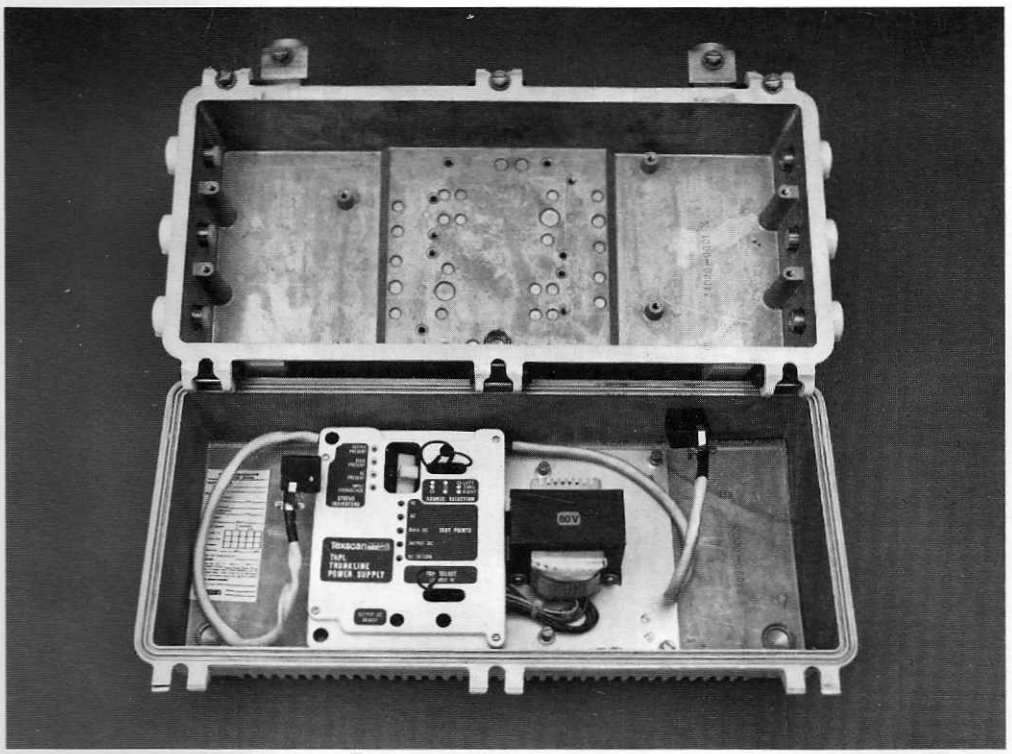
Model T4PL LINEAR POWER SUPPLY



MANUAL

Application Alignment & Troubleshooting

Texscan
CORPORATION

Application Alignment & Troubleshooting Manual

Linear Power Supply

Table of Contents

Figures

Section 1
Specifications

Input Voltage Range	37.5-65 VAC (Note 1)
Input Over Voltage Range	65-150 V Peak (Note 2)
Output Voltage	24 VDC ± 1 VDC (Note 3)
Output Current	0.4 – 1.65 ADC
Output Ripple	below 5 MV P-P
Line/Load Regulation	1%
Temperature Range	–40 to +80 Degree C

NOTES:

1. Normally a Quasi-Square Wave; When wired for a 30 VAC system the input voltage is 22-32 VAC
2. 105 VRMS Maximum
3. Adjustable over a range of 20-24 VDC

Notice:

Changes which occur after this instruction manual has been printed will be described in Instruction Manual Revision Bulletins. These bulletins will give the reader a detailed description of each change and can be attached to the basic manual for reference purposes. Distribution of these bulletins will be automatic if you are on the distribution list for the Texscan Service Literature. Otherwise, copies may be obtained by contacting Texscan at the address shown below.

The Instructions in this manual do not cover all details on the equipment it supports, nor do they provide for all circumstances that could arise during equipment maintenance. The instructions included are intended to be performed only by an experienced CATV service technician. However, if further information is desired, or if certain problems arise which are not covered, please contact Texscan, 1440 Goodyear Drive, El Paso, Texas 79936, Telephone: (915) 594-3555.

Section 2 Introduction

NOTE 2-1

Since this module can be configured for different types of operation, some parts of this manual may not be applicable to your particular application. See "CATV Systems Application Handbook, T Series Equipment," for other applications.

This manual provides application information for the Linear Power Supply Module used in the "T" Series Amplifier Stations. The modular equipment design has the flexibility of meeting present and future equipment needs.

SEE NOTE 2-1

The "T" Series Linear Power Supply is available with a choice of input voltages and with a voltage selection tap which allows the amplifier station that it is installed in to be adapted to most CATV systems. This module is provided with a connector to interface with Texscan's "Vital Sign" Status Monitoring system. Early production units were manufactured without a status monitoring connector. To add a status monitoring connector refer to the following Texscan drawings: 41912-0001, 41913-0001 and, 41914-0001. A retrofit kit may be ordered from Texscan.

Section 3 Description

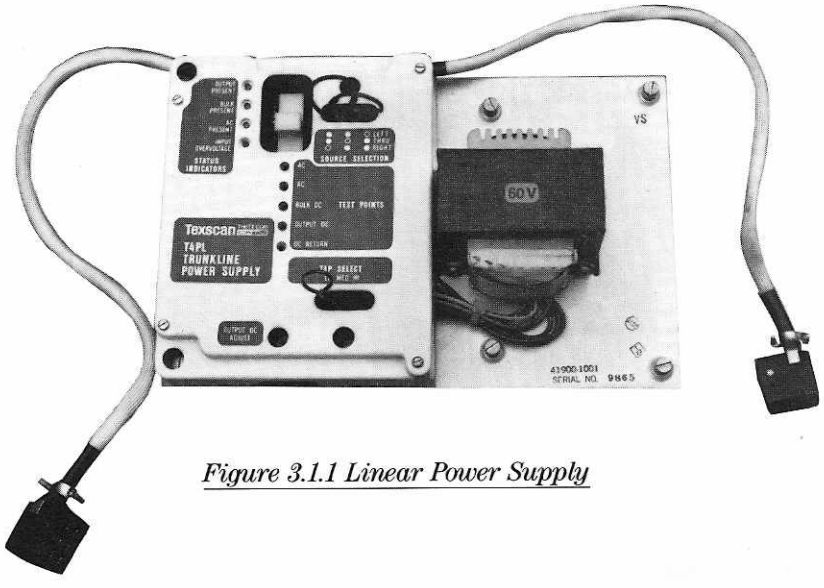


Figure 3.1.1 Linear Power Supply

3.1 General

The T4PL Power Supply is normally mounted in a "T Series" XR2AH housing. This power supply provides a single 24 VDC regulated output which powers all of the modules plugged into the input and output modules in the amplifier housing. Two cables are used to connect the power supply to both the input and output modules. The power supply is illustrated in Figure 3.1.1. See Figure 3.1.2 for a block diagram of the power supply. This module is a highly efficient unit designed to operate with either 30 or 60 VAC input. The module is factory wired for 60 VAC operation. Conversion to 30 VAC is easily accomplished, see Section 4. The module also has tapped windings on the power transformer secondary to accommodate different cable voltage drops occurring with different cable segment lengths. This feature improves regulator efficiency. The power supply features LED test indicators and current limited test points. A power source selection jumper wire is accessable without removing the front cover. A connector is provided to interface to Texscan's status monitoring system.

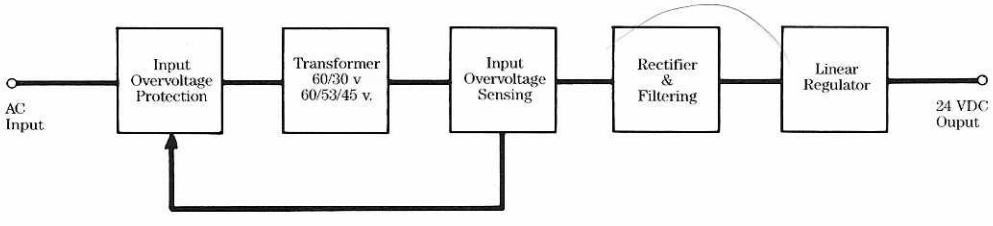


Figure 3.1.2 Linear Power Supply Block Diagram

P305-185

3.2 Input Over-Voltage Protection

This power supply has a unique AC input over-voltage protection circuit. This circuit protects the modules operated by the power supply from transients, power line surges, and steady state input over-voltage conditions. This circuit is designed to protect against most transients, and steady state overvoltages up to 2.5 times normal line voltage. The circuit operates in microseconds, thereby protecting against fast as well as slow transients.

Section 4
Field Set-Up

4.1 General

The power supply covered in this manual is part of the "T" Series system. This manual covers only set-up procedures for this module. Set-up procedures for the complete system are given in Texscan's "CATV Systems Application Handbook T Series Equipment." The output voltage is set-up at the factory for 24 VDC ± 1 VDC.

4.2 Test Equipment Required (or equivalent)*

1. Volt Ohm Meter Triplett 630

*All Test Equipment must be properly calibrated

4.3 Set-up Procedure

1. Remove all of the modules from the trunk station.
2. Verify that the "Source Selection" plug wires are in the correct positions as per your system design.
3. Verify that the AC voltage across the AC test points is within the limits as dictated by your system design.
4. Measure the DC voltage between the Output DC and the DC Return Test Points. It must be 24 VDC ± 1 VDC. If the voltage is not correct adjust it with a miniature screwdriver inserted in the hole marked "Output DC Adjust."
5. Verify that all required modules are plugged into the station being set-up.
6. Using an ohm-meter verify the absence of a short circuit at both DC power input plugs on the input and output modules (Connect the meter across pins #5 and #6 for this test)
7. Connect both power plugs to the input and output modules.
8. Verify that the DC output voltage has remained constant at 24 VDC ± 1 VDC.
9. Measure the voltage between the Bulk DC and the DC Return Test Points. The voltage should be the value that is nearest to, but greater than 27 VDC. This voltage can be varied by changing the tap select wire.
10. If the module cannot be set-up as per these procedures see Section 5, Field Maintenance.

4.4 Input Voltage Changing

1. Remove the jumper between the 60 volt eyelets. See Figure 4.4.1 for wiring details.

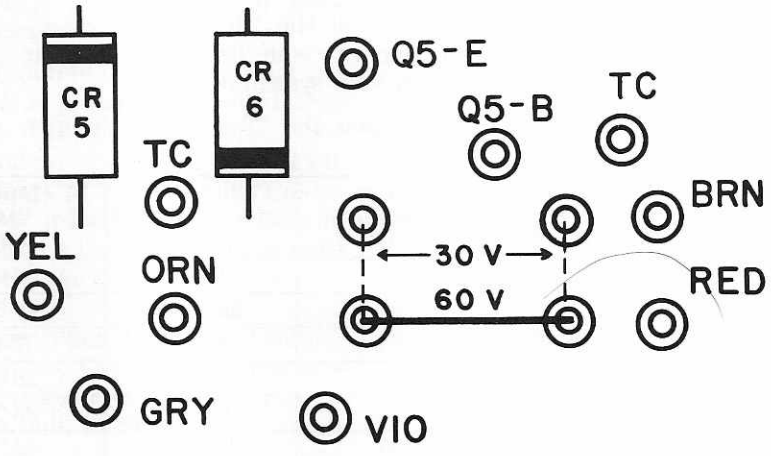


Figure 4.4.1 Input Voltage Jumpers

P305-185

2. Change the fuse from 2.5 A to 5.0 A.
3. Insert and solder a jumper wire between each pair of 30 volt eyelets. (total of two pairs)
4. Verify the AC input voltage. Select the secondary "Tap Select" position as per Figure 4.4.2.

Converting from 30 to 60 VAC operation.

5. Set-up the module as per Section 4.3.
6. Remove the jumper between each of the 30 volt eyelets. (total of two) See Figure 4.4.1 for wiring details.
7. Insert and solder a jumper wire between the 60 volt eyelets.

Primary Voltage	Secondary Tap Positions		
(ACV)	Low	Medium	High
30	22-25	25-28	28-32
60	38.5-45	45-53	53-65

Figure 4.4.2 Secondary Tap Position corresponding to Input Voltage

8. Change the fuse from 5 A to 2.5 A.
9. Verify that the AC input voltage is correct. Select the secondary "Tap Select" position as per Figure 4.4.2.
10. Set-up the module as per Section 4.3.

Section 5
Field Maintenance

5.1 General

This module has been carefully designed to provide efficient and reliable performance. This module is easily replaced in the field, making module replacement the most economical means of field service. A supply of spare T4PL modules should be carried in stock for field replacement. A supply of spare fuses as listed below should also be carried for field replacement.

SEE NOTE 5-1

NOTE 5-1

For information concerning system field service see Texscan's "CATV Systems Application Handbook, T Series Equipment."

NOTE 5-2

Normally available locally

Quan. used per module	Texscan P/N See Note 5-2	Description
1	29-0023312-0259	Fuse (F1), 3AG 2.5 A, Fast-blow (used for 60 VAC operation)
(option)	29-0023313-0005	Fuse (F1), 3AG 5.0 A, Fast-blow (used for 30 VAC operation)

5.2 Test Equipment Required (or Equivalent)*

1. Volt Ohm Meter — Triplett 630

*All test equipment must be properly calibrated

5.3 Module Maintenance Procedure

1. Verify that the "Source Selection" jumper wire is in the correct position as per your system design.
2. Verify that the "Tap Select" jumper wire is in the correct position as per your system design.
3. Using the chart in Figure 5.3.1 measure the AC input voltage at the AC test points. The tap select position in the previous step must correspond to these voltage ranges. The "Tap Select" wire may be changed if required. If the voltage is not correct troubleshoot your downline powering system.
4. Measure the DC output voltage across

System Voltage VAC	Tap	Input VAC RMS	VTVM Reading	VOM Reading
60	High	53-60	43-50	55-65
60	Medium	45-53	37-43	47-55
60	Low	37-45	30-37	38-46
30	High	28-30	21.5-25	27.5-32
30	Medium	25-28	18.5-21.5	23.5-27.5
30	Low	22-25	15.0-18.5	19.0-23.0

Figure 5.3.1 AC Input Voltages

P305-185

NOTE 5-3

This fuse is the only field replaceable part in the module.

the "Output DC" and "DC Return" Test Points. If the voltage is missing or very low remove all modules one at a time while monitoring the power supply voltage. If the voltage returns to normal then you have a defective module which must be replaced.

5. If the DC output voltage is still zero, check F1. Replace the fuse as required and recheck the voltage. If the voltage is still zero, then replace the T4PL module.

SEE NOTE 5-3

6. If the module is replaced, then it will require set-up as per Section 4.
7. Replace all modules previously removed and recheck the DC output voltage. If the voltage is slightly out of limits, adjust the voltage using the "Output DC Adjust" control.
8. Output Voltage Protection Circuit: This circuit was part of the T4PL if manufactured before Feb. 1984. Its use was discontinued because of inadvertant triggering by transients. This circuit can be disabled by removing R14. (0.82 ohm, 5w.) See Technical Bulletin #61 for more information.

Section 6 Troubleshooting

NOTE 6-1

Model should be chosen with capability of increasing voltage for testing over-voltage compensator.

6.1 General

The troubleshooting procedures in this section may be used to make certain that the equipment meets original standards and to return the equipment to such standards after repair. Every effort should be made to set-up the module to the actual system requirements. These procedures assume that the problem has been isolated to this specific module. This section contains a circuit description and test and repair procedures for defective or suspected defective modules. All of these procedures must be performed by technicians skilled in CATV electronic troubleshooting and repair.

6.2 Test Equipment Required (or Equivalent)*

1. Volt Ohm Meter	Triplett 630
2. Oscilloscope	Texscan DU127
3. Variable Load	Clarostat 240C 0.4-2.0A at 26V
4. Variac	Superior Electric 116B (See Note 6-1)
5. Square Wave Source	Texscan XRPR

*All test equipment must be properly calibrated

SEE NOTE 6-1

6.3 Troubleshooting Circuit Description

The following is a troubleshooting circuit description. See Figure 6.3.1 for a troubleshooting block diagram.

Ⓐ Transformer

This section includes the power transformer, source select jumper, tap select jumper, AC test points, AC fuse, and "AC Present" status indicator. The power transformer isolates the power supply and its load from the supply line, while delivering approximately 30 VAC to the bridge rectifier. Primary taps are provided to allow either 30 or 60 VAC operation. (See Section 4.4 for procedure to change input voltage.) Secondary taps are used to keep the voltage to the bridge rectifier from getting below 30 VAC This tap is used to adjust the voltage as the distance from the AC power supply increases. An indicator is included which illuminates when source AC voltage is present.

Ⓑ Full-wave Rectifier

A full-wave bridge rectifier is used consisting of four, 3 amp, 100 PIV diode rectifiers.

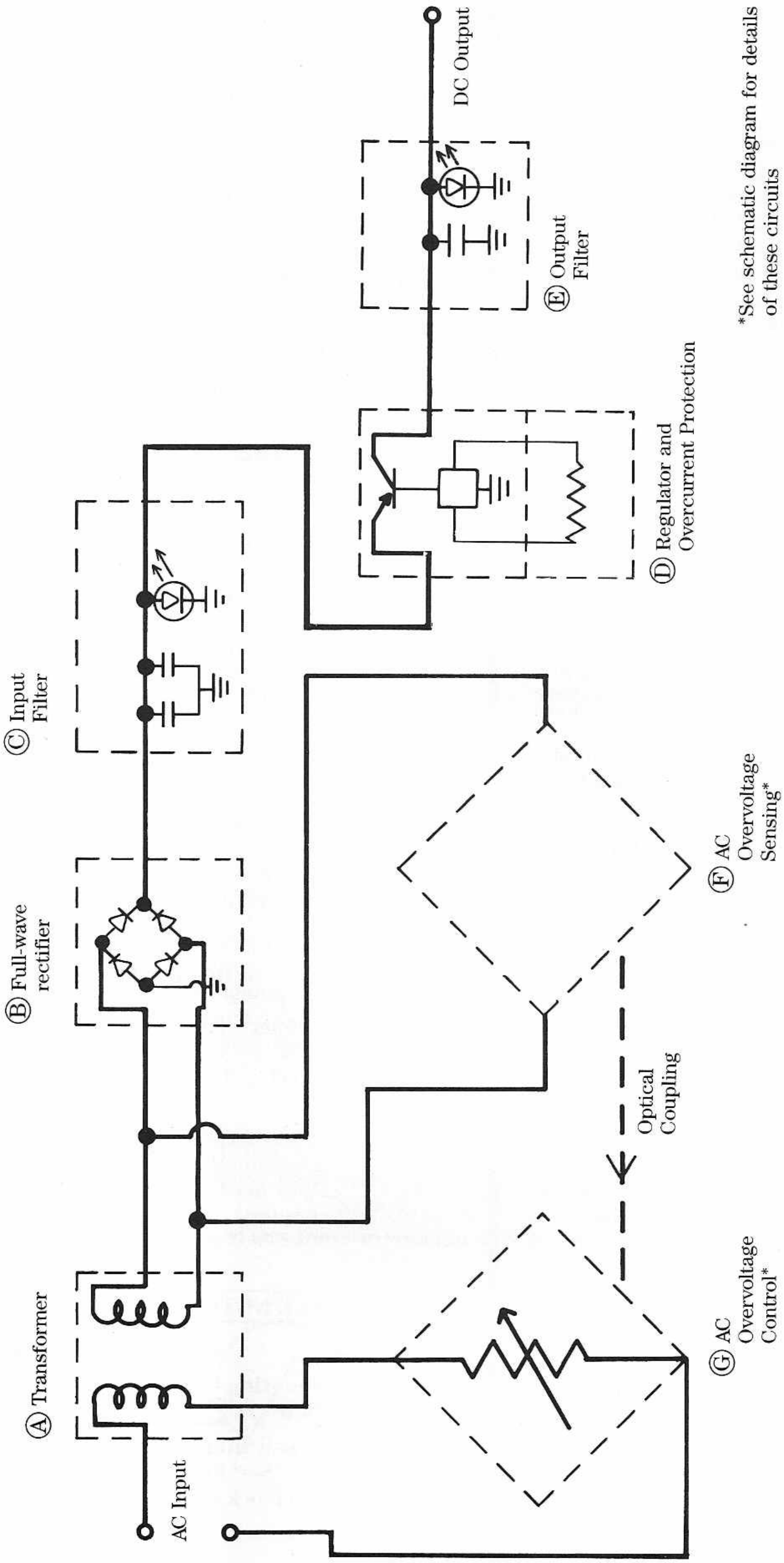
Ⓒ Input Filter

This section consists of a filter, LED indicator, and 2 current limited test points. The filter is used to filter the pulsating DC voltage from the bridge rectifier. The circuit contains two filter capacitors in parallel. An LED is used to indicate the presence of "Bulk DC" voltage. "Bulk" refers to an unregulated DC voltage with a relatively high level of ripple.

Ⓓ Regulator and Over-Current Protection

This circuit consists of: a standard 723 IC regulator with internal reference, a transistor pass element, and

P305-185



P305-185

Figure 6.3.1 Troubleshooting Block Diagram

a voltage set control. See Figure 6.3.2 for a block diagram of this regulator. The regulator takes the nominal 30 VDC from the bulk supply, regulates it, and delivers a low ripple (less than 5 mV) highly stabilized voltage to the load. The transistor pass element (controlled via the Vc connection at Pin 11) allows the system to handle higher currents than it could with the IC regulator alone. The IC regulator changes the effective resistance of the series pass transistor as needed to maintain a constant ouput voltage. A voltage set control is connected to the Inverting input of the Error Amp., Pin 4. This control is part of a voltage divider network which senses the output voltage changes and feeds this information back to the regulator.

The resistors which are part of the voltage divider network must have a low temperature coefficient, to keep temperatures changes from changing the output voltage. Current sensing is across pin 2 & 3 to measure the current across the external 0.24 ohm resistor. If the voltage across the E-B Junction is exceeded then some of the drive current is shunted away from the pass transistor. This is a non latching over current circuit. A frequency compensating capacitor, C-4, is connected to pin 13 of the regulator IC.

A Zener Diode provides an internal voltage reference. If the voltage reference at pin 4 (via R-23 & R-24) is greater than ½ the V Ref. voltage, then the internal error amplifier senses this and turns off the pass transistor, Q6. This is a continually active type of sensing used to regulate the output voltage.

Ⓔ Output Filter

This section consists of the output filter, DC "Output Present" Indicator, and a current limited DC output test point.

SEE NOTE 6-2

Ⓕ AC Overvoltage Sensing

SEE NOTE 6-3

This circuit senses the AC voltage level across the power transformer output. As this voltage rises above a selected level, the voltage delivered through the bridge rectifier across divider network R10 & R11 increases. A signal proportional to this increase is fed to the optical coupler U1. An optical coupler is used to couple the signal to the overvoltage control to provide DC isolation between the power supply input and output circuits.

NOTE 6-2

The DC voltage from the power supply is routed only to the active modules via plugs on the output modules.

NOTE 6-3

The "AC Overvoltage Sensing" Circuit F and the "AC Overvoltage Control" circuit G are combined to make-up the Input Overvoltage Protection Circuit.

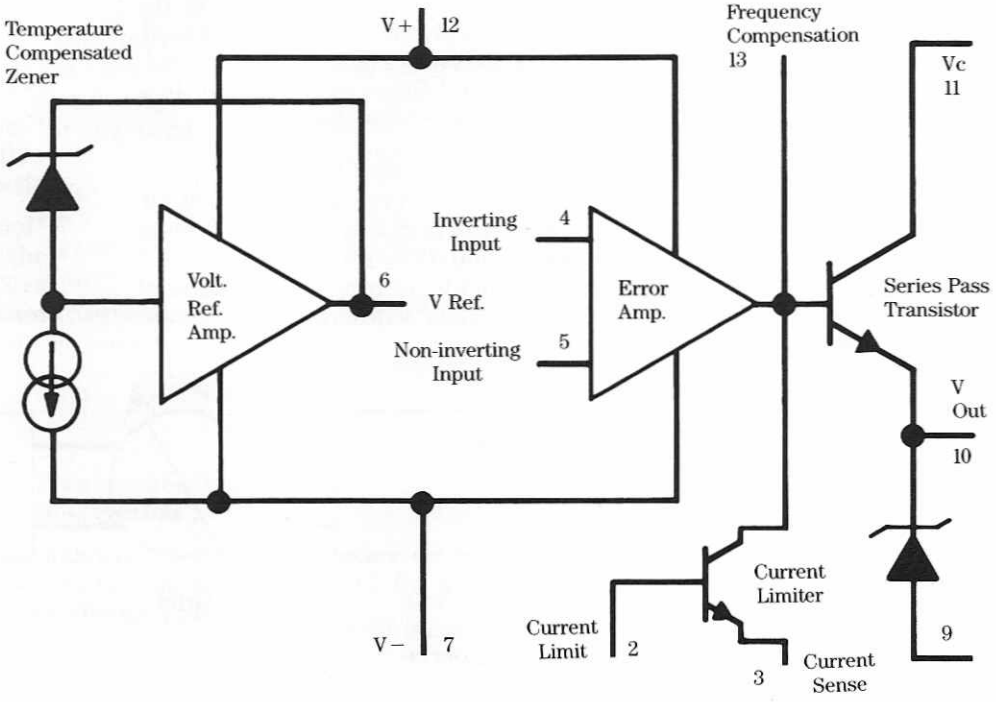


Figure 6.3.2 723 Regulator Block Diagram

P305-185

Ⓖ AC Overvoltage Control

This circuit controls the voltage across the power transformer primary by absorbing higher than normal energy levels (voltages) across this circuit. This circuit receives its control voltage via an optical coupler from Circuit F. This voltage controls Q3, Q4, & Q5, which increases their effective resistance causing the voltage delivered to the transformer to decrease. The excess energy (voltage) is dropped across these parallel connected transistors to safely dissipate the excess power. Resistors, R5, R6, and R7 are used to equalize the current carried by each transistor, helping them each to share part of the load evenly.

SEE NOTE 6-4

6.4 Additional Circuitry

1. Vital Signs

   The power supply uses a Vital Signs inteface connector located on the side of the module. Power is supplied to the separate Vital Signs module via this connector and R32 located on the T4PL PCB. R32 is a 10 ohm ⅛ watt resistor which acts like a fuse in the event the Vital Signs module draws too much current. All of the monitoring points used by the Vital Signs module are current limited using series resistors. The purpose of the current limiting resistors is to provide isolation between the power supply and the Vital Signs module. This is necessary to prevent a fault in the Vital Signs module from disabling the amplifier system.

2. Optional Transient Clipper

   The input overvoltage protection circuitry will normally provide adequate protection. However, a Transient Clipper Module is available if required. This module is described in Texscan's Technical Information Bulletin #11. This module provides additional protection by conducting current (thus holding voltage constant) for voltages in excess of 91 volts on a 60 VAC system, and 43 volts on a 30 VAC system. Extremely fast pulses are safely handled and kept from entering the cable system through the power supply. This small molded plastic module is easily attached across the power supply at the power transformer primary windings. It must be connected at this point because it is not a high energy device. (see schematic diagram)

6.5 Performance Testing

SEE NOTE 6-5

1. This test will verify that the input overvoltage protection circuit is operating properly. At the same time the regulator can be checked for proper operation.
2. Set up the equipment as per Figure 6.5.1. See Section 6.2 for recommended test equipment.
3. Adjust the Variac for 60 volt input to the T4PL. (30 volts for units with this option.)
4. Adjust the variable load for an output current of 1.7 amps.
5. Verify that the DC output voltage of the T4PL is 24 VDC ± 0.1 VDC. If the voltage is not correct, reset it by using the "Output DC Adjust" control. If the voltage cannot be set to proper voltage see Section 6.5.
6. Connect an oscilloscope across the output of the power supply. The ripple should be less than 5 mV peak to peak.
7. Monitor the output DC voltage while adjusting the AC input voltage from 57 to 63 volts. The DC output voltage must remain at 24.0 VDC ± 0.5 VDC.

NOTE 6-4

Due to its sensitivity, the compensation circuit will respond momentarily, to anything that causes the 60 volt line to rise above 65 volts. Typically, power supplies less than about ¼ mile from the power source will see peaks close to 65 volts, causing the input overvoltage status indicator to glow dimly.

NOTE 6-5

All Front Panel Test Points are current limited using series resistors as a protection feature. This prevents shorting of the test points from damaging or disabling the power supply.

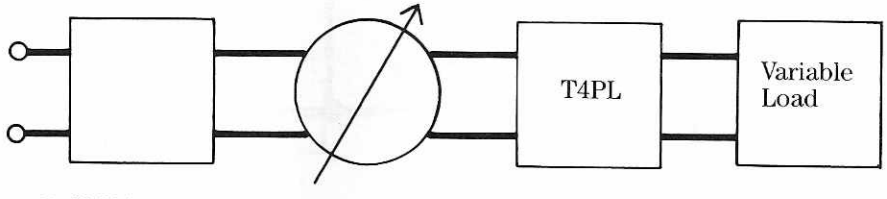


Figure 6.5.1 Equipment Set-up For Performance Testing

P305-185

8. The input overvoltage protection circuitry is checked by increasing the AC input voltage to at least 75 VAC. (The maximum input voltage for testing is 108 VAC.) Verify that the "Input Overvoltage" indicator lights at 70 ± 5 VAC, and that the voltage at the "Bulk DC" test point remains below 40 VDC. Verify that the voltage at the "Output DC" test point remains constant at 24.0 ± 0.5 VDC.

6.6 Troubleshooting and Repair

1. The first step is to determine if the status indicators are operating properly. When the module is operating properly the "output present," "bulk present," and "AC present" indicators will be illuminated. When an indicator(s) is extinguished, measure the voltage across the LED–load resistor combination to determine if the power supply or the indicator is at fault. The voltage should be as follows:

Output Present	24 VDC
Bulk Present	49 VDC
AC Present	60 VAC (Square Wave) 30 VAC (for this option only)

   If the voltage is correct then replace the LED and/or the load resistor as required. If the voltage is missing, repair the PC wiring traces leading to the indicator circuit, or the power supply function indicated as per the rest of this procedure.

2. If the DC output voltage is low or missing and the "Bulk Voltage" is correct, then, Section Ⓓ Regulator is defective. Check and replace U2, Q6, and/or R19, as required.

3. If the DC output voltage varies with input voltage fluctuations, then check and replace U2 or Q6.

4. If the DC output voltage is correct and the ripple is greater than 5mV P-P as checked with an oscilloscope, then check and replace U2, C6 (Output Filter), and/or C2/C3 (Input Filter), as required. In order for the regulator to work properly the "Bulk" voltage must be greater than 26 VDC.

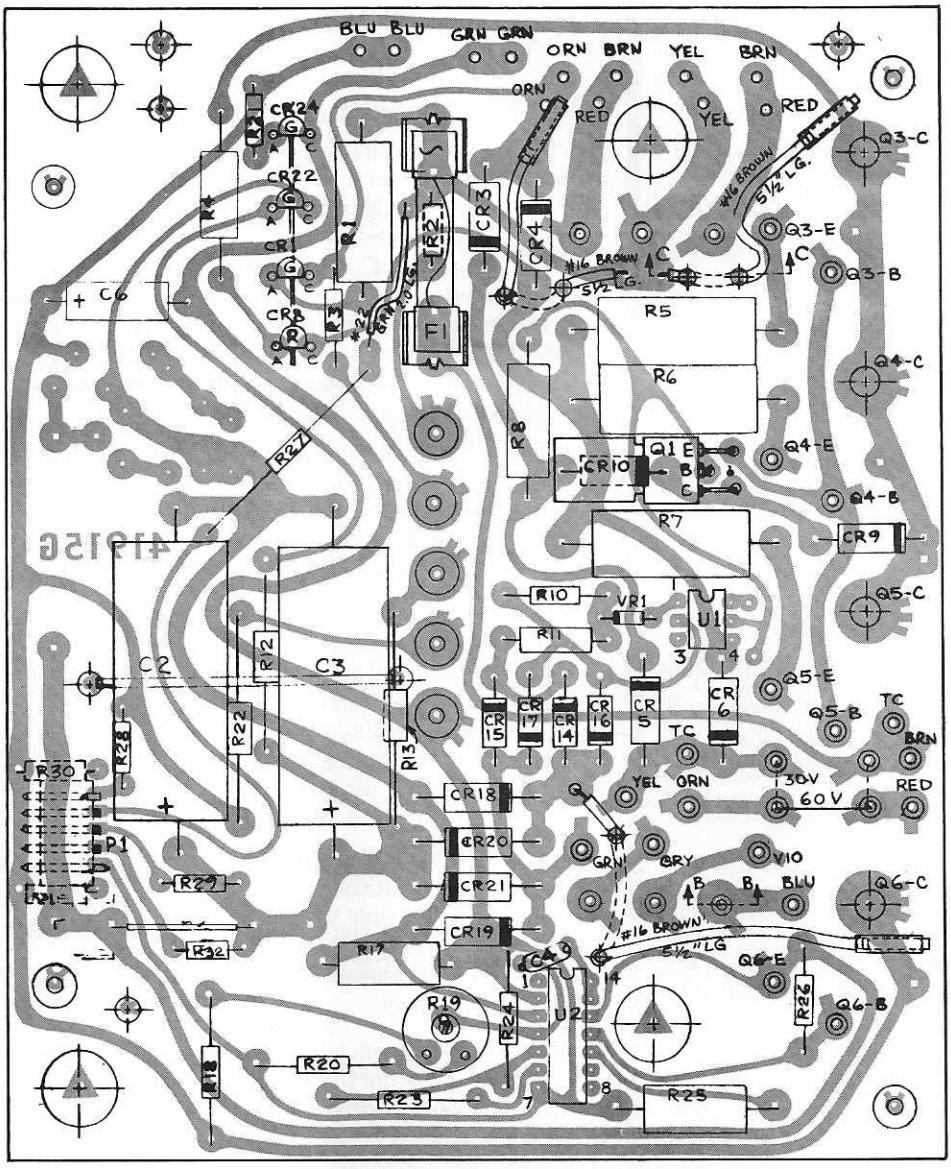
5. Input Overvoltage Protection Circuit
   If the "Input Overvoltage" indicator and load resistor are working properly when the bulk supply voltage exceeds 40 volts and the input voltage is above 75 volts, this circuit has probably failed. Connect a DC Voltmeter across the rectifier CR-14. The meter reading should be approximately 20 volts. If the reading is incorrect check CR-14 to CR-17 and replace any bad diodes. If the voltage is correct connect the voltmeter across Zener diode VR-1. The voltage reading should be between 6 and 7 volts. If the voltage is low check resistors R-10 & R-11. Replace as required and recheck the voltage across VR-1. Measure the voltage across the bridge rectifier. See Figure 6.6.1 for a comparison of the AC Line voltage to the DC voltage across the bridge.

AC Line Voltage	DC Voltage Across Bridge
60 (normal)	2
70	7
80	28
90	44

Figure 6.6.1 Input Overvoltage Protection Circuit Voltages

   A reading of less than a volt across the bridge indicates a possible shorted part such as CR-9, CR-10, or Q-3 to Q-5. A very high reading (above 50 volts) indicates an open circuit or a failure in the feedback loop. Check Q-1 and U-1, and replace as required. Measure the voltage across the emitter resistors R-5 to R-7. The voltage should be approximately 100 mV with a 60 VAC input. A high reading across one resistor indicates a shorted transistor.

6. After the module has been returned to operating condition, it must be set-up as per Section 4.

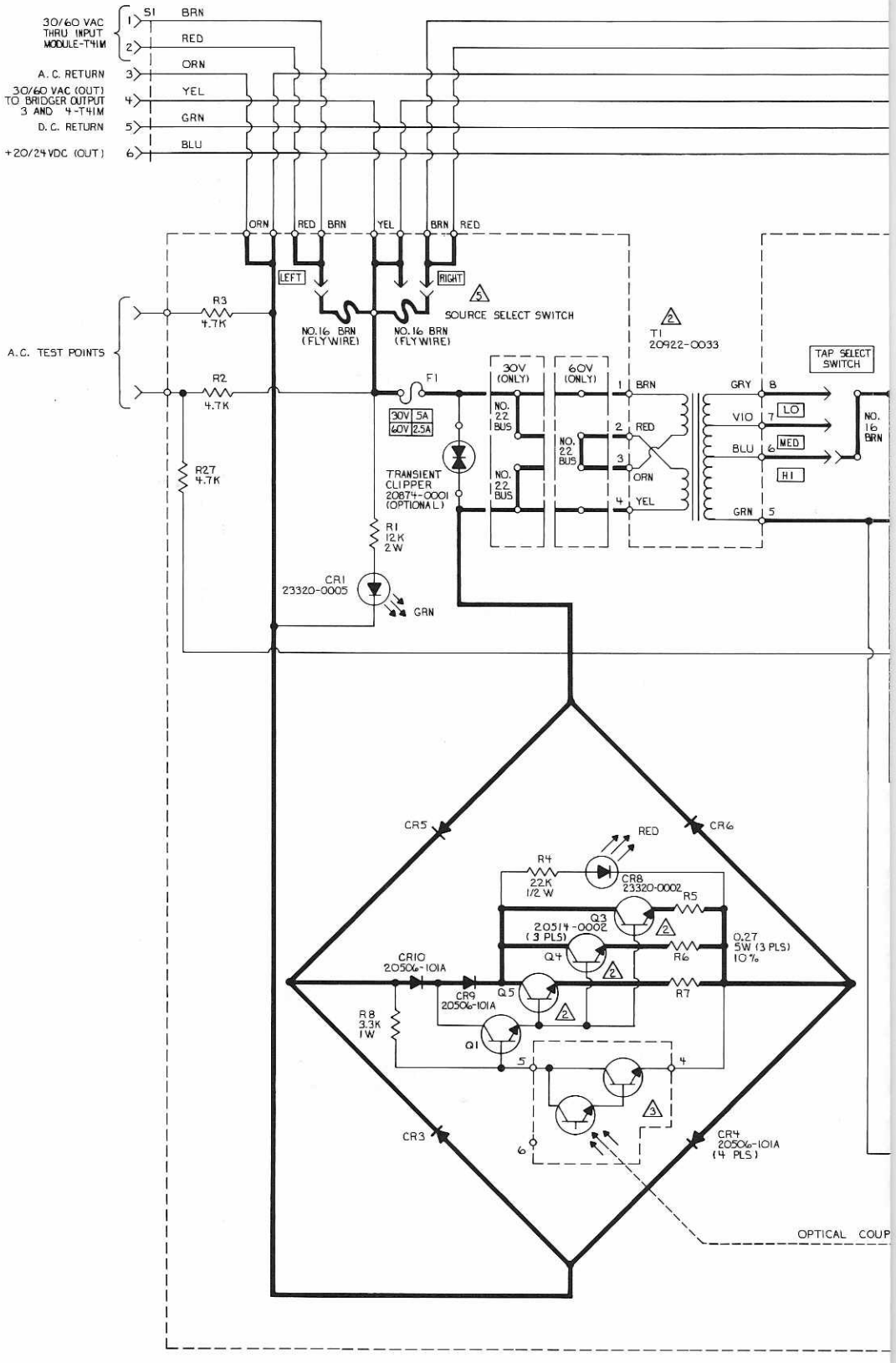


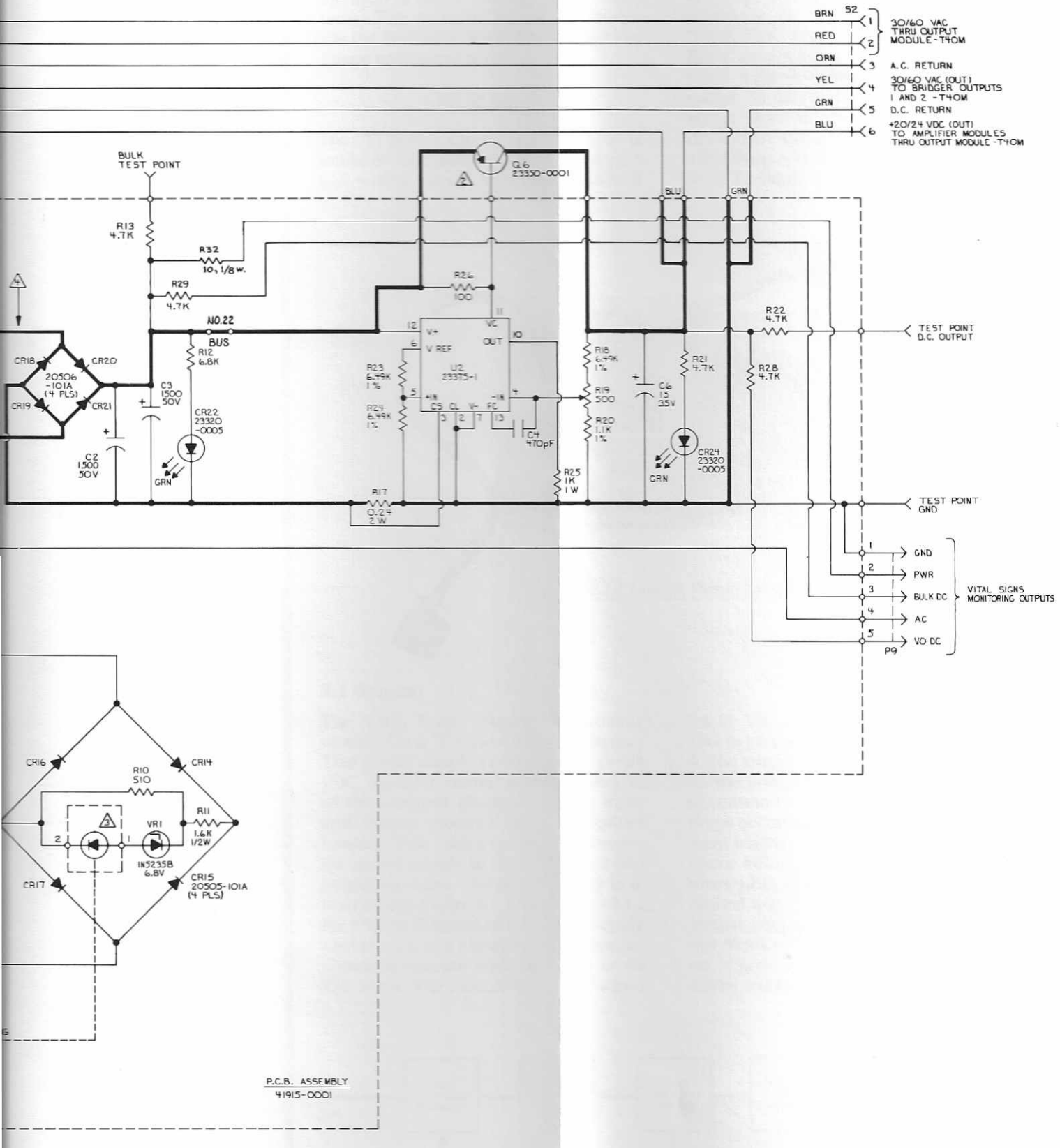
PCB Assembly
03-41915-000
T4PL
Power Supply

P305-185

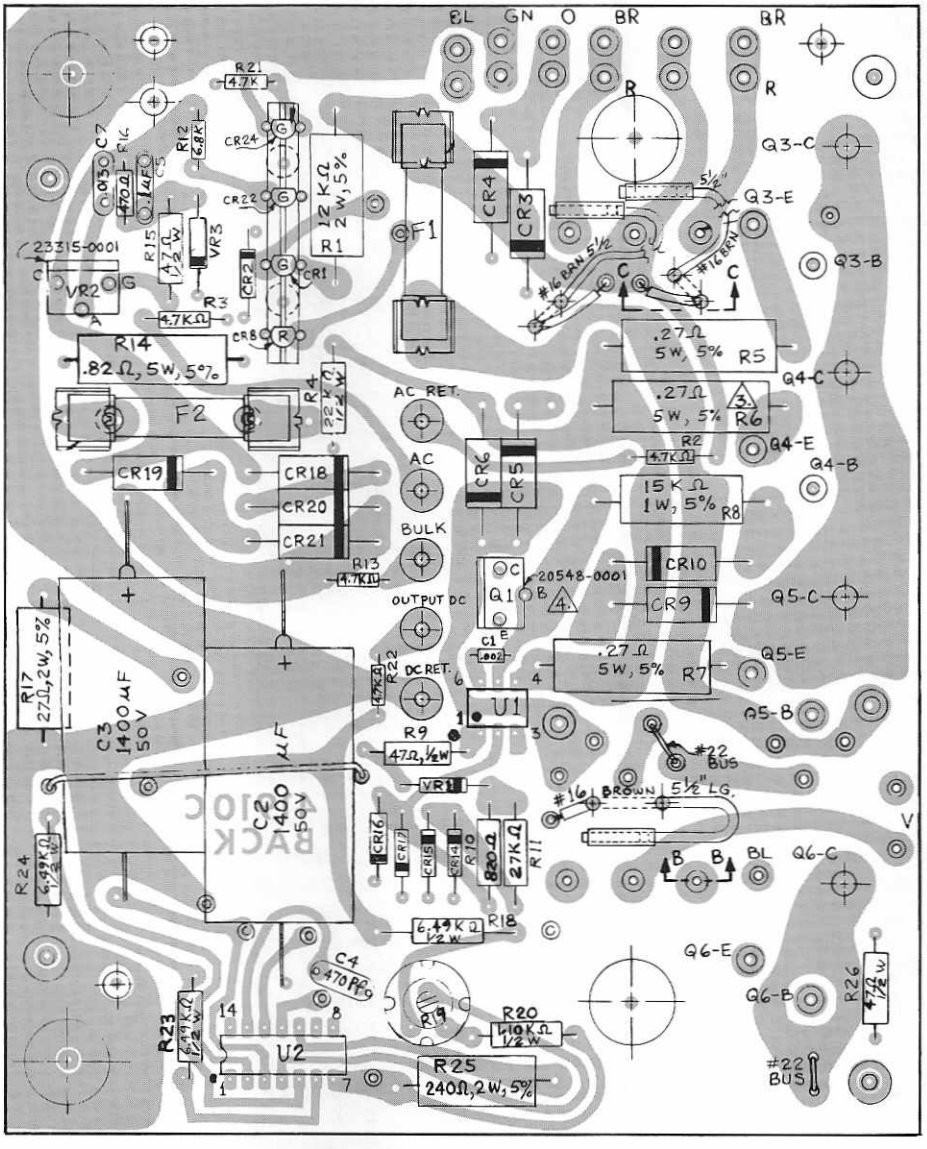
NOTES

1. Unless otherwise specified:
   All capacitor values are in microfarads.
   All resistor values are in ohms, 5%, ¼W.
2. Chassis mounted-part of base plate ass'y, 41902-0001.
3. Part of "UI," integrated circuit (Darlington Optical Coupler), 23385-0002.
4. Heavy lines indicate major current carrying conductors for DC and AC.
5. For thru powering the fly wires must be connected to both left and right.
   For left (or) right powering, a flywire must be connected to the left or right respectively with the other flywire to the center pin.





Schematic Diagram
00-41901-0001 Rev. E
T4PL
Power Supply



PCB Drawing
41910-0001
T4PL–Power Supply
(With front overlay)
OBSOLETE DRAWING

P305-185

NOTE: UNLESS OTHERWISE SPECIFIED

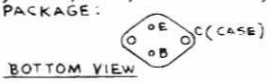
1. RESISTOR VALUES ARE IN OHMS, ±5% 1/4 W.
2. CAPACITOR VALUES ARE IN MICROFARADS.

3. TAP SELECT RANGES

PRIMARY, VAC	SECONDARY TAP POSITIONS, VAC		
	LOW	MEDIUM	HIGH
30	20-24	24-28	28-32
60	41-48	48-56	56-65

4. Q1: DRIVER TRANSISTOR, 120 V., .5 A., NPN. TO-202 PACKAGE:

5. Q3, Q4, Q5: ARE POWER TRANSISTORS, CHASSIS MOUNTED. 140 V., 10 A., NPN, HIGH GAIN, GOOD SAFE OPERATING AREA. TO-3 PACKAGE:



6. T1: TRANSFORMER, CHASSIS
PRIMARY, LOW LOSS, STEP
30 V. OPERATION: INSTALL
AND BET
60 V. OPERATION: INSTALL

7. U1: I.C. IS 20 V. 5090, 6-

8. U2: I.C. IS A VENERABLE
WITH INTEGRAL REF.

9. CR1, CR8, CR22, & CR24 ARE

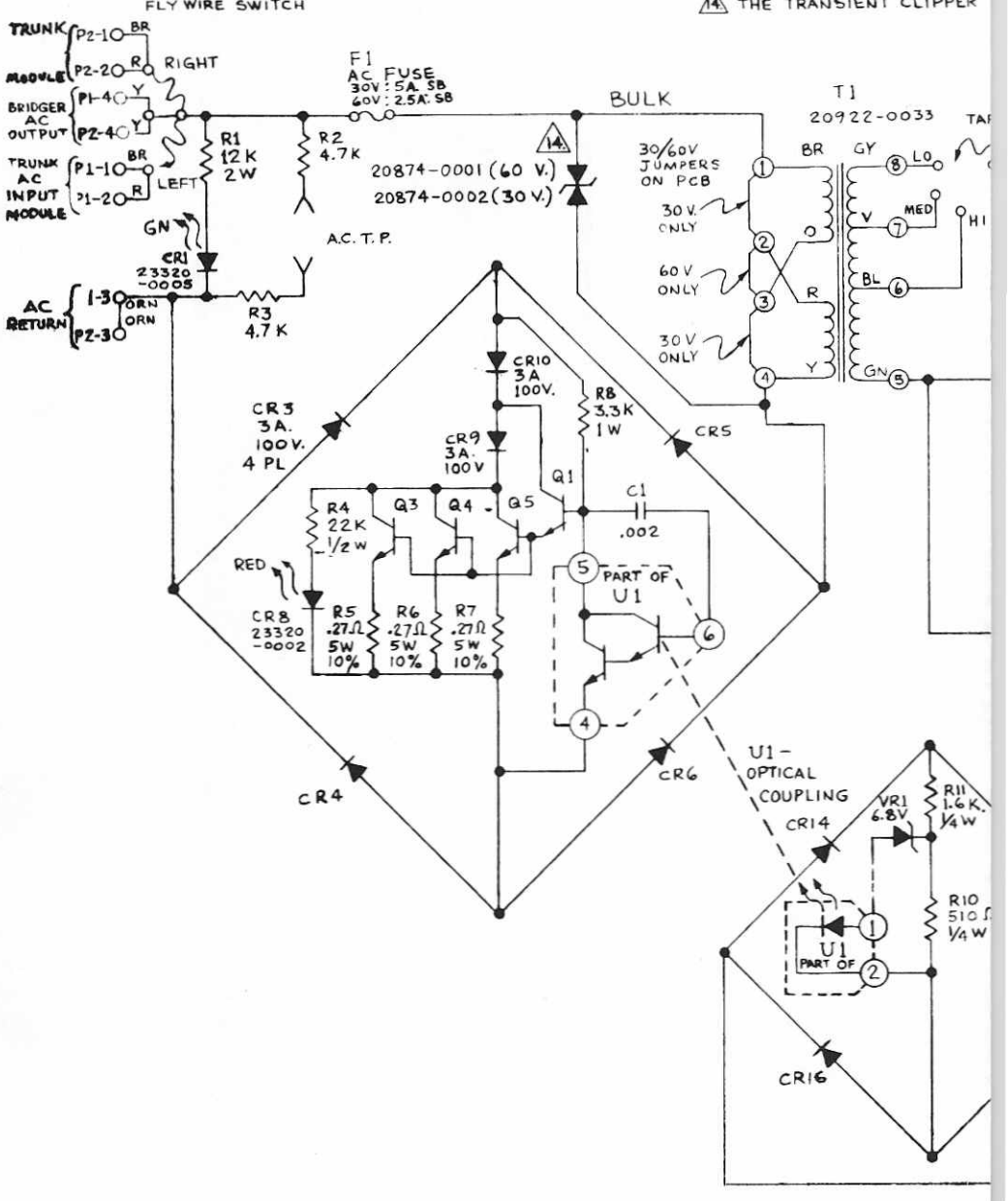
10. ALL PARTS ARE MOUNTED O
EXCEPT T1, Q3, Q4, Q5, &

11. THE INPUT OVERVOLTAGE PR
VOLTS ABOVE THE HIGH B

12. F1, SLOW-BLO, FUSE MUST B
SUPPLY IS REWIRED FROM

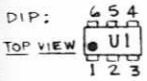
13. Q6 IS: PNP, POWER DARL
90 W, TO-3 PACKAGE, LI

14. THE TRANSIENT CLIPPER

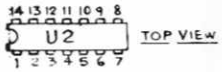


MOUNTED, IS A DUAL
DOWN TYPE.
UMPERS BETWEEN TERMINALS 1 & 2
EEN TERMINALS: 3 & 4.
UMPER BETWEEN TERMINALS 2 & 3.

PIN DIP:



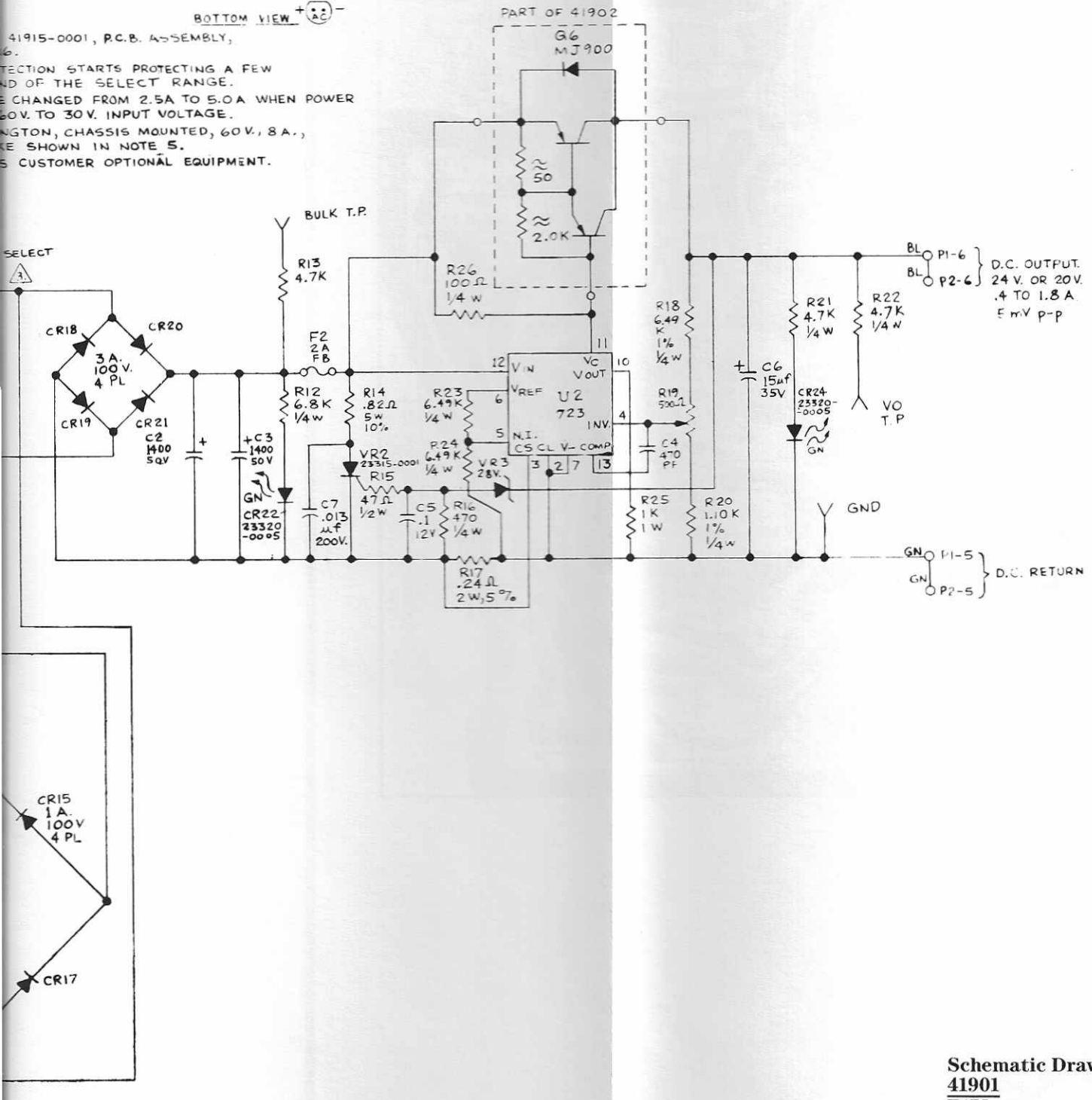
723 REGULATOR
14-PIN DIP:



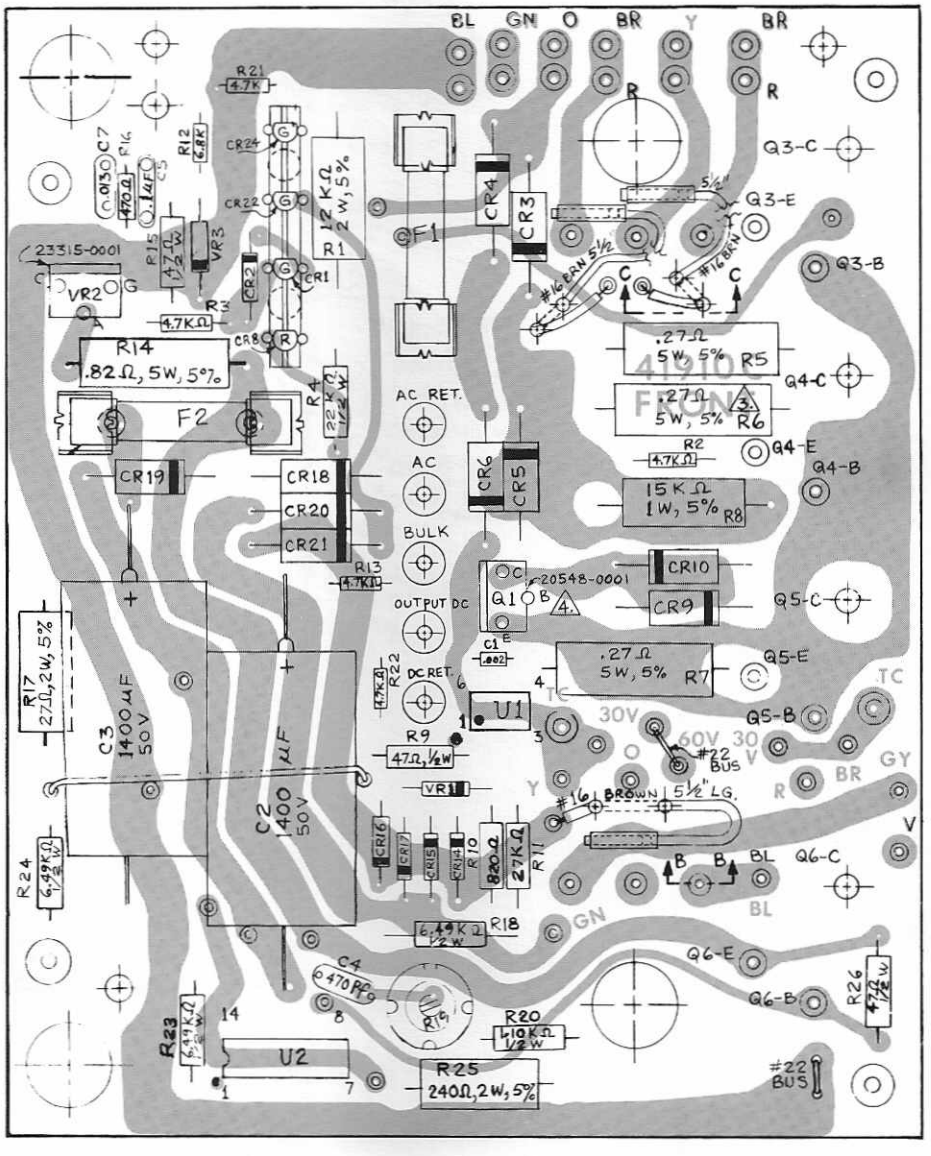
0mA. GALLIUM PHOSPHIDE L.E.D.S;

BOTTOM VIEW

41915-0001, P.C.B. ASSEMBLY,
6.
TECTION STARTS PROTECTING A FEW
ND OF THE SELECT RANGE.
E CHANGED FROM 2.5A TO 5.0A WHEN POWER
60V. TO 30V. INPUT VOLTAGE.
NGTON, CHASSIS MOUNTED, 60V., 8A.,
E SHOWN IN NOTE 5.
S CUSTOMER OPTIONAL EQUIPMENT.



Schematic Drawing
41901
T4PL
OBSOLETE DRAWING



PCB Drawing
41910-0001
T4PL–Power Supply
(With back overlay)
OBSOLETE DRAWING

P305-185

Texscan El Paso Division
1440 Goodyear Drive
El Paso, TX 79936
(915) 594-3555