

The Electro-Voice® Guide to P.A. and Sound Reinforcement Products

Catalog 177



AT ELECTRO-VOICE, WE CARE ABOUT SOUND

Too often sound reinforcement and public address systems do not give the good results you have a right to expect for your money. To avoid that sort of problem E-V offers:

A Variety of High Quality Products for Every Application.

Guidance in System Design.

Outstanding Delivery and Service.

Electro-Voice is a leading supplier of products which demand excellence. In the sports arena, on the stage, in the broadcasting studio, and in the recording studio; in churches, schools, clubs — where only the best sound will do, E-V is there.

In this Guide we provide you with a very complete list of specifications to aid you in sound system design. Specifications given are as accurate as possible, with far more information for the sound installer than is the usual practice. These specifications can be duplicated with standard off-the-shelf product. Our objective is to help you meet your objective — the best possible sound for the money.

Electro-Voice public address and sound reinforcement products may be purchased through any authorized Electro-Voice commercial sound P.A. products dealer. E-V dealers are located in all 50 states, as well as in many countries throughout the world.

The best sound systems are planned

With the increasing sophistication of sound reinforcement and distribution techniques, advance planning takes on new importance.

Because the effectiveness of sound reinforcement and/or sound distribution is strongly influenced by the acoustical characteristics of an area, the solution to a specific problem must be individually determined. In some instances, sound requirements may be in direct conflict with other architectural needs, while in others, optimum design may be a compromise between sound goals.

A case in point is church architecture, an organ acoustician will argue for long reverberation times to add body and depth to the music, but short reverberation times are preferred for sound reinforcement of spoken parts of the service, to improve intelligibility.

This brief introductory section is intended to assist the non-professional sound installer in building a system that will give high quality

sound for the money invested. The definitions, guidelines and examples along with the product specifications, give sufficient information to knowledgeably select the proper equipment.

Thoughtful application of high quality sound components can achieve an effective communication system that is unobtrusive to ear or eye, yet fully meets the user's needs.

BASIC GUIDELINES TO SOUND SYSTEM DESIGN

In designing a sound system, certain things must first be decided:

1. What area is to be covered by the sound system, and
2. Should the speakers be located in a single central cluster, or should a distributed system be considered?
3. What type of loudspeaker system should be employed?
4. Determine the program material that will be used on the system so that the desired frequency response can be established.
5. What loudness (sound pressure level) will be required?

Most of the above questions can probably be answered by finding the sound system examples that comes closest to your situation. These examples are located on Pages 7 & 8.

Also, to help answer the above questions and to understand further what the catalog specifications mean, we offer some explanation of basic terms.

Axial Frequency Response and Polar Response

The frequency response displayed on each Electro-Voice Engineering Data Sheet shows how sound pressure level varies with frequency, at a specified distance in front of the speaker (on axis). See Figure 1.

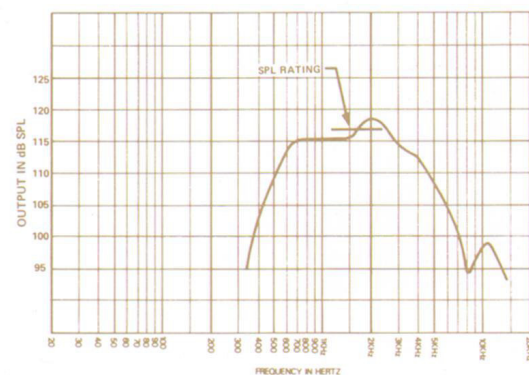


Figure 1.
On Axis Frequency Response

The polar responses represent the speaker's dispersion of sound by showing the sound pressure level encountered—usually a decrease—as the listener moves to various angles off the speaker axis. Octave-bands of random noise are used to avoid the minor variations which occur with single-frequency measurements. Measurements are usually made in both the horizontal and vertical planes as is shown in Figure 2.

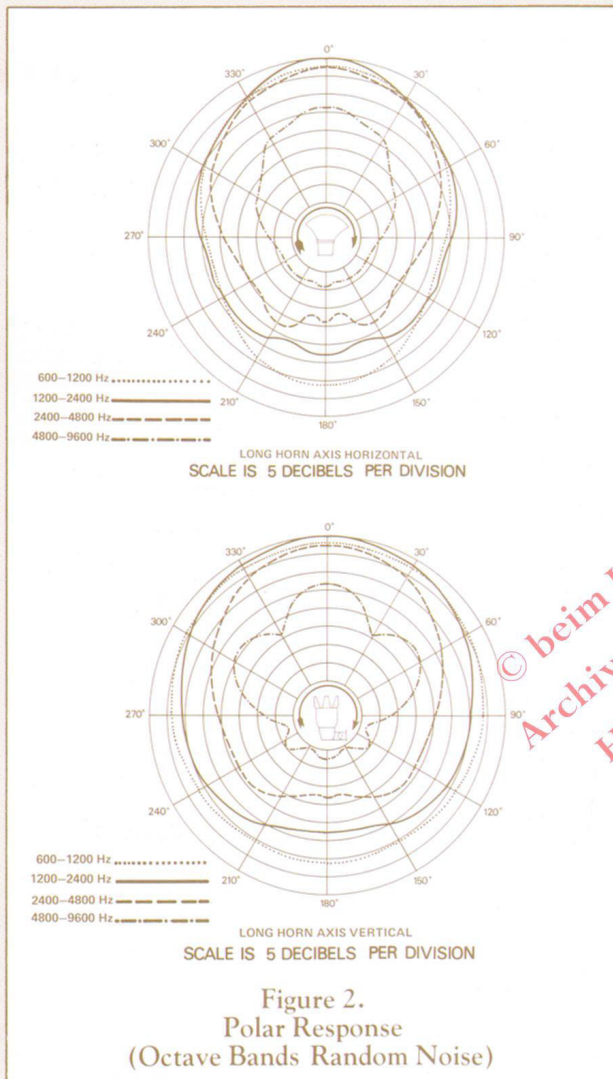


Figure 2.
Polar Response
(Octave Bands Random Noise)

Dispersion Angle Defined

Accurate system design may be made by referring to the axial frequency response and polar responses. However, it is convenient to represent the fairly complex and continuous information of the polar responses (which show that a speaker has some output at any angle) with a single dispersion angle, as if all speaker output were confined to a specific angle. See Figure 3. Although no absolute standard exists, the dispersion angle in any given octave band is often defined as the angle included by the points on the polar response where the response is 6 dB below the on-axis response.

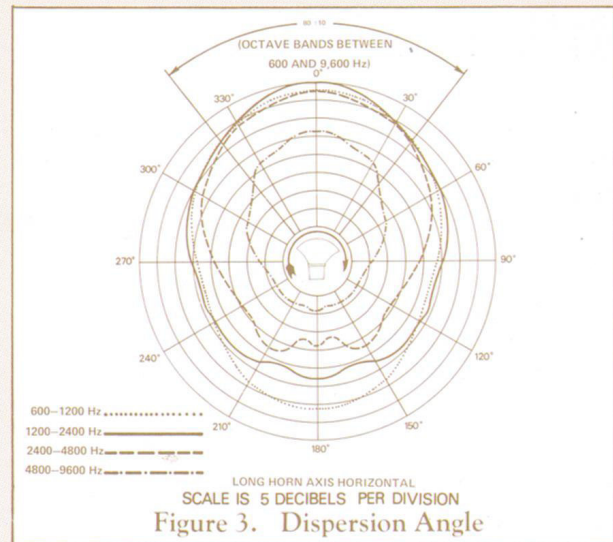


Figure 3. Dispersion Angle

Ideally, a speaker's dispersion angle would be nearly the same in every octave band. The best loudspeakers approach this goal, but most general purpose public address designs miss substantially, with their dispersion angle narrowing as frequency increases.

In conventional paging system design, the dispersion angle in the octave band where speech energy is greatest (centered at 1000 Hz) should provide adequate performance. However, the next two octave bands (centered at 2 kHz and 4 kHz) also contribute substantially to speech intelligibility and under difficult conditions listeners should be within the dispersion angle of these bands for best results.

Utilizing the Dispersion Angle

Speakers should be aimed to cover the listeners. Knowing something about the dispersion angle can help you select speakers for your installation. Viewing from a desired speaker location, what dispersion angle would be needed to adequately cover the listeners without spilling over to the walls in both the horizontal and vertical planes? Once these angles are determined, the correct speaker can be found in the specifications listed in the catalog. This may be visualized in the examples on Page 7.

In multiple-speaker, central-cluster installations, it is best practice to have the speakers in close proximity and angled so that the sides of their dispersion angles just touch each other. In distributed systems, where speakers are widely spaced, the dispersion angles should intersect at ear level. This can be seen in the examples of Figures 11 and 12.

Narrowing the Dispersion Angle and Increasing Sound Pressure Level by Stacking of Horns

A narrow vertical (up-and-down) dispersion angle is appropriate for long-throw

applications. Such dispersion may be obtained over a limited but useful frequency range by vertical, lip-to-lip stacking of the horns. In general, each time the number of horns in the vertical stack is doubled (1) the vertical dispersion angle is halved and (2) the on-axis sound pressure level is doubled (increased by 6 dB.) 3 dB results from the doubling of electrical power fed to the entire array and 3 dB is due to confining acoustic output to a narrower vertical angle. Horizontal dispersion is not affected by vertical stacking. This could be useful in the example of Figure 17.

Reverberation Defined

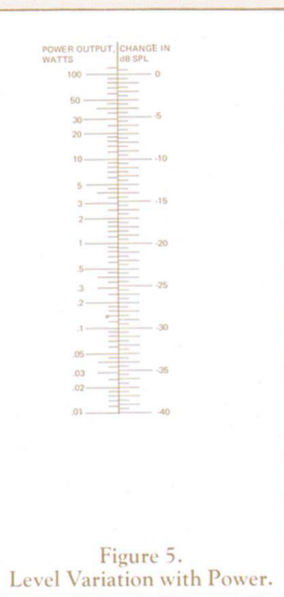
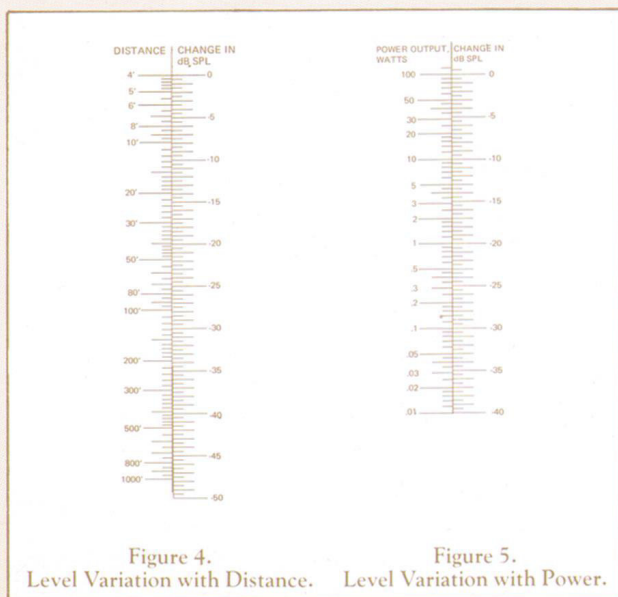
Reverberation is the persistence of sound within an enclosure, such as a room, after the original sound has ceased. Reverberation may also be considered as a series of multiple echoes, decreasing in intensity, so closely spaced in time as to merge into a single continuous sound and eventually be completely absorbed by the room itself. Outdoors is considered to be a "non" reverberant environment.

Level Variations with Distance: Non-Reverberant Environments

In a non-reverberant environment, such as outdoors, sound pressure level will be cut in half (drop 6 dB) every time the distance from the speaker is doubled (inverse square law). Figure 4 shows the dB losses to be expected as distance from the speaker is increased from the four feet used in the SPL specifications.

Level Variation with Power

In addition to the level variations with distance, each time the power delivered to the speaker is halved, a level drop of 3 dB occurs in any type of environment. The nomograph of Figure 5 shows this effect.



Level Variations with Distance: Reverberant Environments Indoors

Where sound is reflected from walls and other surfaces and the environment is reverberant, there is a point beyond which the "reverberant field" dominates and sound pressure level is nearly constant. This distance is typically 10 to 30 feet from the speaker, and is longest for the least reverberant rooms and the most directional speakers. Because of the reverberant field, the sound pressure level obtainable in a room over any reasonably wide band of frequencies is much higher and more constant than that predicted by the inverse square law alone. However, the frequency and dispersion information given in the specifications is still necessary in order to obtain satisfactory distribution of the sound direct from the loudspeaker (direct field), which still follows the inverse square law.

In installations where applicable, it is good practice to make sure that the direct field is no more than 12 dB below the reverberant field to ensure satisfactory intelligibility.

Level Variations Due to Multiple Speakers

The net effect on the total sound pressure level in an environment where two or more speakers are operating, with the same program at the same time, is fairly complex. However, some useful guidelines are possible. When there are two widely-spaced, broad-band sources of equal intensity, the sound pressure level of the combination will be 3 dB higher than that of either source alone. However, when the two signals differ by any substantial amount, like 9 or 10 dB, the combined sound pressure level is only slightly higher than that of the loudest source alone. Table 1 shows this effect for signal level differences up to 12 dB. This table facilitates design of systems employing multiple speakers.

When Two Signals Differ By:	Add to the Larger Reading:
0 dB	3.00 dB
1	2.50
2	2.10
3	1.70
4	1.40
5	1.10
6	.97
7	.79
8	.63
9	.51
10	.43
11	.35
12	.26

Table 1.
Combined Level Two Sound Sources

Impedance Matching

In connecting a speaker to an amplifier, the idea that impedances must match is somewhat fallacious. Actually, the typical speaker load "seen" by the amplifier (like 8 ohms) is very much larger than the impedance "looking into" the amplifier's output terminals (less than 0.5 ohm). Matching is required, however, in the sense that the speaker load impedance must be suited to the amplifier: amplifiers, with or without output transformers, are designed to deliver rated power at rated distortion into the rated load impedance. Thus, in multiple speaker designs, the combined speaker impedance should be calculated and "matched" within reasonable limits to the amplifier's rated load impedance.

Impedances higher than rated load will reduce the power delivered to the speakers, although distortion and other performance characteristics will be essentially unchanged. Impedances substantially lower than rated load should be avoided. Power at rated distortion will be reduced and damage to amplifier output stages or activation of protection circuitry may result.

Low-Impedance Systems

Low-impedance systems usually employ speakers with nominal impedances of 4, 8, 16, or 45 ohms. In series connection, speaker impedances add:

$$Z_T = Z_1 + Z_2 + Z_3 \dots + Z_N,$$

where Z_T = total combined load impedance and Z_N = individual speaker impedance.

In-phase series connection is obtained, as illustrated in Figure 6, by connecting the positive terminal (red or T_1) of one speaker to the negative terminal of the other (black or T_2).

In general, series connection should be used only with speakers of the same model and impedance. Otherwise, each speaker will affect the response of the others. Also, series connection is less reliable because failure of one speaker will disconnect the others.

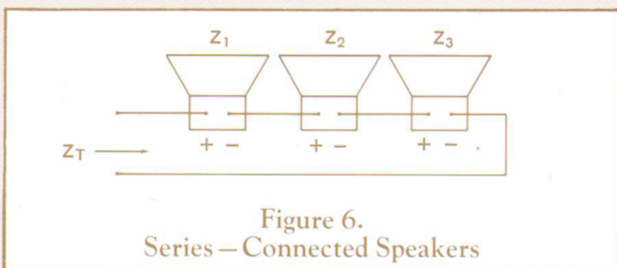


Figure 6.
Series - Connected Speakers

In parallel connection, the combined impedance of like units is the impedance of one unit divided by the number of units; or, in unlike units, the total impedance will be:

$$Z_T = \frac{1}{1/Z_1 + 1/Z_2 + 1/Z_3 + \dots + 1/Z_N}$$

In-phase parallel connection is illustrated in Figure 7, where all like terminals are connected:

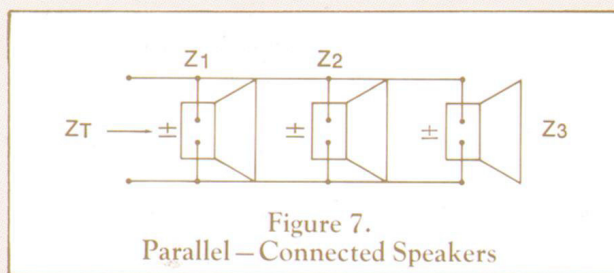


Figure 7.
Parallel - Connected Speakers

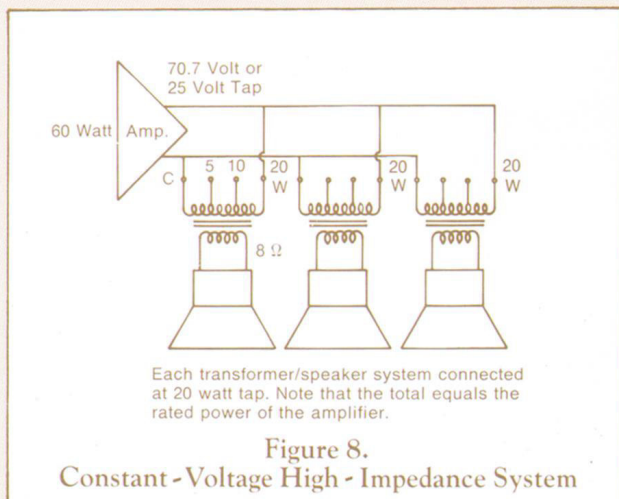
For combination series and parallel, compute the impedance of each similarly wired group of speakers, and then consider each group as a single speaker, compute the total combined impedance.

In the example of Figure 11, the impedance of the LR4B and the Musicaster IIA are both 8 ohms. Therefore, the best approach would be to parallel the two speakers and put them on the 4 ohm tap.

High-Impedance/Constant-Voltage Systems
Systems that require a high-impedance speaker load permit much smaller diameter wire for a given power loss in the speaker lines. Usually, low-impedance speakers are still used in such systems, but transformers are employed at the speaker locations to increase the impedance to the desired value. Multiple transformer taps permit easy adjustment of individual speaker levels. For a broad range of systems, the savings in wire costs more than compensates for the transformer cost and insertion loss.

In speaker systems anything over 32 ohms could generally be considered high impedance.

Constant-voltage high-impedance systems offer the additional convenience of eliminating the impedance-matching calculations described above by keeping the full-power voltage across the speaker load at a constant 25 or 70.7 volts. (Note that the "constant" 25 or 70.7 volts is present only when the amplifier is delivering full rated power and is correspondingly lower at lower power outputs.) This arrangement permits the secondary taps of the transformer to be marked directly in watts. In system hook-up, speaker/transformer combinations are connected in parallel across the amplifier output terminals. When all the power taps add up to the amplifier's rated output, the full rated load impedance is present at the amplifier terminals. See Figure 8 for a typical example.



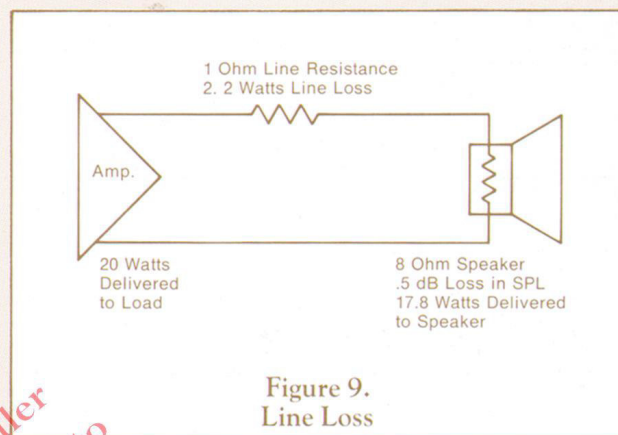
Powers less than rated output are fully acceptable, since the higher-than-rated load impedance that results only decreases the power delivered to the load—precisely the desired effect. Only power totals greater than rated amplifier power should be avoided: load impedance drops below rated load, reducing power delivered at rated distortion and perhaps damaging output stages or activating protection circuitry. A constant-voltage high-impedance system would be used in the distributed system in Figure 11 or the factory example of Figure 12.

Power Loss in Long Lines

For long wire runs, the power losses in the wire become significant, especially for smaller wire sizes. For a 0.1 dB loss in sound pressure level, the total wire impedance, out to the speaker and back, must be limited to 1% of the

speaker impedance. The somewhat larger losses of 0.5 dB and 1 dB are encountered when the percentages increase to 6% and 12%, respectively.

The power supplied from the amplifier terminals to the load is divided between the resistance of the wire and the impedance of the speaker. As an example, look at Figure 9. If we assume that the amplifier is delivering 20 watts to its load, then only 17.8 watts is being delivered to the speaker while 2.2 watts is lost in line resistance.



For a 0.5 dB loss in sound pressure level, Table 2 shows the calculated two-wire cable lengths permissible for a number of wire sizes and impedances.

For a 1 dB loss, the wire lengths in Table 2 may be doubled. For a 2 dB loss, the lengths should be multiplied by 4.4.

AWG Size	Resistance (Ohms/1000 Feet)	Low-Impedance			High-Impedance Systems				
		4 Ω	8 Ω	16 Ω	100 W/70.7V 12½ W/25V (50 Ω)	50 W/70.7V 6¼ W/25V (100 Ω)	25 W/70.7V 3¼ W/25V (200 Ω)	5 W/70.7V ⅝ W/25V (1000 Ω)	1 W/70.7V ⅛ W/25V (5000 Ω)
10	1.00	120	240	480	1,500	3,000	6,000	30,000	150,000
12	1.59	75	150	300	940	1,800	3,800	18,000	94,000
14	2.50	48	96	190	600	1,200	2,400	12,000	60,000
16	4.02	30	60	90	370	740	1,500	7,400	37,000
18	6.39	19	38	76	230	460	920	4,600	23,000
20	10.1	12	24	48	150	300	600	3,000	15,000
22	16.2	7	14	28	93	190	380	1,900	9,300

Table 2.
2-Wire Copper Cable Lengths For
0.5 dB Loss in SPL

SOUND SYSTEM EXAMPLES

Below are some examples of places Electro-Voice PA products are used. These sketches are presented only as a general guideline in system design. You, a sound contractor, or a qualified audio consultant can work out the details.

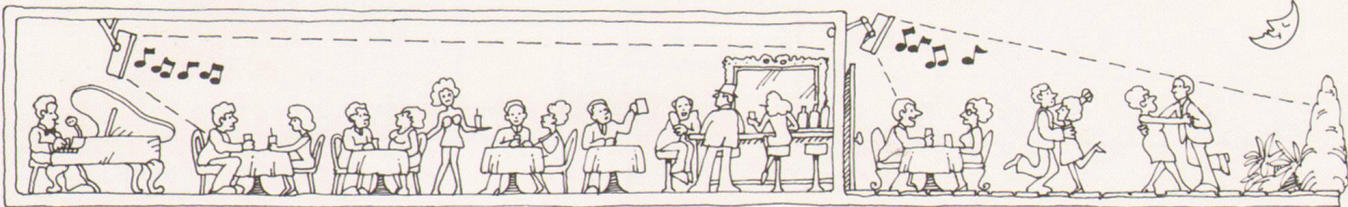


Figure 10. Piano Bar and Patio. LR4B or LR7B used to project sound from main entertainment area. Weatherproof Musicasters used in outdoor patio system.

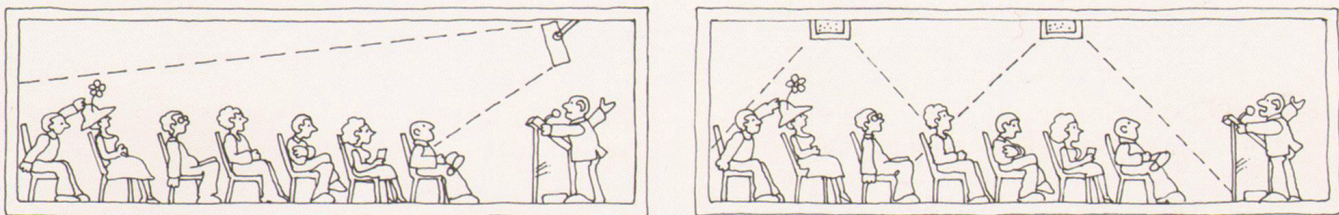


Figure 11. Conference Room. Either a single LR4SA or a distributed system may be used. The distributed system might be better suited for rooms that are long with low ceilings.

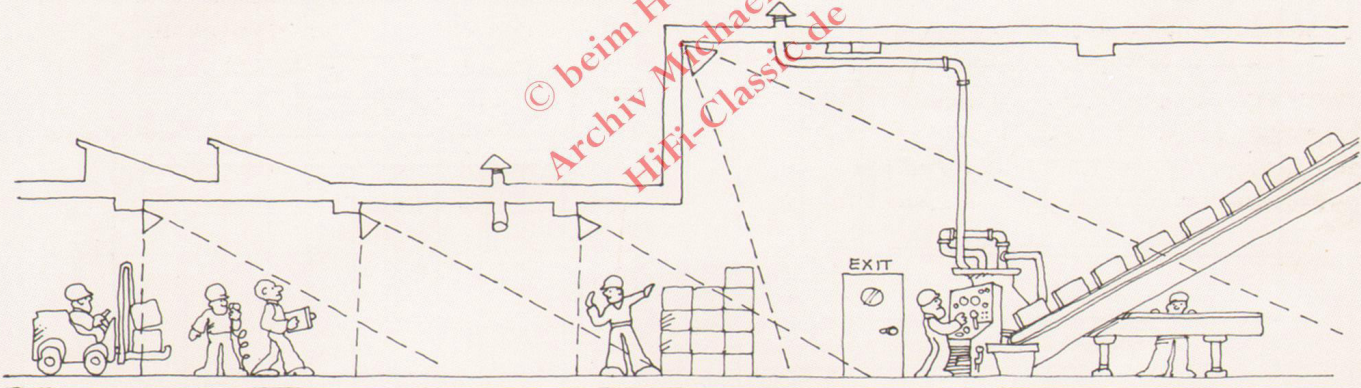


Figure 12. Factory. The size of the paging speaker and/or the power tap selected is determined by the size of the coverage area and the ambient noise in the area.

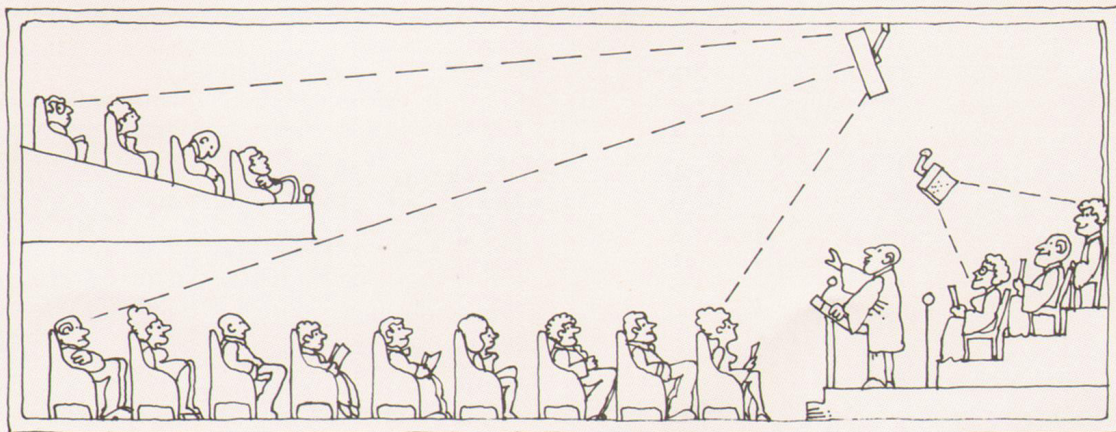


Figure 13. Church. A single LR4B centrally mounted high above center pulpit works very well in most churches. One or two LR2SAT's may be used for choir coverage.

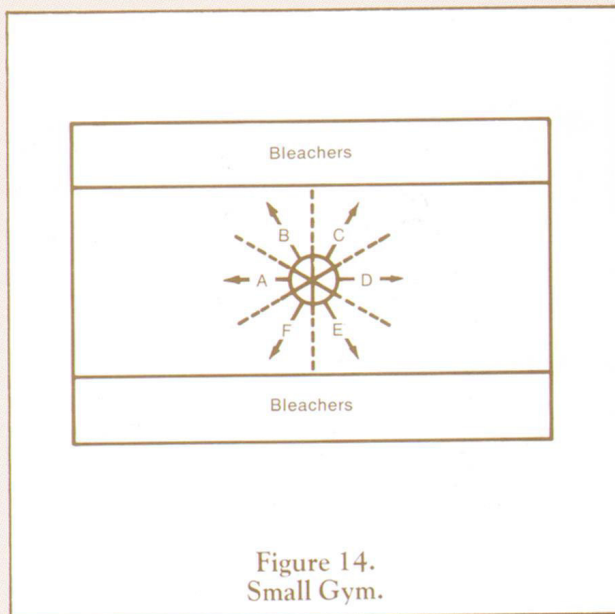


Figure 14.
Small Gym.

The central cluster, mounted slightly off center, would consist of 6 FC100 Horns with 1829T Drivers. A good choice for an announcement microphone would be the 664A.

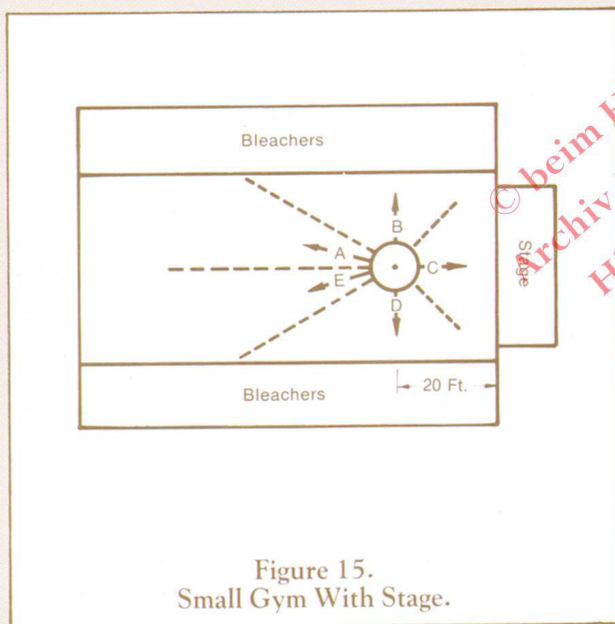


Figure 15.
Small Gym With Stage.

The central cluster would be mounted about 20 ft. from the stage end of the gym, high under the girders. The cluster would be made up of the following: two AC100's with 1829T Drivers for long throw (A & E); two FC100's with 1829T Drivers for short throw (B & D); and a single FC100 Horn with 1828T Driver for stage foldback (C). Back stage monitors could be the LR2SA or Musicaster.

General stage announcement microphones would be the 672, 660, or 664A. For stage productions, the 411 "mike mouse" with the 660 or RE10 microphone, should be used.

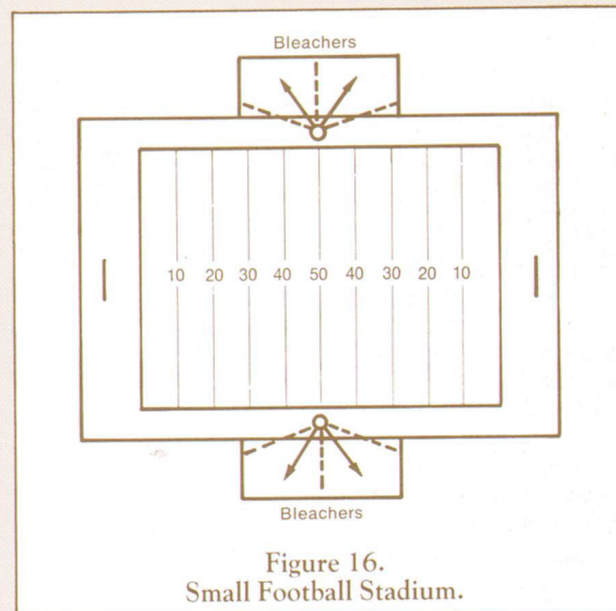


Figure 16.
Small Football Stadium.

There would be a small cluster on each side of the field mounted in front of the bleachers up on a pole 25 ft. or so. Each side would have two 848A's with TR50 transformers mounted in the TH housing.

A good announcement microphone for football stadiums would be the 664A with 360 windscreen.

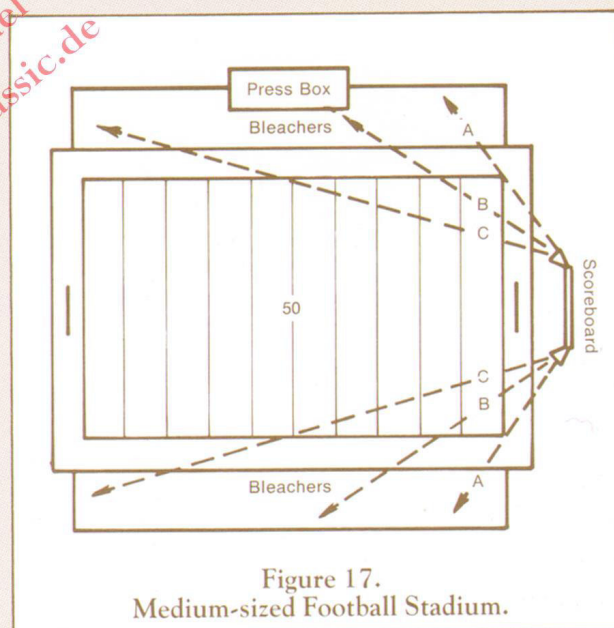


Figure 17.
Medium-sized Football Stadium.

A central cluster system would be mounted at one end of the field up on a scoreboard or poles. The cluster would consist of the following: two FC100's (one facing each side of the field) with 1829T Drivers for short throw (A); two AC100's with 1829T Drivers for medium throw (B); and two or four AC100's with 1829T Drivers for long throw (C). A good announcement microphone for football stadiums would be the 664A with 360 windscreen.

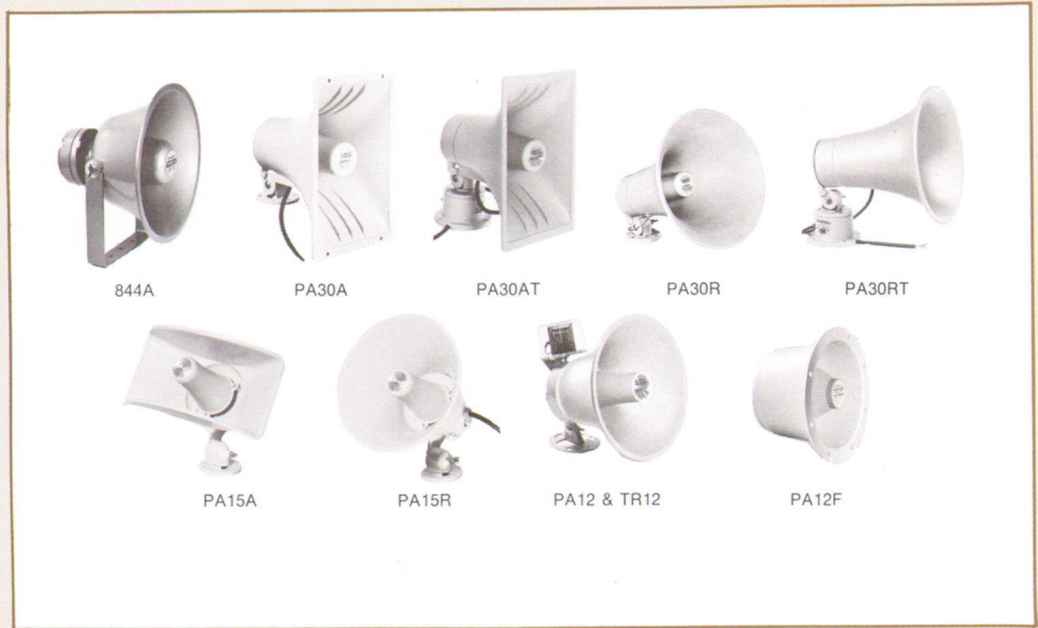
PAGING SPEAKERS

Paging Speakers: 12, 15, & 30 Watt

The Electro-Voice conservatively rated reentrant paging projectors provide high intelligibility, maximum reliability, and easy time-saving installation. Installation costs are kept low on the PA30 and PA15 series by using (1) an easily removable omni mounting base, (2) an integral pigtail for connection to system wiring without tools, and (3) on constant-voltage models, a transformer with out-in-the open screwdriver-adjustable power taps.

Virtual immunity to adverse effects of weather, physical abuse and deterioration is provided by diecast housings on the 844A and PA12F and high-impact molded housings on all other paging speakers. All components are fully moisture and fungus proof.

45-ohm intercom units are also available as indicated.



Model	844A	PA30A	PA30AT	PA30R	PA30RT	PA15A	PA15AT	PA15R	PA15RT	PA12	PA12F
Frequency Response ①	± 10 dB ± 5 dB	360—8kHz 460—7.2kHz	340—11kHz 580—6.4kHz	310—9kHz 500—5.6kHz	360—12kHz 460—6.1kHz	400—11kHz 620—5.1kHz	440—0.5kHz 920—5.6kHz	620—16kHz 810—5.4kHz			
Power Handling ②	30 W	30 W		30 W		15 W		15 W		12 W	12 W
Nominal Impedance	8 Ω	8 Ω	Specify 70 V or 25 V	8 Ω	Specify 70 V or 25 V	8 Ω	70 V or 25 V	8 Ω	70 V or 25 V	8 Ω	8 Ω
Dispersion ③		H V				H V					
Octave Bands	500 Hz 1000 Hz 2000 Hz 4000 Hz	200° 110° 52° 36°	150° x 35° 105° x 72° 65° x 48° 38° x 48°	125° 82° 48° 30°	125° 82° 48° 30°	125° x 200° 80° x 155° 77° x 87° 70° x 50°	145° 72° 55° 32°	175° 100° 72° 40°	183° 140° 95° 55°		
S.P.L. ④	1 watt at 10' Full Power at 4'	100 dB 123 dB	102 dB 125 dB	102 dB 125 dB	97 dB 117 dB	100 dB 120 dB	100 dB 119 dB	97 dB 115.5 dB			
Dimensions (HWD)	10"x10"x7.6"	11"x6.5"x8.5"		10"x10"x9.8"		6.9"x10.7"x10.1"		8.8"x8.8"x11.7"		7.5"x7.5" x7.1"	6"x6" x3.6"
Weight	11.3 lb.	5.6 lb.	6.8 lb.	5.6 lb.	6.8 lb.	2.9 lb.	3.4 lb.	2.9 lb.	3.4 lb.	2 lb.	1.7 lb.
Mounting Method	Universal "U" Bracket	Universal Swivel Base (Adjustable in all planes) with 3 evenly-spaced holes on 2.4" dia. circle PA30AT and PA30RT are mounted by use of 3 evenly-spaced holes on 3.75" dia. circle								Swivel Base —3 holes on 2.4" dia. circle	Flush mounting with 8 holes on 5.4" dia. circle
Similar Models	—	PA30AM Marine Version PA30A-45 45 Ω	—	—	—	PA15A-45 45 Ω	—	PA15R-45 45 Ω	—	PA12-45 45 Ω TR12 Line Transformer	—

HORNS & DRIVERS

FR 150 Reentrant Horn

The Electro-Voice FR 150 reentrant horn provides the convenience of a rectangular horn at low cost. Featuring medium dispersion, this horn can be used where moderate coverage angles are required. The horn may be oriented vertically or horizontally for best sound control and maximum efficiency, but it is recommended that the horn be mounted with long axis vertical for maximum horizontal dispersion. The FR 150 is designed to be used with any Electro-Voice driver.

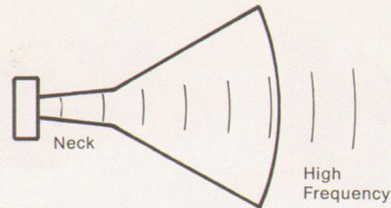
Model	FR 150
Horn Cutoff	150 Hz
Dispersion ③	H V
Octave Bands	80° x 160° 48° x 120° 46° x 50° 38° x 30°
Recommended Drivers	1828R, 1829 1828T, 1829T
Mounting Method	Steel U-Bracket Vert. or Horz.
Dimensions (HWD)	20.5" x 10.5" x 21"
Weight	9.5 lbs.



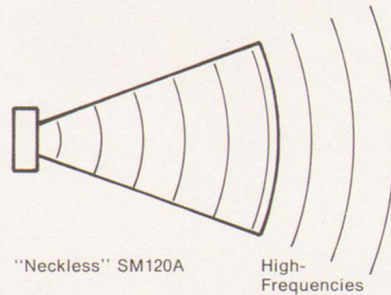
SM120A Radial Horn

The SM120A is the first significantly new radial horn design in 25 years. Its cast resin construction provides a much more "open" and natural sound than most conventional horns. Dispersion is amazingly wide and uniform in the horizontal plane, essentially 120 degrees at every frequency. The SM120A's "neckless" design eliminates the high-frequency beaming of other horns, including conventional radial designs. In such conventional designs, the long neck that joins the driver to the main horn becomes the controlling factor at high frequencies. The highs are never able to "see" the sides of the horn and, instead, tend to beam straight ahead.

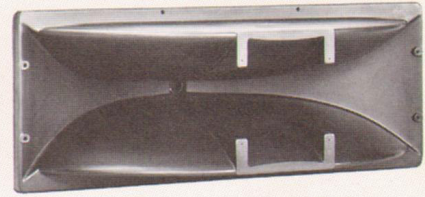
The SM120A horn is ideally suited for front mounting in speaker enclosures or may be mounted with brackets or cables. The 1823M driver was designed to be used with the SM120A, but any E-V driver may be used.



Conventional Radial Horn



"Neckless" SM120A



SM120A

Model	SM120A	
Usable Lower Frequency Limit	300 Hz	
Dispersion ^③	H V	
Octave Bands	500 Hz	90° x 120°
	1000 Hz	125° x 200°
	2000 Hz	120° x 80°
	4000 Hz	120° x 43°
Recommended Drivers	1823M or any other EV Driver	
Baffle Opening size	24¾" x 8¼"	
Overall Dimensions	10" H. x 26½" W. x 15" D.	
Weight	11 lbs.	

CDP® Horns

What is CDP?

CDP is an Electro-Voice exclusive that provides truly high-quality voice and music projection in an affordable, efficient package. CDP stands for "Compound Diffraction Projector."

- "Compound" for two ways for sound to get out and
- "Diffraction" for how the sound is spread throughout the listening area.

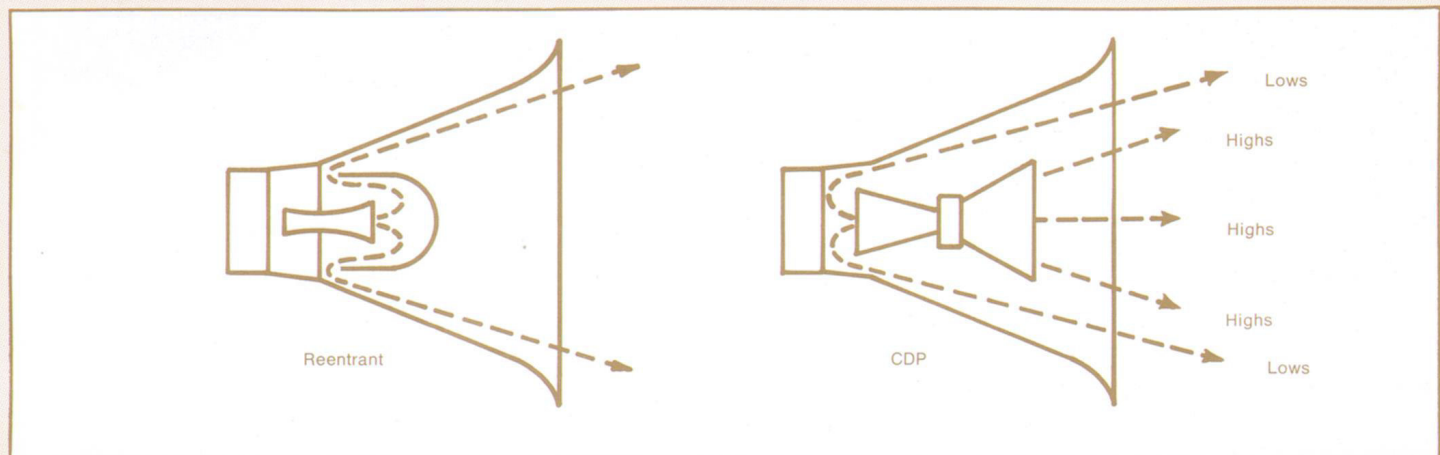
All traditional PA horns are reentrant designs, where the horn is folded back upon itself. This makes the size compact but performance suffers greatly because of the attempt to force all frequencies around some very torturous bends. Low frequencies can withstand the bending, but higher frequencies cancel out on the turns. As

a result, high-frequency output of the driver is drastically reduced and distortion is high.

E-V's exclusive CDP design solves these problems by putting two holes in the driver. The front hole sends the frequencies above 1000 Hz directly to the listener through a small horn without having to follow any bends. The low frequencies exit through the rear of the driver where they see the long air column necessary for proper low-frequency production. The result is significantly improved high-frequency response, more controlled dispersion and reduced distortion, for a unique combination of high intelligibility and outstanding quality on speech and music.

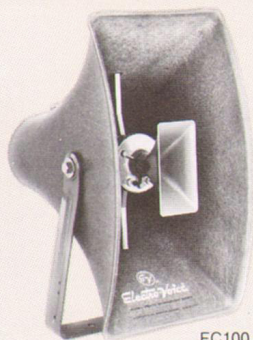
Both the FC100 and AC100 are built around the CDP principle. They may be used with any of the E-V "convertible" drivers: 1828C, 1828T, 1829, and 1829T.

The FC100 is a general purpose wide-angle horn. Its two diffraction horns spread wide-range sound uniformly throughout the listening area. The most uniformly wide horizontal dispersion results when the horn's long axis is vertical. The more specialized AC100 is designed for installations requiring a "long throw." It offers a tight pattern of quality sound, permitting you to "zero in" on listeners many yards from the location of the horn.





AC 100



FC100



848A



847A

CDP Speakers

The 847A and 848A CDP speakers come complete with integrated horn and driver. Both speakers provide quality sound where wide-angle coverage is required. The 848A is recommended where greater sound pressure levels and extended low-frequency performance are desired.

Horn Construction

The bells of the 847A, 848A, and FC100 horn are fabricated from fiber glass and polyester resin which provide an extremely strong light-weight housing. The AC100 bell is constructed of aluminum for a similar combination of strength and light weight.

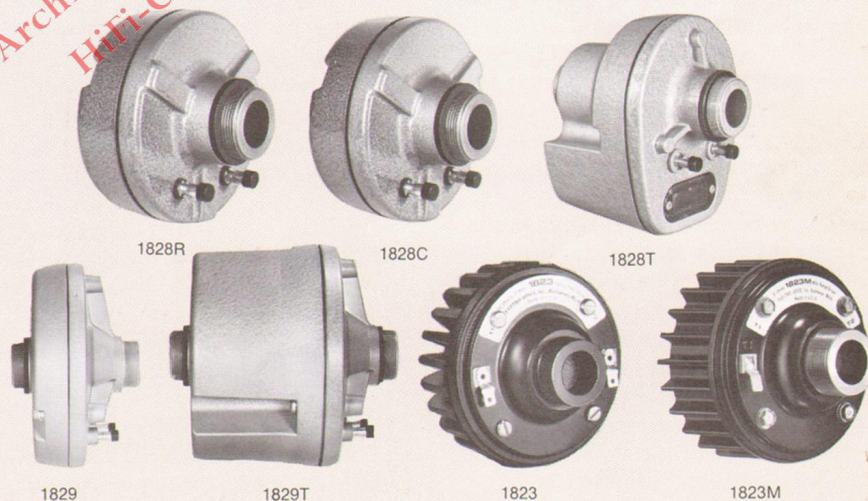
Model	AC100	FC100	848A	847A
Frequency Response ① ± 10 dB ± 5 dB	— —	— —	107—13.5kHz 350—6kHz	260—10kHz 450—10kHz
Horn Cut-off	100 Hz	100 Hz	100 Hz	210
Power Handling ②	—	—	30 W	25 W
Nominal Impedance	—	—	8 ohms	8 ohms
Dispersion ③			H V 160° x 170°	H V 160° x 200°
Octave	120°	110°	120° x 130°	117° x 185°
Bands	60° 30°	60° 30°	120° x 90° 70° x 60°	118° x 118° 65° x 93°
S.P.L. ④ 1 watt at 10 Ft. Full Power at 4 Ft.	— —	— —	97 dB 120 dB	92 dB 114 dB
Recommended Drivers	1828C, 1828T, 1829 or 1829T		—	—
Dimensions (HWD)	7" x 21.4" x 21"	20.5" x 10.5" x 20"		7.8" x 11.8" x 18.2"
Mounting Method	Steel "U"—Bracket			
Similar Models	—	848A With 1828C Driver	FC100 W/O Driver	—
Weight	14.8 lb.	10.8 lb.	15.5 lb.	8 lb.

PA Drivers

Electro-Voice PA drivers offer smooth, peak-free response with maximum efficiency. Outstanding frequency response, dispersion, and minimum distortion are achieved by using E-V's exclusive compound diffraction projector (CDP) horns. Drivers 1828C, 1828T, 1829, and 1829T provide the dual output required for CDP horns FC100 and AC100, and are easily convertible for use with reentrant horns, such as the FR150. The 1828R gives excellent results with reentrant horns.

The 1823 driver is designed for siren applications. The 1823M is used in high power PA applications, generally with the SM120A or similar horn, but can also be used with reentrant horns.

For constant voltage systems, order 1829T or 1828T. All drivers have 1 3/8"-18 threads for mounting to the horn. Diaphragm replacement kits are available for all Electro-Voice public address drivers.



Model	1828R*	1828C**	1828T**	1829**	1829T**	1823*	1823M***
Frequency Response ① ± 10 dB ± 5 dB	170- 13.5kHz 350-6kHz	170- 13.5kHz 360-6kHz	170- 13.5kHz 360-6kHz	140- 11kHz 300-9kHz	140- 11kHz 300-9kHz	200- 6.4kHz 400-5kHz	170 11kHz 410-6kHz
Power Handling ②	30 W	30 W	30 W	60 W	60 W	90 W	60 W
S.P.L. ④ 1 watt at 10 Ft. Full Power at 4 Ft.	97 dB 120 dB	97 dB 120 dB	97 dB 120 dB	101 dB 127 dB	101 dB 127 dB	105 dB 133 dB	94 dB 120 dB
Nominal Impedance	8 Ω	8 Ω	—	16 Ω	—	8 Ω	8 Ω
70.1 V Power Taps (Watts)	—	—	30, 15, 8, 4	—	60, 30, 15, 8	—	—
Dimensions (Dia. x D.)	4" x 2.8"	4" x 3.3"	5" x 5.3"	6" x 4.1"	6" x 6.4"	4.3" x 3.4"	4.2" x 3.3"
Weight	4.75 lb.	4.75 lb.	5 lb.	7 lb.	9.7 lb.	4.9 lb.	4.5 lb.

Measurements made on *FR150; **AC100; ***SM120A

①, ②, ③, ④—See footnotes on page 15.

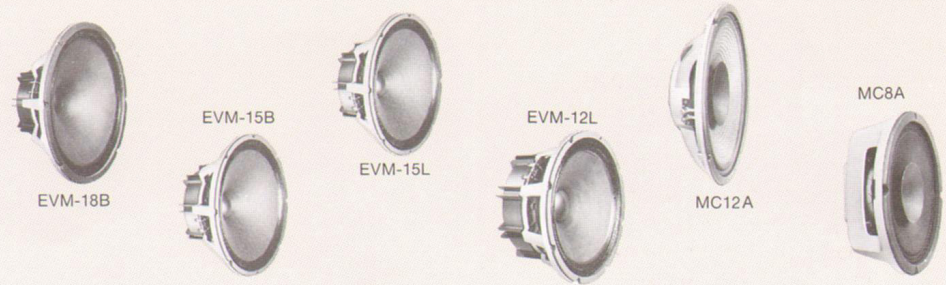
MUSIC & PA CONE SPEAKERS

Music Speakers

Electro-Voice EVM™ speakers offer the ultimate in quality sound reproduction and power handling ability. EVM speakers feature a husky diecast aluminum frame edgewound voice coil, heavy duty curvilinear cone, and heat radiating back cover. The EVM's may either be front or back mounted by the use of the handy SMH-1 mounting kit.

PA Cone Speakers

The MC8A and MC12A speakers provide full range high fidelity reproduction at modest cost. Both speakers are shallow in depth making them ideal for installation in distributed ceiling sound systems and mounting between studs in walls. The MC8A and MC12A have diecast frames which offer long term stability not found in stamped frame speakers. The MC8A's frame has been drilled to accept the TM5, TR5, and TR15 line matching transformers.



Model	EVM18B	EVM15B	EVM15L	EVM12L	MC12A	MC8A
Frequency Response ± 10 dB ± 5 dB	15-4.5kHz 24-4kHz	25-4.5kHz 39-4kHz	25-6kHz 39-5.5kHz	40-6.5kHz 52-6kHz	25-12kHz 27-11kHz	35-20kHz 37-20kHz
Power Handling	100 W	100 W	100 W	100 W	20 W	12 W
Norm. Impedance	4 ohms	8 ohms	8 ohms	8 ohms	8 ohms	8 ohms
S.P.L. 1 Watt At 10 Ft. Full Power At 4 Ft.	89 dB 117 dB	90 dB 118 dB	90 dB 118 dB	89 dB 117 dB	87.3 dB 108 dB	87.3 dB 106 dB
Baffle Opening	16.4"	13.9"	13.9"	11"	11"	7"
Mounting Bolt Circle	17.4"	14.56"	14.56"	11.56"	11.6"	7.6"
Dimensions	18" x 8"	15.1" x 7"	15.12" x 7"	12.2" x 6"	12.25" x 3.5"	8.25" x 3.2"
Weight	22 lb.	22 lb.	22 lb.	19 lb.	5.9 lb.	4.1 lb.
Enclosure Plans Available	TL405 TL505	TL606 TL606Q	TL606 TL606Q	TL806 TL806Q	See Data Sheet	See Data Sheet
Measurements Taken On	TL405	TL606Q	TL606Q	TL806Q		

SPEAKER SYSTEMS

Line Radiator™ Speaker Systems

Electro-Voice column speakers are called Line Radiators because they are much more than a simple column speaker. The ideal height for a column loudspeaker is 1/4 to 1 wavelength to obtain the best vertical polar pattern. Obviously, you cannot change the physical length of a column loudspeaker as you change frequency, but Electro-Voice does change the length acoustically by turning off the outer speakers in the column as the frequency increases. At the highest frequencies, which have the smallest wavelength, only the center speaker operates.

The LR2SA and LR4SA Line Radiators are all weather speaker systems designed to solve difficult sound reinforcement problems. Impervious to damage from extreme atmospheric conditions, the rugged extruded aluminum cabinet is compatible with virtually any decor for indoor use.

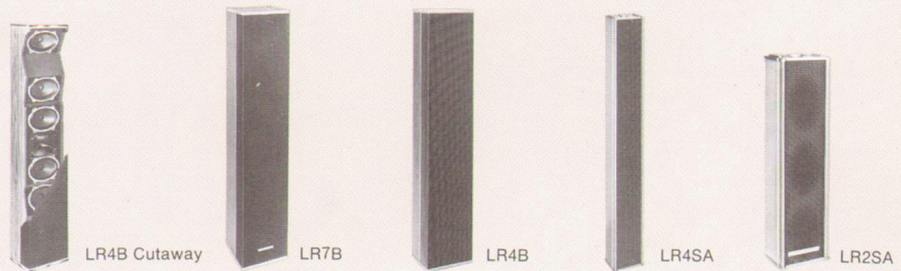
The LR4B and LR7B Line Radiators represent an all-new concept in column speakers. They provide sound quality and dispersion uniformity previously available only in high-performance, multi-way speaker systems.

The unique "multi-facet" or "Fresnel-lens" design concept (see cutaway drawing) affords, in a straight physical package, the uniform vertical dispersion previously associated only with Electro-Voice curved line radiators. Above 3500 Hz, output is provided by the ST350A Radial Horn

Tweeter featured in the famous EV Sentry professional speaker systems. The ST350A has a uniform 120° by 60° coverage pattern perfectly matched to the performance of the line radiator which operates at lower frequencies. A built-in STR "tweeter protector," also featured in Sentry speakers, prevents inadvertent application of excessive power from causing damage.

The results are an overall

uniformity of frequency response and dispersion, virtually eliminating "lobing" and "beaming" which plague ordinary column speakers. The LR4B and LR7B may be used with complete confidence in demanding installations, where they minimize problems of feedback, spotty coverage, poor sound quality and excessive size associated with the many inferior column, horn and horn/woofer speakers in current use.



Model	LR7B	LR4B	LR4SA	LR2SA
Frequency Response ① ± 10 dB ± 5 dB	47-20kHz 75-15kHz	66-20kHz 110-15kHz	105-14kHz 160-10kHz	105-14kHz 170-10kHz
Power Handling ②	90 W	90 W	40 W	20 W
Nominal Impedance	8 ohms	8 ohms	8 ohms	8 ohms
Dispersion ③	H V 180° x 33°	H V 180° x 22°	H V 198° x 52°	H V 206° x 106°
Octave Bands	500 Hz 1000 Hz 2000 Hz 4000 Hz 8000 Hz	115° x 20° 90° x 60° 110° x 70° 118° x 70°	135° x 45° 102° x 21° 105° x 72° 118° x 70°	180° x 47° 108° x 32° 80° x 34° 50° x 50°
S.P.L. ④ 1 Watt At 10' Full Power At 4'	88 dB 115 dB	88 dB 115 dB	92.5 dB 116.5 dB	89.5 dB 112.3 dB
Dimensions (HWD)	62.6" x 12" x 12"	48" x 9.8" x 7.5"	48.4" x 6.3" x 4.7"	24.5" x 6.6" x 4.9"
Weight	62 lb.	40 lb.	25 lb.	12 lb.
70.1 Volt Models	—	—	LR4SAT	LR2SAT

Eliminator™ Speaker Systems

Eliminator speaker systems offer efficient, high power-handling performance over a wide frequency range. Through the use of the EVM15B bass speaker, coupled to a 55 Hz exponential front-loaded horn, an extended low end capable of handling very high power levels is achieved. Additionally, mid and high frequencies are covered by high-performance horn transducers. This combination makes Eliminator systems very suitable for demanding musical instrument, playback, and sound reinforcement systems.

The Eliminator 1B is basically the same as the 2B except for the addition of two T35 tweeters for extended high-frequency response and uniform dispersion. Both systems have rugged enclosures painted mar-resistant black. They are complete with metal corners and carrying handles for portable use.

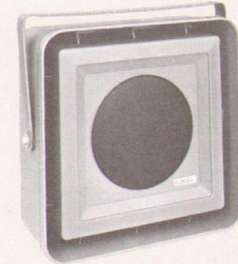
Musicaster™ Speaker Systems

The Electro-Voice Musicaster IA and Musicaster IIA are compact, wide-range, integrated loudspeaker systems particularly suited to voice and music reproduction. Excellent bass response in units of modest size is achieved by use of a special 12-inch wide-range driver and through optimum design of the bass reflex enclosure. High frequencies are smoothly and efficiently radiated from a specially-designed, centrally mounted free-edge cone. In addition, the Musicaster IIA utilizes a T35A

Model	Eliminator 1A	Eliminator 2B	
Frequency Response ① (In Hz)	45—15kHz ± 10 dB ± 5 dB	45—10kHz 55— 8kHz	
Power Handling ②	100 W		
Nominal Impedance	8 ohms		
Dispersion ③	V H	V V	
Octave Bands	500 Hz	60° x 83°	60° x 83°
	1000 Hz	102° x 72°	102° x 72°
	2000 Hz	70° x 90°	70° x 90°
	4000 Hz	87° x 95°	92° x 82°
	8000 Hz	72° x 92°	55° x 59°
S.P.L. ④	97 dB 125 dB		
Dimensions (HWD)	37.5" x 22.5" x 23.1"		
Weight	120 lb.	114 lb.	



Eliminator 1B & 2B



Musicaster 1A & 2A

provides wider and more uniform high-frequency dispersion above 5 kHz and significantly more highs above 10 kHz.

Rugged construction of the Musicasters is achieved through use of a one-piece compression molded housing. The material is highly resilient glass-filled polyester.

All parts of the Musicasters are weatherproof and fungus-proofed for reliable operation under all weather conditions. The Musicasters may be used indoors or out.

Model	Musicaster 1A	Musicaster 2A	
Frequency Response ① (In Hz)	50—11.5kHz ± 10 dB ± 5 dB	50—21kHz 95—18kHz	
Power Handling ②	30 W	30 W	
Nominal Impedance	8 ohms	8 ohms	
Dispersion ③			
Octave Bands	500 Hz	115°	115°
	1000 Hz	80°	80°
	2000 Hz	63°	58°
	4000 Hz	48°	62°
	8000 Hz	25°	102°
S.P.L. ④	88.5 dB 111 dB	88.5 dB 111 dB	
Dimensions (HWD)	21.5" x 21.5" x 8.5"		
Weight	29 lb.	31 lb.	

ACCESSORIES

Special Transformers TR30-7 and TR30-2

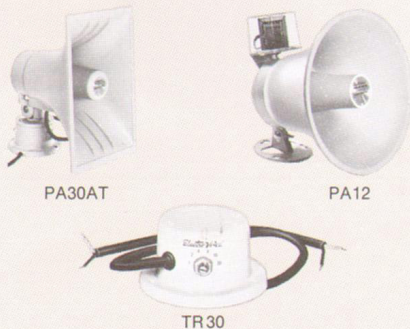
The Electro-Voice TR30-7 and TR30-2 are constant-voltage, line matching transformers, especially created for use with the PA30 Series paging speakers. Easy to install and adjust after installation, the TR30 transformers provide maximum economy in multiple-speaker installations. The complete assembly is

housed in a sturdy, die-cast housing that is carefully sealed for moisture protection.

TR12-7 and TR12-2

The TR12 transformers are constant-voltage line matching transformers especially created for the 8-ohm PA12 paging speaker. The transformer itself is vacuum varnished for full protection

from weather, moisture, and fungus damage. Easy to install on the rear of the speaker housing, the TR12 provides maximum economy in multiple speaker installations. The housing may be snapped off before or after speaker installation to permit easy adjustment of wattage taps.



Model	TR30-2	TR30-7	TR12-2	TR12-7
Frequency Response	60—15 KHz		90—15 KHz	
Power Handling	30 W		12 W	
Insertion Loss (Max.)	0.8 dB		1 dB	
Line Voltage	25	70.7	25	70.7
Secondary Impedance	8 Ω		8 Ω	
Primary Power Taps	30, 15, 8, 4, 2 W, "Off"		12, 6, 3, 1.5, 0.75 W	
Power Selection	6-Position Rotary Switch		Single Push-Clip	
Terminal Connections	9" Cable		15" Cable	
Finish	Mesa Tan			
Mounting	3 Evenly Spaced Holes on 3/4" Center		On Rear of Speaker with Single Screw	
Weight	1.3 lb.	1.3 lb.	8 oz.	8 oz.

①, ②, ③, ④—See footnotes on page 15.

Line Transformers

Use of the constant-voltage distribution concept in paging installations serves several useful purposes. With the line impedance well above the nominal speaker impedance, power loss in long speaker lines is minimized. This can mean a substantial saving in amplifier cost. Smaller wire can be used without excessive power loss, a valuable economy, especially in larger installations. Power demand can be easily adjusted at individual speaker positions while maintaining maximum system efficiency. Amplifiers with different power outputs can be substituted for the existing amplifier without change in system balance.

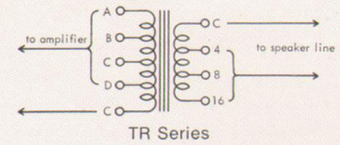
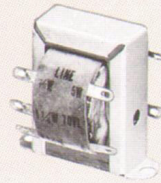
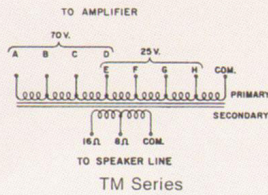
The TR and TM Series Line Matching Transformers are designed to allow efficient matching of E-V public address speakers for virtually every sound distribution application.

The TR Series features 70.7V 4-wattage taps with secondary impedances of 4, 8, and 16 ohms, while the TM Series has dual 25 and 70.7 volt, 4-wattage taps with secondary winding impedances of 8 and 16 ohms.

Model TH Transformer Housing

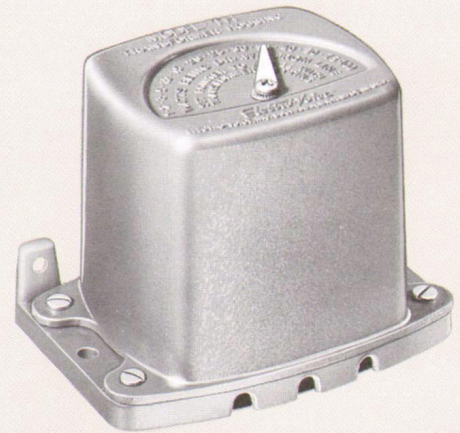
Designed to enclose any E-V 70.7-volt line-matching transformer, the rugged die-cast housing of the TH is completely weather-proof and can be mounted anywhere. The exclusive E-V wattage indicator shows the wattage tap selected without removing the cover.

Input and output screw terminals are accessible from the bottom of the housing and are protected by a heavy steel plate. As many as five separate lines may be accommodated. Wiring to the housing interior is permanently sealed to prevent moisture from reaching the transformer.



Model	TM5	TM15	TM30	TM60	TR5	TR15	TR30	TR50
Frequency Response	35 to 20 kHz				35 to 20 kHz			
Power Handling	5 W	15 W	30 W	60 W	5 W	15 W	30 W	50 W
Insertion Loss (Max.)	0.8 dB	0.6 dB	0.4 dB	0.2 dB	0.6 dB	0.4 dB	0.3 dB	0.2 dB
Line Voltage	70.7 or 25 V				70.7 V			
Secondary Impedance	8 or 16 ohms				4, 8, or 16 ohms			
Primary Power Taps (In Watts)	.62, 1.25, 2.5, 5	1.87, 3.75, 7.5, 15	3.75, 7.5, 15, 30	7.5, 15, 30, 60	.9, 1.25, 2.5, 5	2.5, 5, 10, 15	5, 10, 20, 30	15, 25, 40, 50
Mounting Hole Centers	2 In.	2.4 In.	2.8 In.	3.1 In.	1.7 In.	2 In.	2.4 In.	2.4 In.
Overall Dimensions (HWD) in inches	1.9x2.9x1.9	2.4x2.9x1.9	2.8x3.1x2	3.1x2.5x3.6	1.7x2x1.3	2x2.5x1.5	2.3x2.9x1.8	2.3x2.9x2.1
Weight	1 lb.	1.5 lb.	2 lb.	2.5 lb.	1 lb.	1.5 lb.	1.5 lb.	2 lb.

No soldering is required when using E-V matching transformers, since positive-gripping solderless connectors simply push onto transformer lugs (these terminals may also be soldered, if desired).

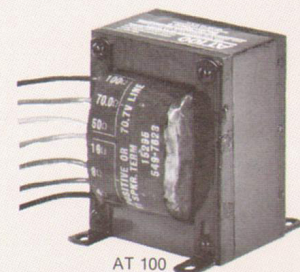
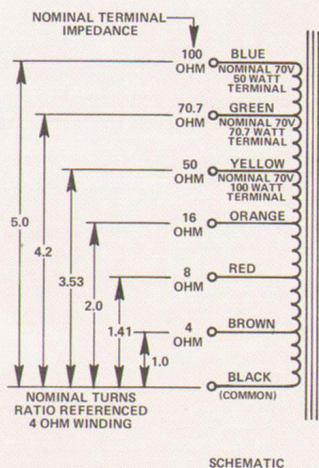


Model	TH
Maximum Transformer Size (HWD)	2 $\frac{1}{8}$ " x 2 $\frac{1}{8}$ " x 2 $\frac{1}{4}$ "
Transformer Mounting Hole Spacing	up to 3 $\frac{1}{8}$ " Maximum
Overall Dimensions (HWD)	4" x 5" x 3 $\frac{1}{2}$ "
Weight	1 $\frac{1}{4}$ lb.

AT100 Autotransformer

The Electro-Voice AT100 is a wide-range audio autotransformer designed for use in high-quality distributed sound systems or for other impedance matching purposes where line losses need to be minimized. Where DC isolation between windings is not required, the autotransformer approach provides lower insertion loss than the typical dual winding transformer due to tighter magnetic coupling and lower coil resistance.

Although nominally rated at 100 watts, the AT100 is capable of operation at peak levels with low distortion far in excess of 100 watts due to its massive core and hefty construction.



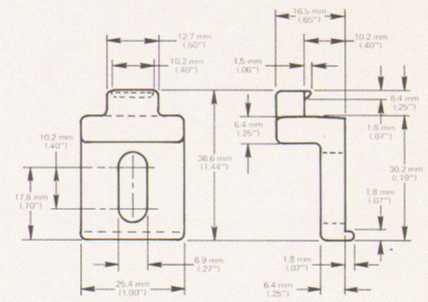
Model	AT100
Frequency Response	20-20000 Hz
Power Handling Capacity	100 Watts
Overall Dimensions (HWD)	3 $\frac{3}{4}$ " x 3 $\frac{1}{8}$ " x 3 $\frac{1}{2}$ "
Weight	6 lb.

SMH-1 Speaker Mounting Hardware Kit

The SMH-1 Speaker Mounting Kit consists of four diecast zinc alloy speaker mounting clamps, four 1/4-20 combination slotted hex washer head machine screws one inch long and four 1/4-20 Teenuts. These clamps and Teenuts are designed to make both initial mounting and subsequent change of any speakers having rim dimensions

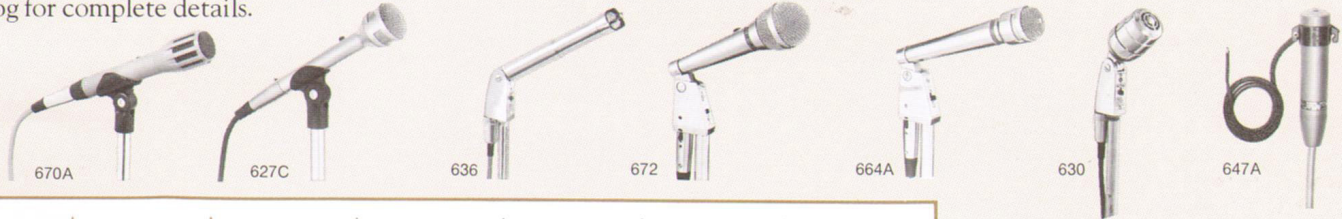
compatible with those listed in this catalog. Panel thickness slightly over one inch can be accommodated using the screws supplied with this kit.

It is not necessary to remove the screws entirely to remove the speaker from the mounting. When the screws are loosened, the clamps can be turned out of the way and the speaker removed.



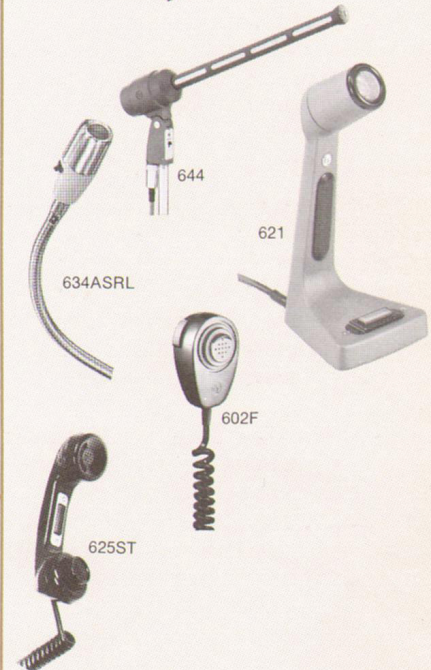
MICROPHONES

Electro-Voice also manufactures a complete line of microphones for sound reinforcement and PA applications. Some of these microphones are shown below. See the Electro-Voice general microphone catalog for complete details.



Model	670A	627C	636	672	664A	630
Type	Single-D Cardioid Dynamic	Single-D Cardioid Dynamic	Omnidirectional Dynamic	Single-D Cardioid Dynamic	Super-Cardioid Variable-D Dynamic	Omnidirectional Dynamic
Response	60-14kHz	60-13kHz	60-13kHz	60-14kHz	90-13kHz	60-11kHz
Impedance	Dual Hi-Z/Lo-Z	Dual Hi-Z/Lo-Z	Dual Hi-Z/Lo-Z	Dual Hi-Z/Lo-Z	Dual Hi-Z/Lo-Z	Dual Hi-Z/Lo-Z
Output	-60 dB	-58 dB	-58 dB	-58 dB	-60 dB	-55 dB
Finish	Gray	Satin Chrome	Satin Chrome	Satin Chrome	Satin Chrome	Satin Chrome
Applications	Entertainers' P.A./Recording	Entertainers' P.A./Recording	P.A./Recording/Schools	Entertainers' P.A./Recording	P.A./Recording/Communications	P.A./Recording/Schools/Paging
Comments	Emphasizes Bass Close-Up On/Off Switch	Emphasizes Bass Close-Up On/Off Switch	On/Off Switch	Emphasizes Bass Close-Up On/Off Switch	No Proximity Effect On/Off Switch	On/Off Switch
Similar Models		626A—Integral Cable/Dual Z 70-12kHz		671—No-Stub	664AA—Gray	

Model	647A	644	634ASRL	621	602F	625ST
Type	Lavalier Dynamic	Unidirectional Line Dynamic	Omnidirectional Dynamic	Omnidirectional Dynamic	Noise Cancelling Handheld Dynamic	Noise Cancelling Handset Dynamic
Response	70-10kHz	40-10kHz	70-10kHz	70-10kHz	100-5kHz	300-3.5kHz
Impedance	Specify Hi or Lo-Z	Dual Hi-Z/Lo-Z	Lo-Z	Specify Hi or Lo-Z	Specify Hi or Lo-Z	Lo-Z
Output	-60 dB	-53 dB	-57 dB	-57 dB	-60 dB	-60 dB
Finish	Gray	Satin Chrome	Satin Chrome & Gray	Chrome & Gray	Gray	Black
Applications	Concealed/Walkaround P.A.	Long-Range Pickup Stage/Outdoors Classrooms	Base Station/P.A./Schools	Base Station/Paging/Communications	Communications/Paging in Noisy Areas	Communications/Paging in Noisy Areas
Comments	Small/Lightweight	90° Acceptance Angle On/Off Switch	On/Off Relay Switch for Gooseneck Mounting	Press-To-Talk or Grip-To-Talk Switch	Press-To-Talk Switch/Coil Cord	Press-To-Talk Switch/Coil Cord
Similar Models			634A—No Switch Hi or Lo-Z	622—Noise Cancelling 607—Stud Mounted Noise Cancelling	600E—Omnidirectional	645TR—Transistorized Drop in Phone Mike Element



NOTES:

- 10 feet on axis, swept one-third octave random noise input, anechoic environment.
- Long-term average power capacity (sometimes called "continuous" or "RMS" power), shaped random noise input.
- Angle included by 6-dB-down points on polar responses, one-octave random noise input at indicated center frequencies, 10-foot microphone distance, anechoic environment. Where speakers have non-symmetrical polar responses, "H" indicates horizontal dispersion and "V" indicates vertical dispersion. The small "H" sketches indicate proper speaker orientation for widest and/or most uniform dispersion in the horizontal plane.
- Octave-band random-noise input, center frequency chosen for maximum speaker output.

Herbst

Ihr Fernseh-/Rundfunkgeschäft
mit Hi-Fi- und Tonbandstudio
Ecke Güntertal-/Bäcker Straße
FREIBURG/Br.,

Großraum-Reparaturwerkstätte
Lörracher Straße 45

WARRANTY

Sound Reinforcement & Public Address Products (Limited)

Electro-Voice Sound Reinforcement & Public Address Loudspeakers and Accessories are guaranteed for five years from date of original purchase against malfunction due to defects in workmanship and materials. If such malfunction occurs, unit will be repaired or replaced (at our option) without charge for materials or labor if delivered prepaid to the proper Electro-Voice service facility. Unit will be returned prepaid. Warranty does not cover finish or appearance items or malfunction due to abuse or operation at other than specified conditions. Repair by other than Electro-Voice or its authorized service agencies will void this guarantee.

General Purpose Microphones (Limited)

Electro-Voice General Purpose Microphones are guaranteed without time limit against malfunction in the acoustic system due to defects in workmanship and materials. (Any active electronics incorporated in a microphone is guaranteed for three years from date of original purchase against such malfunction.) If such malfunction occurs, microphone will be repaired or replaced (at our option) without charge for materials or labor if delivered prepaid to the proper Electro-Voice service facility. Unit will be returned prepaid. Warranty does not cover finish, appearance items, cables, cable connectors, or switches and does not cover malfunction due to abuse or operation at other than specified conditions. Repair by other than Electro-Voice or its authorized service agencies will void this guarantee.

ELECTRO-VOICE®



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