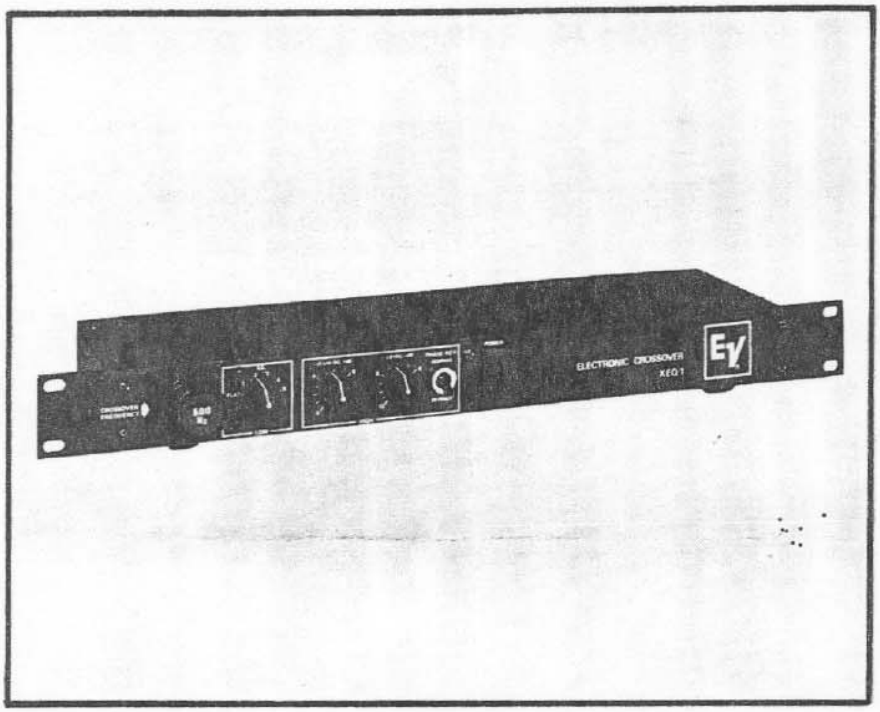
Electro-Voice®
a gulton company



Model XEQ-1 Electronic Crossover

SPECIFICATIONS

Channel Configuration:
One input, one high-pass output, and one-low pass output

Relative Phase,
Low channel:
Output in phase with input (no reversal)
High channel:
Switchable, 0 or 180 degrees

Frequency Response (sum of outputs; controls flat):
± 0.5 dB 30 – 18 kHz

Noise Output (20-20 kHz bandwidth):
–90 dBV maximum (–88 dBm)

Total Harmonic and Intermodulation Distortion:
.02% typical; 0.1% maximum at 20 kHz, +20 dBm

Output Configuration:
Unbalanced; balanced and isolated with optional plug-in transformers

Maximum Output Level:
+ 18 dBV (+20 dBm)

Minimum Load Impedance for Rated Performance:
600 ohms

Output Protection:
Safe for short circuit or ± 25 volts DC

Output Internal Impedance:
50 ohms

Input Configuration:
Balanced or unbalanced, user selectable

Input Impedance,
Bridging:
50,000 ohms unbalanced
Balanced:
100,000 ohms

Input Common-Mode Rejection:
55 dB, typical, 60-1000 Hz

Overall Gain (controls flat):
0 dB into high-Z load

Crossover Frequency Range (determined by module):
100 to 8000 Hz

Filter Type,
Normally Supplied:
Third-order Butterworth (18 dB per octave)
Possible Constructions:
First-, second-, or third-order Butterworth, Bessel, or Chebyshev, high and low channel independantly chosen

High/Low Channel Crosstalk (ultimate rejection):
60 dB typical

Low-Frequency Equalization for "Step-Down" Operation of TL Bass Speaker Systems:
Second-order under-damped filter with switchable plus-6-dB peak boost frequencies of 29, 32, 35, 45, and 60 Hz, plus "flat" with a high-pass f_3 of 20 Hz

High-Frequency Equalization:
Continuously variable 0 to + 12 dB at 15 kHz, with f_3 at 4 kHz

High-Frequency Channel Level Control:
0 to –12 dB relative to low-frequency channel

Transient Performance:
Not limited by slew rate or power bandwidth over 20 – 20 kHz under any normal operation condition

Power Requirements:
90 to 120 V, 50/60 Hz, 8 watts, maximum.

Mounting:
Standard 19" rack panel, 1-3/4" high

Weight:
5 lb

DESCRIPTION

The E-V XEQ-1 electronic crossover/equalizer is a single-channel, high-performance device, intended primarily for professional sound reinforcement applications. It combines an active, two-way frequency dividing network, a five-position "Thiele" low-frequency equalizing network, and a continuously variable high-frequency horn-driver equalizer which are compatible with the Electro-Voice TL bass speaker systems and high-frequency drivers. Such equalization has heretofore been unavailable as part of an active crossover, making the XEQ-1 an extraordinary useful component in high-performance fixed and portable sound systems.

The XEQ-1 is rack mountable with a 1-3/4" panel height. All controls are on the front panel but are protected from uninvited knob twisting by a see-through removable plastic cover.

LOW-FREQUENCY CHANNEL PHASE

This crossover has been designed so that over the flat portion of the low-frequency channel, a positive polarity signal at the input (tip or pin 2) will result in a positive polarity voltage at the output (tip or pin 2). Thus, no basic phase reversals will result from the insertion of an XEQ-1 into the system.

LOW-FREQUENCY EQUALIZATION

The XEQ-1 provides the low-frequency contouring necessary for "step-down" operation of Electro-Voice TL bass speaker systems. The peak frequency for each

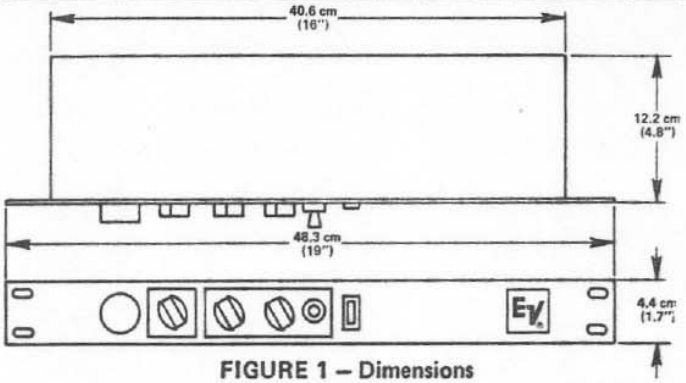


FIGURE 1 – Dimensions

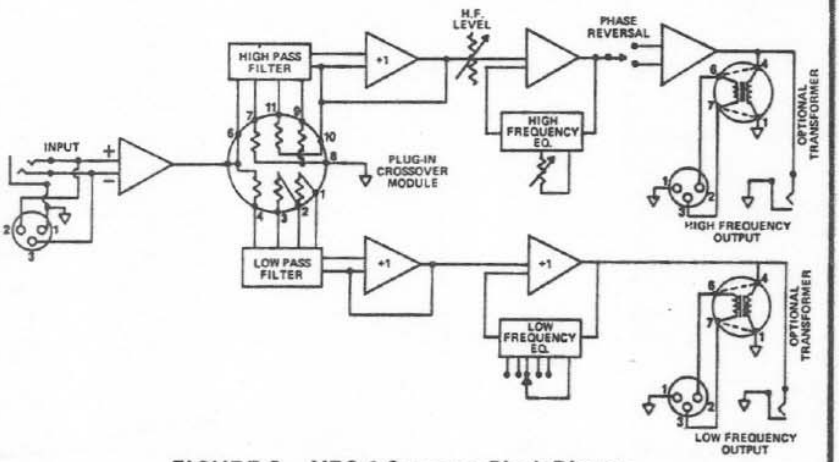
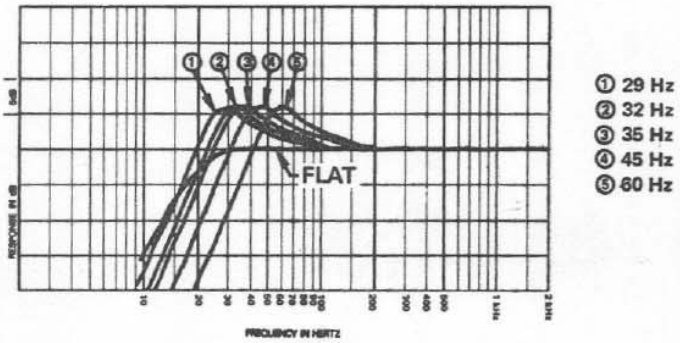


FIGURE 2 – XEQ-1 Crossover Block Diagram



① 29 Hz
② 32 Hz
③ 35 Hz
④ 45 Hz
⑤ 60 Hz

FIGURE 3 – Low-Frequency Equalization

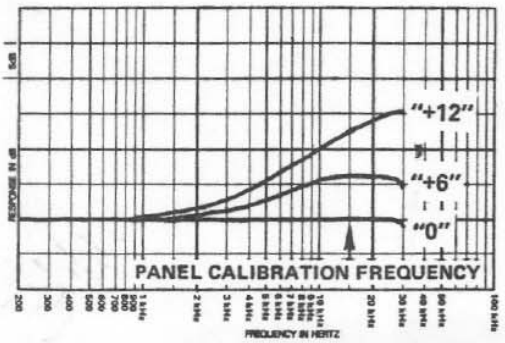


FIGURE 4 – High-Frequency Equalization Limits

switch position is shown in Figure 3 along with the appropriate TL speaker system.

A feature of the circuit for low-frequency equalization is a high-pass filter with 12-dB-per-octave slope below the peak-boost frequency for removing subsonic energy below the lowest usable speaker frequency. Such energy is not audible in itself but at best wastes amplifier power and at worst can modulate (distort) the higher bass and midbass frequencies within the speaker system's effective range.

A high-pass filter is also part of the Flat (no equalization) switch position, with a 3-dB-down point of 20 Hz and a 12-dB-per-octave slope.

HIGH-FREQUENCY EQUALIZATION

A continuously variable calibrated control provides a range of high-frequency boost. (See Figure 4.) While this boost may be useful with any system, it is primarily tailored to complement the Electro-Voice DH1012 and DH1506 high-frequency drivers.

The equalizer produces essentially flat high-frequency power response to the rated upper limits of the drivers, without the need of an external broad-band equalizer (octave, one-third-octave, etc.). Although such equalizers may be readily employed to fine tune the broadband speaker and room response, the XEQ-1's equalization will be sufficient for many applications.

HIGH-FREQUENCY LEVEL CONTROL

A continuously variable calibrated gain control affects only the high-frequency channel. Its primary use is to compensate for differences in efficiency between low-frequency speaker systems and high-frequency speaker systems. The control covers a range in gain of 12 dB and provides equal gain of the high and low channels when in its fully clockwise position.

PHASE REVERSAL SWITCH

A two-position toggle switch is provided to change the phase of the high-frequency channel relative to the low-frequency channel by 180°. Although the "normal" position provides the conventional phase relationship between high and low output channels for a third-order Butterworth (18-dB-per-octave slope) system, it may be advantageous in certain practical acoustic situations to reverse the phase. This will allow the user to optimize crossover response for drivers having widely different phase characteristics or physical placement.

CROSSOVER MODULE

Two plug-in modules are provided for obtaining a 500 Hz and 800 Hz crossover frequency. See Figure 5 for a

typical crossover curve. Both crossover plug-in modules have third-order Butterworth filter characteristics (18-dB-per-octave slopes).

An extra 11-pin plug and cover have been provided to allow a custom plug-in module to be assembled in the field, using resistors calculated from data given below, and purchased at a local parts dealer. The actual assembly should be undertaken only by those with some background in soldering and reading a schematic.

Since all six of the crossover determining resistors are included in the plug-in module, the user has complete freedom in choosing the order, characteristic, and frequency of the high- and low- pass sections, independently from one another. However, for the sake of simplicity, information is given below only for the case of third-order Butterworth filters. This configuration gives a "maximally flat" response shape near crossover with 18-dB-per-octave slopes, the best all-around performance for the vast majority of applications. In the following formulas, f_3 is the crossover frequency desired, sometimes referred to as the "knee" of the curve. Specifically, it is that frequency at which the response has been attenuated by 3 dB (0.7 times the voltage, or 0.5 times the power) from the flat portion of the curve. When the f_3's of the low and high pass sections are made to coincide in frequency, as is usually the case, the total energy of the output channels, when added, is independent of frequency, thus providing a "flat" response. Resistors R_{L1}, R_{L2}, and R_{L3} determine the characteristics of the low-pass filter section, and R_{H1}, R_{H2}, and R_{H3} the high-pass section. One-quarter watt film resistors, having a resistance tolerance of 1% or 2%, are recommended. However, except in highly critical applications, 5% tolerance resistors may suffice. If a resistance bridge is available, it may be possible to "select" values close to the optimum. In the following formulas, R is given in ohms and f_3 in hertz.

I. **Low-pass section:**

$$R_{L1} = R_{L2} = R_{L3} = \frac{24.7 \times 10^6}{f_3}$$

II. **High-pass section:**

$$R_{H1} = \frac{47.6 \times 10^6}{f_3}$$

$$R_{H2} = \frac{15.8 \times 10^6}{f_3}$$

$$R_{H3} = \frac{10600 \times 10^6}{22 f_3 - 478}$$

In general, raising the value of all three resistors by a fixed percentage will lower the crossover frequency of that section by the same percentage, while maintaining the same shape of curve

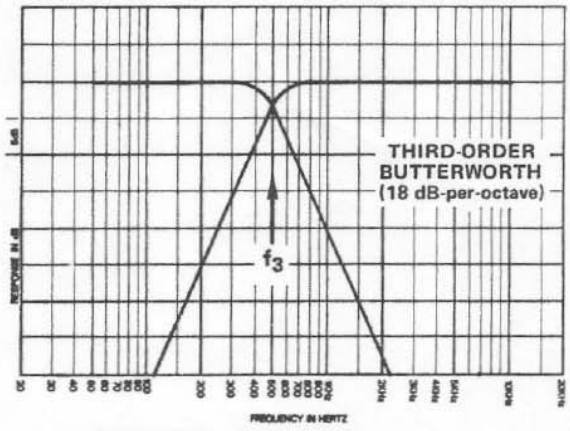


FIGURE 5 – Typical Crossover Curve

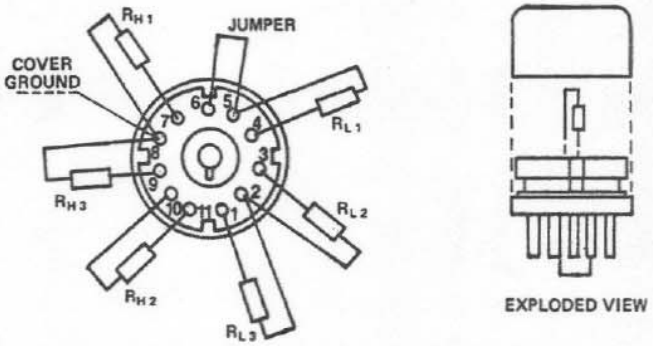


FIGURE 6 – Wiring of Crossover Plug

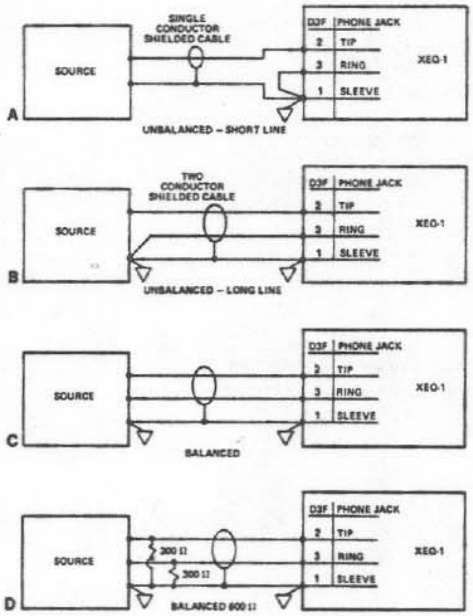


FIGURE 7 – Input Connections to the XEQ-1

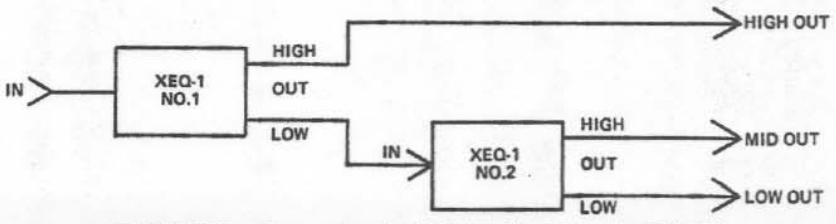


FIGURE 8 – Connection for Tri-Amping Using the XEQ-1

Altering the resistance ratios among the three resistors will change the shape of the knee of the curve, causing either a more gradual crossover, or else a peaked response. It should not, therefore, be attempted indiscriminately. For specialized applications, it is recommended that the factory be consulted.

In constructing the plug-in module, first insert all six resistors and one wire jumper, carefully locating them with respect to the pin numbers which are molded into the black plug body (see Figure 6). Each resistor should be fully seated in its respective pin cavity, and all leads should protrude through the pin ends. Now carefully solder each pin end, allowing solder to be drawn up inside the pin for a secure connection. To avoid excessive flux and solder buildup on the outside of the pin, hold the pins horizontally during soldering, and wipe with a soft cloth, if necessary, before cooling. Use only "electronic grade" solder (60 or 63% tin; rosin or resin core), and be sure the resistor leads are clean and tinned.

After soldering, trim off the protruding leads close to the pin ends, and inspect to see that there is no solder buildup on the pin surfaces (this could damage the socket).

Finally, attach the cover by means of crimping, or use adhesive, such as rubber-to-metal cement. Do not allow the adhesive to contact any resistor leads. Ordinarily, grounding of the cover is unnecessary. However, for critical applications, or for use in severe electrical interference fields, the cover may be grounded to pin 8 by pressing the cover over a short length of bare wire soldered to that pin.

CONTROL COVER

A transparent plastic control cover is provided to cover all the controls so that they may not be altered unintentionally. The cover is held in place with four 6-32 screws. If it is desirable that the on-off switch should be accessible, the cover may be turned end for end, which allows the power switch to remain outside the cover.

INPUT CONNECTIONS

The XEQ-1 input circuit is designed to accommodate any balanced or unbalanced, high- or low-impedance, active or passive source, which is capable of providing a line-level signal. The good common-mode rejection, coupled with low radio-frequency interference susceptibility, makes it ordinarily unnecessary to use an input transformer. The XEQ-1 is typically installed in the audio signal chain immediately preceding the power amplifiers.

Unbalanced (One Side Grounded) Sources

When using a conventional, single-circuit phone plug for the input connector, no further input connections are required. If using a 3-pin professional connector, the input normally goes to pin 2, with pin 1 connected to the shield (ground). Pin 3 must also be tied to pin 1. Connection should not be made to both the phone jack and 3-pin professional connector at the same time (see Figure 7A).

Under adverse conditions (i.e. when the source is located over 10 feet away, and/or in a different equipment rack) it may be possible to greatly reduce hum and noise generated in the input system by adopting the highly recommended circuit of Figure 7B. This will minimize the effect of any ground loop currents which are normally associated with unbalanced systems. The requisite two-conductor shielded cable may be connected either to the 3-pin professional connector input or to the two-circuit (stereo) phone-jack input.

Balanced Sources

When possible, it is always desirable to feed the XEQ-1 with a balanced source. This will minimize hum and other extraneous noise pickup in the input cable, or induced by a system ground loop. Figure 7C illustrates this connection. In unusual cases, where the driving unit (source) must see a load of exactly 600 ohms, a resistor may be placed across the line (or two 300-ohm resistors, as shown in Figure 7D). One-quarter or one-half watt, 5% tolerance units are usually adequate.

OUTPUT CONNECTIONS

Unbalanced Outputs

Output is unbalanced (single-ended) without the accessory transformers, and is present at the phone jack for each output.

The wire straps in the octal sockets adjacent to the output connections on the back panel must be in place to use the 3-pin professional connector for an unbalanced output. The wire straps run between pins 1 and 7 and pins 4 and 6 on each octal socket. When in place, output on the 3-pin professional connector is available at pin 2, with pins 1 and 3 grounded.

Balanced Outputs

Balanced and isolated outputs may be obtained from the 3-pin professional connector by utilizing an accessory Sescom Model MI-100 transformer that plugs into the octal sockets provided. Remove the wire straps before inserting the transformer.

Load-Impedance Requirements

The XEQ-1 outputs have an internal impedance of 50 ohms in the unbalanced or balanced condition, which is suitably low for driving one or many inputs whose combined impedance is 600 ohms or greater. Where a 600-ohm load must be matched, a 560-ohm "build-out" resistor may be used. In this case there would be a 6 dB drop in gain. It is possible to use the phone jack and 3-pin professional connector at the same time to drive multiple loads.

TRI-AMPING

Two XEQ-1's may be "stacked" to provide tri-amp capability as shown in Figure 8. Crossover number 1 should incorporate a plug-in to select the upper (mid/high) crossover frequency. XEQ-1 number 2 should be used for the lower (low/mid) crossover frequency. Thiele equalization should be carried out in unit number 2, with low-frequency equalization in number 1 set "flat." High-frequency controls may be used as needed, with number 1 adjustments affecting both mid and high channels, and number 2 controls influencing only the mid channel (if its range falls within the control range). Typical crossover points might be 500 Hz for unit number 2 and 3500 Hz for unit number 1, depending upon requirements of the speaker system.

WARRANTY (Limited) –

Electro-Voice Professional Sound Reinforcement Electronic Products are guaranteed for two 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.

For shipping address and instructions on return of Electro-Voice products for repair and locations of authorized service agencies, please write: Service Department, Electro-Voice, Inc., 600 Cecil Street, Buchanan, Michigan 49107 (Phone 616/695-6831) or 7473 Avenue 304, Visalia, CA 93277 (209/625-1330,-1).

Electro-Voice also maintains complete facilities for non-warranty service.

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

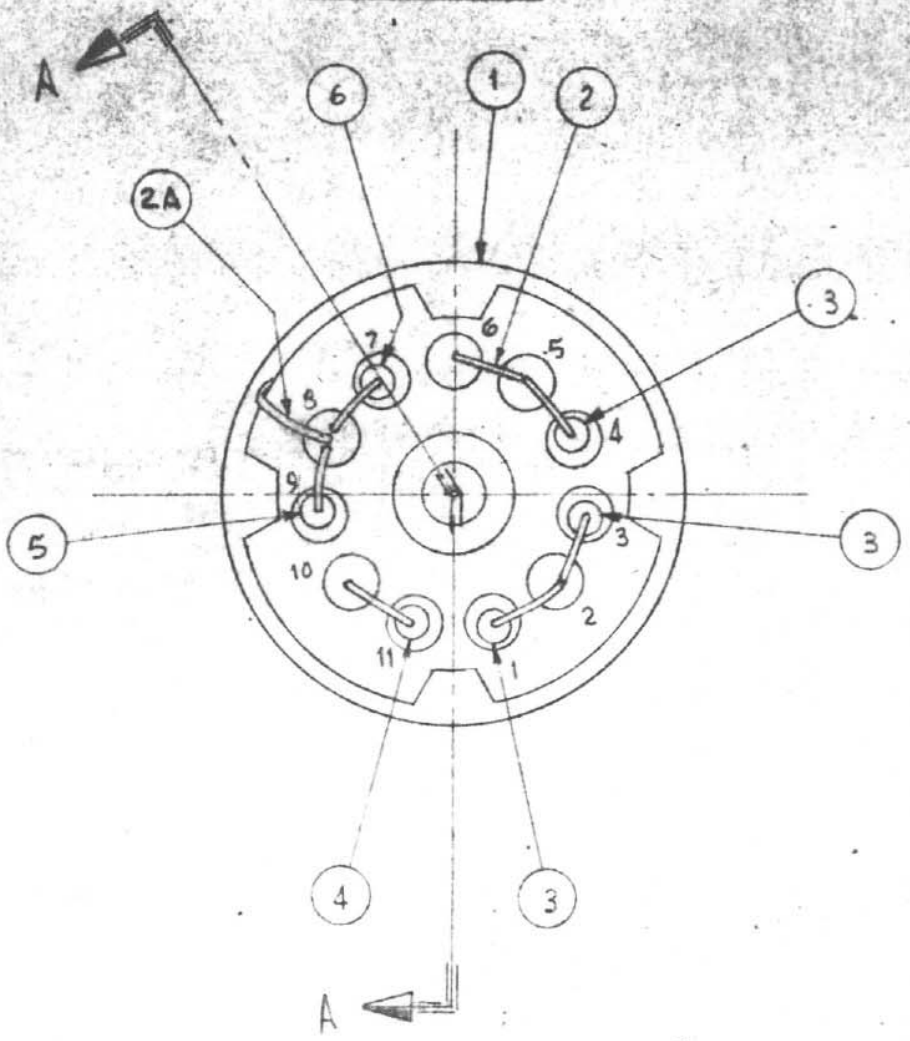
Specifications subject to change without notice.

Part Number 53689 – 924

a Gulton COMPANY **ELECTRO-VOICE, Inc., 600 CECIL ST., BUCHANAN, MICH. 49107**

MANUFACTURING PLANTS AT ■ BUCHANAN, MICH. ■ NEWPORT, TENN. ■ SEVIERVILLE, TENN. ■ GANANOQUE, ONT. ■ LITHO IN U.S.A.

TOP VIEW (SHOWN WITH COVER REMOVED)



NOTES:

1. CRI
   TO
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2. IN
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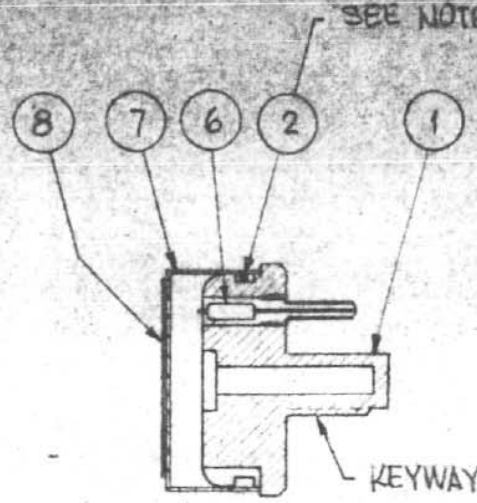
				RL 1 RL 2 RL 3		RH 2		RH 3		RH 1
529-0238	125 HZ	46729	200K	46712	100K	46769	4.7 MEG	46768	360K	D53692
B89172	800 HZ	46732	30.9K	46736	19.6K	46738	620K	46734	59K	B53692
A89172	500 HZ	46733	49K	46737	31.6K	46739	1 MEG	46735	95K	A53692
PART No.	FREQ.	ITEM 3		ITEM 4		ITEM 5		ITEM 6		ITEM 8

SBD-10-5155

CHARTED A89172

REV.	DESCRIPTION	APPROVAL & DATE
A	(1) 529-0238 ADDED & CHARTED ECR# — JWB 6-2-80	



CTION A-A

SCALE 1:1

COVER (ITEM 7) ON TO PLUG (ITEM 1) SECURELY, REVENT ROTATION AND ASSURE ELECTRICAL CONTACT GROUND WIRE (ITEM 2A).

L LABEL (ITEM 8) SO THAT PRINTING IS UPRIGHT HORIZONTAL WHEN PLUG KEYWAY POINTS STRAIGHT DOWN.

T. RESISTORS AS FAR AS POSSIBLE INTO SOCKET ES BEFORE SOLDERING.

SOLDER OR FLUX BUILD-UP ON THE OUTSIDE INS.

SEP 14 1981

UNLESS OTHERWISE SPECIFIED

ALL DIMENSIONS IN INCHES EXCEPT METRIC IN (PAREN.)

INCHES X 25.4 = MM — MM X .0394 = INCHES

TOLERANCES

INCHES	METRIC	ANGLES
.X ± .030	X. ± .8MM	MACHINED, CAST, MOLDED ± 1/2°
.XX ± .010	.X ± .3MM	
.XXX ± .005	.XX ± .1MM	FORMED ± 2°

CONCENTRICITY T. I. R. — DRAFT ANGLES

MATERIAL — FROM

REMOVE ALL BURRS AND SHARP EDGES
THREADS TO BE UNIFIED SERIES
CLASS 2 AFTER PLATING

ITEM	PART No.	REQ'D	DESCRIPTION
8	CHARTED	1	LABEL
7	70575	1	COVER, SOCKET
6	CHARTED	1	RESISTOR
5	CHARTED	1	RESISTOR
4	CHARTED	1	RESISTOR
3	CHARTED	3	RESISTOR
2	16061-04	2	WIRE, #22, SOLID, BARE, 2"LG.
1	17268	1	PLUG, 11 PIN, AMPHENOL

BILL OF MATERIAL FOR ONE COMPLETE UNIT

Gulton — **ELECTRO-VOICE, INC.**
600 CECIL ST. • BUCHANAN, MICH. 49107

TITLE PLUG-IN S/A

SCALE 2:1

MODEL FIRST USED ON SALES XEQ-1 / ENGINE

DRN JWB DATE 9-13-79

CKD DATE

ENGR DATE 9-24-79

PRODUCTION NO. A89172 — REV. A

CHARTED

EXPERIMENTAL NO.