

The logo for CONEQ, featuring the word in a stylized, white, sans-serif font. The 'O' and 'N' are connected, and the 'E' has a horizontal bar. The 'Q' has a small tail that curves back into the letter.

CONEQ

APEQ™ Acoustic Power Equalizer

USER'S GUIDE

(For models APEQ2P02, APEQ2P02DIO, APEQ8P03DIO)

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Part I

GENERAL INFORMATION

ABOUT THIS MANUAL

This manual describes three devices: APEQ-2pro (model APEQ2P02), APEQ-2pro DIO (model APEQ2P02DIO), and APEQ-8pro DIO (APEQ8P03DIO). The first two devices are similar and are described in section "APEQ-2pro, APEQ-2pro DIO" on page 11. The APEQ-8pro DIO is described in section "APEQ-8pro DIO" on page 22.

Described here is only the hardware-related information. The CONEQ™ measurement and filter synthesis is done using the CONEQ™ Workshop or CONEQ™ Starter applications. Most of the configuration of the APEQ™ devices must be done using the APEQ™ Communication Tool (C2) software. Please consult the documentation for these products for information on their usage.

IMPORTANT! Every effort was made to insure that the information contained in this manual is complete and accurate at the time of writing. However, due to ongoing technical improvements, modifications may have occurred that are not covered in this manual.

REVISION HISTORY

- v3.3, 2011.11.17, First release of combined manual for APEQ-2pro and APEQ-8pro devices.

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IMPORTANT SAFETY INFORMATION

IMPORTANT! Do not remove covers. No user serviceable parts inside, refer servicing to qualified service personnel.

IMPORTANT! To reduce the risk of fire or electric shock, do not expose this apparatus to rain or moisture.

IMPORTANT! Terminals marked with the “lightning bolt” are hazardous live; the external wiring connected to these terminals requires installation by an instructed person or the use of ready-made leads or cords.

IMPORTANT! This apparatus is a Class I construction and shall be connected to a mains socket outlet with a protective earthing connection.

Always follow these basic safety precautions when installing and using APEQ™ Acoustic Power Equalizers:

- Read these instructions;
- Keep these instructions;
- Heed all warnings;
- Follow all instructions;
- Do not use this apparatus near water;
- The apparatus shall not be exposed to dripping or splashing and no objects filled with liquids, such as vases, shall be placed on the apparatus;
- Clean only with a dry cloth;
- Do not block any of the ventilation openings. Install in accordance with the manufacturer’s instructions;
- The ventilation should not be impeded by covering the ventilation openings with items, such as newspapers, table-cloths, curtains, etc;
- Do not install near any heat sources such as radiators, heat registers, stoves, or other apparatus (including amplifiers) that produce heat;
- No naked flame source, such as lighted candles, should be placed on the apparatus;

- Do not defeat the safety purpose of the polarized or grounding-type plug. A polarized plug has two blades with one wider than the other. A grounding type plug has two blades and a third grounding prong. The wide blade or the third prong 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 plugs, convenience receptacles and the point where they exit from the apparatus;
- Only use attachments/accessories specified by the manufacturer;
- Unplug this apparatus during lightning storms or when unused for long periods of time;
- Refer all servicing to qualified personnel. Servicing is required when the apparatus has been damaged in any way, such as power supply cord or plug is damaged, liquid has been spilled or objects have fallen into the apparatus, the apparatus has been exposed to rain or moisture, does not operate normally, or has been dropped;
- Use the mains plug to disconnect the apparatus from the mains;
- The mains plug of the power supply cord shall remain readily operable.

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Author: Adam Dunkels

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Part II

USER'S GUIDE

APEQ-2pro, APEQ-2pro DIO

This section provides detailed reference information for the Real Sound Lab's 2-nd generation APEQ-2pro (APEQ2P02) and APEQ-2pro DIO (APEQ2P02DIO) 2-channel acoustic power equalizer hardware, firmware version 2.0.9917. Some pictures may be given for older firmware versions, if it's not important for device functionality description. See section "RS-232 System Output" on page 20 for description how to get device version information.

TECHNICAL SPECIFICATION

Table 1: Analogue Inputs / Outputs.

Channels	2
Conversion Sample Rate / Resolution	48 kHz / 24 bit
Nominal Input Level	+4 dBu
Nominal Output Level	+4 dBu
Maximum Input Level	+21.4 dBu
Maximum Output Level	+21.4 dBu into >500 Ohms load
Input Impedance	2 x 5 kOhm balanced, 5 kOhm unbalanced
Output Impedance	150 Ohm
Input / Output Connectors	XLR, TRS (balanced)
Dynamic Range	115 dBA
THD (at -0.3 dBFS)	<0.01%
Common-Mode Rejection	90 dB
Latency	1.6 ms

Table 2: Digital Inputs / Outputs (APEQ-2pro DIO).

Channels	2
Analogue / Digital Input Selection	Automatic; Digital input has higher priority
Input Sample Rates / Resolution	44.1 kHz, 48 kHz, 88.2 kHz, 96 kHz / 24 bit
Output Sample Rate / Resolution	48 kHz / 24 bit
Input / Output Connectors	XLR
Latency	2.4 ms typical (digital input to digital output, 48 kHz input sample rate)

Table 3: Mechanical / Power Requirements.

Connection Connectors	USB, RS-232
Power	85–265 V AC or 100–300 V DC; 15 VA
Dimensions	483x225x44 mm (19", 1U)
Weight	1.5 kg (3.3 lbs)

DEVICE HARDWARE

The APEQ-2pro two channel acoustic power equalizer is provided in standard 19" 1U rack-mount enclosure. It provides two user-accessible panels: the front panel interface (figure 1) and back panel interface (figure 2).

APEQ-2pro DIO device is equal to APEQ-2pro, only with AES/EBU XLR input and output connectors added (figures 3, 4).

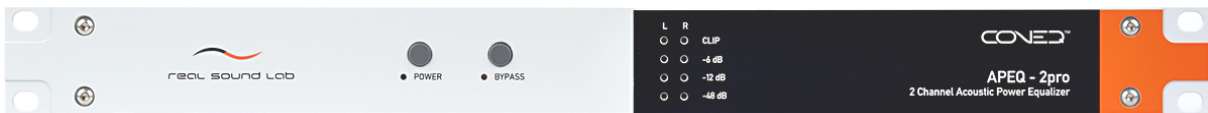


Figure 1: The front panel of APEQ-2pro.



Figure 2: The back panel of APEQ-2pro.

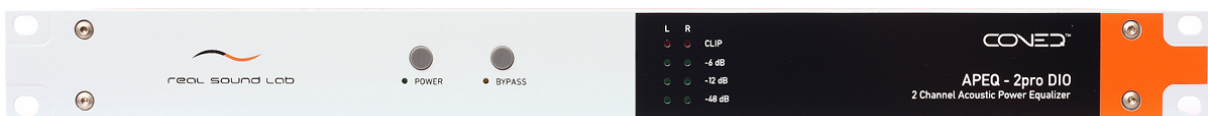


Figure 3: The front panel of APEQ-2pro DIO.



Figure 4: The back panel of APEQ-2pro DIO.

Front Panel Interface

The APEQ-2pro / APEQ-2pro DIO front panel interface (figures 1, 3) provides minimal required user control over the device. A host computer with appropriate software may be used for extended device control and information gathering.

Table 4: APEQ-2pro / APEQ-2pro DIO front panel buttons.

Power button	Switch the device power on/off.
Bypass button	Switch the Digital bypass mode on/off. Together with the Power button also used for some system operations.

Table 5: APEQ-2pro / APEQ-2pro DIO front panel indicators

Power indicator	Indicates that the device power is on.
Bypass indicator	Indicates that the Digital bypass mode is on. Used also to indicate errors (slow regular flashes) and “Device Busy” status (short series of fast flashes).
Sound level indicators	Device output signal level indication for each channel (-48 dB ... CLIP). Used also for system status indication in some service modes. At initialisation time all indicators are turned on for a short time for testing purposes.

Back Panel Interface

The APEQ-2pro / APEQ-2pro DIO back panel interface (figures 2, 4) provides connectors for audio inputs and outputs, as well as host computer interface connectors and mains power connector.

Mechanical Installation

If the unit is likely to undergo extreme vibration through extensive road trucking and touring, the unit must be supported at the rear and/or sides to lessen the stress on the front mounting flange. The necessary support can generally be bought ready-built as a rack tray.

To prevent cosmetic damage to the front panel finish, use protective plastic cups under the rack mounting bolts.

IMPORTANT! *Damage caused by insufficient support when mounted in the rack is not covered by the warranty.*

Table 6: APEQ-2pro / APEQ-2pro DIO back panel interface

Power inlet	Inlet of an auto-ranging power supply. Two fuses T 1.5A L, in a 5 × 20 mm package, are also included, along with the all-pole mains switch for the unit.
RS-232 connector	DB-9 female RS-232 connector. This interface provides service functions and isn't used for device configuration.
USB connector	USB B connector allows connection to a host computer and transferring CONEQ™ equalization filters from the computer to the device and back.
Analogue Input/Output connectors	Each input provides balanced analogue audio input connection using female XLR and 1/4" TRS connectors. Each output provides true-balanced analogue audio output connection using male XLR and 1/4" TRS connectors.
AES/EBU Input/Output connectors	The APEQ-2pro DIO provides 2 additional connectors (figure 4): AES/EBU input provides digital stereo audio input, using a female XLR connector. AES/EBU output provides digital stereo audio output, using a male XLR connector.

Connecting to Electrical Network

Connect mains connector (back panel, figure 2) to the AC/DC electrical network, using appropriate cable for your country standard.

Connecting a Host Computer

Reconfiguration of the APEQ-2pro device is implemented using host computer software, therefore, if device needs to be reconfigured, it must be connected to the host computer using the USB interface.

Connect the APEQ-2pro equalizer to a free USB port on the computer by a standard USB cable (a suitable 1.8 meter USB 2.0 cable is included with APEQ-2pro).

To read or log extended information from APEQ™ device, connect the RS-232 DB-9 connector on the device to a serial port on the computer, using RS-232 straight-thru cable (for example, Stonewall RS-232 Straight-thru DB9MF cable). If the computer doesn't have an RS-232 interface, use a USB-to-Serial adapter (for example, Belkin USB Serial Adapter).

Connecting Audio Inputs and Outputs

Connect the audio inputs and outputs using standard balanced Audio XLR or 1/4" TRS shielded cables.

Connecting AES/EBU Inputs and Outputs

Connect AES/EBU input and output using standard balanced XLR AES/EBU shielded cables.

Hardware Settings

APEQ-2pro / APEQ-2pro DIO devices have a few hardware settings. All of them can be set up using permanent controls placed inside the enclosure and serviced by authorized service engineers only.

DEVICE OPERATION

Switching the Device On

Switch on the mains switch on the device back panel (figure 2). Some device indicators might light up for a short time but turn off immediately after that. Now the device is in standby (energy-saving) mode. Press the **Power** button on the front panel (figure 1). The **Power indicator** will light up, indicating device is in power on mode. All device indicators are turned on for a few seconds. If not, ask your representative or contact Real Sound Lab for device repair or replacement.

In a few seconds, after the device initialization completes, the indicators are switched off. If the device was previously properly configured, the **Bypass indicator** will flash fast for a few seconds, indicating CONEQ™ configuration process. After process completion, all indicators (excluding the **Power** indicator) are off.

Now the APEQ-2pro / APEQ-2pro DIO device is ready for operation.

In case of CONEQ™ configuration error, the **Bypass indicator** will slowly flash. See section "TROUBLESHOOTING" on page 20 for possible solutions.

IMPORTANT! In case of mains power loss while the APEQ-2pro device is operational, the device will automatically switch to standby mode, thus effectively bypassing CONEQ™ filter, and will not return to the normal operating mode until the **Power** button is pressed. To prevent such condition, every APEQ-2pro device is equipped with the **Permanent power on jumper**. If this jumper is installed, the **Power** button is disabled, and device goes on automatically at mains voltage re-appearance. The **Permanent power on jumper** is located inside the device enclosure, and must be accessed by trained service personnel only. To install this jumper, please contact your representative or Real Sound Lab directly for details.

Physical Bypass Relay

The APEQ-2pro device is equipped with **Physical bypass** relay. When the APEQ-2pro device power supply is disconnected or switched off, or if the device firmware detects unrecoverable error situation, the **Physical bypass** relay will be switched on and analogue sound signal will effectively bypass the device, going directly from inputs to outputs.

IMPORTANT! APEQ-2pro DIO AES/EBU inputs and outputs are not equipped with such a circuit, thus in case of power loss, the digital output signal will be lost.

Device Access from a Computer

The APEQ™ device must be connected to computer using appropriate cables (see section "Connecting a Host Computer" on page 14). When the device is connected to the computer using a USB cable, it will be detected by the computer as a USB Mass Storage Device (like commonly used USB flash drives). If you plan to read or log device service information using device RS-232 port, start terminal software (for example, Windows HyperTerminal) and set it up for speed of 115200 baud, 8 bits, 1 stop bit.

Device Identification

The APEQ™ device may be identified in a few ways. Each APEQ™ has unique serial number. This number is displayed on the product label, which may be found on the device back panel or on one of the covers, as well as stored in the internal memory at time of manufacturing. The product label also contains information about device type (APEQ2P02 or APEQ2P02DIO for the 2-nd product generation described in this section) and device manufacturing date. Device serial number is also shown in the RS-232 terminal output (see figure 8). One more way to check device serial number is to read device identification file on the device USB mass storage drive – file !apeq_id.txt (see figure 5).

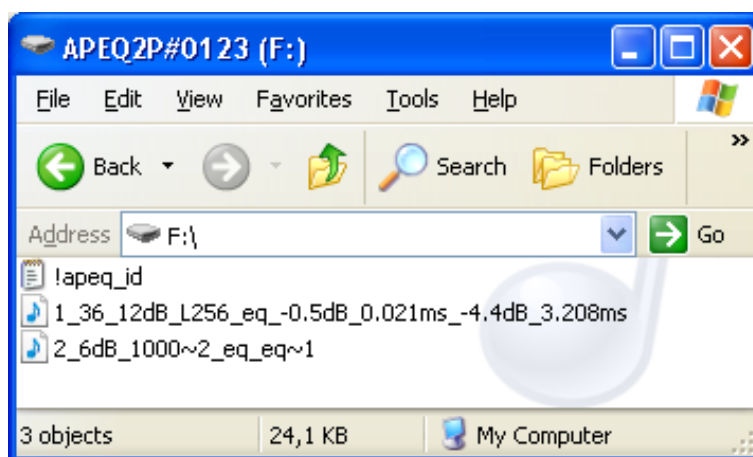


Figure 5: Windows Explorer view of the APEQ-2pro device's USB mass storage device disk drive. Filter file names are given as an example and may be different.

The identification file contains also other information about the APEQ™ device – product type and firmware version. By default, the APEQ™ device drive has a volume label, constructed from shortening of device type (APEQ2P for APEQ-2PRO) and last 4 digits of device serial number. See figure 5 for an example of volume label of device with serial number 0123. You may change the device volume label using standard operating system tools (see figure 6). This name will be stored by the APEQ™ device and may be used later for device identification.

The device serial number is also displayed in APEQ™ Communication Tool (C2) and may be used to choose the device, if multiple APEQ™ devices are connected to the computer (see figure 7).

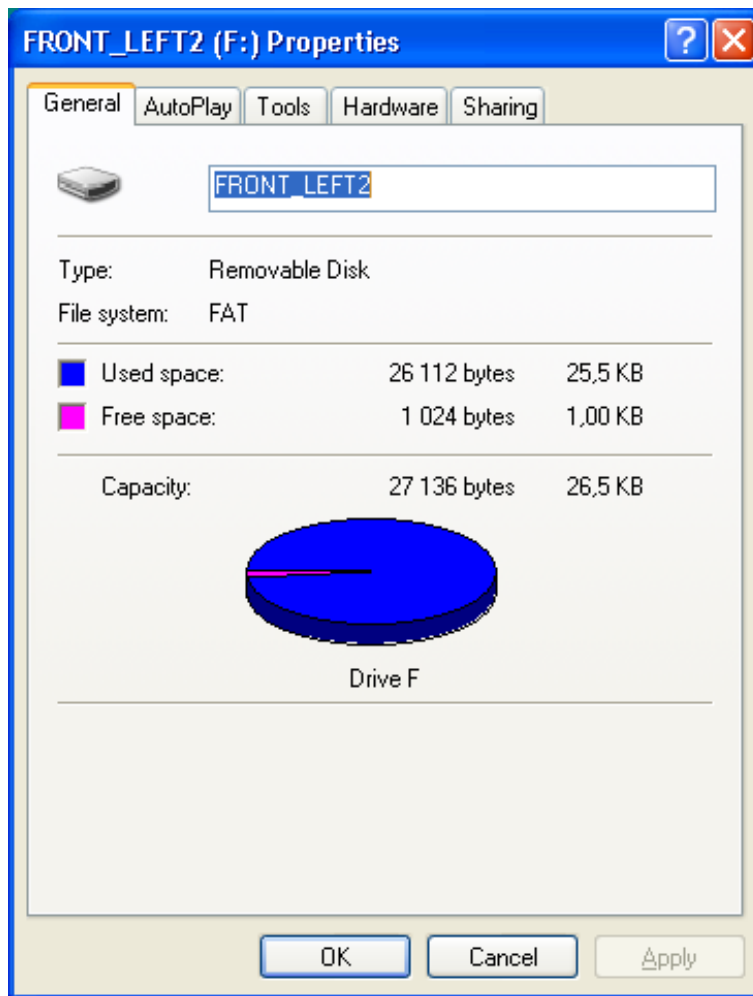


Figure 6: Changing the volume label of the APEQ-2pro device.

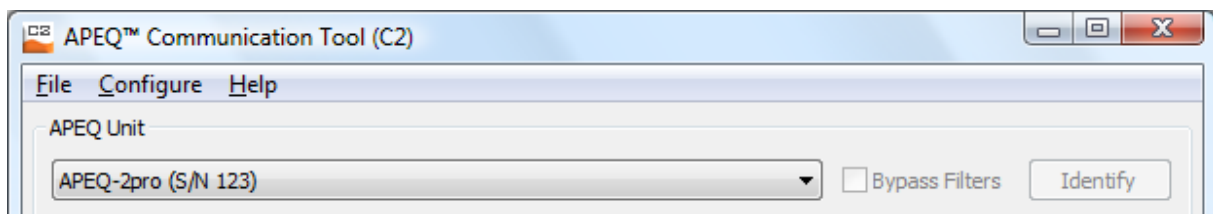


Figure 7: The drop-down list with APEQ™ devices in APEQ™ Communication Tool (C2).

CONEQ™ Equalization Filter Configuration

The primary function of the APEQ™ device is CONEQ™ acoustic power frequency response equalization. To implement this function, the device must be properly configured using correct CONEQ™ equalization filters, generated by the CONEQ™ Workshop software.

When the device is not configured, it transfers sound unaltered directly from inputs to outputs. In this case the **Bypass indicator** on the device front panel flashes slowly, indicating that the CONEQ™ filters are not configured.

After device is manufactured, the default filters `6db_1000.wav` are used for both channels. These filters provide +6 dB sound amplification with no equalization. Two equalization filter files, one for each channel, must be written to the APEQ™ USB mass storage device. Standard operating system tools such as the Microsoft Windows Explorer or the APEQ™ Communication Tool (C2) may be used for this purpose.

IMPORTANT! *The recommended way to configure APEQ™ devices is to use the APEQ™ Communication Tool (C2). Please refer to it's User's Guide for information on how to use it.*

To configure the device using standard operating system tools (Windows Explorer in this example), follow these steps:

- Open the device disk using Windows Explorer. Disk may be easily found by device volume label, which, by default, contains part of the device serial number (if not changed by the user – see section "Device Identification"). See figure 5 for an example of the APEQ™ disk opened in the Windows Explorer application;
- Backup (copy) both channel files (`.FIR` or `.WAV` files) to the computer, if needed;
- Delete channel files from the APEQ™ disk;
- Copy the new files for each channel from the computer. File for a channel must have the first letter equal to the channel number (e.g. 1 for channel 1, 2 for channel 2);
- After both files are copied, the APEQ™ device will automatically reconfigure the CONEQ™ filters (the **Bypass indicator** on the front panel flashes, indicating configuration process).

In case of any CONEQ™ configuration error, device switches on the **Physical bypass** relay and indicates the error by slowly flashing the **Bypass indicator**. Use the RS-232 system interface to check the error details. See the TROUBLESHOOTING section for troubleshooting errors.

Digital Bypass

The **Bypass** button on the front panel (figure 1) controls the **Digital bypass** mode. After pressing the **Bypass** button, the **Bypass indicator** will turn on, indicating that sound path is changed to bypass the CONEQ™ filters. Press the **Bypass** button again to switch the **Digital bypass** mode off.

The **Bypass indicator** is used also to indicate device activity or error state. See other sections of this manual for details.

IMPORTANT! *There is a built-in intentional delay of about 0.5 seconds in the APEQ™ units to prevent accidental switching the **Digital bypass** on or off. Therefore, when pressing the **Bypass** button, hold it pressed for at least half a second to actually trigger the change of the device state.*

Mains Voltage Loss Detector

The APEQ-2pro device is equipped with a mains voltage loss detector. If the mains voltage drops below minimal allowed level for a short time (0.5 sec), device automatically switches on the **Physical bypass** relay (see section "Physical Bypass Relay"), thus preventing sound corruption, and returns back to normal operation mode when mains voltage level is normalized.

The APEQ-2pro device is equipped with a mains voltage loss detector. If the mains voltage drops below the minimal allowed level for more than 0.5 seconds, the device switches on the **Physical bypass** relay, thus, preventing undefined sound corruption. The device returns back to normal operation mode when mains voltage level normalizes.

In case of prolonged mains voltage loss, device switches off permanently. Now the device must be switched on using the **Power** button. If the **Permanent power on** jumper is installed, the device returns to normal operation when the mains voltage normalizes (see page 15).

Sound Level Indication

APEQ-2pro is equipped with two channel sound output level indicator arranged on the device front panel (see figure 1). This indicator has 4 levels of indication: -48 dB; -12 dB; -6 dB and **CLIP** (signal saturation). The indicator shows current output sound level both in the CONEQ™ equalization and **Digital bypass** modes. The output level is indicated in dBFS (dB digital full scale). The table 7 shows the corresponding analogue signal levels in dBu.

Table 7: Relationship between the front panel indicator labels in dBFS and analogue signal level in dBu of APEQ-2pro.

CLIP (0 dBFS)	+21.4 dBu
-6 dBFS	+15.4 dBu
-12 dBFS	+9.4 dBu
-48 dBFS	-26.6 dBu

Device Shutdown

To switch the device to standby mode, press the **Power** button and hold it for at least 0.5 seconds. To completely switch the device off, switch the mains switch on the back panel off (see figure 2).

In either the standby or off modes the device will automatically switch on the **Physical bypass** relay (see section "Physical Bypass Relay"), thus, ensuring unaltered analogue sound path through the device. Note that the digital inputs and outputs on the APEQ-2pro DIO device do not have the **Physical bypass** relay, thus, the digital signal will be interrupted when the device is not fully on.

IMPORTANT! *If the Permanent power on jumper is installed, the device can be switched on/off only by using the mains switch on the back panel. There is no standby mode and the Power button on the front panel is ignored.*

TROUBLESHOOTING

The APEQ-2pro device has a sophisticated internal self-diagnostic system. Device stops initialization and indicates error code only in case of a fatal error, preventing the system from performing the main function – CONEQ™ equalization. In all other error cases, error is indicated on the terminal output but the CONEQ™ filtering is performed.

Error Indication

Errors are indicated in two ways – using the APEQ-2pro front panel indicators, and by RS-232 terminal output. If a fatal error occurs at initialization time, yellow **Bypass indicator** on the front panel will flash approximately once per second.

RS-232 System Output

APEQ-2pro constantly outputs system information, which may be read or logged to file using a computer with the terminal software installed, connected using APEQ-2pro RS-232 interface. See the section "Connecting a Host Computer" on page 14 for information on the connection and terminal software configuration.

At the APEQ-2pro start-up it displays the system type, version, and hardware configuration information (for an example, see the figure 8).

In case of an error the Terminal software will show detailed error information. This information should be analysed by qualified service personnel.

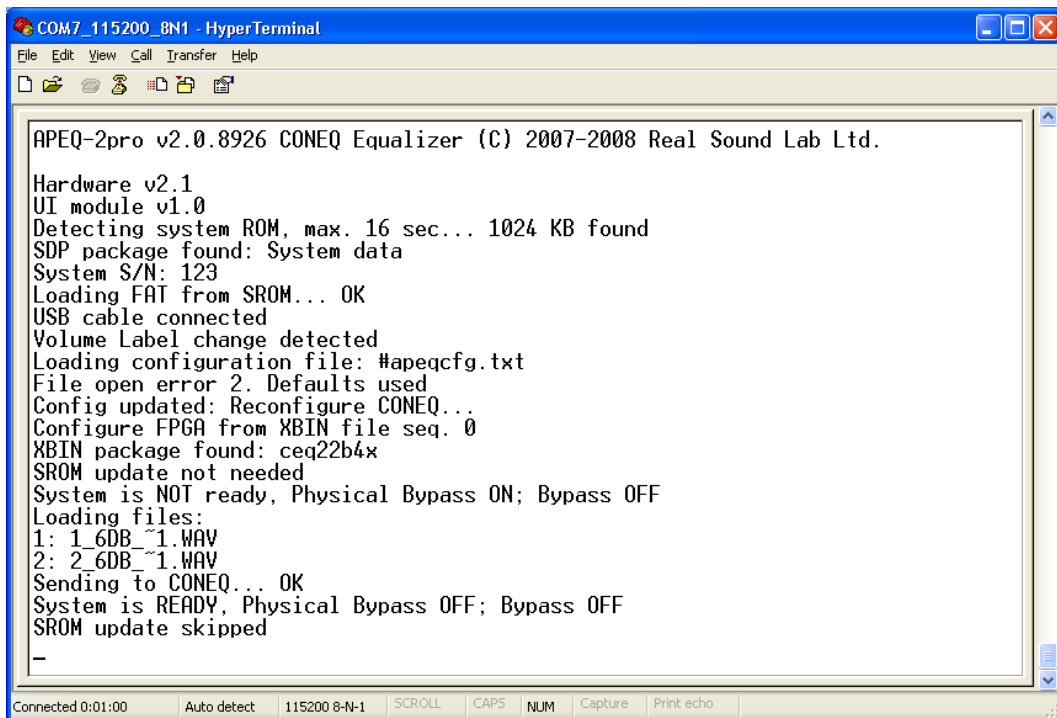
The **Capture** option of the terminal software may be used to log the APEQ™ device's operation history to a file. For example, Windows HyperTerminal has **Transfer⇒Capture Text** menu for this purpose.

Restoring Factory Settings

Starting from firmware version 2.0.9917, the APEQ-2pro device may be reset to the manufacturing state. This operation may be helpful in case of USB mass storage disk corruption or for resetting the device configuration to its initial state.

To start the factory settings reset operation, do the following steps:

- Press and keep the **Bypass** button;
- Cycle the device power using the mains switch on back panel. Device should be in standby mode now;
- Keep the **Bypass** button pressed and press the **Power** button. This starts the device initialization process;



```

COM7_115200_BN1 - HyperTerminal
File Edit View Call Transfer Help
APEQ-2pro v2.0.8926 CONEQ Equalizer (C) 2007-2008 Real Sound Lab Ltd.
Hardware v2.1
UI module v1.0
Detecting system ROM, max. 16 sec... 1024 KB found
SDP package found: System data
System S/N: 123
Loading FAT from SROM... OK
USB cable connected
Volume Label change detected
Loading configuration file: #apeqcfg.txt
File open error 2. Defaults used
Config updated: Reconfigure CONEQ...
Configure FPGA from XBIN file seq. 0
XBIN package found: ceq22b4x
SROM update not needed
System is NOT ready, Physical Bypass ON; Bypass OFF
Loading files:
1: 1_6DB_~1.WAV
2: 2_6DB_~1.WAV
Sending to CONEQ... OK
System is READY, Physical Bypass OFF; Bypass OFF
SROM update skipped
-
Connected 0:01:00 Auto detect 115200 8-N-1 SCROLL CAPS NUM Capture Print echo

```

Figure 8: APEQ-2pro terminal output.

- Wait until the initialization process completes, which is indicated by the device switching off or slow flashes of the **Bypass indicator**;
- Now release the **Bypass** button. Device is now in the service mode, which is indicated by slowly flashing -48 dB level indicator of the channel 1;
- Press and keep for 3 seconds the **Bypass** button. This will activate the factory setting reset procedure (see figure 9). If the **Bypass** button is not pressed for 8 seconds, the device will return to the normal mode.

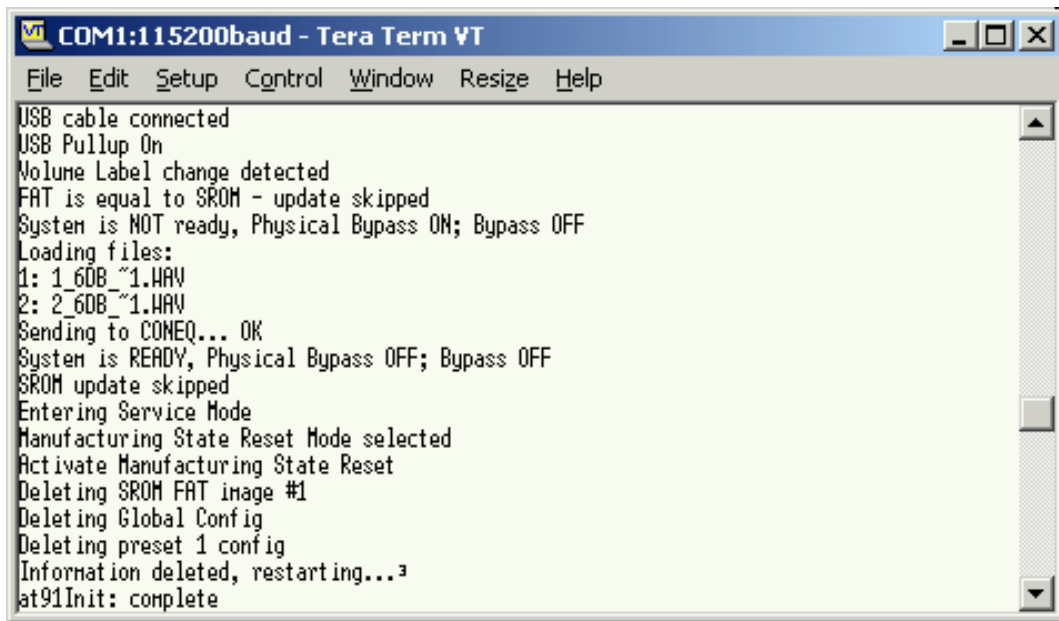


Figure 9: The terminal output while resetting the APEQ-2pro device to the factory settings.

APEQ-8pro DIO



Figure 10: APEQ-8pro DIO hardware equalizer

This section of the manual provides detailed reference information for the Real Sound Lab 3rd generation APEQ-8pro DIO 8 channel acoustic power equalizer hardware. Manual is written for APEQ-8pro DIO v3.0. Some pictures may be given for older device versions, if it is not important for device functionality description.

Please use the APEQ™ Communication Tool (C2) to check the device firmware version.

If your device has an older firmware version than one described in this manual, some features may be missing or be different. Please contact your representative or Real Sound Lab directly for directions how to update the device firmware.

The manual is organized as follows:

- Section "TECHNICAL SPECIFICATION" (page 23): data on technical aspects of the APEQ-8pro DIO hardware;
- Section "DEVICE HARDWARE" (page 23): describes device hardware in detail, including descriptions of front and back panel and hardware installation procedure;
- Section "DEVICE OPERATION" (page 28): describes device hardware settings and every function;

- Section "TROUBLESHOOTING" (page 32): resolving error situations.

The APEQ™ equalizer is complemented with the CONEQ™ Workshop measurement software and APEQ™ Communication Tool (C2) software. For more information on the CONEQ™ Workshop measurement software, please refer to the CONEQ™ Workshop Quickstart Guide and Reference Manual. For more information on the APEQ™ Communication Tool (C2) application, please refer to the APEQ™ Communication Tool (C2) User's Guide.

TECHNICAL SPECIFICATION

The tables 8, 9, 10, 11, and 12 specify various aspects of the APEQ-8pro DIO hardware device.

Table 8: APEQ-8pro DIO analogue inputs / outputs.

Channels	8
Conversion sample rate / resolution	44.1, 48, 88.2, 96 kHz / 24 bit
Nominal input / output level	+4 dBu
Maximum input level	+24 dBu
Maximum output level	+24 dBu into >500 Ohms load
Input impedance	2 x 5 kOhm balanced, 5 kOhm unbalanced
Output impedance	150 Ohm
Dynamic range	115 dBA
THD (at -0.3 dBFS)	<0.01%
Common-mode rejection	90 dB
Latency	1.6 ms typical (Analogue input / output, 48 kHz)
Input & output connectors	DB-25 female, TASCAM pin-out

Table 9: APEQ-8pro DIO digital inputs / outputs.

I/O Standard	AES/EBU
Channels	8
Input sample rates / resolution	44.1 – 192 kHz / 24 bit
Output sample rates / resolution	44,1, 48, 88.2, 96 kHz / 24 bit
Sample rate conversion	Always enabled
Analogue / digital input selection	Automatic; digital input has higher priority
Latency	2.4 ms typical (digital input / output, 48 kHz)
Input & output connectors	XLR

Table 10: APEQ-8pro DIO dedicated CONEQ™ measurement input.

Input Connector	XLR balanced
Maximum Input Level	+0 dBu ... -42 dBu (software gain control)
Phantom power	+48 V, 100 mA

Table 11: APEQ-8pro DIO clock generator and Word Clock input.

Internally generated sample rates	48, 96 kHz
Word Clock Input supported sample rates	44.1, 48, 88.2, 96 kHz
Internal / Word Clock selection	Automatic; Word Clock has priority
Input Connector	BNC 75 Ω, external termination required

Table 12: APEQ-8pro DIO mechanical / power requirements.

Control Interface Connectors	USB, Ethernet 10/100 Mbit RJ45
Power	85–265 V AC or 100–300 V DC; 50/60 Hz; 50 VA
Dimensions	483 x 338 x 44 mm (19x13.3", 1U)
Weight	2.7 kg (6 lbs)

DEVICE HARDWARE

APEQ-8pro DIO 8 channel acoustic power equalizer is provided in standard 19" 1U rack-mount enclosure. It provides two user-accessible panels: the front panel interface (see figure 11) and back panel interface (see figure 12).

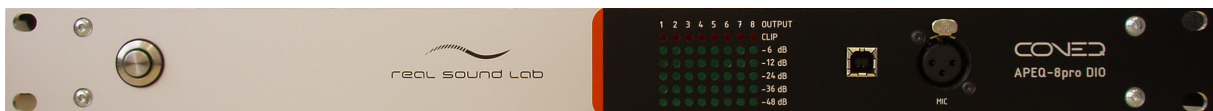


Figure 11: APEQ-8pro DIO front panel.



Figure 12: APEQ-8pro DIO back panel.

Front Panel Interface

The APEQ-8pro DIO front panel interface (figure 11) provides minimal user control over the device.

The only button on the front panel is the **Power** button which is used to switch the device power on/off. The **Power** button incorporates a **Power indicator** – a ring around the button – which indicates that the device power is on.

The **Sound level indicators** on the front panel show the output signal level for all 8 channels (–48 dB ... **CLIP**). The **CLIP** indicators are used also for system status indication in some special cases. During initialization time some or all indicators are lit for a short time for testing purposes.

The **USB connector** is used to connect the device to the host computer. A host computer (Windows or Mac) with appropriate software, connected to the device can be used for full device control, reading the status information, performing CONEQ™ measurements, uploading and downloading of CONEQ™ equalization filters, and updating the device firmware.

The **Microphone input** XLR connector (labeled as **MIC**) is dedicated for connecting a measurement microphone during CONEQ™ measurements. This input can provide standard +48V phantom power supply for condenser measurement microphones.

Back Panel Interface

The APEQ–8pro DIO back panel interface (figure 12) provides connectors for analogue and digital audio inputs and outputs, Word Clock and Ethernet connectors, and a mains power connector.

Analogue inputs / outputs The APEQ–8pro DIO device has two DB–25 connectors with TASCAM standard pin–out (see figure 13). Each connector provides 8 channels of balanced analogue audio signal. There is one connector for the inputs and one for the outputs.

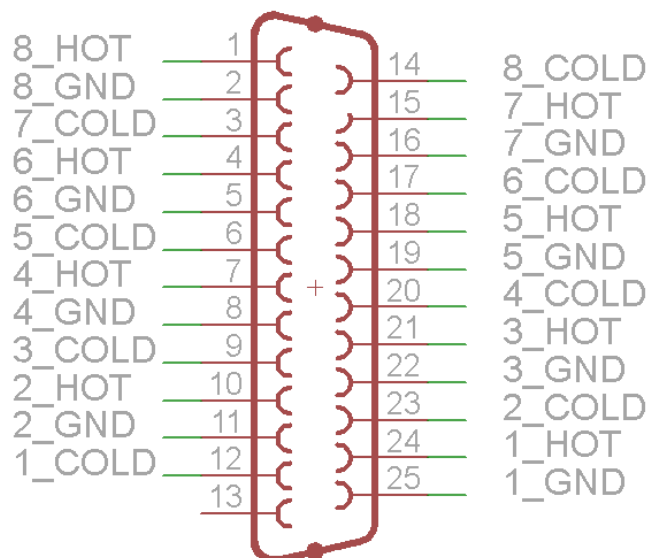


Figure 13: TASCAM analogue input / output connector pin–out

Analogue outputs ground (“common”) signal is connected to the device common ground. Analogue inputs ground signal is connected to the device common ground through a 50 Ohm resistor.

Digital inputs / outputs The APEQ-8pro DIO provides 8 XLR connectors for AES/EBU input / output, each connector providing 2 channels of transformer isolated digital audio input or output.

AES/EBU output “common” signal (XLR connector pin 1) is permanently connected to the device common ground.

AES/EBU input XLR connector “common” signal may be either connected to the ground, connected to the ground through a 50 Ohm resistor, or kept floating (selected by jumper inside of the device enclosure). The floating state is selected by default at device manufacturing, preventing ground loops.

Word Clock input connector The APEQ-8pro DIO is equipped with a 75 Ohm BNC Word Clock input connector. Standard Word Clock signal source may be connected to this input. Word Clock input is not internally terminated, therefore external 75 Ohm termination must be provided. See section “Audio Signal and CONEQ™ Processing Sample Rates” on page 31 for Word Clock input operation details.

Ethernet connector An Ethernet 10/100 Mbit (100Base-T) RJ45 connector allows connecting to host computer using the Ethernet network. A host computer (Windows or Mac) with appropriate software, connected to the device over Ethernet can be used for full device control, reading the status information, and uploading and downloading of CONEQ™ equalization filters.

Two LED indicators are provided on this connector:

- A green LED lights on when a valid link is detected and blinks when network activity is detected.
- A yellow LED lights up when the operating speed is 100Mbps. It is inactive when the operating speed is 10Mbps.

Power inlet The APEQ-8pro DIO equalizer has an auto-ranging power supply, operating from 100–240 VAC, 50–60 Hz.

HARDWARE INSTALLATION

Mechanical Installation

If the unit is likely to undergo extreme vibration through extensive road trucking and touring, the unit must be supported at the rear and / or sides to lessen the stress on the front mounting flange. The necessary support can generally be bought ready-built as a rack tray.

Damage caused by insufficient support is not covered by the warranty. To prevent cosmetic damage to the front panel finish, use protective plastic cups under the rack mounting bolts.

In some operational modes (e.g. all channels active at 96 kHz sample rate) the device may generate considerable amount of heat. In hot environment, or if heat generating devices, such as power amplifiers, are installed nearby, the device may overheat. To prevent device from overheating, have some open space between the APEQ-8pro DIO device and other devices. Most important is open space above and alongside the APEQ-8pro DIO device, where ventilation holes are located.

Connecting to Electrical Network

Connect the mains connector on the back panel to the AC/DC electrical network, using appropriate cable for your country. Make sure that the device is suitable to the voltage and type of current by checking the table 12.

Connecting Analogue Audio Inputs and Outputs

Connect the analogue audio inputs and outputs using a standard balanced TASCAM DB-25 shielded audio cables. Standard TASCAM DB-25 / XLR or TASCAM DB-25 / TRS adapters may be used to connect the APEQ-8pro DIO device and equipment with the corresponding type of analogue audio input / output connectors.

Connecting AES/EBU Inputs and Outputs

Connect the AES/EBU inputs and outputs using a standard balanced XLR AES/EBU shielded cables.

Connecting Word Clock Source

Connect the Word Clock input connector to the Word Clock master, using a 75 Ohm coaxial cable with BNC connectors. The APEQ-8pro DIO Word Clock input must be terminated externally.

Connecting Measurement Microphone

Connect a measurement microphone to the **MIC** XLR connector on the front panel, using standard balanced shielded microphone cable. Please check the CONEQ™ Workshop software manual for measurement microphone types, which could be used with the APEQ-8pro DIO device.

Connecting a Host Computer

Configuration of the APEQ-8pro DIO device is performed using software on a host computer. When the device needs to be reconfigured, it must be connected to the host computer using either the USB or Ethernet interface.

Connecting a computer to the APEQ™ device using the USB interface does not require any setup and more convenient for short-time device connection when the computer is in close proximity to the APEQ™ device.

The Ethernet interface is more convenient for fixed installation, where the existing Ethernet network may be used to connect APEQ™ devices and computers.

Connecting a host computer using USB If the APEQ™ device must be controlled from the host computer using USB interface, connect the device to any computer by a standard USB cable (USB A Male to USB B Male).

Connecting a host computer using Ethernet If the APEQ™ device must be controlled from the host computer on an Ethernet network, connect the device to an Ethernet hub or switch on that network using a standard straight or cross-over Category 5 or 6 network cable.

The APEQ-8pro DIO Ethernet interface has automatic polarity detection and correction feature, thus allowing use of any type of connecting cable without device reconfiguration.

Hardware Settings

The APEQ-8pro DIO device has a few hardware settings. All of them can be configured using permanent controls, placed inside the enclosure, and serviced by authorized service engineers only.

DEVICE OPERATION

Switching the Device On

Press the **Power** button on the front panel (figure 11). The **Power indicator** (a ring around the **Power** button) will light up, indicating that the device is on.

All level indicators will light up for a few seconds and then start to flash, indicating device initialization process.

In a few seconds, after device initialization completes, all level indicators switch off. If device was previously properly configured, the **Power indicator** will flash fast for a few seconds, indicating CONEQ™ configuration process. After the process completes, the **Power indicator** will stop flashing and stay on.

Physical bypass relay switch click will be heard, indicating that the **Physical bypass** is off (see section "Physical Bypass" on page 28 for details).

Now the APEQ-8pro DIO device is ready for operation.

In case of device initialization or CONEQ™ configuration error, the **Power indicator** will flash slowly. See section "TROUBLESHOOTING" on page 32 for possible solutions.

IMPORTANT! *In case of power loss and reappearance, the device will return to the same state as before the power loss.*

Physical Bypass

The APEQ-8pro DIO device is equipped with a **Physical bypass** relay. The **Physical bypass** relay will be switched on when the device power supply is disconnected, the device is switched off, or if the device firmware detects an unrecoverable error situation. Both analogue and AES/EBU digital audio signals will effectively bypass the device, going directly from inputs to outputs.

IMPORTANT! *Physical bypass is an abnormal operation mode. If Physical bypass is on, the harmonic distortion of the analogue outputs may be increased.*

Device Control

APEQ-8pro DIO may be controlled using a host computer using USB or Ethernet communication interfaces. Please check section "HARDWARE INSTALLATION" on page 26 for information on cable connection.

If APEQ-8pro connected to host computer using USB cable, it will be detected by the computer as "APEQ-8pro" device after the initialization completes. The APEQ-8pro DIO USB driver and the APEQ™ Communication Tool (C2) software must be installed on the host computer to access the device. The USB driver package is included with the APEQ™ Communication Tool (C2) installation package. Consult the **APEQ™ Communication Tool (C2) User's Guide** for driver installation details. If the driver is properly installed, The C2 tool will detect a connected APEQ-8pro DIO device automatically.

If an Ethernet connection is used, the APEQ-8pro DIO device may require additional configuration using the USB interface. Consult the **APEQ™ Communication Tool (C2) User's Guide** for configuration details.

Device Identification

APEQ-8pro DIO device may be identified in a few ways.

Each APEQ-8pro DIO device has a unique serial number. This number is displayed on the product label, which may be found on the device back panel or on the top or bottom covers. This number is also stored in internal memory at the time of manufacturing. The product label may also contain information about the device manufacturing date and some additional information.

Information about the device – serial number, firmware version and other information – can also be displayed using the APEQ™ Communication Tool (C2), and may be used for device identification in case multiple APEQ™ devices are connected to a single computer.

Device may also be identified using the **Identify** button from the APEQ™ Communication Tool (C2). Using this button will cause all level indicators to light up for a short period of time. Please consult the **APEQ™ Communication Tool (C2) User's Guide** for details.

Uploading CONEQ™ Equalization Filters

The primary function of the APEQ-8pro DIO device is the application of CONEQ™ equalization filters. To do this, the device must be properly configured using CONEQ™ equalization filter files. The filter files are created by the CONEQ™ Workshop software.

The filter files may be uploaded to the device either using the APEQ™ Communication Tool (C2) or the CONEQ™ Workshop application directly.

IMPORTANT! *The sample rate of the used filter files must match the sample rate of the CONEQ™ processing engine of the APEQ™ device. If the sample rates do not match for some channel, the output of this channel will be muted and this will be indicated by a flashing CLIP indicator of the corresponding channel.*

When a device is not configured properly, it enters **Physical bypass** mode, and transfers the input signal unaltered from inputs to outputs. In this mode the **Power indicator** on the front panel slowly flashes, indicating the error.

At device manufacturing, default equalization filter files are used for all channels. These filter files provide +6 dB amplification with no equalization at 48 kHz sample rate.

Digital Bypass

Device may be switched to **Digital bypass** mode using the APEQ™ Communication Tool (C2) or CONEQ™ Workshop application. In this mode the CONEQ™ filters for all channels are bypassed and device transfers Audio signal from inputs to outputs unaltered.

When the **Digital bypass** is switched on, this status is displayed by flashing **CLIP** indicators on all channels.

Right after the device is powered on, the **Digital bypass** is always off.

IMPORTANT! *To switch the Digital bypass off without the use of host computer, cycle the device power: switch the device power off and then back on using the Power button.*

IMPORTANT! *If a host computer is not available to switch the Digital bypass on, but there is a need to hear the unequalized sound, then switch the APEQ™ device off to enable Physical bypass. Switch the device on and wait for initialization to complete to return to normal operation mode.*

Mains Voltage Loss Detector

The APEQ-8pro DIO device is equipped with a mains voltage loss detector. If the mains voltage drops below the minimal allowed level for more than 0.5 seconds, the device switches on the **Physical bypass** relay, thus, preventing undefined sound corruption. The device returns back to normal operation mode when mains voltage level normalizes.

In case the mains voltage stays below normal level for a longer time, the device switches off permanently. The device returns to normal operation after the voltage level normalizes.

Sound Level Indication

The APEQ-8pro DIO device is equipped with an eight channel output sound level indicator, arranged on the device front panel (see figure 11).

This indicator has 6 levels of indication: -48 dB; -36 dB; -24 dB; -12 dB; -6 dB and **CLIP** (saturation). If sound output level reaches **CLIP** level (red colour indicators), sound distortion may be introduced.

The indicator level labels are in dBFS (dB Full Scale). For digital I/O the indicated values match the signal level. For analogue I/O, 0 dBFS (**CLIP**) is equal to +24 dBu. The table 13 may be used to convert the level indicator dBFS values to analogue dBu level values.

Table 13: Relationship between the front panel indicator labels in dBFS and analogue signal level in dBu.

CLIP (0 dBFS)	+24 dBu
-6 dBFS	+18 dBu
-12 dBFS	+12 dBu
-24 dBFS	0 dBu
-36 dBFS	-12 dBu
-48 dBFS	-24 dBu

The indicator shows the current sound output level for each channel in normal operation, **Digital bypass**, and measurement modes.

The **CLIP** indicator is used to indicate special states in some modes.

Switching Between Analogue and Digital Audio Inputs

Analogue or digital input for each channel pair (1-2, 3-4, 5-6, 7-8) is selected automatically. If AES/EBU input signal is detected, the corresponding channel pair switches to digital input. Once AES/EBU synchronization is lost, channel pair switches back to analogue input.

Both analogue and digital outputs are always active. For each channel, analogue and digital outputs may be used simultaneously.

Audio Signal and CONEQ™ Processing Sample Rates

The APEQ-8pro DIO AES/EBU digital inputs support any sample rate from 44.1 to 192 kHz. Digital input signal is always automatically converted into the internal CONEQ™ processing sample rate using a sample rate converter.

The analogue input signal is sampled at the CONEQ™ processing sample rate.

The digital output signal always has the same sample rate as the CONEQ™ processing sample rate.

The CONEQ™ processing unit supports four sample rate frequencies: 44.1, 48, 88.2 and 96 kHz. It may be clocked either from internal source or from a Word Clock input. The internal clock source provides two sample rate frequencies - 48 and 96 kHz - which can be selected using APEQ™ Communication Tool (C2). The Word Clock input supports four

sample rates – 44.1, 48, 88.2 and 96 kHz. The Word Clock input has priority over internal clock source. If a Word Clock signal of supported frequency is detected, then the CONEQ™ processing unit will switch to that sample rate. If the Word Clock synchronization is lost, the APEQ™ device will switch back to the internal clock source.

IMPORTANT! Currently, the analogue I/O is not supported for CONEQ™ processing sample rates other than 48 kHz. If the CONEQ™ processing sample rate is other than 48 kHz, then analogue inputs and outputs will be muted.

Output Latency

For various combinations of digital and analogue inputs and outputs, the signal latencies are different. Please check the table 14 for details.

Table 14: Audio signal latency.

Input	Output	Latency, for CONEQ™ sample rate			
		44.1 kHz	48 kHz	88.2 kHz	96 kHz
Analogue	Analogue	–	1.6 ms	–	–
Analogue	Digital	–	3.2 ms	–	–
Digital	Analogue	–	0.8 ms	–	–
Digital	Digital	2.6 ms	2.4 ms	1.3 ms	1.2 ms

CONEQ™ Measurement Microphone Connection

The APEQ–8pro DIO device is equipped with a dedicated measurement microphone input for doing CONEQ™ measurements. The microphone input connector is located on the device front panel and marked **MIC** (see figure 11).

The CONEQ™ Workshop measurement software (starting from version 3.1.0) may be used to make CONEQ™ measurements using the APEQ–8pro DIO device. Please refer to the CONEQ™ Workshop Reference Manual for more information on how to use the microphone input on APEQ–8pro DIO.

TROUBLESHOOTING

The APEQ–8pro DIO device has sophisticated internal self–diagnostic system. Device stops initialization and indicates error code only in case when a fatal error prevents the system from executing its main function – CONEQ™ equalization. In all other error cases, error may be indicated and logged, but does not stop the CONEQ™ filtering.

Error Indication

If a fatal error occurs during initialization, the green **Power indicator** will blink with frequency approximately 1 time per second. Please check section "Common Errors and How to Fix Them" on page 33 for possible causes and solutions.

Restoring Factory Settings

The factory settings of APEQ-8pro DIO may be restored using its USB interface and specially provided service software. Please contact your representative or Real Sound Lab directly for details.

Firmware Update

The firmware of the APEQ-8pro DIO device may be updated using its USB interface and specially provided service software. Please contact your representative or Real Sound Lab directly for details.

Common Errors and How to Fix Them

Below we provide a list of common APEQ-8pro DIO device issues and how to fix them.

- APEQ-8pro DIO device is switched on. The **Power indicator** constantly flashes slowly. CONEQ™ equalizer doesn't work, device transfers sound signal from input to output unaltered.

Fatal device initialization or CONEQ™ configuration error has occurred. Most common situation – one of CONEQ™ equalization filter files is lost or corrupt. Try to replace filter files, using APEQ™ Communication Tool (C2) software. See APEQ™ Communication Tool (C2) User's guide for details.

Use the latest version of APEQ™ Communication Tool (C2) to transfer files. Latest version of APEQ™ Communication Tool software may be downloaded from Real Sound Lab home page.

Upgrade the APEQ™ device to the latest firmware version.

If these steps do not help, the device should be reset to Manufacturing State. Contact your representative or Real Sound Lab for more information.

- No sound appears on some or all of the device outputs. The level indicators for the corresponding channels are not showing any signal. The **CLIP** indicators for these channels are flashing slowly.

The CONEQ™ filters with a sample rate that differs from the sample rate of the CONEQ™ processing engine are loaded into the corresponding channels. To resolve, load CONEQ™ filters with matching sample rate or switch the internal CONEQ™ processing sample rate to that of the loaded filters using APEQ™ Communication Tool (C2).

If Word Clock input is used, check, if correct Word Clock source is connected to the APEQ-8pro Word Clock input, the Word Clock source is set to the sample rate of the loaded filters,

and the Word Clock chain is properly terminated. Use APEQ™ Communication Tool (C2) to check if the APEQ™ device has locked to the Word Clock signal.

- Sound passes the APEQ-8pro DIO device unaltered. All **CLIP** indicators are flashing slowly

Digital bypass is activated. Use CONEQ™ Workshop or APEQ™ Communication Tool (C2) to switch the **Digital bypass** off. Alternatively, turn the device off and on again because this also switches **Digital bypass** off.

TECHNICAL SUPPORT

Please feel free to contact our representatives or us directly at any time about any difficulties using the APEQ™ devices. Our contact details are listed below. We will do our best to respond to you as quickly as possible. Our mission is to make your experience with CONEQ™ as simple and rewarding as possible. To help us resolve issues quickly, we might need one or more of the following data:

- The serial number of your APEQ™ device (found on the label on the device case);
- The version of the APEQ™ Communication Tool (C2) and CONEQ™ Workshop software that can be found in **Help**⇒**About** menu;
- The operating system: (e.g. Windows Vista Ultimate SP2 64-bit or Mac OS X 10.6.8);
- Computer information: CPU type and speed, installed memory;
- Description of the problem – as much information as possible for us to understand and reproduce the problem, including screen-shots and/or crash logs if relevant, and the reason why you think it is a problem.

Should you have questions or comments, please contact us using one of the following ways:

- E-mail: support@realsoundlab.com
- WWW: www.realsoundlab.com
- Phone: +371 6788 9828 (Real Sound Lab SIA Headquarters, Riga, Latvia)

Thank you for choosing CONEQ™!