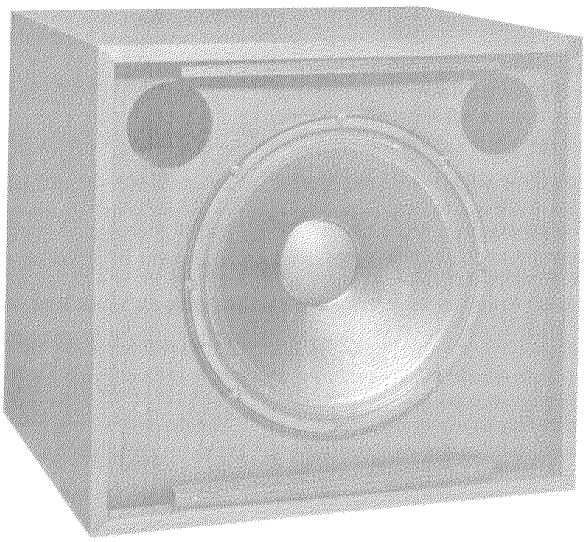
Electro-Voice®

TL15-1

Low-Frequency Speaker System

- 46-Hz f_3 ideal for both voice and music 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



SHOWN WITH GRILLE REMOVED

SPECIFICATIONS:

Frequency Response, 1 Watt at 1 Meter on Axis, Swept One-Third-Octave Pink Noise, Anechoic Environment (see Figure 1):
50-3,500 Hz

Low-Frequency 3-dB-Down Point,
Normal:
50 Hz
Step-Down (with equalization):
36 Hz

Usable Low-Frequency Limit (10-dB-down point),
Normal:
30 Hz
Step-Down (with equalization):
26 Hz

Half-Space Reference Efficiency:
5.1%

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

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

Sound Pressure Level at 1 Meter, 1 Watt (2.83 volts) Input, Anechoic Environment, Band-Limited Pink-Noise Signal,
100-800 Hz:
99 dB
65-125 Hz:
94 dB

Dispersion Angle Included by 6-dB-Down Points on Polar Responses, Indicated One-Third-Octave Bands of Pink Noise (see Figure 3),
50-125 Hz Horizontal and Vertical:
360°
400-800 Hz Horizontal and Vertical:
120° ± 10°

Directivity Factor R_θ (Q), Median over Indicated Range (see Figure 4),
50-125 Hz:
1.0
400-800 Hz:
5.4

Directivity Index D_I (10 log R_θ),
50-125 Hz:
0.0 dB
400-800 Hz:
7.3 dB

Distortion, 0.1 Full Power Input (see Figure 5),
Second Harmonic,
100 Hz:
1.2%
1,000 Hz:
1.6%
Third Harmonic,
100 Hz:
1.2%
1,000 Hz:
1.6%

Distortion, 0.01 Full Power Input (see Figure 6),
Second Harmonic,
100 Hz:
1.0%
1,000 Hz:
0.6%
Third Harmonic,
100 Hz:
0.2%
1,000 Hz:
1.6%

Transducer Complement:
One DL15X-WP

Net Box Volume:
133 liters (4.7 ft³)

Box Tuning Frequency,
Normal:
40 Hz
Step-Down:
28 Hz

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

Impedance, Nominal/Minimum:
8.0/7.0 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 TL15-1 Enclosures section):
HS3 and HS4 independently certified hanging kits available

Grille:
Black vibration-resistant steel

Dimensions,
Height:
22.0 in. (55.9 cm)
Width:
24.0 in. (61.0 cm)
Depth:
20.5 in. (52.1 cm)

Net Weight:
31.0 kg (46 lb)

Shipping Weight:
35.0 kg (54 lb)

DESCRIPTION

The Electro-Voice TL15-1 is a member of the TL series of low-frequency enclosures. The TL15-1 is a direct-radiating vented design that provides high efficiency, low distortion and very good low-frequency performance in a very compact enclosure. The TL15-1 employs a single DL15X-WP 15-inch loudspeaker, in a 4.7-ft³ enclosure.

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

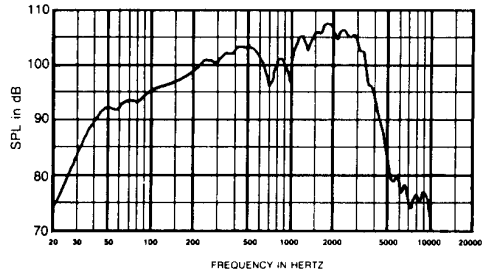


FIGURE 2 — TL15-1 One-Third-Octave Polar Responses (anechoic environment)

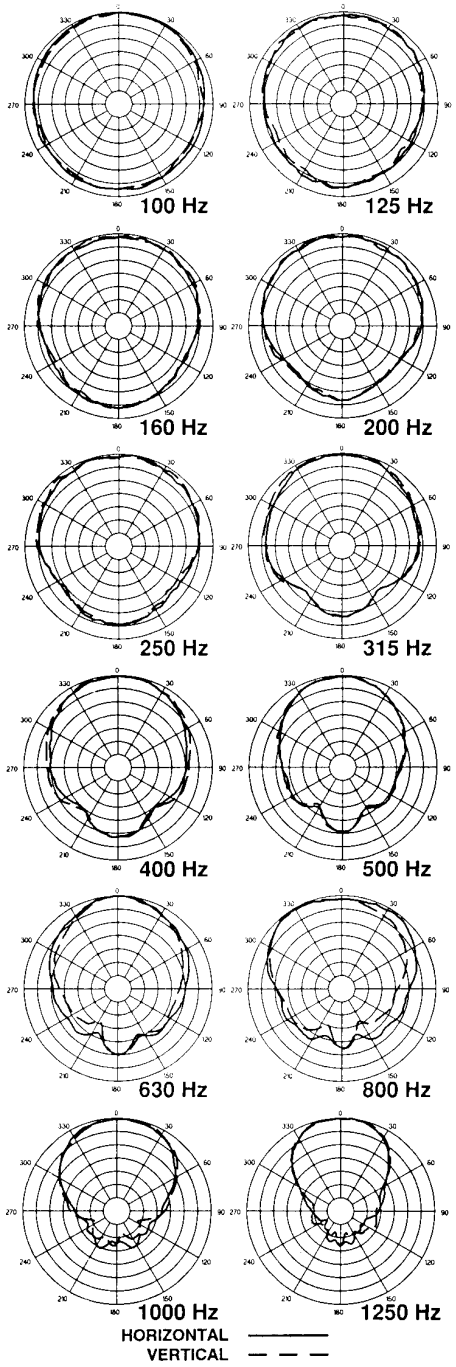


FIGURE 3 — TL15-1 One-Third-Octave Beamwidth vs Frequency (anechoic environment)

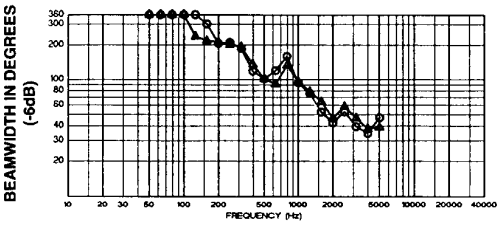


FIGURE 4 — TL15-1 One-Third-Octave Directivity vs Frequency (anechoic environment)

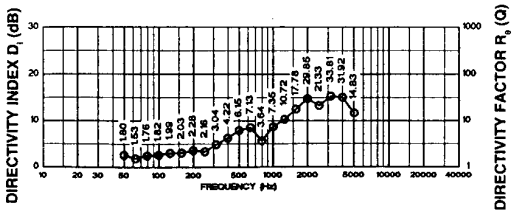


FIGURE 5 — TL15-1 Harmonic Distortion, 0.1 Rated Power Input (40 watts), 10 Feet on Axis

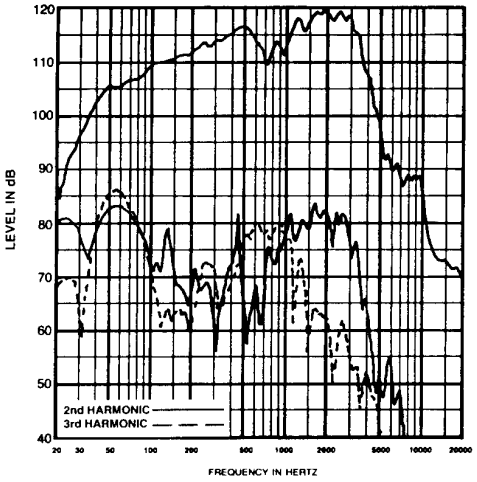
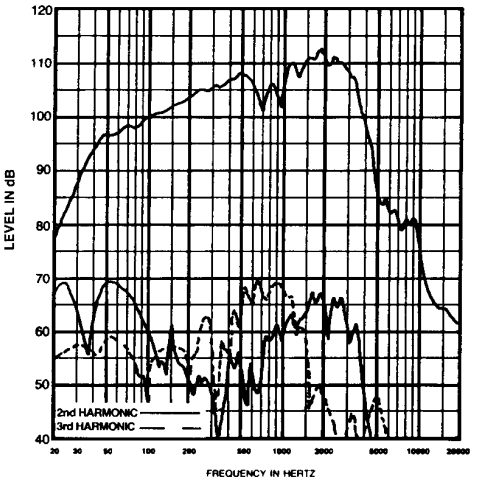


FIGURE 6 — TL15-1 Harmonic Distortion, 0.01 Rated Power Input (4 watts), 10 Feet on Axis



The TL15-1's 46-Hz low-frequency 3-dB-down point makes it appropriate for both voice and music playback and sound reinforcement.

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 TL15-1'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 TL15-1 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 AcoustaCADD™ 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 TL15-1. The directivity factor R_θ (Q) is the relative value, at a point, of the TL15-1 when compared to an ideal spherical response. The directivity index, D_I, is calculated by $D_I = 10 \log R_\theta$.

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 TL15-1 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 6.9-ohm EIA equivalent impedance (52.5 volts rms).

Amplifier clipping sets instantaneous peaks at 6 dB above the continuous power, or 1,200 watts peak (105.0 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 50 Hz is reduced to 36 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

TL systems may be stacked for greater acoustic output and a narrower beamwidth. (It is assumed that all cones are operating in unison or "in phase.")

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:

$$f \cong \frac{3{,}000}{D_{MAX}},$$

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 TL15-1'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 frequencies 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 TL15-1 ENCLOSURES

The TL15-1 has been developed in conjunction with the HS series of hanging hardware. The HS kit allows the TL15-1 to be hung safely in a variety of orientations. The combination of the correct HS kits and TL15-1 enclosure has been