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EPE MOODLOOP POWER SUPPLY

ANDY FLIND

A regulated 13.2V 1A supply which may be modified for 12V output.



THIS power supply was designed to give a constant voltage output with sufficient current for the *EPE Moodloop* project described in last month's issue. The *Moodloop* may be operated from a supply anywhere between 9V and 15V, the only restriction being that the voltage of the supply should not vary.

Although the average supply current drawn at 12V is about 600mA, the peak value is closer to 1A and at 15V it will be even higher. Since the output frequency range of the *Moodloop* extends down to 1Hz, the use of large decoupling capacitors to supply these current peaks is impracticable. Instead, a power supply capable of delivering the peak current continuously is required.

In some cases a suitable regulated supply may already be available, but for *Moodloop* constructors without access to a suitable power source this project will fill the need. It is compact, simple and relatively inexpensive to construct and can also double as a useful source of d.c. power in the workshop for other applications.

HOTLY COMPROMISED

The design of a linear regulated power supply usually involves some compromise. Linear voltage regulators generate heat. The amount of this heat can be

determined from the product of the output current and the voltage difference between the regulator's input and output, in watts. This is why experimenters are sometimes surprised to find regulators overheating or even failing despite not being run at anywhere near their full current rating, an excessive input voltage is often the culprit.

closer to the peak value, which is about 1.414 times this.

The rectifier also introduces a small voltage drop, typically about 1.2V for a silicon bridge rectifier where two diodes are in series with the output at any point during operation. For a 15V transformer with a bridge rectifier and a smoothing capacitor the unregulated d.c. voltage is likely to exceed 20V with no load.

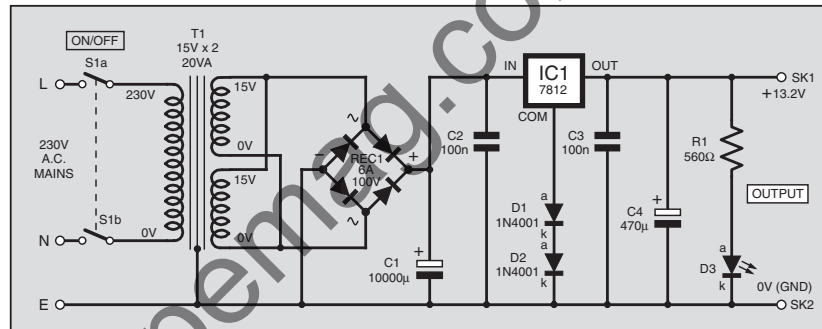


Fig.1. Complete circuit diagram for the EPE Moodloop Power Supply.

Keeping this to a minimum improves efficiency and reduces the heat output, which in turn allows the use of a smaller heatsink or even no heatsink at all in some cases. To minimise heat generation in a mains-operated supply, therefore, it is desirable to keep the voltage difference between the unregulated supply from the rectifier and the regulated output to a minimum.

It should be remembered, however, that the average and "ripple" voltage of the unregulated side both vary considerably with load current and it is essential to ensure that the instantaneous voltage does not dip below the minimum value required for correct operation of the regulator.

Typically this is about 2V to 3V above the regulated output voltage. Transformer output voltages are usually stated in terms of the r.m.s. value at full power but rise when lightly loaded, and the rectified and smoothed d.c. output is in any case

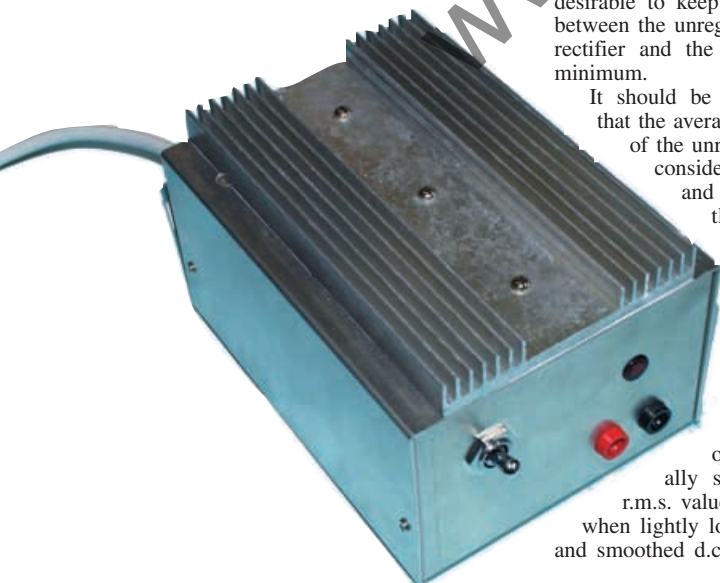
Ripple is usually reckoned to be about 700mV peak-to-peak for each 100mA of load current with a 1000µF smoothing capacitor, so it should be about the same for a 1A output if a 10,000µF capacitor is used. These were the basic factors considered when designing this power supply.

CIRCUIT DESCRIPTION

The full circuit of the project is shown in Fig.1. Transformer T1 is a 20VA type with two 15V outputs which are connected in parallel to provide a total current capacity of about 1.3A. This is full-wave rectified to d.c. by REC1 and then smoothed by the 10,000µF capacitor C1. This is used to supply regulator IC1, a standard 12V 1A positive supply regulator.

The output voltage is raised to 13.2V by the inclusion of the two silicon diodes, D1 and D2, between the regulator's common connection and the 0V supply rail. This serves two purposes as it both increases the output power from the *EPE Moodloop* and reduces the heat generated in the regulator.

Constructors requiring a 12V supply for workshop use can replace these two diodes with a link or even fit a switch to short them out in order to make both output voltages available.



Capacitor C4 provides additional decoupling for the output of IC1 whilst C2 and C3 provide high frequency decoupling for IC1's input and output. The l.e.d. D3, together with current limiting resistor R1, indicate that the unit is operating and the output is present.

UP TO MEASURE

A few measurements taken from the prototype confirm the design considerations just described. The r.m.s. a.c. voltage of the two parallel connected secondary windings of T1 was measured at 16.3V with no load and dropped to 15.5V with a load of about 1A. The unregulated voltage across C1 was found to be 20.9V when unloaded, but dropped to 17.6V with the 1A load.

Maximum ripple at this current was about 600mV peak-to-peak, so the lowest instantaneous voltage, at the bottom of the ripple waveform, was just over 17V. This leaves a minimum "headroom" of almost 4V for the regulator when it is delivering 13.2V, sufficient to ensure correct operation but low enough to minimise heat generation.

With a continuous load of 1A, the regulator will therefore produce about four watts of heat, whilst the rectifier will add a further one watt or thereabouts, so a heatsink of some kind is required. The transformer was also found to generate an appreciable amount of heat at this power level.

CONSTRUCTION

The prototype was constructed within an inexpensive aluminium box as shown in the photographs. Transformer T1, rectifier REC1 and the capacitor C1 were fitted into the bottom section of the box. REC1 is secured with a single screw and a dab of heatsink compound, no insulation being necessary.

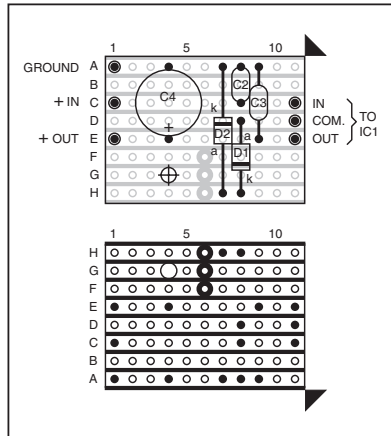


Fig.2. Stripboard component layout.

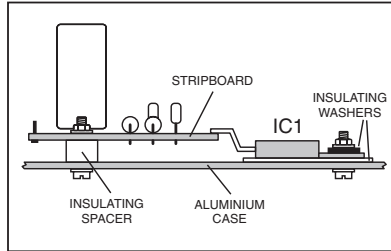


Fig.3. Suggested method of mounting the circuit board and regulator on the underside of the case cover.

Capacitor C1 is a "snap-in" type really intended for mounting on a printed circuit board, but here it is secured with a U-shaped bracket made from a scrap of aluminium and connections are made with soldered leads.

Capacitors C2, C3 and C4 with the two diodes D1 and D2 were assembled on a piece of 0.1-inch pitch stripboard having 8 strips of 11 holes as shown in Fig.2. This and the regulator IC1 were then fitted to

COMPONENTS

See
SHOP
TALK
page

Resistor	
R1	560Ω
Capacitors	
C1	10,000μ radial elect, snap-in, 35V
C2, C3	100n ceramic, resin-dipped (2-off)
C4	470μ radial elect, 35V
Semiconductors	
D1, D2	1N4001 rectifier diode (2 off)
D3	red l.e.d., panel-mounting
REC1	6A 100V bridge rectifier
IC1	7812 1A +12V regulator

Miscellaneous

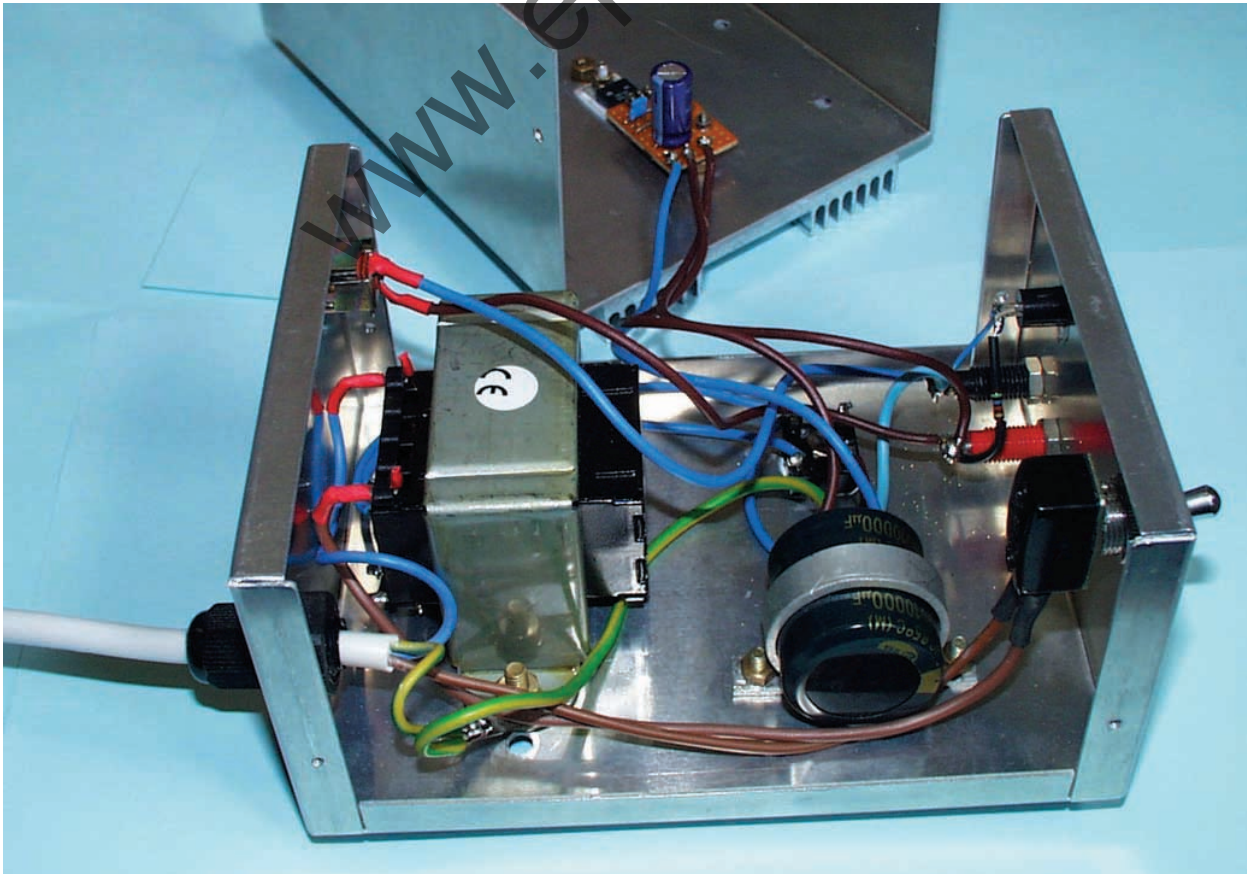
T1	20VA mains transformer, 15V x 2 secondaries
S1	d.p.s.t. switch, mains rated
SK1	4mm socket, red (see text)
SK2	4mm socket, black (see text)
Stripboard, 0.1-inch matrix, 8 strips by 11 holes; insulating mounting kit for IC1; aluminium case 152mm x 114mm x 76mm; heatsink 152mm x 94mm x 14mm, plain aluminium.	

Approx. Cost
Guidance Only

£22
excluding case

the upper section of the box, well away from the transformer and rectifier to distribute the heat as evenly as possible.

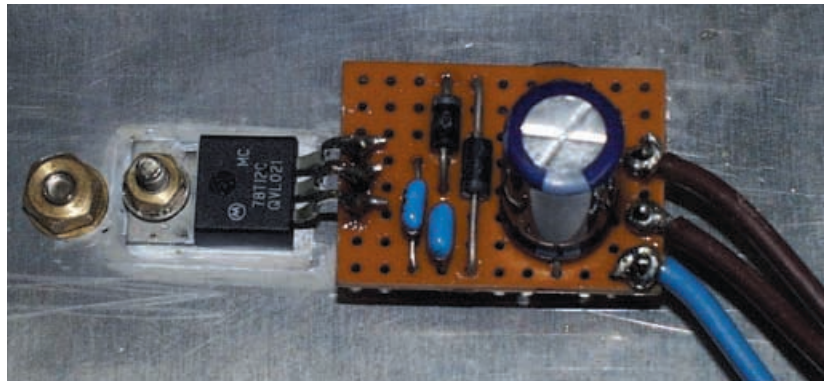
The mounting tab of regulator IC1 is internally connected to the common lead so it was fitted to the aluminium sheet



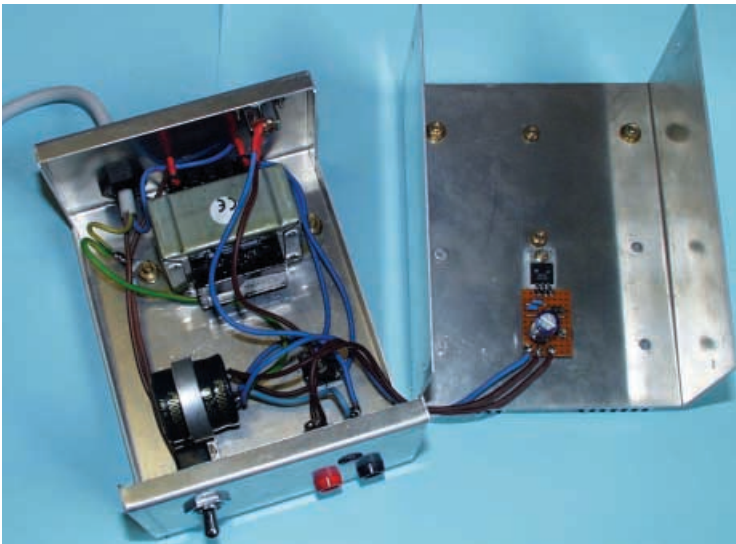
with an insulating washer and some heatsink compound. The leads were then bent to allow them to be soldered directly to their connections on the stripboard as shown in Fig.3. This keeps the decoupling capacitors C2 and C3 close to IC1.

A single mounting screw with an insulating spacer provides additional support for the stripboard. The components are connected together as shown in Fig.4.

Two 4mm sockets are fitted to the case for the output, and i.e.d. D3 and R1 are connected to these as shown. Although a single-pole switch was used for the mains input a double-pole type would be preferable for safety reasons so Fig.4 shows how this should be wired.



Enlargement showing the regulator (IC1) bolted to the underside of the aluminium case cover. It is mounted using an insulating kit and some heatsink compound.



General component layout within the aluminium case. Note the regulator and small circuit board mounted on the underside of the case cover.

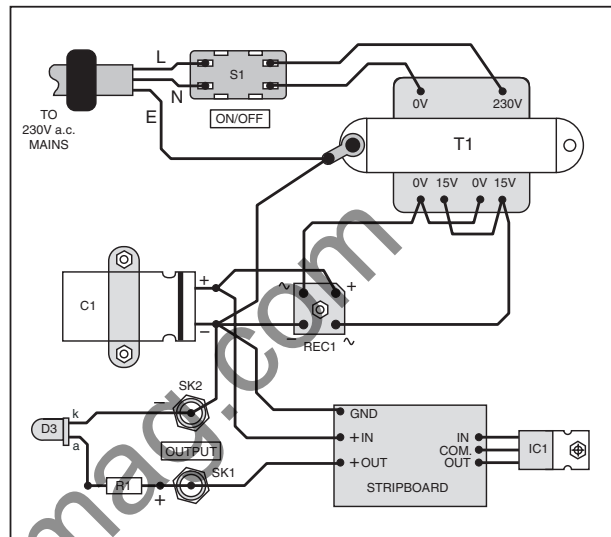


Fig.4. Details of the interwiring between components. The "heavyweight" components are mounted on the base of the aluminium box – see facing photograph.

MAINS SAFETY

Where possible, parts of the circuit connected to the mains supply, such as the switch and transformer connections, should be insulated or shrouded. Some heat-shrink sleeving proved useful for this. Where live parts are exposed, care **MUST** be exercised whilst testing or working on the unit. Temporary covering with insulating tape is often a good idea when working with such hazards.

It is essential to earth the metalwork of the case and it will be seen that the negative output rail (SK2) is also connected to earth. The prototype does not have any built-in fusing, instead it relies on a 3A fuse in the mains plug, but constructors wishing to add fuses to the input or the output for additional safety may easily do so.

If the unit is to be used as a source of power for the workshop a separate switch for the output would be a useful addition as capacitor C1 stores a considerable amount of power and rapid disconnection of this from a circuit on test might occasionally be required. It would also help to spare the unit from the stress of frequent power-up from the mains.

COMPONENT LAYOUT

Apart from keeping the stripboard close to the regulator, the layout of this unit is in no way critical. Built as described, it generates a moderate amount of heat, much of which seems to come from the transformer. To assist with dissipation a large heatsink was screwed to the top of the box, and overnight use with the *EPE Moodloop* results in it becoming quite warm but not too hot to touch, which is quite acceptable for modern electronic components.

If 4mm sockets are used as shown for the output, it is essential to ensure the

leads are plugged in the correct way round when using it with the *Moodloop* as reversing the supply polarity would damage this.

A later addition to the prototype, which may be seen in the photographs, was a concentric type power socket wired in parallel with the 4mm output sockets. This was placed at the rear so that the cable was out of the way when in use.

The unit is capable of continuous output of up to about 1A, in fact most regulators of this type can actually supply a little more than their nominal 1A output for short periods. Momentary short circuiting of the output should not cause damage as they also generally have internal "fold-back" current limiting protection, although for longevity prolonged short circuiting and overload of the output should obviously be avoided. □

NEXT MONTH

We present a Magnetic Field Strength Checker. Ideal for indicating the presence (or absence) of "force fields" from the *EPE Moodloop* relaxation project (Aug. '00) and other sources of magnetic "radiation".

ON SALE – 7 Sept

