MCS 920B COMPUTER TECHNICAL MANUAL

CATALOGUE NO. MCB 143

PART 4: POWER SUPPLIES

CHAPTER 1: INTRODUCTION

CHAPTER 1

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CHAPTER 1

1. POWER SUPPLIES - INTRODUCTION

1.1 General

The power supplies for the 920B may be divided into two groups, those that power the Central Processor or additional store and those for the Paper Tape Station (MCB 60). Other units derive their power from the Central Processor or Paper Tape Equipment. For details of possible system configurations refer to Fig. A1 and B4.

1.2 Central Processor Power Supplies

The Central Processor may be powered by either:

(a) MCB 24. This is a conventional series stabiliser power unit which is suitable for normal mains input. It contains relays for ON/OFF sequencing and is intended for rack mounting. It is not suitable when power failure standby facility or military specification of MCB 21 is required.

(b) MCB 21. This is intended for use from a 24-28V nominal d.c. supply. It is supplied in a military case and is designed to meet the same environment as the central processor. If an a.c. input supply is available the unit may be operated by interposing a primary power unit which converts the a.c. input voltage to 28V d.c. Primary power units also contain a battery across their outputs so that in the event of an a.c. power failure the battery power will run the Central Processor for several minutes. Two primary power units are available:

(i) MCB 23. For the normal range of 50-60 c/s mains voltages.

(ii) MCB 29. For 400 c/s 3 phase 115V or 205V.

The two units are similar in construction and are supplied in a military case.

1.3 Paper Tape Equipment Power Supplies

Paper Tape Equipment may be powered by either:

(a) MCB 30. This is a constant voltage transformer type of power unit of simple design. It is designed for mains input at 50 c/s only and is not suitable for operation with small 50 c/s generators.

(b) MCB 32. A conventional series stabiliser power unit designed for the normal range of a. c. input voltages 50-60 c/s and is not subject to the limitations of MCB 30.

For full details of input and output voltages refer to Part 4, Chapters 6 and 7.

2. POWER SUPPLY UNITS

Supply	Input
MCB 24	100-125V or 200-250V 50-60 c/s
MCB 21	20-34V d. c.
MCB 23	As MCB 24
MCB 29	117·5/204V 400 c/s 3 phase
MCB 30	100-125V or 200-250V 50 c/s ± 1 c/s
MCB 32	100-125V or 200-250V 50-60 c/s

All units except MCB 21, will operate within specification with nominal input voltages in the range shown above (with the input subject to ± 10% variation).

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PART 4: POWER SUPPLIES

CHAPTER 2: 24V POWER SUPPLY MCB 21

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CHAPTER 2

24V POWER SUPPLY MCB 21

1. GENERAL

The 24V power supply MCB 21 comprises:

Auxiliary Inverter (C-H Unit)

Main Inverter (A-HG Unit)

ON-OFF Control (A-HH Unit)

Voltage Sensing and Variable Supply (A-HJ Unit)

A schematic diagram of the 24V power supply is given by Fig. D1.

2. AUXILIARY INVERTER (C-H UNIT)

The Auxiliary Inverter provides +6V and -6V for all the main inverter drive control and voltage sensing circuits. It provides these supplies whenever the input voltage is greater than 18V. (The inverter has no ON/OFF control). Fig. D2 gives the circuit of the unit.

2.1 Input Stabiliser

The stabiliser provides a constant 16V output from an input voltage from the nominal 24V input at pins 3 and 7 on the C-H Unit. The circuit comprises VT1, VT2, VT3, VT109 and their associated components. VT109 is the series element and is mounted on the chassis to provide a good heat sink. When the main inverter is running the auxiliary inverter load current is approximately 1A.

2.2 Inverter

VT5 and VT6, transformer T1 and their associated components form a free running inverter, running at 6 Kc/s., the running frequency not being critical and controlled by the inductance of T1.

D4, D5, C4 and R11 reduce voltage spikes when the transistors switch. R12, R13 and R14 provide some forward bias for self-starting. R12 is temperature sensitive for starting at low temperatures.

2.3 The Output Stabiliser

This provides a constant 12V output from the rectified inverter output which is normally about 15V. The circuit consists of VT6, VT7, VT8 and VT9 with their associated components. D14 provides a means of limiting the output current if an excessive load is placed across the output. Since the load required by the main inverter is principally between the +6V and -6V rails, the current flowing in the 0V rail is low hence a simple stabiliser voltage for this rail is satisfactory. This is provided by the two emitter followers VT10 and VT11.

The output stabiliser is set up during manufacture by selection of R26 to give a 12V output. R29 is selected so that the 0V output is midway between the +6V and -6V rail.

The normal load current of the +6V line when the main inverter is on is approximately 900 mA. The 0V current is approximately 100 mA.

3. MAIN INVERTER (A-HG UNIT)

The Unijunction Oscillator count-down circuit, Driver Circuits, Output circuits and Feedback Control of the Main Inverter are given by Fig. D3

3.1 Unijunction Oscillator

The purpose of the oscillator is to set the running frequency of the main Inverter at 1 Kc/s. Since the frequency is counted down by 2, the oscillator runs at 2 Kc/s providing a positive pulse output across R6 every 500 μs. It comprises the Unijunction VT1, C1, and R1-6. The frequency of oscillation is determined by the time constant C1 with the combination R1-R3. On switching on C1 will commence to charge up through R1. When it has charged to approximalely 6V, VT1 will conduct, discharging C1 and producing a short positive pulse at the junction of R5 and R6. This switches on VT2 so that the anode of VT25 is taken to -6V. C2 will be discharged via D2 and the S.C.R (VT25) will be turned off. The voltage at the junction of R7 and R8 will rise to +6V initiating another main Inverter half cycle.

3.2 Count Down Circuit

The circuit is a conventional count down by 2 bistable. It consists of VT7 and VT8 with their associated components. The circuit is triggered by a short positive pulse which is applied to the base of VT6. The negative-going output pulse is applied to the bases of VT7 and VT8, the transistor to be switched off being determined by the steering circuit D11, D12, C8, D13, D14 and C9.

The outputs from the collectors of VT7 and VT8 are fed to the inputs to the driver circuits D25 and D16. The count down circuit thereby selects which driver circuit will conduct for the current half cycle

3.3 Driver Circuits

The drivers circuits provide from the logic inputs the necessary drive power for the output transistors VT103, VT104 and VT105 or VT106, VT107 and VT108. The input to the driver circuit is on the cathodes of D15, D16, D17, D 24 and D26. There are 3 conditions for a driver to be on. These are:

(a) The input on pin 12 (from shut-down logic) is a logic '1'

(b) The input from the count down circuit is a logic '1'

(c) The input from the Unijunction Oscillator (junction of R7-R8) is a logic '1'

The length of time the output transistors are switched on is determined by condition (c) thus the output voltage is controlled by the unijunction VT1 and its operation with the S.C.R. VT25. Both driver circuits are identical.

Consider the input to VT9. If the inputs on the cathodes of D15, D16 and D17 are all at logic '1', VT9 will be switched on, switching on VT14, VT15 and VT16. The output from VT16 is coupled by the transformer T1 to switch on to saturation the main driver transistors VT103, VT104 and VT105.

If one of the 3 inputs to VT9 is not at logic '1' it will be switched off but if the output from the shut down logic is at logic '1' (Main Inverter on) VT10 will be switched on. This will switch on VT11, VT12 and VT13. The output from VT13 is connected via the current limiting resistors R46, R47, R48 and R49 to the transformer T1. This ensures the transformer is not saturated when VT16 is switched on and also ensures that VT103, VT104 and VT105 can be switched off rapidly.

3.4 Output Circuits

The output from the transformer T4 is a modified square wave, the length of time the output transistors are on during a half cycle is determined by the input voltage and controlled by the feedback circuit. The feedback winding is rectified by a bridge rectifier and its mean value determined. The purpose of the feedback to keep a constant mean output voltage for varying input voltage by controlling the 'ON' period during the half cycle. The constant mean level output voltage is full wave rectified and smoothed by the choke input filter.

The +6V and -6V output voltages depend upon this characteristic of the choke input filter. The 19V output voltage is also required to be reasonably constant.

The transformer T2 on the -6V output voltage is provided to equalise the +6V and -6V outputs. By altering the tappings on the transformer (shown on taps 5 and 8) the voltage in series with main -6V output winding may be increased or decreased by small amounts to adjust for variations in diode voltage drops, transformer winding resistance, etc. The capacitors across the main inverter transformer (T4) secondary windings (C117-C120) are to reduce switching voltage spikes.

The -16V bias supply is obtained by adding 10V to the -6V supply. The 10V circuit is comprised of a bridge rectifier (D33-D36) current limiting resistors (R109-R111) and 2 off 5V Zener diodes (D37 and D38) connected in series.

3.5 Feedback Control

The output from the feedback winding is rectified by the bridge rectifiers (D7-D10) to produce a d.c. voltage across R25, R26 and R27. This is passed through the mean level network C3, C5, C6 etc.

The smooth d.c. voltage across C3 is passed through the potential divider R18 and R19 etc. The output voltage is set up by adjustment of the resistor network R19-R21, and the constant output voltage with varying input voltage is set by adjustment of R25 and R26. These are set during manufacture and should not normally require adjustment.

The output from the mean level circuit is input to the base of VT5, which forms a comparator amplifier with VT4. The output from the collector of VT5 controls the current flowing through VT3. The base of VT4 is a reference voltage but may be adjusted by ± 15% when margins are applied.

The capacitor C2, which is across the input of S.C.R VT25 is charged up by the current flowing through VT3. Hence variation in the potential at the base of VT3 varies the rate at which C2 will charge. When the cathode of D3 has charged to approximately 6V relative to the -6V supply, the Zener diode D3 starts to conduct and provides sufficient trigger current to switch-on VT25. The action of switching on VT25 takes the junction of R7 and R8 to below 0V and switches off the particular drive transistor that was conducting during that cycle.

At the initiation of the next cycle, when VT1 fires, VT2 will be switched on, switching VT25 off and discharging C2 via D2.

3.6 <u>+15V Variable Stabiliser</u>

The stabiliser which is variable to provide variation in store inhibit current with temperature, is derived from the 19V output from the main inverter. The magnitude of the 15V output is controlled by a reference voltage that is 8.6V at 20°C and varies at -0.45% per °C. The reference voltage circuit (A-GZ unit) is in the 920B central processor.

Since the reference voltage requires 15V for its generation, sufficient voltage must be applied to the A-GZ unit before a reference voltage can be obtained. The starting resistor R54 (Fig. D5 refers) provides approximately 12V to enable a reference voltage to be provided to the unit. It should be noted that the 15V load current on starting does not include a significant store load current.

The circuit is basically similar to the auxiliary inverter stabiliser with the series element in the negative voltage line.

4. CONTROL (A-HH UNIT)

The control board is constructed in LSA logic and derives its +6V and -6V supplies from the auxiliary inverter (Fig. D4 refers). Besides controlling the ON/OFF sequence it switches the inverter off, should:

(a) the input voltage be below 20V;

(b) one of the output voltages be incorrect;

(c) the internal computer temperature be over 66°C.

4.1 ON Sequence

In the normal mode of operation (without start address plug) the unit is switched ON by taking pin 6 of element K to 0V. The output from K11 goes to logic '0' switching the output of the ON/OFF statisiser at L12 to a logic '0' provided L3, L4 and L5 are all at logic '1'. The output from L12 is inverted to give the logic '1' signal 'INVERTER ON' to the A-HG unit.

After 100ms the output C11 from the delay circuit goes to a logic '1' and input to D2. D3 and D1 will also be at logic '1' if the output power is correct and the computer is not over temperature so D11 goes to a logic '0' sending the signal $\overline{\text{POWER}}$ $\overline{\text{SUPPLY}}$ $\overline{\text{CORRECT}}$ to the computer.

If there is a faulty output voltage rail, the logic term OUTPUT POWER CORRECT will be at logic '0' so that G1 will be a logic '1'. This enables the error statisiser to be set which then resets the ON/OFF statisiser.

4.2 OFF Sequence

Depressing the OFF button removes the 0V from the input to K3 so that the ON/OFF statisiser is reset when L3 goes to a logic '0'. As soon as the statisiser is reset D3 will go to a logic '0', $\overline{\text{POWER}}$ $\overline{\text{SUPPLY}}$ $\overline{\text{CORRECT}}$ will go to a logic '1' stopping the computer.

4.3 Operation in AUTO

If a start address plug is fitted $\overline{\text{AUTO}}$ is taken to 0V by a link within the start address plug. The unit will then switch-on whenever the input voltage is greater than 20V and less than 34V. This is controlled by the logic signal $\overline{\text{Input}}$ $\overline{\text{Power}}$ $\overline{\text{Correct}}$ going to logic '0' so that L4 goes to a logic '1' allowing the ON/OFF statisiser to be set. The 20ms delay ensures the input voltage is established before the inverter is switched on. Should the input voltage drop below 20V or rise above 34V the ON/OFF inverter is reset immediately; the delay circuit is not operative for positive-going input pulses.

4.4 Initial Reset

The ERROR statisiser requires an initial reset when the unit is switched on in the AUTO mode. The reset is provided by the S.C.-R circuit, VT27 and associated components, on the A-HJ unit. As soon as the auxiliary supplies are established C10 and C11 will charge up via R66. When they have charged up to approximately 6V relative to the -6V supply the S.C.R is triggered on. Whilst the capacitors are charging up, the output at element E13 will be at logic '0', resetting the statisiser (if necessary).

4.5 Conditions Causing Switch OFF

If the unit switches OFF, the output voltages should be checked to determine if the Output Power Correct line, the $\overline{\text{Input Power Correct}}$ line, or the $\overline{\text{Over Temperature}}$ line is causing the switch-off. Having determined which of the three lines if causing the trouble, the particular sensing circuit should be examined.

5. VOLTAGE SENSING CIRCUITS (A-HJ UNIT)

5.1 Input Voltage Sensing

The input voltage sensing is comprised of two long tail pair comparators VT1 and VT2, VT3 and VT4 (Fig. D5 refers). The output from these comparators is fed to the base of VT5. When the input voltage is within range VT5 is switched off, providing no base drive for VT6.

VT7 is a free running Unijunction Oscillator producing a positive pulse at the base of VT8 every 20µs This keeps C4 discharged, keeping VT9 off and VT10 switched on. The logic signal $\overline{\text{INPUT POWER CORRECT}}$ is connected to the control logic.

If the input voltage goes out of range (20-34V) VT6 will switch-on stopping the Unijunction Oscillator. After missing one pulse C4 will have charged up sufficiently for VT9 to switch-on and VT10 to switch-off.

5.2 Output Voltage Sensing

The +6V supply is sensed by two long tail pair comparators VT11 and VT12, VT13 and VT14. The output is fed to the base of VT15 which is normally switched off when the +6V is within the range 5.5V to 6.5V. If the voltage goes out of this range VT15 switches on, switching on VT16 if $\overline{\text{Margin Test Inhibit}}$ is not at logic '0'. The output from VT16 will switch VT22 via VT21 resulting in the control logic down sequencing the inverter.

The 15V supply, variable with temperature, is monitored so that if it falls below 10V the inverter will switch off. If the supply is greater than 10V, the potential at the base of VT 17 is too positive for it to be switched on so that VT18 is off. If the supply is too low, VT17 and VT18 will switch on.

The -6V and -16V are sensed in a similar manner. They are set up during manufacture so that VT19 and VT20 will not conduct unless the supplies fall below -5V and -10V respectively.

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PART 4: POWER SUPPLIES

CHAPTER 3: COMPUTER POWER SUPPLY MCB 24

CHAPTER 4

50-60 c/s COMPUTER POWER SUPPLY MCB 24

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COMPUTER POWER SUPPLY MCB 24

1. INTRODUCTION

The MCB 24 power supply is operated directly from 100-125V or 200-250V mains at 50-60 c/s.

The unit provides all stabilised voltages required by one MCB 920B computer or up to a maximum of three additional store units.

A relay-operated control circuit is included to enable the power supply rails to be switched on and off in sequence without loss of the stored program in the computer.

The three stabilised output voltages may be adjusted by means of lockable potentiometers mounted on the front panel.

Current-limiting of the output voltages can be adjusted by means of presets on the side of the unit.

Monitor points on the front panel enable the output voltages to be checked.

2. CONSTRUCTION

The unit is supplied for rack mounting with a standard 19" x 7" panel. Plug connections are made at the rear of the unit, with the locating key placed upwards.

All fuses are located on the front panel with current ratings and voltages marked.

3. OUTPUT VOLTAGES

The output voltages are isolated from chassis earth and consist of three stabilised and two unstabilised voltages.

3.1 Stabilised Voltages

The stabilised output voltages are protected from short circuits by current-limiting.

(i) +6.4V at 10.5A (to provide +6V at the computer)

(ii) -6.0V at 3.0A (0V line common to +6V supply)

(iii) +15V variable, nominal supply at 3.0A.
This is isolated from all other power supply circuits, but the negative side is connected to 0V in the computer.

An 8.6V reference voltage at 20°C, originating in the computer, varies the 15V supply at -0.45%/°C with temperature.

3.2 Unstabilised Voltages

(i) 10V d.c. at 80mA. The positive side of this supply is connected to the negative output of the -6V, 3.0A supply to provide a -16V bias supply for the store.

(ii) 24V d.c. at 1A. This supply is provided for the relay control circuits for switching other supplies.

4. INTERCONNECTIONS

Two cables connect to the rear of the unit:

(i) mains input power cable

(ii) d.c. supplies and control signals to the computer.

Connection details are given by Fig. A1.

5. OPERATION

The MCB 24 circuit, Fig. D6, comprises three series stabilisers, two unregulated supplies and an ON/OFF control circuit.

5.1 ON/OFF Sequencing

The power supply unit is switched ON or OFF by means of three control lines connected to socket 2 and fed to the control circuit. These lines, designated ON, OFF and ON/OFF common are connected to pins X, Y and Z respectively, where they govern the action of the sequencing relays of the control circuit.

In the quiescent state, (the ON and OFF buttons in the computer control unit MCB 40, 41 not pressed) pins Y and Z are linked by the OFF button. When the ON button is pressed, pin X is connected to pin Y.

When the mains supply is connected to the unit, the control circuit (Section C of Fig. D6) is supplied with 19V r.m.s. from a secondary winding of the power transformer. This voltage is rectified by the full wave bridge D19 and filtered by C21. A voltage of 24V d.c. is developed across load resistor R.50 which may be measured by means of monitor jacks SK 10 and SK 11. The 24V supply is used for relay sequencing and d.c. voltages at relays C and D.

When the ON button (Control Unit) is pressed, RLA pin 3 is taken to -24V, and since pin 10 is at +24V the coil is energised. RLA/2 contacts 6 and 7 are made, maintaining the base of VT 28 at 0V when RLB is energised by RLA/1. RLB is held on after the ON button is released by contacts RLB/2. The actuation of RLB/1 energises RLD and RLC, switching on the stabilisers and providing 24V (+ve) on pin V to switch-on other power supplies in the system.

C25 continues to charge via RLA, D17 and RLA/1 to -24V. After approximately 1 second, the charging current is insufficient to hold RLA on, so that the contacts RLA no longer maintain the base of VT 28 at 0V. The output of VT 28 (at pin T) $\overline{\text{Power}}$ $\overline{\text{Supplies}}$ $\overline{\text{Correct}}$ is routed to the computer allowing it to be started.

The hold on circuit for RLB is broken when the OFF button is pressed so that RLB is released thus causing $\overline{\text{Power}}$ $\overline{\text{Supplies}}$ $\overline{\text{Correct}}$ to go to logic '1' and releasing RLC and RLD. C25 is discharged by R51 and RLB/1.

With $\overline{\text{Power}}$ $\overline{\text{Supplies}}$ $\overline{\text{Correct}}$ at logic '1' the computer is placed in the 'Reset' state on completion of the current cycle, prior to the decay of the power supplies.

NOTE: Earlier models of MCB 24 employed no VT 28 circuit; the two relay contacts RLA/2 and RLB/3 were connected in series between pins T and U (of socket 2). RLA/2 was normally closed and RLB/3 normally open.

5. 2 <u>Stabilisers</u>

Three series regulator stabilisers of similar design provide +6V, -6V and +15V variable supplies. Differences are stated in the appropriate section.

5. 2. 1 <u>+6V Stabiliser</u>

The +6V stabiliser provides the main logic voltage rail for the computer, control and display units, and is fed from an 11V a. c. secondary on the power transformer via full wave bridge D3; smoothing is provided by C2, C3 and C4. When RLC/2 is energised, the rectifier output is applied to the series stabiliser transistors VT 3, VT 4, VT 5, and VT 6.

The output of the four parellel transistors, connected as emitter-followers, is controlled by a feedback amplifier (VT 1, VT 2, VT 8, VT 9, VT 10 and associated components).

The output voltage is sensed by the comparator amplifier VT 9, and VT 10, and may be adjusted by altering the proportion of the output voltage being compared at the base of VT 10 with a reference voltage from Zener diode D4. The comparator amplifier is provided with a stabilised supply of 13V via Zener diode D2. Transistor VT 3 is connected as a common base amplifier so as to have a high collector output impedance and give the comparator amplifier a high voltage gain.

The output voltage from the comparator amplifier is applied to the base of VT 1 whose emitter is connected to the base of VT 2.

The series of emitter-follower connections ensure a low output impedance which is further reduced by the gain of comparator amplifier VT 8, VT 9 and VT 10.

The rectified d.c. output voltage is adjusted during manufacture so that the voltage across any of the transistors VT 3, VT 4, VT 5 and VT 6 is at least 2V on full load when the mains voltage is 10% low and the output voltage is 10% high. It is normally 4-5V.

The output is protected against overload by the action of VT 7 which, under normal load conditions, is not conducting. If the load is increased, the voltage across R5 will increase until VT 7 conducts, reducing the drive to VT 1. The point at which current-limiting occurs can be varied by adjustment of RV1 and is normally set to 10.5A. The output voltage is automatically restored when any overload is removed.

5.2.2 -6V Stabiliser

The design of the -6V stabiliser is essentially identical to that of the +6V stabiliser except that only two series transistors (VT 13 and VT 14) are required. Current-limiting is set to 3A.

5.2.3 +15V Variable Stabiliser

In this stabiliser, comparison of output voltage against a Zener diode reference is not used. Instead, an external reference voltage of 8.6V (at 20^{o}C) from the computer is used. The stabilised output voltage is made to vary with the external reference so that the store inhibit current is compensated correctly. Current-limiting is set to 3A.

5.3 Unstabilised Supplies

The -16V bias supply is obtained by adding a 10V unstabilised supply of 80mA to the -6V supply. The 10V supply is rectified by D 11 and smoothed by C 14.

The 24V for relay sequencing is derived from the full wave bridge D 19 and smoothed by C 21.

5.4 Margin Tests

The +6V, -6V and 15V variable supplies cannot be varied by the Margin Test Unit (MCB 52). The voltages are varied by adjusting the appropriate preset resistors. Each voltage rail has a range of rather greater than ± 10% about its nominal and care must be exercised to ensure that the voltages are reset correctly at the end of any margin tests.
NOTE: Voltages should be measured at the computer; the monitor points at the front of MCB 24 should only be used as a guide.

5.5 Load Currents

The load taken from the voltage rails is typical and is included below to give some assistance in establishing whether fault conditions exist.

Voltage	Current	Remarks
250V a.c.	0.55A	Display Unit not connected
	0.66A	Display Unit connected
+6V	7.5A	Display Unit not connected
-6V	0.9A	Display Unit adds 1.1A on each line.
+15V	1.1A	
-16V	0.025A	

NOTES: Figures quoted were measured when running Test Program X3. The +15V load is dependent upon store operation. The +6V load does not vary by more than ±0.5A.

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CATALOGUE NO. MCB 143

PART 4: POWER SUPPLIES

CHAPTER 4: SINGLE PHASE PRIMARY POWER SUPPLY MCB 23

CHAPTER 4

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CHAPTER 4

SINGLE PHASE PRIMARY POWER SUPPLY MCB 23

1. INTRODUCTION

The primary power supply unit operates from the normal range of mains inputs to give a nominal output of 24V d. c. The unit incorporates two NIFE (Encapsulated Nickel Cadmium) batteries which provide a supply to the load in the event of temporary failure of the a. c. supply. The batteries allow a mains failure for approximately five minutes when loaded with a computer. If more than one mains failure occurs in an hour, the batteries may be discharged in less than five minutes. Under normal operation, the a. c. input is converted to a stabilised d. c. output which provides load current and at the same time charging current for the batteries. For this latter purpose, the output voltage is rendered dependent on battery temperature in order that the cells are not overcharged.

The POWER ON switch turns on the d. c. output when operated.

2. CONSTRUCTION

The front panel is $16\frac{1}{2}$" x $6\frac{3}{4}$" with the chassis it comprises a single unit that can be removed from the cabinet.

Two $\frac{3}{4}$" holes are provided in the front panel to allow the escape of any gasses that may be released by the batteries.

The following equipment is mounted on the front panel:

POWER ON Switch	S1. A & B
Mains Fuse	FS1, 5A
Mains Indicator Lamp	Red (Neon) ILP1
D. C. Output Lamp	White ILP2
Mains Input Plug	15 - PL1
Output Connectors	15 - SKT2, 15 - SKT3

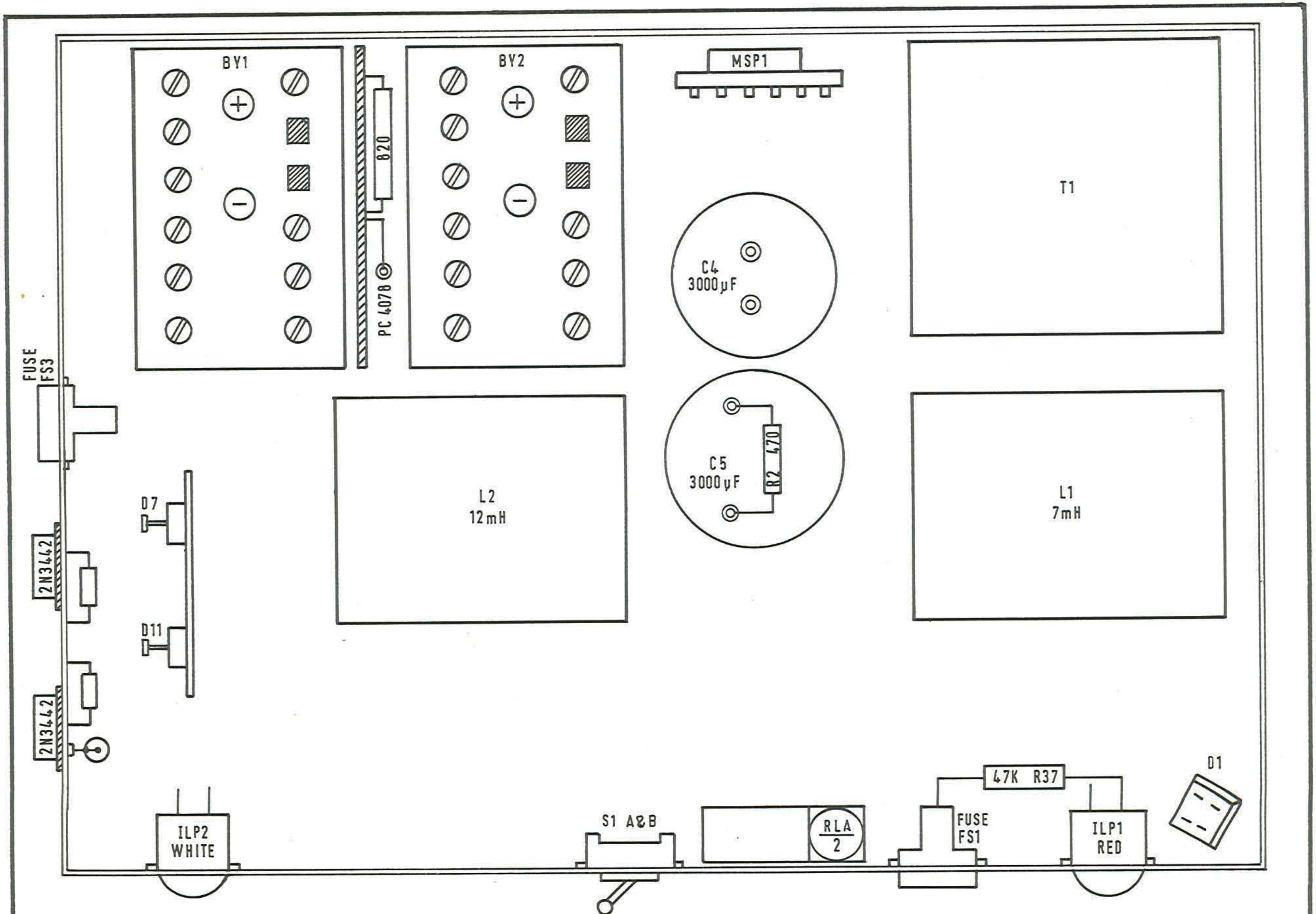

Fig. a MCB23 Power Supply Unit (Top of Chassis) (Issue 1)

The output connectors and input plug are so positioned that the locating keys point to the top of the chassis.

The heavier electronic components are placed on the top of the chassis. (Fig. a refers).

The four power transistors VT2, 2N3442 - VT5, 2N3442 are mounted on the left-hand side of the chassis. The output fuse (FS3 10A) is also mounted on the left-hand side of the chassis.

3. INTERCONNECTIONS

The interconnections between the MCB 23 power supply, the computer power supply and filter unit are given in Fig. A1 (Pt. 1, Chap. 1).

3.1 Input

Input interconnections between power unit socket 15-PL1 and filter unit socket 9-SKT3 are given in Table 1.

TABLE 1

15-PL1 TO 9-SKT3	FUNCTION
A	Line
B	Neutral
C	Mains Earth (Chassis)
D	Unused
E	Unused

3.2 Output

Both output sockets 15-SKT2 and 15-SKT3 are connected in parallel.

Output interconnections between power unit sockets 15-SKT2 or 15-SKT3 and the input socket 14-PL1 of the computer power supply are given in Table 2.

TABLE 2

15-SKT2 OR 15-SKT3 TO 14-PL1	FUNCTION
A	+24V Linked to B
B	Linked to A
C	-24V Lined to D
D	Linked to C
E	Mains Earth

4. INPUT AND OUTPUT VOLTAGES

4.1 Input

The unit requires a 50/60 c/s input from the a.c. mains supply. Plug and socket tappings at terminal board MSP1 enable the unit to accommodate input voltages between 100-125 and 200-250V a.c. The power transformer T1 is protected by 5 ampere fuse FS1 in its input line.

4.2 Output

The output is approximately 28V d.c. when the batteries are being charged and 24V when the input is removed.

5. OPERATION

A schematic diagram of the unit is given in Fig. D7. Mains presence is indicated by the red neon pilot lamp, ILP1. When the unit is switched on, 24V to 28V appears at the d.c. output and is indicated by lamp ILP2.

Transformer T1 has an electrostatic screen between the primary and secondary windings to reduce line noise. A capacitor C1, across the secondary, also helps to by-pass noise peaks.

The low voltage output of T1 is rectified by D1, smoothed by choke L2, with the shunting resistors R38 and R39 connected across the choke to ensure overall stability of the power supply system. Capacitors C4 and C5 are reservoir capacitors.

5.1 Operation of the Switching Regulator

To provide a regulated d.c. voltage output, a switching regulator is employed. Choke L1 is an energy storage device, the transistors VT3, VT4 and VT5 function as a switch which either closes or breaks the junction between D7, L1 and the reservoir capacitors C4 and C5. A fuse FS2, included in this path, affords protection in the event of catastrophic failure of the regulator.

Capacitor C6 is designed to act as a filter in conjunction with L1, to minimise output ripple and to hold the output at constant potential. On closing the switch, the voltage-drop across L1 is equal to the potential difference between the reservoir and output capacitors (disregarding resistive drops and the voltage across the 'bottomed' transistors). When the switch is open, D7 clamps at positive rail potential as the choke current attempts to decay.

It may be noted that the switching elements are in the negative supply line. The positive line is a through-connection from reservoir to output, interrupted only by current sensing resistors R17 and R21.

The current through the switch is nearly the same as the output current, and the control of output voltage is effected by control of the on/off ratio of the switch with time.

Power losses are due to:

(1) resistance in any part of the current path

(2) choke core losses

(3) the voltage-drop of the switched power transistors in their 'on' state

(4) the transient dissipation of the transistor during switching.

Conversion efficiency is about 85%, and a frequency of about 2K c/s chosen where loss (4) is of less effect.

5.2 Closed Loop Voltage Regulation

The control of output voltage is analogous to that obtained by a series regulator except that the on/off switching times are controlled as opposed to the current drive control used in a conventional series regulator.

If it is assumed that VT1 is not conducting, sufficient current flows through R8 into VT2 base to ensure that a current in excess of the full rated current can flow through the power transistors VT3, VT4 and VT5. If VT1 is now 'bottomed', there can be no drive supplied to VT2, since the Vce. sat of VT1 (a planar device) is low. At the same time, a low external impedance is presented to the base of VT2 to facilitate removal of a stored charge. The action of the Bose oscillator VT8 and VT9 is to switch between these two modes and hence to provide the switching action described in Sec. 5. 1.

VT6 and the complementarily connected VT7 and VT10 are current feeds for VT8 and VT9 emitters respectively. When VT8 is off, C7 charges via VT10, and VT9 conducts, causing VT1 to turn on. Similarly when VT9 is off, C7 charges via VT6 and VT8 is on. The dwell times in each state are controlled by these charging currents as the potential across C7 alters and the ratio of the charging currents is controlled by the differential input between the bases of VT6 and VT7. The overall switching repetition rate remains sensibly constant. VT6 base is held at a reference potential, and VT7 base is fed by a sampled fraction of the output voltage. Transistor VT10 gives slightly increased gain. Examination of the system shows that for a small change in output voltage, the operation of the comparator is to control the on/off switching ratio in the correct sense to keep the output constant.

The reference voltage is obtained by a cascade Zener system D9 (a 13V Zener diode) is fed from the output voltage through R24. D8 (a 5V Zener) is fed by R11 from D9 anode. A resistor chain R14, R13 determines the base potential at VT8 base which is decoupled to positive by C8. R15, R16 determine the potential across C7 at which the oscillator switches between states.

5.3 Output Voltage Adjustment

Since the output voltage is to be accurately defined, it is necessary to give facility for selection of more than one resistor to approach the defined limits of ± 0.1V on nominal at a given temperature. The reference voltage on VT6 base is set nominally to 4V and adjusted by R26; the sampled fraction of the output voltage is adjusted by R31. Selection of these resistors in turn permits the necessary limits to be attained. Typically, the values of R26/R31 are 5-10% of the values of R27, R32 respectively.

5.4 Temperature Compensation

Physically associated with the batteries BY1 and BY2 is a 1K Ω resistor of positive temperature co-efficient (0.7%/deg. C) R40. R36 is in series with R40 and R22 shunts this series combination; this group of three resistors forms the lower arm of the potential division chain giving the sampled fraction of the output voltage at VT6 base.

5.5. Battery Isolation Circuit

In order to prevent current drain from the batteries when the system is off, both main current and reference paths are isolated. The former is blocked by series rectifier diode D11 between power supply output and battery input, the latter by VT13. This device is fully 'bottomed' under normal operating conditions, and sustains about 100mV drop (i.e. collector to emitter). This is achieved by feeding the base from the high voltage end of D11, and the transistor feeds the reference line as an emitter follower; the base input potential is however, more negative than the collector potential, thus the emitter remains clamped to the collector voltage. When the input is not connected, the base receives no drive, and the device cannot conduct more than the reverse bias leakage current.

5.6 Current Limiting

Resistors R17 and R21 are in the main current loop, if the voltage drop across them exceeds a certain value, VT11 will conduct. This voltage-drop is divided by R28/R29 and R30 at VT11 base, and resistor R29 is selected on test to give the appropriate limit setting. Because the temperature co-efficient of the base emitter voltage of a transistor is about -2mV/deg. C, it is necessary to use a positive temperature co-efficient resistor in the voltage division chain for compensation.

When VT11 conducts, VT12 conducts also, the complementary connection giving a high overall gain. By the connection of VT12 emitter to VT9 emitter, when current is drawn by VT12, the 'on' time of the series switch is reduced and an automatic current limit is thus provided. Even under extreme loading, when the output rail voltage falls and D9 voltage collapses, limiting is sustained. This limit is the total current drain including load and charging current.

If the unit is severely overloaded the power supply will limit, but battery e. m. f. is still available. A fuse FS3 is included in the battery charging circuit which will rupture if excessive current is demanded from the battery. It may be noted that the voltage to be controlled is taken across the battery terminals, since the voltage-drop of FS3 during normal charging conditions is negligible.

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CATALOGUE NO. MCB 143

PART 4: POWER SUPPLIES

CHAPTER 5: THREE PHASE PRIMARY POWER SUPPLY MCB 29

CHAPTER 5

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CHAPTER 5

THREE PHASE PRIMARY POWER SUPPLY MCB 29

1. INTRODUCTION

The MCB 29 power supply unit gives a nominal 24V d.c. from a three phase 400 c/s mains supply. The unit incorporates two NIFE (Encapsulated Nickel Cadmium) batteries which provide a supply to the load in the event of temporary failure of the a.c. supply. The batteries allow a mains failure for approximately five minutes when loaded with a computer. If more than one mains failure occurs in an hour, the batteries may be discharged in less than five minutes. During normal operation, the a.c. input is converted to a stabilised d.c. output which provides load current and at the same time charging current for the batteries. For this latter purpose, the output voltage is rendered dependent on battery temperature in order that the cells are not overcharged.

The POWER ON switch turns on the d.c. output when operated.

2. CONSTRUCTION

The front panel is $16\frac{1}{2}$" x $6\frac{3}{4}$", it is attached to the chassis comprising a unit that can be removed from the cabinet.

Two ventilating apertures are provided in the front panel to permit the egress of any gases that may escape from the batteries.

The following equipment is mounted on the front panel:

Power ON Switch	S1 A & B
Mains Fuses	FS1, 3A, FS2, 3A, FS3, 3A
Mains Indicator Lamp	Red (Neon) ILP1
D. C. Output Lamp	White ILP2
Mains Input Plug	15-PL1
Output Connectors	15-SKT2, 15-SKT3

Sockets on the front panel are positioned with the locating keys

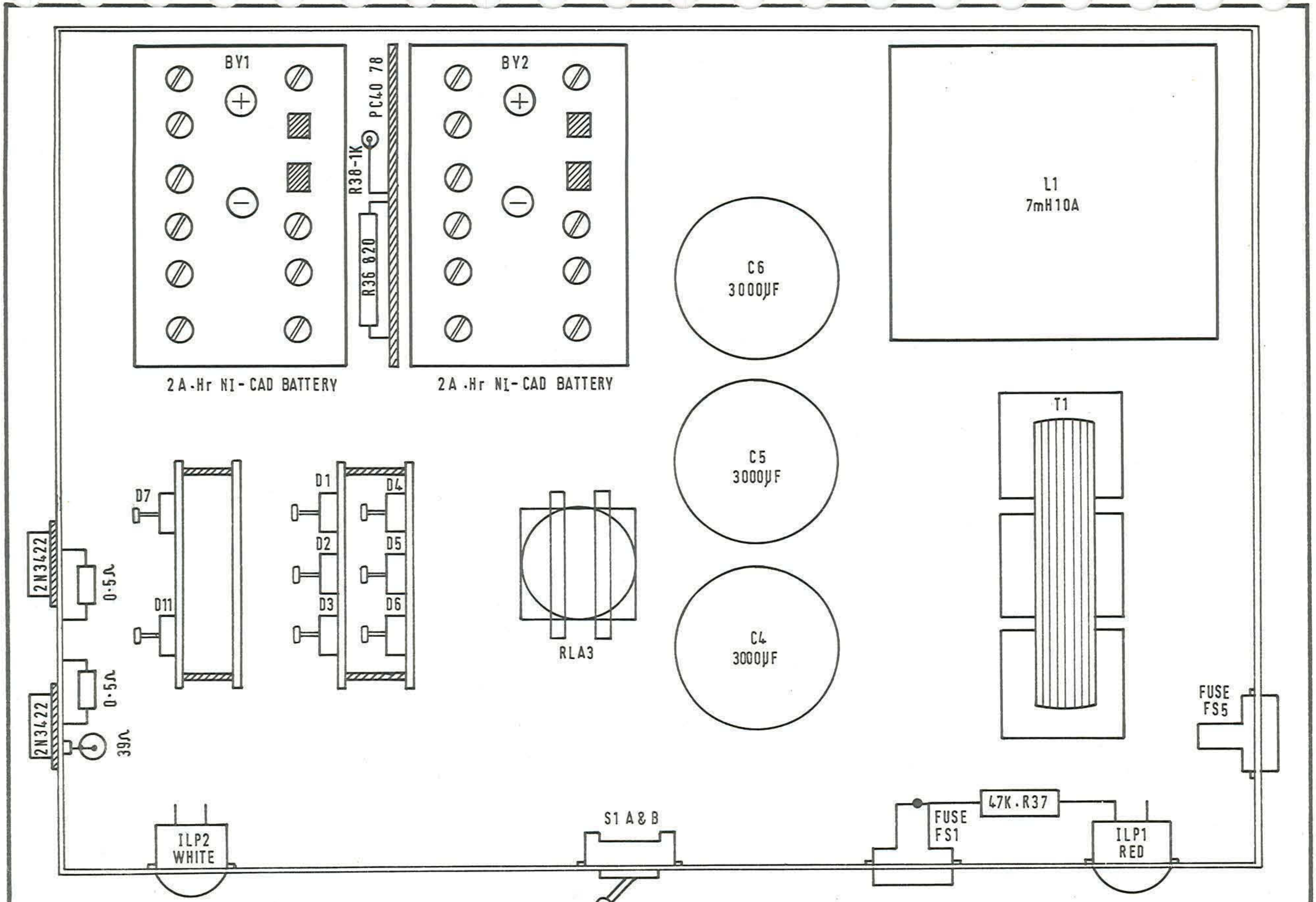

Fig. b MCB29 Power Supply Unit (Top of Chassis)

(Issue 1)

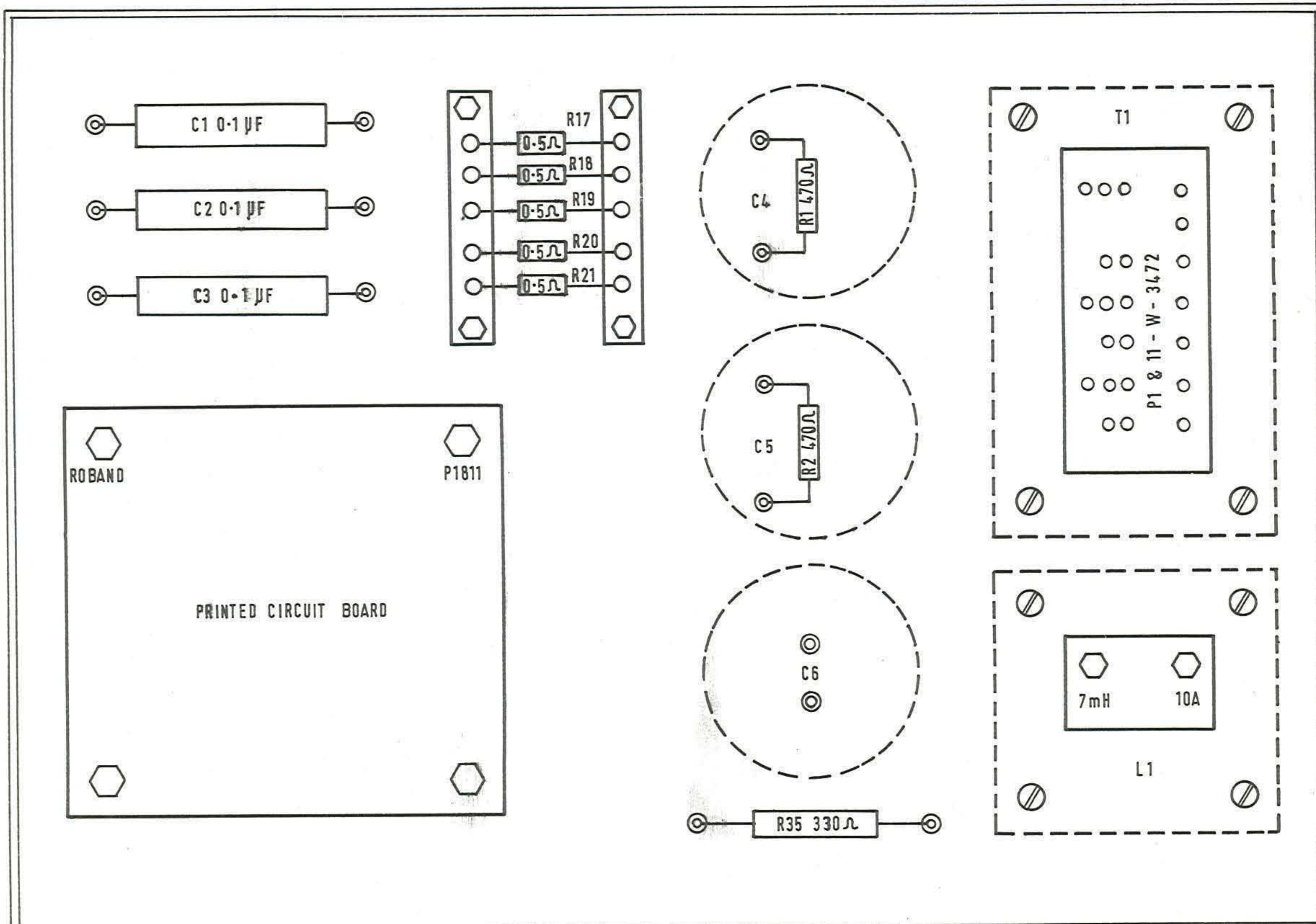

Fig. c MCB29 Power Supply Unit. (Bottom of Chassis) (Issue 1) pointing to the top of the chassis.

The location of the larger electronic components on the top of the chassis may be seen in Fig. b and those on the bottom of the chassis in Fig. c.

The four power transistors VT2, 2N3442 ——> VT5, 2N3442 are mounted on the left-hand side of the chassis. The output fuse FS5 (10A) is mounted on the right-hand side.

3. INTERCONNECTIONS

The interconnections between the MCB 29 power supply, the Computer power supply and filter unit are given in Fig. A1 (Pt. 1, Chap. 1).

3.1 Input

Input interconnections between power unit socket 15-PL1 and filter unit socket 9-SKT3 are given in Table 1.

TABLE 1

15-PL1 TO 9-SKT3	FUNCTION
A	Line, Phase 1. Red
B	Unused
C	Chassis Earth Green
D	Line, Phase 2. Yellow
E	Line, Phase 3. Blue

3.2 Output

The two output sockets 15-SKT2 and 15-SKT3 are connected in parallel.

Output interconnections between power unit sockets 15-SKT2 or 15-SKT3 and the input socket 14-PL1 of the computer power supply are given in Table 2.

TABLE 2

15-SKT2 OR 15-SKT3 TO 14-PL1	FUNCTION
A	+24V. Linked to B
B	Linked to A
C	-24V. Linked to D
D	Linked to C
E	Mains Earth

4. INPUT AND OUTPUT VOLTAGES

4.1 Input

The unit requires 400 c/s three-phase mains supply with a nominal input of 200V; if operation at 117V nominal is desired, the primary must be delta connected. The transformer T1 is protected from overload by a 3A fuse in each phase.

4.2 Output

The output is approximately 28V d.c. when the batteries are being charged and 24V when the input is removed.

5. OPERATION

A schematic diagram of the unit is given in Fig. D8. Mains presence is indicated by the red neon pilot lamp ILP1. When the unit is switched on, 24V to 28V appears at the d.c. output and is indicated by lamp ILP2.

The transformer T1 has an electrostatic screen to reduce input line noise. The primary-secondary connection is a star-delta configuration with two half-wave series connected diode rectifiers for each phase. Each corner of the delta is connected between the series diodes D1-D4, D2-D5 and D3-D6. Capacitors C1, C2 and C3 connected across each phase serve to limit transients. This circuit has very little ripple in its output and a low ratio of peak-to-average voltage.

The output of the rectifier is at the common connections of D1-D3 and D4-D6. Smoothing of the rectified output is effected by the series connected capacitors C4-C5.

5.1 Operation of the Switching Regulator

To provide a regulated d. c. voltage output, a switching regulator is employed. Choke L1 acts as an energy storage device, and transistors VT3, VT4 and VT5 function as a switch which either closes or breaks the junction between D7, L1 and the reservoir capacitors C4 and C5. A fuse FS2, included in this path, affords protection in the event of catastrophic failure of the regulator.

Capacitor C6 is designed to act as a filter in conjunction with L1 to minimise the output ripple and holds the output at constant potential. On closing the switch, the voltage-drop across L1 is equal to the potential difference between the reservoir and output capacitors (disregarding resistive drops and the voltage across the 'bottomed' transistors). When the switch is open, D7 clamps at positive rail potential as the choke current attempts to decay.

It may be noted that the switching elements are in the negative supply line. The positive line is a through-connection from reservoir to output, interrupted only by current sensing resistors R17 and R21.

The current through the switch is nearly the same as the output current and the control of output voltage is effected by control of the on/off ratio of the switch with time.

Power losses are due to:

(1) resistance in any part of the current path

(2) choke core losses

(3) the voltage-drop of the switched power transistors in their 'on' state.

(4) the transient dissipation of the transistor during switching.

Conversion efficiency is about 85%, and a frequency of about 2K c/s chosen where loss (4) is of less effect.

5.2 Closed Loop Voltage Regulation

The control of output voltage is analogous to that obtained by a series regulator except that the on/off switching times are controlled as opposed to the current drive control used in a conventional series regulator.

Assume VT1 is not conducting. Sufficient current flows through R8 into VT2 base to ensure that a current in excess of the full rated current can flow through the power transistors VT3, VT4 and VT5. If VT1 is now 'bottomed', there can be no drive supplied to VT2, since the Vce Sat: of VT1 (a planar device), is low. At the same time, a low external impedance is presented to the base of VT2 to facilitate removal of stored charge. The action of the Bose oscillator VT8 and VT9 is to switch between these two modes and hence to provide the switching action described in Sec. 5.1.

VT6 and the complementarily connected VT7 and VT10 are current feeds for VT8 and VT9 emitters respectively. When VT8 is off, C7 charges via VT10, and VT9 conducts, causing VT1 to turn on. Similarly when VT9 is off, C7 charges via VT6 and VT8 is on. The dwell times in each state are controlled by these charging currents as the potential across C7 alters and the ratio of the charging currents is controlled by the differential input between the bases of VT6 and VT7. The overall switching repetition rate remains sensibly constant. VT6 base is held at a reference potential, and VT7 base is fed by a sampled fraction of the output voltage. Transistor VT10 gives slightly increased gain. Examination of the system shows that for a small change in output voltage, the operation of the comparator is to control the on/off switching ratio in the correct sense to keep the output constant.

The reference voltage is obtained by a cascade Zener system D9 (a 13V Zener diode) is fed from the output voltage through R24. D8 (a 5V Zener) is fed by R11 from D9 anode. A resistor chain R14, R13 determines the base potential at VT8 base which is decoupled to positive by C8. R15, R16 determine the potential across C7 at which the oscillator switches between states.

5.3 Output Voltage Adjustment

Since the output voltage is to be accurately defined, it is necessary to give facility for selection of more than one resistor to approach the defined limits of $\pm$ 0.1V on nominal at a given temperature. The reference voltage on the base of VT6 is set nominally to 4V and adjusted by R26; the sampled fraction of the output voltage is adjusted by R31. Selection of these resistors in turn, permits the necessary limits to be attained. Typically the values of R26/R31 are 5-10% of the values of R27, R32 respectively.

5.4 Temperature Compensation

Physically associated with the batteries BY1 and BY2 is a 1K Ω resistor of positive temperature co-efficient (0.7%/deg. C) R40. R36 is in a series with R40 and R22 shunts this series combination; this group of three resistors forms the lower arm of the potential division chain giving the sampled fraction of the output voltage at VT6 base.

5.5 Battery Isolation Circuit

In order to prevent current drain from the batteries when the system is off, both main current and reference paths are isolated. The former is blocked by series rectifier diode D11 between power supply output and battery input, the latter by VT13. This device is fully 'bottomed' under normal operating conditions, and sustains about 100mV drop (i.e. collector to emitter). This is achieved by feeding the base from the high voltage end of D11, and the transistor feeds the reference line as an emitter follower; the base input potential is however, more negative than the collector potential, thus the emitter remains clamped to the collector voltage. When the input is not connected, the base receives no drive, and the device cannot conduct more than the reverse bias leakage current.

5.6 Current Limiting

Resistors R17 and R21 are in the main current loop, and if the voltage-drop across them exceeds a certain value, VT11 will conduct. This voltage-drop is divided by R28/R29 and R30 at the base of VT11. Resistor R29 is selected on test to give the appropriate limit setting. Because the temperature co-efficient of the base-emitter voltage of a transistor is about -2mV/deg. C, it is necessary to use a positive temperature co-efficient resistor in the voltage division chain for compensation.

When VT11 conducts, VT12 conducts also, the complementary connection giving a high overall gain. By the connection of a VT12 emitter to VT9 emitter, when current is drawn by VT12, the 'on' time of the series switch is reduced and an automatic current limit is thus provided. Even under extreme loading, when the output rail voltage falls and D9 voltage collapses, limiting is sustained. This limit is the total current drain including load and charging current.

If the unit is severely overloaded the power supply will limit, but battery e. m. f. is still available. A fuse FS3 is included in the battery charging circuit which will rupture if excessive current is demanded from the battery. It may be noted that the voltage to be controlled is taken across the battery terminals, since the voltage-drop of FS3 during normal charging conditions is negligible.

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PART 4: POWER SUPPLIES

CHAPTER 6: PAPER TAPE POWER SUPPLY MCB 30

CHAPTER 6

PAPER TAPE POWER SUPPLY MCB 30

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CHAPTER 6

PAPER TAPE POWER SUPPLY MCB 30

1. INTRODUCTION

The Paper Tape Power Supply MCB 30 delivers four stabilised output voltages to the paper tape controller from a 50 $\pm$ 1 c/s mains supply of 100-125V or 200-250V. (The frequency limitation is imposed by the design of the constant voltage transformer). Relays connecting the mains voltage to the power supply are installed within the unit and are remotely controlled.

2. CONSTRUCTION

The power supply is mounted on three sides of an open chassis measuring 19" wide x 12" deep x $8\frac{3}{4}$" high.

The front panel carries the following:

Mains fuse	FS. 1	5A
Punch/Reader fuse	FS. 2	5A
+ 10V	FS. 3	3A
- 10V	FS. 4	1A
+ 28V	FS. 5	10A
10V a. c.	FS. 6	5A

Mains Input indicator lamp

Linked Terminals +10V and -10V (for margin testing).

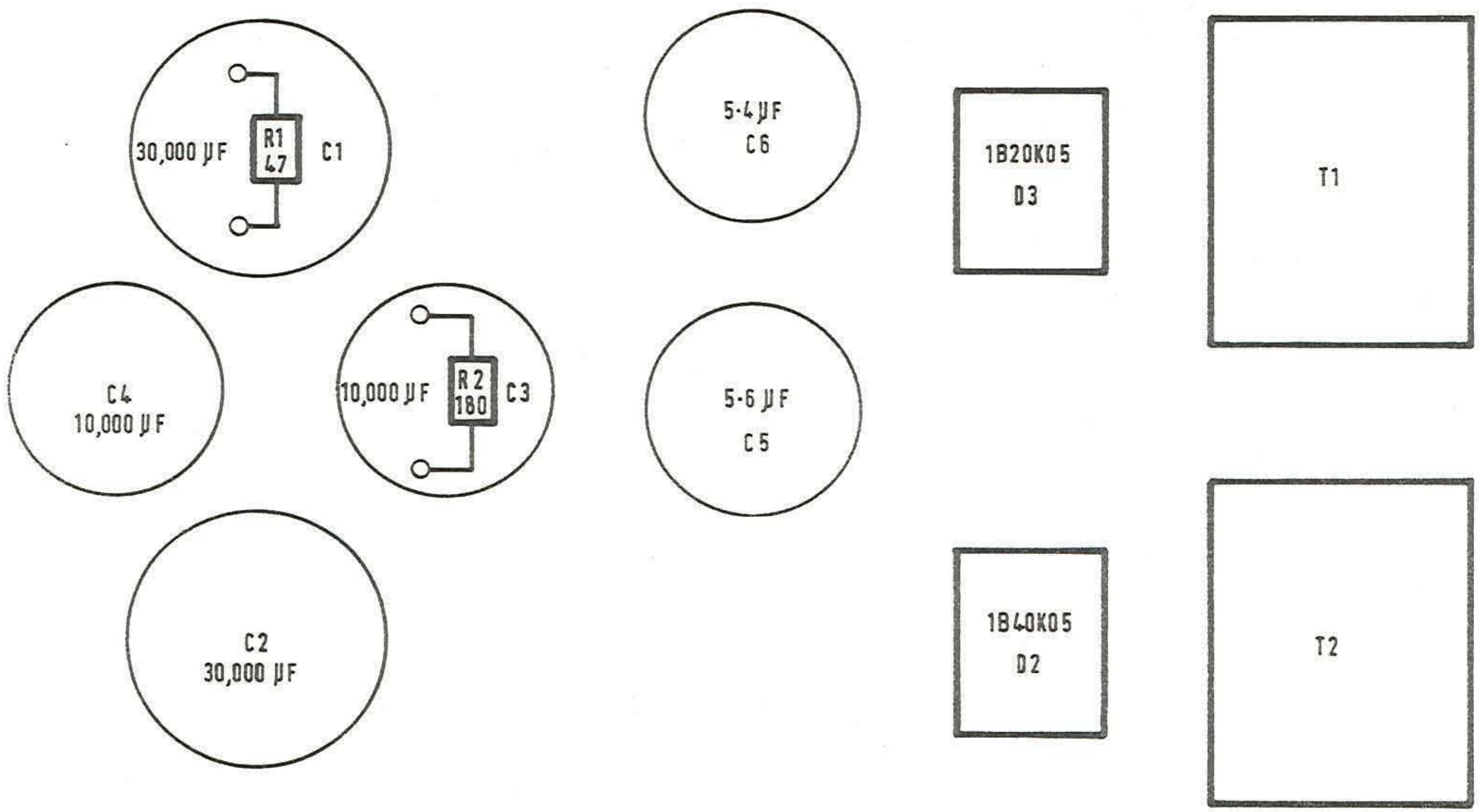

Fig. d M.C.B 30 power supply left panel (Top view)

Issue 1

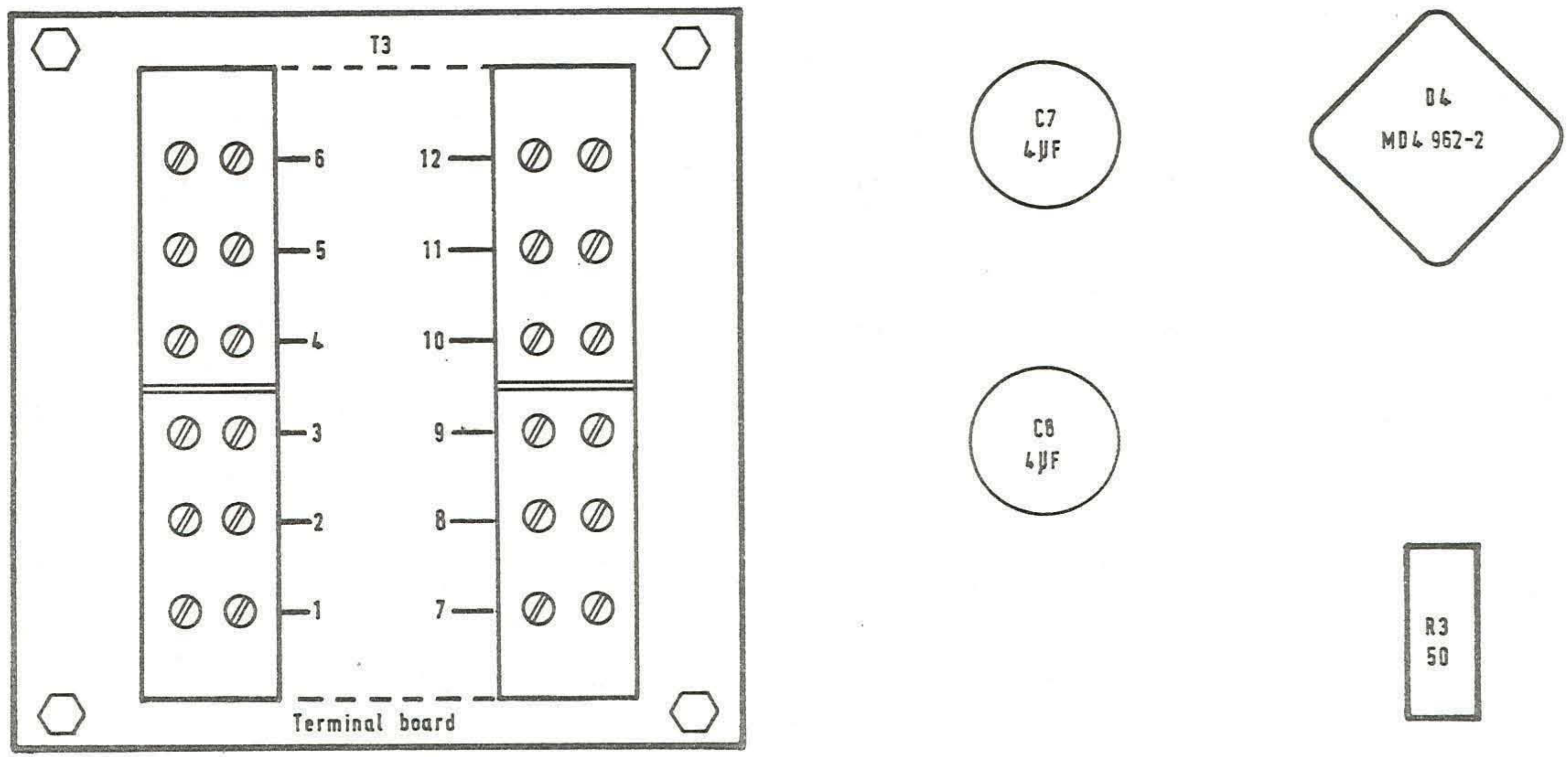

Fig. e MCB 30 power supply right panel (Top view)

Issue 1

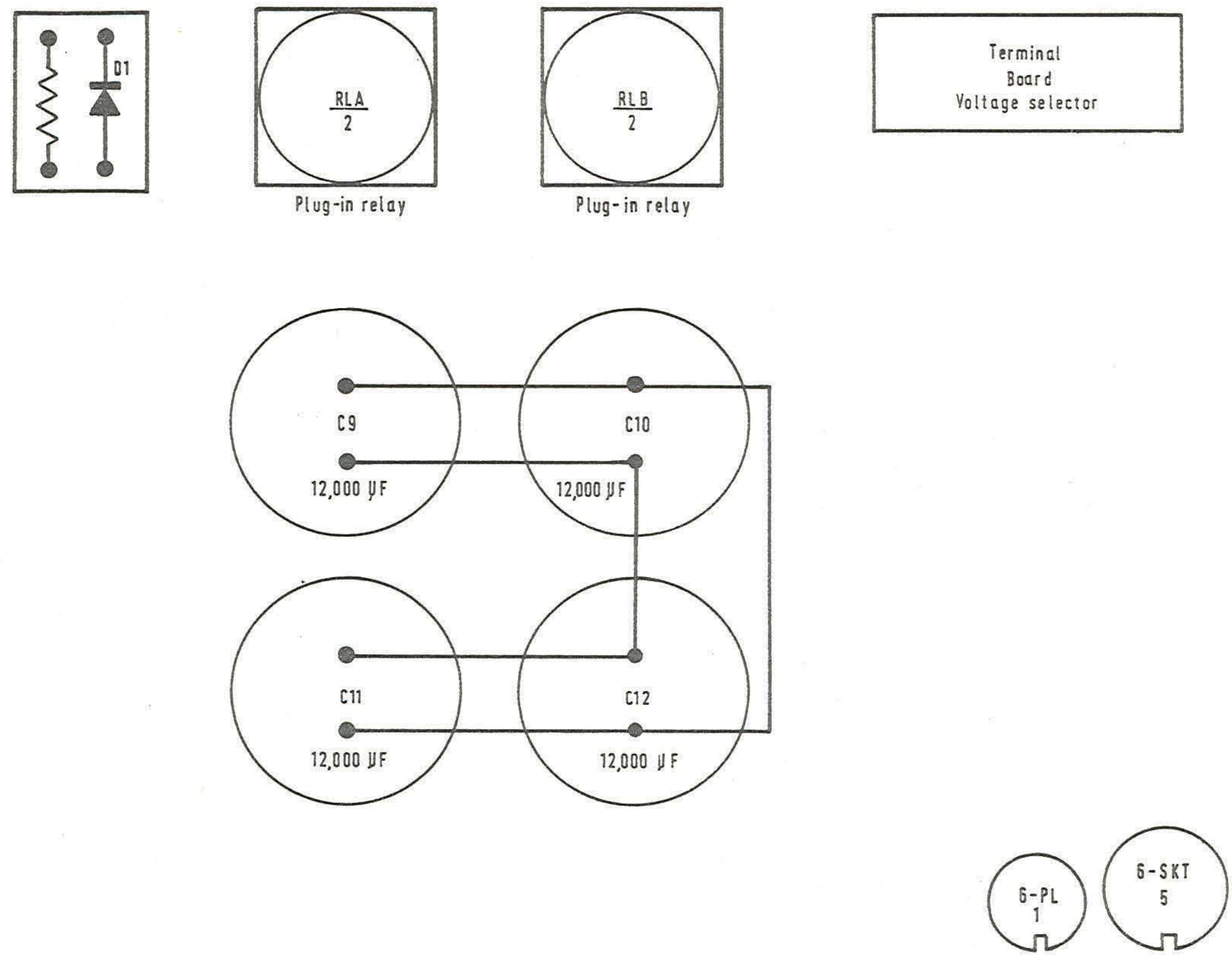

Fig. f MCB 30 power supply rear panel (Top view)

Issue 1

Components for the +10V, -10V and 10V a. c. supplies are mounted on the left hand side panel (when viewed from the front) and include:

Transformers	T1 and T2	Fig. D9 refers
Rectifiers	D2 and D3	
Capacitors	C1 to C6 inclusive	
Resistors	R1 and R2	

The layout is given by Fig. d.

Components for the ± 28V supply are distributed between the right hand and rear panels.

The right hand panel includes:

Transformer	T3	Fig. D9 refers
Rectifier	D4	
Capacitors	C7 and C8	
Resistor	R3	
Mounted on the rear panel:		
Capacitors	C9 to C12 inclusive	
Diode	D1	
Relays	RLA/2 and RLB/2	
Voltage Selector terminal board		
Connectors 6-SKT2 and 6-PL1		

Layout is given by Fig. e and f respectively.

3. INTERCONNECTIONS

The interconnections between the MCB 30 Power Supply unit and the Paper Tape Controller are given in Fig. A1 (Pt. 1, Chap. 1) and in Fig. C2 (Pt. 3, Chap. 3).

Connections to the power supply unit are via two multiway connectors. 6-PL1 carries the mains input supply, 6-SKT2 d. c. supplies and controls signals to the computer.

The plug and socket connections are given in Table 1 and Table 2.

3. 1 Interconnections between Paper Tape Controller and Power Supply

TABLE 1

6-SKT2	FUNCTION	3-PL1	FUNCTION
A	+28V d. c.	A	+28V d. c. Tape Punch Supply
B	+28V d. c.	B	+28V d. c. Tape Punch Supply
C	+28V d. c.	C	+28V d. c.
D	-28V d. c.	D	-28V d. c.
E	-28V d. c.	E	-28V d. c. Solenoid Drive
F	-28V d. c.	F	-28V d. c.
G	+10V 2. 5A	G	+10V 2. 5A
H	+10V 2. 5A	H	+10V 2. 5A Solenoid Drive
J	0V	J	0V
K	0V	K	0V
L	-10V 0. 75A	L	-10V d. c. 0. 75A
M	10V 3. 5A a. c.	M	10V 3. 5A a. c. Lamp Supply
N	10V 3. 5A a. c.	N	10V 3. 5A a. c. Lamp Supply Earth Return
P	+24V (RELAY)	P	+24V
R	-24V (RELAY)	R	-24V
S	SPARE	S	SPARE
T	SPARE	T	SPARE
U	SPARE	U	SPARE

TABLE 1 (Contd.)

6-SKT2	FUNCTION	3-PL1	FUNCTION
V	SPARE	V	SPARE
W	SPARE	W	SPARE
X	SPARE	X	SPARE
Y	SPARE	Y	SPARE
Z	SPARE	Z	SPARE
a	Line	a	Line
b	Neutral	b	Neutral
c	Mains Earth	c	Mains Earth

3.2 Interconnections between Power Supply and Filter Unit

TABLE 2

6-PL1	FUNCTION	9-SKT2	FUNCTION
A	Line	A	Line
B	Neutral	B	Neutral
C	Earth	C	Earth

4. INPUT AND OUTPUT VOLTAGES

4.1 Input

The mains input to the Paper Tape Power Supply may be adjusted by plug and socket tappings for any of the following voltages: 250, 240, 230, 220, 210, 200, 125, 120, 115, 110, 105 and 100 volts.

The schematic of the Paper Tape Power Supply is given in Fig. D9.

A neon pilot lamp ILP1 indicates when the unit is switched on.

4.2 Output

All output voltages are isolated from the chassis earth.

Each stabilised supply is protected against overload by the current limiting action of the constant voltage transformers.

Output Voltages:

+ 10V d.c. at 2.5A

- 10V d.c. at 0.75A

+ 28V d.c. at 6.0A

10V a.c. at 3.5A

NOTE: The 28V regulation is from 1-6 amperes.

5. OPERATION

The magnetic circuit of the transformer produces an almost constant output voltage largely nullifying variations in input voltage. This is achieved by making use of the saturation characteristics of the core and using a tuned circuit in the output, tuned to 50 c/s. The output current is automatically limited to $1\frac{1}{2}$ times the full load current. The use of resonant circuit makes the unit frequency sensitive.

5.1 28V d.c. Supply

The tuned circuit of this supply is C7, C8 and transformer T3 winding 11-12.

The output of transformer T3 winding 9-10 is rectified by the full wave bridge rectifier D4. The output is smoothed by C9, C10, C11 and C12. The bleeder load resistor R3 helps to improve regulation and discharge the capacitors when the power is switched off.

5.2 <u>10V 3.5A a.c.</u>

In this supply capacitor C5 and transformer T2 winding 9-10 are the tuned circuit elements for the regulated a.c. output of 10V.

5.3 <u>+ 10V d.c.</u>

Transformer T1 is electrostatically screened. The tuned circuit is capacitor C6 and transformer winding 9-10. Rectification is effected by the full wave bridge rectifier D2 smoothing by capacitors C1 and C2 with R1 across the output.

5.4 <u>- 10V d.c.</u>

The output of transformer winding 5-6 is rectified by D3 and smoothed by capacitors C3 and C4 with R2 across the output. Both the + 10V d.c. and - 10V d.c. have a common 0V connection. Links in series with the output of these lines may be used for Margin tests.

6. SAFETY DEVICES

Separate fuses protect mains input and each output line.

7. CONTROL

Remote ON/OFF switching is effected by relays RLA/2 and RLB/2 which operate from the 24V rail of the computer power supply.

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PART 4: POWER SUPPLIES

CHAPTER 7: PAPER TAPE POWER SUPPLY FREQUENCY INSENSITIVE MCB 32

CHAPTER 7

PAPER TAPE POWER SUPPLY FREQUENCY INSENSITIVE MCB 32

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CHAPTER 7

PAPER TAPE CONTROLLER POWER SUPPLY CAT. NO. MCB 32

1. INTRODUCTION

The MCB 32 power supply unit is operated directly from the mains and is switched ON and OFF by relays which are operated by the computer 24V rail.

The unit supplies four stabilised output voltages which may be adjusted by four locking potentiometers mounted on the front panel.

Current limiting of the output voltages can be adjusted by means of preset locking potentiometers which are accessible within the unit.

The putput voltages may be checked at monitor points on the front panel.

2. CONSTRUCTION

The unit is of open construction measuring 19" wide x 12" deep x $8\frac{3}{4}$" high.

The front panel carries the following:

Mains fuse		FS. 1	4A	(Slow blow)
Mains fuse		FS. 3	7A	(Supply to tape reader and punch motors).
+10V	2.5A	FS. 102	5A	
-10V	0.75A	FS. 202	2A	
+28V	6.0A	FS. 302	20A	
+10V	3.5A	FS. 402	7A	(tape reader lamp)

Mains Input indicator lamp

Output voltage preset adjusters for the four stabilised supplies.

Monitor points for each of the four stabilised supplies.

Plug and socket connections are made at the rear of the unit with the locating keys of both connectors positioned near the bottom of the chassis. The input voltage selector panel is mounted at the top of the rear panel.

3. INTERCONNECTIONS

Interconnections to the paper tape controller are given in Fig. A1 (Pt. 3, Chap. 1) and in Fig. C1 (Pt. 3, Chap. 3). Connections are made at the rear of the unit by means of a five-way mains input plug 6-PL1 and a 26-way output socket 6-SKT2.

INTERCONNECTIONS BETWEEN POWER SUPPLY AND PAPER TAPE CONTROLLER

TABLE 1 6-SKT2 TO 3-PL1

6-SKT2	FUNCTION
A	+ 28V
B	+ 28V
C	+28V
D	- 28V
E	- 28V
F	- 28V
G	+ 10V 2.5A
H	+ 10V 2.5A
J	0V
K	0V
L	- 10V 0.75A
M	10V (+VE) 3.5A } Reader Lamp
N	10V (- VE) 3.5A } Reader Lamp

TABLE 1 (Cont'd)

6-SKT2	FUNCTION
P	+ 24V (Relay)
R	- 24V (Relay)
S	SPARE
T	SPARE
U	SPARE
V	SPARE
W	SPARE
X	SPARE
Y	SPARE
Z	SPARE
a	Line) Mains output
b	Neutral) to punch
c	Earth (Chassis))

INTERCONNECTIONS BETWEEN POWER SUPPLY AND FILTER UNIT

TABLE 2 6-PL1 TO 9-SKT2

6-PL1	FUNCTION
A	Line
B	Neutral
C	Earth-Chassis
D	Spare
E	Spare

4. INPUT AND OUTPUT VOLTAGES

4.1 Input

The mains input to the Paper Tape Power Supply may be adjusted by plug and socket tappings for any of the following voltages: 250, 240, 230, 220, 210, 200, 125, 120, 115, 110, 105 and 100 volts.

A neon pilot-amp ILP1 indicates when the unit is switched on.

4.2. Output

All voltages are isolated from chassis earth.

Each stabilised supply is protected against overload by current-limiting circuits.

Output Voltages:

+ 10V at 2.5A
- 10V at 0.75A
+ 28V at 6.0A
- 10V at 3.5A

5. OPERATION

The mains voltage is applied to transformer T1 by the contacts of replays RLA and RLB when energised by 24 volts applied to pins P and R of 6-SKT2. Transients originating by relay operation are suppressed by diode D6.

Four stabiliser circuits are provided as shown by Fig. D10.

Each stabiliser comprises a series regulator/comparator amplifier combination.

The comparator amplifiers(mounted on printed circuit boards) for each output are fed from separate 24V secondary windings half wave rectified by D1 and stabilised by Zener diode D2. The series elements in the stabilised rails are fed from separate secondary windings via bridge rectifiers.

+ 10V 2.5A Stabiliser

This supply provides the + 10V rails for the paper tape logic. The output is derived from a 14V 5A secondary winding, bridge rectified and smoothed by D109 and C103 respectively.

The output of the series regulator transistor VT106 is sensed by comparator amplifier VT3/VT4. This output may be adjusted by preset RV101 (situated on the front panel) which alters the proportion of output voltage compared at the base of VT4, with respect to the reference voltage set by Zener diode D4. Coarse setting of the + 10V output is achieved during manufacture by the choice of RT2.

Under operational conditions any rise or fall in output voltage sensed by the comparators varies the bias on the base of VT1 (via VT4) which controls the series element VT106 thus stabilising the output voltage.

Overload protection is afforded by VT2 which is normally non-conducting. However excessive current flow causes an increase in the voltage drop across R6 thus turning on VT2. The resulting drop in potential at the collector of VT2 switches off VT1 hence VT105 and VT106. The output voltage is automatically restored when the overload is removed.

The current limiting threshold set at 2.5A can be adjusted by preset RV102 (mounted in front of the series element heat sink, and accessible from the top of the unit).

- 10V 0.75A Stabiliser

This supply provides the - 10V rail for the paper tape logic. Circuit operation is similar to that of the + 10V 2.5A stabiliser.

Output voltage is adjusted by preset RV201 (situated on the front panel) and current limiting by preset RV202 (mounted in front of the series element heat sink and accessible from the top of the unit).

+ 28V 6A Stabiliser

This supply provides the + 28V rail for tape reader clutch and tape punch solenoids. Circuit operation is similar to that of the + 10V 2.5A stabiliser. However, the higher voltage requirement is provided by a 30V secondary winding and higher current is obtained by additional series elements.

Output voltage is adjusted by preset RV301 (situated on the front panel) and current limiting by preset RV302 (mounted in front of the series element heat sink and accessible from the top of the unit).

+ 10V 3.5A Stabiliser

This supply provides + 10V for the tape reader lamp. Operation is similar to that of the + 10V 2.5A stabiliser with the exception of the current-limiting circuit. A stabilised negative supply, approximately 8V below the output rail, is derived from Zener diode D411 and applied to the overload protection circuit of VT2. This prevents VT2 turning off the stabilised output during the initial current surge caused when the reader lamp is switched on.

Output voltage is adjusted by preset RV401 (situated on the front panel) and current limiting by preset RV402 (mounted in front of the series element heat sink and accessible from the top of the unit).