INSTRUCTION MANUAL

REGULATED POWER SUPPLIES

LCD-4 SERIES

THIS MANUAL APPLIES TO UNITS
BEARING SERIAL NUMBER PREFIXES
A-C

LAMBDA

LAMBDA ELECTRONICS MELVILLE, L. I., N. Y.

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LAMBDA ELECTRONICS MELVILLE, L.I., N.Y.
MAIN PLANT TELEPHONE: 516 MYrtle 4-4200

IM-LCD-4

BK #1496
8/84

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SPECIFICATIONS AND FEATURES

Specifications apply for all models.

DC OUTPUT--Voltage regulated for line and load. See table I for voltage and current ratings. Dual outputs are independent of one another. Both outputs are floating.

TABLE I

VOLTAGE AND CURRENT RANGES

MODEL	VOLTAGE RANGE (EACH SIDE)	MAXIMUM CURRENT (AMPS) AT AMBIENT TEMPERATURE			
		40°C	50°C	60°C	71°C
LCD-4-11	0-7 0-7	1.8 1.8	1.5 1.5	1.2 1.2	0.7 0.7
LCD-4-12	0-18 0-7	1.0 1.8	0.8 1.5	0.65 1.2	0.4 0.7
LCD-4-13	0-32 0-7	0.6 1.8	0.53 1.5	0.4 1.2	0.24 0.7
LCD-4-22	0-18 0-18	1.0 1.0	0.8 0.8	0.65 0.65	0.4 0.4
LCD-4-23	0-32 0-18	0.6 1.0	0.53 0.8	0.4 0.65	0.24 0.4
LCD-4-33	0-32 0-32	0.6 0.6	0.53 0.53	0.4 0.4	0.24 0.24
LCD-4-44	0-60 0-60	0.33 0.33	0.3 0.3	0.24 0.24	0.15 0.15
LCD-4-55	0-120 0-120	0.12 0.12	0.12 0.12	0.12 0.12	0.075 0.075
LCD-4-152 (Fixed)	15 ± 5% 15 ± 5%	1.5 1.5	1.3 1.3	1.0 1.0	0.6 0.6

Current range must be chosen to suit the appropriate maximum ambient temperature. Current ratings apply for entire voltage range.

REGULATED VOLTAGE OUTPUT

Regulation (line) . . . . . 0.01 percent plus 1.0 millivolt for input variations from 105-132 or 132-105 volts AC

Regulation (load) . . . . . 0.01 percent plus 1.0 millivolt for load variations from no load to full load or full load to no load

Remote Programming

External Resistor . . . Nominal 1000 ohms/volt output

Programming Voltage . . One-to-one voltage change

Ripple and Noise . . . . . 250 microvolts rms; 1 millivolt peak to peak with 57-63 Hz input

Temperature Coefficient . . . Output change in voltage (0.01% + 0.3 mv)/°C using an external programming resistor, less than (0.015% + 0.3 mv)/°C with internal resistor

Remote Sensing . . . . . Provision is made for remote sensing to eliminate effect of power output lead resistance on DC regulation.

AC INPUT -- 105-132, 205-265 or 187-242 ("V" option) volts AC at 47-440Hz. Maximum input power*:125 Watts. Ratings apply for 57-63Hz; at 47-57Hz input derate current 10% for each ambient temperature given in table I. For 63-440Hz, consult factory for details of operation.

*With output loaded to full 40°C rating and input voltage 132 volts AC, 60 Hz

OVERLOAD PROTECTION

Thermal . . . . . Thermostat, resets automatically when over temperature condition is eliminated

Electrical

External . . . . . Automatic electronic current limiting circuit, limits output current to a preset value less than 110% of 40°C current rating. Automatic limiting protects the load and power supply when external overloads and direct shorts occur.

Internal . . . . . Fuse F1 provides protection against internal circuit failure in conjunction with overvoltage protector option.

INPUT AND OUTPUT CONNECTORS -- Terminal blocks on rear of chassis.

OPERATING AMBIENT TEMPERATURE RANGE AND DUTY CYCLE--Continuous duty from -20°C to 71°C ambient with corresponding load current ratings for all modes of operation.

STORAGE TEMPERATURE - (non-operating) -55°C to 85°C

CONTROLS

DC Output Control . . . . . Voltage adjust controls permit independent adjustment of DC output.

PHYSICAL DATA

Size.....4-29/32" x 4-29/32" x 5-1/4"
Weight.....7 lbs. net; 8 lbs. shipping
Finish.....Grey, FED STD 595 No. 26081

MOUNTING - Three surfaces, each with tapped mounting holes, can be utilized for mounting this unit. All LCD-4 power supplies can be mounted with, Top, Front, or Rear facing up. Top, Front, or Rear must be in a horizontal plane. Refer to figure 13 for mounting details.

MODEL OPTIONS

"V" OPTION.....Standard LCD-4 power supplies can be obtained for 205-265 VAC, 47-440 Hz input or 187-242 VAC, 47-440 Hz input. See nameplate for AC input rating. See schematic diagram for rewiring of AC input.

"S" OPTION.....Standard LCD-4 power supplies are available for use with Lambda Systems Power Sequencer or Systems Power Protector. On models LCD-4-152 specified with the "S" option, resistors R21 and R121 are replaced by a jumper.

ACCESSORIES

Rack Adapter.....Rack adapters LRA-10, LRA-11, and LRA-13 with or without chassis slides are available.

Overvoltage Protector.....Externally mounted, Overvoltage Protectors LH-OV-4, LH-OV-5, and LH-OV-6 are available for use with Lambda LCD-4-11 through LCD-4-44 power supplies. On model LCD-4-152 use overvoltage protector L-20-OV-15.

Control Panel.....All LCD-4 power supplies may be obtained with a Systems Power Control Panel, SP-5. This unit, mounted on rack adapters LRA-10 or LRA-11 and used with a Systems Cable or Auxiliary Cable, provides an on-off switch, voltage control and pilot light. A single panel controls both master (M) and slave (S) units of the power supply.

Metering Panel.....A Systems Metering Panel, SMP-5 may be used in conjunction with the LCD-4 power supplies. The panel, mounted in rack adapter LRA-10 or LRA-11 and used with a Systems Cable, contains a voltmeter and an ammeter, each with three ranges and pushbutton selector switch. The selector switch allows monitoring of the voltage and current of any of up to 16 outputs.

THEORY OF OPERATION

GENERAL

The text in this section refers to circuit designations for the "M" unit of the LCD-4 power supply, however the discussion is equally applicable to the "S" unit which has electrically identical components in the 100 series except for CR112, which is used in the "S" unit only.

The Lambda Power supply consists of an AC input circuit and transformer; a bias supply consisting of an auxiliary rectifier and filter, and preregulator*; a main regulator circuit consisting of the main rectifier and filter, a series regulator, emitter follower driver, a current comparator*, a voltage comparator*, an amplifier*, current and voltage sensing networks and a voltage reference circuit*.

*This circuit element is part of integrated circuit (IC1) in the supply.

The circuit arrangement is shown in block diagram form, figure 11. The circuitry is discussed with reference to the block diagram and the schematic diagram.

FUNCTIONAL DESCRIPTION

Single phase input power is applied to transformer T1 through the input circuit which contains a thermostat to protect the supply against overheating. Transformer T1 supplies secondary power for both "M" and "S" units.

The main rectifier, a full wave rectifier, provides the power which is filtered by capacitor C6 and then regulated via a series regulator and delivered to the output. Half-wave auxiliary rectifier CR1 provides voltage filtered by capacitor C1 for the preregulator located in IC1. The reference element, powered by the preregulator, provides a reference voltage for the current comparator and the voltage comparator.

Constant voltage circuit operation is determined by changes in the load which cause a change in one input to the voltage comparator. A second input to the comparator is a reference voltage that is developed by a constant current of 1 milliampere flowing in divider element R8. The comparator compares the output voltage change with the reference voltage resulting in an error signal at the output of the comparator.

The error signal from the comparator is then current amplified by drivers Q1 and Q2. The amplified signal from the drivers controls the voltage across the series regulator Q3, which functions as the active regulating element in the supply.

* Current limit circuit operation is determined by changes in the load. The current comparator samples load current through current sensing resistor R7. When the voltage drop across R7 increases to the preset voltage reference determined by R6, R9, and R13, the current comparator conducts. Thus, when the output current rating of the unit is exceeded, the current comparator conducts, decreasing the current through driver Q1, resulting in an increase of voltage across the series regulator and a decrease of the output voltage, effectively limiting the output current to a safe value. The current limit value is determined by fixed resistors R6, R7, R9 and variable resistor R13.

When operating conditions approach short circuit, the output voltage decreases. Since the voltage determined by R13 is proportional to the output voltage, when the output voltage decreases, the amplifier is biased into turn on at lower and lower load currents until output voltage decreases to zero and current decreases to a predetermined low value.

* The following theory applies to model LCD-4-152.

Current limit circuit operation is determined by changes in the load. When load current increases above the rated current value, the voltage drop across current limit potentiometer R13 increases causing the amplifier to turn on. With the amplifier conducting the current to driver Q1 decreases, limiting the base current to series regulator Q3, which results in an increase of voltage across the series regulator and a decrease of the output voltage, effectively limiting the output current to a safe value. The current limit value is determined by the factory setting of current limit potentiometer R13.

When operating conditions reach short circuit, the output voltage value decreases to zero and the current decreases to a predetermined current limit value and remains unchanged.

OPERATING INSTRUCTIONS

BASIC MODE OF OPERATION

This power supply operates as a constant voltage source provided the load current does not exceed the rated value at 40°C. For continuous operation, load current must not exceed the rating for each ambient temperature and will remain limited to less than 110% of 40°C rating.

CONNECTIONS FOR OPERATION

NOTE: Make all connections to the unit before applying AC input power.

Ground Connections. The Lambda power supply can be operated either with negative or positive output terminal grounded. Both positive and negative ground connections are shown in the diagrams for all suggested output connections illustrated in this manual.

Connection Terminals. Make all connections to the supply at the terminal blocks on the rear of the supply. Apply input power to terminals 1 and 2; always connect the ungrounded (hot) lead to terminal 1.

The supply positive terminal is brought out to terminals 6 (M unit) and 14 (S unit). The supply negative terminal is brought out to terminals 4 (M unit) and 12 (S unit). Recommended wiring of the power supply to the load and selection of wiring is shown in figures 1 through 10. Selection of proper wiring is made on the basis of load requirements. Make all performance checks and measurements of current or voltage at the rear output terminals. Connect measuring devices directly to terminals or use the shortest leads possible.

SUPPLY LOAD CONNECTIONS

Connections For Operation as a Constant Voltage Source

The load regulation of the power supply at the load may change when using the supply as a constant voltage source and connecting leads of practical length are used. To minimize the effect of the output leads on load regulation, remote sensing is used. Recommended types of supply-load connections with local or remote sensing are described in the following paragraphs.

Refer to figure 1 to determine voltage drop for particular cable length, wire size and current conditions. Lead lengths must be measured from supply terminals to load terminals as shown in figure 2.

Two-Wire Connection, Figure 3. The two-wire connection, with local sensing, is the connection suitable for applications with relatively constant load.

Four-Wire Connection, Figure 4. The four-wire connection with remote sensing, provides complete compensation for the DC voltage drops in the connecting cables. Sensing leads should be a twisted pair to minimize AC pick-up. A 2.5mf, elect, capacitor may be required between output terminals and sense terminals to reduce noise pick-up.

Programmed Voltage Connections, Using External Resistor, Figure 5. Discrete voltage steps can be programmed with a resistance voltage divider valued at 1000 ohms/volt and a shorting-type switch as shown in figure 5. When continuous voltage variations are required, use a variable resistor with the same 1000 ohms/volt ratio in place of the resistive voltage divider and shorting-type switch. Use a low temperature coefficient resistor to assure most stable operation. Before programming, adjust programming resistor for zero resistance and set voltage adjust controls to the minimum rated output voltage.

As shown in figure 5, voltages can be programmed utilizing either local or remote sensing connections, as desired.

Programmed Voltage Connections Using Programming Voltage, Figure 6. The power supply voltage output can be programmed with an externally connected programming power supply. The output voltage of the programmed supply will maintain a one-to-one ratio with the voltage of the programming supply.

The programming supply must have a reverse current capability of 1.5 ma. minimum.

Alternatively, when supplies with less than 1.5 ma reverse current capability are used, a resistor capable of drawing 1.5 ma. at the minimum programming voltage must be connected across the output terminals of the supply. This programming supply must be rated to handle all excess resistor current at the maximum programming voltage.

Connections For Series Operation

The voltage capability of LCD-4 power supplies can be extended by series oper-

ation. A maximum of 250 volts can be connected between either the +DC or -DC terminal and chassis ground with a maximum voltage capability of 240 volts possible for model LCD-4-55. **If a common load is used, the maximum current rating of the unit with the lower current rating must not be exceeded.

** A common load can not be used with model LCD-4-152.

Figure 7 (or, as applicable, 7A) shows connections for either local or remote sensing in a series connection where the voltage control of each unit functions independently to control the output, and where the S unit does not track the M unit.

Units M and S are shown connected for auto-series operation in figure 8 and 9. Figure 8 (or, as applicable, 8A) shows the series connection diagram which would be suitable for use in most applications where tracking is desired. Using externally connected meters, first set the S unit output voltage adjust control for zero output, then set M unit output voltage adjust control for desired output voltage. Readjust S unit output voltage to agree with the output voltage of the M unit. The S unit will track any change in M unit output voltage made with the M unit voltage adjust control.

Voltage divider R_M must be used during auto-series operation. Variations of R_M according to the desired output voltage of the supply* may be found by applying the following formula:

$$R_M = \frac{E_{out}}{I_{div}}$$

where E_{out} is the desired supply output voltage and I_{div} is the divider current. I_{div} may vary between a minimum and maximum value of one and two milliamperes respectively.

* On hybrid power supplies (LCD-4-12, -13, -23) desired master output voltage must never exceed the slave maximum output voltage rating.

Figure 9 (or, as applicable, 9A) shows the series connection diagram suitable for applications where more precise voltage tracking due to temperature changes is required.

Resistor R_{BAL} should be one-watt, 1 - 2 kilohm resistor. This value would permit wide-range compensation for manufacturing differences inherent in the components used in each unit. Resistors R_S and R_M function in the voltage sensing circuits of both units, enabling the S unit to reference its output voltage to that of the M unit. Select R_M and R_S on the basis of 500 ohm to 1000 ohm per volt of M unit output voltage. R_M must equal R_S.

Capacitor C, used to eliminate stray AC pickup, is rated at 2.5 mf, 200V for models LCD-4-11 thru LCD-4-44 and LCD-4-152. On model LCD-4-55, C is rated at 1.4 mf 400V.

Connections For Parallel Operation

The current capability of LCD-4 power supplies can be extended by parallel operation of LCD-4 power supplies of equal* voltage capacities. Units "M" and "S" are shown connected for parallel operation in figure 10. One power supply designated the "master" or M unit controls its own output as well as the output of the second power supply, designated the "slave" or S unit.

* For applications using supplies of unequal voltage ratings, consult factory for details of operation.

Unit S operates to regulate its current in a ratio to that of the M unit by comparing the current in its internal sampling resistor with that current sampled by the master internal sampling resistor.

OPERATION AFTER PROTECTIVE DEVICE SHUTDOWN

Thermostat Shutdown

The thermostat opens the input circuit only when the temperature of the internal heat sink exceeds a maximum safe value. The thermostat will automatically reset when the temperature of the heat sink decreases to a safe operating value. After eliminating the cause(s) for overheating and allowing time for the power supply to cool to a proper temperature, resume operation of the supply.

Fuse Shutdown

Fuse will blow when the maximum rated current value for the fuse is exceeded. Fatigue failure of fuses can occur when mechanical vibrations from the installation combine with thermally induced stresses to weaken the fuse metal. Many fuse failures are caused by a temporary condition and replacing the blown fuse will make the fuse protected circuit operative. When the LCD-4 supply is used with the overvoltage protector option, fuse F1 will provide load protection against internal component failure.

MAINTENANCE

GENERAL

This section describes trouble analysis routine, replacement procedures, calibration and test procedures that are useful for servicing the Lambda LCD-4 power supply. A trouble chart is provided as an aid for the troubleshooter. The text of the trouble chart refers to component designations of unit M of the LCD-4 supply, but it is equally applicable for unit S which has identical components designated in the 100 series. Refer to the section on specifications and features for the minimum performance standards.

TROUBLE ANALYSIS

Whenever trouble occurs, systematically check all fuses, primary power lines, external circuit elements, and external wiring for malfunction before trouble shooting the equipment. Failures and malfunctions often can be traced to simple causes such as improper jumper and supply-load connections or fuse failure due to metal fatigue.

Use the electrical schematic diagram and block diagram, figure 11, as an aid to locating trouble causes. The schematic diagram contains various circuit voltages that are averages for normal operation. Measure these voltages using the conditions for measurement specified on the schematic diagram. Use measuring probes carefully to avoid causing short circuits and damaging circuit components.

CHECKING TRANSISTORS AND CAPACITORS

Check transistors with an instrument that has a highly limited current capability. Observe proper polarity to avoid error in measurement. The forward transistor resistance is low but never zero; backward resistance is always higher than the forward resistance.

For good transistors, the forward resistance for any junction is always greater than zero.

Do not assume trouble is eliminated when only one part is replaced. This is especially true when one transistor fails, causing other transistors to fail. Replacing only one transistor and turning power on, before checking for additional defective components could damage the replaced component.

When soldering semi-conductor devices, wherever possible, hold the lead being soldered with a pair of pliers placed between the component and the solder joint to provide an effective heat sink.

NOTE: The leakage resistance obtained from a simple resistance check of a capacitor is not always an indication of a faulty capacitor. In all cases the capacitors are shunted with resistances, some of which have low values. Only a dead short is a true indication of a shorted capacitor.

PRINTED CIRCUIT BOARD MAINTENANCE TECHNIQUES

1. If foil is intact but not covered with solder it is a good contact. Do not attempt to cover with solder.

2. Voltage measurements can be made from either side of the board. Use a needlepoint probe to penetrate to the wiring whenever a protective coating is used on the wiring. A brass probe can be soldered to an alligator clip adapted to the measuring instrument.

3. Wherever possible use a heat sink when soldering transistors.

4. Broken or damaged printed wiring is usually the result of an imperfection, strain or careless soldering. To repair small breaks, tin a short piece of hook-up wire to bridge the break, and holding the wire in place, flow solder along the length of wire so that it becomes part of the circuitry.

5. When unsoldering components from the board never pry or force loose the part; unsolder the component by using the wicking process described below:

(a) Select a 3/16 inch tinned copper braid for use as a wick; if braid is not available, select AWG No. 14 or No. 16 stranded wire with 1/2 inch insulation removed.

(b) Dip the wick in liquid rosin flux.

(c) Place the wick onto the soldered connection and apply soldering iron onto the wick.

(d) When sufficient amount of solder flows onto the wick, freeing the component, simultaneously remove iron and wick.

TROUBLE CHART

The trouble chart is intended as a guide for locating trouble causes, and is used along with the schematic diagram. When troubleshooting the S unit, add 100 to the component designations in the trouble chart.

The operating conditions assumed for the trouble chart are as follows:

(a) AC power of proper voltage and frequency is preset at input terminals.

(b) Either positive or negative terminal is connected to chassis ground.

(c) The power supply is connected for constant voltage with local sensing. See schematic; dotted lines indicate jumpers connected for local sensing operation.

TROUBLE SHOOTING CHART

Symptom	Probable Cause	Remedy
1. Zero volts DC output	OUTPUT VOLTAGE Control turned fully CCW	Check OUTPUT VOLTAGE Control for proper setting and correct as necessary
	Short circuit across output of supply	Check load and load connections, correct as necessary
	F1 open	Replace F1; if it blows immediately, check for shorted diode CR7 transistors Q1, Q2, Q3 and capacitors C7, C15, replace as necessary
	Series regulator section open	Check Q1, Q2 and Q3 for open, replace as necessary
	Shorted CR6 (or, as applicable, CR7)	Check CR6 (or CR7) for short, replace as necessary
	Open CR8, CR9 or R1	Check CR8, CR9 and R1 for open replace as necessary
	Current sensing resistor open	Check R7 for open, R6 for short; R9 for open; replace as necessary
	Aux. rectifier CR1 open	Check CR1 for open; replace as necessary
	On S unit, jumper between 9 and 10 open	Check S unit jumper connection to terminals 9 & 10 and correct as necessary

TROUBLE SHOOTING CHART (Cont'd.)

Symptom	Probable Cause	Remedy
2. Unable to adjust output voltage	Damaged OUTPUT VOLTAGE control	Check R8 for short and/or open, replace as necessary
3. High ripple at line frequency or twice line frequency and unregulated DC output	Series regulator transistors shorted	Check Q1, Q2 and Q3 for short and replace as necessary
	Defective main rectifier causes ripple at twice line frequency	Check for open and/or short CR3, CR4 (or, as applicable, CR14, CR15).
4. Same as 3, except intermittent	Foreign matter fallen into unit	Check for loose bench hardware and wire clippings that may have fallen through cover.
5. High ripple at frequency other than line or twice line frequency	Oscillation due to defective component in filter network	Check for open C2, C7, and check for open and/or short in C11, and R2. Replace defective component
6. Large spikes at output	Capacitor C4 and C14 open	Replace C4 and C14 as necessary

PERFORMANCE CHECKS

Check the ripple and regulation of the power supply using the test connection diagram shown in figure 12. Use suggested test equipment or equivalent to obtain accurate results. Refer to SPECIFICATIONS AND FEATURES for minimum performance standards.

Set the differential meter, DC VTVM (John Fluke Model 801H or equivalent) to the selected power supply operating voltage. Check the power supply load regulation accuracy while switching from the load to no-load condition. Long load leads should be a twisted pair to minimize AC pick-up.

Use a Variac to vary the line voltage from 105-132 or 132-105 volts AC and check the power-supply line regulation accuracy on the VTVM differential meter.

Use a VTVM, Ballantine 320 or equivalent, to measure rms ripple voltage of the power supply DC output. Use oscilloscope to measure peak-to-peak ripple voltage of the power supply DC output.

ADJUSTMENT OF CALIBRATION CONTROL R13

Whenever Q3, R6, R7, R9, R13, R21 or IC1 are replaced, and voltage and current indications do not reflect maximum ratings, adjust R13 as follows. The adjustment procedure requires that the power supply is removed from associated equipment, is at an ambient temperature of 25-30°C, and is stabilized and not operating.

1. Remove AC input power to the supply.

2. Break seal on wiper of R13 from resistor housing and turn to full CW position.

3. Operate power supply for constant voltage with local sensing, connected as shown in figure 3, with no external load.

4.* Turn voltage adjust control until rated output voltage is obtained.

5.* Apply load so that output current is 110% of 40°C rating for the unit.

6.* Using an oscilloscope, Tektronix 503 or equivalent, observe unit output voltage while adjusting R13 in a CCW direction. Adjust R13 until output ripple increases sharply and oscilloscope pattern changes.

7.* Place a DC ammeter of appropriate scale across output terminals 4 and 6 of the supply. The meter indication shall be a maximum of 115% of 40°C rating for the unit.

8.* After adjustment is completed, remove AC input power to the supply and use glyptol sealant to seal wiper of R13 to resistor housing.

9.* After sealing, check setting and repeat adjustment procedure if required.

* Perform alternate steps 4A through 8A for adjustment of R13 on model LCD-4-152.

4A. Turn voltage adjust control until an output voltage of 14.25 vdc is obtained.

5A. Apply load so that output current is 2.0 amperes.

6A. Using an oscilloscope, Tektronix 503 or equivalent, observe output voltage while adjusting R13 in a CCW direction. Adjust R13 until output ripple increases sharply and oscilloscope pattern changes.

7A. After adjustment is completed, remove AC power input to the supply and use glyptol sealant to seal wiper of R13 to resistor housing.

8A. After sealing, check setting and repeat adjustment procedure if required.

SERVICE

When additional instructions are required or repair service is desired, contact the nearest Lambda office where trained personnel and complete facilities are ready to assist you.

Please include the power supply model and serial number together with complete details of the problem. On receipt of this information, Lambda will supply service data or advise shipping for factory repair service.

All repairs not covered by the warranty will be billed at cost and an estimate forwarded for approval before work is started.

PARTS ORDERING

Standard components and special components used in the Lambda power supply can be obtained from the factory. In case of emergency, critical spare parts are available through any Lambda office.

The following information must be included when ordering parts:

1. Model number and serial number of power supply and purchase date.

2. Lambda part number.

3. Description of part together with circuit designation.

4. If part is not an electronic part, or is not listed, provide a description, function, and location of the part.

PARTS LIST

The electrical parts located on Lambda models LCD-4-11 — LCD-4-55, and LCD-4-152 are listed here. Parts for units M and S are listed separately by unit. Parts common to a group of models are listed first. Unique parts of individual models within the group are listed separately, by model, immediately following the group common-parts listing. In addition there are separate listings of parts for the V option and SP-5, SMP-5, and LHOV accessories.

COMMON PARTS
MODELS LCD-4-11 — LCD-4-55 & LCD-4-152

CIRC. DESIG.	DESCRIPTION	LAMBDA NO.
C1	Cap., elect., 40 mf -10 + 75%, 33 vdc	CBP-40-036
C2	Cap., mylar, 0.047 mf ±10%, 200 vdc	CGL-47-018
C5, C8	Not assigned	
	Cap., mylar, 1 mf ±10%, 200 vdc	CGN-10-005
C10	Cap., mylar, 0.033 mf ±10%, 400 vdc	CGL-33-009
C12, C13	Not assigned	
C16	Cap., paper, 0.1 mf ±10%, 200 vdc	CAM-10-012
CR1	Rectifier	FBL-00-030
CR2, CR5	Not assigned	
CR10, CR11	Same as CR1	
CR12	Not assigned	
CR13	Same as CR1	
CR22*	Rectifier, zener diode	FBM-Z139
Q4	Not assigned	
R1	Res., film, 8,660 ohms ±1%, 1/4 w	DCS-87-071
R9	Res., film, 10,000 ohms ±1%, 1/4 w	DCT-10-047
R10	Res., comp., 36 megohms ±5%, 1/4 w	DCB-3665
R11	Not assigned	
R12	Res., comp., 68,000 ohms ±10%, 1/4 w	DCB-6831
R14, R15	Not assigned	
R16	Res., comp., 470 ohms ±10%, 1/4 w	DCB-4711
R22	Not assigned	
R23	Res., comp., 100,000 ohms ±10%, 1/4 w	DCB-1041
XF1	Fuseholder	HRM-00-016

* CR22 not used on units with serial no. prefixes A&B.

UNIQUE PARTS
MODEL LCD-4-11 UNIT M

CIRC. DESIG.	DESCRIPTION	LAMBDA NO.
C3	Cap., mylar, 0.001 mf ±10%, 200 vdc	CGK-10-004
C4	Cap., mylar, 0.1 mf ±10%, 200 vdc	CAM-10-012
C6	Cap., elect., 3,600 mf -10 + 100%, 20 vdc	CBS-36-044
C7	Cap., elect., 450 mf -10 + 100%, 25 vdc	CBR-45-075
C11	Cap., mylar, 0.0033 mf ±10%, 200 vdc	CGK-33-003
C14, C15	Same as C4	
CR3, CR4, CR6	Not assigned	
CR7	Rectifier	FBL-00-047
CR8, CR9	Rectifier	FBL-00-030
CR14, CR15, CR16	Same as CR7	
CR17 thru CR21.	Not assigned	
F1	Fuse, 5.0A, 8AG, "NORM-BLO"	FFR-05-000
IC1	Integrated circuit	FBT-00-031
Q1, Q2	Transistor, NPN	FBN-L113
Q3	Transistor, NPN	FBN-36485
R2	Res., comp., 220 ohms ±10%, 1/4 w	DCB-2211
R3	Res., comp., 2,200 ohms ±10%, 1/2 w	DEB-2221
R4	Res., comp., 1,000 ohms ±10%, 1 w	DGB-1021
R5	Res., comp., 1,200 ohms ±10%, 1/4 w	DCB-1221

UNIQUE PARTS (Cont)

MODEL LCD-4-11 UNIT M (Cont)

CIRC. DESIG.	DESCRIPTION	LAMBDA NO.
R6	Res., film, 249 ohms ±1%, 1/4 w	DCR-25-034
R7	Res., ww, 0.25 ohms ±5%, 5 w	DFM-25-016
R8	Res., var., ww or cermet, 10,000 ohms ±10%, 3/4 w	DNT-10-045
R13	Res., var., ww, 100 ohms ±20%, 2 w	DNR-10-046
R17 thru R21	Not assigned	
S1	Thermostat	FKA-155-020
T1	Transformer	ABA-CD4-11

MODEL LCD-4-12 UNIT M

C3	Cap., mylar, 0.001 mf ±10%, 200 vdc	CGK-10-004
C4	Cap., mylar, 0.1 mf ±10%, 200 vdc	CAM-10-012
C6	Cap., elect., 2,100 mf -10 + 100%, 35 vdc	CBS-21-043
C7	Cap., elect., 280 mf -10 + 100%, 40 vdc	CBR-28-074
C11	Cap., mylar, 0.0033 mf ±10%, 200 vdc	CGK-33-003
C14, C15	Same as C4	
CR3, CR4, CR6	Not assigned	
CR7	Rectifier	FBL-00-047
CR8, CR9	Rectifier	FBL-00-030
CR14 thru CR17	Same as CR7	
CR18 thru CR21	Not assigned	
F1	Fuse, 3.0A, 8AG, "NORM-BLO"	FFR-03-000
IC1	Integrated circuit	FBT-00-031
Q1, Q2	Transistor, NPN	FBN-L113
Q3	Transistor, NPN	FBN-36485
R2	Res., comp., 220 ohms ±10%, 1/4 w	DCB-2211
R3	Res., comp., 6,800 ohms ±10%, 1/2 w	DEB-6821
R4	Res., comp., 1,800 ohms ±10%, 1 w	DGB-1821
R5	Res., comp., 1,200 ohms ±10%, 1/4 w	DCB-1221
R6	Res., film, 249 ohms ±1%, 1/4 w	DCR-25-034
R7	Res., ww, 0.5 ohms ±5%, 5 w	DFM-50-015
R8	Res., var., ww or cermet, 23,000 ohms ±10%, 3/4 w	DNT-23-072
R13	Res., var., ww, 100 ohms ±20%, 2 w	DNR-10-046
R17 thru R21	Not assigned	
S1	Thermostat	FKA-155-020
T1	Transformer	ABA-CD4-12

UNIQUE PARTS (Cont)

MODEL LCD-4-13 UNIT M

CIRC. DESIG.	DESCRIPTION	LAMBDA NO.
C3	Cap., mylar, 0.001 mf ±10%, 200 vdc	CGK-10-004
C4	Cap., mylar, 0.1 mf ±10%, 200 vdc	CAM-10-012
C6	Cap., elect., 1,100 mf -10 + 100%, 60 vdc	CBS-11-042
C7	Cap., elect., 175 mf -10 + 100%, 50 vdc	CBR-17-073
C11	Cap., mylar, 0.0022 mf ±10%, 200 vdc	CGK-22-008
C14, C15	Same as C4	
CR3, CR4, CR6	Not assigned	
CR7	Rectifier	FBL-00-065
CR8, CR9	Rectifier	FBL-00-030
CR14 thru CR16	Same as CR7	
CR17	Not assigned	
CR18, CR19	Same as CR8	
CR20, CR21	Not assigned	
F1	Fuse, 1.5A, 8AG, "NORM-BLO"	FFR-01-500
IC1	Integrated circuit	FBT-00-031
Q1, Q2	Transistor, NPN	FBN-L109
Q3	Transistor, NPN	FBN-36220
Q5	Same as Q1	
R2	Res., comp., 470 ohms ±10%, 1/4 w	DCB-4711
R3	Res., comp., 22,000 ohms ±10%, 1/2 w	DEB-2231
R4	Not assigned	
R5	Res., comp., 1,200 ohms ±10%, 1/4 w	DCB-1221
R6	Res., film, 249 ohms ±1%, 1/4 w	DCR-25-034
R7	Res., ww, 1.0 ohm ±3%, 5 w	DFN-10-014
R8	Res., var., cermet, 40,000 ohms ±10%, 0.75 w	DRT-40-009
R13	Res., var., ww, 100 ohms ±20%, 2 w	DNR-10-046
R17	Same as R3	
R18	Res., comp., 820 ohms ±10%, 1/4 w	DCB-8211
R19	Same as R2	
R20, R21	Not assigned	
S1	Thermostat	FKA-155-020
T1	Transformer	ABA-CD4-13

MODEL LCD-4-22 UNIT M

C3	Cap., mylar, 0.001 mf ±10%, 200 vdc	CGK-10-004
C4	Cap., mylar, 0.1 mf ±10%, 200 vdc	CAM-10-012
C6	Cap., elect., 2,100 mf -10 + 100%, 35 vdc	CBS-21-043

UNIQUE PARTS (Cont)

MODEL LCD-4-22 UNIT M (Cont)

CIRC. DESIG.	DESCRIPTION	LAMBDA NO.
C7	Cap., elect., 280 mf -10 + 100%, 40 vdc	CBR-28-074
C11	Cap., mylar., 0.0033 mf ±10%, 200 vdc	CGK-33-003
C14, C15	Same as C4	
CR3, CR4, CR6	Not assigned	
CR7	Rectifier	FBL-00-047
CR8, CR9	Rectifier	FBL-00-030
CR14 thru CR17	Same as CR7	
CR18 thru CR21	Not assigned	
F1	Fuse, 3.0A, 8AG, "NORM-BLO"	FFR-03-000
IC1	Integrated circuit	FBT-00-031
Q1, Q2	Transistor, NPN	FBN-L113
Q3	Transistor, NPN	FBN-36485
R2	Res., comp., 220 ohms ±10%, 1/4 w	DCB-2211
R3	Res., comp., 6,800 ohms ±10%, 1/2 w	DEB-6821
R4	Res., comp., 1,800 ohms ±10%, 1 w	DGB-1821
R5	Res., comp., 1,200 ohms ±10%, 1/4 w	DCB-1221
R6	Res., film, 249 ohms ±1%, 1/4 w	DCR-25-034
R7	Res., ww, 0.5 ohm ±5%, 5 w	DFM-50-015
R8	Res., var., ww or cermet, 23,000 ohms ±10%, 3/4 w	DNT-23-072
R13	Res., var., ww, 100 ohms ±20%, 2 w	DNR-10-046
R17 thru R21	Not assigned	
S1	Thermostat	FKA-155-020
T1	Transformer	ABA-CD4-22

MODEL LCD-4-23 UNIT M

C3	Cap., mylar, 0.001 mf ±10%, 200 vdc	CGK-10-004
C4	Cap., mylar, 0.1 mf ±10%, 200 vdc	CAM-10-012
C6	Cap., elect., 1,100 mf -10 + 100%, 60 vdc	CBS-11-042
C7	Cap., elect., 175 mf -10 + 100%, 50 vdc	CBR-17-073
C11	Cap., mylar, 0.0022 mf ±10%, 200 vdc	CGK-22-008
C14, C15	Same as C4	
CR3, CR4, CR6	Not assigned	
CR7	Rectifier	FBL-00-065
CR8, CR9	Rectifier	FBL-00-030
CR14 thru CR16	Same as CR7	
CR17	Not assigned	
CR18, CR19	Same as CR8	
CR20, CR21	Not assigned	

UNIQUE PARTS (Cont)

MODEL LCD-4-23 UNIT M (Cont)

CIRC. DESIG.	DESCRIPTION	LAMBDA NO.
F1	Fuse 1.5A, 8AG, "NORM-BLO"	FFR-01-500
IC1	Integrated circuit	FBT-00-031
Q1, Q2	Transistor, NPN	FBN-L109
Q3	Transistor, NPN	FBN-36220
Q5	Same as Q1	
R2	Res., comp., 470 ohms ±10%, 1/4 w	DCB-4711
R3	Res., comp., 22,000 ohms ±10%, 1/2 w	DEB-2231
R4	Not assigned	
R5	Res., comp., 1,200 ohms ±10%, 1/4 w	DCB-1221
R6	Res., film, 249 ohms ±1%, 1/4 w	DCR-25-034
R7	Res., ww, 1.0 ohm ±3%, 5 w	DFN-10-014
R8	Res., var., cermet, 40,000 ohms ±10%, 0.75 w	DRT-40-009
R13	Res., var., ww, 100 ohms ± 20%, 2 w	DNR-10-046
R17	Same as R3	
R18	Res., comp., 820 ohms ±10%, 1/4 w	DCB-8211
R19	Same as R2	
R20, R21	Not assigned	
S1	Thermostat	FKA-155-020
T1	Transformer	ABA-CD4-23

MODEL LCD-4-33 UNIT M

C3	Cap., mylar, 0.001 mf ±10%, 200 vdc	CGK-10-004
C4	Cap., mylar, 0.1 mf ±10%, 200 vdc	CAM-10-012
C6	Cap., elect., 1,100 mf -10 + 100%, 60 vdc	CBS-11-042
C7	Cap., elect., 175 mf -10 + 100%, 50 vdc	CBR-17-073
C11	Cap., mylar, 0.0022 mf ±10%, 200 vdc	CGK-22-008
C14, C15	Same as C4	
CR3, CR4, CR6	Not assigned	
CR7	Rectifier	FBL-00-065
CR8, CR9	Rectifier	FBL-00-030
CR14 thru CR16	Same as CR7	
CR18, CR19	Same as CR8	
CR20, CR21	Not assigned	
F1	Fuse 1.5A, 8AG, "NORM-BLO"	FFR-01-500
IC1	Integrated circuit	FBT-00-031
Q1, Q2	Transistor, NPN	FBN-L109
Q3	Transistor, NPN	FBN-36220
Q5	Same as Q1	
R2	Res., comp., 470 ohms ±10%, 1/4 w	DCB-4711
R3	Res., comp., 22,000 ohms ±10%, 1/2 w	DEB-2231
R4	Not assigned	
R5	Res., comp., 1,200 ohms ±10%, 1/4 w	DCB-1221
R6	Res., film, 249 ohms ±1%, 1/4 w	DCR-25-034

UNIQUE PARTS (Cont)

MODEL LCD-4-33 UNIT M (Cont)

CIRC. DESIG.	DESCRIPTION	LAMBDA NO.
R7	Res., ww, 1.0 ohm ±3%, 5 w	DFN-10-014
R8	Res., var., cermet, 40,000 ohms ±10%, 0.75 w	DRT-40-009
R13	Res., var., ww, 100 ohms ±20%, 2 w	DNR-10-046
R17	Same as R3	
R18	Res., comp., 820 ohms ±10%, 1/4 w	DCB-8211
R19	Same as R2	
R20, R21	Not assigned	
S1	Thermostat	FKA-155-020
T1	Transformer	ABA-CD4-33

MODEL LCD-4-44 UNIT M

C3	Not assigned	
C4	Cap., mylar, 0.1 mf ±10%, 200 vdc	CAM-10-012
C6	Cap., elect., 520 mf -10 + 100%, 100 vdc	CBR-52-025
C7	Cap., elect., 60 mf -10 +100%, 100 vdc	CBP-60-051
C11	Cap., mylar, 0.001 mf ±10%, 200 vdc	CGK-10-004
C14, C15	Same as C4	
CR3, CR4	Rectifier	FBL-00-033
CR6	Rectifier	FBL-00-036
CR7	Not assigned	
CR8	Same as CR6	
CR9	Rectifier	FBL-00-030
CR14 thru CR17	Not assigned	
CR18, CR19	Same as CR9	
CR20	Same as CR6	
CR2	Not assigned	
F1	Fuse, 1.0A, 8AG, "NORM-BLO"	FFR-01-000
IC1	Integrated circuit	FBT-00-030
Q1	Not assigned	
Q2	Transistor, NPN	FBN-L108
Q3	Transistor, NPN	FBN-35902
Q5	Same as Q2	
R2	Res., comp., 680 ohms ±10%, 1/4 w	DCB-6811
R3	Res., comp., 47,000 ohms ±10%, 1/2 w	DEB-4731
R4, R5	Not assigned	
R6	Res., film, 249 ohms ±1%, 1/4 w	DCR-25-034
R7	Res., ww, 1.5 ohms ±3%, 5 w	DFN-15-059
R8	Res., var., cermet, 75,000 ohms ±10%, 0.75 w	DRT-75-010
R13	Res., var., ww, 100 ohms ±2%, 2 w	DNR-10-046
R17	Same as R3	
R18	Res., comp., 820 ohms ±10%, 1/4 w	DCB-8211
R19	Res., comp., 470 ohms ±10%, 1/4 w	DCB-4711
R20, R21	Not assigned	
S1	Thermostat	FKA-155-020
T1	Transformer	ABA-CD4-44

UNIQUE PARTS (Cont)

MODEL LCD-4-55 UNIT M

CIRC. DESIG.	DESCRIPTION	LAMBDA NO.
C3	Not assigned	
C4	Cap., mylar, 0.033 mf ±10%, 400 vdc	CGL-33-009
C6	Cap., elect., 240 mf -10 + 100%, 200 vdc	CBR-24-033
C7	Cap., elect., 39 mf -10 + 100%, 200 vdc	CBP-39-050
C11	Cap., mylar, 0.001 mf ±10%, 200 vdc	CGK-10-004
C14, C15	Same as C4	
CR3, CR4	Rectifier	FBL-00-050
CR6	Rectifier	FBL-00-033
CR7	Not assigned	
CR8	Same as CR6	
CR9	Rectifier	FBL-00-030
CR14 thru CR17	Not assigned	
CR18, CR19	Same as CR9	
CR20	Same as CR6	
CR21	Not assigned	
F1	Fuse, 3/8A, 8AG, "NORM-BLO"	FFR-00-375
IC1	Integrated circuit	FBT-00-031
Q1	Not assigned	
Q2	Transistor, NPN	FBN-L108
Q3	Transistor, NPN	FBN-38982
Q5	Same as Q2	
R2	Res., comp., 240 ohms ±5%, 1/4 w	DCB-2415
R3	Res., comp., 100,000 ohms ±10%, 1 w	DGB-1041
R4, R5	Not assigned	
R6	Res., film, 249 ohms ±1%, 1/4 w	DCR-25-034
R7	Res., ww, 4.0 ohms ±5%, 5 w	DFN-40-018
R8	Res., var., cermet, 150,000 ohms ±10%, 0.75 w	DRV-15-006
R13	Res., var., ww, 100 ohms ±20%, 2 w	DNR-10-046
R17	Same as R3	
R18	Res., comp., 820 ohms ±10%, 1/4 w	DCB-8211
R19	Res., comp., 470 ohms ±10%, 1/4 w	DCB-4711
R20, R21	Not assigned	
S1	Thermostat	FKA-137-014
T1	Transformer	ABA-CD4-55

MODEL LCD-4-152 UNIT M

C3	Not assigned	
C4	Cap., mylar, 0.1 mf ±10%, 200 vdc	CAM-10-012
C6	Cap., elect., 2,100 mf -10 + 100%, 35 vdc	CBS-21-043
C7	Cap., elect., 280 mf -10 + 100%, 40 vdc	CBR-28-074
C9	Cap., elect., 2 mf -10 + 50%, 100 vdc	CBN-20-024
C11	Cap., mylar, 0.0033 mf ±10%, 200 vdc	CGK-33-003
C14, C15	Same as C4	

UNIQUE PARTS (Cont)

MODEL LCD-4-152 UNIT M (Cont)

CIRC. DESIG.	DESCRIPTION	LAMBDA NO.
CR3, CR4, CR6	Not assigned	
CR7	Rectifier	FBL-00-047
CR8	Rectifier	FBL-00-030
CR9	Not assigned	
CR14 thru CR16	Same as CR7	
CR17 thru CR20	Not assigned	
CR21	Same as CR8	
F1	Fuse, 5.0A, 8AG, "NORM-BLO"	FFR-05-000
IC1	Integrated circuit	FBT-00-031
Q1, Q2	Transistor, NPN	FBN-L113
Q3	Transistor, NPN	FBN-36485
R2	Res., comp., 330 ohms ±10%, 1/4 w	DCB-3311
R3	Res., comp., 6,800 ohms ±10%, 1/2 w	DEB-6821
R4	Res., comp., 22,000 ohms ±10%, 1/2 w	DEB-2231
R5	Res., comp., 1,200 ohms ±10%, 1/4 w	DCB-1221
R6	Res., comp., 180 ohms 10%, 1/4 w	DCB-1811
R7	Res., ww, 0.39 ohm ±5%, 5 w	DFM-39-046
R8	Res., var., ww or cermet, 20,000 ohms ±10%, 3/4 w	DNT-20-010
R13	Res., var., ww, 5,000 ohms ±20%, 2 w	DNS-50-086
R17 thru R19	Not assigned	
R20	Res., film, 9,100 ohms ±5%, 1/2 w	DCS-91-025
R21	Res., film, 68,000 ohms ±2%, 1/2 w	DCT-68-012
S1	Thermostat	FKA-137-014
T1	Transformer	ABA-CD4-152

PARTS FOR MODELS LCD-4-11—LCD-4-55 & LCD-4-152 UNIT S

Parts for Unit S are identical with unit M parts except as follows:

1. Circuit designations are in 100 series.
2. Rectifier CR112 is only used on unit S. See CR1 of M unit parts list for part identification.
3. The parts listed below differ from those parts used on unit M.

MODEL LCD-4-12 UNIT S

C106	Cap., elect., 3,600 mf -10 + 100%, 20 vdc	CBS-36-044
C107	Cap., elect., 450 mf -10 + 100%, 25 vdc	CBR-45-075
CR117	Not assigned	
F101	Fuse, 5.0A, 8AG, "NORM-BLO"	FFR-05-000
R103	Res., comp., 2,200 ohms ±10%, 1/2 w	DEB-2221
R104	Res., comp., 1,000 ohms ±10%, 1 w	DGB-1021
R107	Res., ww, 0.25 ohm ±5%, 5 w	DFM-25-016

MODEL LCD-4-12 UNIT S (Cont)

CIRC. DESIG.	DESCRIPTION	LAMBDA NO.
R108	Res., var., ww or cermet, 10,000 ohms ±10%, 3/4 w	DNT-10-045

MODEL LCD-4-13 UNIT S

C106	Cap., elect., 3,600 mf -10 + 100%, 20 vdc	CBS-36-044
C107	Cap., elect., 450 mf -10 + 100%, 25 vdc	CBR-45-075
C111	Cap., mylar, 0.003 mf ±10%, 200 vdc	CGK-33-003
CR107, CR114 thru CR116	Rectifier	FBL-00-047
CR118, CR119	Not assigned	
F101	Fuse, 5.0A, 8AG, "NORM-BLO"	FFR-05-000
Q101, Q102	Transistor, NPN	FBN-L113
Q103	Transistor, NPN	FBN-36485
Q105	Not assigned	
R102	Res., comp., 220 ohms ±10%, 1/4 w	DCB-2211
R103	Res., comp., 2,200 ohms ±10%, 1/2 w	DEB-2221
R104	Res., comp., 1,000 ohms ±10%, 1 w	DGB-1021
R107	Res., ww, 0.25 ohm ±5%, 5 w	DFM-25-016
R108	Res., var., ww or cermet, 10,000 ohms ±10%, 3/4 w	DNT-10-045
R117 thru R119	Not assigned	

MODEL LCD-4-23 UNIT S

C106	Cap., elect., 2,100 mf -10 + 100%, 35 vdc	CBS-21-043
C107	Cap., elect., 280 mf -10 + 100%, 40 vdc	CBR-28-074
C111	Cap., mylar, 0.0033 mf ±10%, 200 vdc	CGK-33-003
CR107, CR114 thru CR117	Rectifier	FBL-00-047
CR118, CR119	Not assigned	
F101	Fuse, 3.0A, 8AG, "NORM-BLO"	FFR-03-000
Q101, Q102	Transistor, NPN	FBN-L113
Q103	Transistor, NPN	FBN-36485
Q105	Not assigned	
R102	Res., comp., 330 ohms ±10%, 1/4 w	DCB-3311
R103	Res., comp., 6,800 ohms ±10%, 1/2 w	DEB-6821
R104	Res., comp., 1,800 ohms ±10%, 1 w	DGB-1821
R107	Res., ww, 0.5 ohm ±5%, 5 w	DFM-50-015
R108	Res., var., ww or cermet, 23,000 ohms ±10%, 3/4 w	DNT-23-072
R117 thru R119	Not assigned	

PARTS FOR "V" OPTION

"V" option only affects unit M models. Transformer T1 changes and capacitor C10 is removed on unit with "V" option.

PARTS FOR "V" OPTION (Cont)

For transformer T1 used in this model, see standard parts list for standard transformer part no. and add suffix "G" to the part no.

PARTS FOR SYSTEMS POWER CONTROL PANEL ACCESSORY MODEL SP5

COMMON PARTS

QUANT.	DESCRIPTION	LAMBDA NO.
2	Cap., tant., 1.7 mf -15 + 75%, 150 vdc	CBN-17-031
1	Pilot light, red neon	FCA-00-013
1*	Res., comp., 47,000 ohms ±10%, 1/4 w	DCB-4731
1	Power "ON-OFF" switch	FDA-11-022

* On units with "V" option, this component is 150,000 ohms; Lambda no. DCB-1541.

UNIQUE PARTS

MODEL LCD-4-11

QUANT.	DESCRIPTION	LAMBDA NO.
1	Res., dual, var., cermet, 9K/9K ±10%	DRT-18-012
2	Res., meter shunt, 2A, 50 mV	ESN-20-001
2	Res., meter multiplier, film, 10,000 ohms ±1%, 1/4 w	DCT-10-047

MODEL LCD-4-12

1	Res., dual, var., comp., 23K/9K ±10%	DMT-32-002
1*	Res., meter shunt, ww, 0.05 ohms ±1%, 0.33 w	DEL-50-001
1**	Res., meter shunt, 2A, 50 mV	ESN-20-001
1*	Res., meter multiplier, film, 20,000 ohms ±1%, 1/4 w	DCT-20-053
1**	Res., meter multiplier, film, 10,000 ohms ±1%, 1/4 w	DCT-10-047

MODEL LCD-4-13

1	Res., dual, var., comp., 40K/9K ±10%	DMT-49-003
1*	Res., meter shunt, ww, 0.05 ohm ±1%, 0.33 w	DEL-50-001
1**	Res., meter shunt, 2A, 50 mV	ESN-20-001
1*	Res., meter multiplier film, 49,900 ohms ±1%, 1/4 w	DCT-50-054
1**	Res., meter multiplier, film, 10,000 ohms ±1%, 1/4 w	DCT-10-047

MODEL LCD-4-22

1	Res., dual, var., comp., 23K/23K ±10%	DMT-46-004
2	Res., meter shunt, ww, 0.05 ohm ±1%, 0.33 w	DEL-50-001
2	Res., meter multiplier, film, 20,000 ohms ±1%, 1/4 w	DCT-20-053

MODEL LCD-4-23

1	Res., dual, var., comp., 40K/23K ±10%	DMT-63-005
2	Res., meter shunt, ww, 0.05 ohm ±1%, 0.33 w	DEL-50-001

UNIQUE PARTS (Cont)

MODEL LCD-4-23 (Cont)

QUANT.	DESCRIPTION	LAMBDA NO.
1*	Res., meter multiplier, film, 49,900 ohms ±1%, 1/4 w	DCT-50-054
1**	Res., meter multiplier, film, 20,000 ohms ±1%, 1/4 w	DCT-20-053

MODEL LCD-4-33

1	Res., dual, var., comp., 40K/40K ±10%	DMT-80-006
2	Res., meter shunt, ww, 0.05 ohm ±1%, 0.33 w	DEL-50-001
2	Res., meter multiplier, film, 49,900 ohms ±1%, 1/4 w	DCT-50-054

MODEL LCD-4-44

1	Res., dual, var., comp., 75K/75K ±10%	DMV-15-004
2	Res., meter shunt, ww, 0.100 ohm ±1%, 0.33 w	DEM-10-001
2	Res., meter multiplier, film, 100,000 ohms ±1%, 1/4 w	DCV-10-027

MODEL LCD-4-55

1	Res., dual, var., comp., 150K/150K ±10%	DMV-30-005
2	Res., meter shunt, ww, 0.251 ohm ±1%, 0.33 w	DEM-25-002
2	Res., meter multiplier, film, 200,000 ohms ±1%, 1/4 w	DCV-20-028

MODEL LCD-4-152

1	Res., dual, var., cermet, 23K/23K ±10%	DRT-46-015
2	Res., meter shunt, 2A, 50 mV	ESN-20-001
2	Res., meter multiplier, film, 20,000 ohms ±1%, 1/4 w	DCT-20-053

*ONLY USED ON UNIT M
**ONLY USED ON UNIT S

PARTS FOR SYSTEMS METERING PANEL ACCESSORY, MODEL SMP5

1	Voltmeter	EBP-27-039
1	Ammeter	EDN-12-033
2	Pushbutton switch assembly	FDK-08-001
1	Selector switch, 3 pole, double throw	FDK-32-026

PARTS FOR OVERVOLTAGE PROTECTOR ACCESSORY, MODELS LHOV-4, LHOV-5, LHOV-6

COMMON PARTS

CIRC. DESIG.	DESCRIPTION	LAMBDA NO.
C1	Cap., mylar, 0.01 mf ±20%, 80 vdc	CGL-10-008
Q1	Transistor, NPN	FBN-L102
Q2	Transistor, PNP	FBN-L114
R2	Res., film, 560 ohms ±2%, 1/2 w	DCR-56-002
R3	Res., film, 200 ohms ±5%, 1/2 w	DCR-20-010
R4	Res., thermistor, 425 ohms ±5%, 1-1/4 w	DKR-43-004

COMMON PARTS (Cont)

MODELS LHOV-4, LHOV-5, LHOV-6 (Cont)

CIRC. DESIG.	DESCRIPTION	LAMBDA NO.
R5, R6	Res., comp., 1,200 ohms ±10%, 1/2 w	DEB-1221
R7	Res., comp., 33 ohms ±5%, 1/4 w	DCB-3305
R8	Res., comp., 15,000 ohms ±10%, 1/2 w	DEB-1531
R9	Res., comp., 22 ohms ±10%, 1/2 w	DEB-2201
R10	Same as R5	
SCR1	Rectifier, silicon controlled	FBP-00-009

UNIQUE PARTS

MODEL LHOV-4

CIRC. DESIG.	DESCRIPTION	LAMBDA NO.
R1	Res., var., ww or cermet, 10,000 ohms ±10%, 3/4 w	DNT-10-045

MODEL LHOV-5

R1	Res., var., ww or cermet, 20,000 ohms ±10%, 3/4 w	DNT-20-010

MODEL LHOV-6

R1	Res., var., ww or cermet, 30,000 ohms ±10%, 3/4 w	DNT-30-027

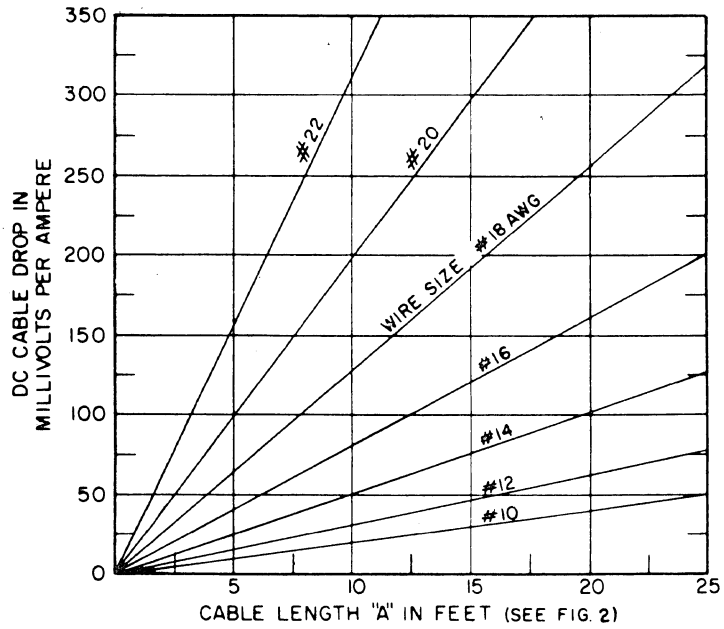


Figure 1. Cable Connection Chart

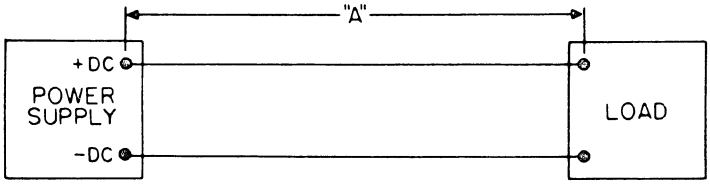
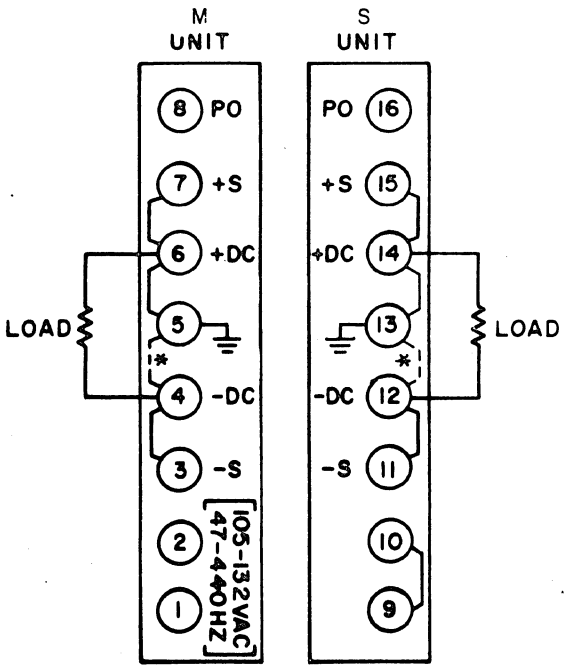
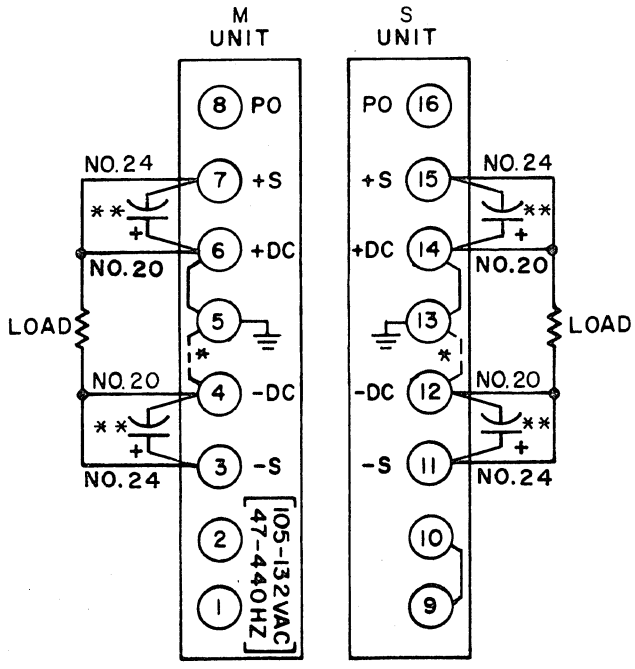


Figure 2. Cable Length "A" in Feet



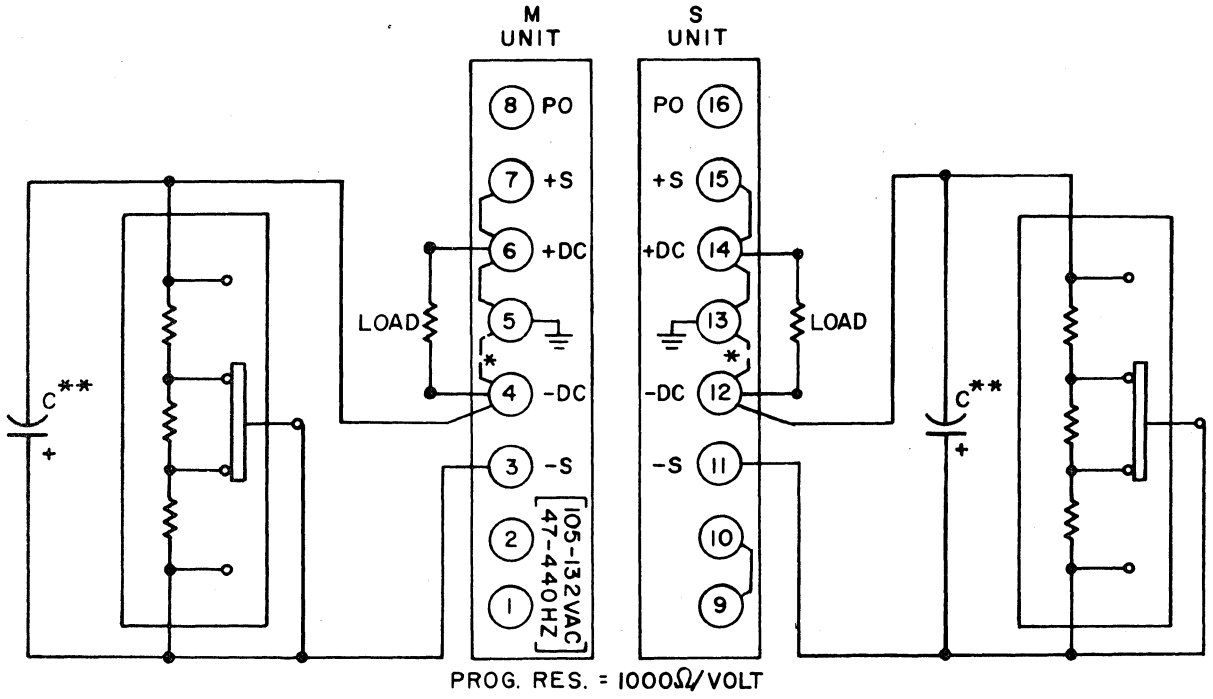
*FOR NEGATIVE GROUND DISCONNECT JUMPERS FROM TERMINALS 5-6,13-14 AND RECONNECT TO TERMINALS 5-4, 12-13.

Figure 3. Two-Wire Connection

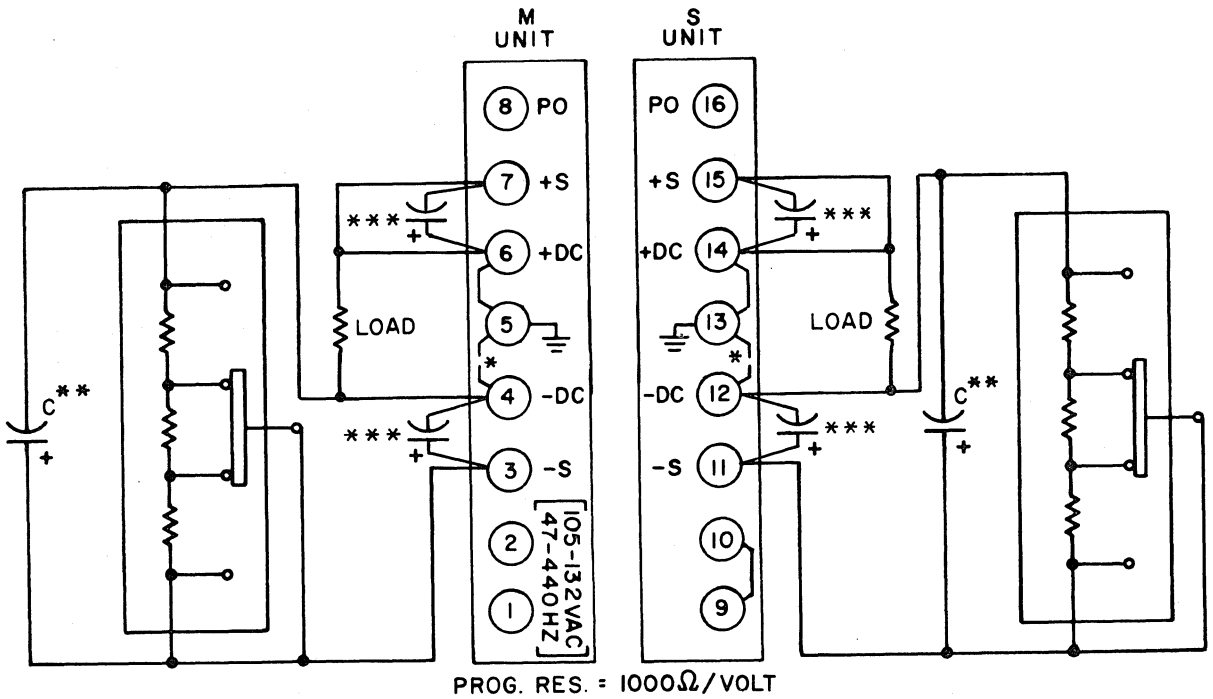


*FOR NEGATIVE GROUND DISCONNECT JUMPERS FROM TERMINALS 5-6,13-14 AND RECONNECT TO TERMINALS 5-4, 12-13.
**A 2.5MF, ELECT., CAP. MAY BE REQUIRED.

Figure 4. Four-Wire Connection



(A)LOCAL SENSING



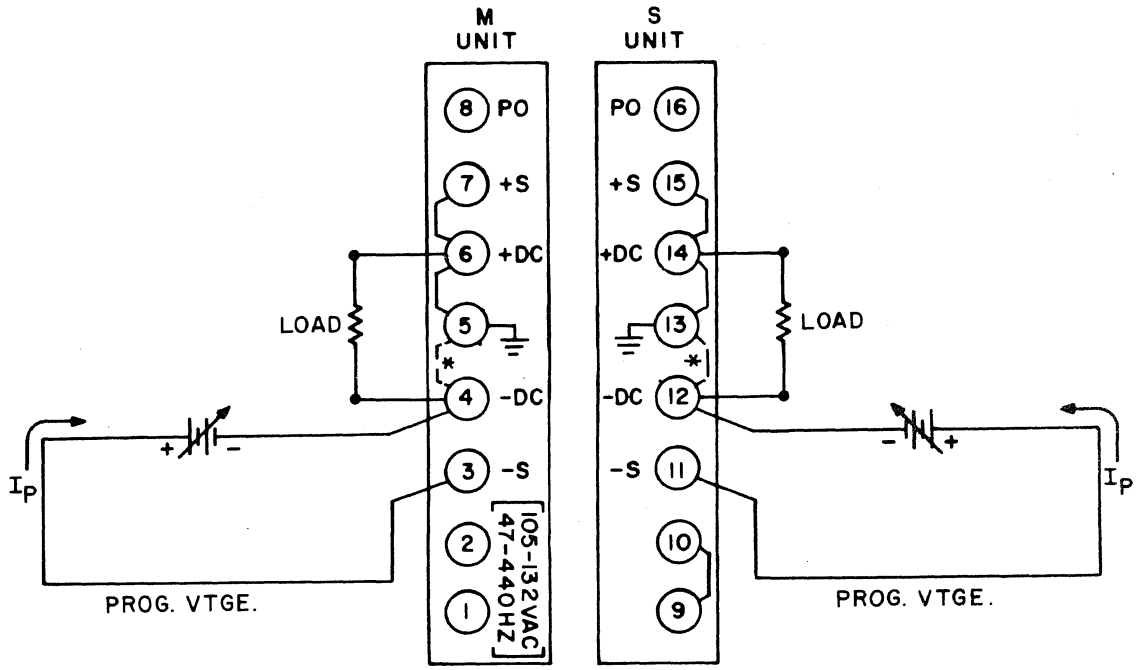
(B) REMOTE SENSING

*FOR NEGATIVE GROUND DISCONNECT JUMPERS FROM TERMINALS 5-6,13-14 AND RECONNECT TO TERMINALS 5-4,12-13.

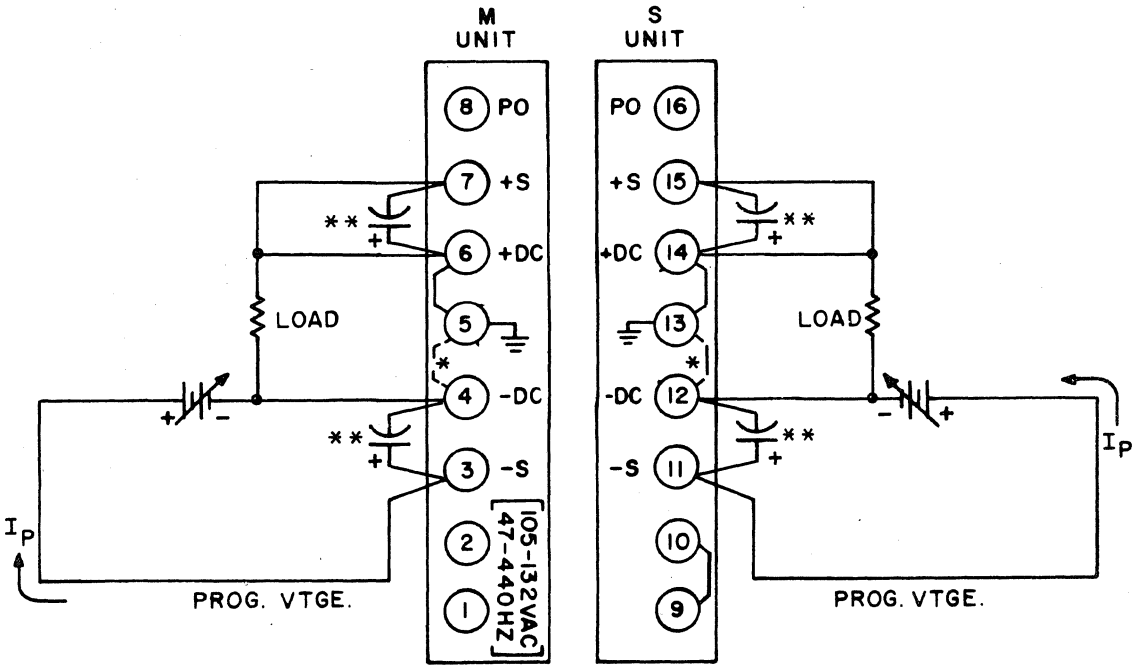
**C = 2.5 MFD, 200V FOR MODELS LCD-4-11, THRU LCD-4-44, LCD-4-152
C = 1.4 MFD, 400V FOR MODEL LCD-4-55.

***A 2.5 MF, ELECT., CAP. MAY BE REQUIRED.

Figure 5. Programmed Voltage, With External Resistor



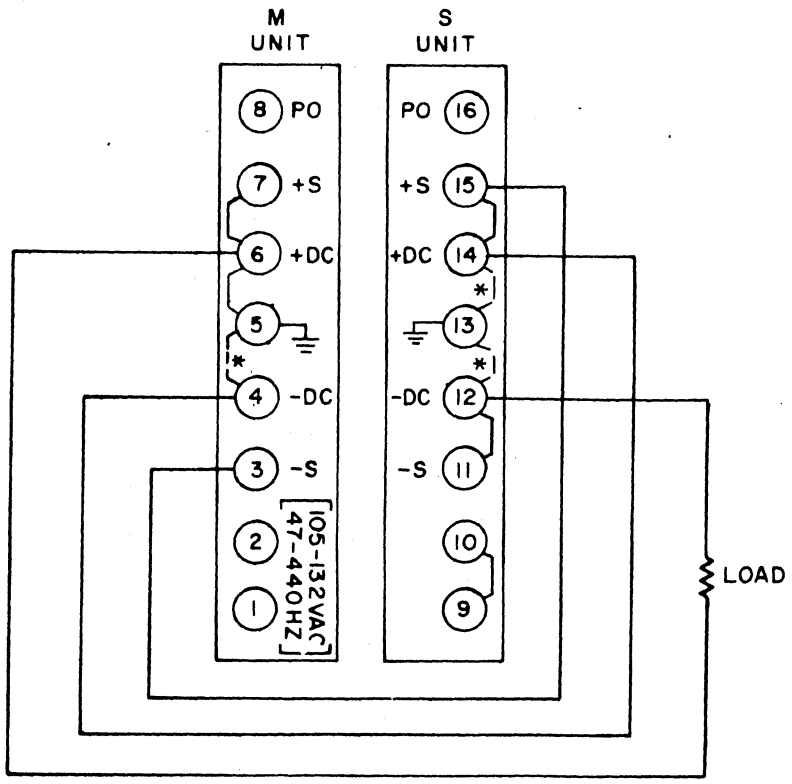
NOTE: VOLTAGE ADJ. CONTROLS MUST BE SET TO MINIMUN OUTPUT VOLTAGE.
(A) LOCAL SENSING



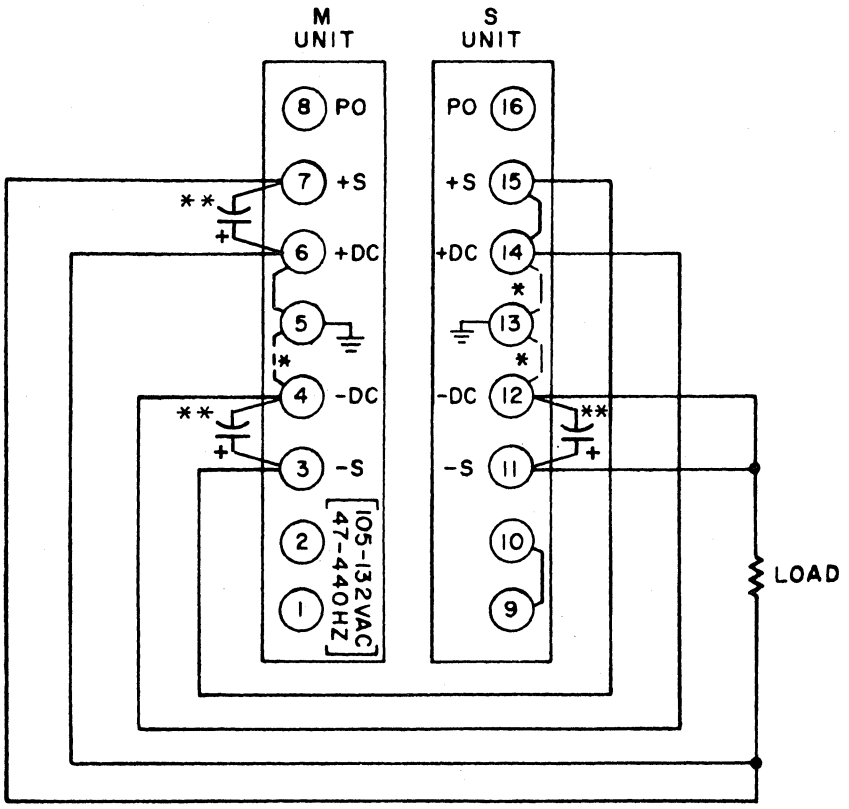
NOTE: VOLTAGE ADJ. CONTROLS MUST BE SET TO MINIMUM OUTPUT VOLTAGE.
(B) REMOTE SENSING

*FOR NEGATIVE GROUND DISCONNECT JUMPERS FROM TERMINALS 5-6, 13-14, AND RECONNECT TO TERMINALS 5-4, 12-13.
**A 2.5 MF, ELECT., CAP. MAY BE REQUIRED.

Figure 6. Programmed Voltage, With External Programming Voltage Source



(A) LOCAL SENSING

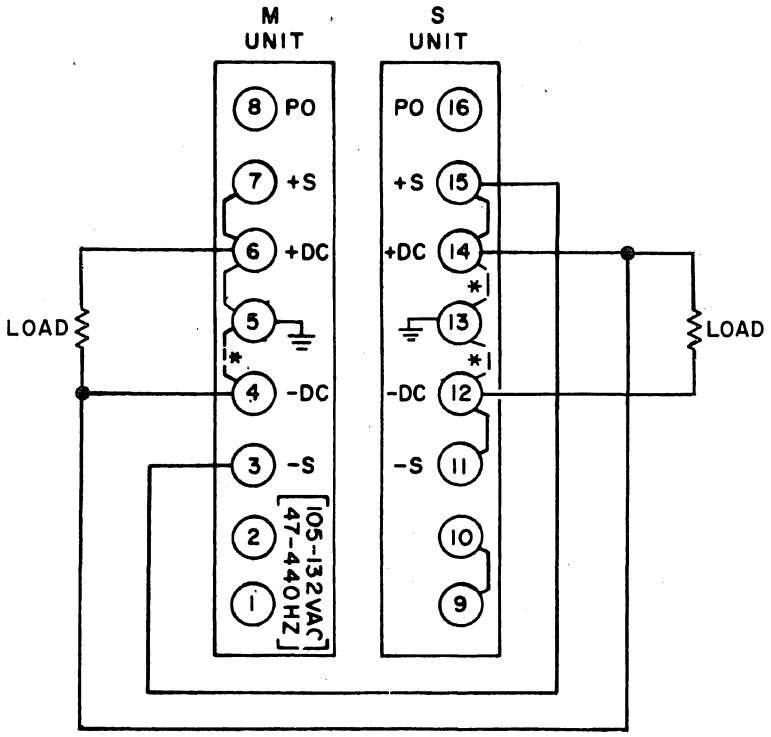


(B) REMOTE SENSING

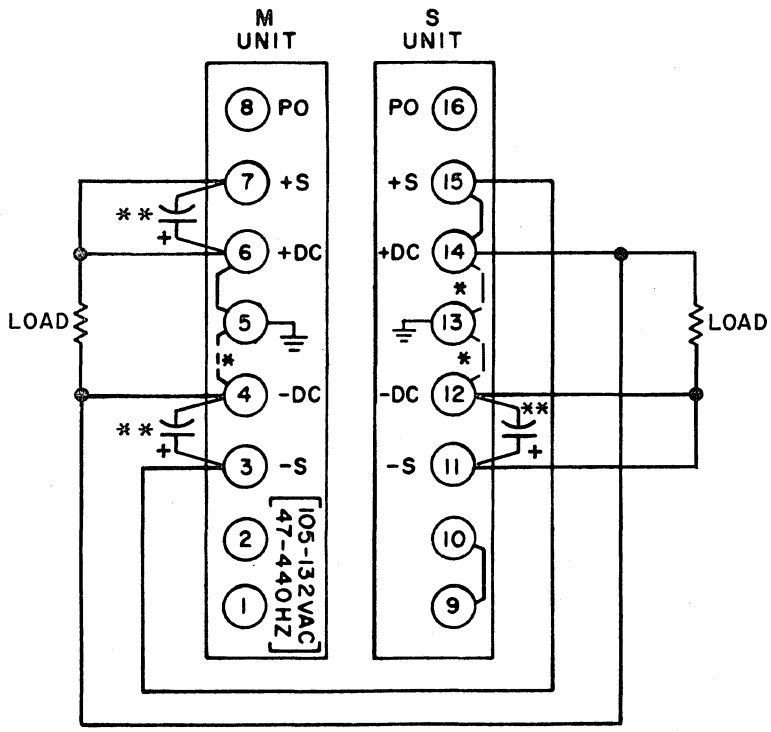
*MAKE ONLY ONE GROUND CONNECTION FOR EACH SERIES COMBINATION; TO CHANGE GROUND AS SHOWN, REMOVE JUMPER FROM TERMINALS 5 AND 6 ON "M" UNIT AND CONNECT ANY ONE OF THE OTHER JUMPERS AS SHOWN IN DOTTED LINE.

** A 2.5MF, ELECT., CAP. MAY BE REQUIRED.

Figure 7. Series Connection For LCD-4-11 thru LCD-4-55, Common Load



(A) LOCAL SENSING

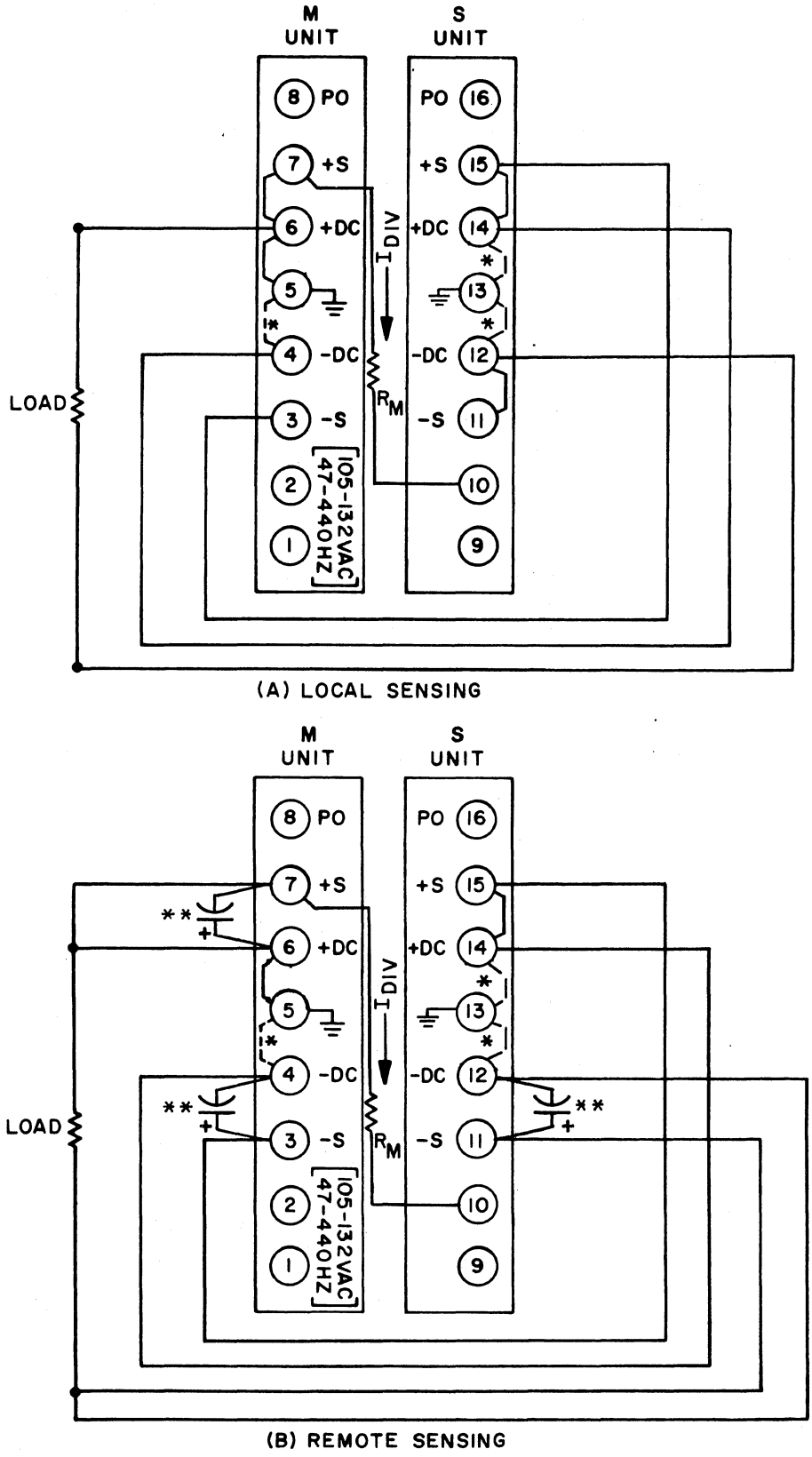


(B) REMOTE SENSING

*MAKE ONLY ONE GROUND CONNECTION FOR EACH SERIES COMBINATION; TO CHANGE GROUND AS SHOWN, REMOVE JUMPER FROM TERMINALS 5 AND 6 ON "M" UNIT AND CONNECT ANY ONE OF THE OTHER JUMPERS AS SHOWN IN DOTTED LINE.

** A 2.5MF, ELECT CAP. MAY BE REQUIRED.

Figure 7A. Series Connection, Dual Load

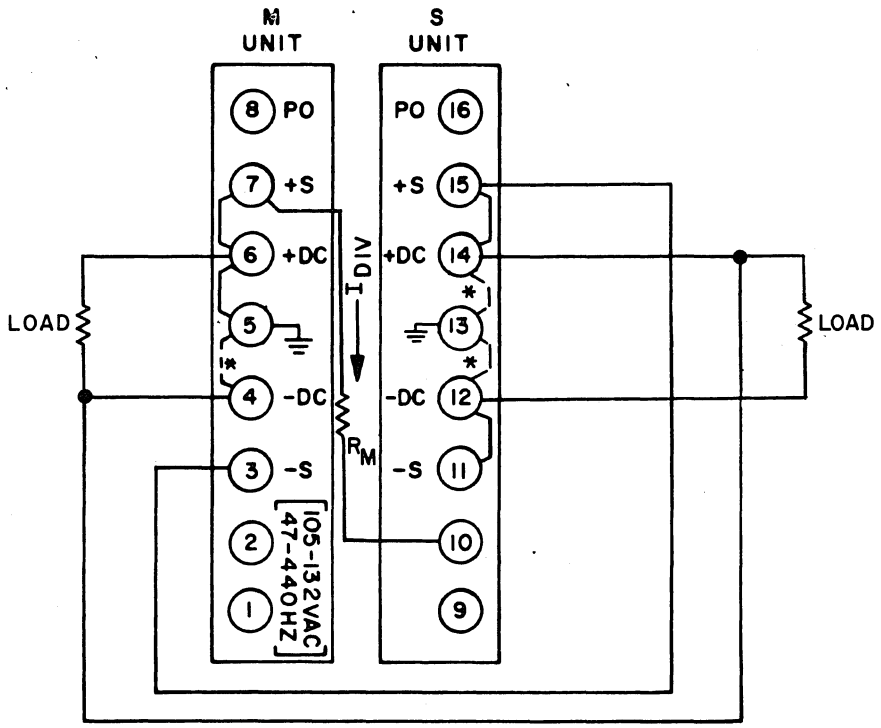


* MAKE ONLY ONE GROUND CONNECTION FOR EACH SERIES COMBINATION; TO CHANGE GROUND AS SHOWN, REMOVE JUMPER FROM TERMINALS 5 AND 6 ON "M" UNIT AND CONNECT ANY ONE OF THE OTHER JUMPERS AS SHOWN IN DOTTED LINE.

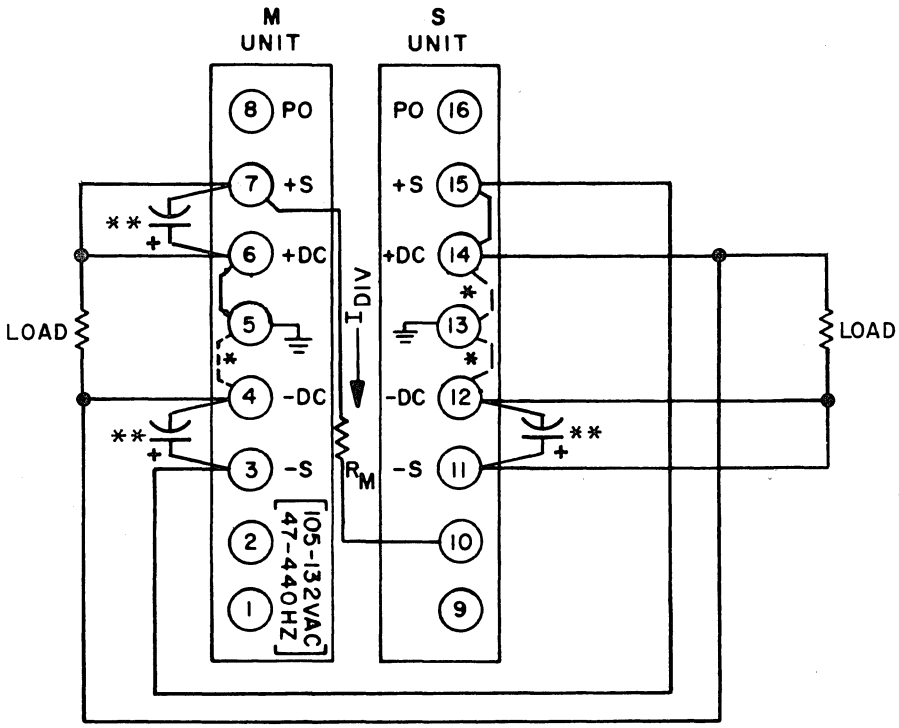
** A 2.5 MF, ELECT., CAP. MAY BE REQUIRED.

NOTE: ONLY USE "M" UNIT OUTPUT VOLTAGE CONTROL TO CONTROL OUTPUT OF THE SERIES COMBINATION.

Figure 8. Auto-Series Connection For LCD-4-11 thru LCD-4-55, Common Load



(A) LOCAL SENSING



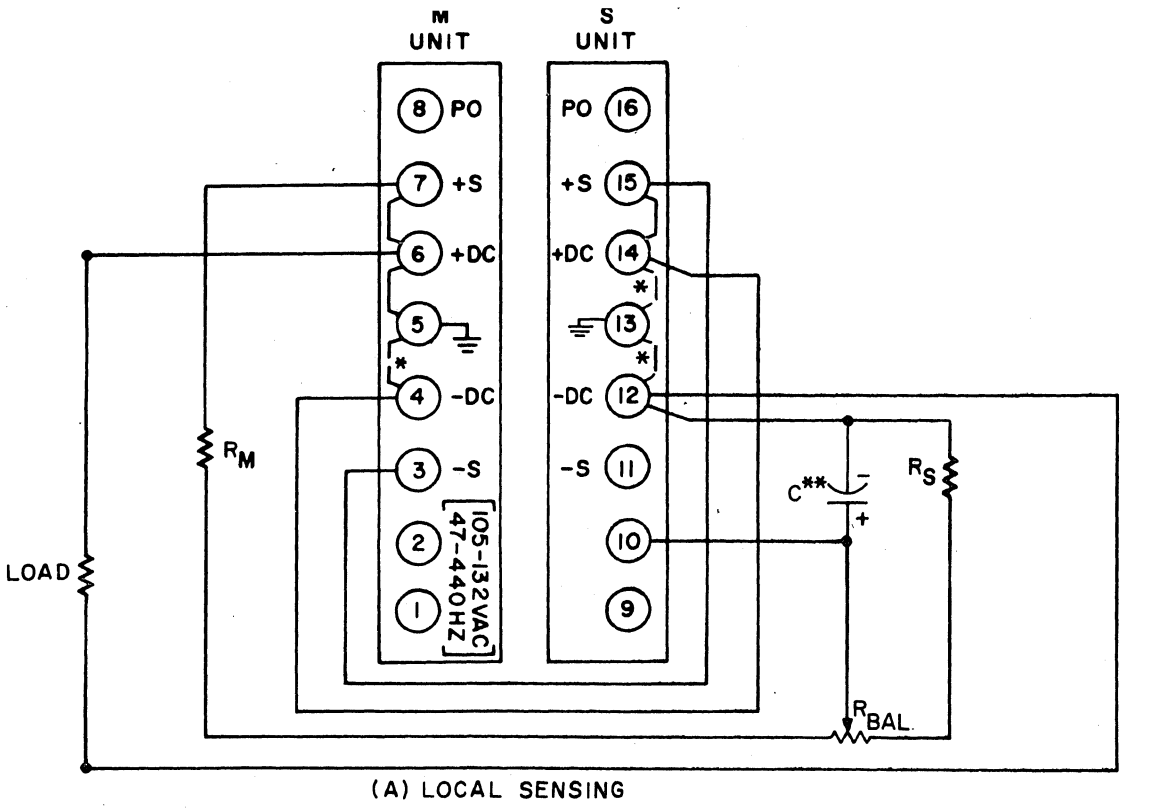
(B) REMOTE SENSING

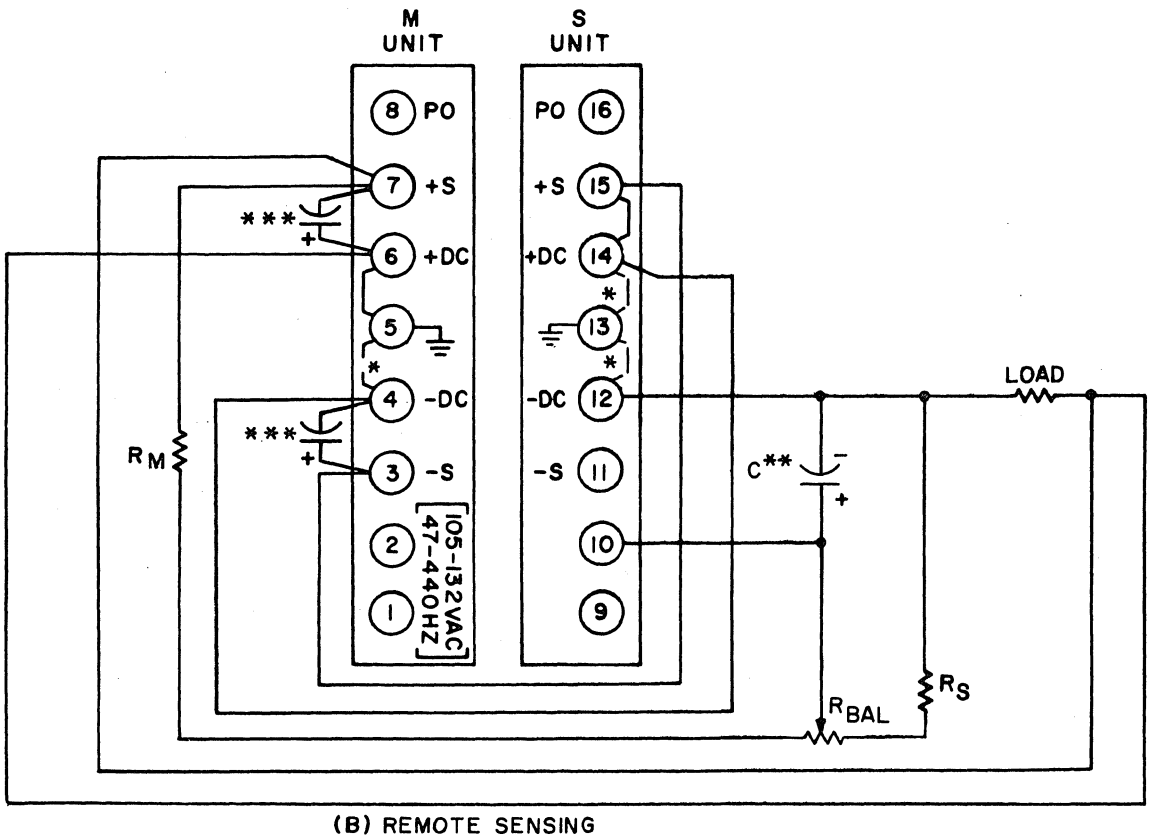
* MAKE ONLY ONE GROUND CONNECTION FOR EACH SERIES COMBINATION; TO CHANGE GROUND AS SHOWN, REMOVE JUMPER FROM TERMINALS 5 AND 6 ON "M" UNIT AND CONNECT ANY ONE OF THE OTHER JUMPERS AS SHOWN IN DOTTED LINE.

** A 2.5MF, ELECT., CAP. MAY BE REQUIRED.

NOTE: ONLY USE "M" UNIT OUTPUT VOLTAGE CONTROL TO CONTROL OUTPUT OF THE SERIES COMBINATION.

Figure 8A. Auto-Series Connection, Dual Load





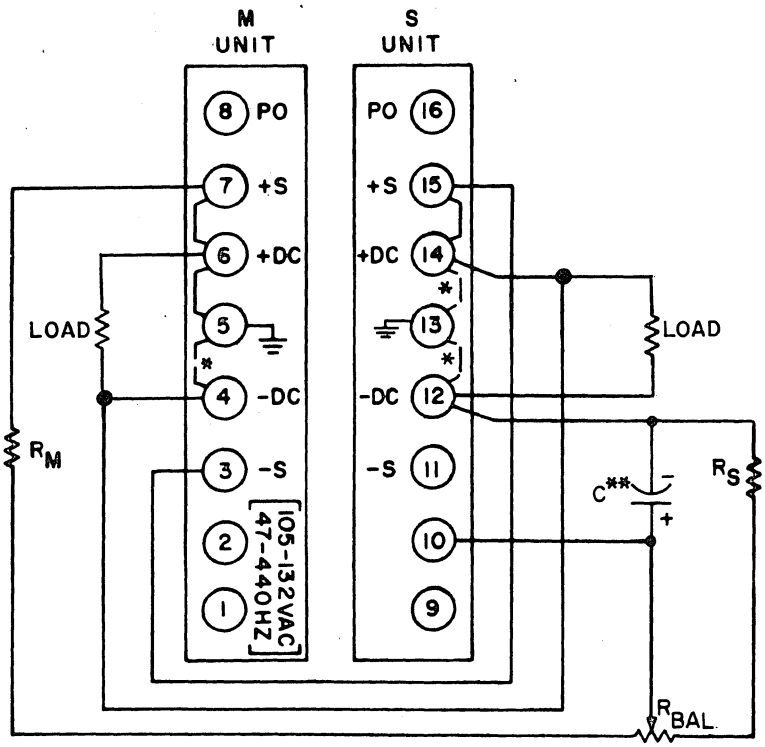
* MAKE ONLY ONE GROUND CONNECTION FOR EACH SERIES COMBINATION; TO CHANGE GROUND AS SHOWN, REMOVE JUMPER FROM TERMINALS 5 AND 6 ON "M" UNIT AND CONNECT ANY ONE OF THE OTHER JUMPERS AS SHOWN IN DOTTED LINE.

** C = 2.5MFD, 200V FOR MODELS LCD-4-11 THROUGH LCD-4-44
C = 1.4 MFD, 400V FOR MODEL LCD-4-55

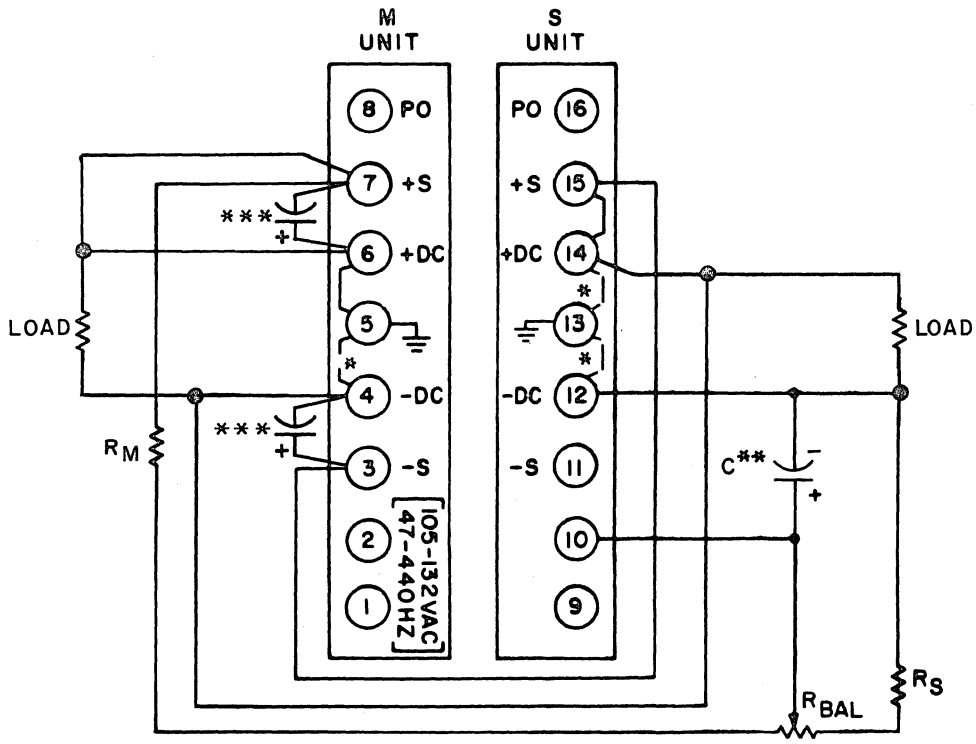
*** A 2.5MF, ELECT., CAP. MAY BE REQUIRED.

Figure 9. Alternate Auto Series Connection For LCD-4-11 thru LCD-4-55

Common Load



(A) LOCAL SENSING



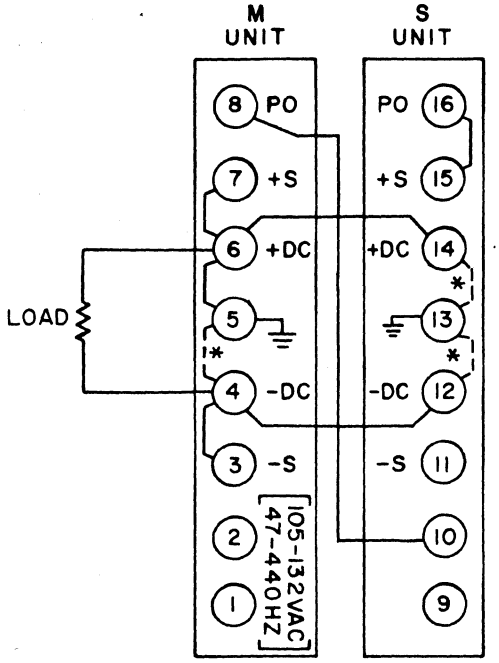
(B) REMOTE SENSING

* MAKE ONLY ONE GROUND CONNECTION FOR EACH SERIES COMBINATION; TO CHANGE GROUND AS SHOWN, REMOVE JUMPER FROM TERMINALS 5 AND 6 ON "M" UNIT AND CONNECT ANY ONE OF THE OTHER JUMPERS AS SHOWN IN DOTTED LINE.

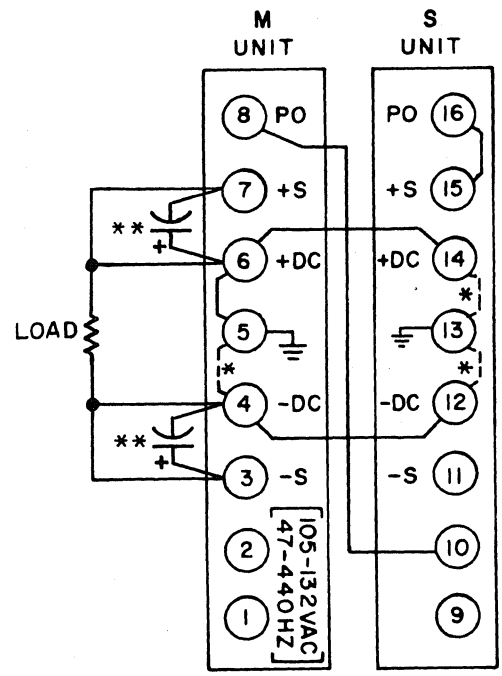
**C = 2.5MFD, 200V

***A 2.5MF, ELECT., CAP. MAY BE REQUIRED.

Figure 9A. Alternate Auto-Series Connection, Dual Load



(A) LOCAL SENSING

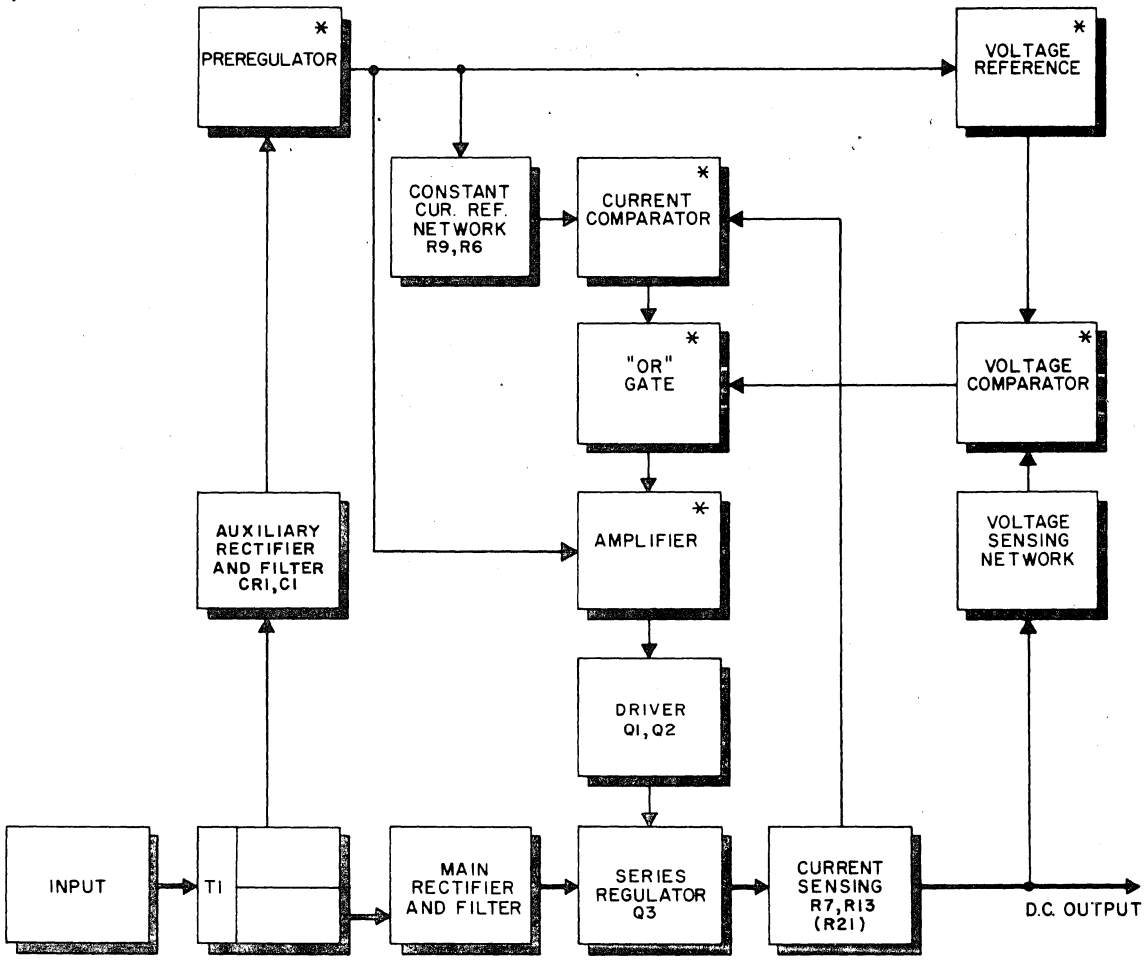


(B) REMOTE SENSING

* MAKE ONLY ONE GROUND CONNECTION FOR EACH PARALLEL COMBINATION; TO CHANGE GROUND AS SHOWN, REMOVE JUMPER FROM TERMINALS 5 AND 6 ON "M" UNIT AND CONNECT ANY ONE OF THE OTHER JUMPERS AS SHOWN IN DOTTED LINE.

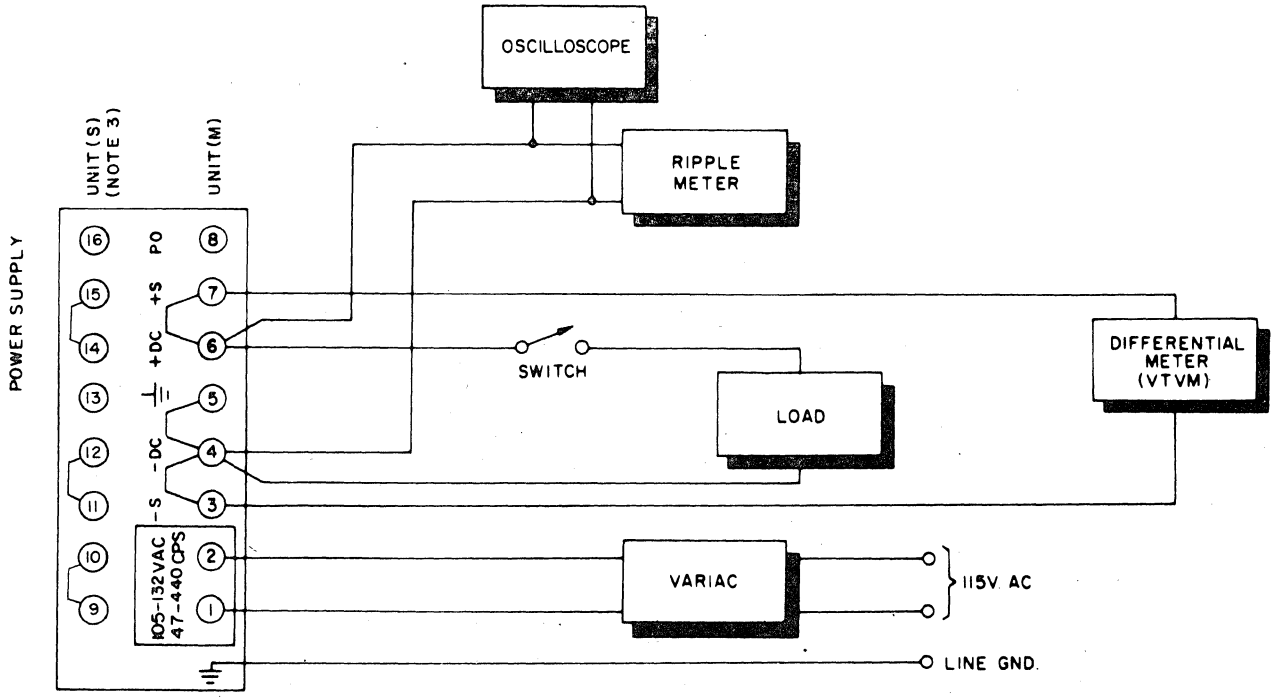
** A 2.5MF, ELECT., CAP. MAY BE REQUIRED.

Figure 10. Parallel Connection



NOTE: THIS DIAGRAM APPLIES TO UNIT(S) EXCEPT INPUT BLOCK AND T1 PRIMARY ARE NOT USED AND CIRCUIT DESIGNATION NUMBERS ARE IN THE 100 SERIES.
*THIS CIRCUIT ELEMENT IS LOCATED IN IC1.

Figure 11. Typical Block Diagram



NOTES

1. REGULATION AND RIPPLE CHECK METERS MUST NOT BE GROUNDED THROUGH THREE-WIRE LINE CORD TO GROUND.
2. PERFORM CHECKS WITH LOCAL SENSING CONNECTIONS ONLY.
3. WHEN CHECKING UNIT(S) CONNECT TO UNIT(S) TERMINALS AND ADD JUMPERS AS SHOWN; AC INPUT STILL CONNECTS TO TERMINALS 1 AND 2; TERMINAL 12 CONNECTS TO TERMINAL 5 OR 13.

Figure 12. Test Connections For Constant Voltage Performance Checks

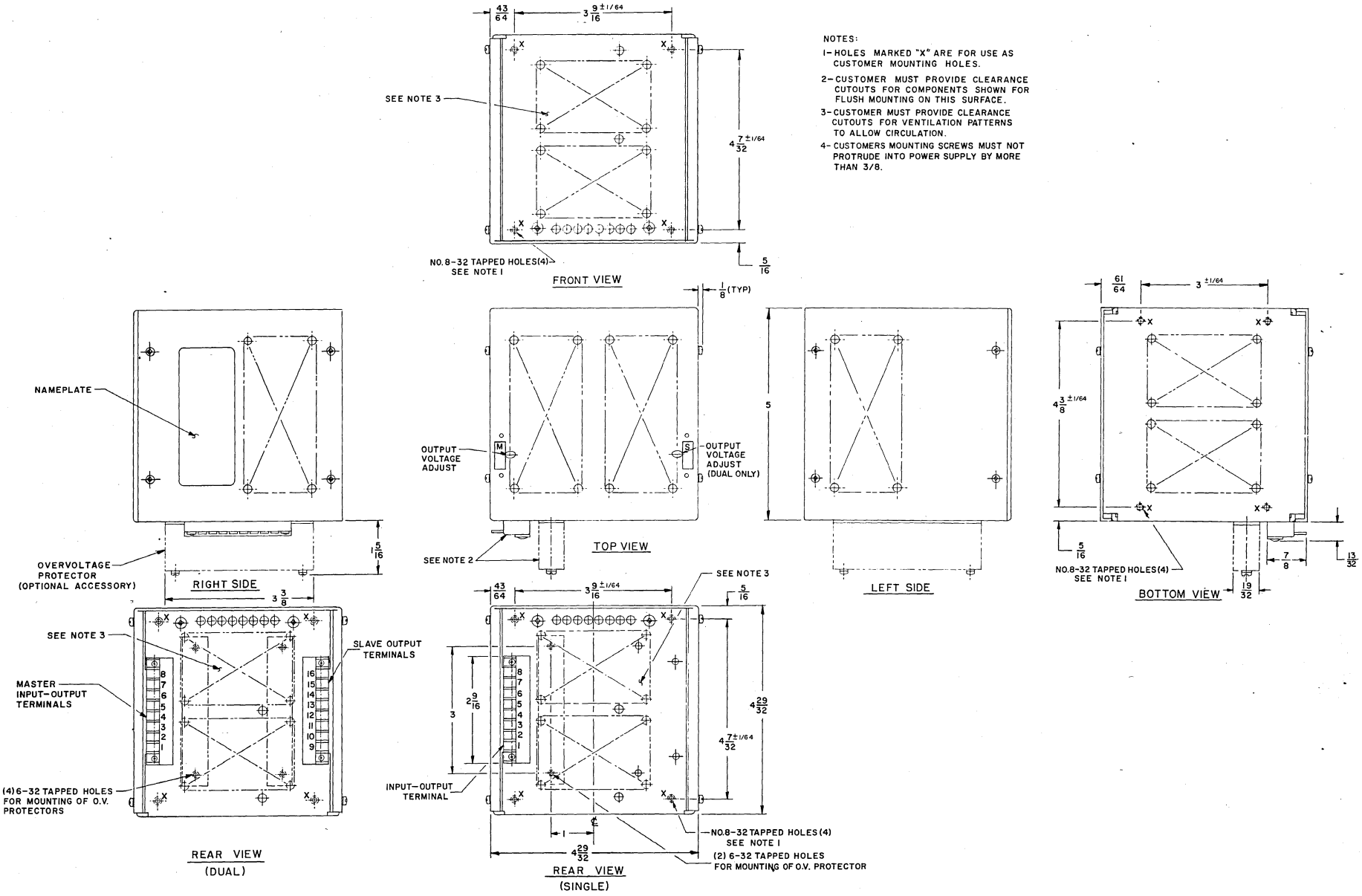
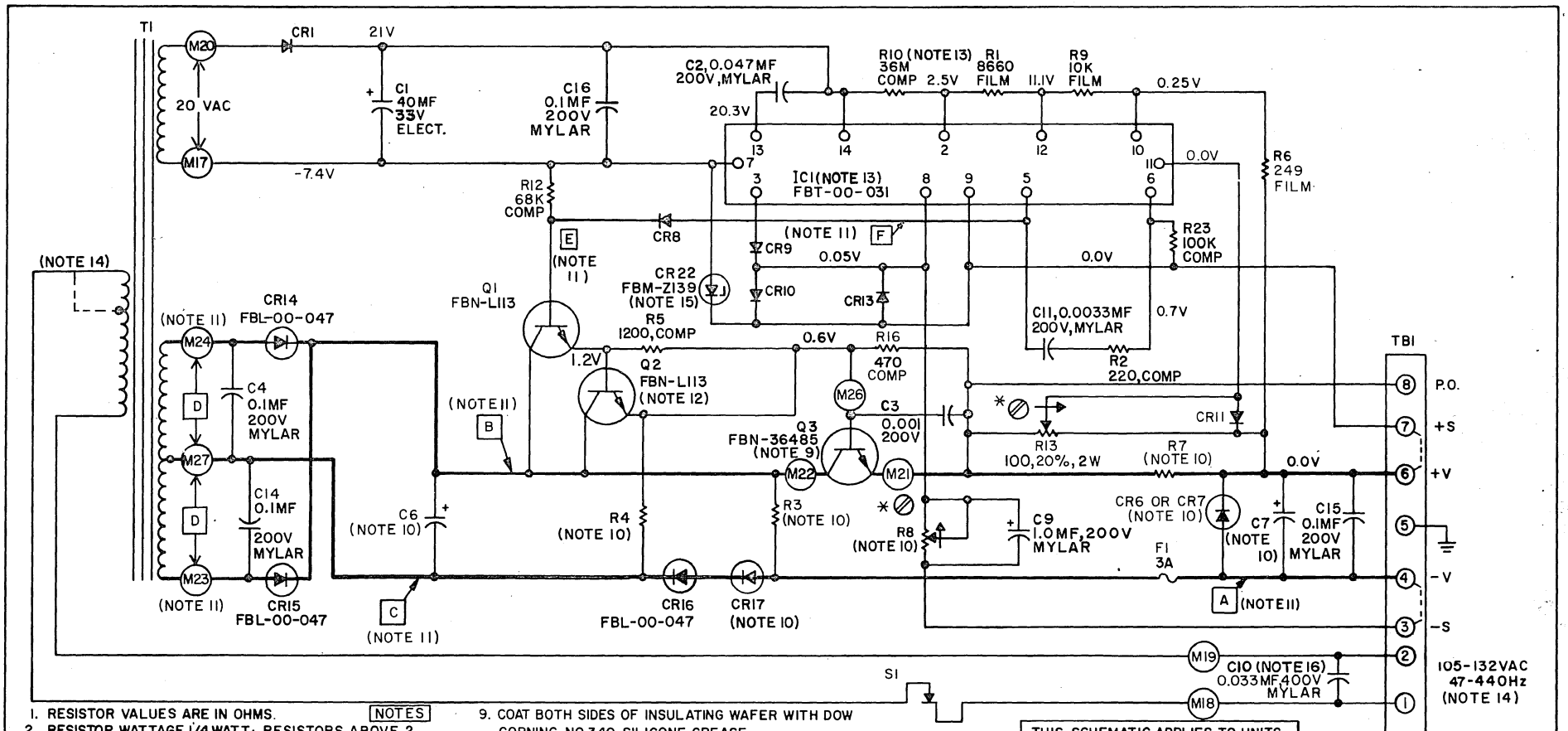


Figure 13. Outline Drawing



NOTES

1. RESISTOR VALUES ARE IN OHMS.
2. RESISTOR WATTAGE 1/4 WATT; RESISTORS ABOVE 2 WATTS ARE WIREWOUND UNLESS OTHERWISE NOTED
3. RESISTOR TOLERANCES: COMP. ±10%; WIREWOUND ±2% FILM ±1%; UNLESS OTHERWISE NOTED.
4. CAPACITOR TOLERANCES: ELECTROLYTIC -10%, +100%; MYLAR ±10%; CERAMIC 10%; UNLESS OTHERWISE NOTED.
5. SYMBOLS:
   - INDICATES CLOCKWISE ROTATION OF SHAFT.
   - INDICATES CONNECTION TO CHASSIS.
   - INDICATES ADJUSTMENT OR CALIBRATION CONTROL.
   - SEE INSTRUCTION MANUAL.
   - LAMBDA PT. # FBL-00-030; USE IN 4002 DIODE FOR REPLACEMENT UNLESS OTHERWISE NOTED.
   - INDICATES TERMINAL ON PRINTED WIRING BOARD.
6. DESIGNATIONS ARE LAMBDA PART NUMBERS.
7. DERATE CURRENT 10% FOR 47-57Hz, FOR 63-440Hz CONSULT FACTORY.
8. CONDITIONS FOR CIRCUIT POINT MEASUREMENTS: INPUT: 115 VAC, 60Hz; MAX. RATED VOLTAGE NO LOAD. INDICATED VOLTAGES ARE TYPICAL VALUES AND ARE DC UNLESS OTHERWISE NOTED. DC MEASUREMENTS TAKEN WITH 20,000 OHMS/V VOLTMETER BETWEEN +S (TERM. 7) & INDICATED POINTS UNLESS NOTED; +S AND +V SHORTED, -S AND -V SHORTED.
9. COAT BOTH SIDES OF INSULATING WAFER WITH DOW CORNING NO. 340 SILICONE GREASE.
10. SEE TABLE I FOR COMPONENT VALUES.
11. SEE TABLE I FOR VOLTAGE VALUES.
12. IF Q2 IS REPLACED RETAIN RADIATOR AND INSTALL WITH NEW TRANSISTOR.
13. ON UNITS WITH SERIAL NUMBER PREFIX A IC1 IS FBT-00-010 AND R10 IS 68M.
14. ON UNITS WITH "V" OPTION, T1 HAS TAPPED PRIMARY. "V" OPTION UNITS CAN BE WIRED FOR 187-242V INPUT (USING TAP) OR FOR 205-265V INPUT (USING ENTIRE PRIMARY).
15. CR22 NOT USED ON UNITS WITH SERIAL NO. PREFIXES A & B.
16. C10 NOT USED ON UNITS WITH "V" OPTION.

MODELS
LCD-4-11
LCD-4-12
LCD-4-22

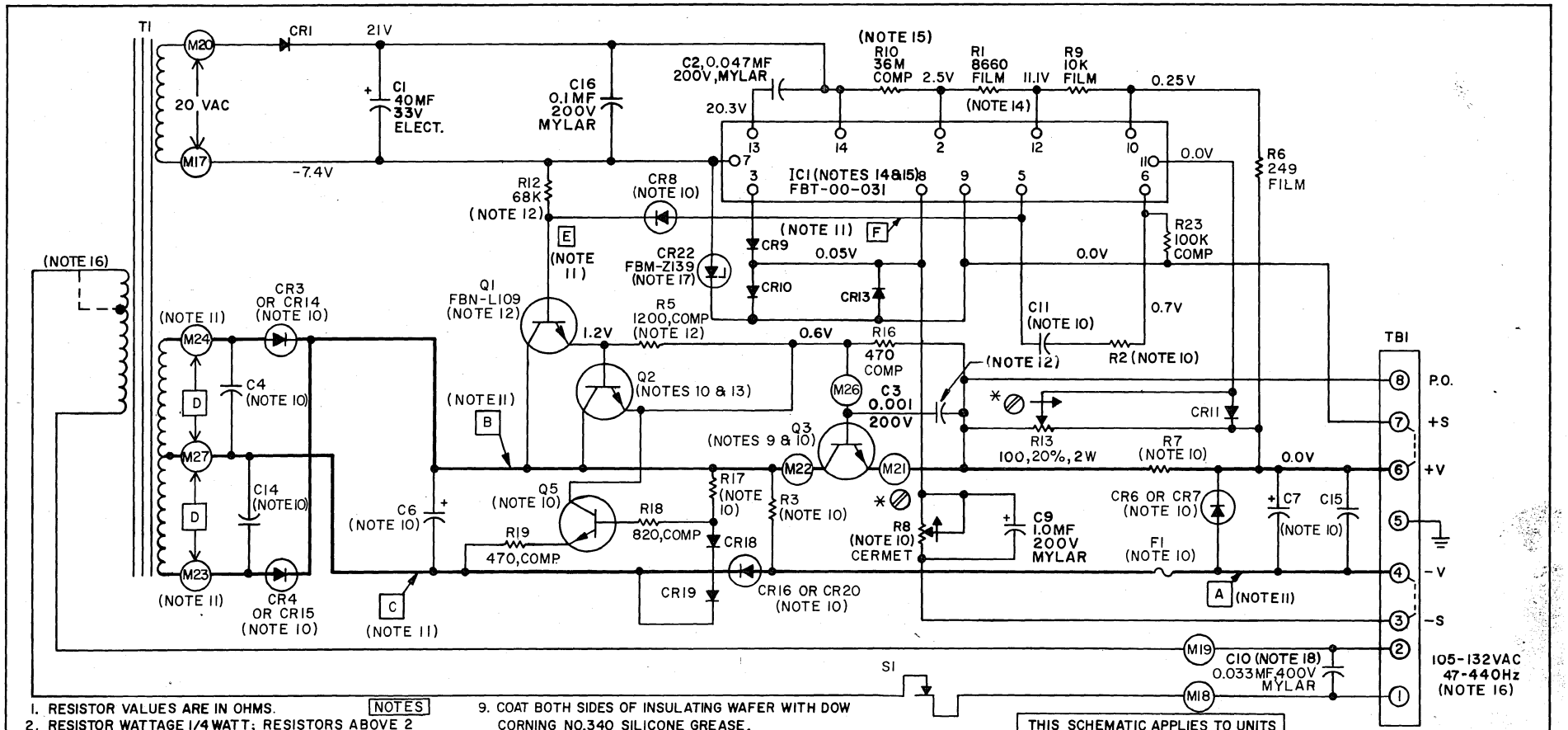
THIS SCHEMATIC APPLIES TO UNITS BEARING SERIAL NO PREFIXES A-C

FOR WIRING OF POWER SUPPLY TO LOAD REFER TO POWER SUPPLY-TO-LOAD WIRING DIAGRAMS

DOTTED CONNECTIONS SHOWN ON TB1 INDICATE JUMPERS IN PLACE FOR LOCAL SENSING "2-WIRE CONNECTION"

UNIT M
SCHEMATIC DIAGRAM
REGULATED POWER SUPPLY

LAMBDA
ELECTRONICS
MELVILLE, L.I., NEW YORK
DIVISION OF Veeco INSTRUMENTS INC.



NOTES

1. RESISTOR VALUES ARE IN OHMS.
2. RESISTOR WATTAGE 1/4 WATT; RESISTORS ABOVE 2 WATTS ARE WIREWOUND UNLESS OTHERWISE NOTED
3. RESISTOR TOLERANCES: COMP. ±10%; WIREWOUND ±2% FILM ±1%; UNLESS OTHERWISE NOTED.
4. CAPACITOR TOLERANCES: ELECTROLYTIC −10%, +100%; MYLAR ±10%; CERAMIC 10%; UNLESS OTHERWISE NOTED.
5. SYMBOLS:
   - INDICATES CLOCKWISE ROTATION OF SHAFT.
   - INDICATES CONNECTION TO CHASSIS.
   - INDICATES ADJUSTMENT OR CALIBRATION CONTROL.
   - SEE INSTRUCTION MANUAL.
   - LAMBDA PT. # FBL-00-030; USE IN 4002 DIODE FOR REPLACEMENT UNLESS OTHERWISE NOTED.
   - INDICATES TERMINAL ON PRINTED WIRING BOARD.
6. DESIGNATION IS LAMBDA PART NUMBER.
7. DERATE CURRENT 10% FOR 47−57Hz, FOR 63−440Hz CONSULT FACTORY.
8. CONDITIONS FOR CIRCUIT POINT MEASUREMENTS: INPUT: 115 VAC, 60Hz; MAX. RATED VOLTAGE NO LOAD. INDICATED VOLTAGES ARE TYPICAL VALUES AND ARE DC UNLESS OTHERWISE NOTED. DC MEASUREMENTS TAKEN WITH 20,000 OHMS/V VOLTMETER BETWEEN +S (TERM. 7) & INDICATED POINTS UNLESS NOTED; +S AND +V SHORTED, −S AND −V SHORTED.
9. COAT BOTH SIDES OF INSULATING WAFER WITH DOW CORNING NO. 340 SILICONE GREASE.
10. SEE TABLE I FOR COMPONENT VALUES.
11. SEE TABLE I FOR VOLTAGE VALUES.
12. THIS COMPONENT NOT USED ON MODEL LCD-4-44 AND LCD-4-55.
13. IF Q2 IS REPLACED RETAIN RADIATOR AND INSTALL WITH NEW TRANSISTOR.
14. ON MODEL LCD-4-44, R1 IS 9.1K, 2% AND IC1 IS FBT-00-030 (SEE NOTE 15).
15. ON ALL UNITS WITH SERIAL NUMBER PREFIX A IC1 NO. FBT-00-031 IS FBT-00-010; IC1 NO. FBT-00-030 IS FBT-00-002. R10 IS 68M.
16. ON UNITS WITH "V" OPTION, T1 HAS TAPPED PRIMARY. "V" OPTION UNITS CAN BE WIRED FOR 187-242V INPUT (USING TAP) OR FOR 205-265V INPUT (USING ENTIRE PRIMARY).
17. CR22 NOT USED ON UNITS WITH SERIAL NO. PREFIXES A & B.
18. C10 NOT USED ON UNITS WITH "V" OPTION.

MODELS
LCD-4-13
LCD-4-23
LCD-4-33
LCD-4-44
LCD-4-55

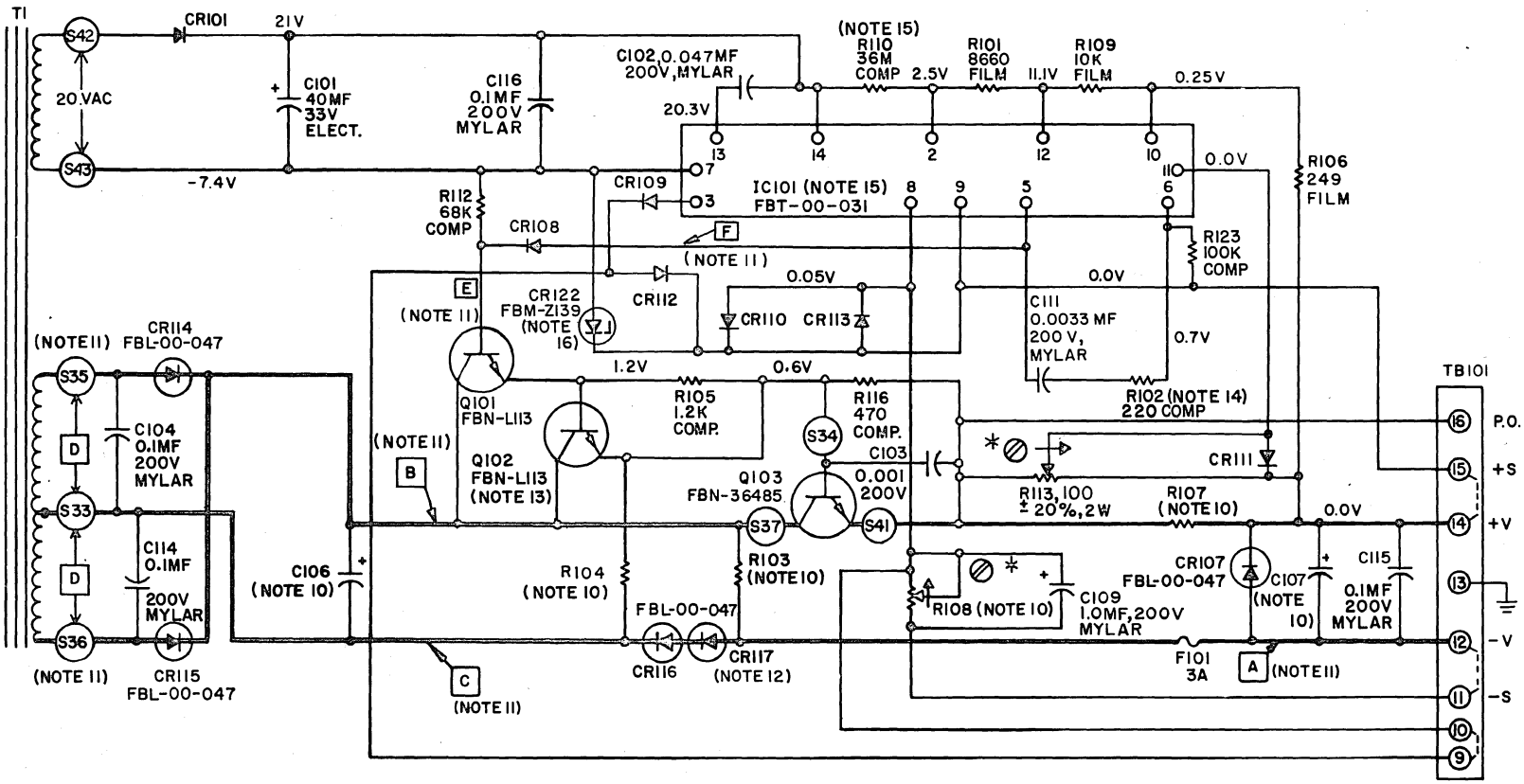
THIS SCHEMATIC APPLIES TO UNITS BEARING SERIAL NO PREFIXES A-C.

FOR WIRING OF POWER SUPPLY TO LOAD REFER TO POWER SUPPLY-TO-LOAD WIRING DIAGRAMS

DOTTED CONNECTIONS SHOWN ON TB1 INDICATE JUMPERS IN PLACE FOR LOCAL SENSING "2-WIRE CONNECTION"

UNIT M
SCHEMATIC DIAGRAM
REGULATED POWER SUPPLY

LAMBDA
ELECTRONICS
MELVILLE, L.I., NEW YORK
DIVISION OF Veeco INSTRUMENTS INC.



NOTES

1. RESISTOR VALUES ARE IN OHMS.
2. RESISTOR WATTAGE 1/4 WATT; RESISTORS ABOVE 2 WATTS ARE WIREWOUND UNLESS OTHERWISE NOTED
3. RESISTOR TOLERANCES: COMP. ±10%; WIREWOUND ±2% FILM ±1%; UNLESS OTHERWISE NOTED.
4. CAPACITOR TOLERANCES: ELECTROLYTIC -10%, +100%; MYLAR ±10%; CERAMIC 10%; UNLESS OTHERWISE NOTED.
5. SYMBOLS:
   - INDICATES CLOCKWISE ROTATION OF SHAFT.
   - INDICATES CONNECTION TO CHASSIS.
   - INDICATES ADJUSTMENT OR CALIBRATION CONTROL.
   - SEE INSTRUCTION MANUAL.
   - LAMBDA PT. # FBL-00-030; USE IN 4002 DIODE FOR REPLACEMENT UNLESS OTHERWISE NOTED.
   - INDICATES TERMINAL ON PRINTED WIRING BOARD.
6. DESIGNATIONS ARE LAMBDA PART NUMBERS.
7. DERATE CURRENT 10% FOR 47-57Hz, FOR 63-440Hz CONSULT FACTORY.
8. CONDITIONS FOR CIRCUIT POINT MEASUREMENTS: INPUT: 115 VAC, 60Hz; MAX. RATED VOLTAGE NO LOAD. INDICATED VOLTAGES ARE TYPICAL VALUES AND ARE DC UNLESS OTHERWISE NOTED. DC MEASUREMENTS TAKEN WITH 20,000 OHMS/V VOLTMETER BETWEEN +S (TERM. 15) & INDICATED POINTS UNLESS NOTED; +S AND +V SHORTED, -S AND -V SHORTED, TERM. 9 AND TERM. 10 SHORTED.
9. COAT BOTH SIDES OF INSULATING WAFER WITH DOW CORNING NO. 340 SILICONE GREASE.
10. SEE TABLE I FOR COMPONENT VALUES.
11. SEE TABLE I FOR VOLTAGE VALUES.
12. CR117 ONLY USED ON MODELS LCD-4-22 AND LCD-4-23.
13. IF Q102 IS REPLACED RETAIN RADIATOR AND INSTALL WITH NEW TRANSISTOR.
14. ON MODEL LCD-4-23 R102 IS 330.
15. ON UNITS WITH SERIAL NUMBER PREFIX A IC101 IS FBT-00-010 AND R110 IS 68M.
16. CR122 NOT USED ON UNITS WITH SERIAL NO. PREFIXES A & B.

MODELS
LCD-4-11
LCD-4-12
LCD-4-13
LCD-4-22
LCD-4-23

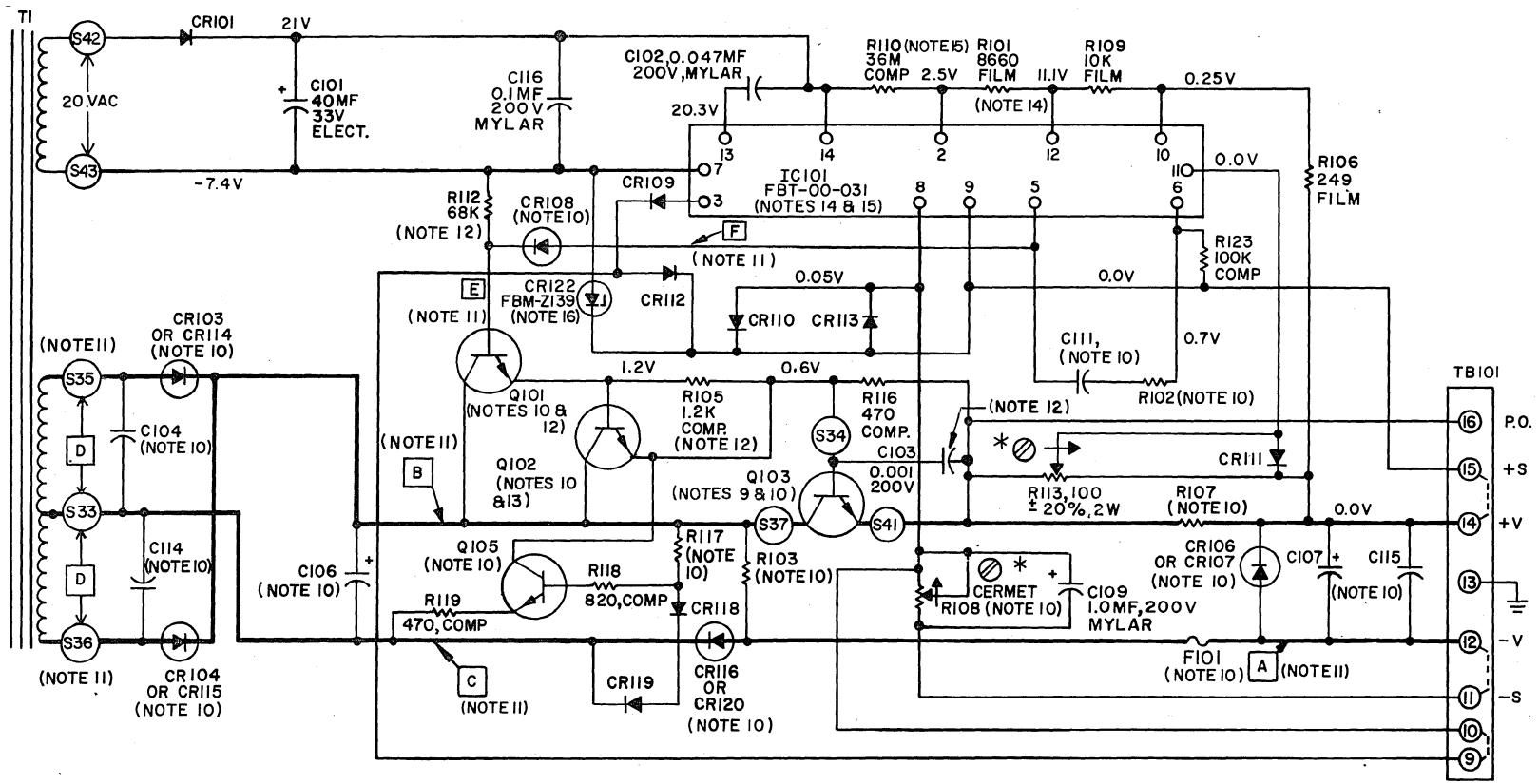
THIS SCHEMATIC APPLIES TO UNITS BEARING SERIAL NO PREFIXES A-C

FOR WIRING OF POWER SUPPLY TO LOAD REFER TO POWER SUPPLY-TO-LOAD WIRING DIAGRAMS

DOTTED CONNECTIONS SHOWN ON TB101 INDICATE JUMPERS IN PLACE FOR LOCAL SENSING "2-WIRE CONNECTION"

UNIT S
SCHEMATIC DIAGRAM
REGULATED POWER SUPPLY

LAMBDA
ELECTRONICS
MELVILLE, L.I., NEW YORK
DIVISION OF Veeco INSTRUMENTS INC.



NOTES

1. RESISTOR VALUES ARE IN OHMS.
2. RESISTOR WATTAGE 1/4 WATT; RESISTORS ABOVE 2 WATTS ARE WIREWOUND UNLESS OTHERWISE NOTED
3. RESISTOR TOLERANCES: COMP. ±10%; WIREWOUND ±2% FILM ±1%; UNLESS OTHERWISE NOTED.
4. CAPACITOR TOLERANCES: ELECTROLYTIC -10%, +100%; MYLAR ±10%; CERAMIC 10%; UNLESS OTHERWISE NOTED.
5. SYMBOLS:
   - INDICATES CLOCKWISE ROTATION OF SHAFT.
   - INDICATES CONNECTION TO CHASSIS.
   - INDICATES ADJUSTMENT OR CALIBRATION CONTROL.
   - SEE INSTRUCTION MANUAL.
   - LAMBDA PT. # FBL-00-030; USE IN 4002 DIODE FOR REPLACEMENT UNLESS OTHERWISE NOTED.
   - INDICATES TERMINAL ON PRINTED WIRING BOARD.
6. DESIGNATION IS LAMBDA PART NUMBER.
7. DERATE CURRENT 10% FOR 47-57Hz, FOR 63-440Hz CONSULT FACTORY.
8. CONDITIONS FOR CIRCUIT POINT MEASUREMENTS: INPUT: 115 VAC, 60Hz; MAX. RATED VOLTAGE NO LOAD. INDICATED VOLTAGES ARE TYPICAL VALUES AND ARE DC UNLESS OTHERWISE NOTED. DC MEASUREMENTS TAKEN WITH 20,000 OHMS/V VOLTMETER BETWEEN +S (TERM. 15) & INDICATED POINTS UNLESS NOTED; +S AND +V SHORTED, -S AND -V SHORTED, TERM. 9 AND TERM. 10 SHORTED.
9. COAT BOTH SIDES OF INSULATING WAFER WITH DOW CORNING NO. 340 SILICONE GREASE.
10. SEE TABLE I FOR COMPONENT VALUES.
11. SEE TABLE I FOR VOLTAGE VALUES.
12. THIS COMPONENT NOT USED ON MODEL LCD-4-44 AND LCD-4-55.
13. IF Q102 IS REPLACED RETAIN RADIATOR AND INSTALL WITH NEW TRANSISTOR.
14. ON MODEL LCD-4-44, IC101 IS FBT-00-030. (SEE NOTE 15)
15. ON UNITS WITH SERIAL NUMBER PREFIX A IC101 NO. FBT-00-031 IS FBT-00-010; IC101 NO. FBT-00-030 IS FBT-00-002, R10 IS 68M.
16. CR122 NOT USED ON UNITS WITH SERIAL NO. PREFIXES A & B.

MODELS
LCD-4-33
LCD-4-44
LCD-4-55

THIS SCHEMATIC APPLIES TO UNITS BEARING SERIAL NO PREFIXES A-C

FOR WIRING OF POWER SUPPLY TO LOAD REFER TO POWER SUPPLY-TO-LOAD WIRING DIAGRAMS

DOTTED CONNECTIONS SHOWN ON TB101 INDICATE JUMPERS IN PLACE FOR LOCAL SENSING "2-WIRE CONNECTION"

UNIT S
SCHEMATIC DIAGRAM
REGULATED POWER SUPPLY

LAMBDA
ELECTRONICS
MELVILLE, L.I., NEW YORK
DIVISION OF Veeco INSTRUMENTS INC.

TABLE I

DATA REFERENCES FOR

MODELS LCD-4-11 — LCD-4-55,

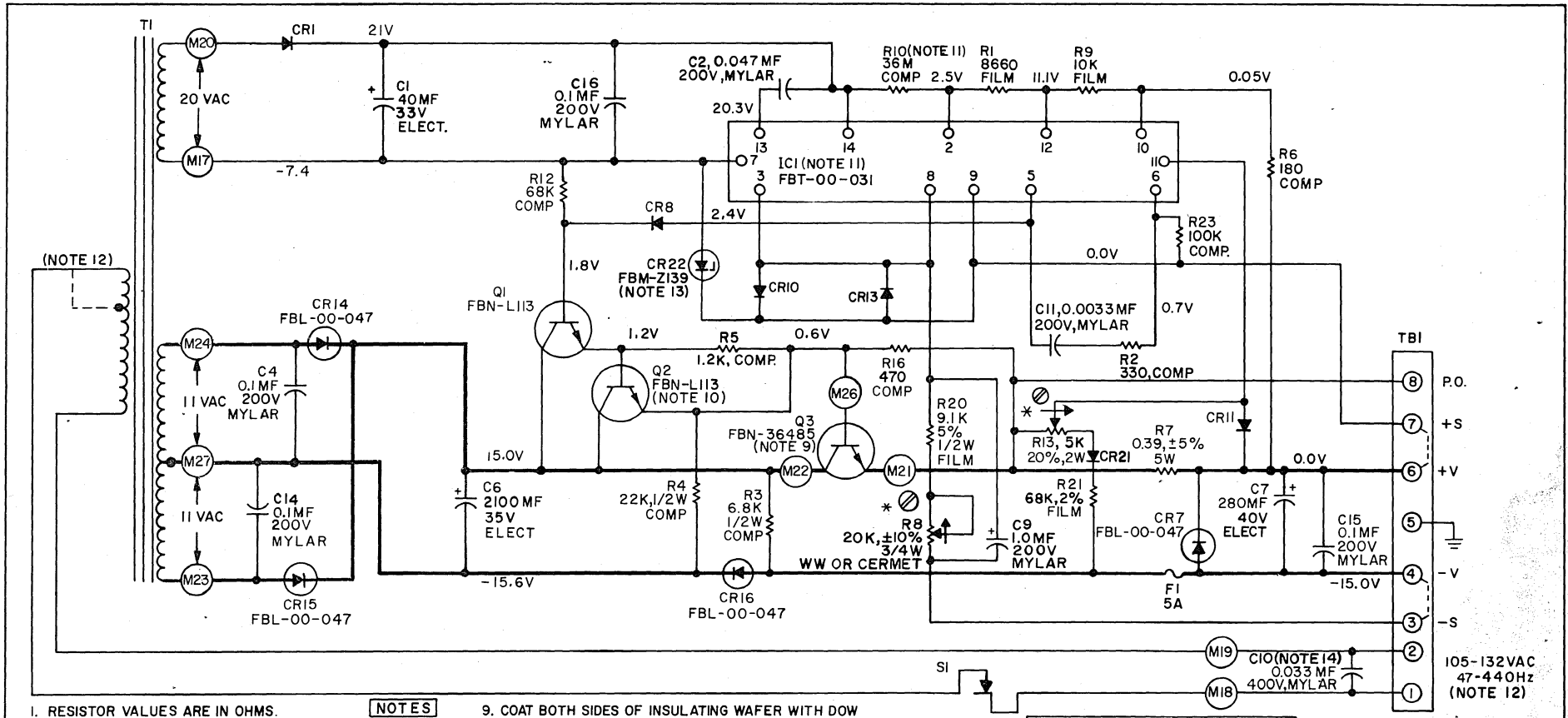
"M" AND "S" UNITS*

Model	Schematic Voltage Measurements						Schematic Components																				
							C4	C6	C7	C11	C14	C15	CR3, CR4	CR6	CR7	CR8	CR14-CR16	CR17	CR20	F1	**Q1, Q2	Q3	Q5	R2	R3	R4	R7	R8	R17
	A (VDC)	B (VDC)	C (VDC)	D (VAC)	E (VDC)	F (VDC)	±10% MYLAR	-10+100% ELECT	-10+100% ELECT	±10%, 200V MYLAR	±10% MYLAR	±10% MYLAR	*FBL-00-	*FBL-00-	*FBL-00-	*FBL-00-	*FBL-00-	*FBL-00-	*FBL-00-	(AMP)	*FBN-	*FBN-	*FBN-	1/4W COMP	±10% COMP	±10%, 1W COMP	5W WW	±10% 3/4W	±10% COMP
LCD-4-11	-7.0	12.0	-7.6	13.9	1.8	2.4	0.1 mf 200V	3600 mf 20V	450 mf 25V	0.0033 mf	0.1 mf 200V	0.1 mf 200V	Not used	Not used	047	030	047	Not used	Not used	5	L113	36485	Not used	330 ±10%	2.2K 1/2W	1K	0.25 ±5%	10K WW or CERM.	Not used
LCD-4-12	-18.0	16.8	-18.6	25.0	1.8	2.4	0.1 mf 200V	2100 mf 35V	280 mf 40V	0.0033 mf	0.1 mf 200V	0.1 mf 200V	Not used	Not used	047	030	047	047	Not used	3	L113	36485	Not used	330 ±10%	6.8K 1/2W	1.8K	0.5 ±5%	23K WW or CERM.	Not used
LCD-4-13	-32.0	17.0	-32.6	41.5	1.8	2.4	0.1 mf 200V	1100 mf 60V	175 mf 50V	0.0022 mf	0.1 mf 200V	0.1 mf 200V	Not used	Not used	065	030	065	Not used	Not used	1-1/2	L109	36220	L109	470 ±10%	22K 1/2W	Not used	1.0 ±3%	40K CERM.	22K 1/2W
LCD-4-22	-18.0	16.8	-18.6	25.0	1.8	2.4	0.1 mf 200V	2100 mf 35V	280 mf 40V	0.0033 mf	0.1 mf 200V	0.1 mf 200V	Not used	Not used	047	030	047	047	Not used	3	L113	36485	Not used	470 ±10%	6.8K 1/2W	1.8K	0.5 ±5%	23K WW or CERM.	Not used
LCD-4-23	-32.0	17.0	-32.0	41.5	1.8	2.4	0.1 mf 200V	1100 mf 60V	175 mf 50V	0.0022 mf	0.1 mf 200V	0.1 mf 200V	Not used	Not used	065	030	065	Not used	Not used	1-1/2	L109	36220	L109	470 ±10%	22K 1/2W	Not used	1.0 ±3%	40K CERM.	22K 1/2W
LCD-4-33	-32.0	17.0	-32.6	41.5	1.8	2.4	0.1 mf 200V	1100 mf 60V	175 mf 50V	0.0022 mf	0.1 mf 200V	0.1 mf 200V	Not used	Not used	065	030	065	Not used	Not used	1-1/2	L109	36220	L109	470 ±10%	22K 1/2W	Not used	1.0 ±3%	40K CERM.	22K 1/2W
LCD-4-44	-60.0	38.4	-60.6	70	1.2	1.8	0.1 mf 200V	520 mf 100V	60 mf 100V	0.001 mf	0.1 mf 200V	0.1 mf 200V	033	036	Not used	036	Not used	Not used	036	1	L108	35902	L108	680 ±10%	47K 1/2W	Not used	1.5 ±3%	75K CERM.	47K 1/2W
LCD-4-55	-120.0	53.0	-120.6	123	1.2	1.8	0.033 mf 400V	240 mf 200V	39 mf 200V	0.001 mf	0.033 mf 400V	0.033 mf 400V	050	033	Not used	033	Not used	Not used	033	3/8	L108	38982	L108	240 ±10%	100K 1W	Not used	4.0 ±5%	150K CERM.	100K 1W

* Lambda part number.
** Q1 not used in models LCD-4-44 and LCD-4-55.
+ "S" unit circuit designations are in the 100 series. Parts and voltages for the "S" unit are identical to those of the "M" unit except as listed below.

Model	Schematic Voltage Measurements						Schematic Components																
							C106	C107	C111	CR107	CR114-CR116	CR117	F101	*Q101, Q102	Q103	Q105	R102	R103	R104	R107	R108
	A (VDC)	B (VDC)	C (VDC)	D (VAC)	E (VDC)	F (VDC)	-10+100% ELECT	-10+100% ELECT	±10%, 200V MYLAR	*FBL-00-	*FBL-00-	*FBL-00-	(AMP)	*FBN-	*FBN-	*FBN-	1/4W COMP	±10% COMP	±10%, 1W COMP	5W WW	±10% 3/4W
LCD-4-11	-7.0	12.0	-7.6	13.9	1.8	2.4	3,600 mf 20V	450 mf 25V	0.0033 mf	047	047	Not used	5	L113	36485	Not used	330 ±10%	2.2K 1/2W	1,000	0.25 ±5%	10K WW or CERM.
LCD-4-12	-7.0	12.0	-7.6	13.9	1.8	2.4	3,600 mf 20V	450 mf 25V	0.0033 mf	047	047	Not used	5	L113	36485	Not used	330 ±10%	2.2K 1/2W	1,000	0.25 ±5%	10K WW or CERM.
LCD-4-13	-7.0	12.0	-7.6	13.9	1.8	2.4	3,600 mf 20V	450 mf 25V	0.0033 mf	047	047	Not used	5	L113	36485	Not used	330 ±10%	2.2K 1/2W	1,000	0.25 ±5%	10K WW or CERM.
LCD-4-22	-18.0	16.8	-18.6	25.0	1.8	2.4	2,100 mf 35V	280 mf 40V	0.0033 mf	047	047	047	3	L113	36485	Not used	330 ±10%	6.8K 1/2W	1,600	0.5 ±5%	23K WW or CERM.
LCD-4-23	-18.0	16.8	-18.6	25.0	1.8	2.4	2,100 mf 35V	280 mf 40V	0.0033 mf	047	047	047	3	L113	36485	Not used	330 ±10%	6.8K 1/2W	1,600	0.5 ±5%	23K WW or CERM.
LCD-4-33	-32.0	17.0	-32.6	41.5	1.8	2.4	1,100 mf 60V	175 mf 50V	0.0022 mf	065	065	Not used	1-1/2	L109	36220	L109	470 ±10%	22K 1/2W	Not used	1.0 ±3%	40K CERM.
LCD-4-44	-60.0	38.4	-60.6	70.0	1.2	1.8	520 mf 100V	60 mf 100V	0.001 mf	Not used	Not used	Not used	1	L108	35902	L108	680 ±10%	47K 1/2W	Not used	1.5 ±3%	75K CERM.
LCD-4-55	-120.0	53.0	-120.6	123	1.2	1.8	240 mf 200V	39 mf 200V	0.001 mf	Not used	Not used	Not used	3/8	L108	38982	L108	240 ±10%	100K 1W	Not used	4.0 ±5%	150K CERM.

* Lambda part number.
** Q101 not used on models LCD-4-44 and LCD-4-55.



NOTES

1. RESISTOR VALUES ARE IN OHMS.
2. RESISTOR WATTAGE 1/4 WATT; RESISTORS ABOVE 2 WATTS ARE WIREWOUND UNLESS OTHERWISE NOTED
3. RESISTOR TOLERANCES: COMP. ±10%; WIREWOUND ±2% FILM ±1%; UNLESS OTHERWISE NOTED.
4. CAPACITOR TOLERANCES: ELECTROLYTIC -10%, +100%; MYLAR ±10%; CERAMIC 10%; UNLESS OTHERWISE NOTED.
5. SYMBOLS:
   - INDICATES CLOCKWISE ROTATION OF SHAFT.
   - INDICATES CONNECTION TO CHASSIS.
   - INDICATES ADJUSTMENT OR CALIBRATION CONTROL.
   - SEE INSTRUCTION MANUAL.
   - LAMBDA PT. # FBL-00-030; USE IN 4002 DIODE FOR REPLACEMENT UNLESS OTHERWISE NOTED.
   - INDICATES TERMINAL ON PRINTED WIRING BOARD.
6. DESIGNATION IS LAMBDA PART NUMBER.
7. DERATE CURRENT 10% FOR 47-57Hz, FOR 63-440Hz CONSULT FACTORY.
8. CONDITIONS FOR CIRCUIT POINT MEASUREMENTS: INPUT: 115 VAC, 60Hz; OUTPUT: NOMINAL V DC. INDICATED VOLTAGES ARE TYPICAL VALUES AND ARE DC UNLESS OTHERWISE NOTED. DC MEASUREMENTS TAKEN WITH 20,000 OHMS/V VOLTMETER BETWEEN +S (TERM. 7) & INDICATED POINTS UNLESS NOTED; +S AND +V SHORTED, -S AND -V SHORTED.
9. COAT BOTH SIDES OF INSULATING WAFER WITH DOW CORNING NO. 340 SILICONE GREASE.
10. IF Q2 IS REPLACED RETAIN RADIATOR AND INSTALL WITH NEW TRANSISTOR.
11. ON UNITS WITH SERIAL NUMBER PREFIX A IC1 IS FBT-00-010 AND R10 IS 68M.
12. ON UNITS WITH "V" OPTION, T1 HAS TAPPED PRIMARY. "V" OPTION UNITS CAN BE WIRED FOR 187-242V INPUT (USING TAP) OR FOR 205-265V INPUT (USING ENTIRE PRIMARY).
13. CR22 NOT USED ON UNITS WITH SERIAL NO. PREFIXES A & B.
14. C10 NOT USED ON USED ON UNITS WITH "V" OPTION.

THIS SCHEMATIC APPLIES TO UNITS BEARING SERIAL NO PREFIXES A-C

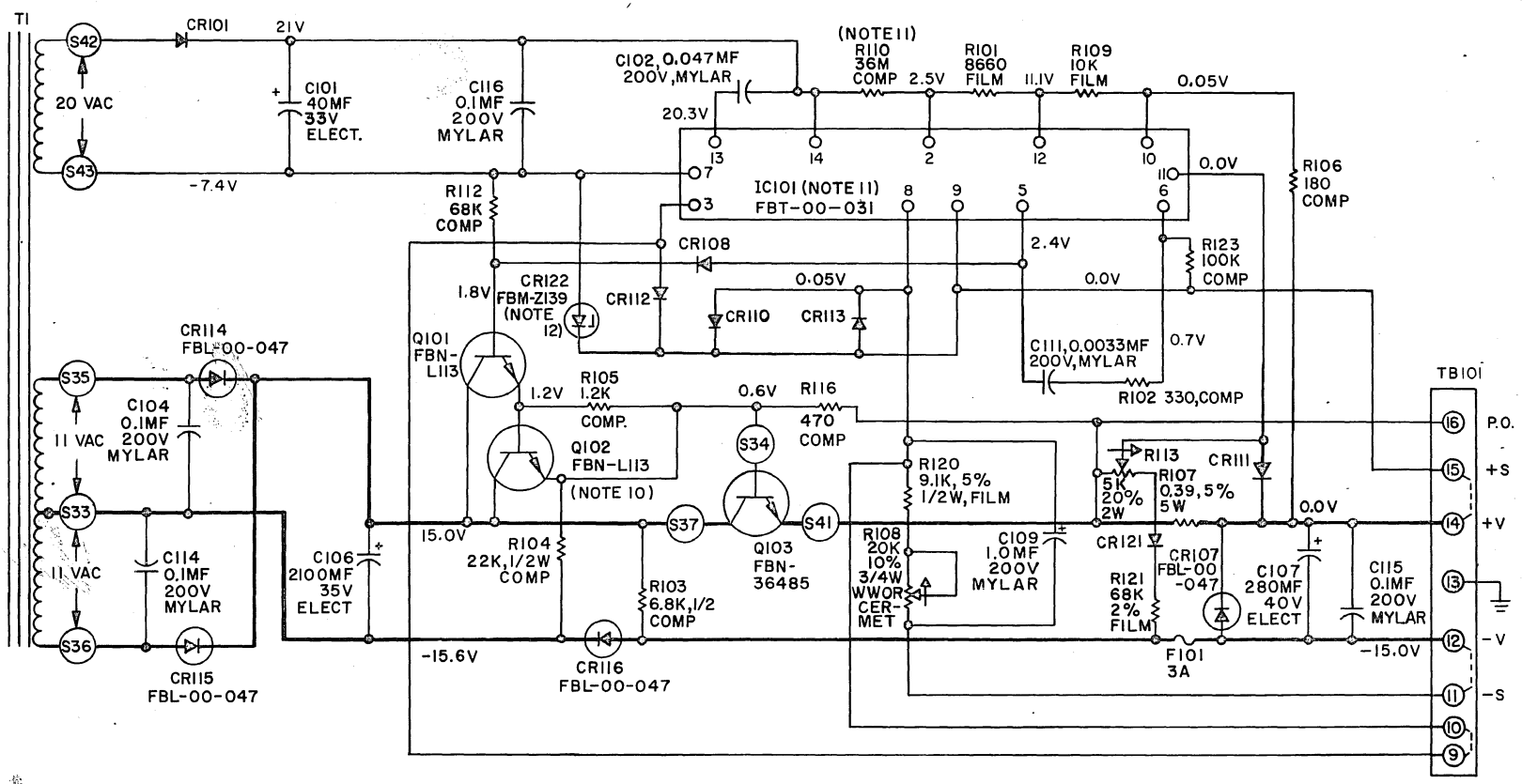
FOR WIRING OF POWER SUPPLY TO LOAD REFER TO POWER SUPPLY-TO-LOAD WIRING DIAGRAMS

DOTTED CONNECTIONS SHOWN ON TB1 INDICATE JUMPERS IN PLACE FOR LOCAL SENSING "2-WIRE CONNECTION"

MODEL
LCD-4-152

UNIT M
SCHEMATIC DIAGRAM
REGULATED POWER SUPPLY

LAMBDA
ELECTRONICS
MELVILLE, L.I., NEW YORK
DIVISION OF Veeco INSTRUMENTS INC.



NOTES

1. RESISTOR VALUES ARE IN OHMS.
2. RESISTOR WATTAGE 1/4 WATT; RESISTORS ABOVE 2 WATTS ARE WIREWOUND UNLESS OTHERWISE NOTED
3. RESISTOR TOLERANCES: COMP. ±10%; WIREWOUND ±2% FILM ±1%; UNLESS OTHERWISE NOTED.
4. CAPACITOR TOLERANCES: ELECTROLYTIC -10%, +100%; MYLAR ±10%; CERAMIC 10%; UNLESS OTHERWISE NOTED.
5. SYMBOLS:
   - INDICATES CLOCKWISE ROTATION OF SHAFT.
   - INDICATES CONNECTION TO CHASSIS.
   - INDICATES ADJUSTMENT OR CALIBRATION CONTROL. SEE INSTRUCTION MANUAL.
   - LAMBDA PT. #FBL-00-030; USE IN 4002 DIODE FOR REPLACEMENT UNLESS OTHERWISE NOTED.
   - INDICATES TERMINAL ON PRINTED WIRING BOARD.
6. DESIGNATION IS LAMBDA PART NUMBER.
7. DERATE CURRENT 10% FOR 47-57Hz, FOR 63-440Hz CONSULT FACTORY.
8. CONDITIONS FOR CIRCUIT POINT MEASUREMENTS: INPUT: 115 VAC, 60Hz; OUTPUT: NOMINAL VDC. INDICATED VOLTAGES ARE TYPICAL VALUES AND ARE DC UNLESS OTHERWISE NOTED. DC MEASUREMENTS TAKEN WITH 20,000 OHMS/V VOLTMETER BETWEEN +S (TERM.15) & INDICATED POINTS UNLESS NOTED; +S AND +V SHORTED, -S AND -V SHORTED, TERM. 9 AND TERM. 10 SHORTED.
9. COAT BOTH SIDES OF INSULATING WAFER WITH DOW CORNING NO.340 SILICONE GREASE.
10. IF Q102 IS REPLACED RETAIN RADIATOR AND INSTALL WITH NEW TRANSISTOR.
11. ON UNITS WITH SERIAL NUMBER PREFIX A IC101 IS FBT-00-010 AND R10 IS 68M
12. CR122 NOT USED ON UNITS WITH SERIAL NO. PREFIXES A & B.

THIS SCHEMATIC APPLIES TO UNITS BEARING SERIAL NO PREFIXES A-C

FOR WIRING OF POWER SUPPLY TO LOAD REFER TO POWER SUPPLY-TO-LOAD WIRING DIAGRAMS

DOTTED CONNECTIONS SHOWN ON TB101 INDICATE JUMPERS IN PLACE FOR LOCAL SENSING "2-WIRE CONNECTION"

MODEL
LCD-4-152

UNIT S
SCHEMATIC DIAGRAM
REGULATED POWER SUPPLY

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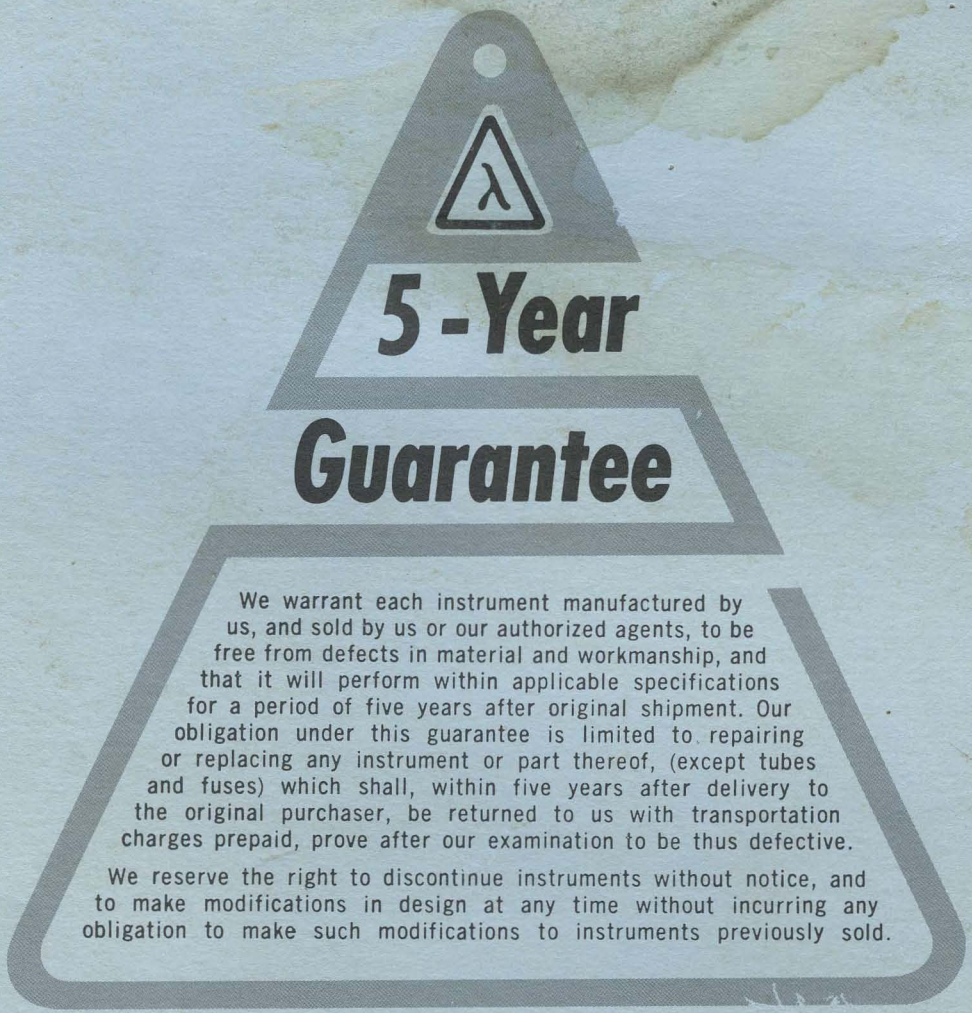

5-Year Guarantee

We warrant each instrument manufactured by us, and sold by us or our authorized agents, to be free from defects in material and workmanship, and that it will perform within applicable specifications for a period of five years after original shipment. Our obligation under this guarantee is limited to repairing or replacing any instrument or part thereof, (except tubes and fuses) which shall, within five years after delivery to the original purchaser, be returned to us with transportation charges prepaid, prove after our examination to be thus defective.

We reserve the right to discontinue instruments without notice, and to make modifications in design at any time without incurring any obligation to make such modifications to instruments previously sold.

LAMBDA ELECTRONICS

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