

SHOWN WITH GRILLE REMOVED

# TL15-2

## Low-Frequency Speaker System

- The bass pumping ability of dual 15-inch woofers and 46-Hz  $f_1$  are ideal for high-output voice and music applications
- 33-Hz  $f_1$  in step-down
- Stacked woofers provide restricted, 55° vertical coverage angle at 500 Hz, useful in many sound reinforcement applications
- Paintable black vinyl finish
- Optional HS hanging kits—through-the-box steel tubes allow vertical suspension of up to three systems
- Indoor and covered outdoor use—waterproof cones and weather-resistant ProWood™ enclosure

**SPECIFICATIONS:**

Frequency Response, 1 Watt at 1 Meter on Axis, Swept One-Third-Octave Pink Noise, Anechoic Environment (see Figure 1):

46-3,500 Hz

Low-Frequency 3-dB-Down Point,

Normal:

46 Hz

Step-Down (with equalization):

33 Hz

Usable Low-Frequency Limit (10-dB-down point),

Normal:

30 Hz

Step-Down (with equalization):

26 Hz

Half-Space Reference Efficiency:

6.4%

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

800 watts

Maximum Long-Term Average Mid-Band Acoustic Output:

51 watts

Sound Pressure Level at 1 Meter, 1 Watt (2.00 volts) Input, Anechoic Environment, Band-Limited Pink-Noise Signal,

100-800 Hz:

101 dB

50-125 Hz:

96 dB

Dispersion Angle Included by 6-dB-Down Points on Polar Responses, Indicated One-Third-Octave Bands of Pink Noise (see Figure 3),

90-125 Hz Horizontal and Vertical:

360°

400-800 Hz Horizontal:

120° ± 10°

400-800 Hz Vertical:

60° ± 20°

Directivity Factor  $R_\theta$  (Q), Median over Indicated Range (see Figure 4),

90-125 Hz:

1.0

400-800 Hz:

9.3

Directivity Index D<sub>i</sub> (10 log  $R_\theta$ ),

90-125 Hz:

0.0 dB

400-800 Hz:

9.6 dB

Distortion, 0.1 Full Power Input (see Figure 5),

Second Harmonic,

100 Hz:

2.5%

1,000 Hz:

1.6%

Third Harmonic,

100 Hz:

2.5%

1,000 Hz:

1.6%

Distortion, 0.01 Full Power Input (see Figure 6),

Second Harmonic,

100 Hz:

0.9%

1,000 Hz:

0.5%

Third Harmonic,

100 Hz:

0.5%

1,000 Hz:

1.1%

Transducer Complement:

Two DL15X-WP

Net Box Volume:

210 liters (7.4 ft<sup>3</sup>)

**Box Tuning Frequency,**

Normal:

40 Hz

Step-Down:

28 Hz

Step-Down Peak-Boost Frequency (see Step-Down section):

30 Hz

Impedance, Nominal/Minimum (see Electrical Connections section):

4.0/3.8 ohms

Input Connectors:

Screw terminals (#10) on barrier strip

Enclosure Materials and Finish:

0.7-in. (1.8-cm) black ProWood™ (see Description section)

Suspension (see Suspending TL15-2 Enclosures section):

HS1 and HS3 independently certified hanging kits available

Grille:

Black vibration-resistant steel

Dimensions,

Height:

34.0 in. (86.3 cm)

Width:

24.0 in. (61.0 cm)

Depth:

20.5 in. (52.1 cm)

Net Weight:

49.0 kg (108 lb)

Shipping Weight:

55.0 kg (122 lb)

**DESCRIPTION**

The Electro-Voice TL15-2 is a member of the TL series of low-frequency enclosures. The TL15-2 is a dual direct-radiating vented design that provides high efficiency, low distortion and very good low-frequency performance in a compact enclosure. The TL15-2 employs two long-throw DL15X-WP 15-inch loudspeakers, in a 7.4-ft<sup>3</sup> enclosure.

FIGURE 1 — Axial Frequency Response  
(anechoic environment, 1 watt/1 meter)

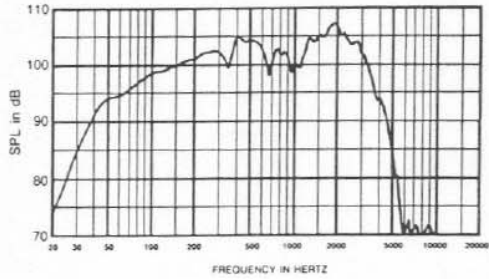


FIGURE 2 — TL15-2 One-Third-Octave Polar Responses  
(anechoic environment)

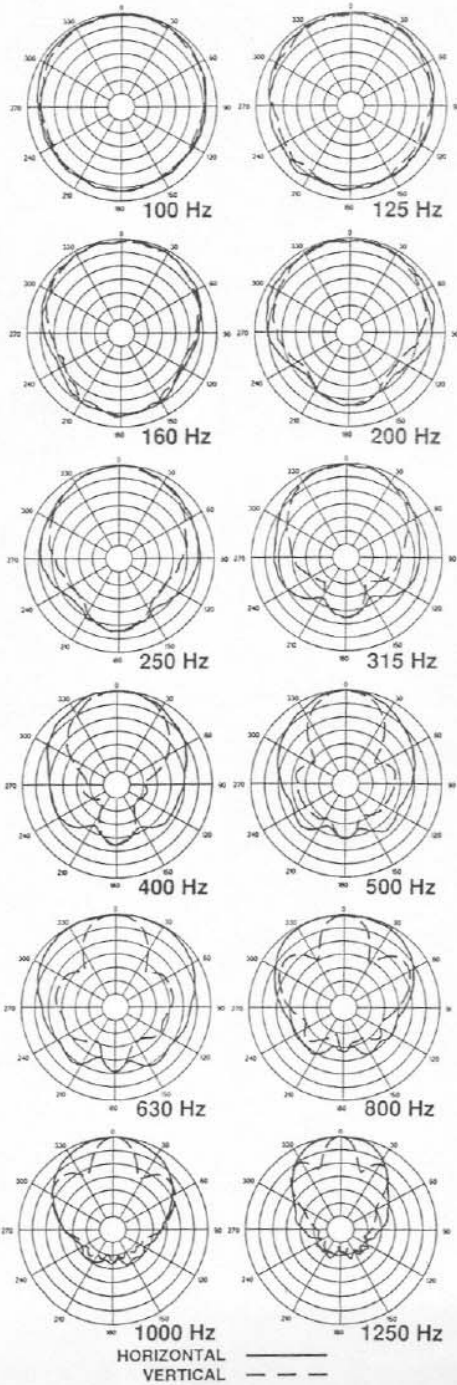


FIGURE 3 — TL15-2 One-Third-Octave Beamwidth vs Frequency  
(anechoic environment)

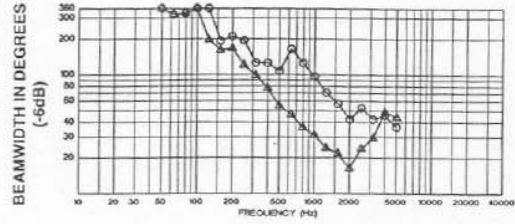


FIGURE 4 — TL15-2 One-Third-Octave Directivity vs Frequency  
(anechoic environment)

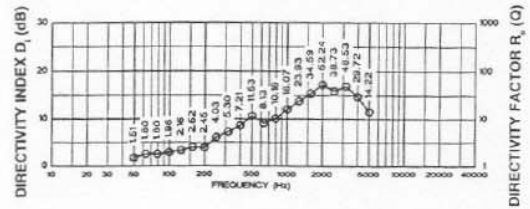


FIGURE 5 — TL15-2 Harmonic Distortion,  
0.1 Rated Power Input (80 watts), 10 Feet on Axis

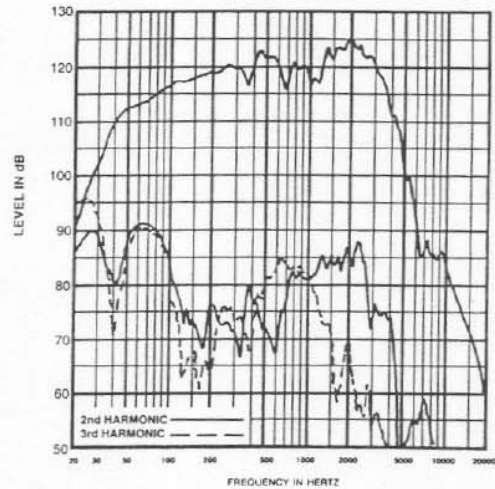
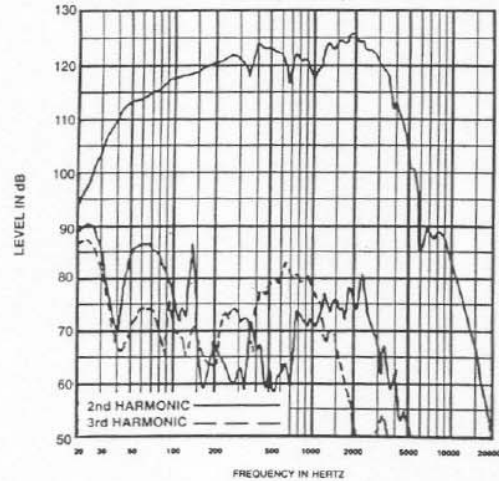


FIGURE 6 — TL15-2 Harmonic Distortion,  
0.01 Rated Power Input (8 watts), 10 Feet on Axis



The TL15-2's large pumping capability and 46-Hz low-frequency 3-dB-down point make it appropriate for both voice and music playback and sound reinforcement. Its stacked woofers provide a restricted, 55° coverage angle at 500 Hz, useful in many sound reinforcement applications (see Use in Multiples section).

The enclosure is finished in black with a matching metal grille. Connections are made via barrier strip (#10) recessed into the back of the enclosure on a durable molded connector panel. The enclosure is constructed from ProWood™, a composite structural material which is easily refinished. ProWood is made of selectively oriented hardwood strands strongly bonded together within a phenolic resin matrix. The surface is a proprietary vinyl laminate, especially formulated for Electro-Voice, which can be painted or stained to match any decorative environment (see Finishing ProWood section).

The TL series is suited for any installation where high-quality sound is required. The weather-resistant finish makes these systems suitable for both indoor and covered outdoor applications including stadiums, auditoriums and churches. The enclosures may be stacked for greater output capability or for a narrower beamwidth (see Use in Multiples section).

#### FREQUENCY RESPONSE

The TL15-2's axial frequency response was measured in Electro-Voice's large anechoic chamber at a distance of 10 feet with a swept sine-wave input of 4 volts. Figure 1 has been averaged and corrected for 1 watt/1 meter.

#### DIRECTIVITY

The directional characteristics of the TL15-2 were measured in Electro-Voice's large anechoic chamber. The test signal was one-third-octave filtered pink noise at the frequencies indicated. A full spherical measurement system was used, which is compatible with the AcostaCADD™ computer-aided design program. All directional information was measured at 20 feet.

Figure 2 illustrates the horizontal and vertical polar responses.

Figure 3 shows 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 axial frequency response.

Figure 4 illustrates the total directivity of the TL15-2. The directivity factor  $R_0(Q)$  is the relative value, at a point, of the TL15-2 when compared to an ideal spherical response. The directivity index,  $D_i$ , is calculated by  $D_i = 10 \log R_0$ .

#### POWER HANDLING CAPACITY

To our knowledge Electro-Voice was the first U.S. manufacturer to develop and publish a power test closely related to real-life conditions. A random noise input signal is used because it contains many frequencies simultaneously, just like real voice or instrument program. The signal contains more energy at extremely high and low frequencies than typical actual program, adding an extra margin of reliability. The test

combines not only the overall long-term average or continuous level—which our ear interprets as loudness—but also short-duration peaks which are many times higher than the average, just like actual program. The long-term average level stresses the speaker thermally (heat). The instantaneous peaks test mechanical reliability (cone excursion). Note that the sine-wave test signals sometimes used have a much less demanding peak value relative to their average level. In actual use, long-term average levels exist from several seconds on up. We test for several hours, adding another extra level of reliability.

Specifically, the TL15-2 is designed to withstand the power test described in EIA Standard RS-426A. The EIA test spectrum is applied for eight hours. The spectrum is obtained by filtering white noise (a particular type of random noise with equal energy per bandwidth). The filter applies a 6-dB-per-octave slope below 40 Hz and above 318 Hz. When measured with a one-third-octave constant-percentage analyzer, this filter produces a spectrum whose 3-dB-down points are at 100 Hz and 1,200 Hz with a 3-dB-per-octave slope above 1,200 Hz. This shaped signal is fed to the power amplifier with the continuous power set to provide 400 watts into the 3.5-ohm EIA equivalent impedance (53.0 volts rms).

Amplifier clipping sets instantaneous peaks at 6 dB above the continuous power, or 3,200 watts peak (106.0 volts peak). This procedure provides a rigorous test of both thermal and mechanical failure modes.

#### STEP-DOWN

Step-down is a method of extending the low-frequency response by increasing the power input to the system instead of the enclosure volume. In step-down mode, the enclosure is tuned at a lower-than-normal frequency. This increases the output at the new tuning frequency and reduces the output at the original tuning frequency. This smoothly falling amplitude response can be equalized to obtain a new 3-dB-down point in the region of 0.7 that of the original. To obtain a similar response without step-down would require an enclosure with at least twice the volume.

Step-down can be instigated by using the supplied port cover. Remove the metal grille. Install the plastic port cover and staple it in place. Replace the metal grille. The enclosure tuning will be lowered from 40 to 28 Hz.

If an appropriate low-frequency boost-and-cut equalization is applied, the normal  $f_3$  of 46 Hz is reduced to 33 Hz. It is suggested that the Electro-Voice XEQ-2 or XEQ-3 active crossover be used to provide the required equalization. The suggested equalization is an underdamped second-order high-pass filter tuned to 29 Hz with a Q of 2. This provides a boost of 6 dB at the tuning frequency and a 12-dB-per-octave roll-off below. This filter is directly available on the XEQ-2 or can be generated in the XEQ-3 by using the optional EB29/35 EQ module.

#### SUBPASSBAND SPEAKER PROTECTION

Below the enclosure tuning frequency, cone excursion increases rapidly. Since acoustic output is also falling rapidly, there is no utility in driving the system with signals much below tuning frequency. While such signals may be in the program material, they are often extraneous, such as a dropped microphone. The step-down equalization described in the Step-Down section provides the required protection. If step-down mode is not used, the Electro-Voice EX-24, XEQ-2 and XEQ-3 electronic crossover/equalizers can also provide subpassband protection. The 3-dB-down points are 30 Hz (EX-24 and XEQ-2) and 16 Hz or 32 Hz (XEQ-3).

Other high-pass filters are available and 1/3-octave equalizers can also be effective at providing the required protection.

#### USE IN MULTIPLES

Cone loudspeakers may be stacked for greater acoustic output and a narrower beamwidth. (It is assumed that all cones are operating in unison or "in phase.") This principle is already employed in the dual-woofer TL15-2, and is responsible for the higher sensitivity and narrower vertical beamwidth (with the system long axis vertical) relative to the single-woofer TL15-1. In addition, two TL15-2's can be used side-by-side and their combined performance will be different from that of a single TL15-2 in the ways outlined.

At relatively low frequencies, below about 150 Hz for typical TL series dimensions, stacking produces additional acoustic output without altering dispersion. When a common signal is applied, a 6-dB increase in maximum acoustic output occurs. The cones "mutually couple" and act as one cone with twice the area (therefore twice the efficiency) and twice the power capacity. The additional cone area provides 3 dB more output and the additional power capacity accounts for the remaining 3 dB.

Specifically, mutual coupling occurs at frequencies whose wavelengths are longer than one-quarter the center-to-center distance between the cones. The highest frequency at which mutual coupling occurs is calculated from the following equation:

$$f \approx \frac{3,000}{D_{\max}}$$

where  $D_{\max}$  (inches) is the distance between the cones, and  $f$  (Hz) is the highest frequency at which coupling occurs. When  $D_{\max}$  is greater than one-quarter wavelength, which would occur if two TL15-2's were widely spaced, or at frequencies much above  $f$  even when closely spaced, the increase in acoustic output is limited to the 3-dB power-handling increase.

At frequencies above the mutual coupling limit,  $f$ , stacking alters dispersion and increases on-axis sensitivity. In the 500-to-800-Hz range, a common crossover frequency for two-way sound reinforcement systems, two nearly adjacent cones have a coverage angle about half that of either cone alone. This is useful, for example, in more closely matching the typical 40° vertical dispersion of a high-frequency horn. (At fre-

quencies much above 800 Hz, the concept of a halved coverage angle no longer applies, since the side lobes, which result from two sources that are not mutually coupled, increase in number and approach or equal the main lobe in amplitude. The number of lobes and their amplitude increases as frequency increases.)

#### SUSPENDING TL15-2 ENCLOSURES

The TL15-2 has been developed in conjunction with the HS series of hanging hardware. The HS kit allows the TL15-2 to be hung safely in a variety of orientations. The combination of the correct HS kits and TL15-2 enclosure has been certified by an independent structural engineer to be safe and secure. Each HS kit consists of a steel tube, two brackets, two eyebolts and the necessary fasteners. The installer must assemble the HS kit by first drilling two holes into the TL15-2 enclosure, in predefined positions, and then screwing the brackets onto the steel tube, which passes through the enclosure. Full instructions and hole locations are included with each cabinet and HS kit. A single TL15-2 requires a single HS3 to suspend it horizontally, or a single HS1, vertically. However each cabinet, when hung in multiples, requires two HS1's horizontally or two HS3's vertically. A maximum of three cabinets can be suspended in this manner. Horizontal is defined by having the central EV logo in its correct orientation. *Full attention must be given to the instructions and limitations in the HS kit instruction sheet.*

#### ELECTRICAL CONNECTIONS

The TL15-2 is supplied with the two woofers connected in parallel at the input panel. The two metal jumpers can be removed and each woofer can be fed independently. The power handling for each woofer is 400 watts (EIA) into 8 ohms.

#### FINISHING ProWood™

Finishing ProWood is simple and straightforward as long as a few things are understood:

1. ProWood has been tested with a large number of commercially available paints with 100% success. However it is impossible to test every paint available. Electro-Voice therefore recommends that you test a small area on the rear of the cabinet or under the grille to check that there are no adverse effects.
2. Ensure the surface is clean and free of grease (use soapy water if necessary).
3. Any latex-, enamel-, or acrylic-based paint can be used. The special top layer of ProWood was developed in conjunction with Pittsburgh Paints. They developed their Manor Hall® Exterior House series of paints to complement ProWood.<sup>1</sup> Electro-Voice recommends the use of these paints in adverse or tough situations.
4. Water-based latex paints in particular can take a considerable time to dry fully. They

1. Manor Hall is a registered trademark of Pittsburgh Paints.

can be handled in a few hours but full strength may not be achieved for a week, particularly in damp or cool conditions.

5. The paint can be applied with a brush, roller or spray. Care should be taken not to get paint on the woofer cone.
6. Stain can be used to highlight the grain in the ProWood or match real wood. The black surface must be initially painted a light color. A good approach is to use a stained varnish. Care should be taken when using stain or stained varnish because it is impossible to lighten a dark staining job without repainting the enclosure in the light base color and restaining.

#### USE OUTDOORS

If the TL15-2 is used outdoors or in adverse conditions the following applies:

1. Direct rain and sunlight must be avoided. For example, under the awning in a baseball stadium is fine but directly exposed to the elements on top of the score board is not.
2. The enclosures should be painted with a high-quality exterior-grade paint (see Finishing ProWood section).
3. The enclosure should not, in any circumstances, be allowed to stand in water or be exposed to damp material, such as damp soil, for any period of time.

#### ARCHITECTS' AND ENGINEERS' SPECIFICATIONS

The loudspeaker system shall be a dual low-frequency, bass-reflex design. Two 15-inch woofers shall be front mounted in a 7.4-ft<sup>2</sup> enclosure. The system shall meet the following criteria: power handling, 800 watts of pink noise with a 6-dB crest factor; frequency response, smooth and uniform, usable at high output levels from 46 to 3,500 Hz; sensitivity, 101 dB at one watt, one meter, 100-800 Hz, on axis; impedance 4 ohms nominal, 3.8 ohms minimum; dispersion angles 120° (horizontal) x 55° (vertical) at 500 Hz. The enclosure shall be constructed of black ProWood™, a structural hard-wood composite material with a refinishing external surface. The enclosure shall be finishable using commonly available paints and finishing materials. The enclosure will contain sound-absorbing glass wool. An integral black steel grille will be fitted. Each woofer shall have the capacity to be fed independently of the other. A port cover shall be included to enable "step-down" operation for enhanced low-frequency performance. The enclosure dimensions shall be 34.0 in. high x 24.0 in. wide x 20.5 in. deep (86.3 cm x 61.0 cm x 52.1 cm). Net weight shall be 108 lb (49.0 kg). The low-frequency speaker system shall be the Electro-Voice TL15-2.

#### WARRANTY (Limited)

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) and/or Electro-Voice West, at 8234 Doe Avenue, Visalia, CA 93291 (209/651-7777). **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.

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

Specifications subject to change without notice.



**ELECTRO-VOICE** a MARK IV company **600 Cecil Street, Buchanan, Michigan 49107**

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