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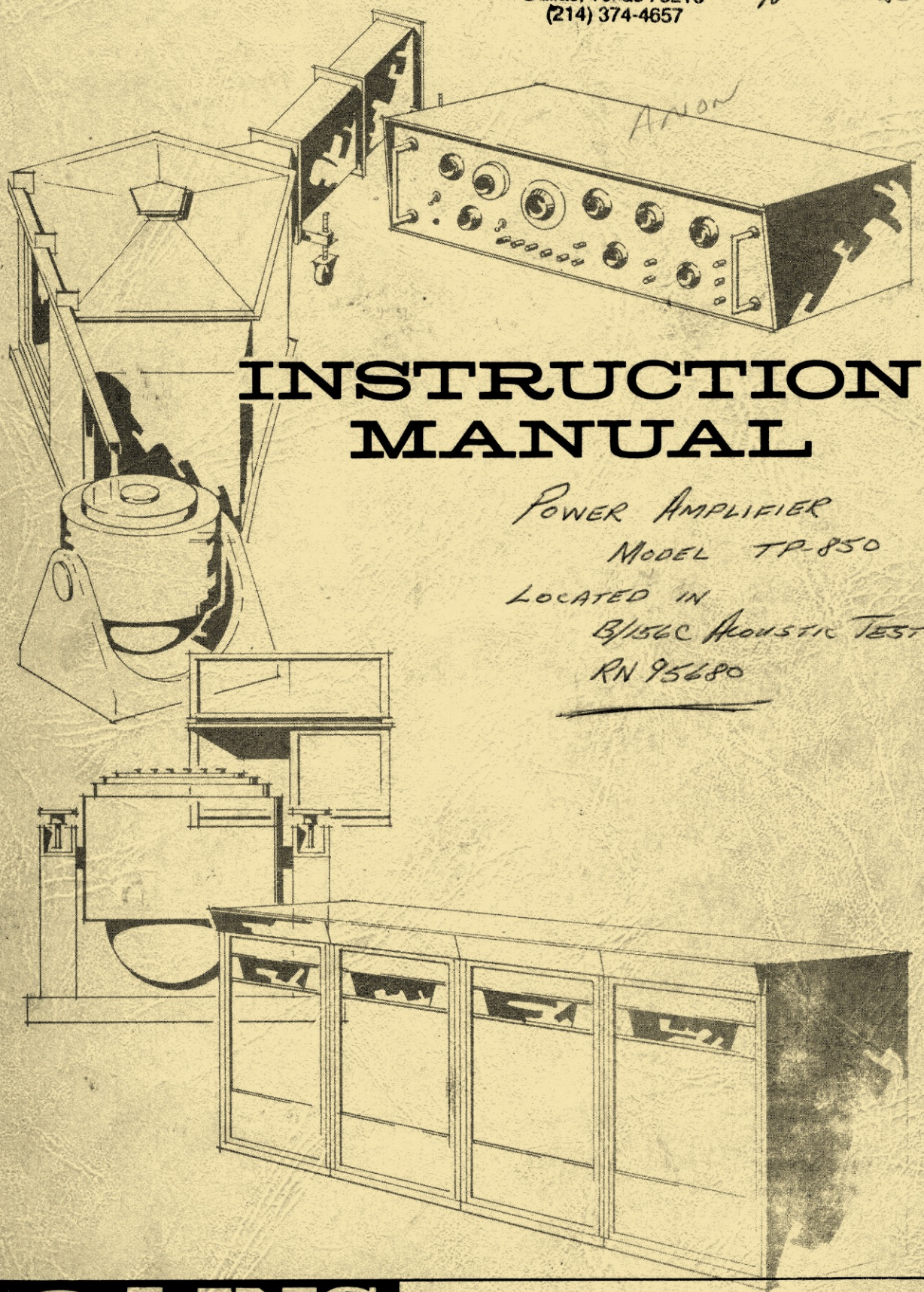

INSTRUCTION MANUAL

POWER AMPLIFIER
MODEL TP-850
LOCATED IN
B/156C ACOUSTIC TEST FACILITY
RN 95680

LING Electronics
A DIVISION OF LTV LING ALTEC, Inc.

Acco

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MODEL

TP-850
POWER AMPLIFIER

IN ALL CORRESPONDENCE WITH THE FACTORY BE SURE TO INCLUDE THE FOLLOWING INFORMATION:

EQUIPMENT MODEL NUMBER
SERIAL NO. 89-92
LING NO. 4340

LING Electronics
A DIVISION OF LTV LING ALTEC, Inc.
1515 S. MANCHESTER AVENUE, ANAHEIM, CALIFORNIA 92803 (714)774-2000

TP-850-38-4

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ADDENDUM

MODEL TP-850 POWER AMPLIFIER

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ADD: 5-4. MODIFICATION TO STANDARD MODEL

a. GENERAL

The Model TP-850 Power Amplifier covered by this addendum has been modified to provide remote control capabilities. The remote control modification enables the user to operate the TP-850 by convenient pushbutton switches.

b. OPERATION

(1). To operate the TP-850 Power Amplifier using the remote control unit, ensure that all control switches on the TP-850 are in the off position, then proceed as follows:

(a). Press the LINE START switch and the LINE START lamp will light.

(b). Ensure that the oscillator output (TP-850 input) is at minimum.

(c). Press the DC START switch and the DC START lamp will light.

CAUTION

WHEN EITHER THE REMOTE CONTROL OR LOCAL SWITCHES ARE USED, FOLLOW THE ABOVE PRESCRIBED SEQUENCE IN PARAGRAPH b. (1). SHOULD THE TP-850 INPUT BE ABOVE MINIMUM BEFORE THE DC START SWITCH IS PRESSED, IT COULD DAMAGE THE LOAD CAUSING THE CIRCUIT TO DUMP.

(2). To turn off the TP-850 using the remote control unit, the following procedure should apply:

(a). Press the DC STOP switch and the DC STOP lamp will light.

(b). Press the LINE STOP switch and the LINE STOP lamp will light.

NOTE

If the DC STOP switch is not pressed before the LINE STOP switch, the amplifier will crowbar, opening the circuit breaker. In time, if incorrect operation continues, the efficiency of the circuit breaker will be reduced.

c. PRINCIPLES OF OPERATION

When the LINE START switch is pressed, 115V ac is applied to pin B on jack J9. The current on pin B energizes relay K2. When K2 is energized, it is maintained through the latching contacts, the normally closed LINE STOP switch, and pin A. When the DC START switch is pressed, 115V ac is applied to pin D on jack J9. The current on pin D energizes relay K3. When K3 is energized, it is maintained through the latching contacts, the normally closed DC STOP switch, and pin C. With K3 energized, 115V ac is applied to terminal 2 of the REMOTE CONTROL SERVO MOTOR which is mechanically attached to CIRCUIT BREAKER CB1. K3 is deenergized by pressing the DC STOP switch, and 115V ac is applied to terminal 1 of the remote control unit, driving open CB1. The LINE STOP lamp will light. If the amplifier crowbars, relay K1 will open, causing K3 to open. The DC STOP lamp lights indicating that the DC power is off.

NOTE

Relay K1 is energized by the LINE START switch. The contacts on relay K1 have been wired in series so that if the DC START switch is pressed before the LINE START switch, the remote control unit will not turn on the amplifier.

d. ENGINEERING DRAWINGS

The following engineering drawings are required as part of this addendum:

50382-89-92 Schematic Model TP-850 Special

SECTION 1 - DESCRIPTION

1-1. INTRODUCTION

a. The Ling Electronics Model TP-850 Power Amplifier is a nominal 850-volt/ampere, solid-state amplifier. It consists of a full bridge, direct-coupled output stage with two preamplifier channels, each driving half-bridge circuits. The amplifier is completely self-contained. Internal fault-protection circuitry stops operation in the event of excessive output current or high temperature within the amplifier. The Model TP-850 has additional circuitry to provide shaker overtravel interlock protection.

b. The amplifier and associated power supplies are contained in a chassis designed for mounting in a standard 19-inch relay rack. All operating controls, indicators, and test connectors are located on the front panel. A thermocouple-type ammeter on the front panel provides an indication of output current. The input and output connections are located on the rear panel. A fan in the rear of the amplifier exhausts cooling air. Incoming air flows through a washable aluminum screen type filter at the front of the unit.

c. Section 5 provides a list of engineering drawings and supplementary information supplied with this instruction manual to aid in operating and maintenance of the Model TP-850.

1-2. ASSEMBLIES OF THE POWER AMPLIFIER

a. The power amplifier consist of the following major assemblies:

1. Pre-amplifier Assembly, 34993-1 (Two)
2. Heatsink Assembly (Final amp), 45740 (Two)
3. Fault Protection Assembly 34991

1-3. REFERENCE DATA

Output power	850 va max at any load power factor from 1.0 to 0.5 leading or lagging. (DC to 10 000 Hz).
Dissipation	2 000 watts max, continuous. (1 000 watts dc-50 Hz).
Output voltage	34v rms, 47.6 vdc max. 1.36Ω 578w/2Ω 433w/2.6Ω
Output current	30 amps rms max. 0.95Ω 722w/1.6Ω
Output impedance	Less than 0.1 ohm.
Frequency response(at rated power)	±0.5 dB, 5 to 10 000 Hz.

Distortion (max power) . . .	Less than 0.5%, 5 to 10 000 Hz.
Noise and Hum.	80 dB below full output.
Direct input:	
Frequency range . . .	dc to 10 000 Hz.
Input voltage	1 v rms ±10% for rated output.
Input impedance	1 500 ohms.
Isolated input:	
Frequency range . . .	15 to 10 000 Hz.
Input voltage	2 v rms max. for rated output.
Input impedance	Greater than 4 000 ohms.
DC offset drift.	Less than 70 mv for ac line and load change, 10 to 45°C.
Power requirements	115/230v, 50/60 Hz, 2 900 w.
Heat rejected to air	6850 BTU/Hr max., fan at rear exhausts 350 cfm approx.
Dimensions and weight:	
Width	19 in.
Depth	25 in.
Height	10-1/2 in.
Weight	125 lbs approx.

SECTION 2 - INSTALLATION AND OPERATION

2-1. INSTALLATION(Refer to the installation drawing listed in Section 5.)

a. As soon as the unit is received, unpack and inspect it for shipping damage, loose knobs and components, or other defects.

b. All components of the Model TP-850 are contained in one rack mounting chassis. Proper connections for the unit are listed in table 2-1.

NOTE

The TP-850 is normally wired for 115-volt operation. If operation from a 230-volt source is desired the following changes are necessary.

1. Remove the shorting bars from TB-2 between terminals 1-2, 3-4, 4-5, 5-6 and 6-7. (TB-2 is located on the bottom of the chassis.)
2. Place shorting bars on TB-2 between terminals 2-3, and 5-6.
3. Replace CB1 with a Heinemann AM12-15-250-5 circuit breaker.

c. Mount the unit in a 19-inch relay rack using standard hardware as illustrated in the installation drawing. Make the operational connections described in table 2-1.

CAUTION

THE INPUT SIGNAL CONNECTION MUST BE MADE TO ISOLATED INPUT CONNECTOR J3 WHEN USING A SINGLE-ENDED OUTPUT.

(1). When a normally-closed overtravel switch is used, connect a jumper from pin M to pin D with pin D connected to one side of the overtravel switch. The other side of the overtravel switch is connected to pin C.

(2). When a normally-open overtravel switch is used, connect pins C and D to the overtravel switch.

d. If technical assistance is required, Ling Electronics field service personnel are available to assist in initial setup, checkout, and briefing instructions.

TABLE 2-1. MODEL TP-850 OPERATIONAL CONNECTIONS

CONNECTION	FUNCTION
J1	117v, 50/60 Hz, operating power.
ISOLATED INPUT J3-1 and J3-2	Input signal, transformer-isolated, to TP-850.
J3-3	Chassis ground.

TABLE 2-1. MODEL TP-850 OPERATIONAL CONNECTIONS(cont)

CONNECTION	FUNCTION
TB1-1 and 2	Can be connected to the remote control terminals of an external field supply. This allows on/off control of field supply power from the TP-850.
TB1-C	To overtravel detector.
TB1-E and F	Tie point for the external field supply; to light the AUXILIARY lamp on the front panel.
TB1-H	Output 1 - one side of bridge output circuit for load connection.
TB1-J	Output 2 - other side of bridge output circuit for load connection.
TB1-M	Amplifier signal ground. (Isolated by 200-Ω).
TB1-N	Chassis ground.
TB1-D	Overtravel Detector.
TB1-K and L	(Blower motor may be terminated here from shakers as a tie point).
DIRECT INPUT J2-1 and J2-2	Differential input signal direct across gain control of TP-850.
J2-3	Chassis ground.

2-2. OPERATION

a. Make certain all requirements of paragraph 2-1 have been met. Refer to table 2-2 for a description of the functions of all operating controls and indicators. Locations of the operating controls and indicators are illustrated in figure 2-1.

CAUTION

NEVER OPERATE THE AMPLIFIER WITH THE TOP OR BOTTOM REAR COVERS REMOVED, THE VENTILATION PORT OBSTRUCTED, OR THE FAN DISABLED. IF ANY OF THESE CONDITIONS EXIST, THE AIR FLOW THROUGH THE OUTPUT ASSEMBLIES WILL BE INADEQUATE. THE ASSEMBLIES WILL OVERHEAT AND PERHAPS DESTROY THE OUTPUT TRANSISTORS.

b. Turn-on procedure.

(1). Set the LINE switch and DC circuit breaker to their off position.

(2). Set the GAIN control fully counterclockwise until the interlock switch is actuated.

(3). Set the LINE switch to ON, the GAIN lamp should light.

(4). Set the DC circuit breaker to ON, the AMPLIFIER lamp should light.

NOTE

The amplifier will not turn on unless the fault lamps are out. (OVERCURRENT, OVERTEMP, and OVERTRAVEL). If a fault occurs during operation, the corresponding fault lamp will be lighted and the amplifier will be turned off. In this case the LAMP TEST toggle switch should be momentarily placed in the LAMP TEST position. If the malfunction lamp does not go out, the turn-off procedure must be followed and the fault corrected.

(5). With the input signal set to at least 1 volt, adjust the GAIN control for desired output level as indicated on the OUTPUT CURRENT METER.

c. Turn-off procedure.

(1). Set the GAIN control fully counterclockwise.

(2). Set the DC circuit breaker to its off position.

(3). Set the LINE switch to the off position.

TABLE 2-2. MODEL TP-850 CONTROLS, INDICATORS AND CONNECTORS

PANEL MARKING	REFERENCE DESIGNATION	DESCRIPTION AND FUNCTION
STATUS		
OVERCURRENT	DS2	Indicator lamp that lights when an overcurrent condition exists.
OVERTEMP	DS3	Indicator lamp that lights when an overtemperature condition exists.
OVERTRAVEL	DS1	Indicator lamp that lights when shaker armature travel limits are exceeded.
AUXILIARY	DS6	Indicator lamp that lights when an external supply provides the required voltage, at TB1, E and F.
AMPLIFIER	DS5	Indicator lamp that lights during normal amplifier operation.
GAIN	DS4	Indicator lamp that lights when GAIN control is in the proper position for amplifier starting or operation.

TABLE 2-2. MODEL TP-850 CONTROLS, INDICATORS & CONNECTORS(cont)

PANEL MARKING	REFERENCE DESIGNATION	DESCRIPTION AND FUNCTION
TEST		
POS	TP2	Test point for measuring the positive voltage output from the amplifier +40-volt power supply.
COM	TP3	Test point access to amplifier signal ground.
NEG	TP1	Test point for measuring the negative voltage output from the amplifier -40-volt power supply.
OUT 1	TP6	Test point access to output of one side of the amplifier output bridge. Common to TB1-J.
COM	TP4	Signal ground.
OUT 2	TP5	Test point access to output of one side of the amplifier output bridge. Common to TB1-H.
OUTPUT CURRENT	M1	Meter that indicates the level in amperes of output current from the power amplifier.
GAIN	R1/S4	Potentiometer controlling gain through the two channels of the power amplifier. The switch is an interlock to prevent starting operation of the amplifier when the GAIN control is not fully counter-clockwise.
DC BAL	R3	Potentiometer that adjusts the dc offset between the two channels within the amplifier.
LAMP TEST, RESET	S3	Toggle switch that resets indicator lamp circuit after a fault indication and tests lamp circuits and fault lamps.
DC	CB1	Circuit breaker that applies power to the output stages of the amplifier.
LINE	S1	Applies initial power to the circuits and power supplies of the pre-amplifier.
S4(rear panel switch)	S4	Switch that selects either the isolated or direct input for the Model TP-850.

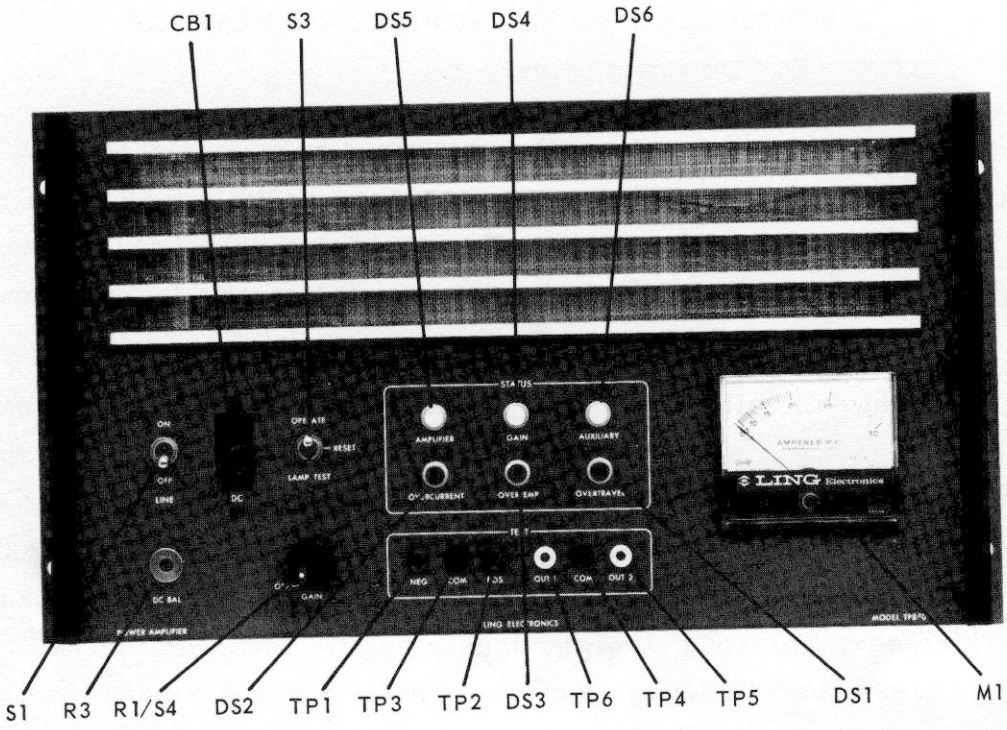
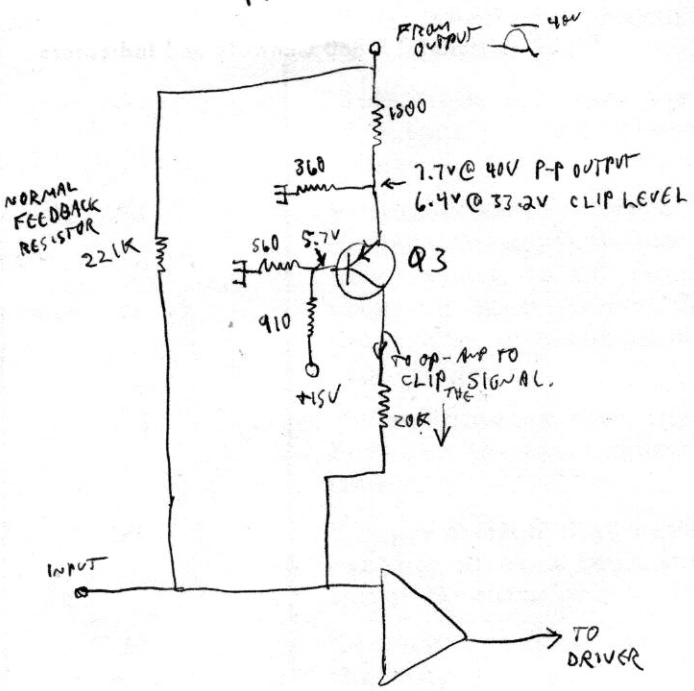


Fig. 2-1. Model TP-850 Controls and Indicators

PRE-AMP
PRE-CLIPPER



WHEN Q3 CONDUCTS, IT INCREASES FEEDBACK BY ABOUT 10X VOLTAGE. THIS EFFECTIVELY CLIPS THE AMP BEFORE THE OUTPUT STAGE CLIPS.

Q4 ACTS SAME, BUT ON NEGATIVE OUTPUT EXCURSIONS.

SECTION 3 - PRINCIPLES OF OPERATION

3-1. INTRODUCTION (Refer to figure 3-1).

The TP-850 consists of two identical preamplifiers and output stages (heat sink assembly), operated as operational amplifiers, combined to form two separate channels which operate as a complimentary full bridge with a push-pull output.

3-2. POWER AMPLIFIER OPERATION (Refer to the power amplifier schematic).

As the right and left channel of the power amplifier are identical, only one will be described.

a. The input signal to the power amplifier is applied through the gain control R1 to the pre-amplifier P. C. card, terminals J and F. The input to the pre-amplifier is applied to amplifier stage A1 which has a signal gain of approximately 300. From amplifier A1 the signal is applied through transistors Q1 and Q2, to J7 terminals A and E of the output stage (Heat Sink Assy). Q1 and Q2 are voltage amplifiers which supply the high voltage required to drive the output stage. Diodes CR3 through CR6 establish the biasing condition for the output stage and potentiometer R29 is adjusted for the proper quiescent current level through the output stages. Transistors Q3 and Q4 operate as feedback clippers which are normally biased by the -15 and +15 volts across the resistors at their base. The output voltage is applied at the emitters of Q3 and Q4, and when the output voltages reaches the biased voltages on the bases of Q3 and Q4 the transistors conduct holding the output voltage to a maximum peak level.

b. The signal from the preamplifier is applied to transistors Q1 and Q2 which drive the parallel bank of transistors Q3 through Q9. The preamplifier signal is applied simultaneously and in phase to both Q1 and Q10 on the positive and negative output circuits. Only one of the two banks of transistors conduct at a time. The output is taken at the emitter junction of the two banks. The thermister (pins B and D on the output assembly) monitors temperature buildup on the output assemblies. Diodes CR1 and CR2 provide transient suppression for the output assemblies.

3-3. FAULT PROTECTION CARD (Refer to the power amplifier schematic).

The fault protection P. C. Card provides circuit protection and front panel indication of amplifier malfunctions. With the amplifier operating normally, the AMPLIFIER, GAIN and AUXILIARY lamps will be lighted and the OVERCURRENT, OVERTEMP and OVERTRAVEL lamps will be out.

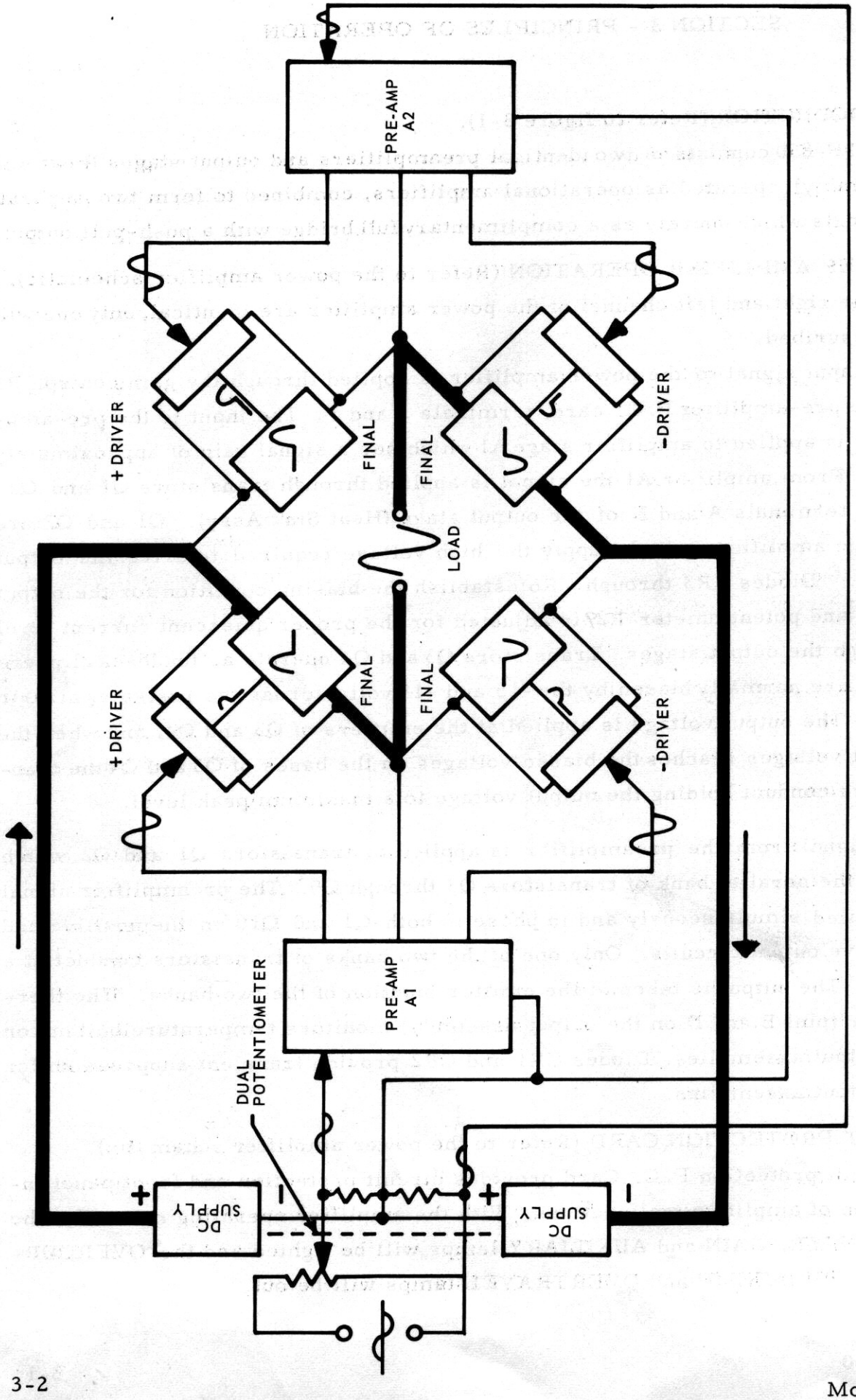


Fig. 3-1. Model TP-850 Functional Block Diagram

a. OVERCURRENT

Transistors Q1 and Q2 operate as voltage detectors. A voltage proportional to current through the driver and output stage is applied between the emitters and the bases of Q1 and Q2. Potentiometers R1 and R2 establish the positive and negative trip levels. With excessive current, either Q1 or Q2 drives Q3. Transistor Q3 drives the OVERCURRENT SCR circuits, and applies a voltage to SCR1 (crowbar) which shorts the ±40v power supply. Upon applying the short circuit breaker CB1 senses the excessive current and trips.

b. OVERTEMP

During a condition of excessive temperature in either of the output stages, a thermistor located on the heat sink of the output stage causes transistor Q4 to conduct, turning on SCR4. This causes the OVERTEMP lamp to be lighted. Also SCR1 is turned on which fires the crowbar circuit.

c. OVERTRAVEL

During a condition of overtravel by the shaker or associated equipment the OVERTRAVEL relay sends a pulse to transformer T1, which fires SCR1 firing crowbar circuit. This causes the OVERTRAVEL lamp to be lighted and the +40 and -40 volt power supply to be dumped, extinguishing the AMPLIFIER lamp.

d. AUXILIARY

During normal operation of the external field supply the AUXILIARY lamp will be lighted.

e. GAIN

If the GAIN potentiometer is not fully c.c.w. (with interlock switch actuated) prior to setting the DC circuit breaker CB1 to its ON position, the GAIN lamp will be out. In this condition relay K1 will dump the +40 and -40 volt power supply. (crowbar)

3-4. AMPLIFIER POWER SUPPLIES (Refer to the power amplifier schematic).

a. Operating power from connector J1 is applied to AC circuit breaker CB1 and line switch S1. When switch S1 is set to ON power is applied to transformer T2, and blower motor B1. Transformer T2 is a stepdown transformer supplying power to full-wave bridge rectifiers CR1 and CR2. CR1 supplies +24 volt power to the fault protection assembly and overtravel, overcurrent and overtemp lamps. CR2 applies +60 and -60 volts for preamplifier operation.

NOTE

LINE switch S1 must be set to ON before DC circuit breaker CB1 can be set to ON.

b. After LINE power has been applied, DC circuit breaker CB1 can be set to ON which applies power to step-down transformer T3. Transformer T3 supplies power to full-wave bridge rectifier CR3 which supplies +40 and -40 volts for output stage (Heat Sink Assembly) operation.

SECTION 4 - MAINTENANCE

4-1. GENERAL

a. The first step in servicing a malfunctioning Model TP-850 Power Amplifier is to localize the fault. Before performing any tests listed, make a complete visual inspection for evidence of overheating, cracked insulation, damaged wire or solder connections, etc.

b. The following is a list of checkout information provided in this section to simplify and shorten work required during equipment maintenance.

(1). Troubleshooting indications are provided to localize a defective part.

(2). Cleaning instructions are provided. Dust and corrosion are often responsible for equipment failures.

> **CAUTION**
>
> THE ALUMINUM SCREEN FILTER MUST BE CLEANED EVERY THREE MONTHS, OR MORE OFTEN, IN DUSTY ENVIRONMENTS.

(3). Calibration procedures are provided to align internal operating circuitry for optimum performance.

> **CAUTION**
>
> BEFORE REMOVING THE MODEL TP-850 POWER AMPLIFIER FOR MAINTENANCE, MAKE CERTAIN IT IS ACTUALLY AT FAULT. THIS UNIT IS ONE COMPONENT IN AN INTEGRATED SYSTEM. MALFUNCTIONS IN ASSOCIATED COMPONENTS MAY APPEAR IN THE POWER AMPLIFIER. HAPHAZARD ADJUSTMENTS TO CORRECT MALFUNCTIONS MAY NECESSITATE ENTIRE CIRCUIT REALIGNMENTS.

4-2. TROUBLESHOOTING

Table 4-1 provides a list of probable troubles. The checks indicated will probably lead to a rapid determination of the cause of the trouble. Figures 4-1 and 4-2 illustrate the locations of parts within the Model TP-850.

TABLE 4-1. MODEL TP-850 TROUBLESHOOTING

TROUBLE	CHECKS
Interlock STATUS lamps do not light when LINE switch is set to ON.	Setting of GAIN switch. Input ac power. Open input power fuse. Q5 on fault protection board.

TABLE 4-1. MODEL TP-850 TROUBLESHOOTING(cont)

TROUBLE	CHECKS
AMPLIFIER lamp lights, but no output is apparent.	Connection of input signal. Preamplifier circuit malfunction. Output stage malfunction. Connection of load circuit.
Output power below rated value with GAIN control set maximum clockwise.	Amplifier circuit malfunction. Adjustment of DC BAL control. Input signal too low. A signal level of 1 volts is required for full output. Load not properly matched to output.
Excessive noise in output.	Ground loops especially in input circuit
Front panel meter indicates current flow when GAIN control fully counter-clockwise.	Adjustment of DC BAL. Perform the DC offset adjustment in the calibration paragraph if the DC BAL range is insufficient.
Amplifier crowbars consistently when DC set to ON.	Shorted output. SCR1 in chassis. SCR1 on assembly 34991. Amplifier output transistors. R29 or CR3-CR6 open on Assy. 34993-1.
Unable to derive full voltage swing from amplifier at high output current.	Low line voltage. Poor crest factor.
Amplifier has oscillation on output waveform.	Improper grounding (Refer to installation procedure). In test setup, check test equipment grounding.
Amplifier dumps on turn on of DC circuit breaker when amplifier connected to transformer with low-impedance primary winding.	High dc offset. Readjust per para. 4-4.
Amplifier dumps early when driving a transformer.	High dc offset, Readjust per para. 4-4.
AMPLIFIER lamp does not light when DC circuit breaker set to ON.	Lamp DS5 defective. Circuit breaker CB1 defective.
OUTPUT CURRENT meter indicates large current when AMPLIFIER switched on.	High dc offset. Readjust per para. 4-4.

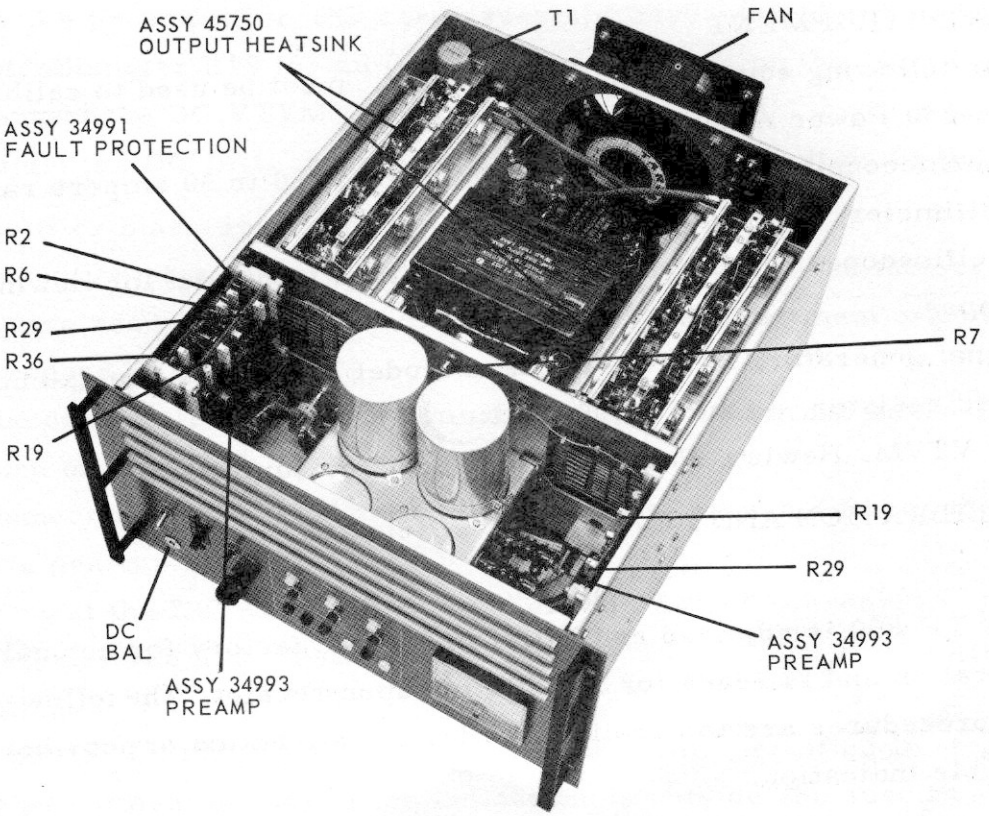


Fig. 4-1. Model TP-850 Front Top View Parts Location

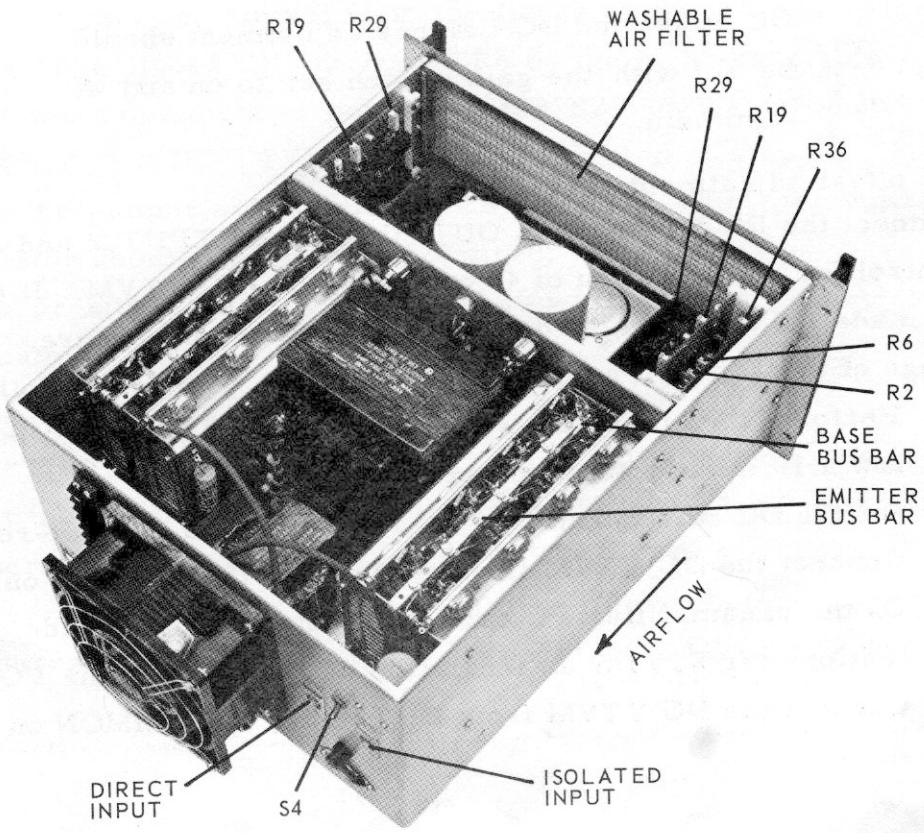


Fig. 4-2. Model TP-850 Bottom Rear View Parts Location

4-3. TEST EQUIPMENT

The following equipment, or equivalent, must be used to calibrate the Model TP-850 Power Amplifier:

a. Thermocouple ammeter, Weston Model 622, 0 to 50 ampere range.

b. Multimeter, Simpson Model 260.

c. Oscilloscope (floating with differential input), optional for viewing output waveshapes.

d. Signal generator, Hewlett-Packard Model 200CD, or equivalent.

e. Load resistor, 1-ohm, 1000-watt.

f. DC VTVM, Hewlett-Packard Model 412A or equivalent.

4-4. CALIBRATION AND ADJUSTMENT (Refer to Fig. 4-1).

NOTE

The TP-850 is adjusted and calibrated at the factory for normal operation and is ready for installation upon receipt. The following procedures are to be followed after a malfunction or possible trouble indication.

a. Connect operating power to the Model TP-850 Power Amplifier Chassis.

NOTE

DC offset and DC Balance adjustment should be set with the gain switch set to on and at minimum.

b. DC offset adjustment.

Connect the DC VTVM from OUTPUT 1 to OUTPUT 2 and adjust the DC BAL control for an indication of 0-volt dc on the DC VTVM. If the adjustment can be made, disregard the dc offset adjustment procedure. If the adjustment range of the DC BAL control is insufficient, proceed as follows:

(1). Perform the amplifier starting procedure described in Section 2, and allow a 10 minute warmup period.

(2). Set the DC BAL control on the front panel to the mid-rotation position.

(3). Connect the DC VTVM from OUTPUT 1 to COMMON on the front panel.

(4). On the preamplifier PC card assembly 34993 (left side of amp) adjust potentiometer R19 for an indication of 0-volt dc on the VOM.

(5). Connect the DC VTVM from OUTPUT 2 to COMMON on the front panel.

(6). On the preamplifier PC card assembly 34993 (right side of amp) adjust potentiometer R19 for an indication of 0-volt dc on the DC VTVM.

(7). Connect the DC VTVM from OUTPUT 1 to OUTPUT 2.

(8). Adjust the DC BAL control for an indication of 0-volt dc on the DC VTVM.

c. Preamplifier bias adjustment.

Each potentiometer R29 on assembly 34993 is adjusted at the factory. It should not require readjustment. In order to check the adjustment of potentiometer R29, proceed as follows:

(1). Disconnect all wiring to terminals J and H on terminal board TB1.

(2). Turn on amplifier.

(3). Connect a jumper to short out diodes CR3 through CR6 on the left-hand side preamplifier.

(4). Connect the DC VTVM across either R10 or R9 overcurrent sensing resistor. The DC VTVM should indicate 20 + 10, -0 millivolts quiescent voltage.

(5). If the DC VTVM indication is within the limits specified in step (4), make no adjustment of R29 if the indication is outside the specification adjust potentiometer R2 (on the right-hand amplifier) for an indication of 20 millivolts on the DC VTVM.

(6). Remove the shorting jumper from the diodes on the left-hand side and connect it across diodes CR3 through CR6 on the right-hand side.

(7). Correct the adjustment of potentiometer R29 on the left-hand amplifier (steps 4 and 5) if DC VTVM does not read stated in step 4.

(8). Remove the jumper across diodes CR3 through CR6, the voltage across the resistor should now read 40+20 mv-0.

(9). If either preamplifier bias resistor R29 was adjusted, recheck the dc offset adjustment.

d. Overcurrent protection adjustment.

(1). Connect the 1-ohm load resistor to terminal J on terminal board TB1.

(2). Connect the thermocouple ammeter from the loose lead of the load resistor to terminal H on terminal board TB1.

(3). Make certain there is no dc offset current flowing before continuing. If dc offset current exists, adjust the front panel DC BAL control for zero current.

(4). Connect a signal generator to the isolated input connector J2 on the rear panel.

(5). Set rear panel switch S4 to ISOLATED.

(6). Set the amplifier GAIN control fully clockwise (maximum gain).

(7). Set the signal generator for an output frequency of 500 hertz.

(8). Observe the output ammeter and slowly adjust the signal generator output amplitude to the point where the amplifier overcurrent protection circuit shuts down the amplifier.

(9). The amplifier output current at the point of shutdown must be approximately 32 $\pm$1 amperes. If the shutdown current is within the specified range, disregard the remainder of this procedure. If shutdown current is abnormal, continue the procedure as described.

(10). Set potentiometers R2 and R6 on the fault protection PC card assembly fully counterclockwise.

(11). Set the signal generator for minimum output signal.

(12). Perform the amplifier starting procedure.

(13). Set the amplifier GAIN control fully clockwise.

(14). Adjust the input signal generator to derive an indication of 32 amperes on the ammeter on terminal board TB1.

(15). Slowly adjust potentiometer R2 clockwise to the point where the amplifier shuts down.

(16). Back potentiometer R2 two 360-degree turns counterclockwise away from the trip point.

(17). Set the signal generator for minimum output signal.

(18). Reset the amplifier, turn gain pot to off, and turn on DC switch.

(19). Set the amplifier GAIN control fully clockwise.

(20). Adjust the input signal generator to derive an indication of 32 amperes on the ammeter on terminal board TB1.

(21). Slowly adjust potentiometer R6 clockwise to the point where the amplifier shuts down.

(22). Back potentiometer R6 one 360-degree turn counterclockwise away from the trip point.

(23). Reset potentiometer R2 one 360-degree turn clockwise toward the trip point. Both potentiometers now have approximately the same trip point adjustment.

(24). Set the signal generator for minimum output signal.

(25). Reset the amplifier, turn gain pot to off, and turn on DC switch.

(26). Set the amplifier GAIN control fully clockwise.

(27). Observe the output ammeter and slowly adjust the signal generator output amplitude to the point where the amplifier shuts down.

(28). The output current of the amplifier at the point of shutdown must be approximately 32 $\pm$1 amperes.

e. Meter calibration adjustment.

(1). Reset the amplifier, turn GAIN pot to off and turn on DC switch.

(2). Set the amplifier GAIN control fully clockwise.

(3). Adjust the input signal generator for an indication of 27 amperes on the ammeter connected to terminal board TB1.

(4). Adjust potentiometer R7 for an indication of 27 amperes on the OUTPUT CURRENT meter.

f. Overtemperature adjustment.

Potentiometer R36 is adjusted on fault protection PC card assembly 34991 to cause amplifier shutdown when the temperature of either output circuit stage reaches 90 degrees centigrade. Unless the amplifier temperature sensitivity is suspected of being far out of adjustment, potentiometer R3 should be left alone. If necessary to adjust R3, the thermistors on the output stages must be heated to 90 degrees centigrade and R3 adjusted for amplifier shutdown at that temperature.

g. Overtravel test.

(1). With the TP-850 running normally and no signal in, short TB1-D to TB1-C, amplifier and GAIN lamp should go out and OVERTRAVEL lamp go on.

(2). Connect a jumper to TB1-M, TB1-D and TB1-C, reset TP-850 to on.

(3). Open jumper to TB1-C, OVERTRAVEL lamp should turn on and AMPLIFIER lamp should go out.

4-5. QUICK CHECK FOR OUTPUT ASSEMBLY

a. This procedure provides a quick check for transistors shorted from collector to emitter in the output assembly which is the usual case. It will not detect open emitter or open base conditions. The procedure may be performed with the output assembly mounted in the amplifier chassis.

b. The two copper bus bars running the length of each assembly are used for making test connections. The outside bar is the emitter bus. The inside is the base bus. The heat sink is the collector at the appropriate transistor.

c. Assembly checkout. (Refer to table 4-2).

(1). Disconnect all wiring to the heat sink assembly (collectors, emitter, and input plug).

(2). Connect a VOM (Simpson Model 260 or equivalent) between the points listed on table 4-2, observing the polarities listed. Set the VOM to the RX1 range.

(3). If VOM indications are received which are different from those described in the table, suspect defective transistors.

d. Locating defective transistors.

(1). Connect the VOM (in the infinite impedance C to E as table 4-2) to the output assembly in the configuration where the incorrect indication was received.

(2). Remove each transistor separately until a normal indication appears in the VOM. Then replace each transistor that has been removed. If a short indication is noted on the VOM remove that transistor and proceed with other transistors.

(3). Replace the defective transistors with new transistors.

(4). Pre-check the assembly using the assembly checkout procedure in step (c) above. The assembly should be checked as described in the assembly zener check of paragraph 4-6 to determine that the other transistors in the output assembly meet the voltage ratings.

4-6. SPECIAL TEST PROCEDURE FOR FINAL OUTPUT STAGE

The output assemblies must be removed from the chassis in order to make this test.

TABLE 4-2. OUTPUT ASSEMBLY MEASUREMENTS

MEASURE BETWEEN BARS	NPN ASSEMBLY (SJ8106 TRANSISTORS)		PNP ASSEMBLY (SJ1255 TRANSISTORS)	
Collector to Emitter	-C, +E	+C, -E	-C, +E	+C, -E
	Low resistance (10 ohms approx)*	∞	∞	Low resistance (10 ohms approx)*
Collector to Base	-C, +B	+C, -B	-C, +B	+C, -B
	Low resistance (10 ohms approx)*	∞	∞	Low resistance (10 ohms approx)*
Emitter to Base	-E, +B	+E, -B	-E, +B	+E, -B
	Low resistance (10 ohms approx)*	Low resistance (10 ohms approx)*	Low resistance (10 ohms approx)*	Low resistance (10 ohms approx)*

*Simpson 270 RX1 (600Ω on DC VTVM RX1 scale)

a. Special test equipment.

Transistor-Curve Tracer, Tektronix Model 575.

b. Determine whether a PNP or NPN side of the heat sink assembly to be tested. The PNP is the SJ1255 transistors. The NPN is the SJ8106 transistors.

c. Set the controls on the curve tracer as specified in table 4-3 for the assembly to be tested.

d. Connect the test leads to the output assembly as illustrated in figure 4-3.

e. Increase the setting of the INTENSITY control until a spot appears on the screen.

f. Use the position controls to locate the spot at the bottom, left-hand corner of the graticule for test of the NPN assembly, or at the upper right-hand corner of the graticule for the PNP assembly.

g. Current gain check.

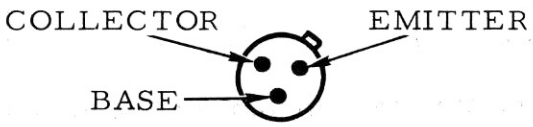
(1). Increase the PERCENT OF PEAK VOLTS RANGE control until the trace covers 10 centimeters. This establishes a 10-volt collector voltage.

(2). On the angular deck into which the test leads are connected, set the TRANSISTOR A/TRANSISTOR B switch towards the leads. If the trace becomes a straight vertical line, the cause is either a mechanical short or a transistor short from emitter to collector. Make a visual inspection of the assembly for a mechanical short. If short is apparent, perform the special checkout procedure in paragraph 4-5.

(3). Advance the STEP SELECTOR control to the 1 milliampere position.

(4). Count the number of vertical divisions between the last step on the screen and the preceeding step. There must be at least four vertical divisions. This is equivalent to a current gain of 8000 or greater. If no steps appear on the screen, and an increase of the STEP SELECTOR does not produce any, check the transistor in the TO5 case and the power transistor on the front end of the assembly.

(5). If the answer is less than 8000, the driver transistors are most likely at fault. Check the gain of the power transistor (Q2 or Q11) with it removed from the assembly. Each transistor must have a gain of at least 10 with a collector-emitter voltage of 10 volts and collector current of 4 amperes. In order to check the gain of the driver transistors (Q1 and Q10), remove them from the sockets and place them directly into the curve tracer. The current gain of Q1 and Q10 should be at least 50 with a collector to emitter voltage of 10 volts at 0.1 ampere.



SJ1379
or
PS11095 is PNP
2N2405 is NPN

(6). Return the PERCENT OF PEAK VOLTS RANGE control to 0.

h. Assembly zener check.

(1). Set the controls on the curve tracer as specified in table 4-4 for the assembly to be tested.

(2). Advance the PEAK VOLTAGE RANGE control until the trace sweeps horizontally across the screen and then curves vertically up four divisions. The point four divisions above the horizontal trace should be at least 5 horizontal centimeters from the point of origination of the trace. If the zener point is less than 100 volts, the problem may be in any one of the transistors. Check each transistor individually.

TABLE 4-3. TRANSISTOR-CURVE TRACER CONTROL SETTINGS

CURVE TRACER CONTROL NAME	SETTING FOR ASSEMBLY UNDER TEST	
	NPN	PNP
COLLECTOR SWEEP		
PEAK VOLTS RANGE	0-20	0-20
PERCENT OF PEAK VOLTS RANGE	0	0
POLARITY	+(NPN)	-(PNP)
DISSIPATION LIMITING RESISTOR	0	0
VERTICAL CURRENT OR VOLTAGE PER DIVISION	1000 MA	1000 MA
HORIZONTAL VOLTS/DIV.	1	1
BASE STEP GENERATOR		
REPETITIVE, SINGLE FAMILY	REPETITIVE	REPETITIVE
STEPS FAMILY	4	4
POLARITY	+	-
STEPS/SEC	120	120
SERIES RESISTOR	NOT USED	NOT USED
STEP SELECTOR	.001	.001

TABLE 4-4. TRANSISTOR-CURVE TRACER CONTROL SETTINGS

CURVE TRACER CONTROL NAME	SETTING FOR ASSEMBLY UNDER TEST	
	NPN	PNP
COLLECTOR SWEEP		
PEAK VOLTS RANGE	0-200	0-200
PERCENT OF PEAK VOLTS RANGE	0	0
POLARITY	+(NPN)	-(PNP)
DISSIPATION LIMITING RESISTOR	2K	2K
VERTICAL CURRENT OR VOLTAGE PER DIVISION	10 MA	10 MA
HORIZONTAL VOLTS/DIV.	20	20
BASE STEP GENERATOR		
REPETITIVE, SINGLE FAMILY	REPETITIVE	REPETITIVE
STEPS FAMILY	4	4
POLARITY	+	-
STEPS/SEC	120	120
SERIES RESISTOR	NOT USED	NOT USED
STEP SELECTOR	.001	.001

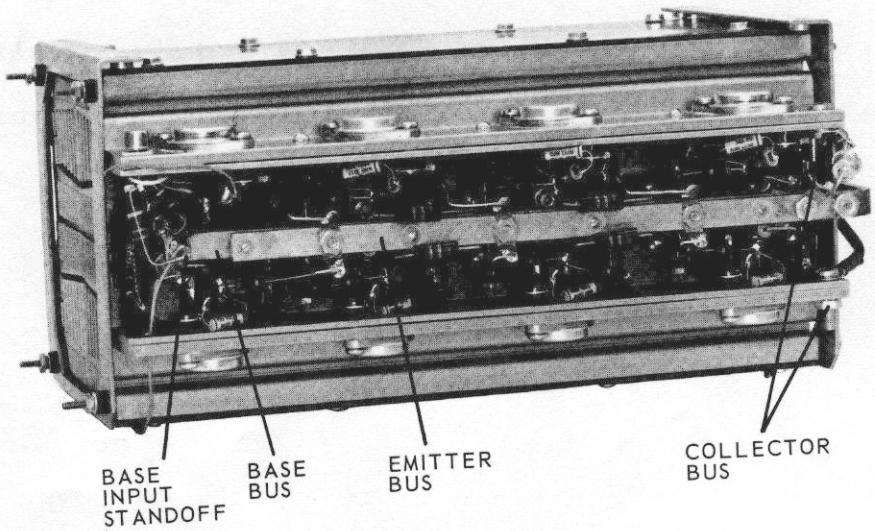


Fig. 4-3. Heatsink Assy.

4-7. CLEANING

The only cleaning necessary for the Model TP-850 is to keep the chassis free from dust. To clean the aluminum screen, run warm water through it to remove all dirt and dust and spray with Rotron Filter or No. 18440. To clean the chassis, use low pressure air, a vacuum cleaner, or a soft bristle brush. Use particular care when cleaning printed circuit cards as they are easily damaged.

4-8. OTHER DIFFICULTY

In the event of troubles not covered in this instruction manual, contact the factory giving serial number, Ling number, conditions of use, and a full description of the problem. For service east of the Mississippi River, contact the Eastern Field Service Office at Ling Electronics, a Division of LTV Ling Altec, Inc., Northern Industrial Park, Wilmington, Massachusetts. For service west of the Mississippi River, contact the Western Field Service Office at Ling Electronics, a Division of LTV Ling Altec, Inc., 1515 South Manchester Avenue, Anaheim, California. Ling Electronics field service personnel are constantly available for consultation on special problems concerning utilization or application of Ling Electronics equipment.

SECTION 5 - SUPPORT DOCUMENTATION

5-1. ENGINEERING DRAWINGS

46178 Installation Drawing.

5-2. OTHER DOCUMENTATION

Parts List, Model TP-850 Power Amplifier. (Includes 34993-1 Assembly)

Parts List, Assembly Heat Sink 45740.

Parts List, Assembly 34991.

Code to Manufacturers.

5-3. APPENDIX OF ENGINEERING DRAWINGS

34991 PC Card Assembly, Fault Protection.

34993-1 PC Card Assembly, Preamplifier.

45740 Heatsink Assembly and Wiring.

50382 Model TP-850 Power Amplifier Schematic

5-4. RECOMMENDED SPARE PARTS

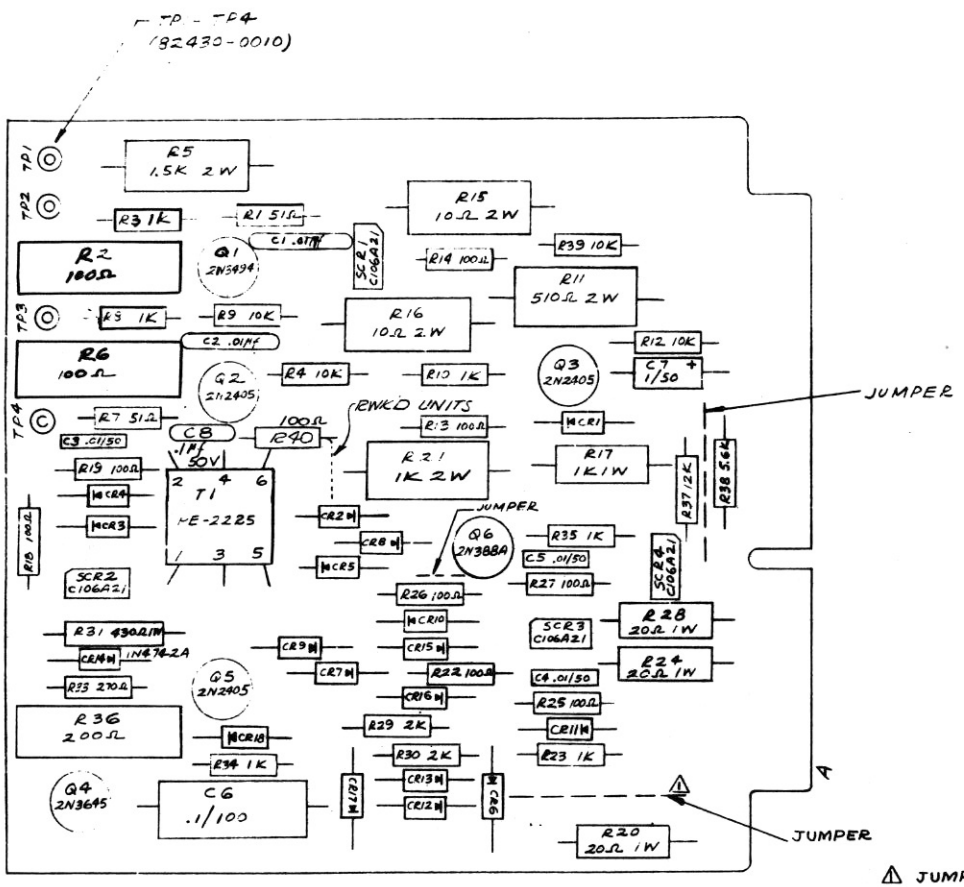
a. Refer to the column marked RS on the Engineering Parts List for quantities of recommended spare parts.

b. Transistor PS11095 may be replaced with 2N4236 with a $V_{cer(sus)}$ or 100 volts where r = 1000 ohms.

c. Transistor SJ-8106 may be replaced with 2N3714 with $V_{ceo(sus)}$ of 100 volts.

d. Transistor SJ-1255 may be replaced with 2N3790 with $V_{ceo(sus)}$ of 100 volts.

REVISIONS				
CHG. LETTER	DESCRIPTION	DATE	APPROVAL	RELEASE NOTICE NO
A	R5 "WAS" 510Ω 2W R32 "WAS" 680Ω	11-21-67		
B	ADDED R37-R39 & Q6 ADDED CR18 & C7 R17(WAS) 120Ω 1/2W R34(WAS) 6.8K 1/2W R5(WAS) 1.5L 3W	1-8-68		
C	JUMPER WAS R32 1.6K 3W ADDED NOTE Δ. C1 & C2 "WERE" .01Mf 50V	2-1-68 RHO	2-2-68	EC 8603
D	ADDED C8 & R40 ADDED NOTES 1 & 2.	3-4-68 RHO	3/14/68	EC 8610



Δ JUMPER FOR 14V FIELD SUPPLY
1.6K 3W FOR 90V FIELD SUPPLY.

34991
D

MAKE FROM 34992

ITEM	QTY	STOCK OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION

LIST OF MATERIAL

LING Electronics
ANAHEIM, CALIFORNIA

UNLESS OTHERWISE SPECIFIED
ANGULAR ± FRACTIONS ±
DECIMAL ± RMS FINISH
BREAK ALL SHARP EDGES ✓
FINISH
CHOKE-HENRIES
RESISTORS, 1 W-5% CAPACITORS-MFD
SCALE DOUBLE
HEAVY ASSEMBLY

DRN.	10-3-67 KUSS
CHKD.	
APPROVED	
P.E.	

ASSEMBLY-
P.C. CARD
FAULT PROTECTION

DWG. NO. 34991

REQ.	NEXT ASSY.	USED ON	DATE
		TP-850	11-3-67
		TP-450	10-3-67

APPLICATION

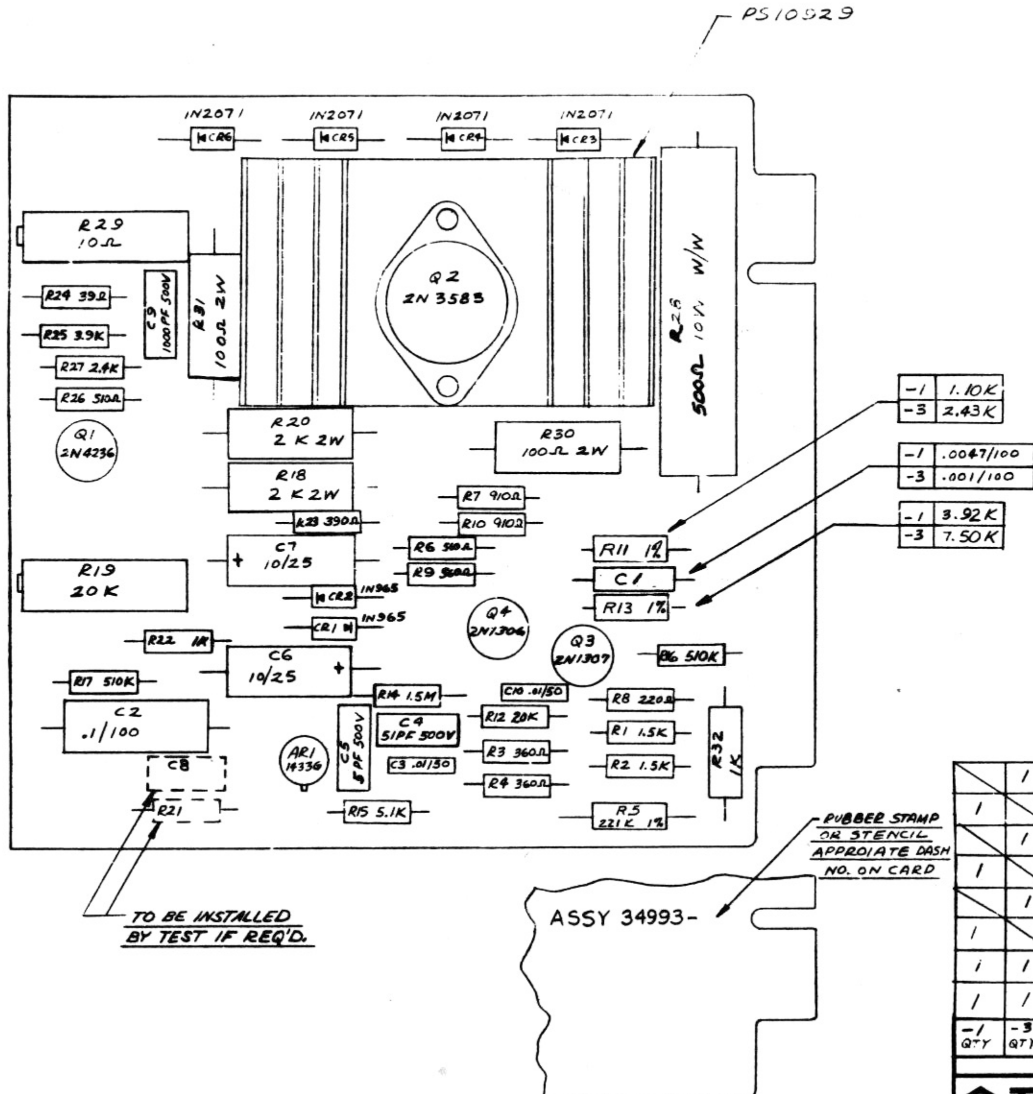
2. ALL RESISTORS 1/2 W 5% COMPOSITION
1. ALL DIODES T1 56.

NOTES: UNLESS OTHERWISE SPECIFIED

LE 439

REVISIONS

LETTER	DESCRIPTION	DATE	APPROVAL	RELEASE NOTICE NO.
A	C8 & R21 REQ'N'T [illegible]	[illegible]	[illegible]	—
B	C5 WAS N P3 [illegible] WAS 5.1K REVERSED Q3 AND Q4 Q3 WAS 2N1377, Q4 WAS 2N388A R6, R9 WERE 510Ω; R7, R10 WERE 1K	2-1-68 RHO	[illegible]	E0862
C	R22 WAS 470 Ω	3-4-68 RHO	[illegible]	EE 8610



PS10929
IN2071 CR6
IN2071 CR5
IN2071 CR4
IN2071 CR3
R29 10Ω
R24 39Ω
R25 3.9K
R27 2.4K
R26 510Ω
C9 1000 PF 500V
R31 100Ω 2W
Q2 2N 3583
R28 500Ω 10W W/W
Q1 2N4236
R20 2 K 2W
R18 2 K 2W
R30 100Ω 2W
R7 910Ω
R10 910Ω
R23 390Ω
C7 10/25
R6 510Ω
R9 510Ω
R19 20 K
IN965 CR2
IN965 CR1
Q4 2N1306
Q3 2N1307
R11 1%
C1
R13 1%
R16 510K
R22 1K
C6 10/25
R17 510K
R14 1.5M
C10 .01/50
R8 220Ω
C2 .1/100
C4 51PF 500V
C5 5PF 500V
R12 20K
R1 1.5K
R32 1K
AR1 14336
C3 .01/30
R3 360Ω
R2 1.5K
R4 360Ω
C8
R21
R15 5.1K
R5 221K 1%
-1 1.10K
-3 2.43K
-1 .0047/100
-3 .001/100
-1 3.92K
-3 7.50K
TO BE INSTALLED BY TEST IF REQ'D.
RUBBER STAMP OR STENCIL APPROIATE DASH NO. ON CARD
ASSY 34993-

34993

C

LIST OF MATERIAL

-1 QTY	-3 QTY	STOCK OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION	
	1	82272-7501F	RESISTOR, M.F 7.50K 1%	R13
1		82272-3921F	RESISTOR, M.F. 3.92K 1%	R13
	1	82272-2431F	RESISTOR, M.F. 2.43K 1%	R11
1		82272-1101F	RESISTOR, M.F 1.10K 1%	R11
	1	82025-0013K	CAPACITOR .001/100	C1
1		82025-0472K	CAPACITOR .0047/100	C1
1	1	PS10929	HEAT SINK	
1	1	34994	P.C. CARD	

APPLICATION

REQ.	NEXT ASSY.	USED ON	DATE
	-3	TP-450	10-4-67
	-1	TP-850	10-4-67

LING Electronics
ANAHEIM, CALIFORNIA

DRN.	10-4-67	KUSS
CHKD.		
APPROVED		
P.E.		

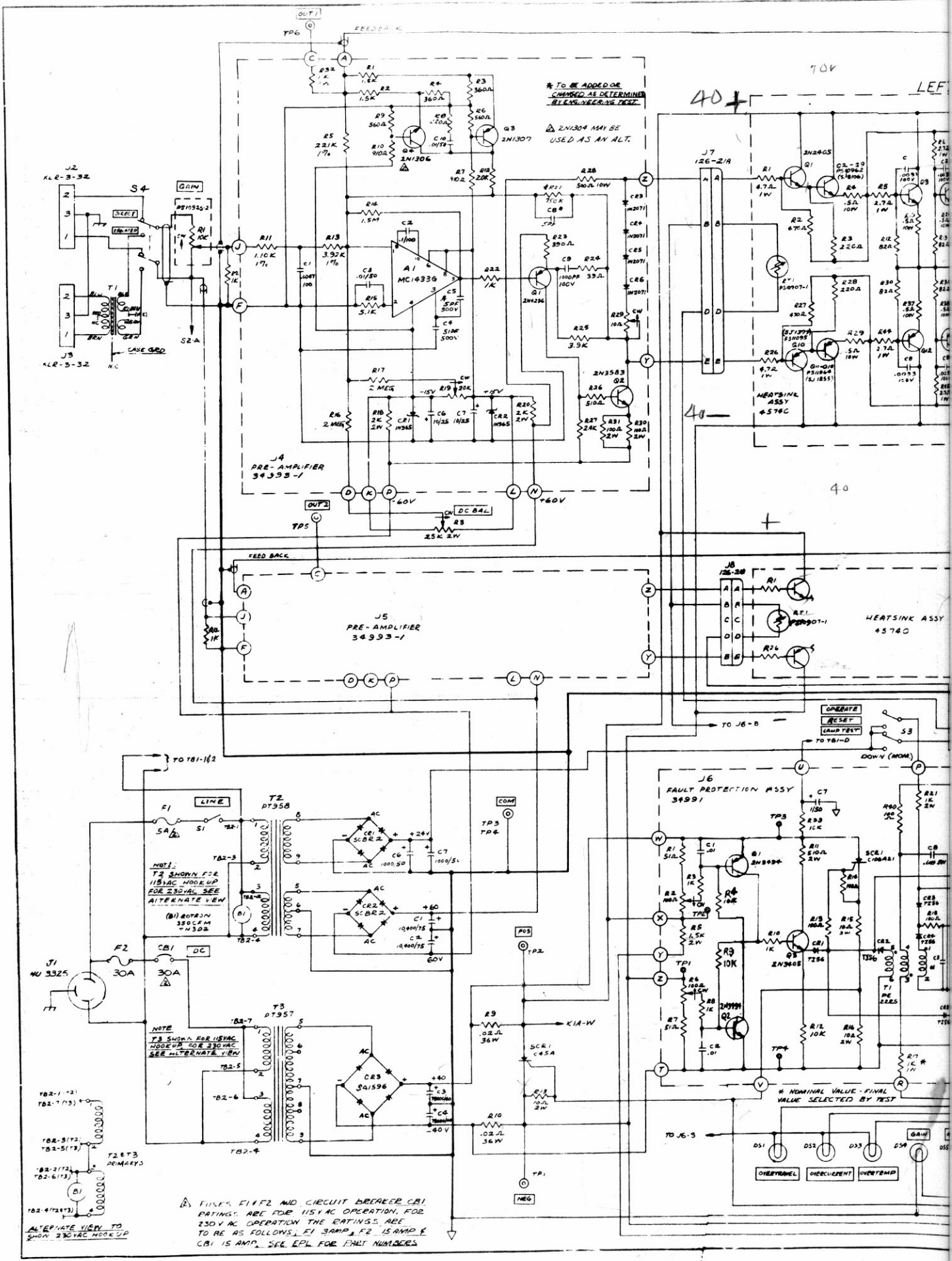
ASSEMBLY
P.C. CARD
PRE-AMPLIFIER

UNLESS OTHERWISE SPECIFIED
ANGULAR ± FRACTIONS ±
DECIMAL ± RMS FINISH
BREAK ALL SHARP EDGES ✓
FINISH
CHOKE-HENRIES
RESISTORS, 1 W.-5% CAPACITORS-MFD

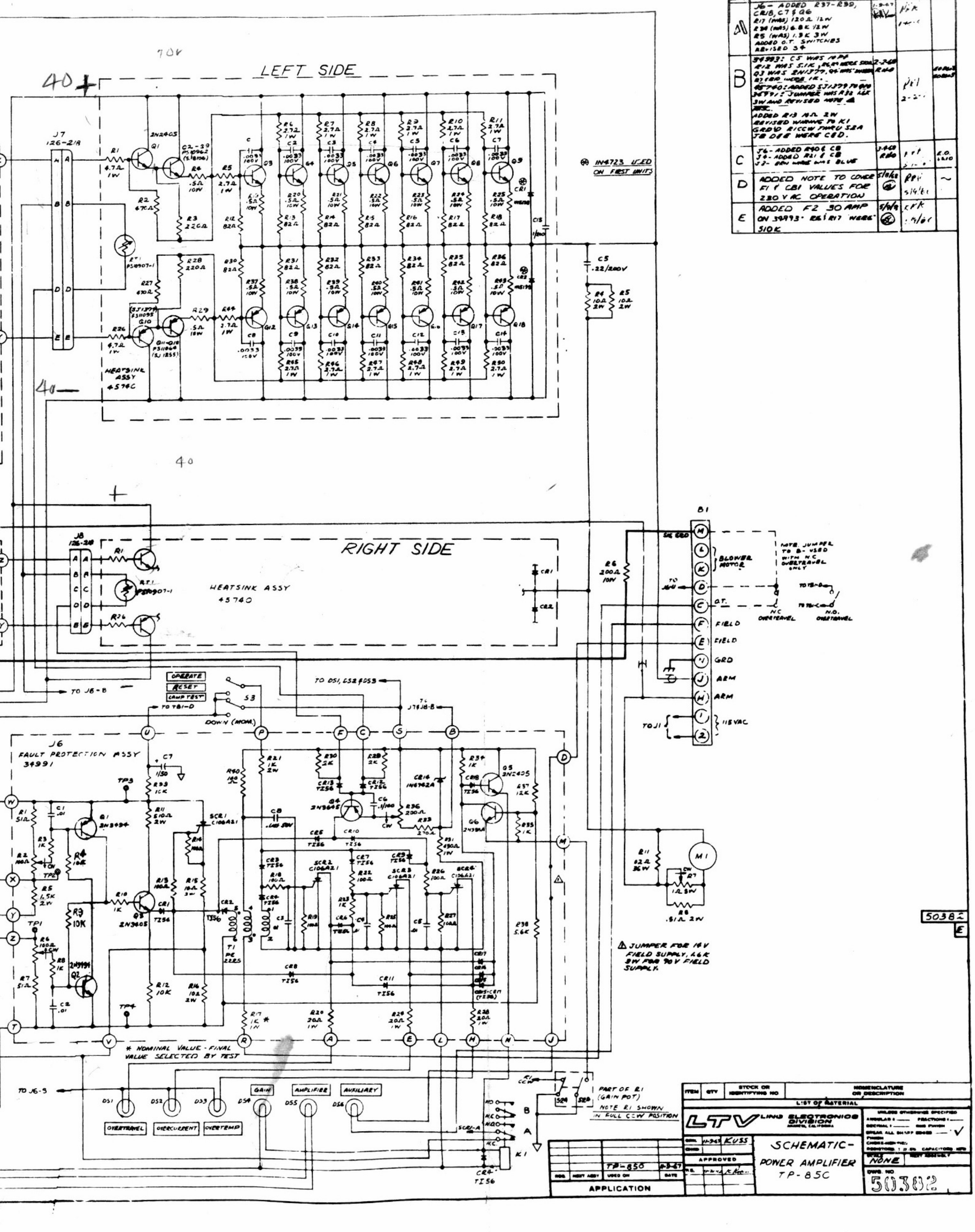
SCALE: DOUBLE
NEXT ASSEMBLY

DWG. NO. 34993

LE 439



⚠ FUSES F1 & F2 AND CIRCUIT BREAKER CB1 RATINGS ARE FOR 115 V AC OPERATION. FOR 230 V AC OPERATION THE RATINGS ARE TO BE AS FOLLOWS, F1 3 AMP, F2 15 AMP & CB1 15 AMP. SEE EPL FOR PART NUMBERS.



LEFT SIDE
RIGHT SIDE
J7 126-21A
J8 126-21B
HEATSINK ASSY 45740
⊗ 1N4723 USED ON FIRST UNITS
J6 FAULT PROTECTION ASSY 34991
B1
BLOWER MOTOR
NOTE JUMPER TO B- USED WITH NC OVERTRAVEL ONLY
NC OVERTRAVEL
N.O. OVERTRAVEL
FIELD
FIELD
GRD
ARM
ARM
115 VAC
TO J1
M1
TO J6-B
TO TB1-D
TO DS1, DS2 & DS3
S3
OPERATE
RESET
LAMP TEST
DOWN (MOM.)
JUMPER FOR 14 V FIELD SUPPLY, 4.6K 3W FOR 90 V FIELD SUPPLY.
* NOMINAL VALUE - FINAL VALUE SELECTED BY TEST
TO J6-S
GAIN
AMPLIFIER
AUXILIARY
OVERTRAVEL
OVERCURRENT
OVERTEMP
PART OF R1 (GAIN POT)
NOTE R1 SHOWN IN FULL CCW POSITION
K1
50382 E

REVISIONS

CHG. LETTER	DESCRIPTION	DATE	APPROVAL
A	J6 - ADDED R37-R39, CR18, C7 & G6; R17 (WAS) 120Ω 1/2W; R34 (WAS) 6.8K 1/2W; R5 (WAS) 1.3K 3W; ADDED O.T. SWITCHES; REVISED 34	1-3-67	
B	34993: C5 WAS 10 PF; R12 WAS 5.1K, R6, R4 WERE 50Ω; Q3 WAS 2N1377, Q4 WAS 2N1889; R7 (30) WAS 1K. 45740: ADDED SJ1379 TO G10; 34991: JUMPER WAS R30 46K 3W AND REVISED NOTE; ADDED R13 10Ω 2W; REVISED WIRING TO K1; GRD'D R1 CCW THRU S2A; J8 D&E WERE CBD.	2-2-68	
C	J6 - ADDED R40 & C8; J4 - ADDED R21 & C8; J3 - GRN WIRE WAS BLUE	3-4-68	
D	ADDED NOTE TO COVER F1 & CB1 VALUES FOR 230 V AC OPERATION	5/16/68	
E	ADDED F2 30 AMP ON 34993. R26/R17 WERE 510K	5/1/69	

ITEM	QTY	STOCK OR IDENTIFYING NO	NOMENCLATURE OR DESCRIPTION

LIST OF MATERIAL

NEXT ASSY	USED ON	DATE
	TP-850	4-3-67

APPLICATION

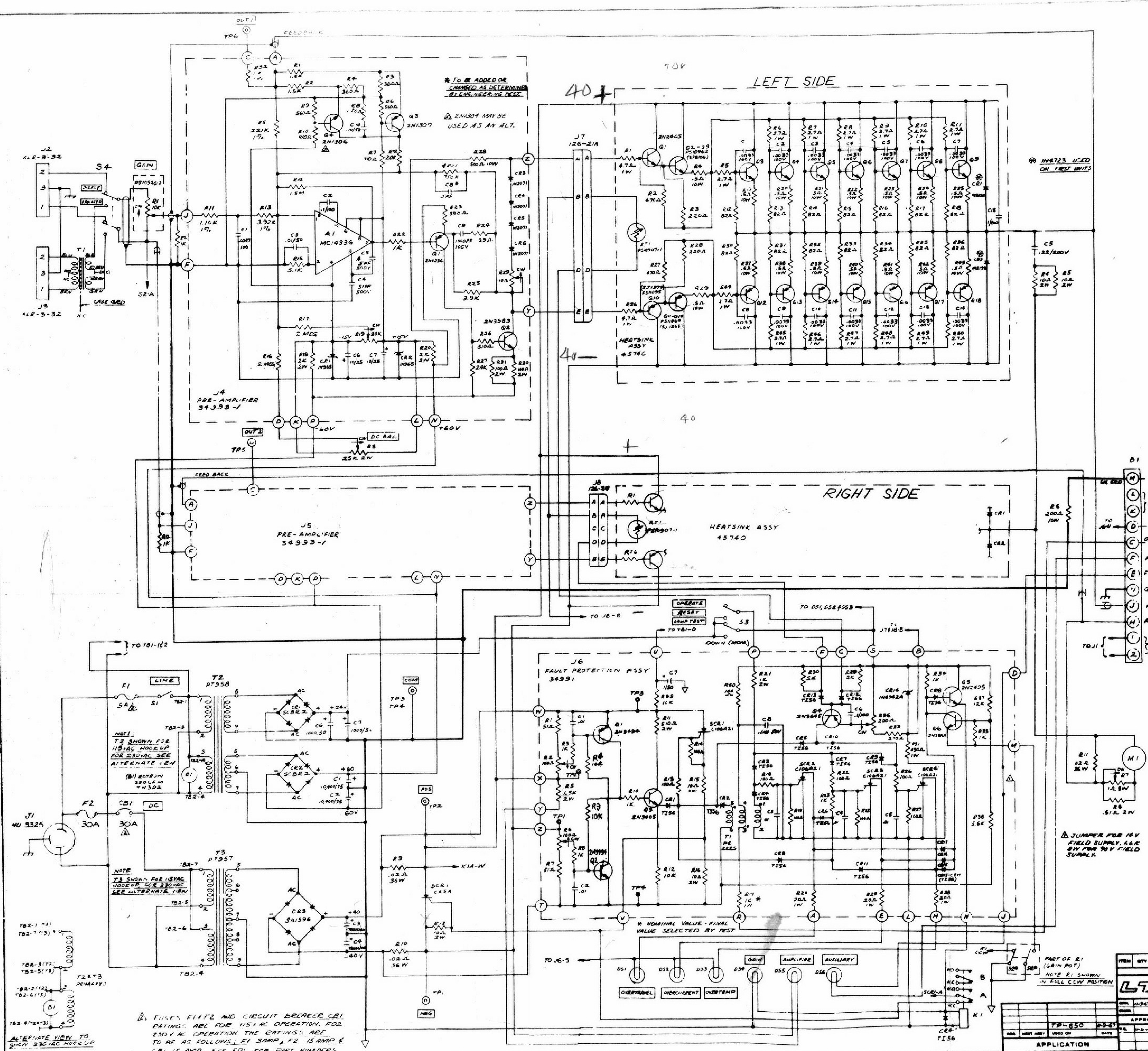
LTV LING ELECTRONICS DIVISION, ANAHEIM, CALIFORNIA

DRN 11-3-66 KUSS

SCHEMATIC - POWER AMPLIFIER TP-85C

SCALE: NONE

DWG NO 50382



REVISIONS

CHG. LETTER	DESCRIPTION	DATE	APPROVAL	
A	J6 - ADDED R37-R39, CR18, C7 & Q6 R17 (WAS) 120Ω 1/2W R34 (WAS) 6.8K 1/2W R5 (WAS) 1.3K 3W ADDED O.T. SWITCHES REVISED J4	1-9-67	[illegible]	
B	34993: C5 WAS 10PF R12 WAS 5.1K, R6, R9 WERE 510Ω Q3 WAS 2N1377, Q4 WAS [illegible] R7 & R10 WERE 1K. 45740: ADDED SJ1379 TO Q10 34991: JUMPER WAS R38 4.6K 3W AND REVISED NOTE ADDED R13 Ω 2W REVISED WIRING TO K1 GRD'D R1 CCW THRU S2A J8 D,E,E WERE C,E,D.	2-2-68	[illegible]	
C	J6 - ADDED R40 & C8 J4 - ADDED R21 & C8 J3 - BRN WIRE WAS BLUE	3-4-68	[illegible]	E.O.
D	ADDED NOTE TO COVER F1 & CB1 VALUES FOR 230VAC OPERATION	5/6/68	[illegible] 5/6/68	~
E	ADDED F2 30 AMP ON 34993. R6 & R17 WERE 510K	5/9/68	[illegible]	

ITEM	QTY	STOCK OR IDENTIFYING NO	NOMENCLATURE OR DESCRIPTION

LIST OF MATERIAL

LTV LING ELECTRONICS DIVISION

SCHEMATIC - POWER AMPLIFIER TP-85C

DRN 11-3-67 KUSS

APPROVED

SCALE NONE

NEXT ASSY	USED ON	DATE
	TP-850	4-3-67

APPLICATION

DWG NO 50382

50382 E