection LED blinks quickly. Briefly press the button to move to the next preset, and repeat until the desired preset LED is lit. Press and hold the control button, and the LED will now remain steady.

To change the selected input

Press and hold the control button. The LED indicating the selected HDMI input will switch to the other input. Release the button.

4.3   INFRARED REMOTE CONTROL

Many standard and programmable remote control units can be used with the nanoAVR. Instead of adding another remote to your collection, the nanoAVR can "learn" the control codes of your current remote if it supports one of the following remote control codes:

- NEC
- Sony
- Philips RC6
- Apple Remote

To initiate the learning process, drop down the IR Remote menu and select **IR learning**. Click on the Learn button for an operation, and then press the desired button on the remote control. If the code is accepted, the status will change to show a tick.

This screenshot shows the IR learning screen:
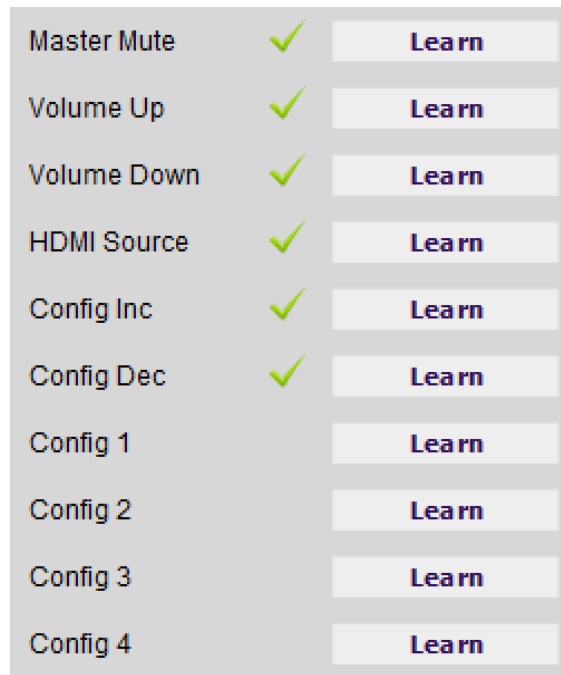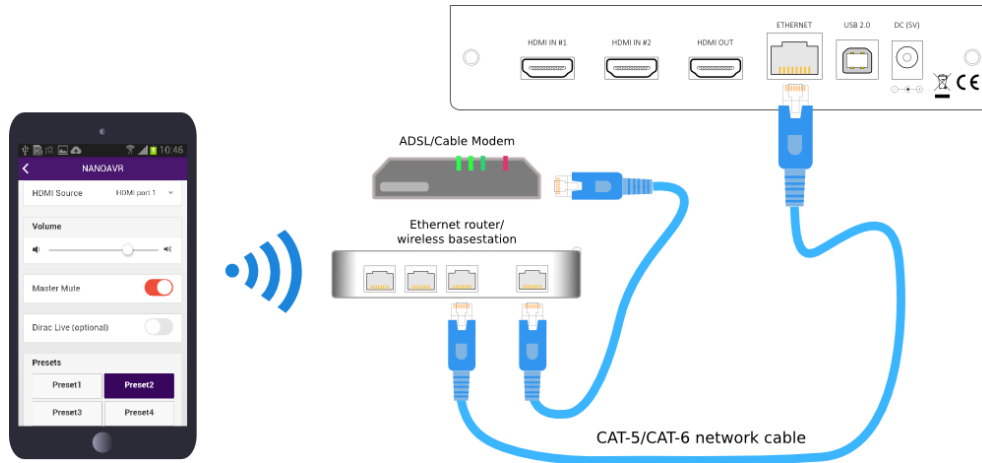

The commands **Config Inc** and **Config Dec** can be used to change the selected configuration preset up or down. This can be used instead of **Config 1**, **Config 2** and so on. Once programmed, check that the programmed buttons perform the expected function.

Note: changing the selected configuration preset with the remote will cause the user interface to disconnect.

4.4 SMARTPHONE CONTROL APP

The nanoAVR HD and nanoAVR HDA can be controlled with the miniDSP control app for Android and iOS (Apple) smartphones and tablets.

To control the nanoAVR over the network, connect an Ethernet from the nanoAVR's Ethernet port to a free port on your Ethernet router or switch. The diagram below illustrates a typical case. The network must be capable of DHCP so that the nanoAVR will be given an IP (network) address.

Download and install the miniDSP control app for your phone or tablet:

- Android - https://play.google.com/store/apps/details?id=com.minidsp.minidsp
- iOS – https://itunes.apple.com/us/app/minidsp-control-app/id945240204?ls=1&mt=8

Select Wifi and then your nanoAVR. From here, the screen allows you to select the HDMI input, control volume, turn mute on and off, and to select from the four presets.
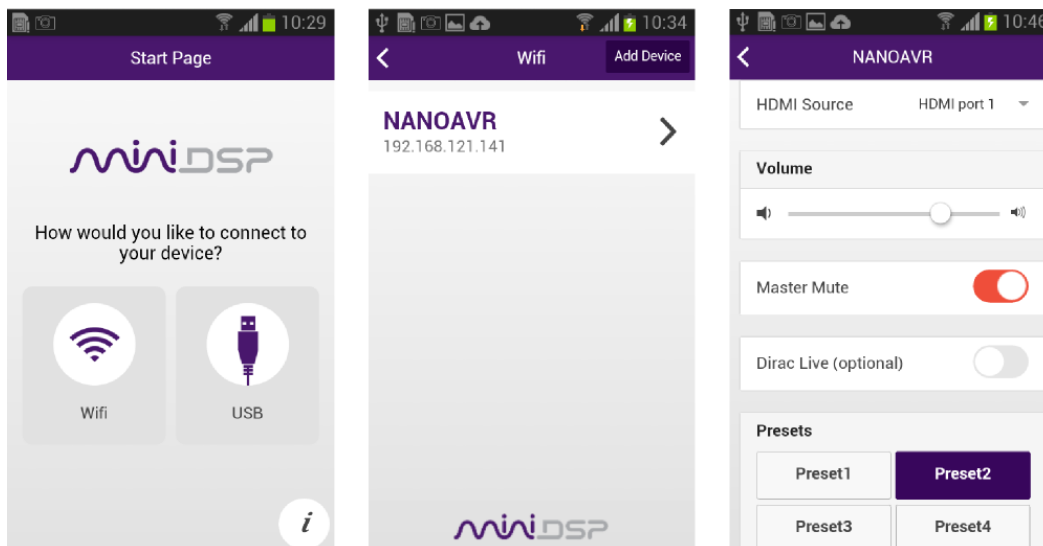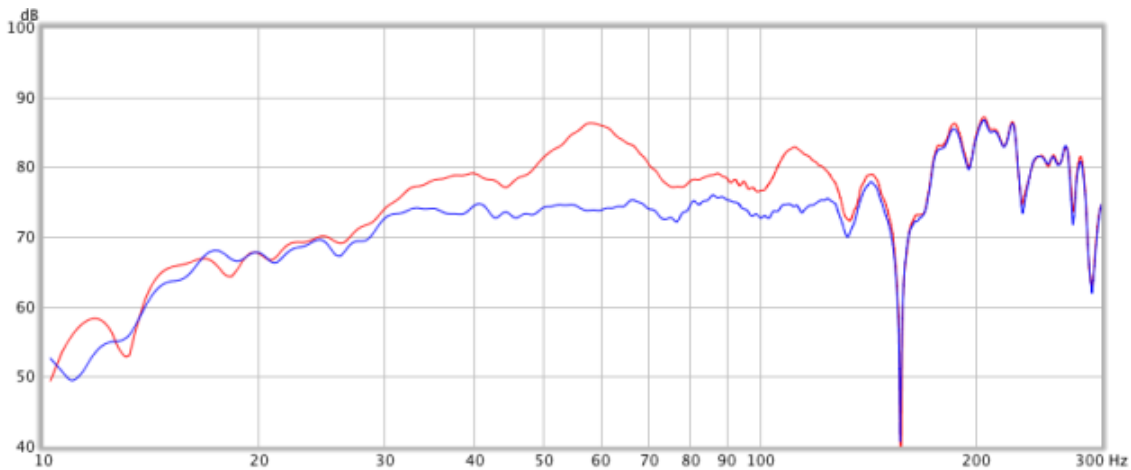
5 ACOUSTIC MEASUREMENT

To obtain most accurate equalization results with the nanoAVR, acoustic measurement will be required. This section provides a brief introduction. For more information, see the Applications section of the miniDSP.com website.

5.1 WHAT IS ACOUSTIC MEASUREMENT?

An audio or home theater system has a frequency response on each channel, which includes the response of the electronics, the loudspeaker, and the listening room. In order to understand how these all combine to affect the sound heard by listeners, an acoustic measurement using a suitable microphone and computer software is required.

The figure below shows a typical frequency response measurement for the bass region, using the freeware program Room EQ Wizard. In this example, we are equalizing the subwoofer channel, so the frequency scale from left to right progresses from 10 Hz to 300 Hz. The height of the solid red line indicates the measured SPL (sound pressure level) at each frequency.

Where there are anomalies such as peaks in the response, these can be corrected electronically in the nanoAVR. In the graph, the blue line shows the measured frequency response after correction with the parametric equalizer (PEQ) on the subwoofer channel.


Figure 1. Sample bass frequency response measurement, before and after applying PEQ

5.2 PERFORMING ACOUSTIC MEASUREMENTS

To perform an acoustic measurement, connect a computer with HDMI or Thunderbolt output to one of the inputs of the nanoAVR and select that input. The miniDSP UMIK-1 measurement microphone (or other measurement hardware) can be connected to a USB input on the computer.

The Room EQ Wizard (REW) program can then be used to generate a test signal that plays through the system and each speaker in turn. This program uses a swept-sine wave technique, which is a signal that starts at low frequencies and gets higher in frequency over the course of a few seconds. After playing the signal and recording the resulting audio, REW analyzes the captured signal and displays a frequency response plot as shown above. It is also capable of many other types of analysis that you can use to optimize your audio or home theater system.
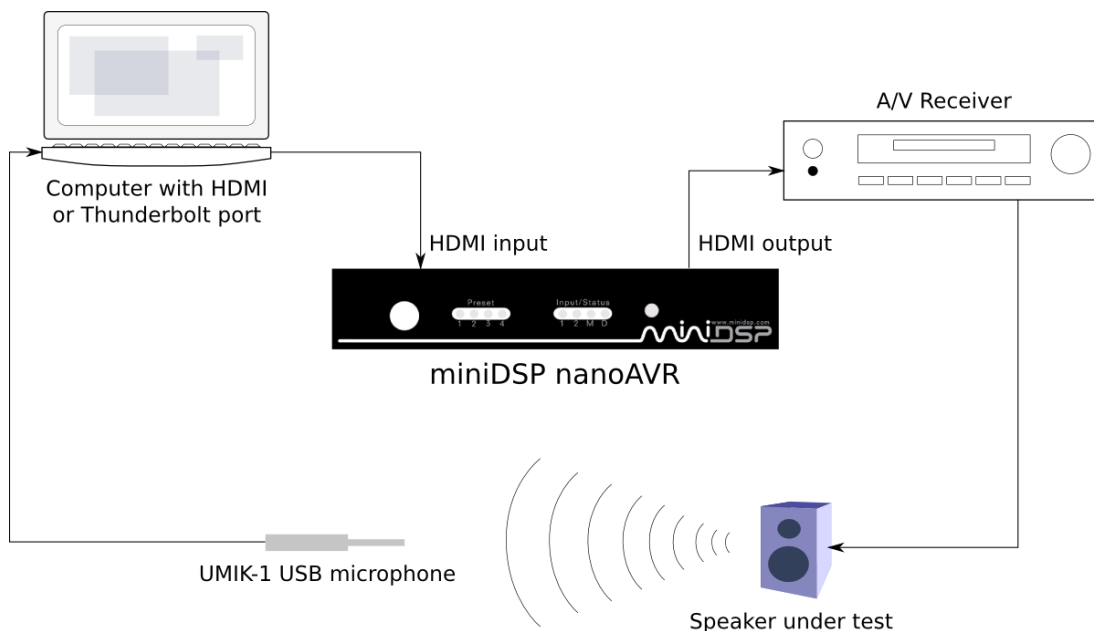
Figure 2. Typical nanoAVR connection for acoustic measurement

It is also possible to perform acoustic measurements using a test disk and an SPL meter. This method is slower and less precise, but can be used if the computer-based method is not feasible.

MORE INFORMATION

To set up your computer to use Room EQ Wizard and a UMIK-1, use one of the following application notes:

- Using the UMIK-1 and REW with HDMI output - Windows
- Using the UMIK-1 and REW with HDMI output - Mac

To learn more about how to analyse and understand the results of your measurements, see:

- Acoustic measurement with the UMIK-1 and REW

5.3 ADJUSTING EQUALIZER SETTINGS

Once a frequency response plot of a channel has been obtained, the parametric equalizers (PEQ) on that channel can be used to adjust or correct the frequency response. In addition, the PEQ can be used to tailor the sound to preference. For example, many listeners prefer an elevated bass to a "flat" response.

5.3.1 Manual method

In the manual method, we use the PEQ user interface directly to create filters that alter the frequency response. For example, in the response curve shown above there is a significant peak at 59 Hz. We can largely remove this peak by applying a corresponding dip in the frequency response with these filter settings:
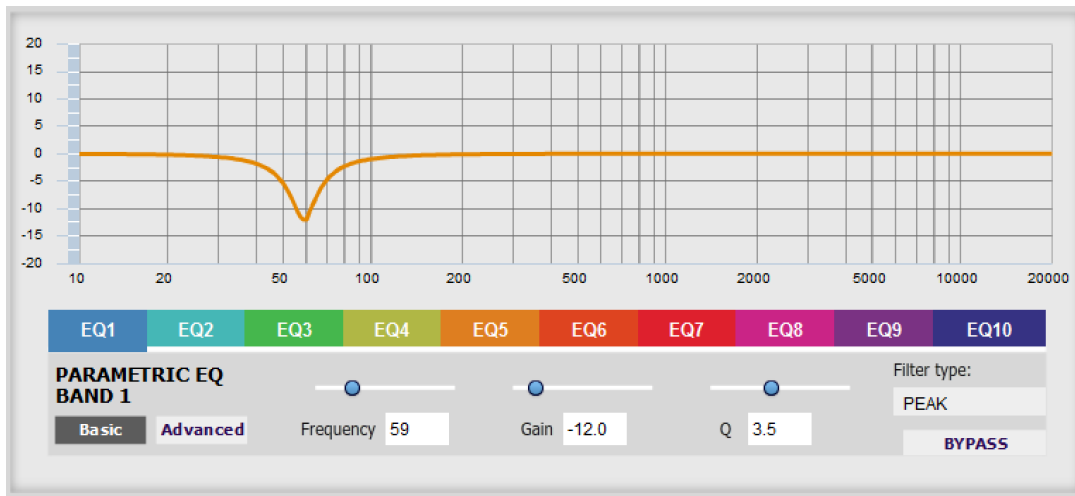

Figure 3. Single PEQ band to correct response peak

Other peaks can be treated in the same manner with additional PEQ bands. Dips in the frequency response can be treated with a corresponding peak filter, but care should be taken when boosting the response not to use too much boost or to use high-Q filters. (Too much boost can cause signal clipping, and narrow dips are typically caused by acoustic cancellations in the room and cannot be removed with EQ.)

Shelving filters can also be used to alter the frequency response. For example, if more weight in the bass is desired, this can be accomplished with a low-shelf filter with some boost, of 3 to 6 dB. Or, if less high treble emphasis is desired, this can be accomplished with a gentle high-shelf filter with a few dB cut at high frequencies.

5.3.2   Automated method

Room EQ Wizard can be used to automatically calculate a set of parametric equalization filters. In brief, the procedure is as follows:

1. Run a frequency response measurement with REW
2. In the REW Equalization window, generate a set of correction filters
3. Export the generated filter to a file
4. Set the nanoAVR parametric filters to Advanced mode and import the file

Figure 4 illustrates a frequency response correction curve generated by Room EQ Wizard.
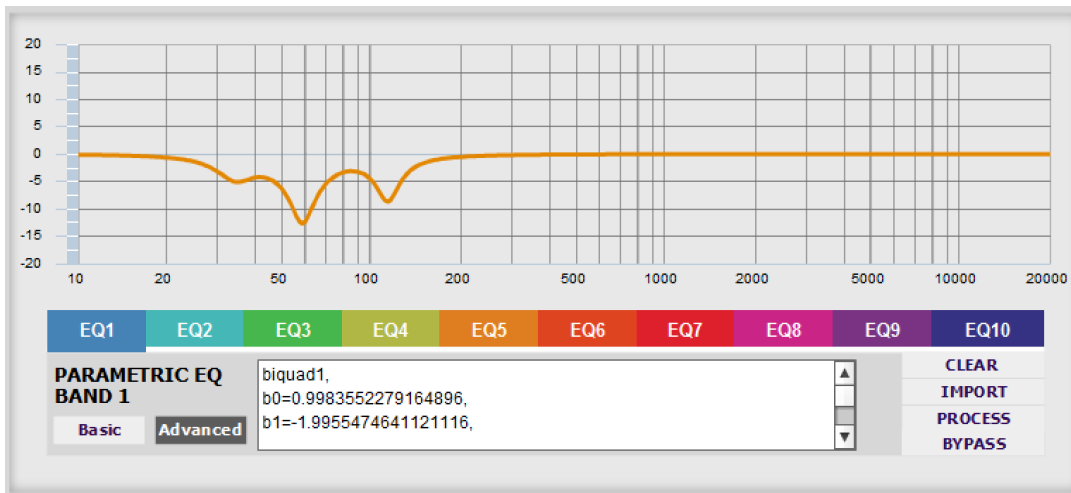
Figure 4. Auto-EQ generated with Room EQ Wizard

Filters generated by REW can be combined with manual filters. To do so, use EQ7 through EQ10 for the manual filters. When an REW file is imported, it will load into EQ1 through EQ6.

MORE INFORMATION

To learn how to use the auto-EQ feature of Room EQ Wizard, see this application note:

*   Auto-EQ tuning with REW

For complete step-by-step guides to equalizing your home theater system with the nanoAVR and configuring bass management, see the following application notes:

*   Equalizing your home theater system with the nanoAVR and UMIK-1
*   Bass management with the nanoAVR

6 ADDITIONAL INFORMATION

6.1 SPECIFICATIONS

Computer connectivity	Driverless USB 2.0 control interface for Windows and Mac OS X
	Ethernet control (RJ45 / 100Mbps) with ZeroConf support (autoIP/DHCP)
HDMI inputs	2 x HDMI 1.4a selectable from software, front panel or IR remote
	Input sample rate: 32 - 192 kHz
HDMI outputs	1 x HDMI 1.4a output
	Output sample rate: 96 kHz
Analog outputs (nanoAVR HDA only)	8 unbalanced (RCA) outputs
	Output level: 2 Vrms Dynamic range: 103 dB THD: 0.006% Output impedance: 560 Ohms
Audio sample rate / Resolution	Input/output resolution: 24-bit (32-bit internal)
	DSP internal processing path: 96kHz
Video support	Video pass-through of selected source (i.e. no video processing)
	36-bit / 3D support / HDCP embedded keys
Audio processing	Complete matrix mixer for routing of audio (8 channels in, 8 channels out)
	10-band parametric equalizer per channel (peak/notch/low&high shelf)
	Per-channel time delay, gain control, and level monitoring
Storage/presets	All settings controllable in real time from software user interface
	Up to 4 presets stored in local flash memory
Infrared remote	"Learning remote" capabilities (NEC, Philips, Sony, Apple)
	Controls master volume, mute, HDMI input selection, preset selection
Power supply	5 VDC single supply @ 600mA, 2.1 mm center-positive
Dimensions (H x W x D)	31 x 161 x 110 mm (nanoAVR HD) 47 x 161 x 110 mm (nanoAVR HDA)

miniDSP

6.2 TROUBLESHOOTING

The following table lists the most common causes of issues with the nanoAVR. If following this table does not provide a solution, see Obtaining Support below.

Item#	Symptoms	Troubleshooting recommendation
1	Cannot install software	a. Confirm that you downloaded and installed the required frameworks first (see Software Installation).
2	Software running in background but not showing	a. The Adobe Air environment may require a version update. Connect your PC to the Internet to automatically get an update, or download manually from http://get.adobe.com/air/.
3	Cannot connect to the board by USB	a. Reset the board by power-cycling the unit. b. Make sure the unit is seen in the device manager as a HID device.
4	Cannot connect to the board by Ethernet	a. With the plugin running, disconnect the Ethernet cable and reconnect it.
5	No audio or video	b. Check that all HDMI cables are securely seated. c. Check that HDMI cables are plugged into the correct inputs and the correct outputs. d. Check that each unit (TV, AVR, nanoAVR) has the correct HDMI input selected. e. Check the source is actually playing video and audio. f. Power-cycle the system. Turn off all equipment and after waiting a minute, turn equipment on again in the following order: TV/display, AVR or AVP, nanoAVR, source/player. Leave a few seconds between powering on each unit.
6	Video but no audio	a. Check that your source/player is set to output Linear PCM over HDMI (the nanoAVR does not decode compressed formats such as Dolby or DTS). b. Check that your audio device supports 96 kHz sample rate (some devices such as TVs support only 48 kHz). c. Start the user interface and press the Connect button. Then: d. Check that global mute is not enabled. e. Check that individual channels are not muted. f. Check that Master Volume is not at a low level. g. Double-check the routing screen to ensure that inputs are correctly routed to outputs.

|			
		h.	Check that the output level meters are displaying signal.
		i.	Check that the HDMI output device (AVR or AVP) is not muted.
7	Cannot reload a configuration	a.	Confirm the file format of your file (.xml).
		b.	Confirm the version of the file.

6.3 MCU FIRMWARE UPGRADE

miniDSP may periodically provide an update to the nanoAVR HD/HDA MCU firmware to enable new features. The most recent MCU firmware is always included in the installation folder of the plug-in download.

Note that firmware update is currently supported only on the Windows platform.

To update the MCU firmware:

1. Download and install the latest **nanoAVR_BM** plugin from the **User Downloads** section of the miniDSP website.

2. Connect the nanoAVR to your computer via USB.

3. Start the **nanoAVR_BM** plugin (if it is not already running).

4. Click on the **Connect** button. The button will display a green tick if connection is successful.

5. From the menus, select **Restore -> Upgrade Firmware**. The nanoAVR will be put into boot loader mode, indicated by just the Preset 1 LED flashing on the front panel. The PIC32 Bootloader application will automatically start.

6. Check the **Enable** checkbox in the **USB** pane near the bottom of the window.
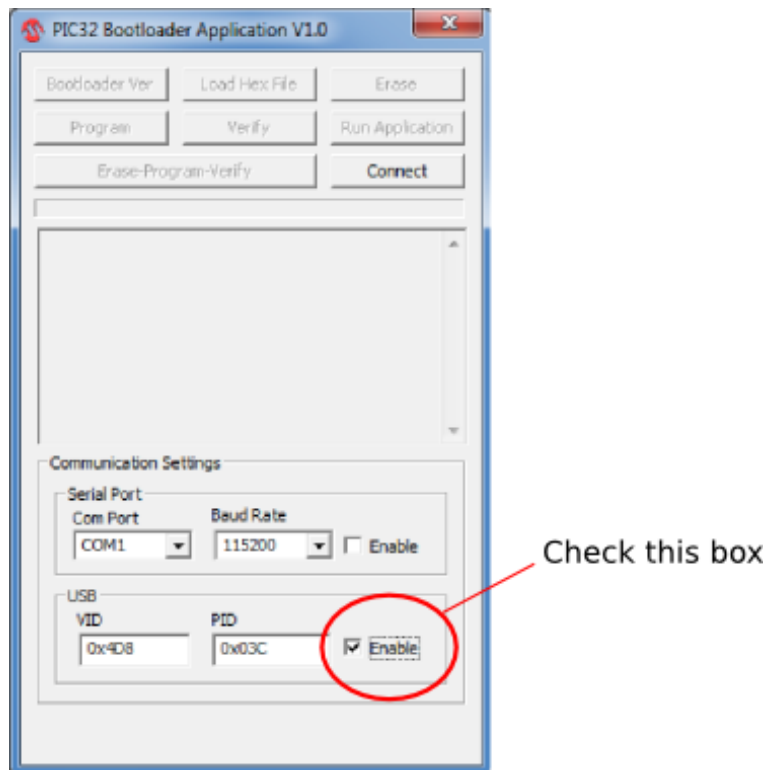
7. Click on the **Connect** button. The status display should change to show that the program has connected:
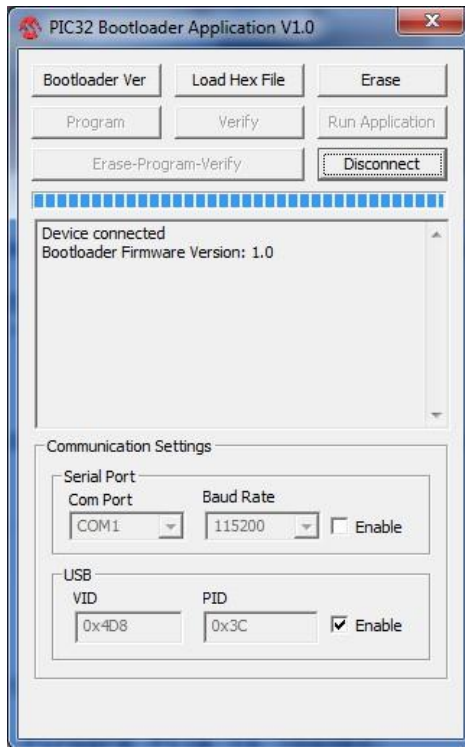
8. Click the **Load Hex File** button. Browse to the .hex firmware file located in the unzipped download folder and select it. This file will have a name like **nanoAVR_v1_23.hex**. The status will show that the hex file has loaded successfully:
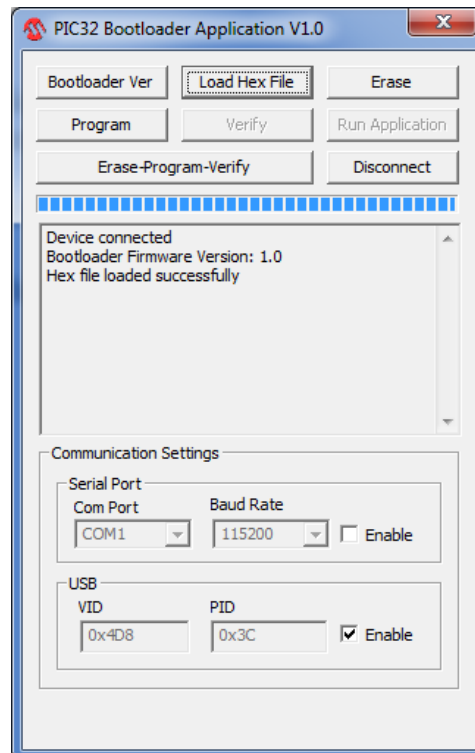
9. Click the **Erase-Program-Verify** button. The progress bar will update. After some time, the status will update to show successful completion.
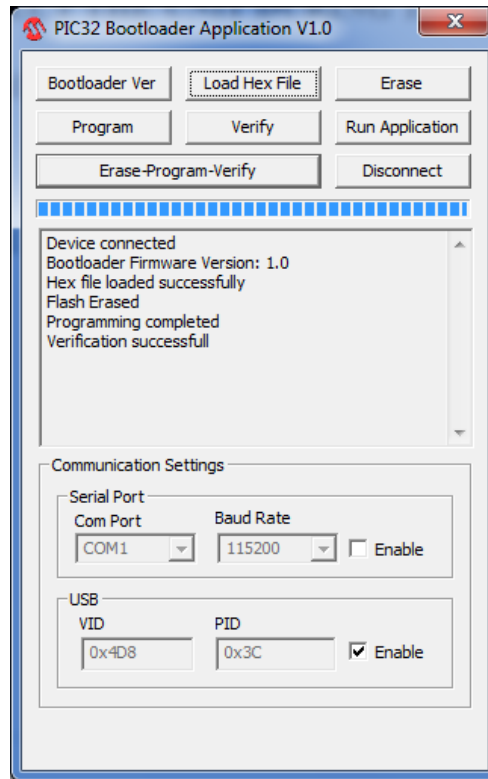
⚠ DO NOT DISCONNECT THE USB CABLE OR POWER FROM THE NANOAVR WHILE THIS IS IN PROGRESS. DOING SO MAY "BRICK" YOUR NANOAVR.

10. Click the **Run Application** button to reboot the nanoAVR.

11. Click the **Disconnect** button

12. Close the **PIC32 Bootloader** program window.

6.4 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 specific product you are having an issue with (in this case, nanoAVR HD or nanoAVR HDA).

   b. A clear explanation of the symptoms you are seeing.

   c. A description of the troubleshooting steps (see Troubleshooting above) you performed and the results obtained.