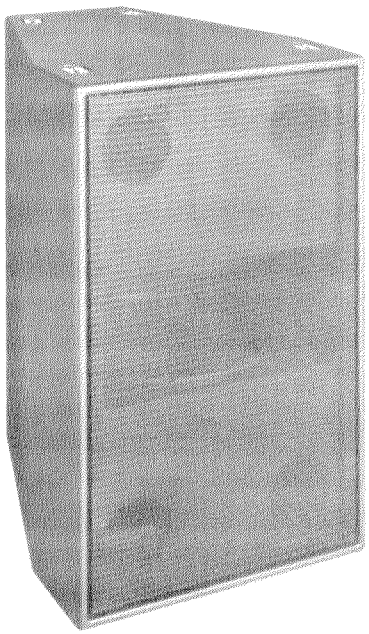
Electro-Voice®



PI218L

Manifold Technology® Low-Frequency Sound Reinforcement System for Permanent Installations

- **Low-frequency complement for PI64 and PI94 systems**
- **Manifold Technology® delivers high acoustic output in the 40- to 200-Hz band**
- **Two DL18MT 18-inch woofers for exceptional bass response**
- **Trapezoidal shape matches PI64 and PI94 enclosures for easy arraying**
- **Integral suspension system for safe and easy installation**
- **Paintable to blend into any surroundings**

SPECIFICATIONS

Typical Axial Frequency Response (swept one-third-octave pink noise, anechoic environment, 1 watt into low-frequency mid band (2.00 V at 80 Hz), measured in farfield and calculated to 1 meter on axis; see Figure 1):
40-200 Hz

Low-Frequency 3-dB-Down Point:
40 Hz

Usable Low-Frequency Limit (10-dB-down point):
35 Hz

Half-Space Reference Efficiency:
6.1%

Long-Term Average Power-Handling Capacity per ANSI/EIA RS-426-A (see Power-Handling Capacity section):
800 watts

Short-Term Power-Handling Capacity (10 milliseconds):
3,200 watts

Sensitivity (SPL at 1 meter, indicated input power, anechoic environment, band-limited pink-noise signal, 50-200 Hz),
1 Watt:
98 dB
800 Watts:
127 dB
3,200 Watts:
133 dB

Impedance,
Nominal:
Two 8-ohm loads
Minimum:
Two 6-ohm loads

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

Beamwidth (angle included by 6-dB-down points on polar responses, indicated one-third-octave bands of pink noise; see Figure 3),
63-100 Hz Horizontal:
285° (+75°, –52°)
63-100 Hz Vertical:
240° (+120°, –77°)

Directivity Factor R_θ (Q), 63- to 100-Hz Median (see Figure 4):
1.84 (+0.36, –0.37)

Directivity Index D_i, 63- to 100-Hz Median (see Figure 4):
2.66 dB (+0.77 dB, –0.99 dB)

Distortion, 0.1 Full Power Input (see Figure 7),
Second Harmonic,
50 Hz: 2.4%
100 Hz: less than 1%
Third Harmonic,
50 Hz: less than 1%
100 Hz: less than 1%

Distortion, Full Power Input (see Figure 8),
Second Harmonic,
50 Hz: 2.8%
100 Hz: 1.0%
Third Harmonic,
50 Hz: 4.5%
100 Hz: less than 1%

Transducer Complement,
Two DL18MT 45.7-cm (18-in.) woofers

Polarity:
A positive voltage applied to the positively marked input terminal produces a positive acoustic pressure at the front of the system

Box Tuning Frequency:
37 Hz

Input Connections:
Screw terminals (#10) on barrier strip; each driver can be individually accessed

Enclosure Materials and Color:
Multi-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 PI218L 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:
70.8 kg (156 lb)

Shipping Weight:
75.7 kg (167 lb)

DESCRIPTION

The Electro-Voice PI218L Manifold Technology® low-frequency loudspeaker system is designed to complement the PI94 and PI64 mid-bass/high-frequency loudspeaker systems. They combine to produce a three-way active, high-output, compact, permanently installed sound reinforcement system ideally suited for the fixed installation market. Optimum performance of the full-range system is obtained when used with the XEQ-3 electronic crossover/equalizer/time-delay unit with the dedicated EQMT-2 plug-in modules.

The PI218L is a vented-box design incorporating two DL18MT 18-in. woofers facing into a central manifold chamber. Manifold Technology®, pioneered in the MTL-4A, is an Electro-Voice-patented method (U.S. patent no. 4,733,749) of combining the output of two or

PI218L SPECIFICATION GRAPHICS

FIGURE 1 — Typical Axial Frequency Response Using Recommended Crossover, Equalization (1 watt/1 meter)

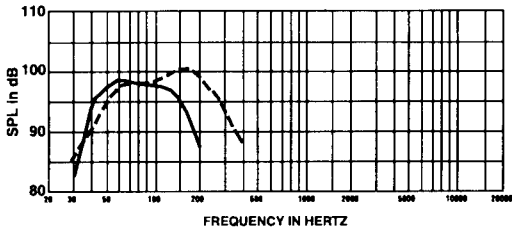


FIGURE 2 — Typical Axial Frequency Response of PI218L-PI64 System Using Recommended Crossover, Equalization and Time Delay

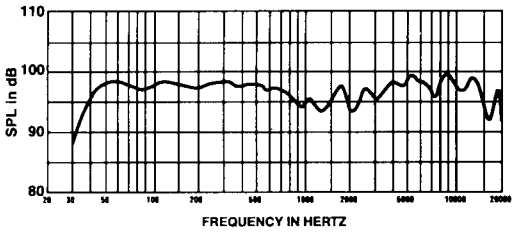


FIGURE 3 — Typical Axial Frequency Response of PI218L-PI94 System Using Recommended Crossover, Equalization and Time Delay

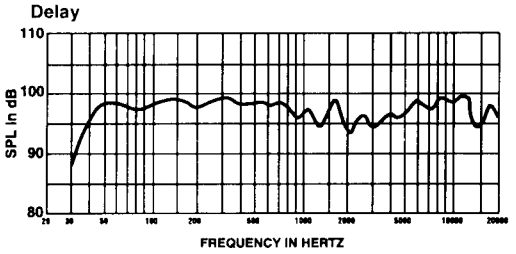


FIGURE 4 — Polar Response

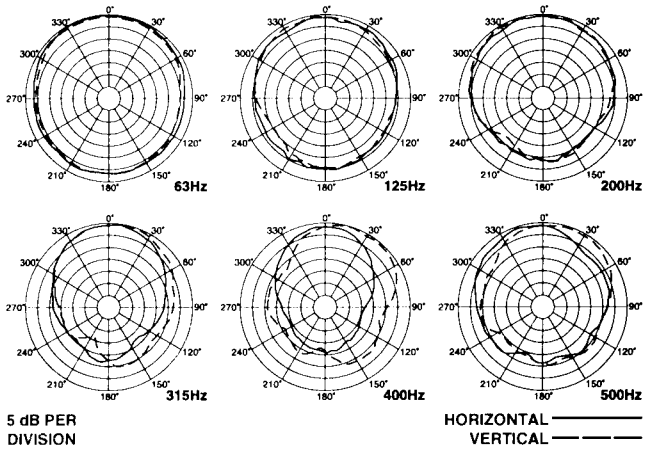


FIGURE 5 — Beamwidth vs. Frequency

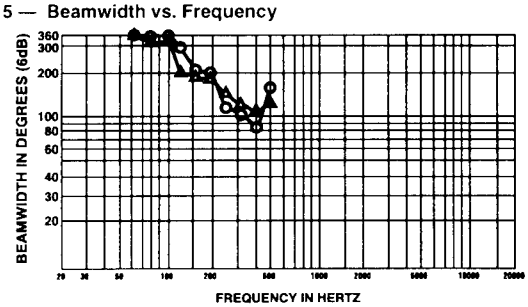


FIGURE 6 — Directivity vs. Frequency

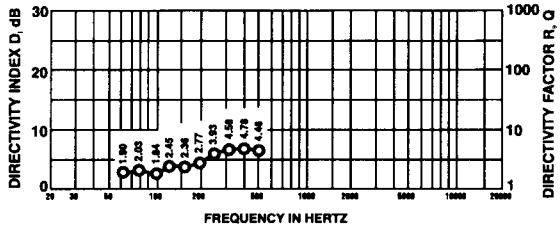


FIGURE 7 — Harmonic Distortion 10% Rated Power Input (80 watts), 10 Feet on Axis

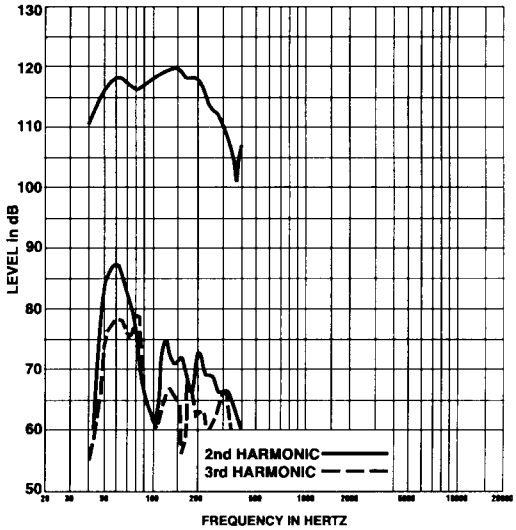
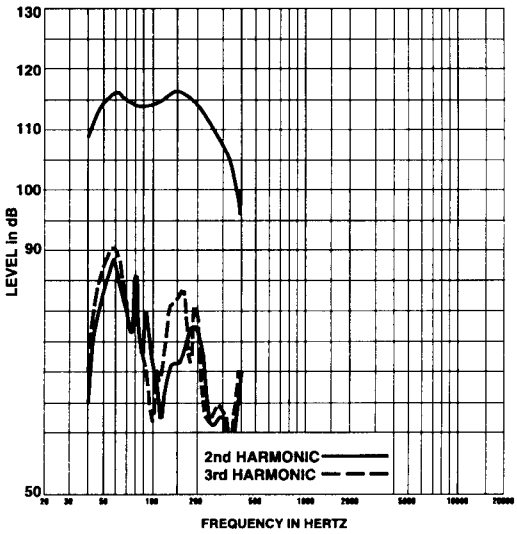


FIGURE 8 — Harmonic Distortion 100% Rated Power Input (800 watts), 10 Feet on Axis



more drivers, and increasing their acoustic load. Compared to conventional direct radiating designs, manifolding allows increased low-frequency efficiency and reduced distortion in a singularly compact box. Typically, the PI218L is 2 to 3 dB more efficient in the crucial 40- to 80-Hz region than a comparable horn.

The DML-18MT 18-inch woofer was designed specifically for manifolding to achieve optimal performance in the PI218L enclosure. Its design assures linear, low-distortion output. The high-power, high-excursion drive of the DL18MT is augmented by two exclusive Electro-Voice features, the Thermo Inductive Ring (TIR™) and PROTEF™ coating (U.S. Patent No. 4,547,632). The TIR acts as a control on drive inductance and, more importantly, provides a major heat-transfer path from the top of the drive coil, reducing thermal dynamic-range compression. PROTEF is a Teflon™-based coating applied to physically protect the voice coil from rubbing during violent power peaks.[1]

The PI218L uses multilayer plywood throughout. Electro-Voice's unique four-point flying is installed as standard. The cabinet is finished with black primer. A black, nylon cloth grille is supplied as standard.

The PI218L, in its standard form, is intended for use indoors. Do not use outdoors.

APPLICATIONS

The PI218L is designed with the professional end user in mind. In fixed installations, the PI218L delivers high-level, low-distortion, low-frequency performance. The small bulk, volume and frontal area of the PI218L belies the performance obtainable with Manifold Technology and allows the construction of compact, tight arrays.

It is possible to use the PI218L to augment the bass of any system, but it has been optimized to complement the PI94 and PI64 high-frequency cabinets. Combining the PI218L with either the PI64 or PI94 systems, and a Dx34 digital sound system processor produces a fully integrated full-range sound system. Both cabinets are dimensionally identical and have similar hardware.

FREQUENCY RESPONSE

The frequency response of the PI218L shown in Figure 1 was measured on axis in the far field of an anechoic environment, using a swept one-third-octave input and calculated to a one-meter equivalent distance using the inverse-square law. The system was set up using the recommended crossover and equalization (see the Crossover, Equalization and Time Delay section). Drive level was set for one watt of power (2.00 volts rms into 4 ohms), delivered to the mid-band of the woofer section. Also shown in Figure 1 is the frequency response of the PI218L without equalization or crossover with a one-watt input. The frequency responses of the complete system (the PI218L and the PI94 together, and the PI218L and the PI64 together) are shown in Figures 2 and 3. Both full-range systems were set up using the Dx34 digital sound systems processor. One watt of power (2.00 volts) was delivered to the PI218L.

DIRECTIVITY

The directional characteristics of the PI218L were measured in Electro-Voice's large anechoic chamber, with a test signal of one-third-octave filtered pink noise at the frequencies indicated. A full spheriecal measurement system, which is fully compatible with Mark IV Audio's AcoustaCADD™ computer-aided design program, was used. All directional information was measured at 6.1 meters (20 ft.).

Figure 4 illustrates the horizontal and vertical polar response.

Figure 5 illustrates the horizontal and vertical beamwidths. Beamwidth is the angle at which the horizontal and vertical polar responses have decreased in level by 6 dB when compared to the on-axis frequency response.

Figure 6 represents the total directivity of the PI218L. The directivity factor R_θ (Q) is the relative value, at a point, when compared to an ideal spherical response. The Directivity Index (D_i) is calculated by $D_i = 10 \log_{10} R_\theta$.

DISTORTION

Inherent in the Manifold Technology design are the greatly reduced distortion components, when compared to conventional vented enclosures. Figure 7 and Figure 8 illustrate the second- and third-harmonic-distortion components of the PI218L at 10% and 100% rated power. The XEQ-3 electronic crossover and dedicated EQMT-2 module set were in operation when the measurements were taken.

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. The EIA Loudspeaker Power Rating Full Range (ANSI/EIA RS-426A 1980) uses a noise spectrums which mimics typical music and tests the thermal and mechanical capabilities of the components. Electro-Voice will support relevant additional standards as and when they become availiable. 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 PI218L passesANSI/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 = 52.5 volts rms,
105 volts peak

The combined power handling of both woofers in the PI218L is twice the above at 800 watts, with peaks of 3,200 watts. The "peak" power-handling capacity of a woofer is determined by the peak test voltage. For the PI218L, a 210-volt peak test voltage (2 x 105 volts peak) translates into a 3,200-watt short-term peak power-handling capacity. This is the equivalent of four times the "average" power-handling capacity. However, this sort of short-duration peak is very typical in speech and music. Providing the amplifier or amplifiers (the DL18MT's can be connected independently) can reproduce the signal accurately, without clipping, the woofers will also perform accurately and reliably, even at these levels.

SUBPASSBAND SPEAKER PROTECTION

If the PI218L is used without the PI64 or PI94 and the recommended EQMT-2 module, then subpassband protection should be incorporated. Below the enclosure tuning frequency, cone excursion increases rapidly. It is therefore highly recommended that a high-pass filter be used. A 32-Hz 12-dB-per-octave filter is sufficient. Without protection, subpassband signals may "bottom" the woofer. Damage may occur, amplifier power is wasted and modulation of the signal will impair performance. Woofer distortion and "muddy bass" are often caused by lack of subpassband protection.

USE IN MULTIPLES

PI218L's may be used in multiples to increase acoustic output. In the following discussion, it is assumed that all speaker cones are operating in unison (in phase) when a common signal is applied. A 6-dB increase in maximum acoustic output results when two speaker systems are located side by side. For operation at very low frequencies, the woofer cones "mutually couple" acting as one system with cone area and power-handling capacity twice that of a single system. The doubling of cone area doubles efficiency, providing a 3-dB increase in sound pressure level. The second 3 dB comes from the doubling of power capacity.

Mutual coupling occurs when the frequency is such that the center-to-center distance between the two woofer manifolds is less than about one-half wavelength. When the distance is greater than one-half wavelength, as would occur if two PI218L's were widely spaced, the level increase tends to be limited to the 3-dB power-handling increase.

SYSTEM POSITIONING

Subwoofer systems such as the PI218L are often located on the floor. This is both convenient and can provide a desired high acoustic impact when the speakers are, for example, placed near the periphery of a dance floor. In other installations, such as theatre or auditorium, the audible location of a subwoofer operating at a sufficiently low crossover frequency (below about 150 Hz) will not be particularly evident. The other system elements operating above the subwoofer range can be positioned for the desired locational cues and uniform audience coverage.

Floor location provides the acoustic half-space environment associated with the 6.1% system efficiency noted in the Specifications sections. Location at a floor-wall junction (acoustic quarter space) doubles efficiency (a 3-dB increase in acoustic power level) and tends to promote the full excitation of more room modes, or standing waves, important in achieving overall bass output in the room. Corner placement (acoustic eighth space) doubles efficiency again and guarantees excitation of all room modes. (Such placement for maximum efficiency and room-mode excitation is not necessary and may not be desirable or possible for a variety of reasons, including aesthetics and practicality.)

The PI218L can also be successfully operated away from any nearby acoustic boundaries, particularly when multiple systems are used for increased output ability (see Use in Multiples

1. Teflon™ is a trademark of Du Pont.

section).

CROSSOVER, EQUALIZATION A'ID TIME DELAY

The usable frequency response of the Electro-Voice PI218L low-frequency loudspeaker system is 35-225 Hz. For maximum performance of the PI218L in full-range applications, the addition of the Electro-Voice PI94 or PI64 mid-bass/high-frequency loudspeaker system and the Dx34 digital sound system processor is recommended.

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 cabinetswith 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 for both the PI64 and PI 94 high-frequency enclosures. Crossover frequencies of 160 Hz and 1600 Hz should be selected. A 30 Hz high-pass filter should be selected for subpassband protection of the PI-218L low-frequency system.

CONNECTIONS

Electrical connections are made on the back of the PI218L via two terminal blocks. The two 8-ohm woofers are wired on separate pairs of terminals for individual access.A positive voltage applied to the positively marked input terminal produces a positive acoustic pressure at the front of the system.

SUSPENDING PI218L 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 PI218L is safely installed in accordance with all applicable regulations. If the PI218L 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 907 kg (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.

FIELD SERVICE

The PI218L was designed for expedient field repair. To access the drivers, first remove the nylon grille. Unscrew the four screws attaching the grille and pull the grille clear. Next, remove the eight 1/4-20 hex-head bolts securing the DL18MT's.. Use a 3/8-inch nutdriver or a rachet with a 3/8-inch socket. The woofers can then be removed from the enclosure. Reverse this procedure to reassemble.

Subwoofer: Complete DL18MT 18-inch woofer. EV Part No. 818-0882.

Complete service information can be found in the Service Data Sheet available from the Service Department in Buchanan, Michigan.

ARCHITECTS' AND ENGINEERS' SPECIFICATIONS

The loudspeaker shall be a low-frequency system with two manifolded 45.7-cm (18-inch) low-frequency woofers. Each woofer shall have an 8-ohm, 2.5-inch-diameter voice coil constructed of edge-wound rectangular copper wire and shall be capable of handling a 400-watt shaped pink-noise signal with 6-dB crest factor for 8 hours (as per ANSI/EIA RS-426-A). The loudspeaker system shall have a sensitivity of 98 dB, one watt at one meter, from 50-200 Hz.

The loudspeaker system shall have an enclosure constructed of .75-inch multilayer plywood and shall have a black nylon grille. The enclosure shall have a trapezoidal footprint. The loudspeaker dimensions shall be 91.4 cm (36.0 in.) high, 57.2 cm (22.5 in.) wide and 75.9 cm (29.9 in.) deep and shall weigh 70.8 kg (156 lb).

The loudspeaker system shall be the Electro-Voice PI218L.

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 customer 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). **Incidental and Consequential Damages Excluded:** Product repair or replacement and return to the customer are 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.

Service and repair address for this product: Electro-Voice, Inc., 600 Cecil Street, Buchanan, Michigan 49107.

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.

ELECTRO-VOICE a MARK IV company **600 Cecil Street, Buchanan, Michigan 49107**
MANUFACTURING PLANTS AT ■ BUCHANAN, MI ■ NEWPORT, TN ■ SEVIERVILLE, TN ■ OKLAHOMA CITY, OK ■ GANANOQUE, ONT.

Part Number 532613 — 9519