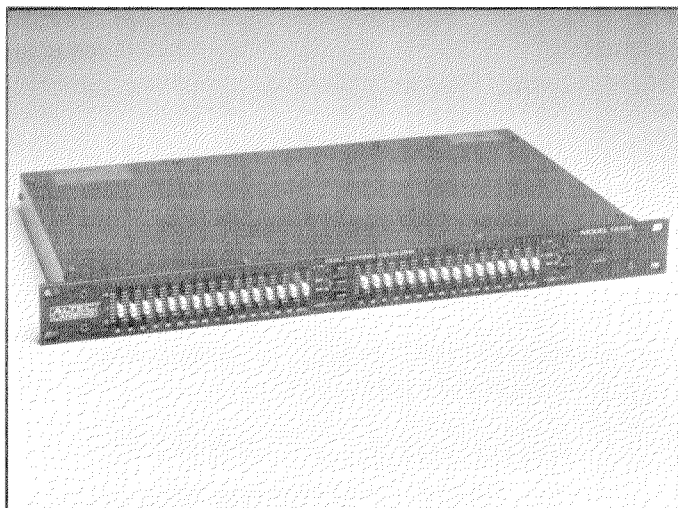




# 1412A

## Variable Q Active Filter

### Stereo 15 Band $\frac{2}{3}$ Octave Equalizer



#### KEY SYSTEM SPECIFICATIONS

**Center Frequencies:** 25, 40, 63, 100, 160, 250, 400, 630, 1k, 1.6k, 2.5k, 4k, 6.3k, 10k, 16k Hz

**Maximum Boost/Cut:**  $\pm 12$  dB

**Operating Gain:** 0 dB

**Low-Cut Filter  
Corner Frequency:** 43 Hz

**Frequency Response  
at Unity Gain:** 20 Hz - 20 kHz,  $\pm 1$  dB  
(High-Pass Filter Disengaged)

**Total Harmonic Distortion  
at Unity Gain:**  $< 0.01\%$   
(20 Hz - 20 kHz, 0 dBu Output)

**Noise at Unity Gain:**  $< -85$  dBu  
(20 Hz - 20 kHz)

**Maximum Input Level  
at Unity Gain:** + 20 dBu (7.75 Vrms)

**Maximum Output Level:** + 20 dBu (7.75 Vrms)

#### KEY FEATURES

- ★ Variable Q filter set
- ★ 15 bands of boost and cut
- ★ Select between 6 dB or 12 dB of boost and cut

#### DESCRIPTION

The Altec Lansing **1412A** is a boost and cut stereo  $\frac{2}{3}$ -octave graphic equalizer whose primary use is for tuning the overall frequency response of a sound reinforcement system, both to increase gain-before-feedback and to compensate for the deficiencies in the acoustic environment and the sound system.

The active Q variable filter set utilized in the **1412A** allows effective equalization with few problematic side effects. As Figure 2 illustrates, the filter characteristics vary with the amount of boost or cut used. At low control settings, the filter Q is very wide. As the control is boosted or cut, the

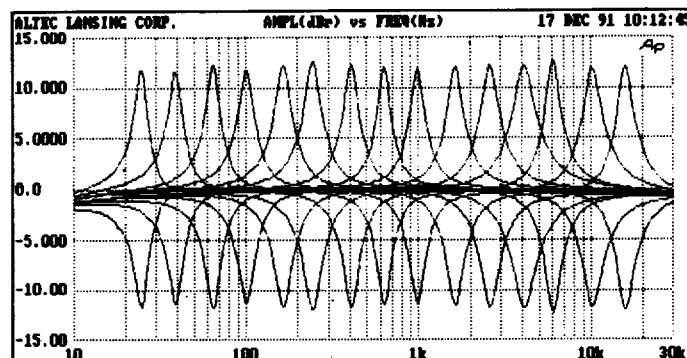
filter Q narrows so that there is minimum interaction between adjacent frequency bands. The filter response is designed to affect a  $\frac{2}{3}$ -octave range.

Each of the 15  $\frac{2}{3}$ -octave filters provide 12 dB of boost or cut at ISO frequencies 20 through 20,000 Hz. The faders have a positive detent in the center, flat-response position. The gain control also has a center detent at unity gain.

A low-cut filter switch, with a 43 Hz corner frequency and 18 dB per octave slope, is located on the front panel. A range select switch allows selection of either 6 dB or 12 dB of boost or cut.

## 1412A Specifications (cont'd)

<b>Input:</b>	(Ref. 0 dBv = 0.775 Vrms)		
<b>Type:</b>	Electronically balanced		• EQ-ON Equalizer ON select switch
<b>Impedance:</b>	44 k $\Omega$ balanced 22 k $\Omega$ unbalanced		• AC Power switch
<b>Normal level:</b>	0 dBv (0.775 Vrms)		• Ground-Lift Switch
<b>Output:</b>	(Ref. 0 dBm = 0.775 Vrms across 600 $\Omega$ )	<b>Connectors:</b>	
<b>Type:</b>	Electronically balanced	<b>Input:</b>	3 Terminal barrier strip (balanced)
<b>Impedance:</b>	120 $\Omega$ balanced 60 $\Omega$ unbalanced	<b>Output:</b>	3 Terminal barrier strip (balanced)
<b>Load Impedance:</b>	600 $\Omega$ or higher	<b>AC Power:</b>	115, 230 Vac 50/60 Hz 18 Watts
<b>Peak Indicator:</b>	Red LED + 14 dBu (6 dB before clipping)	<b>Operating Temperature Range:</b>	Up to 50° C (122° F)
<b>Available Gain:</b>	$\pm 6$ dB or $\pm 12$ dB	<b>Dimensions:</b>	
<b>High-Pass Filter:</b>	Switch selectable with cutoff below 43 Hz and a slope of 18 dB per octave.	<b>Height:</b>	1.73 inches (44 mm)
		<b>Width:</b>	19.0 inches (483 mm)
		<b>Depth:</b>	9.24 inches (235 mm)
<b>Controls:</b>	<ul style="list-style-type: none"> <li>• 15 center detent slide controls at <math>\frac{2}{3}</math>-octave center frequencies from 20 Hz to 20 kHz, selectable <math>\pm 6</math> dB or <math>\pm 12</math> dB boost/cut.</li> <li>• LEVEL control with center detent</li> <li>• LO-CUT select switch</li> <li>• RANGE <math>\pm 6</math> dB or <math>\pm 12</math> dB select switch</li> </ul>	<b>Net Weight:</b>	6.0 lbs (2.7 kg)
		<b>Enclosure:</b>	Rack Mount Chassis (1 $\frac{3}{4}$ inch rack space)
		<b>Accessories:</b>	(Included) Power cord, mounting screws, rubber feet, decal and fuse for 230 Vac line operation, 1412A Installation and Operating Instructions



**Figure 1**  
 $\pm 12$  dB Control Settings, Individually Set

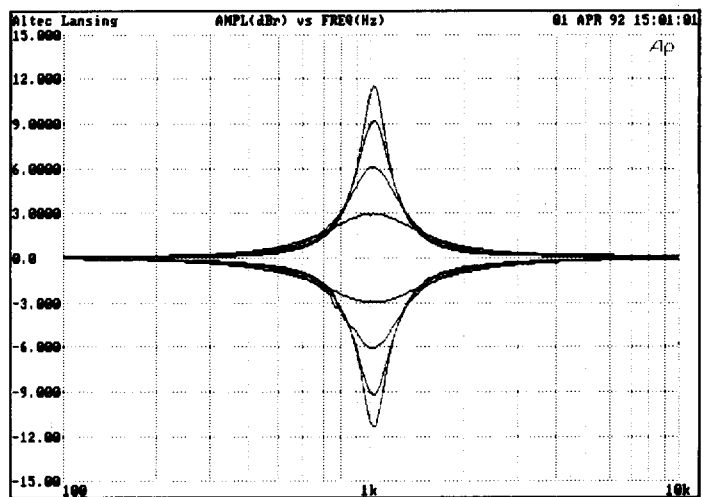


Figura 2

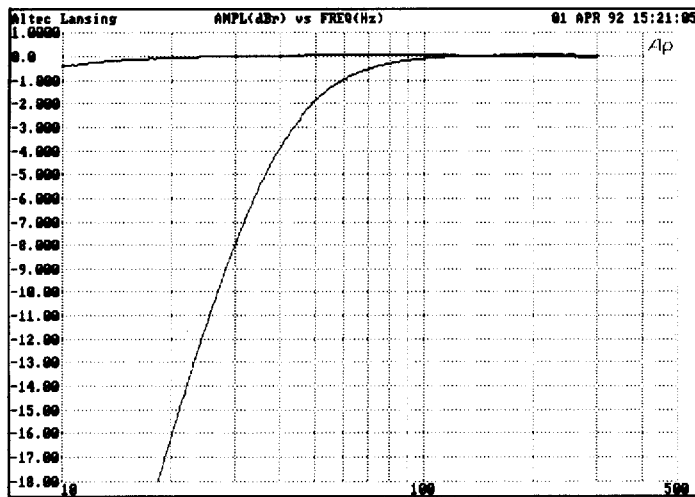


Figura 3

# ARCHITECT'S and ENGINEER'S SPECIFICATION

The equalizer shall operate in stereo with 15 filters centered at the ISO standard  $\frac{2}{3}$ -octave frequencies between 20 and 20,000 Hz. Furthermore, the filters shall provide either 6 dB or 12 dB of boost or cut and be set by 22.5 mm linear controls.

The front panel shall have the following controls: a gain control that is continuously variable from - 12 dB to + 12 dB from unity gain; a high-pass filter with a slope of 18 dB per octave and a corner frequency of 43 Hz; a range switch to select either 6 dB or 12 dB of boost or cut from the filters; an EQ-on switch to put the filters in the signal path and an on/off switch.

The rear panel shall have input and output connectors, a ground-lift switch, and an IEC connector with an integral fuse holder that allows voltage selection by the way it is inserted.

The input and output of the equalizer shall be accessible via 3-terminal barrier strips. The input shall be actively balanced. The output shall be balanced on the 3-terminal barrier strip.

The equalizer shall meet or exceed the following performance specifications: frequency response at unity gain,  $\pm 1$  dB, 20 - 20,000 Hz at 0 dBu; a noise level of less than - 85 dBu; gain of  $\pm 6$  dB or  $\pm 12$  dB; balanced-input impedance of 44 k $\Omega$ ; output impedance of 120  $\Omega$ ; a maximum input level of + 20 dBu at unity gain; a maximum output level of 20 dBu into loads greater than or equal to 600  $\Omega$ .

The equalizer shall operate on 115/230 Vac, 50/60 Hz, and consume less than 18 watts. The unit shall be operable over the temperature range as high as 50° C or 122° F. The chassis shall be steel with a black front panel and black top, bottom, sides and back with white nomenclature. The chassis shall occupy one rack space in a standard 19-inch rack (Height: 1.73 inches, Depth: 9.24 inches, Width: 19 inches). The weight shall be 6 lbs.

The equalizer shall be the Altec Lansing model **1412A**.



a MARK IV company

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*the sound of experience.*

# 1412A

## Stereo 15 Band 2/3 Octave Equalizer

### Installation and Operating Instructions



**ALTEC LANSING CORPORATION**

a MARK IV company

P.O. Box 26105 • Oklahoma City, OK • 73126-0105 USA • Tel: (405) 324-5311 • FAX: (405) 324-8981

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## 1 ELECTRICAL

### 1.1 115 Vac, 50/60 Hz Power Connections

The 1412A is provided with the primary of the power transformer selected for 115 Vac operation from the factory.

**NOTE:** Verify that the ac line voltage is in accordance with the selected voltage rating before connecting the equalizer to the ac line.

### 1.2 230 Vac, 50/60 Hz Power Connections

The 1412A may be powered from 230 Vac line voltages by removing the fuse holder from the power receptacle and then pulling the fuse clip out, turning it 180 degrees and reinserting it, making sure 230 shows in the fuse holder window. Next remove the 315 mA fuse and install the 160 mA fuse (found in the bag marked European) and then place the holder back in the power receptacle.

### 1.3 Fuse Replacement

If the fuse needs replacement, it must be replaced by one of the same type and rating for the power connections being used. See below:

315mA/250V NB (115 Vac line)  
160mA/250V NB (230 Vac line)

## 2 INSTALLATION

### 2.1 Rack Mounting

The 1412A may be installed in a standard 19 inch equipment rack. It requires 1 3/4 inches of vertical rack space and mounting is accomplished by using the four rack mount screws provided.

### 2.2 Ventilation

The 1412A must be adequately ventilated to avoid excessive temperature rise. It should not be used in areas where the ambient temperature exceeds 50°C

(122°F). To determine the ambient air temperature, operate the system in the rack until the temperature stabilizes. Measure the ambient air with a bulb-type thermometer held at the bottom of the upper-most unit. Do not let the thermometer touch the metal chassis because the chassis will be hotter than the ambient air. If the temperature exceeds 50°C (122°F), the equipment should be spaced at least 1 3/4 inches apart or a blower installed to provide sufficient air movement within the cabinet.

**WARNING:** Do not operate the equalizer within a completely closed, unventilated housing.

## 3 SIGNAL CONNECTIONS (Both Channels)

### 3.1 Input Connections

Balanced input connections are made to the 3 terminal barrier strip (one for each channel). For single-ended inputs, strap terminals - and GND. Refer to Figure 1 for typical input connections.

### 3.2 Output Connections

Balanced output connections are made to the 3 terminal barrier strip (one for each channel). For unbalanced output strap terminals - and GND. Refer to Figure 2 for typical output connections.

## 4 OPERATION

### 4.1 Front and Rear Panel Controls

#### FRONT PANEL

- BOOST/CUT slider controls for frequency bands.
- PEAK. Peak indicator.
- LEVEL. Output level control.
- LO-CUT. Bass cut switch.

- EQ ON. Equalizer on/off switch.
- RANGE. Boost/Cut range switch.
- ON/OFF. Power switch.

#### REAR PANEL

- Electronically balanced inputs.
- Balanced/Unbalanced outputs.
- Ground-Lift-Switch.
- Fuse holder/ac line voltage selector.

### 4.2 BOOST/CUT Slider Adjustments

The primary tones of the bass drum, bass tuba, electric and acoustic bass guitar and the organ pedal clavier are affected mostly by the frequency bands 25 Hz to 100 Hz. In special cases the 63 Hz band can be used to filter out line hum (setting slider to max cut).

To modify lower vocals, drum fundamentals, upper bass, and lower bass instruments such as tuba and trombone use the frequency bands 100 Hz through 250 Hz. The 250 Hz band can be used for a slight boost, giving vocals added fullness where a degree of additional support is desired.

The frequency bands 250 Hz to 630 Hz affect the lower mid-range of musical material, such as the fundamental frequencies of voices, string and percussive instruments.

The frequency bands 630 Hz to 2.5 kHz and especially 1 kHz and 1.6 kHz bands enhance harmonics and fundamental frequencies of voices, strings, percussive, and keyboard instruments. These bands also accent the effects of flanging and phasing.

The 2.5 kHz through 6.3 kHz bands affect vocal fricatives, drums, and guitar. The use of

these bands is highly dependent on the acoustical characteristics of the hall, its reverberation and sound absorption.

Cymbals and the synthesizer in particular will be markedly accentuated by boosts in the frequency bands 6.3 kHz to 16 kHz. By turning up the 6.3 kHz control, the presence of a singer's voice can, for example be reinforced. One possibility for reduction of noise in PA systems is to cut the 16 kHz frequency range slightly.

#### **4.3 PEAK Indicator**

The PEAK indicator will light when the output level reaches a point 6dB below output clipping. The 1412A should be operated below this point.

#### **4.4 LEVEL Control**

The LEVEL control provides  $\pm 6\text{dB}$  or  $\pm 12\text{dB}$  of level control (from the detent position) only when all Boost/Cut sliders are in the detent position. The 6 and 12 dB ranges are determined by the RANGE switch.

#### **4.5 LO-CUT Switch**

When the LO-CUT switch is depressed the red LED will light, indicating the frequency response below 43 Hz will be rolled off at 18dB per octave.

#### **4.6 EQ ON Switch**

When the EQ ON switch is depressed the red LED will light, indicating the EQ is activated. In the EQ OFF position, it causes the equalizer to be by passed.

#### **4.7 RANGE Switch**

When in the 6dB position (red LED on) it will allow the sliders to adjust the boost and cut by approximately  $\pm 6\text{dB}$ . The 12dB position (green LED on) will likewise allow approximately a  $\pm 12\text{dB}$  boost and cut adjustment.

#### **4.8 POWER Switch**

Power is turned on or off by this switch.

#### **4.9 Ground-Lift-Switch**

Slide switch for eliminating hum from ground loops. Disconnects circuit chassis. If several units are installed in one rack, the switch should be set to "GROUNDED" on only one of the units.

### **5 IN CASE OF PROBLEMS**

Please check the following items:

1. Verify that the 1412A is properly connected to an ac power source and that the source is active.
2. Verify that the input connections are properly made. Refer to Figure 1.
3. Verify that the output connections are properly made. Refer to Figure 2.
4. Check the input and output cables for proper wiring and continuity.
5. Check the signal source and the load.

Check that the EQ-ON switch is in the ON position.



**6 SPECIFICATIONS (Both Channels)**

**Filter Type:** Variable Q Active filter set.

**Number of Bands:** 15 bands at ISO center frequencies: 25 Hz, 40 Hz, 63 Hz, 100 Hz, 160 Hz, 250 Hz, 400 Hz, 630 Hz, 1 kHz, 1.6 kHz, 2.5 kHz, 4 kHz, 6.3 kHz, 10 kHz, 16 kHz

**Input:**

(Ref. 0dBu = 0.775Vrms)

Type: Electronically balanced

Impedance: 44K  $\Omega$  balanced  
22K  $\Omega$  unbalanced

Normal level: 0dBu(0.775Vrms)

Maximum level: +20dBu(7.75Vrms)

**Output:**

(Ref. 0dBu = 0.775Vrms)

Type: Electronically balanced

Impedance: 120  $\Omega$  balanced  
60  $\Omega$  unbalanced

Maximum level: 20dBu

**Load Impedance:** 600 ohms or higher

**Peak Indicator:** Red LED  
+14dBu(6dB before clipping)

**Frequency Response:**

(Ref. 1 kHz = 0dBu) Across 600  $\Omega$   
20 Hz-20 kHz  $\pm 1$ dB

**Operating Gain:** 0dB

**Available Gain:**  $\pm 6$ dB or  $\pm 12$ dB

**High-Pass Filter:** Switch selectable with Cutoff below 43 Hz and a slope of 18dB per octave.

**THD:** <0.01% from 20 kHz to 20 kHz, all bands at 0 dB

**Noise:** <-85 dBu, 20 Hz - 20 kHz

- Controls:**
- 15 center detent slide controls at 2/3 octave center frequencies from 25 Hz to 16 kHz, with selectable  $\pm 6$ dB or  $\pm 12$ dB boost/cut.
  - LEVEL control with center detent
  - LO-CUT select switch
  - RANGE  $\pm 6$ dB or  $\pm 12$ dB select switch
  - EQ-ON Equalizer ON select switch
  - AC Power switch
  - Ground-Lift-Switch

**Connectors:**

Input: Terminal Strip (balanced)

Output: Terminal Strip (balanced)

**AC Power:** 115, 230 Vac 50/60Hz 19 Watts

**Operating Temperature**

**Range:** Up to 50°C (122°F)

**Dimensions:** 44 mm (1.73 in.) high;  
483 mm (19.0 in.) wide;  
235 mm (9.24 in.) deep

**Net Weight:** 2.7 kg (6.0 lbs)

**Enclosure:**

Rack Mount Chassis (1 3/4 inch rack space)

**Accessories (Included):**

- Power cord
- One pkg. of mounting screws
- One pkg. of rubber feet
- One decal and fuse for 230 Vac line operation
- One 1412A Installation and Operating Instructions

*Altec Lansing continually strives to improve its products and their specifications. Therefore, all specifications are subject to change without notice.*



1412A

STEREO

15 BAND 2/3 OCTAVE EQUALIZER

## SERVICE INSTRUCTIONS

### \*\*\*CAUTION\*\*\*

**No user serviceable parts inside. Hazardous voltage and currents may be encountered within the chassis. The service information contained within this document is for use only by ALTEC LANSING'S authorized warranty stations and qualified service personnel. To avoid electric shock, DO NOT perform any servicing other than that contained in the Operating Instructions unless you are qualified to do so. Refer all servicing to qualified service personnel.**

## **7 SERVICE INFORMATION**

**CAUTION:** *No user serviceable parts inside. Hazardous voltages and currents may be encountered within the chassis. The service information contained within this document is for use only by ALTEC LANSING authorized warranty stations and qualified service personnel. To avoid electric shock **DO NOT** perform any servicing other than that contained in the Operating Instructions unless you are qualified to do so. Otherwise, refer all servicing to qualified service personnel.*

**NOTE:** *Modifications to ALTEC LANSING products are not recommended. Such modifications shall be at the sole expense of the person(s) or company responsible, and any damage resulting therefrom shall not be covered under warranty or otherwise.*

### **7.1 Parts Ordering**

To order replacement parts, look up the ordering number from the parts list and write or call:

ALTEC LANSING Parts Sales  
P.O. Box 26105  
Oklahoma City, OK 73126-0105  
U.S.A.  
Phone: (405) 324-5311  
FAX: (405) 324-8981

### **7.2 Factory Service**

If factory service is required, ship the unit prepaid to:

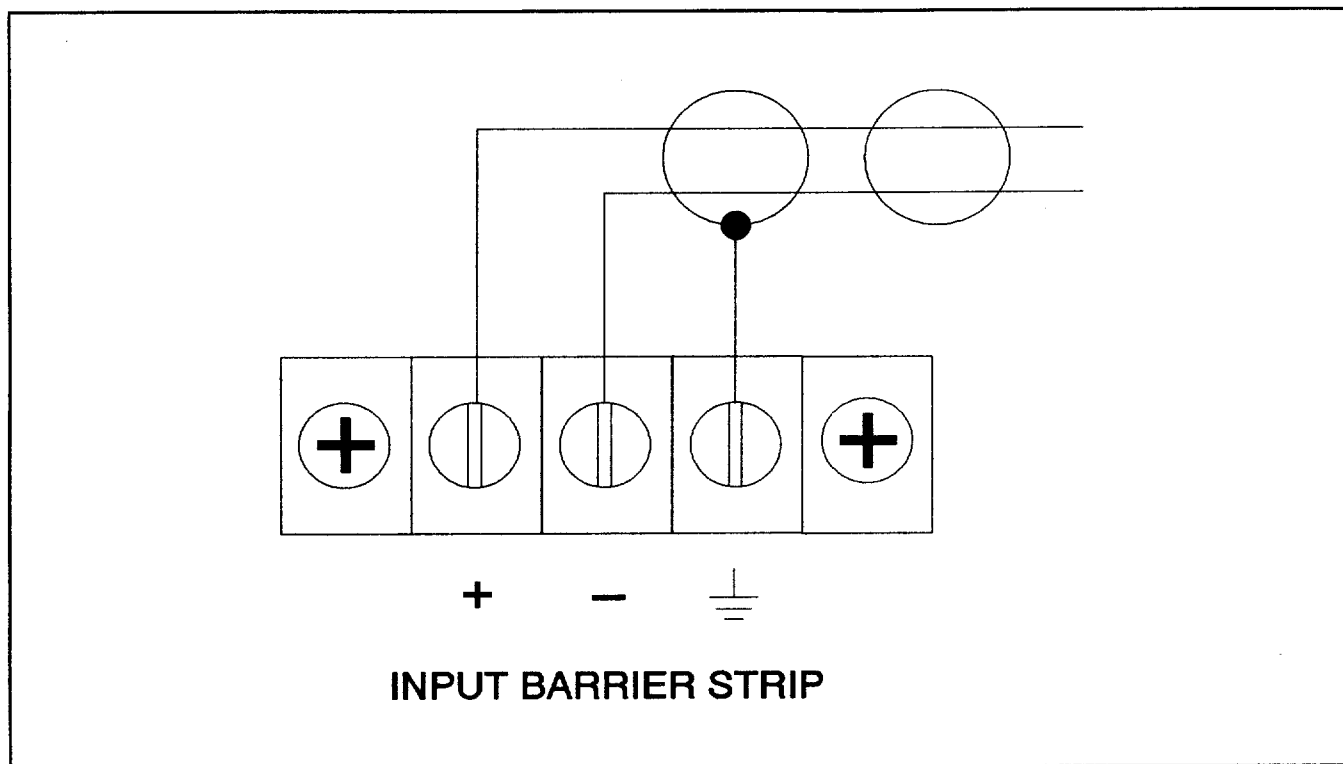
ALTEC LANSING Customer  
Service/Repair  
10500 W. Reno  
Oklahoma City, OK 73128 U.S.A.

Enclose a note describing the problem in as much detail as possible. Include other helpful information such as test conditions, where used, how used, etc.

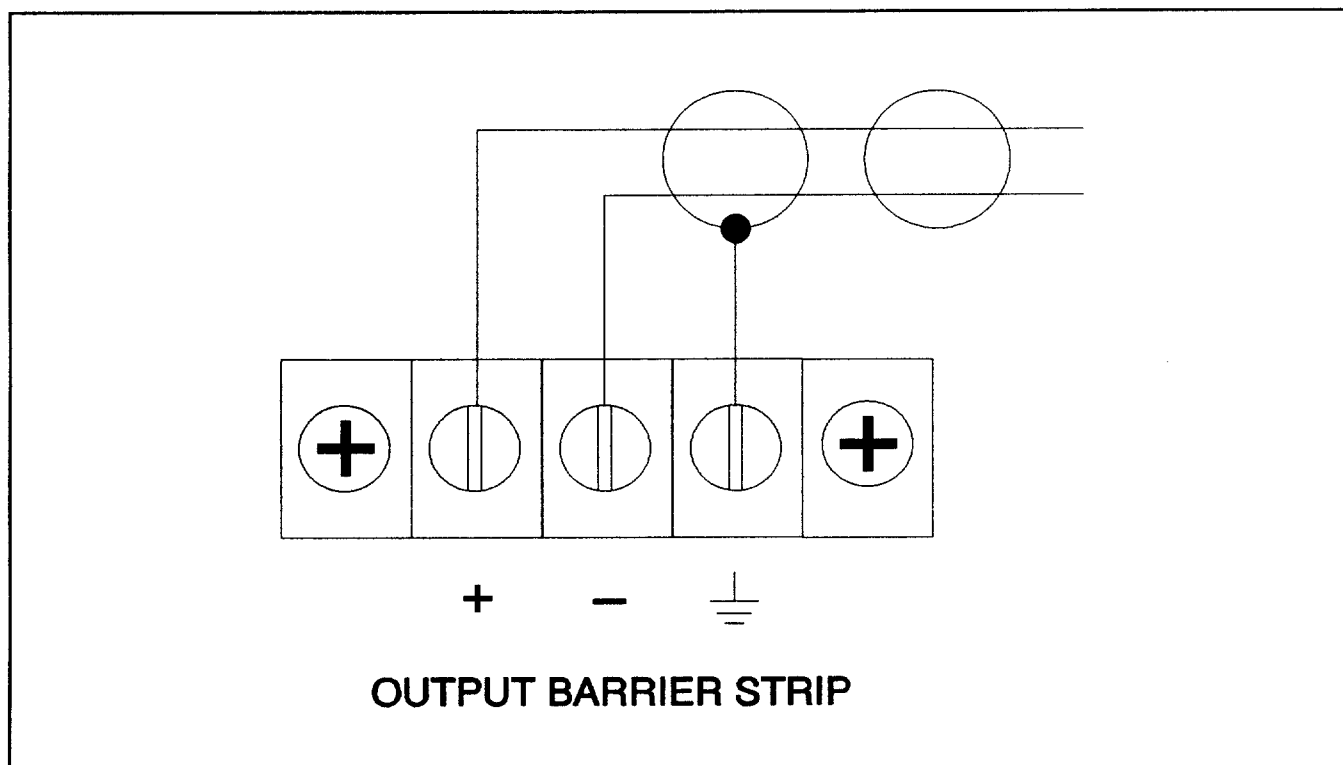
## **7.3 Technical Assistance**

For applications assistance/technical information, write or call:

ALTEC LANSING Technical  
Assistance  
P.O. Box 26105  
Oklahoma City, OK 73126-0105  
U.S.A.  
Phone: (405) 324-5311  
FAX: (405) 324-8981

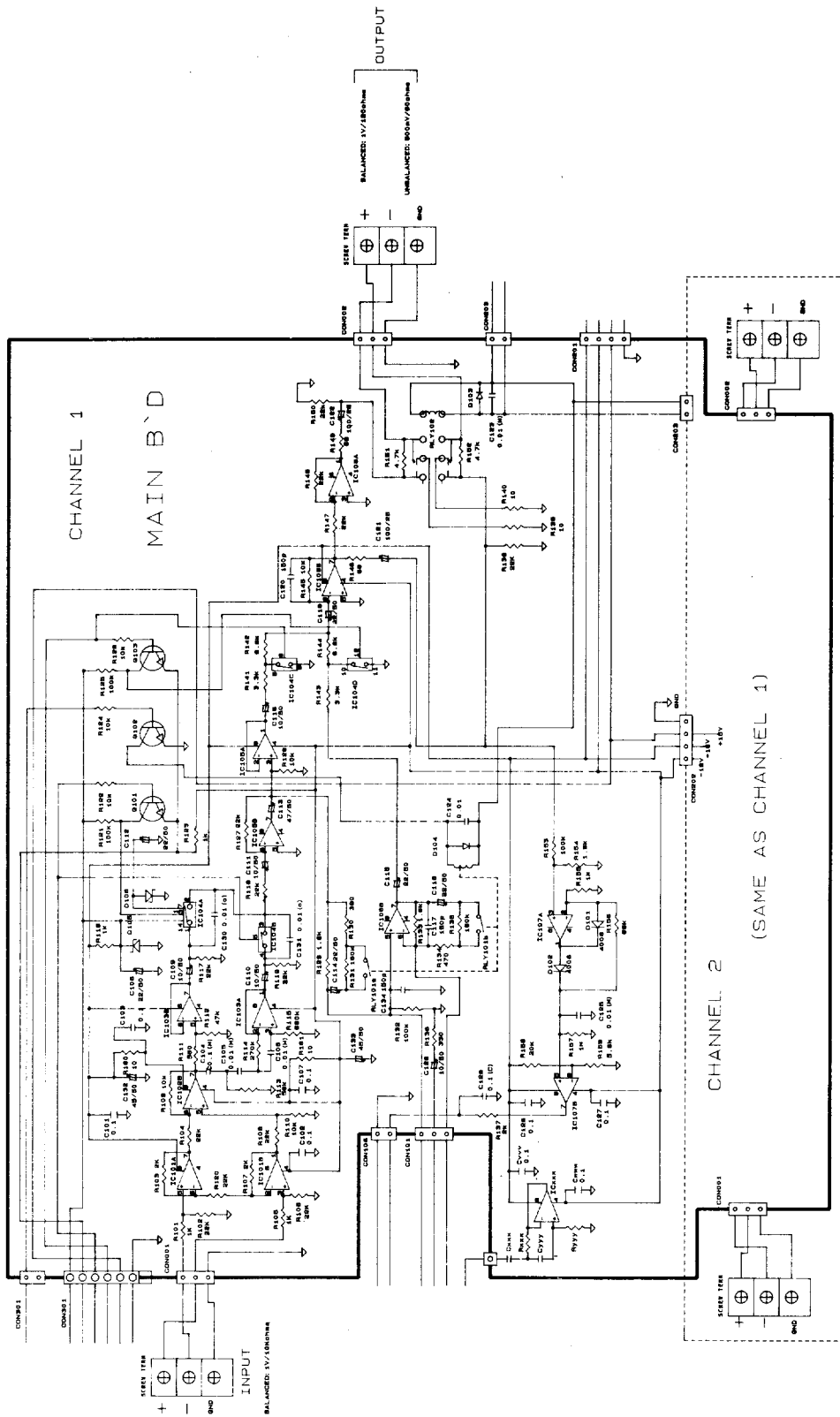


**Figure 1** Input Connections

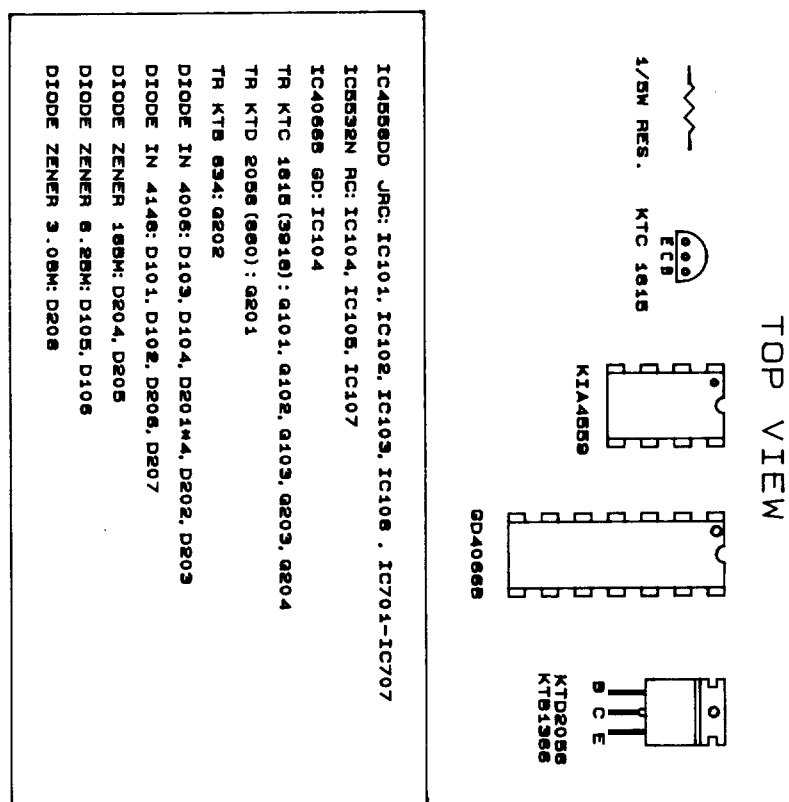
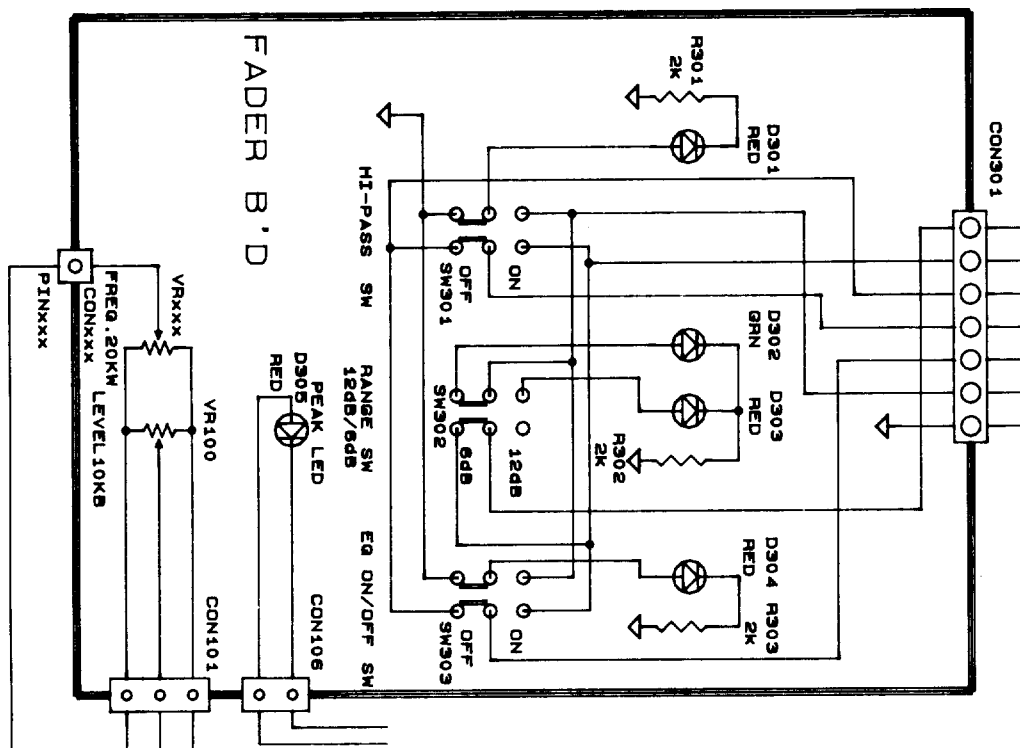


**Figure 2** Output Connections

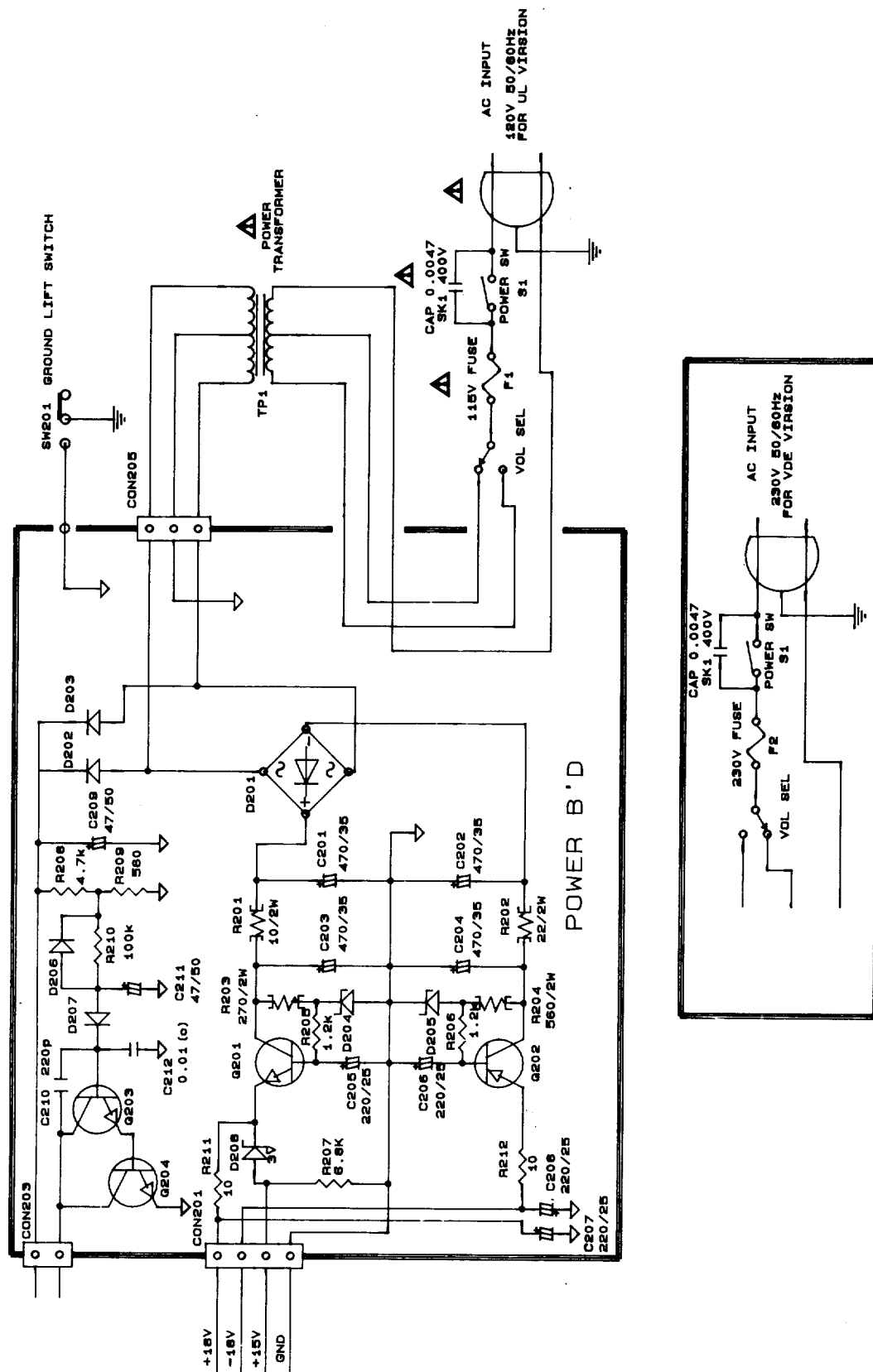
## Installation and Operating Instructions for the 1412A Stereo 15 Band 2/3 Octave Equalizer



**Schematic of 1412A (11D957) Sheet 1 of 4**



Schematic of 1412A (11D957) Sheet 2 of 4



Schematic of 1412A (11D957) Sheet 3 of 4

Freq.	VRxxx	ICxxx	Cxxx	Cyyy	CVVV	CMMM	Rxxx	Ryy	CONxxx: PINxxx
1K	VR109	IC705B	C701: 0.068u	C702: 0.01u	C733: 0.1u	C734: 0.1u	R701: 205	R702: 143K	CON102, 109
1.6K	VR110	IC705A	C703: 0.039u	C704: 0.0056u			R703: 205	R704: 176K	CON102, 109
2.5K	VR111	IC706A	C705: 0.033u	C706: 0.0047u			R705: 249	R706: 105K	CON102, 109
4K	VR112	IC706B	C707: 0.027u	C708: 0.0027u	C731: 0.1u	C732: 0.1u	R707: 261	R708: 62K	CON102, 109
6.3K	VR113	IC102A	C709: 0.012u	C710: 0.0022u			R709: 205	R710: 118K	CON102, 109
10K	VR114	IC707B	C711: 0.0062u	C712: 0.001u			R711: 261	R712: 118K	CON102, 109
16K	VR115	IC707A	C713: 0.0047u	C714: 0.001u			R713: 196	R714: 102K	CON102, 109

Parts Value for Active Inductor (Channel 1)

Freq.	VRxxx	ICxxx	Cxxx	Cyyy	CVVV	CMMM	Rxxx	Ryy	CONxxx: PINxxx
25Hz	VR101	IC701A	C728: 2.2u	C730: 0.68u			R728: 226	R730: 120K	CON104, 105
40Hz	VR102	IC701B	C727: 1.5u	C729: 0.33u			R727: 274	R729: 115K	CON104, 105
63Hz	VR103	IC702B	C725: 1u	C726: 0.15u			R725: 294	R726: 143K	CON104, 105
100Hz	VR104	IC702A	C723: 0.68u	C724: 0.1u			R723: 294	R724: 127K	CON104, 105
160Hz	VR105	IC703A	C721: 0.47u	C722: 0.066u			R721: 294	R722: 102K	CON104, 105
250Hz	VR106	IC702B	C718: 0.33u	C720: 0.047u			R718: 250	R720: 105K	CON104, 105
400Hz	VR107	IC704B	C717: 0.15u	C719: 0.033u			R717: 255	R719: 105K	CON104, 105
630Hz	VR108	IC704A	C715: 0.1u	C716: 0.022u			R715: 249	R716: 120K	CON104, 105



## Component Parts Listing for the 1412A

Reference Designator	Ordering Number	Name and Description
C101, 102, 103, 107, 126, 127, 129	15-02-037884	Capacitor, .1 $\mu$ F, +80-20%, 50V, Axial Ceramic
C104, 715, 724	15-06-037885	Capacitor, .1 $\mu$ F, 5%, 50V, Mylar
C105, 106, 123, 124, 125, C702	15-06-037208I	Capacitor, .01 $\mu$ F, 5%, 100V, Mylar
C108, 112, 114, 115, 116, 119	15-01-037886	Capacitor, 22 $\mu$ F, 50V Elect.
C109, 110, 111, 118, 128	15-01-037222	Capacitor, 10 $\mu$ F, 50V Elect.
C113, 132, 133	15-01-026641	Capacitor, 47 $\mu$ F, 50V
C117, 120, 134	15-02-037887	Capacitor, 150 PF, 10%, 50V, Axial Ceramic
C121, 122	15-01-038331	Capacitor, 100 $\mu$ F, 25V Elect.
C130, 131, 212	15-02-038072	Capacitor, .01 $\mu$ F, +80-20%, 25V, Axial Ceramic
C701, 722	15-06-037895	Capacitor, .068 $\mu$ F, 5%, 100V, Mylar
C703	15-06-038350	Capacitor, .039 $\mu$ F, 5%, 100V, Mylar
C704	15-06-037194	Capacitor, .0056 $\mu$ F, 5%, 100V, Mylar (MINI)
C705, 718	15-06-037898	Capacitor, .033 $\mu$ F, 5%, 100V, Mylar
C706, 713	15-06-037902	Capacitor, .0047 $\mu$ F, 5%, 100V, Mylar
C707	15-06-038351	Capacitor, .027 $\mu$ F, 5%, 100V, Mylar
C708	15-06-037906	Capacitor, .0027 $\mu$ F, 5%, 100V, Mylar
C709	15-06-037209	Capacitor, .012 $\mu$ F, 5%, 100V, Mylar
C710	15-06-037192	Capacitor, .0022 $\mu$ F, 5%, 100V, Mylar
C711	15-06-037904	Capacitor, .0082 $\mu$ F, 5%, 100V, Mylar (MINI)
C712, 714	15-06-037907	Capacitor, .001 $\mu$ F, 5%, 100v, Mylar (MINI)
C716	15-06-037211	Capacitor, .022 $\mu$ F, 5%, 100V, Mylar
C717	15-06-037897	Capacitor, .18 $\mu$ F, 5%, 50V, Mylar
C719, 728	15-06-037891	Capacitor, .33 $\mu$ F, 5%, 50V, Mylar
C720	15-06-037896	Capacitor, .047 $\mu$ F, 5%, 100V, Mylar (MINI)
C721	15-06-037889	Capacitor, .47 $\mu$ F, 5%, 50V, Mylar
C723, 730	15-06-037901	Capacitor, .68 $\mu$ F, 5%, 50V, Mylar
C725	15-06-037892	Capacitor, 1 $\mu$ F, 5%, 50V, Mylar
C726	15-06-037894	Capacitor, .15 $\mu$ F, 5%, 50V, Mylar
C727	15-01-037890	Capacitor, 1.5 $\mu$ F, 50v Elect.
C729	15-01-037888	Capacitor, 2.2 $\mu$ F, 50V Elect.
C201, 202, 203, 204	15-01-037909	Capacitor, 470 $\mu$ F, 35V Elect.
C205, 206, 207, 208	15-01-037910	Capacitor, 220 $\mu$ F, 25V Elect.
C209, 211	15-01-037144	Capacitor, 47 $\mu$ F, 50V Elect.
C210	15-02-037911	Capacitor, 220 PF, 10%, 50V, Axial Ceramic
D101, 102, 206, 207	48-01-122601	Diode, 1N4148
D103, 104, 201-1, 201-2, 201-3, 201-4	48-01-027300	Diode, 1N4006
D105, 106	48-01-037912	Diode Zener, 8.2V, 5%, .5W
D204, 205	48-01-113386	Diode Zener, 18V, 5%, .5W
D208	48-01-037913	Diode Zener, 3.3V, 5%, .5W
D301, 303, 304, 305	39-01-037914	LED, Red, KLR124
D302	39-01-037915	LED, Green, EL 204GD
Q101, 102, 103, 203, 204	48-03-026624	Transistor, NPN, KTC 1815Y
Q201	48-03-037916	Transistor, NPN, KTD 2058Y
Q202	48-03-037917	Transistor, PNP, 834Y

Reference Designator	Ordering Number	Name and Description
R101, 105, 116, 123, 155,	47-01-037121I	Resistor, 1 k $\Omega$ , $\pm 5\%$ , 1/5 W, C.F.
R102, 104, 106, 108, 117,	47-01-037919	Resistor, 22 k $\Omega$ , $\pm 5\%$ , 1/5 W, C.F.
118, 119, 120, 127, 138,		
147, 148, 150		
R103, 107, 137, 301, 302,	47-01-037920	Resistor, 2 k $\Omega$ , $\pm 5\%$ , 1/5 W, C.F.
303		
R109, 110, 122, 124, 126,	47-01-037169I	Resistor, 10 k $\Omega$ , $\pm 5\%$ , 1/5 W, C.F.
128, 145		
R111, 209	47-01-037423	Resistor, 560 $\Omega$ , $\pm 5\%$ , 1/5 W, C.F.
R112	47-01-037258	Resistor, 47 k $\Omega$ , $\pm 5\%$ , 1/5 W, C.F.
R113	47-01-037175	Resistor, 56 k $\Omega$ , $\pm 5\%$ , 1/5 W, C.F.
R114	47-01-037921	Resistor, 270 k $\Omega$ , $\pm 5\%$ , 1/5 W, C.F.
R115	47-01-037365	Resistor, 680 k $\Omega$ , $\pm 5\%$ , 1/5 W, C.F.
R121, 125, 132, 153, 210	47-01-037126	Resistor, 100 k $\Omega$ , $\pm 5\%$ , 1/5 W, C.F.
R129, 133, 154	47-01-037923	Resistor, 1.8 k $\Omega$ , $\pm 5\%$ , 1/5 W, C.F.
R130	47-01-037280I	Resistor, 390 $\Omega$ , $\pm 5\%$ , 1/5 W, C.F.
R131, 135	47-01-037127I	Resistor, 180 k $\Omega$ , $\pm 5\%$ , 1/5 W, C.F.
R134	47-01-037210	Resistor, 470 $\Omega$ , $\pm 5\%$ , 1/5 W, C.F.
R136	47-01-037159	Resistor, 330 $\Omega$ , $\pm 5\%$ , 1/5 W, C.F.
R139, 140, 160, 161, 211,	47-01-102030	Resistor, 10 $\Omega$ , $\pm 5\%$ , 1/5 W, C.F.
212		
R141, 143	47-01-037254	Resistor, 3.3 k $\Omega$ , $\pm 5\%$ , 1/5 W, C.F.
R142, 144, 207	47-01-037922	Resistor, 6.8 k $\Omega$ , $\pm 5\%$ , 1/5 W, C.F.
R146, 149	47-01-037422	Resistor, 68 $\Omega$ , $\pm 5\%$ , 1/5 W, C.F.
R151, 152, 208	47-01-037166	Resistor, 4.7 k $\Omega$ , $\pm 5\%$ , 1/5 W, C.F.
R156	47-01-037259	Resistor, 68 k $\Omega$ , $\pm 5\%$ , 1/5 W, C.F.
R157	47-01-108491	Resistor, 1 M $\Omega$ , $\pm 5\%$ , 1/5 W, C.F.
R158	47-01-037172	Resistor, 20 k $\Omega$ , $\pm 5\%$ , 1/5 W, C.F.
R159	47-01-037255	Resistor, 5.6 k $\Omega$ , $\pm 5\%$ , 1/5 W, C.F.
R701, 703, 717	47-03-038337	Resistor, 255 $\Omega$ , $\pm 1\%$ , 1/5 W, C.F.
R702, 726	47-03-037933	Resistor, 143 k $\Omega$ , $\pm 1\%$ , 1/5 W, C.F.
R704	47-03-037935	Resistor, 178 k $\Omega$ , $\pm 1\%$ , 1/5 W, C.F.
R705	47-03-038336	Resistor, 249 $\Omega$ , $\pm 1\%$ , 1/5 W, C.F.
R706, 718, 720	47-03-037198	Resistor, 105 k $\Omega$ , $\pm 1\%$ , 1/5 W, C.F.
R707, 711	47-03-037976	Resistor, 261 $\Omega$ , $\pm 1\%$ , 1/5 W, C.F.
R708	47-03-037941	Resistor, 82 k $\Omega$ , $\pm 1\%$ , 1/5 W, C.F.
R709	47-03-038332	Resistor, 205 $\Omega$ , $\pm 1\%$ , 1/5 W, C.F.
R710, 712	47-03-038352	Resistor, 118 k $\Omega$ , $\pm 1\%$ , 1/5 W, C.F.
R713	47-03-038346	Resistor, 196 $\Omega$ , $\pm 1\%$ , 1/5 W, C.F.
R714, 722	47-03-123017	Resistor, 102 k $\Omega$ , $\pm 1\%$ , 1/5 W, C.F.
R715	47-03-038335	Resistor, 243 $\Omega$ , $\pm 1\%$ , 1/5 W, C.F.
R716, 730	47-03-037938	Resistor, 120 k $\Omega$ , $\pm 1\%$ , 1/5 W, C.F.
R719	47-03-037939	Resistor, 250 $\Omega$ , $\pm 1\%$ , 1/5 W, C.F.
R721, 723, 725	47-03-037932	Resistor, 294 $\Omega$ , $\pm 1\%$ , 1/5 W, C.F.
R724	47-03-037940	Resistor, 127 k $\Omega$ , $\pm 1\%$ , 1/5 W, C.F.
R727	47-03-037929	Resistor, 274 $\Omega$ , $\pm 1\%$ , 1/5 W, C.F.
R728	47-03-037930	Resistor, 115 k $\Omega$ , $\pm 1\%$ , 1/5 W, C.F.
R729	47-03-038345	Resistor, 226 $\Omega$ , $\pm 1\%$ , 1/5 W, C.F.
R201	47-01-037949	Resistor, 10 $\Omega$ , $\pm 5\%$ , 2 W, M.O.

Reference Designator	Ordering Number	Name and Description
R202	47-01-037950	Resistor, 22 $\Omega$ , $\pm 5\%$ , 2 W, M.O.
R203	47-01-037951	Resistor, 270 $\Omega$ , $\pm 5\%$ , 2 W, M.O.
R204	47-01-037413	Resistor, 560 $\Omega$ , $\pm 5\%$ , 2 W, M.O.
R205, 206	47-01-037371	Resistor, 1.2 k $\Omega$ , $\pm 5\%$ , 1/5 W, C.F.
RLY101, 102	45-01-037394	Relay, RY24W
SK1	15-02-037953	Capacitor, .0047 $\mu$ F, 400V (Spark Killer)
SW1	51-02-037954	Switch, Power
SW201	51-02-037955	Switch, Slide, S.P.D.T.
SW301, 302, 303	51-02-037956	Switch, Push, 122SC
TP1	56-08-037957	Transformer, Power
VR100-VR115	47-06-037958	Potentiometer, Slider, 20 k $\Omega$ , RS2011106-20KW
F1	51-04-038357	Fuse, 0.315A/250V NB, 20 MM, UL/CSA
F2	51-04-038356	Fuse, 0.16A/250V NB, 20 MM, UL/CSA
AI1	21-02-037961	Receptacle, AC Power
AC1	60-06-124962	Cable, Power, 18GA 3 Cond. 120V
ST1, ST2	21-04-038306	Strip, Barrier, 3 Terminal
IC101, 102, 103, 107, 701-706	17-01-038348	Circuit, Integrated, 4558DD
IC105, 106, 108	17-01-038349	Circuit, Integrated, 5532N
IC104	17-01-038347	Circuit, Integrated, 4066B
	24-03-038353	Knob, (used on slider pots)
	24-03-038354	Knob, (used on SW301, 302, 303)
	24-03-038355	Knob, (used on SW1)