SECTION 111

CIRCUIT DESCRIPTION

The supply consists of a mains transformer feeding two bridge rectifier, reservoir capacitor and series regulator systems.

On the 35 volts 10 amps range the outputs of the two systems are paralled by switch S1. The series regulator bank driver inputs are paralled by S1A and driven from the main control circuit board No. 1. On the 70 volts 5 amps range the outputs of the two systems are connected in series. The upper system is driven from the main control circuit board No. 1, and the lower system is driven from circuit board No. 2.

35 Volts 10 Amps RANGE.

Mains Transformer MT1 feeds MR1 from a 37V R.M.S. secondary winding. MR2 is fed from a second 37V R.M.S. secondary. The negatives of reservoir capacitors C21 and 22 are connected to the negative output terminal via fuse F2, switch D1D, current monitoring resistor R67, and switch S3. The positive is connected via series regulators VT17-23 to the positive output terminal. The negatives of reservoir capacitors C25 and 26 are connected via fuse F3, current monitoring resistor R67 and switch S3 to the negative output terminal. The positive is connected via series regulator transistors VT24 - 30 and switch SIC to the positive output terminal. The input bases of VT17 and VT24 are paralled by SIA.

The control circuit of circuit board No. 1 consists of Diodes D1 and D2, and R1 which are fed from a 36-0-36V winding on MT1 and feed reservoir capacitors C1 and C2. This provides an unstabilised D.C. supply for zener diodes Z1 and Z2 which are fed via R2. Z1 and Z2 provide a +15 - 0 - -10 Volt supply for the reference and control amplifier circuitry.

VT4, R11, Z4, R14 and R15 comprise a constant current source which feeds Z3, R8 and T2, pins 3 and 18 being linked externally. Z3 is the main reference zener diode and provides a +5.1V source with respect to Pin 11 which is connected to the + SENSE front panel terminal.

P1 and P2 are the coarse and fine voltage controls on the front panel and are connected between the "-SENSE" terminal and Pin 17 on control circuit board No.1. Pin 17 is connected via R16 to VT5 base. A potential divider comprising P1, P2, T2 and R8 forms the output voltage sensing. The control amplifier VT5, 6, 8, 9, 10 drives emitter follower VT7. This drives the series regulator banks VT17-23 and VT24-30. The connection being from Pin 13 on the circuit board No. 1 via the thermal trip TT1 to Pin 9 on circuit board 2 then via R111 on circuit board No. 2 to Pin 10 and from there to the base of VT17 and via S1A to the base of VT24. The control loop acts in such a sense as to oppose any signal change on VT5 base,

and hence maintains zero voltage between VT5 and VT6 bases. The output voltage Vo is therefore defined as:-

$$Vo = \frac{Vz3(R8 + T2)}{R8.T2}.(P1 + P2)$$

Overload protection is provided by VT11 and 12. P3 with T4 in parallel is connected to R49 and to VT12 base. R33 is connected to the 10 volt auxiliary rail. When the output current is low, the voltage across R49 is low. VT11 is biased off and VT12 is biased on. As output current increases the voltage across R49 increases, and the voltage at VT12 base becomes more positive. This continues until the base of VT12 is sufficiently positive to cause VT11 to begin to conduct. At this point, the voltage across R30 begins to increase until D6 becomes forward biased, and feeds current to VT9 base. This drives VT9 further into conduction, and limits the drive available to emitter follower VT7 and hence to the series regulator transistors. This action causes a fall in output voltage, and VT5 to be driven off. D5 then ceases to conduct and control is now taken over by VT11 and VT12. On further increase of load, the output voltage falls, and output current remains constant. The output characteristic of the supply is therefore constant voltage for loads less than the limit set by P3, the front panel current limit potentiometer and constant current for loads in excess of the limit.

70 volts 5 amps Range.

With switch S1 in the 70 volts 5 amps position, the positives of capacitors C21 and 22 are connected via regulators VT17-23 to the positive output terminal. The negatives of C21 and 22 are connected via fuse F2, and switch SID to the output of regulators VT24 - 30. The positives of C25 and 26 are connected via regulators VT24 - 30 to the negatives of C21 and 22 as above. The negatives of C25 and 26 are connected via fuse F3, resistor R67, and switch S3 to the negative output terminal. The input to regulators VT17-23 is as before, and the input to regulators VT24 to 30 is from Pin 12, circuit board No.2, via S1A. Thus the two regulator systems are connected in series and circuit board No.1 controls the upper regulators VT17-23, and circuit board No.2 controls the lower regulators VT24-30.

The function of circuit board No.1 is the same as on the 35 volt 10 amp range, and this is the master voltage and current limit control of the supply. The control circuitry of circuit board No.2 is merely to hold the voltage at regulators VT24 - 30 output at half the terminal output voltage. D103 and 104, and C101 are a full wave rectifier reservoir capacitor system fed from a 36-0-36 volt transformer winding and supplying D.C. voltage to Z101 and Z102 via R101. This provides a +10 - 0 - -5 volt supply for control amplifier consisting of VT101, 102, 103, and emitter follower VT104. VT104 drives series regulators VT24-30. The base of VT101 is connected to the output of this regulator and VT102 base is connected to the centre of the potential divider R113 and

R112 which is connected between the "+ SENSE" and "-SENSE" terminals. The voltage at the base of VT102 is therefore at half the output terminal voltage. The action of the loop is to maintain zero voltage between the bases of VT101 and 102, and hence the output of regulator VT24 - 30 is controlled at half the terminal output voltage.

The terminal output voltage is controlled by circuit board No. 1, and since switch S1B is closed on this range, the output voltage is now specified by:-

$$Vo = \frac{VZ3 \quad (P1 + P2)}{\frac{(R8 \,//\, T2)\ (R9 + T1)}{(R8 \,//\, T2) + R9 + T1}}$$

where $R8 \,//\, T2 = \frac{R8\ T2}{R8 + T2}$

The voltage Vct at the output of regulators VT24 - 30 is controlled by circuit board No.2 and is specified by:

$$Vct = \frac{R113}{R112 + R113} \quad Vo$$

since R113 and R112 are equal

$$Vct = \tfrac{1}{2}\ Vo$$

General:

T103 and T104 are setting potentiometers to adjust the ammeter full scale deflection. T101 and 102 are setting potentiometers to adjust the voltmeter full scale deflection.

Thermal trip TT1 is a bi-metallic switch which is located on the heat sink assembly. Its purpose is to detect excessive temperatures on the series regulator elements, which could be caused by obstruction of air flow in the fan cooling system or by fan failure.

SECTION 1V

SPECIFICATION

MAINS INPUT.

210, 220, 230, 240 Volts. 50/60 Hz.
105, 110, 115, 120 Volts. 50/60 Hz.

Maximum mains variation tolerated ± 10% of Nominal.

OUTPUT CAPABILITY.

0-70 Volts at 0-5A.
or 0-35 Volts at 0-10A according to the selected range.

Output voltage is continuously variable over either range.

METERING.

Two range voltmeter 35V F.s.d. and 70V F.s.d

Two range ammeter 5A F.s.d. and 10A F.s.d. The meter ranges are controlled by the output range switch to correspond to the output range in use.

LINE REGULATION.

OUTPUT CHANGE FOR 10% MAINS CHANGE.

SHORT TERM LESS THAN 0.01% OR 1mV whichever is greater.

LONG TERM (8 HOUR) LESS THAN 0.05% OR 5mV whichever is greater.

LOAD REGULATION.

OUTPUT CHANGE FOR ZERO TO FULL LOAD CHANGE.

SHORT TERM 0.01% OR 1mV whichever is greater.

LONG TERM 0.05% OR 5mV whichever is greater.

RIPPLE AND NOISE.

LESS THAN 1mV p-p Measured at 80KHz bandwidth.

OPERATING TEMPERATURE RANGE.

0-40°C.

OVERLOAD PROTECTION.

CONSTANT CURRENT LIMIT VARIABLE FROM 0 TO FULL LOAD CURRENT.

DIMENSIONS.	430mm WIDE,	410mm DEEP,	177.8mm HIGH.
	16.93" "	16.14" "	7" "
WEIGHT.	26.2 KGS.	57.75lbs.	

SECTION V.

SETTING UP PROCEDURE.

ACCESS.

Access to the circuitry may be gained by first removing the rear panel, and then withdrawing all the covers, bottom two sides and top, which are located in slots in the four extruded bar chassis members.

Setting the Voltage Ranges and Current Limit.

1) Set the "RANGE" switch to 35V, 10A. Set the COARSE and FINE front panel controls to fully clockwise.

2) Apply mains input to the unit and adjust T2 on circuit board No. 1 to give 35.5 volts output.

3) With the CURRENT LIMIT control set fully anti clockwise, and a short circuit applied to the output terminals, adjust T3 circuit board No. 1 to give zero output current. Remove the short circuit.

4) Connect a load to the output terminals and adjust it to give 11 Amps output current, with the "CURRENT LIMIT" control fully clockwise. Adjust T4 circuit board No. 1 until the output voltage of the unit just begins to fall at 11 Amps. Disconnect the load.

5) Set the range switch to 70V, 5A. Set the COARSE and FINE voltage control fully clockwise.

6) Adjust T1 circuit board No. 1 to give 71 volts output.

Circuit board No. 1 is located on the right hand side of the unit viewed from the front, and is the circuit board nearest to the front panel.

Setting the meter full scale deflections.

1) With the RANGE switch on the 70V 5A position adjust the output voltage of the unit by means of the COARSE and FINE front panel controls to give 70 volts output, as indicated on an accurate external meter. Set T101 until the front panel voltmeter reads 70 volts (full scale)

2) With the RANGE switch on the 35V 10A position adjust the output voltage of the unit to give 35 volts as indicated on an accurate external meter. Set T102 until the front panel voltmeter reads 35 volts. (full scale).

3) With the RANGE switch on the 35V 10A position apply an accurate external ammeter across the output terminals. Adjust the CURRENT LIMIT control to give a reading of 10 amps on this external meter. Set T104 until the front panel ammeter reads 10 amps (full scale).