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# OPERATING AND SERVICE MANUAL

## EL750B ELECTRONIC LOAD TEST INSTRUMENT




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## FUNCTIONAL CONTROLS

ITEM NO.	DESCRIPTION	FUNCTION
1	VOLTMETER	INDICATES VOLTAGE ACROSS INPUT TERMINALS
2	SATURATION INDICATOR LAMP	RED LED LAMP LIGHTS WHEN LOAD SATURATES DUE TO INSUFFICIENT VOLTAGE OR CURRENT FROM TEST UNIT
3	E. I. INDICATOR LAMP	RED LED LAMP LIGHTS WHEN VOLTAGE OR POWER EXCEEDS THE MAXIMUM RATING OF THE INSTRUMENT
4	AMMETER	INDICATES LOAD CURRENT ON FOUR RANGES, DETERMINED BY RANGE SWITCHES
5	OVERTEMPERATURE INDICATOR	RED LED LAMP LIGHTS WHEN INTERNAL HEAT EXCEEDS SAFE OPERATING TEMPERATURE
6	LOAD SWITCH	TURNS LOAD CURRENT ON WHEN IN THE UP POSITION
7	200 AMP RANGE SWITCH	SETS THE INSTRUMENT ON THE 0 TO 200 SCALE ON THE AMMETER
8	100 AMP RANGE SWITCH	SETS THE INSTRUMENT ON THE 0 TO 100 SCALE ON THE AMMETER
9	50 AMP RANGE SWITCH	SETS THE INSTRUMENT ON THE 0 TO 50 SCALE ON THE AMMETER
10	10 AMP RANGE SWITCH	SETS THE INSTRUMENT ON THE 0 TO 10 SCALE ON THE AMMETER
11	DYNAMIC LOADING 1KHz SWITCH	SWITCHES LOAD CURRENT BETWEEN TWO CURRENT LEVELS AT A RATE 1000 Hz PER SECOND (16 TIMES LINE FREQUENCY)
12	DYNAMIC LOADING 100/120 SWITCH	SWITCHES LOAD CURRENT BETWEEN TWO CURRENT LEVELS AT A RATE OF 100/120 Hz PER SECOND (2 TIMES LINE FREQUENCY)
13	DYNAMIC LOADING DC SWITCH	ALLOWS LOWER CURRENT LEVEL TO BE SET WHILE MONITORING CURRENT ON AMMETER
14	DYNAMIC LOADING OFF SWITCH	RESTORES INSTRUMENT TO NORMAL OPERATION
15	R MODE SWITCH	PLACES THE INSTRUMENT IN CONSTANT RESISTANCE MODE
16	I MODE SWITCH	PLACES THE INSTRUMENT IN CONSTANT CURRENT MODE
17	POWER SWITCH	PRESS-ON PRESS-OFF SWITCH CONTROLS INPUT POWER TO THE INSTRUMENT
18	INPUT VOLTAGE CONTROL KNOB	ADJUSTMENT FOR THE RATED VOLTAGE OF THE POWER SUPPLY UNDER TEST WHEN OPERATING MODE IS CONSTANT RESISTANCE
19	DYNAMIC CURRENT CONTROL KNOB	SETS THE LOWER OF THE TWO CURRENT LEVELS WHEN DYNAMIC LOADING FUNCTION IS OPERATING. AS CONTROL IS ROTATED CLOCKWISE LOAD CURRENT INCREASES. CONTROL IS INACTIVATED WHEN DYNAMIC LOADING OFF SWITCH IS DEPRESSED
20	STATIC CURRENT CONTROL KNOB	SETS THE LOAD CURRENT ROTATE CLOCKWISE TO INCREASE
21	AC POWER INDICATOR LAMP	GREEN LED LAMP LIGHTS WHEN AC POWER IS ON
22	LINE FUSE	FUSE HOLDER FOR 1/2 AMP FUSE FOR 115 VOLT OR 1/4 AMP FUSE FOR 230 VOLT CURRENT
23	INPUT-OUTPUT CONNECTOR	USED FOR SPECIAL APPLICATIONS SUCH AS EXTERNAL PROGRAMMING AND REMOTE CONTROL OPERATIONS
24	NEGATIVE INPUT TERMINAL	BUSBAR CONNECTOR FOR NEGATIVE DC SOURCE
25	AC CORD CONNECTOR	FOR AC INPUT POWER CORD
26	POSITIVE INPUT TERMINAL	BUSBAR CONNECTOR FOR POSITIVE DC SOURCE

## INTRODUCTION

This manual contains the information necessary to operate, test, calibrate and service the ACDC Model EL750B Electronic Load instrument. The Model EL750B is a sophisticated unit that requires competent technical personnel for servicing.

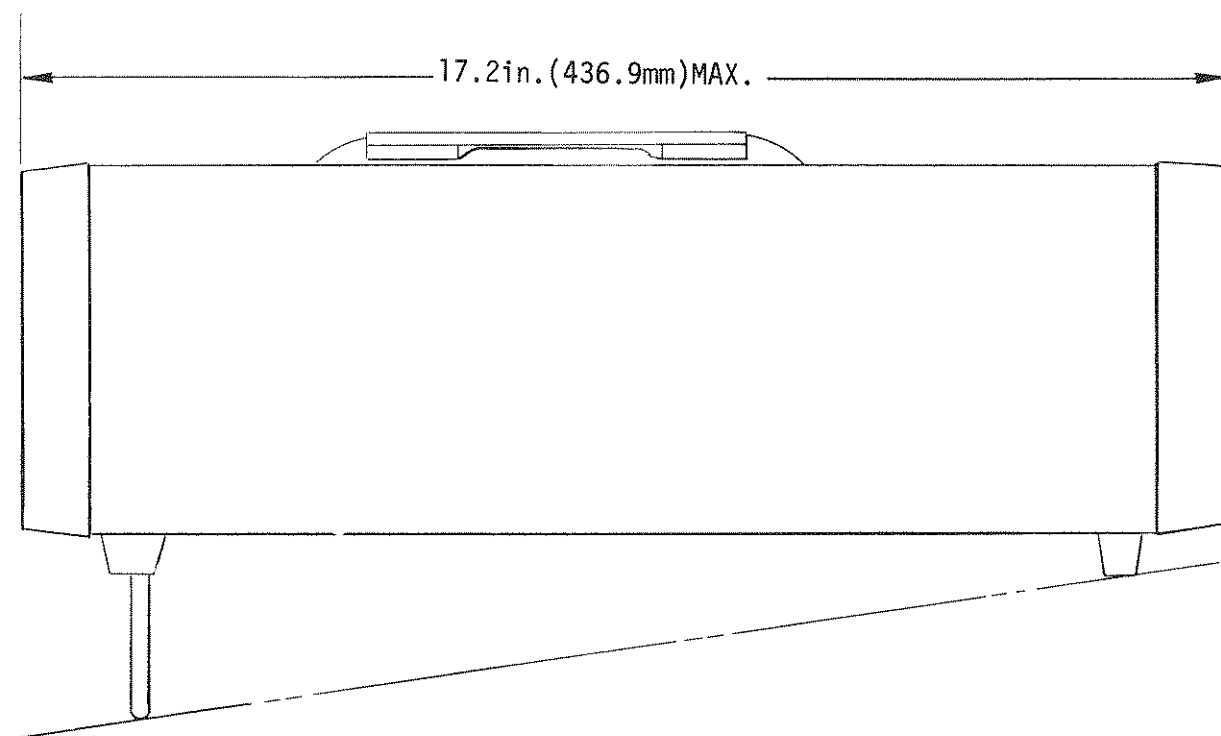
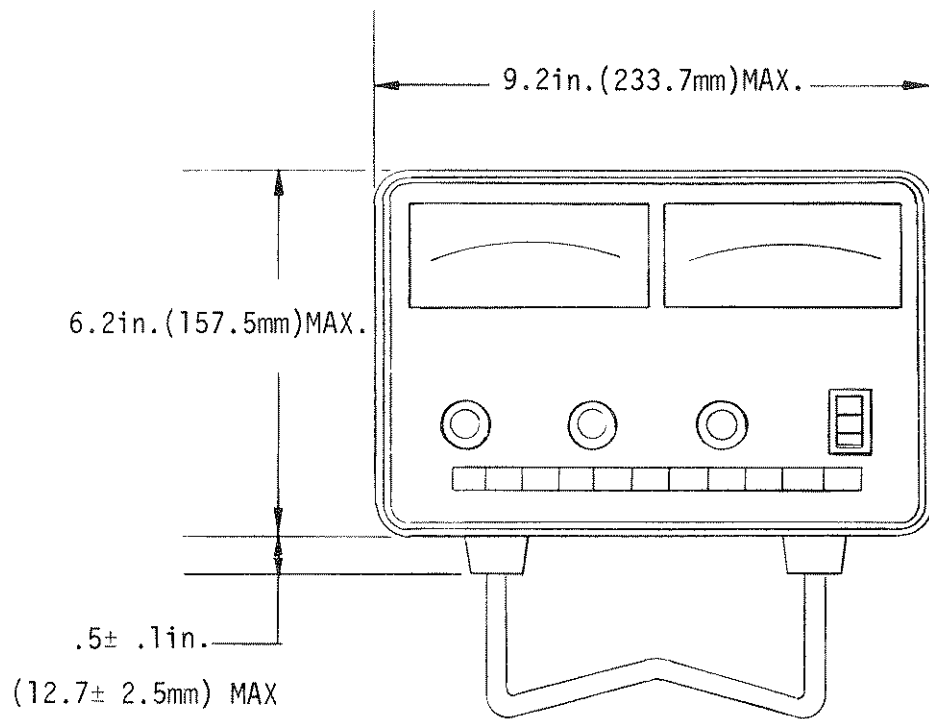
Models EL750B-E for 220VAC, EL750B-A for 230VAC and EL750B-K for 240VAC inputs are also available.

If any problem occurs that is not covered in this manual, please contact the nearest ACDC sales representative or write directly to ACDC Electronics Engineering Department.

Please include instrument serial number when writing for information.



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OUTLINE DIMENSIONS  
FIGURE 1

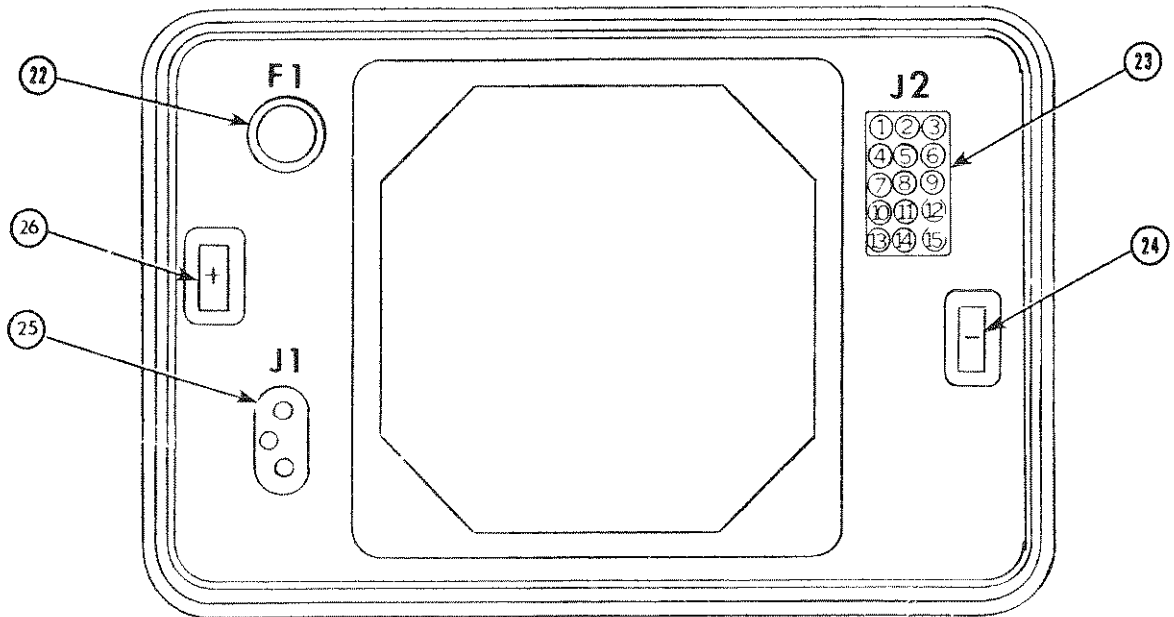
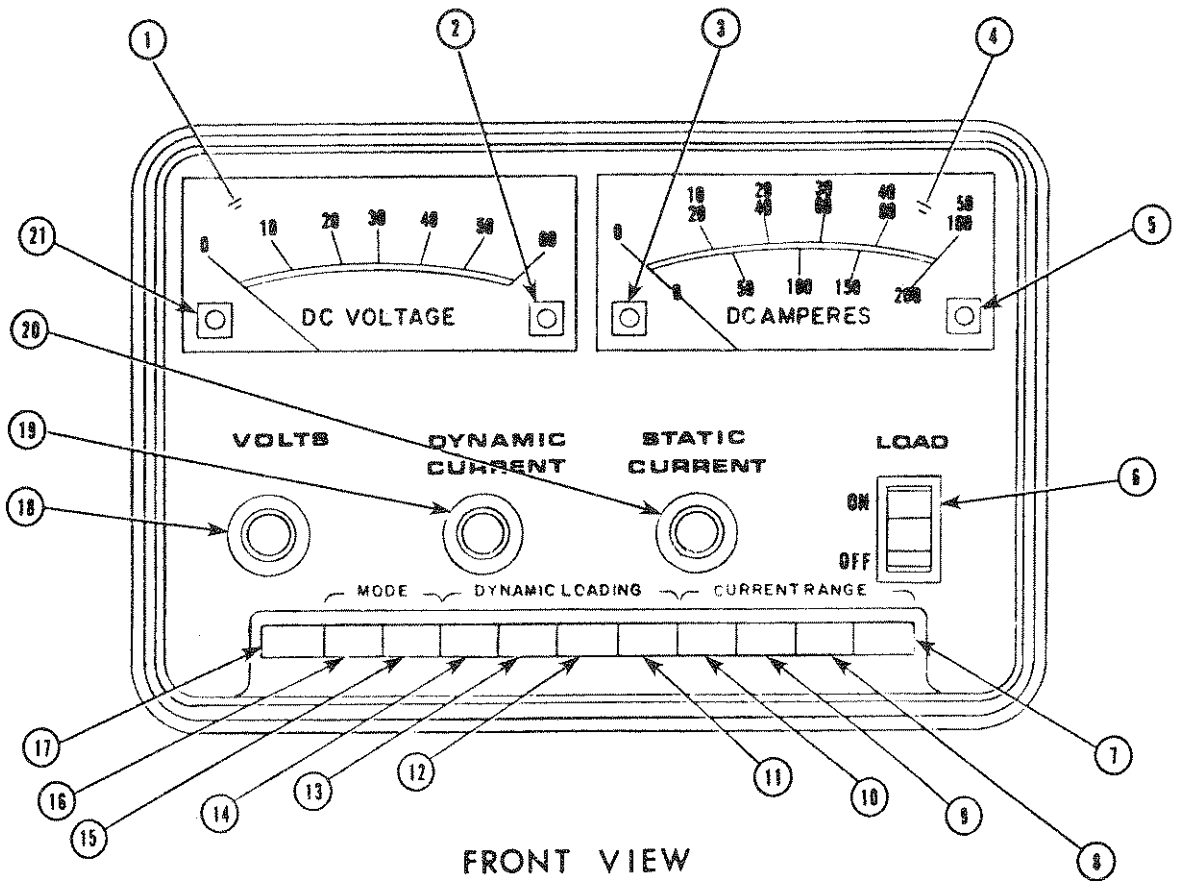


FIGURE 2



## SPECIFICATIONS

### POWER REQUIREMENTS

EL750B	105 TO 125V
EL750B-A	210 TO 250V
EL750B-E	198 TO 242V
EL750B-K	216 TO 264V
	47 TO 63Hz, 10, 20W

### MAXIMUM LOADING POWER

750W (See Safe Operating Curve)

### MINIMUM LOAD VOLTAGE

1.8VDC

### MAXIMUM LOAD CURRENT

150A

### MAXIMUM LOAD VOLTAGE

55VDC

### OPERATING MODE

Constant Current or Constant Resistance.

### CURRENT RIPPLE

Less Than 0.1A P-P

### DYNAMIC LOADING

ALLOWS SWITCHING BETWEEN TWO CURRENT LEVELS AT A SWITCH SELECTED RATE OF  $\approx 1$  KHZ OR TWO TIMES INPUT LINE FREQUENCY. THE TWO CURRENT LEVELS ARE SET BY FRONT PANEL CONTROLS.

### DYNAMIC LOAD RESPONSE TIME

1 MICROSECOND PER AMP OR 50 MICROSECONDS, WHICHEVER IS GREATER.

### REMOTE PROGRAMMING (CONSTANT CURRENT)

0 - 10V IS EQUAL TO 0 - 150A. ACCURACY IS  $\pm 1\%$ . PROGRAM VOLTAGE INPUT IMPEDANCE APPROXIMATELY 100K.

### METER RANGES

VOLTMETER 0 - 60 VDC  
AMMETER 0 - 10 - 50 - 100 - 200A

### METER ACCURACY

2% FULL SCALE

### PROTECTION CIRCUITS

ELECTRONIC CIRCUIT LIMITS POWER DISSIPATION TO 750W. LOAD SHUTS DOWN IN THE EVENT OF AN OVERVOLTAGE. THERMAL SENSORS SHUT OFF LOAD IN THE EVENT OF AN OVERTEMPERATURE CONDITION. UNIT IS PROTECTED AGAINST APPLICATION OF REVERSED POLARITY VOLTAGES.

### CURRENT SIGNAL OUTPUT

VOLTAGE PROPORTIONAL TO CURRENT IS PROVIDED. 1 MILLIVOLT PER AMP,  $\pm 1\%$ .

### OPERATING TEMPERATURE RANGE

0 - 40°C.

### COOLING

FORCED AIR COOLING INTEGRAL IN DESIGN.

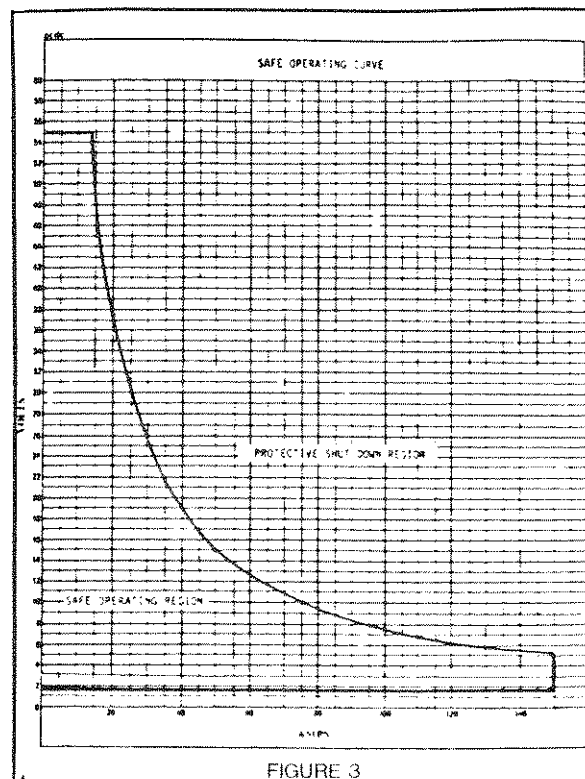


FIGURE 3

SECTION II  
OPERATING INSTRUCTIONS



## OPERATING INSTRUCTIONS

SEE FIG. (2) FUNCTIONAL CONTROLS

### LOAD CONNECTION

The output of the DC power supply should be connected directly to the bus bars of the EL750B. Use short cables of adequate size to handle the rated load current of the power supply.

NOTE: No connections are required at J2 for normal operation.

### CAUTION

OBSERVE POLARITY OF BUS BARS  
WHEN CONNECTING CABLES.

### CONSTANT CURRENT

1. Turn the AC power switch on.
2. Set the mode switch to constant current, load switch off, current controls fully counter-clockwise, dynamic load switch off, and range switch to the desired current range.
3. Turn on power supply under test. At this point the EL750B is at no load.
4. Turn load switch on and adjust static current control clockwise until desired current level is obtained.
5. When the load current exceeds the maximum current capability of the power supply, the instrument will saturate. The indicator lamp marked SAT will indicate this condition. To reset circuit to normal operation turn current control counter-clockwise.

### CONSTANT RESISTANCE

1. Turn the AC power switch on.
2. Set the mode switch to constant resistance, load switch off. Current controls fully counter-clockwise, dynamic load switch off, and range switch to the desired current range.

3. Set the volt selector knob to the voltage rating of the power supply under test.
4. Turn on power supply. At this point the EL750B is at no load.
5. Turn load switch on and adjust static current control clockwise until desired current is obtained.

### DYNAMIC LOADING

The dynamic load section switches the load current from one level to another at a repetition rate of 2 times AC line frequency or  $\approx 1$  KHz and a duty cycle of 50%.

1. Set the upper current level as noted in constant current or constant resistance operating procedures.
2. Set dynamic load current control fully counter-clockwise and dynamic loading switch to DC.
3. Adjust dynamic load current control clockwise until desired lower current level is obtained.
4. After upper and lower current levels have been set, switch dynamic loading switches to either of the two frequencies provided.
5. At this point the current meter should indicate the average of the two current levels.
6. The current waveform may be monitored by connecting a scope to pins 1 and 2 of connector J2.

### LOAD SWITCH

To prevent possibility of short circuit current "lockout", the EL750B load switch must be in the OFF position when connecting or disconnecting the power supply under test.

## DYNAMIC LOADING NOTES

### Dynamic loading in resistance mode.

In the resistance mode the load current change is modified by the voltage transient of the power supply and voltage drop across load cable.

### Dynamic loading in current mode.

In the current mode the load current change is not affected by the power supply voltage transient unless the voltage drops below the minimum operating voltage of the EL750B. In this condition the load transistors will saturate causing distortion of the dynamic current waveform.

## LOAD CABLE INFLUENCE WITH DYNAMIC LOADING

When dynamic loading a power supply with the EL750B, the type and length of interconnect system becomes important. The inductance of the cables or bus bars causes a negative voltage transient at the input terminals of the EL750B. If the input voltage, during the transient, drops below 1.8 volts, the load will saturate causing severe distortion of the current waveform. Load instability or oscillation may also be evident. The maximum interconnect system inductance may be approximated by using the following equation:

$$L = (V_{in} - 1.8) \times 10^{-6}$$

Where: L is in microhenries

$V_{in}$  is the power supply voltage.

The following factors should be considered when selecting an interconnect system:

1. Keep interconnect system short. A five foot length of #2 AWG cable has an inductance of  $2\mu\text{H}$ . A two foot length has  $0.7\mu\text{H}$ .
2. Run interconnect cables parallel in close proximity for lower inductance. For example: Two #2 AWG cables spaced 1/8 inch apart have a total inductance of  $0.68\mu\text{H}$ . Separated by more than 12 inches results in  $4\mu\text{H}$ .
3. Use cables or bus bars with large surface areas to reduce "skin effect".

When operating the EL750B at or near the minimum operating voltage (1.8V), the interconnect system inductance effect becomes severe. Special effort must be made to lower the inductance.

Flat copper strips, separated by 10 mil insulation will provide the lowest inductance. If the inductance cannot be reduced enough, a capacitor may be connected across the input terminals of the EL750B. The capacitance value is not as important as the ESR. ESR should be less than 0.1 ohm at the switching frequency.

## EXTERNAL PROGRAMMING

### Constant Current Mode.

The EL750B can be programmed for constant current externally by applying a 0 to 10 volt signal to J2 pin 8 (+) and pin 7 (-). Set the controls as follows:

1. AC power switch on.
2. Set the load switch off, dynamic load switch off, and meter range switch to desired current range.
3. The setting of the mode switch and voltage and current controls is irrelevant because they are disconnected during external programming.

NOTE: The load switch must be off during external programming. Turning the load switch on restores control of the load to the front panel controls.

Figure 4A shows how to program using the internal 15V supply.

A programmable DC supply and a function generator may be used as shown in Fig. 4B. Any waveform may be used within the frequency range of 20Hz to 50KHz. The DC supply should be set to give the average current of the high and low current levels. For example, if the load is to vary between 50 and 100 amps, the DC program voltage should be set to produce a current of 75 amps (5VDC). The AC voltage is then set to produce a current which varies from 50 to 100 amps (3.33V P-P).

NOTE: Both the AC and DC signal sources must be isolated from the positive or negative inputs to the load.

When the DC and/or AC signal source must be connected to the negative input to the load, the circuit in Figure 4C should be used. An external  $\pm 15$  volt supply must be used to provide operating voltages for the OP amps. The upper frequency response of this circuit is limited due to the slew rate of the OP amps used.

#### Constant Resistance Mode.

The EL750B Electronic Load can be remotely programmed to a fixed resistance within the range of 0.012 ohms to 55 ohms. The circuit shown in Figure 4D connects to the sense leads of the power supply under test and to the remote program input connector J2. The program resistor ( $R_p$ ) value is determined as follows:

$R_p = 1.5 \times 10^4 R$ , where R is the desired load resistance.

## PROTECTION CIRCUIT

The EL750B is protected against over-voltage, overcurrent, and overpower by a circuit that automatically limits the current to a safe value. In the event of an overvoltage condition the protection circuit will reduce the load current to zero. When any of the three conditions occur, the "EI" indicator lamp will turn on to indicate a fault condition.

## CURRENT MONITOR

The load current may be monitored at J2 pin 1 (+) and pin 2 (-) with a digital voltmeter or an oscilloscope. The output is one millivolt per amp. The minus output (J2 pin 2) is connected to the minus bus bar.

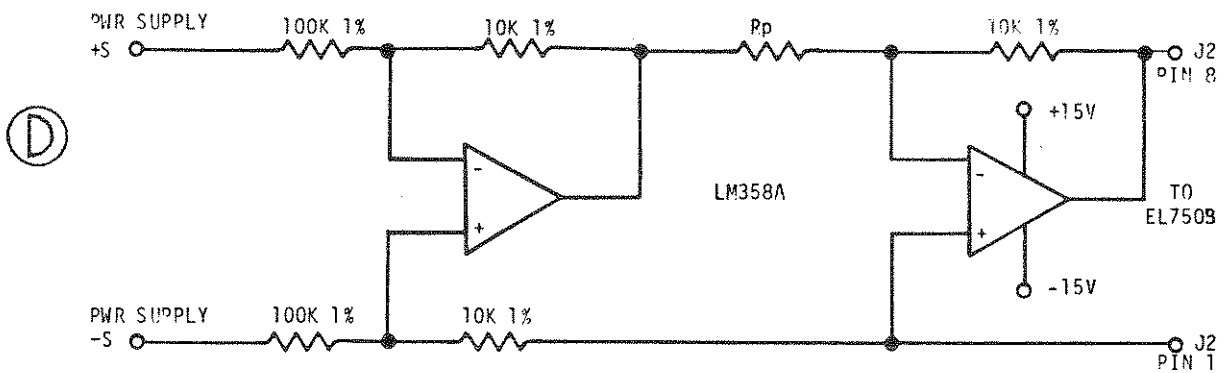
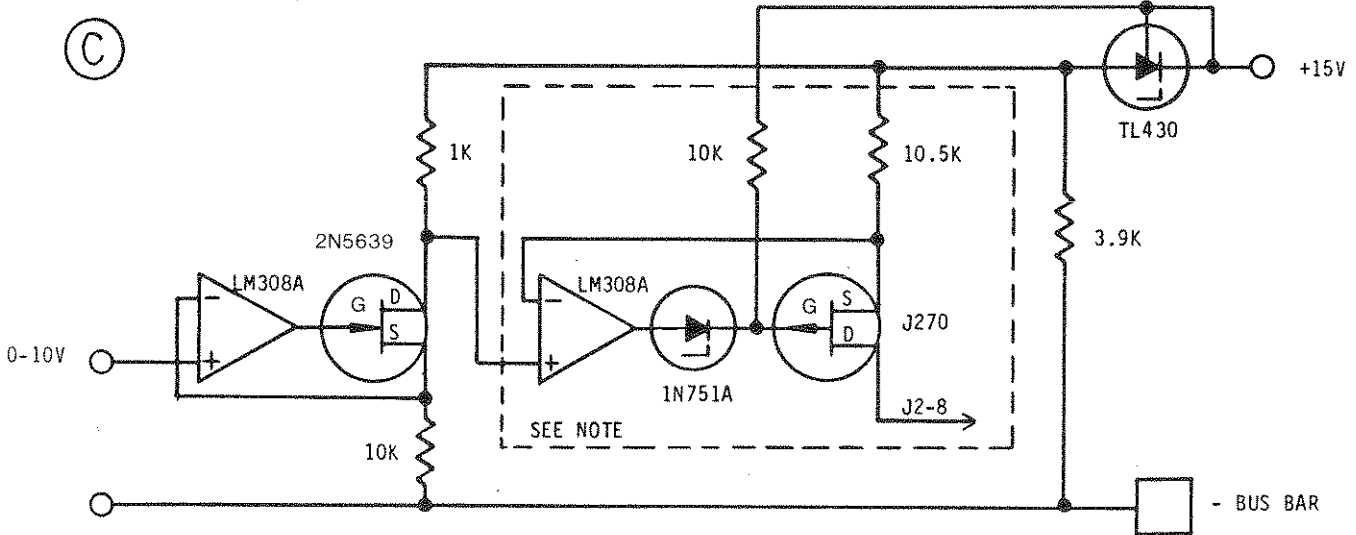
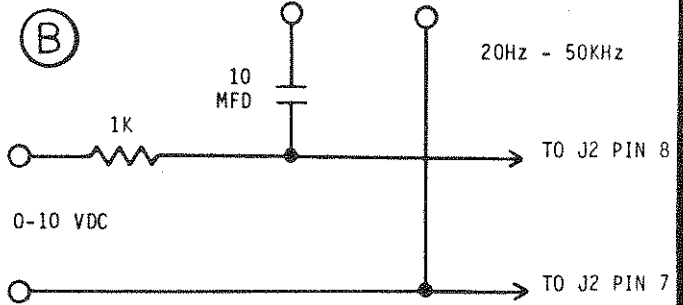
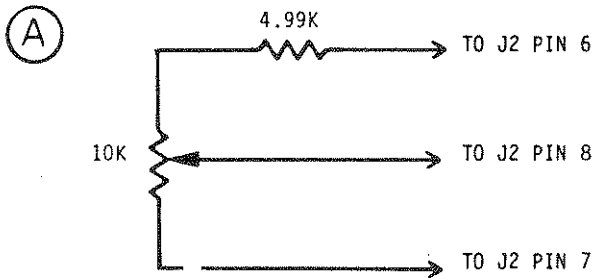
## PARALLEL CONNECTED LOADS

Two or more EL750B's may be paralleled to obtain higher current or power ratings. The control of the loads is the same as for individual loads. If simultaneous control of all loads is required, the circuit described in Fig. 4C in the external programming section may be used. The circuit shown within the dashed lines is to be repeated for each EL750B.

## J2 INPUT/OUTPUT CONNECTOR PIN FUNCTIONS

<u>PIN NO.</u>	<u>FUNCTION</u>
1	Common
2	Current shunt output
3	Not used
4	Not used
5	Not used
6	+15 VDC, 10mA Max. load
7	+15 VDC return
8	Remote Program Input

J2-9 through J2-15 — not used.



NOTE: THE CIRCUIT WITHIN THE DASHED LINES IS REPEATED FOR EACH EL750B USED.

FIGURE 4

SECTION III  
CIRCUIT DESCRIPTION

## CIRCUIT DESCRIPTION

### INTRODUCTION

This section of the manual contains a description of the circuitry used in the EL750B electronic load. Individual descriptions are separated into the following parts: Shunt element and drivers, error amplifier, switch logic, reference supply, meter amplifier, protection circuit, and power supply. Refer to the block diagram (Figure 5) and appropriate schematics (Figures 18 and 19) while reading the circuit description.

### SHUNT ELEMENT AND DRIVERS

The shunt element, consisting of 16 transistors connected in parallel, dissipates the power from the DC source connected to the EL750B. These transistors are located on the four flanges of the heat radiator and soldered directly to the power PC boards. Each transistor is driven by a circuit designed to force the current to share among the 16 transistors regardless of load current. The 16 circuits are identical; therefore, a description of one will be sufficient. The circuit consists of an OP amp, one FET transistor, and two bipolar transistors connected as a constant current sink. The output voltage of the error amplifier is used to program the current to the required level.

This voltage is applied to the non-inverting input of the OP amp. The load current flowing through R7 produces a voltage which is applied to the inverting input of the OP amp. The OP amp compares the two voltage levels and adjusts the drive current to maintain their equality. R2 and C2 provide frequency compensation for the circuit. The low value of R6 (3 ohms) reduces the current gain of the Darlington-connected transistors (Q2 and Q3) and forces Q2 to carry a larger portion of the load current.

### ERROR AMPLIFIER

The error amplifier consists of IC-7 and associated components. These components are located on the PC board.

The load current is controlled by a program voltage which is developed one of three ways:

1. A stable reference source (constant current operation).
2. A portion of the voltage applied to the load (Constant resistance operation).
3. A remote program voltage supplied by the user.

The appropriate voltage is selected by the mode switch (S2) and the switch logic circuit. It is then applied to the positive side of a half bridge consisting of R47 and R50.

A 0.001 ohm meter shunt is used to monitor the total load current. The voltage developed across this shunt is negative with respect to circuit common and is applied to the negative side of the half bridge.

The voltage at the center point of the half bridge will be the difference of the two voltages as referenced to circuit common. This error voltage is amplified and used to program the current in the shunt element.

IC-7 is a precision OP amp connected as a differential amplifier. It provides the gain required to maintain current regulation. R14 and C17 provide frequency compensation. Offset voltages are balanced out by R45 and R46.



## SWITCH LOGIC

The switch logic circuit consists of IC-1 through IC-6 and associated components. These components are located on the control PC board. Inputs to this circuit are controlled by front panel switches S5 through S7 and S12.

An analog switch IC (IC-6) switches the input of the error amplifier to one of three sources:

1. Static current control.
2. Dynamic current control.
3. Remote program input.

NOTE: When remote program is not used, this position becomes "Load Off".

This switch is controlled by the front panel push button switches, IC4, and IC5. The front panel switches program IC4 and IC5 to select the input to the error amplifier and the dynamic loading frequency.

When the dynamic loading feature is being used the switches in IC-6 connected to the static and dynamic current controls are turned on alternately at a repetition rate of 2 times or 16 times the AC line frequencies (120Hz or 960Hz). These frequencies are obtained from a master oscillator operating at 32 times line frequency, phase-locked to the AC power line frequency. The output of the phase-lock-loop IC (IC-1) is divided by 2 and 16 by IC-2 and IC-3.

## REFERENCE SUPPLY

The reference supply consists of IC-11 and associated components. It is located on the control board.

IC-11 is an adjustable shunt regulator which is adjusted to 10 volts with R38. The reference voltage is used by the protection circuit to establish threshold levels. The reference voltage is divided down to 1.5 volts by R41 and R42 to be used during constant current operation.

## METER AMPLIFIER

The meter amplifier consists of IC-10 and associated components. It is a precision OP amp operating at a fixed gain of 60 and is located on the control board.

The input to the amplifier is the voltage from the meter shunt. Offset voltages are balanced out by R32 and R33. The output of the amplifier is used to drive the current meter and the protection circuit. FET transistor Q4 stops the current meter from pegging upscale during power on or off. R36 calibrates the current meter.

## PROTECTION CIRCUIT

The protection circuit consists of IC-8c, IC-8d and IC-9 and associated components located on the control board and IC-2a, IC-2b and associated components located on the power supply board.

The protection circuit monitors four operating parameters: Voltage, current, power dissipation and heatsink temperature. If any or all of these parameters exceed a safe level, the circuit either takes over control of the shunt element or turns it off completely.

## OVERPOWER CIRCUIT

The DC input voltage is divided by R28 and R29 and applied to one input of the analog multiplier IC (IC-9). The output of the meter amplifier is applied to the second input. The output is the product of the two inputs — a voltage level representing the power being dissipated by the load. This voltage is applied to the inverting input of IC-8c, an OP amp operating as a comparator. When the voltage equals the reference voltage applied to the non-inverting input, the output swings negative to take over control of the shunt elements. The result is that the load current is clamped to a safe level. When the output of IC-8c or IC-8d drops, Q3 is biased on to light the "EI" indicator.

### OVERCURRENT CIRCUIT

The output of the meter amplifier is applied to the inverting input of IC-8d, an OP amp operating as a comparator. When the voltage equals the reference voltage applied to the non-inverting input, the output swings negative to take over control as described in the overpower circuit.

### OVERVOLTAGE CIRCUIT

The overvoltage sensor is a zener diode (CR13). When the input voltage exceeds the breakdown voltage of the diode, the voltage at the inverting input of IC-8c is increased. When this voltage exceeds the reference voltage applied to the non-inverting input, the output goes negative, thus turning off the shunt element and turning on Q3 to light the "EI" indicator.

### OVERTEMPERATURE CIRCUIT

The overtemperature sensors are thermistors RT1 and RT2. They are located on the heat radiator at the opposite end from the fan. The thermistors, along with R3 through R6, are connected in a bridge configuration with IC-2a and IC-2b serving as detectors. The outputs of IC-2a and IC-2b are normally positive and go negative when an overtemperature condition exists. This turns off the shunt element and turns on Q1 to light the "OT" indicator. Resistor R7 provides trippoint hysteresis to allow the heat radiator to cool before normal operation can be resumed.

### POWER SUPPLY

The power supply circuitry provides the operating power for the EL750B system. Electronic regulation is used, when necessary, to provide stable, low ripple output voltages. The power supply circuit is lower on the power supply board.

Power is applied to the primary of transformer T1 through fuse F1, power switch S1 and AC input connector J1. The full wave bridge rectifiers and associated filter components in the secondaries of T1 provide filtered DC voltages.

The unregulated output is approximately 5 VDC. This voltage is used to drive the shunt elements and the LED indicators. Transistors Q3 through Q5 and associated components apply the 5 volts to the shunt element after the -15 volt supply exceeds approximately -13 volts. This prevents the shunt element from sinking current when switching the AC power on or off. Transistor Q2 and associated components are connected as a constant current source for AC power indicator DS1.

The  $\pm 15$  volt outputs are electronically regulated by IC-1, a dual-tracking regulator IC.

A line frequency signal is obtained from the secondary of T1 and rectified by CR5 and CR6.

REV. 1  
 DESCRIPTION  
 DATE APPROVED

ALL DIMENSIONS IN INCHES  
 UNLESS OTHERWISE SPECIFIED  
 DO NOT SCALE DRAWING  
 ROUNDED CORNERS UNLESS SHOWN OTHERWISE  
 EDGES ALL BURRS & SHARP  
 TOLERANCES ON:  
 FRACTIONS  $\pm 1/32$  ANGLES  $\pm 1/2^\circ$   
 DECIMALS .XX  $\pm .02$  .XXX  $\pm .010$   
 MATERIAL

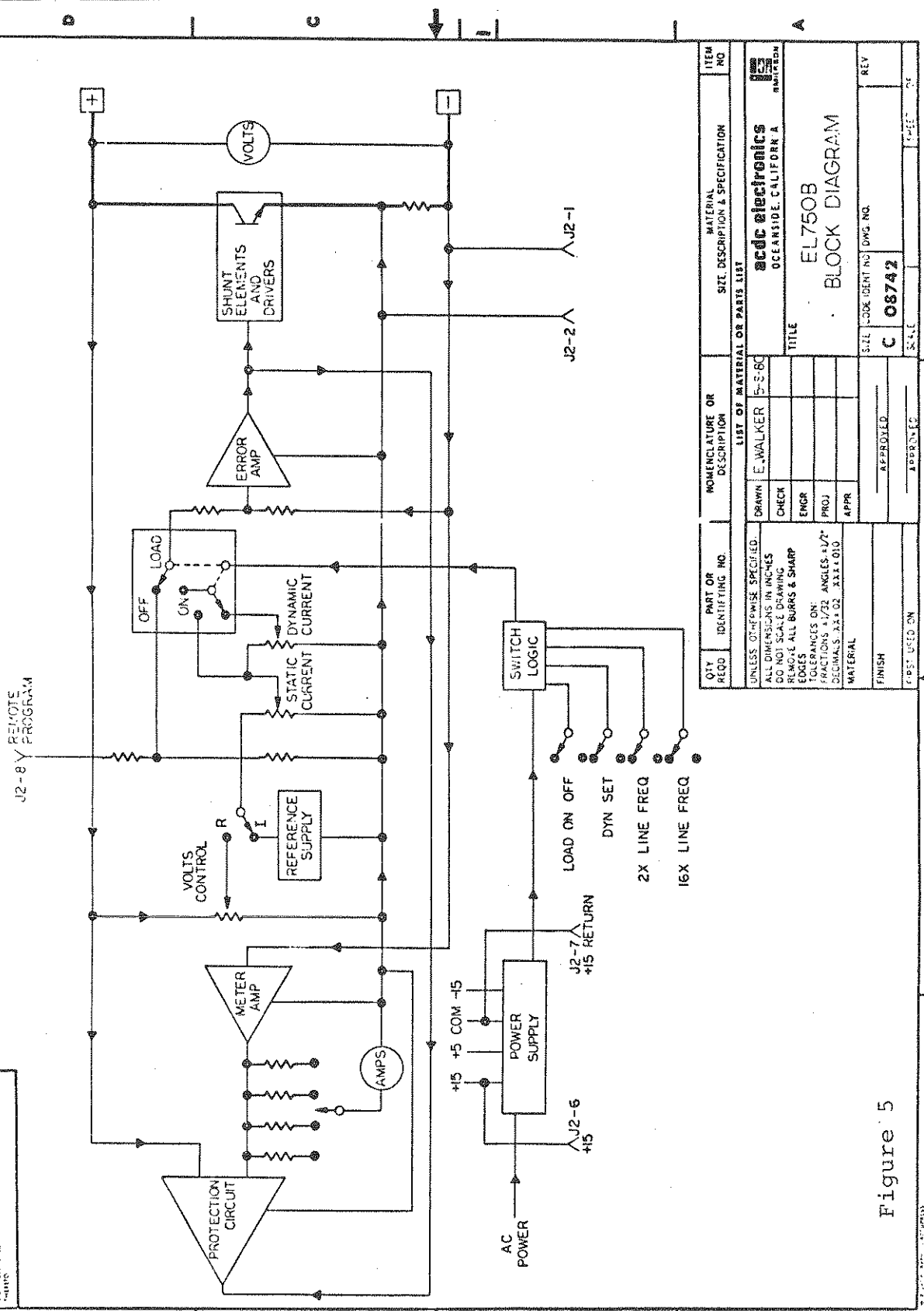


Figure 5

QTY REQD	PART OR IDENTIFYING NO.	LIST OF MATERIAL OR PARTS LIST	NOMENCLATURE OR DESCRIPTION	MATERIAL	ITEM NO
		UNLESS OTHERWISE SPECIFIED: ALL DIMENSIONS IN INCHES DO NOT SCALE DRAWING RADIUS ALL CORNERS & SHARP EDGES TOLERANCES ON: FRACTIONS $\pm 1/32$ ANGLES $\pm 1/2^\circ$ DECIMALS .XX $\pm .02$ .XXX $\pm .010$ MATERIAL	E. WALKER	acdc electronics OCEANSIDE, CALIFORNIA	15
				EL750B BLOCK DIAGRAM	
			APPROVED	SIZE CODE IDENT NO. DWG NO.	REV
			APPROVED	C 08742	1
					2
					3
					4

SECTION IV  
MAINTENANCE AND CALIBRATION

## MAINTENANCE

This section of the manual contains information for performing preventive maintenance, calibration and corrective maintenance for the EL750B.

### PREVENTIVE MAINTENANCE

Preventive maintenance consists of cleaning, visual inspection, etc. Preventive maintenance performed on a regular basis may prevent instrument breakdown and will improve the reliability of the instrument. The severity of the environment to which this instrument is subjected determines the frequency of maintenance. A convenient time to perform preventive maintenance is preceding adjustment of the instrument.

### COVER REMOVAL

#### WARNING

Dangerous voltages exist at several points throughout this instrument. When the instrument is operated with the cover removed, do not touch exposed connections or components. Some transistors have voltages present on their cases. Disconnect power before cleaning the instrument or replacing parts.

The cover is held in place by two screws located on the back panel. To remove the cover, remove the two oval head screws and finish washers and pull away the panel. The cover will now slide off the instrument.

### CLEANING

This instrument should be cleaned as often as operating conditions require. Accumulation of dirt on components acts as an insulating blanket and prevents efficient heat dissipation which can cause overheating and component breakdown.

### CAUTION

Avoid the use of chemical cleaning agents which might damage the plastics used in this instrument. In particular, avoid chemicals that contain benzene, toluene, xylene, acetone, or similar solvents.

### EXTERIOR

Loose dust accumulated on the front panel can be removed with a soft cloth or small brush. Dirt that remains can be removed with a soft cloth dampened with a mild detergent and water solution. Abrasive cleaners should not be used.

### INTERIOR

Dust in the interior of the instrument should be removed occasionally due to its electrical conductivity under high-humidity conditions. The best way to clean the interior is to blow off the accumulated dust with dry, low-pressure air. Remove any dirt which remains with a soft brush or a cloth dampened with a mild detergent and water solution. A cotton-tipped applicator is useful for cleaning in narrow spaces.

## **SWITCH CONTACTS**

Switch contacts and pads are designed to operate dry for the life of the switch. However, as the switches are not sealed, dust attracted to the contact area may cause switch contacts to become electrically noisy. Cleaning may be accomplished by flushing the contact area with isopropyl alcohol or kelite (1 part kelite to 20 parts water). Do not use chemical cleaning agents that leave a film or that might damage plastic parts. Do not use cotton swabs or similar applicators to apply cleaning agents as they tend to snag and leave strands of cotton on switch contacts.

## **VISUAL INSPECTION**

This instrument should be inspected occasionally for such defects as broken connections, improperly seated connectors, damaged circuit boards and heat-damaged parts.

The corrective procedure for most visible defects is obvious; however, particular care must be taken if heat-damaged components are found. Overheating usually indicates other trouble in the instrument; therefore, it is important that the cause of overheating be corrected to prevent recurrence of the damage.



## CALIBRATION

### INTRODUCTION

The following procedure returns the EL750B to correct calibration.

### TEST EQUIPMENT

The following test equipment or equivalent substitutes are required for performing the tests described herein.

### POWER SOURCES

1.8 VDC 150A, ACDC JF2N200P

5.0 VDC 180A, ACDC JF5N200P

0 to 70 VDC 1A, HP 6296A

Voltmeter, 4½ digit digital, Hickok 3400.

Oscilloscope, Tektronix 5440.

Plug-in, vertical Tektronix 5A48.

Plug-in, horizontal Tektronix 5B42.

Test cables, #2 AWG, 5 ft. long.

Card extender, ACDC 70-374-001.

Meter shunt 50mV, 150A, ± 0.1%.

Resistor, 1Ω ± 1%, 5W.

Hipot, 1000 VAC & 500 VDC, Slaughter 103/105 -1.0.

### CALIBRATION CYCLE

Recommended calibration cycle is six months or as required.

The following calibration steps should be performed in sequence as listed.

### PANEL METER MECHANICAL ZERO ADJUST

The mechanical zero adjustment is located below each meter and behind the front panel. Remove any power source connected to the EL750B and turn power switch off. Allow at least one minute for meter pointer to stabilize.

Rotate adjustment screw clockwise until pointer is exactly at zero. Rotate adjustment screw slightly counter-clockwise to relieve tension on pointer suspension.

### REFERENCE VOLTAGE

Set control per Table 1-A.

Connect DVM to TP3 (+) and TP1 (-).

Adjust R38 for a voltage reading of  $10 \pm 0.01$  volts.

### REMOTE PROGRAM CALIBRATION

Connect equipment as shown in Figure 7.

Set controls per Table 1-C.

Set meter range to 200A.

Adjust program voltage to  $10 \pm 0.01$  volts.

Adjust R10 for 50 millivolts across calibration shunt.

Adjust program voltage to  $100 \pm 1$  millivolt.

Adjust R45 for 0.50 millivolt across calibration shunt.

### CURRENT METER ZERO

Hook up test equipment as shown in Figure 6.

Set controls per Table 1-A. *10A RANGE*

The voltage across the calibration shunt must be  $0 \pm 30\mu\text{V}$ . Calibrate per paragraph "Remote Program Calibration" if voltage is not within specification. *90mA*

Adjust R32 for a zero reading on current meter.

### CURRENT METER CALIBRATION

Hook up test equipment as shown in Figure 6.

Set controls per Table 1-B.

Adjust static current control for 3.33 millivolts across calibration shunt.

Adjust R36 for a current meter reading of 10 amps.

Change meter range to 50A.

Adjust static current control for 16.67 millivolts across calibration shunt.

The current meter shall read  $50 \pm 0.5$  amps.

Change meter range to 100A.

Adjust static current control for 33.33 millivolts across calibration shunt.

The current meter shall read  $100 \pm 1$  amps.

Change meter range to 200A.

Adjust static current control for 50 millivolts across calibration shunt.

The current meter shall read  $150 \pm 2$  amps.

### VOLTAGE CONTROL KNOB ADJUST

Connect equipment as shown in Figure 6.

Set controls per Table 1-G.

Adjust voltage control for 150 amps on current meter.

The voltage control knob should be adjusted by loosening two set screws and slipping the knob on the pot shaft so that it indicates 5 volts.

### PERFORMANCE VERIFICATION TESTS

Failure to meet the requirements of the following tests indicates a circuit failure which requires repair. Return the unit to factory for repair or contact factory for assistance in trouble shooting.

#### MINIMUM LOAD VOLTAGE

Connect equipment as shown in Figure 6.

Set controls per Table 1-D.

Set voltage source to  $1.8 \pm 0.05$  volts as measured at the load terminals.

The load current must be adjustable from 0 to 150 amps with the static current control.

#### CURRENT RIPPLE

Connect equipment as shown in Figure 8.

Set controls per Table 1-B.

Adjust load current to 1 amp.

The ripple measured across the 1 ohm resistor shall not exceed 0.1 volt P-P.

#### DYNAMIC LOAD RESPONSE TIME

Connect equipment as shown in Figure 9.

Set controls per Table 1-E.

Set dynamic load to switch between 75 and 150 amps. Verify that both 120Hz and 1KHz frequencies are functional.

Measure rise and fall time on the current across the calibration shunt.

The rise and fall time shall be less than 75 microseconds.

#### PROTECTION CIRCUITS

##### Overvoltage —

Connect equipment as shown in Figure 10.

Set controls per Table 1-D.

Adjust load current to 1.0 amps.

Adjust programmable supply voltage up until the "EI" indicator lights and the load current drops to zero.

The overvoltage point shall occur between 57 and 70 volts.

#### **Overcurrent —**

Connect equipment as shown in Figure 6.

Set controls per Table 1-F.

Set voltage source to 2 volts.

Adjust load current up until the "EI" indicator lights and the load current stops increasing.

The overcurrent point shall occur between 152 and 159 amps.

#### **Overpower —**

Connect equipment as shown in Figure 10.

Set controls per Table 1-D.

Set programmable supply to  $6 \pm 0.01$  volts.

Adjust the load current up until the "EI" indicator lights and the load current stops increasing.

The load current at this point shall be between 125 and 137.5 amps.

Turn static current control fully counter-clockwise.

Set programmable supply to  $50 \pm 0.1$  volts.

Adjust the load current up until the "EI" indicator lights and the load current stops increasing.

The load current at this point shall be between 15 and 17 amps.

#### **Overtemperature —**

Connect equipment as shown in Figure 6.

Set controls per Table 1-D.

Set the load current to 50A.

Remove P6 from power supply board.

Temporarily short terminals 1 to 4 on J6 (located on board).

The load current shall drop to zero and the "OT" indicator shall light.

Remove jumper and replace P6. The unit shall resume normal operation.

#### **HIPOT (DIELECTRIC WITHSTAND TEST)**

Hipot test must be performed with AC power switch in the "ON" position.

1000 VAC: AC input to input bus bars and AC input to chassis.

500 VAC: Input bus bars to chassis.

TABLE I

	VOLTS CONTROL	DYN. CURRENT CONTROL	STATIC CURRENT CONTROL	LOAD ON/OFF	POWER ON/OFF	I (CURRENT)	R (RESISTANCE)	OFF	DC	120HZ	1KHZ	10A	50A	100A	200A
A	5	CCW	CCW	OFF	ON	IN	OUT	IN	OUT	OUT	OUT	IN	OUT	OUT	OUT
B	5	CCW	*	ON	ON	IN	OUT	IN	OUT	OUT	OUT	IN	OUT	OUT	OUT
C	5	CCW	CCW	OFF	ON	IN	OUT	IN	OUT	OUT	OUT	OUT	OUT	OUT	IN
D	5	CCW	*	ON	ON	IN	OUT	IN	OUT	OUT	OUT	OUT	OUT	OUT	IN
E	5	*	*	ON	ON	IN	OUT	*	*	*	*	OUT	OUT	OUT	IN
F	0	CCW	*	ON	ON	OUT	IN	IN	OUT	OUT	OUT	OUT	OUT	OUT	IN
G	*	CCW	CW	ON	ON	OUT	IN	IN	OUT	OUT	OUT	OUT	OUT	OUT	IN

\* REFERENCE PROCEDURE FOR SETTING THIS CONTROL.

CW CLOCKWISE

CCW COUNTER-CLOCKWISE

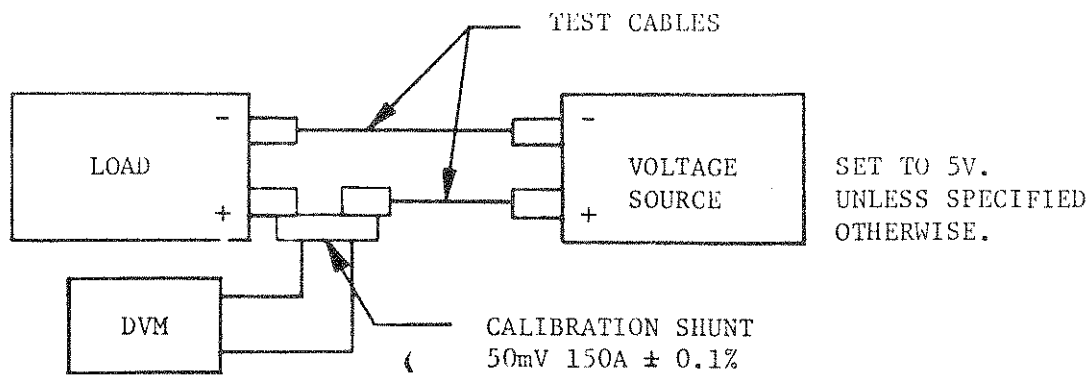


Figure 6

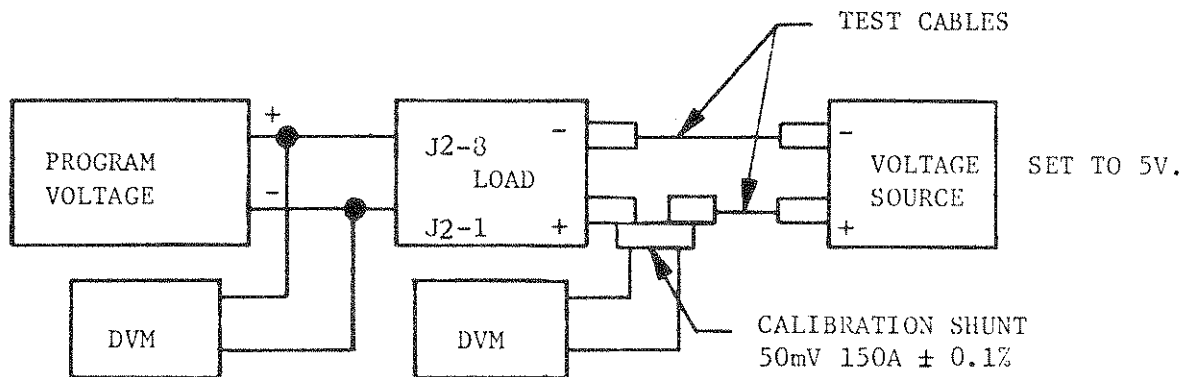


Figure 7

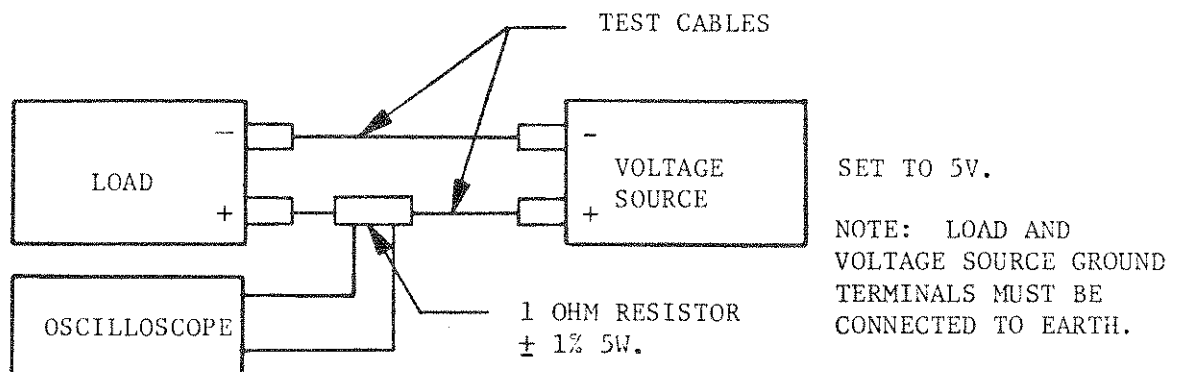


Figure 8

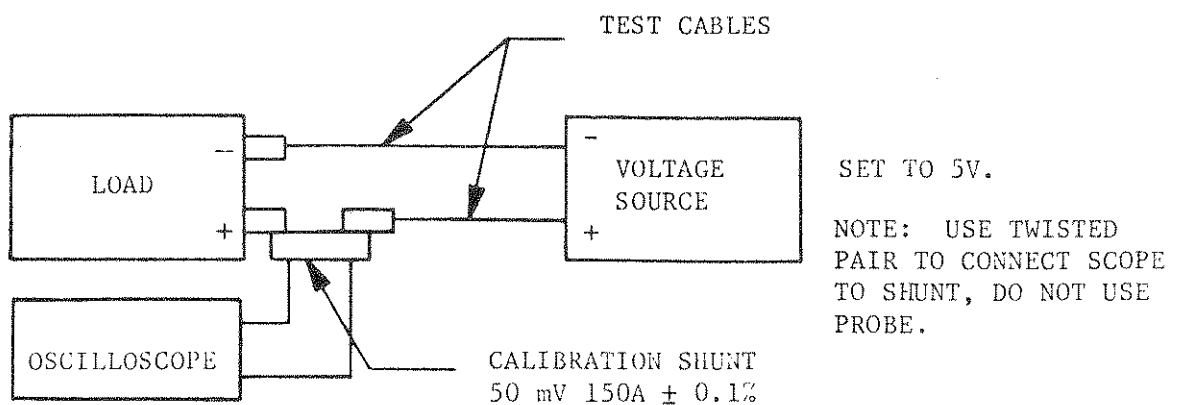


Figure 9

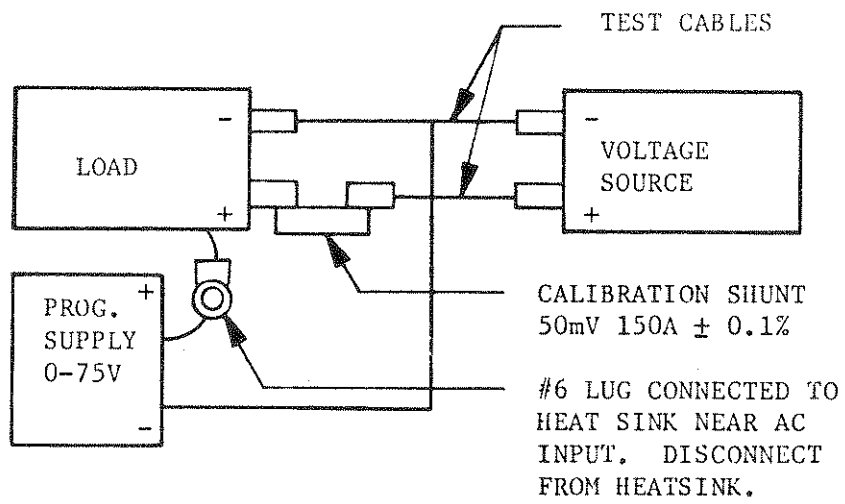


Figure 10



SECTION V

REPLACEABLE ELECTRICAL PARTS

ELECTRICAL COMPONENTS

DIAGRAMS AND CIRCUIT BOARD ILLUSTRATIONS

## REPLACEABLE ELECTRICAL PARTS

The information in this section is for reference only. Schematics may or may not include all revisions. Contact the factory for information pertaining to the current list of materials.

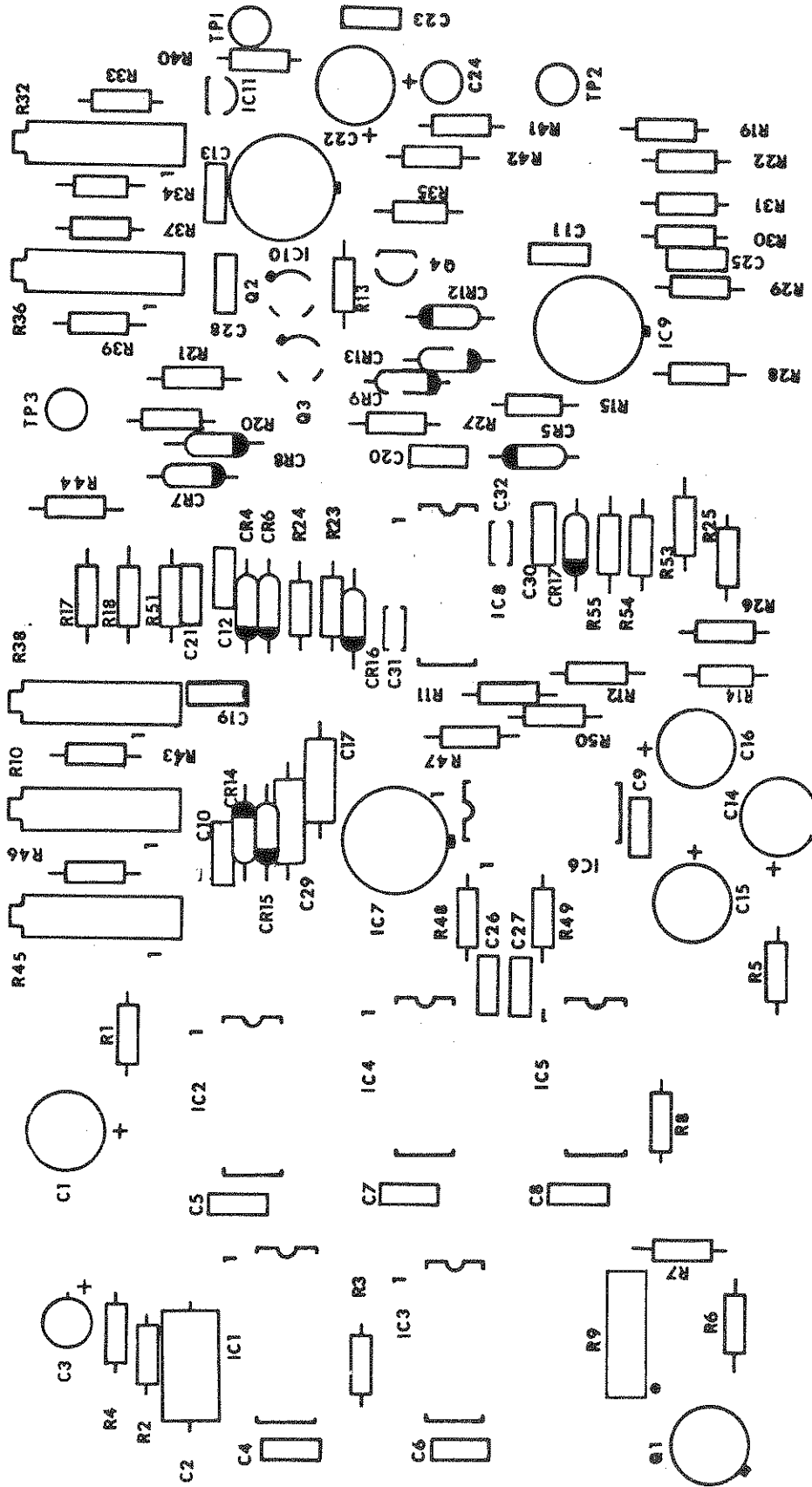
Manufacturer call-outs are for reference only. The equipment may or may not use listed manufacturers.

Replacement parts are available from ACDC Electronics, 401 Jones Rd. Oceanside, Calif. 92054. Direct all enquiries to the CSO department when ordering parts; include model number, ACDC part number, reference designator, and component value or description.

## LIST OF MANUFACTURERS

ACDC	ACDC Electronics, Div. of Emerson Oceanside, Calif. 92054
AD	Analog Devices, Inc. Norwood, Mass. 02062
AVX	AVX Ceramics Myrtle Beach, So. Carolina 29577
BOU	Bourns, Inc. Riverside, Calif. 92507
BUSS	Bussman Manufacturing St. Louis, Mo. 63178
CK	C & K Components, Inc. Newton, Mass. 02158
CRL	Centralab Electronics Div. Milwaukee, Wisc. 53201
CTS	CTS Corp. Elkart, Ind. 46514
DALE	Dale Electronics, Inc. Norfolk, Nebraska 68701
FAIR	Fairchild Camera & Instruments Mountain View, Calif. 94042
GI	General Instrument Optoelectronics Palo Alto, Calif. 94304
ILL	Illinois Capacitor Inc. Morton Grove, Ill. 60053
IMC	IMC Magnetics Rochester, N.H. 03867
MAL	Mallory Capacitor Co. Huntsville, Ala. 35801
MEP	Mepco/Electra, Inc. Morristown, N.J. 07960
MOD	Modutec, Inc. Norwalk, Conn. 06854
MOL	Molex, Inc. Lisle, Ill. 60532
MOT	Motorola Semiconductor Products Phoenix, Ariz. 85036
NSC	National Semiconductor Corp. Santa Clara, Calif. 95051

PAC	Pacific Electrocord Co. Gardena, Calif. 90247
RCA	RCA Solid State Div. Sumerville, N.J. 08876
ROM	R-Ohm Corp. Irvine, Calif. 92716
SPR	Sprague Products Co. North Adams, Mass. 01247
TI	Texas Instruments Inc. Dallas, Texas 75265
TRW	TRW IRC Resitors Philadelphia, Penn. 19108
WTH	Western Thermistor Oceanside, Calif. 92054



CONTROL BOARD

FIGURE 11

EL750B  
CONTROL BOARD ASSEMBLY  
69-364-001 (REV.M)

<u>REF.DES.</u>	<u>DESCRIPTION</u>	<u>SUGGESTED MANUF/TYPE</u>	<u>ACDC P/N</u>
C1,15,16,22	Capacitor	33mf/25V ILL 336RAR025B	62-708-005
C2	Capacitor	0.0068mf/80V MAL M192P682R8	54-435-682
C3	Capacitor	4.7mf/35V MAL TDC475M035NSF	58-577-002
C4-13,19,23 26,27	Capacitor	0.1mf/50V CRL CY20C104M	56-137-005
C14	Capacitor	33mf/35V UC SL33VB35	62-708-018
C17,29	Capacitor	0.0047mf/80V MAL M192P472R8	54-435-472
C20,21	Capacitor	0.1mf/100V MUR RC1-104	67-159-104
C24	Capacitor	22mf/10V ILL 226RLR010M	70-333-004
C25,30	Capacitor	0.01mf/100V MUR RC1-103	67-159-103
C31,32	Capacitor	0.0001mf/100V MUR RC1-101	67-159-101
CR4-9,16	Diode	GE 1N4454	50-464-045
CR12	Diode,Zener	MOT 1N758A	51-739-049
CR13	Diode,Zener	MOT 1N980B	51-739-118
CR14,15	Diode	FAIR 1N3595	50-464-116
CR17	Diode	MOT 1N5297	60-471-004
IC1	Int.Ckt.	MOT MC14046BCP	69-298-003
IC2,3	Int.Ckt.	MOT MC14013BCP	69-298-001
IC4	Int.Ckt.	MOT MC14071BCP	69-298-005
IC5	Int.Ckt.	MOT MC14023BCP	69-298-002
IC6	Int.Ckt.	MOT MC14066BCP	69-298-004
IC7,10	Int.Ckt.	RCA CA3193AT	62-331-020
IC8	Int.Ckt.	MOT 324A	62-331-019
IC9	Int.Ckt.	ANALOG AD532	69-300-001
IC11	Int.Ckt.	TI TL430CLP	69-299-001
Q1,2	Transistor	MOT 2N2222A	52-057-013
Q3	Transistor	MOT 2N2907A	52-725-004
Q4	Transistor	NAT J108	65-969-004

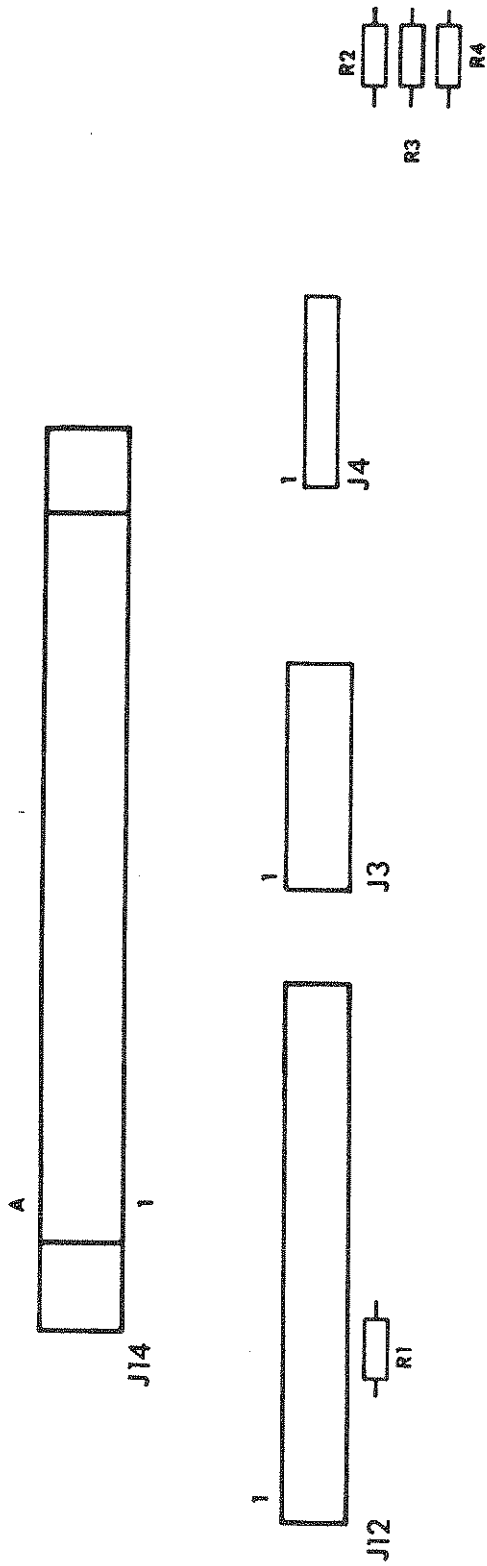


CONTROL BOARD ASSEMBLY  
69-364-001 (REV.M)

<u>REF.DES.</u>	<u>DESCRIPTION</u>	<u>SUGGESTED MANUF/TYPE</u>	<u>ACDC P/N</u>
R1,19,22	Resistor	270 Ohm 5% 1/4W	55-675-271
R2	Resistor	120K 5% 1/4W	55-675-124
R3,4,8,48, 49	Resistor	100K 5% 1/4W	55-675-104
R5,15	Resistor	27K 5% 1/4W	55-675-273
R6,18,27,44	Resistor	10K 5% 1/4W	55-675-103
R7	Resistor	1.0 Meg 5% 1/4W	55-675-105
R9A-E	Resistor Ntwk.	100K	68-474-004
R11	Resistor	102K 1% 1/10W	57-757-502
R12	Resistor	1.78K 1% 1/10W	57-757-325
R13	Resistor	18K 5% 1/4W	55-675-183
R14	Resistor	2.7K 5% 1/4W	55-675-272
R17	Resistor	5.1K 5% 1/4W	55-675-512
R20	Resistor	22K 5% 1/4W	55-675-223
R21	Resistor	6.8K 5% 1/4W	55-675-682
R23	Resistor	6.81K 1% 1/10W	57-757-381
R24	Resistor	100K 1% 1/10W	57-757-501
R25	Resistor	93.1K 1% 1/10W	57-757-494
R26	Resistor	9.09K 1% 1/10W	57-757-393
R28,41	Resistor	82.5K 1% 1/10W	57-757-489
R29	Resistor	18.2K 1% 1/10W	57-757-426
R30	Resistor	12K 5% 1/4W	55-675-123
R31	Resistor	7.15K 1% 1/10W	57-757-383
R33	Resistor	10 Meg 5% 1/4W	55-675-106
R34	Resistor	60K 0.1% 1/4W	64-346-001
R35	Resistor	1K 1% 1/10W	57-757-301
R37	Resistor	499 Ohm 1% 1/10W	57-757-268
R39	Resistor	61.9K 1% 1/10W	57-757-477
R40	Resistor	27.4K 1% 1/10W	57-757-443
R42	Resistor	14.7K 1% 1/10W	57-757-417
R43	Resistor	2K 5% 1/4W	55-675-202
R46	Resistor	18 Meg 5% 1/4W	55-675-186
R47,50	Resistor	20K 1% 1/10W	57-757-430
R51,55	Resistor	1K 5% 1/4W	55-675-102
R53	Resistor	150K 1% 1/10W	57-757-518
R54	Resistor	4.99K 1% 1/10W	57-757-368
R10	Pot	BOU 3006P-1-103	60-301-103
R32,38,45	Pot	BOU 3006P-1-503	60-301-503
R36	Pot	BOU 3006P-1-201	60-301-201

B:69-364.001  
Disk No.9/cd

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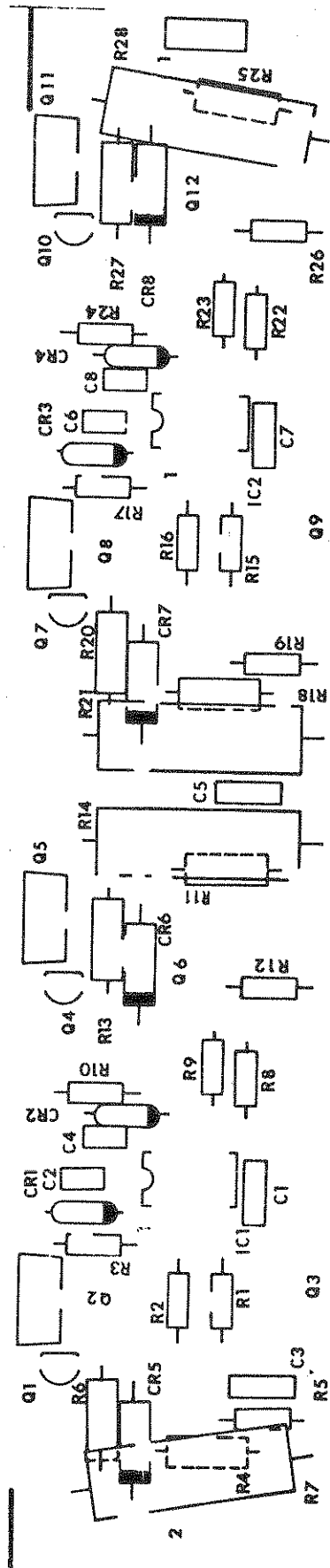
**SWITCH BOARD**

FIGURE 12

EL750B  
MOTHER BOARD ASSEMBLY  
69-365-001 (REV.D)

<u>REF.DES.</u>	<u>DESCRIPTION</u>	<u>SUGGESTED MANUF/TYPE</u>	<u>ACDC P/N</u>
R1	Resistor	60K 0.1% 1/4W	64-346-001
R2	Resistor	2.4K 0.1% 1/4W	64-346-002
R3	Resistor	5.4K 0.1% 1/4W	64-346-003
R4	Resistor	11.4K 0.1% 1/4W	64-346-004
S1-11	Switch	CRL 2KCM0A001-1369	64-062-000

B:69-365.001  
Disk No.9/cd



EL750B POWER BOARD

FIGURE 13

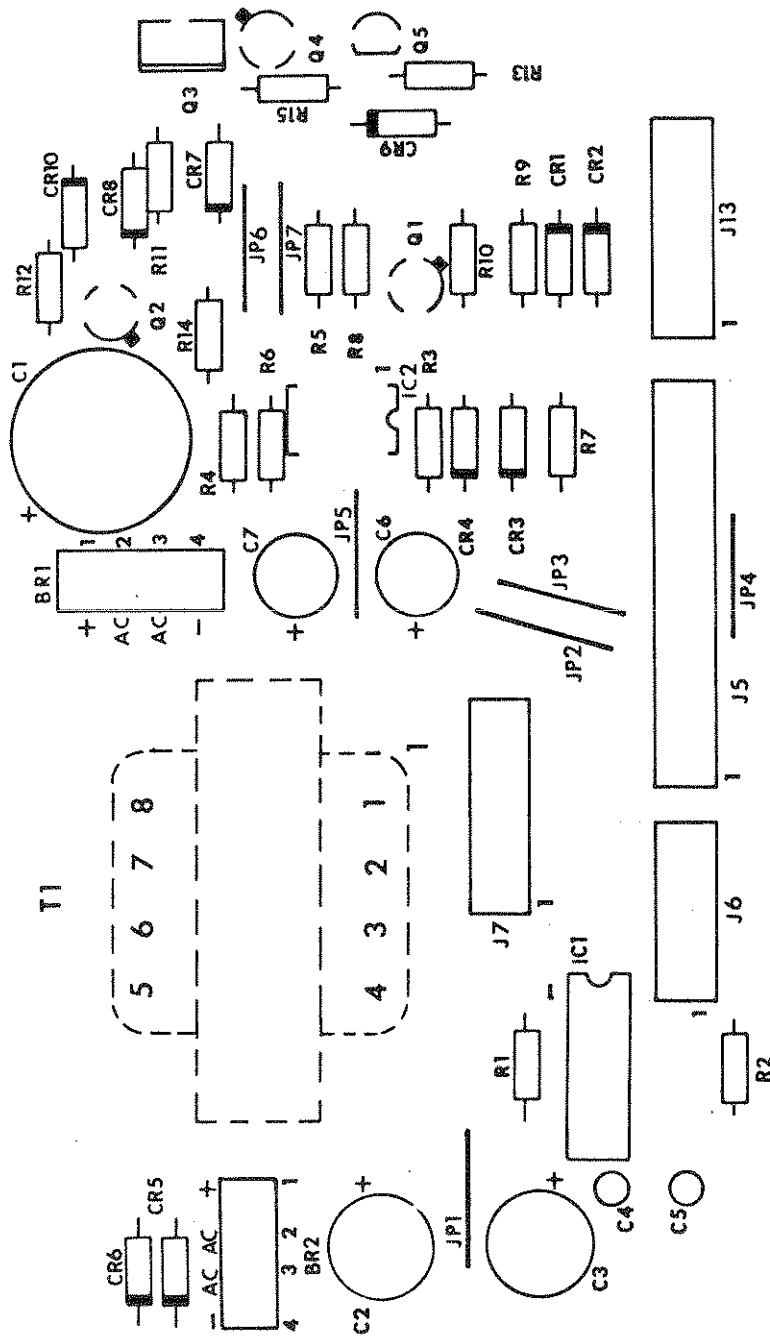
EL750B  
POWER BOARD ASSEMBLY  
69-363-001/002 (REV.J/H)

<u>REF. DES.</u>	<u>DESCRIPTION</u>	<u>SUGGESTED MANUF/TYPE</u>	<u>ACDC P/N</u>
C1,3,5,7	Capacitor	0.1mf/50V CRL CY20C104M	56-137-005
C2,4,6,8	Capacitor	820pf/100V MUR RC1-821	67-159-821
CR1-4	Diode	GE 1N4454	50-464-045
CR5-8	Diode	MOT MR501	50-464-020
IC1,2	Int.Ckt.	RCA CA358A	62-331-017
Q1,4,7,10	Transistor	MOT 2N5638	65-969-005
Q2,5,8,11	Transistor	RCA 2N5298	54-031-088
R1,2,8,9, 15,16,22, 23	Resistor	1K 5% 1/4W	55-675-102
R3,10,17,24	Resistor	68K 5% 1/4W	55-675-683
R4,11,18,25	Resistor	39 Ohm 5% 1/2W	50-461-390
R5,12,19,26	Resistor	2.2K 5% 1/4W	55-675-222
R6,13,20,27	Resistor	3 Ohm 5% 1W	69-332-309
R7,14,21,28	Resistor	0.02 Ohm 5% 5W	63-403-002

B:69-363.001  
Disc No.10/aas



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**POWER SUPPLY BOARD**

FIGURE 14

EL750B -A/-E/-K  
PCB ASSEMBLY POWER SUPPLY  
69-362-001/002/003/004 (REV.F/G/G/G)

<u>REF. DES.</u>	<u>DESCRIPTION</u>	<u>SUGGESTED MANUF /TYPE</u>	<u>ACDC P/N</u>
BR1, 2	Diode, Bridge	MOT MDA-201	67-684-002
C1	Capacitor	2100mf/10V MAL VPR212N010J1L6A	63-284-018
C2, 3	Capacitor	220mf/35V ILL 227RAR035B	62-708-009
C4, 5	Capacitor	0.0015mf/100V MUR RC1-152	67-159-152
C6, 7	Capacitor	33mf/25V ILL 336RAR025B	62-708-005
CR1-8	Diode	GE 1N4454	50-464-045
CR9	Diode, Zener	MOT 1N757A	51-739-101
CR10	Diode	MOT 1N4004	50-464-003
IC1	Int.Ckt.	MOT MC1468L	67-755-001
IC2	Int.Ckt.	RCA CA358AE	62-331-017
Q1, 2	Transistor	MOT 2N2907A	52-725-004
Q3	Transistor	MOT TIP41B	54-031-084
Q4	Transistor	MOT 2N2222A	52-057-013
Q5	Transistor	MOT 2N5639	65-969-003
R1, 2	Resistor	10 Ohm 5% 1/4W	55-675-100
R3, 4	Resistor	4.99K 1% 1/10W	57-757-368
R5, 6	Resistor	49.9K 1% 1/10W	57-757-468
R7, 13	Resistor	100K 5% 1/4W	55-675-104
R8	Resistor	6.8K 5% 1/4W	55-675-682
R9	Resistor	2.7K 5% 1/4W	55-675-272
R10	Resistor	220 Ohm 5% 1/4W	55-675-221
R11	Resistor	30 Ohm 5% 1/4W	55-675-300
R12	Resistor	3.3K 5% 1/4W	55-675-332
R14	Resistor	4.7K 5% 1/4W	55-675-472
R15	Resistor	680 Ohm 5% 1/4W	55-675-681
T1 (115V)	Transformer	ACDC	52222
T2 (230V)	Transformer	ACDC	52533

B:69-362.001  
Disc No.10/aas

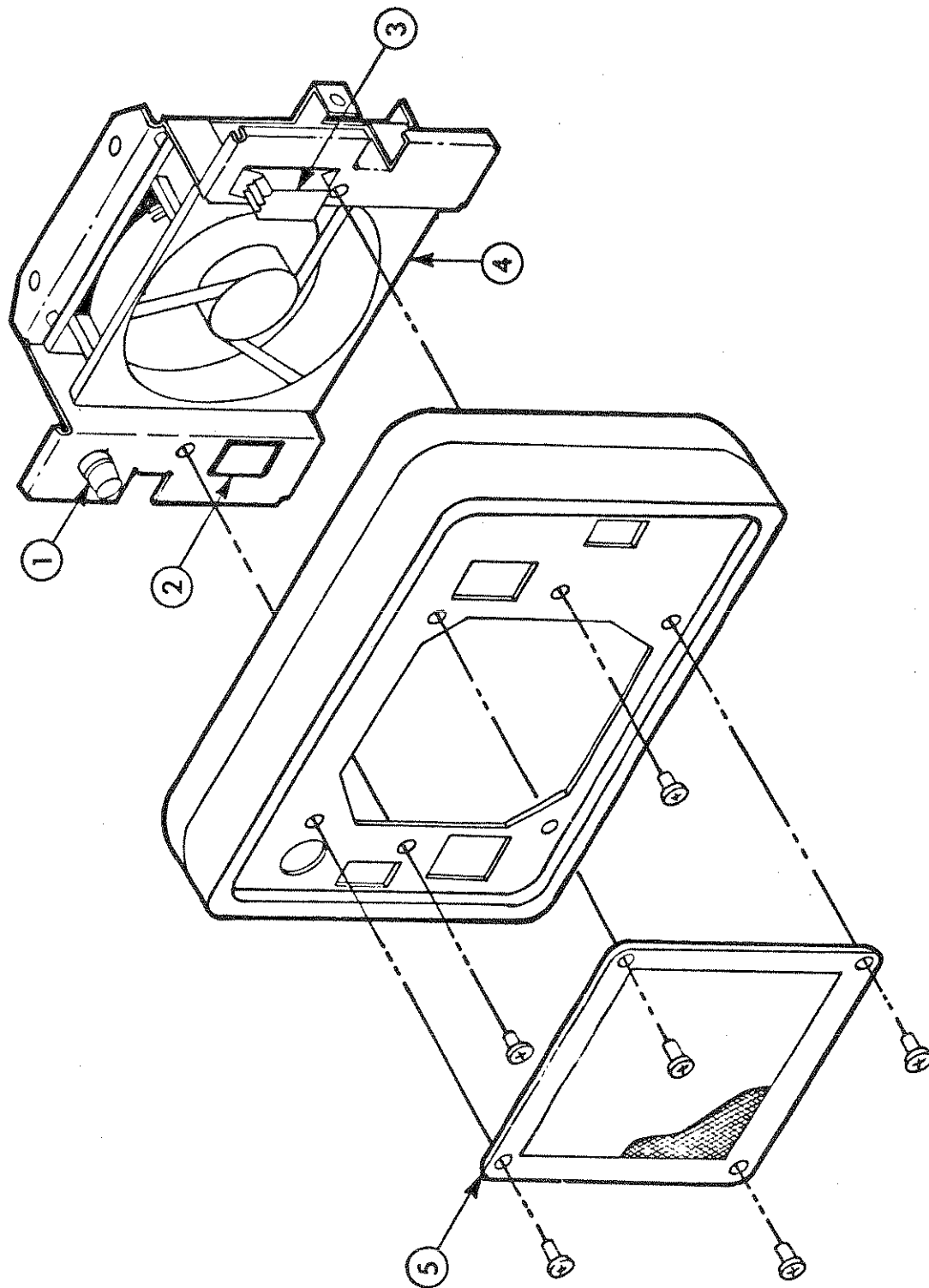





Figure 15

EL750B  
MISCELLANEOUS

REF. DES.	ITEM NO.	ACDC P/N	NAME & DESCRIPTION	 MFR. CODE	MFR. P/N
F1	1	51-533-012	FUSE, 1/2A (115V MODEL ONLY)	BUSS	AGC 1/2
F1	1	51-533-025	FUSE, 1/4A (220-240V MODEL ONLY)	BUSS	AGC 1/4
	2	65-736-000	AC LINE CORD (115V MODEL)	PAC	C-3120-008-BL
	2	65-736-001	AC LINE CORD (220/240V MODEL)	PAC	C-2123-02M-GY
	2	65-737-000	AC INPUT CONNECTOR	BELDEN	EAC-302
P2	3	60-477-022	CONNECTOR	MOL	03-09-2154
	3	60-477-026	CONNECTOR PINS	MOL	02-09-2143
B1	4	55-554-011	FAN (115V MODEL ONLY)	IMC	WS2107FL-1000
B1	4	55-554-005	FAN (220-240V MODEL ONLY)	IMC	WS2107FL-1006
	5	61-469-001	FAN FILTER	IMC	6993
	6	64-022-002	CASE ASSY	ACDC	
Q3, 6, 9, 12	7	69-331-000	TRANSISTOR, POWER	MOT	SJ1891
	8	69-363-001	POWER BOARD ASSY	ACDC	
RT1, 2	9	69-599-001	THERMISTOR	WTH	A1094
R203	10	64-026-000	METER SHUNT, 100A, 100mV	ACDC	
	11	69-362-001	POWER SUPPLY BOARD ASSY	ACDC	
	12	69-364-001	CONTROL BOARD ASSY	ACDC	
	13	69-365-001	SWITCH BOARD ASSY	ACDC	
M2	14	64-061-003	METER, VOLTS	ACDC	
M1	15	64-061-002	METER, AMP	ACDC	
DS2-4	16	64-063-001	LED, RED	GI	MV5053
DS1	17	64-063-002	LED, GREEN	GI	MV5253
R202	18	63-710-105	POTENTIOMETER, 1 MEG	BOU	82A1A-B28-A25
R201	19	63-710-103	POTENTIOMETER, 10K	BOU	82A1A-B28-A15
R200	20	63-520-102	POTENTIOMETER, 1K 3 TURN	BOU	3543S-1-102
S12	21	63-446-007	SWITCH, TOGGLE, SPDT	CK	U11J2ZQE
	22	64-516-001	KNOB, VOLTS	ACDC	
	23	64-140-002	KNOB, CURRENT	ACDC	
	24	64-062-012	PUSH BUTTON SET 	ACDC	

 MFR. CODE IS FOR REFERENCE ONLY - EQUIPMENT MAY OR MAY NOT USE LISTED MANUFACTURER.

 USE 64-062-014 FOR 50 Hz AC LINE INPUTS.

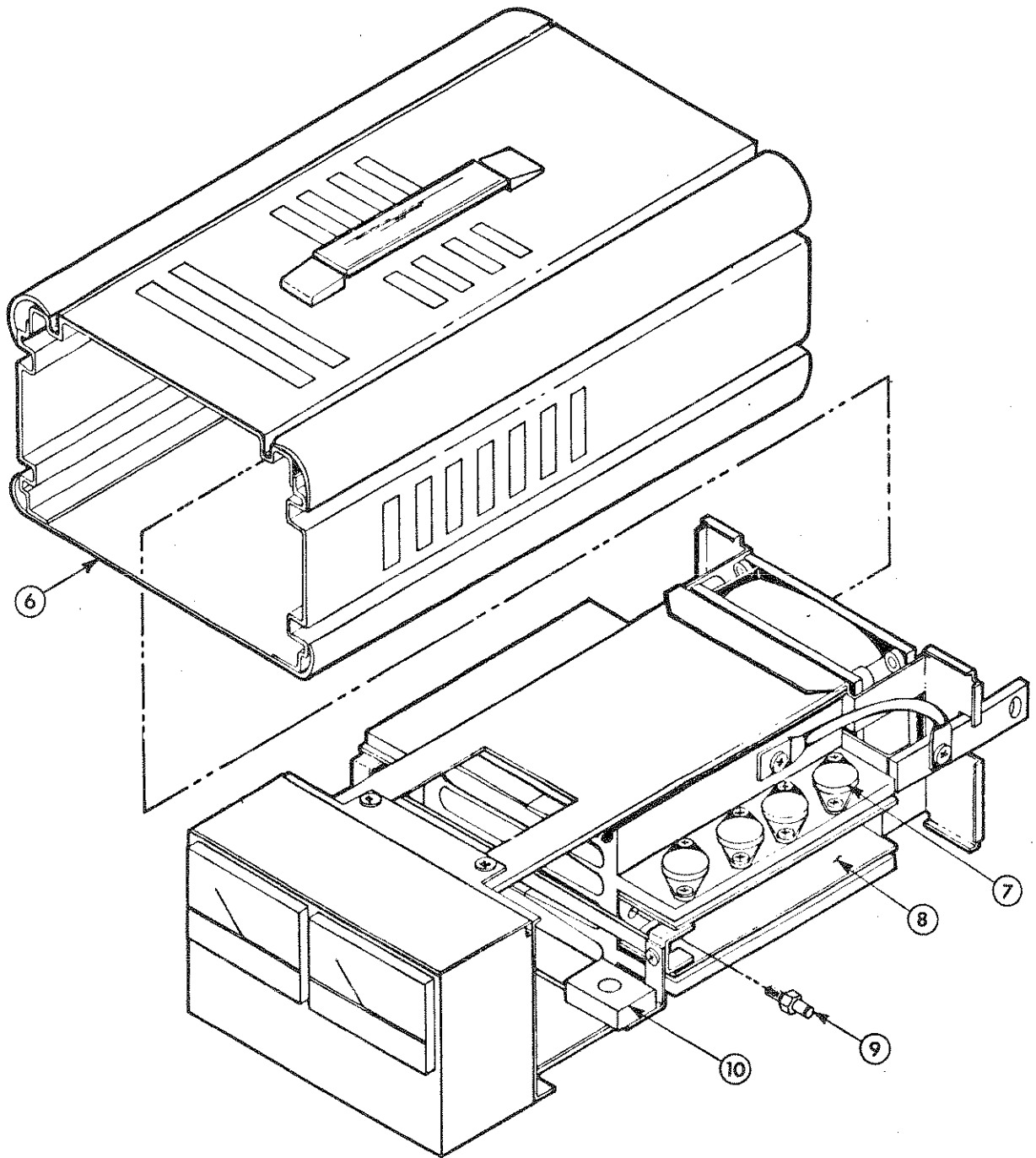


Figure 16



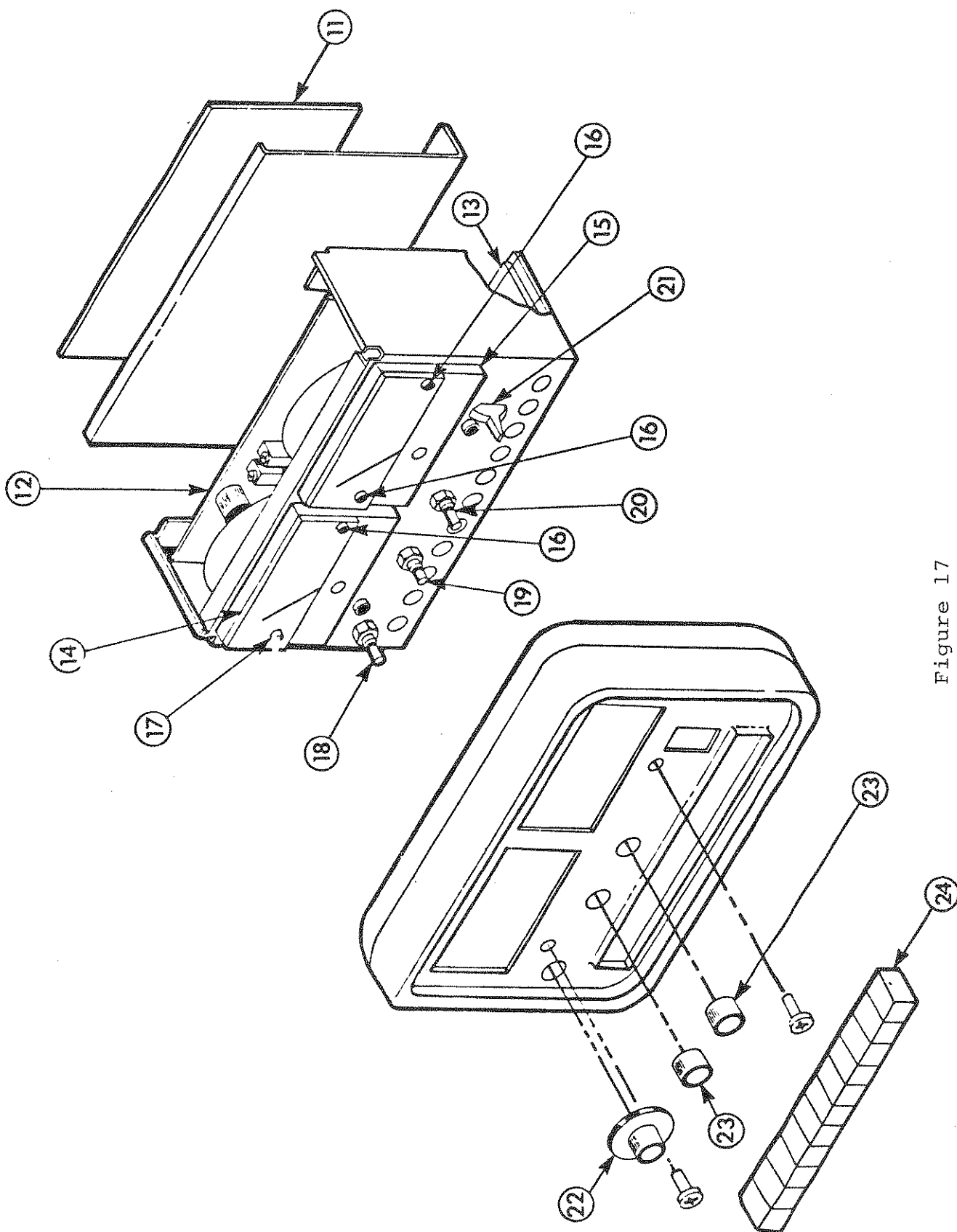
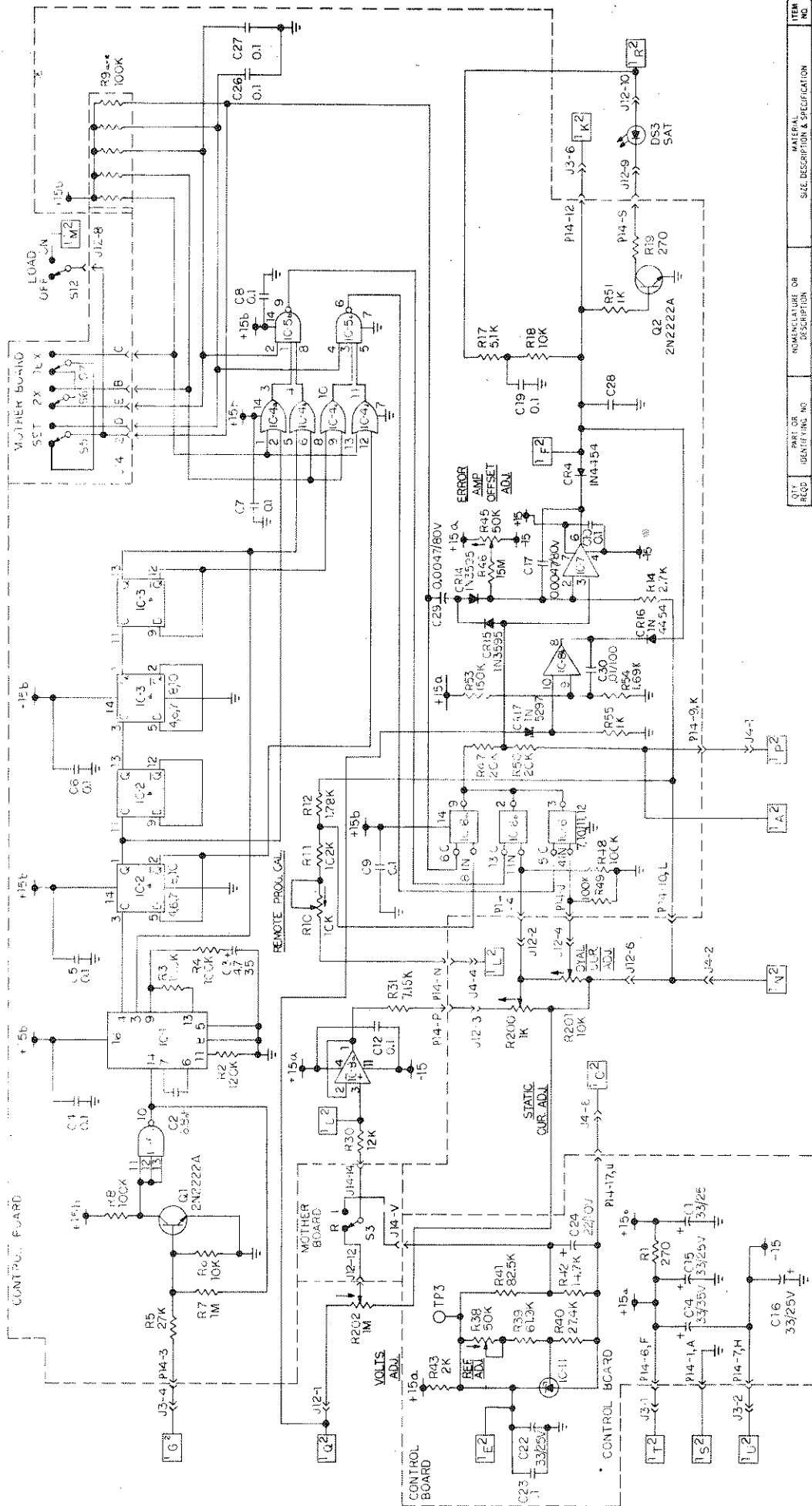


Figure 17



REV	DATE	BY	CHKD	APP'D	DESCRIPTION
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96					
97					
98					
99					
100					

- 1. UNLESS OTHERWISE SPECIFIED: RESISTORS IN OHMS, CAPACITORS IN PFD.
- 2. INTERCONNECT SYMBOL
- 3. PAGE NUMBER OF INTERCONNECT
- 4. INTERCONNECT ID LETTER
- 5. TOTAL NUMBER OF INTERCONNECTS

FIGURE 1.8

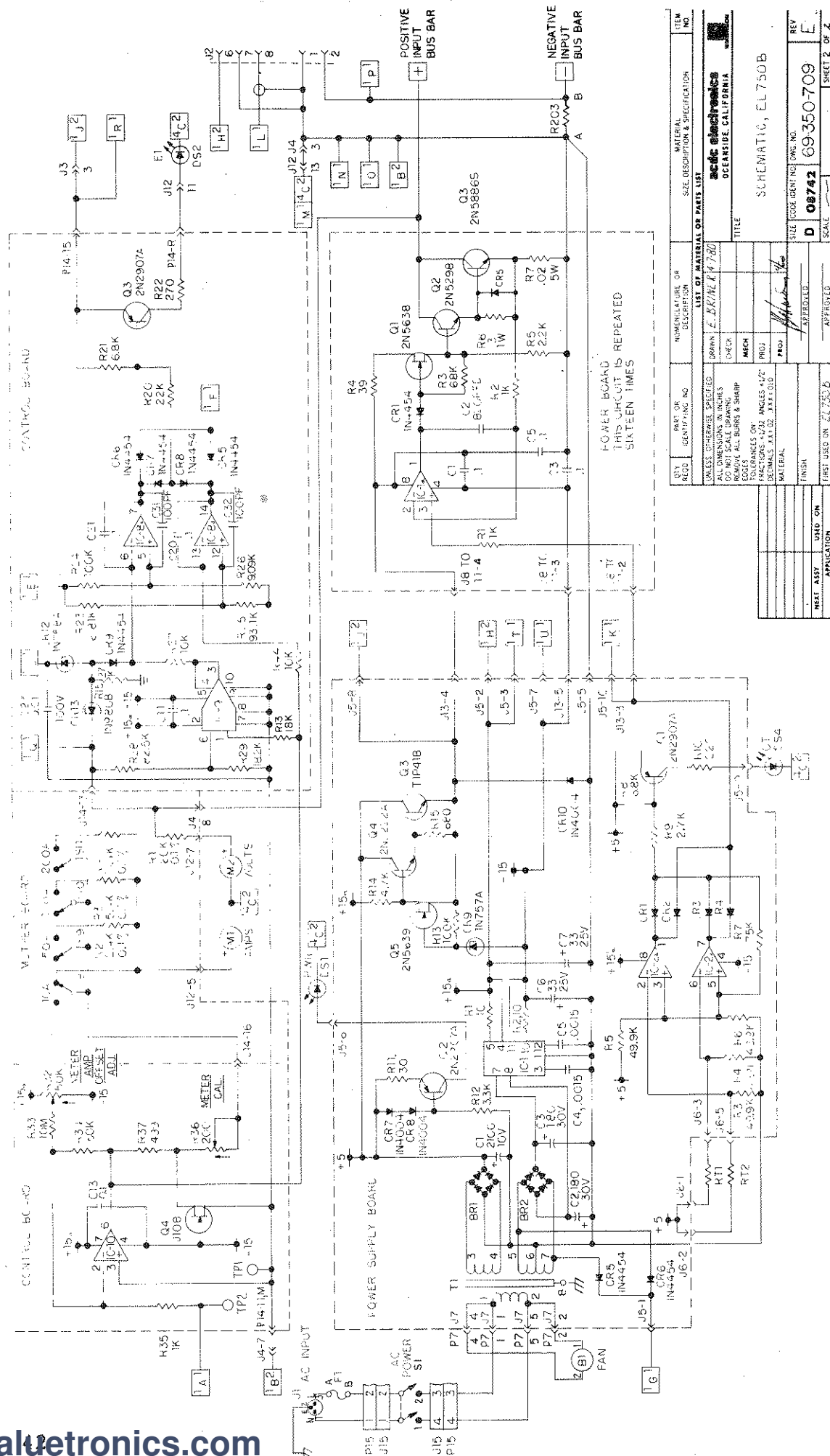
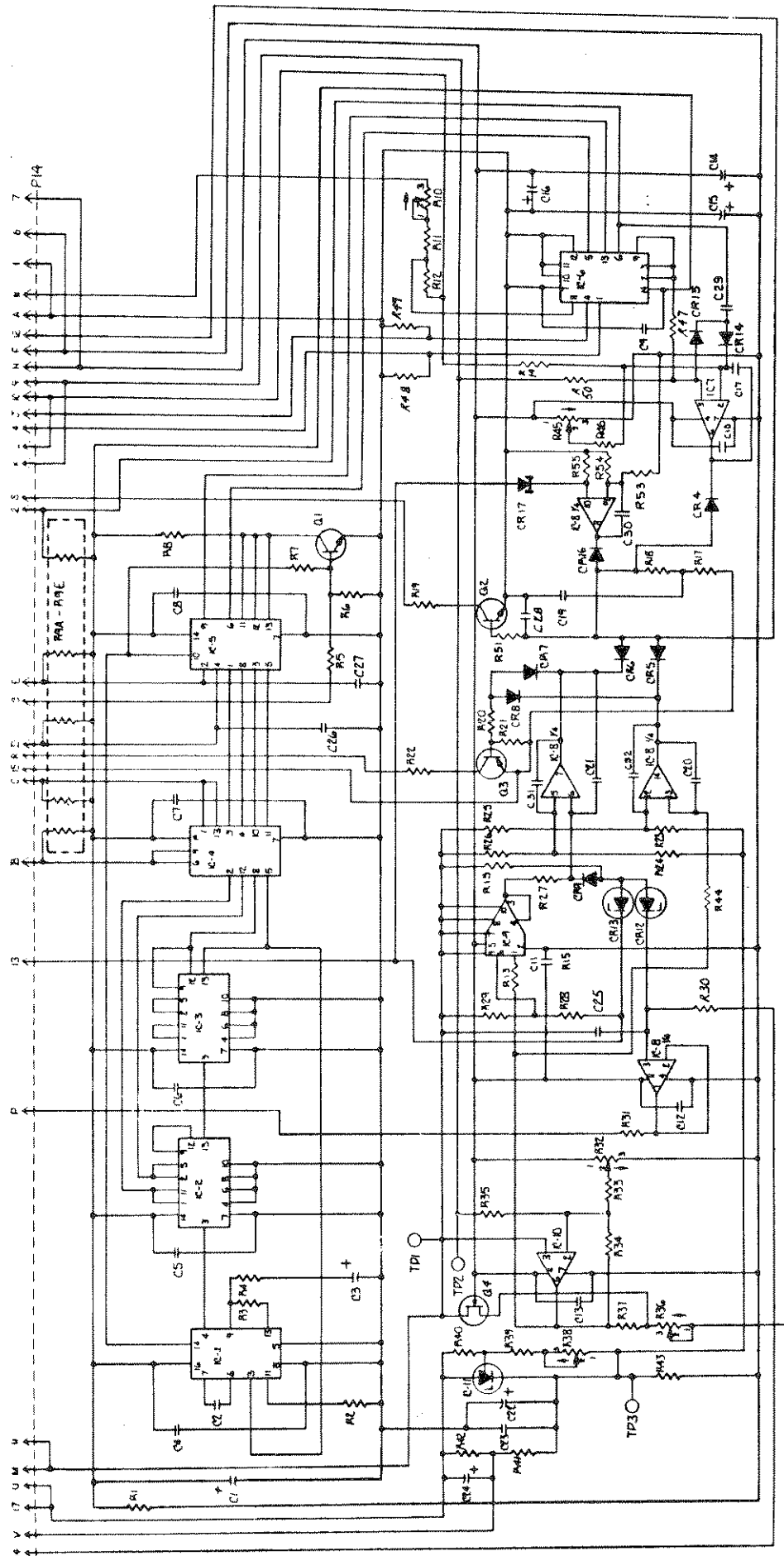


FIGURE 19

ITEM NO.	MATERIAL	SIZE DESCRIPTION & SPECIFICATION
1	acdc electronics	OCRESIDE, CALIFORNIA
TITLE: SCHEMATIC, EL750B		
REV: D 08742 69-350-709		
SCALE: AS SHOWN		
SHEET 2 OF 2		

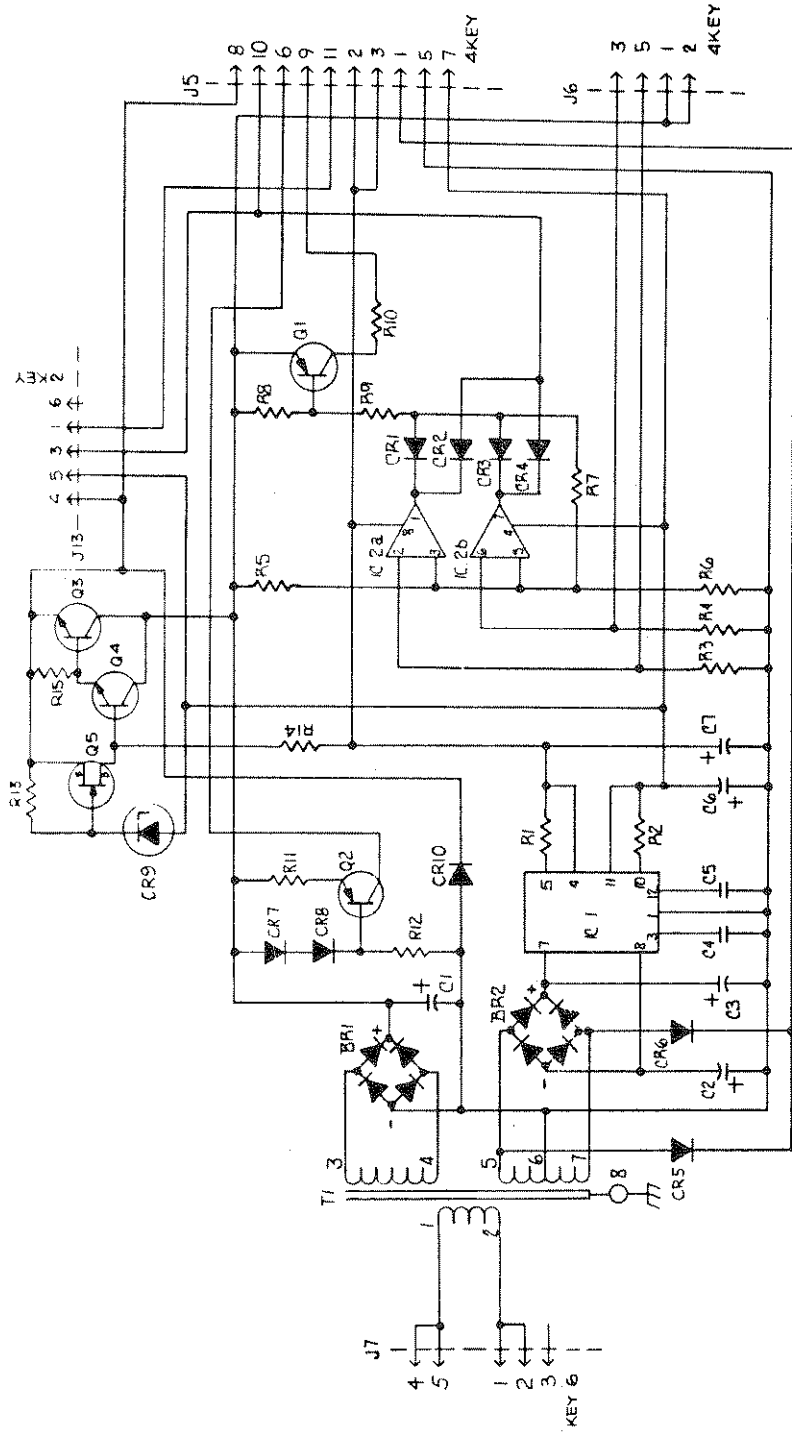
REV	DATE	BY	APP'D	REASON
1				
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QTY	PART OR IDENTIFYING NO.	DESCRIPTION	LIST OF MATERIALS OR PARTS LIST	MATERIAL SPECIFICATION	ITEM NO.
1	IC1	74LS147	74LS147	74LS147	1
1	IC2	74LS14	74LS14	74LS14	2
1	IC3	74LS14	74LS14	74LS14	3
1	Q1	2N4350	2N4350	2N4350	4
1	Q2	2N4350	2N4350	2N4350	5
1	Q3	2N4350	2N4350	2N4350	6
1	CR1	1N4148	1N4148	1N4148	7
1	CR2	1N4148	1N4148	1N4148	8
1	CR3	1N4148	1N4148	1N4148	9
1	CR4	1N4148	1N4148	1N4148	10
1	CR5	1N4148	1N4148	1N4148	11
1	CR6	1N4148	1N4148	1N4148	12
1	CR7	1N4148	1N4148	1N4148	13
1	CR8	1N4148	1N4148	1N4148	14
1	C1	100pF	100pF	100pF	15
1	C2	100pF	100pF	100pF	16
1	C3	100pF	100pF	100pF	17
1	C4	100pF	100pF	100pF	18
1	C5	100pF	100pF	100pF	19
1	C6	100pF	100pF	100pF	20
1	C7	100pF	100pF	100pF	21
1	C8	100pF	100pF	100pF	22
1	C9	100pF	100pF	100pF	23
1	C10	100pF	100pF	100pF	24
1	R1	10k	10k	10k	25
1	R2	10k	10k	10k	26
1	R3	10k	10k	10k	27
1	R4	10k	10k	10k	28
1	R5	10k	10k	10k	29
1	R6	10k	10k	10k	30
1	R7	10k	10k	10k	31
1	R8	10k	10k	10k	32
1	R9	10k	10k	10k	33
1	R10	10k	10k	10k	34
1	R11	10k	10k	10k	35
1	R12	10k	10k	10k	36
1	R13	10k	10k	10k	37
1	R14	10k	10k	10k	38
1	R15	10k	10k	10k	39
1	R16	10k	10k	10k	40
1	R17	10k	10k	10k	41
1	R18	10k	10k	10k	42
1	R19	10k	10k	10k	43
1	R20	10k	10k	10k	44
1	R21	10k	10k	10k	45
1	R22	10k	10k	10k	46
1	R23	10k	10k	10k	47
1	R24	10k	10k	10k	48
1	R25	10k	10k	10k	49
1	R26	10k	10k	10k	50
1	R27	10k	10k	10k	51
1	R28	10k	10k	10k	52
1	R29	10k	10k	10k	53
1	R30	10k	10k	10k	54
1	R31	10k	10k	10k	55
1	R32	10k	10k	10k	56
1	R33	10k	10k	10k	57
1	R34	10k	10k	10k	58
1	R35	10k	10k	10k	59
1	R36	10k	10k	10k	60
1	R37	10k	10k	10k	61
1	R38	10k	10k	10k	62
1	R39	10k	10k	10k	63
1	R40	10k	10k	10k	64
1	R41	10k	10k	10k	65
1	R42	10k	10k	10k	66
1	R43	10k	10k	10k	67
1	R44	10k	10k	10k	68
1	R45	10k	10k	10k	69
1	R46	10k	10k	10k	70
1	R47	10k	10k	10k	71
1	R48	10k	10k	10k	72
1	R49	10k	10k	10k	73
1	R50	10k	10k	10k	74
1	R51	10k	10k	10k	75
1	R52	10k	10k	10k	76
1	R53	10k	10k	10k	77
1	R54	10k	10k	10k	78
1	R55	10k	10k	10k	79
1	R56	10k	10k	10k	80
1	R57	10k	10k	10k	81
1	R58	10k	10k	10k	82
1	R59	10k	10k	10k	83
1	R60	10k	10k	10k	84
1	R61	10k	10k	10k	85
1	R62	10k	10k	10k	86
1	R63	10k	10k	10k	87
1	R64	10k	10k	10k	88
1	R65	10k	10k	10k	89
1	R66	10k	10k	10k	90
1	R67	10k	10k	10k	91
1	R68	10k	10k	10k	92
1	R69	10k	10k	10k	93
1	R70	10k	10k	10k	94
1	R71	10k	10k	10k	95
1	R72	10k	10k	10k	96
1	R73	10k	10k	10k	97
1	R74	10k	10k	10k	98
1	R75	10k	10k	10k	99
1	R76	10k	10k	10k	100

REFERENCE DESIGNATORS IC1 74LS147 IC2 74LS14 IC3 74LS14 Q1 2N4350 Q2 2N4350 Q3 2N4350 CR1 1N4148 CR2 1N4148 CR3 1N4148 CR4 1N4148 CR5 1N4148 CR6 1N4148 CR7 1N4148 CR8 1N4148 C1 100pF C2 100pF C3 100pF C4 100pF C5 100pF C6 100pF C7 100pF C8 100pF C9 100pF C10 100pF R1 10k R2 10k R3 10k R4 10k R5 10k R6 10k R7 10k R8 10k R9 10k R10 10k R11 10k R12 10k R13 10k R14 10k R15 10k R16 10k R17 10k R18 10k R19 10k R20 10k R21 10k R22 10k R23 10k R24 10k R25 10k R26 10k R27 10k R28 10k R29 10k R30 10k R31 10k R32 10k R33 10k R34 10k R35 10k R36 10k R37 10k R38 10k R39 10k R40 10k R41 10k R42 10k R43 10k R44 10k R45 10k R46 10k R47 10k R48 10k R49 10k R50 10k R51 10k R52 10k R53 10k R54 10k R55 10k R56 10k R57 10k R58 10k R59 10k R60 10k R61 10k R62 10k R63 10k R64 10k R65 10k R66 10k R67 10k R68 10k R69 10k R70 10k R71 10k R72 10k R73 10k R74 10k R75 10k R76 10k R77 10k R78 10k R79 10k R80 10k R81 10k R82 10k R83 10k R84 10k R85 10k R86 10k R87 10k R88 10k R89 10k R90 10k R91 10k R92 10k R93 10k R94 10k R95 10k R96 10k R97 10k R98 10k R99 10k R100 10k		PARTS LIST DATE: 12/1/81 BY: J. J. JONES CHECKED: J. J. JONES APPROVED: J. J. JONES TITLE: CONTROL BOARD DRAWING NO.: 100-100-100 SHEET NO.: 1 TOTAL SHEETS: 1
--	--	--

FIGURE 20



QTY REQD	PART OR IDENTIFYING NO	NOMENCLATURE OR DESCRIPTION	LIST OF MATERIAL OR PARTS LIST	SIZE DESCRIPTION & SPECIFICATION	MATERIAL	ITEM NO															
		UNLESS OTHERWISE SPECIFIED ALL DIMENSIONS IN INCHES DO NOT SCALE DRAWING REMOVE ALL BURRS & SHARP EDGES TOLERANCES ON: FRACTIONS ±1/32 ANGLES ±1/2° DECIMALS XX±02 XXX±010 MATERIAL	<table border="1"> <tr> <td>DRAWN</td> <td>E. WALKER</td> <td>2/7/79</td> </tr> <tr> <td>CHECK</td> <td></td> <td>5-5-75</td> </tr> <tr> <td>ENGR</td> <td></td> <td>7-2-79</td> </tr> <tr> <td>PROJ</td> <td></td> <td>7/183</td> </tr> <tr> <td>APPR</td> <td></td> <td></td> </tr> </table>	DRAWN	E. WALKER	2/7/79	CHECK		5-5-75	ENGR		7-2-79	PROJ		7/183	APPR				<p><b>radio electronics</b> 9000 SHERBORNE BLVD ROCKFORD, CALIFORNIA 94281</p> <p><b>SCHEMATIC, POWER SUPPLY BOARD</b></p>	
DRAWN	E. WALKER	2/7/79																			
CHECK		5-5-75																			
ENGR		7-2-79																			
PROJ		7/183																			
APPR																					
		FINISH																			
					SIZE CODE IDENT NO DWG NO	REV															
					<b>C 00742</b>	<b>10-22-79</b>															
						<b>P</b>															

FIGURE 21

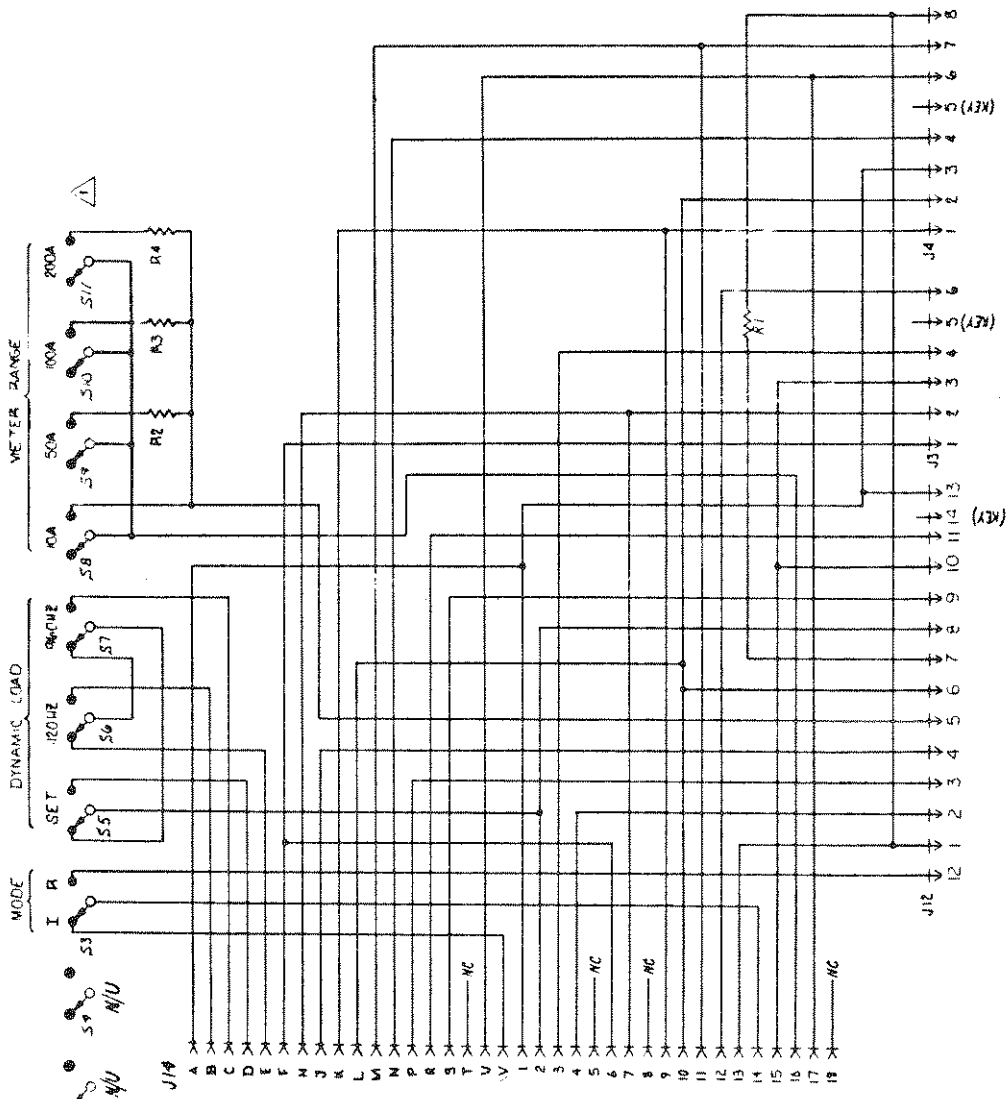
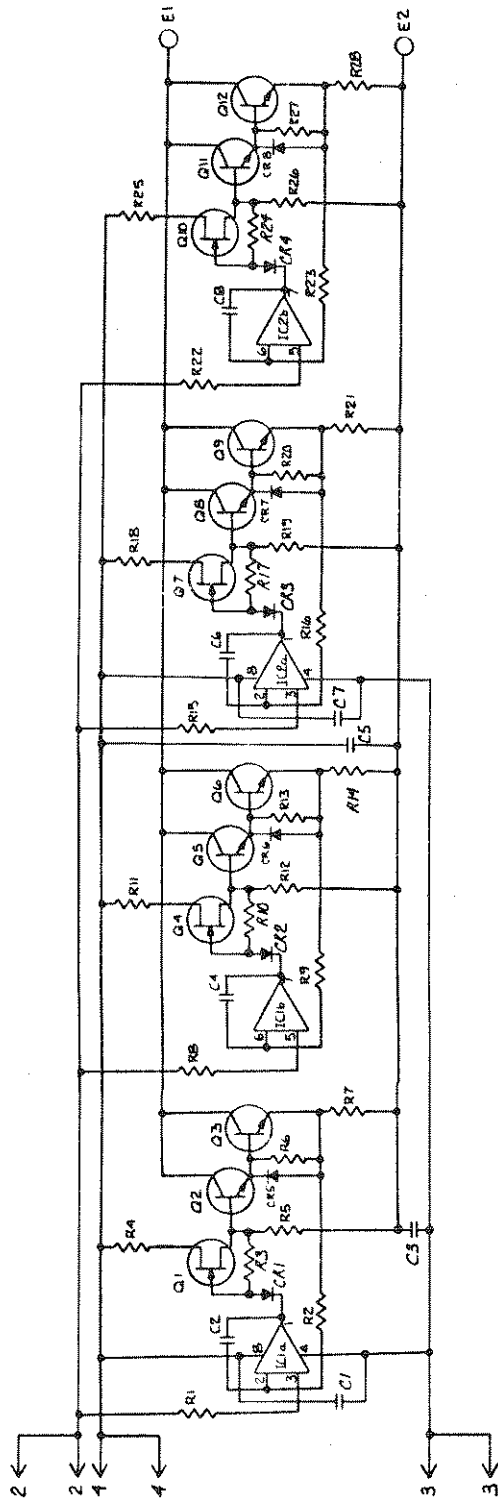


FIGURE 22

△ S2 THRU S11 ARE DPDT. (SPDT SHOWN).  
 △ ALL SWITCHES SHOWN IN OUT POSITION

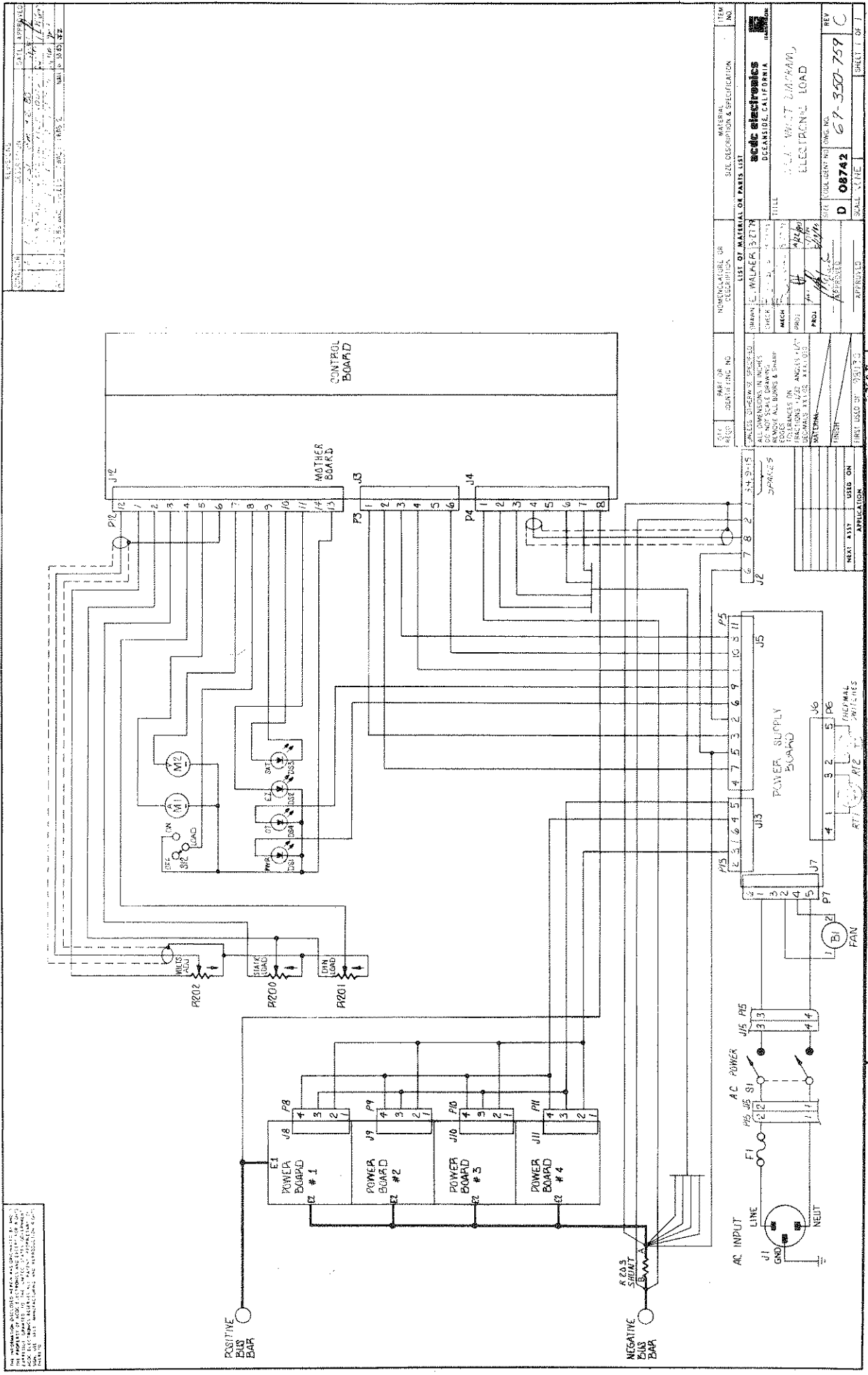
REV. NO.	REV. DATE	REV. BY
B	69-365-769	
DRAWING NO. <b>D 08742</b> PROJECT NO. <b>69-365-769</b>		
TITLE <b>MOTHER BOARD</b>		
MANUFACTURED OR DESIGNATION <b>SEC Electronics</b> DELANISIDE CALIFORNIA		
PART OR IDENTIFYING NO. DRAWING NO. <b>D 08742</b>		
MATERIAL DESCRIPTION <b>SCHEMATIC</b>		
NUMBER AND DESCRIPTION OF PARTS LIST PART NO. PART DESCRIPTION 1 08742 SCHEMATIC		





QTY	PART OR IDENTIFYING NO	NOMENCLATURE OR DESCRIPTION	SIZE, DESCRIPTION OR PARTS LIST	MATERIAL SPECIFICATION	ITER NO
				<b>acdc electronics</b>	
				OCEAN VIEW, CALIFORNIA	
				TITLE	
				SCHEMATIC	
				POWER BOARD	
				SIZE CODE IDENT NO DWG NO	
				<b>C 08742</b>	
				REV	
				<b>69-363-709</b>	
				REV	
				<b>B</b>	

FIGURE 23



ALL INFORMATION CONTAINED HEREIN IS UNCLASSIFIED EXCEPT WHERE SHOWN OTHERWISE. DATE 11/19/01 BY 60322/UC/BAW/STP

REV	DATE	APPROVAL
1	11/19/01	BAW/STP
2	11/19/01	BAW/STP
3	11/19/01	BAW/STP
4	11/19/01	BAW/STP
5	11/19/01	BAW/STP
6	11/19/01	BAW/STP
7	11/19/01	BAW/STP
8	11/19/01	BAW/STP
9	11/19/01	BAW/STP
10	11/19/01	BAW/STP
11	11/19/01	BAW/STP
12	11/19/01	BAW/STP

REV	DATE	APPROVAL
1	11/19/01	BAW/STP
2	11/19/01	BAW/STP
3	11/19/01	BAW/STP
4	11/19/01	BAW/STP
5	11/19/01	BAW/STP
6	11/19/01	BAW/STP
7	11/19/01	BAW/STP
8	11/19/01	BAW/STP
9	11/19/01	BAW/STP
10	11/19/01	BAW/STP
11	11/19/01	BAW/STP
12	11/19/01	BAW/STP

REV	DATE	APPROVAL
1	11/19/01	BAW/STP
2	11/19/01	BAW/STP
3	11/19/01	BAW/STP
4	11/19/01	BAW/STP
5	11/19/01	BAW/STP
6	11/19/01	BAW/STP
7	11/19/01	BAW/STP
8	11/19/01	BAW/STP
9	11/19/01	BAW/STP
10	11/19/01	BAW/STP
11	11/19/01	BAW/STP
12	11/19/01	BAW/STP

REV	DATE	APPROVAL
1	11/19/01	BAW/STP
2	11/19/01	BAW/STP
3	11/19/01	BAW/STP
4	11/19/01	BAW/STP
5	11/19/01	BAW/STP
6	11/19/01	BAW/STP
7	11/19/01	BAW/STP
8	11/19/01	BAW/STP
9	11/19/01	BAW/STP
10	11/19/01	BAW/STP
11	11/19/01	BAW/STP
12	11/19/01	BAW/STP

REV	DATE	APPROVAL
1	11/19/01	BAW/STP
2	11/19/01	BAW/STP
3	11/19/01	BAW/STP
4	11/19/01	BAW/STP
5	11/19/01	BAW/STP
6	11/19/01	BAW/STP
7	11/19/01	BAW/STP
8	11/19/01	BAW/STP
9	11/19/01	BAW/STP
10	11/19/01	BAW/STP
11	11/19/01	BAW/STP
12	11/19/01	BAW/STP

REV	DATE	APPROVAL
1	11/19/01	BAW/STP
2	11/19/01	BAW/STP
3	11/19/01	BAW/STP
4	11/19/01	BAW/STP
5	11/19/01	BAW/STP
6	11/19/01	BAW/STP
7	11/19/01	BAW/STP
8	11/19/01	BAW/STP
9	11/19/01	BAW/STP
10	11/19/01	BAW/STP
11	11/19/01	BAW/STP
12	11/19/01	BAW/STP

REV	DATE	APPROVAL
1	11/19/01	BAW/STP
2	11/19/01	BAW/STP
3	11/19/01	BAW/STP
4	11/19/01	BAW/STP
5	11/19/01	BAW/STP
6	11/19/01	BAW/STP
7	11/19/01	BAW/STP
8	11/19/01	BAW/STP
9	11/19/01	BAW/STP
10	11/19/01	BAW/STP
11	11/19/01	BAW/STP
12	11/19/01	BAW/STP

REV	DATE	APPROVAL
1	11/19/01	BAW/STP
2	11/19/01	BAW/STP
3	11/19/01	BAW/STP
4	11/19/01	BAW/STP
5	11/19/01	BAW/STP
6	11/19/01	BAW/STP
7	11/19/01	BAW/STP
8	11/19/01	BAW/STP
9	11/19/01	BAW/STP
10	11/19/01	BAW/STP
11	11/19/01	BAW/STP
12	11/19/01	BAW/STP

REV	DATE	APPROVAL
1	11/19/01	BAW/STP
2	11/19/01	BAW/STP
3	11/19/01	BAW/STP
4	11/19/01	BAW/STP
5	11/19/01	BAW/STP
6	11/19/01	BAW/STP
7	11/19/01	BAW/STP
8	11/19/01	BAW/STP
9	11/19/01	BAW/STP
10	11/19/01	BAW/STP
11	11/19/01	BAW/STP
12	11/19/01	BAW/STP

FIGURE 24