AUDIMAX

Models 4440A, 4450A

Automatic Level Control

OPERATING AND MAINTENANCE INSTRUCTIONS

THOMSON-CSF LABORATORIES, INC.

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SECTION I

INTRODUCTION

1-1. GENERAL

The Audimax® Models 4440A and 4450A, like their Thomson-CSF Laboratories Volumax(TM) companion piece, are tools to help the broadcaster achieve maximum audio program power within appropriate modulation limits. Designed for use wherever high quality automatic-gain riding is necessary, either model is a unique means of audio signal control for AM, FM, and TV broadcasting, sound recordings, motion picture sound tracks, and public address systems.

The Model 4440A is a single-channel unit for monaural service. The Model 4450A is a dual-channel unit for stereophonic service. Model 4450A units can be obtained either in factory assembled form or by field modifications of Model 4440A units. A field modification kit for this conversion is available from Thomson-CSF Laboratories, Inc.

1-2. FUNCTIONAL DESCRIPTION

The Audimax automatic level control is wholly different in concept from ordinary compressors, limiters, or AGC devices. Two features which are unique to the Audimax design are the gain platform and the gated gain stabilizer.

The exclusive <u>gain platform</u> principle permits gain to remain on a stable plateau over a wide range of input levels rather than continuously being allowed to rise and fall with consequent distortion, thumping and pumping, and audio "holes". The unique gated gain stabilizer bridges program lapses and thus eliminates "swish-up" of background noise. A special return-to-zero function returns gain to normal during standby conditions.

Both the gain platform and the gated gain stabilizer use logic circuits to make processing decisions based on the incoming signal. Thus the Audimax is not just another AGC amplifier, but a sophisticated processing device that eliminates the drawbacks of conventional units.

The Audimax principles apply not only to radio and television stations, but also are valuable in recording, public address, background music, and two-way communication systems.

1-3. PHYSICAL DESCRIPTION

The Audimax Models 4440A and 4450A are slim, neat packages designed for standard rack mounting. Each has a front-panel gain reduction meter and a few simple controls that seldom require resetting. Three controls on the left-hand side of the front panel of either model are duplicated on the right-hand side of the stereo-model front panel for the additional audio channel. (The right-hand side of the 4440A front panel is blank.) (See figure 1-1.)

The overall dimensions of either model are 19 inches wide x approximately 1-3/4 inches high x approximately 15 inches deep. The Model 4440A weighs 8.5 pounds and the Model 4450A weighs 9.5 pounds.

Either model operates from a nominal 115v or 230v, 50 or 60 Hz single-phase power source. The Model 4440A requires 10 watts and the Model 4450A requires 15 watts. A 6-foot ac power cord with a three-prong grounding plug is supplied as a part of each unit.

Signal connections are made at a barrier strip on the rear panel.

The basic front-panel controls consist of an ac POWER ON-OFF switch, INPUT and OUTPUT signal-level adjustments, a TEST switch for maintenance checks, and a CONTROL ON-OFF switch that permits the Audimax channel to be operated as a linear amplifier when automatic gain control is not desired. On the stereo model, the INPUT and OUTPUT signal level adjustments and the CONTROL switch are repeated for the second channel.

The internal components of the Model 4440A consist of an ac power transformer, an audio output transformer, and two easily accessible transistor circuit boards. One board contains the input, amplification, and output circuitry and much of the feedback and logic circuitry used for one audio channel. The other board contains the Audimax dc power supply and the remainder of the audio feedback and logic circuitry. The feedback and logic circuitry on the second board is designed for either monaural or stereo operation. When a Model 4440A is converted into a Model 4450A, its original input/output circuit board is employed for the left channel.

The internal components of the Model 4450A are identical to those of the Model 4440A with the addition of an audio output transformer, front panel controls, and an input/output circuit board for the right channel. The output transformer, controls, and input/output board for the right channel are identical to their counterparts for the left channel.

1-4. WARRANTY

A warranty, with a return post card, is included with your Audimax unit. Fill out the post card and return it to Thomson-CSF Laboratories, Inc. as soon as possible to validate your warranty.

1-5. FACTORY SERVICE AND REPAIR

If you should experience difficulty in installing, operating, or repairing your Audimax unit, please contact your distributor for assistance. If necessary, call Thomson-CSF Laboratories, Inc., Stamford, Connecticut (Area Code 203, 327-7700).

1-6. SPECIFICATIONS

AUDIMAX Model 4440A (Monaural)

Control characteristic	±10 dB of gain control
Frequency response	±1/2 dB from 50 to 15,000 Hz
Harmonic distortion	Less than 0.5% from 50 Hz to 15,000 Hz at +16 dBm output
Signal-to-noise ratio	Greater than 70 dB with respect to normal output level with normal gain (meter reading in green region)
Gated gain stabilization	Threshold adjustable from -20 dB to normal input

Maximum gain	40 dB (nominal)*
Input and output impedances	600 ohms or 150 ohms, balanced or unbalanced
Minimum input level	-25 dBm
Normal output level	14* VU program, 18* dBm sine wave
Maximum output	26 dBm*
Maximum operating temperature	+55^{o}C
Physical dimensions	Standard 19" rack mounting, 1-3/4" high, 15" deep except for cable and connectors
Power requirements	10 watts at 115/230 volts ac, 50-60 Hz

AUDIMAX Model 4450A (Stereophonic)

Physical dimensions	Same as Model 4440A
Power requirements	15 watts at 115/230 volts ac, 50-60 Hz
Other characteristics	Each channel same as Model 4440A

*These specifications do not include the 6-dB output pad

SECTION II

INSTALLATION PROCEDURES

2-1. UNPACKING

Carefully unpack your Audimax unit and examine it for evidence of physical damage that may have occurred during shipment. In the event of damage, file a claim immediately with the transportation carrier. If future transportation of the unit can be expected, save the shipping carton for re-use.

2-2. PHYSICAL INSTALLATION

The Audimax unit is designed to be mounted in a standard 19-inch electronic equipment rack or 19-inch-wide console opening. The mounting dimensions are shown in figure 2-1. Install the unit in a reasonably well ventilated position, making sure there is no high-heat producing equipment beneath it. The ambient temperature should not exceed 130° F.

For broadcast station applications, it is recommended that the Audimax unit be installed in a studio and its output fed directly into the main audio line. Satisfactory operation requires that the unit be presented with a constant 600- or 150-ohm impedance throughout the audio band. A 6-dB 600-ohm pad is provided at the output for isolation purposes.

A fast-acting peak limiter is recommended for use at the transmitter (following the Audimax unit). However, this peak limiter should be set to show only occasional limiting of 5 to 6 dB. For best results, a Thomson-CSF Laboratories

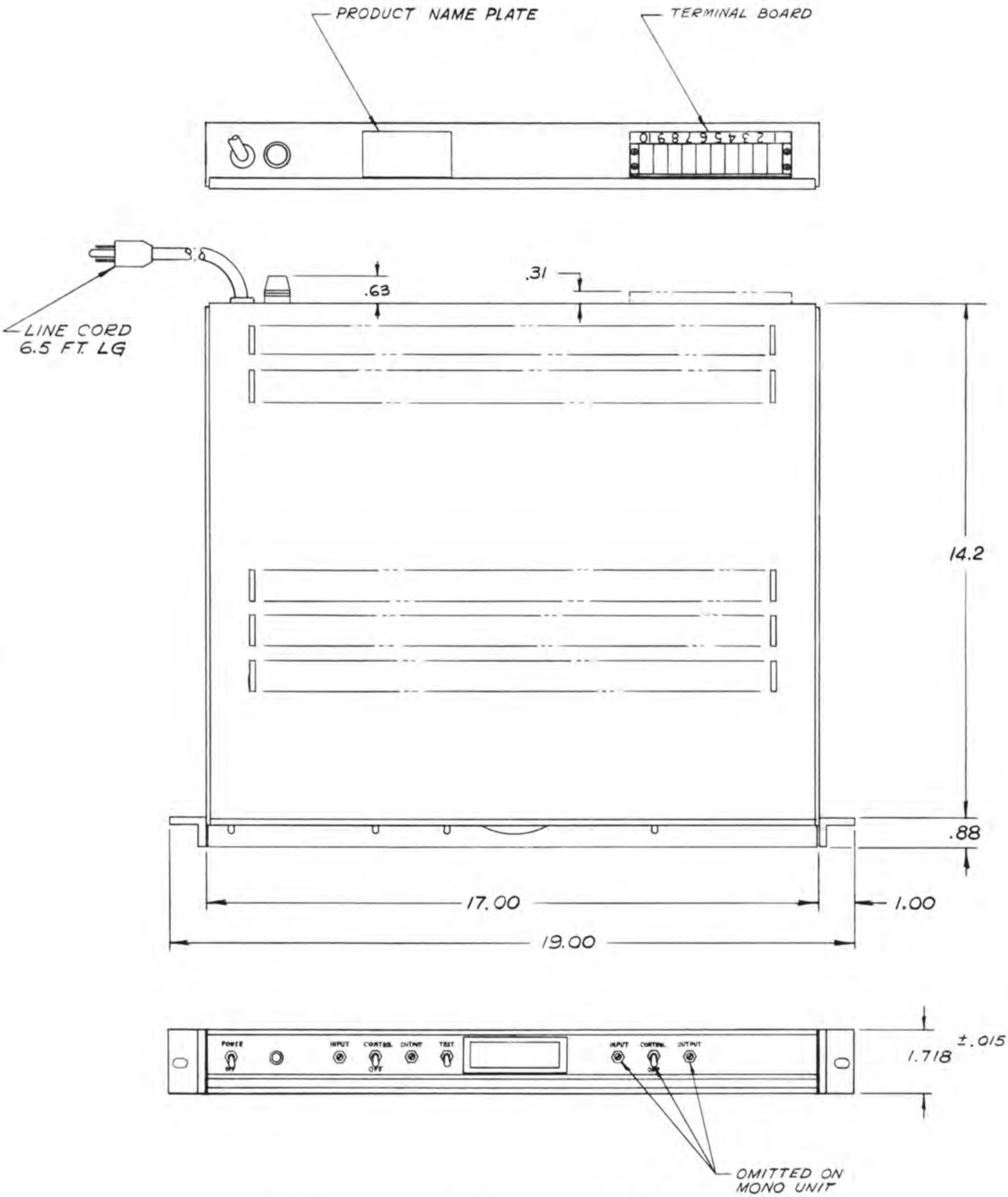


Figure 2-1. Audimax Model 4440A or 4450A, Outline Drawing

Volumax unit should be used instead of a conventional peak limiter.

NOTE

The master volume indicator should follow the Audimax unit. This will discourage unnecessary gain riding that might tend to defeat the automatic features of Audimax.

2-3. POWER SOURCE

The Audimax unit is equipped with a power transformer permitting the selection of either 115-volt or 230-volt operation. If 230-volt operation is required, the following procedure must be performed:

NOTE

For access to internal parts, see Section V of this manual.

A. Unsolder and remove the black/white lead from terminal 4 of TB-1 (figure 7-1). (This is the terminal strip adjacent to the power transformer.)

B. Unsolder and remove the brown lead from terminal 3 of TB-1.

C. Connect these two leads to TB1-1.

D. Unsolder and remove the white lead from TB1-4 and connect it to TB1-1.

2-4. SIGNAL CONNECTIONS

Input and output leads should be connected to the barrier strip at the rear of the chassis as indicated in Figure 2-1. Terminals 1 and 2 are the input terminals while terminals 4 and 5 are the output terminals. Terminal 3 is the chassis ground. In the stereophonic model, the left channel terminals are as listed above while the right channel is connected as follows: input 6 and 7, output 9 and 10, ground 8.

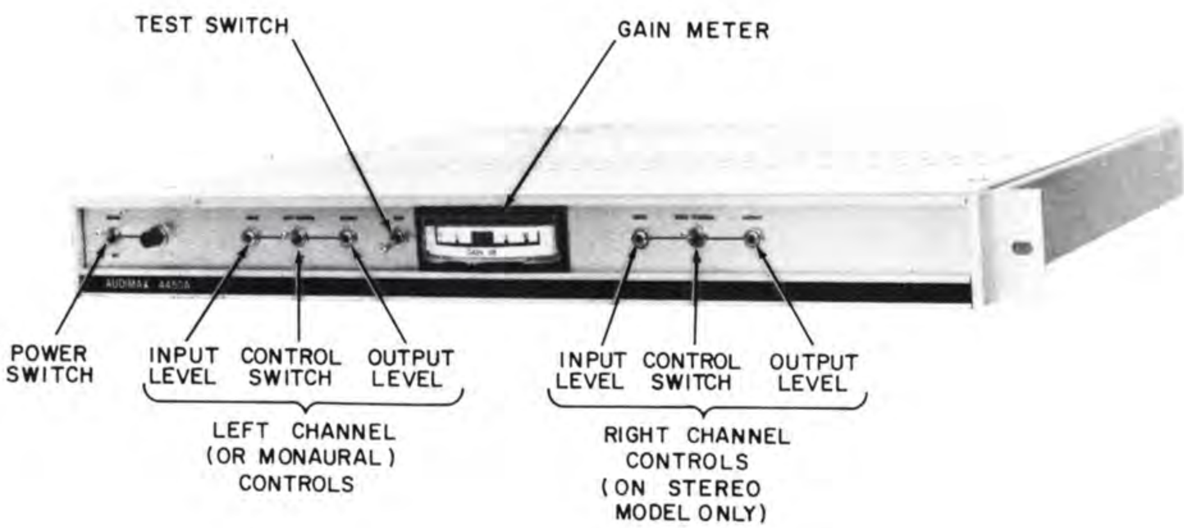


Figure 3-1. Audimax Unit, Front Panel Controls

SECTION III

OPERATIONAL SET-UP PROCEDURE

3-1. LEVEL ADJUSTMENTS

A. Monaural Model

With proper input levels, average program material should cause the front-panel GAIN meter to indicate approximately 0 dB gain. (This figure is relative, and does not refer to actual gain of the amplifier.) In this way, the advantages of ±10 dB of level correction can be realized. See figure 3-1 for the locations of controls. On the stereo model, the audio controls on the left side of the front panel are provided for the left channel and those on the right side of the front panel are provided for the right channel.

The INPUT level setting may be established by either of two methods:

(1) Set the POWER and CONTROL switches at ON, and use a recording or other program source to adjust the INPUT level control as necessary to achieve the average 0-dB reading.

(2) An oscillator may be used in place of the usual program sources or may be connected directly to the Audimax input. The oscillator output at 1 kHz should be adjusted for a level 4 dB above the normal VU level of the line in which the Audimax unit is connected. The INPUT level control is then adjusted for the 0-dB reading. When an oscillator is connected directly to the Audimax unit, it is important that proper impedance matching be observed and that no other loads are present on the line.

The OUTPUT level control is continuously variable over a 30-dB range to provide for a maximum of 8 VU with normal program input when using the 6 dB output pad or 14 VU without the pad.

B. Stereo Model

Adjustment of INPUT levels for the Audimax stereo model is basically the same procedure as used for the monaural unit except that the left channel must be disconnected from the control line when adjusting the right channel INPUT level and vice-versa. Accordingly, the following procedure should be performed when setting up the stereo model:

(1) Place the left CONTROL switch at ON and the right CONTROL switch at OFF and adjust the INPUT level for a 0 dB indication on the meter with normal program-level input connected to the left channel. As for the monaural unit, if an oscillator is used as a signal source, its output should be adjusted to a level 4 dB above the normal VU level of the line in which the Audimax unit is connected. Proper impedance matching is important and no other loads should be present on the line.

(2) Place the left CONTROL switch at OFF and the right CONTROL switch at ON. Then adjust the right INPUT level for a 0 dB indication on the meter with normal program-level input connected to the right channel.

(3) Place both CONTROL switches at ON and adjust the OUTPUT level controls as needed to produce the desired output levels.

3-2. VARIATIONS FROM STANDARD OPERATING PROCEDURES

Three variations from standard operating procedures should be made when the Audimax unit is used:

A. If the master volume indicator is properly installed at the Audimax output, there will be little tendency for manual gain control at this point. In fact, the rule here should be "DON'T TOUCH!"

B. However, in individual studios preceding the Audimax unit (through a common console), it may be occasionally desirable to readjust levels slightly. This should be done slowly, whether the program level is too low or too high.

C. The third variation from usual procedures concerns "fades". Since the Audimax unit will defeat any slow, deliberate reduction of level, all fade operations must be performed more rapidly than in the past. A little practice will easily result in the required skill. The most convenient way to insure proper procedures at all locations is to connect all cue lines to some point beyond the Audimax output.

3-3. GATED GAIN STABILIZER

The function of the Audimax Gated Gain Stabilizer (GGS) is to answer the following question: Should the gain be increased when a lapse occurs in the audio program? This is especially important for television and motion pictures where the lapses occur quite often. To prevent level increases of system noise or audio signals which are clearly background effects, the GGS inhibits gain "recovery" during those intervals when the input level drops below a preset threshold.

The GGS threshold has been factory set to inhibit gain increase when the incoming-signal level has dropped approximately 14 dB below the normal line level. This figure has been established after extensive field experience, and represents a satisfactory value for typical broadcasting use. For special applications, the GGS threshold may be moved upwards towards normal program level by increasing the resistance values of R63 and R64 on the input/-output board(s) A1 (and A3). Or, the threshold may be lowered by reducing the values of these resistors. The following table gives suggested values:

GGS Threshold	R63, R64
-4 dB	1, 100 ohms
-8 dB	620 ohms
-11 dB	270 ohms
-14 dB	200 ohms
-17 dB	110 ohms*

Sine-wave verification of the GGS threshold level may be obtained by the following procedure:

A. Apply a sine-wave input to cause the front-panel meter to read 0 dB gain reduction.

B. Remove the signal and wait at least 15 seconds for full stabilization.

C. Re-apply the input signal at a level below the desired threshold and slowly increase the signal level until the front panel meter just begins to deflect

*May result in increased high frequency distortion.

toward the right. The input level at this time should be approximately 5 dB less than that indicated in the foregoing table. This 5-dB difference is a special factor that must be considered when sine-wave calibration of the GGS threshold is performed.

3-4. TEST SWITCH

The Audimax unit is, in operation, performing automatic level control when the TEST switch is in the OFF position. Turning the TEST switch to the TEST position causes the gain to remain fixed at the mid point of its control range. The function of the TEST position is to facilitate overall system performance measurements.

3-5. DECAY (RECOVERY) TIME SWITCH

The gain control action of the Audimax unit has been designed to provide a precise degree of control with a minimum of noticeable change in the short term dynamic range. As a tool for the broadcaster, it provides maximum modulation consistent with artistically acceptable performance for a wide variety of program material. In some applications, however, it is practical and desirable to impose more limitation on the dynamic range of the program material. This is commonly done for the purpose of achieving higher average modulation, or more uniform sound -- as in the case of a public address system. The additional limiting may be achieved by decreasing the Audimax recovery time.

Although the total gain-increasing action of the Audimax is a complex function of many variables, one phase of the recovery characteristic may be modified by changing the ohmic value of the gated recovery resistance. By decreasing this value, the speed of recovery is increased.

The ohmic value of the gated recovery resistance can be varied through the use of the internal DECAY TIME switch located on the power supply and logic board A2. While selection of the most appropriate recovery time is left to the discretion of the user, the following table indicates general preferences, based on programming format:

Format	Recovery Time
Mixed	Slow (10 megohms)
Talk	Medium (4 megohms)
Top-40	Fast (3 megohms)

3-6. MODIFICATION OF MONAURAL UNIT TO STEREO UNIT

The expansion of the monaural Audimax Model 4440A to a stereo Audimax Model 4450A can be accomplished in the field with a Thomson-CSF Laboratories conversion kit. This kit contains:

1) A3, the right channel input/output board, Thomson-CSF Laboratories p/n 991627
2) T3, output transformer, Thomson-CSF Laboratories p/n 961634
3) Stereo nameplate strip
4) Right channel escutcheon panel
5) R3, R4, INPUT and OUTPUT controls, Thomson-CSF Laboratories p/n 991303

6) S4, CONTROL switch, Thomson-CSF Laboratories p/n 990848

7) Assorted jumper wires

A. Physical Conversion

To make the conversion:

(1) Remove the top cover from the unit to be converted.

(2) Remove the right-hand blank escutcheon panel and replace it with the right-channel escutcheon panel.

(3) Mount the right-channel INPUT and OUTPUT controls and CONTROL switch on the front panel. Use the left-channel controls as a guide, since the right-channel components are to be mounted in a similar manner.

(4) Mount the transformer T3 on the deck plate, using the two studs provided on the upper right-hand side of the chassis. (Hardware is provided.)

(5) Mount the input/output board A3 on the standoffs on the right side of the chassis.

(6) Using the jumpers provided, connect the input/output board A3 to the appropriate components in accordance with the stereo interconnecting schematic (figure 7-1).

(7) Connect the right channel interface cables to your system in accordance with the stereo interconnecting schematic (figure 7-1).

(8) The physical modification is now complete.

B. Alignment Procedure (Prior to Installation in Equipment Rack)

(1) Set both the left and right INPUT and OUTPUT level controls fully clockwise. Place the TEST switch at ON.

(2) Apply a 1-kHz tone at a level of -25 dBm to both channels in parallel.

(3) Adjust A2R30 (on the central board) as required to equalize the left and right channel outputs.

(4) Set the TEST switch at OFF and perform the set-up procedure given in paragraph 3-1B.

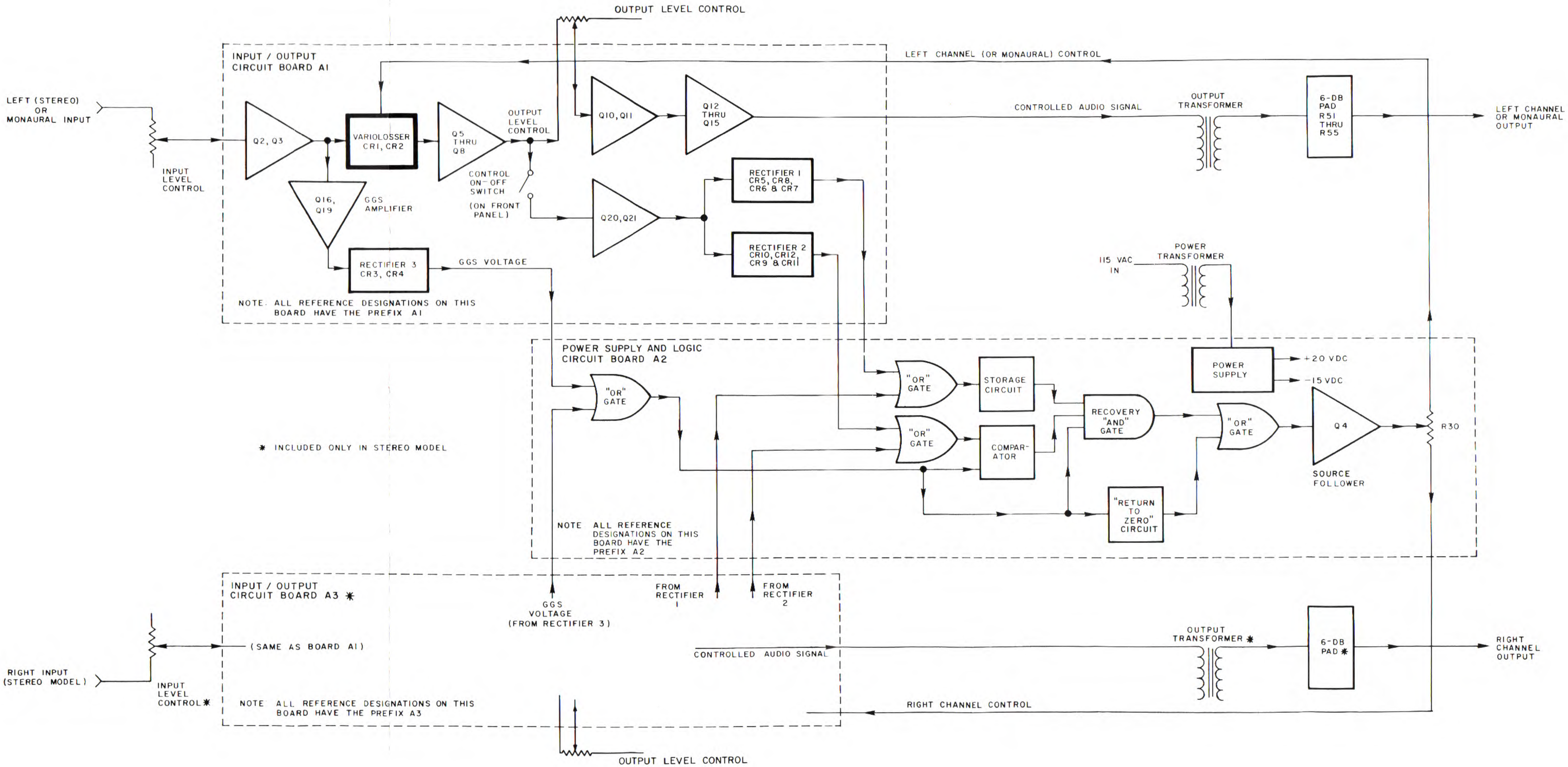


Figure 4-1. Audimax Block Diagram

SECTION IV

THEORY OF OPERATION

NOTE: This section explains circuit operation but should not be used for maintenance measurements. For measurements, see Section V.

4-1. GENERAL

Figures 4-1 and 7-1 through 7-3 are the block, interconnecting, and schematic diagrams for the monaural or stereo Audimax unit. Model differences are indicated in the block diagram, figure 4-1, and interconnecting diagram, figure 7-1. The monaural model has the same input/output, feedback, and logic circuits as provided for the exclusive use of the left channel in the stereo model and the same feedback, logic, and power supply circuits as for the shared use of both the left and right channels in the stereo model.

4-2. BLOCK DIAGRAM THEORY

(See figures 4-1 and 7-1 through 7-3.)

Since the right channel circuit board A3 and associated output transformer and controls in the stereo model are identical to board A1 and associated transformer and controls in either model, the following discussion is largely confined to the single channel associated with A1. For the stereo model, this discussion applies equally to board A3 and all other parts of the right channel.

Transistors A1Q1 through A1Q15 with input and output attenuators A1R4, A1R31 and output transformer T2 comprise a high quality audio amplifier with push-pull (balanced) design throughout. Diodes A1CR1 and A1CR2 form a

Variolosser (variable loss device) whose attenuation varies as a function of the control voltage which it receives from A2Q4. Thus, the overall system gain becomes a function of output level, as determined by rectifiers 1 and 2, and the input level as determined by rectifier 3. (See figure 4-1.) Each of the three rectifiers is appropriately weighted with respect to charge and discharge time constants to handle speech and music most effectively. For example, rectifier 2 is weighted to permit a more rapid discharge following a short impulsive signal -- excessive with respect to average program level -- than if there were merely an ordinary shift in average level.

The attack time of the Audimax circuitry, i.e., the time required to effect a gain reduction when the signal level rises suddenly, is approximately 10 milliseconds and is determined by the charging time of the rectifier 1 capacitor in the memory unit (figure 7-3). The recovery time, i.e., the time required to effect a gain increase when the signal level drops, is a function of several variables. Audimax utilizes the "platform" concept. This means that instead of a recovery action wherein the control voltage tends to follow the amplitude of the audio signal, peaks in the audio signal cause the gain to be set at an appropriate level and a reduction of signal amplitude from these peaks over a suitable range will be accommodated without gain change unless there is a change in <u>average</u> level. When an increase in gain does become necessary, this change is effected in a length of time determined by the resistance selected with the DECAY TIME switch, A2S1 (figure 7-3), which has three positions: S (slow), M (medium), and F (fast). The <u>G</u>ated <u>G</u>ain <u>S</u>tabilization (GGS) feature of the Audimax allows discharge at the main storage capacitor in the memory unit A2Z1 through the recovery resistor A2R9 (medium), A2R11 (slow), or A2R13 (fast). This provides for a slow upward drift, toward "platforms" of higher gain, only during the time when the program signal level exceeds the GGS threshold.

The GGS voltage, derived from rectifier 3, supplies a third input for the recovery AND gate (figure 4-1). If this voltage is positive, the normal recovery mode is in effect. However, during a lapse of audio, this AND input drops to about -4 volts, inhibiting the recovery gate and electrically opening the discharge path for the storage capacitor. In this way, gain is held constant during pauses until the GGS voltage again becomes positive.

The gentle action provided by the selected recovery resistor is especially useful in improving average modulation levels. This action is independent of the normal Audimax gain-riding functions, and is completely unobjectionable with normal programming. If it is deemed desirable to speed-up or slow-down this aspect of the recovery characteristics, the resistance value of A2R13 may be decreased or that of A2R11 may be increased, respectively. (See paragraph 3-5.) The GGS voltage also drives a time-delay return-to-zero circuit which is coupled to the control voltage bus (gate of A2Q4) by an OR circuit. If the audio program should lapse for more than 10 seconds, and if the system gain is greater than 0 dB, the gain will automatically be returned to 0 dB. Or, if the audio program should lapse for more than 20 seconds and the system gain is less than 0 dB, the gain will, similarly, be returned to 0 dB. These return-to-zero functions place the Audimax unit in a proper standby condition for the reappearance of audio signals after a program pause.

4-3. CIRCUIT OPERATION

The input signal is applied through the input attenuator A1R1 through A1R5 and the coupling capacitor A1C1 and A1C2 to the bases of the push-pull (differential) amplifier formed by A1Q2 and A1Q3. (See figure 7-2.) The transistor A1Q1 is used as constant-current source to bias the amplifier. The matched diodes A1CR1 and A1CR2 form Variolosser before the next stage of gain, A1Q5, A1Q6. The Variolosser diodes effect a variable shunt impedance on the audio path, controlled via A2R30 by the voltage from the source follower A2Q4 (figure 7-3.) Thus, amplifier gain varies as a function of control voltage. Transistors A1Q7 and A1Q8 (figure 7-2) are connected as emitter followers to provide a low driving impedance for the output and logic circuits.

The output stage consists of a 600-ohm output transformer, T2, driven by a class A push-pull amplifier A1Q14 and A1Q15, which is, in turn, driven by the balanced emitter followers A1Q12 and A1Q13. The output level is adjusted with the front panel OUTPUT potentiometer R2 (figures 7-1 and 7-2). The balanced gain stage A1Q10 and A1Q11 is used to compensate for the insertion loss of the attenuator network R2 and A1R29, A1R30.

The feedback control logic circuits, which follow the three rectifiers, are driven through OR gates permitting either one or two audio channels to act as the source(s) of the drive signals. Similarly, a feedback signal is available from each end of the AGC potentiometer A2R30 at the output of these logic circuits. Thus, the logic circuits, on board A2, are capable of monaural or stereo service.

For maximum efficiency and sensitivity to both positive and negative peaks, each side of each balanced channel is amplified with respect to ground and these two outputs A1Q20, 21 (or A3Q20, 21) drive the rectifiers. Rectifier 1 (figure 4-1) consists of two voltage doublers A1CR6, 7 and A1CR5, 8 (figure 7-2) (or A3CR6, 7 and A3CR5, 8). Each is biased at +12 volts. Rectifier 2 (figure 4-1) consists of two more voltage-doublers A1CR10, 12 and A1CR9, 11 (figure 7-2) (or A3CR10, 12 and A3CR9, 11). These are biased at +6 volts.

The program audio signal is rectified by rectifier 1 and the negative voltage thus generated is applied through A2R10 (figure 7-3) to the main storage capacitor in the memory unit (figure 7-3). This point is connected to the gate of the FET source-follower A2Q4, which has negligible loading effect on the storage capacitor and also serves as a low-impedance voltage source for the Vario-losser(s). Rectifier 2 also generates a negative voltage from the program audio signal but, because of the different bias and different time constants, its output may be more or less negative than that of rectifier 1; this will depend on program dynamics. The control voltage applied to A2Q4 from either audio channel is obtained from the corresponding rectifier 1 <u>or</u> rectifier 2, <u>depending upon which rectifier output is the less negative</u>. This measurement is made by the comparator.

4-4. GATED GAIN STABILIZER (GGS)

GGS action is employed to prevent the Audimax circuit from seeking its maximum gain during a lapse of audio greater than 2 seconds. For this discussion, "lapse of audio" refers to a condition wherein the input signal level is below the GGS threshold. Referring to figure 7-2, the signal from the collectors of A1Q2, 3 is capacitively coupled to the balanced push-pull amplifier A1Q17, 18. The amount of gain in this stage determines the GGS threshold, and the gain is determined by A1R63, 64 (see paragraph 3-3). The push-pull amplifier output is applied to a single-ended rectifier driver A1Q19, which drives rectifier 3 (the biased voltage-doubler A1CR3, 4). The positive GGS voltage there developed is stored across A1C16, which has a relatively fast discharge path in A1R73.

With no input, the GGS voltage is about -4 volts, but, as signal is applied, the GGS voltage becomes more and more positive up to a limit of about +10 volts. Rectifier 3 determines the voltage at the output of rectifier 2 whenever the output of rectifier 2 is less negative than the output of rectifier 3. If the input signal were suddently removed without rectifier 3 in the circuit, the control voltage would soon return to zero. However, since the no-signal output of the board is -4 volts, the output from rectifier 2 will rise only up to -4 volts upon signal lapse; thereupon, rectifier 2 will relinquish control to rectifier 3, which continues to furnish an output at a constant -4 volts. This means that the output of rectifier 1 must also remain at -4 volts, and the amplifier gain is held constant until the reappearance of signal causes the output of rectifier 3 to become positive with respect to that of rectifier 1. Since rectifier 3's attack and decay times are much faster than those of rectifier 1 or 2, it assumes rapid control when signal changes occur requiring such action. Rectifier 3's behavior may be likened to an electronic "gate" which either inhibits or permits gain increases in accordance with the input signal level.

4-5. FUNCTIONAL GRAPHS

The functional graphs in figure 4-2 illustrate the steady-state interrelationships among the several elements of the Audimax circuitry. Figure 4-2E is a composite, or overall, graph of the Audimax action. Figures 4-2A through 4-2D each illustrate one function independently of the others, but they are arranged in such a way as to allow one to see the interrelationships.

Figure 4-2A indicates the relative gain of the Variolosser (in decibels) as a function of control voltage. For example, when a control voltage of -2v is applied, the Variolosser loss is approximately -15 dB.

Figure 4-2B shows the outputs of rectifiers 1 and 2 as a function of Audimax output levels. The voltage across the storage capacitor developed by the biased rectifier 1 is shown by the curve OGH, while the voltage developed by rectifier 2, which drives the comparator, is shown by curve OJQ.

Figures 4-2C and D, along with 4-2B, can be used to illustrate the platform principle. Below an input level of -40 dBm, the Audimax has a constant gain of 40 dB. Now consider the case where the input level is smoothly increased from -50 dBm to -15 dBm, then back down to -50 dBm. As the input is increased from -40 dBm to about -35 dBm, the gain of the device is constant because, although rectifier 2 has developed about -3 volts, the output from rectifier 1 is zero. Since 0v is less negative than -3v, rectifier 1 controls the gain. This is

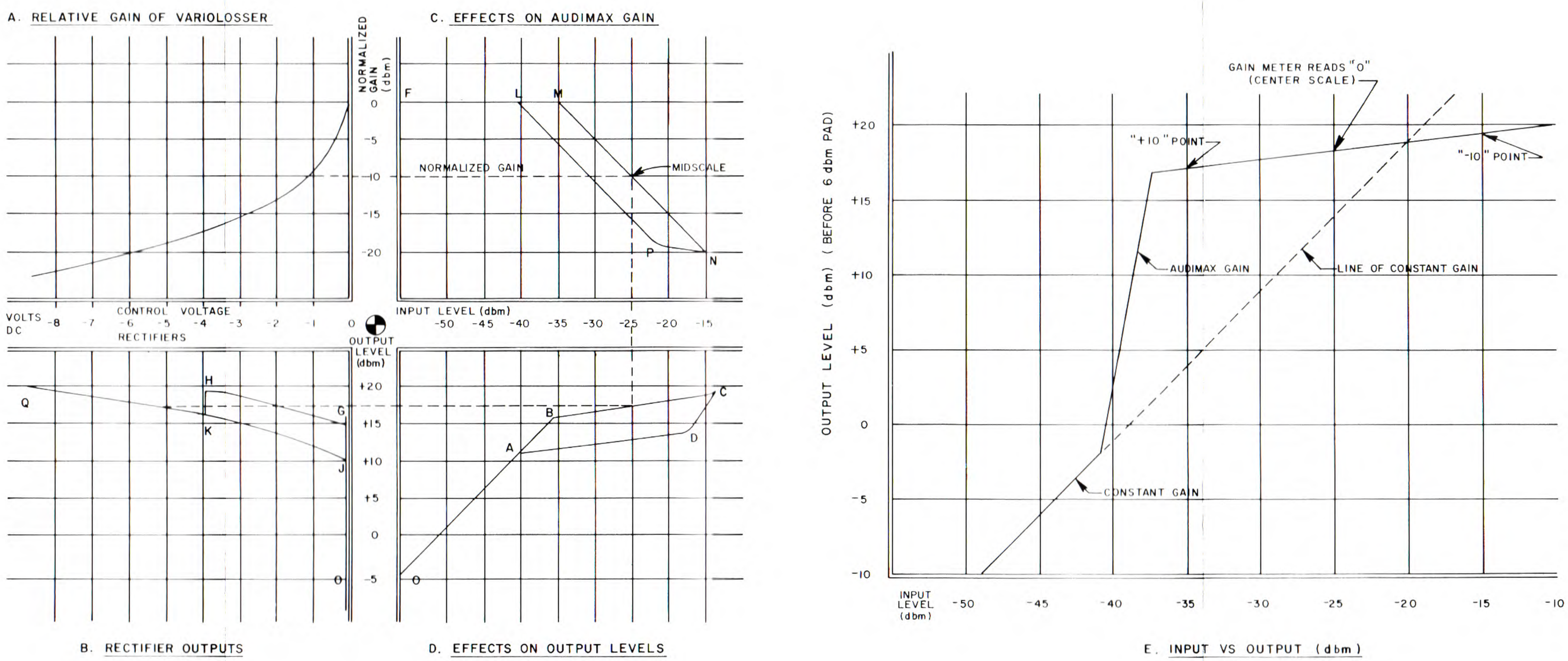


Figure 4-2. Functional Graphs

shown on the normalized gain curve, figure 4-2C, as the straight portion of the curve, FM. Here normalized gain is shown as a function of input level. As the input is further increased above -35 dBm, rectifier 1 begins to develop negative dc (curve GH, figure 4-2B). Since the output of rectifier 2, JQ, is more negative than the output of rectifier 1, control remains with rectifier 1, Audimax gain follows the line MN, and the output is determined by the line BC (figure 4-2D).

When the input level has reached -15 dBm, the output is +19 dBm and the normalized gain reduction is 20 dB. If the input level is now reduced, the output of rectifier 1 will not become less negative, because charge is retained by the recovery AND circuit; hence, as the input drops from -15 dBm to -20 dBm, the gain remains constant along NP, the output follows the line CD, control voltage to Q27 remains constant along HK while the output of rectifier 2 drops along QK.

As the input level is reduced below -20 dBm, however, the output of rectifier 2 becomes less negative than the output of rectifier 1, and gain control reverts to rectifier 2. Thus, the gain increases along the line PL and the Audimax output level follows the line DA because both rectifiers act along KJ. Finally, at the input levels below -40 dBm, the Audimax circuit becomes a constant gain amplifier.

Figures 4-2A through D may be used to determine the Audimax behavior for either ascending or descending input signal levels by rectangular projection along the four sets of curves, using the rule of precedence indicated above.

It must be remembered that the gain control is vested in rectifier 1 or 2 according to which has the less negative output.

The composite input-output curve is shown in figure 4-2E. (The INPUT and OUTPUT level controls are still set fully clockwise.) This graph illustrates the overall steady-state relationship between the input and the output. Bear in mind that the behavior shown in all of these figures indicates only the steady-state performance of the Audimax circuit. Transient behavior is a complex function of these characteristics, and has been carefully designed to produce artistically acceptable automatic level control.

4-6. POWER SUPPLY

The regulated power supply in the Audimax unit provides +20 vdc and -15 vdc. The schematic diagram of the regulated power supply is shown in figure 7-3. Line regulation is used to prevent variations in the ac line input from affecting Audimax circuit operation. Line voltage is applied to the primary of the power transformer T2 through the front panel POWER switch S1 and fuse F1 (figure 7-1). The primary of T2 can be strapped for nominal 117-volt or 230-volt operation. (See paragraph 2-3.) The secondary winding is center tapped and supplies 50 vac to drive the full-wave bridge rectifier A2CR1. Resistors A2R2, 3 and capacitors A2C1, 2, 4 filter the positive output of the bridge and supply an unregulated dc voltage to the collector of A2Q2 which is operated as a series-pass (emitter follower) regulator. The zener diode A2VR2 supplies a constant +20 volts to the base of A2Q2 via A2R7. The emitter voltage of A2Q2 is always 0.6 volt lower than the base voltage when this transistor is in the "on" condition. Thus, the nominal positive output is +19.4 volts.

Similarly, A2R1 and A2C3 filter the negative output of the bridge rectifier and supply an unregulated negative voltage to the collector of the PNP transistor A2Q1 which is also operated as a series-pass regulator. Zener diode A2VR1 sets the base potential of A2Q1 at -15 volts. Thus, the nominal negative output is -14.4 volts.

4-7. TEST SWITCH AND METER

For the OFF position of the TEST switch (figure 7-1), the Audimax unit operates while the GAIN meter monitors the voltage at the source of A2Q4 (figure 7-3). This voltage is proportional to Variolosser attenuation, and the meter indicates the approximate relative gain in the system. For the TEST position, the switch connects the control line to the voltage divider consisting of A2R15, 16 and A2CR4, 6 (figure 7-3), providing a constant gate potential for A2Q4 and overriding all other control voltages. This constant gate potential is equivalent to the approximate midpoint gain of the Audimax circuit, i.e., GAIN meter center scale.

4-8. STEREOPHONIC OPERATION

The stereo Audimax model differs from the monaural Audimax model only in the addition of the input/output board A3 and associated controls, switch, transformer, and connector. The board A3 and the other additional parts are identical to A1 and its associated parts and provide for a second high quality, variable-gain channel. The original channel (A1) is normally used for "left" information and the second channel (A3) for "right" information.

Two GGS voltages are generated in stereophonic operation, one from each channel. These are connected to the logic circuitry by the logical "OR" gate A2CR3, 5 (figure 7-3). Thus, when either channel has a program level above the GGS threshold, the normal recovery mode is in effect. Rectifier 3 assumes control only if the inputs to both channels are below the GGS threshold. In the logic circuit, both channels drive independent rectifiers 1 and 2. Thus, in the left channel, rectifier 1 is composed of A3CR6, 7 and A3CR5, 8. Similarly, rectifier 2 in the left channel is composed of A1CR10, 12 and A1CR9, 11 and in the right channel is composed of A3CR10, 12 and A3CR9, 11. In creating the control voltage, the outputs of all four diode pairs termed rectifier 1 are combined in a logical OR function and collectively used to charge the main storage capacitor in the memory unit as previously described. The four diode pairs termed rectifier 2 are likewise combined and collectively used to drive an input to the comparator. In this way, the composite rectifier 1 and rectifier 2 voltages are determined by whichever of the two channel input signals is higher in level. The two derived voltages are processed as previously described in paragraphs 4-2 and 4-3.

This system arrangement insures that, in stereo operation, the signal in one channel cannot be enough greater than the other to cause overmodulation. Furthermore, since identical control voltages are fed back into the two channels, the channels change gain in tandem, preventing any shift of the stereo center.

This preservation of balance in both amplitude and phase is vital when broadcasting matrixed quadraphonic records; such as those recorded in the Columbia SQ(TM) system. In the SQ system, the rear channels are encoded as signals of equal amplitude in both left and right channels but at a relative phase of 90° -- left leading for a left back signal, right leading for a right back signal. However, if receivers are to decode this information correctly, it is imperative that this relative amplitude and phase relationship be maintained throughout the transmission chain.

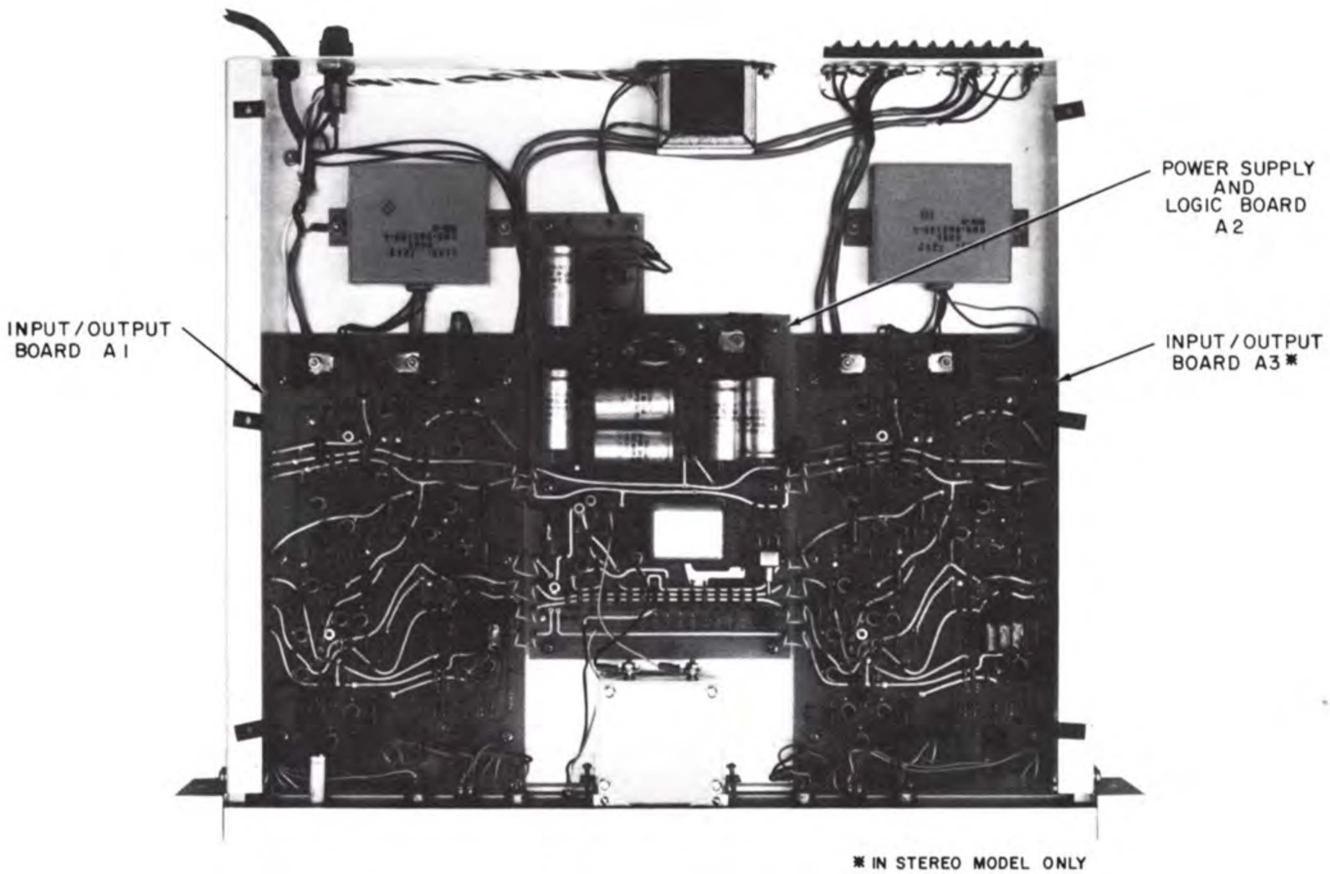


Figure 5-1. Audimax Circuit Boards and Their Locations

SECTION V

MAINTENANCE

5-1. GENERAL

If necessary to make internal adjustments or troubleshooting checks and replacements in the Audimax unit, remove the cover (removed in figure 5-1).

See figures 7-2 and 7-3 for circuit-board parts locations.

NOTE

The instructions in this section have been largely prepared for the stereophonic Audimax model. To the fullest appropriate extent, the same instructions should also be followed for the monaural model. Steps requiring "both inputs" or "both outputs" to be connected in parallel, etc., are to be omitted for the monaural model, but all steps and measurement values pertinent to the left audio channel, a logic circuit, or power supply are equally applicable to the monaural model.

5-2. QUICK OVERALL CHECK

A. Connect both inputs together and turn the INPUT and OUTPUT level controls completely clockwise. Place the TEST switch in the TEST position and each CONTROL switch in the ON position.

B. Apply a sine-wave input level of 30 mv rms to either input connector pin.

C. The following list indicates the approximate voltages to be expected at the test points indicated if the unit is functioning correctly. Ac measurements should be made with a VTVM and dc measurements with a VOM having a sensitivity of at least 20,000 ohms per volt. All measurements should be made against the ground test point on the circuit board under test.

Circuit	Test Point	Voltage
Left control voltage	A1TP1	-1.1 dc
Left output A	A1TP3	0.30 ac
Left output B	A1TP2	0.30 ac
Left drive A	A1TP5	0.35 ac
Left drive B	A1TP4	0.35 ac
Power Supply:		
+20 volts	A2TP2	+19.4 dc
-15 volts	A2TP1	-14.4 dc
Panel meter		Should read at mid-scale
Left GGS output	A1TP9	+12.5 dc
Platform	A1TP10	-6.5 dc
Control (Note: measure this point with a VTVM only.)	A2TP5 or A2TP6	-1.3 dc
Right GGS output	A3TP9	+12.5 dc
Right control voltage	A3TP1	-1.1 dc
Right output A	A3TP3	0.30 ac
Right output B	A3TP2	0.30 ac
Right drive A	A3TP5	0.35 ac
Right drive B	A3TP4	0.35 ac

The output level from each channel should be 3 volts (+12 dBm).

D. Next, place the TEST switch in the OFF position. The test-point status should remain approximately the same.

E. Alternately switch the left and right CONTROL switches to OFF. The test-point status should again remain approximately the same.

F. Separate the two inputs. Proceed with alignment or troubleshooting if the readings obtained were significantly different from the indicated values.

5-3. ELECTRICAL ALIGNMENT PROCEDURE

A. Turn the INPUT and OUTPUT controls fully cw. Set A1R17, A1R44, A2R24, and A2R30 in center positions, A1R15 in midposition, A2R27 fully cw, TEST switch at TEST, and CONTROL switch at ON. Set A2S1 at M (medium).

B. With no input, adjust A2R24 for a zero (0) reading on the GAIN meter.

C. Connect a jumper between the control test point A2TP5 and ground. Then apply a 1-kHz signal at a level of 12mv to the input of the left channel. The output, when terminated with a 600-ohm load, should read 3.75 volts rms (13.7dBm) ±1 dB.

D. Adjust A2R27 for 0.5 dB reduction in output.

E. Short the left channel input, place the TEST switch in the OFF position, and remove the jumper. The GAIN meter reading should return to 0 in about 10 ±2 seconds. Remove the input short.

F. Slowly increase the input test-signal level until GAIN meter reads in center of green region. Output level should be 3.0v rms (11.8 dBm) ± 1 dB.

G. Decrease the output level by 10 dB. The GAIN meter should read +10. The output should decrease less than 1 dB with respect to the final level in F.

H. Increase the input level by 20 dB. The GAIN meter should read -10 or slightly off scale to the left. The output should increase less than 1.5 dB with respect to the final level in F.

I. Measure the harmonic distortion of the left channel output at 1 kHz (input signal frequency). Minimize the distortion by adjusting A1R17. It should be less than 0.5 percent.

J. Remove the input. After the meter reading has come to rest in the green region, adjust A1R15 for minimum output noise. The wideband noise measured should be less than 0.9mv rms. Alternately repeat step I and the present step until both noise and distortion are minimized.

K. Drop the input signal frequency to 50 Hz and measure the harmonic distortion in the output. Now minimize the distortion by adjusting A1R44. It should be less than 0.5 percent.

L. Measure the distortion at 5 kHz and 15 kHz. It should be less than 0.5 percent.

M. If the unit is monaural, the alignment is complete. If stereo, perform the preceding steps at board A3 for the right channel. (The A2 settings are the same as above.) Then proceed with steps N and O below.

N. Connect the two inputs in parallel and apply a 1-kHz input signal of sufficient amplitude to cause the GAIN meter to read in the center of the green region. Monitor the two outputs.

O. Adjust A2R30 as required to equalize the two outputs. Then separate the two channels.

5-4. TROUBLESHOOTING SUGGESTIONS

A. Power Supply Board (Board (A2))

Troubleshooting of any apparent malfunction of the Audimax unit should begin with a check of the power supply. The dc voltages indicated at the power supply test points on board A2 should be within ± 10 percent of the nominal values indicated on the schematic diagram, figure 7-3. Accidental shorting of the +20-volt supply could cause A2Q2 to fail. Similarly, shorting of the -15-volt supply could cause A2Q1 to fail. The normal value of ripple is 1 mv p-p in the +20v supply, 2 mv p-p in the -15 volt supply. The presence of ripple voltages significantly in excess of these values indicates defective filter capacitors A2C1 through A2C6.

B. Input Circuit (Left or Right)

The quickest way to check the input circuit is the procedure given in paragraph 5-2. If the control voltage is correct but not the signal voltages, check the dc voltages at the transistors. The problem may be a defective transistor or a shorted coupling capacitor C3 or C4 on board A1 or A3. If the voltages seem normal, an opened coupling capacitor (C1 through C6 on board A1 or A3) is probably the trouble source.

C. Output Circuit (Left or Right)

If the input circuit appears satisfactory but the output is deficient in level or distorted, the output circuit should be checked. Paragraph 5-2 indicates the proper drive voltages to be expected at the appropriate test points. If the outputs of the board A1 or A3 are correct but not the corresponding drive voltages, suspect the A1 or A3 stage containing Q10 and Q11. If the drive voltages are present but no output, examine the transistors in the A1 or A3 output amplifier, Q12 through Q15. If any of these transistors is replaced, it will be necessary to readjust R44 on the same board. In this case, feed a 50-Hz signal to the input at a level sufficient to drive the meter to midscale, and adjust R44 as necessary to minimize the harmonic distortion in the output. The distortion in a correctly operating Audimax channel is less than 0.5 percent.

D. GGS Circuit (Left or Right)

For an input signal of zero volts, the output of the GGS circuit should be approximately -3.5 volts. Apply an input signal of -45 dBm to the channel under test and monitor the corresponding GGS output while slowly raising the input level. The GGS output should rise to 0 volt for an input of 0.009 volt (-39 dBm). With further increasing input, the GGS output should continue to rise until it reaches a limiting value of +11.5 volts for an input level of 0.05 volt (-22 dBm). (If the GGS threshold has been modified as outlined in paragraph 3-3, the input levels at which the foregoing actions occur will be different.)

E. Logic Circuits

CAUTION

Be careful when making the following tests. The memory unit can be permanently damaged if the voltmeter probe shorts these points to other voltages.

(1) Testing the Logic Circuits. The solid-state memory unit on board A2 has been encapsulated in epoxy for maximum stability and protection. No attempt should be made to open it, since all test measurements can be made at appropriate external connection points. Before undertaking any tests of the memory unit, be sure that the input/output board(s) and Gated Gain Stabilizer (GGS) circuit(s) are functioning properly.

To test the steady-state performance of the logic circuits and memory unit (A2Z1), first turn the INPUT level control fully clockwise. An input of -30 dBm at 1 kHz then should produce -1 volt at A2Z1-4 and -6 volts at A2Z1-2.

With A2R27 correctly set, there should be -1 volt at connection point A2E5-2 (figure 7-3), which should cause approximately 10 dB of gain reduction in the Variolosser. To check the relinquishment of control by rectifier 2 to rectifier 3, slowly decrease the input level to -30 dBm while monitoring the voltage at pin 2 of the memory unit. Use a vacuum-tube voltmeter with an input impedance of at least 10 megohms. This voltage should rise toward 0, then change direction and move progressively back toward larger negative values at approximately -45 dBm. The turning point occurs when the output of rectifier 3 becomes more negative than the output of rectifier 2.

The steady-state voltage relationships are graphically shown in figure 4-2.

(2) If Necessary to Replace A2Q4: several calibration adjustments will have to be made when the replacement transistor is installed. Important: Replace A2Q4 with the same transistor type and manufacture as installed when the Audimax unit was shipped from the factory. Then follow one -- not both! -- of the two adjustment procedures given below. The procedure to follow depends on the type of transistor used for A2Q4, also the values and circuit configuration of the other parts of this transistor stage.

(a) For TIS58 (Grn Stripe)* replacement of A2Q4 (circuit configuration "A" per page 6-3 and figure 7-3):

NOTE

Circuit configuration "A", using a TIS58 (Grn Stripe) transistor, is easily recognized by the presence of a transistor socket for A2Q4 and the absence of a potentiometer A2R35. If A2Q4 has a socket and there is no A2R35, follow this procedure. If A2Q4 has no socket and there is a potentiometer A2R35, follow the procedure in subparagraph (b).

1. Before inserting the replacement transistor, measure its source-to-drain current, I_{dss}, in a bench test circuit as shown in figure 5-2.

2. Inspect the following list of I_{dss} limits to determine whether a bleeder resistor (dash-lined in the configuration "A" diagram of figure 7-3) is needed in the Q4 circuit on board A2.

*Field effect transistor (FET) by Texas Instruments

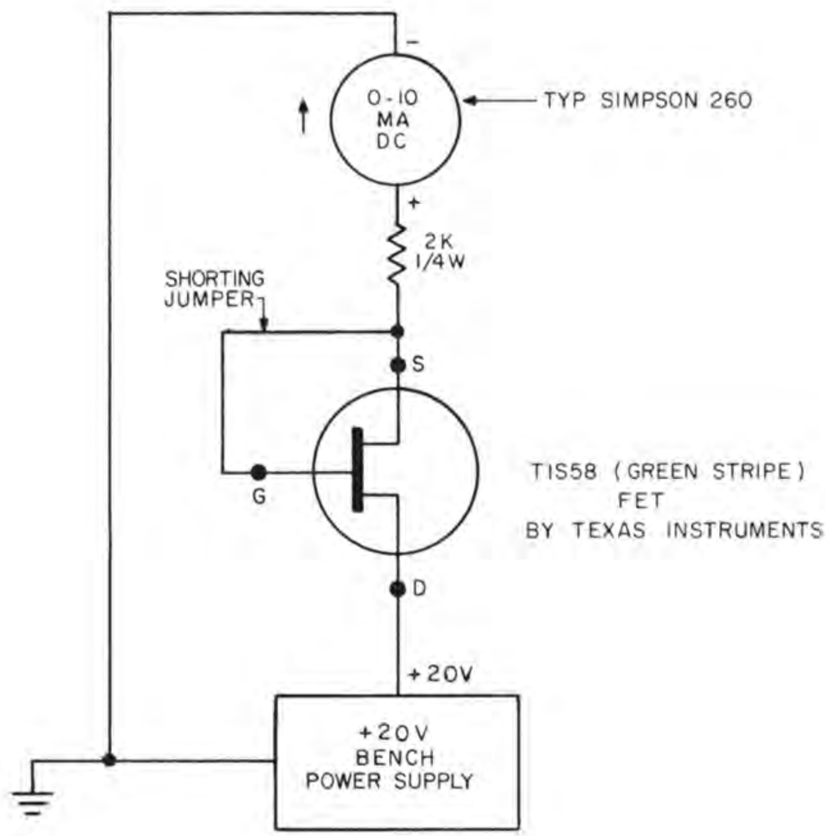


Figure 5-2. I_{dss} Bench Test Circuit for T1S58 (Grn Stripe) Replacement of A2Q4

I_{dss} Min	I_{dss} Max	Bleeder Resistor (1/4w, ±5%)
7.8	8.0	4.3K
7.3	7.7	5.1K
6.8	7.2	6.2K
6.3	6.7	7.5K
5.8	6.2	10K
5.3	5.7	15K
4.8	5.2	30K
4.0	4.7	No resistor

3. Remove inappropriate bleeder, if a bleeder was previously installed. Connect appropriate bleeder, if required. Connect one end of the bleeder to the FET source pin of the A2Q4 socket, using the run to the end of the potentiometer A2R29. Connect the other end of the bleeder to the -15v terminals of the board (E19-1 and E19-2), using the available -15v run that has a blank hold.

4. Remove the replacement FET from the bench test circuit and plug it into the Q4 socket. The flat of the FET must face the adjacent memory unit (metal can).

5. Recalibrate A2R24, A2R27, and A2R30, as necessary, in accordance with the alignment procedure in paragraph 5-3.

(b) For 2N5952* replacement of A2Q4 (circuit configuration "B" per page 6-3 and main diagram in figure 7-3):

NOTE

Circuit configuration "B", using a 2N5952 transistor, is easily recognized by the absence of a transistor socket for A2Q4, and the presence of an I_{dss} calibration potentiometer, A2R35. If A2Q4 has no socket and there is a potentiometer A2R35, follow this procedure. If there is a socket for A2Q4 and no potentiometer A2R35, follow the procedure in subparagraph (a).

1. Install the replacement transistor. Then place the front panel TEST switch in upper position and remove signal inputs (if any).

2. Connect a jumper from A2TP5 (control) to A2TP4 (ground). Connect a second jumper between A2TP6 (control) and A2TP7 (I_{dss}).

*Field effect transistor (FET) by Texas Instruments

3. Adjust A2R24 for full scale deflection of the front panel GAIN dB meter, to the right.

4. Remove the jumper from A2TP4 and A2TP5.

5. Adjust A2R35 as needed to deflect the GAIN dB meter between the mid-green mark and the full-scale-to-right mark.

6. Further adjust A2R35 as needed for a deflection as far to the right as possible without going off scale.

7. If a vtvm is available, use it to measure the dc voltage at A2TP5 (gate of A2Q4). A potential from 0v to -1v dc should be here. This verifies proper setting of A2R35. If the voltage is satisfactory, leave A2R35 at its present setting; otherwise, repeat the preceding steps.

8. Remove the jumper from A2TP6 and A2TP7.

9. Recalibrate A2R24, A2R27, and A2R30, as necessary, in accordance with the alignment procedure in paragraph 5-3.

5-5. TRANSIENT PERFORMANCE

To check transient performance, turn INPUT level control fully cw; then drive GAIN meter to 0 dBm with 1-kHz signal. Increase input +10 dB. GAIN meter should read at least -10. Output should be +10 dBm.

With the DECAY TIME switch in the SLOW position, rapidly reduce the input signal exactly 20 dB. Recovery to maximum gain should then occur in two steps: 1) after an initial delay, quickly to a reading of approximately +5 dB, then slowly to +10 dB. The fast mode of recovery is typical of the speed at which gain is increased when program levels exceed the lower boundaries of the "platform". The slower recovery mode is equivalent to that speed at which a drift toward "platforms" of higher gain occurs. This latter time constant is controlled by A2R9, A2R11, and A2R13.

After the gain has stabilized at maximum, short out the input signal and watch the GAIN meter. Gain should remain constant for at least 8 seconds and then slowly return to the normal region.

Next, increase the input signal level 20 dB for a GAIN meter reading of approximately -10 dB. Short out the input signal and check that, after at least 20 seconds delay time, the gain will recover to 0 dB.

To verify correct operation of the Gated Gain Stabilizer (GGS), apply a 1-kHz input signal at the level required to produce a reading of 0 dB on the GAIN meter. Then quickly reduce the input 20 dB. The meter reading should not move out of the green region. Increase the input 6 dB and check that the meter reading moves out of the green region toward maximum gain.

This check is valid only for 100-ohm resistors A1R63, A1R64 and A3R63, A3R64 as factory supplied. If the values of these resistors have been changed to alter the GGS threshold, the performance check must be accordingly changed.

SECTION VI

PARTS LIST

6-1. GENERAL

This section contains parts lists for the complete monaural or stereo Audimax unit. Each list gives the circuit designation of the part, an electrical description, a reference to the manufacturer where significant, and that manufacturer's part number. In all cases, the use of original manufacturers' parts is recommended for any necessary replacements. If the part cannot be readily obtained, contact Thomson-CSF Laboratories to procure it.

6-2. RESISTORS

Except where otherwise indicated in the parts lists, all resistors used in the Audimax unit are carbon composition, 1/4 watt, plus or minus 5%.

6-3. TRANSISTORS AND DIODES

When replacing transistors and diodes called out in the parts lists with 1N and 2N standard numbers, replace them with the same manufacturing brands of transistors or diodes as removed, when possible. Where the parts list indicates a specific manufacturer and part number, only that part should be used for the replacement.

6-4. MANUFACTURERS' NAME ABBREVIATIONS

AB	-	Allen Bradley
ALCO	-	Alco Electronic Products, Inc.
AMRA	-	American Radionics
AUG	-	Augat
BECK	-	Beckman
BEL	-	Belden
CDE	-	Cornell Dubilier
CIN	-	Cinch Manufacturing
CK	-	C & K Components
COM	-	Components, Incorporated
FAIR	-	Fairchild Semiconductor
HHS	-	Herman H. Smith
IERC	-	IERC, Inc.
LF	-	Littlefuse
MA	-	Mallory
MO	-	Motorola
MR	-	Milton Ross
SLOA	-	Sloan
SPR	-	Sprague
T-CSF	-	Thomson-CSF Laboratories, Inc.
THRM	-	Thermalloy
TI	-	Texas Instruments
VAR	-	Varo

DESIGN DIFFERENCES NOTE

Several parts in the latest serial-number Audimax units differ from corresponding parts in units of earlier manufacture. Most of these differences relate to a change in the type of transistor used as A2Q4. In the earlier serial-number units, A2Q4 is a TIS58 (Grn Stripe) FET by Texas Instruments (TI), requiring an associated circuit "A". In late serial-number units, A2Q4 is a 2N5952 FET by TI, requiring an associated circuit "B". For convenience, all differences between the latest and earlier serial-number units are summarized below in the Configuration "A" and Configuration "B" columns.

Location	Ref Para.	Ref Desig.	Configuration "A"*	Configuration "B"**
Power supply and logic board A2	6-7	R26	3.9 kilohms	4.7 kilohms
		R27	Variable, 200 ohms	Variable, 500 ohms
		R32	3.9 kilohms	2 kilohms
		R33	1.2 kilohms, 1w	1 kilohm, 3 w
		R34	Not used	3.6 kilohms
		R35	Not used	Variable, 50 kilohms
		Bleeder resistor (no reference designation)	Value determined at test. (See Section V.)	Not used
		Q4	FET TIS58 (Grn Stripe) by TI	FET 2N5952 by TI
Front panel assembly	6-8	DS1	Indicator (red), LED (SLOA)	Indicator (red), LED (FAIR)

*Earlier serial numbers
**Latest serial numbers

6-5. MAIN ASSEMBLY (MODEL 4440A or 4450A)

Ref	Description	Mfr	Part No.	T-CSF No.	Used on (X) Model 4440A	Used on (X) Model 4450A
	Chassis assembly	T-CSF		962156	X	X
	Front panel assembly (See paragraph 6-8.)	T-CSF		962161-1* or -3**		X
	Front panel assembly (See paragraph 6-8.)	T-CSF		962161-2* or -4**	X	
	Nameplate	T-CSF		960315-66	X	
	Nameplate	T-CSF		960315-67		X
	***Accessory kit and assembly	T-CSF		962163-1	X	
A1	Input, GGS, logic I output circuit board assy (See paragraph 6-6.)	T-CSF		961627	X	X
A2	Power supply and logic II circuit board assy (See paragraph 6-7.)	T-CSF		961628-2* or -3**	X	X
A3	Input, GGS, logic I output circuit board assy (Same as A1. See paragraph 6-6.)	T-CSF		961627		X
F1	Fuse, 3/10 amp	LF	3AG SLO-BLO	991256	X	X
T1	Transformer	T-CSF		962132	X	X
T2	Transformer	T-CSF		962133	X	X
T3	Transformer	T-CSF		962132		X
TB1	Terminal strip	HHS	850	991188	X	X

*Configuration "A". See Design Differences Note on page 6-3.
**Configuration "B". See Design Differences Note on page 6-3.
***Customer option - used to convert Model 4440A to a Model 4450A.

6-5. MAIN ASSEMBLY (MODEL 4440A or 4450A) (Cont)

Ref	Description	Mfr	Part No.	T-CSF No.	Used on (X) Model 4440A	Model 4450A
TB2	Terminal strip	CIN	353-18-10-001	991518	X	X
XF1	Fuseholder	LF	342012	990595	X	X
	Three-wire power cord assy	BEL	17237	991443	X	X

6-6. INPUT/OUTPUT BOARD A1 or A3*

Ref	Description	Mfr	Part No.	T-CSF No.
	RESISTORS			
R1	620 ohms			
R2, R3	2.4 kilohms			
R4	(Not used)			
R5	10 ohms			
R6, R7	24 kilohms			
R8, R9, R18, R25, R26, R29, R30, R34, R35, R56, R60, R61, R67, R72	10 kilohms			

*Board A3 is included only in the stereo Model 4450A

6-6. INPUT/OUTPUT BOARD A1 or A3* (Cont)

Ref	Description	Mfr	Part No.	T-CSF No.
	RESISTORS (Cont)			
R10	12 kilohms			
R11, R12	560 ohms			
R13, R14, R87	6.2 kilohms			
R15, R17	Variable (linear Helipot.) to 10 kilohms	BECK	62PR10K	991315
R16, R19	4.7 kilohms			
R20	1 kilohm			
R21, R22, R37, R38	75 ohms			
R23, R24, R59	5.1 kilohms			
R27, R28, R32, R33, R57, R58, R69, R74, R75	100 kilohms			
R31	(Not used)			
R36	1.2 kilohms			
R39, R40	3 kilohms			
R41, R42, R88	5.6 kilohms			
R43, R45, R62	9.1 kilohms			
R44	Variable (linear Helipot.) to 2 kilohms	BECK	62PR2K	991314
R46, R47, R71	30 kilohms			
R48	15 ohms			
R49, R50	33 ohms			
R51, R52, R54 R55	100 ohms			

*Board A3 is included only in the stereo Model 4450A

6-6. INPUT/OUTPUT BOARD A1 or A3* (Cont)

Ref	Description	Mfr	Part No.	T-CSF No.
	RESISTORS (Cont)			
R53	820 ohms			
R63, R64	200 ohms	AB	CD	
R65, R66, R82, R85	20 kilohms			
R68	680 kilohms	AB	CD	
R70	510 ohms			
R73	51 kilohms			
R76, R77	47 kilohms			
R78, R79	910 kilohms			
R80, R81	27 kilohms			
R83, R84	240 ohms			
R86	8.2 kilohms			
	CAPACITORS (Values in microfarads, except where otherwise indicated)			
C1, C2, C5 thru C14, C17, C18	4.7, 35v, ±20%	MA	TAC475M035P04	991317
C3, C4, C15	8.2, 35v, ±20%	MA	TAC825K035P04	991318
C16, C19 thru C22	0.47, 100 wvdc, ±20%	AMRA	2MBPC1474M	991252
C23	Not used			

*Board A3 is included only in the stereo Model 4450A

6-6. INPUT/OUTPUT BOARD A1 or A3* (Cont)

Ref	Description	Mfr	Part No.	T-CSF No.
	CAPACITORS (Cont)			
C24	200 pf, ±5%	CDE	CM05FD201J03	991203
C25, C26	100 pf, ±5%	CDE	CD15FD101J03	991158
	SEMICONDUCTORS			
CR1, CR2	Diode		1N456A**	
CR3 thru CR12	Diode	FAIR	1N456A***	961806
Q1, Q4, Q7 thru Q13, Q16, Q19, Q20, Q21	Transistor		2N3393	
Q2, Q3, Q5, Q6	Transistor	MO	MPS 6521	
Q14, Q15	Transistor		D40D4	
Q17, Q18	Transistor		2N3390	
	MISCELLANEOUS			
	Transipad	MR	10171	990747
	Heatsink	IERC	PA1-1CB	991316
	Etch, drill, and mark assy			961621-1

*Board A3 is included only in the stereo Model 4450A

**Matched pair; V_f matched to within 10v when I_f = 1.0 ma.

***Must have opaque body

6-7. POWER SUPPLY AND LOGIC BOARD A2

Ref	Description	Mfr	Part No.	T-CSF No.
	RESISTORS			
R1	100 ohms, 2 w			
R2	12 ohms, 3 w, wirewound	SPR	242E1205	991332
R3	3.9 ohms, 1/2 w			
R4	1 kilohm, 1/2 w			
R5	470 ohms, 1/2 w			
R6	82 ohms, 1/2 w			
R7	68 ohms, 1/2 w			
R8	33 kilohms			
R9	5.1 megohms			
R10, R17	100 kilohms			
R11, R23	10 megohms			
R12	750 ohms			
R13	3 megohms			
R14, R18	1 megohm			
R15	680 ohms			
R16	51 kilohms			
R19	10 kilohms			
R20	6.2 kilohms			
R21	2 kilohms			
R22	300 kilohms			
R24	Variable (linear Helipot.) to 1 kilohm	BECK	62PR1K	991161
R25	2.2 kilohms			

6-7. POWER SUPPLY AND LOGIC BOARD A2 (Cont)

Ref	Description	Mfr	Part No.	T-CSF No.
	RESISTORS (Cont)			
R26 (Configuration "A")	3.9 kilohms			
R26 (Configuration "B")	4.7 kilohms	AB	Type CB	
R27 (Configuration "A")	Variable (linear Helipot.), to 200 ohms	BECK	62PR200	991163
R27 (Configuration "B")	Variable (linear Helipot.), to 500 ohms	BECK	62PR500	991162
R28	1.2 kilohms			
R29	820 ohms			
R30	Variable (linear Helipot.), to 5 kilohms	BECK	62PR5K	991311
R31	Not used			
R32 (Configuration "A")	3.9 kilohms			
R32 (Configuration "B")	2 kilohms	AB	Type CB	
R33 (Configuration "A")	1.2 kilohms, 1 w	AB		
R33 (Configuration "B")	1 kilohm, 3 w	SPR	242E1025	991716
R34 (Configuration "A")	Not used			
R34 (Configuration "B")	3.6 kilohms	AB	Type CB	
R35 (Configuration "A")	Not used			

6-7. POWER SUPPLY AND LOGIC BOARD A2 (Cont)

Ref	Description	Mfr	Part No.	T-CSF No.
	RESISTORS (Cont)			
R35 (Configuration "B")	Variable, (linear Helipot.), to 50 kilohms	BECK	62PR50K	991433
No ref. (Configuration "A" only)	Resistor, fixed, bleeder, R value in range of 4.3 kilohms to 30 kilohms (or no resistor) as determined at test*.			
	CAPACITORS			
	(Values in microfarads, except where otherwise indicated.)			
C1 thru C6	250, 50v electrolytic	MA	TCW250N050P1J	991320
C7	33, 4vnp	COM	NS336A	991149
	SEMICONDUCTORS			
CR1	Diode, rectifier	VAR	VE18	991219
CR2, CR3, CR5 thru CR13	Diode	FAIR	1N456A**	961806
CR4	Not used			
Q1	Transistor	GE	D41D1	
Q2	Transistor		2N3766	
Q3	Transistor, PNP	MO	2N3906	
Q4 (Configuration "A")	Transistor, FET	TI	TIS58 (Grn Stripe)	
Q4 (Configuration "B")	Transistor, FET	TI	2N5952	

*See Section V.
**Must have opaque body

6-7. POWER SUPPLY AND LOGIC BOARD A2 (Cont)

Ref	Description	Mfr	Part No.	T-CSF No.
	SEMICONDUCTORS (Cont)			
VR1	Diode, zener, 15v		1N4744A	
VR2	Diode, zener, 20v		1N4747A	
	MISCELLANEOUS			
S1	Switch, DPDT	CK	7211A	991313
XQ4	Socket, transistor	AUG	8060-1G7	990662
Z1	Memory unit assy			961594-1
	Transipad	MR	10171	990747
	Heatsink	IER	PA1-1CB	991316
	Heatsink	THRM	6166	991312
	Etch, drill, and mark assy			961622-1

6-8. FRONT PANEL ASSEMBLY

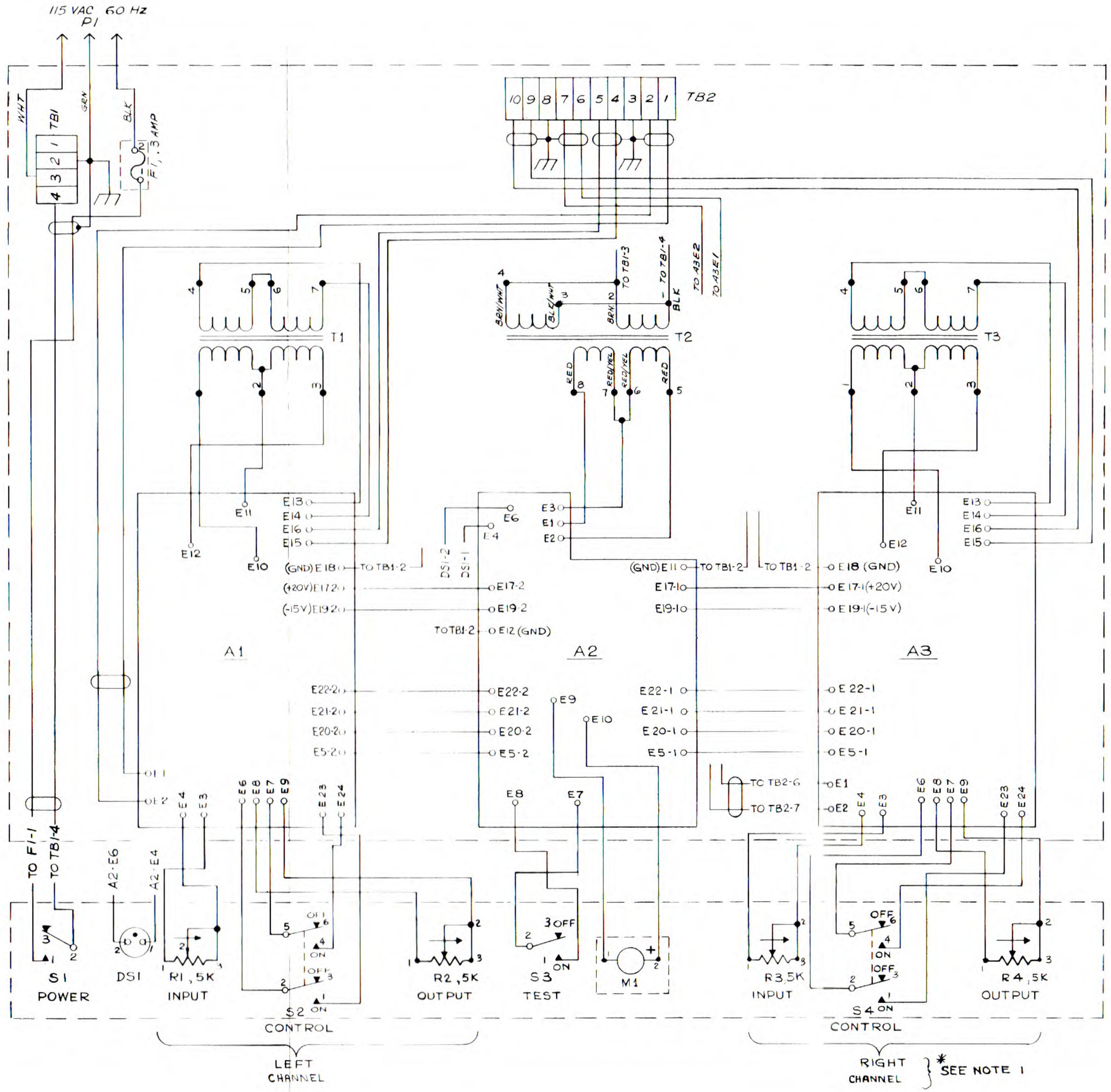
Ref	Description	Mfr	Part No.	CBS No.	Used on (X) Model 4440A	Used on (X) Model 4450A
DS1	Indicator, LED (red) (Configuration "A")	SLOA	P175RRRJPD		X	X
DS1	Indicator, LED (red) (Configuration "B")	FAIR	FLV110	921729	X	X
M1	Meter			962167	X	X
R1, R2	Resistor, variable to 5 kilohms	AB		991303	X	X
R3, R4	Resistor, variable to 5 kilohms	AB		991303		X

6-8. FRONT PANEL ASSEMBLY (Cont)

Ref	Description	Mfr	Part No.	T-CSF No.	Used on (X) Model 4440A	Used on (X) Model 4450A
S1, S3	Switch, SPDT	ALCO	MST-105D	991176	X	X
S2	Switch, DPDT	ALCO	MST-205N	990851	X	X
S4	Switch, DPDT	ALCO	MST-205N	990851		X
XDS1	Not used (Configuration "A")					
XDS1	Socket (Configuration "B")	AUG	8060-1G34	991708	X	X
	Adapter, panel mount (for DS1) (Configuration "B" only)	FAIR	FLS-012	991730	X	X

SECTION VII

DRAWINGS



NOTES:

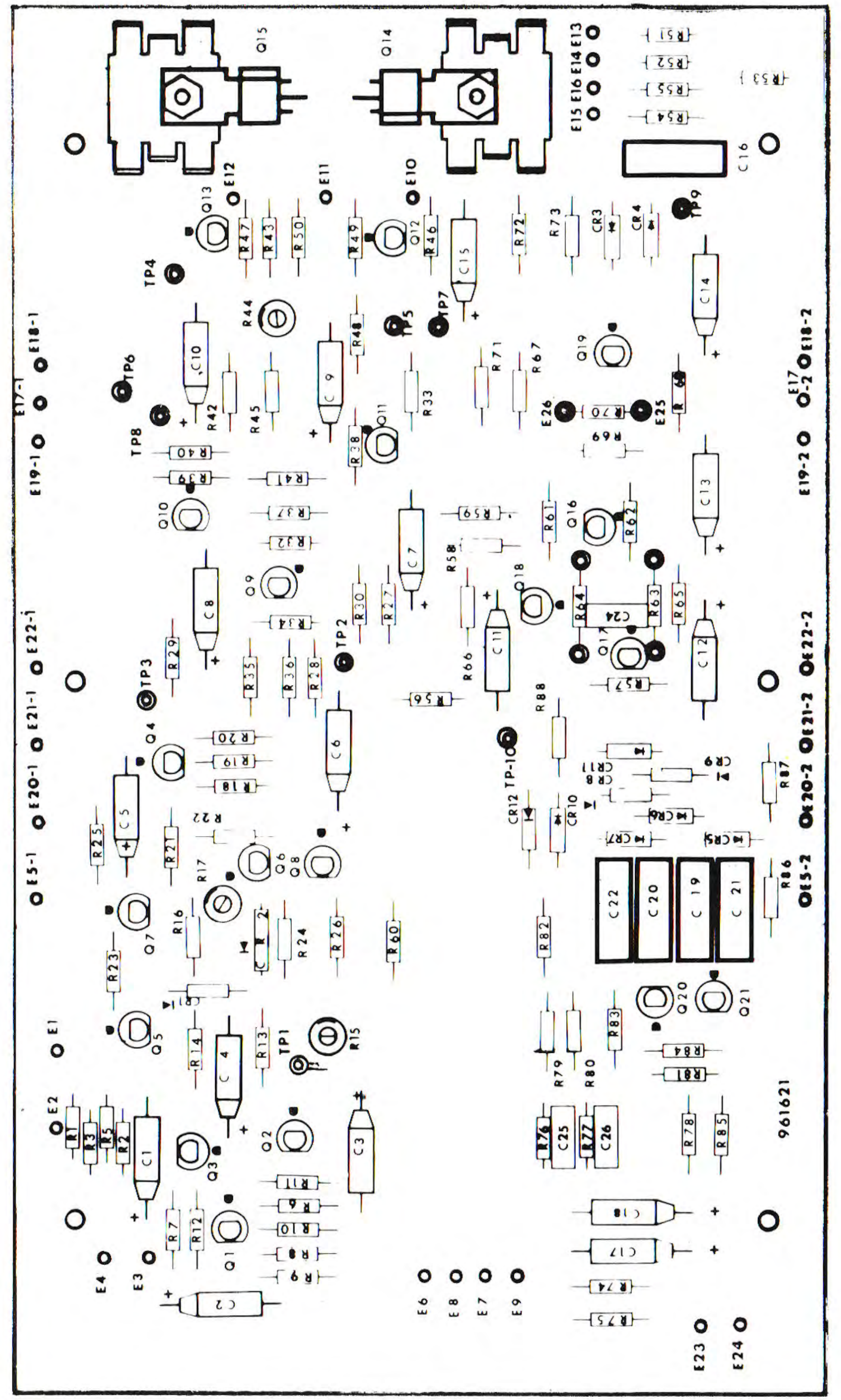
1. *RIGHT CHANNEL TO BE USED WITH STEREO ONLY.
2. AUDIMAX MONAURAL MODEL 4440A.
3. AUDIMAX STEREO MODEL 4450A.

This diagram applies to the stereo Audimax Model 4450A. The electrical schematic of the monaural Audimax Model 4440A is identical except for the omission of the following components and their associated wiring:

Board assembly	A3**
Output transformer	T3
Connectors	J2, P2
INPUT potentiometer	R3
OUTPUT potentiometer	R4
CONTROL switch	S4

** Identical to board assembly A1

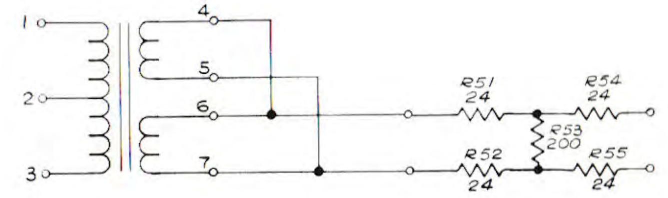
Figure 7-1. Audimax Unit, Internal Interconnections



NOTES:

1. UNLESS OTHERWISE SPECIFIED:
   A. ALL RESISTOR VALUES ARE IN OHMS, 1/4 W, ±5%.
   B. ALL CAPACITOR VALUES ARE IN MICROFARADS.
   C. ALL TRANSISTORS ARE TYPE 2N3393.
   D. ALL DIODES ARE TYPE 1N645A. DIODES CR1 AND CR2 ARE TO HAVE FORWARD VOLTAGE DROPS MATCHED TO WITHIN ±10 MV AT A FORWARD CURRENT OF 1 MA. DIODES CR3 THROUGH CR12 MUST BE INSENSITIVE TO AMBIENT LIGHT IN ACCORD WITH DWG. B961806.

2. FOR 150-OHM OPERATION:
   A. INPUT: CHANGE R1 FROM 620 OHMS TO 150 OHMS.
   B. OUTPUT: CHANGE OUTPUT CIRCUIT TO:



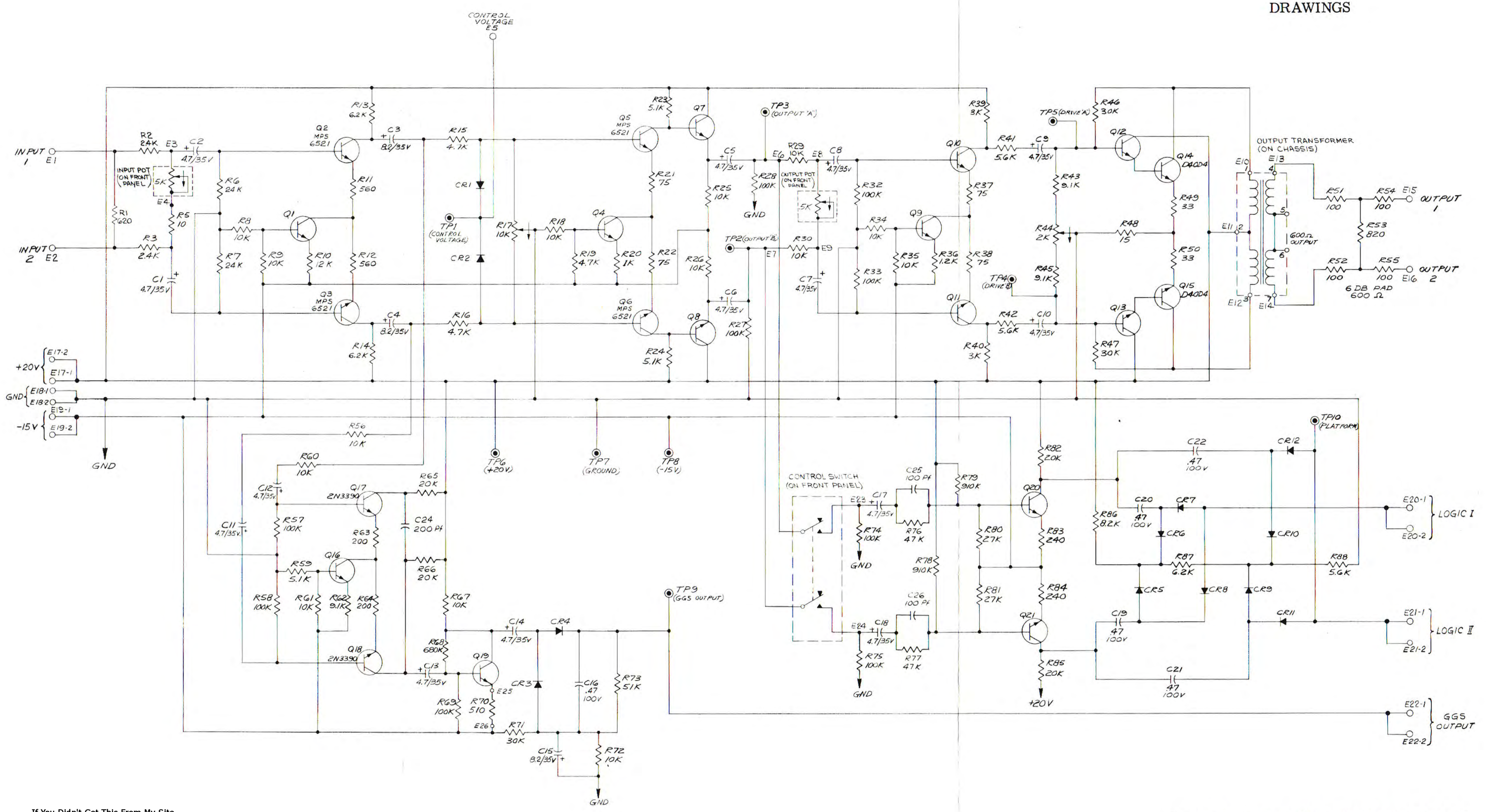
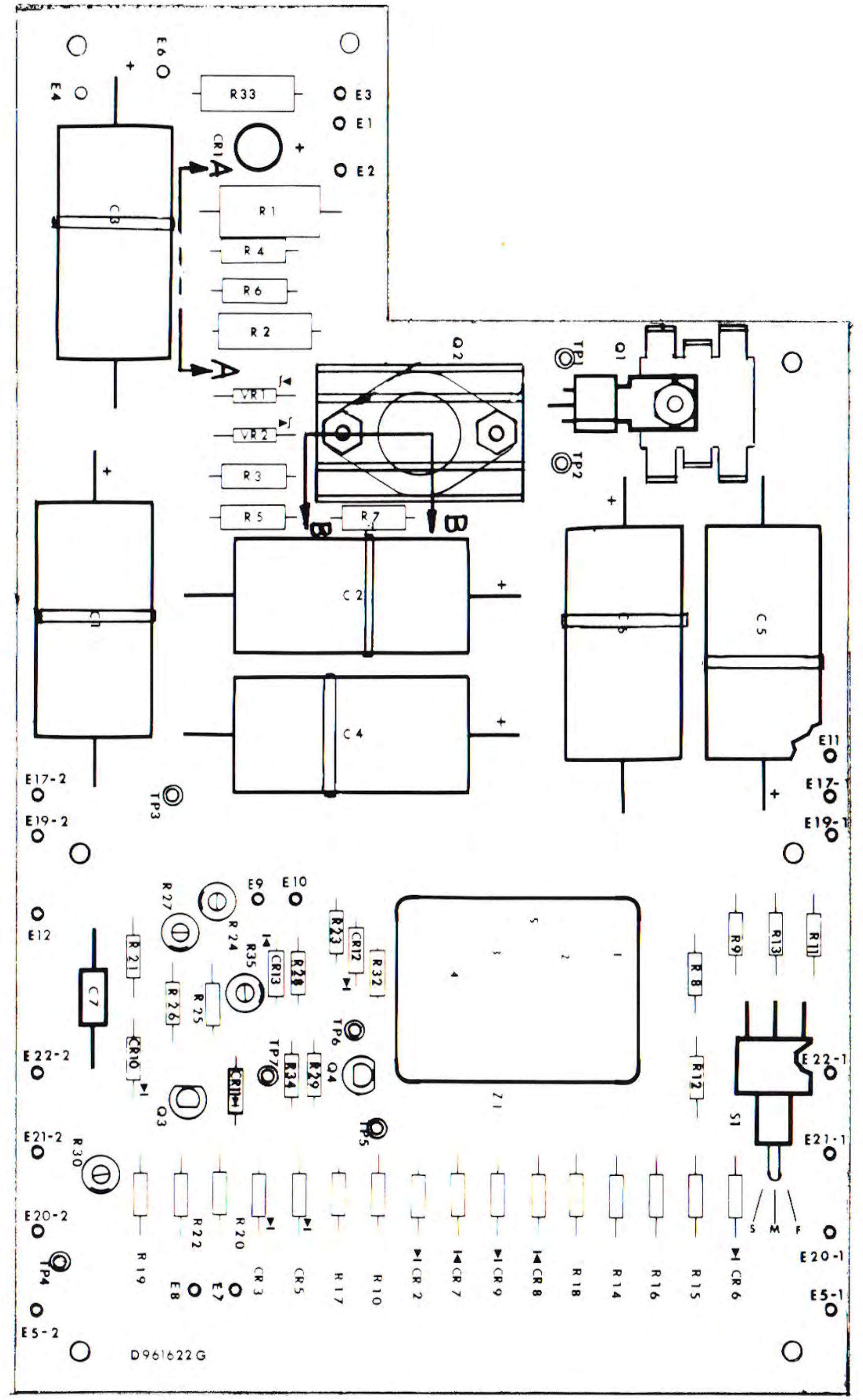
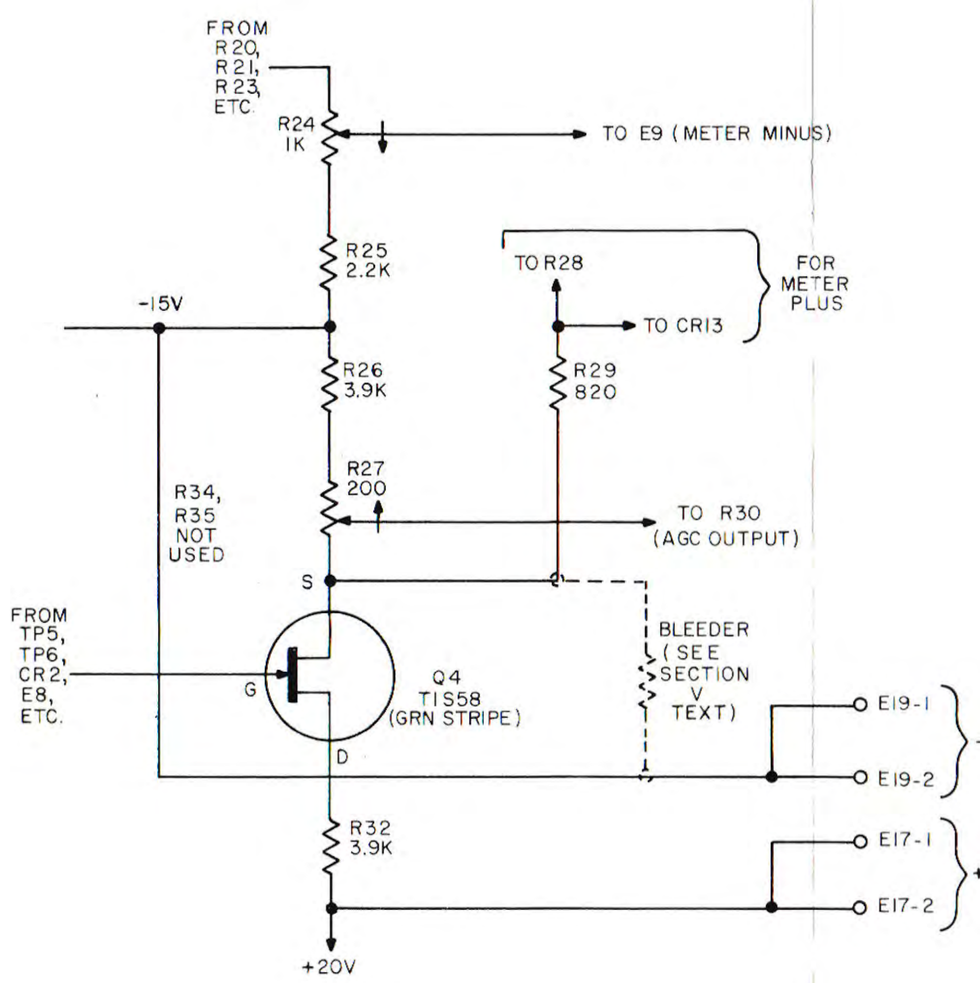
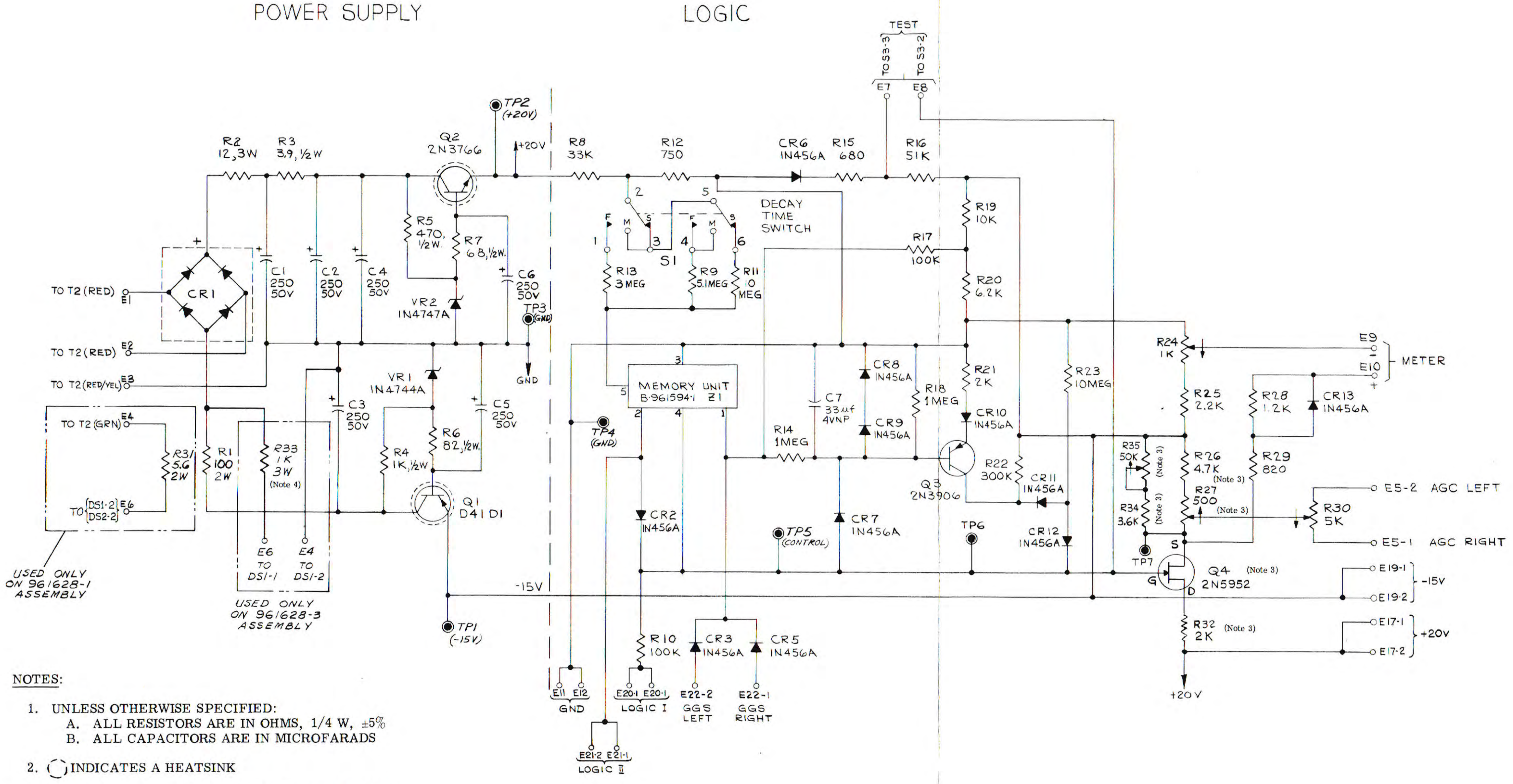


Figure 7-2. Input/Output Board A1 or A3, Schematic Diagram and Parts Locations





Q4 CIRCUIT CONFIGURATION "A"
(SEE NOTE 3)



NOTES:

1. UNLESS OTHERWISE SPECIFIED:
   A. ALL RESISTORS ARE IN OHMS, 1/4 W, ±5%
   B. ALL CAPACITORS ARE IN MICROFARADS
2. ( ) INDICATES A HEATSINK
3. Q4 CIRCUIT CONFIGURATION "B" SHOWN IN MAIN DIAGRAM. SEE SUPPLEMENTARY DIAGRAM ON APRON OF THIS ILLUSTRATION FOR Q4 CIRCUIT CONFIGURATION "A" (EARLIER SERIAL-NUMBER AUDIMAX UNITS).
4. CONFIGURATION "B" VALUE OF R33 SHOWN. IN CONFIGURATION "A" (EARLIER SERIAL-NUMBER AUDIMAX UNITS), VALUE OF R33 IS 1.2K, 1 W.

Figure 7-3. Power Supply and Logic Board A2, Schematic Diagram and Parts Locations