

PI94 Manifold Technology® Mid-Bass/ High-Frequency Permanent Installation System

- Rotatable mid-bass and high-frequency horns for easy orientation
- Integral suspension system for safe and easy installation
- High-performance speech and music system for permanent installations
- Paintable to blend into any surroundings

SPECIFICATIONS

Typical Axial Frequency Response (swept one-third-octave pink noise, anechoic environment, 1 watt into mid-bass mid-band (2.83 V at 500 Hz), measured in farfield and calculated to 1 meter on axis; see Figure 1):

150-20,000 Hz

Long-Term Average Power-Handling Capacity per (see Power-Handling Test section),

Mid Bass (per ANSI/EIA RS-426-A):
400 watts

High Frequency (per AES2-1984/ANSI S4.26-1984):
120 watts

Short-Term Power-Handling Capacity (10 milliseconds),

Mid Bass (per ANSI/EIA RS-426-A):
1,600 watts

High Frequency (per AES2-1984/ANSI S4.26-1984):
480 watts

Sensitivity (SPL at 1 meter, indicated input power into nominal impedance, anechoic environment, band-limited pink-noise signal), Mid Bass/High Frequency,

1 Watt/1 Watt:
104 dB/110 dB

400 Watts/120 Watts:
130 dB/130 dB

1,600 Watts/480 Watts:
136 dB/136 dB

Impedance (mid-bass/high-frequency drivers, wired in parallel),

Nominal (mid bass/high frequency):
8 ohms/8 ohms

Minimum (mid bass/high frequency):
5.6 ohms/7.7 ohms

Efficiency,

Mid Bass:
16%

High Frequency:
25%

Maximum Long-Term Average Mid-Band Acoustic Output:
64 watts

Beamwidth (angle included by 6-dB-down points on polar responses, indicated one-third-octave bands of pink noise; see Figure 3),

400-20,000 Hz, Horizontal:
90° (+15°, -20°)

900-20,000 Hz, Vertical:
40° (+20°, -5°)

Directivity Factor R_0 (Q), 600- to 20,000-Hz Median (see Figure 4):

17.9 (+3.0, -8.5)

Directivity Index D_i , 600- to 20,000-Hz Median (see Figure 4):

12.5 dB (+1.2 dB, -3.5 dB)

Distortion (120 dB SPL at 1 meter, shaped spectrum; see Figure 6),

Second Harmonic,

200 Hz: 1.3%

1,000 Hz: 1.6%

3,000 Hz: 6.3%

10,000 Hz: 4.9%

Third Harmonic,

200 Hz: 0.4%

1,000 Hz: 1.6%

3,000 Hz: 0.6%

10,000 Hz: 0.3%

Transducer Complement,

Mid Bass:

Two EVI 25.4 cm (10-inch) mid-bass drivers; proprietary 90° x 40° mid-bass fiberglass horn

High Frequency:

Two DH2As1-16 3.3-cm (1.3-inch) compression drivers; HP94 variant 90° x 40° horn

Recommended Crossover Frequencies:

160 Hz, 1,600 Hz

Input Connections:

Screw terminals (#10) on barrier strip; each driver can be individually accessed; high frequency driver has blocking capacitor for protection

Enclosure Materials and Color:

Multy-layered Plywood with Black Textured Paint

Grille:

Removable, black nylon

Hanging:

Integral four-point flying system (accepts Ancra 42546-10 single-stud tie-down cargo fitting; four fittings supplied with system; see Suspending PI94 Enclosure section)

Dimensions,

Height:
91.4 cm (36.0 in.)

Width:
57.2 cm (22.5 in.)

Depth:
75.9 cm (29.9 in.)

Net Weight:

77.1 kg (170 lb)

Shipping Weight:

86.2 kg (190 lb)

DESCRIPTION

The Electro-Voice PI94 Manifold Technology® mid-bass/high-frequency loudspeaker system is designed for the permanent-installation market. The PI94 is a two-way, active horn-loaded system with two drivers manifolded together in each frequency band. There are four drivers contained within the PI94's compact dimensions.

The combination of the PI94 mid-bass/high-frequency loudspeaker system and the PI218L low-frequency loudspeaker system forms a three-way active loudspeaker system. Optimum performance of the PI94 is obtained when used with the Dx34 digital sound system processor.

PI94 SPECIFICATION GRAPHICS

FIGURE 1 — Typical Axial Frequency Response Using Recommended Crossover, Equalization (1 watt/1 meter into mid-bass section)

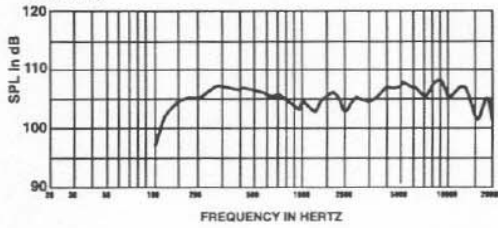


FIGURE 2 — Polar Response

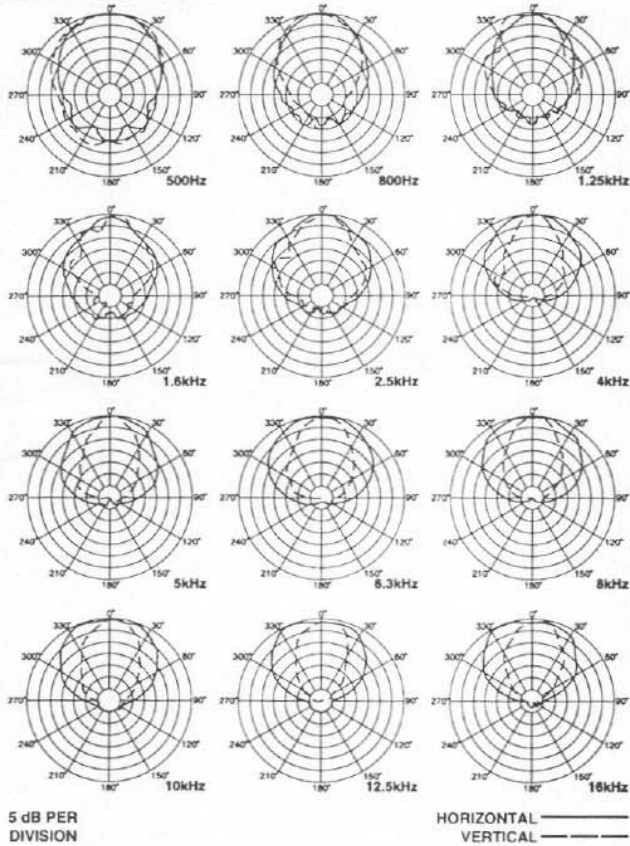


FIGURE 3 — Beamwidth vs. Frequency

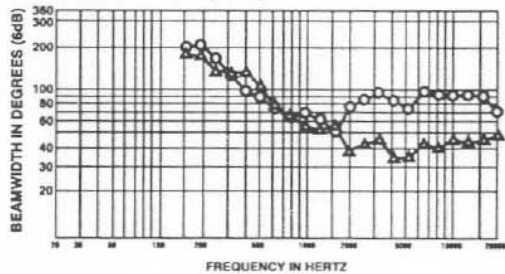


FIGURE 4 — Directivity Factor and Directivity Index vs. Frequency Response (composite of both orientations)

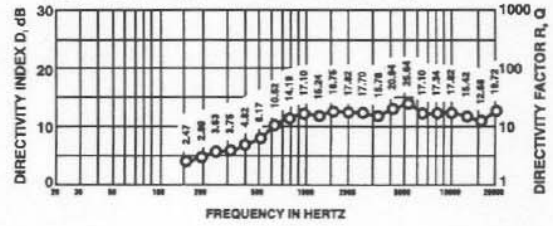


FIGURE 5 — Typical Axial Frequency Response Using Recommended Crossover, Equalization, Time Delay and PI-218L Low-Frequency System

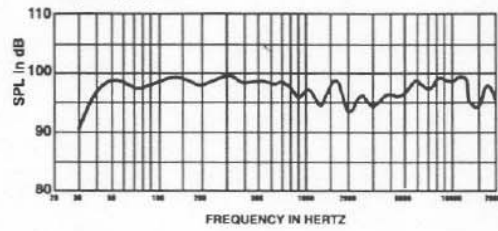
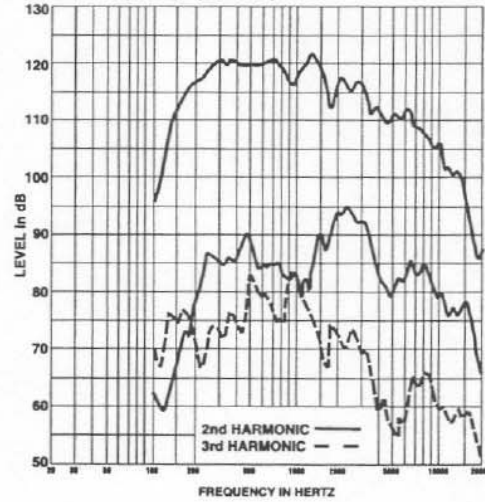


FIGURE 6 — Harmonic Distortion (120 dB SPL/1 meter using typical music frequency spectrum)



The mid-bass frequencies (160 to 1,600 Hz) are reproduced by two EVI 25.4 cm (10-inch) drivers. The drivers are loaded by Electro-Voice's proprietary aperiodic phase plug (U.S. Patent No. 4,718,517) for extended upper-end response. The phase plug makes use of the fact that at higher frequencies, only the apex area of the cone near the voice coil is in motion and acoustic loading is automatically adjusted to maximize high-frequency output. The outputs of the two drivers are summed using Electro-Voice's patented Manifold Technology® (U.S. Patent No. 4,923,031) and fed directly into a 90° x 40° fiberglass horn. The horn provides a uniform coverage pattern with exceptional control and natural sound. A special feature of the horn is that it is structurally independent of the drivers. This makes it very easy to re-orient the horn to suit prevailing circumstances (see Horn Rotation section).

The higher frequencies (1,600-20,000 Hz) are reproduced by two DH2As1-16 compression drivers, manifolded on the MTA-22 (U.S. Patent No. 4,629,029) and mounted on a special modified HP94 90° x 40° constant-directivity horn. The HP series horn (U.S. Patent No. 4,685,532) features integral fiberglass-and-zinc construction, which helps eliminate unwanted vibrations and allows the construction of beamwidth control vanes—special waveguides in the horn throat—that correct for very-high-frequency dispersion anomalies. The HP94 is also structurally independent of its drivers, allowing it to be easily removed and matched to the orientation of the mid-bass horn (see Horn Rotation section).

The PI94 uses multilayer plywood throughout the cabinet. Electro-Voice's unique four-point flying system is installed as standard. The cabinet is multi-layered plywood with black textured paint. A black, nylon cloth grille is supplied as standard.

When an extended low-end response is needed, the PI94 can be used with the PI218L low-frequency loudspeaker system.

The PI94, in its standard form, is intended for use indoors. Do not use outdoors.

APPLICATIONS

The PI94 is designed with the professional end-user in mind. The PI94 delivers versatile, high-level, low-distortion, wide-coverage performance. The relative light weight and small volume of the PI94 belies the performance obtainable with Manifold Technology®. The compact dimensions and trapezoidal shape allow the construction of very tight arrays.

It is possible and often beneficial to use the PI94 as a stand-alone device; for example, in pure speech reproduction. However, the PI218L low-frequency loudspeaker system has been designed to complement the PI94 and produce a fully-integrated full-range sound system. The cabinets are dimensionally identical and have matching hardware.

The 90° x 40° coverage pattern is independent of cabinet orientation. The mid-bass and high-frequency horns are mounted from the front and are independent of their respective drivers (see Horn Rotation section). This means it is possible to use the PI94 either horizontally or vertically without losing the desired coverage pattern.

It is strongly recommended that, when the PI94 is operated by itself or with the PI218L, a Dx34 digital sound system processor may be used. This unit provides equalization, crossover filters, subpassband protection, time delay, and limiting functions. Carefully selected settings for the PI94/PI218L are available in each Dx34 as a preset.

Alternatively, an XEQ-3 electronic crossover/equalizer/time-delay unit may be used. EQMT-EQ modules will provide appropriate equalization. Select 160 Hz and 1600 Hz crossover frequencies.

FREQUENCY RESPONSE

The PI94 frequency response, shown in Figure 1, was measured on axis in the farfield in an anechoic environment using a swept one-third-octave input and calculated to a one meter equivalent distance by using the inverse-square law. The PI94 system was set up using the Dx34 digital sound system processor. One watt of power (2.83 V at 500 Hz) was delivered to the mid-band of the mid-bass section. The frequency response of the complete system (the PI94 and the PI218L together) using the Dx34 with one watt (2.83 V at 500 Hz) being delivered to the mid-bass section (of the PI94) is shown in Figure 5.

DIRECTIVITY

Figure 2 illustrates the polar response of the PI94. The measurements were taken in EV's large anechoic chamber at a distance of 20 feet using pink noise at selected one-third-octave bands. Crossover equalization and time delay were set as recommended in the Crossover, EQ and Time Delay section. Beamwidths are illustrated in Figure 3 and directivity factors R_{θ} (Q) and directivity indexes D, in Figure 4. These figures show how smooth and controlled the PI94 is over its entire operating range. Data for Mark IV Audio's AcoustaCADD™ computer-aided design program is available for the PI94.

DISTORTION

Using the recommended crossover, equalization and time delay, distortion for the PI94 was measured in the farfield with an input power that would result in a sound pressure level of 120 dB at one meter. A frequency spectrum typical of contemporary, close-miked rock music was employed. Plots of second- and third-order harmonic distortion are shown in Figure 6.

POWER-HANDLING TEST

Electro-Voice components and systems are manufactured to exacting standards, ensuring they will hold up, not only through the most rigorous of power tests, but also through continued use in arduous, real-life conditions. Two main test specifications are used. The AES Recommended Practice for Specification of Loudspeaker Components Used in Professional Audio and Sound Reinforcement (AES2-1984/ANSI S4.26-1984) and the EIA Loudspeaker Power Rating Full Range (ANSI/EIA RS-426-A 1980). Both of these specifications use noise spectrums which mimic typical music and test the thermal and mechanical capabilities of the components. Electro-Voice will support relevant additional standards as and when they become available. Extreme, in-house power tests, which push the performance boundaries of the components, are also performed and passed to ensure years of trouble-free service.

Specifically, the PI94 high-frequency section passes AES2-1984/ANSI S4.26-1984 with the following values:

Z_{MIN} = 7.7 ohms at 7,000 Hz
 $P_{E(MAX)}$ = 120 watts
Test voltage = 27.6 volts rms,
55.2 volts peak (+6 dB)
Selected decade = 1,500-15,000 Hz

The PI94 mid-bass section passes ANSI/EIA RS-426-A 1980 with the following values:

R_{SR} = 6.9 ohms (1.15 x R_E)
 $P_{E(MAX)}$ = 400 watts
Test voltage = 37.1 volts rms,
74.1 volts peak (+6 dB)

CROSSOVER, EQ AND TIME DELAY

The usable frequency ranges of the individual sections of the PI94 are 150-2,000 Hz for the mid-bass and 1,200 to 20,000 Hz for the high-frequency band. Minimum crossover slopes of 12-dB-per-octave are recommended. Low-frequency protection capacitors are included in the high-frequency section, with a 3-dB-down point of 800 Hz.

The usable frequency response of the overall PI94 mid-bass/high-frequency loudspeaker system is 150-20,000 Hz. For maximum performance of the PI94 in a full-range application, the addition of the Electro-Voice PI218L low-frequency loudspeaker system is recommended. This combination forms the PI94 full-range high-level sound-reinforcement system.

The Electro-Voice Dx34 Digital Sound System Processor has been pre-programmed with presets for each member of the PI line. Great care has been taken to optimize the directional response through crossover, and to ensure that cabinets with different coverage patterns will sound the same on axis, as well as summing optimally, off axis.

If the Electro-Voice XEQ-3 electronic crossover/equalizer/delay unit is used, the EQMT-2 plug-in module will provide appropriate horn equalization. Crossover frequencies of 160 Hz and 1600 Hz should be selected. A 30 Hz high-pass filter should be selected for subpassband of the low-frequency section.

CONNECTIONS

Electrical connections are made on the back of the PI94 via two terminal blocks. The mid-bass has two 8-ohm loudspeakers; however, the acoustic loading of the mid-bass phase plugs and horn increases their electrical impedance to 16 ohms each. The two loudspeakers are wired in parallel, resulting in an 8-ohm load accessed by one terminal block. The high-frequency section has two 16-ohm drivers wired in parallel, resulting in an 8-ohm load accessed by the remaining terminal block.

SUSPENDING PI94 ENCLOSURES

Suspending any object is potentially dangerous and should only be attempted by individuals who have a thorough knowledge of the techniques and regulations of rigging objects overhead. It is the responsibility of the installer to ensure the PI94 is safely installed in accordance with applicable regulations. If the PI94 is suspended, Electro-Voice strongly recommends that the system be inspected at least once a year. If any sign of weakness or damage is detected, remedial action should be taken immediately.

Every enclosure incorporates eight independent suspension points, four on the top and four on the bottom. **A minimum of four points must always be used to suspend the enclosure.** The suspension points, which "tie" the top and sides of the enclosure together, are made of structural aluminum. The suspension points "mate" to an Ancra 42546-10 locking fitting, of which four are supplied with every enclosure.¹ Each of these suspension points has a break-strength of 2,000 lb in any direction. This approach has been approved by an independent structural engineer. A maximum of two enclosures can be "daisy-chained" together, allowing the construction of vertical arrays. If longer arrays are required, provision must be made to independently suspend each enclosure.

HORN ROTATION

Place PI94 on a flat surface with horns facing up. Unscrew the four screws attaching the grille and pull the grille clear. Remove all screws from around both horns' mouths. Lift the mid-bass horn and rotate through 90°. Lower the horn back into cabinet. Make sure the rear flange of the horn is seated correctly. Repeat this procedure with the high-frequency horn. Special care must be taken to locate and seal the rear flange into the proprietary sealing gasket.

Replace all screws; tighten down firmly but do not over-tighten. It is also possible to re-orient the EV logo on the grille by removing the central screw, rotating the logo and replacing the screw. Replace the grille.

SERVICE

Full details of these procedures can be found in the Service Data sheet available from the Service Department in Buchanan, Michigan.

ARCHITECTS' AND ENGINEERS' SPECIFICATIONS

The loudspeaker system shall be a two-way active mid-bass/high-frequency system with two drivers manifolded in each frequency band for a total of four drivers. The mid-bass section shall have two 25.4-cm (10-inch) drivers, each having an 8-ohm, 2.5-inch-diameter voice coil constructed of edge-wound rectangular aluminum wire, and shall be capable of handling a 200-watt shaped pink-noise signal with 6-dB crest factor for 8 hours (as per ANSI/EIA RS-426-A 1980). These two drivers shall each be loaded on a phase plug and manifolded onto a single 90° x 40° constant-directivity-type horn. The high-frequency section shall have two 3.3-cm (1.3-inch) compression drivers, each hav-

ing a 16-ohm, 2.0-inch-diameter voice coil constructed of edge-wound rectangular aluminum wire mounted on a 0.00125-inch-thick titanium diaphragm, and shall be capable of handling a 60-watt, 1,500- to 15,000-Hz pink-noise signal with a 6-dB crest factor for 2 hours (as per AES2-1984/ANSI S4.26-1984). These two drivers shall be manifolded onto a single 90° x 40° constant-directivity-type horn.

The loudspeaker system shall produce a horizontal beamwidth of 90° (+15°, -20°) from 400 to 20,000 Hz and a vertical beamwidth of 40° (+20°, -5°) from 900 to 20,000 Hz. The loudspeaker system shall have a uniform on-axis frequency response from 160 to 20,000 Hz when used with the Electro-Voice XEQ-3 electronic crossover with crossover frequency at 1,600 Hz. The overall system shall have an efficiency of 16%/25%.

The loudspeaker system shall have an enclosure constructed of multi-layered plywood with black textured paint and shall have a black nylon grille. The loudspeaker enclosure shall be trapezoidally shaped. Dimensions shall be 91.4 cm (36.0 in.) high, 57.2 cm (22.5 in.) wide and 76.2 cm (29.9 in.) deep. Weight shall be 77.3 kg (170 lb).

The loudspeaker system shall be the PI94.

UNIFORM LIMITED WARRANTY

Electro-Voice products are guaranteed against malfunction due to defects in materials or workmanship for a specified period, as noted in the individual product-line statement(s) below, or in the individual product data sheet or owner's manual, beginning with the date of original purchase. If such malfunction occurs during the specified period, the product will be repaired or replaced (at our option) without charge. The product will be returned to the customer prepaid. **Exclusions and Limitations:** The Limited Warranty does not apply to: (a) exterior finish or appearance; (b) certain specific items described in the individual product-line statement(s) below, or in the individual product data sheet or owner's manual; (c) malfunction resulting from use or operation of the product other than as specified in the product data sheet or owner's manual; (d) malfunction resulting from misuse or abuse of the product; or (e) malfunction occurring at any time after repairs have been made to the product by anyone other than Electro-Voice or any of its authorized service representatives. **Obtaining Warranty Service:** To obtain warranty service, a cus-

tomers must deliver the product, prepaid, to Electro-Voice or any of its authorized service representatives together with proof of purchase of the product in the form of a bill of sale or receipted invoice. A list of authorized service representatives is available from Electro-Voice at 600 Cecil Street, Buchanan, MI 49107 (616/695-6831 or 800/234-6831). **Incidental and Consequential Damages Excluded:** Product repair or replacement and return to the customer are the only remedies provided to the customer. Electro-Voice shall not be liable for any incidental or consequential damages including, without limitation, injury to persons or property or loss of use. Some states do not allow the exclusion or limitation of incidental or consequential damages so the above limitation or exclusion may not apply to you. **Other Rights:** This warranty gives you specific legal rights, and you may also have other rights which vary from state to state.

Electro-Voice Speakers and Speaker Systems are guaranteed against malfunction due to defects in materials or workmanship for a period of five (5) years from the date of original purchase. The Limited Warranty does not apply to burned voice coils or malfunctions such as cone and/or coil damage resulting from improperly designed enclosures. Electro-Voice active electronics associated with the speaker systems are guaranteed for three (3) years from the date of original purchase. Additional details are included in the Uniform Limited Warranty statement.

Electro-Voice Flying Hardware (including enclosure-mounted hardware and rigging accessories) is guaranteed against malfunction due to defects in materials or workmanship for a period of one (1) year from the date of original purchase. Additional details are included in the Uniform Limited Warranty statement.

Electro-Voice Accessories are guaranteed against malfunction due to defects in materials or workmanship for a period of one (1) year from the date of original purchase. Additional details are included in the Uniform Limited Warranty statement.

Service and repair address for this product: Electro-Voice, Inc., 600 Cecil Street, Buchanan, Michigan 49107 (616/695-6831 or 800/234-6831).

Specifications subject to change without notice.

1. For additional information, contact Ancra International at 606/371-7272 or toll free (within the U.S. only) at 800/233-5138.



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