...the measure of excellence!™

Benchmark *HPA4*
Instruction Manual

Reference Stereo Headphone Amplifier
and
Reference Line Amplifier
with
Relay Gain and Input Control

Safety Information

Fuses

CAUTION: FOR CONTINUED FIRE HAZARD PROTECTION ALWAYS REPLACE THE FUSES WITH THE CORRECT SIZE AND TYPE (T 0.5A 250V 5 X 20 MM – LITTELFUSE® SLO-BLO® HXP218.500 OR EQUIVALENT). THE FUSE DRAWER INCLUDES TWO FUSES. ALWAYS REPLACE BOTH FUSES AT THE SAME TIME.

AC Input Voltage Range

NOTE: THE *HPA4* IS EQUIPPED WITH A UNIVERSAL POWER SUPPLY. THERE IS NO VOLTAGE SELECTION SWITCH. AC VOLTAGE RANGE IS 88-264 VAC, 50-60 HZ. THE PRODUCT MAY ALSO BE OPERATED FROM DC POWER OVER A VOLTAGE RANGE OF 125-373 VDC.

Power Cord

CAUTION: ALWAYS USE A GROUNDED POWER CORD. THE PRODUCT IS EQUIPPED WITH A STANDARD IEC POWER ENTRY MODULE. USE AN IEC POWER CORD THAT IS EQUIPPED WITH THE APPROPRIATE CONNECTOR FOR YOUR LOCATION. CORDS ARE AVAILABLE FROM YOUR DEALER.

Modifications

CAUTION: DO NOT SUBSTITUTE PARTS OR MAKE ANY MODIFICATIONS WITHOUT THE WRITTEN APPROVAL OF BENCHMARK MEDIA SYSTEMS, INC. MODIFICATION MAY CREATE SAFETY HAZARDS AND VOID THE WARRANTY.

CAUTION: CHANGES OR MODIFICATIONS NOT EXPRESSLY APPROVED BY BENCHMARK MEDIA SYSTEMS COULD VOID THE USER'S AUTHORITY TO OPERATE THE EQUIPMENT UNDER FCC REGULATIONS.

Repairs

CAUTION: DO NOT SERVICE OR REPAIR THIS PRODUCT UNLESS PROPERLY QUALIFIED. ONLY A QUALIFIED TECHNICIAN SHOULD PERFORM REPAIRS.

Contents

Front Panel

Rear Panel

Features

- **THX-888 Headphone Amplifier** with **THX AAA™ Technology**
- Benchmark **Line Amplifier**
- 256-Step Fully-Balanced **Relay Gain Control**, 0.5 dB Steps
- Precision **Timed Relay Closures**
- Precision **Metal Film Resistors**
- **Gold-Contact Relays**
- Balanced and Unbalanced I/O
- **6 Watts** into 16 Ohm Headphones
- **11.5 Vrms** into 300 Ohm Headphones
- **0.1 Hz to 500 kHz** frequency response
- **SNR > 135 dB**
- **THD < 125 dB** (0.00006%) under full load
- **Short-Circuit Protection** on Headphone Amplifier
- **DC Protection** on Headphone Amplifier
- **Over-Voltage Protection** on Headphone Amplifier
- **Over-Current Protection** on Headphone Amplifier
- **Thermal Protection** on Headphone Amplifier
- Full-Color 3.5" **Capacitive Touch Screen**
- **IR Remote Control** (optional)
- **2 Balanced Stereo Line Inputs**
- **2 Unbalanced Stereo Line Inputs**
- **Balanced Stereo Line Output**
- **Unbalanced Stereo Line Output**
- **Balanced Mono Sum Output**
- **12V Trigger I/O** – two bi-directional 12V trigger ports
- **AUTO-ON Function** - can be programmed to turn on when AC is applied
- **Power Switch** – very low standby power , <0.5 W at 120 VAC
- **High-Efficiency Low-Noise Power Supplies** – 100-240 VAC, 50-60 Hz
- Meets **FCC Class B** and **CE** emissions requirements
- **Tested for immunity** to radiated and conducted RF interference

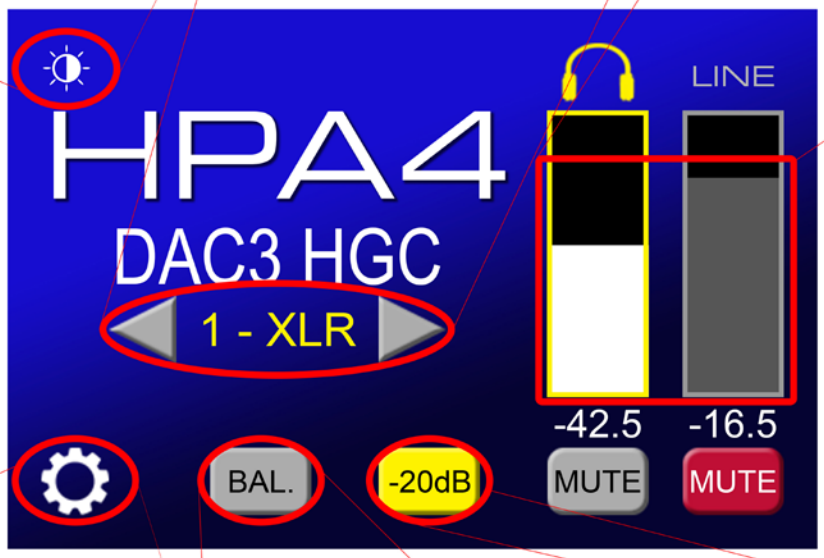
Quick Start Guide

Main Screen

BRIGHTNESS button. Use this button to dim the screen. When the screen is dimmed, touch anywhere to restore to full brightness. A DIM timer is available in the DISPLAY settings menu.

INPUT SELECTION. Use the left/right arrows to change inputs. Disabled inputs will be skipped. The input type is displayed between the arrows (XLR, RCA…).

VOLUME CONTROL ENABLE
Touch this area to change the selected output group (headphone, line, or both). Selected output groups are highlighted.

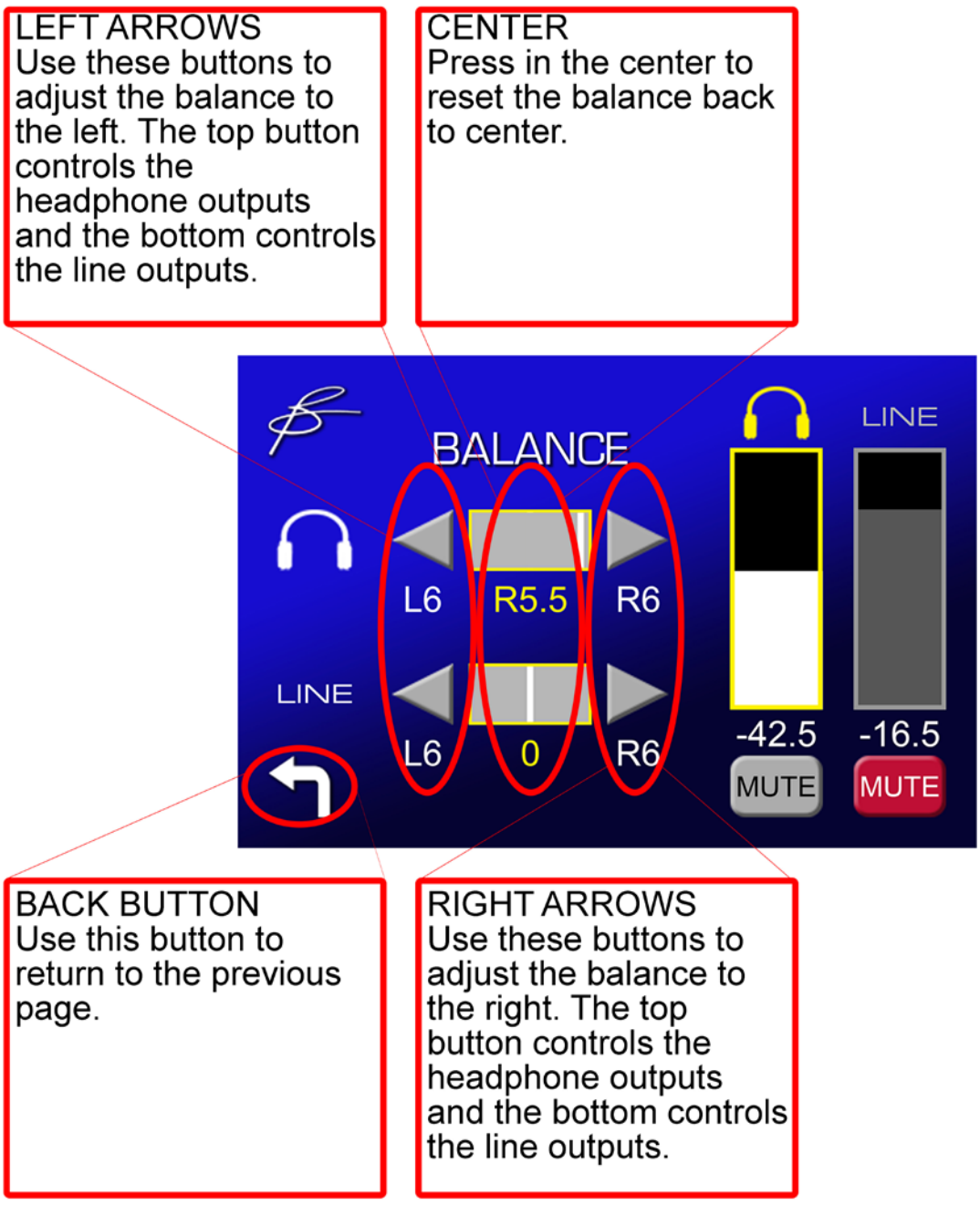


SETTINGS button. Use this button to access the SETTINGS menu.

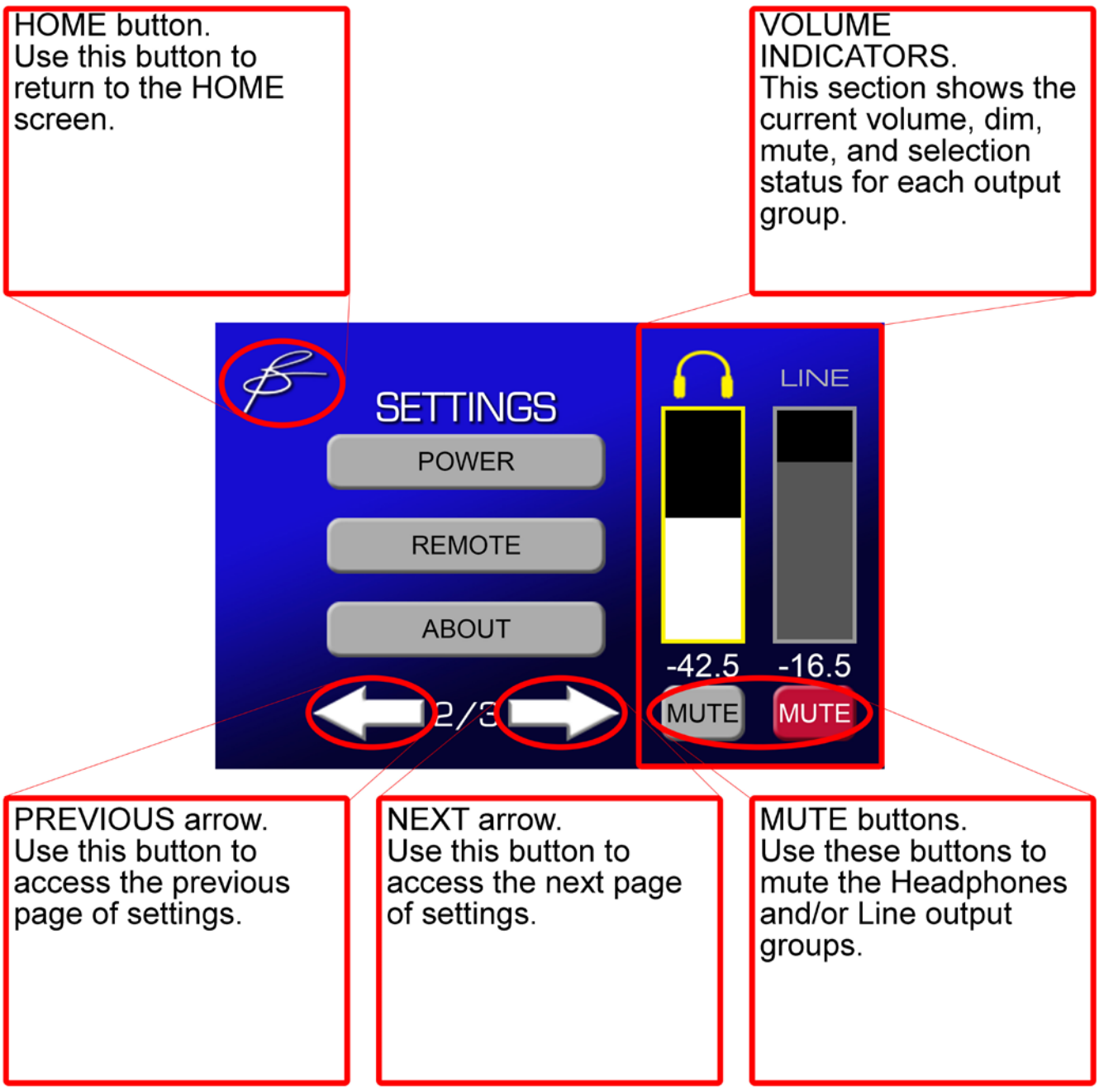
BALANCE button. Use this button to adjust the balance of the headphone and/or line output groups.

-20 dB Button. Use this button to reduce the volume of selected output group(s) by 20dB. Press again to return to previous volume setting.

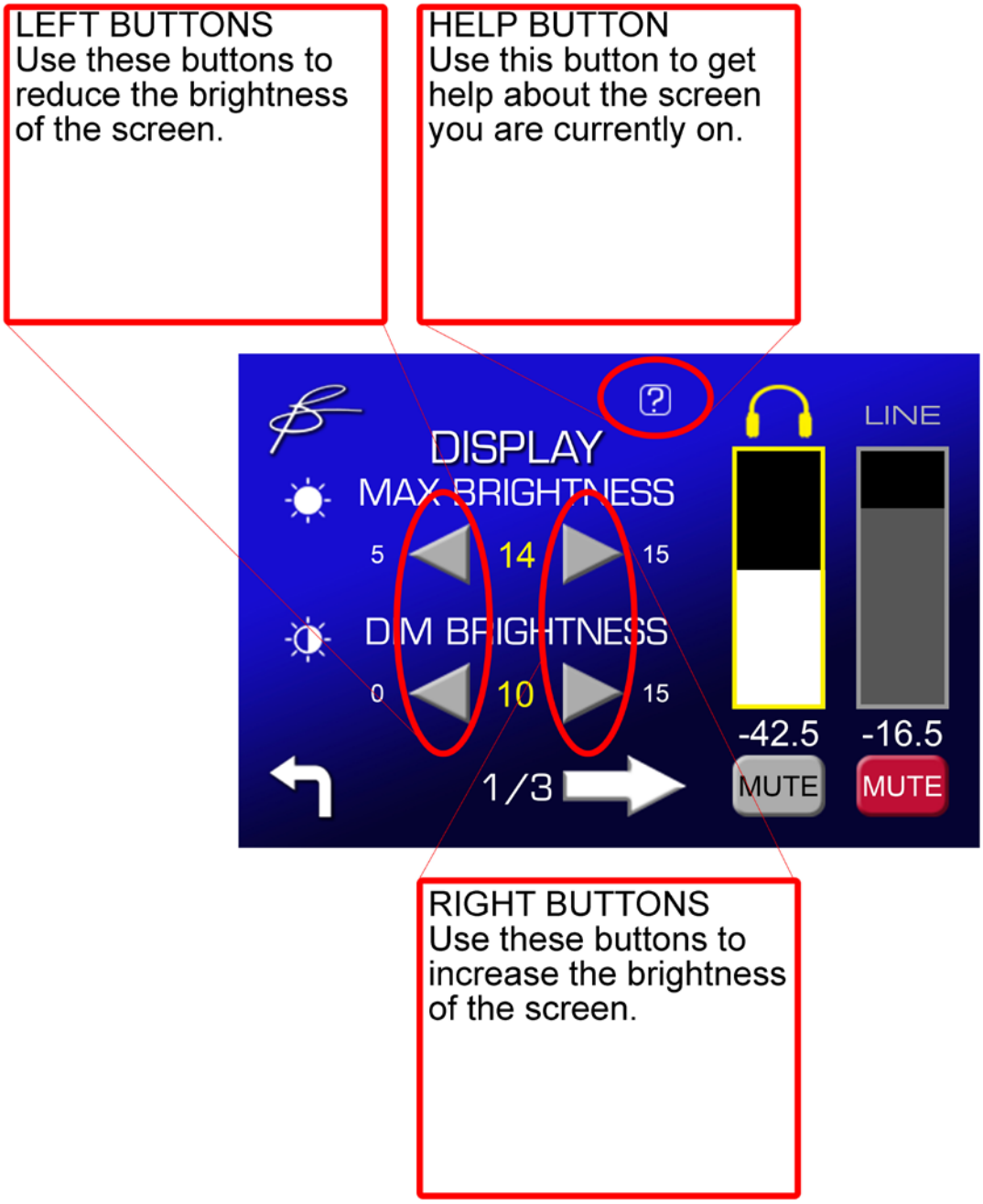
Balance Controls



Screen Navigation



Display Settings



Remote Control

The remote control is designed to control the ***HPA4*** and any Benchmark D/A converter that supports remote control.

The bottom six input selection buttons select the DAC inputs if the **DAC MODE** is enabled (on the **REMOTE** setup screen).

The ***HPA4*** inputs are controlled with the **INPUT ARROWS**.

The chart at the right summarizes the functions of the IR remote control.

ON	Turns the ***HPA4*** on. Any devices slaved to the **12V TRIGGER** will also turn on in a controlled sequence. If the ***HPA4*** is ON, this button toggles the **OUTPUT GROUP SELECTION** (headphone, line, or both).
OFF	Turns the unit off. Any devices slaved to the **12V TRIGGER** will turn off in a controlled sequence.
VOLUME ARROWS	Turns the volume up or down. Volume up cancels **MUTE** and **DIM**. Volume will only be adjusted on selected output group(s).
-20 dB DIM	Toggles the -20 dB **DIM** function. **DIM** will only be toggled on selected output group(s).
MUTE	Toggles the **MUTE** function. **MUTE** will only be toggled on selected output group(s).
INPUT ARROWS	Scrolls through the enabled inputs on the ***HPA4***.
D1	Selects input **D1** on DAC if connected.
D2	Selects input **D2** on DAC if connected.
D3	Selects input **D3** on DAC if connected.
D4	Selects input **D4** on DAC if connected.
USB	Selects **USB** input on DAC if connected.
Analog	Selects analog input(s) on DAC if connected.

Front Panel Controls

The front panel features a color touch screen, a power switch and a volume knob.

The volume knob includes a push switch that can be used to select which output group will be controlled by the knob rotation.

Tip: The IR remote sensor is located just to the right of the power switch. Keep this sensor unobstructed if you will be using the optional remote control.

Tip: When **AUTO-ON** is enabled, a switched AC outlet can be used to turn your system on and off. The **12V TRIGGER I/O** can be used as a trigger output to control the power state of additional components.

The chart at the right summarizes the functions of the power button and volume knob.

POWER (button)	Turns the unit on or off. Any devices slaved to the **12V TRIGGER** will also turn on or off in a controlled sequence. If **AUTO-ON** is enabled, the **POWER** button will toggle **MUTE** on and off (the unit will remain on at all times).
VOLUME (knob)	Adjusts the volume in 0.5 dB steps. The knob features an acceleration function. Rotate the knob quickly and the volume will change in larger steps. Volume up automatically cancels **DIM** and **MUTE**. Volume will only be adjusted on selected output group(s). Push the volume knob to select which output group(s) will be controlled (headphone, line, or both).

Connecting Other Audio Components

Use Balanced Interfaces When Possible

When possible, use balanced interfaces to connect the primary devices in your system. Balanced interfaces offer significant performance advantages due to the differential signals and higher voltage levels. In most cases, balanced interfaces will reduce noise in your system.

Balanced XLR Signal Levels

The *HPA4* Supports Professional Signal Levels

The XLR line inputs and outputs on the ***HPA4*** support very high +28 dBu signal levels. These high levels are used in professional studio environments because of the high performance that comes with using higher voltages. All Benchmark products support professional signal levels. Benchmark DACs and power amplifiers will interface to the ***HPA4*** using peak signal levels between +22 dBu and +24 dBu.

The *HPA4* Also Supports Consumer Signal Levels

The stepped gain controls in the ***HPA4*** have excellent noise performance and provide a wide dynamic range. This allows the simultaneous use of consumer-level and professional-level balanced interfaces. Professional XLR interfaces are usually 10 dB hotter than consumer-level XLR interfaces. The stepped gain control in the ***HPA4*** can easily provide a 10 dB boost or cut without sacrificing performance.

Selecting Components for Your System

Select devices with balanced XLR inputs and outputs. Balanced interfaces are vastly superior to unbalanced RCA interfaces.

When possible, select devices that have professional-level XLR interfaces. These will usually have better SNR specifications than devices with consumer-level XLR interfaces. This difference in SNR is often about 10 dB. Look for high signal levels when purchasing audio components and check the SNR specifications.

Use the 12V Trigger Connections

Trigger ports can be used to sequence the power-up and power-down operations so that all of your components turn on and off with a single switch. The trigger ports can also eliminate the loud pops that can occur when devices are turned on or off in the wrong sequence.

The trigger ports on the ***HPA4*** are bi-directional and can be connected to inputs or outputs on other devices. All Benchmark trigger ports are bi-directional. Most other products will have dedicated trigger inputs or outputs.

If you want the ***HPA4*** to control your system, connect the ***HPA4*** trigger ports to the trigger inputs on the other devices. When the ***HPA4*** turns on, the other devices will follow.

If you want to use another device as a trigger master, connect its trigger output to one of the trigger ports on the ***HPA4***. When this other device turns on or off, the ***HPA4*** will follow.

In an all-Benchmark system, just connect the trigger ports in a star or daisy chain. The system can be turned on or off using the power switch on any Benchmark device. This is one of the advantages provided by Benchmark's bi-directional trigger ports.

Connecting Benchmark Components

Benchmark *AHB2* Power Amp

1. Set the **SENSITIVITY** switch on the ***AHB2*** to 22 dBu (switch in the down position).
2. Connect either trigger port on the ***AHB2*** to either trigger port on the ***HPA4***. If you are using two ***AHB2*** amplifiers in bridged mono, the second amplifier can be connected to an unused trigger port on the ***HPA4*** or the other amplifier.
3. Connect the left and right XLR outputs on the ***HPA4*** to the left and right XLR inputs on the amplifier. If you are using two amplifiers in bridged mono mode, connect the cables to the **MONO** input on each amplifier.
4. If you are using a single ***AHB2***, set the **MODE** switch on the back of the amplifier to **STEREO**. If you are using two ***AHB2*** amplifiers, set the **MODE** on each to **MONO**.

Tip: If you turn the system on or off using the ***HPA4*** or the remote control, the amplifiers will follow. If you will be listening to headphones and you wish to turn off the amplifiers, you can do this: Just press the **POWER** buttons on each amplifier and they will turn off without turning off the ***HPA4***.

Tip: If you want to shut down the entire system using the **POWER** switch on an amplifier, you will need to press and hold the switch for 3 seconds.

Benchmark DAC

1. Set the XLR output attenuators in the DAC to **0 dB**. You will need to open the cover on the DAC if these jumpers need to be changed.
2. If your DAC has a trigger port, connect it to either port on the ***HPA4***. This trigger connection provides a control link so that the remote, DAC or ***HPA4*** can be used to turn the entire system on or off in a sequenced fashion.
3. Use XLR cables to connect the DAC to Input 1 on the ***HPA4***. This input supports a special DAC compatibility mode.
4. If your DAC has a '**DAC-ONLY MODE**', enable this mode. This will bypass the **VOLUME**, **MUTE** and **DIM** controls on the DAC.
5. If your DAC does not have a '**DAC-ONLY MODE**', set every input on the DAC to '**HT**' mode, or '**CALIBRATED**' mode. This will bypass the volume control on the DAC, but IR remote **MUTE** and **DIM** controls may still be active on some DAC models.

If you have a Benchmark DAC with remote control, the ***HPA4*** has a special mode of operation that allows both devices to be controlled from a single remote. If your Benchmark DAC has remote control, follow this additional step:

6. Go to the **REMOTE** settings screen on the ***HPA4*** and select '**BENCHMARK DAC ON XLR1**'. The Benchmark IR remote control will now control both devices. The ***HPA4*** will provide volume control and switching between analog inputs. The DAC will provide switching between digital inputs.

Tip: Use the dedicated digital input select buttons (**USB**, **D1**, **D2**, **D3** and **D4**) to select digital inputs on the DAC. Use the **INPUT** scroll buttons on the remote to select analog inputs on the ***HPA4***. Use the dedicated **ANALOG** button on the remote to select the analog inputs on the DAC (if any).

Tip: We recommend using the direct analog inputs on the ***HPA4*** before using the analog inputs on the back of the DAC. The direct connections on the back of the ***HPA4*** will provide better performance.

Tip: Use the **VOLUME UP** key on the remote if you wish to release the **MUTE** and **DIM** on all devices.

Basic Features

Input Selection

Use the input selection arrows to scroll through the enabled inputs. These arrows are displayed on the **HOME** screen and are also available on the **REMOTE**.

Volume Control

The volume of the headphone and line output groups can be adjusted independently. The bar graphs show the current volume settings. The volume controls are enabled when the bar graph(s) are highlighted.

Select the OUTPUT GROUP(S)

Press the volume knob or touch the bar graphs to select the **OUTPUT GROUP** that you would like to adjust (headphones, line or both). If you are using the remote, press the **ON** button to toggle between output groups.

Adjust the volume

Rotate the volume knob or use the remote control to adjust the volume of the selected output group(s).

Balance Adjust

Press the **BAL** button on the **HOME** screen to change the L/R balance of the headphone and/or line outputs. These are independently adjustable.

MUTE Function

The headphone output and line output groups have separate **MUTE** buttons on the touch screen. Each **MUTE** button is highlighted in red when the output group is muted.

When **MUTE** is toggled on, the audio is immediately muted. When **MUTE** is toggled off, the volume will fade back up to the original level.

The **MUTE** key on the remote will mute the selected output group(s).

Tip: Turn the **VOLUME** up to release **MUTE** and return to the prior volume setting.

-20 dB DIM Function

The **DIM** function reduces the level of the selected output group(s) by 20 dB. When **DIM** is toggled on, the volume fades down by exactly 20 dB. When **DIM** is toggled off, the volume fades back up to the original level.

The volume bar graph will be displayed in yellow when **DIM** is on.

Tip: Turn the **VOLUME** up to release **DIM** and return to the prior volume setting.

Advanced Features (Settings Screens)

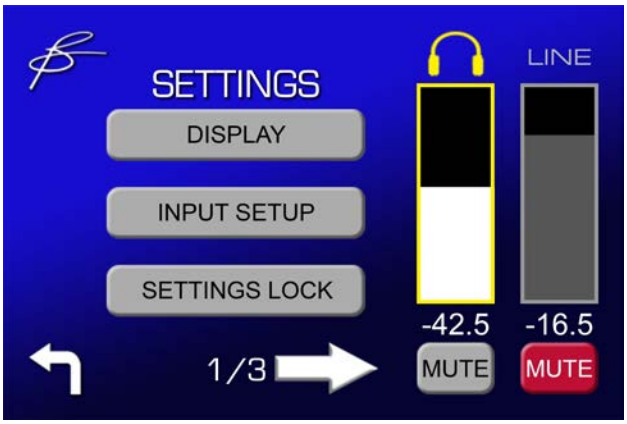
Press the gear icon on the HOME screen to access the advanced features.

If the advanced features have been locked, a locked gear icon will be displayed on the HOME screen. Press and hold the locked gear icon for 3 seconds to access the advanced features.

Settings Menu Screens

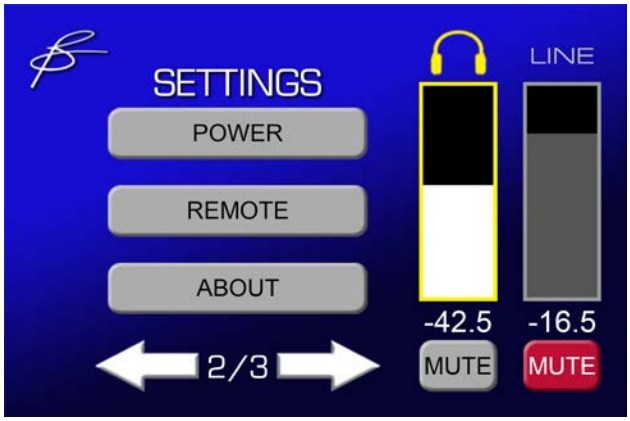
Settings 1

- Display Settings
- Input Setup
- Lock/Unlock Advanced Settings



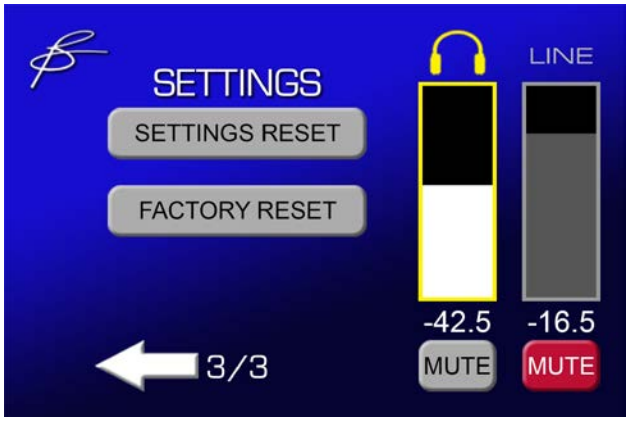
Settings 2

- Power (Auto-On, Trigger)
- Remote (IR Enable, DAC Mode)
- About (System Information)



Settings 3

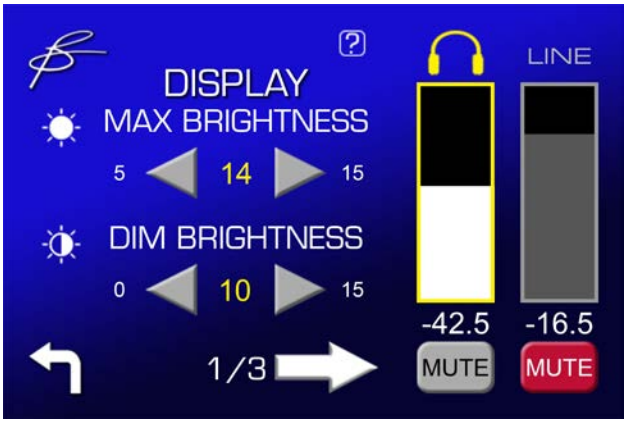
- Reset Advanced Settings
- Full Factory Reset



DISPLAY Settings

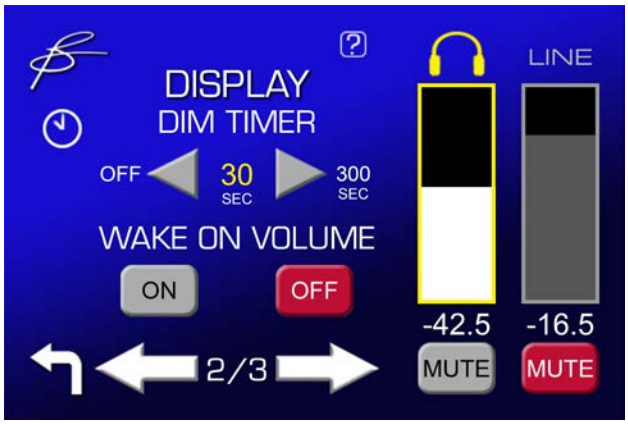
Display Settings 1

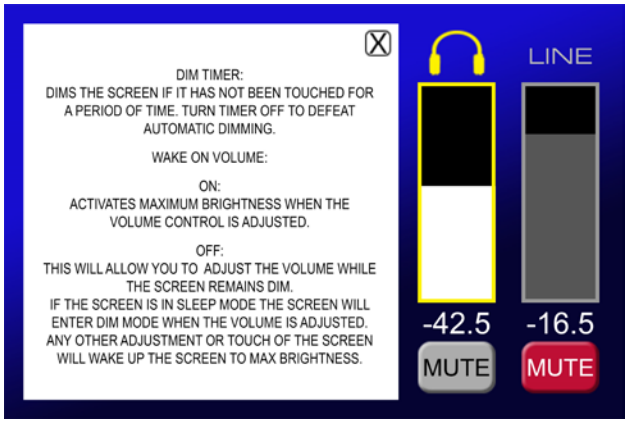
- Maximum Screen Brightness
- Screen Brightness when Dimmed



DISPLAY Settings 2

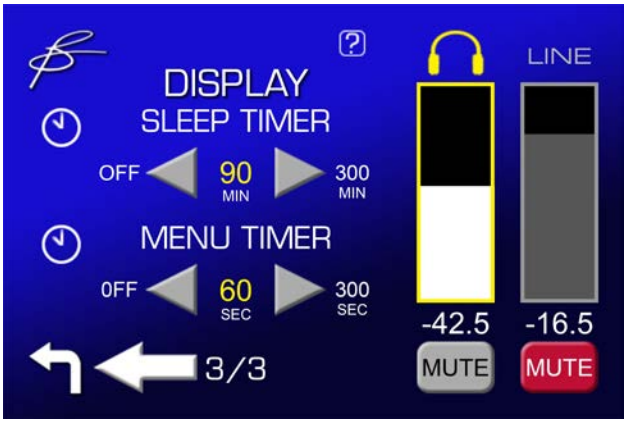
- Screen Dim Timer
- '**WAKE ON VOLUME**' Function

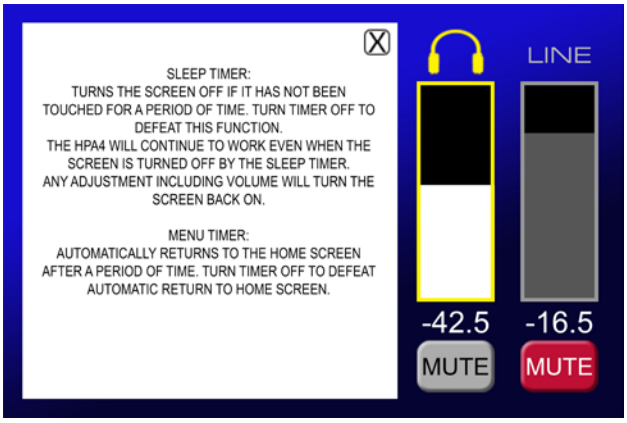




DISPLAY Settings 3

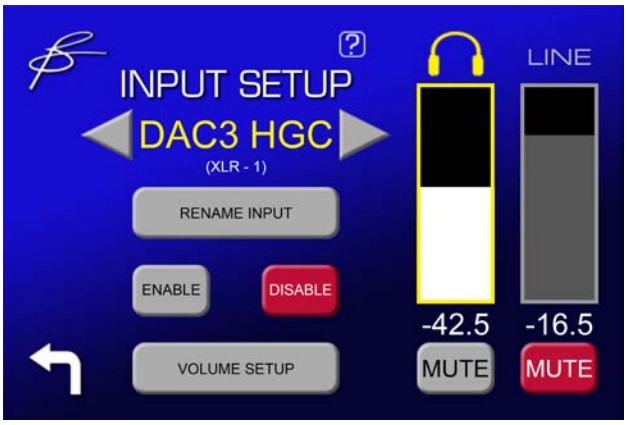
- Display Sleep Timer (screen off)
- Menu Timer (return to home page)

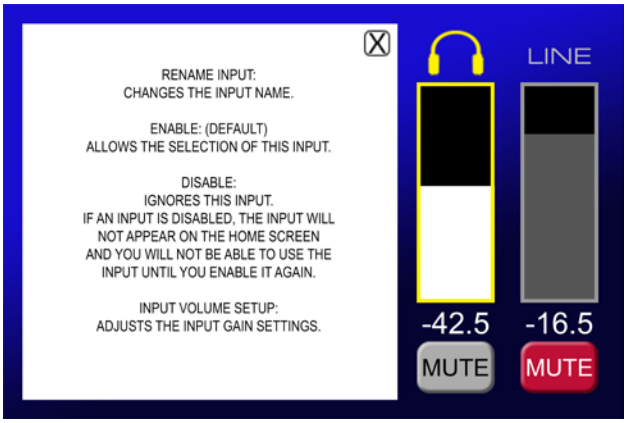




INPUT SETUP

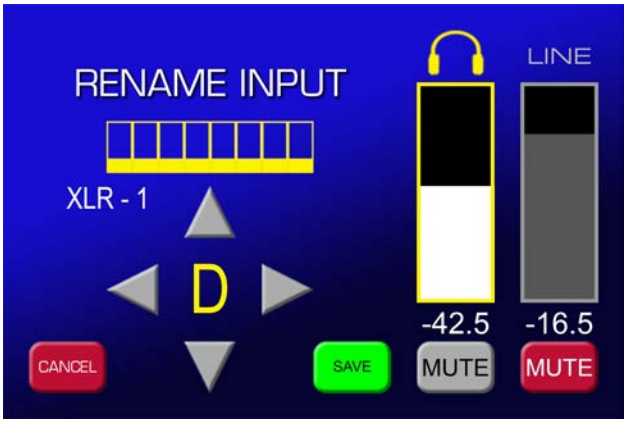
- Rename Inputs
- Disable/Enable Inputs
- Volume Setup for Each Input





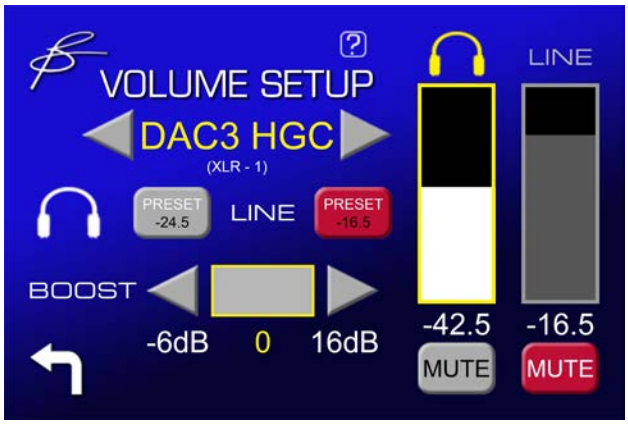
RENAME INPUT

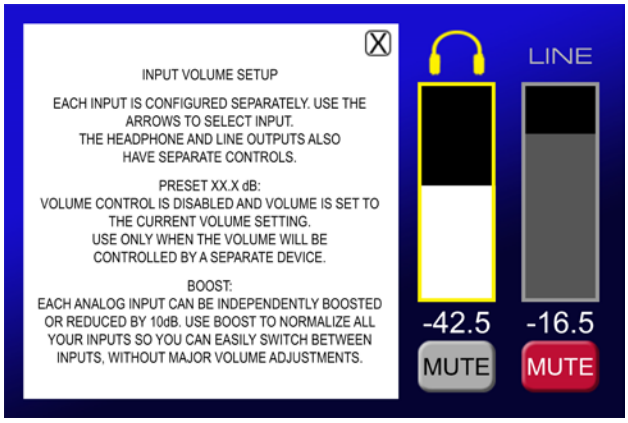
- Input Name Edit



VOLUME SETUP

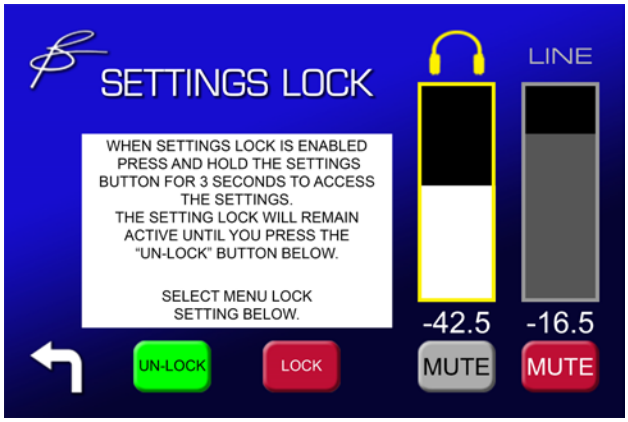
- Volume Preset - Enable/Disable
- Boost Adjust (input volume offset)





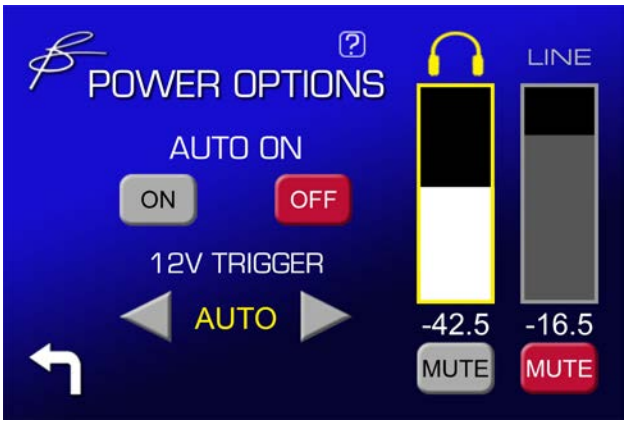
SETTINGS LOCK

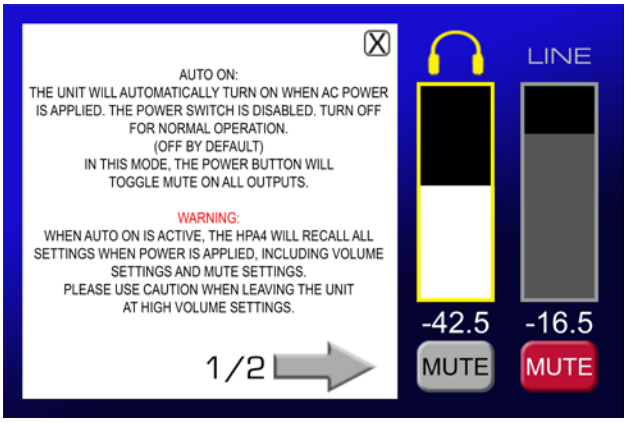
- Lock/Unlock Advanced Settings

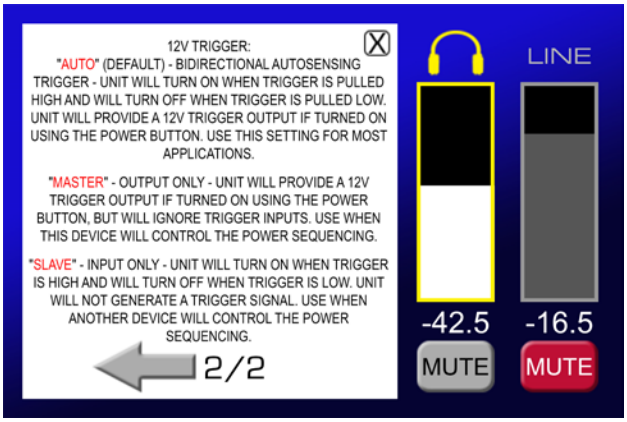


POWER Settings

- Auto-On - Enable/Disable
- 12V Trigger Mode

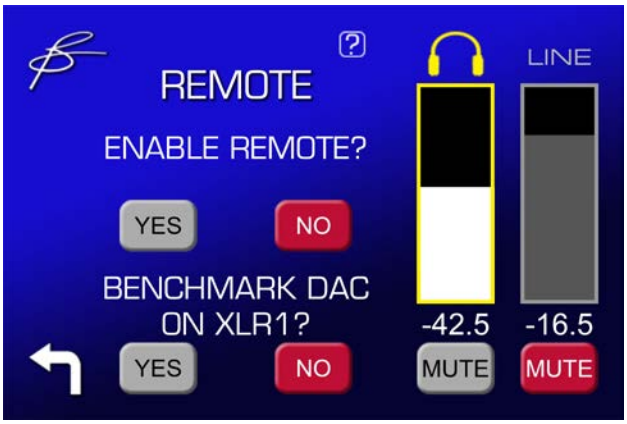


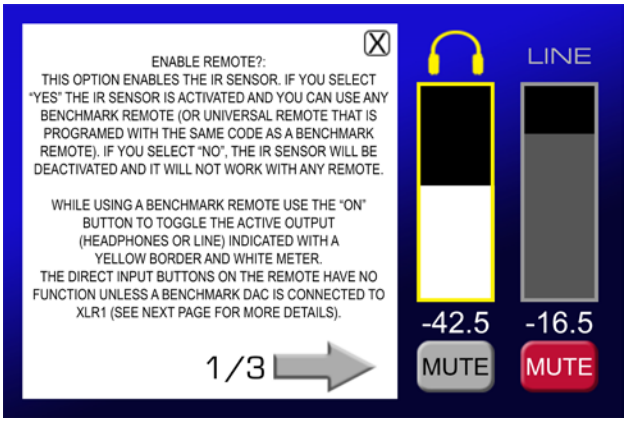


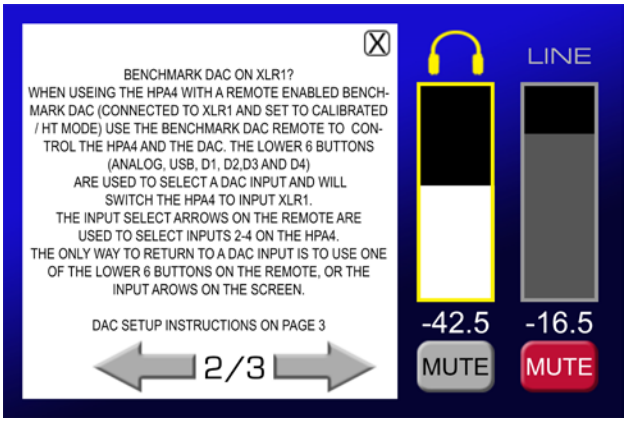


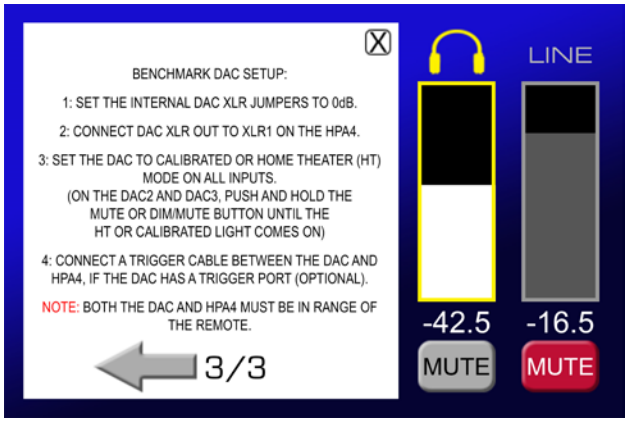
REMOTE Settings

- Enable IR Remote Control
- Integrate with Benchmark DAC









ABOUT Screens

ABOUT

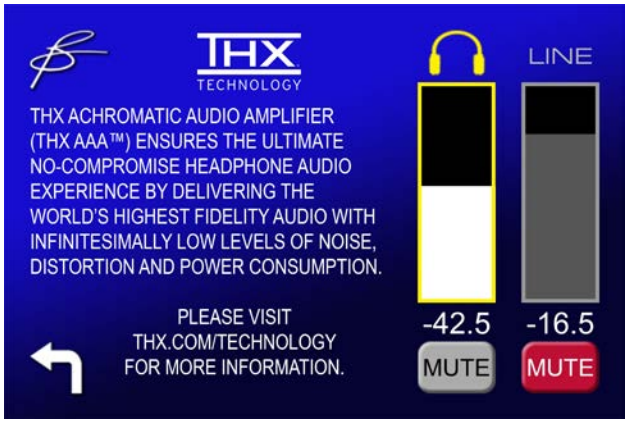
- Firmware Version (hardware drivers)
- Software Version (touch screen)

ABOUT BENCHMARK

- Benchmark Contact Information

ABOUT THX

- **THX AAA™** Technology Information



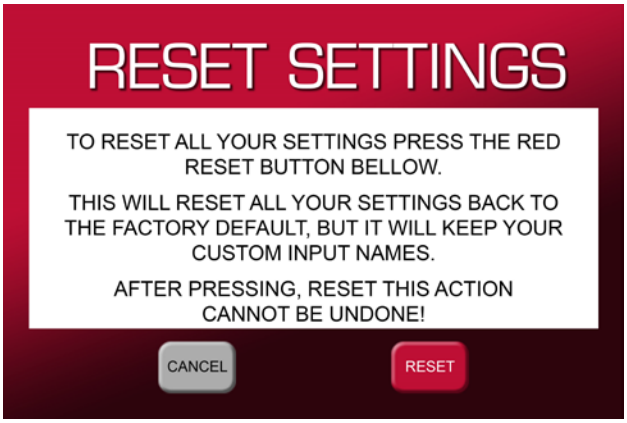
SPLASH SCREEN

- Unit is Turning On or Off, Audio is Muted
- May be manually enabled from ABOUT screen (this does not mute the audio, touch the screen to exit).

RESET Screens

RESET SETTINGS

- Reset all Advanced Settings Except Input Names



FACTORY RESET

- Reset all Advanced Settings Including Input Names

HPA4 System Overview

The Ultimate Headphone Amplifier

Benchmark Media Systems, Inc. and THX, Ltd. have partnered to introduce the Benchmark ***HPA4*** headphone/line amplifier featuring THX Achromatic Audio Amplifier (AAA™) technology.

THX AAA™ reduces harmonic, intermodulation, and crossover distortion by 20 to 40 dB to guarantee a realistic and fatigue-free listening experience. It accomplishes this using a patented feed-forward topology to null conventional distortion and noise mechanisms, resulting in the world's most linear amplifier. THX AAA™ allows the amplifier to reach its maximum output power and sound pressure level (SPL) without producing the distortion that normally accompanies increased output levels in traditional amplifiers.

Featuring the flagship **THX-888** amplifier design, the revolutionary ***HPA4*** headphone amplifier incorporates the same THX AAA™ technology that Benchmark uses in the ***AHB2*** power amplifier. The ***HPA4*** delivers sonic perfection. Hear the music without any contamination from electronic noise or distortion. The ***HPA4*** delivers power, audio fidelity, speed and accuracy over an utterly silent background.

The Ultimate Line Amplifier

The **THX-888** amplifier is driven by a Benchmark line amplifier that features relay gain control, relay input selection, and relay muting. It is designed to deliver the lowest possible distortion and noise over a wide range of volume settings. We believe that the ***HPA4*** line amplifier is the finest available at any price.

Relay-Controlled Gain Stages

The relay-controlled gain stages provide 256 volume steps in precise 0.5 dB increments. These gain stages feature the finest gold-contact relays available.

Relay closures are precisely timed to deliver silky-smooth volume changes. No other relay-controlled gain stage offers this level of precision or performance.

The ***HPA4*** includes 4 independent fully-balanced 256-step volume controls: two for the L&R headphone outputs, and two for the L&R line outputs. To make this all happen, the ***HPA4*** includes a total of 64 precision relays.

Balance Controls

The line and headphone outputs feature independent balance controls that are adjustable in 0.5 dB steps.

100% Analog Signal Path

The ***HPA4*** is 100% analog. It is designed to be driven from an external D/A converter or an external analog source. The ***HPA4*** is designed to provide the ultimate analog signal path between inputs and outputs. The ***HPA4*** eclipses the performance of typical high-end preamplifiers by achieving much lower noise and distortion.

Fully-Balanced Signal Paths

The internal signal paths are fully balanced. The inputs are routed to a balanced pair of precision differential amplifiers. These drive two sets of fully-balanced 256-step volume controls. The balanced outputs from the volume controls drive the headphone amplifier and line output drivers.

Differential Amplifiers

The ***HPA4*** features precision differential amplifiers on all inputs. These reject common-mode noise, common-mode distortion and common-mode interference. This feature is especially important when using D/A converters that lack their own differential amplifiers.

Benchmark D/A converters include differential amplifiers, but many competing converters

lack these stages which remove the common-mode distortion produced by D/A chips.

Powerful Headphone Output

The **THX-888** amplifier in the ***HPA4*** can cleanly deliver high power and current into low-impedance headphones. It can also deliver the high voltage required by very low-sensitivity headphones.

High Power

The ***HPA4*** delivers 6 Watts into 16 Ohms. Best of all, there is no increase in THD when driving low-impedance headphones. The THX AAA™ technology keeps the output distortion free while driving very difficult low-impedance loads.

High Current

Low-impedance headphones may also require high current due to difficult phase angles presented by non-resistive driver loading. The ***HPA4*** can provide peak currents exceeding 1.5 amps. This is more than enough current to drive difficult headphones with ease.

High Voltage

High-impedance headphones may not draw much power or much current, but they may demand high drive voltages. The ***HPA4*** delivers 11.9 Vrms into 300-Ohm headphones. This is plenty of voltage to drive headphones with very low sensitivities.

Dual Headphone Outputs

The ***HPA4*** features a traditional 1/4" TRS headphone jack and a 4-pin XLR jack.

The 4-pin jack provides separate returns for the left and right channels. Each output channel is driven differentially relative to its return pin on the 4-pin jack.

We recommend using the 4-pin jack because the XLR connector provides lower contact resistance than the TRS connector.

Ultra-Wide Bandwidth

The frequency response of the ***HPA4*** extends from 0.1 Hz to 500 kHz. This extended range keeps the phase response extremely accurate over the entire audio band. The entire audio spectrum is delivered with the proper timing.

Bass is delivered with the correct timing relative to other frequencies. Most audio products deliver the bass slightly late. Bass that arrives late tends to mask high-frequency details. In contrast, bass that arrives with the correct timing will sound deep, full and well damped. For this reason, all Benchmark products feature low-frequency extension to 0.1 Hz.

The extreme 500 kHz high-frequency extension delivered virtually perfect timing at the high end of the audio spectrum. High frequencies are delivered with precise timing relative to low and mid frequencies. In addition, the left-right differential phase is virtually perfect at 20 kHz. These timing characteristics preserve the precise placement of voices within a well-defined 3D stereo image.

Rotary Encoder

The volume control knob features a high-quality optical encoder that is rated for heavy use. An acceleration feature makes it easy to move through the 256 volume steps while maintaining 0.5 dB/step resolution. A press of the control knob toggles between headphone volume, line volume, or both.

Convenience Features

The ***HPA4*** includes independent on-screen mute buttons for the headphone and line outputs. Both can also be muted with the volume knob or with the optional remote control.

The ***HPA4*** includes an on-screen -20 dB dim button that fades the level down by 20dB. This function provides a temporary volume reduction and an easy return to the previous

listening level. This control makes it easy to transition between a normal listening level and a background level. The **DIM** function is also accessible from the optional remote control.

Inputs may be renamed and unused inputs may be disabled. Input levels can be trimmed to provide input-to-input level matching.

Screen brightness is adjustable and timers can be set to dim or shut off the display. The setup screen can be locked to prevent access to advanced features.

12V Trigger

The ***HPA4*** has two trigger ports. These can be connected to other audio components so that the entire audio system can turn on and off in a sequenced fashion. The ***HPA4*** will pull the trigger I/O to 12 volts DC while the ***HPA4*** is on. If the ***HPA4*** is off and an external device pulls the trigger I/O to 12 volts, the ***HPA4*** will turn on.

The trigger ports are bi-directional by default, but they can be configured as inputs or outputs.

Auto-On Function

The ***HPA4*** can be programmed to automatically turn on when AC power is applied.

Casework

The ***HPA4*** is available with a black or silver faceplate and is designed to match the Benchmark ***AHB2*** power amplifier. It occupies the same footprint as the Benchmark ***DAC1***, ***DAC2*** and ***DAC3*** converters. The case features a milled faceplate and milled sides. Top, bottom, and rear panels are made from thick aluminum and feature a brushed texture. The ***HPA4*** is built to last and will be a fine addition to your listening space.

Equipment Placement

Locate the ***HPA4*** where the side panels are exposed to air. These panels help dissipate heat and should not be obstructed.

The IR sensor for the remote control is located to the right of the power switch on the front panel. Make sure this is visible from your listening position.

The ***HPA4*** does not emit strong magnetic fields and for this reason, it will not create interference with audio devices that are placed above or below the ***HPA4***.

Please note that most power amplifiers emit strong magnetic fields. In most cases, the ***HPA4*** should not be stacked directly above or below a power amplifier. Allow at least a few inches of space above or below a power amplifier. The magnetic fields produced by the power amplifier may interfere with the ***HPA4***. One exception is the Benchmark ***AHB2*** power amplifier. The ***HPA4*** can be stacked directly above or below an ***AHB2*** without any risk of magnetic interference from the power amplifier.

The ***HPA4*** can also be stacked directly above or below Benchmark ***DAC2*** or ***DAC3*** converters. The older ***DAC1*** series converters emit stronger magnetic fields and should not be stacked directly above or below the ***HPA4***.

Auto-Ranging Power Supply

The internal power supply automatically senses the AC line voltage. There are no settings or fuses to change for international operation. Select a grounded IEC power cord that matches the AC outlets in your country.

Audio Line Inputs

The ***HPA4*** features two stereo balanced XLR analog inputs and two stereo unbalanced RCA analog inputs.

Balanced XLR Interfaces

Balanced interfaces use higher signal levels and for this reason, they provide better signal to noise ratios. Balanced interfaces also provide immunity from ground loop induced hum and buzz. In general, balanced interfaces are vastly superior to unbalanced. Select products with balanced interfaces and avoid the use of unbalanced interfaces whenever possible.

Unbalanced RCA Interfaces

Given the widespread consumer use of unbalanced RCA interconnects, we have made every effort to extract the highest possible performance from these antiquated consumer audio interconnects.

The unbalanced RCA inputs on the ***HPA4*** are connected to balanced receivers. These balanced receivers provide significant immunity to ground loop induced hum and buzz. This topology provides the RCA inputs with some of the advantages of fully-balanced interfaces. Nevertheless, unbalanced interfaces can never match the full performance of professional-grade balanced interfaces.

If your D/A converter and/or power amplifier lack balanced interfaces, it is a good indication that these devices are not true high-resolution audio products. Look for professional-grade balanced interfaces that support 24 dBu signal levels.

Input Level Matching

By default, the unbalanced inputs on the ***HPA4*** are automatically boosted by 15.8 dB so that they will match the level of the professional-grade balanced inputs. If the 15.8 dB default boost doesn't work in your system, individual inputs can be trimmed by +/- 10 dB in 0.5 dB steps using the **BOOST** function. The boost value does not impact the audio performance. It is equivalent to automatically rotating the volume control when the input is changed. The boost value changes the way the volume is numerically displayed.

Tip: We recommend using professional-grade balanced XLR interconnects that provide +24 dBu at 0 dBFS. Consumer-grade balanced XLR interconnects operate at levels that are about 10 dB lower (4 Vrms or +14.2 dBu at 0 dBFS). Consumer RCA interconnects operate at levels that are about 16 dB lower (2 Vrms or 8.2 dBu at 0 dBFS). High signal levels and differential signaling are essential in high-resolution audio systems. RCA interconnects will limit system performance.

Audio Line Outputs

The ***HPA4*** features a stereo pair of balanced XLR outputs and a stereo pair of unbalanced RCA outputs. It also includes a balanced mono sum output. The mono sum can be used to drive a powered subwoofer.

The balanced outputs are designed to operate at professional levels (+24 dBu at 0 dBFS).

The unbalanced outputs are designed to operate at consumer levels (2 Vrms at 0 dBFS).

Unity Gain at 0 dB

If the volume control is set to 0 dB, the XLR output levels will be identical to the XLR input levels feeding the system. Likewise, the RCA output levels will be identical to the RCA input levels feeding the system.

15.8 dB Offset Balanced vs. Unbalanced

Balanced outputs are 15.8 dB hotter than the unbalanced outputs. Balanced inputs are assumed to be 15.8 dB hotter than unbalanced.

Headphone Outputs

The left-hand jack is a traditional 1/4" TRS headphone jack. The L & R channels share a common return.	The right-hand jack is a 4-pin XLR headphone jack that features dedicated returns for each channel.

Driving Two Sets of Headphones

The ***HPA4*** has more than enough power and output current to drive two sets of headphones simultaneously. The two headphone jacks can be used simultaneously, but the two sets of headphones need to have similar sensitivities. If the sensitivities are different, one set of headphones will play louder than the other.

The main purpose of the second connector is to provide a high-performance alternative to the traditional TRS phone jack.

Standard 1/4" TRS Connector

The ***HPA4*** included a traditional 1/4" tip-ring-sleeve (TRS) headphone jack. This provides a convenient output that is compatible with most headphone cords. Slightly higher performance is available from the XLR4 connector.

In our tests we have found that the TRS contacts can occasionally produce more distortion than the entire ***HPA4*** headphone amplifier. We have selected one of the highest quality TRS jacks available, but the performance of the TRS jack is highly dependent upon the quality and condition of the headphone plug. Gold plated plugs are highly recommended.

The traditional 1/4" TRS connector uses the sleeve as a common ground for the left and right channels. This connection carries twice the current carried by the other contacts. High contact resistance at the sleeve connection can cause distortion on both channels.

With many TRS plugs we have found that the tip connection is somewhat less reliable than the ring connection. This means that there is a higher chance of distortion being added to the left channel.

Tip: If the TRS plug is gold plated, clean and in good condition, the TRS jack can match the performance of the XLR4. When conditions are less than ideal, the TRS contact resistance can be the largest source of distortion in the entire ***HPA4*** headphone system.

High Performance XLR4 Connector

The 4-pin XLR connector provides dedicated pins for the left and right returns. There are no shared connections. In the ***HPA4***, the left and right outputs are differentially driven relative to their respective returns.

The separate returns eliminate any interaction between the channels. More importantly, the XLR4 connector provides much lower contact resistance than the traditional 1/4" TRS connector.

Our tests have shown that XLR jack and plug combinations provide very reliable electrical connections. No measurable distortion was produced by the XLR4 connector in any of our tests.

Tip: The **Volume Control** simultaneously adjusts the level for both headphone jacks. If two listeners will be simultaneously using the headphone outputs, we recommend using headphones with identical or very similar voltage sensitivities.

THX-888 Amplifier

The headphone outputs are driven by the flagship **THX-888** amplifier. This headphone amplifier incorporates the same patented THX AAA™ technology that Benchmark uses in the ***AHB2*** power amplifier. The ***HPA4*** is designed to deliver power, audio fidelity, speed and accuracy over an utterly silent background.

THX AAA™ reduces harmonic, intermodulation, and crossover distortion by 20 to 40 dB to guarantee a realistic and fatigue-free listening experience. It accomplishes this using a patented feed-forward topology to null conventional distortion and noise mechanisms. THX AAA™ allows the amplifier to reach its maximum output power and sound pressure level (SPL) without producing the distortion that normally accompanies increased output levels in traditional amplifiers.

Headphone and Hearing Warnings

CAUTION: The **THX-888** headphone amplifier in the ***HPA4*** is capable of delivering peak-to-peak voltages of about 25 Volts. It is also capable of delivering 1.5 Amps. These levels are high enough to damage most headphones (and your ears). Use caution when adjusting playback levels.

CAUTION: Do not drive a set of headphones while they are sitting on a desk or stand. It is easy to accidentally overdrive them. This is especially true when you have set the headphones aside while listening to speakers. Mute or unplug your headphones when they are not in use!

Soft-Start Circuit

The **THX-888** uses relays to mute the headphone output until the power supplies have reached normal voltages.

Protection Circuits

The **THX-888** headphone amplifier has several circuits that are intended to protect the amplifier from overloads and short circuits. Fault conditions will disable a pair of output relays which will disconnect the amplifier from the output jacks. The output relays are only energized when all conditions are normal.

Over Current Protection

If the output current exceeds 1.5 Amps on either output channel, the protection relays will disconnect the amplifier from the output jacks. The connection will be restored after a few seconds. The protection cycle will repeat if necessary. This protection mode may engage if headphones are plugged into the 1/4" TRS jack while audio is playing. TRS plugs can cause a temporary short-circuit condition while the plug is being inserted.

Clip Detection

If the headphone amplifier is driven into clipping, the protection relays will disconnect the amplifier from the output jacks. If clipping ceases, the connection will be restored after a few seconds.

DC Detection

If DC is detected on the output of the headphone amplifier, the protection relays will disconnect the amplifier from the output jacks. This protection circuit is intended to protect the headphones in the unlikely event of a catastrophic component failure.

Temperature Limiting

If the **THX-888** is severely overloaded for a period of time, component temperatures may start to climb. If safe operating temperatures are exceeded, the protection relays will disconnect the amplifier from the output jacks. After the drivers have cooled, the connection will be restored. This cooling cycle may take several minutes.

Advanced Feature Details

PRESET Mode

The **PRESET** mode sets the output level to a fixed level. There are separate presets for the headphone and line outputs. Each input has two preset buttons. One for the headphone outputs and one for the line outputs. These can be set on the **VOLUME SETUP** screen which is accessed from the **INPUT SETUP** screen.

Auto-On Function

The ***HPA4*** can be programmed to automatically turn on whenever AC power is applied. This function allows automation using switched AC outlets. When **AUTO-ON** is enabled, the ***HPA4*** cannot be turned off without removing AC power.

The **AUTO-ON** function is programmed on the **POWER** screen.

If **AUTO-ON** is enabled, the power switch will mute all of the outputs, but will not turn the unit off. Likewise, the **OFF** button on the remote will mute all of the outputs.

Tip: Turn the **VOLUME** up to release **MUTE** and return to the prior volume setting.

Bi-directional 12V Trigger

Benchmark has reinvented the 12 volt trigger by adding bi-directional signaling. The trigger connection on the ***HPA4*** can be used as an input, an output, or both. It is compatible with any common 12 volt trigger input or output.

The **12V TRIGGER** I/O can be used to turn other audio components on when the ***HPA4*** turns on. The ***HPA4*** can also turn on and off in response to other connected components. The Benchmark bi-directional **12V Trigger** is compatible with virtually all trigger systems.

The **12V TRIGGER** I/O can be connected to the trigger input or output ports on a D/A converter, power amplifier, or both.

The ***HPA4*** can send a 12 Volt DC trigger signal to start other components in the system, or it can wake up in response to an externally generated trigger signal.

The trigger modes can be set using the **POWER** screen.

Auto Trigger Mode

By default, the trigger ports are set to **AUTO TRIGGER** mode. In this mode, the ***HPA4*** automatically configures its trigger I/O ports as inputs (slave) or outputs (master) as needed. This mode is recommended for most applications. In **AUTO TRIGGER** mode, the ***HPA4*** will always turn other devices on and off. It will also respond when other devices force the trigger line high or low.

Master Trigger Mode - (Output Only)

In **MASTER TRIGGER** mode, the ***HPA4*** will ignore external inputs to the trigger ports. The ***HPA4*** will force the trigger ports to 12 volts DC when the unit is **ON**, and will force the ports to 0 volts while the unit is turning **OFF**.

Slave Trigger Mode - (Input Only)

In **SLAVE TRIGGER** mode, the ***HPA4*** will not drive the trigger ports. The ports will be configured for input only. The ***HPA4*** will turn on and off in response to the trigger signal supplied by other system devices.

Typical Trigger Applications

Typical trigger applications:

- ***HPA4*** → Amplifier
- ***HPA4*** → Amplifier → Amplifier
- ***HPA4*** → DAC → Amplifier

Bi-Directional Trigger Applications

Benchmark products support bi-directional communications over the trigger bus. Any Benchmark product connected to the bus can turn the entire system on or off. Because of the bi-directional design, any power button on a Benchmark ***HPA4***, ***AHB2***, or ***DAC*** can be used to start or stop the system.

The Benchmark device that starts the system will become the trigger master. If the trigger master is turned off, all slave devices will follow. If a slave device is turned off, all other devices will stay on.

If the ***HPA4*** is used to turn the system on, any connected ***AHB2*** amplifiers will become slave devices and they can be turned off without shutting down the ***HPA4***. This feature makes it easy to turn the ***AHB2*** amplifier(s) off when listening to headphones.

Slave devices can force the entire trigger bus to shut down if the **POWER** button or **OFF** button is pressed and held for 3 seconds.

Tip: Press and hold the **POWER** button on any Benchmark device for 3 seconds to force a shutdown of the entire trigger-connected system.

Trigger Specifications

The Benchmark **12V TRIGGER** I/O has a wide operating range to allow interfacing with most other DC trigger systems. It should only be used with trigger inputs that are designed to tolerate 12 VDC.

- 12 VDC 200 mA current-limited output
- Input responds to 3.3 V logic and higher
- Maximum input voltage = 30 VDC
- Maximum reverse input voltage = -0.3 VDC
- Input Impedance = 20 k Ohms
- 1/8" (3.5 mm) TRS jack
- Tip = 12 Volt Trigger I/O
- Ring = no connection
- Sleeve = chassis ground

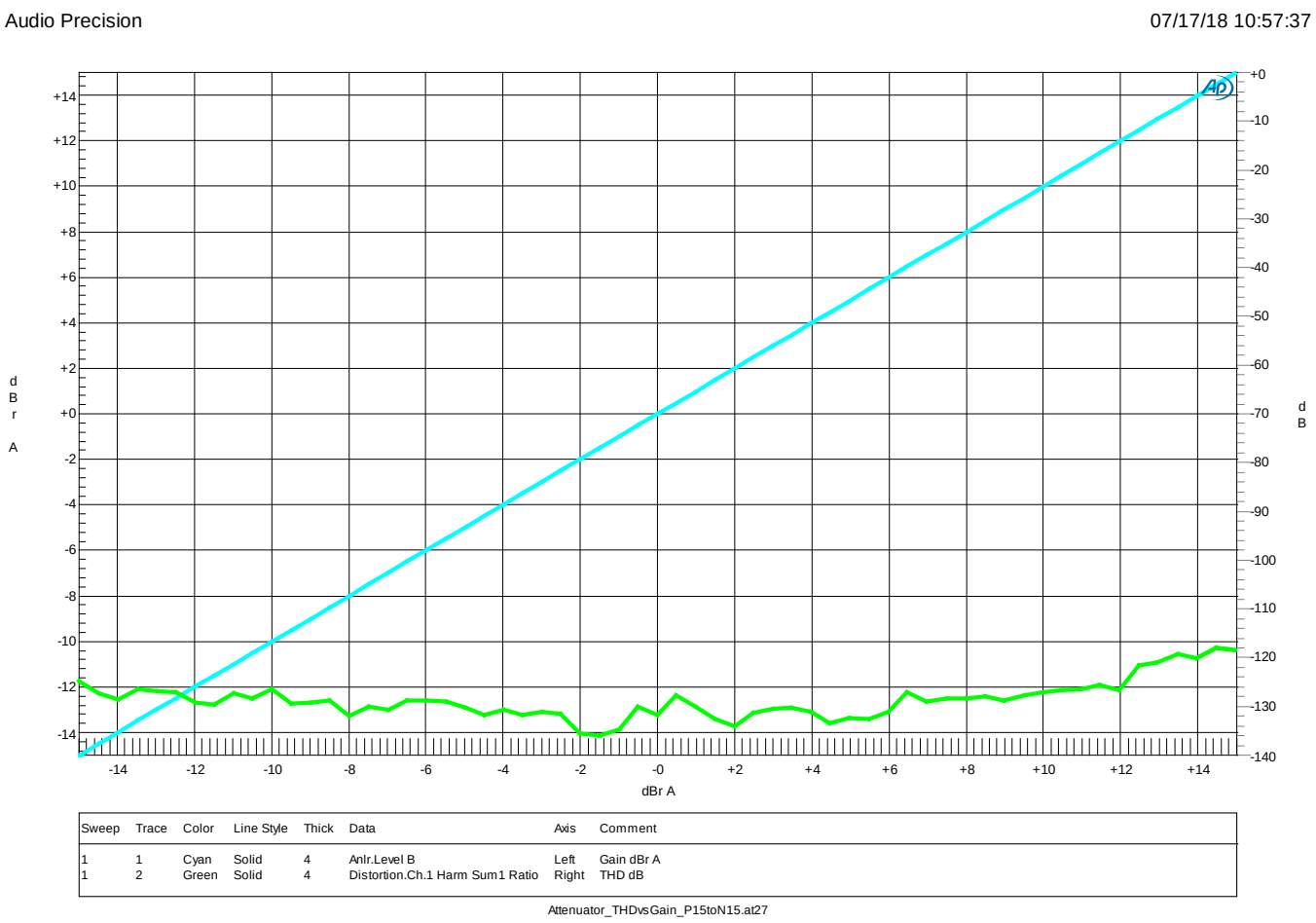
Caution: The **12V TRIGGER** I/O is not an audio connection! This is a 12V DC connection for synchronizing the on and off sequencing of an entire audio system.

Tip: The trigger ports can be connected with 2-conductor or 3-conductor 1/8" (3.5 mm) cables. The 3rd conductor is not used. Benchmark products are supplied with 3-conductor cables, but any mix of 2 and 3 conductor cables can be used.

Software Version Identification

The software and firmware versions are displayed on the **ABOUT** screen. The software drives the touch screen and the firmware programs the Xilinx FPGA hardware control system. The FPGA controls the power supplies, trigger ports, rotary volume knob, remote control and relays. The FPGA has the speed and precision required to execute precise timing of the make-before-break relay closures in the stepped volume control.

Performance Graphs



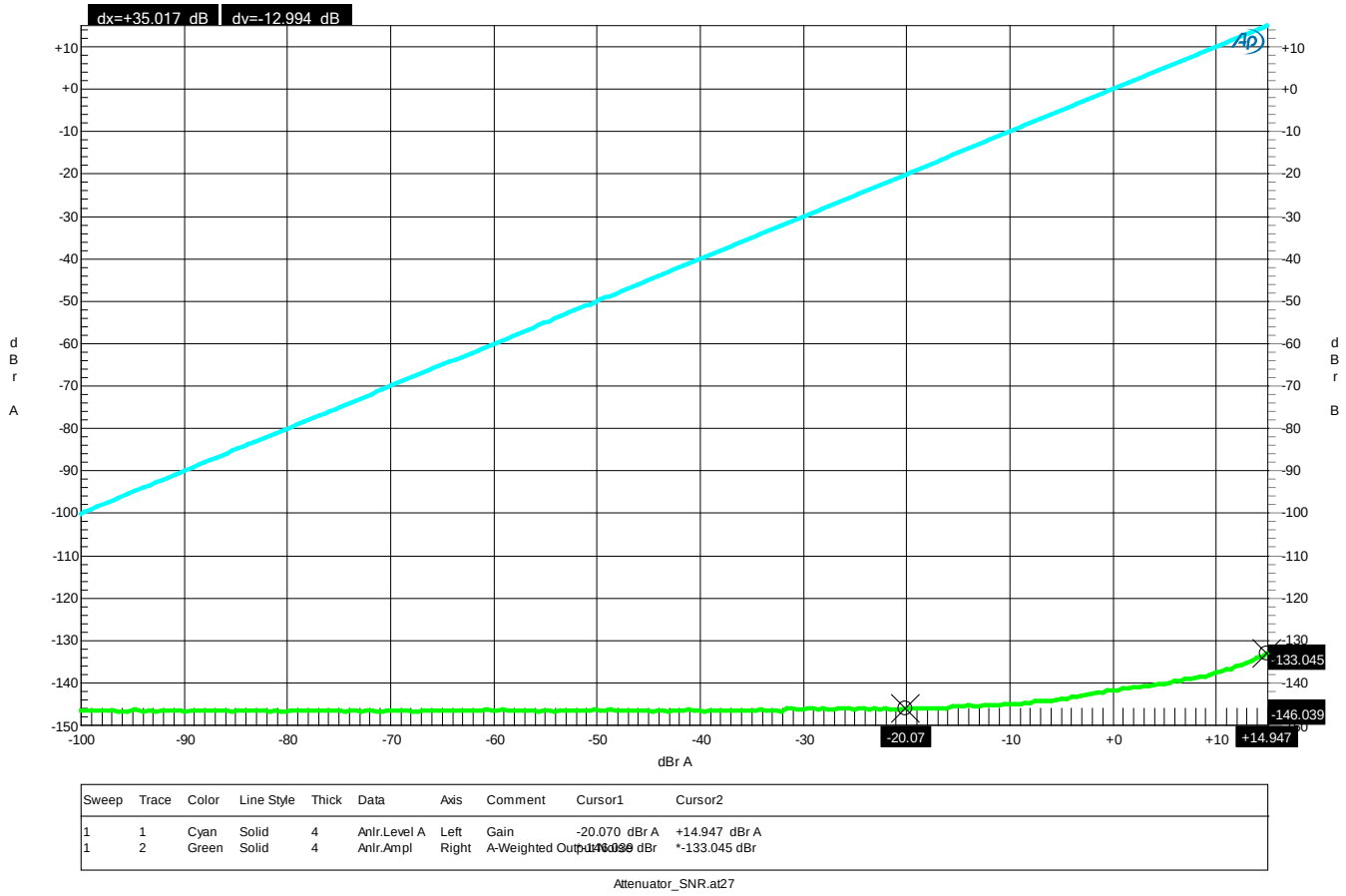
Graph 1 - Stepped Gain Control - THD vs. Gain (-15 dB to +15 dB)

The relay-controlled stepped gain controls are a key feature of the ***HPA4***. The headphone and line outputs have fully-independent controls. These stepped gain controls are designed to provide volume control over a wide operating range without adding any significant noise or distortion.

This plot shows that the stepped gain control produces almost no measureable THD. Over a range of -15 dB to +15 dB, the THD is between -120 dB (0.0001%) and -140 dB (0.00001%) and is near the measurement limits of the AP2722 test system! This measurement includes the balanced input and output buffers. This is a virtually distortion-free signal path with gain control.

Notes:

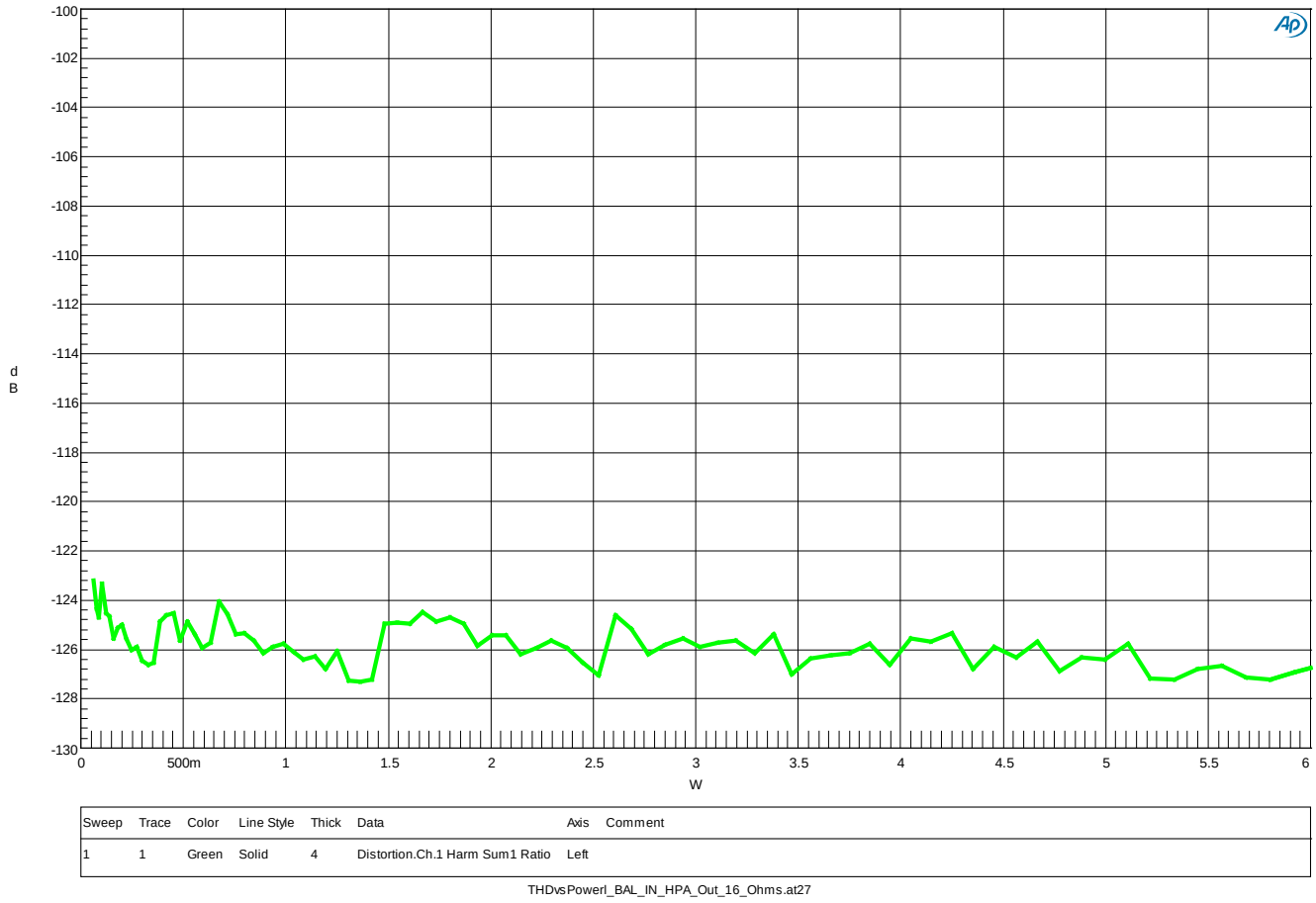
- The cyan curve shows the gain and uses the left-hand (dBr A) scale to show the gain in dB. This scale is dB relative to the input level. The input level was 10 dBu throughout the test.
- The green curve shows the THD using a 1 kHz test tone. The THD is plotted in dB relative to the output level and uses the right-hand (dB) scale. The output level was adjusted from -5 dB to +25 dBu using the stepped attenuator.
- Balanced inputs to balanced outputs.



Graph 2 - Stepped Gain Control - Output Noise vs. Gain Setting

The stepped gain control has a gain range of -112.5 to +15 dB in 0.5 dB steps. This plot shows the A-weighted output noise over a gain range of -100 dB to + 15 dB. The A-weighted output noise is plotted relative to the maximum balanced output level of 28 dBu. The signal to noise ratio at any gain setting is the difference between the two curves. At maximum gain, the SNR is 15 dB - (-133 db) = 148 dB. At a gain of -20 dB, the SNR is -20 dB - (-146 dB) = 126 dB. This test demonstrates the wide operating range of the fully-balanced low-impedance stepped gain controls.

Below a gain of -20 dB, the noise is determined by the thermal noise (Johnson noise) produced by the resistors in the stepped attenuator. Each side of the balanced attenuator has an impedance of just 1210 Ohms. This means that the balanced output impedance of the attenuator is 2420 Ohms. This resistance determines the output noise of the balanced attenuators. At any gain less than -20 dB, the A-weighted noise floor of the stepped gain control in combination with the balanced output buffers is -146.5 dB relative to +28 dBu. In other words, the A-weighted output noise is -118.5 dBu. This is approximately equivalent to the thermal noise produced by a single 2.5 kOhm resistor. This shows that the active balanced output buffers do not add any significant noise to the stepped gain control. The active output buffers are important because they provide low impedance drive to downstream devices (such as power amplifiers and the internal **THX-888** headphone amplifier).



Graph 3 - THD vs. Output Power - Headphone Amplifier - 0 to 6 W into 16-Ohms

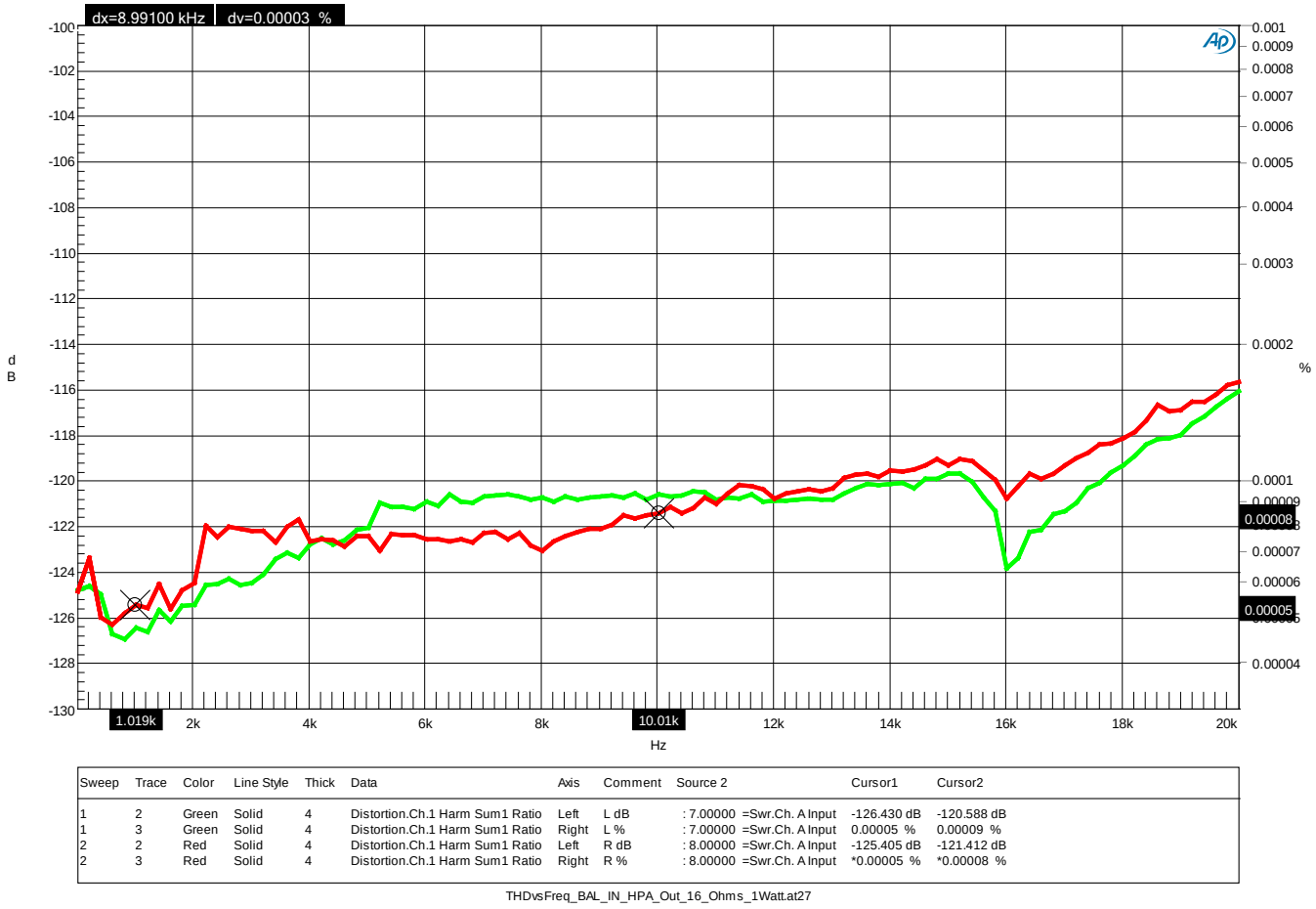
The **THX-888** headphone amplifier is designed to drive heavy loads at high levels without an increase in THD. It is also virtually distortion-free at low signal levels and/or light loads.

This output power sweep shows that THD does not increase with output power. The **THX-888** headphone amplifier stays extremely clean as the output power is swept from 60 mWatts to 6 Watts. Over this 100:1 range of power, the THD is virtually unchanged! The THD measures better than about -125 dB (0.000056%) over this wide range of output power into a 16-Ohm load. At the maximum rated output power or 6 Watts, THD measures about -127 dB (0.00004%).

This test demonstrates the effectiveness of the **THX AAA™** technology in the **THX-888** amplifier.

Notes:

- The scale on the left is dB THD relative to the output level.
- The test tone is 1 kHz. The test tone level was varied to sweep the output power from 0.06 Watts to 6 Watts.
- Balanced inputs to headphone outputs, volume control set at 0 dB.



Sweep	Trace	Color	Line Style	Thick	Data	Axis	Comment	Source 2	Cursor1	Cursor2
1	2	Green	Solid	4	Distortion.Ch.1 Harm Sum1 Ratio	Left	L dB	: 7.00000 =Swr.Ch. A Input	-126.430 dB	-120.588 dB
1	3	Green	Solid	4	Distortion.Ch.1 Harm Sum1 Ratio	Right	L %	: 7.00000 =Swr.Ch. A Input	0.00005 %	0.00009 %
2	2	Red	Solid	4	Distortion.Ch.1 Harm Sum1 Ratio	Left	R dB	: 8.00000 =Swr.Ch. A Input	-125.405 dB	-121.412 dB
2	3	Red	Solid	4	Distortion.Ch.1 Harm Sum1 Ratio	Right	R %	: 8.00000 =Swr.Ch. A Input	*0.00005 %	*0.00008 %

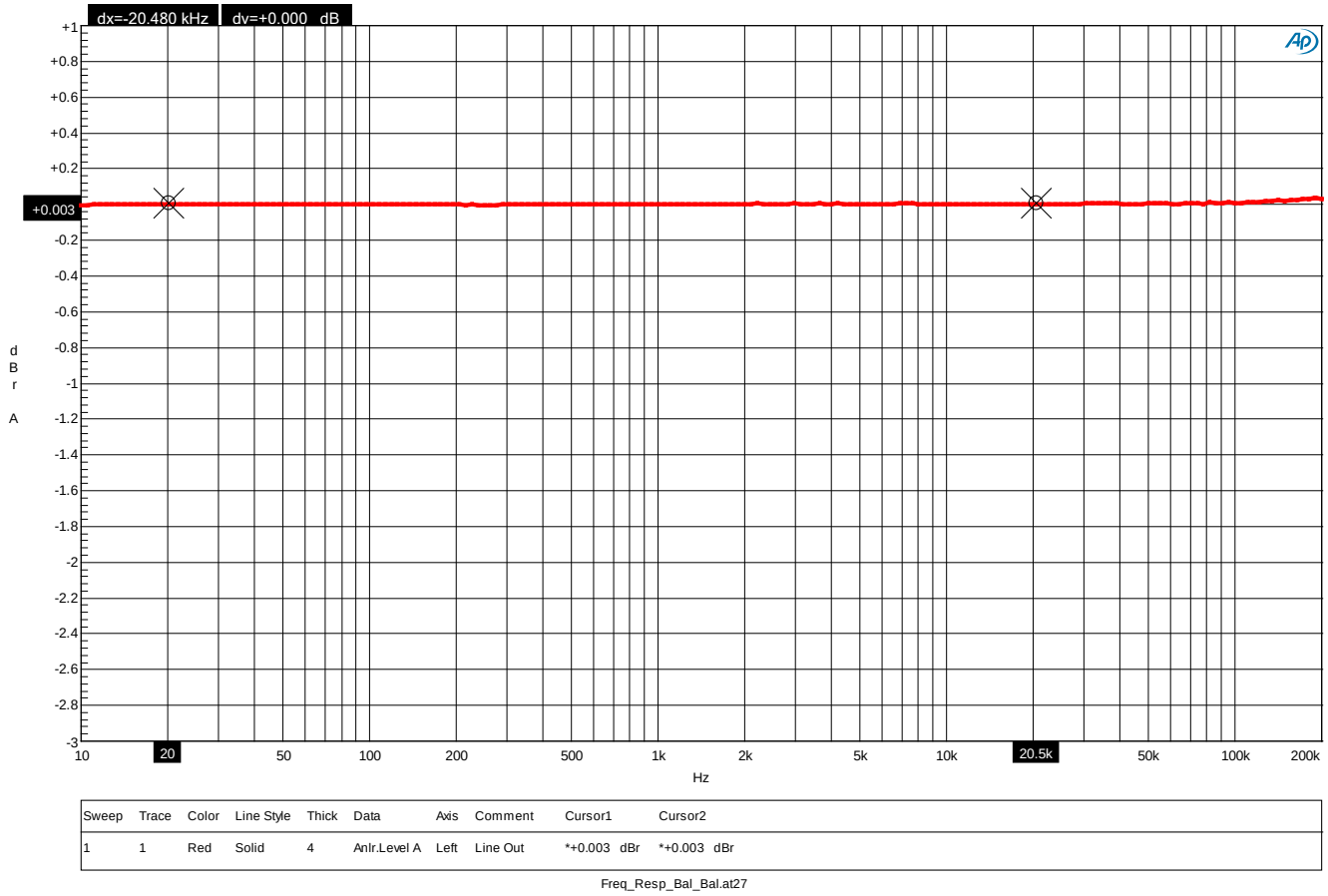
THDvsFreq_BAL_IN_HPA_Out_16_Ohms_1Watt.at27

Graph 4 - THD vs. Output Frequency - Headphone Amplifier - 20 Hz to 20 kHz Sweep

This frequency sweep shows that the THD remains extremely low when the frequency increases. The **THX-888** headphone amplifier delivered this performance while driving a 16-Ohm load.

Notes:

- The scale on the left is dB THD relative to the output level.
- The output level is 1 Watt into 16-Ohms (4 Vrms, 14.3 dBu).
- The THD measurement bandwidth is 48 kHz.
- The test tone is swept from 20 Hz to 20 kHz.
- Balanced inputs to headphone outputs, volume control set at 0 dB.



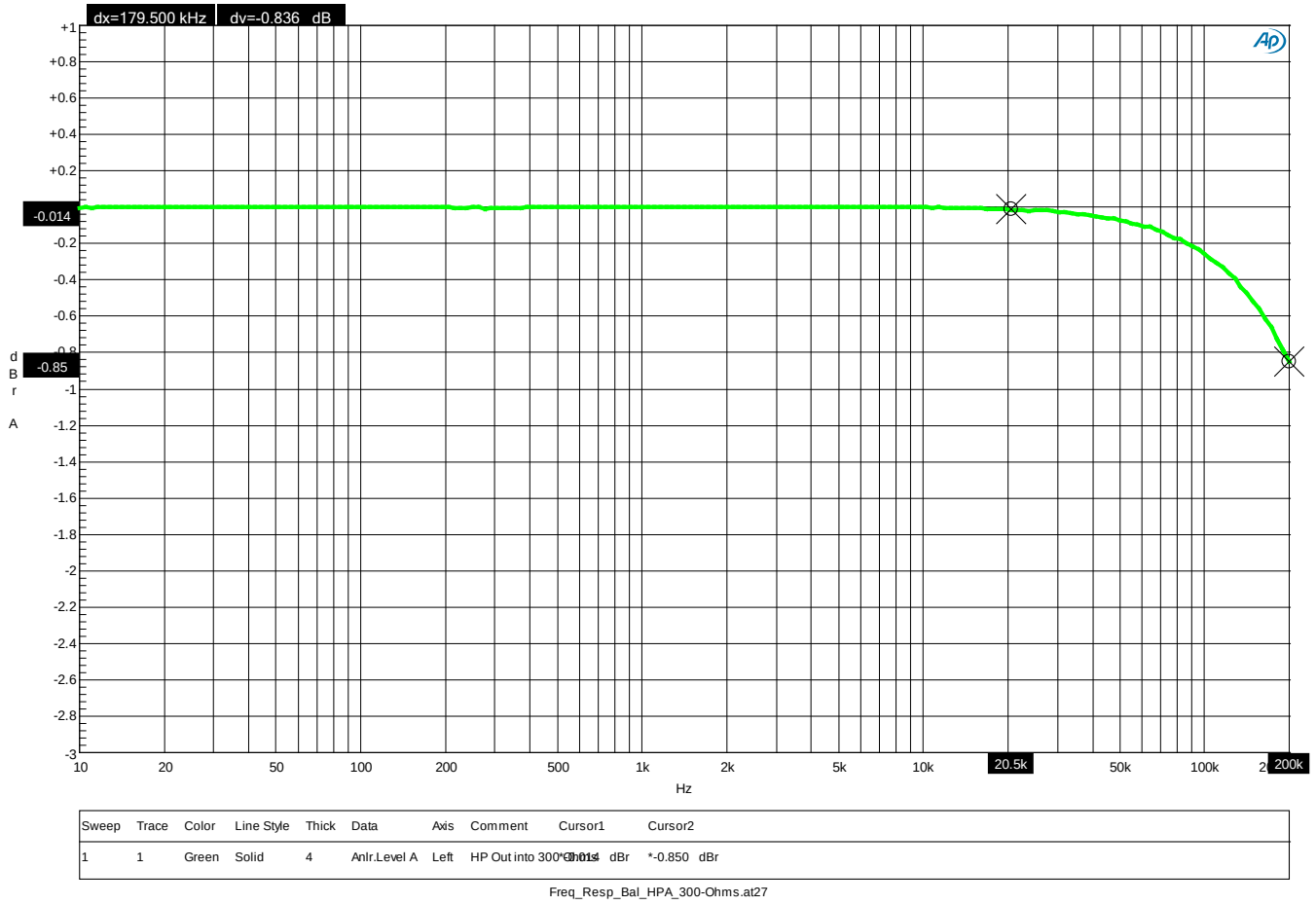
Graph 5 - Frequency Response - Line Amplifier

The -3 dB frequency response of the line amplifier extends from about 0.1 Hz to 500 kHz. This is well beyond the 10 Hz to 200 kHz range of our AP2722 measurement system. Over our 10 Hz to 200 kHz measurement range, the frequency response is perfectly flat.

The primary advantage of this wide frequency response is that it delivers a very precise phase response. Low bass is delivered with precise timing relative to the highest audible frequencies (and everything in between). Furthermore, the extreme bandwidth keeps the L/R differential phase nearly perfect. The result is an unrivaled stereo image with accurate placement of musical voices within a 3D sound stage.

Notes:

- The scale on the left (dBr A) is dB relative to the output level at 1 kHz. The test used a 0-dBu test tone. The small +/- 0.003 dB random variations shown are due to the measurement limitations of the AP2722.
- Balanced inputs to balanced line outputs, volume control set at 0 dB.

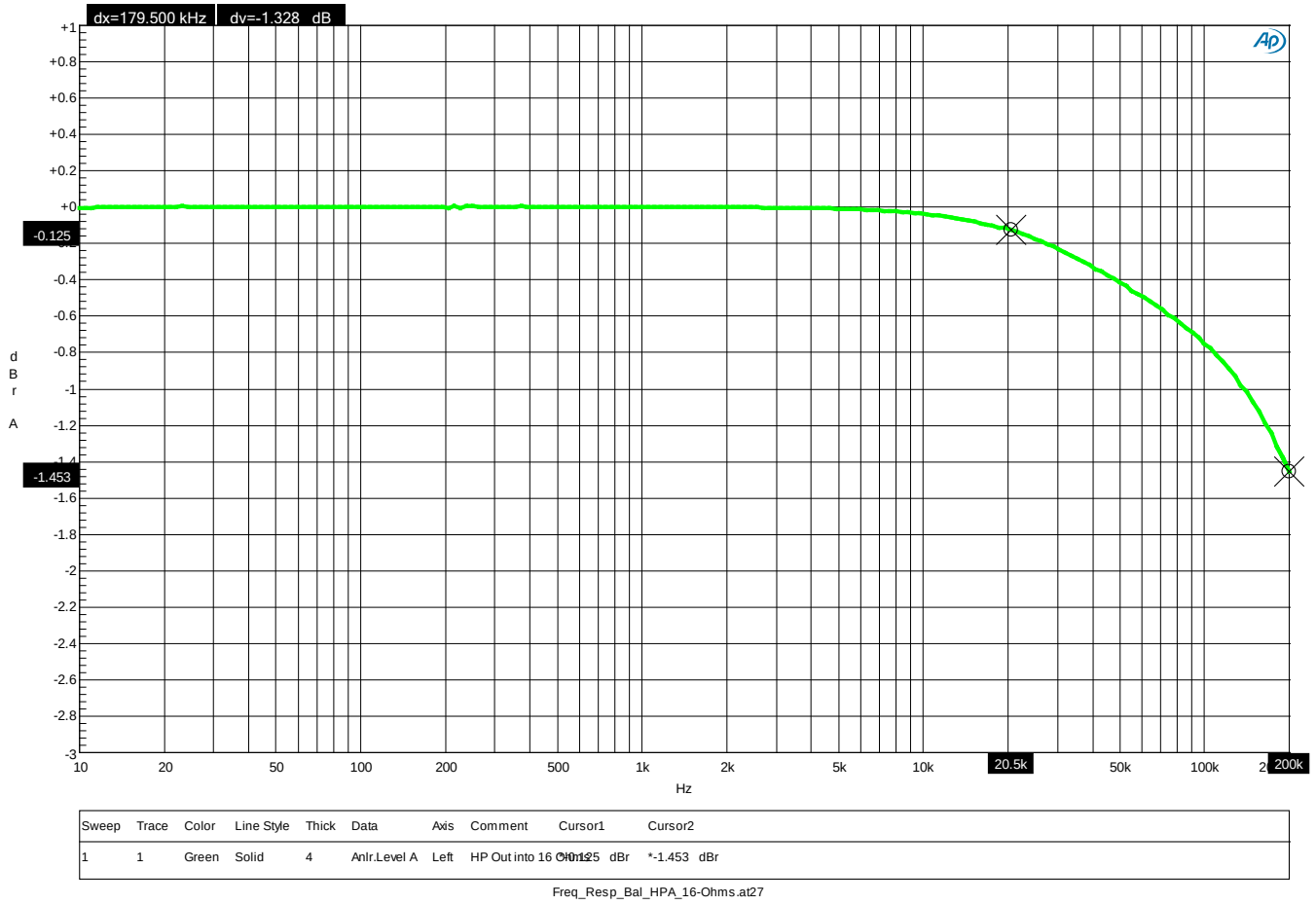


Graph 6 - Frequency Response - Headphone Amplifier - 300-Ohm Load

This plot is included to show that the frequency response of the headphone amplifier changes very little when the load impedance changes. The 16-Ohm response (shown in **Graph 7**) is nearly identical to the 300-Ohm response shown in this graph.

Notes:

- The scale on the left (dBr A) is dB relative to the output level at 1 kHz. The test used a 0-dBu test tone.
- Balanced inputs to headphone outputs, volume control set at 0 dB.

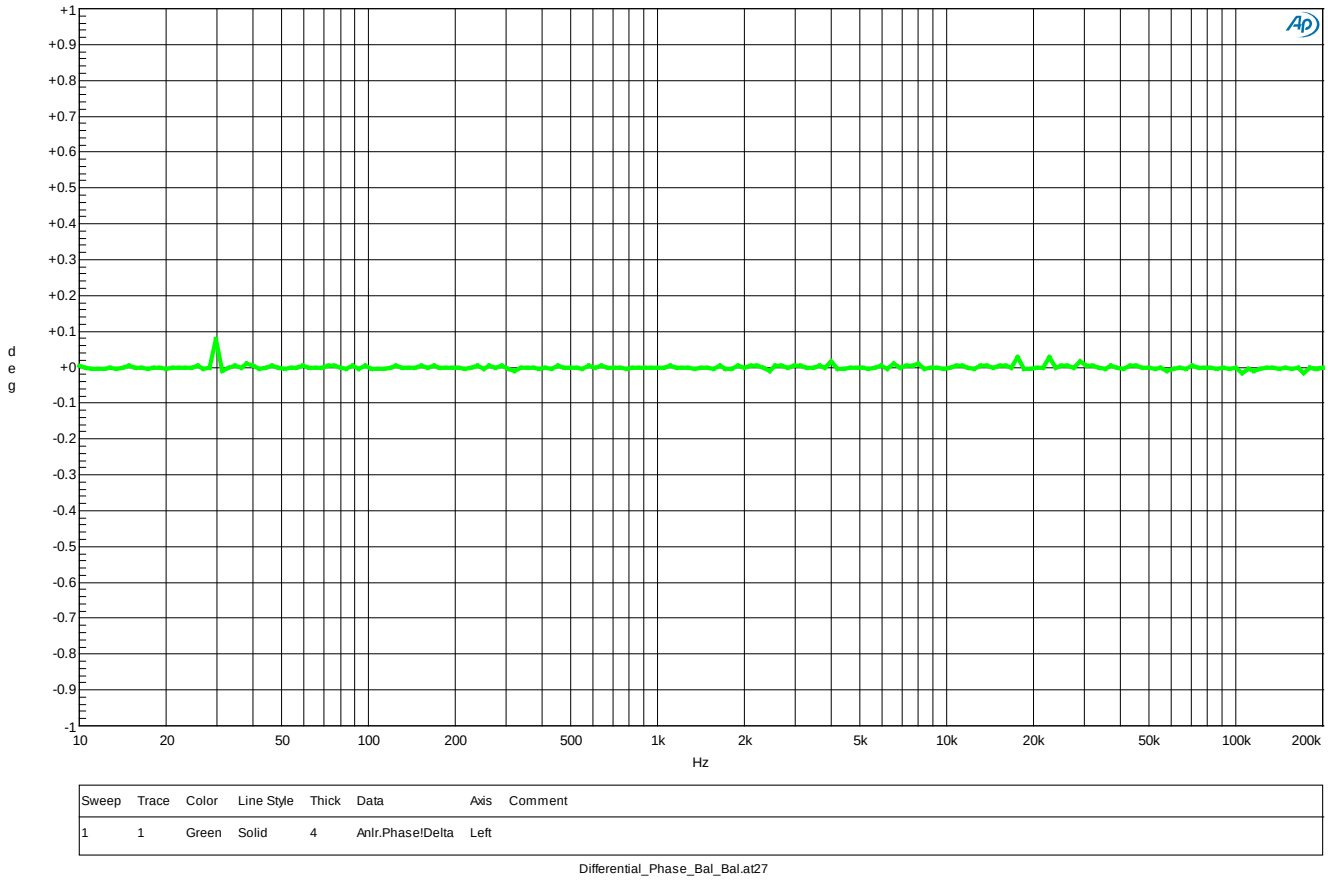


Graph 7 - Frequency Response - Headphone Amplifier - 16-Ohm Load

The -3 dB frequency response of the headphone amplifier extends well beyond the 10 Hz to 200 kHz range of our AP2722 measurement system. The response is -0.125 dB at 20 kHz and -1.45 dB at 200 kHz when driving a heavy 16-Ohm load. Compare this to **Graph 6** (frequency response into 300 Ohms). The difference in frequency response due to the heavy 16-Ohm loading is minimal. The difference due to loading is only 0.1 dB at 20 kHz and 0.6 dB at 200 kHz.

Notes:

- The scale on the left (dBr A) is dB relative to the output level at 1 kHz. The test used a 0-dBu test tone.
- Balanced inputs to headphone outputs, volume control set at 0 dB.

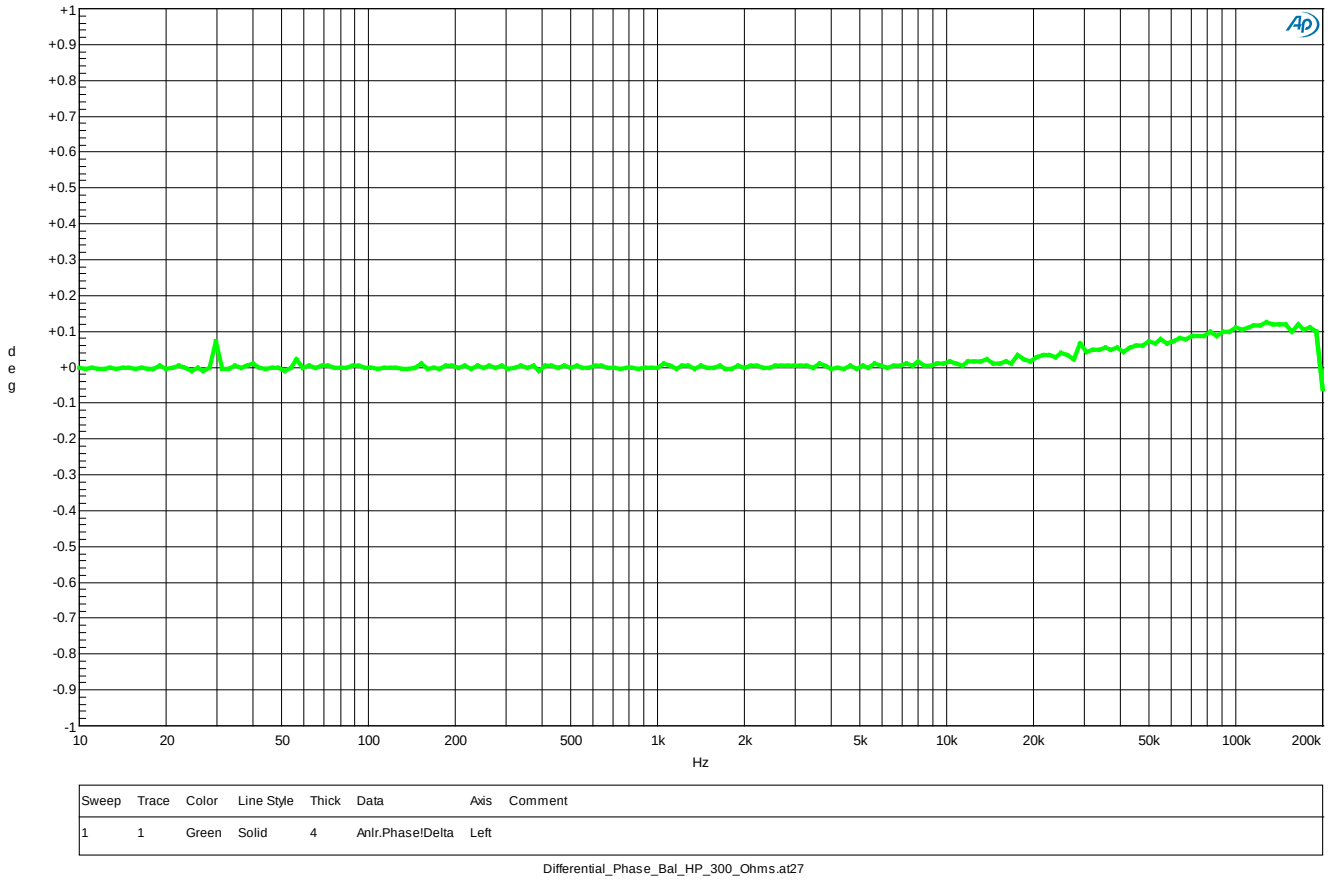


Graph 8 - Differential Phase - Line Amplifier

This plot shows the differential phase between the left and right channels. The extended 0.1 Hz to 500 kHz frequency response keeps the phase response of the two channels well matched over the audio band. This plot shows that the differential phase is virtually perfect! Notice that the scale is highly expanded (+/- 1 degree). The slight bumps in the curve are due to the measurement limits of the AP2722 test station. This L/R phase matching is much better than the L/R phase matching in the AP2722 test station. To make this measurement, we had to create a correction curve for the AP2722. The correction curve removes the phase errors produced by the test equipment, allowing measurement of the line amplifier.

Notes:

- The vertical scale is the phase difference between the left and right channels.
- Balanced inputs to balanced outputs, volume control set at 0 dB.

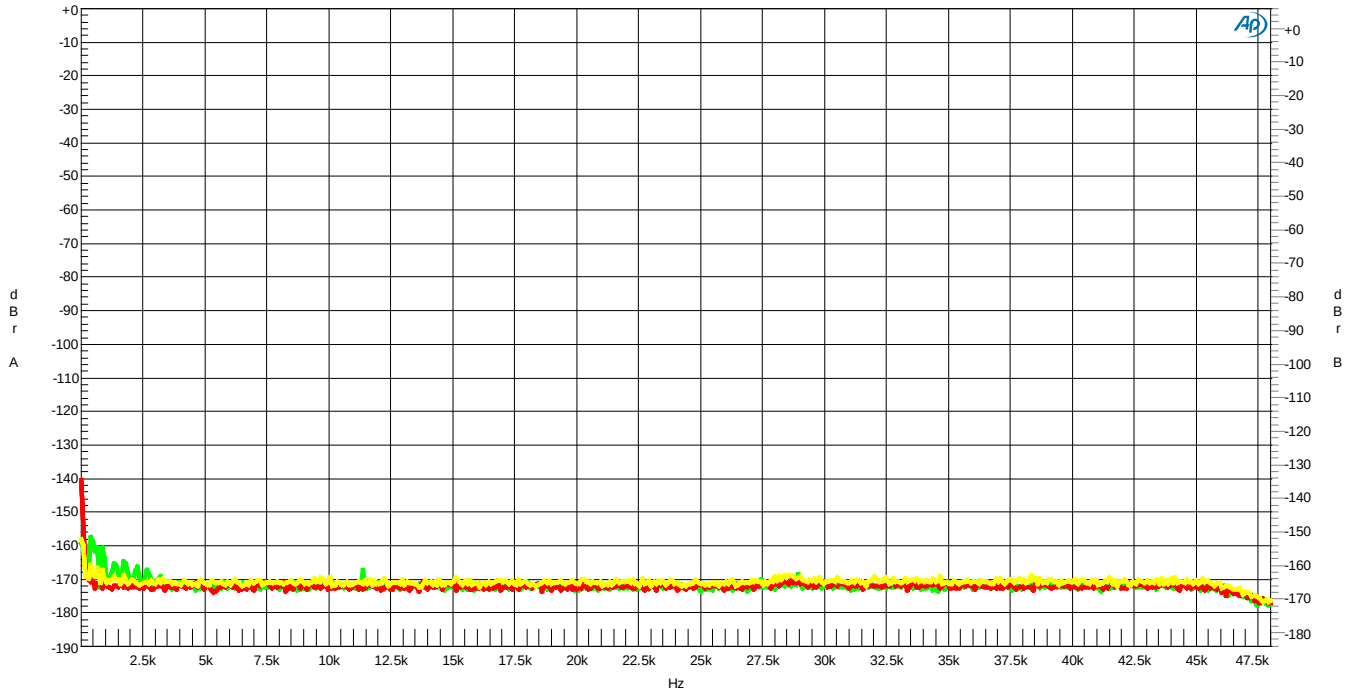


Graph 9 - Differential Phase - Headphone Amplifier - 300-Ohm Load

This plot shows the differential phase between the left and right headphone channels. The extended frequency response keeps the phase response of the two channels well matched over the audio band. This plot shows that the differential phase is virtually perfect! At 200 kHz, the differential phase error is only about 0.1 degree.

Notes:

- The vertical scale is the phase difference between the left and right channels.
- Balanced inputs to headphone outputs, volume control set at 0 dB.



Sweep	Trace	Color	Line Style	Thick	Data	Axis	Comment	Source 2
1	2	Green	Solid	4	Fft.Ch.1 Ampl	Left	Left Line Output	1.00000 =Swr.Ch. A Input
1	3	Green	Solid	4	Fft.Ch.1 Ampl	Right		: 1.00000 =Swr.Ch. A Input
2	2	Red	Solid	4	Fft.Ch.1 Ampl	Left	Right Line Output	2.00000 =Swr.Ch. A Input
2	3	Red	Solid	4	Fft.Ch.1 Ampl	Right		: 2.00000 =Swr.Ch. A Input
3	2	Yellow	Solid	4	Fft.Ch.1 Ampl	Left	Mono Line Output	3.00000 =Swr.Ch. A Input
3	3	Yellow	Solid	4	Fft.Ch.1 Ampl	Right		: 3.00000 =Swr.Ch. A Input

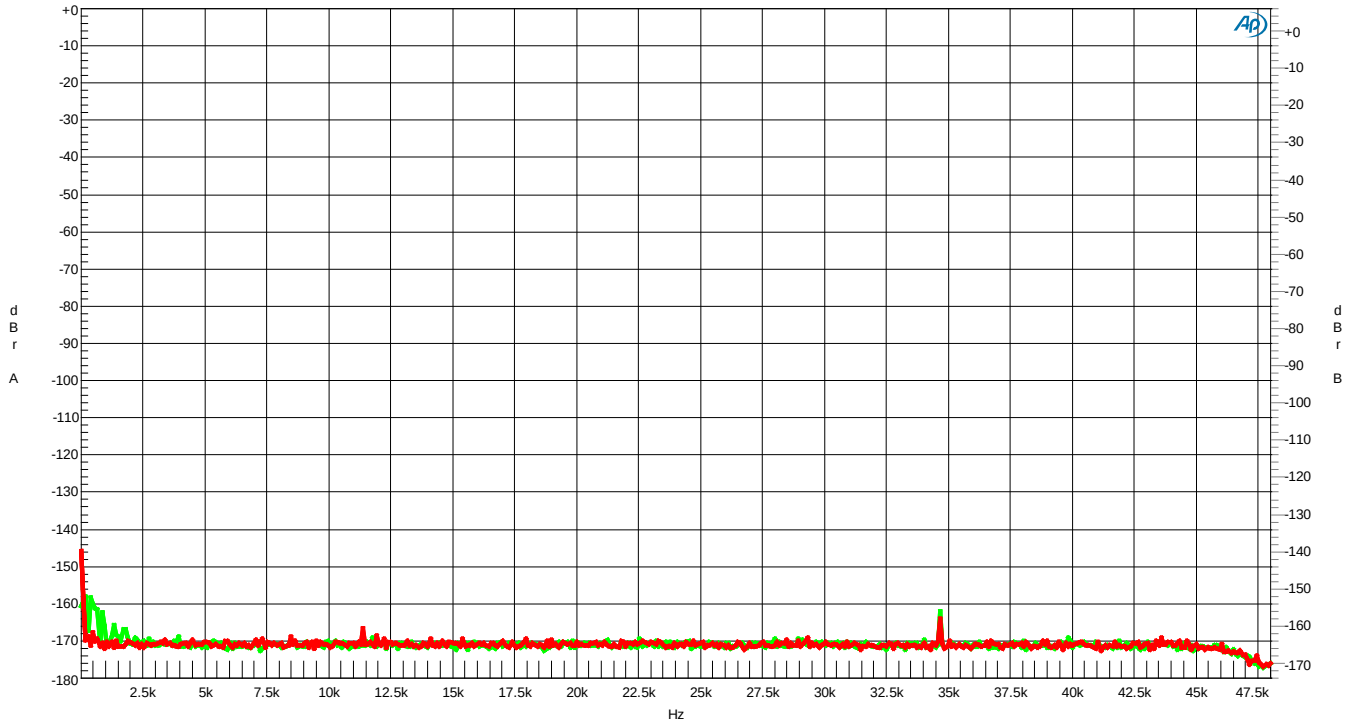
FFT_Idle_Unity_Gain_Bal_Bal.at27

Graph 10 - FFT Idle Channel Noise - Balanced In to Balanced Out

The ***HPA4*** is an exceptionally quiet line amplifier. This allows it to be inserted between a Benchmark ***DAC3*** and an ***AHB2*** power amplifier without degrading the noise performance of the system. This same line stage is used in front of the **THX-888** headphone amplifier. The line stage provides volume control without degrading the performance of the headphone amplifier.

Notes:

- The scale on the left (dBr A) is dB relative to +28 dBu. This is the maximum input and output level supported by the ***HPA4*** line stage.
- The scale on the right (dBr B) is dB relative to +22 dBu. This is the input level required to drive an external ***AHB2*** power amplifier to full output power. It is also the level required to drive the internal **THX-888** to full output power.
- Balanced inputs to balanced line outputs, volume control set at 0 dB.



Sweep	Trace	Color	Line Style	Thick	Data	Axis	Comment	Source 2
1	2	Green	Solid	4	Fft.Ch.1 Ampl	Left	Left HP Output	7.00000 =Swr.Ch. A Input
1	3	Green	Solid	4	Fft.Ch.1 Ampl	Right		: 7.00000 =Swr.Ch. A Input
2	2	Red	Solid	4	Fft.Ch.1 Ampl	Left	Right HP Output	8.00000 =Swr.Ch. A Input
2	3	Red	Solid	4	Fft.Ch.1 Ampl	Right		: 8.00000 =Swr.Ch. A Input

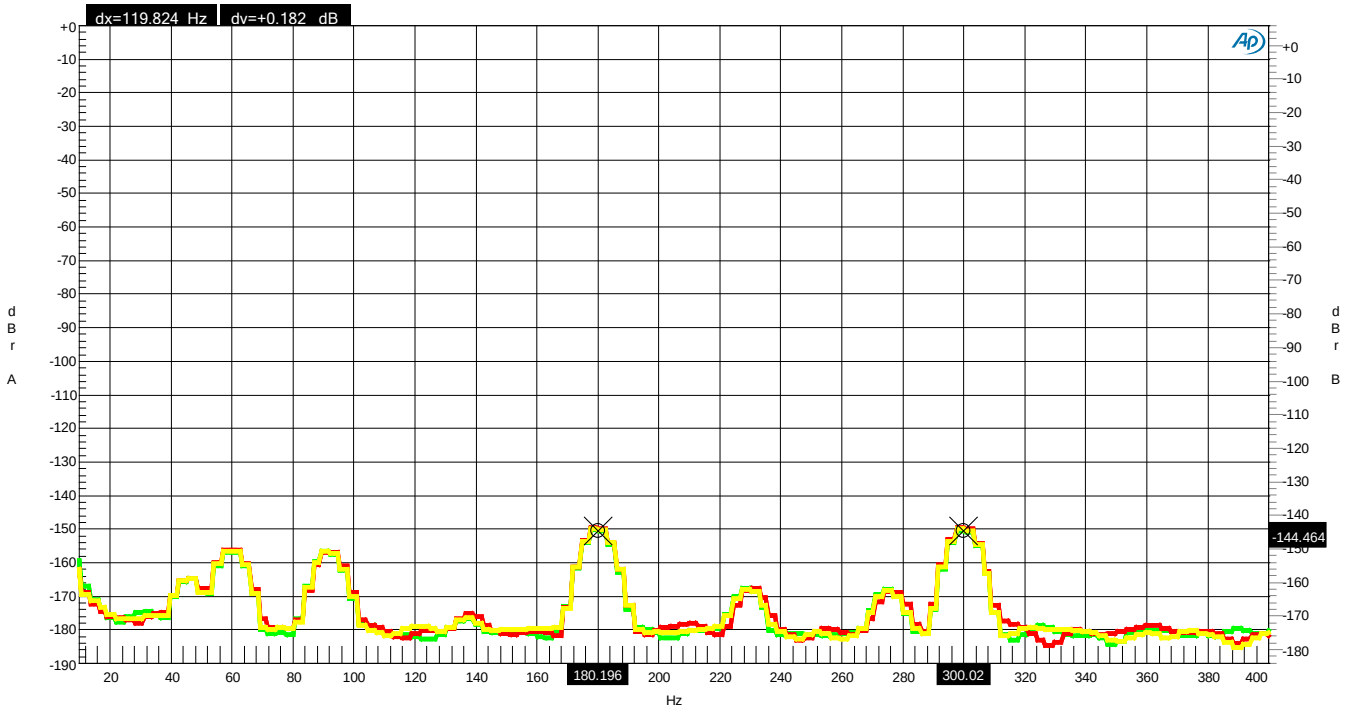
FFT_Idle_Unity_Gain_Bal_HPA.at27

Graph 11 - FFT Idle Channel Noise - Balanced In to Headphone Out

This graph shows the noise performance of the ***HPA4*** from the balanced inputs to the output of the **THX-888** headphone amplifier. This extraordinary performance keeps noise at inaudible levels, even when using high-efficiency headphones.

Notes:

- The scale on the left (dBr A) is dB relative to +28 dBu. This is the maximum input and output level supported by the ***HPA4*** line stage.
- The scale on the right (dBr B) is dB relative to +22 dBu. This is the input level required to drive an external ***AHB2*** power amplifier to full output power. It is also the level required to drive the internal **THX-888** to full output power.
- Balanced inputs to headphone outputs, volume control set at 0 dB.



Sweep	Trace	Color	Line Style	Thick	Data	Axis	Comment	Source 2	Cursor1	Cursor2
1	2	Green	Solid	4	Fft.Ch.1 Ampl	Left	Left Line Out	: 1.00000 =Swr.Ch. A Input	-150.645 dBr A	-150.464 dBr A
1	3	Green	Solid	4	Fft.Ch.1 Ampl	Right		: 1.00000 =Swr.Ch. A Input	*-144.645 dBr	*-144.464 dBr
2	2	Red	Solid	4	Fft.Ch.1 Ampl	Left	Right Line Out	2.00000 =Swr.Ch. A Input	-149.889 dBr A	-149.685 dBr A
2	3	Red	Solid	4	Fft.Ch.1 Ampl	Right		: 2.00000 =Swr.Ch. A Input	-143.889 dBr B	-143.685 dBr B
3	2	Yellow	Solid	4	Fft.Ch.1 Ampl	Left	Mono Line Out	3.00000 =Swr.Ch. A Input	-150.113 dBr A	-150.050 dBr A
3	3	Yellow	Solid	4	Fft.Ch.1 Ampl	Right		: 3.00000 =Swr.Ch. A Input	-144.113 dBr B	-144.050 dBr B

FFT_Idle_Unity_Gain_Bal_Bal_Low_Freq.at27

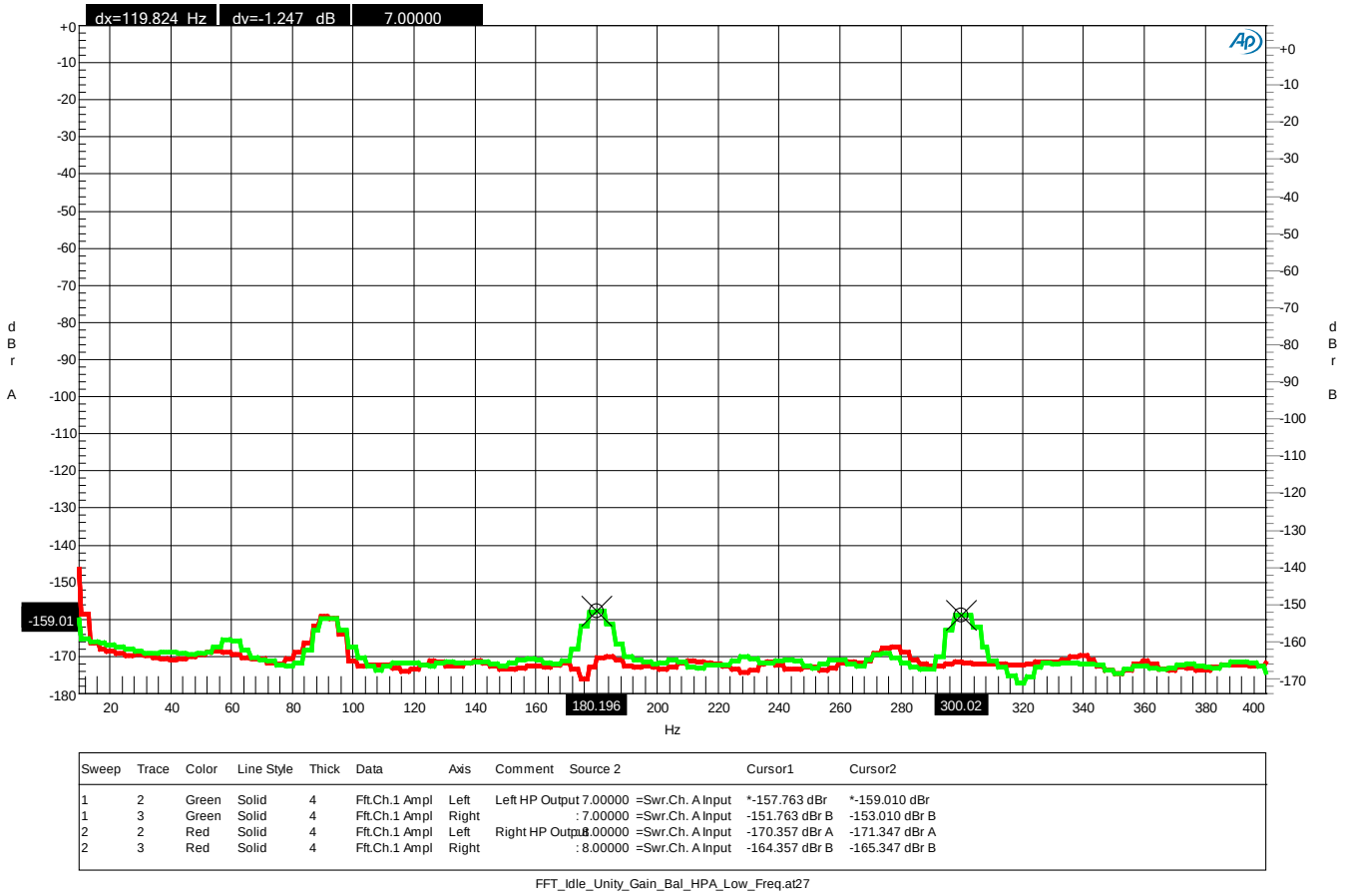
Graph 12 - AC Line-Related Hum - Line Amplifier

This FFT plot shows that AC line-related hum is 150 dB below the maximum output level of +28 dBu (use the left-hand dBr A scale)! The AC line frequency was 60 Hz in this test.

This plot also shows that AC line-related hum is 144 dB below the maximum input level of the internal **THX-888** and an externally connected ***AHB2*** power amplifier. These levels are so low that they will not impact the system SNR through the internal **THX-888** or an external ***AHB2***.

Notes:

- The scale on the left (dBr A) is dB relative to +28 dBu. This is the maximum input and output level supported by the ***HPA4*** line stage.
- The scale on the right (dBr B) is dB relative to +22 dBu. This is the input level required to drive an external ***AHB2*** power amplifier to full output power. It is also the level required to drive the internal **THX-888** to full output power.
- Balanced inputs to balanced line outputs, volume control set at 0 dB.



Sweep	Trace	Color	Line Style	Thick	Data	Axis	Comment	Source 2	Cursor1	Cursor2
1	2	Green	Solid	4	Fft.Ch.1 Ampl	Left	Left HP Output	7.00000 =Swr.Ch. A Input	*-157.763 dBr	*-159.010 dBr
1	3	Green	Solid	4	Fft.Ch.1 Ampl	Right		: 7.00000 =Swr.Ch. A Input	-151.763 dBr B	-153.010 dBr B
2	2	Red	Solid	4	Fft.Ch.1 Ampl	Left	Right HP Output	8.00000 =Swr.Ch. A Input	-170.357 dBr A	-171.347 dBr A
2	3	Red	Solid	4	Fft.Ch.1 Ampl	Right		: 8.00000 =Swr.Ch. A Input	-164.357 dBr B	-165.347 dBr B

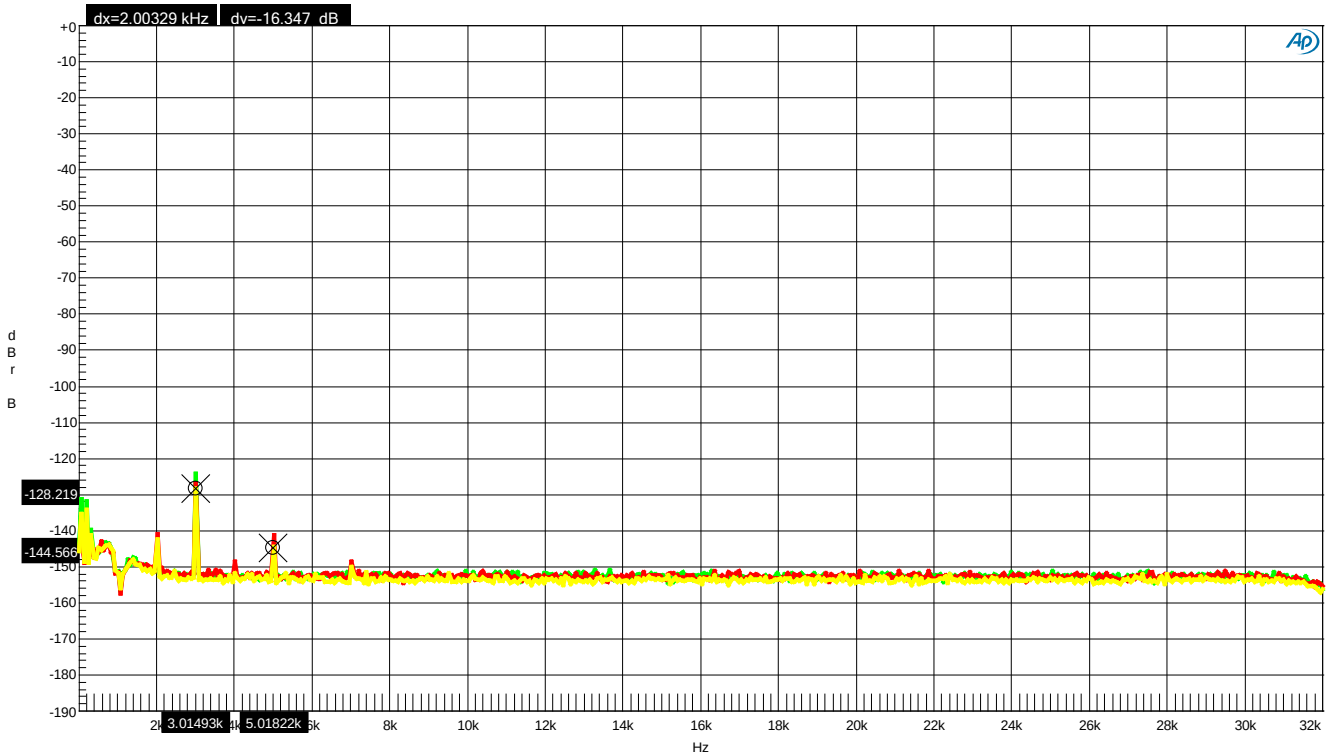
FFT_Idle_Unity_Gain_Bal_HPA_Low_Freq.at27

Graph 13 - AC Line-Related Hum - Headphone Output

This FFT plot shows that AC line-related hum is at least 152 dB below the **THX-888** headphone amplifier's maximum output level of +22 dBu (use the right-hand dBr B scale)!

Notes:

- The scale on the left (dBr A) is dB relative to +28 dBu. This is the maximum input and output level supported by the ***HPA4*** line stage.
- The scale on the right (dBr B) is dB relative to +22 dBu. This is the input level required to drive an external ***AHB2*** power amplifier to full output power. It is also the level required to drive the internal **THX-888** to full output power.
- Balanced inputs to headphone outputs, volume control set at 0 dB.



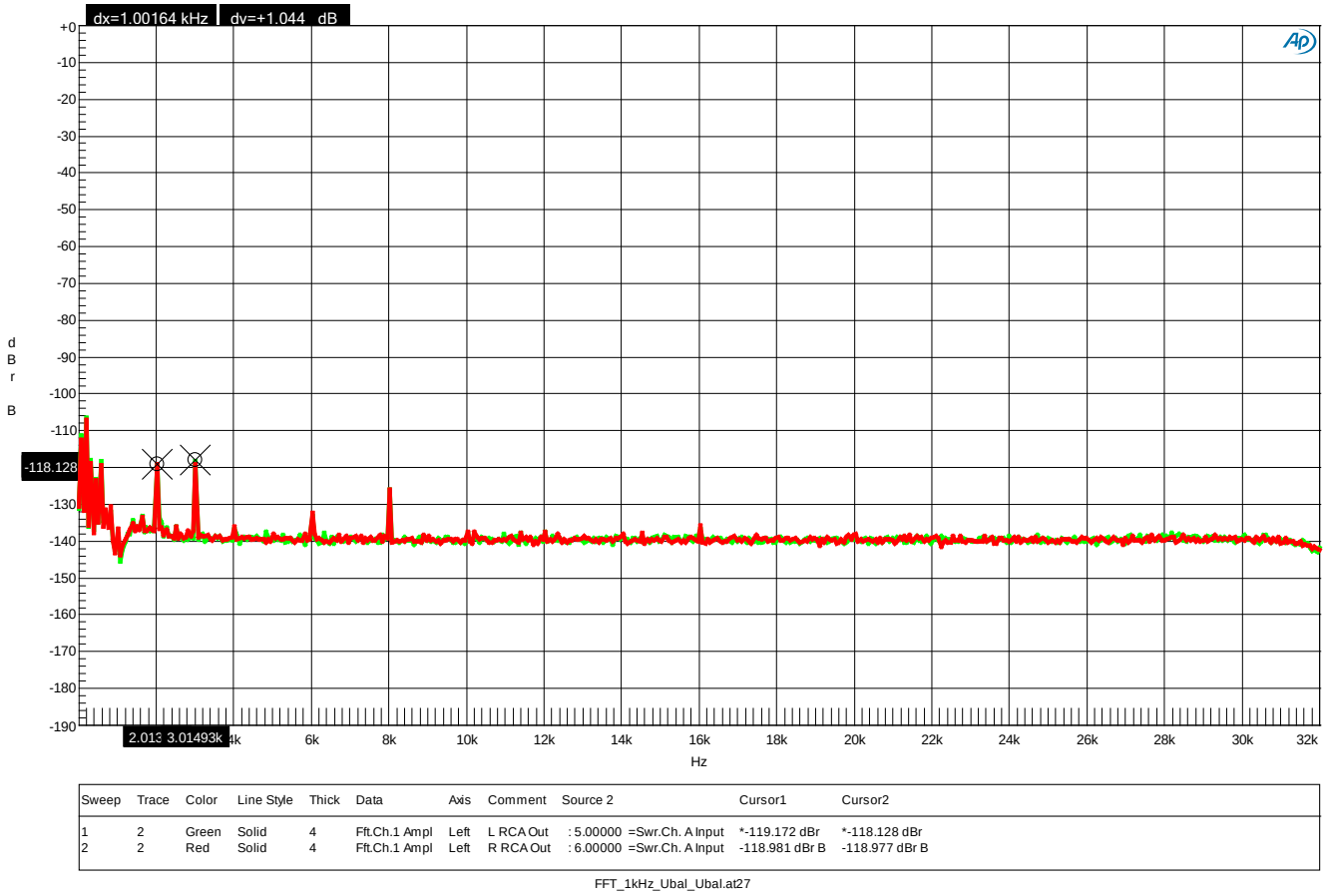
Sweep	Trace	Color	Line Style	Thick	Data	Axis	Comment	Source 2	Cursor1	Cursor2
1	2	Green	Solid	4	Fft.Ch.1 Ampl	Left	Left Line Out : 1.00000	=Swr.Ch. A Input	-124.094 dBr B	-146.609 dBr B
2	2	Red	Solid	4	Fft.Ch.1 Ampl	Left	Right Line Out 2.00000	=Swr.Ch. A Input	-126.729 dBr B	-141.285 dBr B
3	2	Yellow	Solid	4	Fft.Ch.1 Ampl	Left	Mono Line Out 3.00000	=Swr.Ch. A Input	*-128.219 dBr	*-144.566 dBr

Graph 14 - FFT 1 kHz Tone at 22 dBu - Line Amplifier - Balanced to Balanced

This plot shows that the THD produced by the line amplifier is extremely low, even when delivering a very high 22 dBu output. The third harmonic measures better than -124 dB (0.00006%) on all balanced outputs! The 5th harmonic measures better than -141 dB (0.000009%) on all balanced outputs!

Notes:

- The scale on the left (dBr B) is dB relative to +22 dBu. This is the signal level required to drive an external ***AHB2*** power amplifier to full output power. It is also the level required to drive the internal **THX-888** to full output power. It is also the level of the test tone.
- Balanced inputs to balanced line outputs, volume control set at 0 dB.
- The 1 kHz fundamental has been removed using a notch filter. This filter increases the resolution of the AP2722 test system.



Sweep	Trace	Color	Line Style	Thick	Data	Axis	Comment	Source 2	Cursor1	Cursor2
1	2	Green	Solid	4	Fft.Ch.1 Ampl	Left	L RCA Out	: 5.00000 =Swr.Ch. A Input	*-119.172 dBr	*-118.128 dBr
2	2	Red	Solid	4	Fft.Ch.1 Ampl	Left	R RCA Out	: 6.00000 =Swr.Ch. A Input	-118.981 dBr B	-118.977 dBr B

FFT_1kHz_Ubal_Ubal.at27

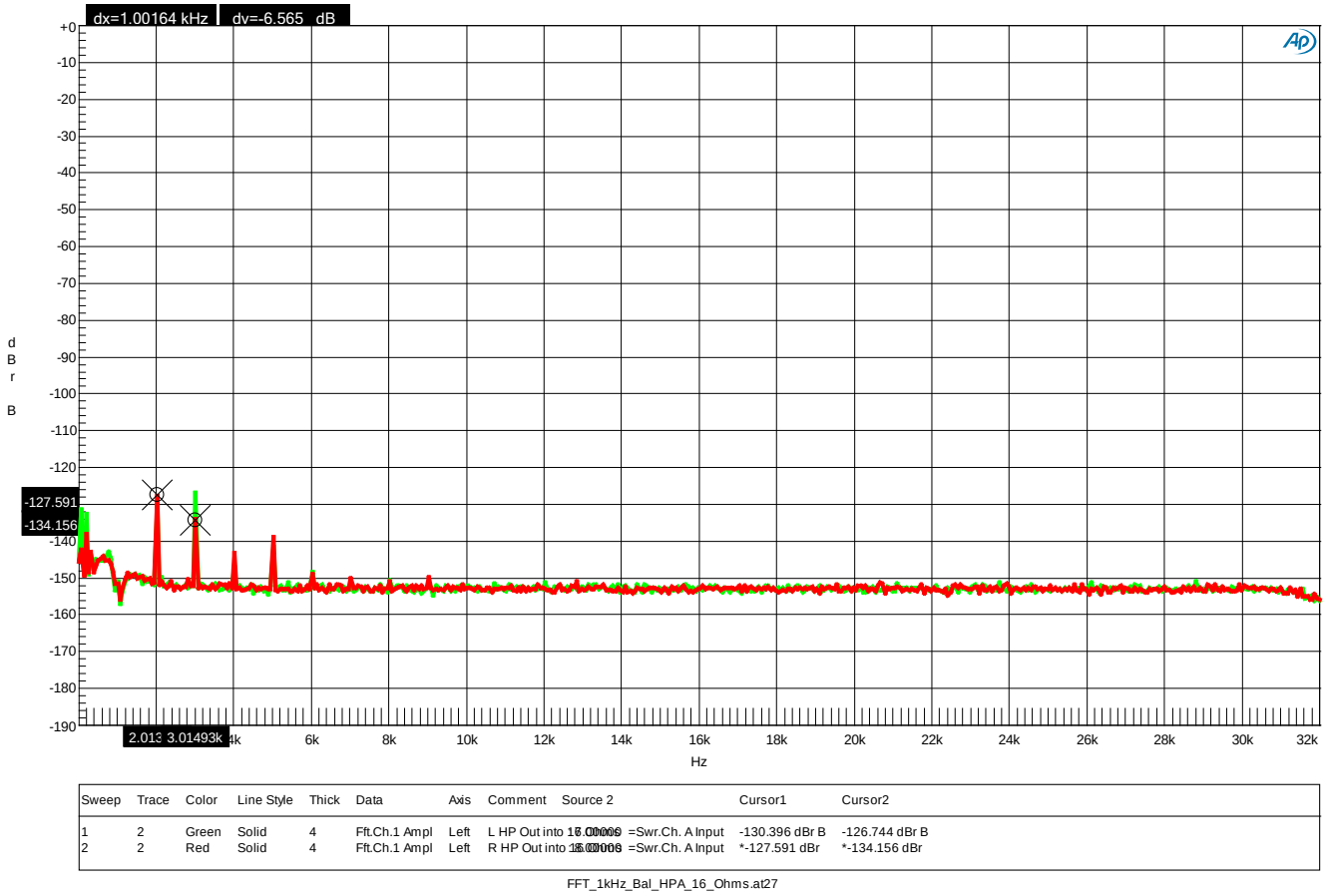
Graph 15 - FFT 1 kHz Tone at 1.6 Vrms - Line Amplifier - Unbalanced to Unbalanced

This plot shows the performance of the unbalanced inputs and outputs. The input level is 1.6 Vrms which is the level required to produce 22 dBu on the balanced outputs. This level was selected to match the operating point used in **Graph 14**.

If you compare Graph 6 (unbalanced) to Graph 5 (balanced) you can see that the unbalanced inputs and outputs perform very well in terms of THD. However, the SNR is slightly reduced due to the much lower signal levels used with unbalanced interconnects.

Notes:

- The scale on the left (dBr B) is dB relative to 1.6 Vrms. It is also the level of the test tone.
- Unbalanced inputs to unbalanced line outputs, volume control set at 0 dB.
- The 1 kHz fundamental has been removed using a notch filter. This filter increases the resolution of the AP2722 test system.

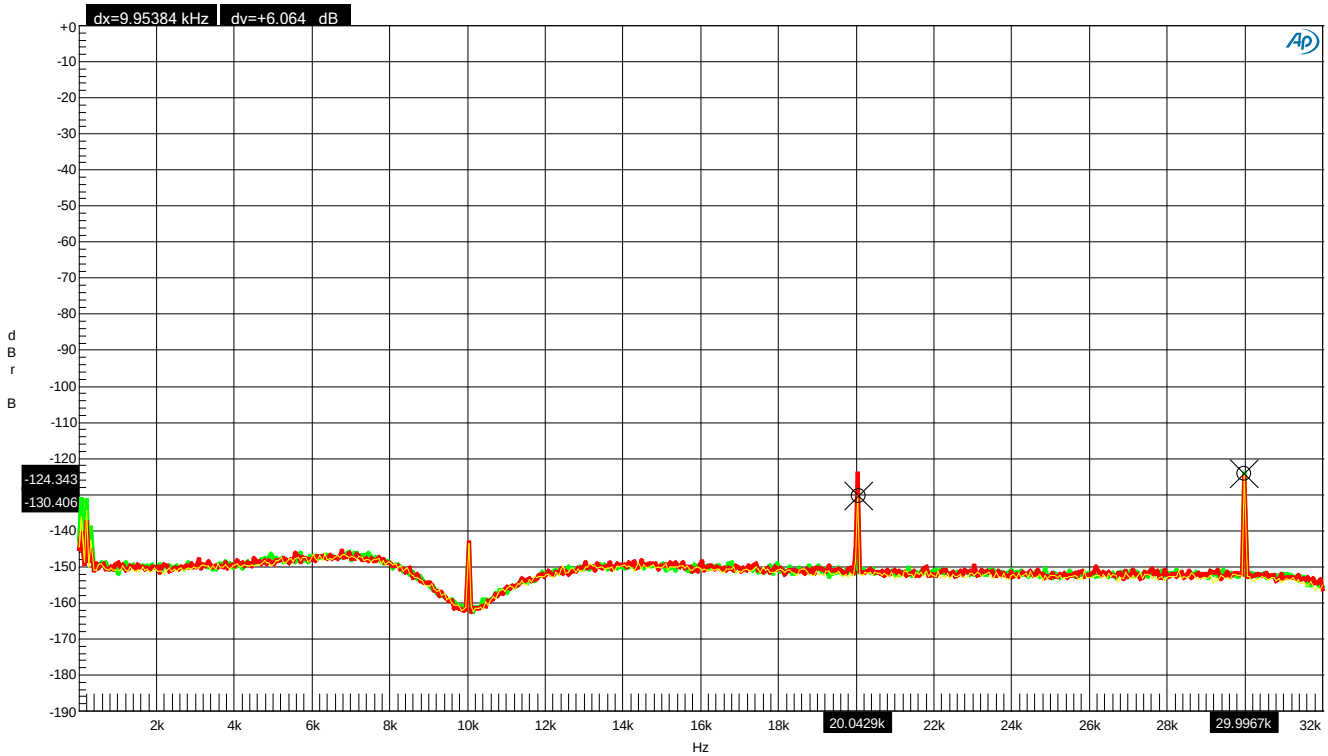


Graph 16 - FFT 1 kHz Tone at 22 dBu - Headphone Amplifier - 6 W into 16-Ohms

This plot shows that the THD produced by the **THX-888** headphone amplifier is extremely low, even when delivering a very high 22 dBu output into a low-impedance 16-Ohms load. The output power is 6 Watts per channel. The 2nd harmonic measures better than -127.5 dB (0.00004%) under full rated load! The 3rd harmonic measures better than -126.5 dB (0.000005%)! This test demonstrates the effectiveness of the **THX AAA™** with feed-forward error correction.

Notes:

- The scale on the left (dBr B) is dB relative to +22 dBu. This is the signal level required to drive an external ***AHB2*** power amplifier to full output power. It is also the level required to drive the internal **THX-888** to full output power. It is also the level of the test tone.
- Balanced inputs to headphone outputs, volume control set at 0 dB.
- The 1 kHz fundamental has been removed using a notch filter. This filter increases the resolution of the AP2722 test system.

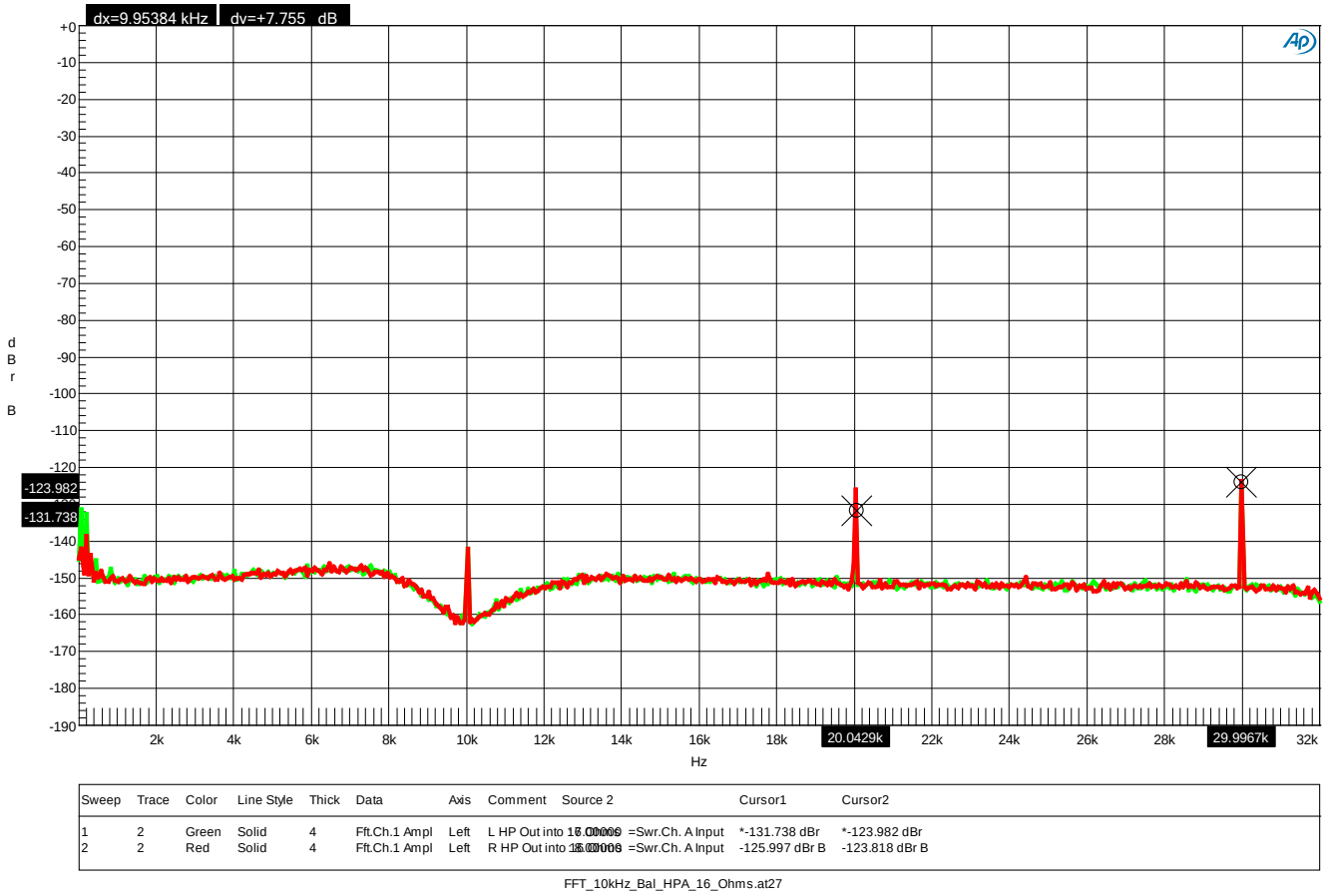


Graph 17 - FFT 10 kHz Tone at 22 dBu - Line Amplifier

This plot shows that the THD produced by the line amplifier is extremely low, even when delivering a very high 22 dBu output. The 2nd and 3rd harmonics each measure better than -124 dB (0.00006%)! This test shows that THD does not increase when reproducing high frequencies.

Notes:

- The scale on the left (dBr B) is dB relative to +22 dBu. This is the signal level required to drive an external ***AHB2*** power amplifier to full output power. It is also the level required to drive the internal **THX-888** to full output power. It is also the level of the test tone.
- Balanced inputs to balanced line outputs, volume control set at 0 dB.
- The 10 kHz fundamental has been removed using a notch filter. This filter increases the resolution of the AP2722 test system.



Graph 18 - FFT 10 kHz Tone at 22 dBu - Headphone Amplifier - 6 W into 16-Ohms

This plot shows that the **THX-888** headphone amplifier stays extremely clean, even when delivering 6 Watts at 10 kHz! The output level is 22 dBu (9.8 Vrms). The load impedance is 16 Ohms. Under these extreme high slew rate conditions, the 2nd and 3rd harmonics measure better than about -124 dB (0.00006%) into a difficult 16-Ohm load! This test demonstrates the effectiveness of the **THX AAA™** technology which includes feed-forward error correction.

Notes:

- The scale on the left (dBr B) is dB relative to +22 dBu. This is the signal level required to drive an external ***AHB2*** power amplifier to full output power. It is also the level required to drive the internal **THX-888** to full output power. It is also the level of the test tone.
- Balanced inputs to headphone outputs, volume control set at 0 dB.
- The 10 kHz fundamental has been removed using a notch filter. This filter increases the resolution of the AP2722 test system.

Specifications

THX-888 Headphone Outputs	
Test conditions: 1 kHz test tone, Output Level = +21 dBu, Unity Gain (unless noted)	
Number of Headphone Outputs	2
Output Connector - Differential Drive	Gold-Pin Neutrik™ XLR4 - female
Output Connector - Common Ground Return	1/4" Neutrik™ TRS Jack
SNR	135 dB, A-Weighted 131 dB, 20 Hz to 20 kHz
Output Noise	< 2.45 uV, 20 Hz to 20 kHz
Frequency Response	-0.006 dB at 10 Hz -0.014 dB at 20 kHz -3 dB at 0.1 Hz and 500 kHz
Output Impedance	Near 0 Ohms
Maximum Output Power and Voltage	6 Watts into 16 Ohms, 9.8 Vrms 2.6 Watts into 45 Ohms, 10.8 Vrms 640 mW into 200 Ohms, 11.3 Vrms 440 mW into 300 Ohms, 11.5 Vrms
Maximum Output Current (protection threshold)	1.5 Amps
Crosstalk, XLR4 Output	-133 dB@1kHz, -115 dB@10kHz
THD, 16-Ohm Load	-125 dB, 0.00006%, 16-Ohm Load
THD+N, 20 kHz BW, 16-Ohm load	-115 dB, 0.00018%
Volume Control Range	Mute, -112 dB to +15 dB in 0.5 dB steps
Balance Control Range	+/- 6 dB in 0.5 dB steps

Balanced Analog Outputs	
Test conditions: 1 kHz test tone, Output Level = +24 dBu, Unity Gain (unless noted)	
Number of Balanced Analog Outputs	3 (left, right, mono sum)
Output Connectors	Gold-Pin Neutrik™ XLR - male
SNR	137 dB, A-Weighted 135 dB, 20 Hz to 20 kHz
Output Noise	< 2.1 uV, 20 Hz to 20 kHz
Frequency Response	-0.005 dB at 10 Hz -0.001 dB at 20 kHz -3 dB at 0.1 Hz and 500 kHz
Output Impedance	60 Ohms
Maximum Output Level	+28 dBu, 19.5 Vrms
THD	-126 dB, 0.00005%
THD+N, 20 kHz BW	-115 dB, 0.00018%
Volume Control Range (with 0 dBFS digital input)	Mute, -112 dB to +15 dB in 0.5 dB steps
Balance Control Range	+/- 6 dB in 0.5 dB steps

Unbalanced Analog Outputs	
Test conditions: 1 kHz test tone, Input Level = 2 Vrms, Unity Gain (unless noted)	
Number of Unbalanced Analog Outputs	2 (left, right)
Output Connectors	Gold RCA - female
SNR	116 dB, A-Weighted 108 dB, 20 Hz to 20 kHz
Output Noise	< 8 uV, 20 Hz to 20 kHz
Frequency Response	-0.008 dB at 10 Hz -0.005 dB at 20 kHz -3 dB at 0.1 Hz and 500 kHz
Output Impedance	30 Ohms
Maximum Output Level	+12.2 dBu, 3.2 Vrms
Volume Control Range (with 0 dBFS digital input)	Mute, -112 dB to +15 dB in 0.5 dB steps
Balance Control Range	+/- 6 dB in 0.5 dB steps

Balanced Analog Inputs	
Number of Unbalanced Analog Inputs	4 (2 stereo pairs)
Input Connectors	Gold-Pin Neutrik™ XLR - female
Input Impedance	>50 k Ohms
Maximum Input Level	+28 dBu, , 19.5 Vrms
Input Selection and Muting	Gold-Contact Relays
Input State when Power is Off	Inputs are Disconnected using Relays

Unbalanced Analog Inputs	
Number of Unbalanced Analog Inputs	4 (2 stereo pairs)
Input Connectors	Gold RCA - female
Input Impedance	>50 k Ohms
Maximum Input Level	+12.2 dBu, 3.2 Vrms
Input Selection and Muting	Gold-Contact Relays
Input State when Power is Off	Inputs are Disconnected using Relays

Status Display	
Type	3.5" Color TFT with Capacitive Touch
Volume Indication - Headphone Output	Bar Graph and dB Gain
Volume Indication - Line Output	Bar Graph and dB Gain
MUTE Indicator	One for Headphone, One for Line
-20 dB DIM Indicator	Common for Both Output Groups
Input Name	8-Character, User Programmable
Input Connector Display	Input Number, Connector Type

AC Power Requirements	
Nominal Operating Range	100 – 240 VAC, 50 - 60 Hz
Min/Max Operating range	90 – 260 VAC, 47 - 63 Hz
Power	< 0.5 Watts Standby 15 Watts Typical Program 28 Watts Maximum
Fuses (2 required)	5x20 mm, 0.5 A 250 V Slo-Blo® Type

Dimensions	
Form Factor	½ Rack Wide, 2 RU High
Depth - excluding knob and connectors	8.33” (220 mm)
Overall Depth - including knob and connectors	9.33” (237 mm)
Width	8.65” (220 mm)
Height - excluding feet	3.47" (88 mm)
Height - including feet	3.88” (99 mm)

Weight	
HPA4 only	8 lb.
HPA4 with remote, power cord and manual	9 lb.
Shipping weight	12 lb.

Model Numbers	
The ***HPA4*** model number is 450-17200-XXX	XXX is a code for the chassis color

AC Power-Entry and Fuse Module

Input Voltage Range

Note: The ***HPA4*** is equipped with a universal power supply. There is no voltage selection switch. AC voltage range is 100 to 240 VAC, 50 to 60 Hz.

Power Cord

Note: The AC power input uses a standard IEC type connector. One USA-compatible power cord is included with the ***HPA4***. IEC style power cords in country-specific configurations are available in your locality.

Caution: Always use a grounded power cord. The *HPA4* is equipped with a standard IEC power entry module. Use an IEC power cord that is equipped with the appropriate connector for your location. Cords are available from your dealer.

Fuses

Caution: For continued fire hazard protection always replace the fuses with the correct size and type (T 0.5A 250V, 5 x 20 mm – Littelfuse® Slo-Blo® HXP218.500 or equivalent). The fuse drawer includes two fuses. Always replace both fuses at the same time.

Regulatory Compliance

FCC Notice (U.S. Only)

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

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

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

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

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

RoHS Compliant Information

This statement clarifies Benchmark Media Systems, Inc. product compliance with the *EU*'s (European Union) directive 2002/95/EC, or, *RoHS* (Restrictions of Hazardous Substances).

As of July 01, 2006, All Benchmark Media Systems, Inc. products placed on the European Union market are *compliant* (containing quantity limit weight less than or equal to 0.1% (1000 ppm) of any homogeneous Lead (Pb), Mercury (Hg), Hexavalent Chromium (Cr VI), and flame retardant Polybrominated Biphenyls (PBB) or Polybrominated Diphenyl Ethers (PBDE)).

CE Certificate of Compliance

Note: The ***HPA4*** model number is 450-17200-XXX where XXX is a code for the chassis color.

RF Solutions
801 Hiawatha Blvd East
Syracuse NY 13208
Phone 315-457-0245 | Fax 315-457-0428

Certificate of Compliance

RF Solutions, LLC has tested the product to the current appropriate standards and finds that the product is in compliance with those requirements.

EMC Directive:	**2014/30/EU**	
Generic Emissions Standard:	EN 61000-6-3:2007+A1:2010	
Product Specific Emissions:	55032:2015 Class B	
Generic Immunity Standard:	EN 55103-2:2010	
Immunity:	EN 61000-4-2:2009	Electrostatic Discharge
	EN 61000-4-3:2016	Radiated Susceptibility
	EN 61000-4-4:2012	Electrical Fast Transient/Burst
	EN 61000-4-5:2014	Surge
	EN 61000-4-6:2014	Conducted Susceptibility
	EN 61000-4-8:2010	Magnetics
	EN 61000-4-11:2004	Voltage Dips & Interruptions
	EN 61000-3-2:2014	Harmonic Current
	EN 61000-3-3:2013	Voltage Fluctuations & Flicker

Manufacturer's Name:	Benchmark Media Systems
Manufacturer's Address:	203 E Hampton Pl, Ste 2 Syracuse, NY 13206
Product:	HPA4 Headphone / Line Amplifier
Model Number:	450-17200-xxx

This Certificate of Compliance issued July 11, 2018 is valid for the test sample of the product specified above and that it complies with the Directive(s) and Standard(s).

Signature: Annelle Frierson

Annelle Frierson, Managing Partner
RF Solutions, LLC
801 Hiawatha Blvd. East
Syracuse, NY 13208
Phone: 315-457-0245 / Fax: 315-457-0428

Warranty Information

Benchmark 1-Year Warranty

The Benchmark 1-Year Warranty

Benchmark Media Systems, Inc. warrants its products to be free from defects in material and workmanship under normal use and service for a period **of one year from the date of delivery.**

This warranty extends only to the original purchaser. This warranty does not apply to fuses, lamps, batteries, or any products or parts that have been subjected to misuse, neglect, accident, modification, or abnormal operating conditions.

In the event of failure of a product under this warranty, Benchmark Media Systems, Inc. will repair, at no charge, the product returned to its factory. Benchmark Media Systems, Inc. may, at its option, replace the product in lieu of repair. If the failure has been caused by misuse, neglect, accident, or, abnormal operating conditions, repairs will be billed at the normal shop rate. In such cases, an estimate will be submitted before work is started, if requested by the customer.

Attempts to deliberately deface, mutilate, or remove the product's label will render this warranty void. Benchmark will not honor warranties for any products disingenuously purchased on the US or Canadian markets for export.

The foregoing warranty is in lieu of all other warranties, expressed or implied, including but not limited to any implied warranty of merchantability, fitness or adequacy for any particular purpose or use. Benchmark Media Systems, Inc. shall not be liable for any special, incidental, or consequential damages, and reserves the right to change this information without notice. This limited warranty gives the consumer-owner specific legal rights, and there may also be other rights that vary from state to state.

Benchmark Extended Warranty Options

The Benchmark Extended 5-Year Warranty *

Benchmark Media Systems, Inc. optionally extends the standard 1-year warranty to a period of **five years from the date of delivery.**

*For the extended warranty to become effective, the original purchaser must register the product at the time of purchase either by way of the enclosed registration card or through the product registration section of the Benchmark Media Systems, Inc. website. This optional warranty applies only to products purchased within the US and Canada and is extended only to the original purchaser.

Attempts to deliberately deface, mutilate, or remove the product's label will render this warranty void. Benchmark will not honor warranties for any products disingenuously purchased on the US or Canadian markets for export. The terms of the extended warranty are subject to change without notice. For products purchased outside the US and Canada, please refer to the Extended Two 2-Year International Warranty.

The Benchmark Extended 2-Year International Warranty **

Benchmark Media Systems, Inc. optionally extends the standard 1-year warranty to a period of **two years from the date of delivery.**

**For the extended warranty to become effective, the original purchaser must register the product at the time of purchase either by way of the enclosed registration card or through the product registration section of the Benchmark Media Systems, Inc. website. This optional warranty applies only to products purchased outside the US and Canada and is extended only to the original purchaser.

Attempts to deliberately deface, mutilate, or remove the product's label will render this warranty void. Benchmark will not honor warranties for any products disingenuously purchased on the US or Canadian markets for export. The terms of the extended warranty are subject to change without notice. For products purchased in within the US and Canada, please refer to the Extended Five 5-Year Warranty.

Notes on Warranty Repairs

An RMA (return merchandise authorization) number, issued by our Customer Service Department, is required when sending products for repair.

They must be shipped to Benchmark Media Systems prepaid and preferably in their original shipping carton with the RMA number clearly visible on the exterior of the packaging. A letter should be included giving full details of the difficulty.

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Benchmark Media Systems, Inc.
Benchmark Media Systems, Inc.
203 East Hampton Place, STE 2
Syracuse, NY 13206
USA

PHONE: +1-315-437-6300
FAX: +1-315-437-8119
benchmarkmedia.com