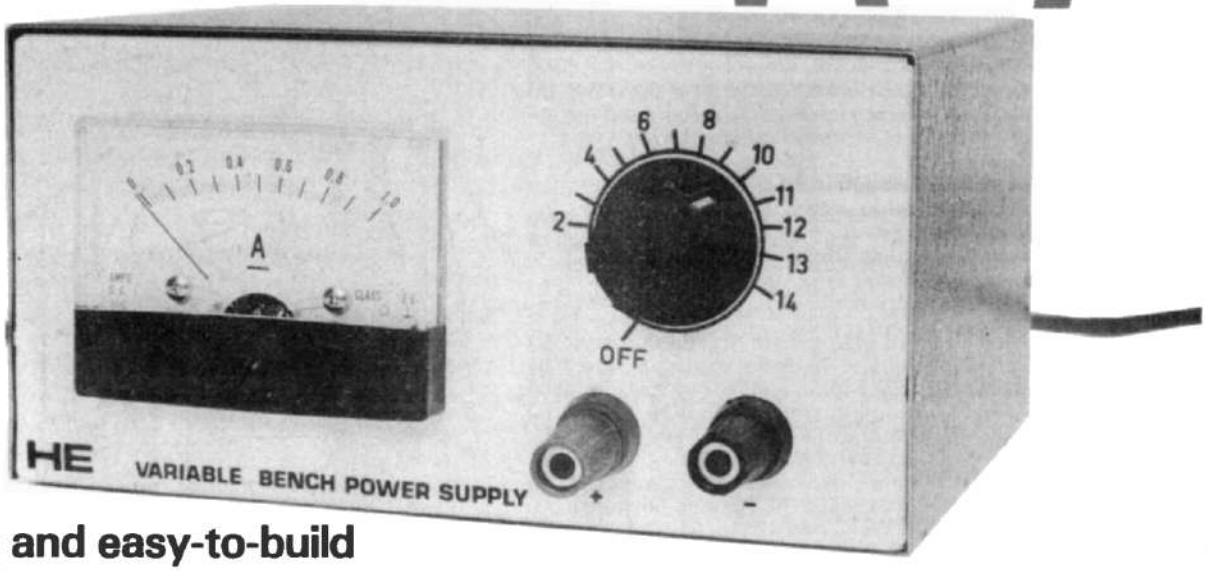
Variable Bench Power Supply



A cheap and easy-to-build project for use wherever you need a good-quality, low-voltage supply

WE KNOW THAT a bench power supply isn't the most original of projects, but we are sure that it *is* one of the most useful.

A good quality, well regulated power supply has a place on virtually every electronics hobbyist's bench. You see dry-cell batteries, while useful in self-contained projects, have their drawbacks: a limited range of voltages; an output which varies with battery age; low current; and last but not least — their cost. However, a power supply, because it is mains-operated, doesn't suffer from these drawbacks.

The HE Variable Bench Power Supply is a simple-to-build project using a minimum of components to provide an output which is an ideal voltage source for experiments, most projects, or car radios etc — in fact, it can be used for any circuit requiring a voltage between 1.4 V and 13.5 V and a maximum current of 1 A.

With series resistors the power supply can also charge Ni-Cd cells (by setting the output voltage to 12 V and selecting resistor values as shown by Table 1).

Resistor values for other currents and combinations of cells can be calculated from the formula:

$$R = \frac{12 - V_c}{I_c}$$

where V_c is the total voltage of the cells and I_c is the charging current. The resistor power rating is given by:

$$P = I_c^2 \times R.$$

After setting up the power supply with the resistor and the cells in series, simply adjust the power supply output voltage to trim the charging current to the exact value required.

Output voltage is fully variable within the upper and lower limits via a calibrated control, which also serves as an on/off switch. The output current is indicated on a panel meter. Ripple (the variation in output voltage — greatest when the supply is fully loaded) is negligible ie, less than 5 mV peak-to-peak, at full output.

Battery or cell type	Current 12-hour charge	Resistor value	Resistor rating
PP3§	9 mA*	470R	¼W
PP9§	100 mA	39R	½W
AAA	20 mA	530R	¼W
AA	66 mA	150R	1W
C	250 mA	39R	3W
D	500 mA	18R	6W

* — 17-hour rate
§ — 8.4 V batteries
all others — single cells 1.25 V

Table 1. Values and powers of resistors to use in series with the power supply when charging Ni-Cd cells

The heart of the bench power supply is a voltage regulator integrated circuit LM317K — a simple three-terminal device (input — adjust — output) — well tried and tested in industry for some years but still relatively new to the hobby market-place. This IC monitors its own output current and limits it to 2 A in the event of a short circuit, thus avoiding any possible damage.

Two fuses are used — one within the mains circuitry, to cover transformer failure, and one in the low-voltage circuitry to give protection in the event of a prolonged short circuit.

Construction

The first constructional step is the marking and drilling of the case. A mild steel case similar to that of our prototype is recommended to avoid electrical interference with equipment positioned near the power supply.

Cut out a round hole in the front panel for the panel meter — probably the most suitable tool for this is an Abraframe hacksaw — alternatively you can drill a circle of small holes and then file-out the large hole for the meter.

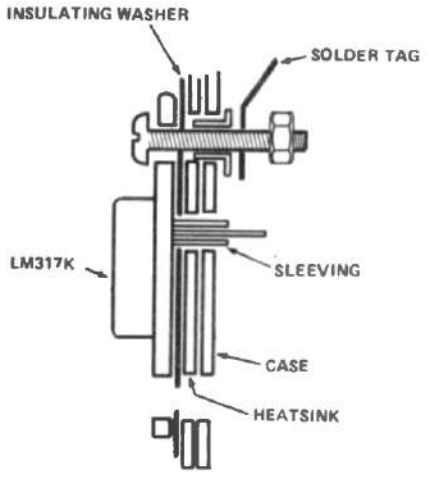


Figure 1. How to mount IC1 and its heatsink to the case

Drill and fit the two output terminals and the switched potentiometer onto the front panel.

Next, mount the transformer firmly to the base of the case not forgetting the solder tag for an earth connection.

Using the heatsink as a drilling guide mount the LM317K IC and heatsink using an insulating kit as shown in **Fig.1**. Remember to put a solder tag under one of the IC mounting screws.

Drill and fit the panel-mounting fuseholder and cable clamp to the rear panel.

Now, fix the tag strip, the chassis-mounting fuseholder and capacitor C1 into position. We found that the most convenient way to mount the capacitor was with a couple of double-sided adhesive pads.

Following **Fig.3** wire up the project, including diodes D1 to D4, capacitor C2 and resistor R1. *Remember that the unit is mains-powered so be careful with all connections (the earth wires are particularly important), and sleeve or tape all mains connections.*

Finally your power supply is ready to test. If you have a multimeter, checking the output voltage is straightforward. If you haven't got a multimeter, then set the output to minimum and connect a 12 V bulb (max 12 W) across the output of the supply and check that the bulb brightness increases as you turn the control clockwise. The scale shown in **Fig.4** can be marked onto your front panel, and should give fairly accurate results.

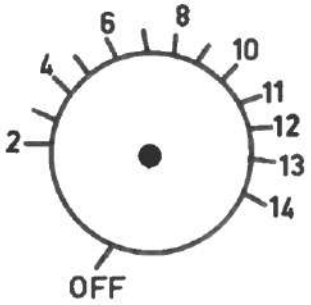


Figure 4. Mark the front panel control with this scale to give an accurate indication of output voltage

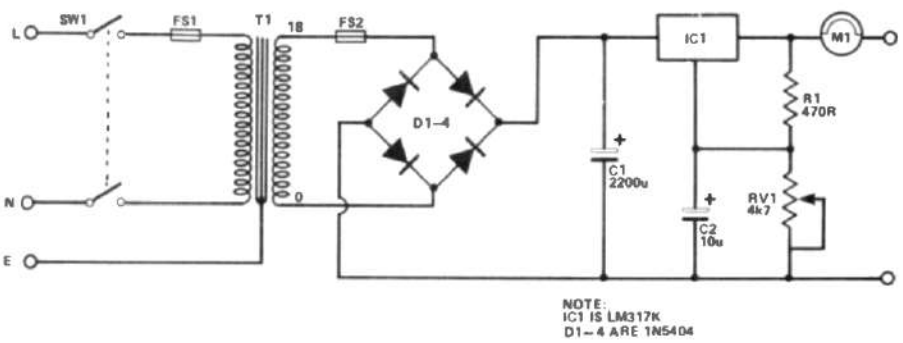


Figure 2. Circuit of the HE Variable Bench Power Supply — it's very simple, because the complicated things happen inside IC1

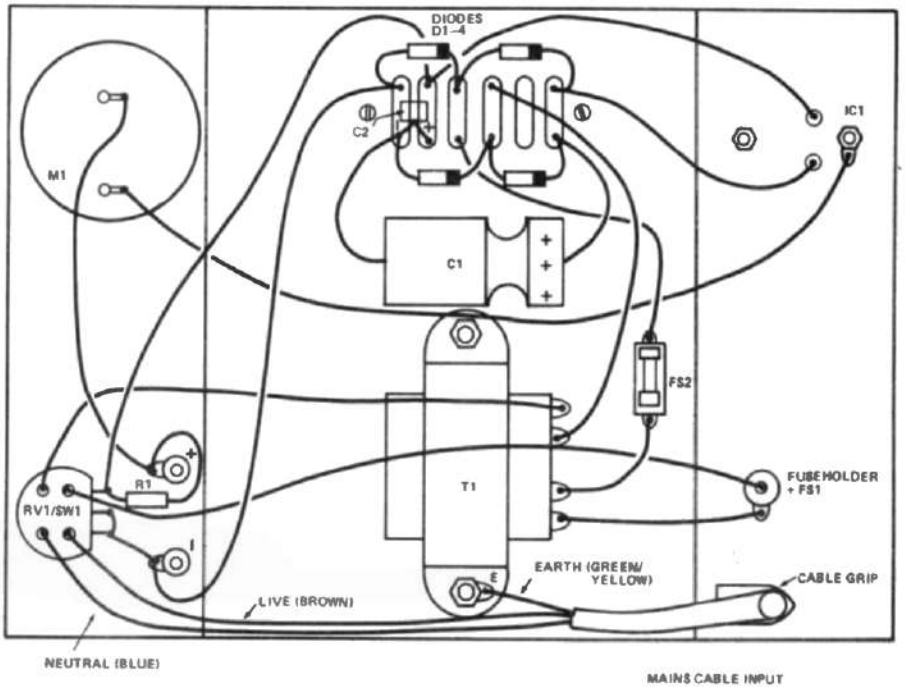
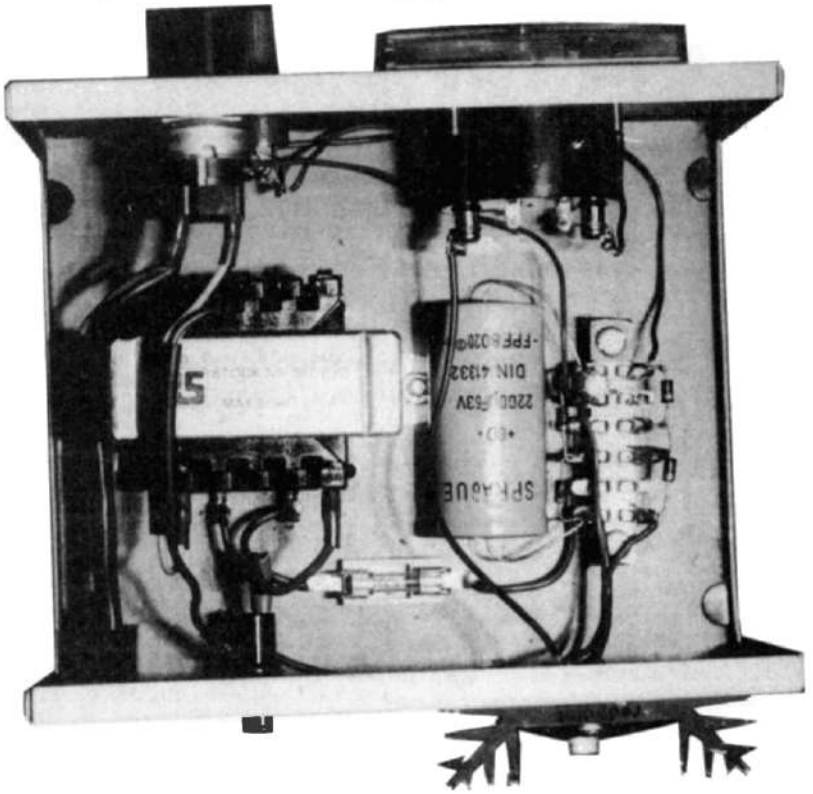


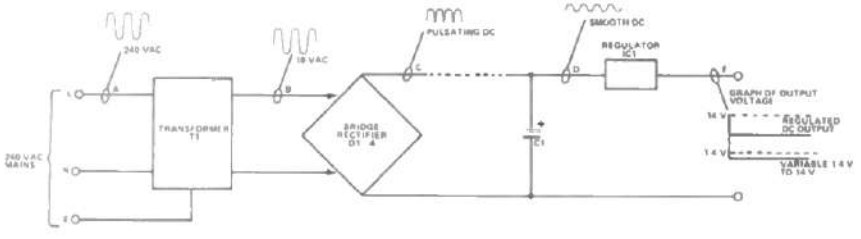
Figure 3. Wiring and connection details of the project



How It Works

There are four basic changes taking place within the HE Variable Bench Power Supply:

- the incoming 240 VAC mains (point A) is reduced to 18 VAC (point B)
- the voltage at point B is changed to a pulsating DC voltage (point C)
- this pulsating DC voltage is smoothed to that at point D
- the smoothed voltage is regulated and adjusted to a variable DC output.



Transformer T1 reduces the mains input voltage to 18 VAC. Full-wave rectification of this AC voltage is provided by bridge rectifier D1 to D4, and this full-wave rectified DC voltage is smoothed by capacitor C1.

Integrated circuit IC1 compares a proportion of the output voltage with an internal 1.2 V reference, and then allows more or less current to pass in order to keep the voltage output constant. Adjusting RV1 determines how much of the output is compared with the reference and therefore determines the output voltage. Capacitor C2 helps the regulator to give an extra smooth output by providing extra feedback of ripple voltage.

Parts List

RESISTOR (¼ W, 5%)
R1 470R

CAPACITORS
C1 2200u, 63 V electrolytic
C2 10 u, 35 V electrolytic

SEMICONDUCTORS
IC1 LM317K voltage regulator
D1-4 1N5404, 3A diodes

MISCELLANEOUS
T1 240/18 V, 1 A transformer
FS1 panel mounting fuseholder + 500 mA fuse
FS2 chassis fuseholder + 2 A fuse
M1 1 A panel meter
2 x output terminals
Knob to suit
Heatsink + mounting kit for IC1
Case to suit
Mains cable clamp
Tagstrip

Buylines

A full kit of parts for the HE Veriable 8ench Power Supply is available from Magenta Electronics, who advertise in HE. The kit will cost £23.35 and is complete with case, meter and all parts. This price includes VAT.

Please add 40p to the kit price to cover p&p.