# RECEIVING SYSTEM

# TYPE R10

# PART 5 - UNIT TECHNICAL INFORMATION

# CHAPTER 3 - POWER SUPPLY TRC1801

# PATT NO 0625-18-891882

## CONTENTS



## TABLES

## ALGORITHMS



## ILLUSTRATIONS

# RECEIVING SYSTEM

# TYPE R10

# PART 5 - UNIT TECHNICAL INFORMATION

# CHAPTER 3 - POWER SUPPLY TRC 1801

# PATT NO 0625-18-891882

## PURPOSE

1. The Power Supply Sub-assembly Type TRC1801, converts an ac mains supply into stabilised dc voltages.

## SERVICE INFORMATION

2. The Power Supply Type TRC1801 supplies the following sub-assemblies, which together comprise the Receiving Systems Types R10A, R10B and R10C.

(a) Receiver Type TRC1800
(b) Synthesizer Type TRC2111.
(c) Antenna Pre-selector Type TRC1806.
(d) VLF-LF Adaptor Type TRC1802.
(e) ISB Adaptor Type TRC1805.
(f) VHF Adaptor Type TRC1803.

## SPECIFICATIONS

3. The following specifications apply, provided the mains supply voltage to the sub-assembly does not fluctuate by more than +7 per cent. Outputs are as follows:

(a) +12V stabilised.

(b) -12V stabilised.

(c) +5V stabilised.

(d) Output voltage variations under "no load" to "full load" conditions - less than 0,01V.

(e) Ripple and noise in the 10Hz to 10MHz range -less than 3mV rms.

(f) Power factor - better than 0,8.

(g) Short circuit protection - 2A maximum.

## MASS AND DIMENSIONS

4. The sub-assembly has the following mass and dimensions:

(a) Mass - 7,6kg.
(b) Height - 192mm.
(c) Width - 64mm.
(d) Depth - 420mm.

## SERVICES REQUIRED

5. The Power Supply Type TRC 1801 requires as a source of power one of the following ac mains supplies:

100V, 110V, 115V, 125V,
200V, 220V, 230V, 250V.

The frequency of the supply should be between 50Hz and 400Hz. The maximum current drawn from the mains will be 0,8A.

## SAFETY PRECAUTIONS

6. Standard safety precautions are to be observed whilst operating or maintaining the sub-assembly.

## MANNING REQUIREMENTS

7. The sub-assembly can be carried, operated and manned by one person.

## OPERATING INFORMATION

8. Operation of the Power Supply Type TRC1801 entails mov= ing the power toggle switch to the up position and observing that the indicator lamp for "power on" is illuminated.

## MECHANICAL DESCRIPTION

Figs (5)3.1 to (5)3.5

9. The Power Supply Type TRC 1801 consists of a mains chassis, to which a front and a rear panel are attached.

10. The main chassis provides the framework upon which are secured three heat-sink assemblies with their associated transistors, three smoothing capacitors, a printed circuit board (PCB) and a mains transformer. (Figs (5)3.3 and (5)3.4).

11. The components accommodated on the front panel are as follows: (Fig (5)3.2).

(a) Power on/off switch S01.
(b) Indicator lamp DS01.
(c) Mains fuse F02 or F01.
(d) Audio output loudspeaker LS01.
(e) Output voltage test sockets:

(i) +12V regulated - RED.
(ii) -12V regulated - BLUE.
(iii) +5V regulated - GREEN.
(iv) Earth potential - BLACK.

NOTE A handle is secured to the front panel to facilitate withdrawal of the sub-assembly from the console.

12. The components on the rear panel are as follows: (See Fig (5)3.5).

(a) Multi-connectors P01 and P02.
(b) Two sub-assembly locating stubs.
(c) Identification and modification plate.

## TECHNICAL DESCRIPTION

### Brief Functional Description

13. The Power Supply Sub-assembly TRC 1801 converts the mains input supply into the following regulated DC supplies:

(a) +12V.
(b) -12V.
(c) +5V.

14. The circuit comprises a mains transformer, three full-wave rectifiers, three series elements and three voltage and current regulators. The majority of the components for the regulator circuits are accommodated on a printed circuit board (PCB 26-044952). The series elements, comprising transistors connected as Darlington pairs, are fitted in heat-sinks.

Detailed Description | Fig (5)3.6

15. The mains supply is connected to the sub-assembly at multi-pin connector P02, contacts 1/2 and 3/4. From thence it is fed to the power on/off switch S01 on the front panel.

16. When switched to the ON position S01 routes the AC mains to the Antenna Preselector TRC 1806 via contacts 16 and 17 of multi-pin connector P02. Additionally the AC mains voltage is applied to the mains transformer T01 primary, via fuse F02 or F01, and the transformer tapping selecting links.

17. Fuse F02 has a rating of 200/250V, 0,8A, and must be inserted into the fuse holder on the front panel in all 200V-250V installations. If the mains supply source is 100V-125V, then the fuse F01, rated at 100/125V 1,6A, is to be inserted. The fuse not in use is stowed in a clip inside the sub-assembly. (Fig (5)3.3).

18. The mains transformer T01 has two primary windings. These are connected in series for 200 - 250V operation, and in parallel for 100 - 125V operation, by the positioning of links. In 200 - 250V installations two links of the same size are positioned between terminals 1 and 6 and another two links, which are movable after loosening the terminal nuts, are used to select the required primary tapping as follows:

(a) 32 connected to 2 and 33 connected to 7 selects the 200V tapping.

(b) 32 connected to 3 and 33 connected to 8 selects the 220V tapping.

(c) 32 connected to 4 and 33 connected to 9 selects the 230V tapping.

(d) 32 connected to 5 and 33 connected to 10 selects the 250V tapping.

19. In 100 - 125V installations, the two links connecting terminals 1 and 6 are removed. One of these is then used to connect terminals 1 and 33, and the other is used to connect terminals 6 and 32. This connects the two primary windings in parallel. Selection of a particular tapping is performed in a similar manner as described for 200 - 250V operation:

(a) 32 connected to 2 and 33 connected to 7 selects the 100V tapping.

(b) 32 connected to 3 and 33 connected to 8 selects the 110V tapping.

(c) 32 connected to 4 and 33 connected to 9 selects the 120V tapping.

(d) 32 connected to 5 and 33 connected to 10 selects the 125V tapping.

20. The secondary of transformer T01 has three separate windings, one for each of the three DC supplies to be produced. The similarity between these three supply and regulating circuits is such that a description of one such circuit will suffice to explain the other two. Therefore the +12V circuit will be described in detail.

21. Terminals 18, 19 and 21 of the secondary of transformer T01 are connected to a full-wave rectifier and smoothing circuit comprising CR03, CR04 and C02. In addition, terminals 18 and 19 are connected to a half-wave rectifier and smoothing circuit composed of CR07 and C05.

22. When power is applied to transformer T01, diodes CR03 and CR04 will conduct during alternate half cycles, charging C02. The positive voltage thus produced is applied to the collectors of a Darlington pair, consisting of the transistors Q02 and Q05. These act as a series control element. Both transistors are normally conducting, current flow being from earth, through R15 and R14, emitter and collectors of the Darlington pair, to positive supply.

23. The current flow through Q11 causes a voltage drop across R05, and it is this voltage which controls the amount that the series element shall conduct and, thus, the amount of current delivered to the load.

24. The emitter of Q11 is held at +12V by the Zener diode CR12. The common point of the diode and the emitter is connected to pin 3 of the integrated circuit Z02, and is the collector supply via a load resistor to an internal transistor, which is connected in the common emitter mode. The collector of this transistor is connected to pin 2, and the base to pin 6 of Z02. Thus if the voltage at pin 6 rises, then that at pin 2 will fall, and vice versa.

25. The voltage at pin 6 of Z02 is supplied from the wiper of R25. This resistor forms part of a voltage divider connected between the regulated output, pin 8 of Z02 and earth. The voltage at the wiper of R25 depends upon the output voltage. If the load resistance increases the current drawn will decrease, and the voltage at pin 8 will rise. This will be sensed at the wiper of R25, causing a rise in voltage at pin 6 and consequently a drop in voltage at pin 2. This causes Q11 to conduct less and reduces the voltage drop across R05.

26. The voltage drop across R05 is the base emitter bias voltage for the Darlington pair, which therefore conducts less, reducing the current supplied to the load. The reverse would be true for a decrease in the resistance of the load. This would cause more current to flow and, consequently, the voltage at pin 6 to fall. The Darlington pair is made to conduct more heavily to supply the extra current required.

27. Overload protection is provided by a system known as "foldback current limiting". If, due to an overload, the current drawn by the load exceeds 2,5A, the voltage developed across R15 causes an internal transistor in Z02 to conduct and increases the voltage at pin 6. An increase in the voltage at pin 6 causes the Darlington pair to conduct less, and a stable point is reached where the Darlington pair supplies approximately 2,0A.

28. The supply for Z01 is obtained from the stabilised +12V supply via resistor R18. Therefore a fault in the +12V supply will be reflected in the +5V supply. However the value of R18 is such that a fault in the +5V circuit does not affect the +12V circuit. Current limiting in the +5V circuit in the event of overload or a short circuited output is similar to that for the +12V output. Current limiting to 2A is performed under overload conditions. The circuit will operate up to 3,7A output under normal loading conditions.

29. The -12V regulated supply operates in a similar manner to the +12V regulated supply. The main difference is that the capacitor C03 in the rectifier and smoothing is unearthed, and the negatively charged plate is connected to the output terminal E. The earth reference point is provided by earthing terminal Z03/8.

30. Under overload conditions the current is limited to 2A by resistor R02. Under normal load conditions the circuit will operate correctly, supplying currents up to 1,3A.

31. The receiver system monitor loudspeaker is fitted in the power supply sub-assembly. It is wired to terminals 13 and 14 of the multi-pin connector P02.

32. A socket is provided for a timer meter, which can be supplied as an optional extra (Fig (5)3.1).

## TEST INFORMATION

33. The following items of test equipment are required to carry out the tests listed:

**Table 3.1 — Test Equipment**

| Item | Qty | Description | CRETE | Commercial Ref |
|---|---|---|---|---|
| A | 1 | Digital voltmeter | CT469 | Solartron LM1420 |
| B | 1 | Multimeter | 0657-99-943-1524 | Avometer Model 8 |
| C | 1 | Millivoltmeter (rms) | | Hewlett-Packard HP3400A |
| D | 1 | GP Oscilloscope | CT536A | Tekronix 545A |
| E | 3 | Variable resistors 1ohm to 10ohms 50W, or (i) 9,2ohms 15,6W (ii) 4,8ohms 30W (iii) 1,30ohms 18,5W | | |
| F | 2 | Connector, socket D series | | Cannon DDM24W7S |
| G | 1 | Variac | | |

34. Before proceeding with the tests or switching on the supply, ascertain that the links are in the correct position for the mains supply available, and that the appropriate fuse is inserted in the fuse holder on the front panel, (F02 for 200/250V mains, F01 for 100/125V mains).

35. No load test. This test is conducted with the sub-assembly TRC 1801 isolated from the console. It will be necessary to make up a supply lead as detailed in tasks (1) to (5), using test equipment item F, 1 off, and a suitable length of three-core cable. Proceed as follows:

(1) Solder the blue lead to terminal 1/2 of the connector.

(2) Solder the red lead to terminal 3/4 of the connector.

(3) Solder the black or green lead to either terminal 6, 7 or 8.

(4) Connect the other end of the supply to a suitable mains plug with the black/green lead to earth.

(5) Insert the extension connector into connector P02.

(6) Connect the digital voltmeter (DVM), test equipment item A, to the -12V and earth points on the front panel.

(7) Switch on the supply and allow a 10 minute warm-up period.

(8) Insert a small screwdriver into the appropriate hole, and engage it in the slot of the pre-set resistor R31. Fig (3)3.1.

(9) Adjust the control to the fully clockwise position.

(10) Record the voltage reading on the DVM.

(11) Rotate the control to the fully anti-clockwise position.

(12) Record the reading obtained on the DVM.

(13) Compare the readings obtained in (10) and (12). These should be between the limits -10V to -14V.

(14) Re-adjust R31 until a reading of -12V $\pm$0,1V is obtained.

(15) Disconnect the DVM from the -12V test point.

(16) Connect the DVM to the +12V test point.

(17) Insert the screwdriver into the appropriate hole to engage in the slot of the pre-set resistor R25.

(18) Obtain readings as in (9) to (12).

(19) The readings obtained should be between the limits of +10V and +14V.

(20) Re-adjust R25 until a reading of +12V ±0,1V is obtained.

(21) Obtain readings for the +5V circuit in a similar manner, adjusting R22. These readings should be between the limits of +4V and +6V.

(22) Re-adjust R22 to obtain a reading of +5V ±0,1V.

(23) Disconnect the DVM.

36. Full load test. The DC voltages measured under these conditions, should not differ from those set in the "no load" test by more than ±10mV.

(1) Switch off the power supply.

(2) Connect test equipment item E(i) between pins 15 and 16 of connector P01.

(3) Connect test equipment item E(ii) between pins 4 and 1 of connector P01.

(4) Connect test equipment item E(iii) between pins 9 and 6 of P02.

(5) Switch on the mains supply.

(6) Switch on the TRC 1801 sub-assembly. Allow a 10 minute warm-up period.

(7) Connect the DVM between the -12V and the earth test points, on the front panel.

(8) Check that the voltage reading is within 10mV of the reading obtained in Paragraph 35 (14).

(9) Disconnect the DVM.

(10) Connect the DVM between the +12V and the earth test points.

(11) Check that the reading is within 10mV of the reading obtained in Paragraph 35 (20).

(12) Connect the DVM between the +5V and the earth test points.

(13) Check that the voltage reading is within 10mV of the reading obtained in Paragraph 35 (22).

37. Ripple and noise. Using test equipment item C, check each of the three dc outputs in turn. The amount of ripple or noise should not be greater than 3mV rms.

(1) Connect the millivoltmeter test equipment item C between the -12V and the earth points on the front panel.

(2) Record the reading obtained.

(3) Disconnect the millivoltmeter from the -12V test point.

(4) Connect the millivoltmeter to the +12V test point.

(5) Record the reading obtained.

(6) Disconnect the millivoltmeter from the +12V test point.

(7) Connect the millivoltmeter to the +5V test point.

(8) Record the reading obtained.

(9) Note that the readings obtained in (2), (5) and (8), do not exceed 3mV rms.

38. Variations in mains voltage. Provided the variations in the mains supply do not exceed 7 per cent, the variation in each of the three dc outputs should not exceed 10mV.

(1) Connect the TRC 1801 sub-assembly to the mains via the variac.

(2) Connect the multimeter across the secondary of the variac.

(3) Adjust the variac to obtain a mains voltage corresponding to the position of the links.

(4) Using the DVM, check that each of the three dc outputs are as stated in Paragraph 35 (14), (20) and (22).

(5) Adjusting the variac, increase and decrease the voltage applied to the TRC 1801 sub-assembly by ±7 per cent.

(6) Check each dc output in turn. Observe that these outputs do not vary by more than 10mV.

(7) Adjust the variac so that the voltage variations exceed 7 per cent.

(8) Observe that the three dc supplies are no longer stabilised ie the outputs rise and fall with the supply voltage when 7 per cent variations is exceeded.

39. Maximum current check. Using the multimeter, and the 1 to 10ohm variable resistor, carry out the following test:

(1) Switch off the mains on/off switch on the front panel.

(2) Connect the multimeter and the variable resistor in series between the -12V test point and earth.

(3) Adjust the multimeter to the 10A dc range.

(4) Adjust the variable resistor until maximum resistance is in circuit.

(5) Switch on the mains on/off switch.

(6) Adjust the variable resistor to decrease the amount of resistance in circuit.

(7) Check that it is possible to obtain an output current of 1,5A.

(8) Carry out the same test for the +12V and +5V outputs. The current obtainable should be 3A and 4A respectively.

40. Short circuit protection. Using the multimeter and the variable resistor as detailed in Paragraph 39 carry out the following test:

(1) Perform the tasks listed in Paragraph 39 (1), (2) and (3) for each of the three outputs.

(2) Adjust the variable resistor for minimum resistance in circuit.

(3) Observe the current readings. This should be 2A on each of the three DC outputs.

## MAINTENANCE INFORMATION

### Removal and Replacement Procedures

41. TRC 1801 removal. To remove the sub-assembly TRC 1801 from the console for replacement test or repair purposes, the following procedure should be adopted:

(1) Switch off the mains supply.

(2) Unscrew the three captive screws securing the TRC 1801 to the console frame.

(3) Grip the black handle located on the front panel and pull steadily but firmly.

(4) When the sub-assembly is loosened ease it forward whilst supporting the underside with the other hand.

(5) Take care when placing the sub-assembly on the test bench as it has no side panels.

42. TRC 1801 replacement. When replacing a sub-assembly the reverse procedure should be adopted.

## FAULT LOCATION

43. Fault diagnosis. When a fault occurs on a sub-assembly type TRC 1801, the following points should be borne in mind:

(a) The common points affecting all three dc supplies are:

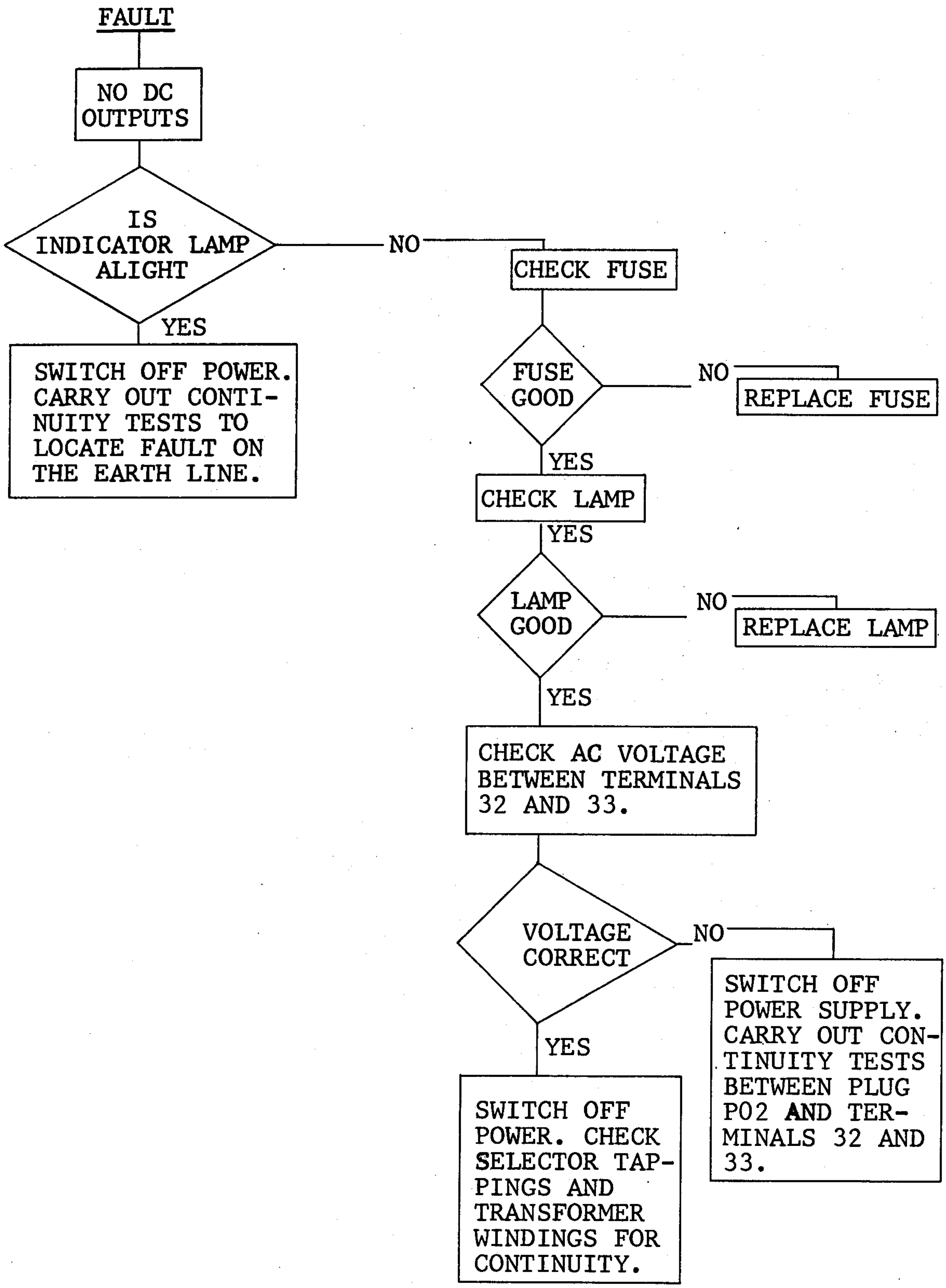
(i) Mains supply.
(ii) Earth return.
(iii) Power on/off switch.
(iv) Fuse.
(v) Transformer.
(vi) Transformer tapping links.

(b) The power supply indicating lamp is connected across the secondary winding of the +5V dc supply circuit, and will light when the power supply switch is in the up position. The brightness of the lamp could indicate a low mains supply or an incorrect voltage tapping.

(c) A fault on both the +12V and +5V is most likely due to a fault on the +12V supply, as the correct operation of the +5V circuit depends upon the +12V circuit.

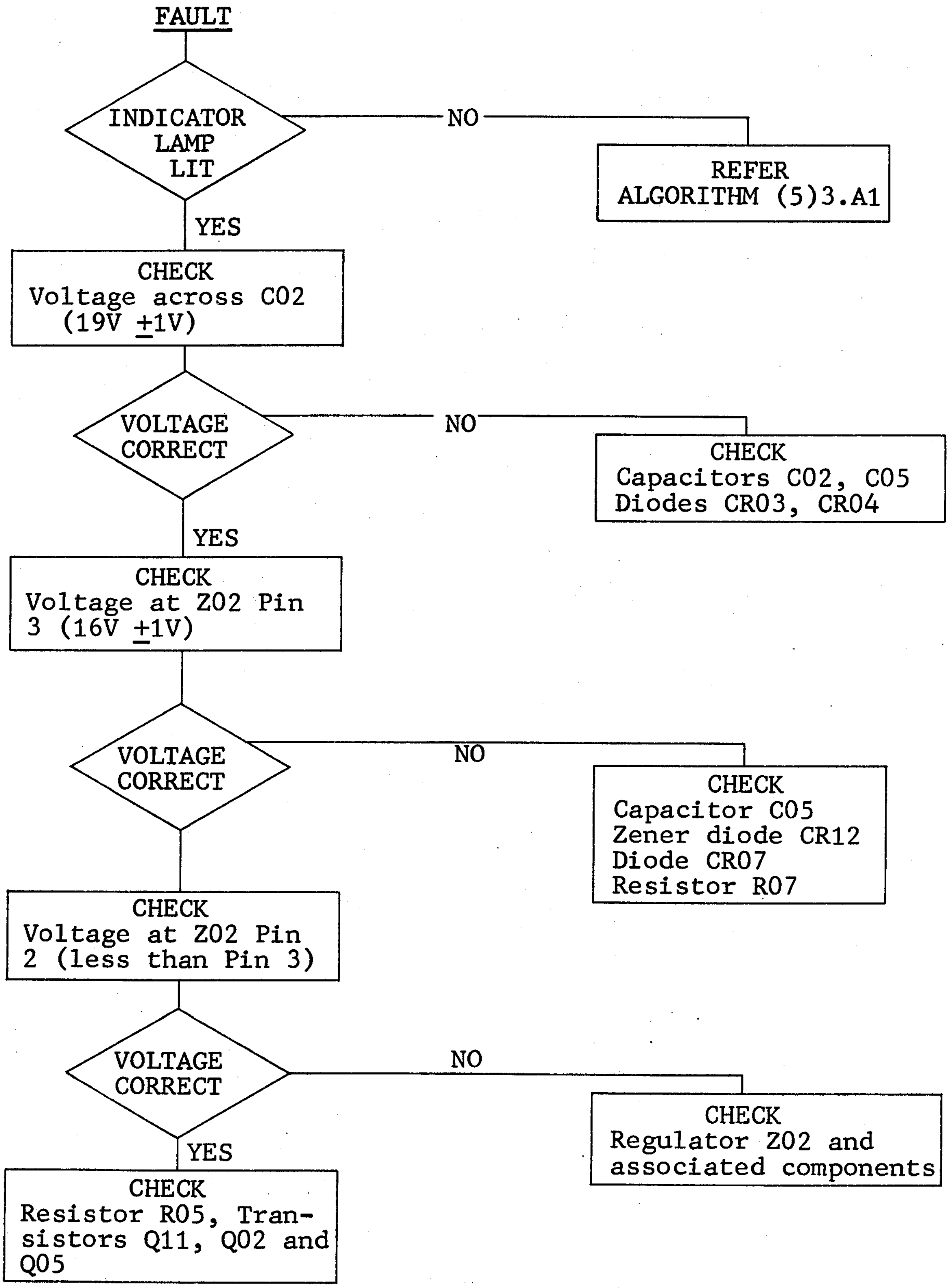
44. The following four algorithms are compiled to assist in fault location.

ALGORITHM (5)3.A1



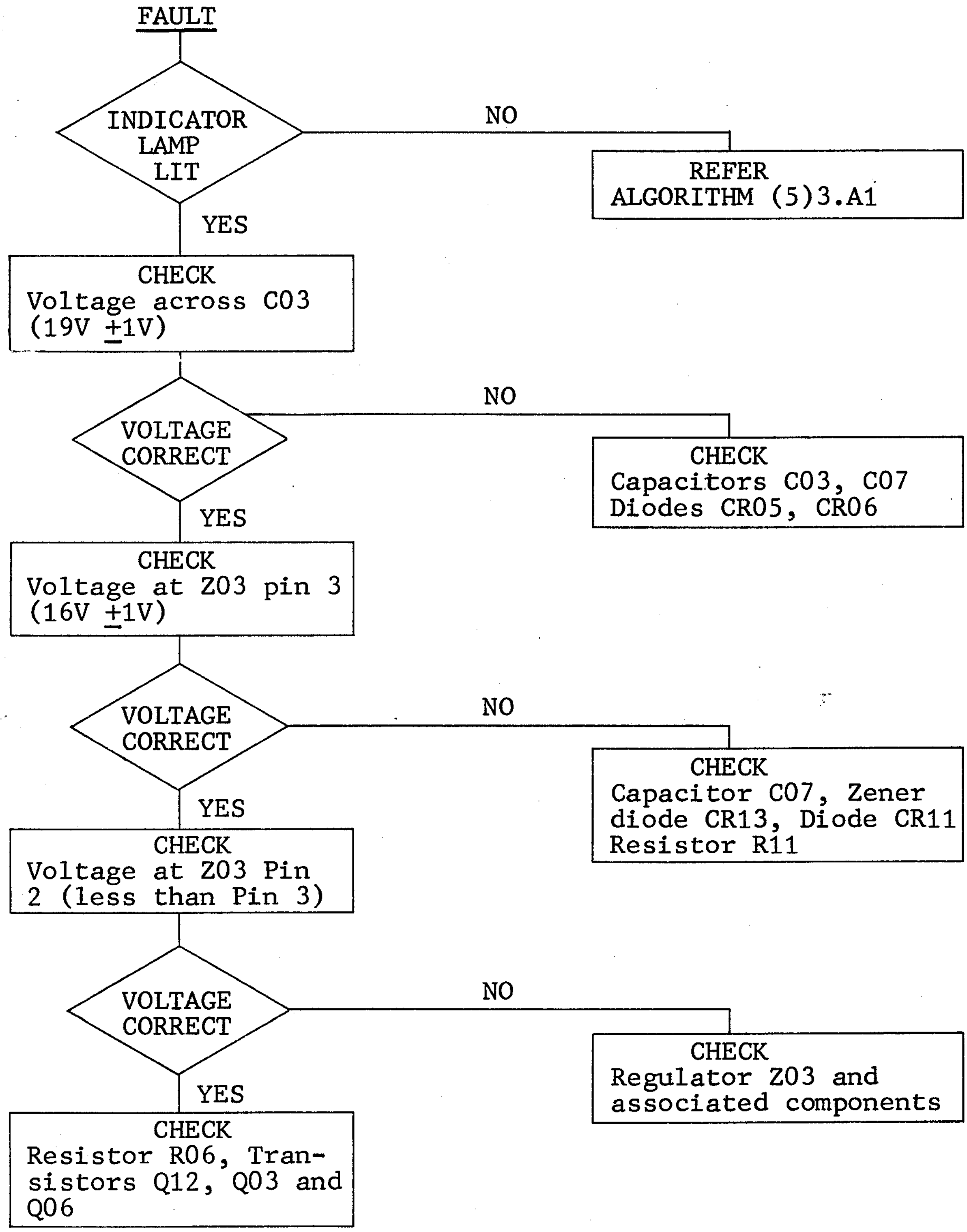
ALGORITHM (5)3.A2

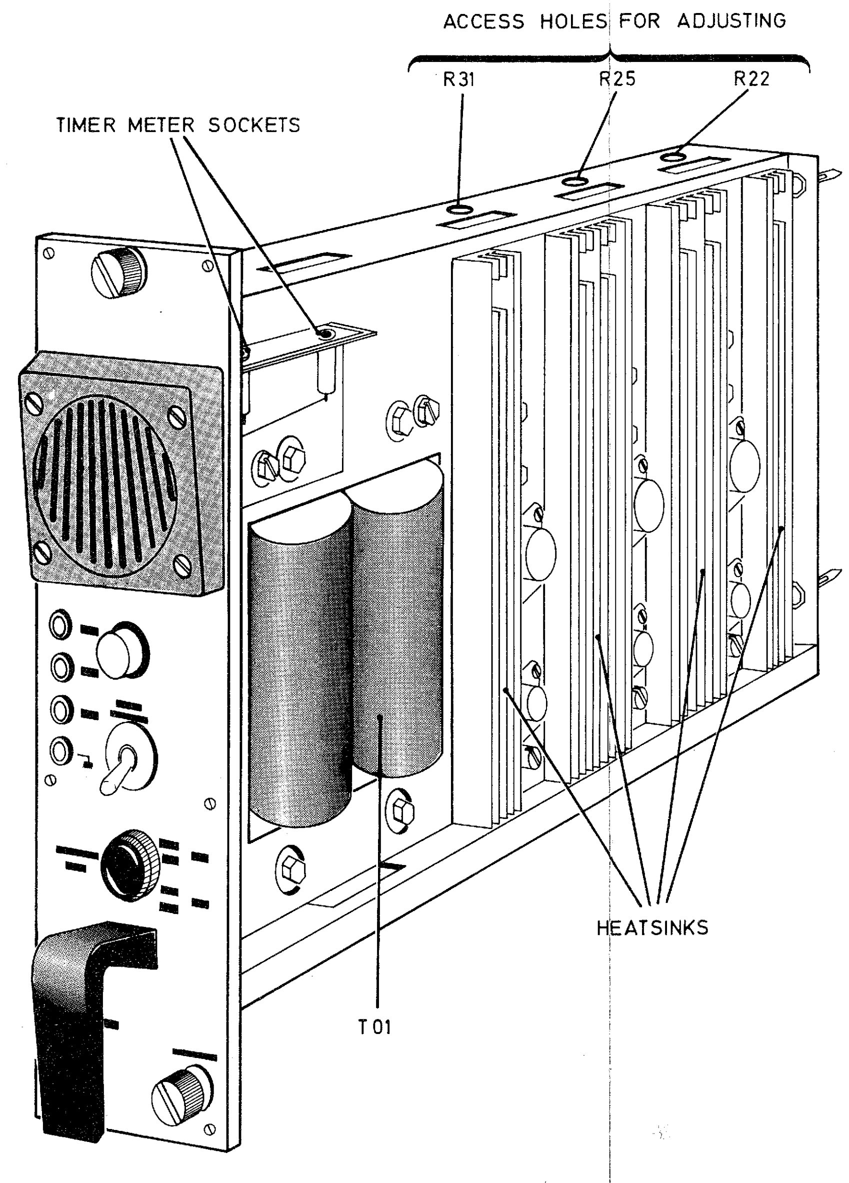
No output, or output low, from +5V and +12V regulated supplies.



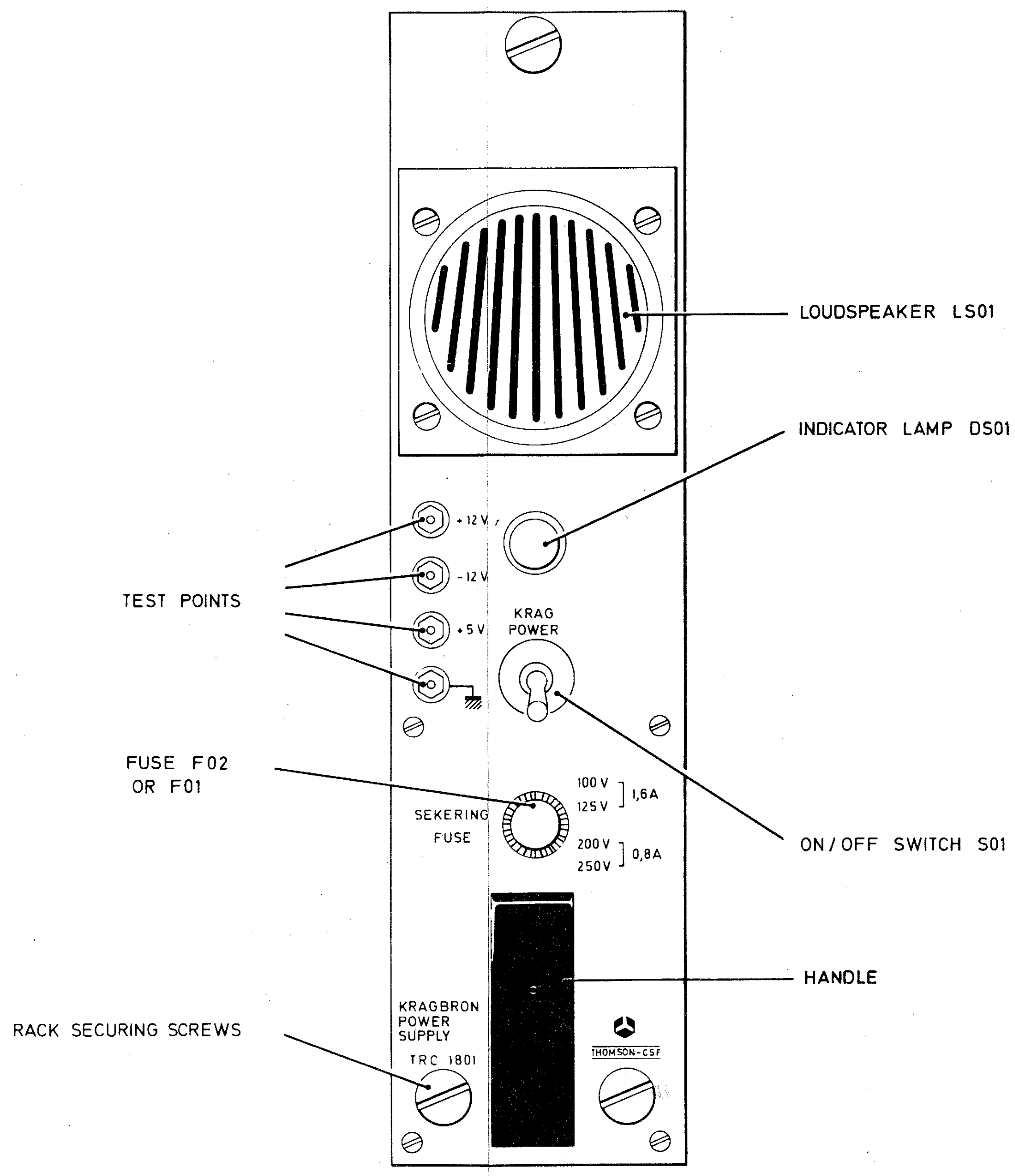
ALGORITHM (5)3.A4

No output, or output low, from the -12V regulated supply.

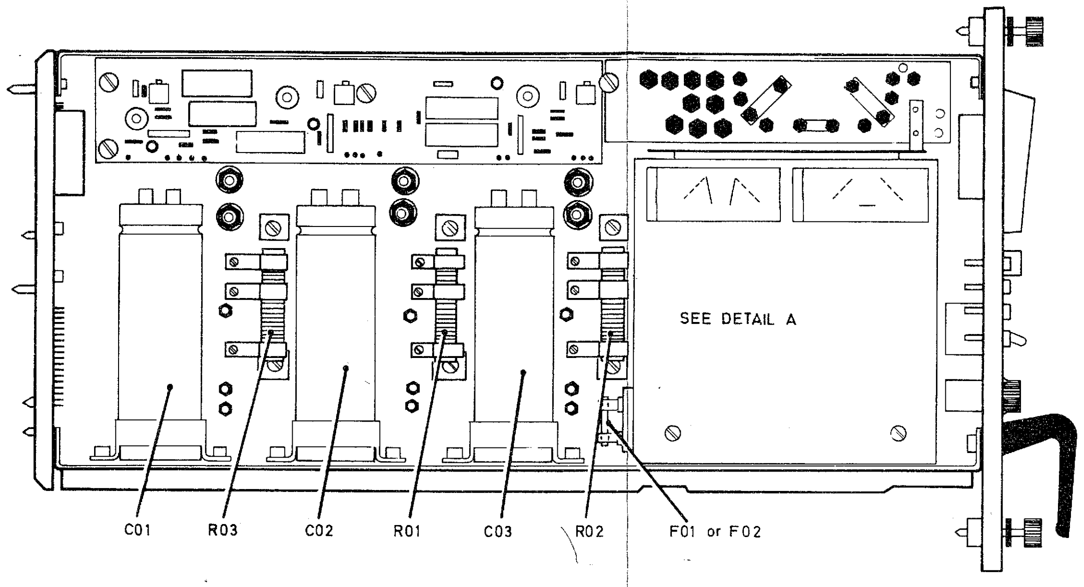


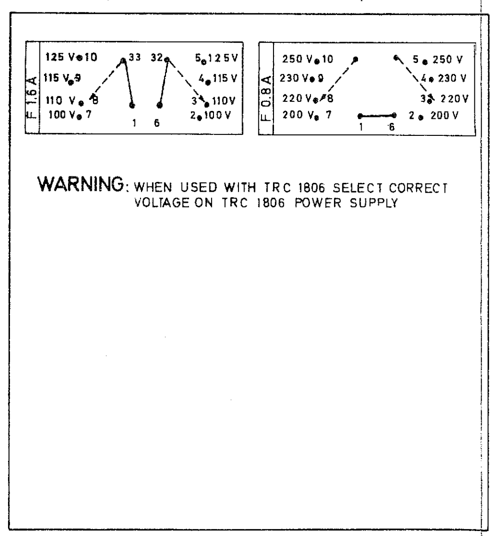



POWER SUPPLY SUB-ASSEMBLY TRC 1801
GENERAL VIEW



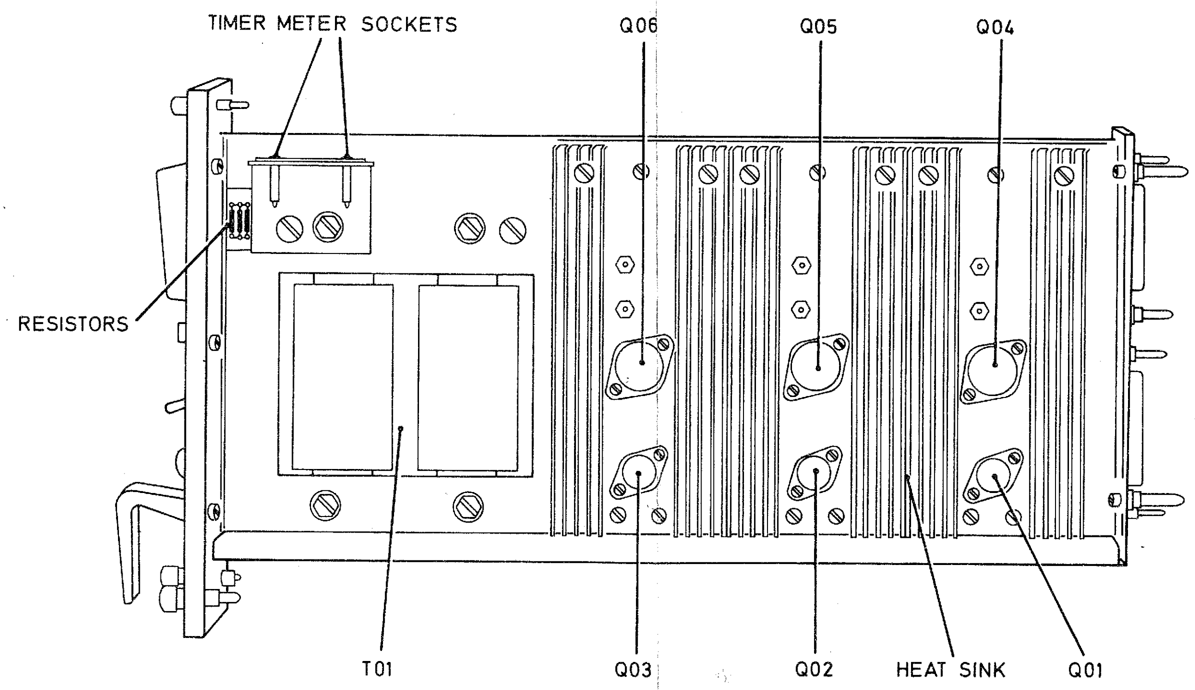

# POWER SUPPLY SUB-ASSEMBLY TRC 1801
FRONT PANEL



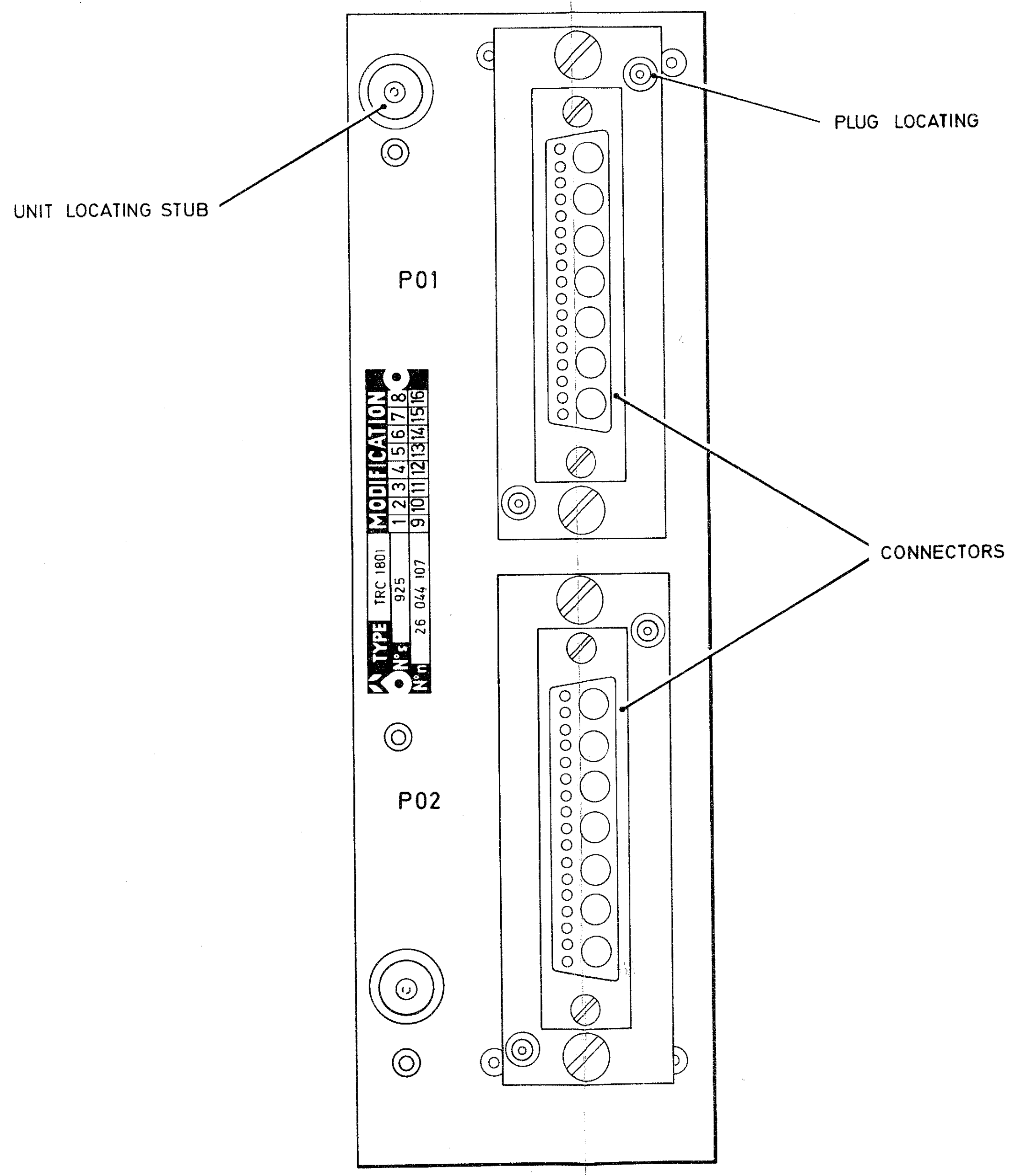




DETAIL A

# POWER SUPPLY SUB-ASSEMBLY TRC 1801
LEFT SIDE VIEW

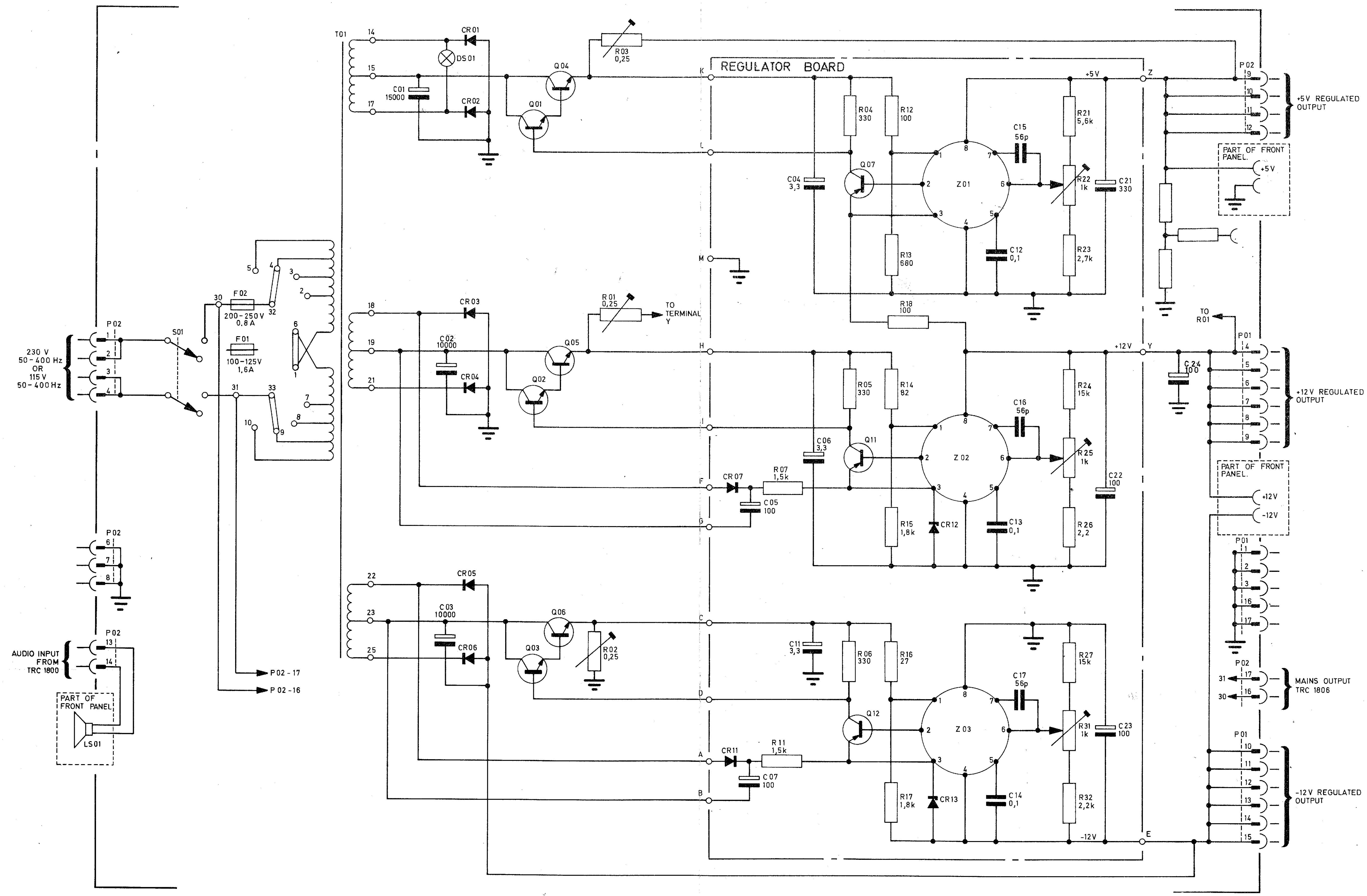



**POWER SUPPLY SUB-ASSEMBLY TRC 1801**
RIGHT SIDE VIEW




# POWER SUPPLY SUB-ASSEMBLY TRC 1801
## REAR PANEL

RESTRICTED




# POWER SUPPLY SUB-ASSEMBLY TRC 1801

CIRCUIT DIAGRAM