THOSE who contemplate carrying out much experimental and constructional work with transistorised electronics will find that the use of batteries as a power supply can prove rather expensive.

A simple variable voltage power supply of the kind illustrated in this article will more than pay for itself in quite a short time and unlike batteries it doesn't run down. It will supply any voltage up to 16V at a nominal maximum current of 100mA and is fully protected against overload even to the extent of a direct short circuit across the output.

At very low current drain i.e. in the region of 10 to 20mA, the maximum voltage is about 17V which is suitable for many *npn* silicon transistor audio pre-amplifiers for example, requiring between 16 and 18V for operation.

POSITIVE OR NEGATIVE EARTH

Either the positive or negative rails can be "earthed" according to the requirements of the circuit being supplied. It is only necessary to move switch S2 to the appropriate position.

The meter always indicates the voltage at the output terminals i.e. the operating voltage being used. The a.c. ripple at any operating voltage and up to maximum nominal current drain is less than 0·5mV.

At any steady continuous current drain the voltage variation at any setting is negligible.

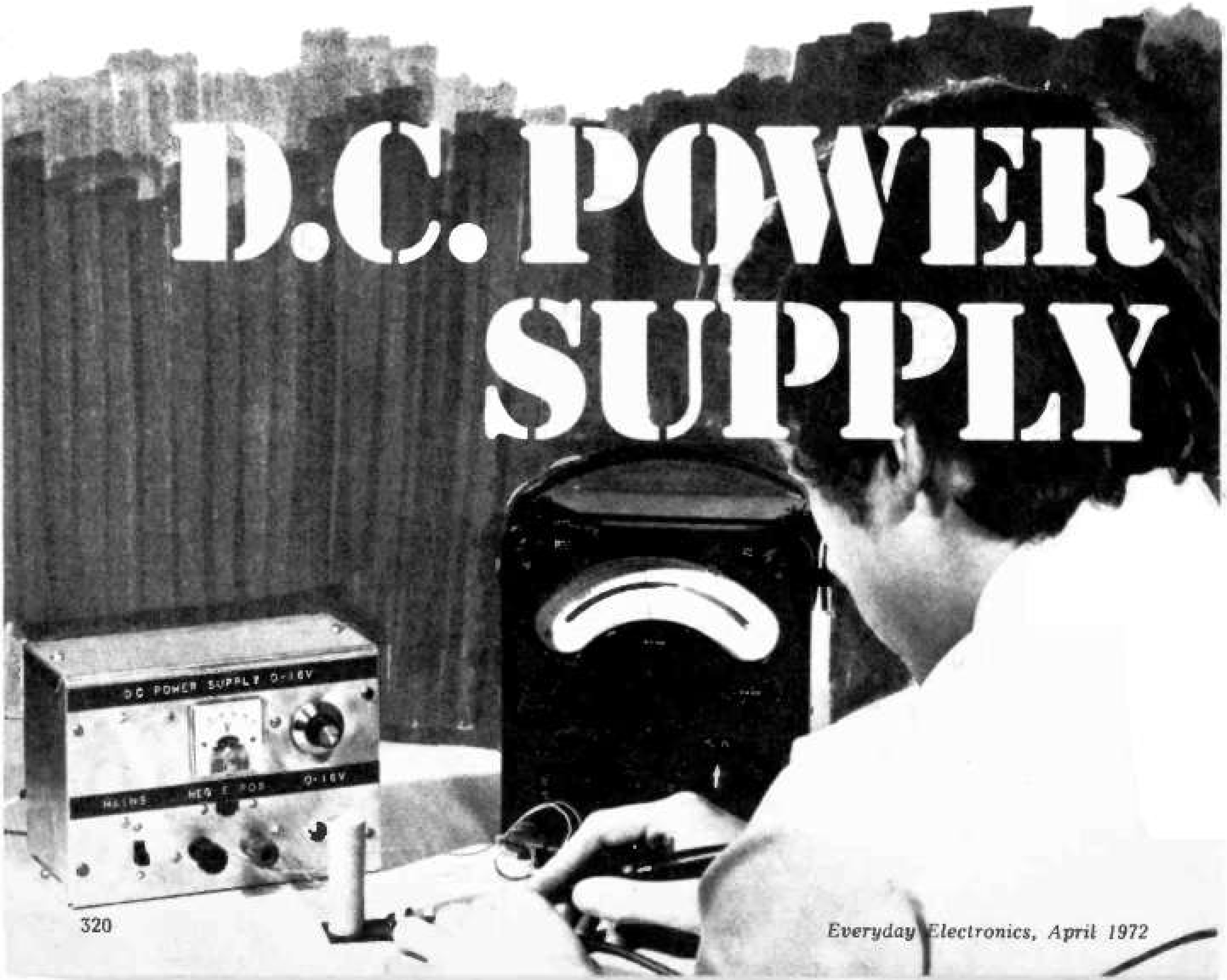
CIRCUIT DESCRIPTION

The complete circuit diagram is shown in Fig. 1 and is a fairly simple arrangement employing a small power transistor, TR1, to control the output voltage.

The transformer T1 steps down the mains voltage to 14V a.c. (r.m.s.) and applies this to points X and Y on the "diode bridge" network. This arrangement of the diodes gives full-wave rectification across points A and B.

The reservoir capacitor C1 connected across the bridge "smoothes" the pulsating d.c. from the bridge producing a mean d.c. level of about 20V with a small amount of "ripple" voltage. This is applied to the series combination of R1 and the Zener diode, D5. Capacitor C2 across

D.C. POWER SUPPLY



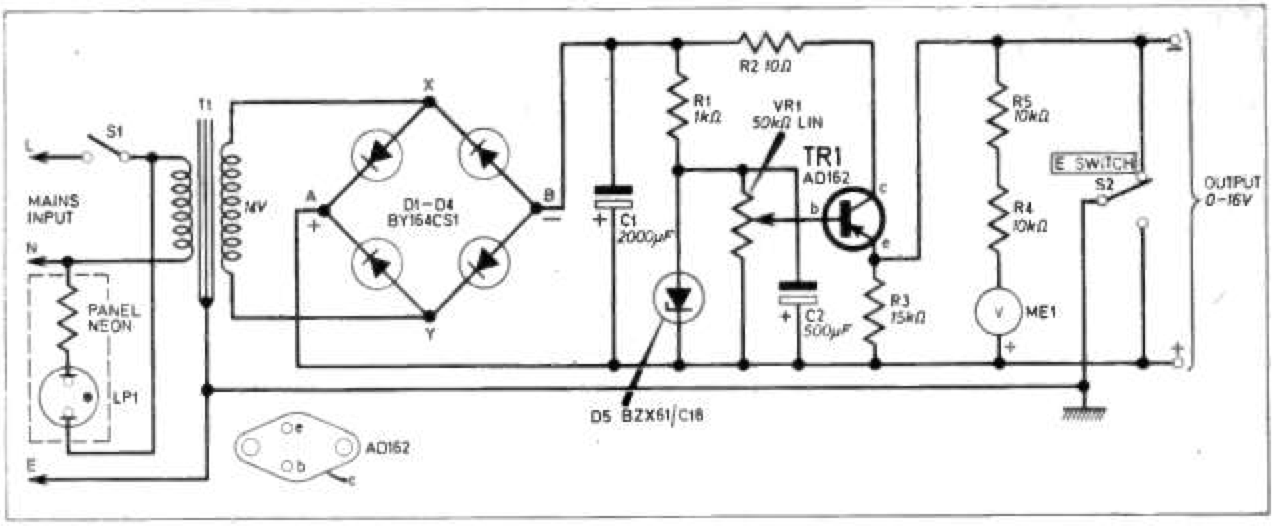


Fig. 1. The complete circuit diagram of the D.C. Power Supply Unit.

D5 helps to eliminate ripple voltage that may be present.

The Zener diode has the property of being able to supply a constant voltage over a wide range of current flow through it.

A small amount of voltage is dropped across R1 (Zener current limiting resistor) while D5 supplies a constant voltage of 18V to the potentiometer VR1 which controls the voltage applied to the base of TR1.

The inclusion of TR1 in the circuit affords stabilisation since without it, loads drawing large current would cause the voltage across the Zener to vary.

The voltage output from TR1 is a function of the potential drop across the transistor and also a function of the base-emitter voltage and affords stabilisation as follows.

UNIT

Approximate cost of components... £5·00 plus case

A simple stabilised supply providing 0 - 16 volts d.c. continuously variable output.

by F. C. Judd

Components....

Resistors
- R1 1kΩ ±1% ¼W hi-stab.
- R2 10Ω 10W wirewound
- R3 15kΩ ±10% ¼W carbon
- R4 10kΩ ±1% ¼W hi-stab.
- R5 10kΩ ±1% ¼W hi-stab.

SEE SHOP TALK

Capacitors
- C1 2000μF 25V elect.
- C2 500μF 25V elect.

Diodes
- D1–D4 BY164CS1 Bridge type rectifier (1 off) or if desired 1N4002 (4 off)
- D5 BZX61/C18 18V 1W Zener or any 18V 400mW Zener

Transistors
- TR1 AD162 germanium *pnp*

Potentiometers
- VR1 50kΩ linear carbon

Miscellaneous
- T1 240V primary 12 to 14V 200mA secondary transformer.
- ME1 0–1mA 75Ω internal resistance meter
- S1 Mains switch slide type, D.P.S.T.
- S2 Slide type switch, D.P.D.T.
- LP1 Mains panel neon with built in resistor

2 insulated terminals (1 red, 1 black); 0·15in matrix perforated s.r.b.p. size 3¾ x 2¼in.; 16 s.w.g. aluminium 3½ x 2½in. for heatsink; control knob to suit VR1; aluminium angle ⅜ x ⅜in.; various B.A. nuts and bolts for fixing of panel components; aluminium for building housing case or Universal chassis parts—CU168 (7 x 5in.) 2 off, CU147 (7 x 3in.) 2 off, CU145 (5 x 3in.) 2 off.

The base-emitter voltage is the difference between the output voltage and the voltage supplied to the base of TR1 via VR1 from the Zener diode (which is constant for any setting of VR1).

If the output voltage decreases (due to heavy load for example) so the base-emitter voltage increases, causing the output voltage to increase and in doing so causes the base-emitter voltage to decrease thereby decreasing the output voltage. Thus the circuit is self-compensating and the output voltage remains substantially constant for a wide range of output loads.

The supply rails can only be earthed by the switch S2 which connects either the positive or negative rail to common earth.

No part of the circuit, except the frame and core of the mains transformer, is directly connected to the panel and case, which is earthed.

CONSTRUCTION

The prototype was constructed in a box made from Universal chassis parts with everything mounted on the front panel, but any size case will do. The layout is not critical and may be modified to suit individual requirements. However it is essential that a heatsink be used to mount TR1 otherwise damage will occur to TR1.

Most of the components are mounted on a piece of 0·15in matrix perforated s.r.b.p. size 4×2¼in. The layout of these components on the board is shown in Fig. 2.

Begin by wiring up the board as indicated, attaching all the flying leads and remembering to use a heat shunt when soldering the Zener diode, D5, in position.

The next thing to do is to make the mounting bracket for the component board and the heatsink, and cut and drill the front panel to the sizes given in Figs. 3 and 4.

When this is done, attach the remaining components including the transformer T1, to the front panel in the positions indicated.

It is best next to attach TR1 to its heatsink making sure that TR1 is completely insulated from the heatsink by using the appropriate size mica washer and insulating bushes. Connection to the collector (which is the body of the transistor) is made via a solder tag under one of the securing bolts.

Now connect the transistor to the component board via the flying leads and then attach it to the front panel in the positions indicated.

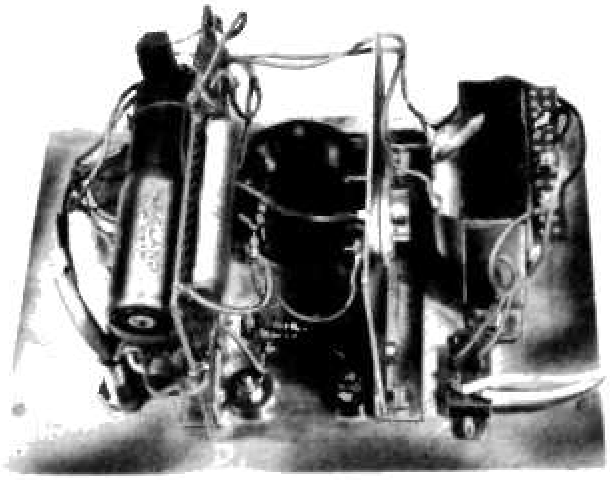
Connect all the flying leads from the component board and the transformer to the panel mounted components and wire an R3, R4 and R5 as shown in Fig. 5. Connect a suitable length of mains lead to S1 as shown.

THE METER

The resistors R4 and R5 are hi-stability types, and in series with the 1mA full scale deflection meter convert it to a 20V voltmeter.

Although the prototype was built with this kind of meter arrangement, it may be better to use one of the readily available 20V voltmeters which costs the same as the 1mA meter and need no calibration. The 20V meter would

D.C. POWER SUPPLY UNIT



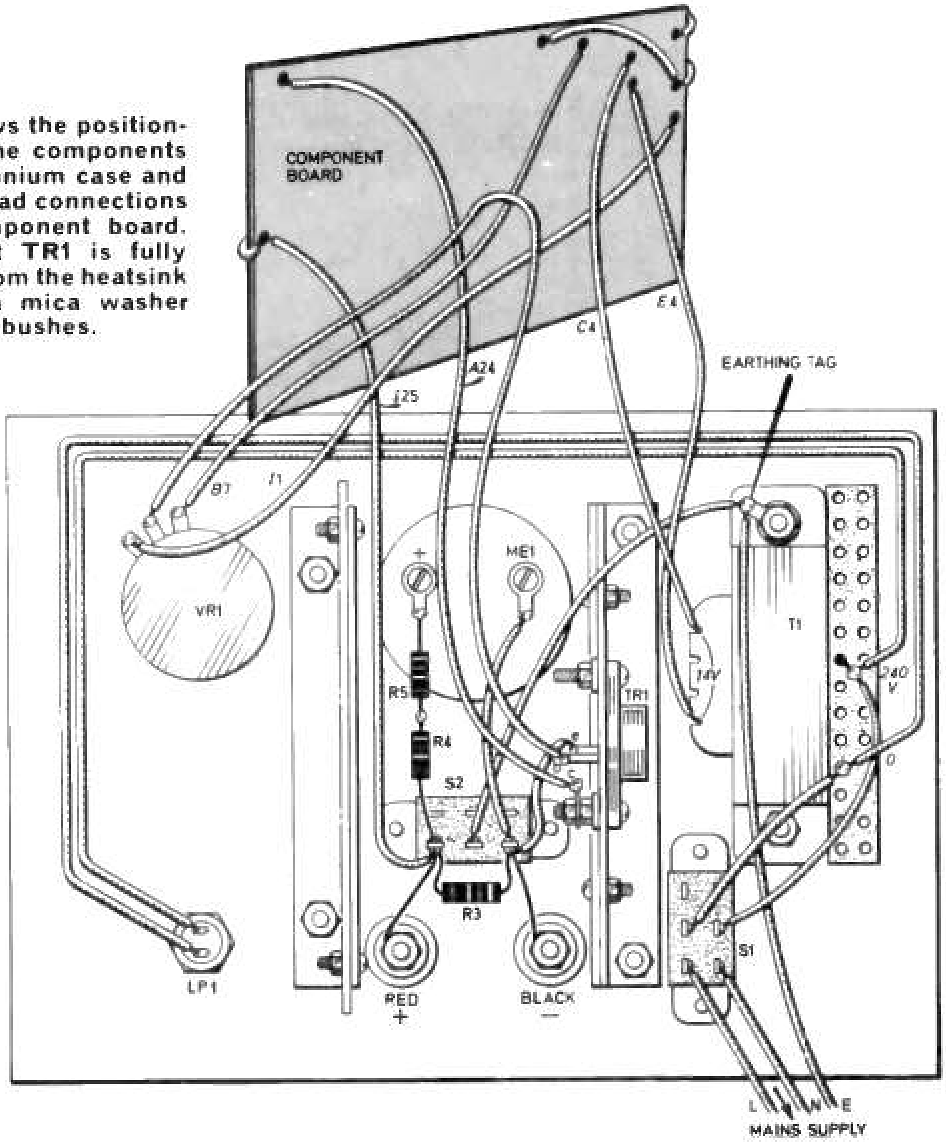


Fig. 5. Shows the positioning of all the components in the aluminium case and the flying lead connections to the component board. Ensure that TR1 is fully insulated from the heatsink by using a mica washer and plastic bushes.

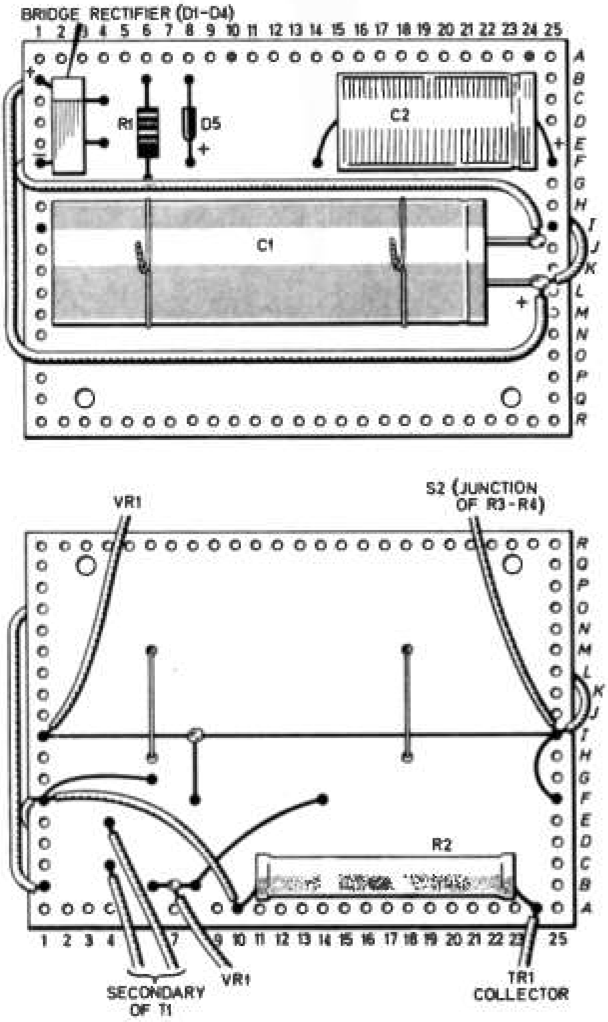


Fig. 2. The layout of the components on both sides of the board.

replace the 1mA meter and the series resistors R4 and R5.

If however, a 1mA f.s.d. meter is used as the voltmeter, it will be necessary to remove the meter scale and recalibrate it to read 0 to 20 volts.

This is done as follows: take off the meter cover and remove the meter scale by undoing the two retaining screws; gently slide the scale away from the meter. The original figures can be era-ed and new figures 0-20 inscribed.

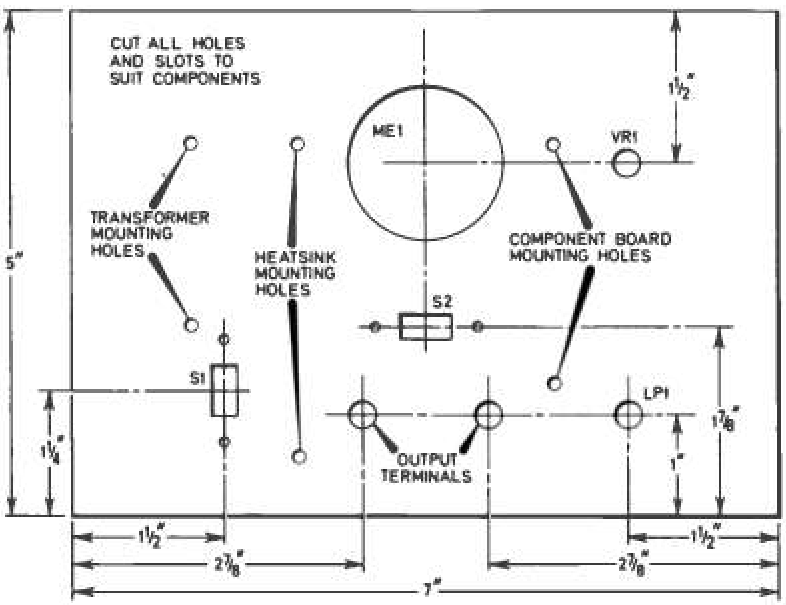
USING THE UNIT

It is a simple matter setting up the power supply unit for a specific job and should be carried out as follows: attach the battery leads from the test project to the negative and positive insulated terminals on the unit panel, decide which lead is the earth lead and switch S2 (marked E on front panel) to the correct position.

Turn VR1 fully anticlockwise (zero volts) and then plug in to the mains and turn on switch S1. Rotate VR1 to give desired voltage level—this is indicated on the meter.

The completed power supply unit is protected against temporary short circuits by the inclusion of the high wattage resistor R2 which will dissipate any power due to overload, However do not leave the unit running with a short circuited output, but switch it off until the overload is removed.

A direct short circuit will instantly reduce the output volts to zero and this will be shown on the meter. The unit will comfortably supply up to 100mA continuous at any voltage below 16V and between 150 and 200mA intermittent at 16V. ▣



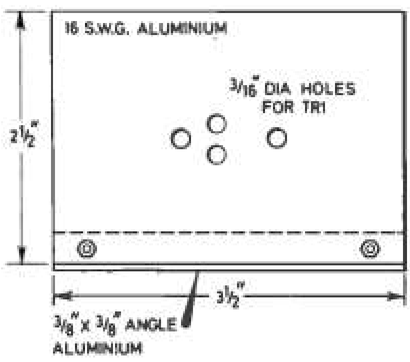


Fig. 3. (above) The dimensions of the heatsink for TR1.
Fig. 4. (left) The dimensions of the front panel showing positions of holes and cut-outs for mounting the components.