DEQX®

High Definition Preamp Processor

HDP-4

HDP-5

PreMATE

PreMATE+

HDP-Express II

# User Manual

Revision 1.
Applies to DEQX-Cal version 3.02.

# IMPORTANT INFORMATION

## DISCLAIMER AND LIMITATION OF LIABILITY

DEQX Pty. Ltd. ('DEQX') assumes no responsibility for loss or damage resulting from the use of any of its products.

Refer to the license supplied with the DEQX® Calibration software (pages 3 and 4).

**Specifications are subject to change without notice.**

Contact DEQX Support at http://deqx.com/support.php for installation and operational support. We highly recommend using the DEQXpert™ on-line installation and/or training service.

The exclamation point within a triangle is intended to alert the user to the presence of important operating and maintenance instructions in the literature accompanying the product.

The lightning with arrowhead symbol within a triangle is intended to alert the user to the presence of un-insulated "dangerous voltage" within the products' enclosure that may be of sufficient magnitude to constitute a risk of electrical shock to person.

## WARNING

To prevent fire or shock hazard, do not expose the unit to rain or moisture. To avoid electrical shock, do not open the unit. No user-serviceable parts are inside. Refer any servicing to qualified personnel.

ALWAYS TURN THE DEQX UNIT AND ANY ASSOCIATED AUDIO EQUIPMENT OFF BEFORE CONNECTING OR DISCONNECTING AUDIO CABLES.

ANY AUDIO EQUIPMENT REQUIRING GROUNDING MUST BE GROUNDED TO THE SAME POINT (CIRCUIT) AS THE DEQX UNIT.

FAILURE TO OBSERVE THESE WARNINGS CAN RESULT IN DAMAGE TO THE DEQX UNIT AND OTHER AUDIO EQUIPMENT AND MAY NOT BE COVERED BY WARRANTY.

Caution: Damage may result to your speaker drivers and other equipment if your audio system is connected incorrectly or if the unit is used incorrectly. Read this user manual in full before configuring your hardware and refer to your speaker manufacturer's specifications to ensure correct connection. If you are in doubt as to as the connection of your audio equipment, seek assistance from a professional audio installer or contact DEQX at http://deqx.com/support.php.

## IMPORTANT SAFETY INSTRUCTIONS

Read these instructions entirely before installing or operating this product. Keep these instructions. Heed all warnings. Follow all instructions.

Do not use this product near water. Clean only with a dry cloth.

Do not block any ventilation openings. Install in accordance with the manufacturer's instructions.

Do not install near any heat source such as radiators, heat registers, stoves, or other apparatus (including amplifiers) that produce heat.

Do not defeat the safety purpose of the grounding-type safety plug. A grounding-type plug has two blades and a third grounding prong or blade. The third prong or blade is provided for your safety. If the provided plug does not fit into your outlet, consult an electrician for replacement of the obsolete outlet.

Protect the power cord from being walked on or pinched, particularly at the plug and the point where the cord exits from this product.

Do not use this product with a damaged cord or plug.

Only use attachments and accessories specified by the manufacturer.

Unplug this product during lightning storms or when unused for long periods of time.

Refer all servicing to qualified service personnel. Servicing is required when the product has been damaged in any way, such as when the power cord or plug are damaged, liquid has been spilled or objects have fallen into the product, the product has been exposed to rain or moisture, does not operate normally, or has been dropped.

## CLEANING AND MAINTENANCE

Always unplug the product from the electrical outlet before cleaning. Do not use abrasive cleaners. Simply wipe the exterior with a clean soft cloth. A small amount of non-abrasive cleaner may be used on the cloth to remove any excessive dirt or fingerprints.

## LICENSE

This is a legal agreement ('Agreement') between you (either an individual or an entity), the end user, and DEQX Pty Limited, Sydney, Australia. By installing, copying, or otherwise using the Product (as defined below), you agree to be bound by the terms of this Agreement. If you do not agree to the terms of this Agreement, do not install, copy, or use the product, and promptly return the disks and any accompanying items (including written materials and binders or other containers, if any) to DEQX Pty Limited.

**DEQX LICENSE AGREEMENT** for one Copy of DEQX-Cal™ Acoustic Calibration Software and Firmware © 2004–2016 DEQX Pty Limited. All rights reserved.

### GRANT OF LICENSE

DEQX grants the 'Recipient' a limited, nonexclusive, non-transferrable, royalty-included with hardware purchase, license to make and use DEQX-Cal™ software ('Product') to be installed on approved Windows platforms for Recipient's use ONLY with DEQX® speaker and room

calibration products including but not limited to PDC-2.6, PDC-2.6P, HDP-3, HDP-4, HDP-5, DEQX MATE, PreMATE, PreMATE+, HDP-Express, and HDP-Express II.

All other rights are reserved to DEQX. Recipient shall not rent, lease, sell, sublicense, assign, or otherwise transfer the Product, any accompanying printed materials ('Documentation'), or a digital content created with the Product ('Filter coefficients'). Recipient may not reverse engineer or decompile the Product. DEQX and its suppliers shall retain title and all ownership rights to the product, and this Agreement shall not be construed in any manner as transferring any rights of ownership or license to the Product or to the features or information therein, except as specifically stated herein.

### TERM OF AGREEMENT

The term of this Agreement shall commence on the date you accept this Agreement and shall continue unless terminated by DEQX in writing at any time, with or without cause. In the event that DEQX terminates this agreement, Recipient shall promptly return to DEQX, or certify destruction of, all full or partial copies of such product and related materials provided by DEQX.

### PRODUCT MAINTENANCE

DEQX is not obligated to provide maintenance or updates to Recipient for Product licensed under this Agreement.

### DISCLAIMER OF WARRANTY

DEQX-Cal™ software ('Product') is deemed accepted by Recipient upon first use. The PRODUCT IS PROVIDED 'AS IS' WITHOUT WARRANTY OF ANY KIND. TO THE MAXIMUM EXTENT PERMITTED BY APPLICABLE LAW, DEQX FURTHER DISCLAIMS ALL WARRANTIES, INCLUDING WITHOUT LIMITATION ANY IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE AND NONINFRINGEMENT. THE ENTIRE RISK ARISING OUT OF THE USE OR PERFORMANCE OF THE PRODUCT AND DOCUMENTATION REMAINS WITH RECIPIENT.

TO THE MAXIMUM EXTENT PERMITTED BY APPLICABLE LAW, IN NO EVENT SHALL DEQX OR ITS SUPPLIERS BE LIABLE FOR ANY CONSEQUENTIAL, INCIDENTAL, DIRECT, INDIRECT, SPECIAL, PUNITIVE, OR OTHER DAMAGES WHATSOEVER (INCLUDING, WITHOUT LIMITATION, DAMAGES FOR LOSS OF BUSINESS PROFITS, BUSINESS INTERRUPTION, LOSS OF BUSINESS INFORMATION, OR OTHER PECUNIARY LOSS) ARISING OUT OF THE USE OF OR INABILITY TO USE THE PRODUCT OR DOCUMENTATION, EVEN IF DEQX HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES.

### GOVERNING LAW; ATTORNEY'S FEES

The laws of the State of New South Wales, Australia shall govern this Agreement and Recipient further consents to jurisdiction by the state and Australian federal courts sitting in the State of New South Wales. If either DEQX or Recipient employs attorneys to enforce any rights arising out of or relating to this Agreement, the prevailing party shall be entitled to recover reasonable attorneys' fees.

## COPYRIGHT

# CONTENTS

## LIST OF EXPLANATORY BOXES



## LIST OF FIGURES

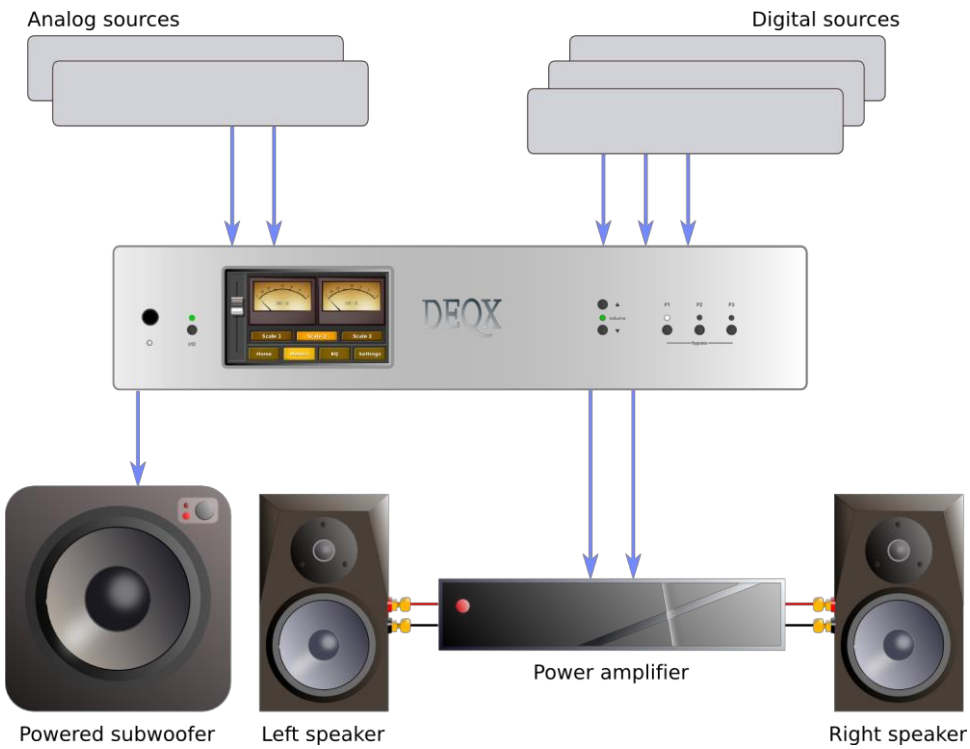


## LIST OF TABLES

# 1 WELCOME TO DEQX

Congratulations on purchasing a DEQX® High Definition Preamp Processor. Your DEQX is one of the most advanced audio processors in the world, with patented digital audio processing, advanced algorithmic design, and an impeccable pedigree focused on delivering the best possible performance from a high-end audio system.

The DEQX® Preamp Processor tackles head-on the most fundamental issues of high-fidelity speaker design. It is used in the world's most technically advanced speakers. In addition, *any* speaker can be improved by deploying a DEQX processor. In most high-end home or professional audio systems, the DEQX completely replaces the preamp and the DAC. (The HDP-5 and PreMATE+ also act as a networked streaming audio destination, further simplifying system configuration.)

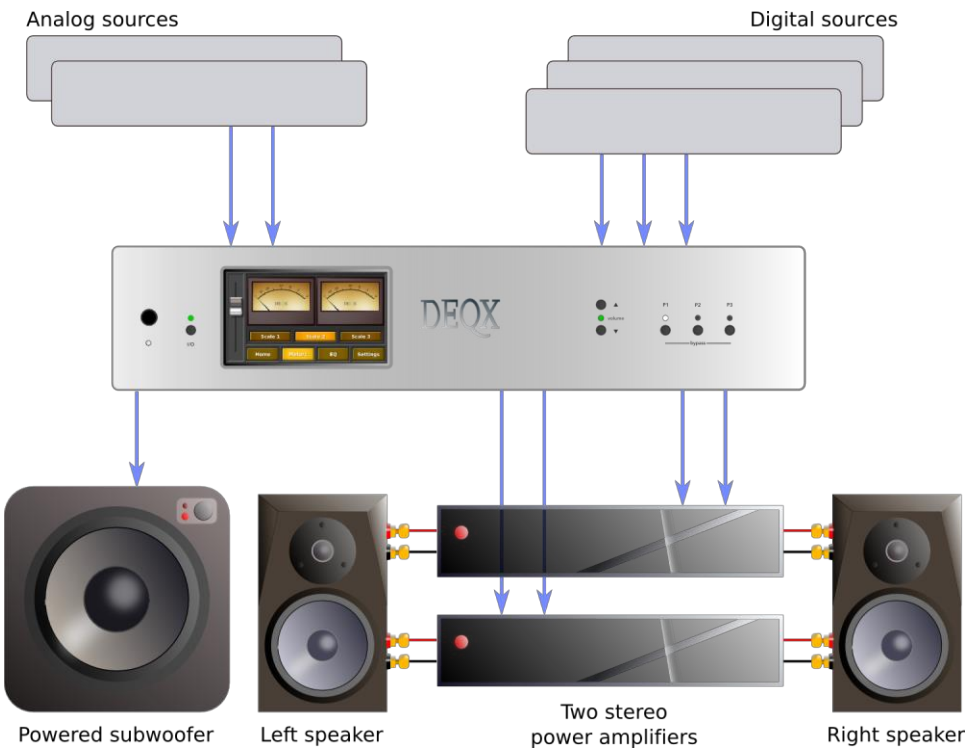


## 1.1 SYSTEM CONFIGURATIONS

The DEQX® Preamp Processor is a powerful and flexible tool. In its first mode of operation, the DEQX acts as preamp, DAC, and correction processor for a conventional pair of full range[1] speakers. The diagram on the previous page illustrates a typical system configuration. The speakers usually contain multiple transducers, or *drivers*, and a passive *crossover* that divides the frequency range between the drivers. The DEQX also integrates either mono or stereo subwoofers.

In that mode of operation, known as "single amp" in this manual, the DEQX and its accompanying DEQX-Cal™ software calibrate the speaker, correct for the room, and provide a fine-grained Preference EQ for different listening situations, media, and even for individual recordings.

In its more advanced "HD-active speaker" mode of operation (applicable to HDP models only), the DEQX also implements steep *linear-phase active* crossovers between the individual drivers in the speaker. Used by speaker designers and advanced enthusiasts, this third-generation active speaker architecture takes the passive crossovers out the equation completely, allowing complete optimization of the individual transducers by the DEQX. This diagram illustrates:




[1] By "full range," we are referring to the frequency range covered by the speaker – nominally 20 Hz to 20 kHz, although few speakers (without subwoofers) extend as low as 20 Hz.

## 1.2 How DEQX® calibration works

Compared to every other component in the audio recording, production, media and playback chain, the mechanical nature of speakers makes them extraordinarily prone to errors and distortion that detract from realism. These include timing or phase errors where numerous "groups" of frequencies lag behind others to varying degrees; amplitude (volume) errors that result in inaccurate tonal characteristics; and frequency-dependent distortion many times higher than the signal from the electronics.

The advanced algorithms in DEQX software analyze the behavior of the speaker based on anechoic measurements, creating detailed corrections that calibrate the transducers ("drivers") and correct for these errors. Each speaker or driver can be calibrated individually for the utmost in reproduction accuracy. These detailed corrections are then assembled into a configuration of filters that is uploaded to the DEQX, and which it uses to process the audio signal that you ultimately hear as music in your listening room. This *measure-calibrate-configure* cycle is the core of optimizing your speakers using DEQX.

## 1.3 How to use this manual

Chapters 2 through 4 guide you through the initial hardware setup and describe the front panel and the DEQX Remote. You will need to come back to these chapters to re-read the more in-depth sections, such as the three-band Preference EQ.

Chapter 5 walks you through the initial setup of DEQX-Cal. We strongly recommend that you carefully follow this chapter. Chapters 6 to 9 will guide you through your first *measure-calibrate-configure* cycle. These chapters are both tutorial and reference.

Chapters 10 to 12 deal with room-related issues: room measurement, subwoofer integration, and room EQ. Chapters 13 and 14 are for speaker designers and advanced enthusiasts implementing active speakers with DEQX. The remaining chapters and the appendixes provide detailed reference information.

## 1.4 DEQXpert consultation

Your purchase of a new PreMATE, PreMATE+, HDP-4 or HDP-5 includes an initial DEQXpert™ consultation. (It is an optional upgrade for the HDP-Express II.) This consultation gets you started with your initial setup. We will walk you through the steps to set up your speakers and microphone, and control your computer remotely (with your permission) to perform your first *measure-calibrate-configure* cycle.

After your initial consultation, you will have a set of profiles configured that you can switch between with the DEQX remote. You can use the guidance in this manual to continue to refine your configuration, or purchase additional DEQXpert™ consultation to have us do it for you. For more information, see http://deqx.com/deqxpert.php.

## 1.5 WARRANTY REGISTRATION

To register your DEQX, fill in the warranty registration form on our website:

http://deqx.com/warranty.php

After registering, you will receive a return email with information and a password to obtain software updates, microphone calibration files, and documentation downloads. In addition, by registering, DEQX will be able to keep you informed of any important updates.

## 1.6 OBTAINING SUPPORT

To obtain support, fill in the support form on our website:

http://deqx.com/support.php

If you provide as much information as you can in the form, it will help us to troubleshoot your issue more effectively. It is important to be as complete as possible.

## 1.7 A NOTE ON DEQX LEGACY PRODUCTS

This manual applies to the current generation of DEQX products: PreMATE, PreMATE+, HDP-4, HDP-5, and HDP-Express II. The DEQX-Cal™ software continues to be fully compatible with DEQX legacy products, including the PDC-2.6, PDC-2.6P, HDP-3, DEQX Mate, and HDP-Express. The following features present in DEQX-Cal are intended for legacy products only:

- 48 kHz operation, selectable in the configuration window (page 72). Current generation products should always be set for 96 kHz operation.
- External digital clock, selectable in the IO Manager (page 134). Current generation products do not require or support this option.
- Analog-only output, selectable in the IO Manager (page 134). Current generation products always have digital outputs enabled. (Note that all outputs are isolated, so there is no benefit to be gained by turning off the digital outputs.)
- Digital Upsampling and Analog 96 kHz, selectable in the IO Manager (page 135). Current generation products always use digital upsampling and analog 96 kHz operation, so these options have no effect.

Note also that some legacy products may require a firmware upgrade to be controlled over the USB interface by the current version of DEQX-Cal. For these products, connect first via RS-232 and check the firmware version in the IO Manager. If it is not version 45.6 or higher, upgrade the firmware (page 167) and then try a USB connection.

# 2 INSTALLATION AND CONNECTIVITY

This chapter guides you through the hardware setup of the DEQX.

## 2.1 UNPACKING THE UNIT

Carefully remove the unit and the accessory kit from the shipping carton. Visually check for shipping damage. Contact both the shipper and DEQX immediately if the unit or any of the accessories bear any sign of damage from mishandling. All DEQX equipment is carefully inspected before leaving our factory.

Keep the shipping carton and packing materials for future use or in the unlikely event that the product needs servicing. If the product is shipped without the original packaging, damage could occur and void the warranty.

**Accessory kit contents**

You should find the following in the accessory kit:

- One (1) AC mains cable
- One (1) USB cable
- One (1) microphone cable
- One (1) CD-ROM with the DEQX Calibration software and USB drivers
- One (1) measurement microphone with microphone holder
- One (1) remote control
- Two (2) AAA batteries
- One (1) printed User Manual (additional documentation is located on the CD-ROM)

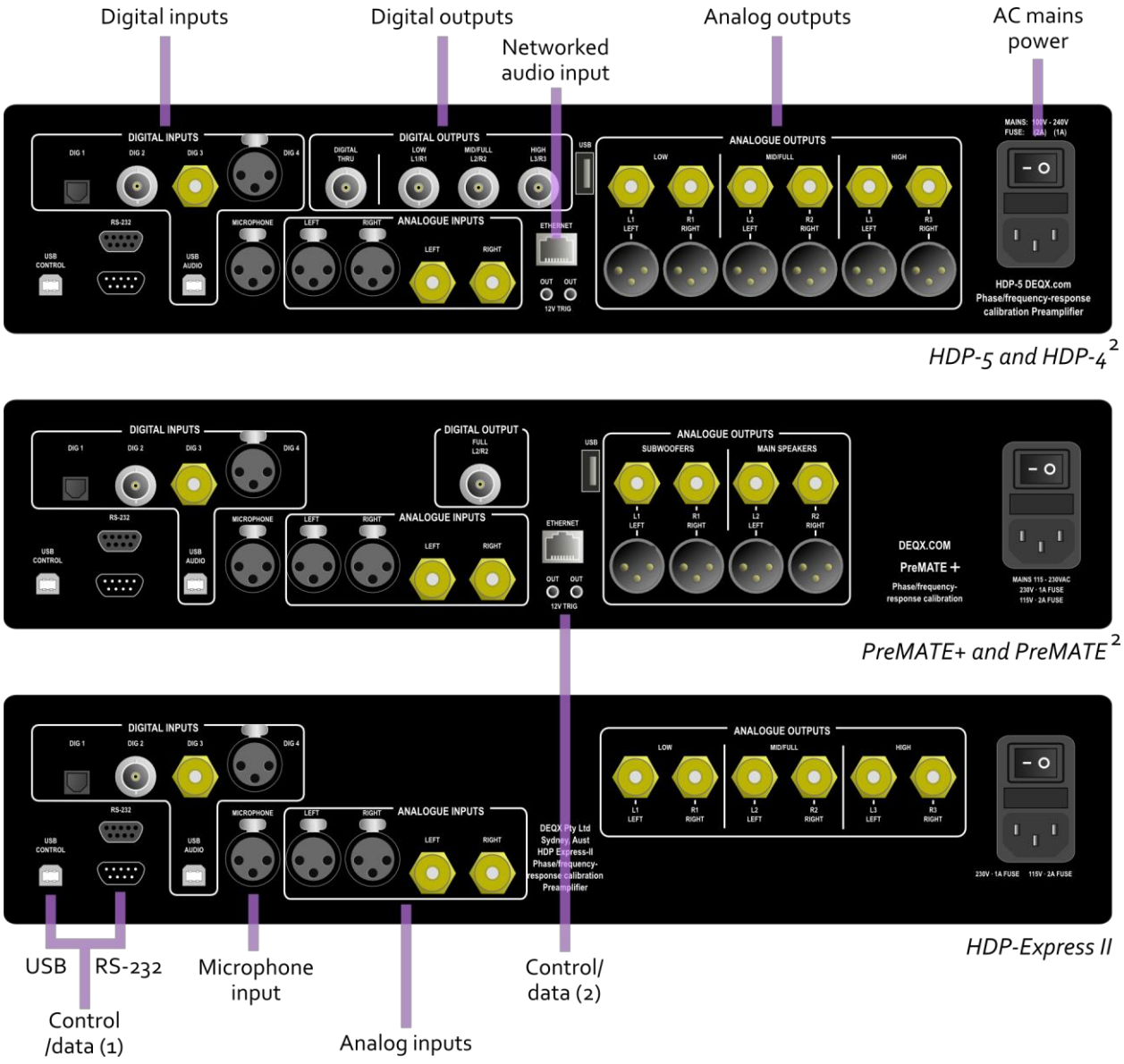
**Physical installation**

The DEQX must be placed on a sturdy level surface, such as a shelf or in a suitable rack or cabinet. Allow a minimum of 5 cm (2 inches) on both sides for ventilation.

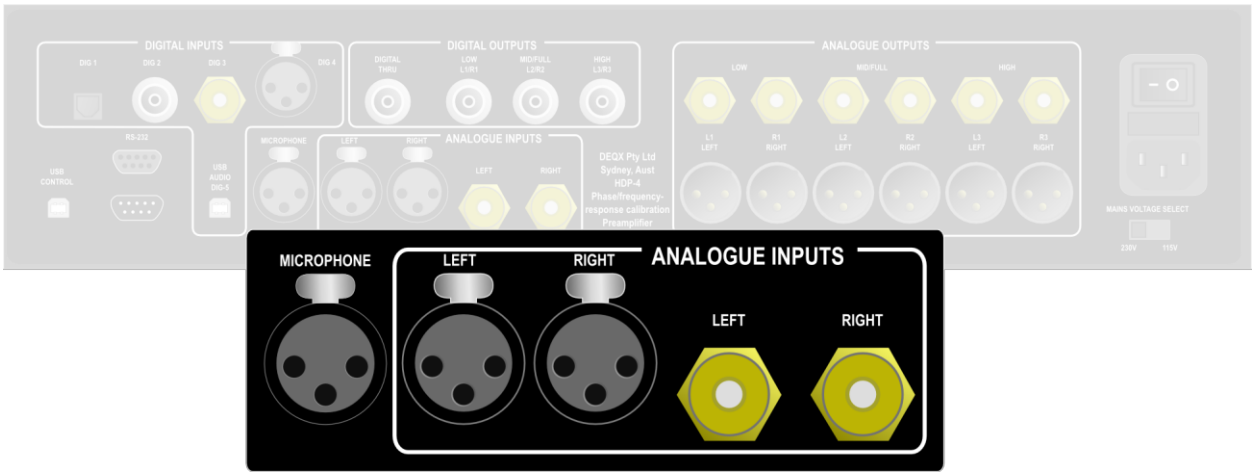
During initial setup and calibration, it may be preferred to not install the unit within a rack or cabinet, in order to allow easy access to the rear panel.

## 2.2 REAR PANEL OVERVIEW

All DEQX units are variations on a theme, designed to provide a high degree of flexibility in connecting your new DEQX into your audio system. Each features a full complement of five digital inputs as well as balanced and unbalanced analog inputs. The HDP-5 and PreMATE+ also act as a networked streaming audio destination via their Ethernet port. Specific units differ in output connectivity with different analog and digital output configurations according to intended use.[2]




[2] The HDP-4 and PreMATE lack the USB A, Ethernet, and 12V Trigger connectors in the center of the rear panel. The HDP-4 has an additional switch for mains input voltage selection.




## 2.3 ANALOG INPUTS

All DEQX units have two stereo analog input pairs: unbalanced and balanced. The two input pairs are independent, and are selectable with the DEQX Remote and from within DEQX-Cal. On the HDP-5 and PreMATE+, inputs can also be selected with the touchscreen display.

**Unbalanced input (Analog 1)**

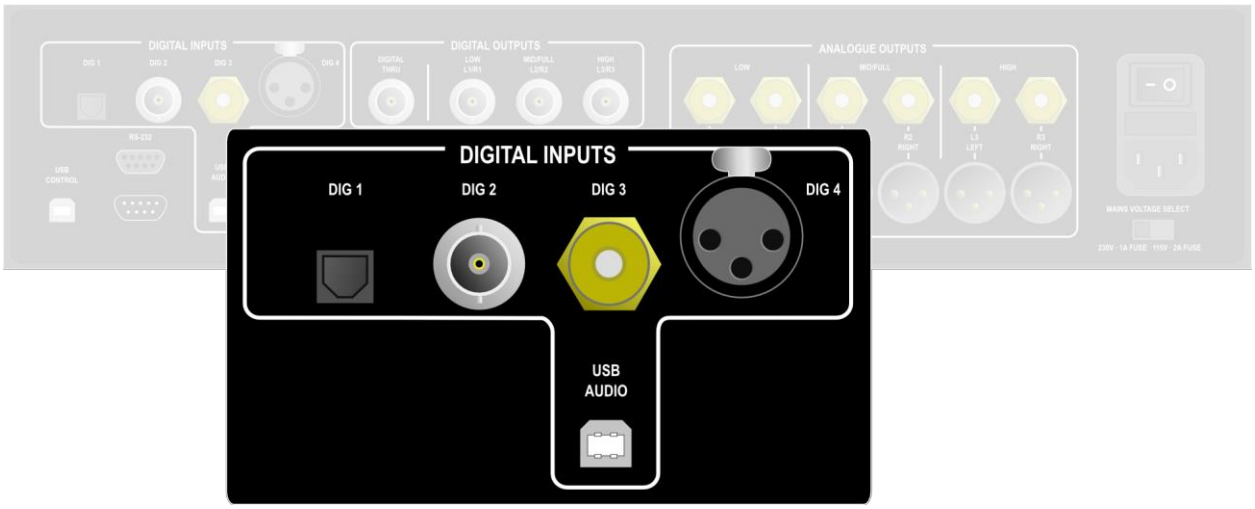
This is a stereo input pair on standard RCA connectors. Use a suitable pair of RCA line-level interconnect cables to connect an analog source. Alternatively, this input can be connected to an analog preamp. If necessary, the sensitivity of this input can be adjusted by hardware jumpers (see Appendix D).

**Balanced input (Analog 2)**

This is a stereo input pair for connecting to balanced equipment. Use a suitable pair of high quality balanced XLR cables to connect an analog source. Alternatively, this input can be connected to an analog preamp.

### NOTES ON MAKING AND BREAKING CONNECTIONS

1. Power off the DEQX with the rear panel switch before changing any input or output audio connections. All connected equipment should also be powered off.
2. When connecting to the rear panel, double-check that the connections are made correctly. If the DEQX is installed in a rack or cabinet, use good light so that the labeling is clearly visible.
3. Confirm output connections using the diagrams on pages 23, 107, and 108.
4. Push RCA connectors straight on and pull them straight off – avoid twisting them to get them on and off.




## 2.4 DIGITAL INPUTS

All DEQX units have a full complement of digital inputs. Digital inputs are selectable with the DEQX Remote and from within DEQX-Cal. On the HDP-5 and PreMATE+, inputs can also be selected with the touchscreen display.

**TOSLINK optical (DIG 1)**

This is a standard digital audio optical connection that accepts standard sample rates up to 96 kHz.

**S/PDIF on BNC (DIG 2)**

This is an S/PDIF digital input via a 75 Ω (75 ohm) BNC connector. Connecting a source with S/PDIF output over BNC and a 75 Ω cable provides optimum digital signal transmission. It accepts all standard sample rates up to 192 kHz.

**S/PDIF on RCA (DIG 3)**

This is an S/PDIF digital input via RCA connector. It accepts all standard sample rates up to 192 kHz.

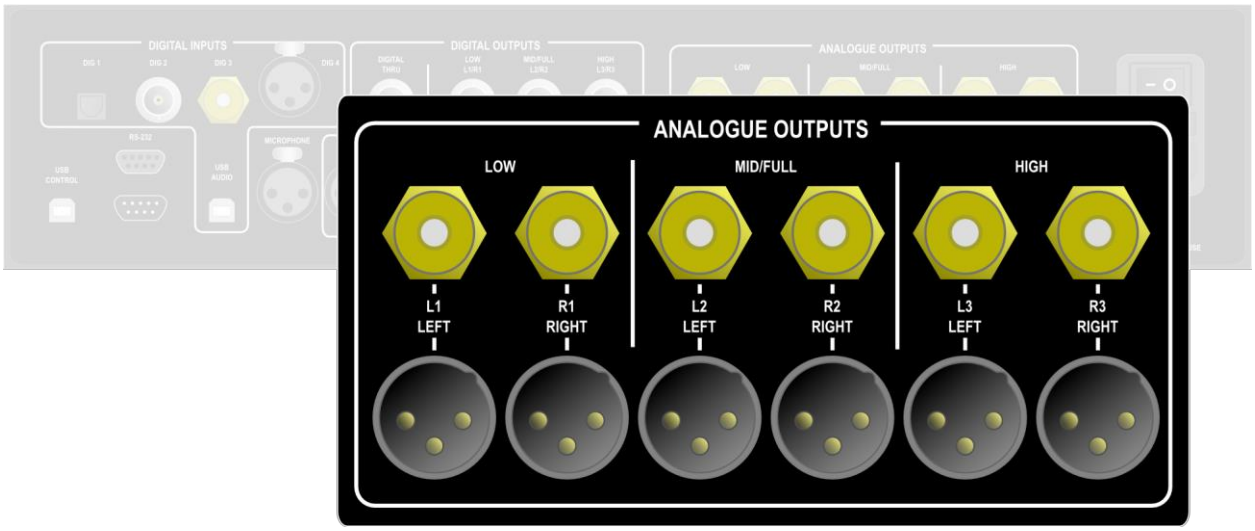
**AES/EBU on XLR (DIG 4)**

This is an AES/EBU digital input via XLR connector. It accepts all standard sample rates up to 192 kHz.

**USB Audio**

This is an asynchronous USB Audio Class 2 input for connection to a computer or high-end music server/streamer. It accepts PCM audio at all standard sample rates up to 192 kHz. For Windows, a driver will need to be installed (see Appendix B on page 161).

The HDP-5 and PreMATE+ also act as a networked streaming audio destination via the Ethernet jack in the center of the rear panel. See Appendix C for details.




## 2.5 ANALOG OUTPUTS

The set of analog outputs varies by model. In all cases, the maximum output voltage can be set by internal jumpers (see Appendix D). The connections made to the analog outputs depend on the chosen system configuration – see the explanatory box on page 23 for use with full range passive speakers and pages 107–108 for active speakers.

### HDP-4 and HDP-5

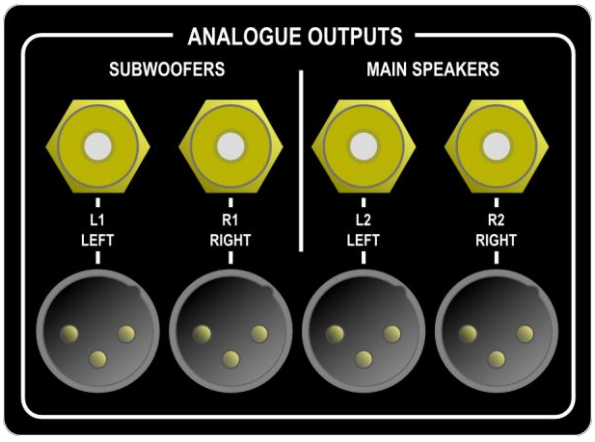
The HDP-4 and HDP-5 have three pairs of outputs, provided by separate unbalanced (on RCA) and balanced (on XLR) circuits. In accordance with the full tri-amped output configuration (page 108), each pair is labeled **Low**, **Mid/Full**, and **High**. Individual outputs are labeled **L1**/**R1**, **L2**/**R2**, and **L3**/**R3**.

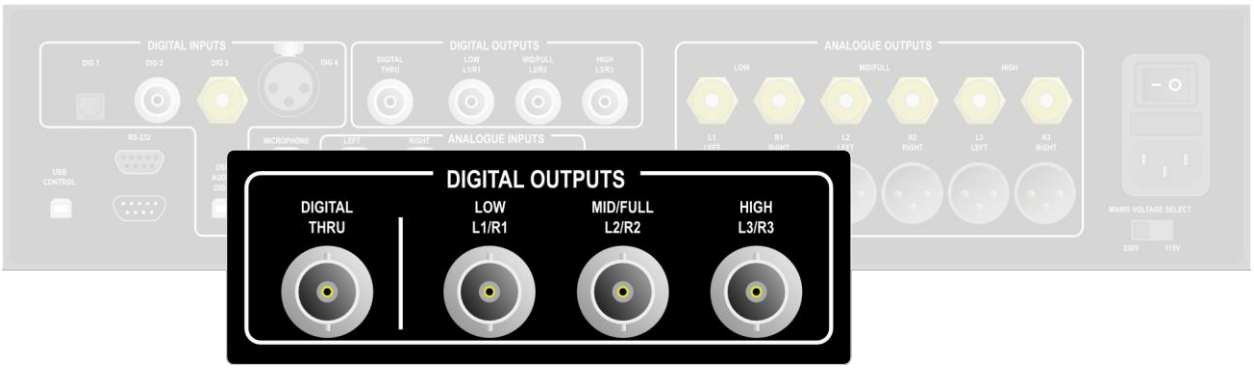
### HDP-Express II

The HDP-Express II has three pairs of outputs as per the HDP-4 and HDP-5, provided as unbalanced signals on RCA connectors. The HDP-Express II does not have balanced outputs.

### PreMATE and PreMATE+

The PreMATE and PreMATE+ have two pairs of outputs, labeled **Subwoofers** and **Main Speakers**, provided by separate single-ended (on RCA) and balanced (on XLR) circuits. Individual outputs are labeled **L1**/**R1** and **L2**/**R2**.






## 2.6 DIGITAL OUTPUTS

The HDP-4 and HDP-5 provide a full complement of digital outputs, as shown above. All digital outputs are on professional 75 Ω (75 ohm) BNC connectors and produce an S/PDIF digital audio stream at 96 kHz sample rate. (BNC-RCA adapters can be used for connection of RCA digital cables.) See page 24 for an example of the use of digital outputs.

**Digital Thru**

This is the selected stereo input signal (analog or digital), with no correction or processing applied. It is used to create more complex system configurations by chaining multiple DEQX units (see Chapter 14). Digital Thru does not have volume control or any form of filtering or other processing applied to it.

**Low, Mid/Full, High**

These three stereo digital outputs carry the same signal as the analog **Low**, **Mid/Full**, and **High** outputs. They can be used to connect external DACs instead of using the internal DACs of the DEQX.

The PreMATE and PreMATE+ provide a single digital output:


**Full**

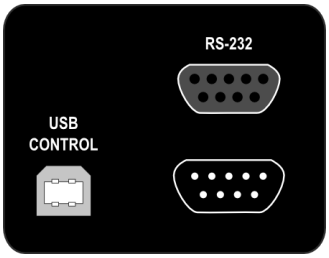
This is the same signal as provided on the **Main Speakers** analog output. It carries the corrected audio signal for the speakers, optionally with limit filters for subwoofer integration. It can be used to connect an external DAC instead of using the internal DAC of the DEQX.

The HDP-Express II does not have digital outputs.

## 2.7 CONTROL/DATA INTERFACES

The rear panel contains a number of control/data interfaces.

### USB Control




The USB Control socket is located at the lower left of the rear panel (when facing the rear panel). Use the supplied USB cable to connect the DEQX to your computer when running DEQX-Cal.

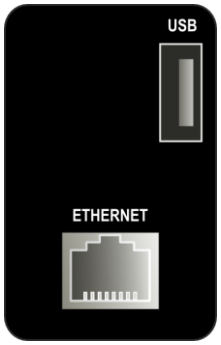
(For PreMATE+ and HDP-5 owners: when the DEQX detects communication from the DEQX-Cal software over USB, the LCD touchscreen will be disabled and will power off after a time.)

### RS-232

The top RS-232 port is an input control port. It is used when the DEQX is a slave unit in a multi-DEQX system (Chapter 14). It can also be used to control the DEQX from certain home automation systems (e.g. Crestron). In the latter case, contact DEQX directly for details of the RS-232 control protocol.

The bottom RS-232 port is an output control port, used in master-slave configurations with multiple DEQX units (see Chapter 14).

### Ethernet (PreMATE+ and HDP-5 only)




The Ethernet port is used for networked streaming audio. See Appendix C for full information on this feature.

### USB (PreMATE+ and HDP-5 only)

The USB (Type A) port is used for firmware updates of the touchscreen display CPU.

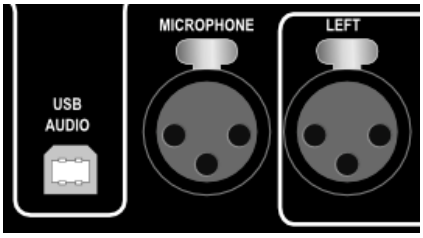
## 2.8 TRIGGER OUTPUT

The PreMATE+ and HDP-5 have two 3.5 mm trigger sockets on the rear panel. These outputs provide a 12 V DC trigger shortly after the DEQX is taken out of standby, and can be used to turn on external amplification.

Both sockets are identical. There are two sockets provided for convenience, as the DEQX unit often drives multiple amplifiers.

## 2.9 MEASUREMENT MICROPHONE

The input connector for the measurement microphone is located between the stereo analog input block and the USB Audio input. For information about connecting and setting up the measurement microphone, see page 44. When connecting the measurement microphone, always double-check that the cable is inserted into the correct socket.




## 2.10 POWER

The rear panel contains the AC mains power block:


**Mains voltage selector (HDP-4 only)**

The mains voltage selector switch should be set upon delivery to the correct voltage for your country. Double-check this before powering on the DEQX for the first time.

**IEC mains socket**

This socket accepts a standard IEC (IEC 60320 C13) mains plug. The specified AC mains voltage is 100-120 or 220-240 V at 50 to 60 Hz as set by the mains selector switch (HDP-4 only), or 100 to 240 V at 50 to 60 Hz (all products except HDP-4).

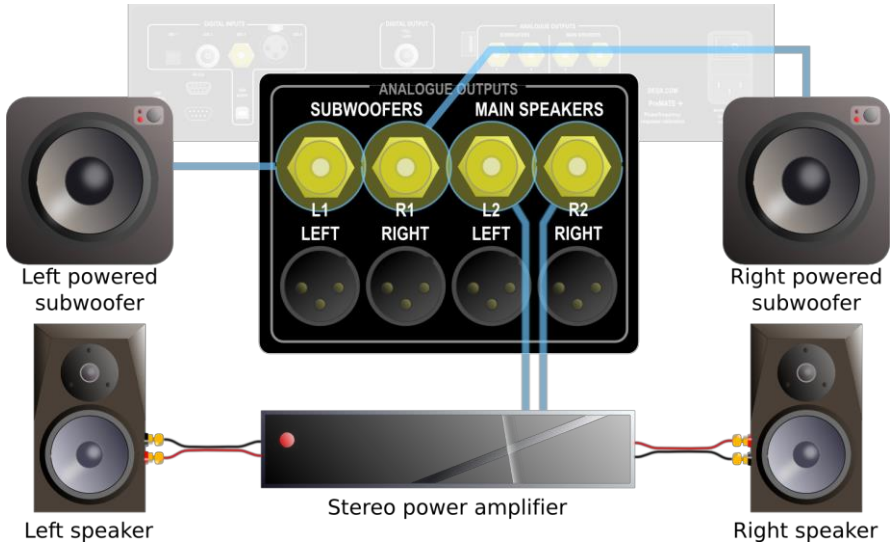
**Power switch**

The power switch applies power to the unit. This is typically left switched on and the standby mode invoked from the front panel or with the DEQX Remote. Use the power switch to physically remove power from the unit when connecting or disconnecting cables or when changing analog gain jumpers (Appendix D).

**Fuse**

The fuse holder uses a standard 5x20 mm glass fuse. In the event that the fuse needs to be replaced, it must be rated at 2A for 100–120 V or 1A for 220–240 V.

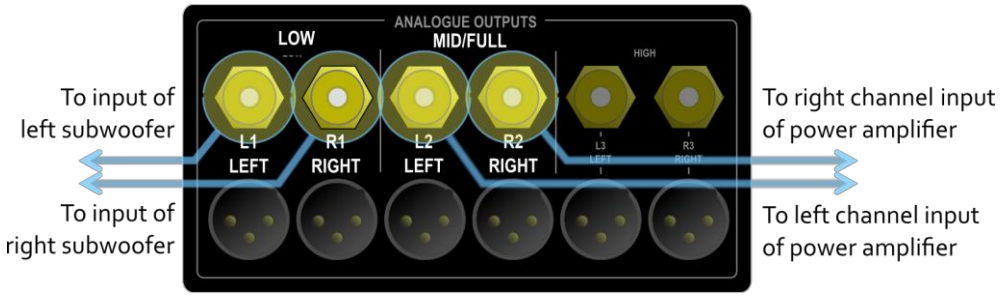
## ANALOG OUTPUT EXAMPLE




The diagram above illustrates the connections for a pair of full range speakers and a pair of stereo subwoofers connected to a PreMATE or PreMATE+. Take the left channel speaker output from **L2** and the right channel speaker output from **R2**. Connect the left and right subwoofers to **L1** and **R1** and in DEQX-Cal, set the speaker configuration mode to "Single amp with optional stereo subwoofers."

If using just one (mono) subwoofer, connect it to **L1** and leave **R1** unconnected. In that case, set the speaker configuration mode in DEQX-Cal to "Single amp with optional mono subwoofer." If not using a subwoofer, simply leave the subwoofer outputs disabled when configuring the DEQX in DEQX-Cal.

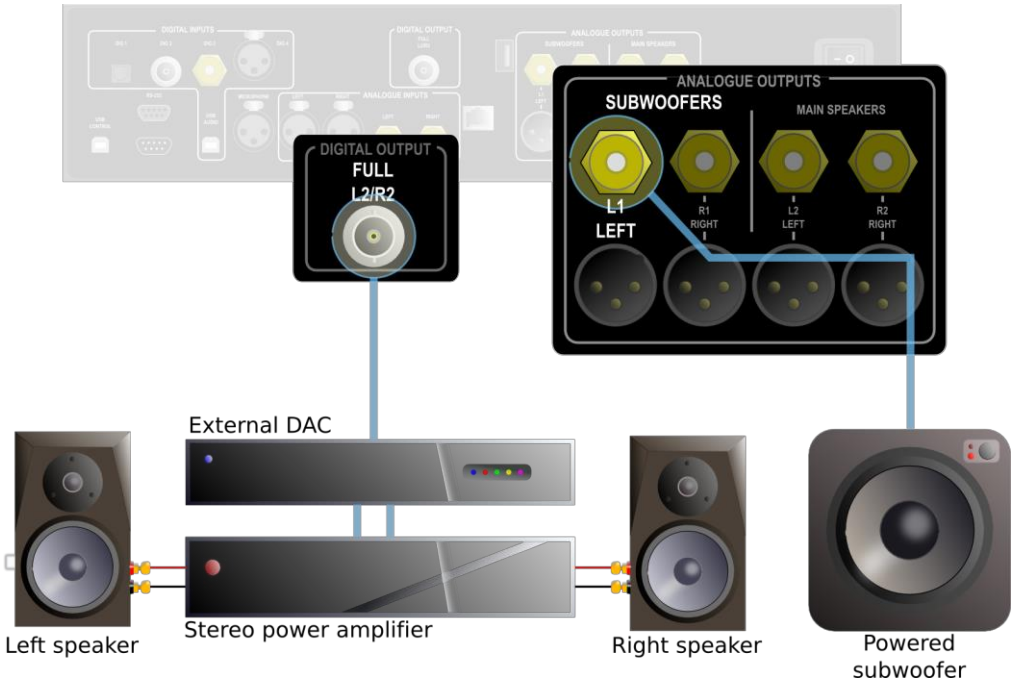
For the HDP-4 or HDP-5, the output connections are still taken from **L2** and **R2** for the speakers and from **L1** and **R1** for the subwoofers. However, the labeling on the rear panel is slightly different, as shown below.




In the case of the PreMATE, PreMATE+, HDP-4 and HDP-5, use the balanced outputs if the connected amplifiers or subwoofers have balanced inputs.

For the HDP-Express II, the connections are as shown above for the HDP-4 and HDP-5, but there are no balanced outputs.

## DIGITAL OUTPUT EXAMPLE

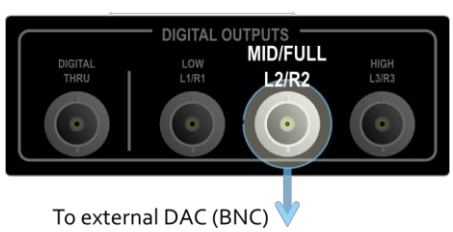



The diagram above illustrates the use of the digital output of the PreMATE or PreMATE+. Connect the digital output, labeled **Full L2/R2**, to an external DAC via a BNC cable (or an RCA cable with a BNC-RCA adapter). The outputs of the DAC are connected to the power amplifier, which in turn drives the left and right speakers. Note that the external DAC must be capable of decoding a 24-bit 96 kHz signal.

If a single (mono) subwoofer is used (as shown above), connect it to the **L1** analog output (either unbalanced or balanced) and in DEQX-Cal, set the speaker configuration mode to "Single amp with optional mono subwoofer." If stereo subwoofers are used, connect them to the **L1** and **R1** analog outputs (either unbalanced or balanced), and set the speaker configuration mode to "single amp with optional stereo subwoofers." If not using a subwoofer, simply leave the subwoofer outputs disabled when configuring the DEQX in DEQX-Cal.

If using an HDP-4 or HDP-5, connect the DAC to the **Mid/Full L2/R2** digital output (at right).

With the HDP-4 and HDP-5, an external DAC can be used for the subwoofer(s) as well, if desired. In that case, connect the digital output **Low L1/R1** to the DAC being used for the subwoofer(s).



# 3 THE FRONT PANEL

The DEQX front panel provides basic controls as well as status and feedback indicators for standby, volume control, and profile selection. These are a subset of the controls provided by the DEQX Remote (Chapter 4). The PreMATE+ and HDP-5 add an LCD touchscreen that provides a volume slider, input and profile selection, real-time metering, and other functions.

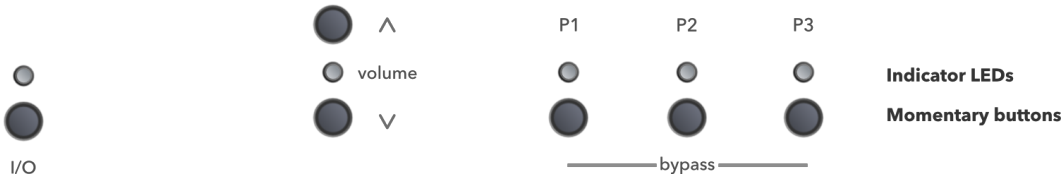

*DEQX PreMATE and HDP-4 — black*


*DEQX PreMATE and HDP-4 — silver*


*DEQX PreMATE+ and HDP-5 — black*

## 3.1 BUTTONS AND INDICATOR LEDS

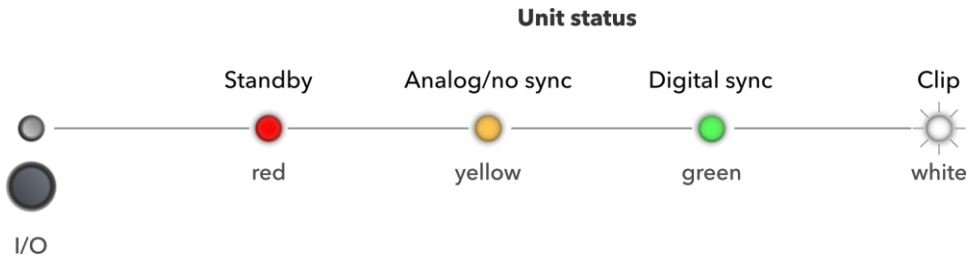
There are five sets of buttons and corresponding indicator LEDs on the front panel. The standby (I/O) button and indicator is to the left of the panel, while the volume and profile selection buttons and indicators are clustered on the right side of the panel.




Note: the HDP-Express II does not have the buttons on the front panel and relies on the DEQX Remote for these operations. The indicator LEDs behave the same way as other models.

## 3.2 STANDBY

Press the I/O button to take the DEQX out of or put it into standby mode. The indicator LED displays current unit status as shown here:




**Standby (red)**

The DEQX is in standby mode.

**Analog/no sync (yellow)**

An analog input is selected, *or* a digital input is selected and there is no sync signal detected.

**Digital sync (green)**

A digital input is selected and digital sync is detected. (Note that the USB Audio input will always flag a sync detect even if there is nothing connected to the USB Audio input port.)

**Clip (white)**

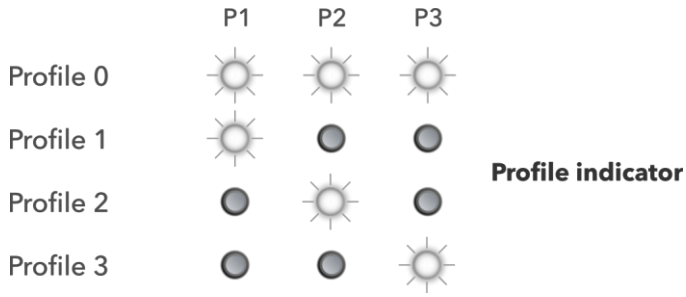
Clipping was detected on the analog input or on an output channel. The LED remains white for several seconds after a clipping event is detected.

## 3.3 PROFILE SELECTION

The P1, P2 and P3 buttons are used to select a profile. Each profile contains a set of correction filters and room EQ, so switching between profiles can be used to audition different correction filters and for different listening situations. Use a single button to select Profiles 1 to 3 and any two buttons to select Profile 0.

- PreMATE+ and HDP-5: Press and hold the button or buttons for two seconds.
- PreMATE, HDP-4, and HDP-Express II: Press the button or buttons and release immediately.

The LEDs light white to indicate the currently selected profile:

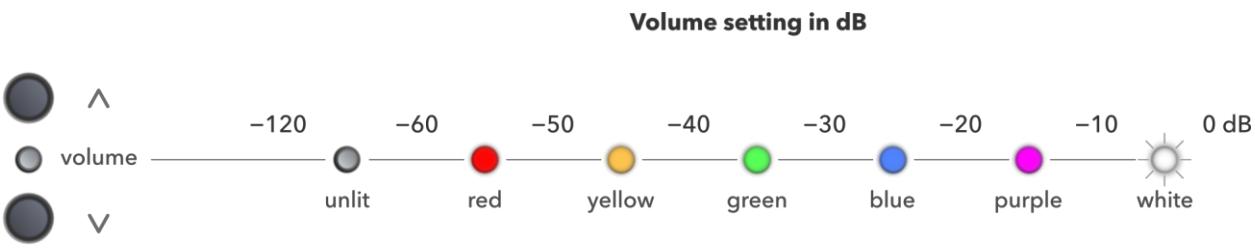



## 3.4 VOLUME

Press the up and down buttons to increase or decrease the master volume. The change in volume on each button press depends on the current volume setting:

| Current volume | Volume step size (approx.) |
|---|---|
| −24 to 0 dB | 1 dB |
| −36 to −24 dB | 2 dB |
| −48 to −36 dB | 3 dB |
| −120 to −48 dB | 6 dB |

Below −120 dB, the DEQX is effectively muted. The Volume LED provides an indication by color of the volume setting in 10 dB ranges, as illustrated in the diagram below.



## 3.5 TOUCHSCREEN DISPLAY

The HDP-5 and PreMATE+ incorporate a touchscreen display on the front panel. It provides volume control, input and profile selection, real time metering, and other functions.

When turning on the DEQX with the rear panel switch, the touchscreen will remain blank for a short period of time while its microprocessor initializes. When taking the DEQX out of standby, the touchscreen will come to life almost instantly.

The touchscreen display turns itself off approximately ten minutes after the last user input (use of the display, any front panel buttons or the DEQX Remote), *unless* the metering screen is displayed, in which case it stays illuminated. It turns on again as soon as any user input is received.

Note that the touchscreen display becomes inactive when DEQX-Cal connects to the DEQX. When this happens, the volume slider decreases to –∞ (all the way down) and all user input on the panel will be ignored. The display will turn itself off after approximately ten minutes.

The master volume slider is present at the left of every screen. Touch the silver bar with a finger and slide it up or down to change the master volume. All the way up is 0 dB, or maximum volume; all the way down is –∞, or effectively muted.

### Home screen

The Home screen displays the currently selected input source and profile. Press gently on a button to select that input or profile.


The "Internal" button puts the DEQX (HDP-5 or PreMATE+) into networked streaming audio mode, whereby a networked audio source can be streamed to the DEQX for playback. See Appendix C for full information on this feature. (This is the same as the "Auto" button on the DEQX Remote.)

### Meters screen

The Meters screen displays the input signal level on both channels, with three metering ranges selectable by the Scale 1, Scale 2, and Scale 3 buttons. The marked values on the meter are:

- –20 to 0 dB for Scale 1
- –30 to 0 dB for Scale 2
- –60 to 0 dB for Scale 3

The meter mimics the "ballistics" of a traditional VU meter, which displays neither peak nor average signal but a perceived loudness level. When set to Scale 2, it also mimics the amplitude range of a traditional meter.


Note that the touchscreen display does not go to sleep when the Meters screen is displayed.

### EQ screen

The EQ screen is, as of the writing of this version of the DEQX User Manual, still in development.

### Settings screen

The Settings screen provides two functions:

**Update**

This button updates the touchscreen display firmware. Insert a USB stick containing the DEQX-supplied firmware update, and then press the **Update** button.

**Reset**

This button resets the touchscreen display drivers. It can be used on the advice of DEQX Support in the event of specific operational issues with the unit.


## 3.6 SPECIAL STATUS INDICATORS

The front panel LEDs indicate special status, as follows.

**All LEDs are yellow**

No filter profiles have been loaded into the DEQX.

**All LEDs blinking blue**

The DEQX has been booted into safe mode. See page 167.

**All LEDs turned on in a combination of red, blue and yellow**

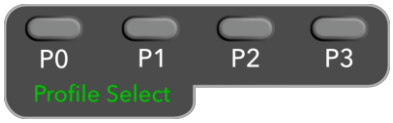
The DEQX has entered fault mode. See page 170.

# 4 THE DEQX REMOTE

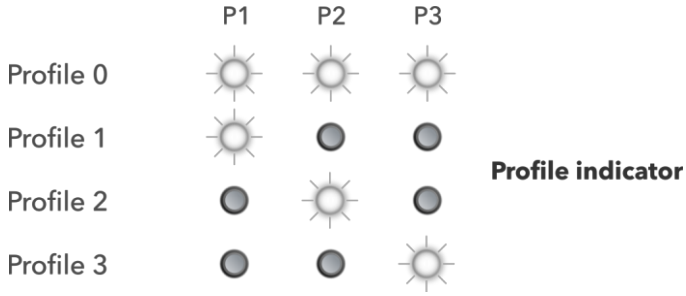
The DEQX Remote provides input and profile selection, mute and standby, and volume control. In addition, it provides access to the powerful three-band Preference EQ.

## 4.1 PROFILE SELECTION

Press any of the four buttons to select the corresponding profile.

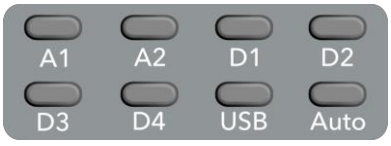



The corresponding front panel LED will light white for Profiles 1 to 3. All three LEDs will light white for Profile 0.




## 4.2 INPUT SELECTION

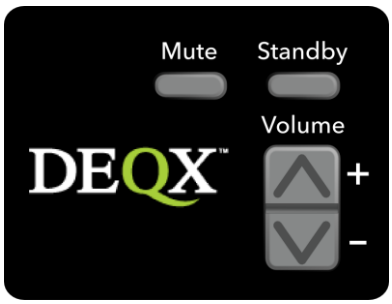
All DEQX models have two analog inputs and five digital inputs, all selectable with the DEQX Remote. The HDP-5 and PreMATE+ also act as a networked streaming audio destination if the "Auto" button is used.




| Button | Selected input |
|---|---|
| A1 | Unbalanced analog (RCA) |
| A2 | Balanced analog (XLR) |
| D1 | TOSLINK (optical) |
| D2 | S/PDIF on BNC |
| D3 | S/PDIF on RCA |
| D4 | AES/EBU (XLR) |
| USB | USB Audio input |
| Auto | HDP-5 and PreMATE+: The DEQX is put into networked streaming audio mode (see Appendix C for full details).<br><br>HDP-4, PreMATE, and HDP-Express II: The DEQX plays the last-selected digital or analog source, according to which has signal. |

The input selection affects the I/O (standby) LED – see page 26.

## 4.3 VOLUME, MUTE AND STANDBY




**Mute**

Mutes all outputs. The Volume LED on the front panel will flash while the DEQX is muted (unless the level is below 60 dB, in which case the Volume LED is not lit at all).

**Standby**

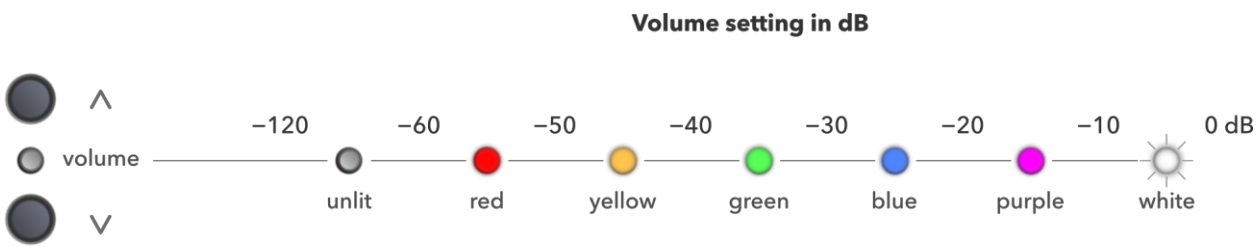
Takes the DEQX out of standby mode, or puts it into standby mode. In standby mode, the I/O LED is red. When out of standby mode, the I/O LED is yellow, green, or white (see page 26). In the case of the HDP-5 and PreMATE+, the touchscreen becomes active when the DEQX is taken out of standby mode.

**Volume + and –**

Increase or decrease the master volume level. The change in volume on each button press depends on the current volume setting:

| Current volume | Volume step size (approx.) |
|---|---|
| –24 to 0 dB | 1 dB |
| –36 to –24 dB | 2 dB |
| –48 to –36 dB | 3 dB |
| –120 to –48 dB | 6 dB |

Below –120 dB, the DEQX is effectively muted. The Volume LED provides an indication by color of the volume setting in 10 dB ranges, as illustrated in the diagram below.



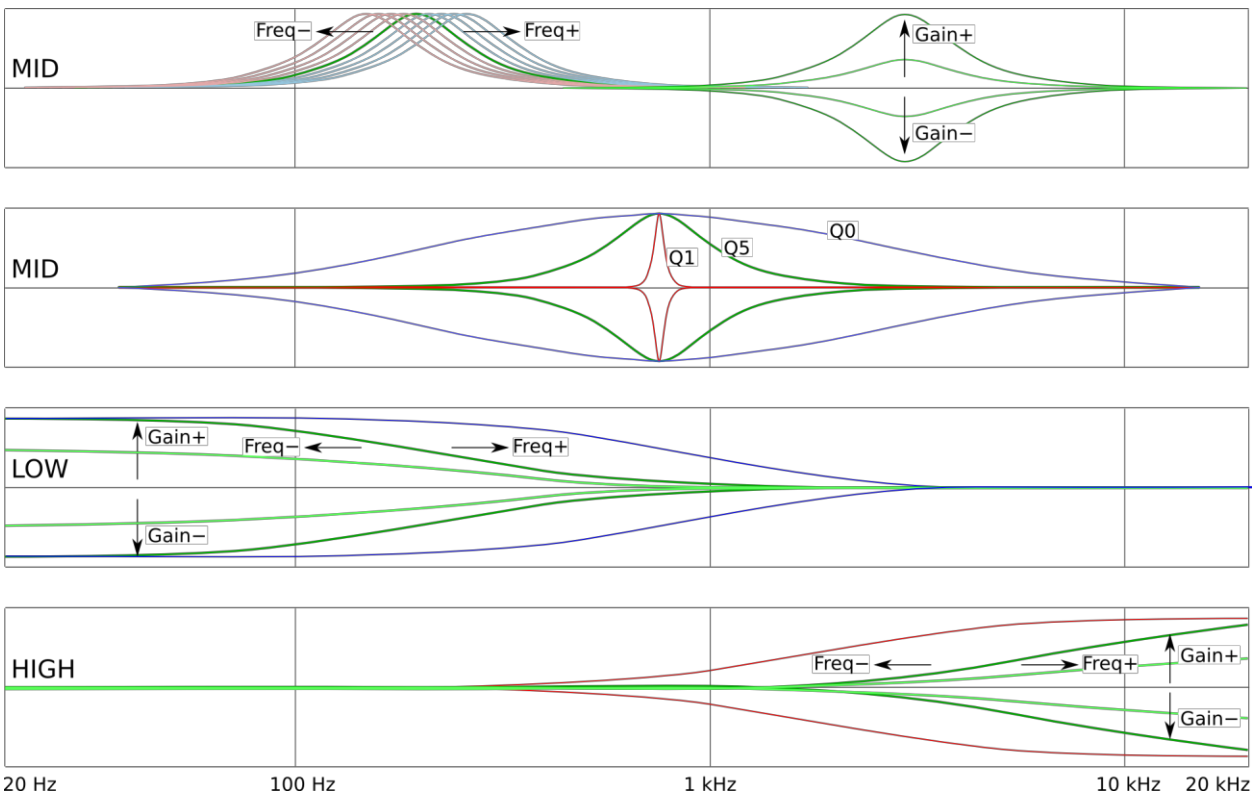
## 4.4 PREFERENCE EQ

The DEQX has three Preference EQ bands, named HIGH, MID, and LOW, that are controlled with the DEQX Remote. Preference EQ is used to adjust system response with fine-grained frequency shaping to cater for different listening situations and for different recordings. Up to 100 Preference EQ presets can be stored in the DEQX and recalled with the remote.

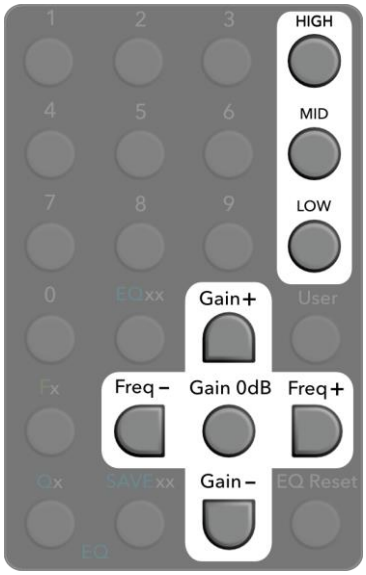
Note that Preference EQ is distinct from room EQ: Preference EQ is stored in the DEQX for each profile, but is not stored in the configuration. Loading a new configuration will therefore not change Preference EQ settings.

Referring to the diagram below, the MID band is a fully parametric peaking or cut filter. The center frequency is adjustable in semitone steps from 20 Hz to 20 kHz; the gain (boost or cut) of the filter can be varied in 1 dB steps between –9 dB and +9 dB; and the Q, which controls the width of the filter, can be set from very narrow to very broad.

The LOW and HIGH bands are shelving filters – that is, low or high frequencies below or above the transition frequency are shelved up or down. The transition frequency of the filters is settable in semitone steps and the gain (boost or cut) is adjustable in 1 dB steps between –9 dB and +9 dB.



**To set the active EQ band:**




One of the three EQ bands is designated "active," meaning that subsequent changes to gain, frequency or Q will act on that band.

To set the active band, press HIGH, MID, or LOW. One of the three profile LEDs, as indicated in Table 1 below, will briefly light green to confirm the choice.

(For example, suppose MID is pressed. If the DEQX currently has Profile 1 selected, the P1 LED will go out while P2 lights green, then P2 will go out and P1 will turn back on. If, however, the DEQX currently has Profile 2 selected, the P2 LED will change from white to green, then back to white.)

*Table 1. Mapping of EQ bands to Profile LEDs*

| EQ band | Corresponding Profile LED |
|---|---|
| LOW | P1 |
| MID | P2 |
| HIGH | P3 |

**To change gain:**

Press **Gain+** or **Gain–**. The Profile LED corresponding to the active EQ band will briefly light green. The gain of the EQ band will be changed in 1 dB steps, up to +9 dB or down to –9 dB.

**To reset the gain:**

Press **Gain 0dB**. The Profile LED corresponding to the active EQ band will briefly light green. The gain of the EQ band will be set back to 0 dB (flat).

**To change frequency incrementally:**

Press **Freq+** or **Freq–**. The Profile LED corresponding to the active EQ band will briefly light green. The corner or center frequency of the EQ band will be changed in semitone steps. (That is, the frequency will double or halve after 12 presses.) Table 2 shows the default frequencies of each band.

*Table 2. Default frequency and Q*

| EQ band | Default frequency | Default Q |
|---|---|---|
| LOW | 110 Hz (F3) | — |
| MID | 440 Hz (F5) | 1 octave (Q5) |
| HIGH | 3.5 kHz (F8) | — |

**To change to a specific frequency:**


Press **Fx** and then a single digit. The Profile LED corresponding to the active EQ band will briefly light green. The frequency of the active EQ band will be changed to the corresponding Quickset value printed on the back of the remote control and also shown below.

(Note that to access F10, you can simply press **Fx** and then the digit **0**. Pressing **Fx**, then **1** and then **0** will have the same effect.)

**To change the MID band Q:**

Press **Qx** and then a single digit. The Profile LED corresponding to the active EQ band will briefly light green. If the active EQ band is MID, the Q will be changed to the corresponding Quickset value (see below). If the active EQ band is LOW or HIGH, there will be no change.

## Quickset values

The back of the remote contains a key for the Quickset values of frequency and Q:

Parametric EQ Quicksets

| | Hz | | Hz | | Oct | | Oct |
|---|---|---|---|---|---|---|---|
| F1 | 28 | F6 | 880 | Q1 | 1/12 | Q6 | 1.5 |
| F2 | 55 | F7 | 1.7k | Q2 | 1/6 | Q7 | 2.0 |
| F3 | 110 | F8 | 3.5k | Q3 | 1/3 | Q8 | 2.5 |
| F4 | 220 | F9 | 7.0k | Q4 | 1/2 | Q9 | 3.0 |
| F5 | 440 | F10 | 14.0k | Q5 | 1.0 | Q0 | 4.0 |

### Frequency Quicksets

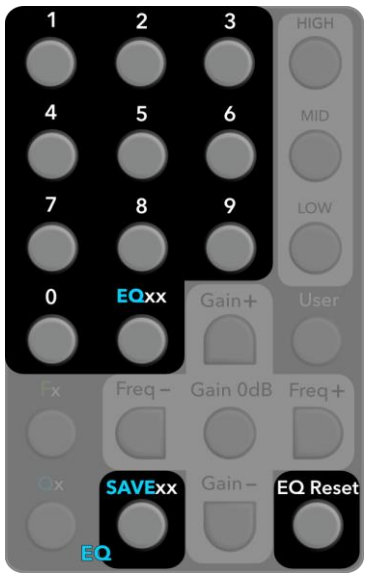
The nominal audio band of 20 Hz to 20 kHz contains ten octaves. The Quickset frequencies are in the (logarithmic) center of each octave band. Thus, F1 is in the middle of the lowest octave, and F10 (or F0) is in the middle of the highest octave. The frequency quickset will get you instantly into the octave of interest, after which you can use **Freq+** and **Freq–** to fine-tune.

### Q Quicksets

The Quickset values of Q range from narrow to very broad. Q1 has a bandwidth of 1/12 of an octave, or approximately a single semitone, so will cut or boost a very narrow range of frequencies. At the other extreme, Q0 has a bandwidth of four octaves, so will cut or boost a sizable portion of the audio band.

**To save the current EQ settings to a preset:**

Press **SAVExx** and then two digits. All three Profile LEDs will briefly light green. The current EQ settings will be stored in the preset given by the two digits. (For example, to save to preset 57, press **SAVExx**, then **5**, then **7**.)




**To recall EQ settings from a preset:**

Press **EQxx** and then two digits. Provided that EQ settings have previously been saved to the given preset, those settings will be loaded into the current profile. (For example, to recall preset 57, press **EQxx**, then **5**, then **7**.)

All three Profile LEDs will briefly light green if the recall operation was successful. If there were no settings stored in that preset, the LEDs will not change.

**To reset the current EQ settings:**

Press **EQ Reset**. All three Profile LEDs will briefly light green. The three EQ bands of the currently selected profile will be reset to their default values. That is: gains set to zero, and frequencies and Q set to the values given in Table 2 (page 35).

## NOTES ON PREFERENCE EQ

- Be careful when using boost with EQ, as strong boost can potentially demand a lot of additional amplifier power. (3 dB boost requires twice the amplifier power at that frequency; 6 dB boost requires four times the amplifier power at that frequency.) At low frequencies, boost can potentially cause your speakers to run into excursion limits, limiting dynamic range and in extreme cases even causing damage. Always listen to the effects of any EQ and "back off" if any distortion is heard.
- When running a room measurement (Chapter 10), the effects of Preference EQ will be included in the room measurement if the "Include parametric filters" option is checked. If that is not desired, press **EQ Reset** first.
- The Preference EQ will be disabled if any of the profiles currently loaded into the DEQX use more than seven EQ bands for Room EQ (Chapter 12).
- Preference EQ commands are not transmitted over the RS-232 link from master to slave units (Chapter 14).

## 4.5 USER MODE

The User Mode button accesses diagnostic and testing functions built into the DEQX. These must be used **only** on the advice of DEQX Support.

It is important that you do not attempt to use these functions except on specific advice from DEQX Support. Attempting to do so can potentially cause damage to your speakers or amplifiers.

## 4.6 BATTERY REPLACEMENT

The remote control takes two AAA size batteries. The battery compartment is at the top rear of the remote control. To install the batteries, open the battery cover at the back of the remote control by sliding it upward. Install the batteries with + and – signs matching the + and – signs in the compartment.

Replace the cover by sliding it back into place. If the remote control does not work, check that the batteries have been installed correctly.

The batteries will run down over time and with use. Replace both batteries when this occurs.

# 5 GETTING STARTED WITH DEQX-CAL

DEQX-Cal™ is a comprehensive measurement, analysis and configuration program that interfaces with the DEQX hardware unit.

## 5.1 INSTALL THE SOFTWARE

The main software installer installs both DEQX-Cal™ and the USB driver needed by DEQX-Cal to communicate with the DEQX over USB. The software can be installed on 32-bit and 64-bit versions of Windows from Window XP through to Windows 10. (An Apple Mac computer can be used if Boot Camp is used to install and run Windows, or a virtual machine emulator such as Parallels or VMWare Fusion is used.)

To install the software from the provided installation CD, insert the CD into the computer's CD drive. The installer should automatically start. If not, double-click on the **setup.exe** program. Proceed through the steps of the installation and click **Finish** when done. Windows will then complete installation of the USB driver.

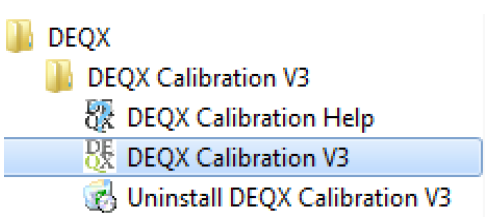
If your computer does not have a CD drive, you can download the latest version of the software installer from the DEQX website, at:

http://deqx.com/upgrades.php

To install the driver for streaming USB Audio, see Appendix B. This can be done later, after you have completed your initial configuration of the DEQX.

## 5.2 A TOUR OF DEQX-CAL

After installation is complete, start DEQX-Cal to familiarize yourself with its layout and main features. It can be started by double-clicking the desktop icon, or by selecting it from the Windows Start menu.

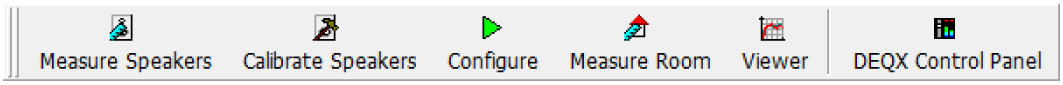
### 5.2.1 The DEQX-Cal user interface

The major areas of the DEQX-Cal user interface are shown in the annotated screenshot at the bottom of this page. The menus and toolbars shown here and in the rest of this manual are the defaults but can be customized if desired (see Chapter 18).

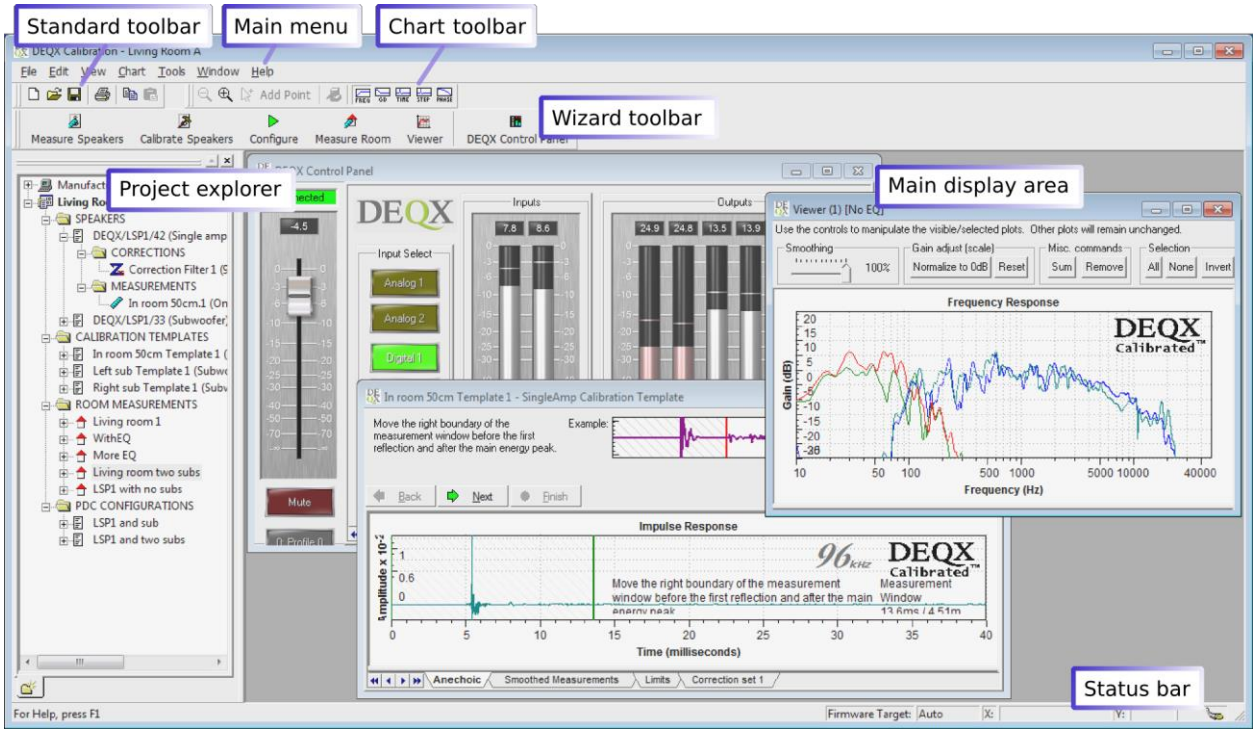
The main menu bar contains menus for managing projects, windows and wizards, and for configuring DEQX-Cal:


The standard toolbar contains buttons for creating, opening and saving a project. The chart toolbar to its right contains buttons that are used to manipulate measurement plots – these are described in Chapter 16.


The wizard toolbar contains buttons that start the various wizards used to perform key functions in DEQX-Cal. The wizards are described in following chapters.

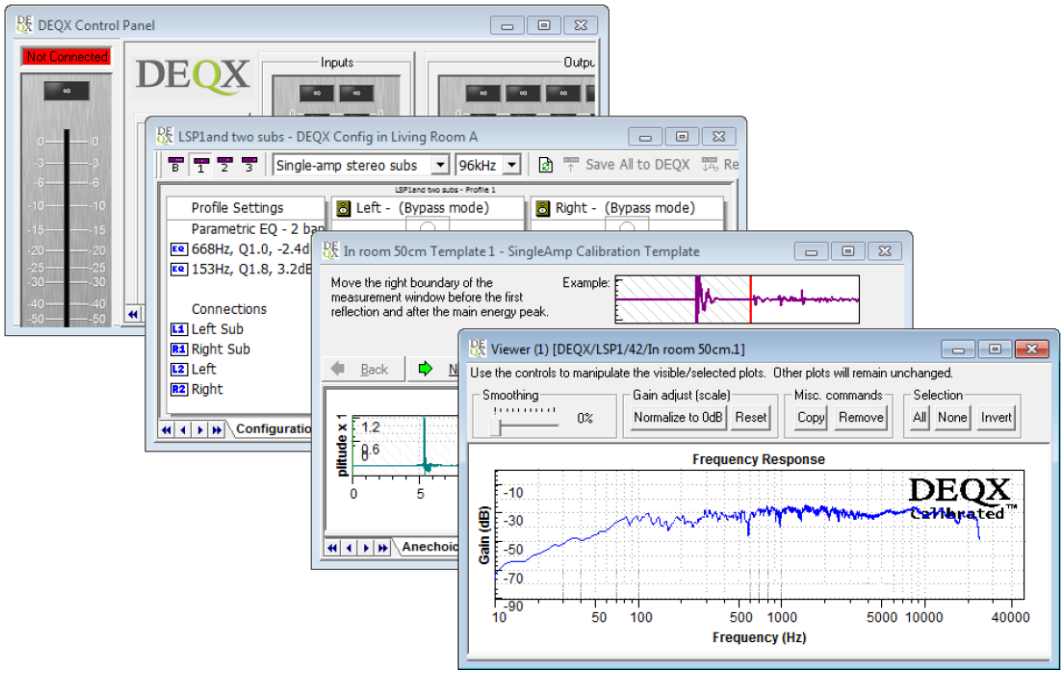



The status bar at the bottom of the window contains context-aware information, such as the current location of the cursor on a plot and the status of the DEQX connection.

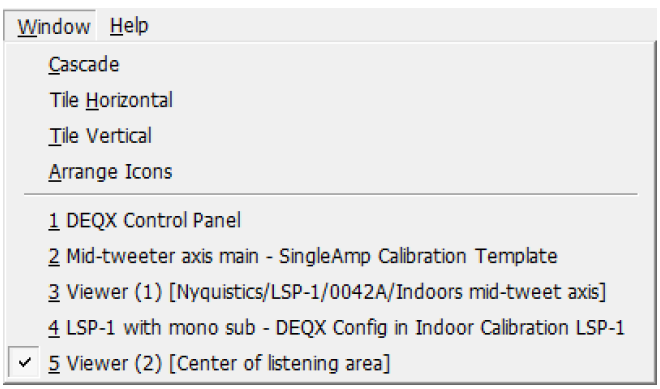


### 5.2.2 The main display area

The main display area holds a variety of windows that display controls, measurement plots, correction filters, configurations, and so on. These windows are opened as you work with DEQX-Cal to measure and calibrate your speakers and room.




These wIndows can be manipulated with the Maximize, Minimize, Restore and Close buttons at their top right (just like regular full-sized windows). Any edge or corner of a window can be dragged to resize it. An open window can be quickly brought to the front of the display by dropping down the Window menu and selecting it from the list:




The Window menu contains several other commands that can be used to help with arranging windows by cascading or tiling them, and to arrange minimized window icons along the bottom of the display area.

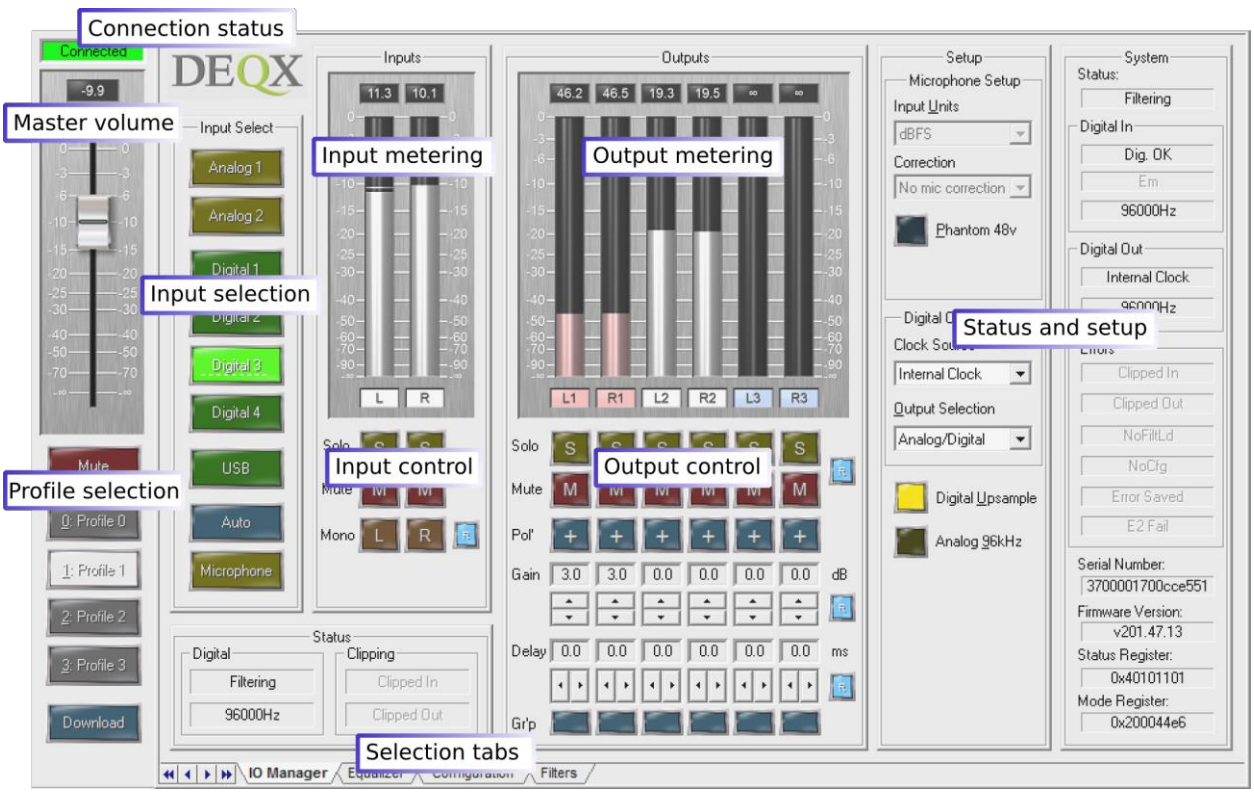
### 5.2.3 The Control Panel and IO Manager


The Control Panel is the real time control interface to the DEQX. It is one of the windows in the main display area. To open the control panel, click the **DEQX Control Panel** button in the Wizard toolbar, or select it from the Tools menu.

The Control Panel manages the "live" parameters of the DEQX, such as master volume, profile selection, input selection, output channel level and delay, and room EQ for each profile. (Some of these functions are also accessible from the DEQX Remote.)

The screenshot below illustrates the main areas of the Control Panel. Other than the leftmost master volume and profile selection strip, the display changes according to the selected tab at the bottom.


The screenshot below is also annotated with the major areas of the **IO Manager** tab, which is displayed by default and is the tab most commonly viewed. More detail on the Control Panel and the IO Manager is provided in Chapter 15.

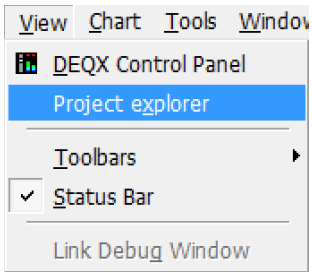


## 5.3 CREATE A NEW PROJECT

DEQX-Cal stores all measurements, filters and configuration data in a *project*. Projects can be saved, loaded, or even sent to DEQX if you need assistance from a DEQXpert.

To create a new project, drop down the File menu and choose "New Project." Select its location in the file system, enter a name, and click **OK**. Initially, the project is empty. Each measurement, calibration, and configuration that you subsequently create (Chapters 6 through 10) will automatically be added to the project.

DEQX-Cal directly supports ongoing and evolutionary refinement of your project (or projects, for more advanced users). The full overview of the project can be seen in the project explorer, accessible from the View menu in the main menu bar. (For more information on the project explorer, see Chapter 17.)




## 5.4 CONNECT THE DEQX AND POWER IT ON


Make the necessary input and output audio connections to your DEQX. For a single pair of main speakers, with or without subwoofers, the output connections are as shown on page 23.

Connect the PC to the DEQX USB Control port using the supplied USB cable. This port is on the lower left of the rear panel, when facing the rear panel.

Connect the DEQX to power, as described on page 22. Turn on the DEQX with the rear panel switch, wait a few seconds and then take it out of standby by pressing the I/O button on the front panel or the Standby button on the DEQX Remote. The status LED will change from red to either yellow or green.

Wait a few moments. When DEQX-Cal finds the connected DEQX, the status indicator in the lower right of the DEQX-Cal window will change:

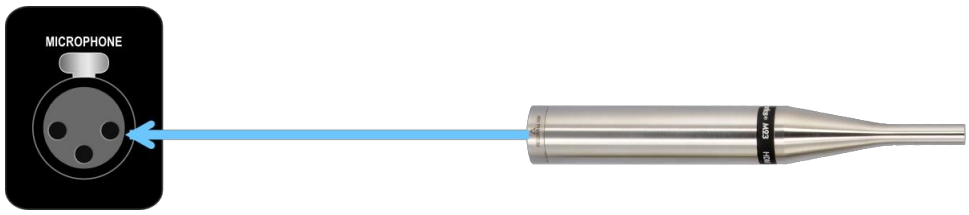
Not connected

Connected

If the DEQX Control Panel is open, the status indicator above the master volume slider will also change:


## 5.5 SET UP THE MEASUREMENT MICROPHONE

Accurate measurements are essential for accurate speaker calibration. Each new DEQX is supplied with a calibrated measurement microphone in the form of the Standard Calibration Kit. An upgraded Reference Calibration Kit is an optional additional purchase. Mount the microphone in a suitable stand and connect the XLR-XLR cable from the microphone to the **Microphone** input on the rear panel.




Each microphone supplied with a DEQX Calibration Kit has a unique calibration file, identified by the serial number printed on the microphone. The calibration file must be loaded into DEQX-Cal for accurate results.

**Standard Calibration Kit**

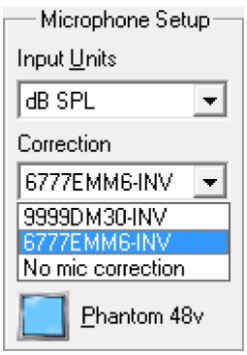
Drop down the File menu and select "Install Microphone…" Locate the calibration file corresponding to your microphone's serial number on the installation CD and open it. (If you are unable to locate the correct calibration file for your microphone on your installation CD, check the calibration file downloads at http://deqx.com/upgrades.php. If the file is still not found, contact DEQX Support.)

**Reference Calibration Kit**

After receiving the Earthworks microphone, contact DEQX Support with its serial number in order to receive the DEQX-compatible calibration file. Then drop down the File menu and select "Install Microphone…" In the dialog box, locate the received calibration file and open it.

In the IO Manager, go to the **Input Select** area and click the **Microphone** button to select it as the active input.


Go to the **Microphone Setup** area (over to the right of the IO Manager), drop down the menu for **Correction**, and select the installed microphone calibration file. Also confirm that the **Phantom 48V** option is enabled (it should be enabled by default).




Note that DEQX does not recommend or support microphones that are not supplied in an authorized DEQX Calibration Kit.

You can now proceed to perform your first *measure-calibrate-configure* cycle (starting in Chapter 6).

# 6 SPEAKER MEASUREMENT


With the DEQX connected into your system and DEQX-Cal running, it is time to measure the speaker. This chapter walks you through the first step of the *measure-calibrate-configure* cycle, to measure a full range speaker in a typical listening room. It assumes that the DEQX is connected for single-amp speaker configuration mode e.g. as on page 23. (For bi-amp and tri-amp configurations, see Chapter 13.)

One of the vexing issues in speaker measurement is the presence of the room – it is difficult to measure *only* the properties of a speaker, because reflections from any other object (including furniture, floor, ceiling and walls) conspire to corrupt the measurement. DEQX-Cal is able to remove these reflections from the measurement when doing a speaker calibration (described in the next chapter).

While the reflections can be removed with software, a longer time delay before the first reflection arrives at the microphone is still beneficial, because it enables correction to lower frequencies. Figure 1 and the description on the next page describe how to accomplish this in a typical listening room. Measuring outdoors on a raised platform can provide a longer reflection-free time window, but excellent results can still be obtained using the method described in this chapter.

To simplify the explanation, this chapter generally assumes that just one speaker is being measured. This is a good choice if you are still becoming familiar with DEQX-Cal, as modern hi-fi speakers (of a given model) are quite close to each other in response. Once you have mastered the art of measurement and calibration with DEQX-Cal, measuring and calibrating both speakers separately will provide the ultimate calibration accuracy.


To obtain accurate speaker measurements, the measurement microphone **must** be pointed directly at the speaker. While it is essentially omnidirectional at lower frequencies, it becomes more directional at higher frequencies and is calibrated for a flat response at high frequencies *only* when pointed directly at the speaker. If the microphone is pointed vertically at the ceiling or floor, or anywhere but *directly at the speaker*, your measurement (and thus calibration) will not be accurate at high frequencies.

## 6.1 SPEAKER AND MICROPHONE POSITIONING

Figure 1 illustrates a typical indoor speaker measurement setup. A microphone stand with a boom arm is recommended for placement flexibility.

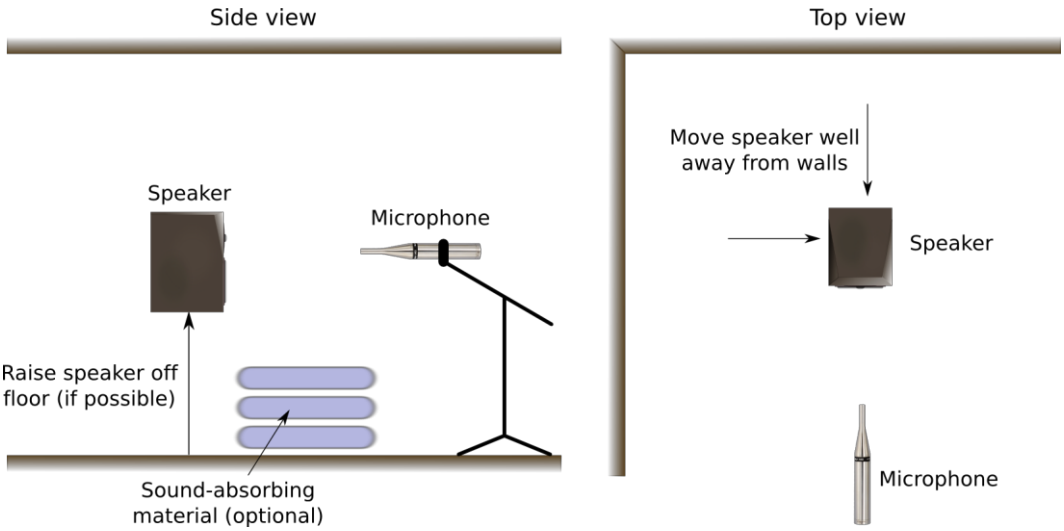



*Figure 1. Speaker measurement setup*

- Move the speaker well away from the walls or other large objects such as furniture. (They should be at least as far from the walls as the tweeter is from the floor, otherwise those reflections will reduce the reflection-free time window.)
- If possible, raise the speaker so the tweeter is about halfway between the floor and ceiling. This ensures that reflections from the floor and ceiling are as delayed as possible.
- If it is not possible to obtain a sufficiently long reflection-free time window (see Chapter 7), place thick absorbing material (e.g. cushions and pillows) on the floor between the speaker and microphone to reduce the level of the floor reflection.
- Position the microphone 600 mm (two feet) away from the speaker. Larger speakers may need the microphone positioned further away so the drivers integrate properly for the measurement. (Moving the microphone further away will reduce the length of the reflection-free time window.)
- Position the microphone at a height midway between the centers of the midrange (or midwoofer) and tweeter drivers. In cases where the tweeter has limited vertical dispersion (some types of ribbon tweeters, for example), positioning the microphone at the same height as the tweeter center may be more accurate.
- While the microphone is typically positioned horizontally on the speaker's axis, in some cases a better measurement can be obtained if the microphone is slightly off the horizontal axis (such as inline with the edge of the speaker cabinet).

## 6.2 START THE SPEAKER MEASUREMENT WIZARD

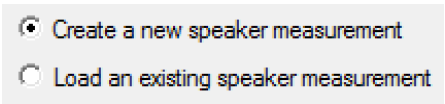
If you do not already have a project open, open an existing project or create a new one.

Start the speaker measurement wizard by clicking on the **Measure Speakers** button in the Wizard toolbar or by selecting it from the Tools menu.


The wizard will take you through a series of screens. To proceed through them, select the necessary options on each screen and click the **Next** button. If you realize you've made a mistake or need to check what you've done, click the **Back** button to go back through the screens already visited.

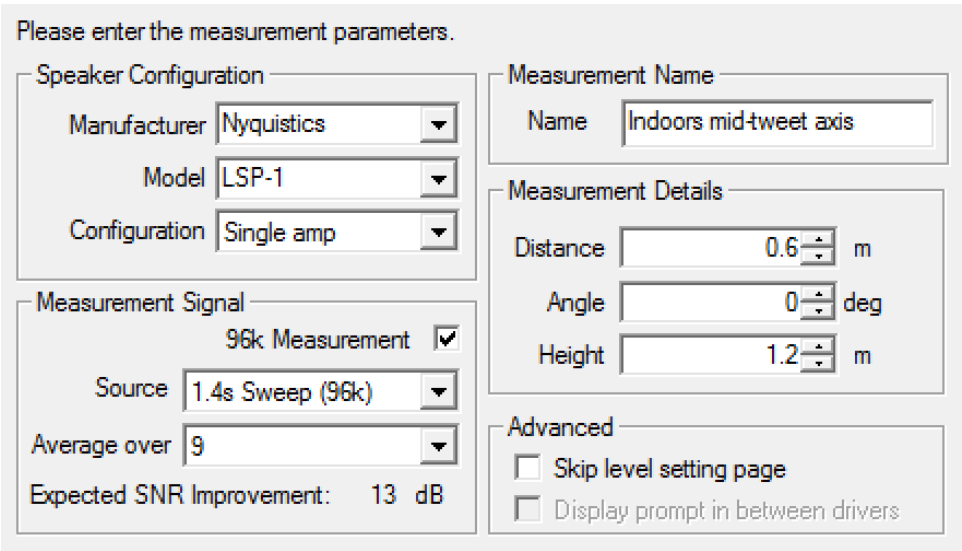
**Screen 1**. If you have more than one project open (page 149), this screen is used to select the project in which the measurement will be stored. Otherwise, this is just an informational screen.

**Screen 2**. Create a new measurement, or select an existing measurement to open. (The following steps assume that you have selected "Create a new speaker measurement.")




## 6.3 SET SPEAKER MEASUREMENT PARAMETERS

**Screen 3**. This screen sets a number of parameters that control the measurement. (See next page for descriptions.)



**Manufacturer**

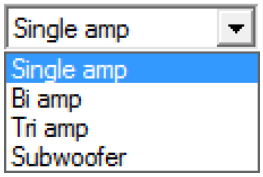
Enter the manufacturer of the speaker. This is used to help organize measurements within the project. The drop-down selector can be used to select from manufacturers that were previously entered.

**Model**

Enter the model of the speaker. This is used to help organize measurements within the project. The drop-down selector can be used to select from models that were previously entered.

**Configuration**

To measure a single speaker (or a pair of speakers), select "Single amp" from the drop-down menu. (The following steps assume that you have selected "Single amp" here. See Chapter 8 for the "Subwoofer" option and Chapter 13 for the "Bi amp" and "Tri amp" options.)

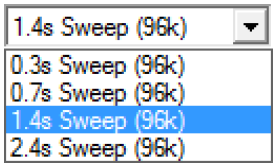



**96k Measurement**

If this box is checked, the DEQX runs the measurement at a 96 kHz sample rate. This is recommended for all current DEQX products. If the box is unchecked, the DEQX runs the measurement at a 48 kHz sample rate.

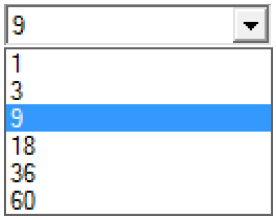
**Source**

This option selects from one of several sweep lengths. At right are the choices for a 96 kHz measurement, showing sweep lengths from 0.3 to 2.4 seconds. Longer sweeps give higher resolution measurements.




**Average over**

Averaging multiple measurement sweeps will improve the signal-to-noise ratio of the measurement. DEQX recommends a minimum of 9 sweeps to guard against noise corrupting the measurement. If you have trouble obtaining a high confidence level (page 51) in the measurement, redo the measurement with a higher number of sweeps.




**Measurement Name**

Enter a name that characterizes this measurement. This name is used for informational purposes and will help you to navigate the project later on.

**Measurement Details**

Enter the dimensional information about the measurement: the distance of the microphone from the speaker, the angle of the microphone relative to the speaker axis in the horizontal direction (this should be zero for this measurement), and the height of the microphone.

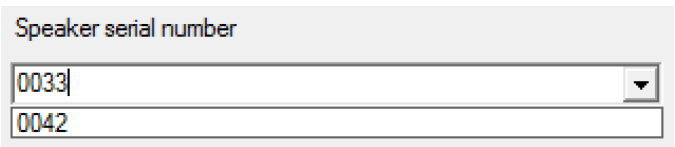
The information entered here is used by DEQX-Cal to calculate the initial length of the speaker calibration time window (page 56).

**Skip level setting page**

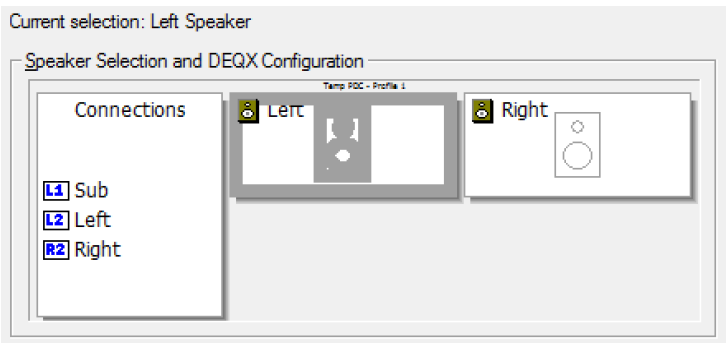
If this box is checked, the level-setting screen (Screen 6, page 50) will not be displayed. Check this box *only* if you have previously set the measurement levels. If in any doubt, leave this box *unchecked*.

## 6.4 SELECT THE SPEAKER TO BE MEASURED

**Screen 4**. Enter the serial number of the speaker being measured. (While this field doesn't *have* to be the speaker's serial number, we recommend that it be set correctly in order to assist in identifying measurements later.) The drop-down selector can be used to select from serial numbers that were previously entered.




**Screen 5**. Select either the left or right main speaker by clicking on its icon.

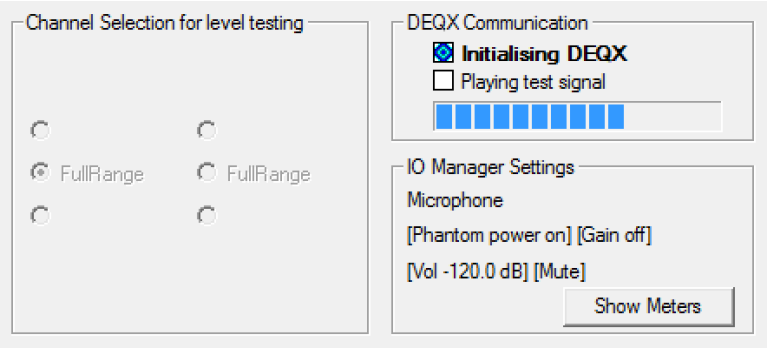



If this is the first measurement, this is a good time to confirm that you have made your output connections to the rear panel correctly, as indicated in the "Connections" list on the left.

Click **Next** to continue.

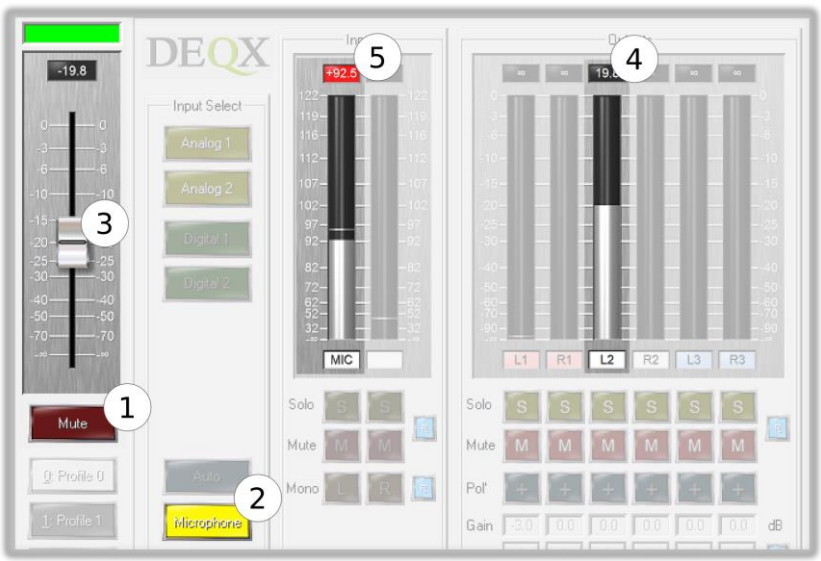
## 6.5 SET THE MEASUREMENT SIGNAL LEVEL

**Screen 6**. DEQX-Cal will upload the test signal to the DEQX, as shown by the "Initializing DEQX" indicator.




When the screen switches to the "Playing test signal" indicator, switch to the IO Manager to view the meters. (Click the **Show Meters** button if it is not visible.)

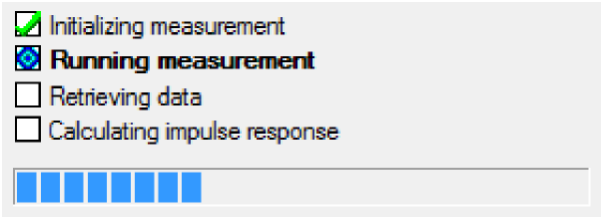
1. Confirm that the DEQX is not muted. (Click the **Unmute** button if it is.)
2. Confirm that the microphone is selected as the input source.
3. Raise the output level slider *slightly*.
4. Confirm output signal on the L2 or R2 output. You should hear a frequency sweep test tone at low volume from the speaker being measured.
5. Raise the output level slider slowly until the test tone is moderately loud and the microphone input level is peaking in the range of 90–95 dB.




To proceed, go back to the measurement wizard and click **Run**.

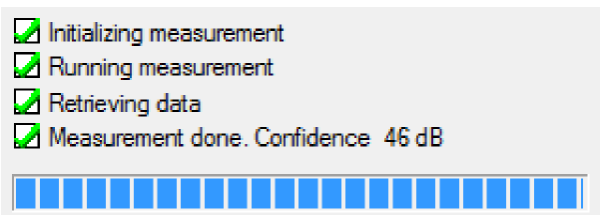
## 6.6 RUN THE SPEAKER MEASUREMENT

**Screen 7**. DEQX-Cal runs through a series of steps to measure the speaker.




1. "Initializing measurement" uploads the measurement signal to the DEQX.
2. "Running measurement" executes the measurement sweeps at the level set on Screen 6. The number of sweeps will be as set in the "Average over" parameter on Screen 3, plus one. (The first sweep is used by the DEQX to calibrate itself internally. The remaining sweeps are the ones used to determine the speaker response.)
3. "Retrieving data" transfers the captured measurement data from the DEQX to DEQX-Cal running on the computer.
4. "Calculating impulse response" displays while DEQX-Cal calculates the *impulse response* based on the measurement data. All subsequent measurement plots are derived from the calculated impulse response.

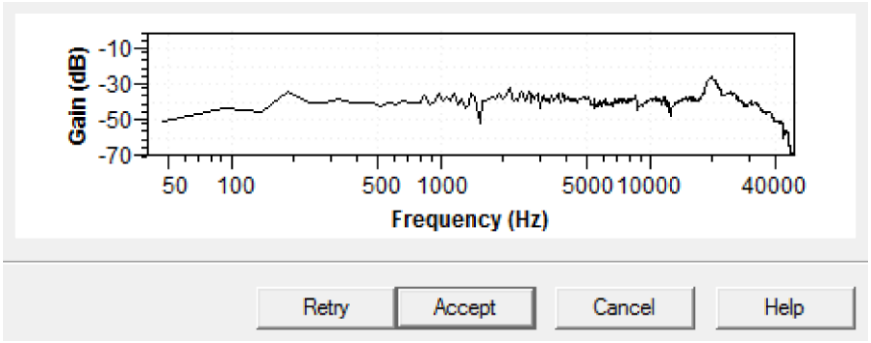
When the impulse response has been calculated, the wizard displays the *confidence level* of the measurement. The confidence level indicates the quality of the measurement – the higher, the better. It is related to signal-to-noise ratio but takes additional factors into account, such as distortion anywhere in the signal chain and whether room reverberation has died off before the next measurement cycle begins.



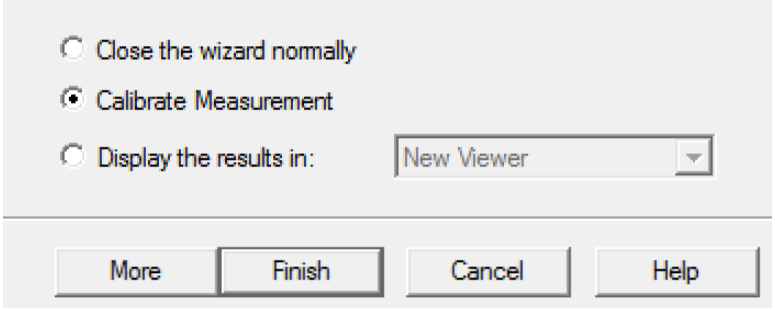

For a speaker measurement, the confidence level should always be greater than 20 dB. If it is not, you will need to retry the measurement (see next page). Increasing the number of sweeps, increasing the sweep length, reducing background noise, and increasing the signal level (but not so far as to introduce distortion) are all ways to improve the confidence level of the measurement.

## 6.7 COMPLETE THE MEASUREMENT

**Screen 8**. When the measurement is completed, a thumbnail of the measured frequency response is displayed. Most of the time, you will simply click **Accept**. If you think there is an error in the measurement (for example, there was unexpected external noise or the confidence level is low), click **Retry** to run the measurement again.




**Screen 9**. This is the exit screen.




To proceed directly to speaker calibration, leave the option "Calibrate Measurement" selected and click **Finish**. This is a convenience feature that will take you directly to the calibration wizard (next chapter) with the measurement just taken already pre-selected for calibration.

Or, if you want to measure the other speaker, move the microphone to the correct position for measuring it, then click **More**. You will be taken back to Screen 4. (The level setting screen will be bypassed when taking the second measurement.)

Otherwise, choose one of the remaining options and click **Finish**:

**Close the wizard normally**

The wizard will close without opening the measurement just taken.

**Display the results in:**

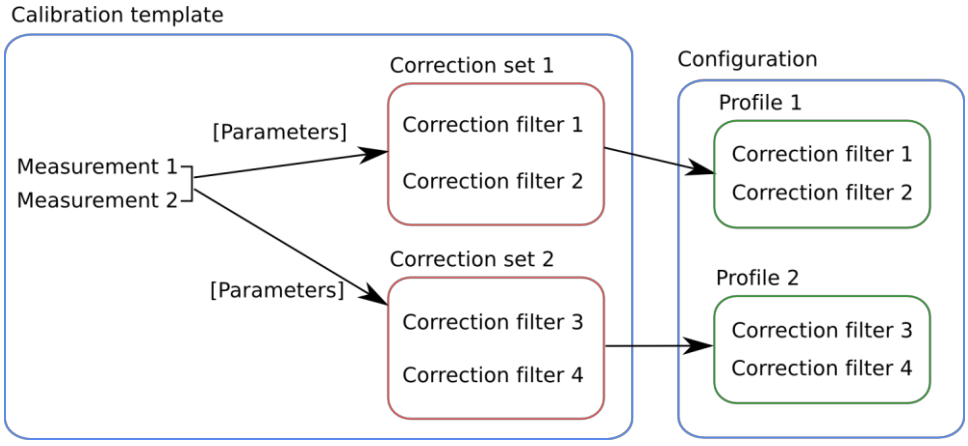
Choose "New Viewer" to open a new data viewer. Or, select an open data viewer from the drop-down menu to display the measurement in that viewer. (The viewer will appear as shown on page 141.)

# 7 SPEAKER CALIBRATION


To *calibrate* the speaker means to correct its *anechoic* amplitude and phase response – that is, without the effects of the room. This is the second step of the *measure-calibrate-configure* cycle. DEQX-Cal will use the speaker measurement or measurements taken earlier to generate these filters, via the use of *calibration templates*.

A calibration template is the container for sets of correction filters. When a calibration template is created, one or more measurements are selected as "input." Various parameters are then specified in order to create a correction set, which contains one correction filter per "input" measurement.

More correction sets can be created from the same measurements, but with different parameters. These can be loaded into different profiles (see Chapter 9) to audition the effect of the different parameters.




This chapter explains how to create a calibration template and generate correction sets for the *single-amp* speaker configuration modes. To keep the presentation simple, the examples show a single measurement being used for both speakers. Once you are more familiar with DEQX-Cal, you can use a separate measurement for each speaker. (For bi-amp and tri-amp speaker configuration modes, see Chapter 13.)

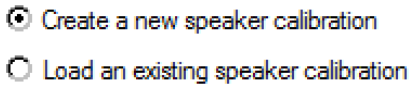
## 7.1 CREATE A CALIBRATION TEMPLATE


The calibration wizard can be entered directly from the last screen of the speaker measurement wizard (page 52). Or, start the calibration wizard by clicking on the **Calibrate Speakers** button in the Wizard toolbar or by selecting it from the Tools menu. If entering directly from the speaker measurement wizard, Screens 2 and 3 below will not be displayed.

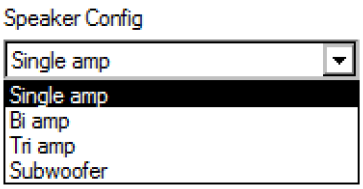
The calibration wizard will take you through a series of screens. Select the necessary options on each screen and click the **Next** button. If you realize you've made a mistake or need to check what you've done, click the **Back** button.

**Screen 1**. If you have more than one project open (page 149), this screen is used to select the project in which the calibration will be done. Otherwise, this is just an informational screen.

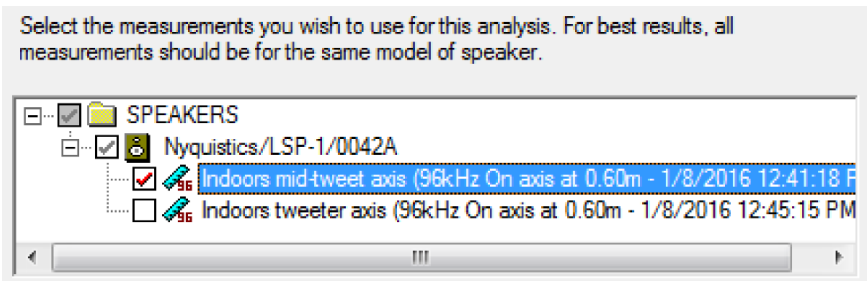
**Screen 2**. Create a new calibration template, or select an existing calibration template to open. (The following steps assume that you have selected "Create a new speaker calibration.")




**Screen 3**. Select the "Single amp" speaker configuration mode. (See Chapter 8 for the "Subwoofer" option and Chapter 13 for the "Bi amp" and "Tri amp" options.)

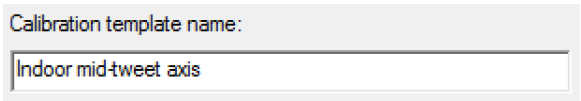



**Screen 4**. Select or confirm the measurement that will be used to create the correction set. (If you measured both speakers, select both of those measurements here.) Only measurements that match the chosen configuration can be selected. (You cannot, for example, calibrate a speaker with a subwoofer measurement.)




**Screen 4a**. If you have selected only one measurement, you will be given a warning. Click **Next** to proceed.

**Screen 5.** Enter the name of the calibration template.



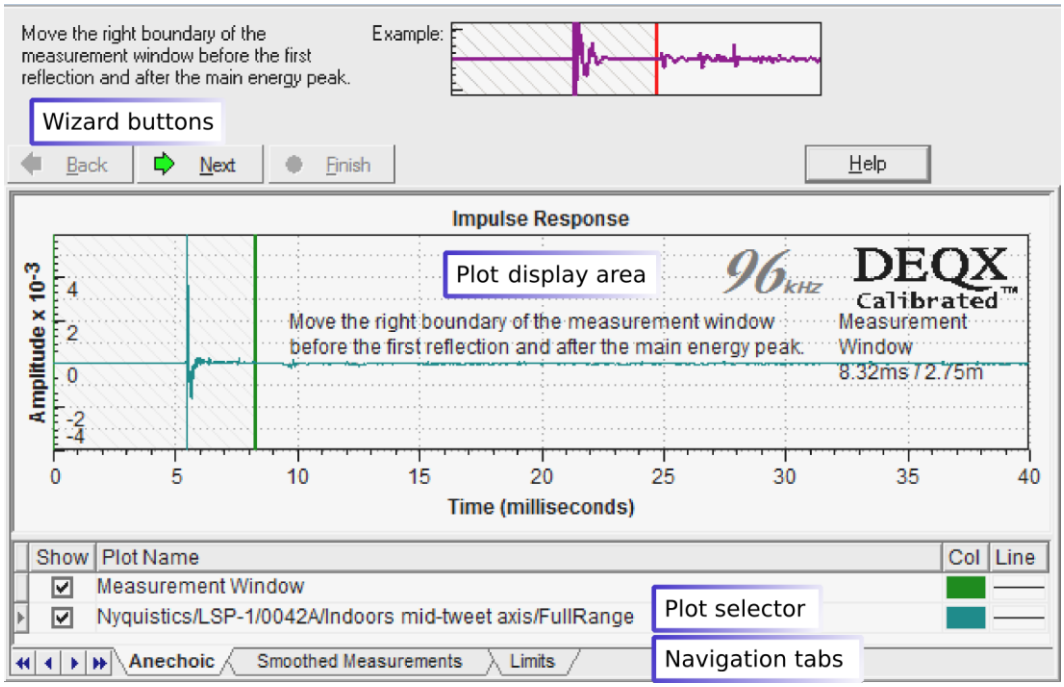

**Screen 6**. You will be presented with a summary of the template parameters:

| Parameter | Value |
|---|---|
| Sample Rate | 96000 Hz |
| Configuration | Single-Amp |
| Smoothing amount | 100 % |
| Number of boost/cut bands | 1 |
| Default boost limit | 6 |
| Default cut limit | -20 |
| Group Delay tolerance | 0.5 ms |
| Magnitude tolerance | 0.2 dB |

Click **Finish** to proceed.

On completing the wizard, a new calibration template opens, as shown in the annotated screenshot below. Above the plot is a wizard-like set of buttons used to proceed through the steps of creating a correction set. Note also the row of navigation tabs along the bottom – these can be used as an alternate navigation method to the wizard-like Back/Next buttons.

The plot selector at the bottom lists the various plots shown in the plot display area and enables them to be turned off and on. (For more operations on plots, such as zooming, refer to Chapter 16.)

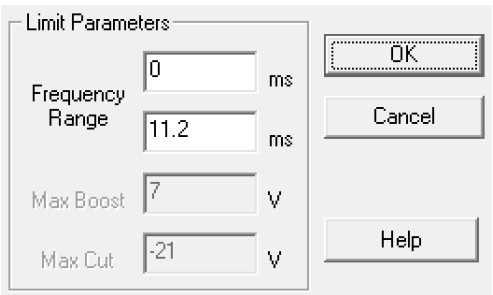


## 7.2 SET THE IMPULSE RESPONSE TIME WINDOW

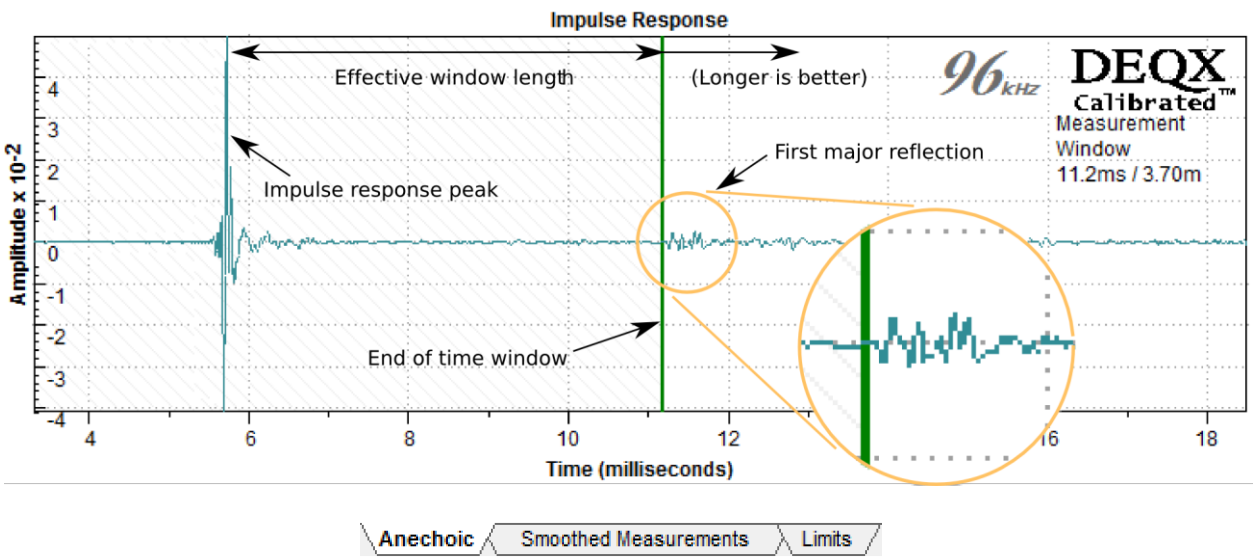
**Screen 1 / Anechoic tab**. This tab shows the measured time domain *impulse response* of the speaker and the room. It is used to set a time "window" on the impulse response to exclude room reflections, thus obtaining the *anechoic* response of the speaker alone.

The time window is shown as a shaded area to the left side of the plot, with a vertical green bar marking its end (see the example below). When the calibration template opens, the end of the window is set automatically based on the distance parameters entered when the measurement was taken (page 47). To adjust it manually, click on and drag the vertical green bar. Ideally, it should be positioned just before the first major reflection, as shown below. (You may find this easier if you zoom in on the plot using the "+" zoom icon in the toolbar.) A high quality measurement will have no significant reflections before the first major room-related reflection.

You can also set the end of the time window by double-clicking on the vertical bar to open the dialog box shown at right. Change only the higher limit (the lower text box) and leave the lower limit (the upper text box) set at 0. (Ignore the Max Boost and Max Cut parameters, as they cannot be set here.)

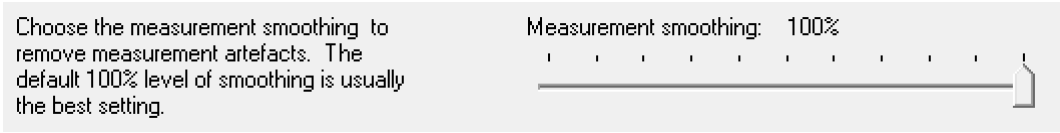



The *effective length* of the time window is the time difference between the impulse response peak and the vertical bar. In the example below, the impulse response peak occurs at 5.7 ms and the bar is set at 11.2 ms. Therefore, the effective window length is (11.2 – 5.7) = 5.5 ms. The effective window length determines the frequency resolution and thus the lowest correction frequency, as given by Table 3 on page 58.



## 7.3 SET SMOOTHING

**Screen 2 / Smoothed Measurements tab**. This tab shows the frequency response corresponding to the impulse response time window. The adjustment on this tab is the *smoothing* applied to the frequency response plot:

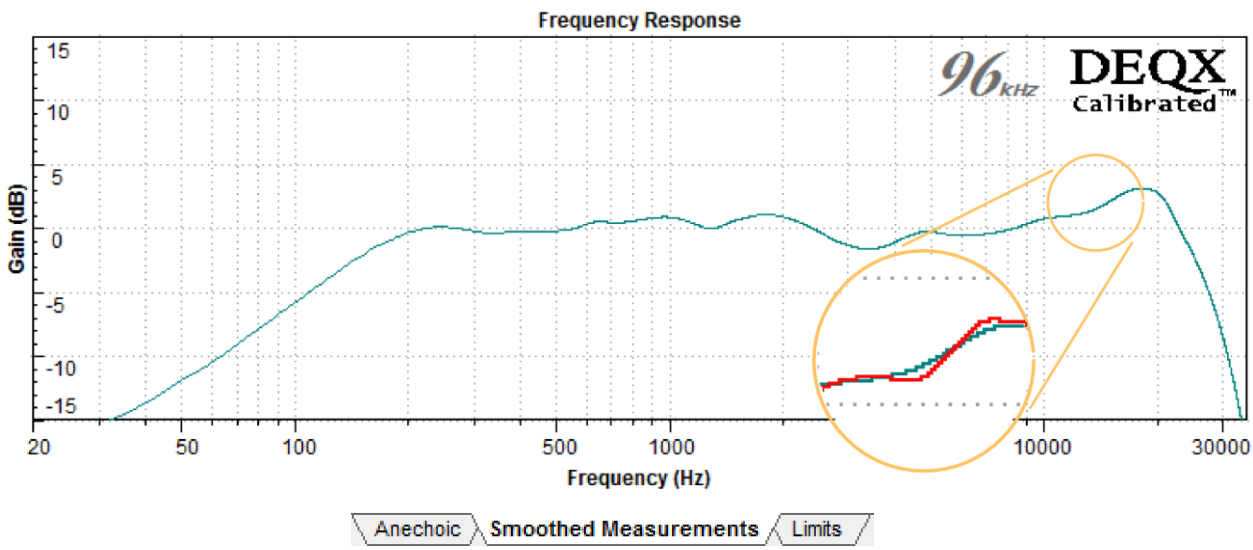



Smoothing is used to compensate for unwanted reflections in the speaker measurement. While the time window is used to remove the major reflections, other reflections and noise may still be present within the window (such as from the edges of the speaker or from the speaker stand). 0% smoothing can be used if the time window is *completely* free of reflections, but up to 100% may be required if there are reflections present. As a general rule, it is best to start with 100% smoothing, and then experiment with and audition additional correction filters with less smoothing.

In some cases, such as larger speakers that cannot be moved or raised, the reflection-free time window may not be as long as desired. One option is simply to raise the lower frequency correction limit (next page). Another is to use damping material on the floor when measuring, set the end of the time window past the location of the (damped) floor reflection, and set smoothing to 100%. (Consult your DEQXpert for advice on this.)

Note that the plot falls off at low frequencies. Below the lower correction limit (see Table 3 on the next page), the displayed measurement is **not valid**. *This is not the actual response of the speaker*, but an unavoidable artifact of the short impulse response time window. A more accurate response to lower frequencies will require a longer window.

Click **Next** to proceed.



## 7.4 SET THE CORRECTION FREQUENCY LIMITS

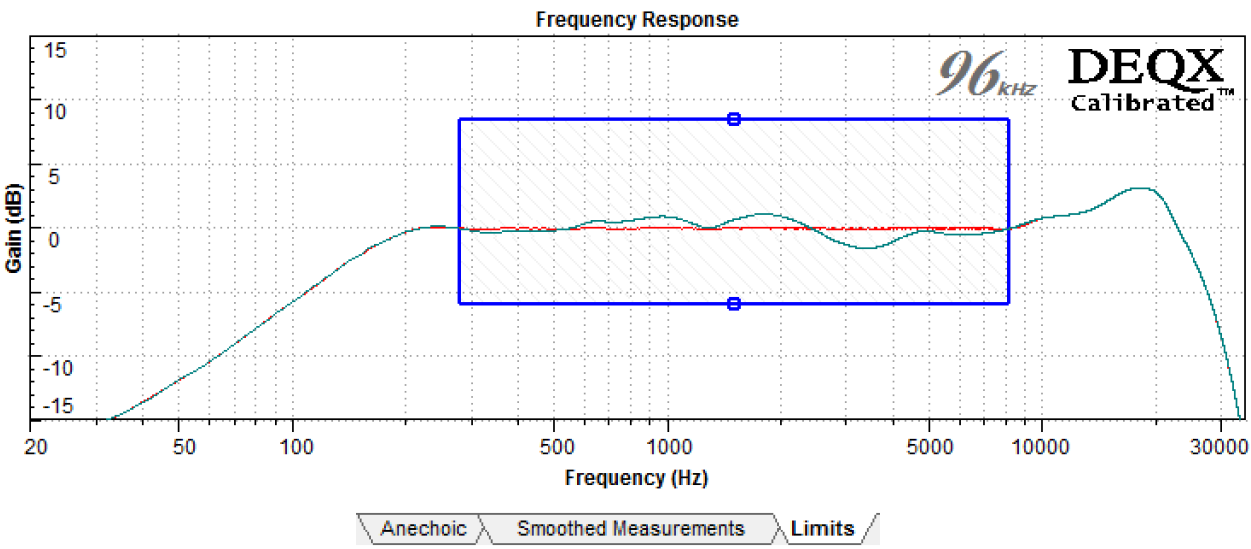
**Screen 3 / Limits tab**. The blue rectangle on this tab sets the correction frequency region and its cut and boost limits. The rectangle can be altered by clicking and dragging on any of its edges. The predicted response (shown in red by default) will change as the edges are moved.

- The left edge sets the lower frequency limit . Set this edge using Table 3 below as a guide. *Do not set the limit any lower than suggested in* Table 3*, as your calibration will be incorrect if you do so.*

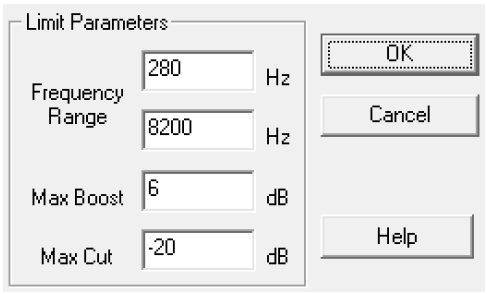
*Table 3. Lower frequency limit vs window length*

| Effective window length | Low frequency limit |
|---|---|
| 4 ms | 300–400 Hz |
| 8 ms | 150–200 Hz |
| 12 ms | 100–150 Hz |

- The right edge sets the upper frequency limit. Set it at or close to a frequency where the plot crosses the 0 dB line (in order to minimize abrupt changes in the correction filter). A frequency between 5 and 10 kHz is often a good choice, as this allows the tweeter to keep its own character at the extreme high frequencies while providing accurate calibration across the midrange and most of the treble. Alternatively, set the upper frequency near or above 20 kHz to fully correct the speaker's response.
- The top and bottom edges set the maximum cut and boost (respectively) of the correction filter. Move the top edge down toward 0 dB to limit the amount of cut, and move the bottom edge up toward 0 dB to limit the amount of boost. When the edge intersects the plot, the amount of cut or boost will be reduced and the predicted response plot will change accordingly.



You can also double-click on the limits rectangle to bring up a dialog box that allows you to enter the limits directly (shown at right). As a general rule, increasing Max Boost beyond the default of 6 dB is not recommended.



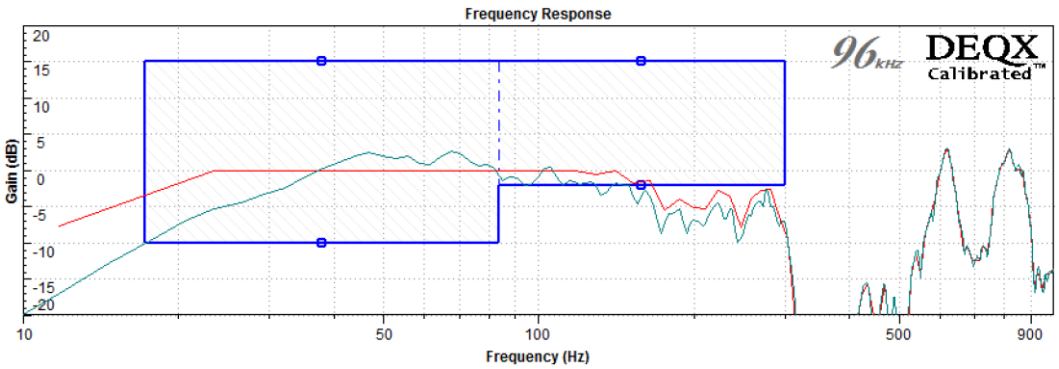

Above the plot area is a checkbox to enable automatic rescale of the plot. If checked, the graph is automatically adjusted vertically so that the left edge of the limit box is at 0 dB. If unchecked, the scale value can be set manually (in the example below, it is set to –2.0 dB). If in any doubt as to the behavior of this option, it is best to leave it *unchecked*.



In some cases, you may require different maximum cut and boost limits in different frequency ranges. This is usually required only by advanced users, such as when using an in-room measurement as the basis for speaker correction (page 121).

To set up multiple limit regions:

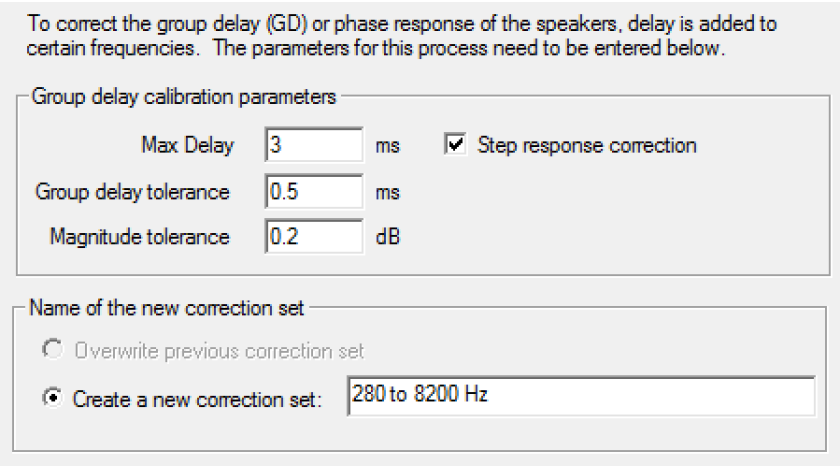
1. Click the **Add Point** button in the chart toolbar.
2. Click in the plot area between the left and right edges of the limit box. A dashed vertical line will appear.
3. Click and drag the edges and dashed line(s) to change the limits.




Once the frequency limits have been set to your satisfaction, click **Finish** to proceed.

## 7.5 SET CORRECTION PARAMETERS

**Screen 4**. DEQX-Cal will ask you to confirm parameters that set how tightly it attempts to correct for amplitude and group delay:




**Max Delay**

Sets the maximum delay that can be introduced by the correction filter. If using the DEQX with video, the default of 3 ms is recommended in order to avoid introducing video sync errors. Otherwise, this parameter can be increased if desired, up to the maximum of 24 ms (in the single amp configuration modes). See the tip box on page 79 for more information on delays.

**Step response correction**

Check this option for speakers, and uncheck it for subwoofers. If this option is checked and the correction algorithm fails to complete, uncheck it and try again.

**Group delay tolerance**

Sets the target group delay variation of the corrected speaker. The default value represents a tight tolerance that will usually succeed. This can be set tighter than the default, although the algorithm may not always succeed.

**Magnitude tolerance**

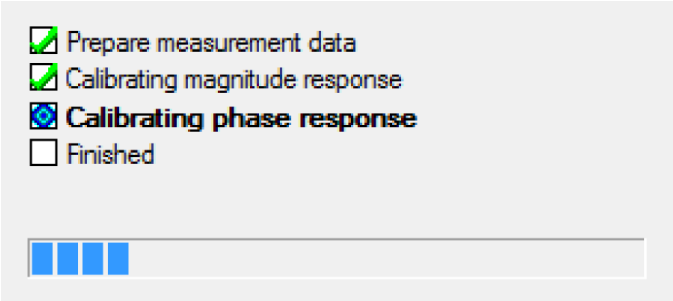
Sets the target magnitude variation of the corrected speaker. The default value represents a tight tolerance that will usually succeed. This can be set tighter than the default, although the algorithm may not always succeed.

**Name of the new correction set**

If "Create a new correction set" is selected, provide a name for it here. The default is "Correction set 1" and so on, but a more meaningful name will help with navigating the project later. (The option "Overwrite previous correction set" becomes available on subsequent runs.)

## 7.6 GENERATE THE CORRECTION SET

**Screen 5**. After completing the correction parameters, a progress window appears that shows the steps of the correction algorithm and a progress bar. Typically, the algorithm will take less than a minute to run.

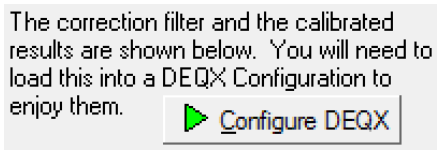


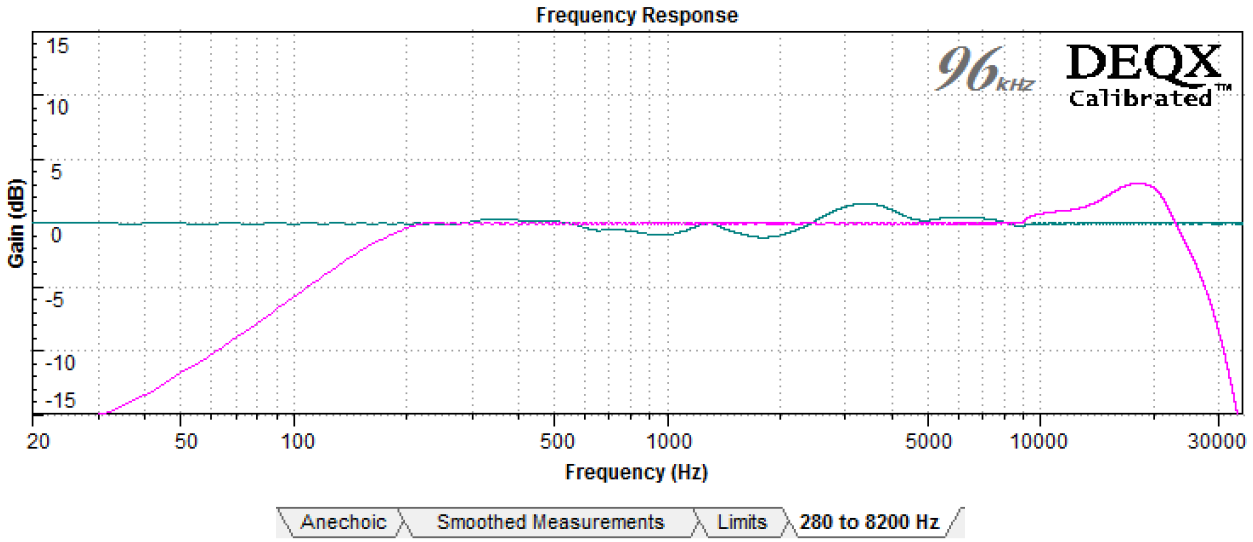

After calculation completes, click **Finish**.

**Screen 6 / Correction set tab**. The calibration template will create a new tab displaying the correction filters. In the example below, there is a single filter in the correction set (the correction filter is in green and the predicted response is in purple).

Note that the predicted response includes the effect of the impulse response time window (as set on the **Anechoic** tab). There is therefore a visible fall-off at low frequencies, below the frequency given by Table 3 on page 58. Once again, this is not real – the fall-off is an artifact of the short time window.

To proceed directly to configuration (Chapter 9), click the **Configure DEQX** button to the top left of this tab. Or, to create additional correction sets, read the following pages.



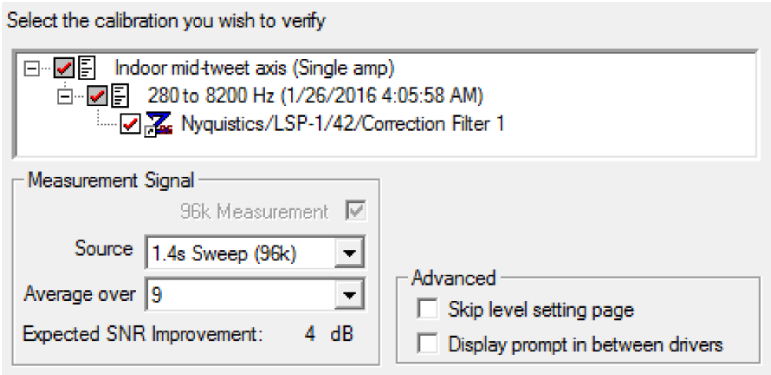



## 7.7 VERIFY THE CORRECTION FILTER

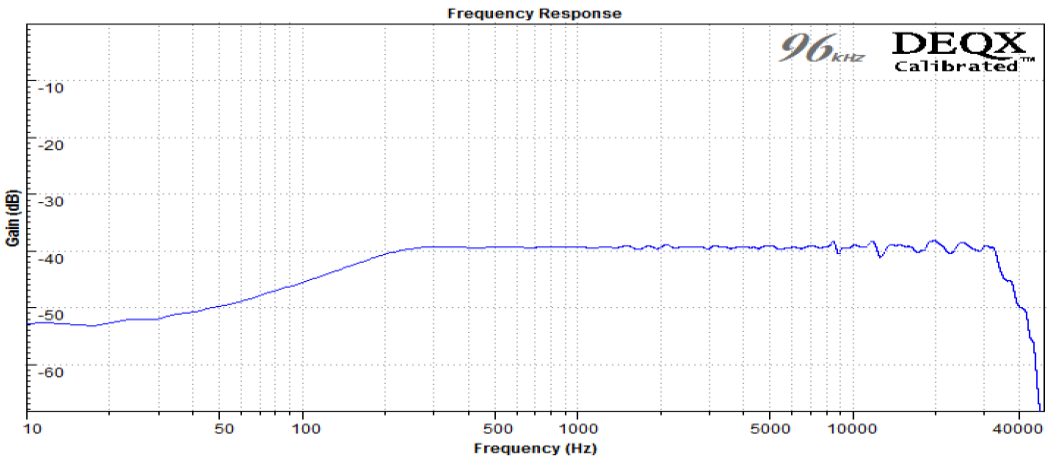

The DEQX has the ability to immediately take a verification measurement on a correction filter without having to first configure the DEQX and upload the correction filter to it. To start a verification measurement, go to the correction set tab that you wish to verify and click the **Verify Results** button.

**Screen 1**. The first screen is an informational screen.

**Screen 2**. Confirm the correction filter to be verified and the measurement parameters:




**Screens 3 to 6**. Proceed through the measurement in the same way as described for the initial measurement (pages 49 to 52). When the measurement is complete, click **Finish**. A new data viewer will open with the measured response that includes the effect of the correction filter, as shown in this example (note that the time window is still in place):



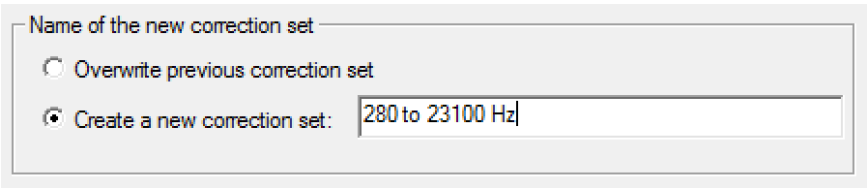

Note also that verification measurements are not saved in the project.


To compare the verification measurement to the original measurement, locate the original measurement in the project explorer, and drag and drop it onto this data viewer.

## 7.8 CREATING ADDITIONAL CORRECTION SETS

A calibration template can hold any number of correction sets, which differ in the length of the correction time window, smoothing, correction frequency limits, and correction parameters. To create another correction set:

1. Click on the **Anechoic** tab. Adjust the time window if desired.
2. Click on the **Smoothed Measurements** tab, or on **Next**. Adjust the smoothing.
3. Click on the **Limits** tab, or on **Next**. Adjust the correction filter limits.
4. Click on **Finish**. You can either overwrite the most recently generated correction set, or select the option "Create a new correction set" and enter a name for it. On this screen, you can also change parameters such as Max Delay.

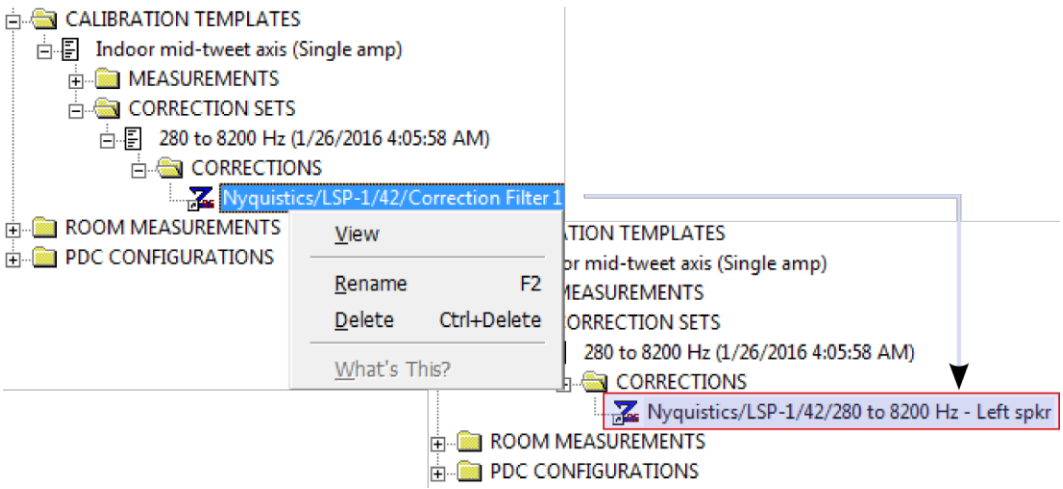



5. Proceed through the remaining screens to generate the new correction set.


### RENAMING CORRECTION FILTERS

While DEQX-Cal allows you to name the correction *set* when generating filters, the names of the individual correction *filters* are still automatically generated ("Correction Filter 1" and so on). Once you have generated a few different correction filters, this can make selecting the correct filter for configuration (Chapter 9) more difficult.

Therefore, use the project explorer to navigate to the individual filters, right-click, and select "Rename." Use the same name as the template, and indicate which speaker is which. For example, here we have used "280 to 8200 Hz - Left spkr."

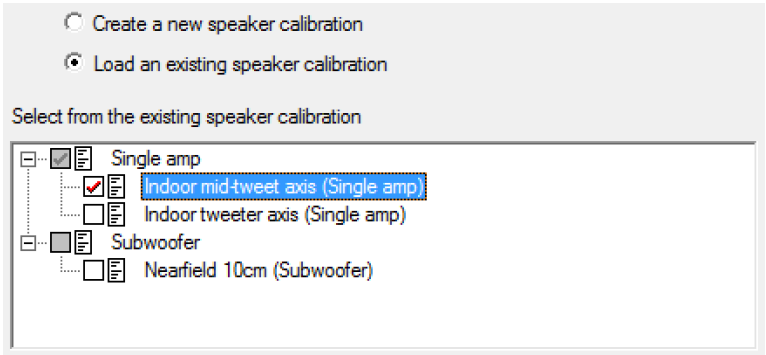


## 7.9 TO RE-OPEN A CALIBRATION TEMPLATE

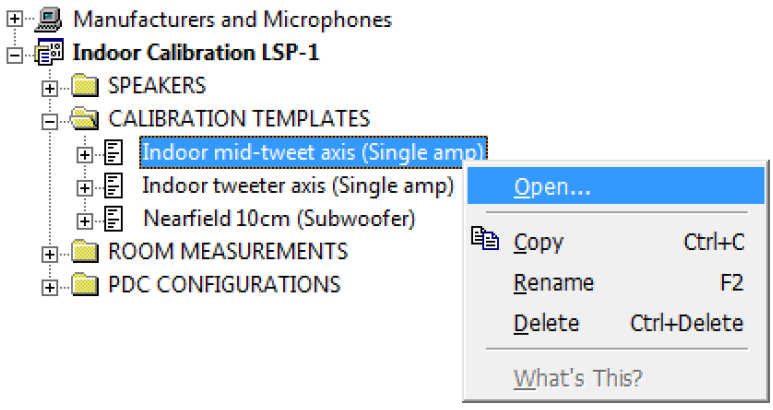
Calibration templates are stored in the project file. Any edits to a calibration template are saved when the project is saved.

There are two ways to open an existing calibration template for viewing:

1. By using the calibration wizard. Click the **Calibrate Speakers** button and on Screen 2, select the option "Load an existing speaker calibration." In the pane underneath, select the calibration template that you wish to load. Then click **Finish**.




2. From the project explorer. Unfold the CALIBRATION TEMPLATES folder, right-click on the calibration template that you wish to open, and select "Open" from the popup menu. (If this entry is greyed out, the template is already open and you can bring it to the front from the Window menu.)




The popup menu can also be used to rename and delete a calibration template (see page 148).

# 8 SUBWOOFER MEASUREMENT AND CALIBRATION

The approach taken to measure and calibrate subwoofers is different than for speakers. Instead of using windowing, a nearfield measurement is taken so that the direct sound from the subwoofer dominates the room effects.

(See page 121 for an alternative but more advanced approach to low-frequency measurement that can be used with subwoofers.)

If you are not using subwoofers, skip this chapter.

## 8.1 MEASURE THE SUBWOOFER

The diagram below illustrates how a subwoofer is measured. The subwoofer should be measured in its intended location. Position the microphone 5 to 20 cm (2 to 8 inches) from the subwoofer cone.

Set the controls on the subwoofer for minimum processing: disable its low pass filter (crossover) if possible, or if not, set it to its highest frequency; turn off any equalization in the sub; and set any phase or invert controls to their neutral positions.

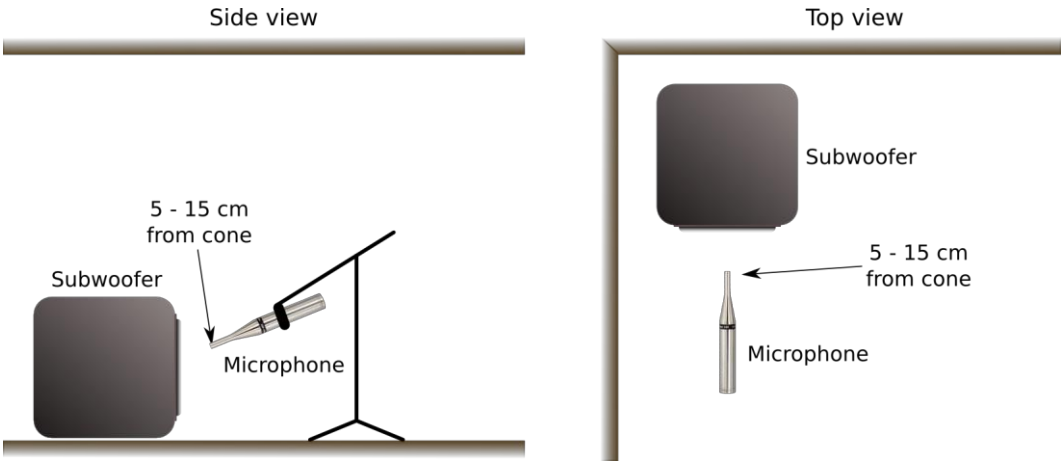
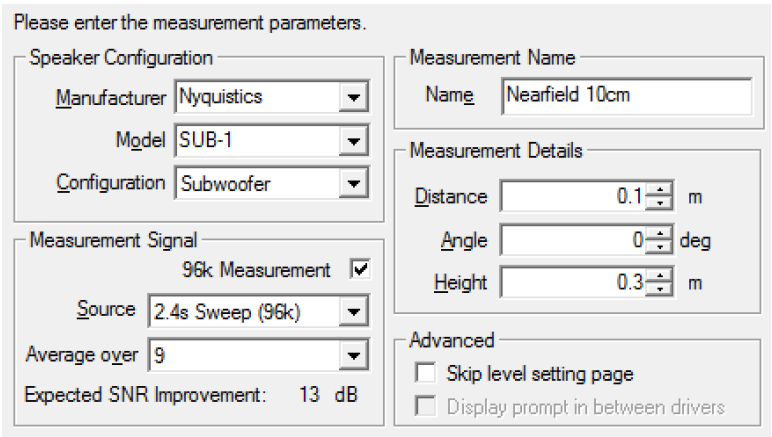


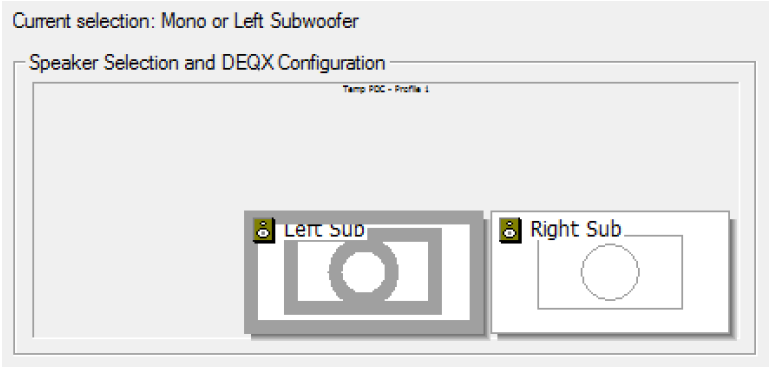

*Figure 2. Subwoofer measurement setup*

Once the microphone is in place, follow the measurement procedure given for speakers (starting on page 47), but with the following specific differences.

**Screen 3**. Select "Subwoofer" for the **Configuration** parameter. For **Source,** select the longest sweep available.

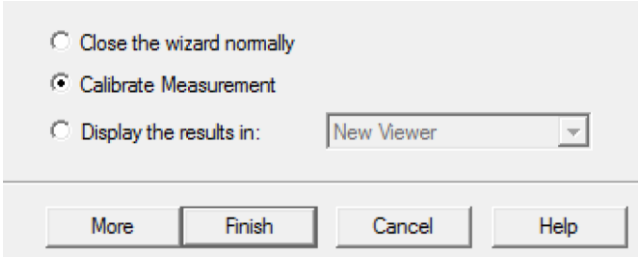



**Screen 5**. Select the subwoofer being measured. If using stereo subwoofers and both subwoofers are identical, there is no need to measure both of them. If they are not identical, then you will need to measure both.




**Screen 6**. For a *nearfield* subwoofer measurement, measurement levels can peak in the 100 to 110 dB range.

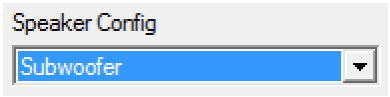
**Screen 9**. Select "Calibrate Measurement" and click **Finish** to jump directly to the calibration wizard, or click **More** to measure a second subwoofer.



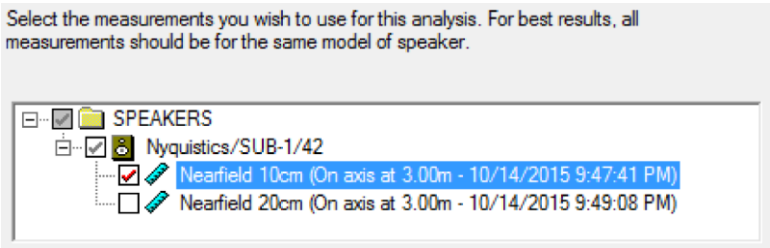
## 8.2 CALIBRATE THE SUBWOOFER

To calibrate the subwoofer, follow the procedure given for speakers in Chapter 7, but with the following specific differences.

**Screen 3**. If you did not jump directly from the measurement wizard to the calibration wizard, select "Subwoofer" for the **Speaker Config** parameter.

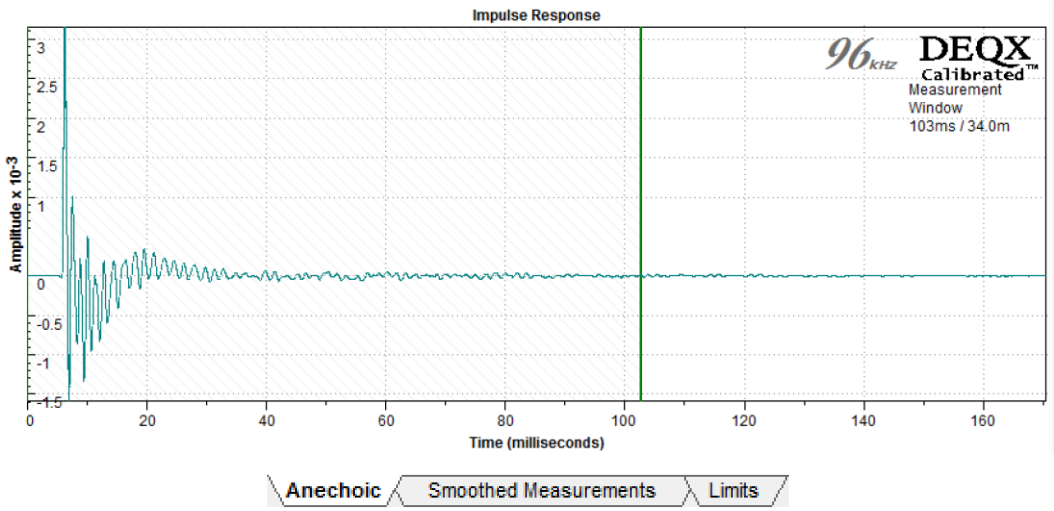



**Screen 4**. Select or confirm the measurement to use for subwoofer calibration (DEQX-Cal will only list measurements here that were taken with the **Configuration** parameter in the speaker measurement wizard set to "Subwoofer"):



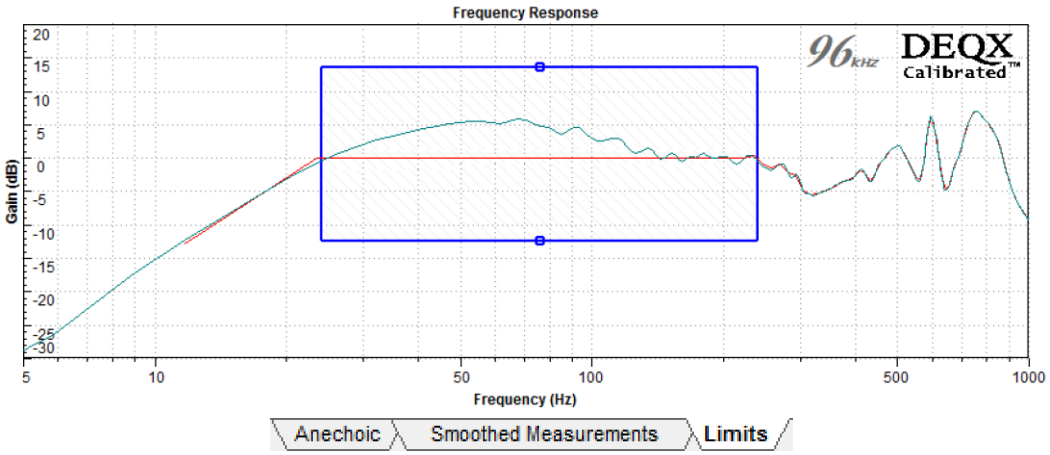

(If you are using stereo subwoofers and you measured both of them, select both measurements here.)

**Anechoic** tab. Set the end of the correction time window at a fairly high value, like 100 ms. Or double-click on the vertical green bar and enter 170 ms (the maximum).




**Smoothing** tab. Set smoothing to 100%. (Less smoothing can be trialed and auditioned later if desired.)

**Limits** tab. Set the frequency range so that the subwoofer extends from its lowest useful frequency to significantly past the intended crossover frequency. This example uses a frequency range from 25 Hz to 250 Hz:

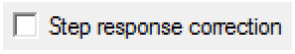




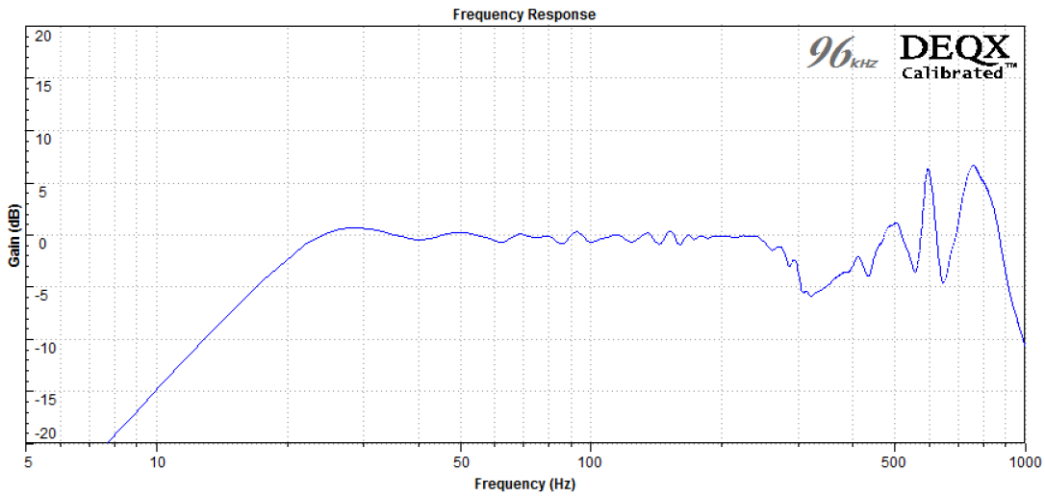
The frequency range limits may be easier to set if the **Auto rescale** option is turned off.

It is important to be realistic with subwoofer equalization. At the low end of their range, all speaker drivers can be pushed into excessive distortion if correction is not applied in a manner that is within the driver's capabilities. Set the lower limit at a frequency that is realistic for your subwoofer(s) and listening levels.

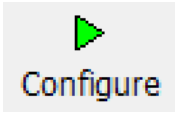
Click **Finish** to initiate generation of the subwoofer correction filters. On the parameters screen, be sure to turn step response correction **off**:




After completing the calibration, a verification measurement can be used to confirm the effect of the correction filter:



# 9 CONFIGURING THE DEQX




In order for the DEQX to execute speaker correction, it needs to be told which correction filters to use. This is the third step of the *measure-calibrate-configure* cycle. This chapter will show you how to configure the DEQX with speaker and subwoofer correction filters and set things up for room measurement and correction later on.

## 9.1 WHAT IS A CONFIGURATION?

A *configuration* is a set of data that is created in DEQX-Cal and then uploaded to the DEQX to control its audio processing. It consists of:

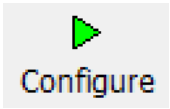
1. The speaker configuration mode – single amp with optional mono subwoofer, single amp with optional stereo subwoofers, bi-amp with optional mono subwoofer, bi-amp with optional stereo subwoofers, or tri-amp.
2. Four profiles, each of which contains:
    a. A correction/crossover filter for each speaker, subwoofer, or driver;
    b. Limit filters for each speaker or subwoofer;
    c. Individual gain and delay settings for each speaker or subwoofer;
    d. Individual polarity settings for each speaker, subwoofer, or driver; and
    e. Parametric EQ for room correction.

Once the configuration has been uploaded to the DEQX, the four profiles make it easy to audition different speaker correction filters and room EQ filters simply by pressing a button on the DEQX Remote. The correction filters may have different settings such as the amount of smoothing, correction frequency range, crossover slope, and so on.

A configuration is stored on the computer (in the project file). Advanced users can create multiple configurations if desired and upload them to their DEQX at different times. Note that uploading a configuration does not change any of the "live" parameters set in the IO Manager (pages 130 to 133).

## 9.2 CREATE A CONFIGURATION

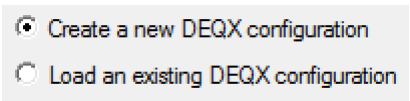
Start the configuration wizard by clicking on the **Configure** button in the Wizard toolbar or by selecting "Configure DEQX" from the Tools menu.



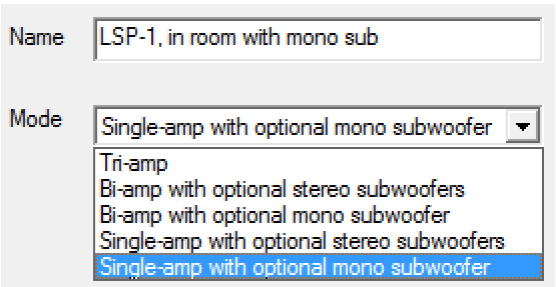

The wizard will take you through a series of screens. To proceed through them, select the necessary options on each screen and click the **Next** button. If you realize you've made a mistake or need to check what you've done, click the **Back** button to go back through the screens.

**Screen 1**. If you have more than one project open (page 149), this screen is used to select the project in which the configuration will be created. Otherwise, this is just an informational screen.

**Screen 2**. You can create a new configuration, or select an existing configuration to view and modify. (The following steps assume that you have selected "Create a new DEQX configuration.")




**Screen 3**. Name the configuration, and select the speaker configuration mode. There are five modes to choose from, depending on the exact way in which you are deploying your DEQX.



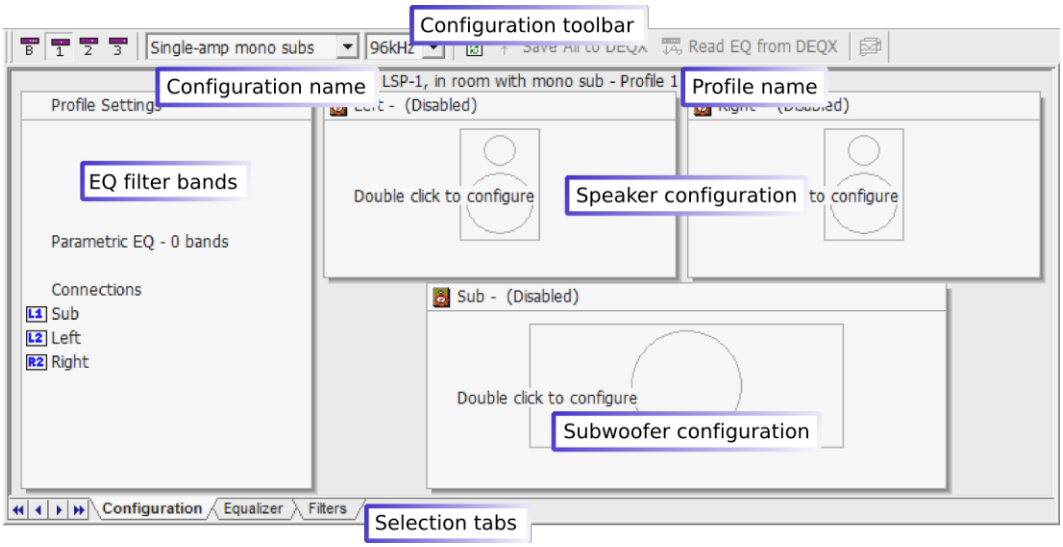

The rest of this chapter assumes that you have chosen either "Single-amp with optional mono subwoofer" or "Single-amp with optional stereo subwoofers." (For bi-amp and tri-amp modes, see Chapter 13.)

Note that the speaker configuration mode is the same for all four profiles. If you want to experiment with, for example, using both a mono subwoofer and using stereo subwoofers, you will need to create separate configurations.

**Screen 4**. This is a confirmation screen. Click **Finish** to proceed. The wizard will close and DEQX-Cal will open a new configuration window.

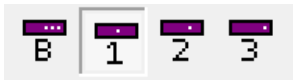
## 9.3 THE CONFIGURATION WINDOW

The configuration window contains a diagrammatic representation of the speakers, with either one or two subwoofers. By default, all speakers in each profile of a new configuration are disabled, as indicated by the labels "Left - (Disabled)" and so on.




At the top of the window is a toolbar containing a set of important controls. (While you are becoming familiar with them, you may prefer to turn on text labels. To do so, see page 158.) From left to right:

**Profile selection**

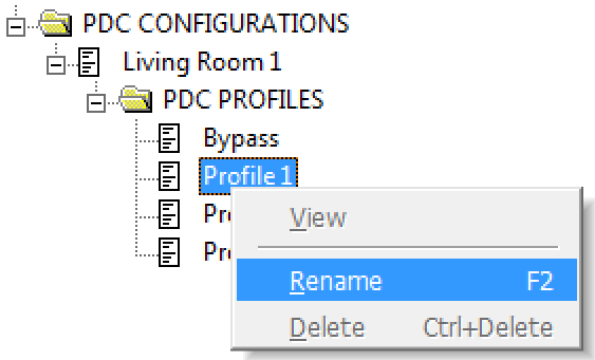



These buttons set the profile currently being displayed or edited.

Check this selection every time you edit a configuration, to avoid changing the wrong profile. To make these buttons more prominent, you can enable text labels for the toolbar – see page 158.

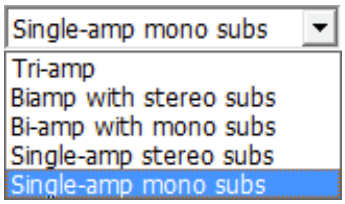

### RENAMING PROFILES

The profile name displayed in the window can be changed by renaming the profile, so that e.g. "Profile 1" in the screenshot above is replaced with a meaningful name. Do this in the project explorer: navigate to the configuration, right-click on the profile, and select "Rename" from the pop-up menu.



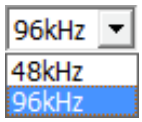
**Speaker configuration mode**

This drop-down selector sets the speaker configuration mode for all profiles in this configuration. It is initially set to the value chosen in the configuration wizard. While it can be changed later, some configuration data may be lost.




**Sample rate**

This drop-down selector sets the sample rate at which this configuration operates. The 48 kHz option is to support legacy DEQX products only. For current generation DEQX products, always leave this set to 96 kHz.

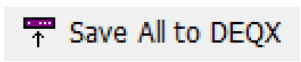



**Refresh Filters**

This button updates the correction filters. Use it if any of the filters have been changed in the calibration template, or whenever viewing the Filters tab.

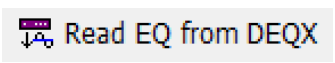
**Save All to DEQX**

This button uploads all profiles in the configuration to the connected DEQX. See page 79.



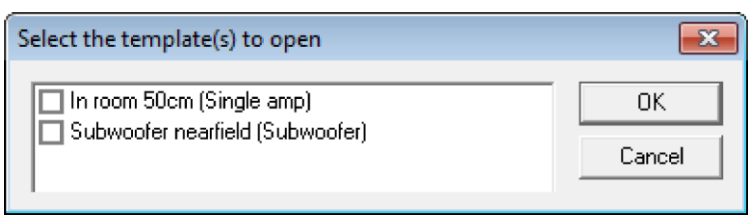

**Read EQ from DEQX**

This button reads room EQ settings for all profiles from the DEQX into the configuration. See page 102.

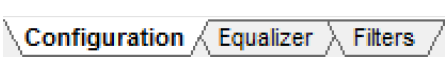



**Open Template**

This button opens the calibration template that created the correction filters loaded into the selected profile. If no filters have been loaded, this button is greyed out; if the filters have been loaded from a single calibration template, it will be opened; if the filters have been loaded from more than one calibration template, a dialog will allow you to select which to open:

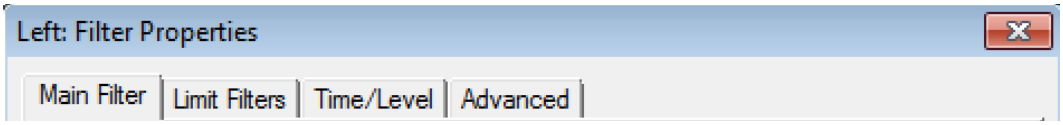



The three tabs at the bottom of the window select the content to be displayed in the main area. In most of this chapter, the **Configuration** tab is assumed to be selected. The **Equalizer** tab is described on page 102 and the **Filters** tab on pages 76 and 78.



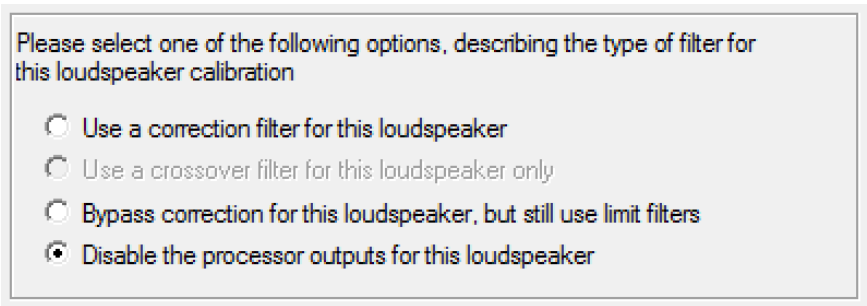
## 9.4 THE FILTER PROPERTIES DIALOG

The filtering applied to each individual speaker is set in its Filter Properties dialog, opened by double-clicking on the speaker (or subwoofer) icon. It contains four tabs:



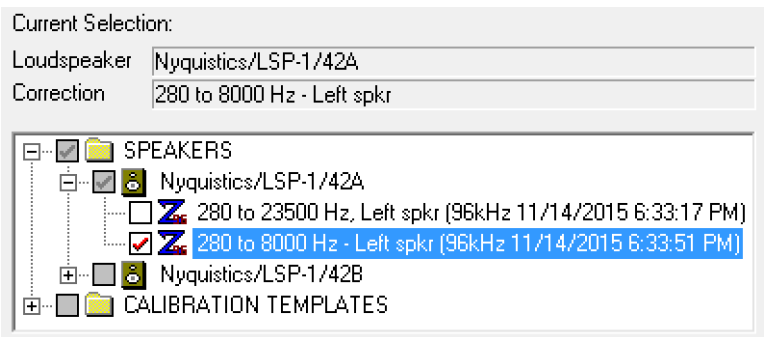

### 9.4.1 Main Filter tab

This tab selects the main correction filter (if any). There are four options:




**Use a correction filter for this loudspeaker**

Select this option if you have generated a correction filter for the speaker. A pane will open underneath, from which you can select the correction filter:




(In this example screenshot, the correction filters have been made easier to find by renaming them during calibration, as described in the tip box on page 63.)

Note that the selection pane will only show filters that match the speaker and the speaker configuration mode. You cannot, for example, load a filter generated for a subwoofer into a speaker, or a filter generated from a bi-amp measurement into a single-amp configuration.


You can also select a correction filter by navigating to it in the project explorer and then dragging and dropping it onto the speaker (or subwoofer) icon.

**Use a crossover filter for this loudspeaker only**

This option is available only in the bi-amp and tri-amp speaker configuration modes. See page 122.

**Bypass correction for this loudspeaker, but still use limit filters**

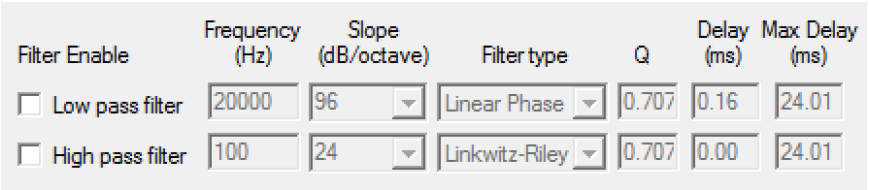
The speaker output is enabled but no correction will be applied to it. You can still set limit filters (high pass and low pass filters) on the Limits Filters tab.

**Disable the processor outputs for this loudspeaker**

This is the default setting. The corresponding speaker output is disabled.

### 9.4.2 Limit Filters tab

This tab sets the limit filter parameters. There are two filters: low pass (aka high cut) and high pass (aka low cut). By default, both filters are disabled.



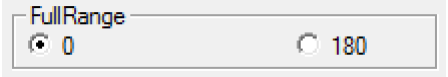

See page 77 for information on how to use limits filters for a subwoofer crossover, and pages 118 and 119 for information on how to use limit filters for the woofer-mid crossover in a three-way active speaker.

### 9.4.3 Time/Level tab

This tab is used to set a delay on the speaker (or subwoofer) and to adjust its level. It is typically used for subwoofer integration (Chapter 11).


### 9.4.4 Advanced tab

In single-amp mode, this tab can be used to invert the polarity of the speaker (or subwoofer). In some cases, this can help with subwoofer integration. It can also be used to correct for absolute phase with some types of amplification.



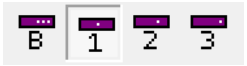

In bi-amp and tri-amp modes, this tab contains additional options – see page 124.


### COPY FILTER SETTINGS BETWEEN SPEAKERS

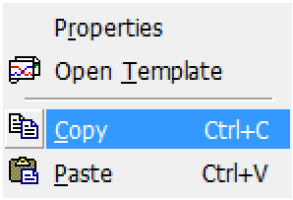
To copy filter settings from one speaker to another, you can use drag and drop. For example, to copy the filter settings from the left speaker to the right speaker:

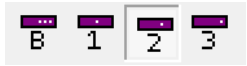
1. Click on the left speaker icon (but don't release the mouse button). It will be highlighted in a grey outline.
2. Drag the mouse over to the right speaker.
3. Release the mouse button.

To copy filter settings between different profiles, use copy-and-paste operations. For example, to copy settings from Profile 1 to Profile 2:




1. Click on the Profile 1 selector.
2. Right-click on the speaker from which you wish to copy filter settings and select "Copy" from the popup menu.
3. Click on the Profile 2 selector.
4. Right-click on the same speaker in this profile and select "Paste" from the popup menu.




After copying settings, visually check the configuration to confirm that the data has been copied.

## 9.5 CREATE A PROFILE WITH NO CORRECTION

This example profile will be set up to play audio to a pair of main speakers, with no correction filters applied.

1. Select Profile 0 from the toolbar:[3]

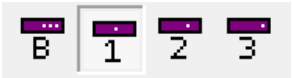

2. Open the Filter Properties dialog of the left speaker.
3. On the Main Filter tab, select "Bypass correction for this loudspeaker, but still use limit filters."
4. Repeat steps 2 and 3 for the right speaker. Alternatively, just copy the filter settings from the left speaker to the right speaker, as described in the tip box above.

[3] For historical reasons, Profile 0 is sometimes referred to as "Bypass." It is, however, identical to the other three profiles and can contain correction and limit filters and delay and gain settings. In the buttons at the top of the configuration window, select Profile 0 by pressing the "B" button.

## 9.6 CREATE A CORRECTION PROFILE

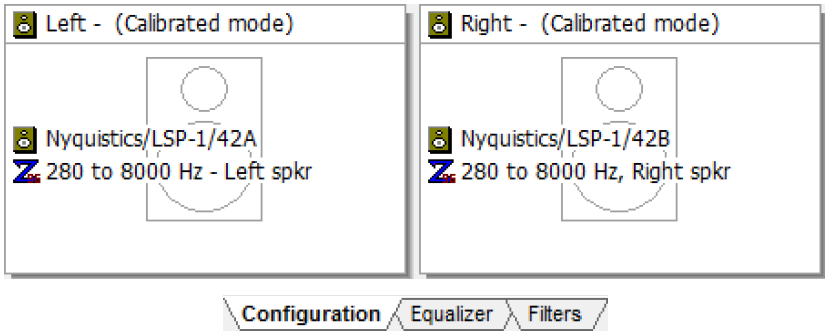
This example profile will be set up to play audio to a pair of main speakers, with correction filters applied.

1. Select Profile 1 from the toolbar:

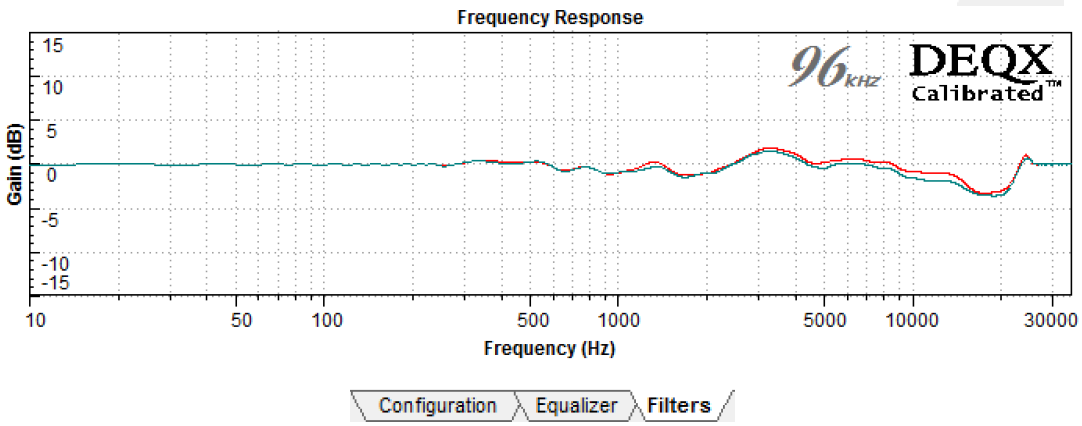



2. Open the Filter Properties dialog of the left speaker.
3. On the Main Filter tab, select "Use a correction filter for this loudspeaker." In the pane that opens underneath, select the desired correction filter (page 73).
4. Repeat steps 2 and 3 for the right speaker. Alternatively, if you are using the same correction filter for both speakers, copy the filter settings from the left speaker to the right speaker as described in the tip box on page 75.

After closing the dialog, the configuration tab will overlay the speaker icons with information about the filters that have been set up. For example:



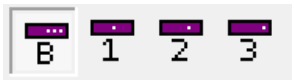

The filters can also be viewed graphically on the Filters tab (use the Refresh Filters button to ensure that you are seeing the current filters):



## 9.7 ADD A SUBWOOFER OR SUBWOOFERS

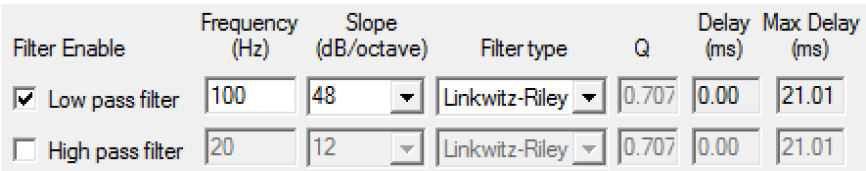
If you are using a subwoofer or subwoofers, add limit filters to implement a crossover between the subwoofer and the main speakers. (The following steps assume that Profile 0 and Profile 1 have been set up as described on the previous two pages.)

1. Select Profile 0 from the toolbar:




2. Open the Filter Properties dialog of the subwoofer (or the left subwoofer if using stereo subwoofers) and select the Limit Filters tab.

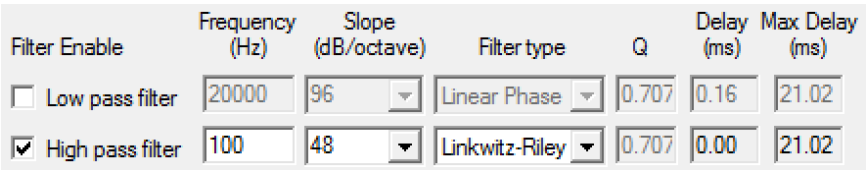
3. Enable the checkbox labeled "Low pass filter" and then set the desired filter type, frequency and slope parameters. Typically, this is a Linkwitz-Riley filter between 80 and 120 Hz with a 24 or 48 dB/octave slope:




4. Close the dialog box. If using stereo subwoofers, repeat for the right subwoofer.

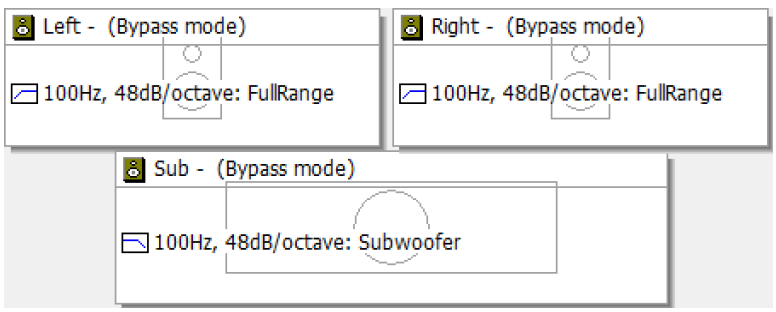
5. Open the Filter Properties dialog of the left speaker and select the Limit Filters tab.

6. Enable the checkbox labeled "High pass filter" and then set the desired filter type, frequency and slope parameters. As a starting point, use the same values used for the low pass filter:



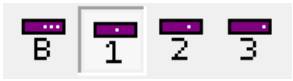

7. Close the dialog box and repeat for the right speaker.

The speaker and subwoofer icons will display the limit filters:

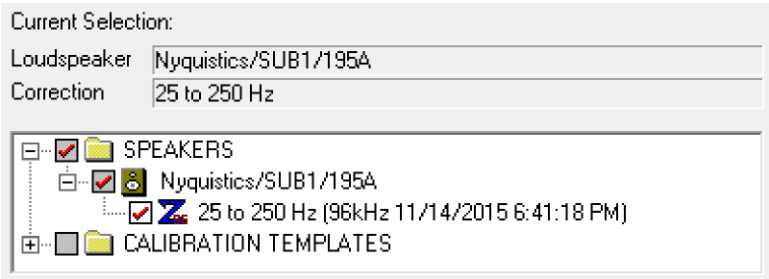


Profile 1 must be set up in the same way, but with the correction filter for the subwoofer added.

1. Select Profile 1 from the toolbar:



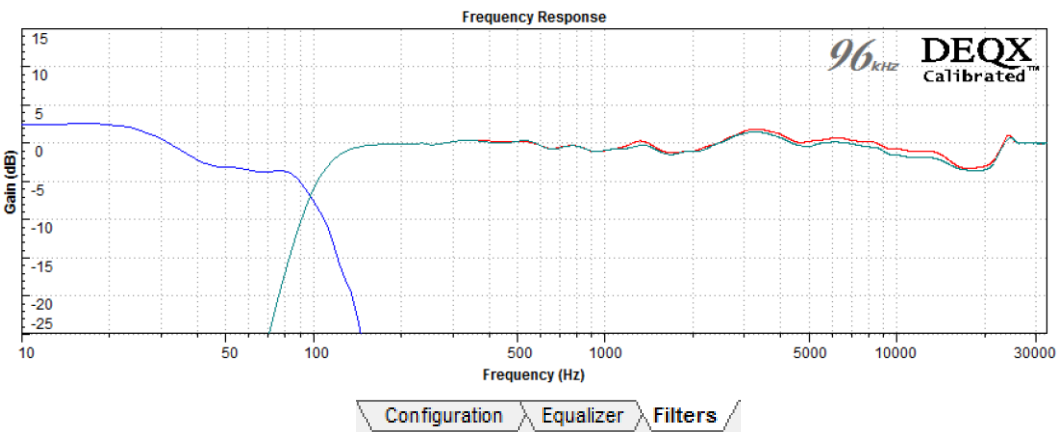

2. Set up limit filters as described on the previous page.
3. Open the Filter Properties dialog box of the subwoofer (or the left subwoofer if using stereo subwoofers).
4. On the Main Filter tab, select "Use a correction filter for this loudspeaker," and select the subwoofer correction filter in the pane that opens underneath:




5. Close the dialog. If using stereo subwoofers, repeat for the right subwoofer.

The speaker and subwoofer icons on the **Configuration** tab will update to display the correction and limit filters.

To graphically confirm the effect of these filters, view the **Filters** tab. The displayed plots will show the combined effect of the correction and limit filters, as shown here:



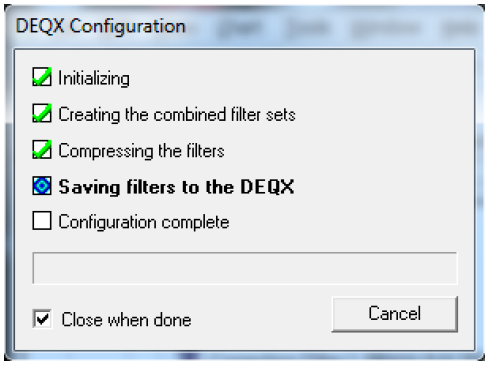


When viewing this tab, click the **Refresh Filters** button to ensure that you are seeing the latest version of the filters.

## 9.8 UPLOAD THE CONFIGURATION TO THE DEQX

Click on each profile button in turn and confirm that all speakers in each profile display the expected data. Once you have checked the configuration over, click the **Save All to DEQX** button.


DEQX-Cal will package up the filters and other data for all four profiles and upload them to the DEQX. A progress dialog keeps you informed:




Now save the project.


Don't forget to use "Save All to DEQX" every time you edit or update your configuration. Remember also that all four profiles will be uploaded to the DEQX.

### A NOTE ON LIMIT FILTERS AND DELAYS FOR ADVANCED USERS

By default, the Max Delay parameter used to generate a correction filter in single amp mode is set to 3 ms, out of a possible maximum 24 ms.

When limit filters are set, the delay of the correction filter is subtracted from the maximum of 24 ms. The examples on page 77 therefore show a maximum delay available of 21 ms (24 – 3). If 10 ms delay were used for the correction filter, then the Limit Filters tab would show 14 ms maximum.

Limit filters can be linear phase, as well as the Linkwitz-Riley examples given in this chapter. If using stereo subwoofers located next to the left and right loudspeaker, for example, the frequency of the crossover to the subwoofer can often be set significantly higher than the examples given earlier in this chapter. Linear phase filters may then be feasible, but will be limited in frequency/slope by the available delay. A higher delay in the correction filter may reduce the delay available in the limit filters.

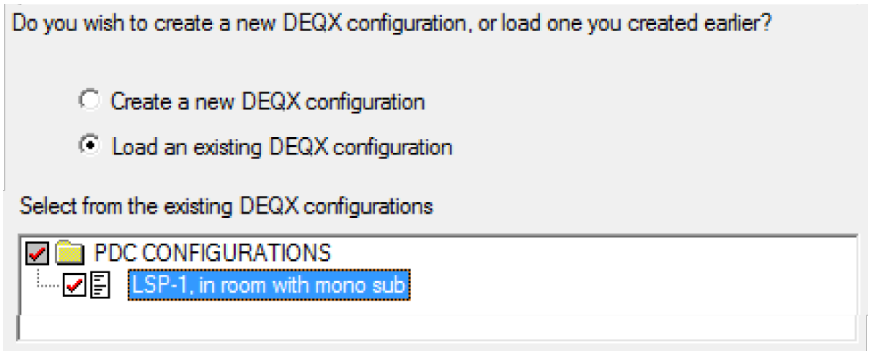
DEQX-Cal manages the delays of all filters specified in a profile and provides warnings if the maximum allowable delay is exceeded. The advanced user, however, should be aware of the interaction between the delays and make the appropriate trade-offs.

## 9.9 TO RE-OPEN A CONFIGURATION

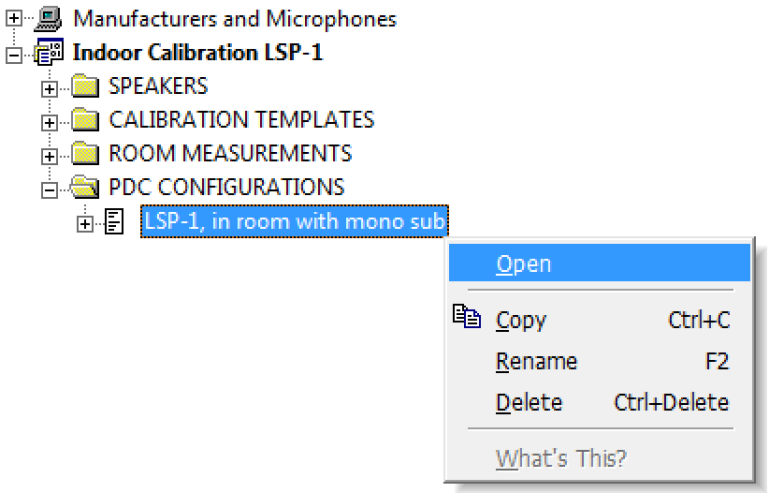
Each configuration is stored in the project file. Any edits to a configuration are saved when the project is saved.

There are two ways to open an existing configuration for viewing:

1. By using the configuration wizard. Click the **Configure** button to start the wizard. On Screen 2, select the option "Load an existing DEQX configuration." Select the configuration that you wish to load from the pane underneath, and click **Finish**.




2. From the project explorer. Unfold the PDC CONFIGURATIONS folder, right-click on the configuration that you wish to open, and select "Open" from the popup menu. (If this entry is greyed out, the configuration is already open and you can bring it to the front from the Window menu.)




The popup menu can also be used to rename and delete a configuration (see page 148).

# 10 ROOM MEASUREMENT


Once the speakers and subwoofers have been calibrated, their *anechoic* response has been corrected in both frequency and time. When placed in a room, however, reflections and resonances in the room act to degrade the frequency response.

To correct for the effects of the room, the DEQX uses parametric EQ, described in Chapter 12. As a starting point for room EQ, a *room measurement* is necessary – that is, the response of the speakers (and subwoofers) when measured from the listening position. Room measurements are also used to integrate the subwoofers (if used) with the main speakers.

When taking room measurements, the speakers and subwoofers are positioned in their regular locations. If you are still experimenting with the best locations for the speakers or subwoofers in the room, be aware that you will need to redo your room measurements and EQ each time you move the speakers or subwoofers. The room measurement can in fact be used to help you determine the optimum locations for speakers and subwoofers.

It is important to be aware that room measurements show the response not only of the speakers and subwoofer(s) but also the effect of a long series of resonances and reflections in the room. They are very different in nature to the anechoic and nearfield measurements taken in earlier chapters. There is no such thing as a "clean" room measurement.

## 10.1 ROOM MEASUREMENT SETUP

In Chapters 6 and 8, the speaker, subwoofer and microphone were positioned in order to minimize the effect of the room on the measured response. Now that the speakers and subwoofers have an accurate, calibrated response, it is time to measure them together with the full effect of the room.

Position the speakers and subwoofers (if used) in their normal locations. For the first measurement, place the microphone at the center of the listening area, at ear height. Position the microphone horizontally and point it between the speakers.

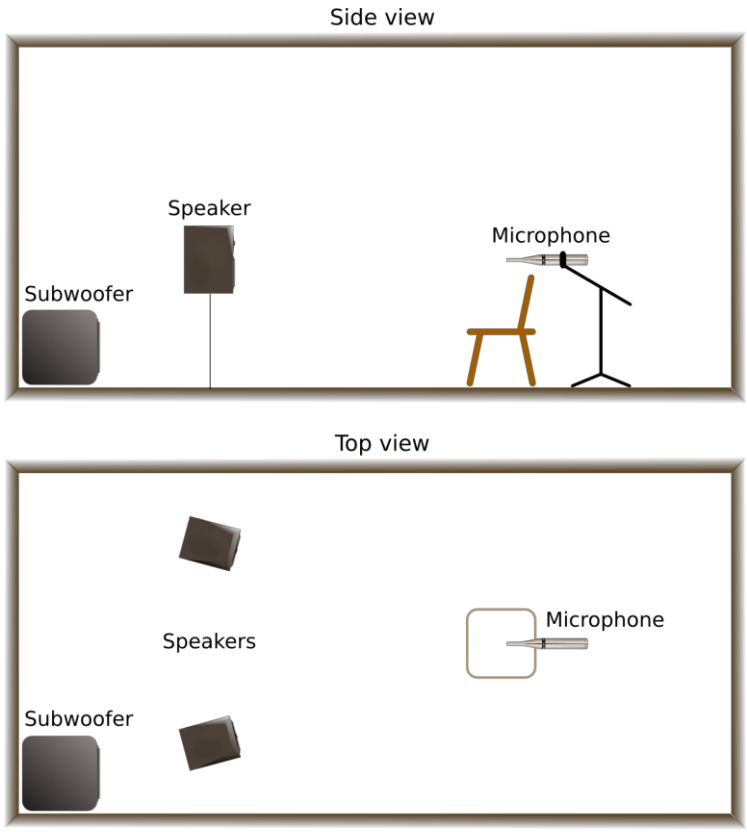


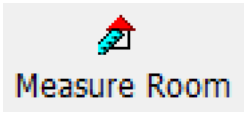

*Figure 3. Room measurement setup*

Set the controls on the subwoofer as when initially measured: disable its low pass filter (crossover) if possible, or if not, set it to its highest frequency; turn off any equalization in the sub; and set any phase or invert controls to their neutral positions.

Your initial room measurement may reveal room-related problems that are best corrected by moving the speakers or subwoofers. We suggest that you initially take a single room measurement and examine it (pages 89 and 90) to establish whether better results would be obtained with the speakers or subwoofers in a different location.

## 10.2 START THE ROOM MEASUREMENT WIZARD

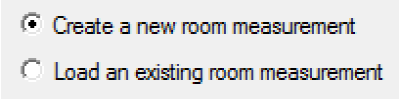
Start the room measurement wizard by clicking on the **Measure Room** button in the Wizard toolbar or by selecting it from the Tools menu.




The wizard will take you through a series of screens. To proceed through them, select the necessary options on each screen and click the **Next** button. If you realize you've made a mistake or need to check what you've done, click the **Back** button to go back through the screens.

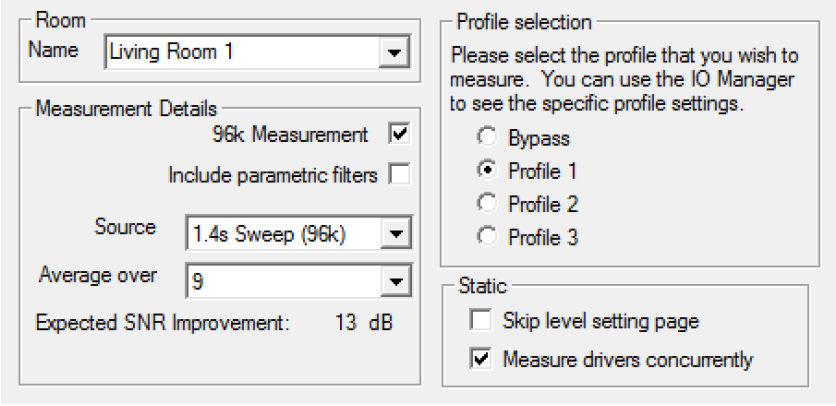
**Screen 1**. If you have more than one project open, this screen allows you to select the project in which the measurement will be stored. Otherwise, this is an informational screen only.

**Screen 2**. Create a new room measurement, or select an existing measurement to open. (The following steps assume that you have selected "Create a new room measurement.")



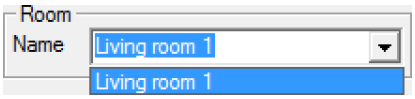

## 10.3 SET ROOM MEASUREMENT PARAMETERS

**Screen 3**. This screen sets a number of parameters that control the measurement.




### Room Name

Enter the name of the room being measured. If you have previously done room measurements, you can select from these rooms using the drop-down menu.



**96k Measurement**

If this box is checked, the DEQX runs the measurement at a 96 kHz sample rate. DEQX recommends leaving this box checked for all measurements.

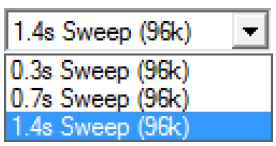
**Include parametric filters**

If this box is checked, the DEQX includes the effect of all parametric EQ filters (room EQ *and* the three-band Preference EQ set by the DEQX Remote). To measure the effects of the room only (without parametric EQ), leave it *unchecked*.


If you check this option and intend to measure the effects of room EQ but *without* including Preference EQ, reset Preference EQ with the DEQX Remote (page 37).

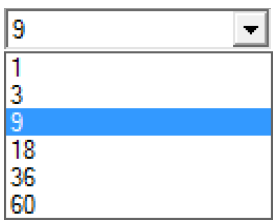
**Source**

This option selects from one of several sweep lengths. At right are the choices for a 96 kHz measurement, ranging from 0.3 to 1.4 seconds. Longer sweeps give higher resolution measurements.



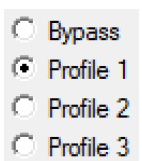

**Average over**

The DEQX can make multiple measurement sweeps in order to improve the signal-to-noise ratio of the measurement. DEQX generally recommends a minimum of 9 sweeps to guard against noise corrupting the measurement. For quick confirmation and verification measurements, however, 3 sweeps may be adequate.




**Profile selection**

Selects which profile will be active while the measurement is being taken. (If you have set up your initial correction profile as suggested on page 76, select Profile 1.)




**Skip level setting page**

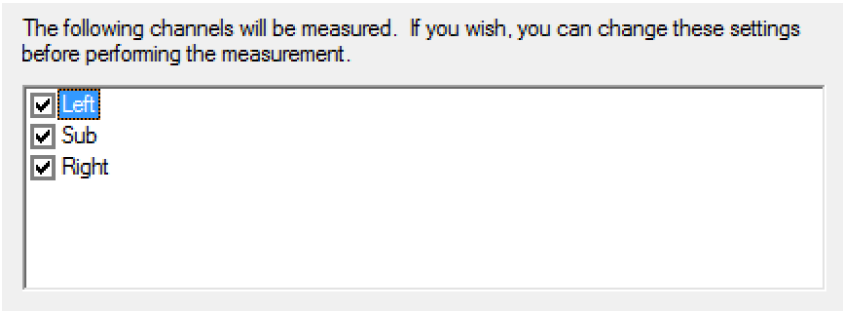
If this box is checked, DEQX-Cal skips Screen 6, in which you set the playback level of the test signal. Check this box *only* if you previously taken a room measurement and set the master volume to a suitable level, as a timesaving feature and to ensure consistent levels.

**Measure drivers concurrently**

With the bi-amp and tri-amp speaker configuration modes, this checkbox makes both (bi-amp) or all three (tri-amp) drivers be measured together, and is the usual choice. Even with the single amp speaker configuration modes, leave this box checked – this means that the level setting screen uses the main speaker to set the measurement level.

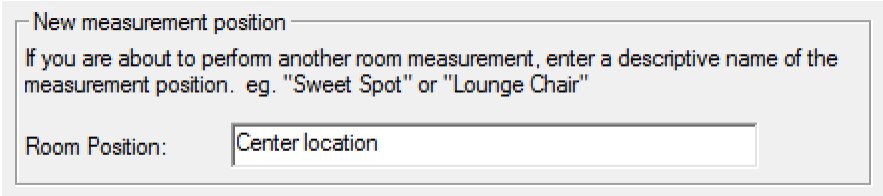
## 10.4 SET LOCATION AND SPEAKERS TO BE MEASURED

**Screen 4**. Select the speakers and subwoofers to be measured. Shown below is the screen for the "single amp with optional mono subwoofer" speaker configuration mode. (If you have not enabled the subwoofer, it will display as "Sub (Disabled)" and be deselected by default.)

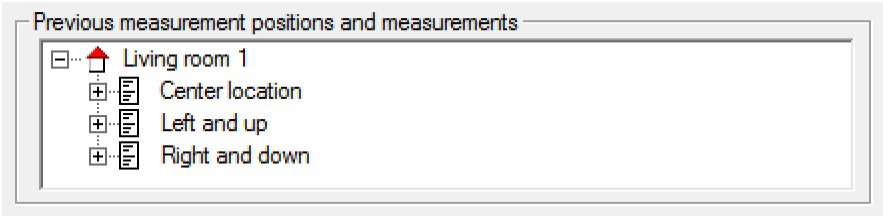



Usually, you will run the room measurement on all enabled outputs. You can select and deselect specific channels with the checkboxes if you wish.

**Screen 5**. Provide a name for the measurement position. To start with, you could name it "Center location."



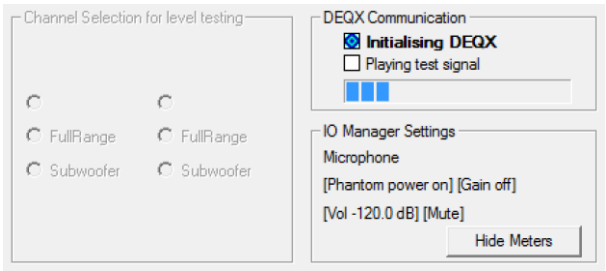

When you take further room measurements, existing measurements done in the same room will appear in the list above the entry box. For example:




Click **Run** to continue.

## 10.5 RUN THE MEASUREMENT

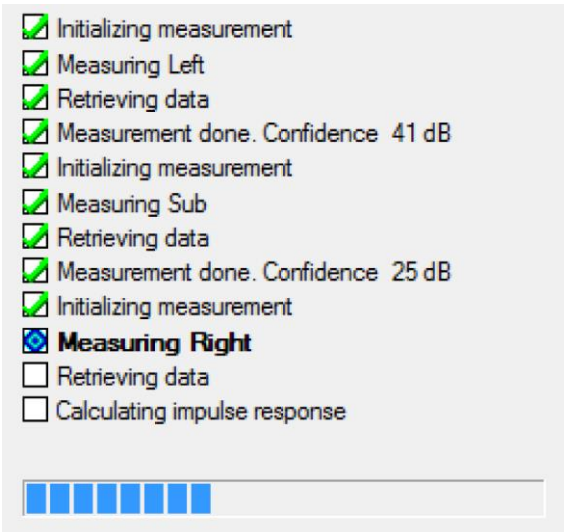
**Screen 6**. DEQX-Cal will upload the test signal to the DEQX, as shown by the "Initializing DEQX" indicator.




When the indicator changes to "Playing test signal," adjust the measurement signal level as described on page 50. For a room measurement, however, the input level should typically be peaking in the range of 75–85 dB.

Click **Run** to proceed.

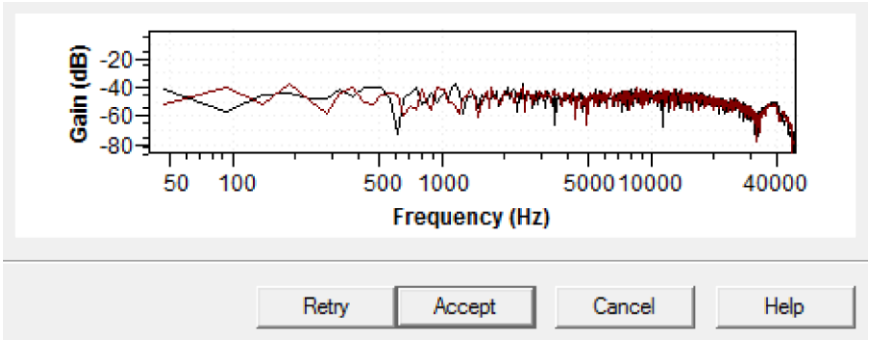
**Screen 7**. DEQX-Cal runs through a series of steps to measure the selected speakers and subwoofers:



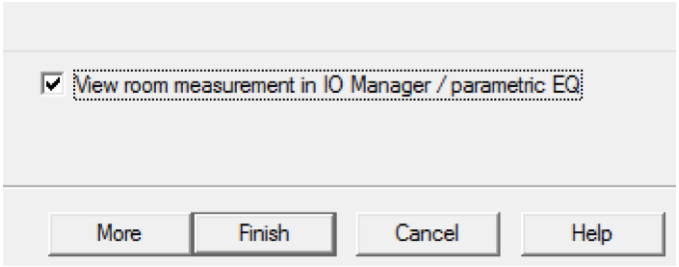

The measurement proceeds in a similar manner as for a speaker measurement, but for each selected speaker and subwoofer in turn.

As the measurement of each speaker or subwoofer completes, the wizard displays its confidence level. With room measurements, the confidence level is much less critical than it is for speaker measurements, as room measurements are not used to directly generate correction filters. As long as DEQX-Cal completes each measurement item with a green tick, you can consider the measurement to be acceptable.

**Screen 8**. When the measurement process is completed, thumbnails of the room measurements are displayed. Most of the time, you will simply click on **Accept**. If you think there is an error in the measurement (for example, from unexpected external noise), click **Retry** to run the measurement again.




**Screen 9.** This is the exit screen.

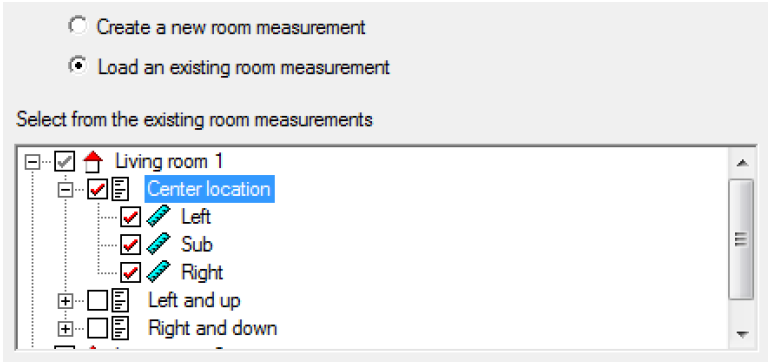



- To proceed with subwoofer integration or room EQ now, leave the box "View room measurement in IO Manager / parametric EQ" checked and click **Finish**. (This is a convenience feature to take you directly to the Equalizer tab of the DEQX Control Panel.)
- To assess the initial room measurement as described on pages 89 and 90, uncheck "View room measurement in IO Manager / parametric EQ" and click **Finish**. Then open the measurement that you have just taken in a new data viewer (see next page).
- If you wish to do additional room measurements at this point, click **More** to be taken directly back to Screen 5. (The level setting screen will be bypassed when taking additional measurements, in order to ensure matching measurement levels. See pages 103 and 104 for more information on using multiple room measurements.)

## 10.6 TO OPEN EXISTING ROOM MEASUREMENTS

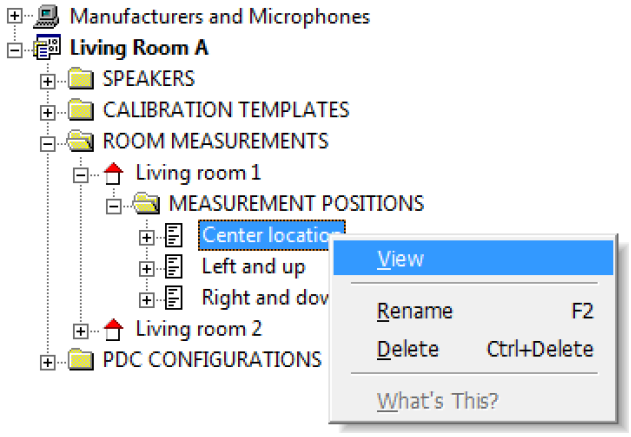
There are three ways to open existing room measurements:

1. Using the room measurement wizard. Click the **Measure Room** button and on Screen 2, select the option "Load an existing room measurement." In the pane underneath, select the measurement or measurements to open.




On Screen 3, select the data viewer in which to open the selected measurements. By default, this is the Equalizer tab of the Control Panel:


2. From the project explorer. Unfold the ROOM MEASUREMENTS folder, navigate to the measurement position that you wish to open, right-click and select "View" from the popup menu:




You can also unfold a measurement position and open single room measurements from within it. (See page 103 for an example.)

3. With drag and drop. Unfold the project as above, then drag a measurement from the project explorer and drop it onto an open data viewer or onto the Equalizer tab of the IO Manager. (You may need to bring the desired data viewer to the front by selecting it from the Window menu before you do this.)

## 10.7 ASSESS THE INITIAL MEASUREMENT

The measurement taken in the center of the listening area can be examined to confirm suitable speaker and subwoofer locations. It can also be used to confirm that the microphone has in fact been placed in the center of the listening area.

The procedures in this section are optional, but you may find that you get a better end result by using them. To proceed, start by opening the room measurement taken at the center of the listening area in a new data viewer.

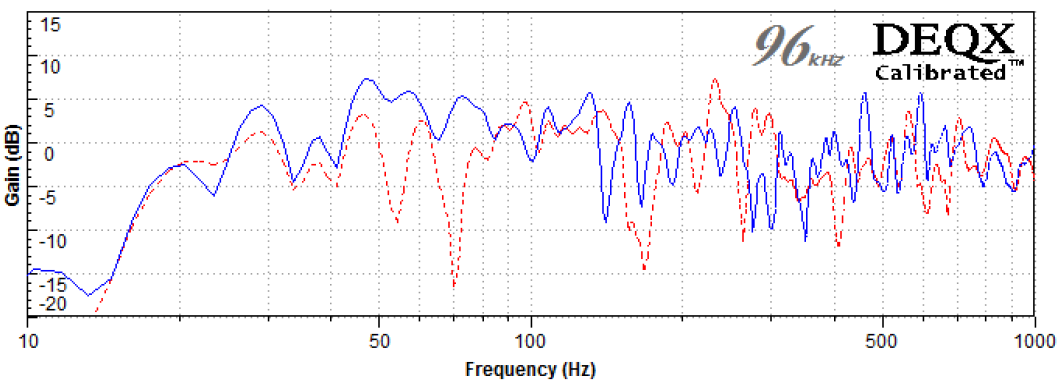
You will need to zoom in on the plots to view them more clearly. To do so, click the zoom icon in the toolbar and then either click on the graph or drag out a rectangle around the area of interest. For more detailed information on how to work with the measurement plots, see Chapter 16.

### 10.7.1 Speaker location

When a DEQX is used in your system, the *optimal* speaker (and subwoofer) placement may be different to what you have previously found. Without the DEQX, you may have (even unknowingly) chosen a speaker location and listening position that tends to result in low output at low frequencies, in order to avoid "boominess."

With a DEQX' capability to linearize the speaker/subwoofer response and address room modes, the optimum speaker and listening positions are often those that tend to excite room modes more. The peaks can be addressed by the DEQX, with a better end result and less risk of overdriving amplifiers.

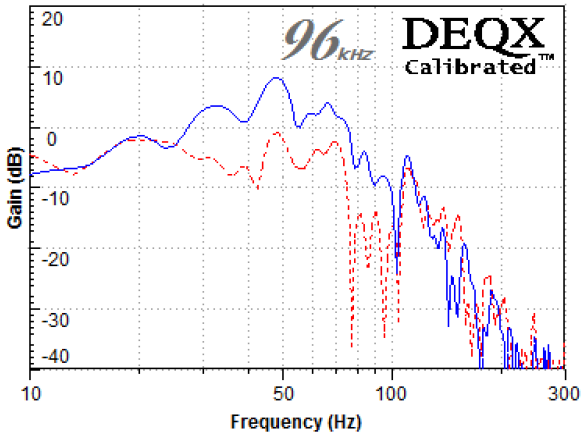
The example below shows the measurements of two speaker and listening location combinations in the same domestic living room. In both cases, the microphone was approximately 2.4 m (8 feet) from the speaker. The response shown in blue is likely to lead to a better end result than the response shown in dotted red, which has significant "suck-out" in the 50 – 75 Hz and 160 – 180 Hz ranges.



### 10.7.2 Subwoofer location

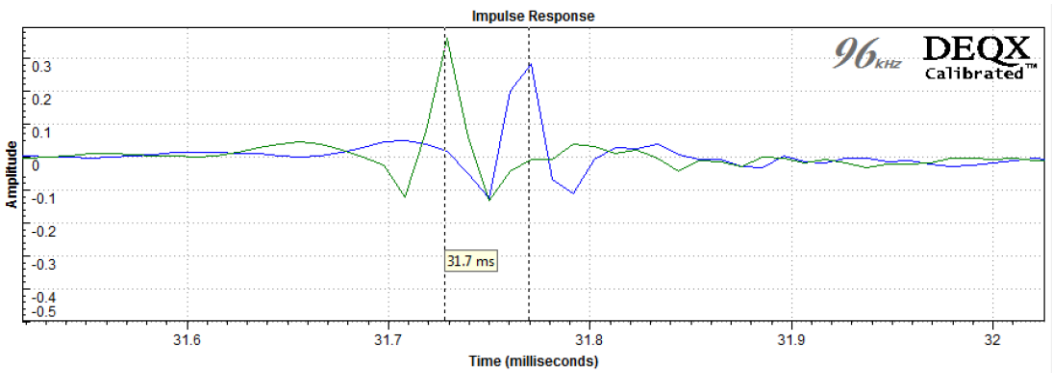
If a subwoofer or subwoofers are used, the same principle applies. If possible, choose subwoofer locations that enhance bass output. Often, one or both corners behind the speakers will work well.

The example below shows the response of a subwoofer at two different locations in the room. While the dotted red response initially looks flattest, it has a suckout in the frequency range from 75 to 100 Hz that cannot be effectively addressed with EQ. The solid blue curve has a peak at 48 Hz and may – without room EQ – sound a little boomy. However, once the low frequency response curve has been corrected with room EQ, the end result is likely to be better.




### 10.7.3 Microphone location


To check that the microphone is the same distance from both speakers, click the **Time** button in the Chart toolbar. Zoom in on the plots to clearly display the impulse responses of the left and right speakers. It is not uncommon to see a difference of a tenth or two of a millisecond between the two impulse response peaks, due to the microphone not being positioned exactly equidistant from the two speakers. If the difference between the two speakers is more than this, check your microphone position and repeat the measurement.



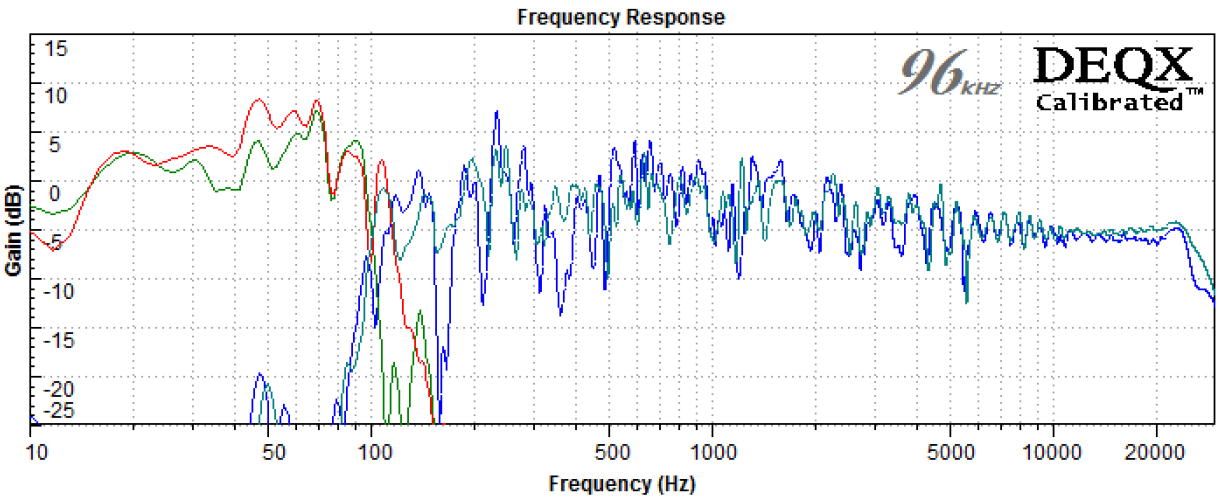
# 11 SUBWOOFER INTEGRATION

To *integrate* subwoofers means to ensure that they are correctly time-aligned with the main speakers and matched in level. While this manual presents subwoofer integration before room EQ, it is also possible to do it afterward once you are familiar with the operations involved. In either case, the final subwoofer level is a result of listening to a variety of program material.

If you are not using subwoofers, skip this chapter.

## 11.1 VIEW THE ROOM MEASUREMENT

Open the most recent room measurement taken at the center of the listening area. The screenshot below shows a typical example with stereo subwoofers. (If you left "View room measurement in IO Manager / parametric EQ" checked on the exit screen of the room measurement wizard, this window will already be open.)




| Show | Plot Name | Col | Line | Smooth | Scale |
|---|---|---|---|---|---|
| ☑ | Center first/Left | | | 100% | 45.4 dB |
| ☑ | Center first/Left Sub | | | 100% | 45.4 dB |
| ☑ | Center first/Right Sub | | | 100% | 45.4 dB |
| ☑ | Center first/Right | | | 100% | 45.4 dB |

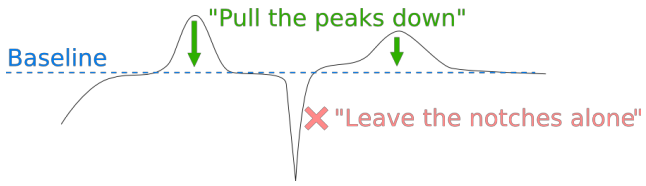
## 11.2 LEVEL MATCHING

To determine level adjustments, the **Scale** parameter of each plot (lower right of the window) will be adjusted to visually equalize the level of all plots.

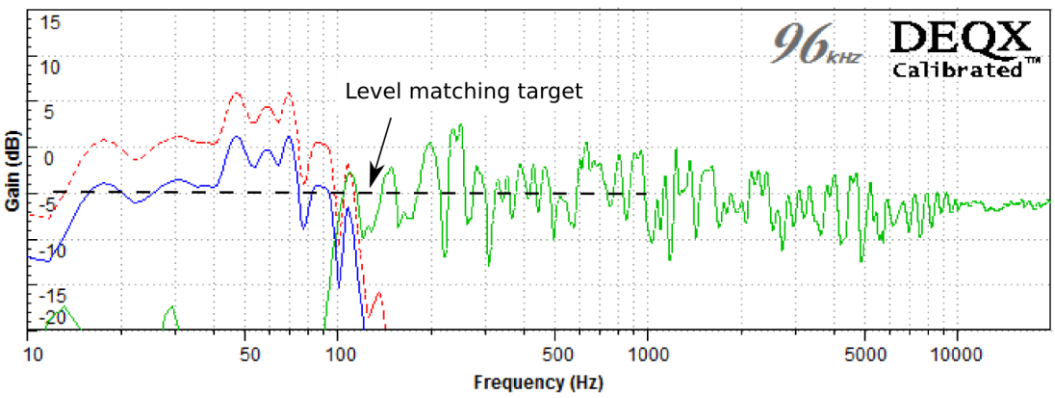
As a starting point, you can use the **Normalize to 0 dB** button. Deselect the subwoofers (so only the speaker plots are displayed) and click on **Normalize to 0 dB**. Then select the subwoofers, deselect the speakers, and click on **Normalize to 0 dB** again.

### 11.2.1 Level matching stereo subwoofers

Display the plots for the left speaker and left subwoofer. Adjust the **Scale** value of the left subwoofer so that its baseline is at or slightly above the average level of the speaker in the region from 100 to 1000 Hz. This diagram illustrates what we mean by "baseline" – it allows for subsequent EQ that "pulls the peaks down":




For example, the plot below shows the left speaker in green, the left subwoofer before adjustment in dashed red, and the left subwoofer after adjustment in solid blue:



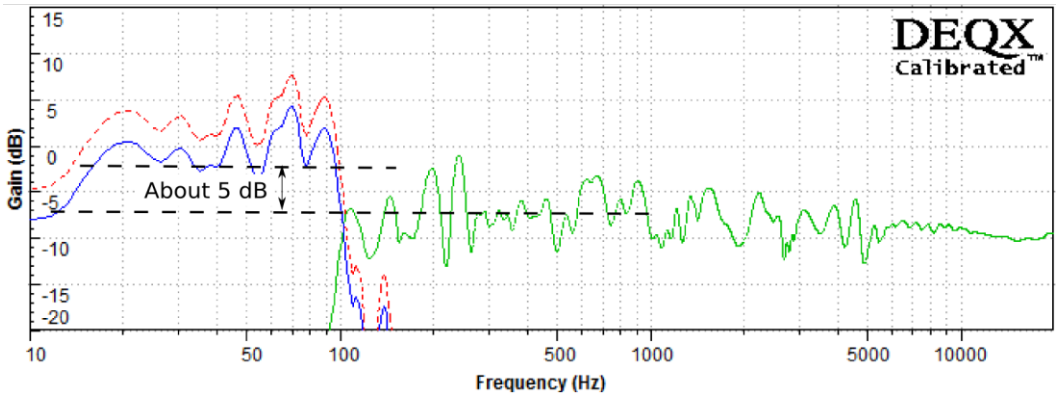

Repeat for the right speaker and right subwoofer.

### 11.2.2 Level matching a mono subwoofer

Because the mono subwoofer carries signal from both input channels, the way that initial level matching is performed is slightly different to that for stereo subwoofers.

Display the plots for the left speaker and the subwoofer together. Adjust the **Scale** value for the subwoofer so that the baseline level of the subwoofer plot is about **5 dB higher** than the average level of the speaker in the region from 100 to 1000 Hz. (5 dB is one division on the vertical scale.)

For example, the plot below shows the left speaker in green, the subwoofer before adjustment in dashed red, and the subwoofer after adjustment in solid blue:




### 11.2.3 Calculate gain adjustments

The gain adjustments are calculated from the **Scale** values in the plot selector. Here is an example of a set of scale values after adjusting as described above:

| Show | Plot Name | Col | Line | Smooth | Scale |
|---|---|---|---|---|---|
| ☑ | Center position/Left | | | 100% | 39.4 dB |
| ☑ | Center position/Left Sub | | | 100% | 35.1 dB |
| ☑ | Center position/Right Sub | | | 100% | 33.9 dB |
| ☑ | Center position/Right | | | 100% | 39.4 dB |

To calculate the gain adjustments, assign the plot with the highest **Scale** the value 0, and then calculate the gain adjustment for the others using this formula:

gain_adjustment = – (highest_scale – this_scale)

This diagram illustrates for the above **Scale** values:

| *Speaker or sub* | *Scale* | *Calculation and result* |
|---|---|---|
| Left speaker | 39.4 | 0 |
| Right speaker | 39.4 | −(39.4 − 39.4) = 0 |
| Left sub | 35.1 | −(39.4 − 35.1) = −4.3 |
| Right sub | 33.9 | −(39.4 − 33.9) = −5.5 |

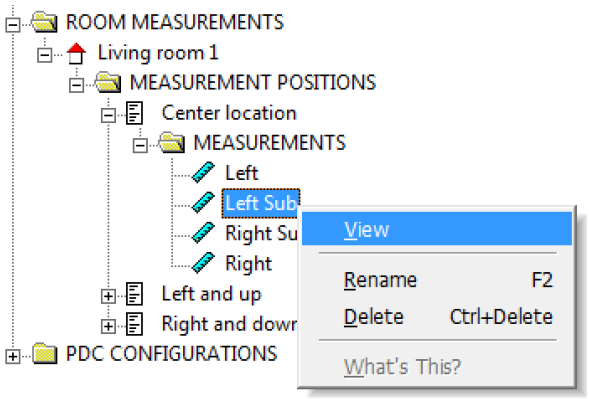
In this example, we need to adjust the gains of the subwoofers. If you need to adjust the gains of the main speakers instead, adjust the gains of both speakers by the *same* amount. (In *some* cases, a slightly different adjustment to each speaker can be useful but this should only be done with careful auditioning.)


If a substantial gain adjustment is needed, it may be advisable to adjust the analog gains in the system and re-measure. For subwoofers, this can often be done simply by adjusting their onboard gain controls. If not, see Appendix D.

## 11.3 TIME ALIGNMENT

Time delays between the speakers and subwoofers are calculated using their impulse responses. The delay that needs to be added to speakers or subwoofers depends not only on their physical distance from the listening position but also the delay in the filters that have been applied to them. The following method accounts for all of these factors.

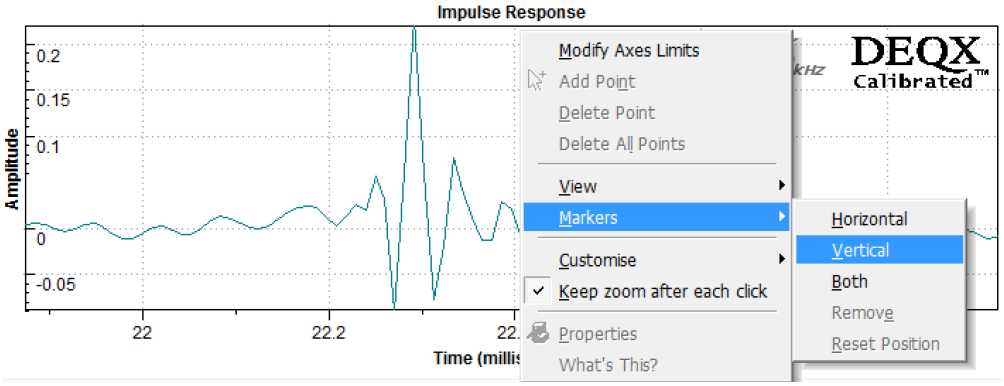
In order to determine time delays, it is necessary to view the *impulse response* of the speakers and subwoofers. The impulse response cannot be viewed in the Equalizer tab, so the measurements will need to be opened in a data viewer by using the room measurement wizard (page 88) or by using the project explorer, like this:



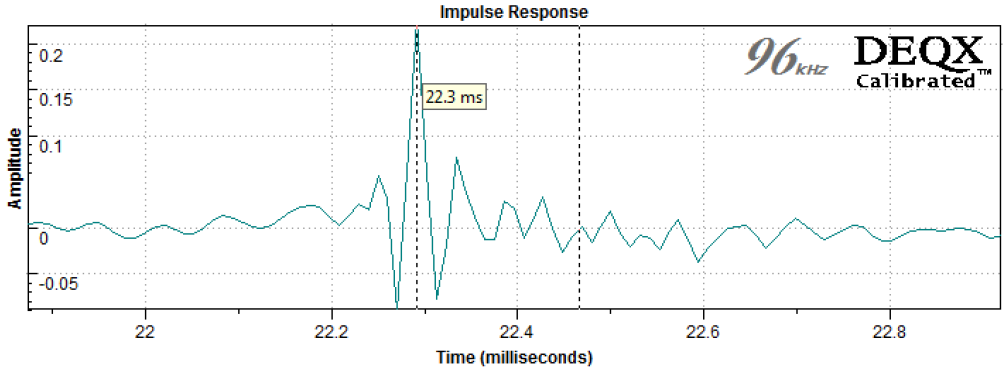

### 11.3.1 Determine speaker delay

Open one of the speaker measurements and click the **Time** button in the chart toolbar to display its impulse response.


To zoom in on the impulse response, click on the zoom icon in the toolbar and then drag out a rectangle around the impulse response so that it can be viewed clearly:

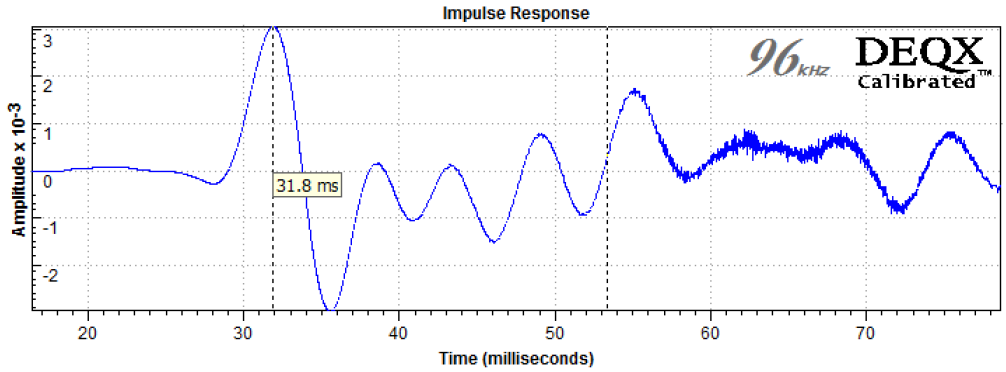


Right-click on the plot and select "Markers" then "Vertical." Place one of the markers at the impulse response peak. In this example, the delay of the speaker is 22.3 ms:




### 11.3.2 Determine subwoofer delay

Open the measurement of each subwoofer as described above, and click the **Time** button to display its impulse response. Use a vertical marker to find the time delay of the first peak. In this example, the delay of the subwoofer is 31.8 ms:

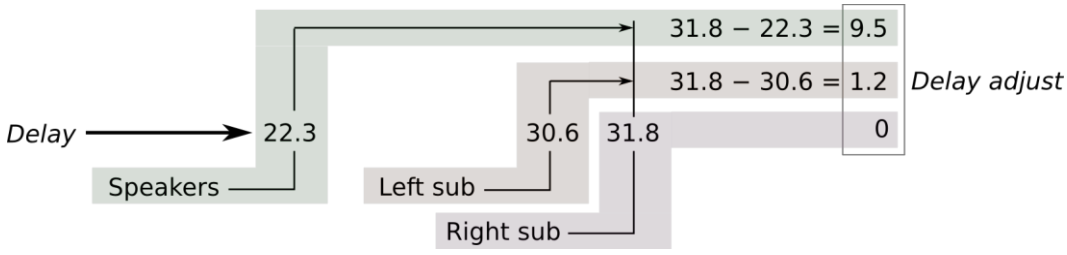



### 11.3.3 Calculate relative delays

The delay to be added to the speakers or to each subwoofer is given by this formula:

delay_adjustment = longest_delay – this_delay

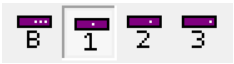
This diagram illustrates for the above time delay values:



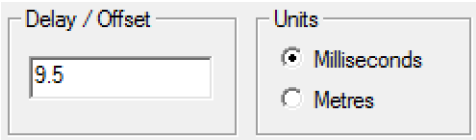

Note that both speakers should always have the same delay adjustment.

## 11.4 UPDATE THE CONFIGURATION

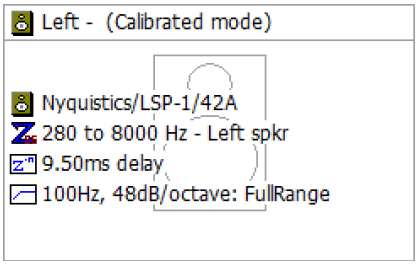
Return to the configuration window. Then:



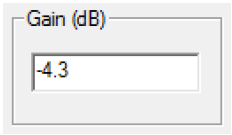

1. Ensure that you have selected the correct profile.
2. For each speaker or subwoofer that requires a delay, double-click on its icon to open its Filter Properties dialog. On the **Time/Level** tab, set the calculated delay value for that speaker or subwoofer.




Click **OK** to close the dialog. The speaker (or subwoofer) icon updates to show the delay:




3. For each speaker or subwoofer that requires a gain adjustment, double-click on its icon to open its Filter Properties dialog. On the **Time/Level** tab, set the calculated gain adjustment for that speaker or subwoofer:




Click **OK** to close the dialog.

4. Click on **Save All to DEQX**.


5. Save the project.

## 11.5 RE-MEASURE THE ROOM

Before proceeding with room EQ in the next chapter, redo your room measurement. This will give you a measurement with the correct initial levels for room EQ.

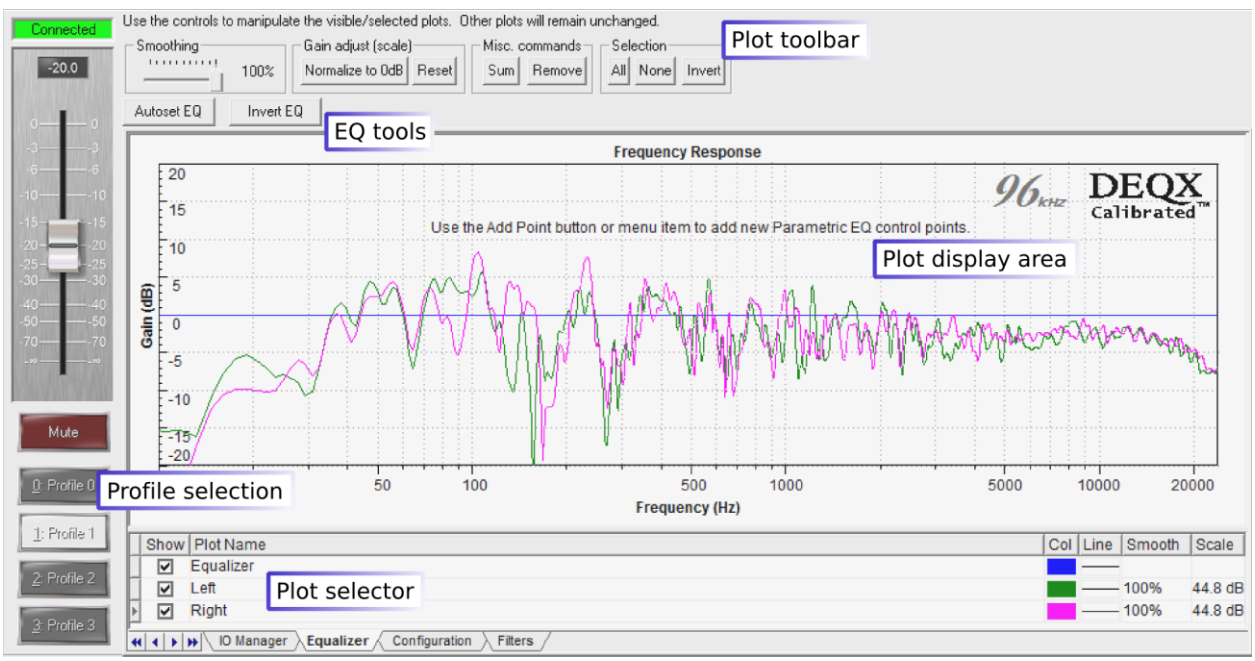
# 12 ROOM EQ

The DEQX uses parametric equalization (EQ) to correct for the effects of the room. Room EQ can be applied anywhere in the frequency range, but is typically most effective in the modal region (below 200 to 300 Hz, depending on the room).

Room EQ starts based on room measurements, but these measurements are only a *guide*. Always confirm your EQ settings by listening to a variety of music and making further adjustments as needed. You will never get a "perfect" room measurement.

Room EQ is done in the Equalizer tab of the Control Panel – see the annotated screenshot below. This is a customized version of the data viewer that adds two buttons for EQ control, **Autoset EQ** and **Invert EQ**. There is also a plot for the equalization curve, named "Equalizer" and displayed in blue (by default).

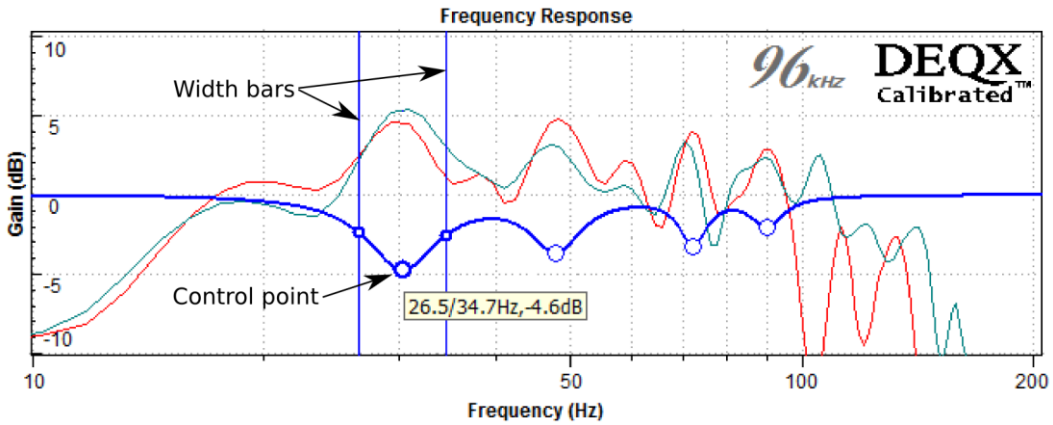
Room EQ is done per-profile, so use the **Profile** buttons to select the same profile that you used when making this room measurement ("Profile Selection" on page 84). In the example screenshot below, Profile 1 is selected.



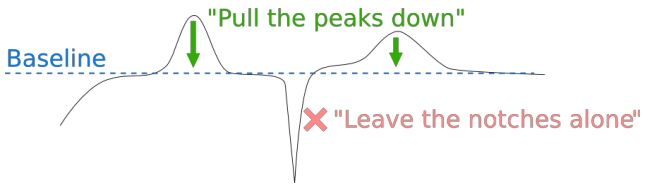
## 12.1 How to use manual EQ

To add an EQ control point, right-click on the plot and select "Add Point" from the menu, or click the **Add Point** button in the chart toolbar. Then click on the plot display area.


The example below shows an EQ curve for stereo subwoofers with four control points added. (The plot has been zoomed in to show the frequency range from 10 to 200 Hz.)

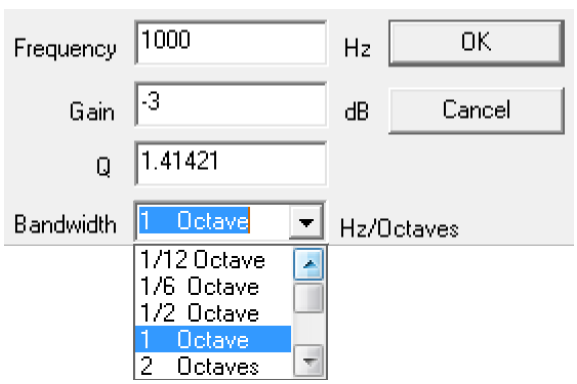



In this example, the EQ curve is set to "pull the peaks down." This can be done because the subwoofers' **Scale** has been set so that their baseline is at about 0 dB.




To change the center frequency and gain of a filter band, click and drag the control point. To change the width, click and drag either of the two vertical bars. These bars are located at the "half way" points of the filter. (For example, if the filter is set for a gain of −6 dB, the bars are at the frequencies of −3 dB gain.) As a general rule, narrow filters are used at low frequencies and wider filters are used at higher frequencies. All changes are "live," so the effect can be heard while listening to music.

A tooltip overlay displays the parameters of a filter band. Exact parameters can be set by double-clicking on the control point to bring up the dialog box shown at right.




**Frequency**

The center frequency of the filter band.

**Gain**

The gain of the filter band in dB. (Positive is boost and negative is cut.) As a general rule, gains greater than 6 dB should be used with caution, as doing so may require substantial additional amplifier power.

**Q**

The width of the filter band. High values represent a narrow filter, low values a broad filter. When **Q** is set, **Bandwidth** automatically updates.

**Bandwidth**

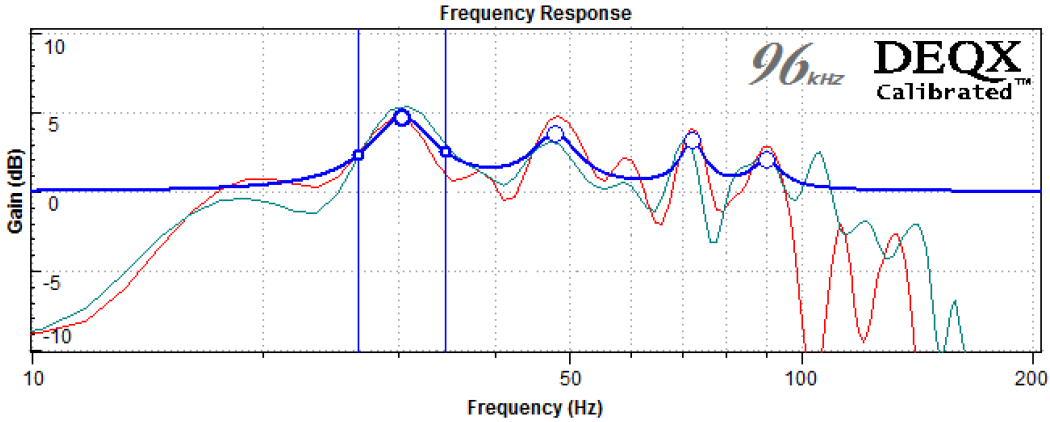
This drop-down menu selects the bandwidth of the filter either in Hertz or in octaves. When **Bandwidth** is set, **Q** automatically updates.

You can add up to ten points to the EQ curve. If you add more than seven, you will receive a warning that Preference EQ (pages 34 to 37) will no longer work.


## TIPS FOR MANUAL ROOM EQ

Room measurements typically exhibit a downward "tilt" from low bass to high treble of 6 up to 15 dB. This is caused by a number of factors including reduced dispersion and greater absorption in the room at high frequencies. *Do not attempt to EQ your room measurement completely flat* – that will most likely sound overly bright.

Here is a simple and effective way to create a suitable manual EQ curve. First, create control points that "follow the curve," as in this example:




Then click the **Invert EQ** button to obtain the "right way up" EQ curve as shown on the previous page. (If you use this method, be sure to always set the EQ curve to the correct orientation before re-measuring or listening to the effect of the EQ.)

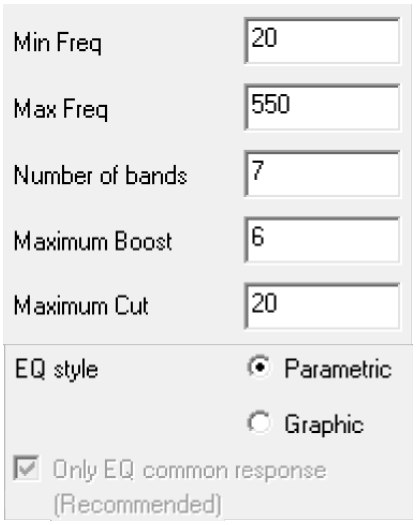
If you have difficulty creating a suitable EQ curve, adjust the **Scale** parameters in the right-most column of the plot selector – this may result in a simpler curve.

Always audition the effect of any EQ. Using multiple profiles to set up different EQ curves can be helpful to find the optimum settings.

## 12.2 How to use Autoset EQ

The Autoset EQ feature provides a calculated starting point for further manual EQ adjustments. It will aim for "minimal disturbance" by creating narrow filters and choosing conservative gains. If multiple plots are selected, it will only make corrections that have the same effect on all measurements. (For example, it will not reduce a peak if that peak is not present in all of the selected plots.)

To use it, first select the plots that you want the EQ to be calculated against. Then click the **Autoset EQ** button. The options for Autoset EQ are as shown at right below. (The greyed-out option "Only EQ common response" is always on.)




**Min Freq, Max Freq**

Set the minimum and maximum frequencies that Autoset EQ will assign to filter bands.

**Number of bands**

Sets the number of filter bands that you want Autoset EQ to use. This can be up to ten, but if greater than seven, Preference EQ (as described on pages 34 to 37) will be disabled.

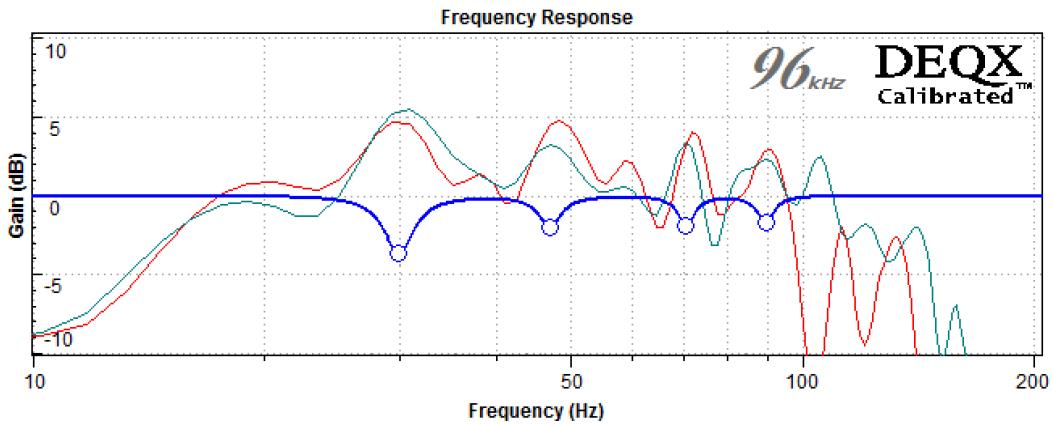
**Maximum Boost, Maximum Cut**

Set the maximum boost and cut that Autoset EQ will assign to any filter. As a general rule, avoid using more than 6 dB of boost.

**EQ style**

"Parametric" sets each filter band at the location where maximum cut or boost is needed whereas "Graphic" equally spaces the filter bands. "Parametric" is usually the best choice.

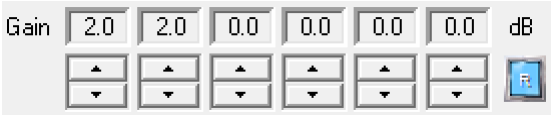
This example illustrates the effect of Autoset EQ on stereo subwoofers. This curve can now be fine-tuned using manual EQ:



## 12.3 FINE-TUNE YOUR RESULTS

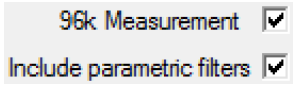
The EQ control points on the Equalizer tab are "live" – that is, the effect on the audio will be heard immediately as they are changed. Once you have set up an initial EQ curve, play music (or movies) through the DEQX and adjust the control points to obtain the best audible result. Small changes can make quite a difference, so listen to a variety of different tracks.

If you are using subwoofers, you can also use the Gain adjustment buttons in the IO Manager (pages 132 and 133) to increase or decrease the level on channels L1 and R1. For example, after addressing room modes you may find that bass sounds "lighter" than expected, so increasing subwoofer level by 2–3 dB can correct this impression. (Once you have found the best setting in the IO Manager, you will write that back into the configuration – see step 5 on the next page.)




Remember also that the DEQX Preference EQ has not yet been harnessed. Even if you like a lot of bass, it is best to find a neutral bass level here. Later on, set up your Preference EQ as described on pages 34 to 37.

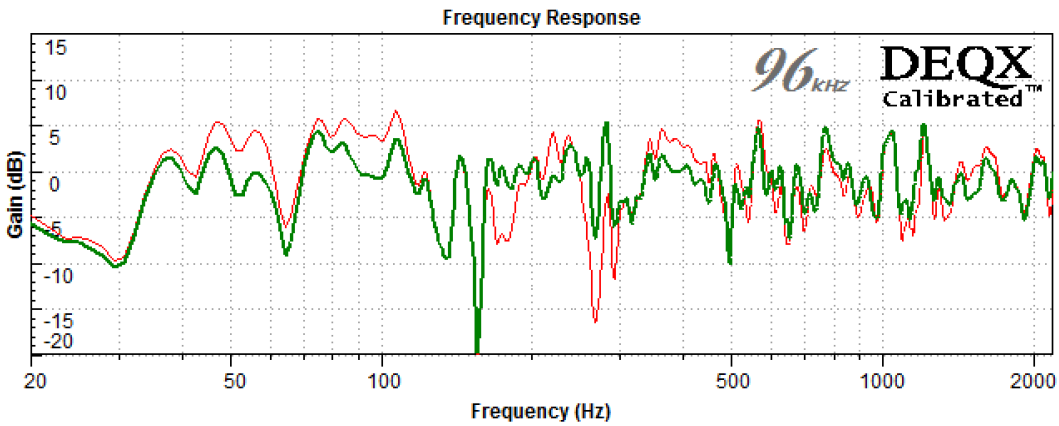
You can also do additional room measurements to verify the effect of your EQ settings. The procedure is the same as described in Chapter 10, except that you must enable the "Include parametric filters" option on Screen 3.





Check that your EQ curve is not inverted before running the measurement. Also make sure that you have reset the Preference EQ with the DEQX Remote (page 37).

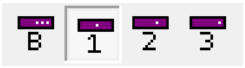
The new measurement can be compared to the original. While (as mentioned on page 81) room measurements will always look "rough," you can see in the example below how room EQ has mitigated the worst effects of the room – "before" is in red and "after" in green. (Remember also that this is just one of two speakers.)



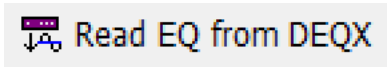
## 12.4 UPDATE THE CONFIGURATION

With room EQ and levels adjusted to your satisfaction, these new settings need to be copied to the configuration and saved.

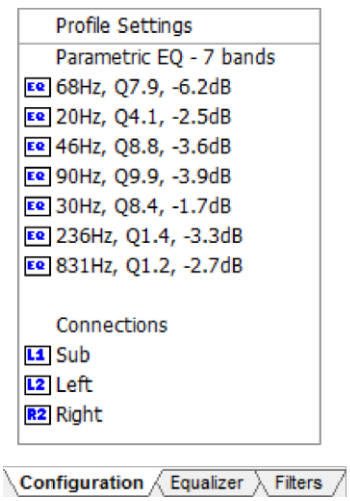
1. Open the configuration if it is not already open (page 80).
2. In the configuration window, select the same profile that you have been applying EQ to.

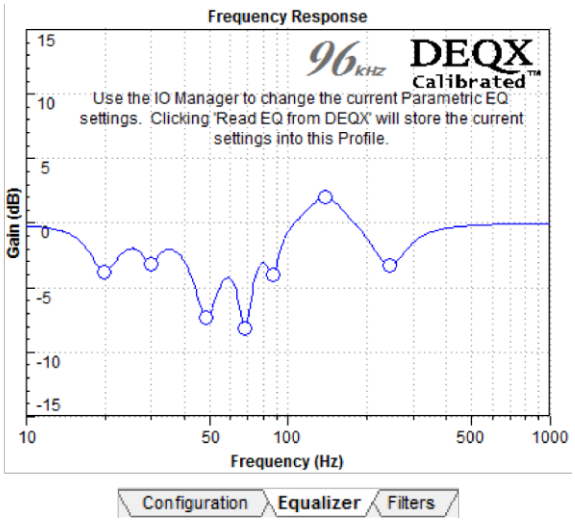



3. Click the **Read EQ from DEQX** button:

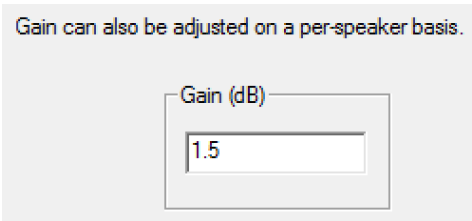



4. The EQ points for all four profiles will be downloaded from the DEQX. On the **Configuration** tab, the parameters of the EQ filter bands will be shown numerically (below left). On the **Equalizer** tab, the EQ filters will be shown graphically (below right).

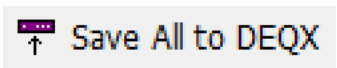



5. If you have changed subwoofer channel levels in the IO Manager, adjust gain in the Filter Properties dialog box of each subwoofer by the same amount. After doing this, return to the IO Manager and reset the channel gains back to zero.




6. Click **Save All to DEQX** to upload the updated configuration to the DEQX.




7. Save the project.

## COPYING ROOM EQ FILTERS

Parametric room EQ filters can be copied between profiles using cut-and-paste operations. For example, to copy room EQ settings from Profile 1 to Profile 2:

1. Click on the Profile 1 selector button.
2. Right-click in the Profile Settings area and select "Copy" from the popup menu.
3. Click on the Profile 2 selector button.
4. Right-click in the Profile Settings area and select "Paste" from the popup menu.

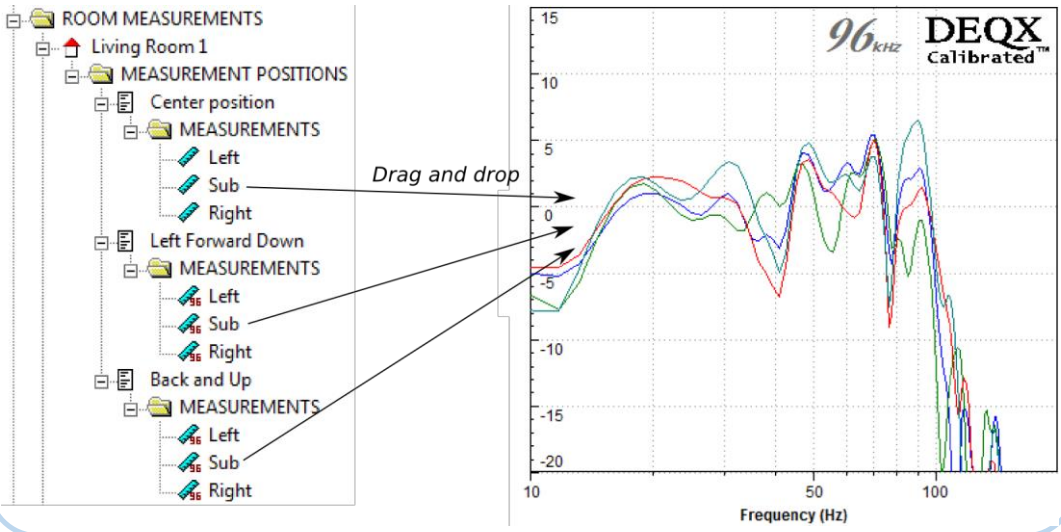
## VIEWING MULTIPLE ROOM MEASUREMENTS

Multiple measurements around the listening area can be used to perform more comprehensive room analysis and EQ. To take a series of measurements with different microphone positions, click on **More** on Screen 9 of the room measurement wizard (page 87). You will be taken back to Screen 5, where you can enter the name of the new position and proceed with another measurement.

When viewing multiple measurements for room EQ, it is often desired to view a single speaker or subwoofer, but at multiple positions. (For example, the subwoofer at four different measurement positions.) One way to do this is to use the room measurement wizard, select "Load an existing room measurement," and then use the checkboxes to select the required individual measurements.

A second approach is to use drag and drop from the project explorer – locate each measurement in turn and drag and drop it onto the Equalizer tab of the IO Manager.

This example shows the measurements of a subwoofer at four different locations:

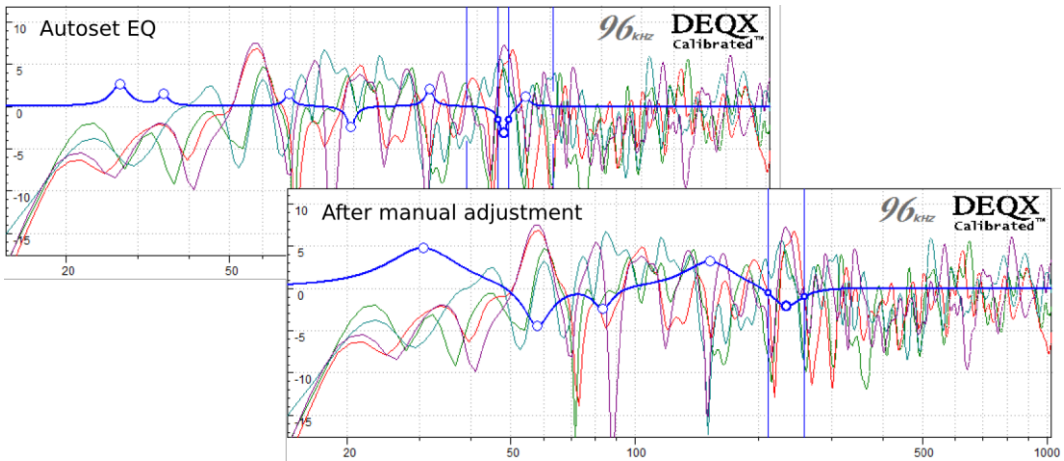



## USING MULTIPLE ROOM MEASUREMENTS

While the central position is generally a good indicator of the overall response around the listening area, multiple measurements can be used to refine your EQ, especially if the listening area is large.

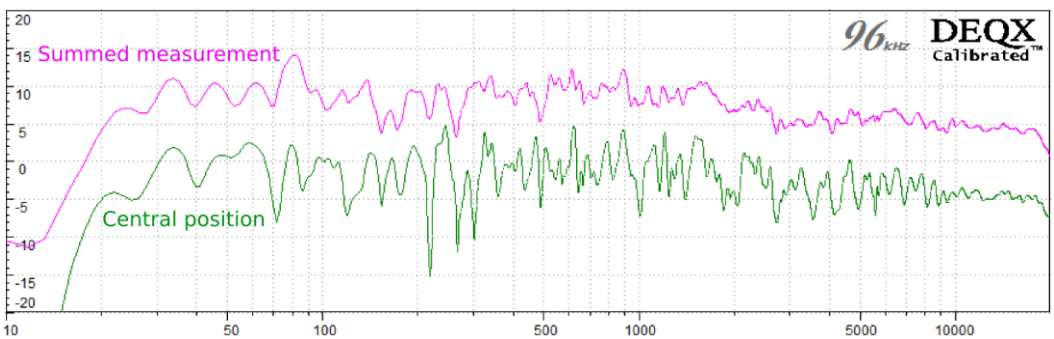
### Method 1: Take multiple measurements first

Take several measurements around the listening area and load them into the Equalizer tab of the Control Panel. Click **Normalize to 0 dB**, and then on **Autoset EQ** to get a starting point. Autoset EQ takes a conservative approach when asked to EQ multiple plots, so manual adjustment may then be needed. This composite illustrates:




### Method 2: Take multiple measurements later

Use the central position of the listening area to do your room EQ. Then take several measurements around the listening area, being sure to enable "Include parametric filters" on Screen 3 of the room measurement wizard. Load the measurements into a data viewer and use the **Sum** button to see how applicable your EQ is across the listening area. For example, the summed measurement below (in purple) suggests that a little more cut at 80 Hz may be beneficial. (The green plot is the same speaker measured at the central position, for comparison.)



# 13 ACTIVE MULTI-WAY SPEAKERS

When used in the *bi-amp* and *tri-amp* speaker configuration modes, the DEQX becomes the heart of an *active* speaker, with each driver being driven by a dedicated amplifier channel. The bi-amp and tri-amp speaker configuration modes are supported by the HDP-4, HDP-5, and HDP-Express II.

The bi-amp and tri-amp configurations are considered an **advanced** mode of operation, as using them will require knowledge of the intricacies of speaker design as well as improved measurement technique. The explanation assumes that Chapters 5 to 9, which focus on the *single-amp* speaker configuration modes, are already fully understood.

Bi-amp and tri-amp modes can potentially damage drivers if settings are incorrect. The symbol at left will appear wherever particular note must be paid to settings or options.

## 13.1 ACTIVE CONFIGURATIONS WITH DEQX

By way of introduction to active speakers, Figure 4 illustrates a system using a pair of *passive* two-way speakers and a DEQX running in single-amp speaker configuration mode. The internals of the right speaker are shown for illustrative purposes.

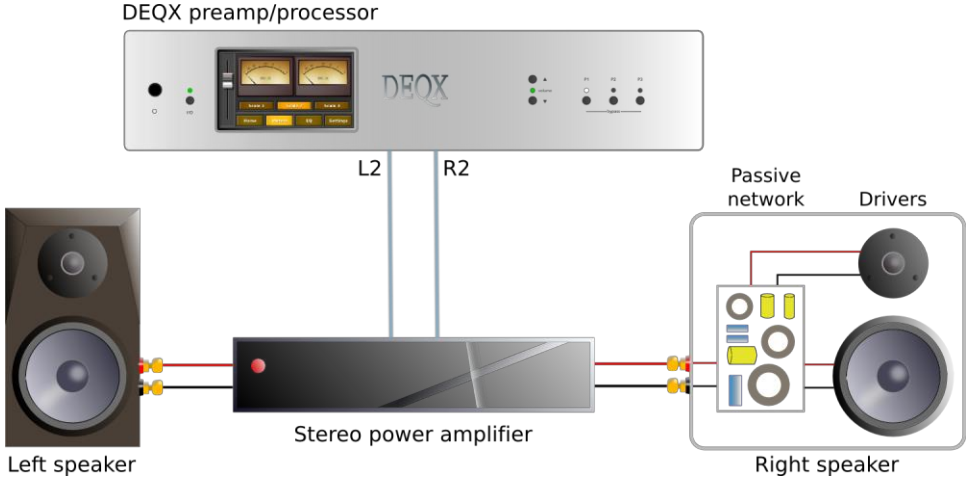



*Figure 4. Passive two-way speaker*

Each speaker in Figure 4 has an internal crossover network consisting of passive components – inductors (coils), capacitors, and resistors. This passive network divides the frequency range into high frequencies for the tweeter and low frequencies for the woofer. The transition between the two drivers is gradual, with a slope ranging from very shallow to moderate. The passive network typically also does some response shaping to compensate for the natural response of the drivers and the acoustic effect of the speaker cabinet.

By removing the passive crossover network and instead using a DEQX to divide the frequency range "in front of" the amplifiers, an active speaker is realized, as illustrated in Figure 5 on the next page. Each amplifier is thus required to deliver only a portion of the full frequency range. The passive crossover is no longer present[4], removing any possibility of non-linearities in the passive components and giving the amplifiers direct control over each individual driver. The DEQX adjusts the response of each driver in minute detail, reducing group delay and amplitude errors dramatically and providing accurate acoustic transitions between the drivers with steep *linear phase* filter slopes.

### 13.1.1 Active speaker design considerations

There are many design considerations when implementing an active speaker: raw driver response (both on-axis and off-axis), driver sensitivity, baffle size and shape, power handling versus frequency vs crossover slope, and so on. With a DEQX at hand, the designer may make different choices than when designing a passive speaker.

The bi-amp and tri-amp modes should therefore be considered **advanced** modes of operation. The following paragraphs discuss specific considerations when using a DEQX to implement an active speaker:

1. As indicated in Figure 5 and Figure 6, a protection capacitor (a high voltage film capacitor) in series with the tweeter is generally recommended. This will help protect it from DC offsets and turn-on and turn-off transients. If there is any question that the amplifier and upstream equipment is not perfectly behaved or that the tweeter is fragile, the capacitor is strongly recommended.

   Unlike other systems, the DEQX will compensate for the roll off and phase shift introduced by the capacitor. The capacitor therefore does not have to be large (a common rule of thumb is to size it so that its roll off starts two octaves below the crossover frequency), but sized to roll off at the anticipated crossover frequency. Since it is relatively small in size, a very high quality capacitor can be used.

2. The analog gains post-DEQX should be reasonably well matched. If there are significant discrepancies in amplifier gain and driver sensitivity (greater than 5 dB), it is recommended that you adjust output analog gain as described in Appendix D.

[4] With the exception of a protection capacitor on the tweeter. See the section "Active speaker design considerations."

3. Measurement technique is usually more demanding for the bi-amp and tri-amp configurations. In cases such as when measuring a small two-way speaker, a sufficiently accurate correction and crossover can be obtained with indoor measurement. Otherwise, unless there is access to facilities such as an anechoic chamber, it *may* be necessary to:

    a. Take measurements outside (or in a large structure such as a gymnasium), and

    b. Use a raised platform to extend the time to the first reflection. (In this case, ensure that the platform does not extend past the front of the speaker, as that will create its own reflection.)

The following sections describe the main active speaker configurations as well as hybrid active-passive configurations. Take careful note of the output connections (L1 etc.) on each diagram. (For configurations using more than one DEQX, see Chapter 14.)

### 13.1.2 Active two-way speaker

Figure 5 shows the physical connections for an active two-way speaker. If stereo subwoofers are used (as shown in the diagram), set the speaker configuration mode to "bi-amp with optional stereo subwoofers."

If a single subwoofer is used, connect it to L1 only and set the speaker configuration mode to "bi-amp with optional mono subwoofer."

If no subwoofer is used, the speaker configuration mode can be set to either of the two bi-amp modes and the subwoofer channels left disabled.

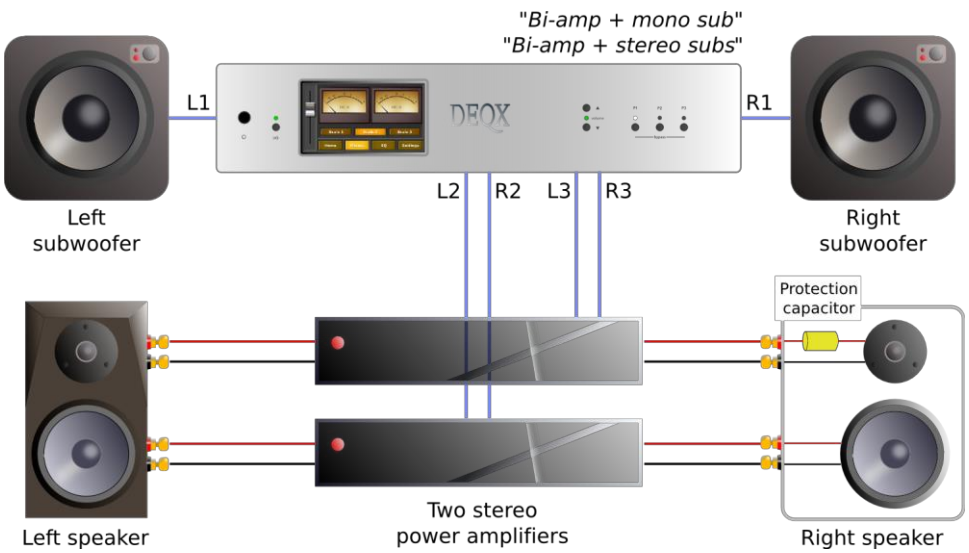



*Figure 5. Active two-way speaker*

### 13.1.3 Active three-way speaker

Figure 6 shows the physical connections for an active three-way speaker. The DEQX can use two different speaker configuration modes:

**Tri-amp**

The tri-amp speaker configuration mode is the most demanding of accurate measurements. The reflection-free time window must be long enough that correction can be done to well below the woofer-mid crossover frequency. In addition, the acoustic half-space to full-space transition due to the cabinet will need to be taken into account.

**Bi-amp with optional stereo subwoofers**

In this case, the "subwoofers" are the main woofers of the speaker and the limit filters are simply set higher than is typical for subwoofers. Measure and calibrate the tweeter and midrange drivers as for a two-way active speaker, and measure and calibrate the woofers using a nearfield measurement as for subwoofers (Chapter 8). Alternatively, you can use an in-room calibration for the woofers, as described on page 121. Set up the woofer-midrange crossover with limit filters, as explained on pages 118 and 119.

To add subwoofers to this type of speaker, see page 123.

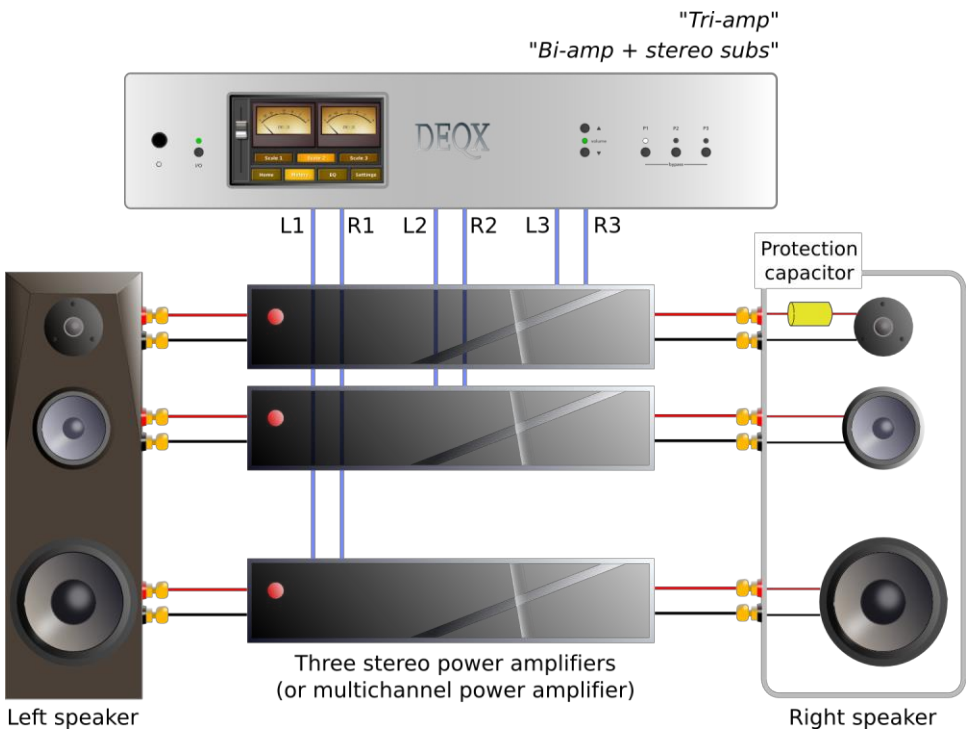



*Figure 6. Active three-way speaker*

### 13.1.4 Hybrid active-passive speakers

With speakers that bring out separate internal crossover networks to the binding posts, the DEQX can be used to implement a hybrid active-passive speaker. The existing passive crossover can be left untouched to split the frequency range; alternatively, the DEQX can be used to override the passive crossover (with some limitations).

In the case of a two-way speaker, the physical connections are as shown in Figure 5, but the tweeter and woofer each retain their own internal passive filter network. Calibration proceeds in much the same manner as for an active two-way, but the crossover frequency will need to be set at or somewhere near the crossover frequency defined by the passive crossover. The DEQX will compensate for the frequency and phase response of the passive crossover and still realize an ideal linear-phase crossover.

In the case of a three-way speaker with three pairs of binding posts, connections and calibration are similar to an active three-way speaker (page 108). In other cases, the speaker may have two pairs of binding posts, with the mid-tweeter network brought out to one pair and the woofer network to the second pair. If so, there are two options:

- If the woofer-mid crossover frequency is high enough (at least 300 Hz), it may be possible to use a bi-amp speaker configuration mode as described above.
- Otherwise, use the "single amp with optional stereo subs" speaker configuration mode, with connections as shown in Figure 7 below. Some care will be needed if using limit filters between the woofer and mid-tweeter networks.

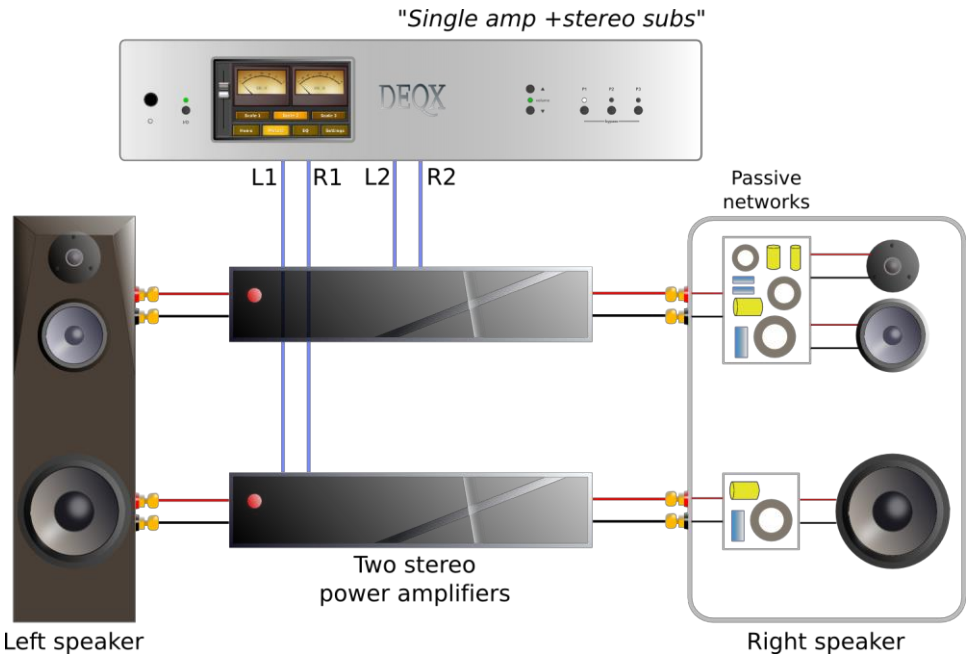



*Figure 7. Hybrid active-passive three-way speaker*

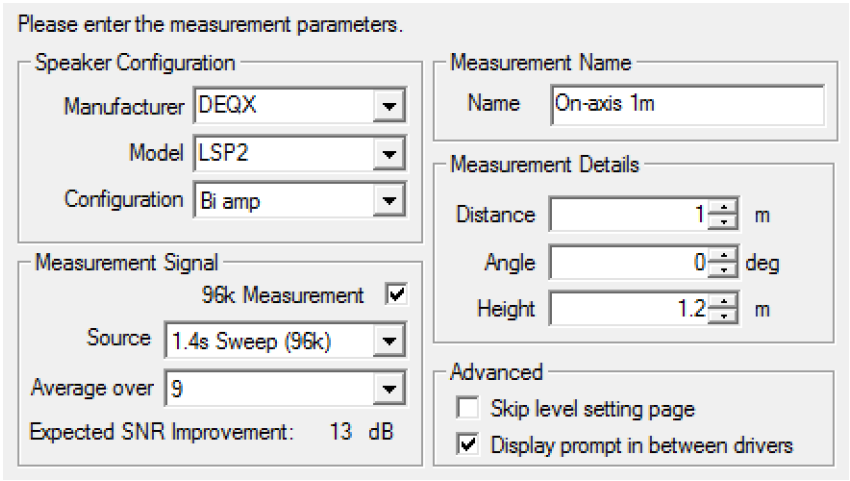
## 13.2 MEASURING MULTIPLE DRIVERS

Each driver of an active speaker is measured in turn, starting with the woofer. Measurement technique for the bi-amp and tri-amp configuration modes generally needs to be better than for single amp mode. A longer reflection-free time window will be required not only for lower crossover points (in the case of tri-amp), but also to take account of the transition of acoustic radiation from half-space to full-space as wavelengths become greater than the baffle width (also known as diffraction loss or "baffle step").

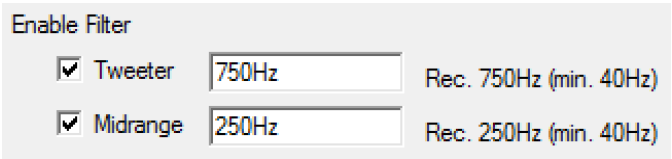
The overall procedure is the same as for the single-amp configuration described in Chapter 6, with specific differences noted here.

**Screen 3**. Set the **Configuration** parameter to "Bi amp" or "Tri amp."

Usually, the option "Display prompt in between drivers" is checked, so that the microphone can be moved between the measurements of each driver. This may not be necessary in bi-amp mode, but usually will be in tri-amp mode.

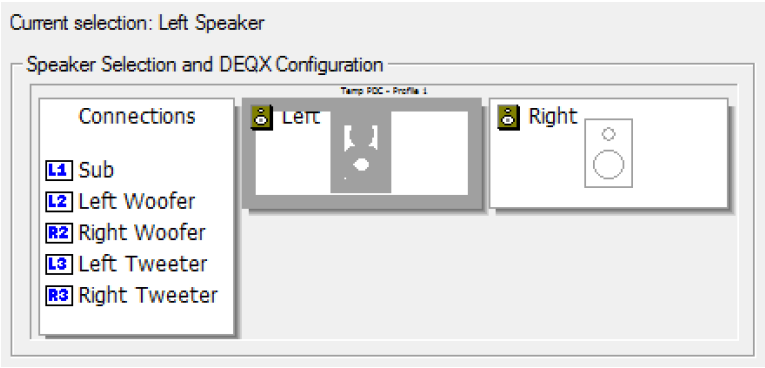



**Screen 3a**. After clicking **Next**, an additional screen appears. This screen can be used to set a lower frequency limit on the measurement sweeps for the tweeter and midrange drivers. As a rule of thumb, the lower frequency limit should be set one to two octaves below the intended crossover frequency.



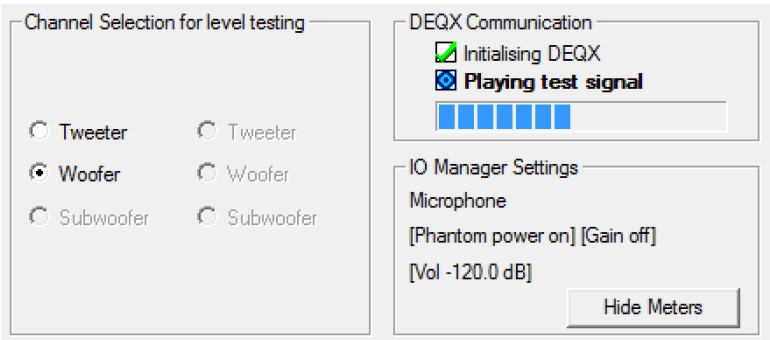

The tweeter is especially prone to damage if this option is turned off. Be sure that you understand the potential consequences before turning off this option.

**Screen 5**. Select the speaker to be measured. If this is the first measurement, this is a good time to confirm that you have made your output connections to the rear panel correctly, as indicated in the "Connections" list on the left:

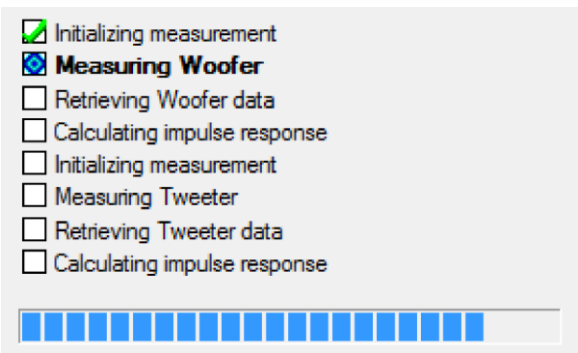



**Screen 6**. Any of the (two or three) drivers can be selected for test signal playback (left-hand side of the example screenshot below). The woofer is the default, but a different driver can be selected by clicking on its radio button. This will result in a short pause while a new test signal is uploaded to the DEQX. The test signal will then resume from the selected driver.

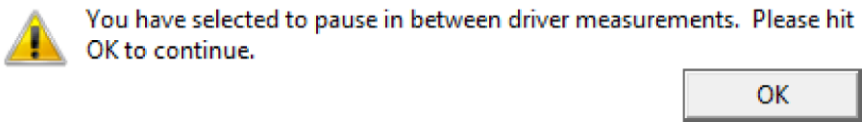
If you have not previously checked driver levels, first select each driver in turn while playing the test signal at a low volume. Only then increase the volume.




**Screen 7**: Measurement sweeps execute for each driver in turn, starting with the woofer:



**Screen 7a**: If the option "Display prompt between drivers" was selected, the following prompt appears after the woofer and midrange measurements. Move the microphone to the correct location for the next driver, then click **OK**.




**Screen 8**: After the tweeter measurement completes, you can accept the measurement or retry. The response thumbnail on this screen will show all (two or three) driver responses.

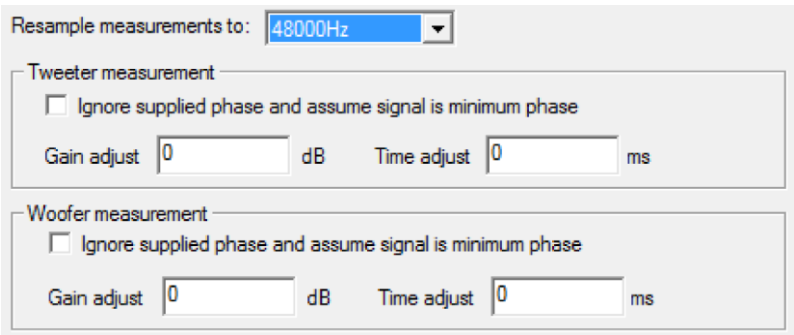
## 13.3 IMPORTING MEASUREMENTS

Measurements can be imported from a third-party measurement program. This feature is intended for use by speaker designers who may need to import measurements taken by a third party or in a different location. The primary intended format is an MLSSA ".TIM" format (binary impulse response) file.

In addition to the MLSSA ".TIM" format, text files in FRD format (textual frequency response) can also be imported. This is, however, intended only for comparative viewing of measurements, *not* for speaker calibration. Poor calibration results may be obtained if imported text files are used for calibration.

To begin, select "Import Measurement" from the File menu. The measurement import wizard is similar to the speaker measurement wizard, except that existing measurement files are selected. After you select the speaker configuration mode, the wizard will ask you to select the measurement files (one per driver).

On the next screen, set the resampling frequency to be the same frequency at which the measurement was taken. The option is also available to have minimum phase response inferred from each driver's amplitude response.

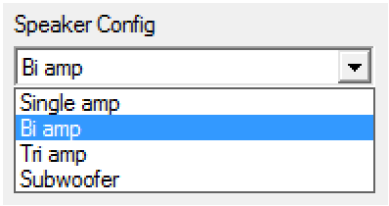



After entering a set of informational parameters (similar to screen 3 on page 47), the measurement will be imported. Open the imported measurement in a new data viewer to check for successful import prior to starting a calibration.

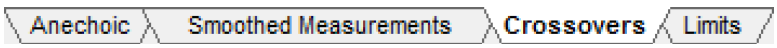
## 13.4 CALIBRATING AN ACTIVE SPEAKER

Calibration proceeds in a similar manner to Chapter 7, with specific differences noted here.

**Screen 3**. Choose "Bi amp" or "Tri amp."

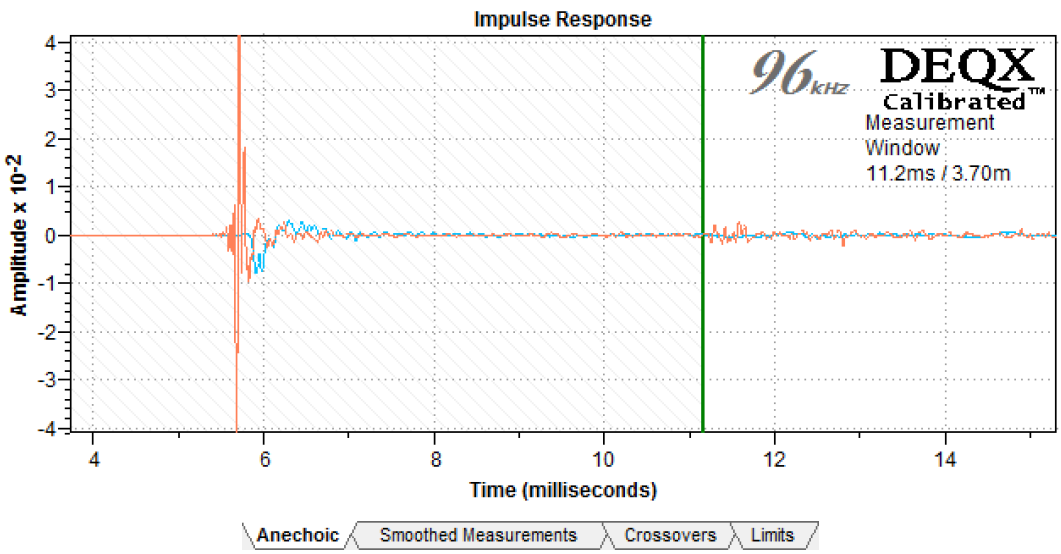



When the Calibration window opens, it will be seen that there is an additional tab, **Crossovers**. As before, you will usually proceed through these tabs in sequence, but can also jump back and forth by clicking on individual tabs.



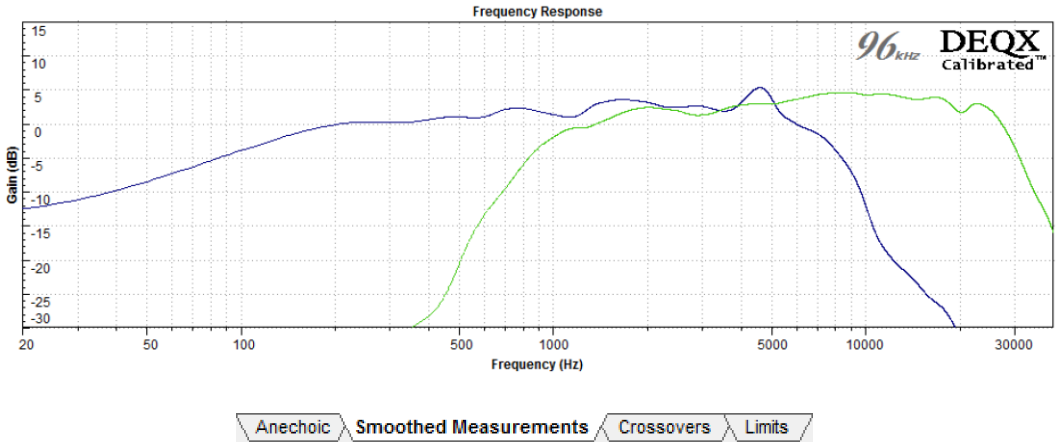

### 13.4.1 Anechoic tab

Set the time window as described on page 56. This time, there will be two or three impulse responses visible, one for each driver.



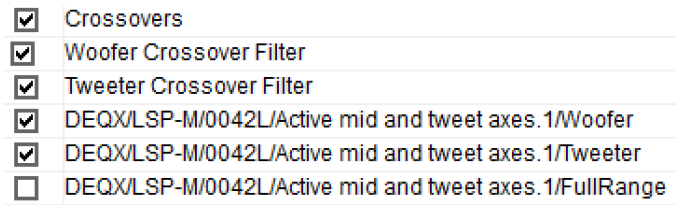
### 13.4.2 Smoothed Measurements tab

Two or three plots will be visible, being the anechoic frequency response of each driver. Set the smoothing as described on page 57.

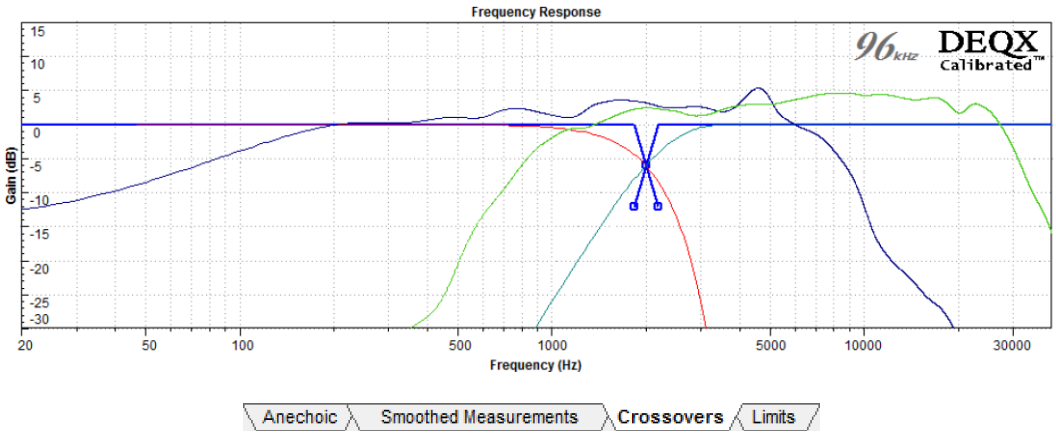



### 13.4.3 Crossovers tab

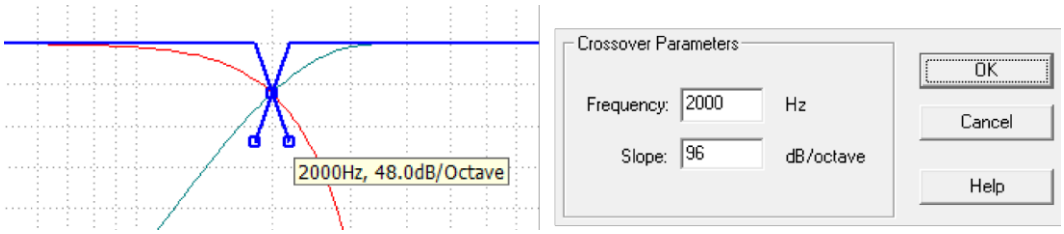
There are quite a number of plots on this tab, so you may find it easier to work with if you selectively turn them off and on (in the plot selector underneath).



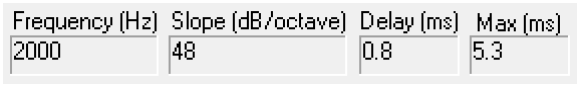

The example below shows the woofer and tweeter responses for a bi-amp configuration. The crossover filters are shown in light blue and red, and the crossover setting control in heavy blue:



To change the crossover frequency, drag the central control point (below left). To change the crossover slope, drag one of the two lower control points to the left or right. Alternatively, double-click on the crossover control to bring up a dialog that allows you to enter the frequency and slope directly (below right).




Hovering the mouse over a control point will display the crossover frequency and slope. The frequency and slope are also displayed above the plot area, together with the delay introduced by that choice of frequency and slope, and the maximum allowed delay.




(If you choose a combination of frequency and slope that exceeds the maximum allowed delay, a dialog box will warn you.)

The choice of crossover frequency and slope is a trade-off between driver on-axis and off-axis response, distortion, excursion limits, and other potential driver issues such as resonance or ringing. DEQX recommends a slope between 48 and 96 dB/octave for most speakers. Higher slopes can be auditioned by creating additional correction sets. Slopes higher than 96 dB/octave (up to 300 dB/octave) may be important in cases such as when drivers have pronounced resonance just outside the pass band, or in order to sharply limit signal below the crossover frequency to tweeters and midrange units being driven at high power (such as in sound reinforcement applications).

In the case of hybrid active-passive speakers, set the crossover to the same frequency as the passive crossover, or near to it. This frequency will be visible in the plots as the intersection of the measured responses.

Two additional controls are visible on this tab:


**Crossover type**

For an active speaker, this setting **must** always be set to "Linear-phase."

For a hybrid active-passive speaker, this can be set to "No Crossovers," in which case both amplifiers will receive the same frequency range and the passive crossover in the speaker will work to split the frequency range.

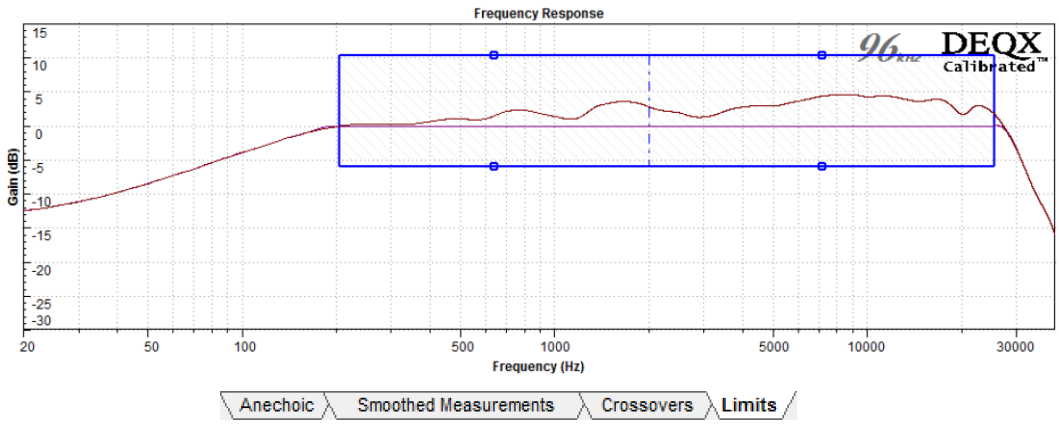
**Time align individual drivers**

This option causes the DEQX to adjust the filters so that the sound wave from the two drivers arrives at the listener at the same time. It should always be turned on.

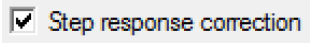
Never turn off the crossover for a fully active speaker. Distortion and possible damage to one or more drivers is the likely result if the speaker is misconfigured.

### 13.4.4 Limits tab

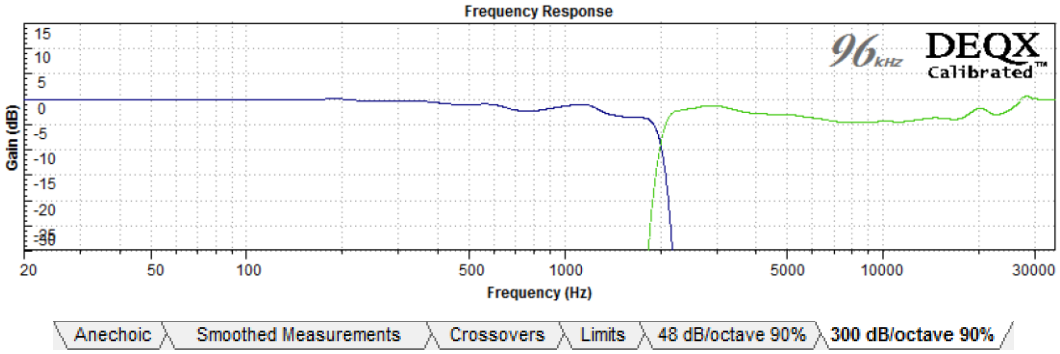
This tab is used to set the correction frequency limits as described on pages 58 and 59. By default, there are two or three (for bi-amp and tri-amp respectively) sets of correction limits for cut and boost. (More can be added if needed – see page 59.)




When done, click on **Finish** and follow the rest of the calibration procedure (pages 60 and 61). Turn step response correction on (but if the calibration algorithm fails to complete, turn it off and try again).

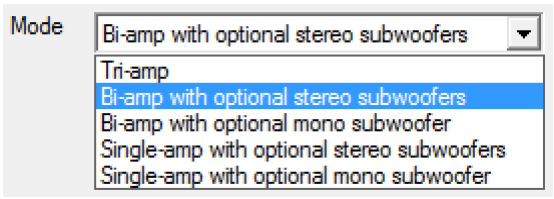



A new tab will be created showing the correction filter set. Additional correction sets can then be created with different parameters (such as crossover frequency, slope, and percent smoothing). Each new correction set creates a new tab, as shown at the lower right of this example:



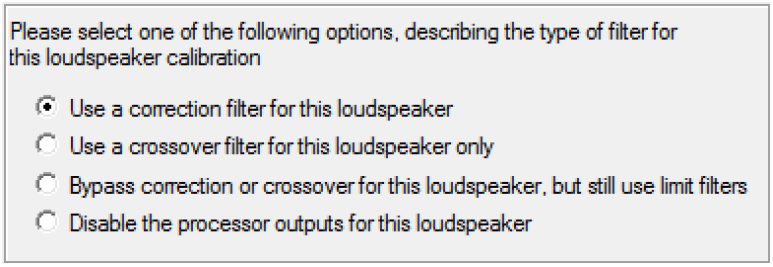
## 13.5 CONFIGURING AN ACTIVE SPEAKER

Configuration proceeds in a similar manner to Chapter 9, with specific differences noted here. In the configuration wizard, select the appropriate bi-amp or tri-amp configuration:



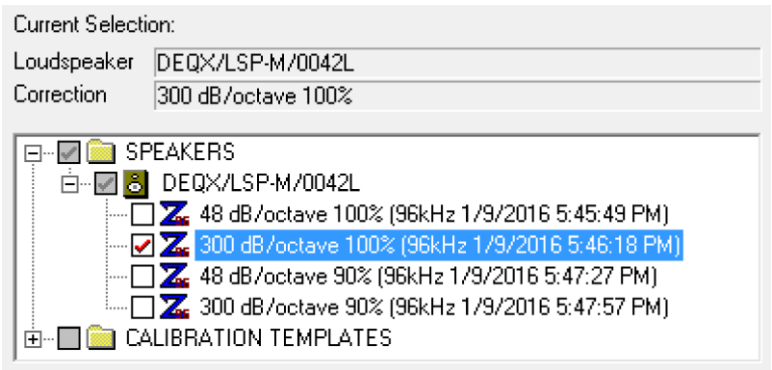

### 13.5.1 Correction filters for speakers

In the configuration window, open the Filter Properties dialog box for the left speaker. On the Main Filter tab, select "Use a correction filter for this loudspeaker":




Never select "Bypass correction or crossover for this loudspeaker, but still use limit filters" for a fully active speaker. This will send the full frequency range to all (two or three) drivers, potentially resulting in damage to tweeters and midrange drivers.

Select the correction filter from the pane that opens underneath (in this example, the individual correction filters have been renamed as described on page 63):





You can also select a correction filter by navigating to it in the project explorer and then dragging and dropping it onto the speaker icon.

### 13.5.2 Correction and limit filters for subwoofers (two-way)

If using subwoofers with a two-way active speaker (Figure 5 on page 107), you will need to measure and calibrate the subwoofers as described in Chapter 8, and configure limit filters as described on pages 77 and 78.

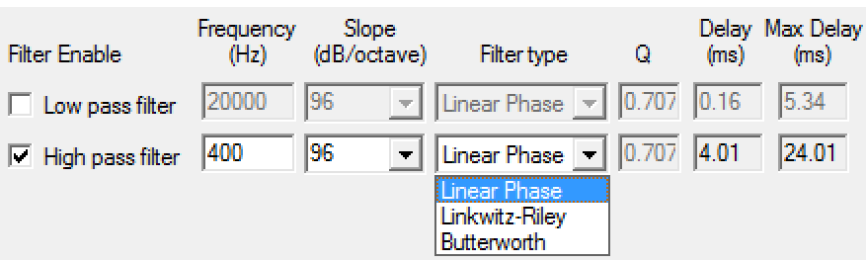
After uploading the configuration to the DEQX ("Save All to DEQX"), you can then perform room measurement, subwoofer integration, and room correction as described in Chapters 10 through 12.

### 13.5.3 Correction and limit filters for woofer-mid crossover (three-way)

With a three-way active speaker using the "bi-amp with optional stereo subwoofers" speaker configuration mode (as per page 108), the crossover between the woofer and midrange is implemented with limit filters. Since this crossover is usually at a higher frequency than a subwoofer crossover, linear phase filters are typically used.

First, calibrate the woofers using a nearfield measurement as for subwoofers (Chapter 8). Alternatively, you can use an in-room calibration for the woofers, as described on page 121. Load the correction filter or filters in the Filter Properties dialog box of the "Left Sub" and the "Right Sub" (remember that these are actually the woofers).

To set up a linear phase crossover between the woofer and midrange, open the Filter Properties dialog of the left speaker. On the Limit Filters tab, enable the high pass filter. Enter the crossover frequency in the **Frequency** field, then drop down the **Filter type** menu and select "Linear Phase":




Then drop down the **Slope** menu and select the desired slope. Typically, a slope between 48 and 96 dB/octave works well, but higher slopes can be auditioned if desired.

After closing the Filter Properties dialog of the left speaker, repeat for the right speaker. Then set up matching low pass filters for the two woofers. While the low pass filter on the woofer will usually have the same slope and frequency as the high pass filter on the midrange, an asymmetric crossover can be useful in some cases to account for the acoustic responses of the drivers near the crossover frequency.

It is not *required* to use linear-phase filters for the woofer-mid crossover. At lower frequencies, the delay of linear-phase filters increases significantly, so a Linkwitz-Riley filter may be preferable, either to avoid video sync issues or because the Max Delay limit is reached with a linear phase filter (see below).

The **Filter type** drop-down offers three choices:

**Linear Phase**

Linear phase filters have no phase shift across the audio band. Filter slopes can be set in 6 dB increments from 48 to 300 dB/octave.

**Linkwitz-Riley**

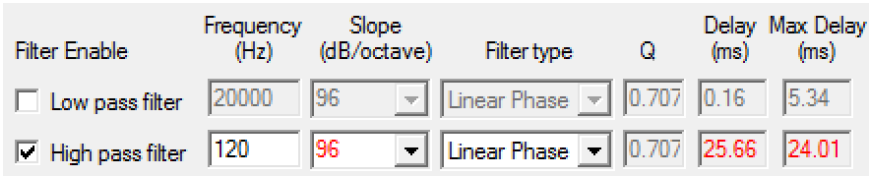
Linkwitz-Riley crossover filters are conventional (non-linear phase) filters with phase shift above and below the roll off frequency and with symmetrical vertical lobing. Filter slopes can be set in 12 dB increments from 12 to 120 dB/octave.

**Butterworth**

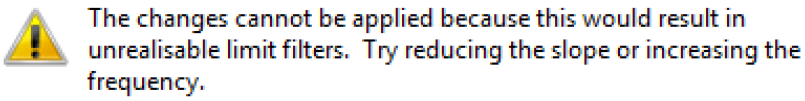
Butterworth crossover filters are conventional (non-linear phase) filters with phase shift above and below the roll off frequency. Filter slopes can be set in 6 dB increments from 6 to 120 dB/octave.

Note that the filter slope is limited by the maximum allowed delay and the type of filter chosen. The maximum allowed delay is displayed in the dialog (24.01 ms in the example shown below) and is determined by the delays introduced by all currently selected filters. The **Slope** drop-down menu will always reflect the allowable set of filter slopes for a given filter type and frequency.

If you manually enter an unrealizable combination of frequency, slope, and crossover type, the fields are displayed in red:



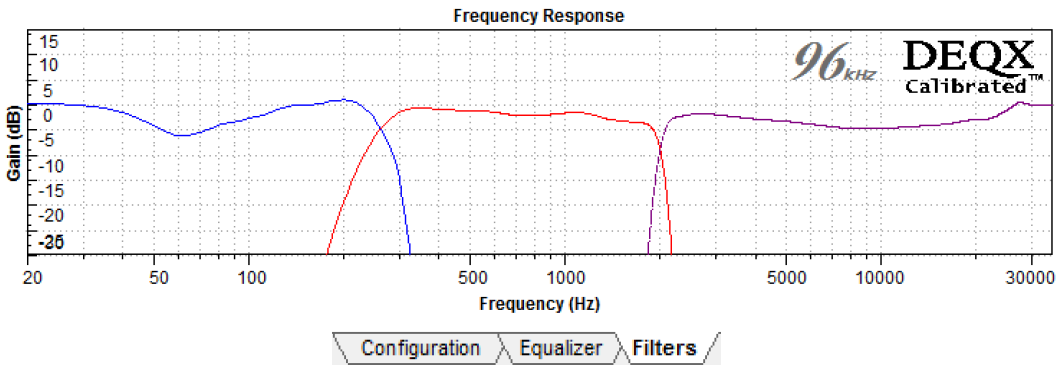

The Filter Properties dialog box cannot be closed until the error is corrected:




The polarity of individual drivers can be inverted if necessary on the **Advanced** tab (page 124).

### 13.5.4 Viewing correction and limit filters

To view the complete set of correction and limit filters, go to the **Filters** tab and click the **Refresh Filters** button. In the example below, the lower crossover has been set with 96 dB/octave limit filters and the higher crossover with 300 dB/octave crossover slopes.




### 13.5.5 Upload to DEQX

After completing initial configuration, click **Save All to DEQX**. If implementing a 2-way active speaker with subwoofers, proceed to perform room measurement, subwoofer integration, and room correction as described in Chapters 10 through 12. If implementing a 3-way speaker using the "Bi-amp with optional stereo subwoofers" configuration mode, you will need to perform an additional configuration step to set delays and levels (see below), after which room measurement and correction can be performed.

### 13.5.6 Woofer-mid time alignment and level adjustment (three-way)

A three-way speaker using the "bi-amp with optional stereo subwoofers" speaker configuration mode (Figure 6 on page 108) requires a separate level and delay adjustment step. (In tri-amp mode, the relative level and delay of the woofer is automatically set. This does not happen automatically when the woofer is measured and calibrated separately.)

One effective way to make this adjustment is to complete configuration of the DEQX, then run a room measurement. To improve the quality of this measurement, locate the microphone 1 to 2 meters (3 to 6 feet) from the speaker and an equal distance from the woofer and midrange.

Open this measurement in a data viewer and determine the relative levels and time delays of the woofer and midrange, then set these levels and delays in the configuration. Apart from microphone location, the procedure is essentially the same as described in Chapter 11.

## 13.6 WOOFER CALIBRATION WITH AN IN-ROOM MEASUREMENT

The woofer of a three-way speaker can be calibrated with a speaker measurement taken with the microphone at the listening position. This technique can be used if the three-way speaker is being implemented with the "bi-amp with optional stereo subwoofers" speaker configuration mode (Figure 6 on page 108). It can also be used with a three-way hybrid active-passive three-way speaker (Figure 7 on page 109).

This method is an alternative to the nearfield measurement and calibration technique. It is a little more involved but – if done correctly – can also address room modes directly. DEQX recommends that the nearfield measurement and calibration method be used *first*. Once good results are obtained, this method can then be trialed and compared by switching between profiles.

**Measurement**

Position the microphone at the center of the listening area and take a speaker measurement. Move the microphone around the listening area during the sweeps. (Use a higher number of sweeps, and move the microphone after every three sweeps.)

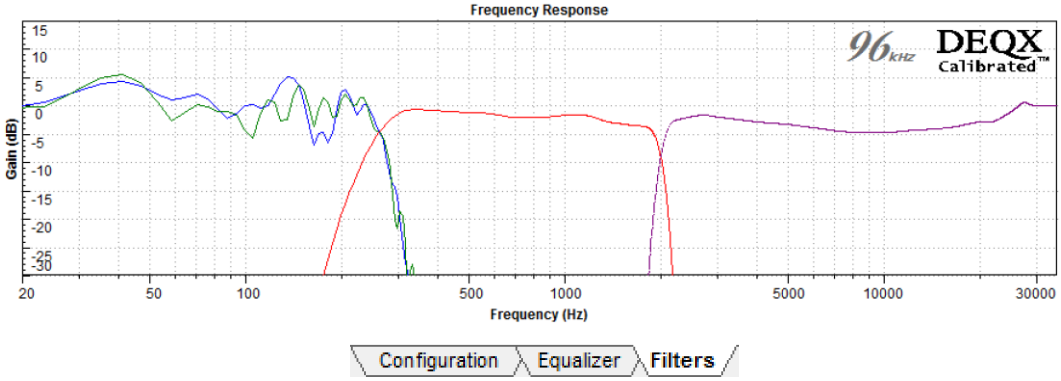
**Calibration**

Use a long time window and set smoothing at 100%. If the microphone has been moved during measurement, a lower amount of smoothing can also be trialed. Use the **Limits** box to limit boost to the range 3–6 dB and turn step correction off.


**Configuration**

Load the correction filters into the configuration and upload the configuration to the DEQX. Then perform an integration step using the procedure described in Chapter 11 to set the levels and delays of the woofer and the mid-tweeter.

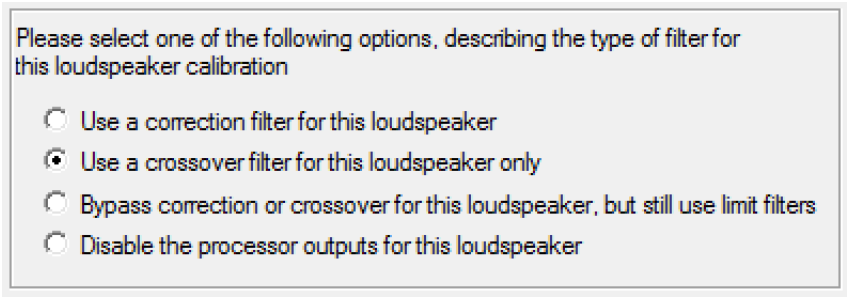
The example below shows the **Filters** tab after configuring the three-way speaker. Note that the curves for the left and right woofers are different (compare to the example on page 120) and account for room response variations between left and right woofers.



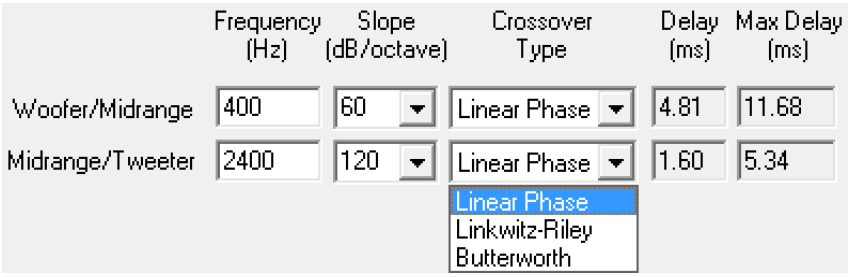
## 13.7 CONFIGURING AN ACTIVE SPEAKER WITHOUT CORRECTION

An active speaker can be configured without using correction filters. This is a basic form of crossover that doesn't take into account the measured anechoic response of the drivers. It is useful for quick prototyping, to simulate passive crossovers, or in situations where conditions are not conducive to accurate anechoic measurements. Its use requires speaker drivers that are acceptably flat in their pass band and above and below the crossover frequency (to an extent that depends on the crossover slope).

To use this mode, select "Use a crossover filter for this loudspeaker only" on the Filter Properties dialog:




The crossover parameters appear underneath:




The parameters are the same as those described on page 119 for limit filters, but this time they control a symmetric crossover (high pass and low pass).

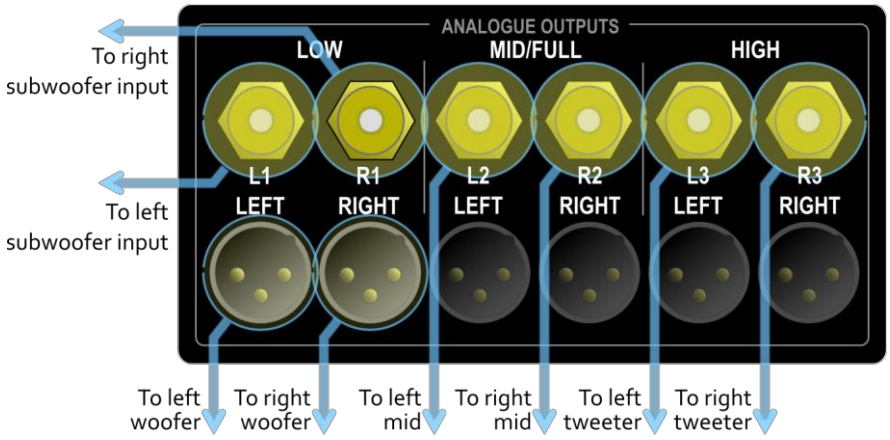
If an unrealizable combination of frequency, slope, and crossover type is entered, the fields are displayed in red and the Filter Properties dialog box cannot be closed until the error is corrected:


The polarity of individual drivers can be inverted if necessary on the **Advanced** tab (page 124).

## 13.8 SUBWOOFER INTEGRATION FOR A THREE-WAY SPEAKER

The three-way speaker configurations described in this chapter use outputs L1 and R1 for the woofers. These outputs are therefore unavailable for a subwoofer or subwoofers. One very effective method of adding subwoofers to a three-way speaker is to chain a slave DEQX unit, as described in Chapter 14. Even without that, however, subwoofers can still be integrated effectively, provided that the woofer can be driven with a full-range signal at power (that is, without a high pass filter) and the subwoofer has an inbuilt low pass filter.

1. Connect L1 and R1 to the line-level inputs of the subwoofer or subwoofers **as well as** to the woofer amplifier inputs. Ideally, connect to both the unbalanced (RCA) and balanced (XLR) outputs as shown below (adapters can be used). Or, use Y-connectors.




   a. For a mono subwoofer, connect L1 and R1 to the subwoofer's left and right inputs. (This assumes that the subwoofer has separate left and right line-level inputs.)

   b. For stereo subwoofers, connect L1 to the left subwoofer and R1 to the right subwoofer.

2. In the configuration window, ensure that the high pass limit filter on the woofer is turned **off**.

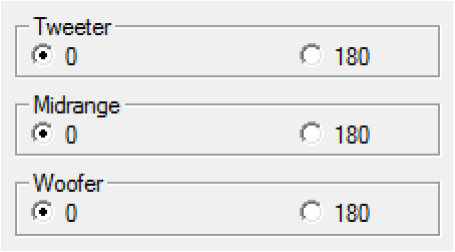
3. Adjust the low pass (may also be referred to as "high cut" or "crossover") filter on the subwoofer for the best audible result. You may also need to experiment with subwoofer location.

4. Use room measurements and room EQ (Chapters 10 and 12) to adjust subwoofer level and equalize the low-frequency response of the system. You may need to change subwoofer location or adjust the subwoofer's low pass filter when doing this.

## 13.9 ADVANCED CONFIGURATION OPTIONS

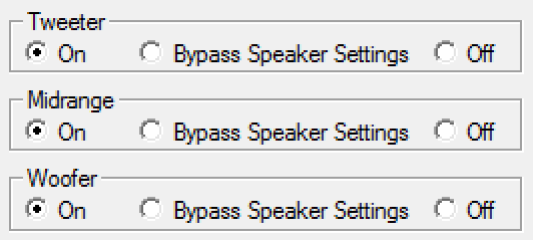
The **Advanced** tab of the Filter Properties dialog provides settings for each of the individual channel outputs.

The polarity of each channel can be inverted. This may be necessary with some types of crossover, or to correct for absolute phase with some types of amplification.




Note: during testing of a speaker, the individual outputs can be inverted in the IO Manager. However, for permanent storage into a configuration, any polarity inversion must be set on this tab.

Individual outputs can have their filtering disabled:




While normally left at "On," setting a driver to "Bypass Speaker Settings" sends the unfiltered signal to that driver. Setting it to "Off" turns off that driver.

Use "Bypass Speaker Settings" with great caution, as the driver will receive the full frequency range signal. This can potentially damage a driver.

The **Time/Level** tab has adjustments for delay and gain. These values apply to the whole "speaker" – that is, both drivers in a bi-amp configuration, or all three drivers in a tri-amp configuration.


(The delay and gain of individual drivers cannot be set here because DEQX-Cal calculates them when creating the correction/crossover filter.)

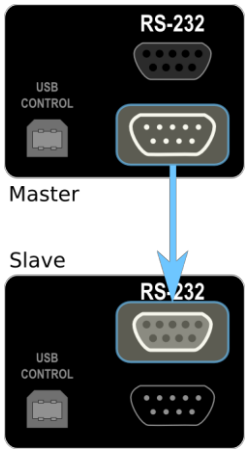
# 14 USING MULTIPLE DEQX UNITS

Multiple DEQX units can be combined to build more complex active speakers, as well as multichannel systems for home theater. A single master DEQX unit can control up to nine slave DEQX units for volume and profile selection.

Note that all of the configurations described in this chapter are considered to be **advanced** configurations. We *strongly* recommend that you enlist the assistance of a DEQXpert to ensure that your system is commissioned and configured correctly.

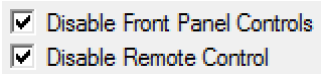
## 14.1 MASTER-SLAVE CONTROL

Any DEQX unit can act as a master, with the proviso that only the HDP-4 and HDP-5 provide the digital pass-through necessary to realize some configurations. The HDP-4, HDP-Express II, and PreMate can act as slave units. (The HDP-5 and PreMATE+ cannot be used as slave units.)




Multiple DEQX units are connected via their RS-232 ports. The master unit sends volume control and profile selection commands to the slave unit(s). The RS-232 connecting cable from DEQX to DEQX must be a fully-wired straight-through cable. Sometimes, this cable is referred to as an "RS-232 extension cable." A cable without all connections or with loopbacks (such as a "null modem" cable) will not work.

With the PC connected to the slave DEQX unit and DEQX-Cal running, open the Options dialog to disable the slave's front panel and remote control (see page 151). This ensures that the master is the only unit that responds directly to user input:




Note that Preference EQ commands are not transmitted over the RS-232 interface. Preference EQ will therefore be operational on the master unit only. In some cases, this detail will affect the choice of connections – that is, which drivers or speakers are driven from the master unit and which are driven from from the slave(s).

## 14.2 MULTI-AMP STEREO CONFIGURATIONS

Two DEQX units can be used to create an active speaker of up to 5-way, or 4-way with mono or stereo subwoofers.[5] The master must be an HDP-4 or HDP-5 (these two models are the only ones with a Digital Thru output). The slave can be a PreMATE, HDP-Express II, or HDP-4. (Legacy models may also work as slaves – contact DEQX Support if needed.)

Table 4 lists a comprehensive set of usable configurations. (It is assumed here that the tweeter is handled by the master and the lowest frequency driver by the slave. The roles can be reversed if desired.)

Figure 9 illustrates the connections for a "4-way with mono sub" configuration.

Connecting the master and slave units is straightforward. The RS-232 output of the master is connected to the RS-232 input of the slave. In addition, the Digital Thru output of the master is connected to the Digital 2 input of the slave. See Figure 8.

To configure the slave unit in DEQX-Cal, open the Options dialog (from the Tools menu) and disable the front panel buttons and remote control. In the IO Manager, select Digital 2 as the input source.

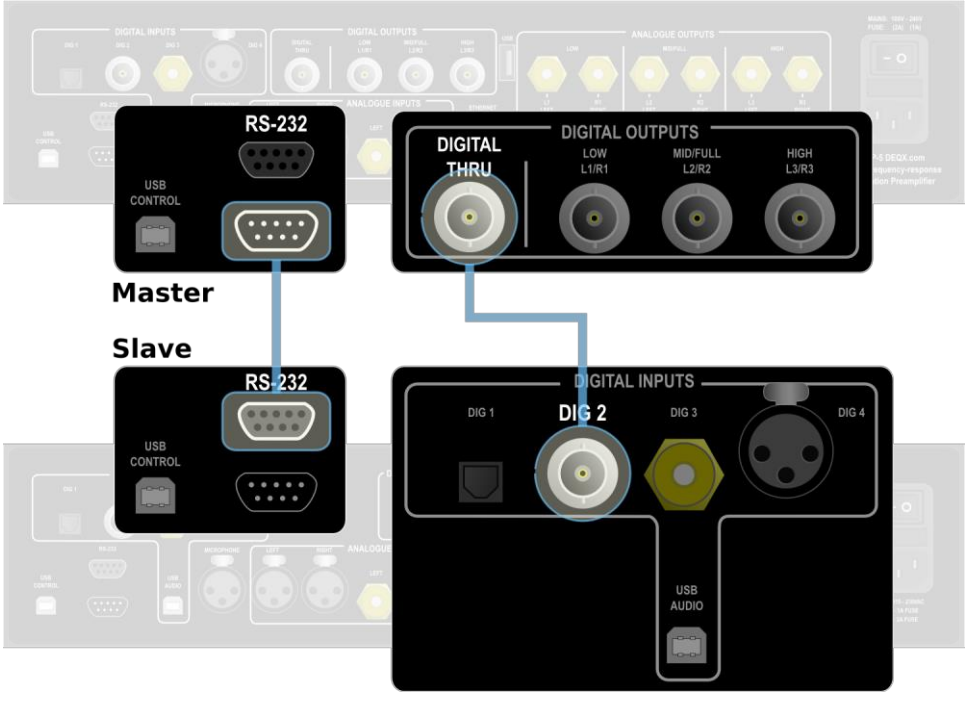



*Figure 8. Connections between master and slave DEQX units*

[5] A 6-way speaker (or 5-way plus subs) is usually not practical, because of limitations in how low the mid-high crossover on the "lower" unit can be set.

When measuring, calibrating, and configuring the two DEQX units, it is easiest to use a single project for both units. It is not possible to connect both DEQX units to the computer at the same time, so simply reconnect the USB cable to the unit being worked on. (If you choose to use multiple projects, create both first and then load them both into DEQX-Cal with "Insert Project..." – see page 149.)

*Table 4. Multi-amp active configurations with two DEQX units*

| Overall Configuration | Master Configuration | Slave Configuration |
|---|---|---|
| 3-way with sub/s | Tri-amp | Single amp + mono/stereo sub/s[1] |
| | Bi-amp + stereo subs | Single amp + mono/stereo sub/s[1] |
| | Bi-amp[2] | Single amp + mono/stereo sub/s |
| 4-way | Tri-amp | Single amp + stereo subs[1] |
| | Bi-amp[2] | Single amp + stereo subs |
| 4-way with sub/s | Tri-amp | Single amp + mono/stereo sub/s |
| 5-way | Tri-amp | Single amp + stereo subs |

*1 Speaker outputs disabled in the slave unit.

*2 Subwoofer outputs disabled in the master unit.

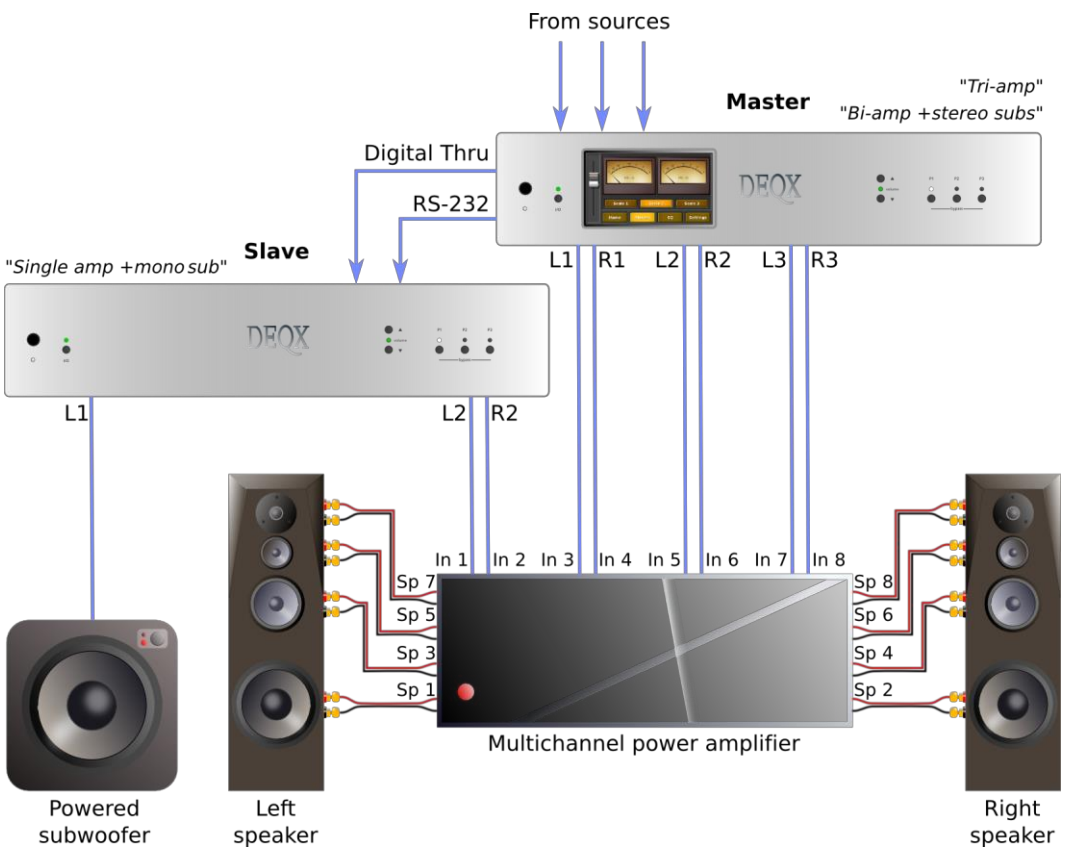



*Figure 9. Multi-way active speaker with master and slave DEQX*

## 14.3 MULTICHANNEL OR HOME THEATER CONFIGURATIONS

Multiple DEQX units can be slaved in a multichannel or home theater system. All slave units are set to a fixed input (usually one of the analog inputs) and have audio provided from a multichannel decoder or A/V processor. (The Digital Thru of the master is not used in this type of system.)

A typical configuration is to use a PreMATE+ as the master unit, and PreMATE or HDP-Express II units for the slaves. The RS-232 connections are "daisy chained" from master to slave to slave. Figure 10 illustrates the key connections for a 5.1 system. Expansion to higher numbers of channels is straightforward.

To configure each slave unit in DEQX-Cal, open the Options dialog (from the Tools menu) and disable the front panel buttons and remote control. In the IO Manager, select either Analog 1 or Analog 2 as the input source.

If desired, active speakers on all channels can be implemented by using an HDP-5 as the master unit and HDP-4 or HDP-Express II units for the slaves.

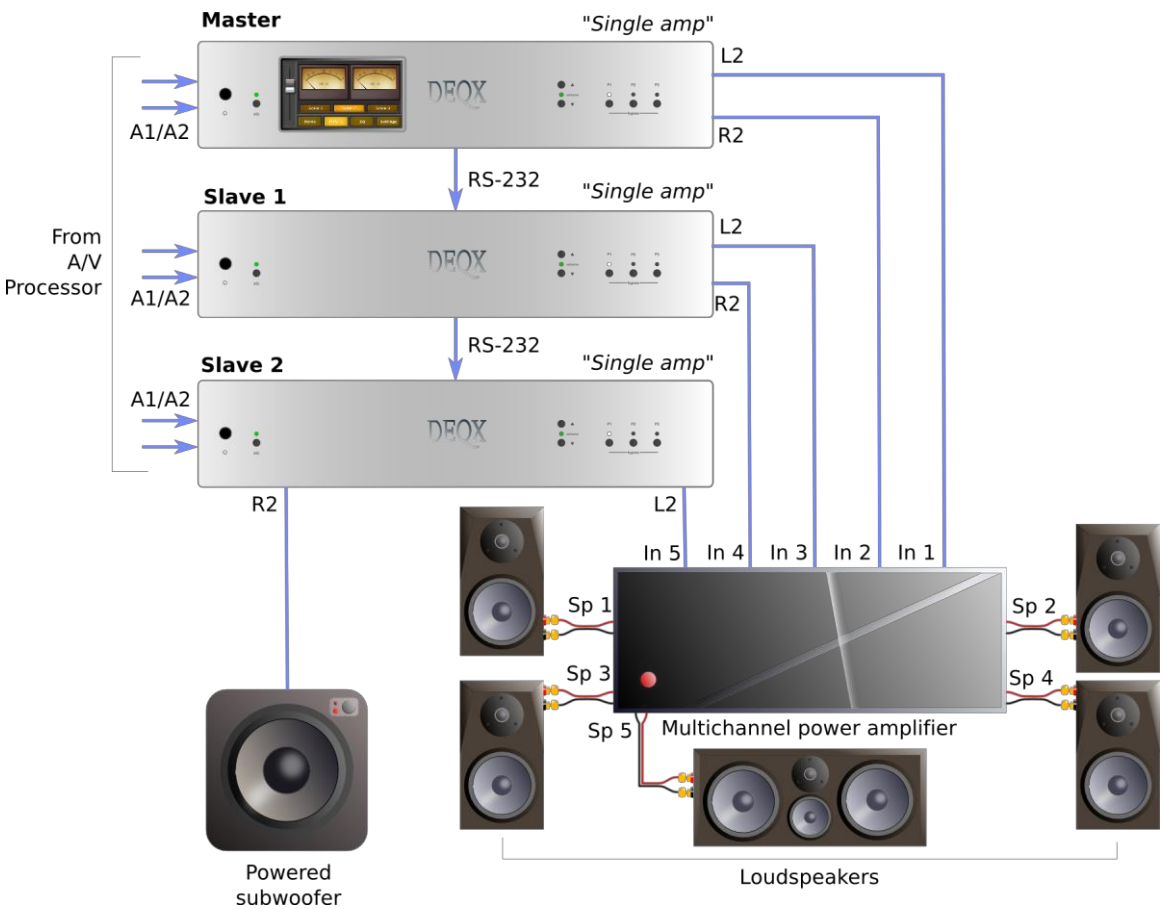
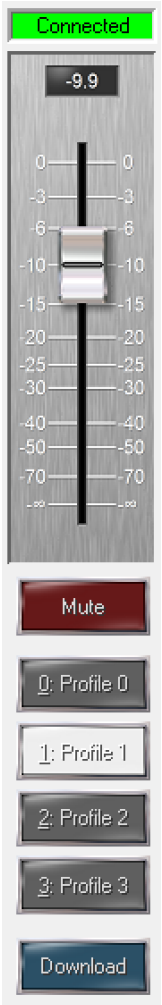



*Figure 10. Multichannel or home theater DEQX system*

# 15 DEQX CONTROL PANEL REFERENCE

The DEQX Control Panel displays the current status of the connected DEQX unit. In contrast to the configuration window, the Control Panel manages "real time" information about the DEQX, including volume, input selection, room EQ and per-channel delay and level controls.


At the left of the Control Panel is a strip that displays the master volume slider and profile selectors. The status indicator at the top is green if DEQX-Cal detects connection to the DEQX. It turns red if clipping is detected (page 135).

Click and drag the slider to adjust master volume. The numeric display above the slider shows the exact volume setting in dB. Once the slider has been clicked on, volume can be adjusted in fine (0.1 dB) steps with the up and down arrows on the keyboard.

The **Mute** button mutes all output channels. Mute is automatically engaged by DEQX-Cal in some circumstances, such as when the microphone input is selected and a measurement is not in progress.

The four **Profile** buttons select the profile currently being used for processing by the DEQX. These are equivalent to the profile selection buttons on the DEQX Remote and the front panel.

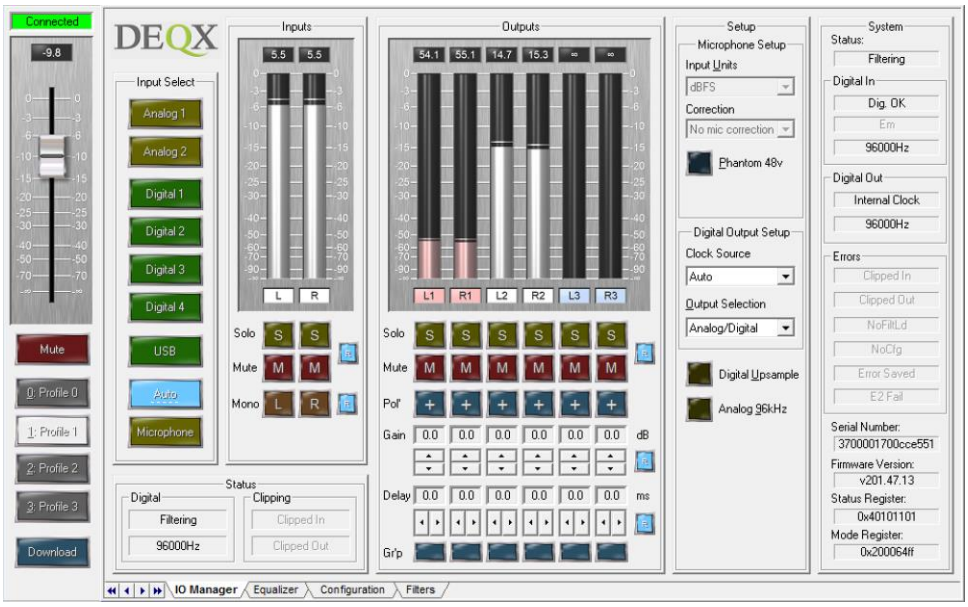
The **Download** button downloads all filters resident in the DEQX to the Control Panel for display.

To the bottom of the Control Panel is a row of four tabs, which select different information and control displays. They are described in detail in the rest of this chapter.


Selecting the **Filters** tab or the **Configuration** tab, pressing **Download,** and then cycling through the four **Profile** buttons will provide at-a-glance confirmation of the data loaded into each profile.

## 15.1 IO MANAGER

The IO Manager is the real-time control interface to the connected DEQX unit. It is selected by the IO Manager tab at the bottom of the DEQX Control Panel.




### 15.1.1 Input Select

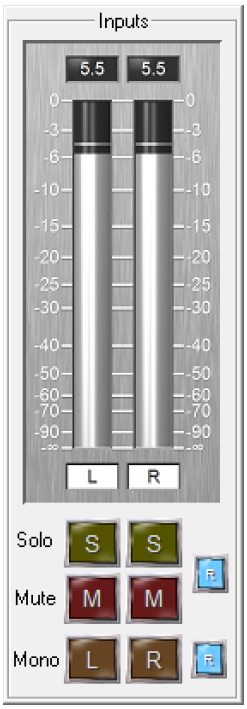
The main input source buttons are the same as the DEQX Remote.


| Button | Selected input |
|---|---|
| Analog 1 | Unbalanced analog (RCA) |
| Analog 2 | Balanced analog (XLR) |
| Digital 1 | TOSLINK (optical) |
| Digital 2 | S/PDIF on BNC |
| Digital 3 | S/PDIF on RCA |
| Digital 4 | AES/EBU (XLR) |
| USB | USB Audio (see Appendix B) |
| Auto | HDP-5 and PreMATE+: The DEQX is put into networked streaming audio mode (see Appendix C).<br>HDP-4, PreMATE, and HDP-Express II: The DEQX plays the last-selected digital or analog source, according to which has signal. |

If **Microphone** is selected, the microphone is the active input source. Normally, it is not necessary to select the microphone as input, as the DEQX will automatically switch to the microphone when necessary. However, by manually selecting the microphone as input, the Microphone Setup area becomes active (see pages 44 and 134).

### 15.1.2 Inputs

The input meters show the level of the selected input. Levels are displayed relative to full scale input, so "0" is full scale input, "20" is 20 dB below full scale input, and so on.




The buttons underneath the meters modify the default stereo input as follows:

**Solo**

Only the input channel with "S" pressed will play.

**Mute**

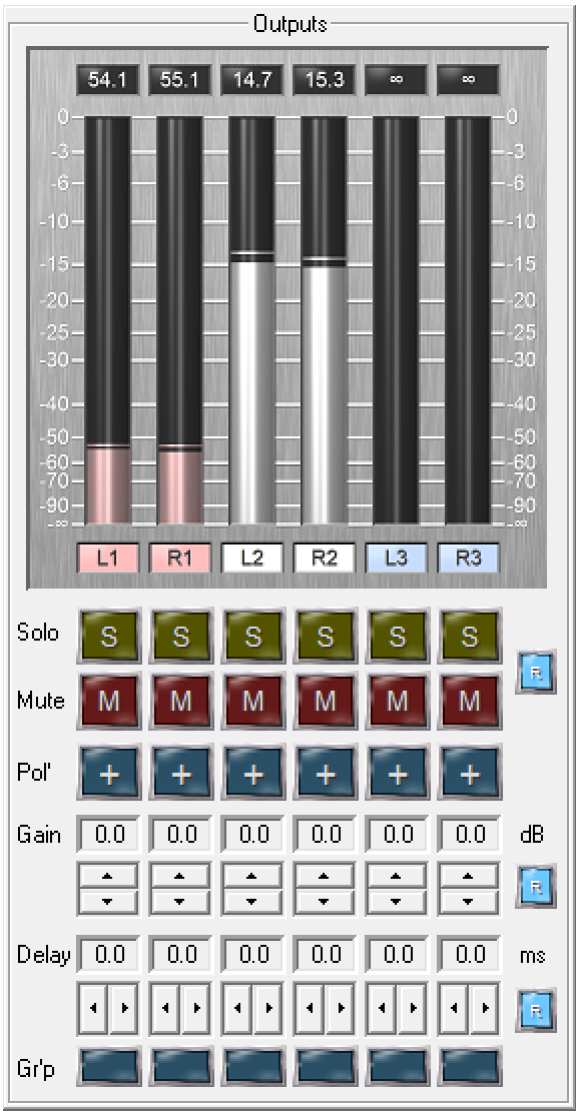
The input channel with "M" pressed will be muted. (Solo and Mute are mutually exclusive – muting a channel will automatically turn off Solo, and vice versa.) Press the "R" button to the right of the Solo and Mute buttons to restore normal operation.

**Mono**

If the left Mono button is pressed, the left input signal will be sent to left and right outputs. If the right Mono button is pressed, the right input signal will be sent to left and right outputs. This is useful for checking center imaging.

### 15.1.3 Outputs

The output meters show the level of the respective output channels. Levels are displayed relative to full scale output, so "0" is full scale output, "20" is 20 dB below full scale output, and so on.




The buttons underneath the meters modify the output signal for each channel. These controls are intended for use in testing, prototyping, and speaker design work.

For permanent storage of any values set here, it is necessary to a) update the configuration with the desired delay, gain and polarity settings, and b) reset these parameters in the IO Manager.

**Solo**

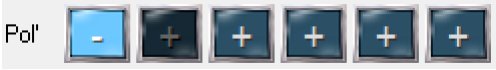
Only the output channels with "S" pressed will play. Use this to select a single speaker, subwoofer or driver to check for correct connections. Or by selecting a pair of speakers or drivers and playing a mono signal, correct polarity can be checked (see "Polarity" below).


**Mute**

The output channels with "M" pressed will be muted. (Solo and Mute are mutually exclusive – muting a channel will automatically turn off Solo, and vice versa.) Press the "R" button to the right to reset all Solo and Mute buttons.


**Pol' (Polarity)**

If pressed, the polarity of the corresponding output channel is inverted. Use this to invert one of a pair of speakers or drivers to check for correct relative polarity – when polarity is correct, a mono input signal will produce a solid center image. It can also be used while checking subwoofer integration.




**Gain**

Click the up or down arrows to increase or decrease the gain of that output channel in 0.5 dB increments.


**Delay and group**

Click the right or left arrows to increase or decrease the delay of that output channel in approximately 1.3 ms increments. Delay can only be positive.

Channels can be grouped by pressing the dark blue button. Changing the delay on any one of a grouped set of channels will change the delay of all grouped channels. For example, by grouping the main speakers, incrementing the delay can be used to check the audible integration with subwoofers. Press the "R" button to the right to reset delays and grouping.

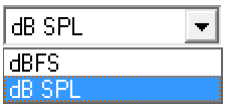
## 15.1.4 Setup

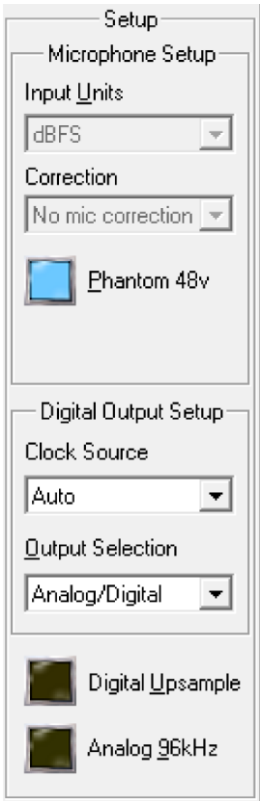
### Microphone Setup

The Microphone must be selected as the input source to change these settings.

#### Input Units

If **dBFS** is selected, the input meter will display the microphone input volume relative to a full scale signal (in the same manner as for other inputs). If **dB SPL** is selected, the input meter will display the actual sound pressure level (SPL) measured by the microphone.




#### Correction

Use the drop-down menu to select the microphone correction to use. The microphone correction must have been previously loaded from a calibration file with "Install Microphone..." (page 44).


For accurate results with your DEQX, you *must* select a microphone correction.

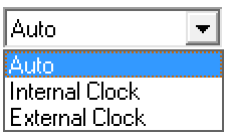
#### Phantom 48V

Enable phantom power to the microphone. This must be enabled for the DEQX Standard and Reference Calibration Kits. (If you are not using a DEQX Calibration Kit, check whether your microphone requires 48V phantom power.)

### Digital Output Setup

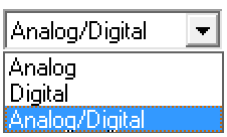
#### Clock Source

This drop-down menu is to support DEQX legacy products with an external word clock input. For current generation products, leave this set to "Auto."




#### Output Selection

This drop-down menu is to support DEQX legacy products. For current generation products, leave this setting at the default, "Analog/Digital."



**Digital Upsample**

This option is to support DEQX legacy products. For current generation products, this setting is effectively always on.

**Analog 96 kHz**

This option is to support DEQX legacy products. For current generation products, this setting is effectively always on.

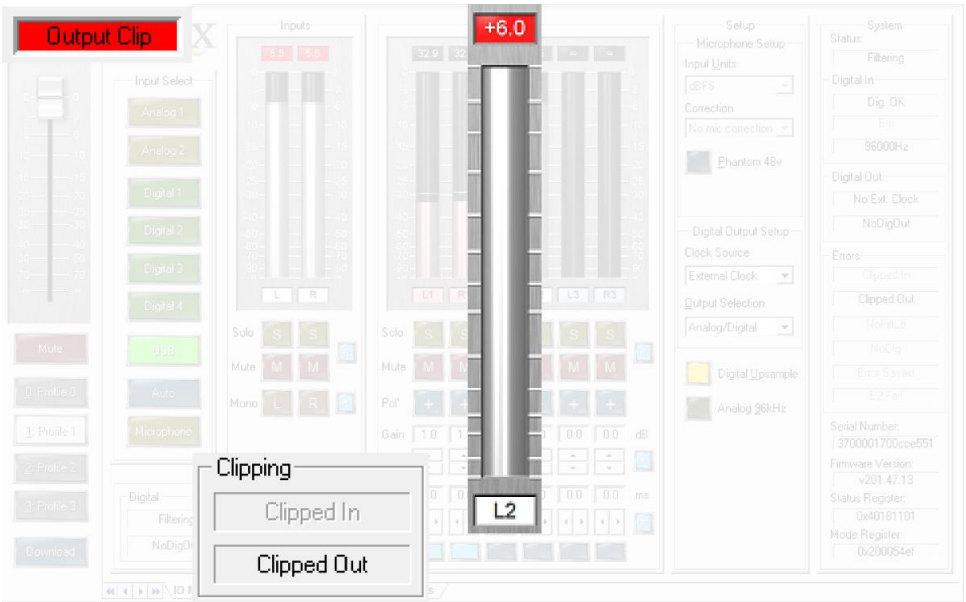
### 15.1.5 Status


**Digital**

Indicates the status of the internal digital processing. In normal operation, the two fields will say "Filtering" and "96000Hz."

**Clipping**

If clipping is detected on the analog inputs, the status indicator "Clipped In" lights; if clipping is detected on any output channel, the status indicator "Clipped Out" lights. In addition, the connection status above the master volume slider and the level indicator above the relevant input or output channel will turn red. The I/O LED on the front panel will also light white.



### 15.1.6 System

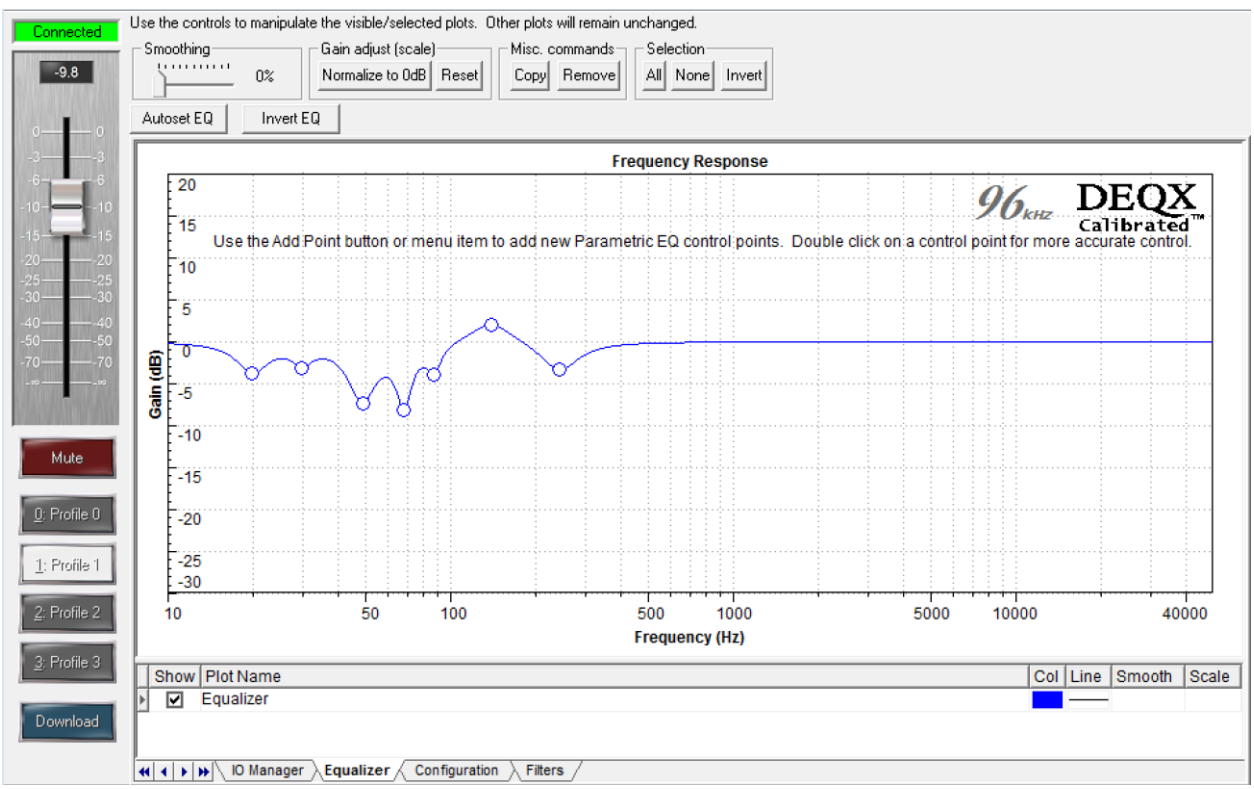
This area provides system status and diagnostic information. Provide this information to DEQX Support in the event of a trouble-shooting request.

## 15.2 EQUALIZER TAB

The Equalizer tab is used to set up room EQ for each profile. As this tab is in the IO Manager, changes made here take effect in real time – in other words, changes will be heard immediately if music is playing. For permanent storage, the room EQ settings must be loaded into a configuration and saved with the project (see page 102).

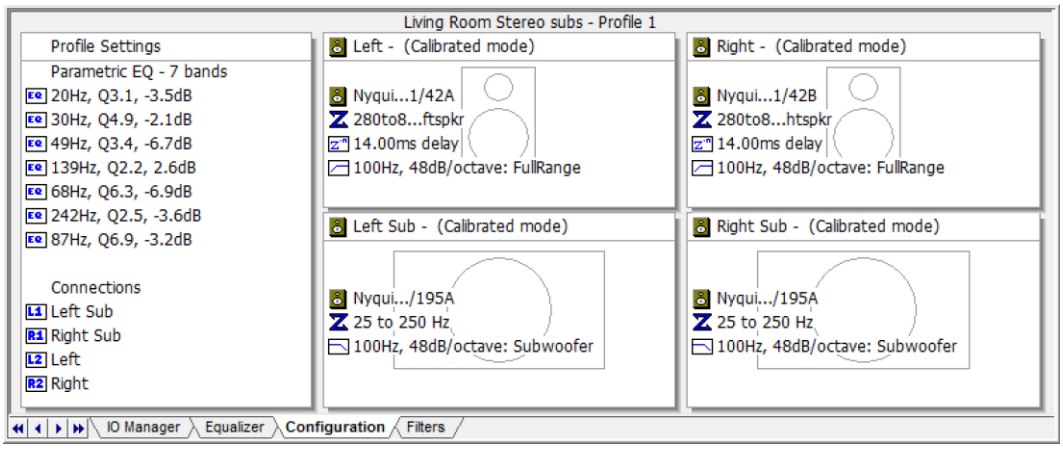
The general procedure for using this tab is as follows:

1. Take a room measurement.
2. Open the room measurement in the Equalizer tab.
3. Select the profile that you want the EQ to be loaded into.
4. Add EQ control points to set up the EQ.
5. Fine-tune EQ settings by listening.
6. Confirm EQ with another room measurement.
7. Open the configuration and download the EQ settings from the DEQX ("Read EQ from DEQX").
8. Upload the configuration back to the DEQX ("Save All to DEQX").
9. Save the project.



## 15.3 CONFIGURATION TAB

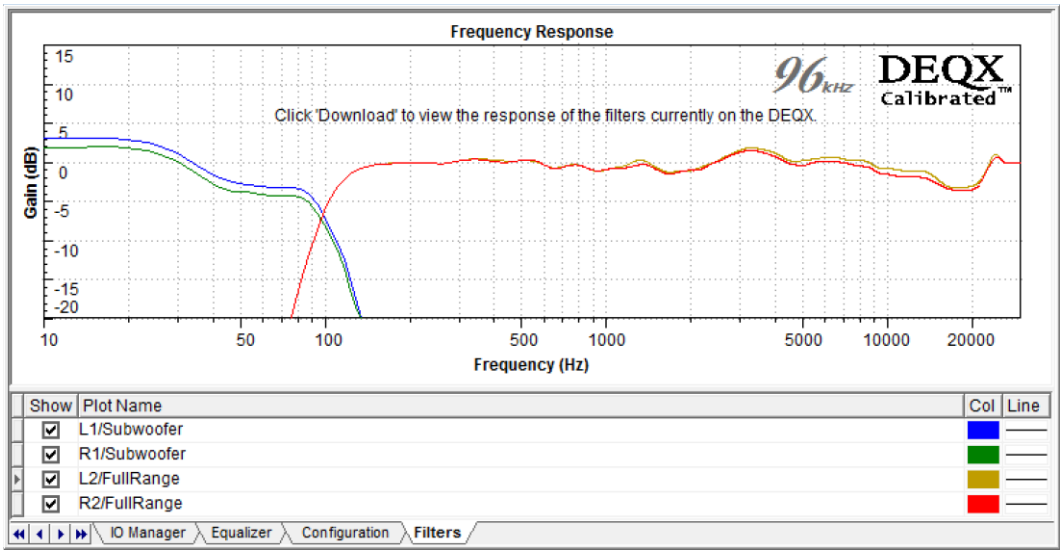
The Configuration tab displays the configuration data that is currently loaded into the connected DEQX. Click the **Profile** buttons to view the configuration of each profile.




This tab cannot be used to modify the configuration. (To modify the configuration, open the configuration window and update it as described on pages 73 to 79. Then click the **Save All to DEQX** button to upload the updated configuration to the DEQX.)

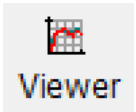
## 15.4 FILTERS TAB


The Filters tab displays the filters that are currently loaded into the connected DEQX. Click the **Download** button to fetch the current set of filters, then click the **Profile** buttons to view the filters loaded into each profile. This tab cannot be used to change the filters. (To change the filters, use the configuration window as described above.)



# 16 DATA VIEWER REFERENCE

All measurements taken with the DEQX can be viewed using the *data viewer*. This window can also be used to view correction filters. The data viewer has been shown by example in earlier chapters of this manual. This chapter describes its capabilities in detail.

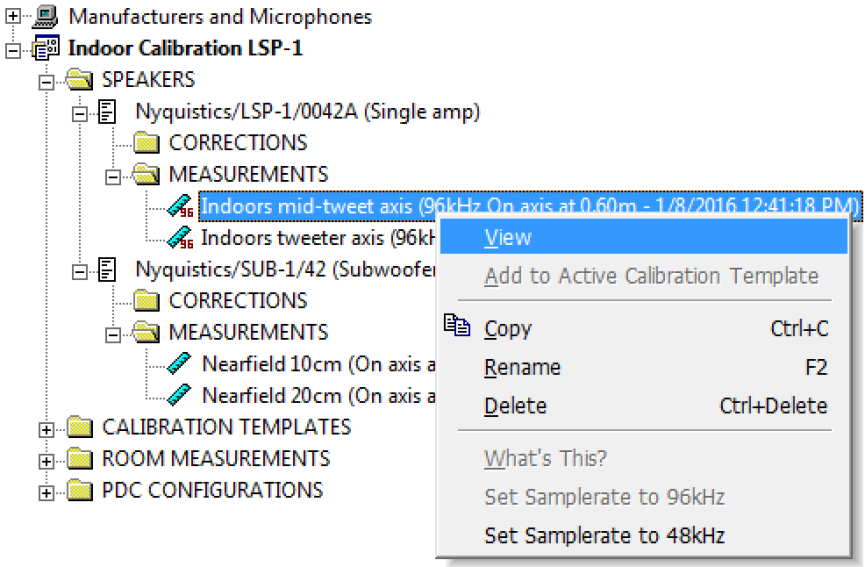



Note that the Equalizer tab of the Control Panel is a customized version of the data viewer, and most of the operations described in this chapter also apply to it.

## 16.1 TO OPEN A MEASUREMENT FROM THE PROJECT EXPLORER

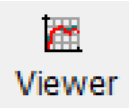
In the project explorer, navigate to the measurement or correction filter that you want to view. Then do one of the following:

1. Right-click to open the popup menu and select "View." This will open the measurement or filter in a new data viewer.




2. Drag and drop the measurement or filter from the project explorer onto an already-open data viewer window, or onto the Control Panel's Equalizer tab.

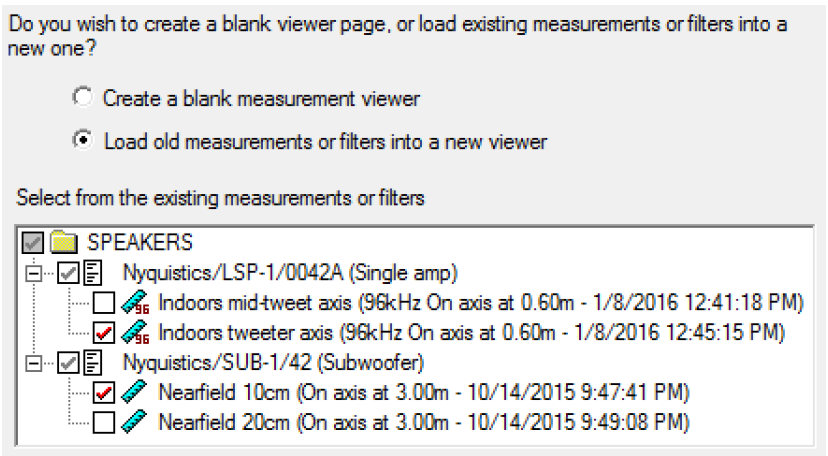
## 16.2 TO OPEN MEASUREMENTS WITH THE VIEWER WIZARD




The viewer wizard makes it easy to open multiple measurements at once. Start the wizard by clicking on the **Viewer** button in the Wizard toolbar, or by selecting it from the Tools menu. The wizard proceeds through three screens, as follows:

**Screen 1**. If you have more than one project open (page 149), select the project containing the measurements that you wish to view. Otherwise, this is just an informational screen.

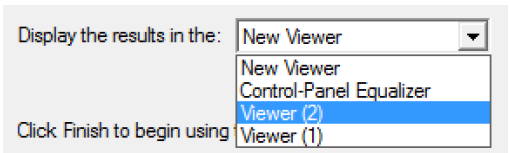
**Screen 2**. To open existing measurements for viewing, select "Load old measurements or filters into a new viewer." From the pane that appears underneath, unfold folders and select the measurement or measurements that you wish to open:




Alternatively, to create a new data viewer into which measurements can be loaded later, select "Create a blank measurement viewer."

**Screen 3**. If you opted for a blank data viewer, just click **Finish**. If you selected measurements to display, the wizard will by default suggest that you open the selected measurements in a new data viewer window:

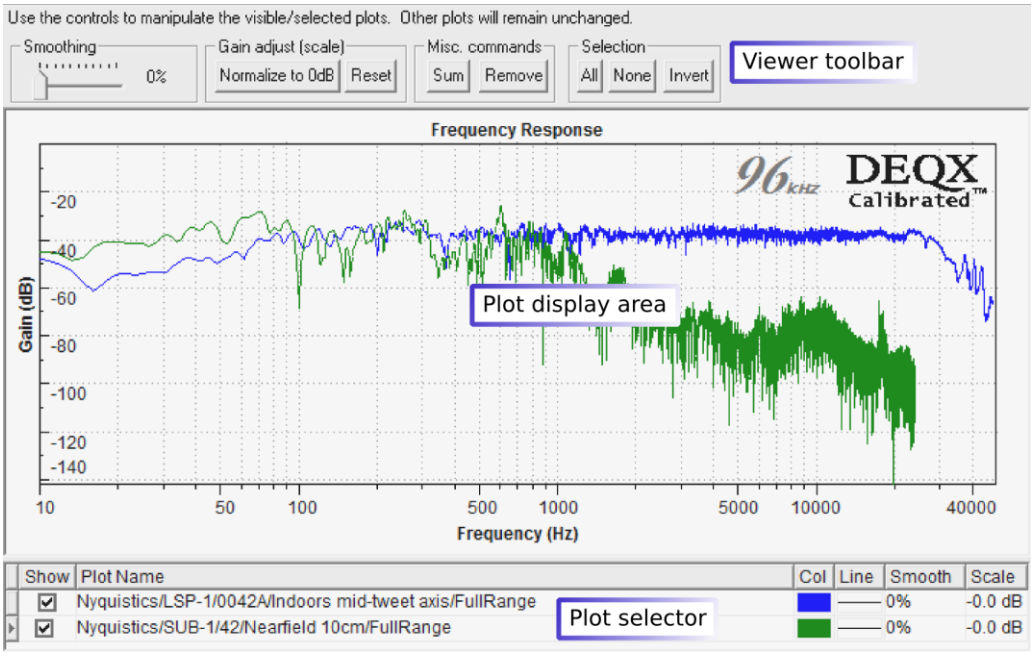

You can instead use the drop-down menu to open the selected measurements in an existing data viewer window or in the Equalizer tab of the Control Panel:




Click **Finish** to open the selected measurements.

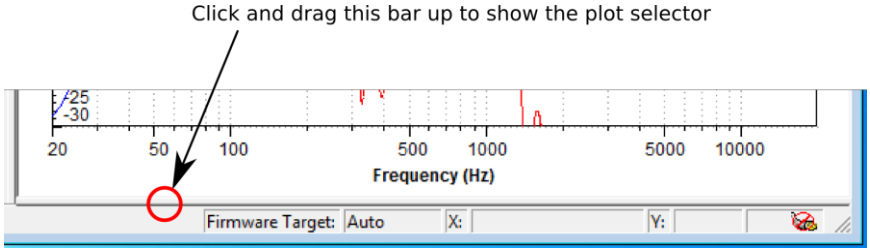
## 16.3 THE DATA VIEWER WINDOW

The data viewer window displays any number of measurement plots. The screenshot below is annotated with the main areas of this window: the viewer toolbar, the plot display area, and the plot selector.





If the plot selector is not visible, click on the bar at the bottom of the window and drag it upward to expose the plot selector:





To add more measurements to an open data viewer, drag and drop them from the project explorer onto the open viewer.

## 16.4 OPERATING ON MEASUREMENTS

The chart toolbar, viewer toolbar, and plot selector provide a comprehensive set of functions for viewing and manipulating measurement plots.

**To select individual plots for display:**

Click on the checkboxes in the **Show** column of the plot selector.

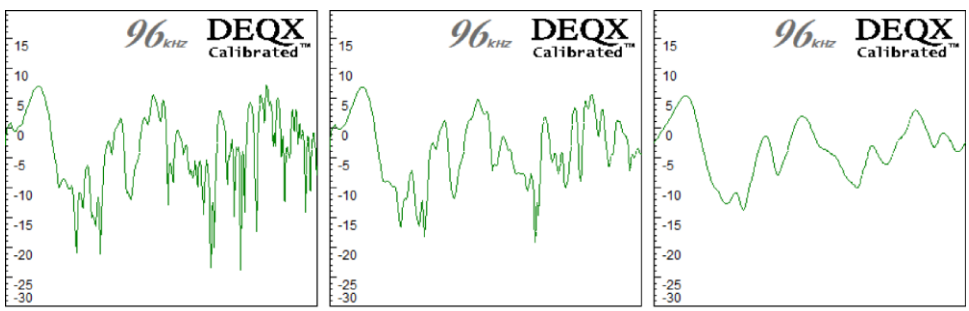
| Show | Plot Name | Col | Line | Smooth | Scale |
|---|---|---|---|---|---|
| ☑ | Nyquistics/LSP-1/0042A/Indoors mid-tweet axis/FullRange | | | 0% | -0.0 dB |
| ☐ | Nyquistics/SUB-1/42/Nearfield 10cm/FullRange | | | 0% | -0.0 dB |

**To change plot color or line style:**

Click in the **Col** or **Line** column and select a color or line style.

**To set plot smoothing:**

Click in the **Smooth** column and type in the new smoothing amount (0 to 100%). Smoothing serves to make measurements more legible by removing comb filtering (particularly when measuring indoors). It is also an adjustment that is made to control speaker calibration (see pages 57 and 114 for examples).




0% smoothing | 85% smoothing | 100% smoothing

In addition to the individual adjustment for each plot, all selected plots can have their smoothing changed with the slider at the left of the viewer toolbar.


**To change plot scale:**

Click in the **Scale** column and enter a value. This value adjusts the offset of the plot relative to the decibel scale on the left hand side. It is used to align plots to calculate gain levels and to aid in room EQ. (See page 93 for an example.)

**To normalize plots:**

Click the **Normalize to 0 dB** button. The selected plots will have their scale values changed so that the signal level is nominally at 0 dB.

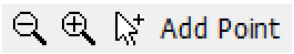
**To remove a plot or plots from the display:**

Select the plots to be removed and click the **Remove** button.

**To create a summed plot:**

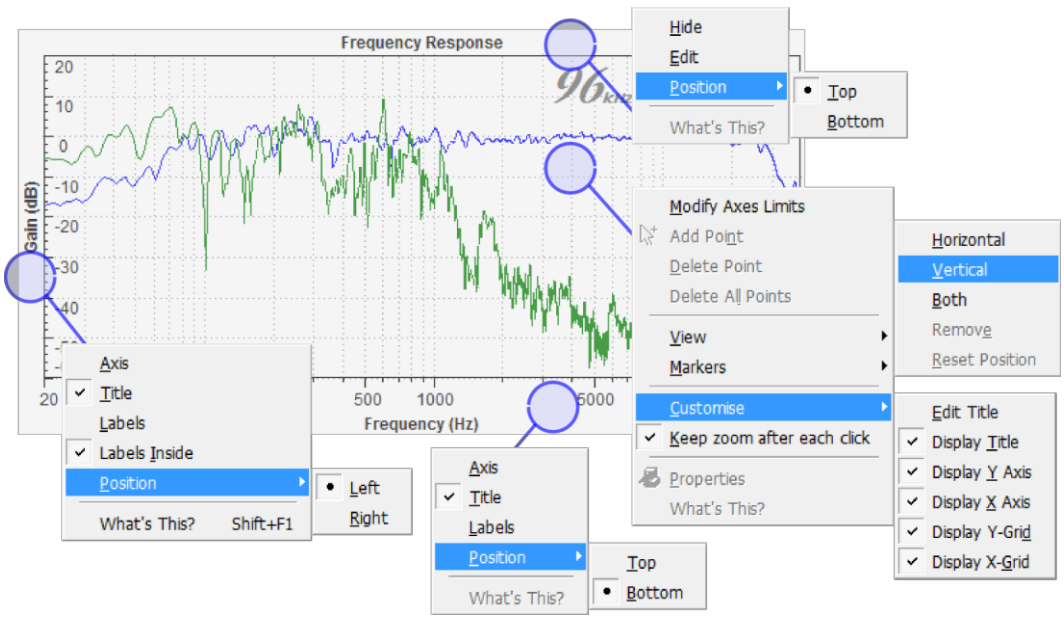
Select the plots to be summed and click the **Sum** button. (See page 104 for an example.)

**To zoom in and out on a plot:**




Click on the "+" magnifying glass icon in the chart toolbar. Then, either click once on the plot display area, or drag-select a region to zoom in on it. To zoom out, click on the "–" magnifying glass icon and then on the plot. By default, the zoom buttons are "sticky." To have the zoom buttons reset themselves after each click, right-click on the plot display area and uncheck the option "Keep zoom after each click." (See also "To change plot axis limits" on the next page.)

The plot display area responds to a right-button mouse-click by bringing up a context menu. The menu entries depend on where the click is, as shown in this overlay:




**To change the title of a plot:**

Right-click on the title bar and select "Edit." Type in the new name and click OK.

**To disable the X or Y-axis display**

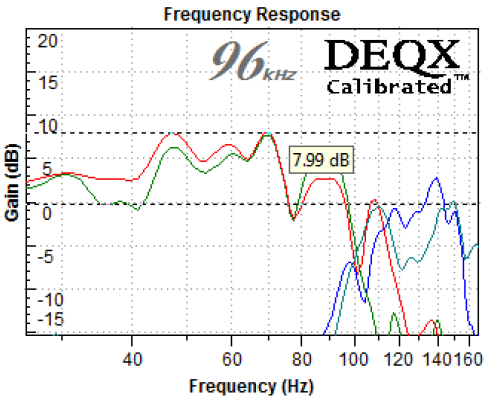
Right-click on either axis and turn off the "Axis" entry. Alternatively, right-click on the main plot display area, open the "Customize" sub-menu, and turn off "Display X Axis" or "Display Y Axis."

**To disable the chart grid:**

Right-click on the main plot display area, open the "Customize" sub-menu, and turn off "Display X-Grid" or "Display Y-Grid."

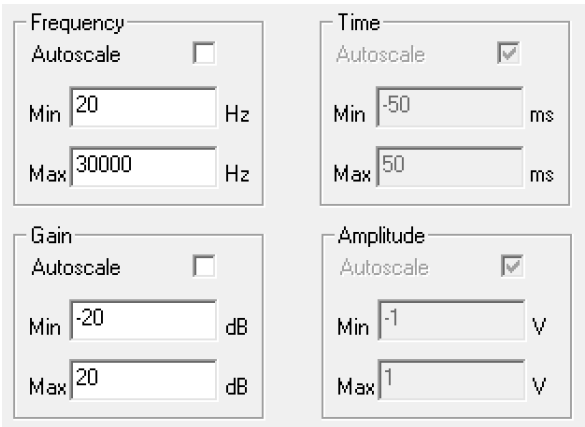
**To add markers to the plot:**

Right-click on the plot display area, open the "Markers" sub-menu, and select either "Vertical" or "Horizontal." The markers can then be dragged to the desired location.




**To change plot axis limits:**

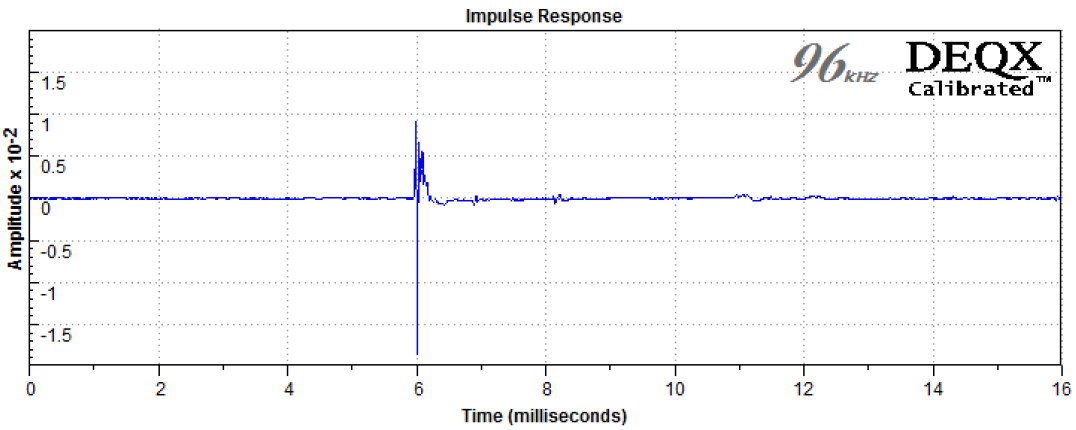
The "+" and "–" magnifying glass icons change the displayed plot range within the overall limits, which are by default set automatically. To set these limits manually, right-click on the plot display area and select "Modify Axes Limits." Uncheck the **Autoscale** checkboxes and enter the desired limits.




Other changes to the plot display can be made in the Chart tab of the Options dialog (pages 153 and 154).

## 16.5 VIEWING THE IMPULSE RESPONSE

Click the TIME button on the chart toolbar to display the impulse response of the selected measurements. The impulse response is used to calculate timing delays (see pages 56 and 95 for examples).

# 17 PROJECT EXPLORER REFERENCE

The project explorer is used to navigate and manage a project. Various ways of using the project explorer have been described in earlier chapters. This chapter provides a more complete reference.

Note that it is not always necessary to use the project explorer. The various wizards provide the ability to create and open measurements, calibration templates and configurations without using the explorer.

The project explorer is more likely to be useful to advanced users who are creating multiple measurements and correction sets, as it provides an at-a-glance view of the complete set of data in the project. Even so, it is recommended that a project not be allowed to get *too* large. (For example, consider creating a new project when starting a fresh *measure-calibrate-configure* cycle.)

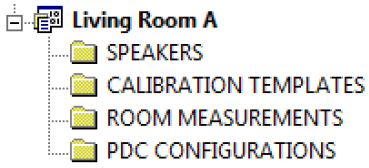
## 17.1 WORKING WITH PROJECTS

**To open the project explorer:**

Drop down the View menu and select "Project explorer."

**To create a new project:**

Drop down the File menu and choose "New Project." Alternatively, click on the "New" icon in the toolbar. Enter the name of the new project and click **OK**. Initially, the project is unpopulated:




**To open an existing project:**

Drop down the File menu and choose "Open Project." Alternatively, click on the "Open" icon in the toolbar. Select the project in the file browser and click **OK**. You can also open a project by double-clicking on it in the Windows Explorer.

**To save the active project:**

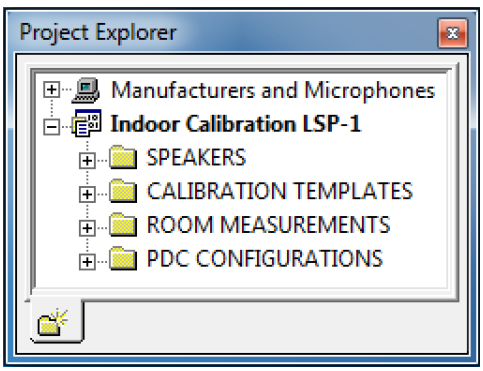
Drop down the File menu and choose "Save Project." Alternatively, click on the "Save" icon in the toolbar or press Ctrl-S on the keyboard.

**To close a project:**

Right-click on the project name and select "Close." The currently open project will also be closed when a new project is created or an existing project is opened.

**To move or undock the project explorer:**

The project explorer can be moved to other locations by dragging its grab-handle (the double horizontal line just above or to its left). It can also be undocked from the main window by dragging it well away to a blank area of your screen. Here is the result:



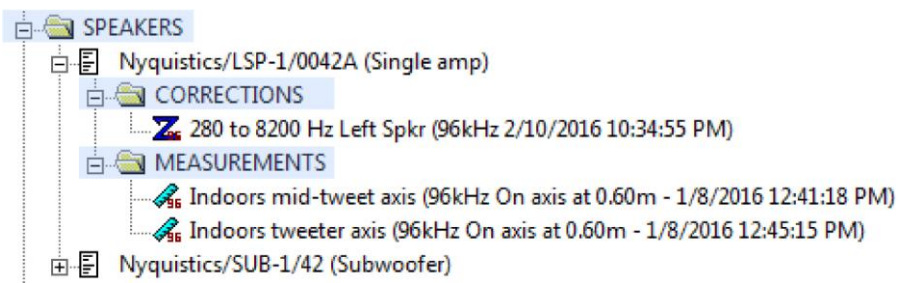

## 17.2 PROJECT FOLDERS

The project consists of four main folders. These folders will be populated as you take measurements, create calibrations, and so on. To open a folder, click on the "+" icon or double-click on its name. To close it, click on the "–" icon or double-click on its name.

In the following screenshots, the folders created by DEQX-Cal are shown highlighted.

### SPEAKERS

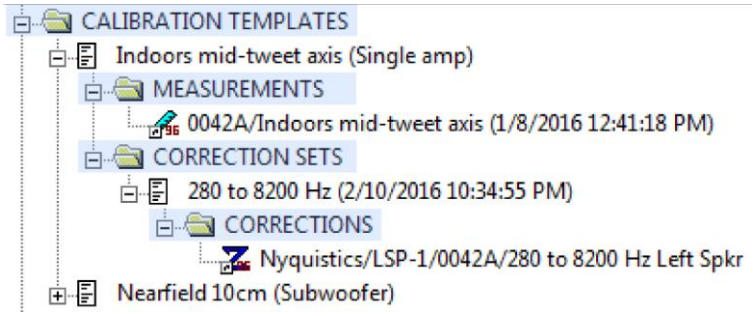
This folder contains items identified by the combination of speaker manufacturer, model, and serial number. Under each, there are two folders: CORRECTIONS, containing correction filters generated for that speaker, and MEASUREMENTS, containing measurements made of that speaker.



### CALIBRATION TEMPLATES

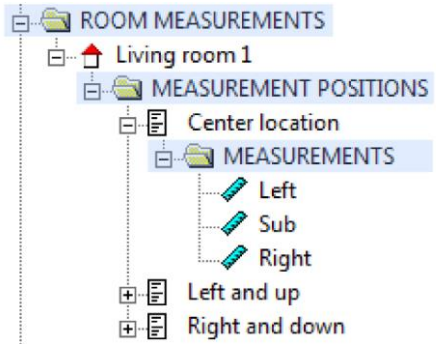
This folder contains calibration templates. Each of these contains two folders: MEASUREMENTS, which references measurements used by that template, and CORRECTION SETS, which contains sets of correction filters.

Note that the correction filters and measurements here are references or *aliases* to the items contained under SPEAKERS. Therefore, deleting a calibration template does not delete the filters or measurements that it references.



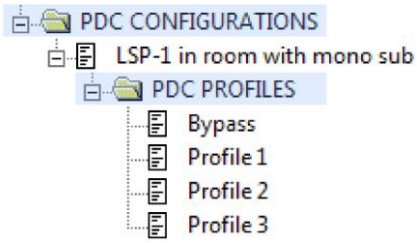

### ROOM MEASUREMENTS

This folder contains sets of measurements for each room. The top-level list of items is the list of room names. Within each room is the list of measurement positions, each of which contains measurements for the speakers or drivers.




### PDC CONFIGURATIONS

This folder contains DEQX configurations. Each configuration contains four profiles, with default names as shown below.



## 17.3 EXPLORER OPERATIONS

Right-clicking on any folder or item in the project explorer will open a context-sensitive menu that provides a number of common operations. The possible operations will differ by the folder or type of item.

**Open (or View)**

Open the item in a data viewer (for measurements, correction filters and individual profiles) or in the appropriate type of window (for calibration templates and configurations). In the case of room measurements, multiple measurements can be opened at once by right-clicking on a measurement position.

**Rename**

Rename the clicked-on item. The new name can then be typed over the old one. You can also click on an item and then click again to enable renaming (but not quickly enough to be registered as a double-click.)

**Delete**

Delete the clicked-on item from the project.

Note that deleting a calibration template does not delete the measurements or correction filters that it references – those are contained in the SPEAKERS folder.

Use caution when deleting items. It is strongly recommended that you close all relevant windows before deleting any item from the project explorer. Do not delete correction filters or speaker measurements that are in use by a calibration template or a configuration. Avoid deleting calibration templates that were used to create correction filters that are in use by any configuration.

**Drag and Drop**

Speaker measurements, room measurements, correction filters and profiles (within a configuration) can be dragged from the project explorer onto an open data viewer or onto the Equalizer tab of the Control Panel. In the case of room measurements, a measurement position or just a single speaker or driver measurement can be dragged and dropped. In the case of a profile, the filters that it contains will be displayed.

**Copy and Paste**

This is essentially the same as drag and drop, and applies to the same items listed above for drag and drop. Select the item and then "copy" it by pressing Ctrl-C on the keyboard. Then click once in an open data viewer or on the Equalizer tab of the Control Panel and press Ctrl-V on the keyboard.

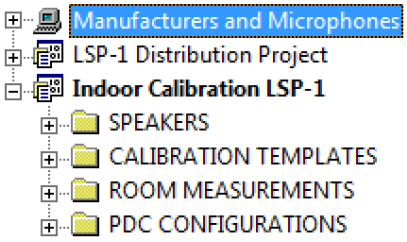
## 17.4 WORKING WITH MULTIPLE PROJECTS


The project explorer can open more than one project at a time.

Note: this feature is **not** intended as a general-purpose mechanism for sharing data between projects. The primary purpose of this function is to enable the speaker designer to create a project for *distribution* – that is, a project containing only what is needed to upload a configuration to a DEQX in a different physical location, without all of the other measurements and templates that may have been created during the design process.

In general, it is best to use a single project for development work, even when using multiple DEQX units (Chapter 14).

To open a second (or third etc.) project, drop down the File menu and choose "Insert Project..." Select the project in the file browser and click **OK**. The project is added to the project explorer:




Right-clicking on a project name provides two options:

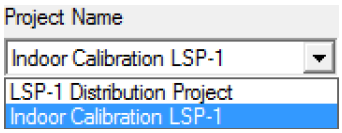
**Set as Active Project**

The active project is the default selection on the first screen of each wizard. It is also the project used for operations like Save.

**Remove Project**

Remove this project from the explorer.

If multiple projects are open, the various wizards provide an option on their first screen to select the project to use for following steps. By default, the active project is selected, but any other open project can be selected instead:




Note that it is not possible to have (for example) a calibration template in Project B create a correction filter based on a speaker measurement that is in Project A. Each wizard operates within the confines of the selected project.

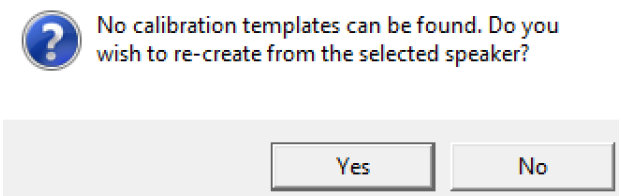
There are two ways to copy data between projects:

- Room measurements. Drag and drop a "room" (the top level item) from the ROOM MEASUREMENTS folder of one project onto the ROOM MEASUREMENTS folder of another project. All of the measurement positions and the individual measurements underneath them will be copied over.
- Configurations. Drag and drop a configuration from the PDC CONFIGURATIONS folder of one project onto the PDC CONFIGURATIONS folder of another project. All of the data associated with that configuration will be copied over, including EQ settings, correction filters, and the speaker measurements used to create the correction filters.

While the intent of multiple projects is to create a project for distribution and not as a way to continue development work, it is still possible to create calibration templates from the data contained in a copied configuration. This feature is provided so that refinements or adjustments to correction filters can be made on-site i.e. after distribution of the project. (It is not intended to be a way to recreate the full original calibration template in a different project.)

1. Open the configuration and select the profile containing the relevant correction filters.
2. Click on one of the speaker or subwoofer icons.
3. Click the "Open Template" button. (Or right-click anywhere in the Configuration tab and select "Open Template" from the popup menu.)

4. You will be asked if you wish to recreate a calibration template from the selected speaker. Click "Yes."




5. A new calibration template will be created.

# 18 OPTIONS AND CUSTOMIZATION

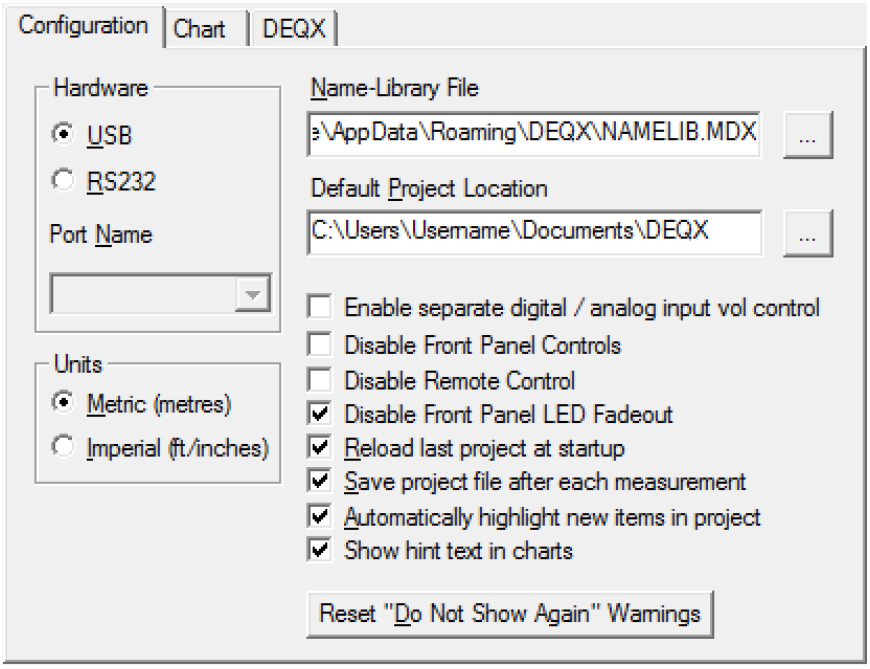
DEQX-Cal has many configuration options that control its behavior and appearance. This chapter provides a reference for them.

## 18.1 OPTIONS DIALOG

The Options dialog is opened from the Tools menu. After changing any options, click Apply to make them take effect without closing the dialog, or OK to make them take effect and close the dialog.

### 18.1.1 Configuration tab

This tab holds most of the key options. (See the next two pages for descriptions.)



**Hardware**

Selects the port that the computer uses to communicate with the DEQX. This must always be set to **USB** for current generation software and products. (The RS-232 mode is retained for specific legacy support reasons only.)

This setting has no effect on master/slave mode operation (Chapter 14).

**Units**

The measurement system that DEQX-Cal uses for recorded distances.

**Name-Library File**

The location and name of the file that DEQX-Cal uses to store names added by the user (manufacturers, speaker models, measurement locations, and so on). This must never be changed except on specific instruction from DEQX Support.

**Default Project Location**

The directory that DEQX-Cal uses by default for storing project files. This can be changed if you prefer to store projects in a different location (for example, on a network drive or external hard drive).

**Enable separate digital/analog volume control**

If checked, the DEQX remembers two volume control settings: one for the analog inputs and one for the digital inputs. Changes to the master volume setting will affect one or the other according to whether an analog or digital input is selected at that time.

As an example usage of this feature: if the analog input is connected to the left and right outputs of a home theater processor and the analog volume is set to maximum, this effectively creates a "home theater bypass."

**Disable Front Panel Controls**

If checked, the front panel controls for volume and profile selection do not respond. (The Standby button still operates.) This is used when the DEQX is set up as a slave unit (Chapter 14).

**Disable Remote Control**

If checked, the DEQX does not respond to remote control commands. This is used when the DEQX is set up as a slave unit (Chapter 14).

**Disable Front Panel LED Fadeout**

Leave this option turned on.

**Reload last project at startup**

If checked, DEQX-Cal reloads the project that was in use when it was previously closed. This is a convenience feature, and is checked by default.

**Save project file after each measurement**

If checked, DEQX-Cal saves the whole project after completing each measurement. It is checked by default.

**Automatically highlight new items in project**

If this option is checked, any new item (measurement, calibration template, or configuration) added to the project is highlighted in the project explorer. Folders above the new item will be unfolded. It is checked by default.

**Show hint text in charts**

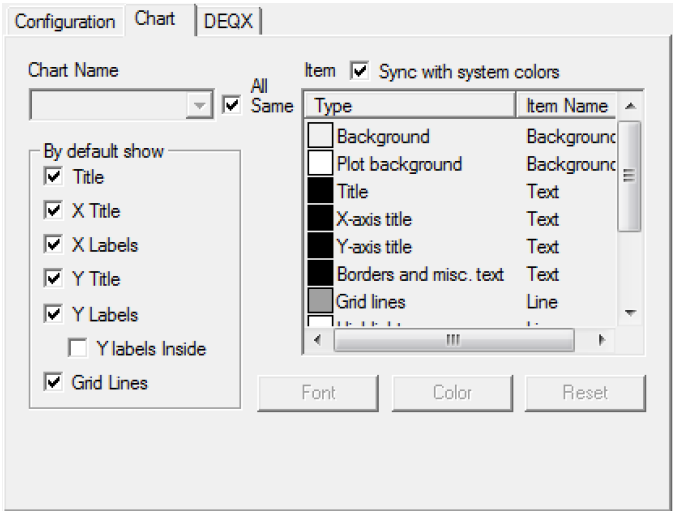
If this option is checked, some charts have text overlaid with short instructions on how to use them. (For example, the Anechoic tab of the calibration template.) It is checked by default.

**Reset "Do not show again" warnings**

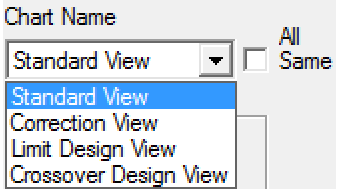
DEQX-Cal has a number of warnings with a checkbox "Do not show again." Click this button to reset the state of these warnings so that they will display again.

### 18.1.2 Chart tab

This tab is used to customize elements of the various charts in DEQX-Cal, such as the title, labels, and grid lines.




To make changes to all charts, leave the "All Same" option checked. Uncheck it and use the drop-down selector to change just one chart type:



**Standard View**

This refers to most charts: the data viewer, the Equalizer tab of the control panel, and the Anechoic and Smoothing tabs of the calibration template.

**Correction View**

This refers to the tabs of the calibration template that display the correction filter sets (named "Correction Set 1" and so on by default).

**Limit Design View**

This refers to the **Limits** tab of the calibration template.

**Crossover Design View**

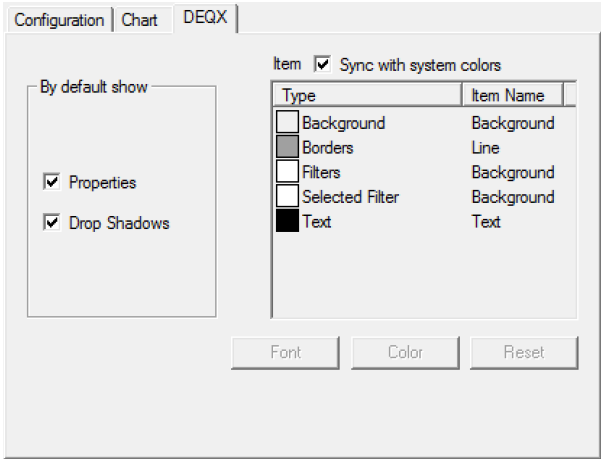
This refers to the **Crossovers** tab of the calibration template.

Use the checkboxes on the left of the dialog to set the items displayed by default on the selected chart type. Most of these can also be disabled and enabled for individual charts (see page 143).

The right side of the dialog box is used to set colors and fonts. To change colors and fonts specifically for DEQX-Cal, uncheck "Sync with system colors," then click the **Font** or **Color** button to make the desired changes.

### 18.1.3 DEQX tab

This tab controls the appearance of the configuration window.




If the **Properties** option is checked, the configuration window displays the parametric room EQ filter settings and the key correction and limit filter parameters (in text). If unchecked, this information is not displayed. It is checked by default.

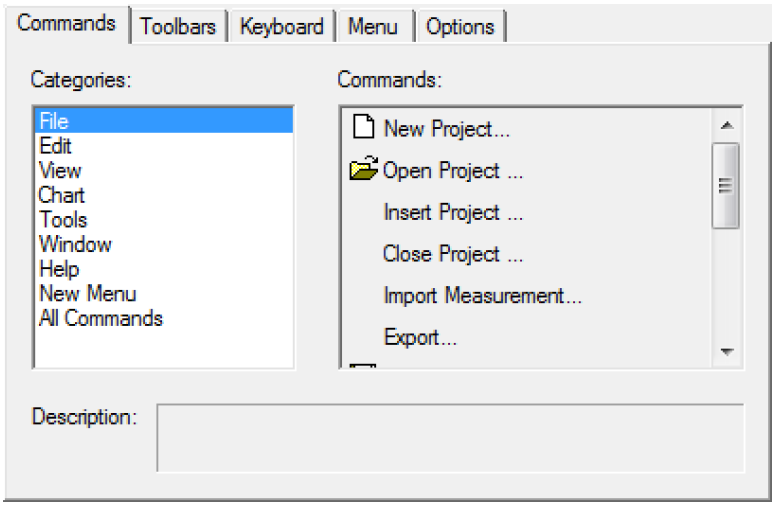
The right side of this tab can be used to change the colors and fonts of items in the configuration window. Uncheck "Sync with system colors," select the item from the list, then click the **Font** or **Color** button to make the desired changes.

## 18.2 CUSTOMIZE DIALOG

The Customize dialog is opened from the Tools menu. Changes made in this dialog take effect immediately.

### 18.2.1 Commands tab

Use this tab to add commands to toolbars or menus. (For examples, see page 158.)




**To add a command:**

Locate the desired command by selecting the category on the left, and then the command on the right. Drag the selected command onto:

- An existing toolbar, or
- A menu in the main menu bar (the menus will unfold as the drop cursor is moved over them).

**To add a new menu:**

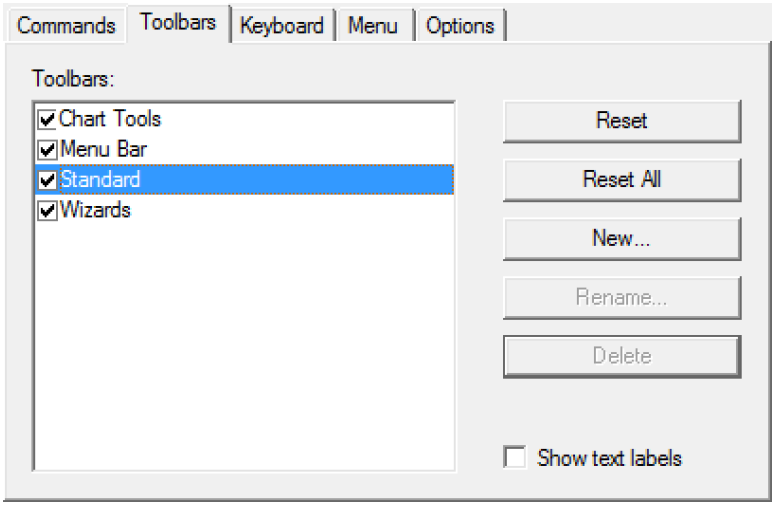
Select the "New menu" category on the left, and drag the item "New menu" on the right onto a menu bar. (It can also be dragged onto a toolbar.)

**To rename or delete an item from a menu or toolbar:**

While the Customize dialog is open, right-click on the menu or toolbar item that you want to change. Select "Edit" to change its name, or "Delete" to remove it.

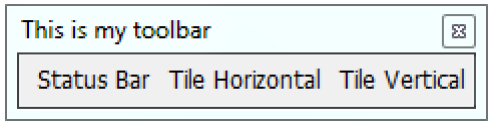
### 18.2.2 Toolbars tab

Use this tab to create and delete toolbars.




To create a new user-defined toolbar, click **New** and enter the toolbar name. It will appear as a separate toolbar window (below right). Then:

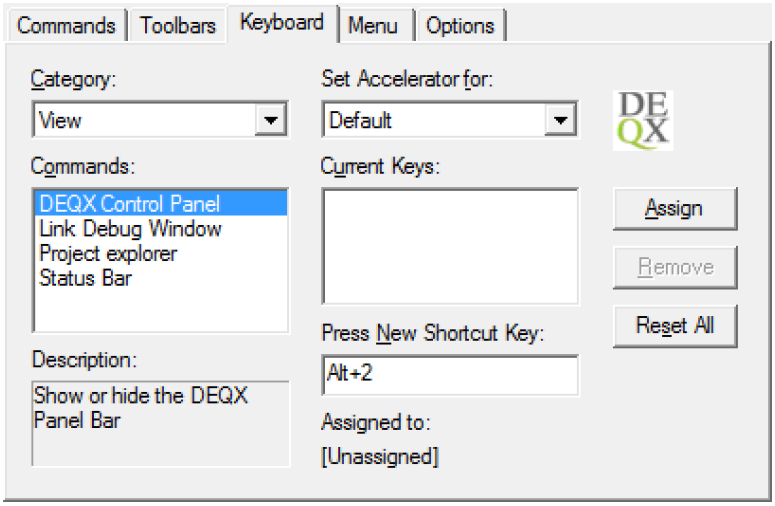
1. Go back to the **Commands** tab and drag and drop commands from it onto the new toolbar window.




2. Drag the new toolbar window onto a toolbar location (such as next to an existing toolbar) to dock it to the main window.

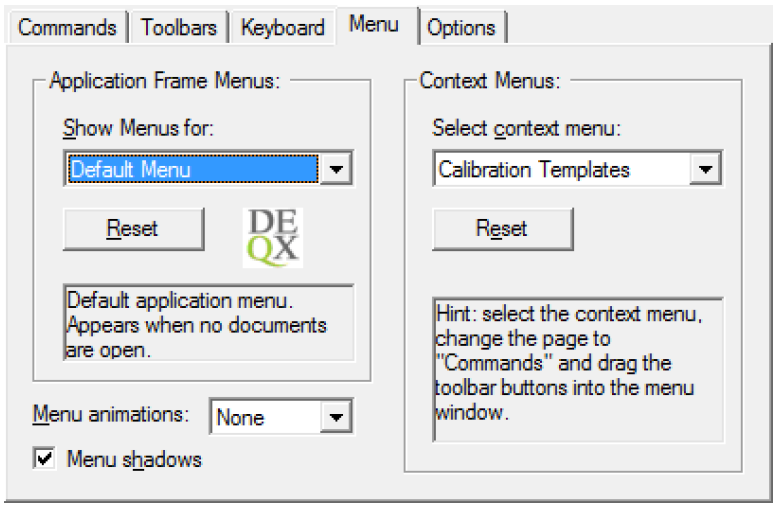
### 18.2.3 Keyboard tab

Use this tab to set up keyboard shortcuts for commands.

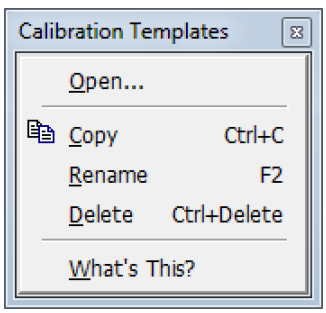


### 18.2.4 Menu tab

Use this tab to customize the context menus that appear in various places in DEQX-Cal when the right mouse button is clicked (such as the project explorer and data viewer).



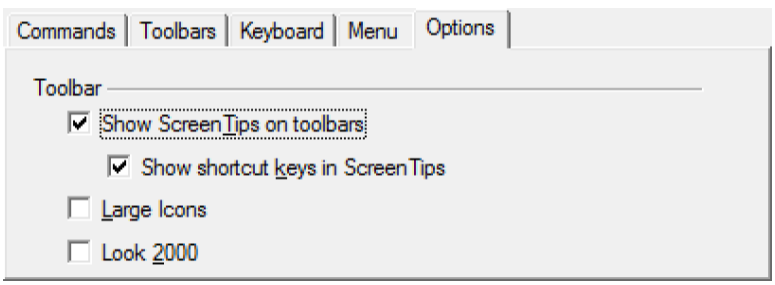

To edit a context menu, select it with the drop-down on the right-hand side. It will appear as a separate window as shown at right. Then go back to the **Commands** tab and drag commands from it onto this separate window. Or, right-click on an entry in this window to delete or edit it.




To reset the selected menu to its defaults, click the **Reset** button (while the window is still open).

### 18.2.5 Options tab

This tab contains a small number of additional options.



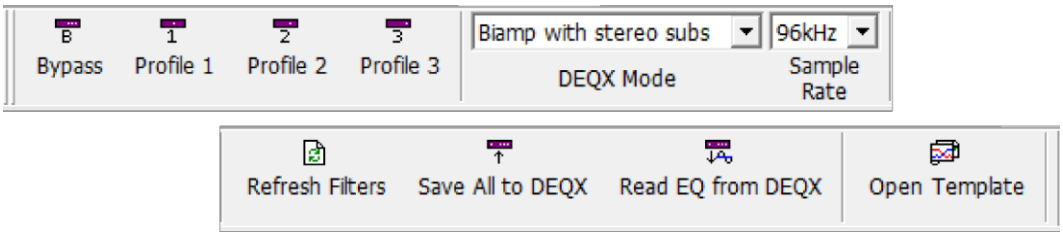

The "Show Screen Tips on toolbars" option controls the tooltip that appears when hovering the mouse over any toolbar item. The "Show shortcut keys in Screen Tips" option also enables display of the relevant shortcut key.

## ADDING TEXT LABELS TO THE CONFIGURATION TOOLBAR

The toolbar of the configuration window is quite small. Especially when editing a profile, it can be hard for a novice user to distinguish the buttons. It is simple to add text labels to this toolbar, as follows:

1. Open the configuration window (if it is not already open).
2. Open the Customize dialog and select the **Toolbars** tab.
3. Click on "DEQX Configuration" at the left.
4. Turn on the "Show text labels" checkbox.

The toolbar of the configuration window will display as shown below (the image shows the toolbar split for space reasons, but in DEQX-Cal it will be a single row).



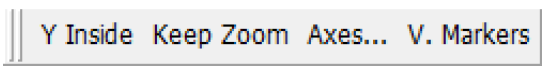

Note: if you are an advanced user and have more than one configuration in your project, this will need to be done separately for each of them.

## MAKING AN AUXILIARY CHART TOOLBAR

To create an auxiliary toolbar for common chart operations:

1. Open the Customize dialog and select the **Toolbars** tab.
2. Click on **New**, enter "Chart Tools 2" and click **OK**. A small window appears.
3. Go to the **Commands** tab, click on the Chart category, and drag these commands onto the new toolbar window: "Y Labels Inside", "Keep zoom after each click", "Axes Limits...", and "Vertical".
4. Right click on each item in the new toolbar window and select "Button Appearance" to edit the label.
5. Drag the toolbar window onto the main window to dock it.

Here is the result:



# A SPECIFICATIONS

*Specifications are subject to change without notice.*

## AUDIO PROCESSING

| | |
|---|---|
| Crossover slope (*1) | 48 to 300 dB/octave (linear-phase)<br>6 to 96 dB/octave (Linkwitz-Riley and Butterworth) |
| Crossover frequency | 22 to 18,340 Hz |
| Limit filters (*1) | 6 to 300 dB/octave, 20 Hz to 20 kHz |
| Latency | From 2.5 ms, typically 15 ms depending on filters |
| Group delay tolerance | Better than 0.5 ms, typical |
| Amplitude tolerance | Better than 0.2 dB, typical |
| Room EQ (*2) | Seven bands, 1 Hz to 48 kHz, –300 to +40 dB, Q 0.01 to 17 |
| Preference EQ | Three bands, 20 Hz to 20 kHz, gain to +/– 9 dB, Q 0.5 to 10 |
| DSP resolution | > 140 dB |

*1 Available slopes are subject to filter delay limits.

*2 Ten bands available if Preference EQ is not needed.

## DIGITAL AUDIO INPUTS

| | |
|---|---|
| TOSLINK (optical) | 24-bit, 44.1 to 96 kHz |
| S/PDIF (BNC) | 24-bit, 44.1 to 192 kHz, 75Ω |
| S/PDIF (RCA) | 24-bit, 44.1 to 192 kHz |
| AES/EBU (XLR) | 24-bit, 44.1 to 192 kHz, 110Ω |
| USB Audio | Asynchronous USB Audio Class 2, 24-bit, 44.1 to 192 kHz. Driver not required for Mac OS X; XS-1 driver supplied for Microsoft Windows. |

## DIGITAL AUDIO OUTPUTS (*3)

| | HDP-4, HDP-5 | PreMATE, PreMATE+ | HDP-Express II |
|---|---|---|---|
| Digital Thru | 24-bit, 96 kHz | — | — |
| Low | 24-bit, 96 kHz | — | — |
| Mid/Full | 24-bit, 96 kHz | 24-bit, 96 kHz | — |
| High | 24-bit, 96 kHz | — | — |

*3 All digital outputs are S/PDIF via BNC 75Ω connector.

## ANALOG AUDIO INPUTS

| | Balanced | Unbalanced |
|---|---|---|
| Full scale input level | 17 dBu / 5.5 VRMS | 9.3 dBu / 2.25 VRMS (*4) |
| Input impedance | 50 kΩ | 50 kΩ |
| A/D convertor | 24-bit, 96 kHz | |
| Signal-to-noise ratio | 107 dB, A-weighted | |

*4 Jumper-selectable to reduce sensitivity (see Appendix D). The given value is the factory default.

## ANALOG AUDIO OUTPUTS

| | Balanced (*5) | Unbalanced |
|---|---|---|
| Full scale output level (*6) | 17.4 dBu / 5.7 VRMS | 10.8 dBu / 2.7 VRMS |
| Output impedance | 150 Ω | 75 Ω (*7) |
| Frequency response | 10 Hz – 45 kHz | |
| Total harmonic distortion | 0 0008% (analog in to analog out) | |
| Signal-to-noise ratio | 107 dB, A-weighted | |

*5 Not applicable to HDP-Express II.

*6 Jumper-selectable in five ranges up to 22.3 dBu balanced, 15.7 dBu unbalanced (see Appendix D). The given value is the factory default.

*7 Into an earth-referenced amplifier i.e. one where the RCA ground pin connects to mains ground. This is normally the case. The precise output impedance is 75 ohms, plus 75 ohms in parallel with whatever the amplifier puts in series between its RCA connector and mains ground. If the latter is open, then the impedance can be as high as 150 ohms (such as may happen with a two-pin power connector).

## CALIBRATION KIT

| | Standard Calibration Kit | Reference Calibration Kit |
|---|---|---|
| Calibration file | 20 Hz – 20 kHz | 20 Hz – 35 kHz |
| Maximum SPL | 127 dB | 140 dB |
| Phantom power | 48 V | 48 V |

## HARDWARE AND GENERAL

| | |
|---|---|
| Computer control | USB 2.0 |
| Mains input voltage | HDP-5, PreMATE, PreMATE+, HDP-Express II: 100 – 240 V AC, 50 – 60 Hz, auto-select<br>HDP-4: 100 – 120 or 220 – 240 V AC, 50 – 60 Hz, switch-selectable on rear panel |
| Fuse rating | 100 – 120V: 2 Amps; 220 – 240V: 1 Amp |
| Power consumption | 30 W (max) |

# B USB AUDIO

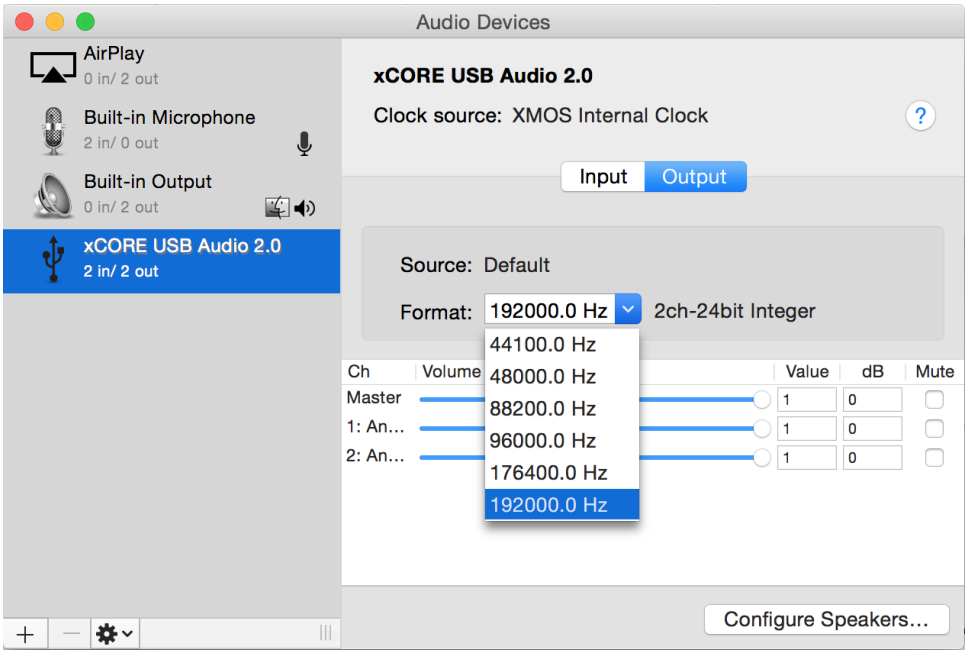
All current DEQX models incorporate the XS-1 USB Audio interface board, which accepts USB Audio at all standard sample rates from 44.1 up to 192 kHz.

## OS X

Driver installation is not required for OS X. Connect the DEQX USB Audio port to your Mac using the supplied cable.

To set the DEQX as the default system audio output device, open System Preferences, click on Sound, select the Output tab, and then select **xCORE USB Audio 2.0** in the list of output devices. In addition, audiophile-quality music players will allow you to select the DEQX as the output device independently of the system default.

More detailed properties of the DEQX USB Audio port can be verified in the Audio MIDI Setup program by clicking on the device **xCORE USB Audio 2.0**, as shown here:



### Windows

Microsoft Windows requires that a driver be installed in order to stream audio from the PC to the DEQX. Once installed, the DEQX output driver ("XMOS USB AUDIO 2.0") can be selected as the audio output device in any audiophile-quality music player.

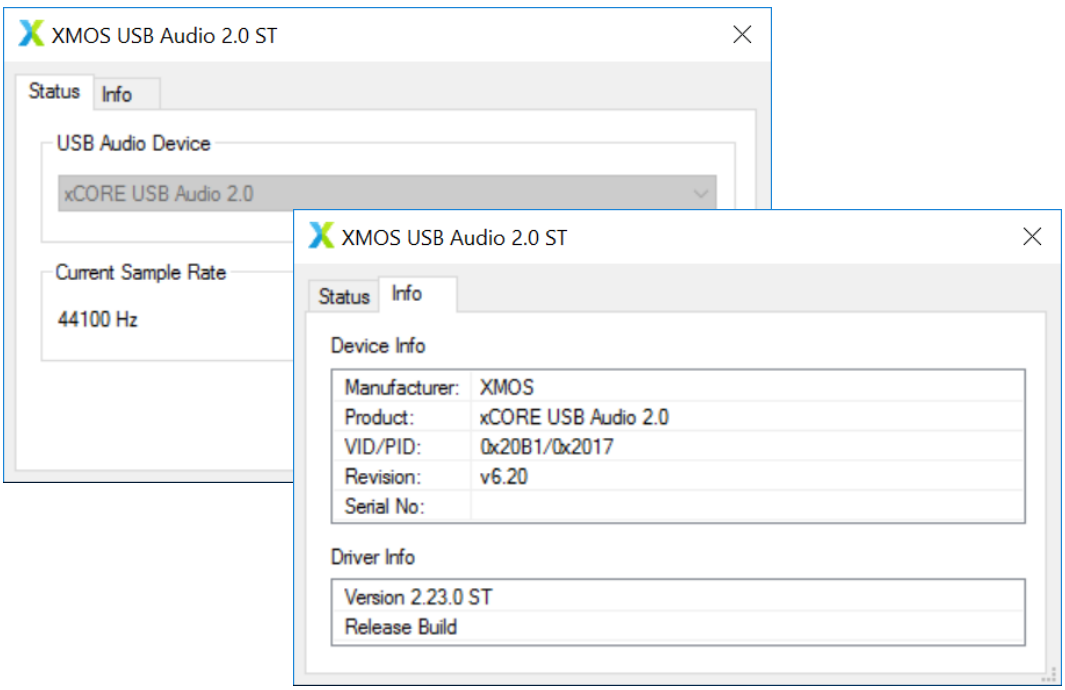

Before installing, check the upgrades section of the DEQX website (http://deqx.com/upgrades.php) for the latest version of the driver.

To install the driver, first connect the USB Audio input of the DEQX to a USB port on your computer using the supplied cable. Turn on the DEQX with the rear panel switch, wait a few seconds and then take it out of standby by pressing the I/O button on the front panel.

Navigate to the **XS-1 USB Board** -> **USB Audio Windows Stereo Driver** folder on the installation CD, and double-click on the installation program to start it. It will have a name similar to **XMOS-Stereo-USB-Audio-Class2-Driver-2017(v2.23.0).exe**. Step through the installer until it completes.

The PC **must** be connected to the USB Audio input of the DEQX, and the DEQX powered on and not in standby, before starting the USB Audio driver installer.

Correct installation of the USB audio driver can be viewed by starting the **XMOS USB Audio 2.0 ST Control Panel** (under DEQX Pty Ltd in the Windows Start Menu).



# C NETWORKED STREAMING AUDIO

The DEQX HDP-5 and PreMATE+ provide, in addition to the multitude of digital audio inputs, a carefully selected set of networked streaming audio functions. In this mode, the DEQX acts as a destination for third-party audio playback sources (software).

This Appendix describes supported networked audio sources. Others *may* work, but will not be supported by DEQX. (Note also that DEQX support is limited specifically to issues related to streaming networked audio to a DEQX unit. Core installation and configuration issues must be directed to the third-party hardware/software provider.)

To enable the DEQX as a networked audio destination, connect an Ethernet cable from your network router to the Ethernet port on the rear panel. Then select the "Internal" input on the front panel touchscreen or press the "Auto" button on the DEQX Remote.

### JRiver Media Center

JRiver Media Center (https://www.jriver.com/) is a comprehensive audio playback and library management suite that runs on Windows, Mac, and Linux.

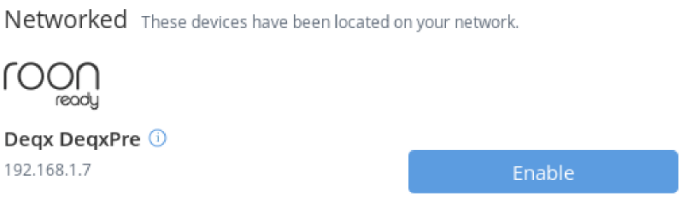
To enable playback to a network-connected DEQX, drop down the **Player** menu and go to the Zone sub-menu. Select the zone "DeqxPre," as shown here:


Proceed to your normal JRiver library view, hover the mouse over an album or playlist, and click on the "Play" overlay. The "Now Playing" section of the sidebar will show that "DeqxPre" is the playing destination (example shown below). Control playback volume from the DEQX touchscreen or with the DEQX Remote.

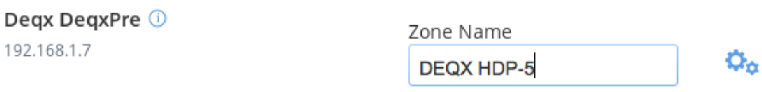
## Roon

Roon (https://roonlabs.com/) is a music player that runs on Windows, Mac, and Linux. It integrates various sources of music data, including content from the streaming audio service Tidal (http://tidal.com/). From the Roon website: "Roon looks at your music and finds photos, bios, reviews, lyrics, and concert dates, and makes connections between artists, composers, performers, conductors, and producers."

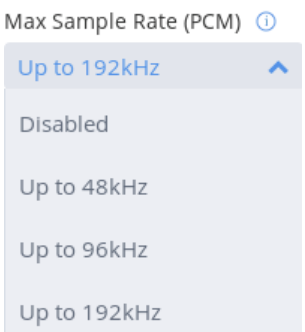
The DEQX HDP-5 and PreMATE+ are Roon Ready network players. To send audio from Roon to your DEQX, open Roon's Audio Setup panel. Scroll down, and you will see "Deqx DeqxPre" listed in the "Networked" section:




Click the **Enable** button. You can now rename the DEQX as you wish:




Click on the "gears" icon to the right and select 192 kHz as the Max Sample Rate:




Select your DEQX as the playback zone:


Select music to play using the Roon interface. Roon will display your DEQX as its playback device (lower right of player window). Control playback volume from the DEQX touchscreen or with the DEQX Remote.

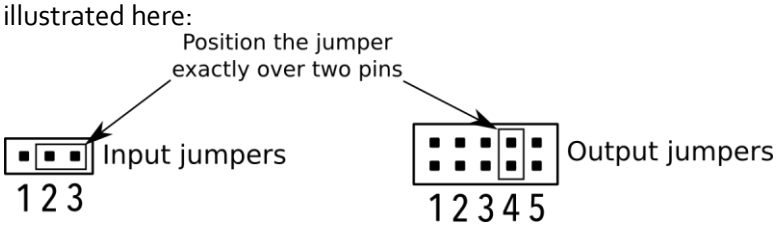
# D ANALOG GAINS

All DEQX units have settable analog gain on inputs[6] and outputs[7]. Changing the analog gain is accomplished by removing the top cover and moving a set of jumpers.

Power off the DEQX with the rear panel switch and **disconnect AC mains power** before performing this procedure. *Remove the IEC plug from the rear of the unit*. If you are not confident in your ability to perform this procedure safely, contact DEQX Support.

## TO CHANGE ANALOG GAIN

1. Remove 14 screws from the sides and top of the unit. Depending on date of manufacture, a small Philips screwdriver or 2 mm Allen (hex) key will be required.
2. Lift the cover straight up. You may need to pull the sides out slightly to do this.
3. Change the jumpers for each channel to the desired positions (see Table 5 and Table 6 on page 166). Be sure that the jumpers are positioned correctly over both pins, as illustrated here:




   Do **not** force jumpers – they will slide easily when positioned correctly.
4. Carefully replace the top cover. You may need to pull the sides out slightly as you do this. Be sure that the front edge of the top cover is flat against the rear of the front panel.
5. Replace the 14 screws. *Do not over tighten*.

---

[6] Input gain/sensitivity applies to the single-ended (RCA) inputs only. If even lower sensitivity is required than provided by jumpers, use the balanced inputs with a suitable RCA-XLR adapter.

[7] The DEQX has a 6 dB insertion loss to provide headroom for equalization. Therefore, with a bypass profile (page 75), full scale input gives half the listed output voltage. To obtain the listed full scale analog output for testing purposes, set channel gains in the IO Manager to +6 dB.

## JUMPER SETTINGS

Table 5 and Table 6 list the full scale input or output voltage for each jumper position. The highlighted row indicates the default setting as shipped from the factory.

*Table 5. Analog input sensitivity jumper settings*

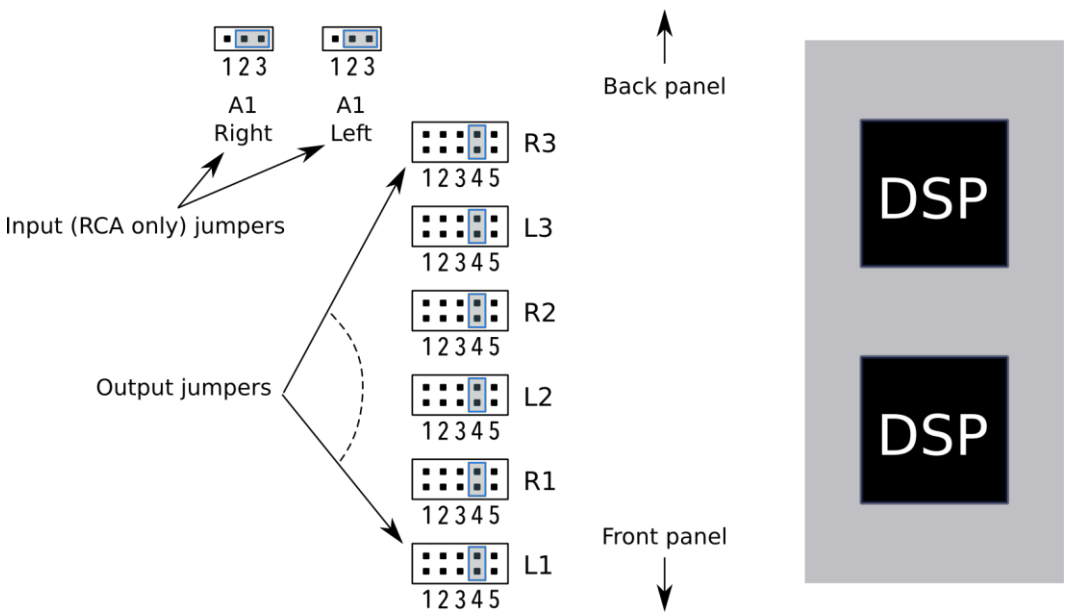
| | Full scale single ended input | | dB Sensitivity Change |
|---|---|---|---|
| **Position** | **dBu** | **V RMS** | |
| 1–2 | 11.6 | 2.95 | −2.3 |
| 2–3 (default) | 9.3 | 2.25 | 0 |

*Table 6. Analog output gain jumper settings*

| | Full scale balanced output (typ.) | | Full scale single ended output (typ.) | | dB Gain Change |
|---|---|---|---|---|---|
| **Position** | **dBu** | **V RMS** | **dBu** | **V RMS** | |
| 1 | 9.8 | 2.4 | 3.2 | 1.1 | −7.6 |
| 2 | 13.1 | 3.5 | 6.5 | 1.6 | −4.3 |
| 3 | 15.5 | 4.6 | 8.9 | 2.2 | −1.9 |
| 4 (default) | 17.4 | 5.7 | 10.8 | 2.7 | 0 |
| 5 | 22.3 | 10.1 | 15.7 | 4.7 | +4.9 |

## JUMPER LOCATIONS

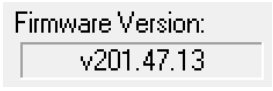
View the main circuit board from above and with the front panel of the unit toward you. The jumpers are located to the left of the DSP daughterboard as shown in the diagram below. The jumper positions on this diagram match those in Table 5 and Table 6 above.



# E FIRMWARE AND EEPROM

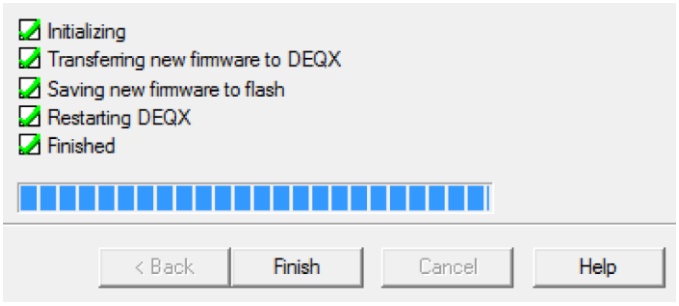
### TO CHECK THE FIRMWARE VERSION

Connect the DEQX to your PC and run DEQX-Cal. The firmware version will display toward the lower right of the IO Manager.




### TO UPGRADE THE FIRMWARE (NORMAL MODE)

Install and run the latest version of DEQX-Cal. With the DEQX connected to the PC, drop down the Tools menu and select "Upgrade DEQX firmware from file…" The next screen will show the selected firmware file. Confirm that this is the same file as listed in Table 7 (on the next page), then click **OK** to proceed. The firmware upgrade will then proceed through a series of steps until successful completion. Click **Finish** on the final screen to return the DEQX to normal use.




Do **not** power off or disconnect the DEQX while firmware upgrade is in progress.

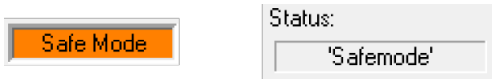
### TO BOOT IN SAFE MODE

Safe mode is intended for diagnostic and upgrade operations **only**. The DEQX will not perform any filtering while in safe mode, nor operations such as measurement. Ensure that all connected equipment is turned off before booting in safe mode.

1. Turn off the DEQX with the rear panel power switch.
2. Connect the DEQX to the PC with a USB cable and start DEQX-Cal.

3. Press and hold the P1, P2 and P3 buttons. While continuing to hold them down, turn on the DEQX with the rear panel power switch. All LEDs will flash blue.
4. Release the three buttons.

The DEQX-Cal status fields will indicate that it is connected in safe mode:




To upgrade firmware while in Safe Mode, drop down the Tools menu and select "Upgrade DEQX firmware from file…". It is **IMPERATIVE** at this point that you select the correct firmware file for your DEQX model, as per Table 7 below:

*Table 7. Firmware upgrade file by DEQX model*

| DEQX Models | Firmware file name |
|---|---|
| PDC-2.6, PDC-2.6P, HDP-Express (Mk1), HDP-3 | eqf.pdc |
| DEQX Mate, PreMate, HDP-Express II, HDP-4 | eqf2.pdc |
| PreMate+, HDP-5 | eqf3.pdc |

To exit safe mode, turn the DEQX off using the rear panel switch, and then turn it on again (without pressing any front panel buttons).

## TO RESET THE EEPROM

In rare cases, it may be necessary to reset the EEPROM in order to restore normal function of the DEQX. The EEPROM is a non-volatile memory chip that stores the status of the DEQX (i.e. whether normal or in error), the master volume, parametric EQ settings, and other parameters accessible from the IO Manager.

To reset the EEPROM, turn the DEQX off using the power switch on the rear panel. Press and hold the P3 button on the front panel, then turn the DEQX back on while keeping the P3 button held. This will clear any error messages and set the status of the DEQX to normal. In addition, it will:

- Reset the volume to -120dB;
- Set the current profile to Profile 0;
- Set the analog input to Analog 1, the digital input to Digital 3, and the input selection to Auto;
- Remove all parametric EQ filters i.e. both room EQ and Preference EQ;
- Clear all IO Manager per-channel settings: channel gains, channel muting, soloing, delay and polarity.

Resetting the EEPROM won't remove the correction  filters from the DEQX. However, all room EQ has been cleared, so it is recommended that the configuration now be re-uploaded to the DEQX.

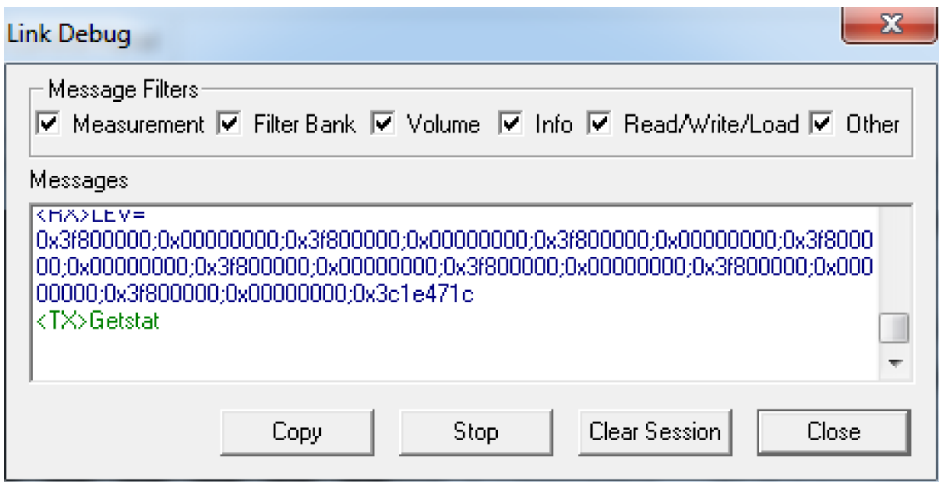
# F TROUBLESHOOTING

If you experience difficulties with your DEQX, consult the information below. If the problem persists, contact DEQX Support (see page 14), providing as much information as you can about the error and the results of following the steps given here.

### DEQX-CAL DOES NOT DETECT A CONNECTED DEQX UNIT

1. Check that the DEQX is not in standby mode.
2. Check that the USB cable is securely connected to the USB **Control** port of the DEQX. (DEQX-Cal cannot communicate with a DEQX that is connected via the USB Audio port. The PC **must** be connected via the USB **Control** port.)
3. Remove any USB hubs or extenders.
4. Connect the PC to the DEQX with the supplied USB cable.
5. Quit and restart DEQX-Cal.
6. Power cycle the DEQX (turn power off with the rear panel switch, wait a few seconds, then turn it on again).
7. Restart the Windows PC.

If none of the above yields a successful connection, you will need to contact DEQX Support. Before doing so, open the Link Debug dialog (shown below) by double-clicking on the link status icon at the bottom right of the DEQX-Cal window. Unplug the USB cable from the DEQX and then reconnect it. Click **Copy**, and paste the captured data into your support request (page 14).



### THERE IS NO SIGNAL ON THE INPUT LEVEL METER WHEN TAKING A MEASUREMENT


1. Check that the Microphone input is active in the DEQX-Cal IO Manager.


2. Check that the **Microphone Setup** area in the IO Manager shows that Phantom 48V power is turned on. (This applies to microphones supplied with the DEQX Standard Calibration Kit and the DEQX Reference Calibration Kit. If you are not using a DEQX Calibration Kit, double-check whether your microphone requires 48V phantom power. Note that use of microphones not supplied in a DEQX Calibration Kit is not supported by DEQX.)
3. Check that the microphone cable is plugged into the **Microphone** input on the DEQX rear panel. (Make sure that you have not inadvertently plugged the microphone into the **Dig 4** input or the left balanced analog input.)

### COMMUNICATION TO THE DEQX FAILS

1. Try the operation (e.g. "Save All to DEQX") again.
2. If it fails again, save the project and quit DEQX-Cal. Restart DEQX-Cal and retry the operation.
3. Proceed through the steps given on page 169 for "DEQX-Cal does not detect a connected DEQX unit." (Sometimes a marginal USB connection can appear to connect successfully, but fail on data-intensive operations.)
4. If the operation continues to fail, contact DEQX Support (page 14).

### THE PROJECT ICON IS GREYED OUT

The corresponding project file is read-only, preventing DEQX-Cal from updating it. This can happen if the project file is on a read-only medium such as a CD-ROM, or if it is set to read-only in the Windows file system.

1. Close the project in DEQX-Cal and copy the project file to a writable medium (such as a hard drive). Then open the new copy in DEQX-Cal.
2. If the file is already on a writable medium (such as a hard drive), check that the file has not been set to read-only in the Windows file system.

### THE DEQX ENTERS FAULT MODE

Fault mode is indicated by the front panel LEDs displaying a combination of red, blue and yellow. The DEQX will usually not respond to any user input when in fault mode.

1. Turn off all connected equipment and power cycle the DEQX.
2. If the DEQX does not reboot and operate normally, or if the error recurs, contact DEQX Support (page 14).

# G INDEX