PE/D60
Powered Equalizer/Delay

Operation Manual

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an affiliate of Rauland-Borg Corp.

PE/D60

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INTRODUCTION

The Advantage **PE/D60** is an integrated power amplifier, distribution autoformer, 9-band graphic equalizer, and single-tap digital delay line, ideally suited for remote and under-balcony speaker systems in churches, theaters, auditoriums, and gymnasiums. The PE/D60 is easy to install and operate, and is covered by a 5-year warranty.

PE/D60 features include:

- integral digital-delay, equalizer, amplifier, and autoformer
- electronically balanced differential line level input stage
- digital delay line for alignment of remote speaker systems
- delay selectable in 1 mSec increments (0~1.023 seconds)
- 9-band graphic equalizer (±15dB on ISO center frequencies)
- 60W of power into 4W, 8W, or distributed speaker systems
- HPF (12dB/octave @ 60Hz) selectable with internal jumpers
- direct output selectable pre or post equalizer/master level
- passively cooled amplifier eliminates fan noise/maintenance
- complete short-circuit and thermal protection with auto-reset
- turn-on muting to provide noiseless power switching
- front panel indicators for power, signal present, and peak
- input/output connections provided on barrier strip terminals
- table-top design with optional rack-mounting accessory
- covered by Advantage Five-Year "Gold Seal" Warranty

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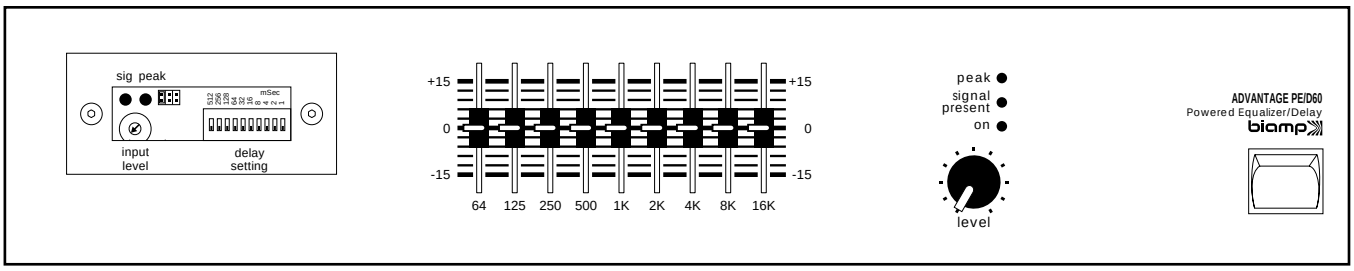
After reading this manual, if you have any questions or need technical assistance, please call Biamp Systems toll-free (1-800-826-1457).

FRONT PANEL FEATURES



Delay Security Cover Mounting Screws: These two hex screws fasten the see-through delay security cover to the front panel. The security cover must be removed to adjust any of the front panel delay controls. A 5/64" allen wrench is provided.

Delay Input Level Control: This screwdriver adjustable control sets the input level (-60dB to +6dB of gain), to compensate for different input signal levels. The Input Level Control should be adjusted so the delay A/D converter is working full-scale, providing the best signal-to-noise without distortion. Proper adjustment of input level is achieved by turning this control up (clockwise) until the Peak Indicator (5) begins to flash. Then turn the control down (counter-clockwise) *only slightly*, until the Peak Indicator no longer flashes.

Delay Signal Present (Sig) Indicator: This green LED indicates signal is present at the delay input. Once the Input Level Control is properly adjusted, the Signal Present Indicator will remain lit whenever signal levels of -24dB or greater reach the delay A/D converter. If this indicator does not light, please check signal connections and Input Level Control adjustment.

Delay Peak Indicator: This red LED indicates the delay A/D converter is working full-scale (0dBu max.). Use this indicator only as an aid in adjusting the Input Level Control. If the Peak Indicator flashes on normal signal levels, then the Input Level Control should be properly re-adjusted to avoid distortion.

Delay DIP Switches: These ten DIP switches are used to select the desired delay time (see Calculating Delay Times on page 4). To select a delay time, raise the corresponding switch(es) using a small screwdriver or other implement. The Delay DIP Switches provide an *additive* delay time. Raising multiple switches will provide a delay time which is the sum of all switches selected. For example, raising the "1mSec", "2mSec", and "4mSec" switches provides a delay time of 7mSec. Likewise, raising all switches provides the maximum delay time of 1.023 seconds. Standard minimum delay time increments are 1 milli-second.

Delay Bypass Jumper: A movable jumper is provided on the delay front panel. This jumper may be removed using needle-nose pliers. When removed, this jumper provides a delay bypass. This allows comparison of the direct signal and the delayed signal. After comparisons, always make sure this jumper is properly re-installed.

Graphic Equalizer: This graphic equalizer provides ±15dB of cut/boost within each of the nine frequency bands. Each band is one octave wide, and is centered on an ISO standard frequency (64Hz~16kHz). Each mark above and below the center position indicates a level change of approximately 3dB. Proper equalization should require only moderate (and equal) amounts of cutting and boosting. Equalization adjusts the frequency response of the sound system to compensate for room acoustics, and may also be used to reduce feedback. The graphic equalizer is post-delay and pre-amplifier.

Amplifier Level Control: This rotary control adjusts the level of signal sent to the amplifier. After the Delay Input Level Control has been properly adjusted, the Amplifier Level Control is used to set the desired volume level for the amplifier. Final adjustment of the Amplifier Level Control should wait until the necessary equalization settings have been made.

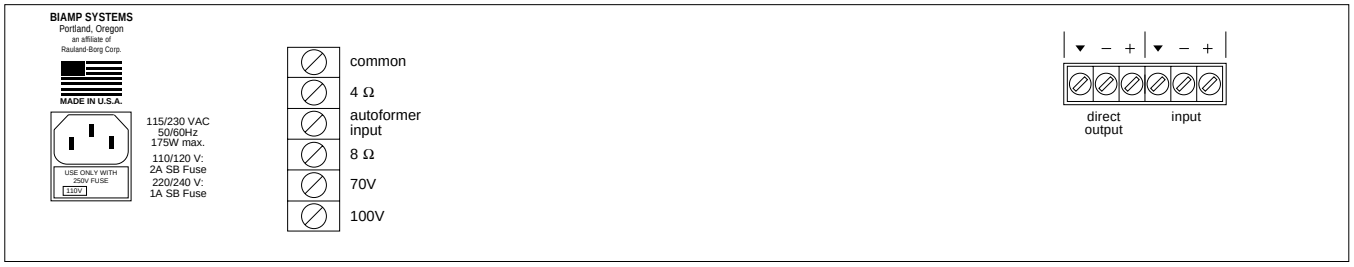
Amplifier Peak Indicator: This red LED indicates when the amplifier is on the verge of clipping (maximum power). The Amplifier Level Control should be adjusted so the Amplifier Peak Indicator does not light during normal operation. If changes to input level or equalization cause the Amplifier Peak Indicator to light, reduce level with the Amplifier Level Control.

Amplifier Signal Present Indicator: This green LED indicates when the amplifier output is greater than -20dBu (80mV) at the 4 ohm output. The Amplifier Signal Present Indicator will remain lit whenever signal is present at the amplifier output.

Power On Indicator: This green LED indicates when the Power switch is turned on, and AC power is applied to the unit.

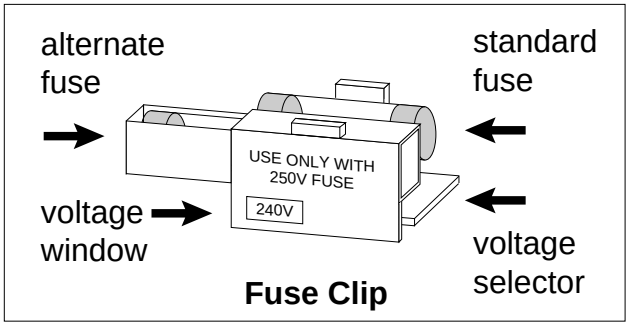
Power Switch: This switch applies AC power to the unit. When the Power Switch is turned on, the Power On Indicator will light. If the Power On Indicator does not light, check the AC connections and fuse (see Rear Panel Features on page 3).

REAR PANEL FEATURES



Power Cord Receptacle: This receptacle accepts the detachable AC Power Cord. The AC Power Cord is for connection to three-prong grounded AC outlets. *CAUTION: Do not remove or defeat the ground prong on the AC Power Cord, as this constitutes a shock hazard.*

Fuse Clip: The Fuse Clip may be removed by first detaching the AC Power Cord, then prying the Fuse Clip out from above, using a flat-blade screwdriver in the notch provided. The Fuse Clip contains both the standard fuse and an alternate fuse (see diagram below). The standard fuse is held in the clip, and becomes the actual AC fuse when the Fuse Clip is installed. Replace the standard fuse only with the same value and type (2A SB for 110 VAC operation or 1A SB for 240 VAC operation). The alternate fuse, held in a drawer inside the Fuse Clip, is provided only for use at the alternate operational voltage setting. If it is necessary to change the operational voltage, first slide the voltage selector out of the left side of the Fuse Clip. Turn the voltage selector over, and slide it back into the Fuse Clip, making sure the desired voltage selection is visible through the voltage window. Then change the standard fuse value (2A SB for "110V" or 1A SB for "240V"), before re-installing the Fuse Clip.



Output Terminals: These six screw terminals are for connection of the internal amplifier (and autoformer) outputs to desired speaker systems. The "common" terminal is for connection of the speaker system negative line. From the factory, a jumper connects the "4Ω" terminal to the "autoformer input" terminal. When using the "4Ω" terminal to power speakers directly, this jumper must be removed. The "4Ω" terminal will provide 60 watts into 4 ohm loads (40 watts into 8 ohm loads). When using the "8Ω" (21.9V), "70V", or "100V" terminals, the factory jumper, connecting the "4Ω" terminal to the "autoformer input" terminal, must be installed. The "8Ω" terminal provides 60 watts into 8 ohm loads (21.9V). The "70V" terminal provides up to 60 watts for 70.7 volt distributed speaker systems. The "100V" terminal provides up to 60 watts for 100 volt distributed speaker systems. **CAUTION:** *High voltages may be present at the output terminals. Make sure power is turned off or disconnected before making connections.* From the factory, a high-pass filter (12dB/octave @ 60Hz) is enabled via an internal jumper on the amplifier circuit board (see Modifications on page 9). This high-pass filter should remain enabled whenever the internal autoformer is being used. An internal speaker protection fuse is also included on the amplifier circuit board (see Modifications on page 9).

Input Terminals: These three screw terminals are for connection of balanced or unbalanced line level input signal from devices such as mixers, distribution amplifiers, tape decks, etc. For balanced input, connect high to (+), low to (-), ground to (⏚). For unbalanced input, connect high to (+) and ground to both (-) & (⏚). This input will accept either -10dBu or +4dBu nominal levels. Input Impedance is 20k ohms (balanced). Maximum input level is +24dBu. Input signals are sent directly to the internal delay, which requires adjustment of the Delay Input Level Control (see Front Panel Features on page 2).

Direct Output Terminals: These three screw terminals are for connection of balanced or unbalanced line level output signal to auxiliary amplifiers, hearing impaired systems, etc. For balanced output, connect high to (+), low to (-), ground to (⏚). For unbalanced input, connect high to (+) and ground to (⏚), leaving (-) unconnected. Output Impedance is 150 ohms (balanced). Maximum output level is +6dBu (balanced). Output signals are either pre or post equalizer/master level, selectable via an internal jumper (see Modifications on page 9). From the factory, Direct Output signals are pre-equalizer/master level. Direct Output signal is always post-delay/HPF.

CALCULATING DELAY TIMES

NOTE: *PC Control Software is available from Biamp Systems, which includes a program for calculating delay times and switch settings.*

Before calculating a delay time, you should begin with some preliminary calculations. First, determine the typical (or average) air Temperature for the location. Using this air temperature, you can then accurately calculate the Velocity (speed) of sound. Next you have determined the Distance between the direct and delayed sound sources. An accurate delay Time can then be calculated. The following tables show the actual mathematic equations needed to calculate delay time.

AMERICAN SYSTEM		**METRIC SYSTEM**	
Temperature (Fahrenheit) = **°F**	Velocity (feet/second) = **V**	Temperature (Celsius) = **°C**	Velocity (meters/second) = **V**
Distance (feet) = **D**	Time (milli-seconds) = **T**	Distance (meters) = **D**	Time (milli-seconds) = **T**
$\mathbf{V} = 49 \times \sqrt{459.4 + \mathbf{°F}}$	$\mathbf{T} = \mathbf{D} \div \mathbf{V}$	$\mathbf{V} = 20.06 \times \sqrt{273 + \mathbf{°C}}$	$\mathbf{T} = \mathbf{D} \div \mathbf{V}$

Some additional factors must be considered before actually making delay settings:

1) For best accuracy, Distance should be calculated as the *difference* between the direct and delayed sound sources, with respect to the listener (i.e...direct source to listener = 200 feet; delayed source to listener = 20 feet; Distance = 200'-20' = 180 feet).

2) When sounds from the direct source and the delayed source reach the listener at roughly the same volume level, additional delay of approximately 20 milli-seconds may be added to the delay time calculation. This added delay time will produce what is known as the Haas Effect. The Haas Effect will give the listener the impression that all sound is eminating from the direct sound source (i.e...calculated delay time = 159 milli-seconds; Haas Effect = 20 milli-seconds; delay time setting = 179 milli-seconds).

3) Calculations are necessary to determine proper delay time settings. However, it should be remembered that they are only accurate for a specific listening position (distance), and at specific temperature/velocity. Therefore, "fine tuning" the delay setting by ear is often times the best final adjustment. It may also be acceptable (in some applications) to make calculations assuming a Temperature of approximately 72°F (23°C) and, therefore, Velocity of 1130 feet/second (345 m/sec).

For more information on calculating delay times, see Sound System Engineering by Don Davis & Carolyn Davis, Howard W. Sams & Co.

CALCULATING DELAY TIMES

The following examples include a description of an application, delay time calculations, and actual delay settings.

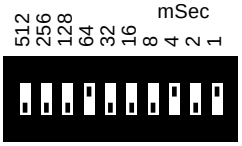
EXAMPLE #1

Application: A church with reinforcement near the front and under-balcony speakers towards the rear (see Applications on page 6).

Calculations:

American:	**°F** = 72° (approx.)	**V** = 1130 ft/sec (approx.)	**D** = (60 – 5) = 55ft	**T** = (55 ÷ 1130) = 49mS
Metric:	**°C** = 23° (approx.)	**V** = 345 m/sec (approx.)	**D** = (18.3 – 1.5) = 16.8m	**T** = (16.8 ÷ 345) = 49mS

Settings: Delay time settings include approximately 20mS of delay added for Haas Effect. **T** = (49mS + 20mS) = **69mS**.



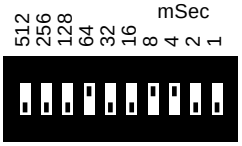
EXAMPLE #2

Application: A large banquet room with low ceilings, having reinforcement both towards the front and rear (see Applications on page 7).

Calculations:

American:	**°F** = 75° (estimated)	**V** = $49 \times \sqrt{459.4+75}$ = 1132.7 ft/sec	**D** = (75 – 12) = 63ft	**T** = (63 ÷ 1132.7) = 56mS
Metric:	**°C** = 24° (estimated)	**V** = $20.06 \times \sqrt{273+24}$ = 345.7 m/sec	**D** = (22.9 – 3.7) = 19.2m	**T** = (19.2 ÷ 345.7) = 56mS

Settings: Delay time settings include approximately 20mS of delay added for Haas Effect. **T** = (56mS + 20mS) = **76mS**.



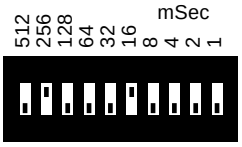
EXAMPLE #3

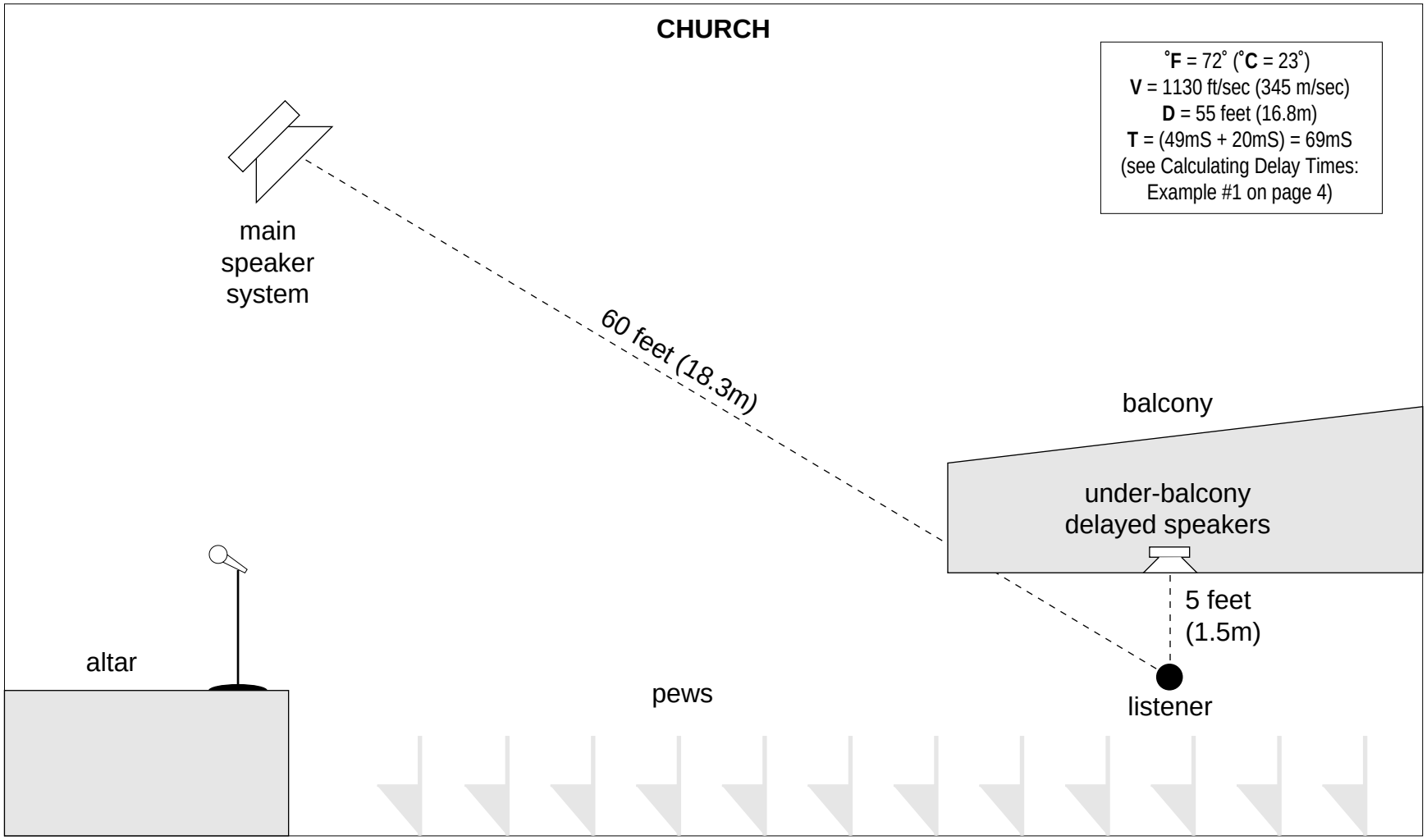
Application: An outdoor sports field, with reinforcement for bleachers on both sides of field (see Applications on page 8).

Calculations:

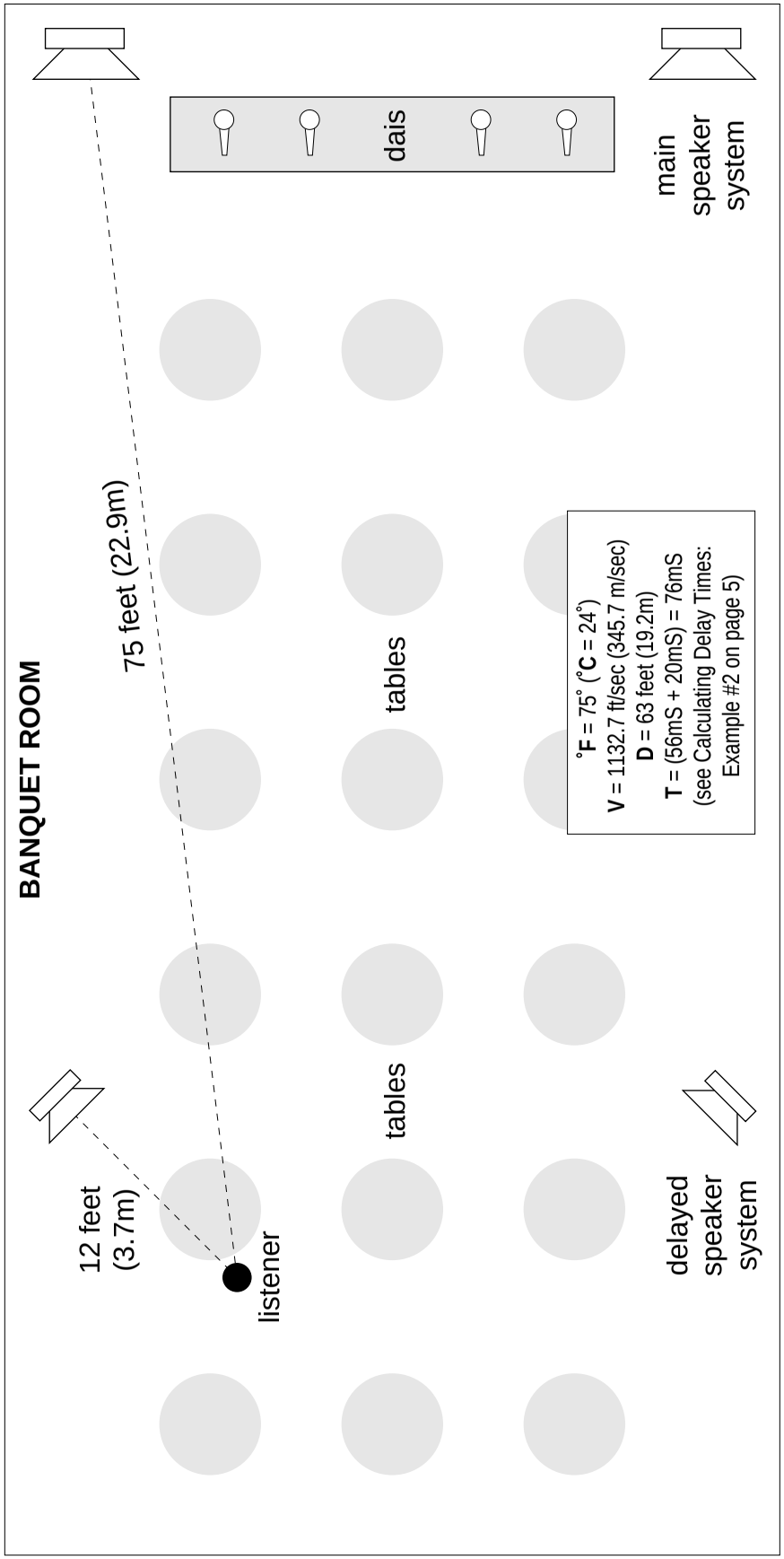
American:	**°F** = 55° (average)	**V** = $49 \times \sqrt{459.4+55}$ = 1111.3 ft/sec	**D** = (360 – 80) = 280ft	**T** = (280 ÷ 1111.3) = 252mS
Metric:	**°C** = 13° (average)	**V** = $20.06 \times \sqrt{273+13}$ = 339.3 m/sec	**D** = (109.7 – 24.4) = 85.3m	**T** = (85.3 ÷ 339.3) = 252mS

Settings: Delay time settings include approximately 20mS of delay added for Haas Effect. **T** = (252mS + 20mS) = **272mS**.



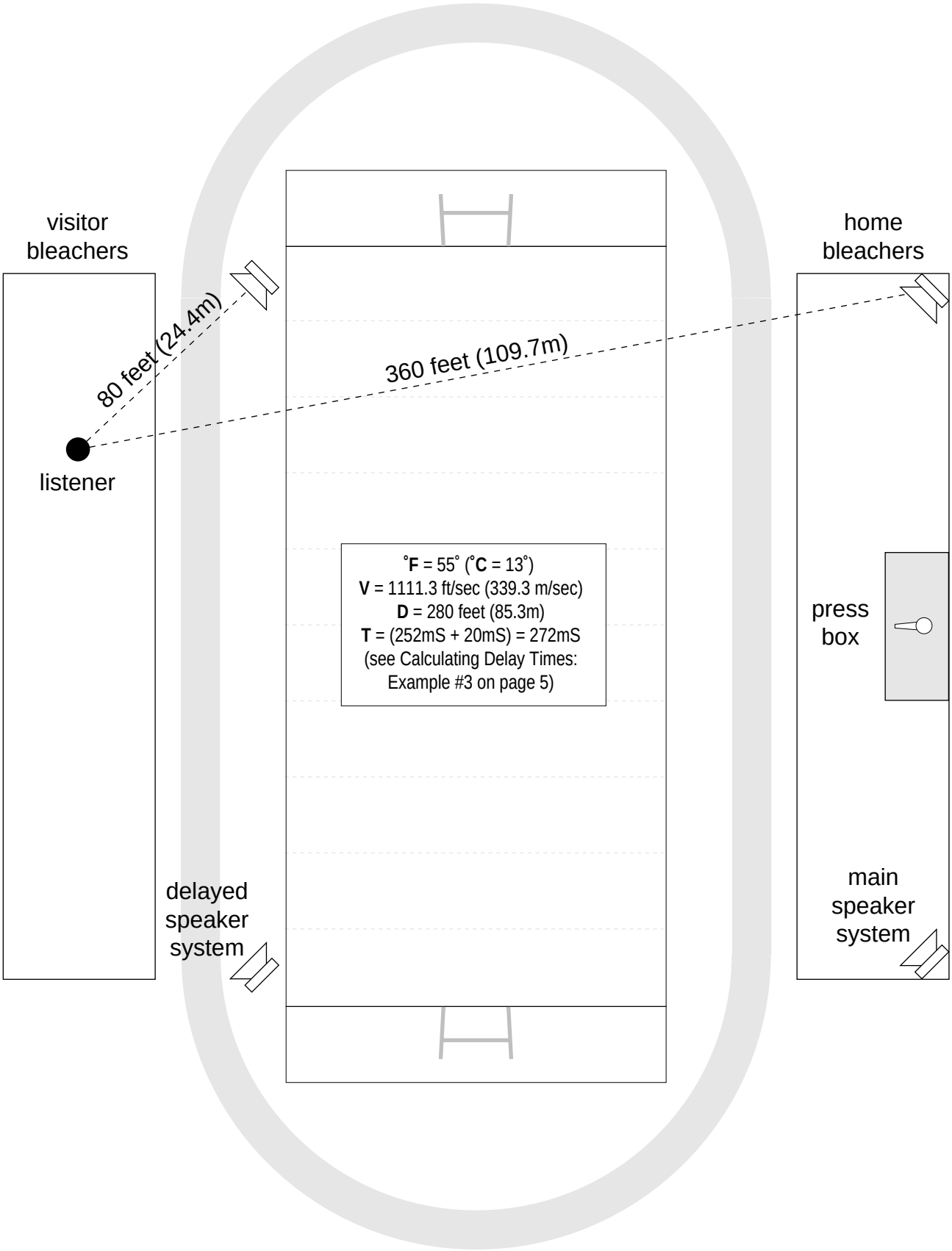

CHURCH
°F = 72° (°C = 23°)
V = 1130 ft/sec (345 m/sec)
D = 55 feet (16.8m)
T = (49mS + 20mS) = 69mS
(see Calculating Delay Times: Example #1 on page 4)
main speaker system
60 feet (18.3m)
balcony
under-balcony delayed speakers
5 feet (1.5m)
altar
pews
listener

APPLICATIONS



APPLICATIONS

SPORTS FIELD

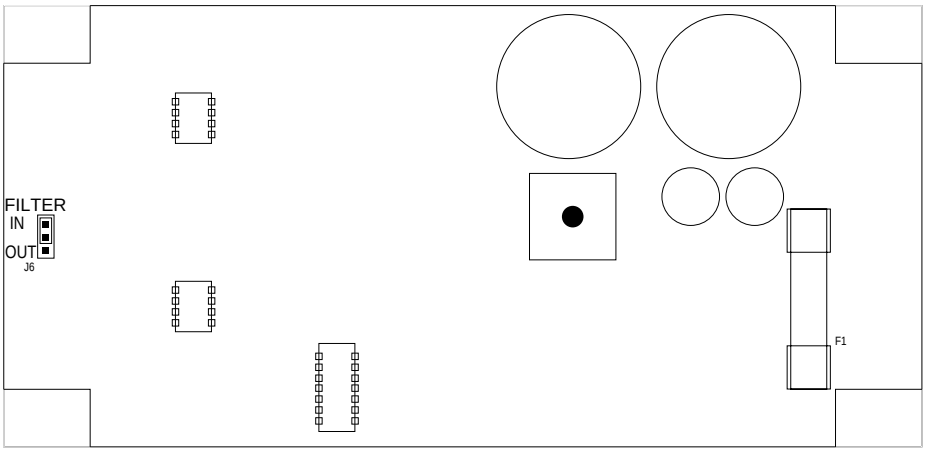


MODIFICATIONS

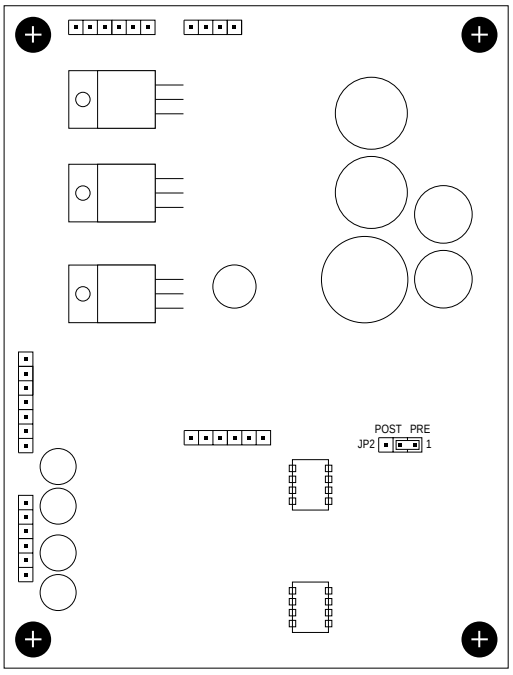
Before performing any internal modifications, first disconnect power from the unit. Then remove the top cover (secured with 14 screws).

High-Pass Filter: A jumper strap is provided on the left side of the amplifier circuit board, to enable or disable an internal high-pass filter (12dB/octave @ 60Hz). From the factory, the high-pass filter is enabled, and should remain enabled whenever the internal autoformer is being used. To disable the internal high-pass filter, move the jumper strap labelled 'FILTER' (J6) down one pin to the "OUT" position, using needle-nose pliers.

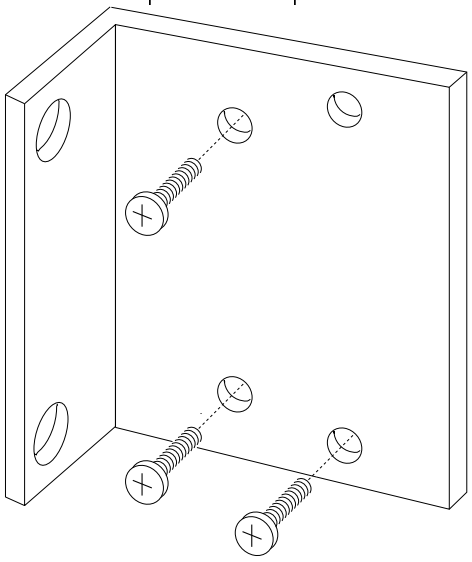
Speaker Protection Fuse: A fuse is provided on the right side of the amplifier circuit board, to offer some protection of speakers against catastophic amplifier failure. This fuse (F1) should always be replaced with the same type and value fuse (4A SB).



Direct Output: A jumper strap is provided on the power supply circuit board (behind the equalizer) to select Direct Output signal to be either pre or post equalizer/master level. From the factory, Direct Output signal is pre-equalizer/master level. To select post-equalizer/master level signal, move the jumper strap labelled 'POST PRE' (JP2) left one pin to the 'POST' position, using needle-nose pliers. The Direct Output signal is always post-delay/HPF.



Rack-Mounting Kit: A rack-mounting kit is available, as a user installed option (Biamp #909-0053-00). Installation of the rack-mounting kit does not require complete removal of the top cover. The rack-mounting kit includes two identical "rack-wings". Each rack-wing has four mounting holes provided on the side. To install the rack-wings, first remove the front three screws from each side of the top cover. Then fasten a rack-wing securely to each side, using the three screws removed from the top cover (one rack-wing hole remains unused). Make sure the "wing" with the two rack-mounting holes is facing toward the front of the unit. The PE/D60 occupies two rack spaces.



SPECIFICATIONS

AMPLIFIER SECTION:	
Output Power (2kHz @ 0.08% THD)	> 60 watts
Frequency Response (20Hz-20kHz @ 60W)	+0/-0.5dB
Total Harmonic Distortion (20Hz-20kHz @ 60W)	< 0.08%
Intermodulation Distortion (SMPTE)	< 0.015%
Signal-to-Noise Ratio (20Hz-20kHz @ 60W)	> 95dB
Input Impedance (balanced)	20k ohms

INTERNAL AUTOFORMER:	
Frequency Response (150Hz-20kHz @ 60W/70V output)	+0/-3dB
Total Harmonic Distortion (2kHz @ 60W/70V output)	< 0.02%

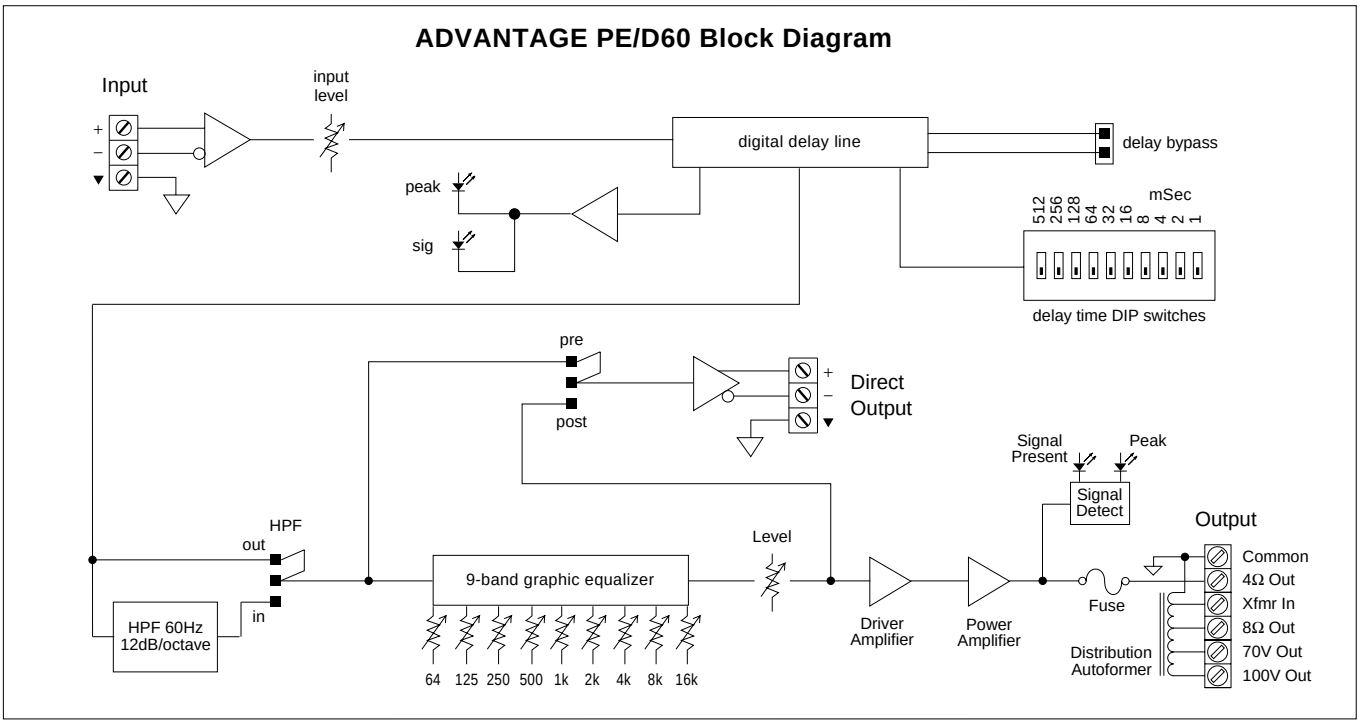
EQUALIZER SECTION:	
Filter Gain	±15dB
Frequencies	64Hz, 125Hz, 250Hz, 500Hz, 1kHz, 2kHz, 4kHz, 8kHz, 16kHz

DIRECT OUTPUT:	
Output Impedance (balanced)	150 ohms
Maximum Output (balanced)	+6dBu
Source	selectable pre or post equalizer/master level
HIGH PASS FILTER:	12dB/octave @ 60Hz

DIGITAL DELAY SECTION:	
Frequency Response (20Hz~20kHz @ +4dBu)	±1.5dB
Total Harmonic Distortion (1kHz @ +4dBu)	< 0.015%
Dynamic Range (20Hz~20kHz)	> 90dB
Maximum Delay Time	1.023 seconds
Delay Resolution (minimum increments)	1 mSec
Sampling Rate	48kHz
Analog-to-Digital Converter	16 bit Sigma-Delta (64x oversampled)
Digital-to-Analog Converter	16 bit PCM linear
64x oversampling Decimation Delay	764 mSec

SYSTEM:	
Power Requirements	115/230VAC 50/60Hz
Power Consumption	175 watts max.
Dimensions	
Height (2 rack spaces)	3.5 inches (89mm)
Width	17 inches (432mm)
Depth	10.25 inches (260mm)
Weight	19 lbs. (8.62kg)

BLOCK DIAGRAM



WARRANTY

BIAMP IS PLEASED TO EXTEND THE FOLLOWING 5-YEAR LIMITED WARRANTY TO THE ORIGINAL PURCHASER OF THE PROFESSIONAL SOUND EQUIPMENT DESCRIBED IN THIS OWNER'S MANUAL.

BIAMP Systems expressly warrants this product to be free from defects in material and workmanship for a period of 5 YEARS from the date of purchase as a new product from an authorized BIAMP dealer under the following conditions.

1. The Purchaser is responsible for completing and mailing to BIAMP, within 10 days of purchase, the attached warranty application.

2. In the event the warranted BIAMP product requires service during the warranty period, BIAMP will repair or replace, at its option, defective materials, provided you have identified yourself as the original purchaser of the product to any authorized BIAMP Service Center. Transportation and insurance charges to and from an authorized Service Center or the BIAMP factory for warranted products or components thereof to obtain repairs shall be the responsibility of the purchaser.

3. This warranty will be VOIDED if the serial number has been removed or defaced; or if the product has been subjected to accidental damage, abuse, rental usage, alterations, or attempted repair by any person not authorized by BIAMP to make repairs; or if the product has been installed contrary to BIAMP's recommendations.

4. Electro-mechanical fans, electrolytic capacitors, and the normal wear and tear of appearance items such as paint, knobs, handles, and covers are not covered under this warranty.

5. BIAMP SHALL NOT IN ANY EVENT BE LIABLE FOR SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES, INCLUDING LOST PROFITS, LOSS OF USE, PROPERTY DAMAGE, INJURY TO GOODWILL, OR OTHER ECONOMIC LOSS OF ANY SORT. EXCEPT AS EXPRESSLY PROVIDED HEREIN, BIAMP DISCLAIMS ALL OTHER LIABILITY TO PURCHASER OR ANY OTHER PERSONS ARISING OUT OF USE OR PERFORMANCE OF THE PRODUCT, INCLUDING LIABILITY FOR NEGLIGENCE OR STRICT LIABILITY IN TORT.

6. THIS WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES EXPRESSED OR IMPLIED. BIAMP EXPRESSLY DISCLAIMS ALL IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. THE REMEDIES SET FORTH HEREIN SHALL BE THE PURCHASER'S SOLE AND EXCLUSIVE REMEDIES WITH RESPECT TO ANY DEFECTIVE PRODUCT. THE AGENTS, EMPLOYEES, DISTRIBUTORS, AND DEALERS OF BIAMP ARE NOT AUTHORIZED TO MODIFY THIS WARRANTY OR TO MAKE ADDITIONAL WARRANTIES BINDING ON BIAMP. ACCORDINGLY, ADDITIONAL STATEMENTS SUCH AS DEALER ADVERTISEMENTS OR REPRESENTATIONS DO NOT CONSTITUTE WARRANTIES BY BIAMP.

7. No action for breach of this warranty may be commenced more than one year after the expiration of this warranty.

Thank you for purchasing BIAMP...
AMERICAN SOUND CRAFTSMANSHIP

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