I.C. UNIBOARDS

SIMPLE INTEGRATED CIRCUIT DESIGNS

6V:7·5V:9V POWER SUPPLY

No. 3

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THIS MONTH'S design is a Mini Power Unit designed for general-purpose applications. From a mains input it will supply 6V, 7·5V or 9V d.c. The maximum recommended load is about 300mA, although in some applications (where noise is not important) this can rise to 500mA maximum.

The Mini Power Unit, although useful for powering radios, cassette recorders, calculators from the mains could also be used as a simple bench power unit, where it has proved ideal for simple experiments and testing.

CIRCUIT

The full circuit can be seen in Fig. 1. Mains voltage is applied through S1 (the on/off switch) and FS1 to the primary of T1, a step-down transformer. This reduces the mains to 12V a.c. and this is rectified by D1-D4 and smoothed by C2 to produce a d.c. output of roughly 17V, no load. The capacitor C1 removes noise which may arise in the bridge rectifier diodes and D5 is a standard l.e.d. with current-limiting resistor R1. This provides a "power on" indication.

In its present form the 17V d.c. is of course not variable. Furthermore, being unregulated, it will tend to reduce somewhat as the load current increases.

VOLTAGE REGULATOR

The most important part of the circuit is IC1, a LM317H three-terminal variable voltage regulator. The 17V d.c. is passed through R2 and R3 to the input of the regulator. These two resistors, which are wirewound, assist in diverting power dissipation away from IC1, allowing it to run more efficiently.

The integrated circuit itself is fully protected. Included on the chip are both thermal overload protection and current-limiting circuits. This means that the i.c. will shut down if overheating due to insufficient heatsinking occurs.

Current limiting prevents the current passing through the device from exceeding 750mA as actually measured on the prototype.

This means that the Mini Power Unit will not suffer any damage if the output is temporarily shorted, although prolonged short-circuits are not recommended.

OUTPUT

A reference voltage is supplied via R10 and 240 ohms is the value used in most applications. The output of the regulator depends on the resistance between the Pin 3 of IC1, and 0V. The formula is:

$$\text{Output voltage} = \frac{1{\cdot}2\ (240+R)}{240}\ \text{Volts}$$

where R is the resistance (in ohms) between Pin 3 and ground.

The various resistor values are selected by S2 so that by altering this switch, various output voltages are obtainable. Fixed resistors (as opposed to presets) are used as shown so that 6, 7·5 or 9 volts are obtainable at the touch of a switch. Also, no test equipment is needed in setting up readers' models.

Capacitors C3, C4 and C5 in the circuit help to improve the performance of the unit by reducing noise around the i.c. and on the voltage rails.

MULTIPLUG LEAD

This design is intended for use with a "multiplug" power lead. On one end this has a 2·5mm and 3·5mm jack plug, together with a 2·1mm and 2·5mm d.c. power plug. The other end requires a 3·5mm jack plug.

The sockets SK1 and SK2 are two insulated 3·5mm jacks. Depending on which socket the multi-plug power lead is inserted into, the tips of the

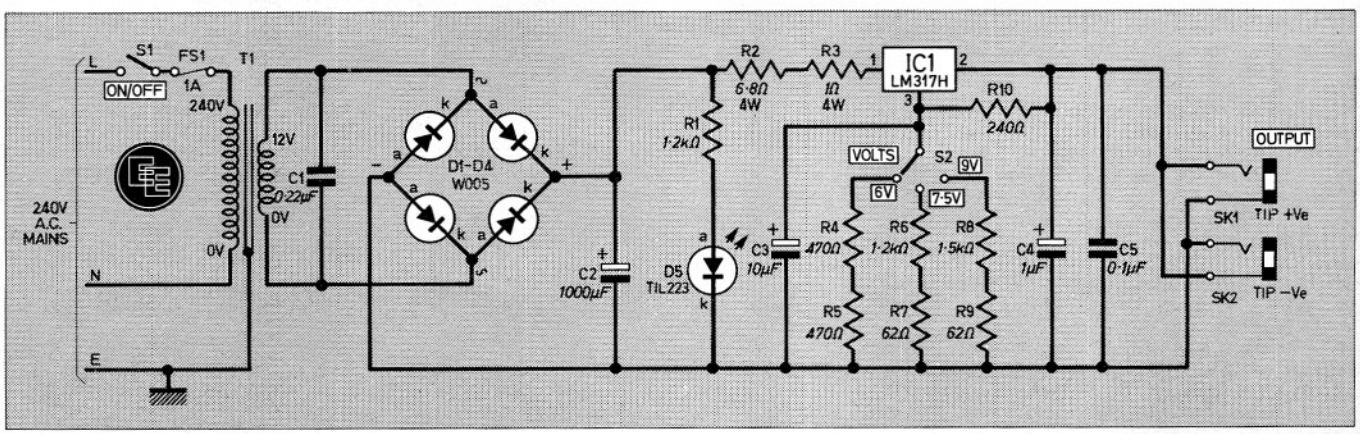


Fig. 1. Full circuit diagram of the Uniboard Power Supply.

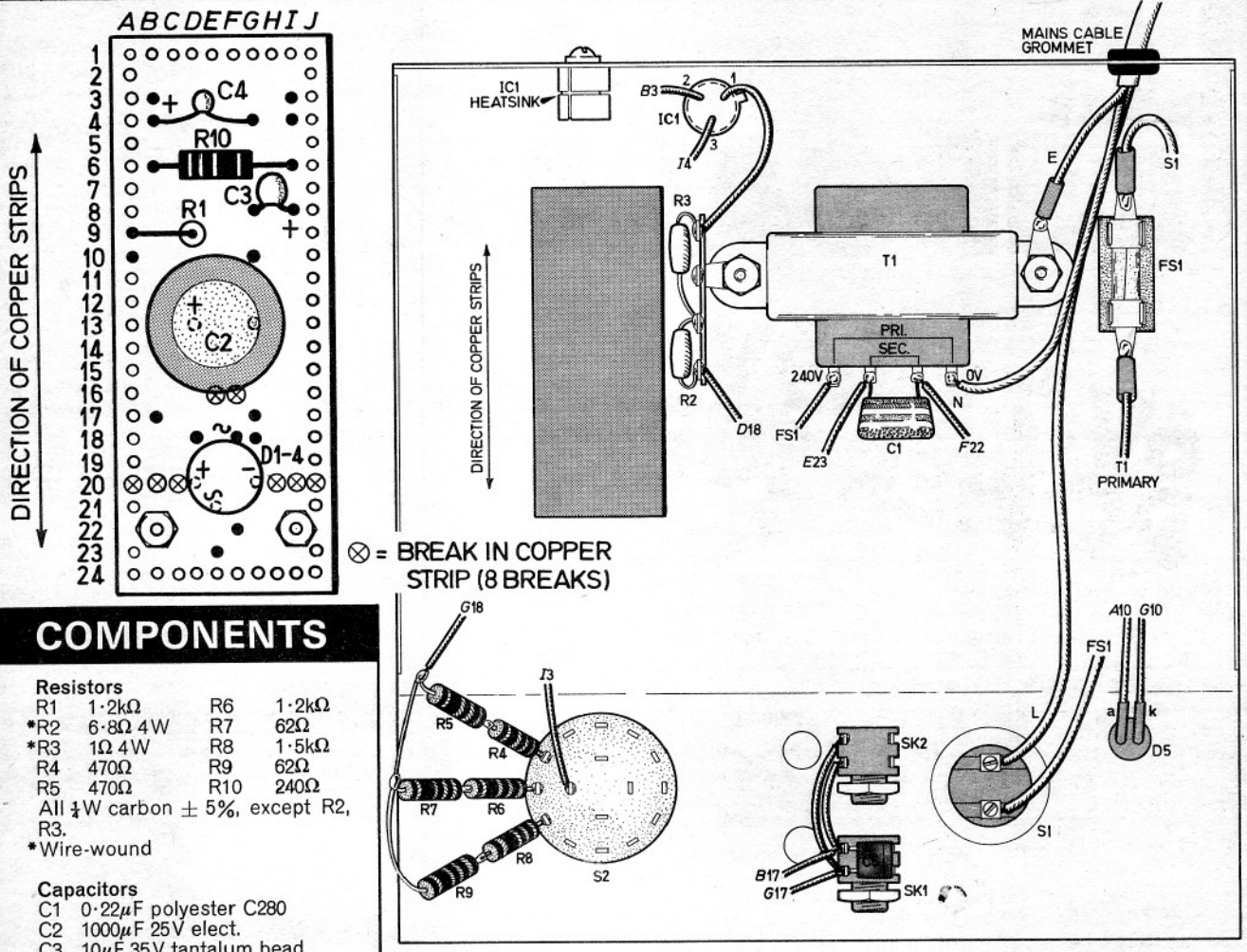


Fig. 2. Circuit board layout and interconnection diagram. The heatsink for IC1 must be insulated from the metal chassis.

COMPONENTS

Resistors

R1	1·2kΩ	R6	1·2kΩ
*R2	6·8Ω 4W	R7	62Ω
*R3	1Ω 4W	R8	1·5kΩ
R4	470Ω	R9	62Ω
R5	470Ω	R10	240Ω

All ¼W carbon ± 5%, except R2, R3.
*Wire-wound

Capacitors

C1 0·22μF polyester C280
C2 1000μF 25V elect.
C3 10μF 35V tantalum bead
C4 1μF 35V tantalum bead
C5 0·1μF ceramic plate

Semiconductors

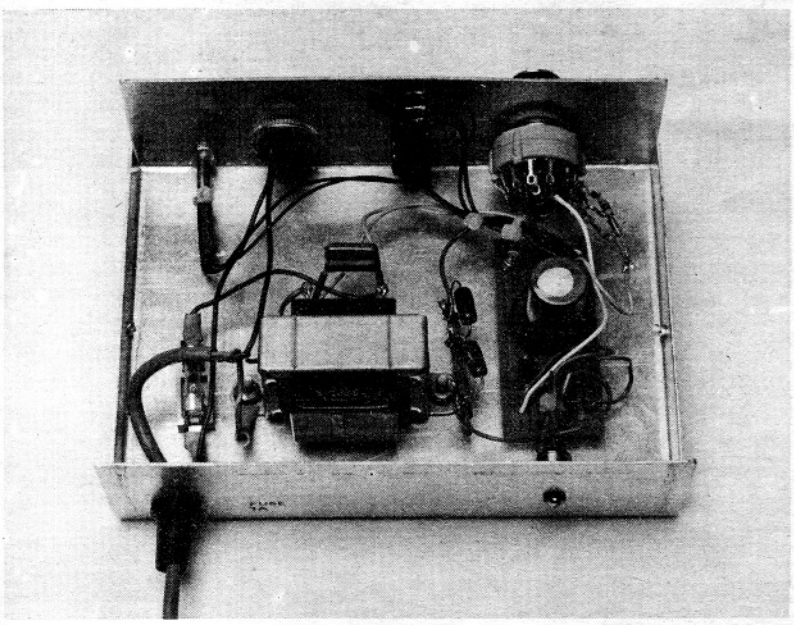
IC1 LM317H variable voltage regulator, TO-5 can
D1-D4 W005 50V, 1·5A bridge rectifier
D5 TIL223 0·2 inch yellow l.e.d.

Miscellaneous

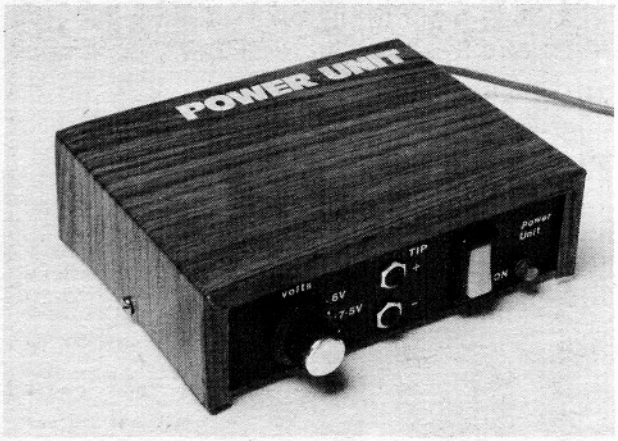
T1 Mains primary/ 12V 500mA secondary
S1 s.p.s.t. mains rocker switch
S2 one-pole, three-way rotary switch (see text)
SK1, 2 3·5mm mono jack, fully insulated type (2 off)
FS1 20mm 1A fuse with chassis mounting holder

Case, 150 × 125 × 50mm, type TP2, or similar; 0·1 inch matrix stripboard, 10 strips × 24 holes; panel mounting TO-5 type heat-sink; four-way tagstrip; solder tag; lens clip for D5; knob; multi-plug power lead; adhesive rubber feet; mounting hardware; cable grommet and retainer; three core mains cable; interconnecting wire.

Guidance only
Approx cost
See page 93
£12·50
complete



Interior view of the unit from the rear. The wiring to the front panel mounted controls can be clearly seen.



Exterior view of the completed power supply showing front panel controls and labelling.

multi-plug will be positive (SK1) or negative (SK2). Therefore an output of either polarity is obtainable, making the Mini Power Unit compatible with many types of apparatus.

TRANSFORMER

It would be wise to obtain the transformer first, and then choose a housing of suitable height to encase the unit. The prototype was built in an aluminium/steel box measuring 150 x 125 x 50mm.

Some components are accommodated on a piece of 0·1 inch matrix stripboard of the usual Uniboard dimensions, 10 strips x 24 holes. The board layout is shown in Fig. 2 along with the off-board component interwiring. The stripboard requires two 6BA clearance holes so that it can be bolted down with nuts, bolts and spacers.

The rotary switch S2 is mounted on the front panel, and resistors R4 to R9 are soldered to its terminals as shown. A four-pole three-way switch can be employed, of which only one section is used, so that a one-pole three-way switch is achieved.

For SK1 and SK2 fully insulated sockets *must* be used. The standard metal open sockets will short out the output and are not suitable here. Fig. 2 shows how these two sockets are wired. Note that C5 is also soldered across SK1.

TABLE 1

Output Voltage	Actual Voltage (*no load*)	Actual Voltage (*with load*)
6V	6·2V	6·1V at 200mA
7·5V	7·8V	7·8V at 250mA
9V	9·3V	9·2V at 300mA

HEAT SINK

The i.c. is fixed down with a TO-5 panel-mounting heatsink to help in heat dissipation. The three wires to the i.c. should be soldered on and then the TO-5 case should be pushed into the heatsink, which is then bolted to the back panel with a steel 6BA bolt passing through an insulating bush.

Also the aluminium-oxide washer (provided with the heatsink) is sandwiched between the chassis and the heatsink, thereby preventing electrical contact.

The two power resistors can be soldered onto a piece of insulated tag strip which can be retained by one of the transformer mounting bolts. The other bolt on the transformer holds a solder tag in place, to which the earth input should be connected. This earths the metal case.

The mains cable passes through a hole in the chassis rear panel. This hole must be fitted with a rubber grommet to prevent chafing and also a cable retainer to hold the mains lead firmly in position. Miniature 3A three-core cable can be used for the mains input. Elsewhere employ standard hook-up wire. Plastic sleeving (2mm diameter) should be used as necessary on the l.e.d. and i.c. leads to prevent short-circuiting.

FINISHING OFF

The l.e.d. should be fitted with a lens-clip to keep it in place and to improve appearance. If you wish to letter the front panel do this before fitting the panel mounted components and use rub-down lettering as required. A couple of coats of lacquer will help protect the transfers.

Solder a 3·5mm jack plug to the bare end of the multi-way power lead. The tips of the multiplug are connected to the wire with the tracer marking. Stick four adhesive feet onto the bottom of the case.

With construction complete, check all interwiring carefully, especially that going to IC1, and then switch on the mains to the unit. If a voltmeter is available then test to see that roughly the correct output voltages are generated (of the correct polarity) when S2 is operated.

The unit is then finished and ready for use. Table One gives a brief summary of readings taken on the author's prototype. ⌑

JACK PLUG & FAMILY... BY DOUG BAKER