

# INSTRUCTION MANUAL

ON

STABILIZED

TRIPLE POWER SUPPLY

## TL8-3 SERIES

SYSTRON  DONNER  
G M B H



# INSTRUCTION MANUAL



MODEL TL8-3 EG and TL8-3 EG OV

STABILIZED TRIPLE POWER SUPPLY

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Note: In case of technical questions or spare part requests please specify the model and serial-No. of the power supply.

Address: SYSTRON DONNER GMBH, 8 München 60, Bodenseestraße 113  
Telephone: (0811) 8711021

### WARRANTY.

SYSTRON-DONNER instruments are warranted during a period of one year from date of shipment to the original purchaser to be free from defects in material and workmanship. This warranty does not apply to vacuum tubes, except as they are warranted by the tube manufacturer. The liability of SYSTRON-DONNER under this warranty is limited to replacing or repairing any instrument or component thereof which is returned by the buyer, at his expense during the one year period and which has not been subjected to mis-use, neglect, improper installations, repair, alteration or accident. SYSTRON-DONNER shall have the right of final determination as to the existence and cause of the defect. In no event shall SYSTRON-DONNER be liable for collateral or consequential damages.

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Every SYSTRON-DONNER instrument is carefully inspected and is in perfect working order at the time of shipment. Each instrument should be checked as soon as it is received. If the unit is damaged in any way or fails to operate, a claim should immediately be filed with the transportation company.

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Whenever a SYSTRON-DONNER instrument requires service, the nearest SYSTRON-DONNER representative should be contacted. All representatives will provide immediate service or arrange the return of the instrument to the factory if necessary.

Please specify both model and serial number in all correspondence concerning claims for warranty repair. Address all enquiries to

SYSTRON-DONNER GMBH., 8 MÜNCHEN 60, BODENSEESTRASSE 113,  
Telephone: (0811) 871 10 21.

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## MEASUREMENT OF REGULATION AND RIPPLE

The specifications cited herein for regulation and ripple can be readily attained on every SYSTRON-DONNER power supply, provided the proper method of measurement is employed. The major consideration is that the highly stable meter and oscilloscope, specified in the calibration section test procedures, must be connected to the sensing terminals and not the load terminals. The reason for this precaution is that the voltage drop between the load terminals and sensing terminals will yield an inaccurate regulation ripple measurement.

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## SECTION 1

### DESCRIPTION

#### 1.1 INTRODUCTION

The TL 8-3 Triple Output Lab Series power supplies are flexible and dependable sources of D.C. power, which can be used to meet a variety of needs. These needs may range in scope from inspection and production testing, to laboratory bench testing and systems applications.

The wide range of outputs available makes these units well suited for use as basic laboratory power sources. The ability to provide power packaged in minimum space with high reliability meets the demands of most systems and laboratory requirements.

All components used in the construction of the Medium Power Half Rack units are of the highest quality available, and have been subjected to 100% incoming inspection.

Each electrolytic filter capacitor is of computer grade, and has been quoted by the manufacturer as having a life expectancy exceeding ten (10) years. All silicon transistors have been "derated" and temperature aged to provide high reliability. All rectifiers are hermetically sealed silicon units, and all zener diodes have been temperature stabilized.

#### 1.2 GENERAL FEATURES

Independent metering for each output allows simultaneous monitoring of voltages and current. A front panel lamp indicates an overload condition on any of the three outputs. Coarse and fine output controls for each output permit precise adjustability.

##### Constant Voltage Mode

A constant voltage is maintained across the output terminals at any preset value from zero to rated voltage output, provided that the load does not draw more than the rated output current.

##### Automatic Current Limiting

Short circuit protection is provided by the Automatic Current Limiting circuit which limits the maximum output current under all load conditions. The point at which automatic current limiting occurs is at approximately 110% of the maximum rated current output of the unit. In the event of a short circuit, the output voltage will drop to zero, and will return to its previous level only upon removal of the short circuit.

### Automatic Overvoltage Protection (Optional Feature, "A" output only)

Automatic Overvoltage (OV) protection prevents the output voltage from exceeding the programmed voltage and can be internally adjusted through an access slot in the cover.

## 1.3 PRECAUTIONARY MEASURES

### Wire Size

To assure proper regulation under all load conditions, and to prevent severe distortions of the AC line voltage, it is very important to take into consideration the physical size and current handling capabilities of the input power line. Serious losses in regulation and an increase in ripple may result from underrated or overloaded AC input lines. The maximum AC impedance from the breaker box to the power supply input should not exceed 0.75 ohms.

### Voltage Regulator and Inverter Inputs

Do not use voltage regulators or inverters as a primary power source. The outputs of these devices are usually not sinusoidal in nature, and if used as the AC source for the power supply, may cause serious loss of regulation of the power supply output. Capacitive input filtering used for semiconductor power supplies requires charging to the peak of the rectified AC wave which non-sinusoidal AC sources may not provide.

### Systems Considerations

In systems applications it is recommended that each power supply input power line be run separately to the AC distribution box, in order to minimize cross coupling and interaction between equipment. To keep the AC ripple in the output to a minimum, it is recommended that the AC input cables should not be run in close proximity to the output load cables.



## FEATURES

- THREE OUTPUTS – INDEPENDENTLY ADJUSTABLE
- AUTOMATIC ELECTRONIC CURRENT LIMITING
- NO TURN ON/TURN OFF TRANSIENTS
- THREE INDEPENDENT DUAL RANGE METERS
- OVERVOLTAGE PROTECTION OPTION



## ELECTRICAL SPECIFICATIONS

**Input:** 220 VAC  $\pm$  10%; 47-65 Hz

**Output:**<sup>(1)</sup> Triple Floating; isolated from ground, 300 VDC max.

A) 0 to +8 VDC, 3 ampere; rating reduces to 2 ampere at 0 VDC.

B) 0 to +32 VDC, 1 ampere; rating reduces to 0.5 ampere at 0 VDC.

C) 0 to -32 VDC at 1 ampere; rating reduces to 0.5 ampere at 0 VDC.

All outputs are referenced to a common return electrically isolated from chassis ground.

**Regulation, Line:** 0.02% or 2 mV\*, for 200-240 VAC line change, at any output within specifications.

**Regulation, Load:** 0.02% or 5 mV\*, no load to full load, at any output within specifications.

**Ripple:** 500  $\mu$ V RMS ; 3 mV p-p. (10 MHz)

**Stability:** 0.05% or 10 mV\*, for 8 hours after warm-up.

Measured at constant line voltage, load and ambient temperature.

**Temperature Coefficient:** (0.02% + 400  $\mu$ V)/°C

**Temperature Range:** 0 °C to +40 °C.

**Recovery Time:** 50 microseconds to within 0.05% or 15 mV\* of output voltage, for 80% step change in rated load (.2 load to full load)

**Short Circuit Protection:** Automatic Electronic Current Limiting.

**AC Power Input Protection:** Fuse.

**Voltage Adjustment Range:** Continuously adjustable vernier controls.

\*Whichever is greater.

(1) At maximum line voltage condition, the total output current should not exceed 80% of total allowable current.

### Output

| Model   | Volts        | Amps | Impedance*<br>DC-1 KHz |
|---------|--------------|------|------------------------|
| TL8-3EG | 0 to +8 VDC  | 0-3  | 0.003                  |
|         | 0 to +32 VDC | 0-1  | 0.010                  |
|         | 0 to -32 VDC | 0-1  | 0.010                  |

\* Nominal

## GENERAL AND PHYSICAL SPECIFICATIONS

**Operation Mode:** Constant voltage with automatic current limiting.

**Controls:**

**Voltage:** Coarse and Fine; 0 to rated output; front panel. Resolution 1 mV on fine control.

**Input Power:** Front panel switch and indicator, AC ON.

**Metering:** (3) Combination Volt/Ammeters with front panel selector switch.

**Terminals:**

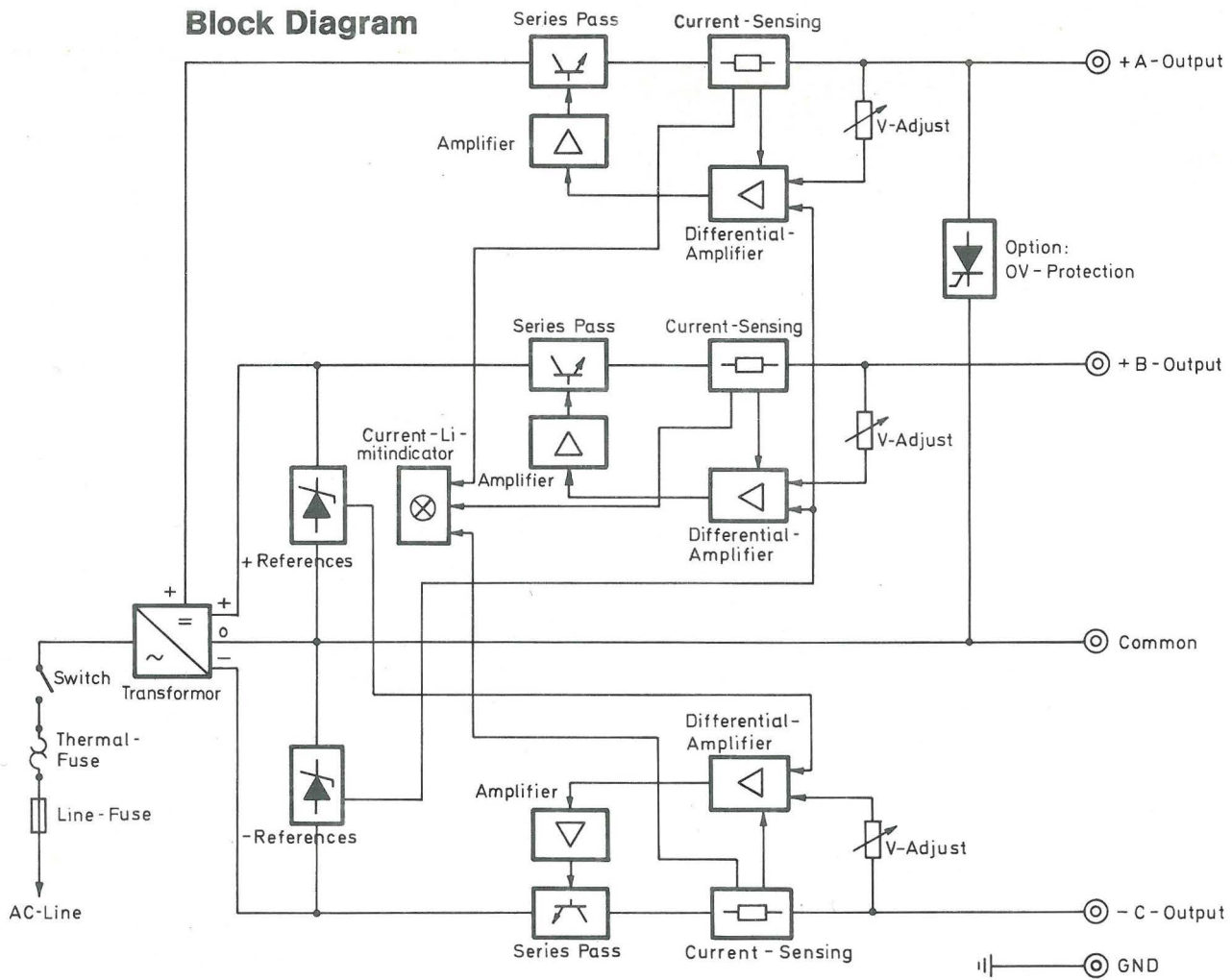
**Front Panel:** Positive output A, Positive output B, Negative output C, common return, chassis ground.

**Overvoltage Protection:** Internal adjustable overvoltage protection is available, as a factory option on output A (0 to +8 VDC)

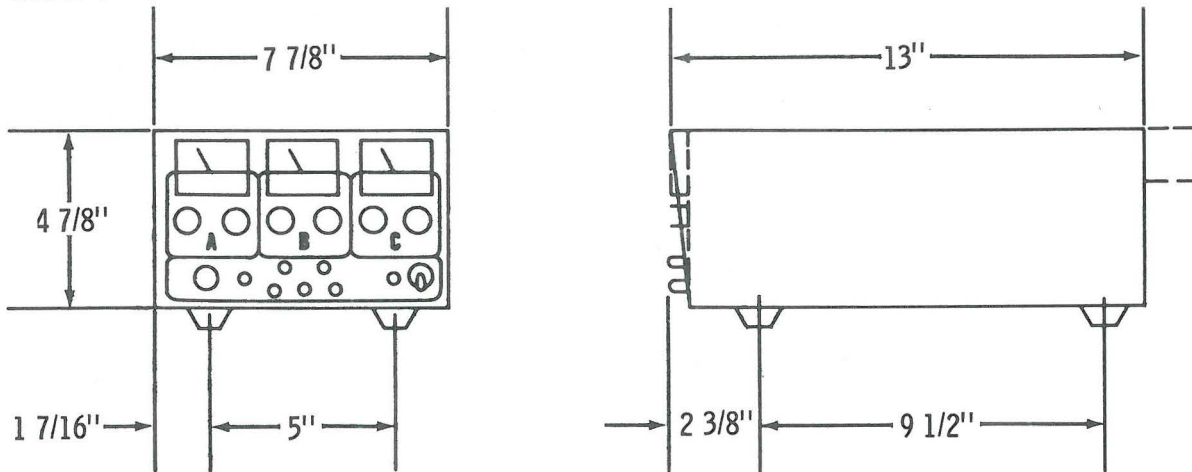
**Size:** 7<sup>7</sup>/<sub>8</sub>" W  $\times$  4<sup>7</sup>/<sub>8</sub>" H  $\times$  12<sup>9</sup>/<sub>16</sub>" D

**Weight:** 16 lbs.

## Block Diagram

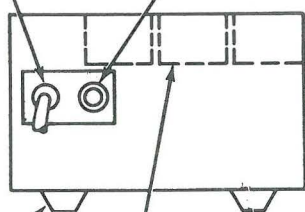


## Mechanical Dimensions



AC LINE CORD  
7 FEET LONG WITH  
3 PRONG MOLDED  
MALE PLUG

AC LINE FUSE



OPTIONAL OVS  
MODULES

(4) RUBBER FEET (REMOVABLE)  
(10-32 THREADED MOUNTING)

## Description

The TL8-3 Triple Output Lab power supply is a multiple output unit specifically designed for laboratory applications utilizing IC circuitry. Independent output voltages are provided to allow simultaneous power to be supplied to a typical IC (digital or analog) breadboard circuit, as well as simultaneously, two additional independent power sources for typical auxiliary circuitry. Output voltage and currents may be independently monitored.

A variety of voltage and current outputs are available providing unexcelled operational versatility and flexibility. This output flexibility permits the user to have complete convenience in filling laboratory power requirements.

The Triple Lab Power Supply utilizes silicon semiconductors permitting operation at its maximum temperature rating without derating.

## SECTION 2

### OPERATION

#### 2.1. ELECTRICAL CONNECTIONS

##### Input, Power

A heavy duty 3 wire line cord and molded plug with grounding prong provides a path for input power to the unit.

The power handling ability of the AC power lines feeding AC power to the line cord must be considered, as serious losses in regulation and substantial increases in ripple can occur as a result of insufficient power handling capacity of these lines. The AC impedance from the breaker box to the power supply input connector should not exceed 0.75 ohms. All AC power line connections must be securely tightened, and any movable electric contact surface (such as the wiper arm of a variable transformer) should be kept clear of impedance producing oxide coatings.

Care should be exercised in selecting the proper wire size for the AC input lines. The figures listed in Table 2-1 will serve as a guide in making this selection.

TABLE 2-1 - AC INPUT WIRE SIZE

| Length of Run (Single Lead) | Wire Size (AWG Standards) |
|-----------------------------|---------------------------|
| 10 feet or less             | 12                        |
| 10 feet to 20 feet          | 10                        |
| 20 feet to 50 feet          | 8                         |
| 50 feet to 100 feet         | 6                         |

##### Output, Front Panel

Five binding post terminals mounted on the front panel provide output and ground connections.

## 2.2 CONTROLS

### Front Panel

#### FRONT PANEL CONTROLS

| Name                       | Function  |
|----------------------------|---|
| AC POWER                   | Toggle switch, controls input power                           |
| VOLTAGE ADJUST<br>(Coarse) | Potentiometer, adjusts voltage output                         |
| VOLTAGE ADJUST<br>(Fine)   | Potentiometer, adjusts voltage output                         |
| METER SELECT<br>(V, I)     | Rotary switch, controls function of<br>(2 pos.) output meters |

### Internal

All internal control settings have been factory preset, and require no additional adjusting. However, if it should become necessary to adjust any of the internal controls due to circuit changes caused by component aging or replacement, refer to the calibration section of this instruction manual.

## 2.3 OPERATION

### Control Settings

Set all coarse and fine output controls fully CCW and set the meter select switch to V.

### Grounding

Either side of either output may be grounded or the outputs may be used in a floating condition.

### Power On

Connect the power supply to a nominal AC power source. Set power switch S101 to AC-ON, and observe that pilot lamp DS101 glows.

### Warm-up

No warm-up time is necessary to place the unit into operation. However, a 30 minute warm-up period is recommended to reach rated stability.

## SECTION 3

### THEORY OF OPERATION

#### 3.1. GENERAL

The purpose of the TL 8-3 Triple Output Lab Series power supplies is to transform and rectify the AC input a well regulated, stable and adjustable DC output. The following paragraphs describe the major circuits. As each circuit is described, reference should be made to the schematic diagram in the rear of this manual.

#### Primary Input

Input power is obtained through transformer T101 full wave rectifier diode sets (CR1, CR10), (CR2, CR11), (CR19, CR20) and filter capacitors C3, C10 and C17.

When AC power switch S101 is set to AC-ON, AC pilot lamp DS101 glows, and AC power is applied to T101. Regulated DC output power is immediately available.

#### Reference Supplies

The C3 voltage appears across the +12V and (+10V, +6.2V) reference supplies. These reference voltages are, in turn, developed across CR25, CR5 and CR6, respectively.

The C10 voltage appears across the -12V and (-10V, -6.2V) reference supplies. These reference voltages are, in turn, developed across CR26, CR14 and CR15, respectively.

#### Series Regulator

The rectified and filtered voltages from the three input rectifier sections are directed through each of the respective series pass transistors. The conduction of each of these transistors is controlled by independent circuitry which causes them to act as variable resistors. Their overall resistance varies in accordance with the need of the power supply to increase or decrease the output voltage.

Each pass transistor is controlled by a driver transistor which is, in turn, controlled by the corresponding voltage (error) amplifier.

#### Voltage (error) Amplifier

The theory of operation for all three voltage amplifiers is identical. A sample of the output voltage is compared with a stable reference (see Reference Supplies) at the base of the input stage of the amplifier. An unbalance caused by a voltage change at either the output terminals or across the output control pots will appear as a voltage change at the collector of the first stage. For example, an

increase in output causes the first stage to turn off, turning on the second transistor, turning off the third transistor and turning off the driver transistor. This causes the pass to be turned off and the output voltage to decrease.

### Current Limit Circuit

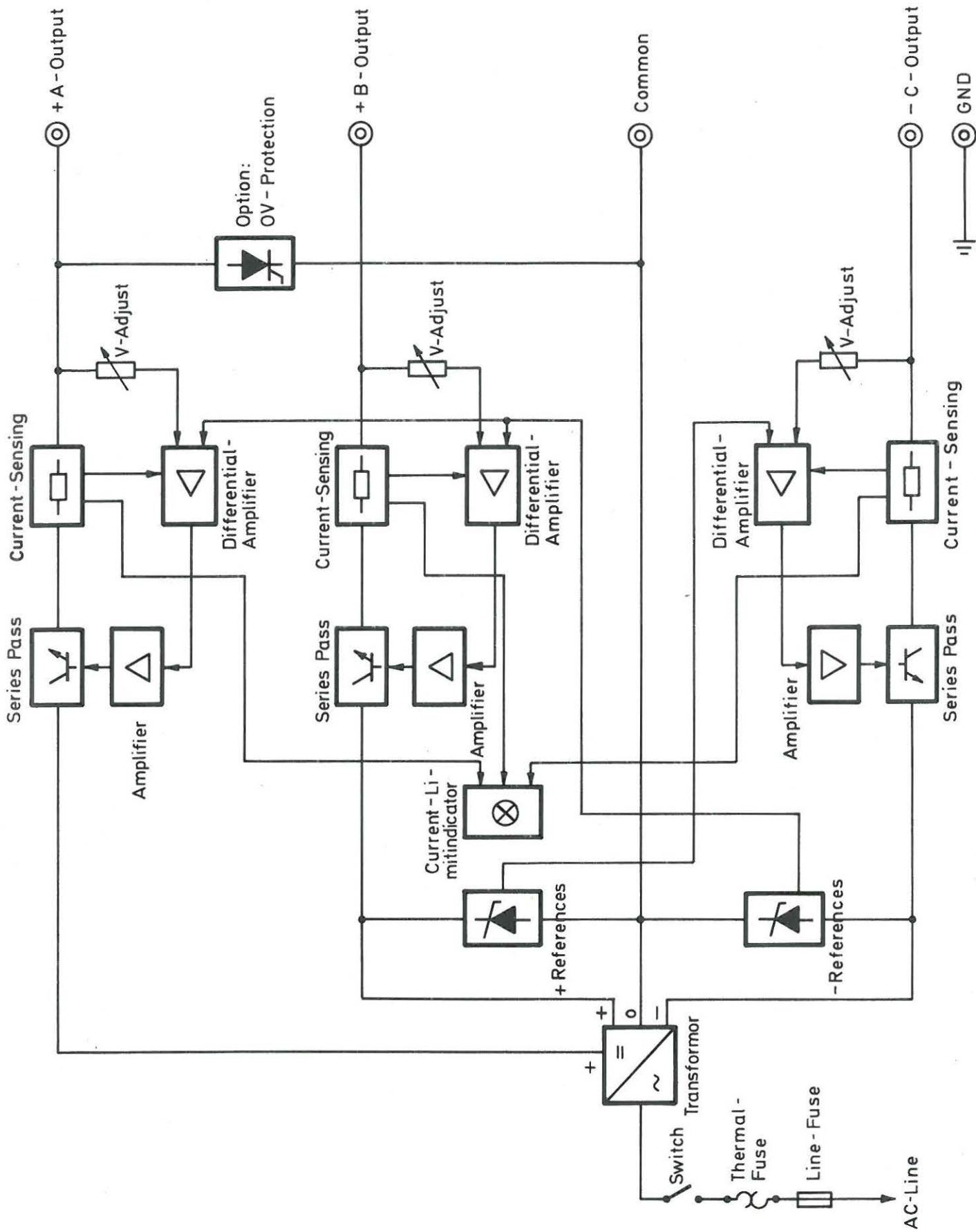
In the case of all three current limit circuits, a voltage drop is sensed across a small resistance in series with each output. As current increases, this voltage drop increases, eventually turning on a transistor in its current limit circuit which turns off the first stage of the voltage amplifier for this output. This has the overall effect of independently shutting down this output.

## 3.2 OPTIONAL FEATURES

### Overvoltage (OV) Protection

If the output voltage should use above the threshold set by the OV pot, the OV sensing transistor will turn on, turning on the SCR driver. This applies a signal to the gate of the SCR causing it to "fire" and place a "crowbar" across the output. This short circuits the output and activates the current limit circuit which turns off the pass transistor.

# Block Diagram to TL8 - 3 EG







SECTION 4  
MAINTENANCE

-----  
- W A R N I N G -  
High Voltages Are Present  
Use Caution  
-----

4.1. GENERAL

This power supply is a precision instrument. It is strongly recommended that only experienced troubleshooting personnel perform troubleshooting operations or attempt to repair the unit. If the power supply appears to be malfunctioning at all, the following procedure is recommended for isolating possible defects.

4.2 LOADS AND INTERCONNECTIONS

1. Disconnect all interconnections and loads to which the unit is normally connected.
2. Connect a separate resistive dummy load across each output terminal. This load should be of sufficient value to allow the unit to operate at its maximum rated current and voltage output.
3. Apply nominal AC input power to the unit and check for normal operation. Satisfactory operation at this time would indicate that any malfunction previously encountered, is external in nature. All interconnections and loads normally used in conjunction with this power supply should then be carefully checked for electrical defects.

4.3 TROUBLESHOOTING

1. Set VOLTAGE ADJUST and VOLTAGE VERNIER controls fully CW. Using a 20,000 ohms per volt voltmeter or oscilloscope, check the voltages across the various circuit components listed in the TROUBLESHOOTING GUIDE, located immediately before the schematic diagram at the rear of this instruction manual. The sample voltages listed in this guide apply only if the unit is operating at its nominal AC input, and has no load on any output unless otherwise specified. Any reading which is grossly incorrect indicates that the stage being tested or the one immediately preceding it, is defective. The Schematic Diagram and appropriate sections of the Theory

of Operation will prove helpful in any troubleshooting work. Proper polarity to be observed when testing can be easily obtained from the Schematic Diagram.

2. If voltage checks show no noticeable deviations from the prescribed values, disconnect AC power and proceed with point-to-point resistance checks across pots, switches, diodes, resistors, transistors, in that order.
3. When the trouble is of an intermittent nature, such as poor regulation, ripple, etc., the use of an oscilloscope to determine dynamic changes will be necessary.

SECTION 5  
CALIBRATION

5.1     GENERAL

The following adjustments should be made when necessary to assure optimum operating characteristics and maximum efficiency of the SYSTRON-DONNER power supply.

5.2     TEST EQUIPMENT REQUIRED (or equivalent)

- (A) Oscilloscope, Tektronix Type 561
- (B) Differential Amplifier Plug In, Tektronix Type 63
- (C) Time Base Plug In, Tektronix Type 67
- (D) Differential VTVM, Fluke Model 825A
- (E) DC Ammeter, Weston Model 901

5.3     CALIBRATION PROCEDURE

- (A) Maximum Voltage - set front panel "V ADJ" fully clockwise, and "Fine" fully counter-clockwise for all three outputs. Adjust maximum voltage control R92 (0 to +32V), R93 (0 to -32V), and R94 (0 to +8V) to obtain the maximum rated output voltage for each output.
- (B) (0 to +8V) Maximum Current - set output voltage equal to 8.00 VAC  $\pm$  10 mv. Monitor Vout with a scope (10mv/cm scale). Rotate the current adjust pot (R59) fully clockwise. With an external DC current meter and a variable load adjust the output current to 3.3 Amps.  $\pm$ 100ma. Slowly rotate R59 in the counter-clockwise direction until an affect is seen on the output voltage. Check the setting by adjusting the variable for max. current. The maximum current the until should be capable of is 3.3 Amps.
- (C) Meter Circuit - Place the meter select switch in the volts position. Adjust each output to its nominal voltage  $\pm$ 20mv. (Differential VTVM, Fluke Model 825A is recommended). Calibrate each meter by adjusting the pot R26a for +32V -Output; R51a for -32V -Output and R55a for m8V -Output.

Place the meter select switch in the Amps position, then load down one output at a time. Monitor the output current carefully with an accurate DC current meter. For the 0 to +32V output, adjust R16 so both the "A" meter and the reference meter indicate the same current. For the 0 to -32V output, calibrate the "B" meter by adjusting R50. Finally, calibrate the "C" meter with R54.

TROUBLESHOOTING GUIDE

0 to +32V Output

Vin ≈ 220VAC  
 No load on output unless  
 otherwise specified

| Symptom                               | Possible Problem Area   |   |
|---------------------------------------|---|---|
| Zero output voltage                   | AC Input Section  | If the AC power lamp (DS101) is off, one or more of the components listed has probably failed.<br>F101 open circuit; S101 open circuit; S102 open circuit.  |
| Zero or small negative output voltage | Rectifier Section<br>or<br>-6.2V and -10V<br>Reference Section                | Measure the voltages across the following components. Check the levels measured with those indicated below.<br>C3 ≈ 26V; CR14 ≈ 10V; CR15 ≈ 6.2V  |
|                                       | Series Pass and Driver Section  | Measure the voltage drop across the base to emitter junction of Q101 and Q3 (across R9 and R6). Both transistor junctions should be forward biased.   |
|                                       | Voltage Amplifier Circuit   | The base to emitter voltages of Q20, Q5 and Q6 should be about 0.6 volts DC, in the forward direction for that transistor.  |
| Zero or small positive output voltage | Current Limit Circuit   | If the voltage across R14 is approximately zero, then Q4 should be cutoff and CR7 reversed biased.<br><br>If the voltage across R14 is significant, then there is current flowing in the supply. The output terminals are probably shorted to common. |
| Large and unregulated output voltage  | Series Pass and Driver Section<br>or<br>Voltage Amplifier Circuit             | Check Q101 for collector emitter short<br>" Q3 " " " "<br>" Q20 " " " " "<br>" Q6 " " " " "<br>" Q5 " " " " open  |
| Output does not current limit         | Voltage Amp. Ckt.<br>or<br>Current Limit Ckt.<br>or<br>-12V Reference Section | Probably Q4 has failed open and/or CR7 has failed open.<br>Measure the voltage across CR26, the level is approximately 12 volts.  |

| Symptom  | Possible Problem Area       |   |
|--|-----------------------------|---|
| Overload lamp does not turn on when current limiting | Overload Lamp Logic Circuit | Check for failure of DS102 overload lamp. With the supply in current limit operation, the base to emitter voltage of Q21 and Q1 should be about 0.6 volts in the forward direction. |
| Overload lamp always on                              | Overload Lamp Logic Circuit | Check Q21 for collector emitter short<br>" Q1 " " " "<br>(Insure that no other output is in current limit).<br>Check Q24 for collector emitter short<br>" Q23 " " " "               |

TROUBLESHOOTING GUIDE

0 to -32V Output

| Symptom  | Possible Problem Area  |  |
|--|--|--|
| Zero or small positive output voltage                | Rectifier Section<br>or<br>-6.2V and -10V Reference Section                              | Measure the voltage across the following components. Check the levels measured with indicated below.<br>C10 $\approx$ 26V; CR5 $\approx$ 10V; CR6 $\approx$ 6.2V                     |
|  | Series Pass and Driver Section   | Measure the voltage drop across the base to emitter junction of Q102 and Q8 (across R32 and R33). Both transistor junctions should be forward biased.                                |
|  | Voltage Amplifier Circuit  | The base to emitter voltages of Q9, Q11 and Q12 should be about 0.6 volts DC, in the forward direction for that transistor.  |
| Zero or small negative output voltage                | Voltage Amplifier Circuit<br>or<br>Current Limit Circuit                                 | If the voltage across R47 is approximately zero, then Q10 should be cut-off and CR16 reversed biased.  |
|  | Current Limit Circuit  | If the voltage across R47 is significant, then there is current flowing in the supply. The output terminals are probably shorted to common.  |
| Large and unregulated output voltage                 | Series Pass and Driver Section<br>or<br>Voltage Amplifier Circuit                        | Check Q102 for collector emitter short<br>" Q8 " " " "<br>" Q9 " " " " "<br>" Q12 " " " " "<br>" Q11 " " " " open  |
| Output does not current limit                        | Voltage Amplifier Circuit<br>or<br>Current Limit Circuit<br>or<br>+12V Reference Section | Measure the voltage across CR25, this is approximately 12 volts.<br><br>Possibly Q10 has failed open and/or CR16 has failed open.  |
| Overload lamp does not turn on when current limiting | Overload Lamp Logic Circuit  | Check for failure of DS102 overload lamp. With the supply in current limit operation, the base to emitter voltage of Q21 and Q24 should be about 0.6 volts in the forward direction. |

TROUBLESHOOTING GUIDE

0 to +8V Output

| Symptom                               | Possible Problem Area   |   |
|---------------------------------------|---|---|
| Zero or small negative output voltage | Rectifier Section<br>or<br>-6.2V and -10V<br>Reference Section                  | Measure the voltage across the following components. Check the levels measured with those indicated below (at no load). C17 $\approx$ 17.5V, CR14 $\approx$ 10V, CR15 $\approx$ 6.2V.   |
|                                       | Series Pass and Driver Section  | Measure the voltage drop across the base to emitter junction of Q103 and Q13 (across R57 and R56). Both transistor junctions should be forward biased.                                  |
|                                       | Voltage Amplifier Circuit   | The base to emitter voltage of Q15, Q16 and Q17 should be about 0.6 volts DC, in the forward direction for that transistor.   |
| Zero or small positive output voltage | Current Limit Circuit   | If the voltage across R65 and R98 is approximately zero, then Q14 and Q23 should be cut-off. The base to emitter junction of Q23 should be reversed biased.                             |
|                                       | Current Limit Circuit<br>or<br>Overvoltage Circuit                              | If the voltage across R65 and R98 is significant, then there is current flowing in the supply. The output terminals are probably shorted together, possibly by the overvoltage circuit. |
| Large and unregulated output voltage  | Overvoltage Circuit   | Set R74 fully CW.<br>The base to emitter voltages of Q18 and Q19 should be approximately 0.6V forward biased. Q19 collector should be equal to the observed output.                     |
|                                       | <u>And</u><br>Series pass and Driver Section<br>or<br>Voltage Amplifier Circuit | Check Q103 for collector emitter short<br>" Q13 " " " "<br>" Q15 " " " " "<br>" Q17 " " " " "<br>" Q16 " " " " open   |

| Symptom   | Possible Problem Area  |   |
|---|--|---|
| Overvoltage triggers, even though output is normal and R74 is set fully CCW | Overvoltage Circuit<br>or<br>-12V Reference Section                                | Check Q18 for collector emitter short<br>" Q19 " " " " "<br>Measure the voltage across CR26;<br>the level should be 12 volts.   |
| Output does not current limit   | Current Limit Ckt.<br>or<br>+12V Reference Section<br>or<br>-12V Reference Section | Q14 failed open or CR23 failed open.<br>Measure the voltage across the following components. Check the levels measured with those indicated below.<br>CR25 $\approx$ 12V; CR26 $\approx$ 12V. |
| Overload lamp does not light during current limiting                        | Overload lamp logic circuit  | Check for failure of DS102 (overload lamp). With the supply in current limit operation, the base to emitter voltage of Q21 and Q1 should be about 0.6V forward biased.                        |

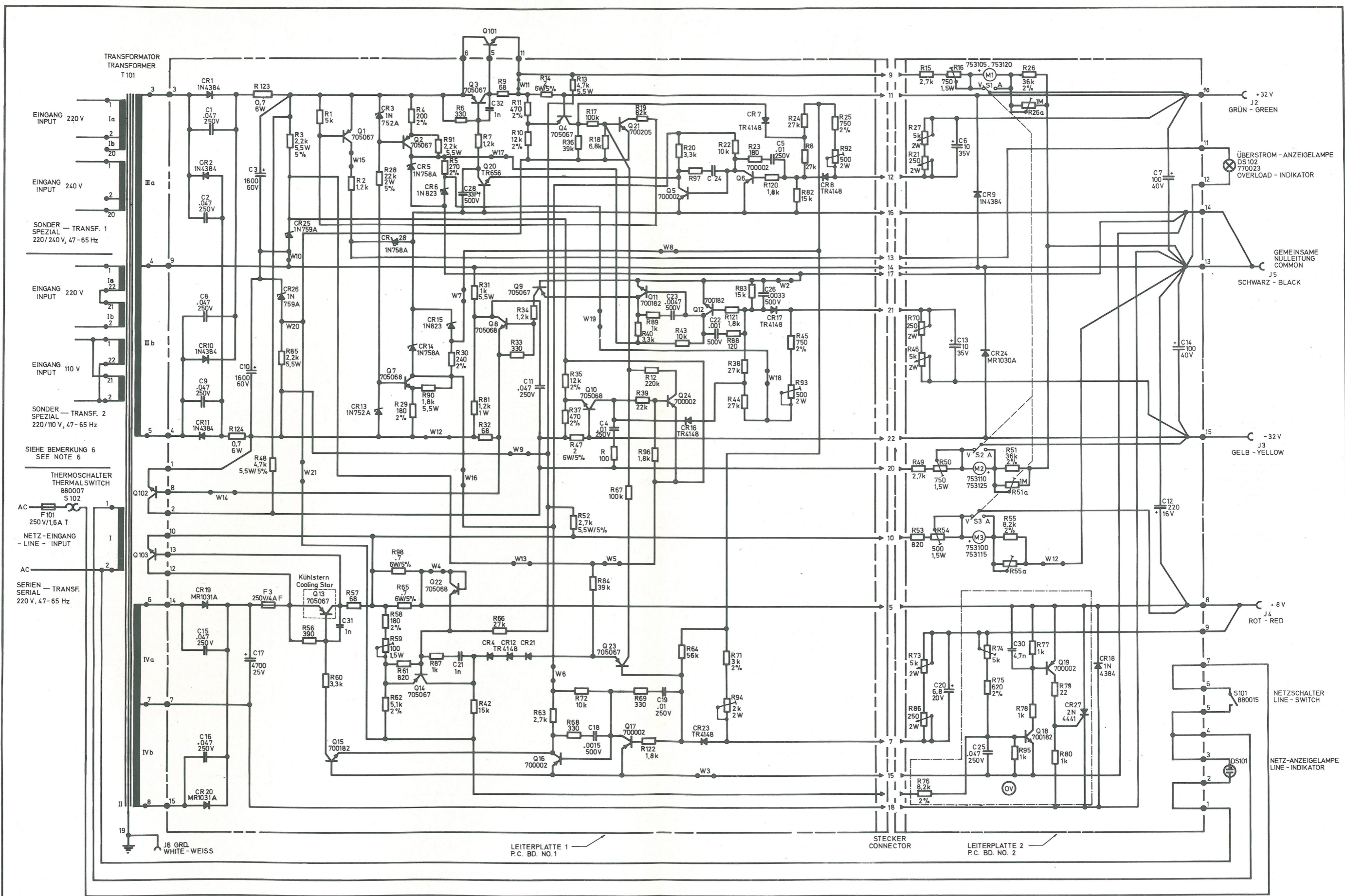












- NOTES:
- UNLESS OTHERWISE SPECIFIED:  
ALL RESISTORS ARE IN OHMS, 1/2WATT, 10%  
ALL CAPACITORS ARE IN MIKROFARADS
  - S1, S2 AND S3 IS ONE SWITCH (104330)
  - Q101, Q102, Q103 = 2N3055/7
  - OV OVERVOLTAGE PROTECTION  
ONLY IF MOUNTED
  - W = JUMPER
  - PRIMARY - WINDING AND CONNECTION  
OF SPECIAL - TRANSFORMERS

- BEMERKUNGEN:
- WENN NICHT ANDERS ANGEGEBEN:  
ALLE WIDERSTÄNDE IN OHM, 1/2WATT, 10%  
ALLE KONDENSATOREN IN MIKROFARAD
  - S1, S2 UND S3 IST EIN SCHALTER
  - Q101, Q102, Q103 = 2N3055/7
  - OV ÜBERSpannungSSchutz  
NUR WENN EINGEBAUT
  - W = Drahtbrücke
  - PRIMÄR - Wicklung und Anschluss  
von Sondertransformatoren

|                         |  |
|-------------------------|--|
| MODEL TL8-3             |  |
| SCHALTBILD<br>SCHEMATIC |  |
| Z. NR. TL8-S1001        |  |
| CODE ID. NO. TL8-S1001  |  |
| TRYGON<br>ELECTRONICS   |  |

