

## Xi-2181/2181F

### X-Array™ Install Bass System

- Unprecedented acoustic output in a small, lightweight package
- Ring-Mode Decoupling (RMD)™ provides accurate transient detail
- EVX-180B woofers
- Unique rear-hinge rigging
- Flying and non flying configuration

#### Description

The X-Array Install™ product line represents important advancements in concert-sound-reinforcement technology. The design goals called for the highest acoustic output capability with the highest fidelity in lightweight, compact enclosures that were easy to array. The development began with a clean sheet of paper and took an integrated approach. The individual loudspeaker drivers, horns, enclosures, rigging hardware and system configurations were designed from the ground up specifically for this high-performance application.

The Xi-2181 is a manifolded, vented-box bass system utilizing two 457-mm (18-in.) woofers. The two woofers face each other in a manifold chamber at the center of the enclosure. This manifolding technique (U.S. Patent Number 4,733,749) increases the acoustic loading, resulting in increased low-frequency efficiency (at slightly above box tuning) and reduced distortion compared to conventional direct-radiating designs. The woofers were designed as part of the Xi-2181 development and represent a step forward in state-of-the-art loudspeaker design in terms of high acoustic output with low distortion and low power compression. Electro-Voice engineers developed a new technology dubbed Ring-Mode Decoupling

(RMD™) to substantially improve clarity and intelligibility by reducing both linear and nonlinear resonance modes that color the sound.

The low-frequency driver in the Xi-2181 is the EVX-180B. An improved version of the industry-standard EVX-180A high-excursion 467-mm (18-in.) woofer that has distinguished itself as an industry standard for high-power, low-frequency reproduction. During the X-Array™ development, the thermal conduction of the motor was improved and the suspension was redesigned, giving the EVX-180B even lower power compression and a longer mechanical lifetime. In the Xi-2181, the woofers are manifolded in a vented enclosure optimized for maximized output from 37-160 Hz with minimized distortion.

Ring-Mode Decoupling, (RMD™), is a technique utilized and named by Electro-Voice to describe a process used to improve sound quality in loudspeaker systems. RMD™ offers a solution to a very fundamental problem. It has long been recognized that two different loudspeaker systems can sound different even though they both may be equalized to have the same frequency response. This difference is due to a variety of resonances, or ring modes that color the sound. Although this ringing may be very low in level compared to the program material, it is

still audible. The source of these resonances may be mechanical or acoustical in nature, or a combination of both. In addition, they may be linear or nonlinear, resulting in their character changing with level. Furthermore, these ring-modes may be aggravated when multiple loudspeaker enclosures are assembled into arrays. The result is a coloration that decreases intelligibility and clarity, with the nature of that coloration varying with level. Often, the listener perceives that coloration as imbalance in the frequency response, and will attempt to electronically adjust the system to restore the spectral balance. However this electronic equalization has the negative effect of changing the program material itself.

Ring-Mode Decoupling (RMD™) addresses mechanical resonances with mechanical solutions, and acoustical resonances with acoustical solutions. In the Xi-2181 development, RMD™ was applied at every level – to the individual low-frequency drivers, the low-frequency enclosure chambers and the interaction between multiple enclosures. The design process included, for example, the driver cone, suspension geometry and materials, enclosure geometry and materials, absorptive materials, etc. The result is a dramatic improvement in clarity and with a much more neutral sound (a lack of coloration) with the loudspeaker system maintain-

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ing its sonic integrity from the very-lowest sound pressure levels to the very-highest sound pressure levels. This means that the front-of-house engineer will not have to retune the EQ and level settings as the SPL is increased throughout the show. This also means that the sound-system performance will remain consistent in different array configurations and from venue to venue.

The X-Array Install™ systems utilizes full top/bottom L-track.

The durable Xi-2181 enclosure is constructed of 18-mm, 13-ply birch plywood and has a wear-resistant black, textured paint finish. The system is trapezoidal, forming an 18° wedge and includes a heavy-duty steel grille with a water-resistant charcoal-gray foam interlining.

### Applications

The X-Array Install™ loudspeaker systems were designed for optimal performance in both concert-sound and permanent-installation applications where studio-monitor sound quality is required at concert-sound levels. The X-Array Install™ loudspeaker systems work well individually, in small arrays and in large arrays. The high acoustic output from these compact, lightweight systems provide the highest acoustic-power-to-weight ratio, the highest acoustic-power-to-frontal-area ratio, and the highest acoustic-power-to-bulk-volume ratio in the industry. That means that X-Array™ systems will be considerably smaller and lighter compared to competitive systems having equivalent acoustic output. With its response from 37-200 Hz, the Xi-2181 is recommended for low-frequency applications where very-high levels of bass are required from a compact enclosure. Specifically, the Xi-2181 has been optimized to provide low-frequency reinforcement for the Xi 2153, 2183, 2123, 1123, 1153, 1152, 1122 systems. The Xi-2181 may be used individually or in multiples to construct low-frequency arrays, or may be used with the mid-bass-/high-frequency or low-/mid-bass-/high-frequency X-Array Install™ loudspeaker systems to construct large full-range arrays. The Merlin ISP100 as well as the Electro-Voice Dx34A and Klark Teknik DN8000 digital crossovers are recommended for signal control. (See the *Crossover, Equal-*

*ization and Signal Delay Controller* section.) The Electro-Voice P3000 amplifier is recommended for powering the Xi-2181. (See the *Amplifier Recommendations* section.)

### Power-Handling Capabilities

The Xi-2181 systems are rated as per the "ANSI/EIA RS-426-A Loudspeaker Power-Rating, Full-Range Test," which uses a shaped-random-noise signal to simulate typical music to test the mechanical and thermal capabilities of the loudspeakers. A digital crossover was used to provide the appropriate filtering and equalization. The test parameters are as follows:

#### Low-Frequency Section (Pins 1 and 2 paralleled):

$P_{E(MAX)}$ :	1,200 watts
Test Voltage:	58.7-volts rms 117.4-volts peak
$R_{SR}$ (1.15 $R_E$ ):	2.88 ohms

### Amplifier Recommendations

Power amplifiers with the following ratings are recommended for use with the Xi-2181 loudspeaker systems:

LF:	800 watts into 8 ohms 91-volts rms short term 130-volts peak
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Xi-2181 loudspeakers may be paralleled with other Xi-2181 systems as long as the amplifiers can drive the lower impedances. To maintain a sufficient damping factor with long cable runs, amplifier loads of four ohms per channel are recommended. The Electro-Voice P3000 amplifiers are ideal for powering the X-Array™ systems.

### Crossover, Equalization and Signal Delay Controller

The Xi-2181 is intended to be used with other X-Array Install™ loudspeaker systems to construct full-range arrays as an active system requiring an active crossover, equalization and signal delay controller. For basic applications, the Merlin ISP100, or the Electro-Voice Dx34A 2-in/4-out controller is recommended. The Klark Teknik DN8000 2-in/5-out controller is also recommended. Linkwitz-Riley crossover filters with a minimum slope of 24 dB per octave at 125 Hz are recommended, and infrasonic filter pro-

tection at 32 Hz or higher with a minimum slope of 12-dB/octave is recommended in the low-frequency section. The ISP100 as well as the Dx34A and the DN8000 offer appropriate filtering, equalization and signal delay capabilities to provide optimum performance of the X-Array Install™ loudspeaker systems. Digital parameter settings for all controllers are available upon request.

### Electrical Connection and System Wiring

Two paralleled Neutrik 8-pin Speakon® connectors are used for electrical connection to the Xi-2181 loudspeakers with the following pin assignments:

LF1:	Pins 1 Paralleled
LF2:	Pins 2 Paralleled

The Xi-2181 wiring diagram is shown in Figure 7. Since the connectors are paralleled, it does not matter which connector is used as the input or output when paralleling Xi-2181 systems. Although Pins 3 and 4 are not used by the Xi-2181 systems, they are paralleled on the input panel. This allows an X-Array Install™ MB/HF box to be paralleled with an Xi-2181, allowing all eight conductors to be used with a single cable run to the amplifiers. Note that, when two Xi-2181 systems are jumped from one to another via the input/output connections, the amplifier home-run cable will have two woofers on Pins 2 (for a 4-ohm load) and two woofers on Pins 1 (for a 4-ohm load).

### Flying the X-Array Install™ Systems

A manual entitled the *X-Array Install™ Flying Manual* is available from Electro-Voice and is included with each flying Xi loudspeaker system. A brief introductory overview is included here. *The X-Array-Install™ Flying Manual* should be consulted for complete structural specifications and detailed information on safely suspending and using the Xi systems.

The Xi-2181 loudspeaker system includes flying hardware, a unique two-point flying system that permits a wide range of vertical angle adjustment, and offers maximum flexibility in array design for both touring sound and permanent installations. The quick-release, aircraft-rated heavy-duty L-track type hardware design allows arrays of loudspeakers to be assembled (and disassembled) very

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quickly, and offers such flexibility in the vertical angling of cabinets that pull-up points are usually unnecessary. Furthermore, all of the flying Xi loudspeaker models include the same rigging hardware, allowing different models to be mixed as necessary throughout an array.

The working-load limit (for an 8:1 safety factor) for each rigging point on the Xi loudspeaker enclosure is 227 kg (500 lb) for a 0° pull angle and 170 kg (375 lb) for a 90° pull angle when used with the New Haven NH32101-2 double-stud fitting, and 113 kg (250 lb) when used with the New Haven NH8192-2S or Ankra 42546-10 single-stud fittings with locking pins. The working-load limit (for an 8:1 safety factor) for the overall enclosure is 340 kg (750 lb). (Consult the *X-Array Install™ Flying Manual* for specific structural ratings and limitations.) The enclosures may be oriented with the rigging track on the side of the enclosure, or on the top and bottom, and may be daisy-chained together as long as the safety factor is 8:1 or greater and local regulations are met. For fire safety and additional structural strength in both flying orientations, top-to-bottom and side-to-side metal straps link the rigging track inside the enclosure.

**CAUTION:** The Xi loudspeaker system should be suspended overhead only in accordance with the procedures and limitations specified in the *X-Array Install™ Flying Manual* and manual update notices.

### Field Replacement

Normal service for the Xi-2181 requires only a #2 Phillips screwdriver and a 3/16-inch hex-key wrench. The drivers may be accessed as follows:

**LF:** First remove the grille, then remove the screws securing the hatch on the front of the enclosure. Remove the screws securing the 18-inch woofer and lift the woofer out of the enclosure. In the event of failure, the entire woofer must be replaced or reconed. The following service parts are available from the service department in Buchanan, Michigan USA:

LF #818-2883 EVX-180B complete driver. The complete drivers are available only for repair replacement and are not available for general sale.

### Architects' and Engineers' Specifications

The loudspeaker system shall be a two-driver, manifolded, vented-box low-frequency system with a frequency response from 37-200 Hz. The loudspeaker system also shall have two 457-mm (18-in.) low-frequency woofers and each shall have an 8-ohm, 101-mm (4-in.) diameter voice coil and a 600-watt power rating. The loudspeaker shall have a rigging system enabling a column of loudspeakers to be hinged at their back corners, with relative downward angles set by adjustable rigging straps at the front. The enclosure shall be constructed of 18-mm thick, 13-ply birch plywood, and shall be trapezoidal, forming an 18° wedge and be 914 mm (36.00 in.) high, 584 mm (23.00 in.) wide at the front, 354 mm (13.93 in.) wide at the back and 759 mm (29.88 in.) deep, and shall weigh 83.5 kg (184 lb.)

### Electronic Accessories:

**Merlin ISP-100 Integrated Signal Processor:** The ISP-100 is a 2-channel, modular, signal processor configurable from 2 in/2 out up to 2 in/8 out, or 4 in/2 out up to 4 in/6 out. Completely customizable by the designer from input to output; integrating, crossovers, compressors, limiters, PEQ's, high pass/low pass/all pass, gates, and routing/combining, etc. Program parameters (including factory designed topologies) for optimal performance of the X-Array systems are available. Merlin, 600 Cecil St., Buchanan, MI, 49107, U.S.A., 616/695-6831.

**Klark Teknik DN8000 Digital Controller:** The DN8000 digital electronic loudspeaker controller has a two-in/five-out architecture, with each output having programmable high-pass and low-pass filters, four-band equalization, signal delay, compressor-limiter-and noise-gate functions. Program parameters for optimal performance of the X-Array™ systems are available. Klark Teknik, Klark Industrial Park, Walter Nash Road, Kidderminster, Worcestershire DY11 7HJ England, 44-156-274-1515

**Electro-Voice Dx34A Digital Controller:** The Dx34A digital electronic loudspeaker controller has a two-in/four-out architecture, with each output having programmable high-pass and low-pass filters, two- or three-band

equalization, signal delay and limiter functions. Program parameters for optimal performance of the X-Array™ systems are available. Electro-Voice, 600 Cecil St., Buchanan, MI 49107 USA, 616/695-6831

**Electro-Voice P3000 Power Amplifiers:** The stereo P3000 power amplifiers are rated at 800 watts into 8 ohms, or 91-volts rms short term. The amplifiers are 3-U high and weigh 28 kg (62 lb) each. Electro-Voice, 600 Cecil St., Buchanan, MI 49107 USA, 616/695-6831

### 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 Service or any of its authorized service representatives. Obtaining Warranty Service: To obtain warranty service, a customer must deliver the product, prepaid, to Electro-Voice Service 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 Service at 600 Cecil Street, Buchanan, MI 49107 (800-234-6831 or FAX 616-695-4743). Incidental and Consequential Damages Excluded: Product repair or replacement and return to the customer are the only remedies provided to the customer. Elec-



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tro-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 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.

**Electro-Voice Flying Hardware** (including enclosure-mounted hardware and rigging accessories) is guaranteed against malfunc-

tion 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.

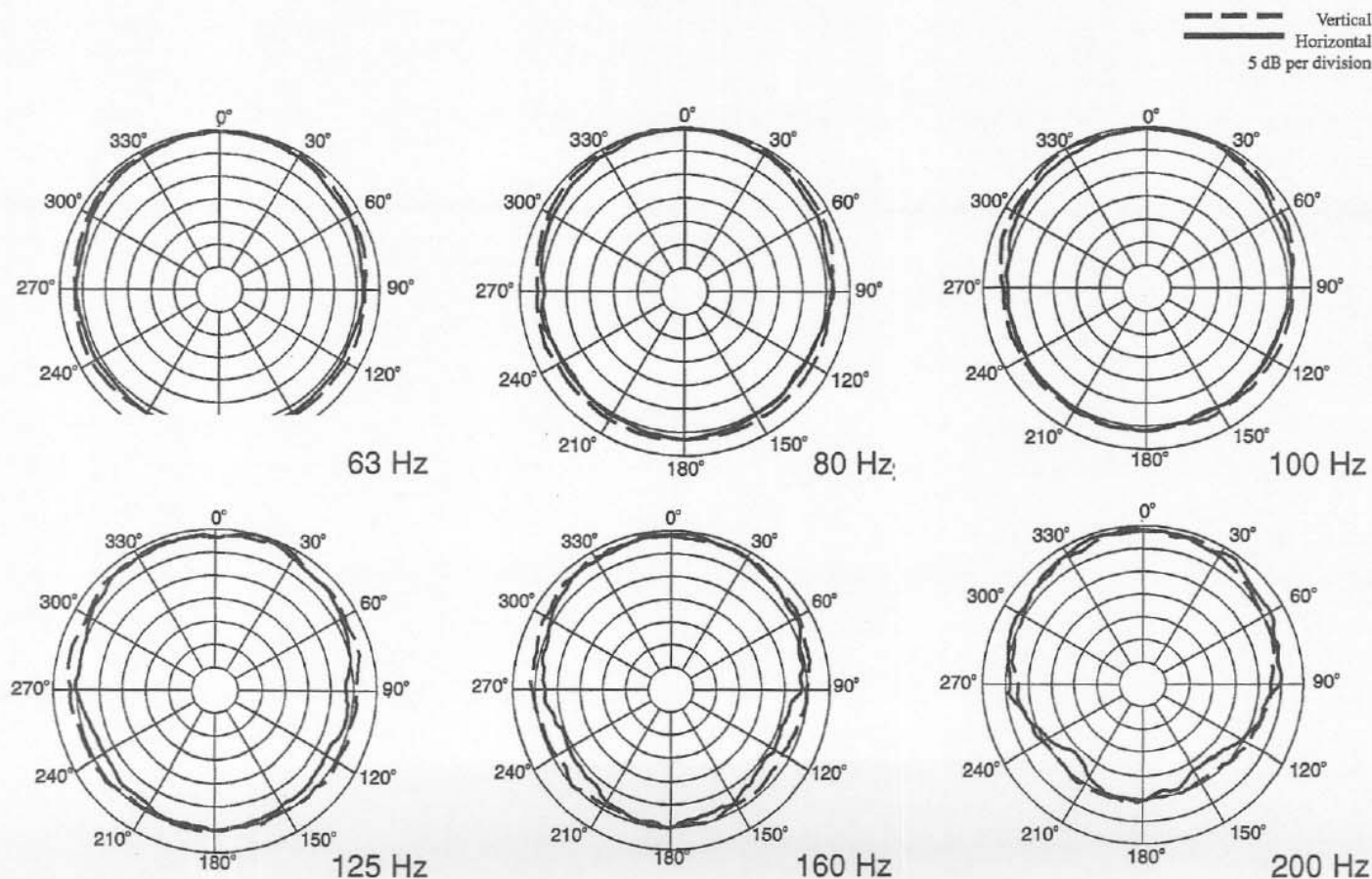
For warranty repair, service information, or a listing of the repair facilities nearest you, contact the service repair department at: 616/695-6831 or 800/685-2606.

For technical assistance, call: 800/234-6831.

Specifications subject to change without notice.

**Figure 1 — Polar Response**

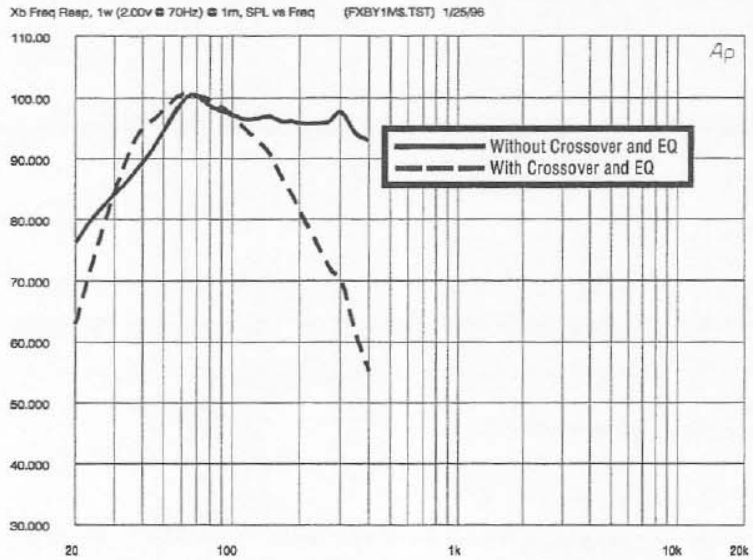
The directional response of the Xi-2181 was measured in an anechoic environment at a distance of 6.1 m (20 ft.) using 1/3-octave-filtered pink noise with a full spherical measurement system. The polar response of the loudspeaker system at selected 1/3-octave frequencies is shown. The selected frequencies are representative of the polar response of the system.



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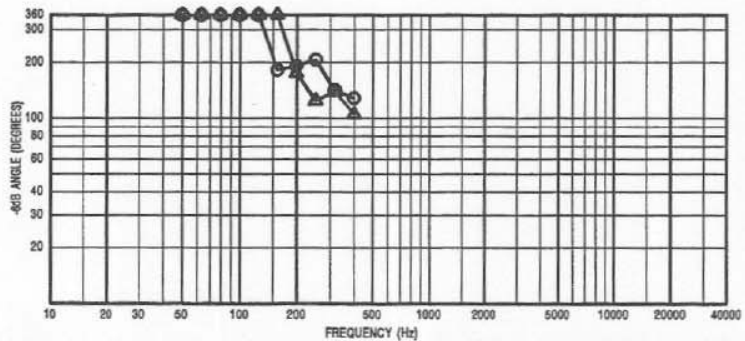
**Figure 2 — Frequency Response**

The frequency response of the Xi was measured on axis in the far field in an anechoic environment using a swept sine-wave signal. One watt of power (2.00-volts rms at 70 Hz) was applied to the mid band of the low-frequency section. The sound pressure level was normalized for an equivalent one-meter distance.



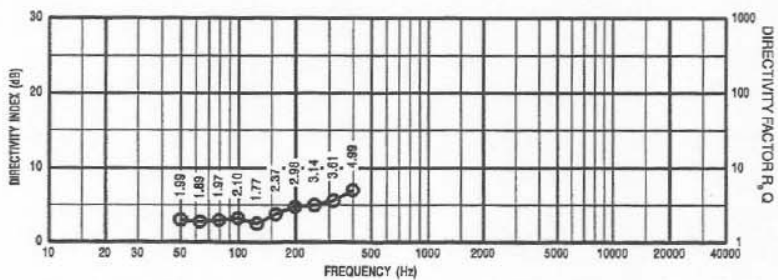
**Figure 3 — Beamwidth**

The beamwidth of the Xi, (i.e., the included horizontal and vertical coverage angles at the -6-dB points) was measured with a full-spherical measurement system as described in Figure 1.



**Figure 4 — Directivity**

The directivity index,  $D_i$ , and directivity factor,  $R$ , of the Xi-2181 were measured with a full-spherical measurement system as described in Figure 1.

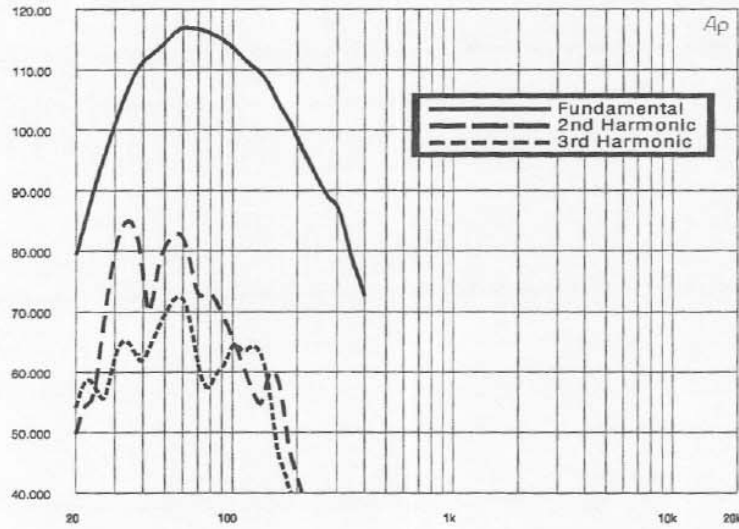


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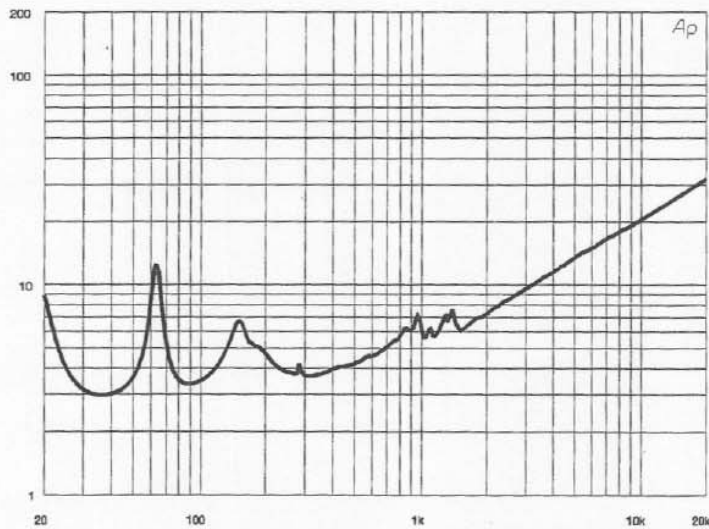
**Figure 5 — Distortion**

Distortion for the Xi was measured on axis in the far field in an anechoic environment with an input signal that would result in a sound pressure level of 115 dB at one meter. The sound pressure level was normalized for an equivalent one-meter distance. Plots of second and third harmonic distortion are shown referenced to the fundamental.



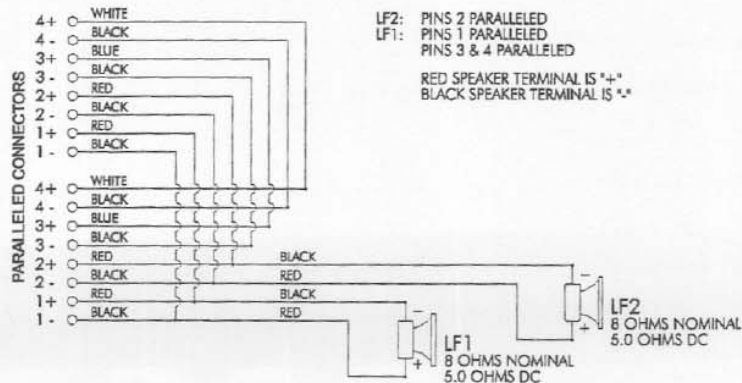
**Figure 6 — Impedance**

The impedance of each frequency band of the Xi was measured in an anechoic environment



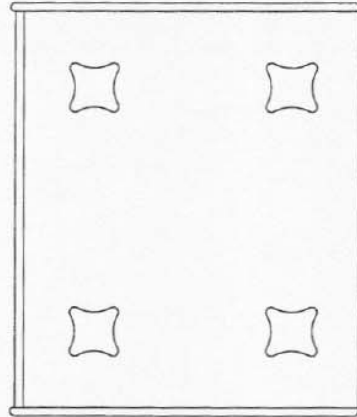
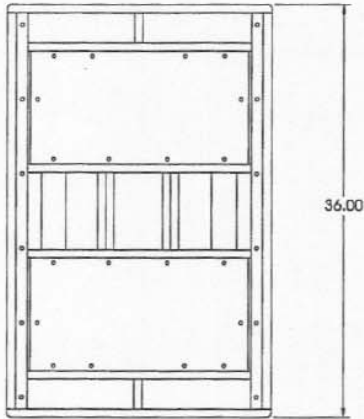
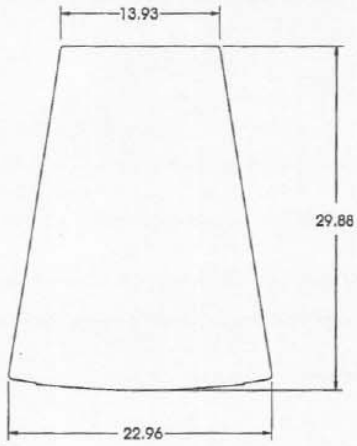
**Figure 7 — Wiring Diagram**

The wiring diagram of each frequency band of the Xi is shown.



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Figure 8—Dimensions



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### Specifications

Frequency Response (measured in far field, with and without crossover and equalization, calculated to one meter on axis, swept sine wave, one watt into system - 2.00 V at 70 Hz, anechoic environment; see Figure 2):

37-200 Hz

Crossover Frequency:

125 Hz

Efficiency Mid Band:

5.3 %

Maximum Long-Term-Average Power-Handling Capacity (per ANSI/EIA RS-426A 1980):

1,200 watts

Maximum Long-Term-Average Mid-Band Acoustic Output, LF/HF:

64 acoustic watts

Sensitivity (SPL at one meter, indicated input power, anechoic environment, average level),

1 watt:

98.5 dB-full space

(101.5 dB-1/2 space, 104.5 dB-1/4 space)

1,200 watts:

129.3 dB

Beamwidth (angle included by 6-dB-down points on polar responses, indicated one-third-octave bands of pink noise; see Figures 1 and 3),

Horizontal, 63-200 Hz:

240° (+120°, -60°)

Vertical, 63-200 Hz:

300° (+60°, -120°)

Directivity Factor, R (Q), 63-200 Hz

Average (see Figure 4):

2.2 (+0.8, -0.4)

Directivity Index, D<sub>i</sub>, 63-200 Hz

Average (see Figure 4):

3.4 dB (+1.4 dB, -0.9 dB)

Distortion (115 dB SPL at one meter, shaped spectrum; see Figure 5),

Second Harmonic,

40 Hz:

1.8%

80 Hz:

0.7%

Third Harmonic,

40 Hz:

0.3%

80 Hz:

0.1%

Transducer Complement,

Two EVX-180B 18-in. woofers

Impedance (see Figure 6),

Nominal:

Two 8-ohm loads

Minimum:

Two 6.0-ohm loads

Input Connections:

Two Neutrik NL8MPR Speakon® connectors paralleled

Recommended Amplifier Power, Rating:

800 watts @ 8 ohms

(91-volts rms short term)

Enclosure Construction,

Enclosure Shell:

18-mm, 13-ply birch plywood

Finish:

Black textured paint

Grille:

Powder-coated steel with foam

Rigging: Heavy-duty L-track on top/  
bottom which accepts New Haven  
NH32102-2 double-stud fittings

Dimensions,

Height:

914 mm (36.00 in.)

Width (front):

584 mm (23.00 in.)

Width (back):

354 mm (13.93 in.)

Depth:

759 mm (29.88 in.)

Angle:

18° wedge

Net Weight:

83.5 kg (184 lb)

Shipping Weight:

91.8 kg (202 lb)

# Electro-Voice®

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SPEAKERS—X-Array™

Part Number 535474—9913