

# ALTEC®

## 1608A MIXER/POWER AMPLIFIER

### OPERATING INSTRUCTIONS



### OPERATION

#### CONTROLS AND INDICATORS

All normal operating controls are on the front panel. Installation and service adjustments include an Acousta-Voicing pad at rear of chassis, a tone control in-out switch on the preamplifier board and a power driver balance control on the power driver board. Control and indicator functions are described in Table II.

#### WRITE-IN BLOCKS

The write-in blocks above the six gain controls may be marked with a *soft* lead pencil to identify use. To remove writing, use a damp cloth — never use a pencil eraser or other abrasive material because the writing surfaces will become unusable.

#### NORMAL GAIN SETTINGS

For average input signals, the MASTER gain control should be set to approximately 14 dB. This allows maximum flexibility in setting individual mixer gain controls (MIX 1, MIX 2, MIX 3, MIX 4 and MIX 5) to the desired operating level for respective input channels. If one input is unusually low, it may be necessary to increase the MASTER gain control setting and operate the other inputs at a proportionately lower gain setting. A recommended procedure is to divide the losses equally between the MASTER and MIX gain controls.

#### VU METER ACCESSORY

The 1608A output may be indicated in VU with the VU meter accessory. The range of the meter is selected with the VU METER switch. The VU meter accessory is operated by switching the VU METER switch from OFF to the desired range; +40 VU, +43 VU, +46 VU, or +49 VU.

The upper scale of the VU meter is calibrated in VU from -20 VU to +3 VU. A value in VU of the 1608A output is obtained by adding the range setting to the meter indication. Example: An indication of -2 VU on the meter with a range setting of +46 VU means the 1608A output is +44 VU.

The VU meter gives direct indication of sine wave output. A value of +46 VU indicates an output of 40 watts and a value of +52 VU indicates an output of 160 watts.

VU meter indications are approximately 10 dB below peak output of voice and music program material because the meter cannot follow such rapidly changing signal peaks. Thus, for an indication of +43 VU, the output may be assumed to have peaks of 200 watts.

The relationship between indicated VU and output power in watts (with normal settings of MIX and MASTER gain controls) is shown in Table I. Approximate output of the 1608A can therefore be set in accordance with the listed values.

#### COMPRESSOR ACCESSORY

Excessively high input-signal peaks may be controlled with the compressor accessory. The compression threshold to which the signal must rise before compression begins is selected with the COMPRESSION THRESHOLD switch. The Compressor accessory is operated by switching the COMPRESSION THRESHOLD switch from OFF to the desired threshold; +40 VU, +43 VU, +46 VU or +49 VU.

A family of amplifier performance curves is presented in Figure 1 for the different compressions. With no compression (switch in OFF position), amplifier performance follows the "0 dB COMPRESSION" curve. Performance of the 1608A

Table I. Wattage Outputs for VU Values\*

| VU Values<br>Meter<br>Indication<br>Plus Range<br>Settings) | Average<br>Output | Peak Level<br>Output for<br>Voice & Music<br>Program<br>Material |
|---|-------------------|--|
| +40 VU  | 10W               | 100W   |
| +43 VU  | 20W               | 200W**   |
| +46 VU  | 40W               | 400W**   |
| +49 VU  | 80W               | 800W**   |
| +52 VU  | 160W              | 1600W**  |

\*Additional values within those listed may be found by linear interpolation.

\*\*Amplifier overload indicator may be expected to illuminate. Optimum area of operation for typical program material is 41-42 VU.

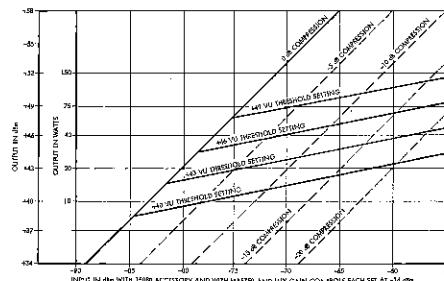


Figure 1. Compression Characteristics of 14678A Compressor Assembly

Specifications and components subject to change without notice. Overall performance will be maintained or improved.

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**ALTEC®**  
SOUND PRODUCTS DIVISION

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for any compression follows the "0 dB COMPRESSION" curve to the intersection of the selected COMPRESSION THRESHOLD curve and then follows the reduced slope of that curve. Reduction in output is a ratio of five to one.

Dashed COMPRESSION lines are shown in 5 dB increments. The intersection of these COMPRESSION lines with the COMPRESSION THRESHOLD curves shows input/output values for input levels reduced by 5, 10, 15 or 20 dB.

Table II. Control and Indicator Functions

| Name   | Function/Description  |
|--|---|
| POWER Switch (S8)                                      | Applies primary power. Two-position switch for on-off modes.  |
| PRESS TO RESET Pushbutton (CB1)                        | Restores operation if circuit breaker CB1 opens. If CB1 opens repeatedly, find and correct the cause before resetting.  |
| MIX 1-5 Controls (R12-R16)                             | Continuously variable potentiometers, graduated from 0 dB to $\infty$ . Each provides attenuation for corresponding input channel. Rotate cw to increase gain. (The MIX 1 gain control is also used for adjusting test tone level.)   |
| LOW-HI GAIN Switches (S1-S5)                           | For use with 1588C Microphone Preamplifier accessory. Reduces gain on corresponding input channel at LOW, to allow use of high-output microphones without introducing distortion. Place switch to HI for other applications, such as use of 15095A or 15356A Transformer. Turn associated MIX control ccw to $\infty$ , before switching, to avoid system "pops". |
| MASTER CONTROL (R22)                                   | Continuously variable potentiometer, graduated from 0 dB to $\infty$ . Provides simultaneous attenuation for all input channels. Rotate cw to increase gain.  |
| NORMAL-BRIGHT Switch (S7)                              | Raises response in the 3-5 kHz range, when in the BRIGHT position, to improve articulation.   |
| LF Control (R23)                                       | Continuously variable potentiometer. Provides boost or attenuation in bass response. Normal or flat response is obtained at zero setting. Rotate cw to boost response.  |
| HF Control (R25)                                       | Continuously variable potentiometer. Provides boost or attenuation in treble response. Normal or flat response is obtained at zero setting. Rotate cw to boost response.  |
| Tone Control IN-OUT Switch (S1 on Pre-amplifier PCB)   | Two-position switch for installation use only. OUT position disconnects LF and HF tone controls when tone control is inappropriate for application, such as Acousta-Voicing.  |
| MON VOL Control (R26) and MONITOR Jack (J17)           | MON VOL control is a continuously variable potentiometer to adjust monitor output level from MONITOR jack. Maximum output is +18 dBm. Rotate cw to increase level. MONITOR jack accepts standard phone plug. Headphones with 600-ohm impedance are recommended but any high-impedance headphones provide satisfactory operation.                                  |
| TEST TONE Switch (S6)                                  | Two-position switch for on-off modes. When ON, provides 1000 Hz tone to aid in setting system levels, adjusting compressor thresholds and checking multiple speaker arrangements. The test tone level is adjusted with the MIX 1 gain control.  |
| ACOUSTA-VOICING Pad Control (R32)                      | Continuously variable potentiometer (see Figure 3). Factory adjusted. Setting should not be changed. Readjustment may be required with passive Acousta-Voicing equalizers. See SERVICE information for readjustment procedure.  |
| Power Driver Balance Control (R23 on Power Driver PCB) | Continuously variable potentiometer. Factory adjusted. Setting should not be changed. Balances output of transistors Q6 and Q7 on Power Driver PCB. See SERVICE information for readjustment procedure.   |
| VU Meter (optional accessory)                          | Displays output in VU. Meter is illuminated when power is ON.   |
| VU METER Switch  | Part of optional VU meter accessory. Selects full-scale range of VU meter. Selectable positions are +40 VU, +43 VU, +46 VU, +49 VU and OFF.   |
| COMPRESSION THRESHOLD Switch                           | Part of optional COMPRESSOR accessory. Selects threshold limit to which signal must rise before compression begins. Selectable positions are +40 VU, +43 VU, +46VU, +49 VU and OFF.   |
| COMPRESSION THRESHOLD Adjustment                       | Continuously variable potentiometer. On rear side of optional COMPRESSOR accessory. Factory adjusted. Setting should not be changed. Sets compression threshold limit for calibration of COMPRESSION threshold switch setting. See SERVICE information for readjustment procedure.  |

## INSTALLATION

### MECHANICAL

The 1608A may be mounted in a standard 19-inch equipment rack or it may be shelf-mounted when supplied with an ALTEC 42625 Cover. 8 3/4 inches of vertical space is required for mounting the 1608A in an equipment rack.

### Rack Mounting

1. Remove four screws securing front panel, open and lower panel (see Figure 2).
2. Install 1608A in equipment rack with appropriate four screws supplied with unit.
3. Close front panel and secure with four screws previously removed.

### Shelf Mounting

The 1608A may be shelf mounted after installing the ALTEC 42625 Cover.

### VENTILATION

The 1608A generates minimal heat during normal use. Although the amount of heat is relatively low, the amplifier must be ventilated to prevent a temperature rise. Because transistors are heat sensitive, the 1608A should not be placed adjacent to heat-generating equipment or in areas where ambient temperature exceeds 50°C (122°F).

If the 1608A is mounted in an equipment rack or cabinet with other heat-producing equipment mounted above and/or below (two or more 1608A's or one 1608A with real time analyzer, oscilloscope, etc.), space must be provided between the units or the 1608A may become too warm. The 1 3/4" perforated panel (ALTEC Part No. 10399) is recommended for this purpose.

When several amplifiers or other heat-producing units are mounted in a single rack or cabinet, acceptable air temperature may be in doubt. To determine temperature conditions, operate the system until temperatures stabilize, then measure air temperature with a bulb-type thermometer held at the bottom of the uppermost amplifier. Do not let the thermometer bulb touch metal because the metal will probably be hotter than the ambient air. If air temperature exceeds 50°C, the equipment should be spaced further apart or a blower should be installed to ventilate the cabinet.

### CAUTION

Do not block the cover ventilation holes when placing other equipment on the 42625 Cover Accessory. When shelf-mounting the 1608A, allow at least 1 3/4" between the unit and any wall behind it to assure air circulation past the output transistors.

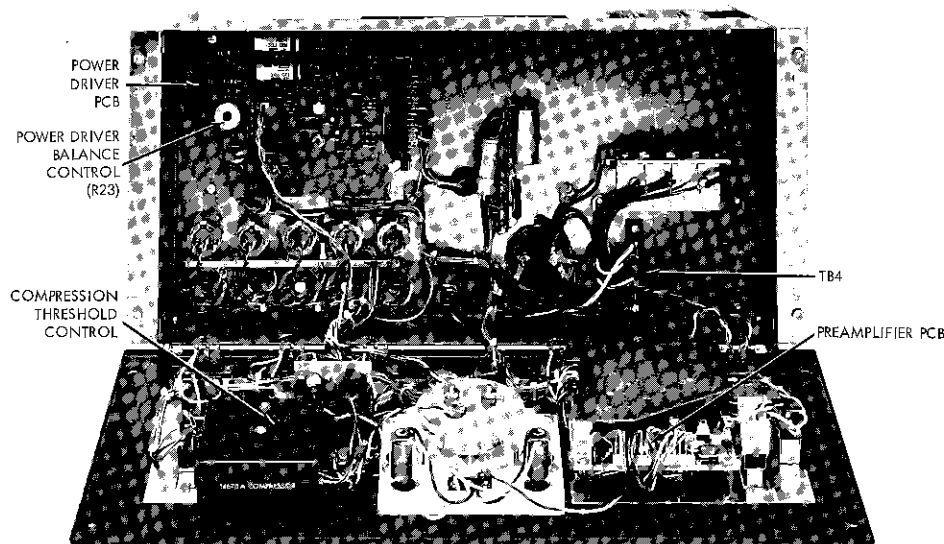


Figure 2. Front View 1608A with Hinged Front Panel Opened

## ELECTRICAL

### 120 Volt, 50/60 Hz Power Connections

Equipment supplied for domestic use is provided with the power transformer primary strapped for 120 volts (terminals 1 to 2 and 3 to 4 on TB4). The power input nameplate, adjacent to the power cord on the chassis, is mounted to show the appropriate side specifying the connections (see Figure 3). Verify that line voltage is in accordance with the voltage rating *before* connecting the 1608A to line power.

### 240 Volt, 50/60 Hz Power Connections

Export equipment, specified, is provided with the power transformer primary strapped for 240 volts (terminals 2 to 3 on TB4). The power input nameplate, adjacent to the power cord on the chassis, is mounted to show the appropriate side specifying the connections.

Use the following procedure to change factory wiring if the 1608A is to be powered from a 240-volt, 50/60 Hz line.

1. Remove four screws securing front panel, open and lower panel.
2. Locate terminal board TB4 beneath power transformer T1. (See Figure 5.)
3. Remove strap "A" connecting terminals 1 and 2, and remove strap "B" connecting terminals 3 and 4; then solder strap "C" to terminals 2 and 3 (see Figure 4).
4. Remove voltage-rating plate from chassis, reverse and reinstall to show 240V rating (see Figure 3).
5. Close front panel and secure with four screws previously removed.

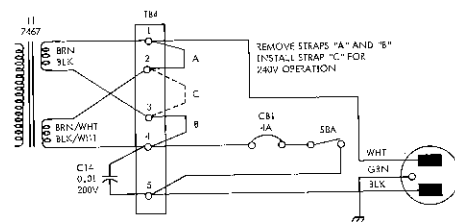


Figure 4. Converting to 240V, 50/60 Hz Power

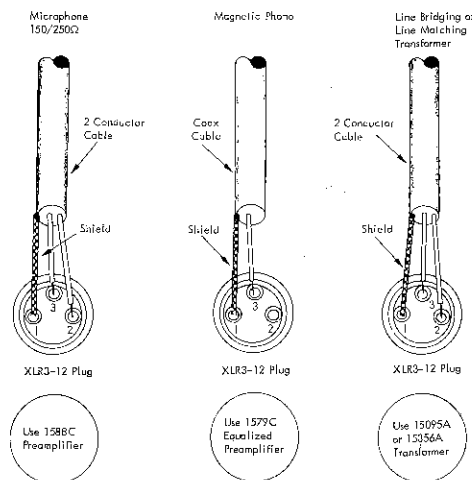


Figure 5. Input Cable Plug Wiring

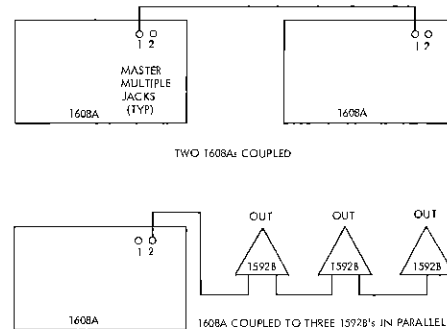


Figure 6. Multiple Coupling of Amplifiers

## Battery Connections

If desired, the 1608A may be connected to an external 24/28 volt battery with minus (-) as ground. Terminals for the dc power connections are on TB2 (see Figures 3 and 13). If ac power fails, transfer to dc power is instantaneous, automatic and silent. A built-in charging circuit supplies a 100 mA trickle current to maintain battery charge during ac operation. The battery power supply is not operated by the POWER switch on the front panel. If switching of battery power is desired, an external relay or switch should be provided by the user.

## Input Connections

Inputs to the mixer channels are connected on the chassis at connectors J1 through J5 (see Figures 3 and 13) with cables terminating in XLR3-12-type plugs. Appropriate internal wiring of the plugs is shown in Figure 5. Input for any channel may be microphone, magnetic phono or line. The corresponding plug-in input accessory must be used for each channel.

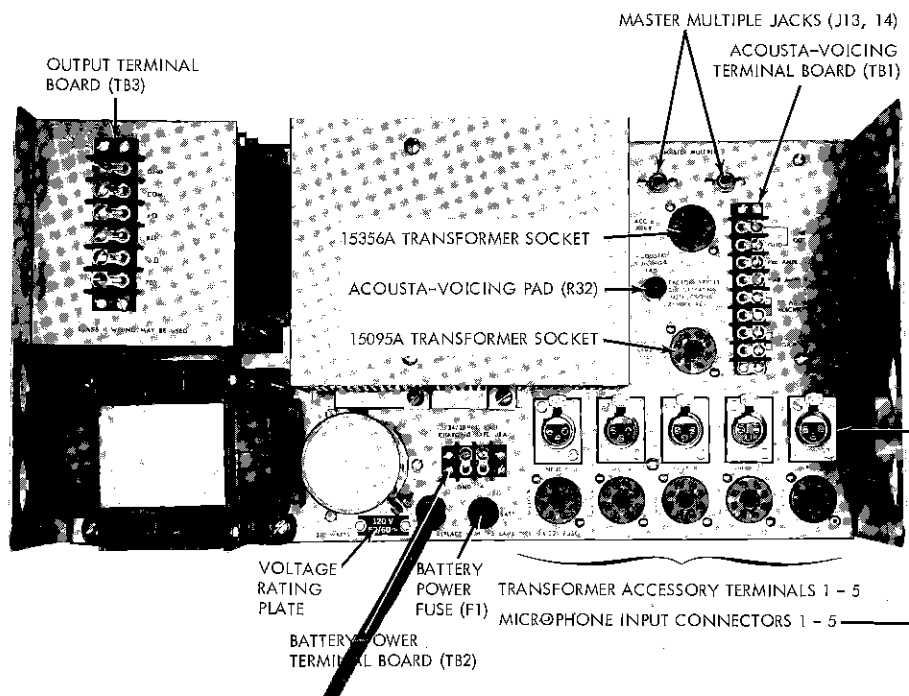


Figure 3. Rear View of 1608A

## Output Connections

Output transformer taps provide connections for 4-ohm, 8-ohm and 16-ohm speakers, plus 70.7-volt and 25-volt speaker distribution outlets. Class II wiring may be used. Connect to the terminal of desired impedance and terminal 5 (common). Terminal functions and designations are listed in Table III. If stray electrostatic radiation causes interference, strap terminal 5 (common) to terminal 6 (ground).

Table III. Speaker Outputs

| Terminal | Function  |
|----------|---|
| TB3-1    | 70.7V (32 ohms) speaker distribution system             |
| TB3-2    | 16-ohm speaker system                                   |
| TB3-3    | 8-ohm speaker system                                    |
| TB3-4    | 4-ohm speaker system or 25V speaker distribution system |
| TB3-5    | Common  |
| TB3-6    | Ground  |

### CAUTION

When using stranded wire, be sure no frayed wire strands short circuit one terminal to another.

## Monitor Output Connection

The MONITOR jack (J17) on the front panel (see cover photo and Figure 13) accepts a standard phone plug. Headphones with an impedance of 600 ohms are recommended for monitoring program material, but any high-impedance headphones are satisfactory. Maximum monitor output level is +18 dBm across a 600-ohm load.

## Line Output Connections

High-level devices, such as recorders and tape machines, may be connected to terminals 1 (LINE OUT) and 2 (GND) of TB1 on the chassis (see Figures 3 and 13.) This output may be connected to a telephone transmission line when suitable line-matching transformers are used on the line. Maximum line output is +18 dBm across a 600-ohm impedance.

## Master Multiple Connections

Two MASTER MULTIPLE jacks, independent of all gain controls, enable combining two or more 1608A amplifiers, or up to three additional 1592B amplifiers, in a single sound system. All inputs of such a system appear at the output of each amplifier; the output of each amplifier is then adjustable for a separate application. Typical combinations of amplifiers are shown in Figure 6. A single coaxial cable with phono plugs connects each amplifier. Either MASTER MULTIPLE jack (see Figure 3) may be used for interconnection.

## ACCESSORIES

### Plug-In Input Accessory Modules

The ALTEC plug-in input accessory modules are plugged into sockets ACC1 through ACC7 (J6 through J12) on the chassis (see Figures 3 and 13). Module selection is determined by channel application. Use care when installing the modules to prevent damage.

### Acousta-Voicing Equalizers

The 1608A may be used with passive Acousta-Voicing equalizers such as the ALTEC 9014A Narrowband Equalizing Set or the ALTEC 9018A Broadband Equalizing Set (or any combination of these units), or with the ALTEC 9860A Active Equalizer.

When Acousta-Voicing with passive equalizers, the equalizer connections should be made in accordance with Figure 7, using two-conductor shielded and twisted cable, such as Belden 8450 or 8451 cable. Connect shield to GND of TB1 and opposite end of shield to chassis ground of equalizer. An ALTEC 15356A Line Matching Transformer must be installed in socket ACC6 (J11) and an ALTEC 15095A Bridging Transformer must be installed in socket ACC7 (J12). These transformers provide proper impedance matching plus 11 dB additional gain to the system. This gain usually compensates for losses in the passive equalizing filters. If more gain is required, remove the cap from the Acousta-Voicing pad (see Figure 3) and rotate the control clockwise (cw) only enough to compensate for gain lost in the passive Acousta-Voicing equalizers. If it subsequently becomes necessary to readjust the pad, refer to SERVICE instructions.

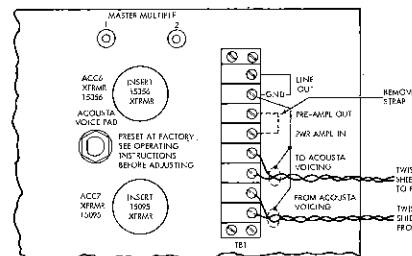


Figure 7. Connecting Passive Acousta-Voicing Equalizers

When Acousta-Voicing with the ALTEC 9860A Active Equalizer, connections should be made in accordance with Figure 8, using two-conductor shielded and twisted cable, such as Belden 8450 or 8451 cable. Connect shield to GND of TB1 and opposite end of shield to chassis ground of equalizer. Because matching transformers are provided in the 9860A, no plug-in accessory modules are required in sockets ACC6 and ACC7. The output terminals of the 9860A must be terminated with a 620-ohm, 1-watt resistor.

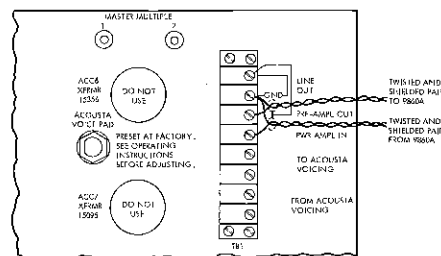


Figure 8. Connecting the 9860A Active Equalizer

### NOTE

When using the 9860A Active Equalizer, *do not* adjust the Acousta-Voicing pad on the 1608A. It has been preset at the factory for proper gain.

### ALTEC 14678A Compressor Assembly

1. Remove four screws securing front panel, open and lower panel.
2. Remove hole plug from COMPRESSION THRESHOLD switch-mounting hole on front panel, then discard plug.
3. Install accessory in hole from rear side of front panel, as shown in Figure 9, using mounting hardware supplied. The lockwasher should be adjacent to inward side of panel and flatwasher should be next to front surface of panel and secured with 3/8" I.D. hex nut. The mounting hole contains a key slot for properly locating assembly.

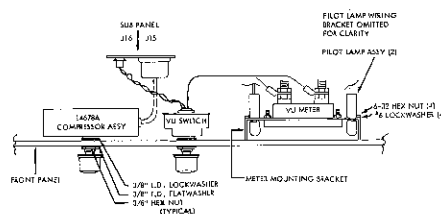


Figure 9. Installation of Compressor and VU Meter Assemblies

4. Install knob on switch shaft of assembly with set screw in knob aligned with flat side of shaft, then secure knob by tightening screw with a small slot-type screwdriver.
5. Insert 6-pin plug, attached to assembly, in socket J15. Be careful not to damage pins of plug or socket.
6. Close front panel and secure with four screws previously removed.

### ALTEC 42500 VU Meter Assembly

1. Remove four screws securing front panel, then open and lower panel.
2. Remove hole plug from VU meter switch-mounting hole on front panel, then discard plug.
3. Remove four No. 6 screws from meter-hole cover and remove four

No. 6 nuts and washers from bolts welded to inside of front panel. Remove meter mounting bracket assembly and meter-hole cover, then discard meter-hole cover.

4. Install VU meter in meter mounting bracket, as shown in Figure 9, and secure with four No. 6 washers and hex nuts supplied.
5. Install meter mounting bracket assembly (now containing VU meter) on inside of front panel as previously installed, using mounting hardware previously removed.
6. Install VU meter switch assembly in VU METER switch-mounting hole from rear side of front panel, as shown in Figure 9, using mounting hardware supplied. The lockwasher should be adjacent to inward side of front panel and flatwasher should be next to front surface of panel and secured with 3/8" I.D. hex nut. The mounting hole contains a keyslot for properly locating assembly.
7. Install knob on switch shaft of assembly with set screw in knob aligned with flat side of shaft, then secure knob by tightening screw with a small slot-type screwdriver.
8. Insert phono plug, on end of two wires from switch assembly, in J16 jack.
9. Two wires with lugs emerge from VU meter switch assembly. Connect lug on red wire positive (+) terminal of VU meter. Connect lug on other wire to negative (-) terminal of VU meter.
10. Close front panel and secure with four screws previously removed.

#### ALTEC 42625 Cover

1. Attach four polyethylene feet with 8-32 screws supplied (see Figure 10).

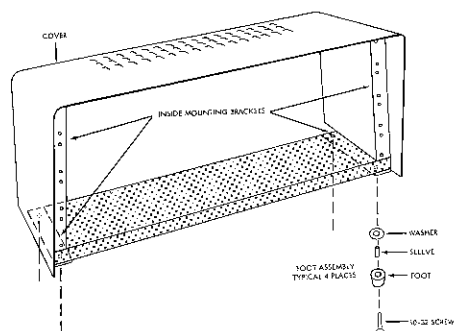


Figure 10. Installation of 42625 Cover Assembly

2. Set cover on rear edge with inside facing outward.
3. Slide 1608A into cover on top of inside cover-mounting brackets.
4. Remove four screws securing front panel, then open and lower panel.
5. Fasten 1608A to inside cover-mounting brackets with four 10-32 screws supplied.

6. Adjust position of 1608A within cover and tighten four 10-32 screws.

7. Close and secure front panel with four screws previously removed, then place covered 1608A on its feet.

#### SERVICE AND MAINTENANCE

This service information is for the use of authorized warranty stations (dealers) only. Service must be performed by an ALTEC Qualified Service Representative.

**NOTICE**  
**REPAIR PERFORMED BY OTHER THAN AUTHORIZED WARRANTY STATIONS (DEALERS) OR OTHER QUALIFIED PERSONNEL SHALL VOID THE WARRANTY PERIOD OF THIS UNIT. TO AVOID LOSS OF WARRANTY, SEE YOUR NEAREST ALTEC AUTHORIZED DEALER.**

For factory service, ship the 1608A prepaid to Altec Customer Service/Repair, 1491 N. Main Street, Orange, California 92667. For additional information or technical assistance, call (714) 774-2900, or Telex 65-5415.

#### ACCESS

Remove the four screws securing the front panel, then open and lower the hinged front panel to gain access to the chassis interior.

#### COVER REMOVAL

If the ALTEC 42625 Cover accessory is installed, remove by reversing the steps of the cover installation procedure.

#### ADJUSTMENTS

Three adjustable controls are set at the factory for proper operation in most applications; the Power Driver Balance Control, the Acousta-Voicing Pad and the Compression Threshold Control. Normally, the setting of these controls should not be changed.

#### Power Driver Balance Control

The Power Driver Balance Control (R23 on Power Driver PCB) balances the outputs of transistors Q6 and Q7 on the PCB. Improper adjustments of this control results in high-frequency distortion. If adjustment is required, use the following procedure.

1. Connect a 16-ohm dummy load across terminals 2 and 5 of TB3 (16 ohm output). (See Figure 3.)
2. Apply a 12 kHz sine wave to one input channel.
3. Adjust gain for 150W output.
4. Connect a frequency distortion analyzer (preferred) or an oscilloscope to terminals 2 and 5 of TB3 (16-ohm speaker output) and observe output.
5. Remove four screws securing front panel, then open and lower panel.

6. Locate R23 on Power Driver PCB (see Figure 2) and adjust R23 until minimum distortion is observed on distortion-measuring instrument.

7. Close front panel and secure with four screws previously removed.

#### Acousta-Voicing Pad

The Acousta-Voicing pad, located on chassis (see Figure 3), is for adjusting gain correction when using passive Acousta-Voicing equalizers. If the pad requires readjustment, use the following procedure.

1. Install an ALTEC 15095A Bridging Transformer plug-in accessory module in socket ACC1 (J6).
2. Set switch S1 on Preamplifier PCB to OUT (see Figure 2), set NORMAL-BRIGHT switch to NORMAL, set MASTER and MIX 1 gain controls to maximum and set all other gain controls to minimum.
3. Place an 8-ohm dummy load across terminals 3 and 5 of TB3 (8-ohm speaker output). (See Figure 3.)
4. Verify terminals 3 and 4 (PREAMPL OUT, POWER AMPL IN) on TB1 are strapped.
5. Apply a 1000 Hz signal at 87 mV rms to MIX 1 input channel.
6. Connect an ac VTVM across 8-ohm dummy load on TB3.
7. Remove cover from Acousta-Voicing pad and adjust control (R28) until 34.6V rms (150W) is indicated on VTVM.
8. Replace cover on Acousta-Voicing pad and remove VTVM and dummy load resistor from TB3.

#### Compression Threshold Control

The Compression Threshold Control is a continuously variable potentiometer with a recessed Phillips adjusting screw and is located in the back of the compressor accessory module (see Figure 2). This control has been carefully set at the factory and should not be changed unless absolutely necessary. If compression threshold must be readjusted, use the following procedure.

1. Set COMPRESSION THRESHOLD switch to OFF.
2. Connect a 16-ohm dummy load across terminals 2 and 5 of TB3 (16-ohm speaker output). (See Figure 3.)
3. Remove four screws securing front panel, then open and lower panel.
4. Apply a 1000 Hz signal to MIX 1 input channel and connect a VTVM to terminals 3 and 5 of TB3 (16-ohm speaker output).
5. Rotate Compression Threshold Control fully cw (see Figure 2).

6. Adjust MIX 1 and MASTER gain controls on 1608A until VTVM at 16-ohm speaker output indicates 6.0V ac.
7. Set COMPRESSION THRESHOLD switch to +49 VU.
8. Rotate Compression Threshold Control counterclockwise until VTVM indicates 5.9V ac.
9. Disconnect VTVM, then close front panel and secure with four screws previously removed.

#### PILOT LAMP REPLACEMENT

If pilot lamps (DS1 and DS2) fail, open and lower the hinged front panel. The lamps are mounted with spring clips. Squeeze the clip of the inoperative lamp and lift the lamp assembly from the mounting bracket. Verify type of lamp from the parts list. Replace with identical lamp, then replace the lamp assembly in the mounting bracket, close the hinged front panel and secure with the four screws previously removed.

#### FUSE REPLACEMENT

The fuse is mounted on the chassis (see Figure 3) and is associated only with the battery circuit. If replacement is required, determine and correct any cause of failure. Install an identical fuse (see parts list) by unscrewing fuse holder, replacing fuse and resealing fuse holder.

#### PCB REPLACEMENT

A Power Driver PCB and a Preamplifier PCB are located within the chassis. To restore operation if a PCB fails, replace the faulty PCB with a new or repaired PCB of the same type, using the following procedure.

1. Remove four screws securing front panel, then open and lower panel.
2. Carefully remove all wire connectors from PCB, tagging each connector as removed.

3. Remove screws securing PCB to standoff spacers.
4. Carefully remove PCB from receptacle. (Remove shield if servicing Preamplifier PCB.)

#### CAUTION

Do not warp, bend or twist the board or conductor may fracture.

5. Carefully insert replacement (or repaired) PCB in receptacle.
6. Secure PCB on standoff spacers (with shield if servicing Preamplifier PCB) with PCB mounting screws previously removed.
7. Attach all wire connectors to PCB in accordance with tagging (see Step 2).
8. Close front panel and secure with screws previously removed.

### PARTS LIST

#### MAIN CHASSIS

| Reference Designator    | Ordering Number | Name and Description                     |
|-------------------------|-----------------|--|
| A1                      | 27-01-042482-02 | PCB Assembly, Preamplifier               |
| A2                      | 27-01-042483-05 | PCB Assembly, Power Driver               |
| C1, 2, 3, 4, 5          | 15-02-107454-01 | Cap., 100 pF $\pm 10\%$ , 100V           |
| C7                      | 15-01-114213-01 | Cap., 470 $\mu$ F, 40V                   |
| C6, 8                   | 15-01-106575-01 | Cap., 1000 $\mu$ F, 25V                  |
| C9                      | 15-01-100299-02 | Cap., 13500 $\mu$ F, 35V                 |
| C10                     | 15-06-102605-01 | Cap., 0.47 $\mu$ F $\pm 10\%$ , 100V     |
| C11                     | 15-01-108236-01 | Cap., 100 $\mu$ F, 35V                   |
| C12                     | 15-02-100307-01 | Cap., 0.01 $\mu$ F $\pm 20\%$ , 100V     |
| C13                     | 15-02-100302-01 | Cap., 470 pF $\pm 10\%$ , 100V           |
| C14, 15, 16             | 15-02-100089-01 | Cap., 0.01 $\mu$ F $\pm 20\%$ , 4000V    |
| CB1                     | 51-03-113176-02 | Circuit breaker, 4A hold, 7A trip        |
| CR1, 4                  | 48-01-108576-02 | Diode, Zener, 15V $\pm 5\%$              |
| CR3                     | 48-01-107271-01 | Diode, Zener, 20V $\pm 5\%$              |
| CR5, 6, 7               | 48-02-108690-01 | Diode, 1N3492, 18A, 100 PIV              |
| CR8, 9                  | 48-02-042787-01 | Rectifier, 1N4004                        |
| DS1, 2                  | 39-01-100784-01 | Lamp, pilot, 28V, 40 mA                  |
| F1                      | 51-04-113175-01 | Fuse, 15A, 3AG                           |
| J1, 2, 3, 4, 5          | 21-02-113172-01 | Receptacle, 3-terminal                   |
| J6, 7, 8, 9, 10, 11, 12 | 21-02-100973-01 | Socket, octal                            |
| J13, 14, 16             | 21-01-100508-01 | Jack                                     |
| J15                     | 21-02-100950-01 | Socket, 6-pin                            |
| J17                     | 21-01-107505-01 | Jack, phono, 3-conductor                 |
| L1 thru L14             | 56-01-044110-01 | Choke, Ferrite Bead                      |
| P1                      | 60-06-012636-03 | Cord, 18GA, 3-conductor, 6 ft, with plug |
| Q2                      | 48-03-112928-01 | Transistor, 2N5305W                      |
| Q3, 4, 5, 6, 7, 8       | 48-03-040934-05 | Transistor, 2N6254 (selected)            |
| R1, 2, 3, 4, 5          | 47-01-102109-01 | Res., 20K $\Omega$ $\pm 5\%$ , 1/4W      |
| R6, 7, 8, 9, 10         | 47-01-102163-01 | Res., 1K $\Omega$ $\pm 10\%$ , 1/4W      |
| R11                     | 47-01-100639-01 | Res., 68 $\Omega$ $\pm 10\%$ , 1W        |

| Reference Designator | Ordering Number | Name and Description                 |
|----------------------|-----------------|--------------------------------------|
| R12, 13, 14, 15, 16  | 47-01-102175-01 | Res., 10K $\Omega$ $\pm 10\%$ , 1/4W |
| R17, 18, 19, 20, 21  | 47-06-042485-03 | Pot., 1M $\Omega$                    |
| R22                  | 47-06-013600-03 | Pot., 750 $\Omega$ $\pm 20\%$        |
| R23, 25              | 47-06-014573-01 | Pot., 50K $\Omega$                   |
| R24                  | 47-01-102261-01 | Res., 750 $\Omega$ $\pm 5\%$ , 1/2W  |
| R26                  | 47-06-014574-05 | Pot., 750 $\Omega$ $\pm 30\%$        |
| R27                  | 47-01-100644-01 | Res., 560 $\Omega$ $\pm 10\%$ , 1W   |
| R28                  | 47-01-102103-01 | Res., 11K $\Omega$ $\pm 5\%$ , 1/4W  |
| R29                  | 47-01-102093-01 | Res., 4.3K $\Omega$ $\pm 5\%$ , 1/4W |
| R30, 42              | 47-02-100713-01 | Res., 47 $\Omega$ $\pm 10\%$ , 5W    |
| R32                  | 47-06-042509-01 | Pot., 15K $\Omega$ $\pm 20\%$        |
| R33                  | 47-01-102893-01 | Res., 100 $\Omega$ $\pm 10\%$ , 1W   |
| R34                  | 47-01-102101-01 | Res., 9.1K $\Omega$ $\pm 5\%$ , 1/4W |
| R35                  | 47-01-102112-01 | Res., 27K $\Omega$ $\pm 5\%$ , 1/4W  |
| R36                  | 47-01-102551-01 | Res., 470 $\Omega$ $\pm 10\%$ , 1W   |
| R37, 38              | 47-01-100638-01 | Res., 47 $\Omega$ $\pm 10\%$ , 1W    |
| R39                  | 47-02-100715-01 | Res., 200 $\Omega$ $\pm 10\%$ , 5W   |
| R40, 41, 43, 44      | 47-02-108691-01 | Res., 0.3 $\Omega$ $\pm 10\%$ , 5W   |
| R45                  | 47-02-108692-01 | Res., 1 $\Omega$ $\pm 10\%$ , 5W     |
| R46                  | 47-01-100652-01 | Res., 1.8K $\Omega$ $\pm 10\%$ , 1W  |
| S1, 2, 3, 4, 5, 7    | 51-02-113177-01 | Switch, DPDT, rocker                 |
| S6A-B                | 51-02-113178-02 | Switch, DPDT, rocker                 |
| S8A-B                | 51-02-113179-01 | Switch, DPDT, rocker                 |
| T1                   | 56-08-007467-01 | Transformer, power                   |
| T2                   | 56-07-016745-01 | Transformer, output                  |
| TB1                  | 21-04-113171-01 | Terminal board, 8-terminal           |
| TB2                  | 21-04-101034-01 | Terminal board, 2-terminal           |
| TB3                  | 21-04-101059-01 | Terminal board, 6-terminal           |
| TB4                  | 21-04-101013-01 | Terminal board, 5-terminal           |
| XA2                  | 21-02-100755-01 | Receptacle                           |

## PARTS LIST (Continued)

## PREAMPLIFIER PCB

| Reference Designator | Ordering Number | Name and Description                 |
|----------------------|-----------------|--------------------------------------|
| C1, 9, 15, 16, 21    | 15-01-107452-01 | Cap., 10 $\mu$ F, 50V                |
| C2, 7, 11            | 15-06-100311-01 | Cap., 0.1 $\mu$ F $\pm$ 20%, 250V    |
| C3                   | 15-02-100018-01 | Cap., 47 pF $\pm$ 10%, 500V          |
| C4, 6, 12            | 15-02-100304-01 | Cap., 0.001 $\mu$ F $\pm$ 10%, 100V  |
| C5                   | 15-02-107469-01 | Cap., 0.0015 $\mu$ F $\pm$ 10%, 100V |
| C8                   | 15-02-107470-01 | Cap., 220 pF $\pm$ 10%, 100V         |
| C10                  | 15-06-109094-01 | Cap., 0.0047 $\mu$ F $\pm$ 5%, 100V  |
| C13                  | 15-02-100307-01 | Cap., 0.01 $\mu$ F $\pm$ 10%, 100V   |
| C14, 18              | 15-01-100234-01 | Cap., 50 $\mu$ F, 25V                |
| C17                  | 15-01-107495-01 | Cap., 25 $\mu$ F $\pm$ 10%, 25V      |
| C19                  | 15-02-100012-01 | Cap., 20 pF $\pm$ 10%, 500V          |
| C20                  | 15-06-109103-01 | Cap., 0.047 $\mu$ F $\pm$ 10%, 250V  |
| C22                  | 15-01-108236-01 | Cap., 100 $\mu$ F, 35V               |
| C24                  | 15-02-107470-01 | Cap., 0.0033 $\mu$ F $\pm$ 20%, 100V |
| C25                  | 15-02-100303-01 | Cap., 680 pF $\pm$ 10%, 100V         |
| CR2                  | 48-01-107017-01 | Diode, 1N456A, 25V, 100 mA           |
| IC1                  | 17-01-118679-01 | Integrated Ckt, 18V, regulated       |
| Q1, 15               | 48-03-119140-02 | Transistor, 2N5308 (selected)        |
| Q2                   | 48-03-112934-01 | Transistor, 2N6027                   |
| Q3, 4, 6             | 48-03-109714-01 | Transistor, TZ81                     |
| Q5, 9, 11            | 48-03-108557-03 | Transistor, 2N5367 (selected)        |
| Q7, 8, 10            | 48-03-101098-03 | Transistor, 2N2712 (selected)        |
| R1, 3, 12, 27, 45    | 47-01-102175-01 | Res., 10K $\Omega$ $\pm$ 10%, 1/4W   |
| R2, 29, 30           | 47-01-102163-01 | Res., 1K $\Omega$ $\pm$ 10%, 1/4W    |

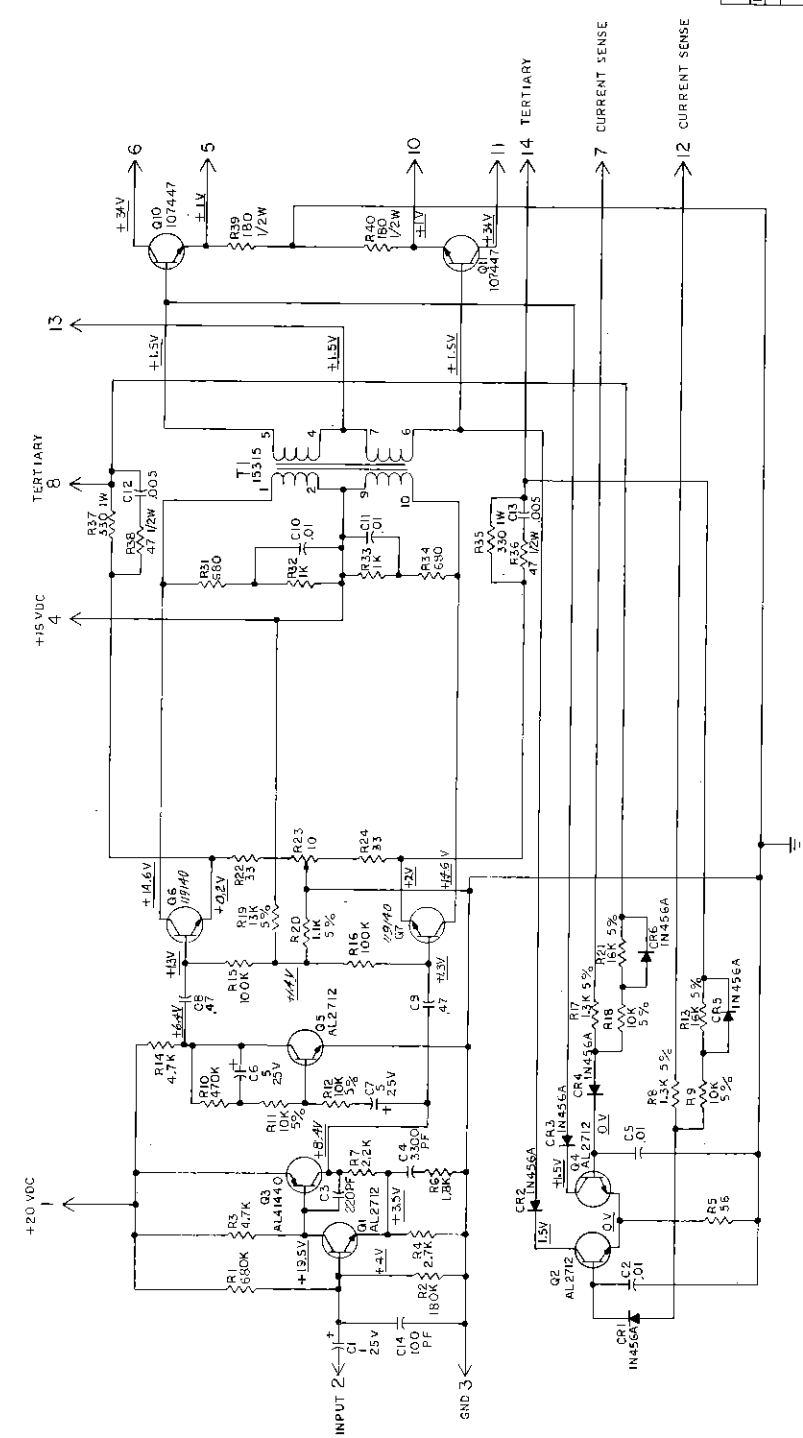
| Reference Designator           | Ordering Number | Name and Description                |
|--------------------------------|-----------------|-------------------------------------|
| R4                             | 47-01-102190-01 | Res., 180K $\Omega$ $\pm$ 10%, 1/4W |
| R5                             | 47-01-102170-01 | Res., 3.9K $\Omega$ $\pm$ 10%, 1/4W |
| R6, 10, 13, 18, 19, 24, 44, 47 | 47-01-102171-01 | Res., 4.7K $\Omega$ $\pm$ 10%, 1/4W |
| R7                             | 47-01-108933-01 | Res., 1.2M $\Omega$ $\pm$ 10%, 1/4W |
| R8                             | 47-01-102075-01 | Res., 750 $\Omega$ $\pm$ 5%, 1/4W   |
| R9                             | 47-01-102187-01 | Res., 100K $\Omega$ $\pm$ 10%, 1/4W |
| R14                            | 47-01-108931-01 | Res., 3.9M $\Omega$ $\pm$ 10%, 1/4W |
| R15, 32                        | 47-01-102159-01 | Res., 470 $\Omega$ $\pm$ 10%, 1/4W  |
| R16                            | 47-01-102154-01 | Res., 180 $\Omega$ $\pm$ 10%, 1/4W  |
| R17                            | 47-01-102145-01 | Res., 33 $\Omega$ $\pm$ 10%, 1/4W   |
| R20, 34                        | 47-01-102157-01 | Res., 330 $\Omega$ $\pm$ 10%, 1/4W  |
| R21, 22                        | 47-01-102179-01 | Res., 22K $\Omega$ $\pm$ 10%, 1/4W  |
| R23, 31                        | 47-01-102168-01 | Res., 2.7K $\Omega$ $\pm$ 10%, 1/4W |
| R25                            | 47-01-100474-01 | Res., 330K $\Omega$ $\pm$ 10%, 1/4W |
| R26                            | 47-01-100477-01 | Res., 470K $\Omega$ $\pm$ 10%, 1/4W |
| R28, 33                        | 47-01-102183-01 | Res., 47K $\Omega$ $\pm$ 10%, 1/4W  |
| R35                            | 47-01-102166-01 | Res., 2.7K $\Omega$ $\pm$ 10%, 1/4W |
| R36, 37                        | 47-01-102140-01 | Res., 10 $\Omega$ $\pm$ 10%, 1/4W   |
| R39                            | 47-01-102160-01 | Res., 560 $\Omega$ $\pm$ 10%, 1/4W  |
| R41                            | 47-01-102147-01 | Res., 47 $\Omega$ $\pm$ 10%, 1/4W   |
| R46                            | 47-01-102166-01 | Res., 1.8K $\Omega$ $\pm$ 10%, 1/4W |
| S1                             | 51-02-107498-01 | Switch, DPDT, rocker                |

## POWER DRIVER PCB

| Reference Designator | Ordering Number | Name and Description                 |
|----------------------|-----------------|--------------------------------------|
| C1                   | 15-01-100156-01 | Cap., 1 $\mu$ F, 25V                 |
| C2, 5, 10, 11        | 15-02-100307-01 | Cap., 0.01 $\mu$ F $\pm$ 20%, 100V   |
| C3                   | 15-02-107470-01 | Cap., 220 pF $\pm$ 10%, 100V         |
| C4                   | 15-02-107047-01 | Cap., 0.0033 $\mu$ F $\pm$ 20%, 100V |
| C6, 7                | 15-01-108543-01 | Cap., 5 $\mu$ F, 25V                 |
| C8, 9                | 15-06-102605-01 | Cap., 0.47 $\mu$ F $\pm$ 10%, 100V   |
| C12, 13              | 15-02-100305-01 | Cap., 0.005 $\mu$ F $\pm$ 20%, 100V  |
| C14                  | 15-02-107454-01 | Cap., 100 pF $\pm$ 10%, 100V         |
| CR1, 2, 3, 4, 5, 6   | 48-01-107017-01 | Diode, 1N456A, 25V, 100 mA           |
| P1                   | 21-01-110772-01 | Plug, 2-pin                          |
| Q1, 2, 4, 5          | 48-03-101098-03 | Transistor, 2N2712 (selected)        |
| Q3                   | 48-03-041440-02 | Transistor, 2N3906 (selected)        |
| Q6, 7                | 48-03-119140-02 | Transistor, 2N5308 (selected)        |
| Q10, 11              | 48-03-107447-03 | Transistor, 2N5320 (selected)        |
| R1                   | 47-01-100479-01 | Res., 680K $\Omega$ $\pm$ 10%, 1/4W  |
| R2                   | 47-01-102190-01 | Res., 180K $\Omega$ $\pm$ 10%, 1/4W  |
| R3, 14               | 47-01-102171-01 | Res., 4.7K $\Omega$ $\pm$ 10%, 1/4W  |

| Reference Designator | Ordering Number | Name and Description                |
|----------------------|-----------------|-------------------------------------|
| R4                   | 47-01-102168-01 | Res., 2.7K $\Omega$ $\pm$ 10%, 1/4W |
| R5                   | 47-01-102148-01 | Res., 56 $\Omega$ $\pm$ 10%, 1/4W   |
| R6                   | 47-01-102166-01 | Res., 1.8K $\Omega$ $\pm$ 10%, 1/4W |
| R7                   | 47-01-102167-01 | Res., 2.2K $\Omega$ $\pm$ 10%, 1/4W |
| R8, 17               | 47-01-102081-01 | Res., 1.3K $\Omega$ $\pm$ 5%, 1/4W  |
| R9, 11, 12, 18       | 47-01-102102-01 | Res., 10K $\Omega$ $\pm$ 5%, 1/4W   |
| R10                  | 47-01-100477-01 | Res., 470K $\Omega$ $\pm$ 10%, 1/4W |
| R13, 21              | 47-01-102107-01 | Res., 16K $\Omega$ $\pm$ 5%, 1/4W   |
| R15, 16              | 47-01-102187-01 | Res., 100K $\Omega$ $\pm$ 10%, 1/4W |
| R19                  | 47-01-102105-01 | Res., 13K $\Omega$ $\pm$ 5%, 1/4W   |
| R20                  | 47-01-102079-01 | Res., 1.1K $\Omega$ $\pm$ 5%, 1/4W  |
| R22, 24              | 47-01-102145-01 | Res., 33 $\Omega$ $\pm$ 10%, 1/4W   |
| R23                  | 47-05-108544-01 | Pot., 10 $\Omega$ , 2W              |
| R31, 34              | 47-01-102161-01 | Res., 680 $\Omega$ $\pm$ 10%, 1/4W  |
| R32, 33              | 47-01-102163-01 | Res., 1K $\Omega$ $\pm$ 10%, 1/4W   |
| R35, 37              | 47-01-100642-01 | Res., 330 $\Omega$ $\pm$ 10%, 1W    |
| R36, 38              | 47-01-102338-01 | Res., 47 $\Omega$ $\pm$ 10%, 1/2W   |
| R39, 40              | 47-01-102345-01 | Res., 180 $\Omega$ $\pm$ 10%, 1/2W  |
| T1                   | 56-07-015315-07 | Transformer, output                 |

| REV | DESCRIPTION                    | DATE    | BY  | CHK |
|-----|--------------------------------|---------|-----|-----|
| 1   | REL FOR P20D                   | 1/15/70 | WJS | WJS |
| 2   | ADD C15, R20, R21, R22         | 1/15/70 | WJS | WJS |
| 3   | REV. 1/15/70, 1/15/70, 1/15/70 | 1/15/70 | WJS | WJS |
| 4   | REV. 1/15/70, 1/15/70, 1/15/70 | 1/15/70 | WJS | WJS |
| 5   | REV. 1/15/70, 1/15/70, 1/15/70 | 1/15/70 | WJS | WJS |
| 6   | REV. 1/15/70, 1/15/70, 1/15/70 | 1/15/70 | WJS | WJS |
| 7   | REV. 1/15/70, 1/15/70, 1/15/70 | 1/15/70 | WJS | WJS |
| 8   | REV. 1/15/70, 1/15/70, 1/15/70 | 1/15/70 | WJS | WJS |
| 9   | REV. 1/15/70, 1/15/70, 1/15/70 | 1/15/70 | WJS | WJS |
| 10  | REV. 1/15/70, 1/15/70, 1/15/70 | 1/15/70 | WJS | WJS |



| HIGHEST REFERENCE DESIGNATION | DESIGNATION | VALUE | UNIT |
|-------------------------------|-------------|-------|------|
| R40                           | C10         | 10    | μF   |
| R40                           | C10         | 10    | μF   |
| R40                           | C10         | 10    | μF   |
| R40                           | C10         | 10    | μF   |
| R40                           | C10         | 10    | μF   |
| R40                           | C10         | 10    | μF   |
| R40                           | C10         | 10    | μF   |
| R40                           | C10         | 10    | μF   |
| R40                           | C10         | 10    | μF   |
| R40                           | C10         | 10    | μF   |

| REV | DESCRIPTION                    | DATE    | BY  | CHK |
|-----|--------------------------------|---------|-----|-----|
| 1   | REL FOR P20D                   | 1/15/70 | WJS | WJS |
| 2   | ADD C15, R20, R21, R22         | 1/15/70 | WJS | WJS |
| 3   | REV. 1/15/70, 1/15/70, 1/15/70 | 1/15/70 | WJS | WJS |
| 4   | REV. 1/15/70, 1/15/70, 1/15/70 | 1/15/70 | WJS | WJS |
| 5   | REV. 1/15/70, 1/15/70, 1/15/70 | 1/15/70 | WJS | WJS |
| 6   | REV. 1/15/70, 1/15/70, 1/15/70 | 1/15/70 | WJS | WJS |
| 7   | REV. 1/15/70, 1/15/70, 1/15/70 | 1/15/70 | WJS | WJS |
| 8   | REV. 1/15/70, 1/15/70, 1/15/70 | 1/15/70 | WJS | WJS |
| 9   | REV. 1/15/70, 1/15/70, 1/15/70 | 1/15/70 | WJS | WJS |
| 10  | REV. 1/15/70, 1/15/70, 1/15/70 | 1/15/70 | WJS | WJS |

3. ALL DIMENSIONS ZERO SEVEN - D.C. VOLTS.  
2. CAPACITANCE VALUES ARE IN MICROFARADS  
1. RESISTANCE VALUES ARE IN OHMS 1/4W 10%

NOTES: UNLESS OTHERWISE INDICATED.

Figure 12. Schematic (2D684-4), Power Driver PCB Assembly



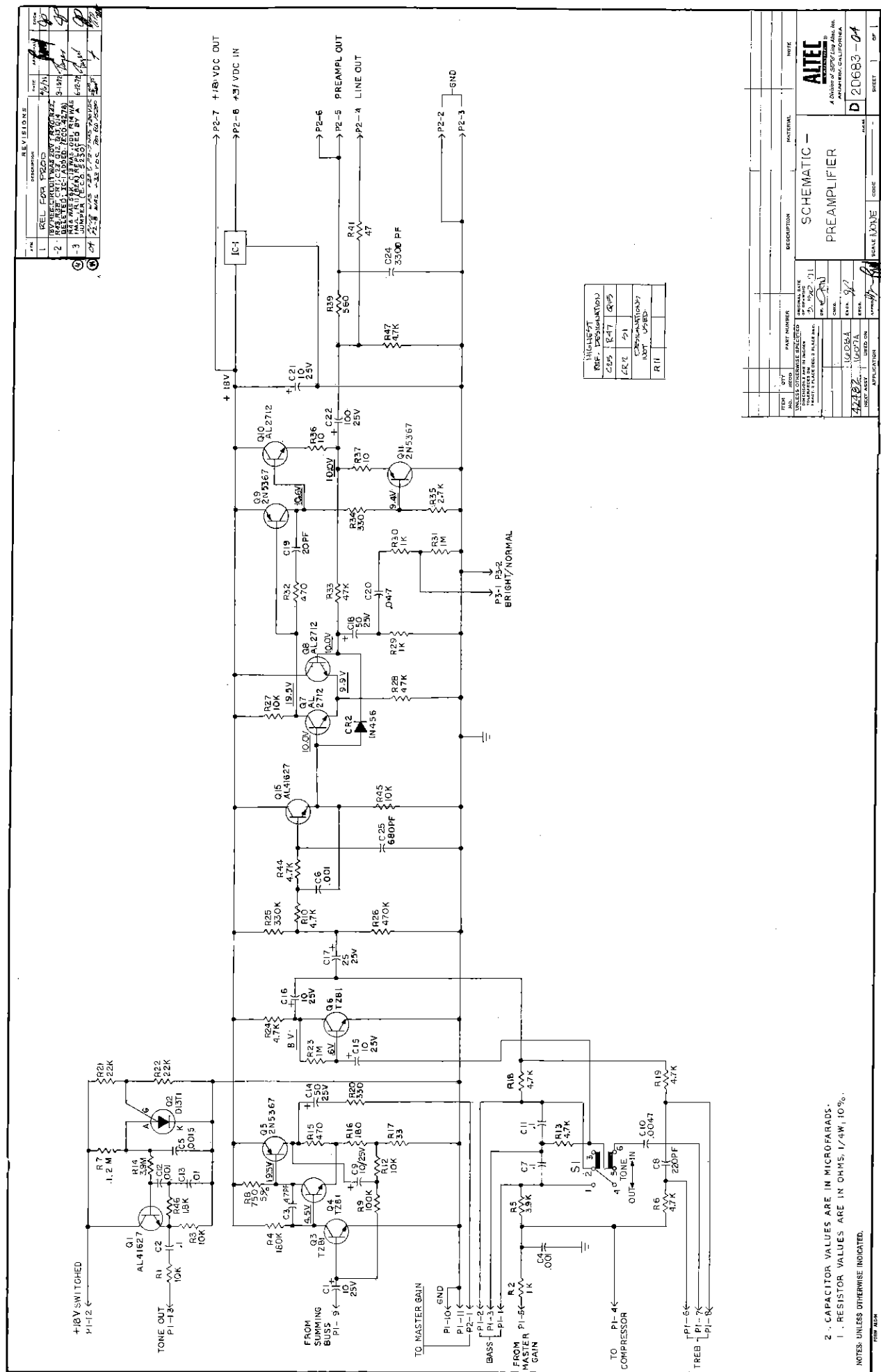


Figure 11. Schematic (2D683-4), Preamplifier PCB Assembly

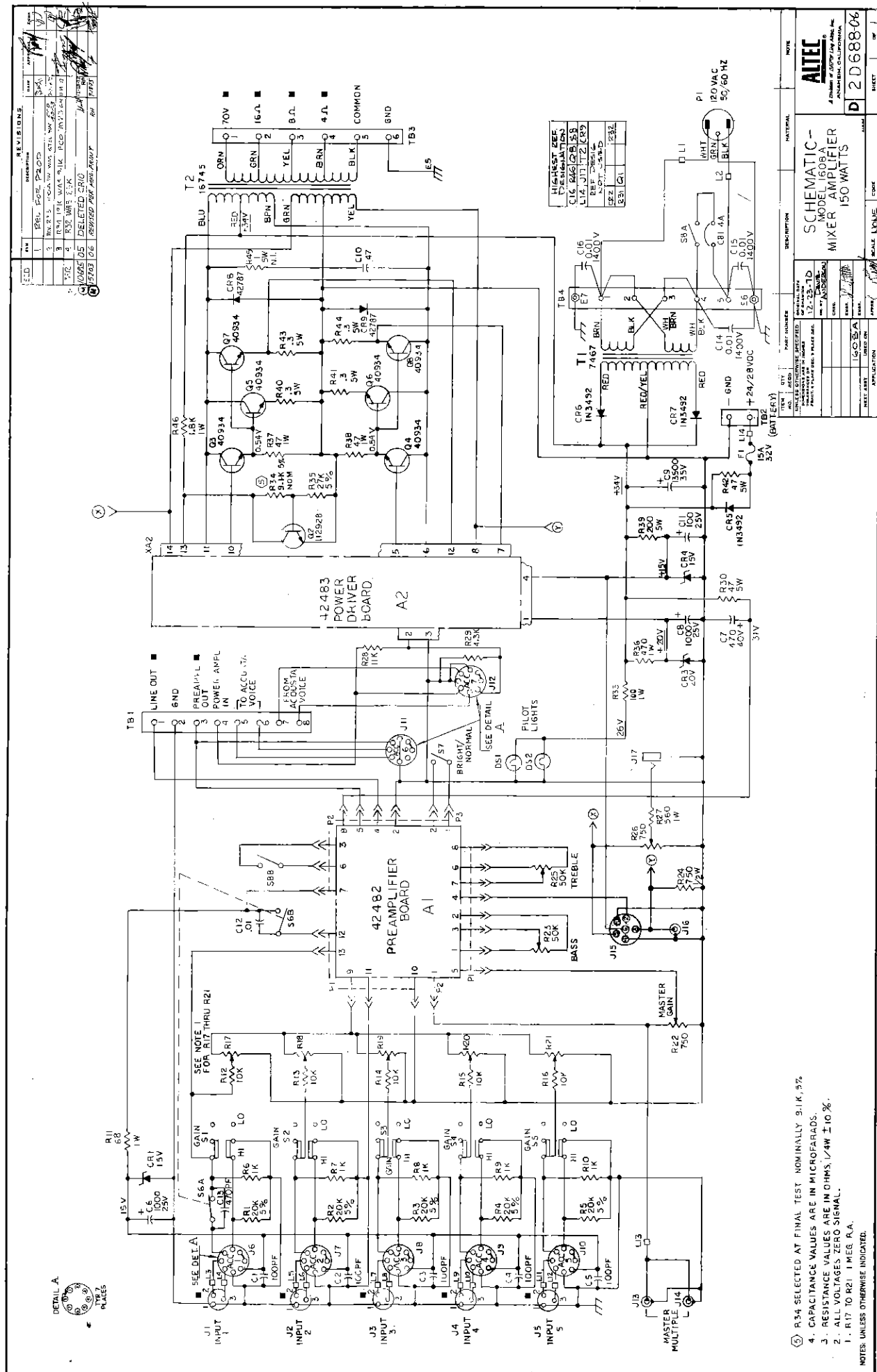


Figure 13. Schematic (2D688-6), 1608A Mixer/Power Amplifier