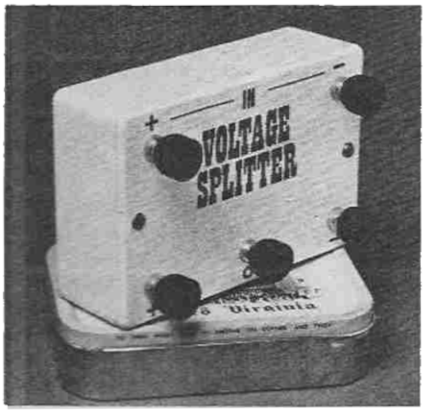

MINI-MODULES

By George Hylton

Handy "Beginner" projects based on simple circuits and featuring a variety of building methods.

9 VOLTAGE SPLITTER

THIS month's Mini Module is a simple but effective circuit for turning a single-ended d.c. voltage supply into a centre-tapped supply. Such a supply is needed for powering operational amplifier circuits and other circuits which call for a three-rail supply with positive, zero-voltage and negative lines.

Normally the zero voltage rail is earthed or commoned but this is not obligatory and any *one* output terminal may be earthed. The circuit in the form given here (Fig. 1) can deliver enough output current for most low-power circuits. Higher outputs are obtainable by adding a power transistor output stage.

The *input* voltage is, however, limited to 30V by the ratings of the 741 op-amp, which is used. This gives a maximum output of 15-0-15V.

If what is needed is not a centre-tapped supply but one divided unequally, for example, 20-0-10V, this is easily arranged by a simple change of resistances. The low-voltage limit of useful input voltage is about 6V, to give outputs of 3-0-3V.

A 741 op-amp, IC1, is used to compare the output voltage with half the input voltage, as set by the voltage divider R1+R2. Any error is amplified and used to adjust the output voltage to the correct value. In other words the circuit acts as a negative feedback stabiliser but the reference voltage is not a fixed value but is half the input voltage, whatever that may be.

The BFY51 output transistor, TR1, is able to deliver more current than the 741 alone. It acts as an emitter-follower buffer amplifier and the maximum output current is as shown in the chart in Fig. 1.

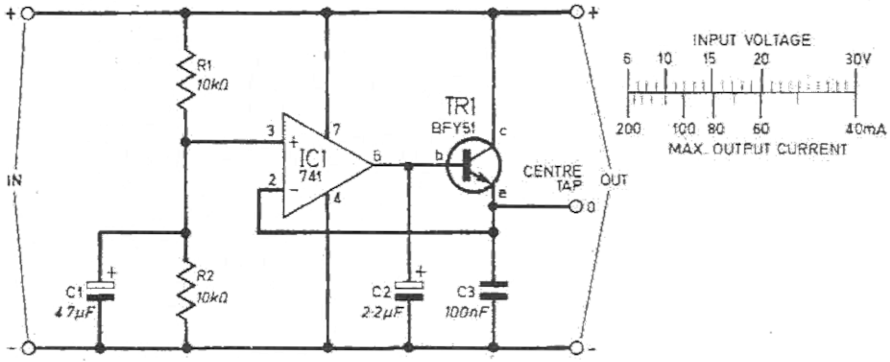

Fig. 1. Circuit diagram of the Voltage Splitter and input voltage/output current chart.

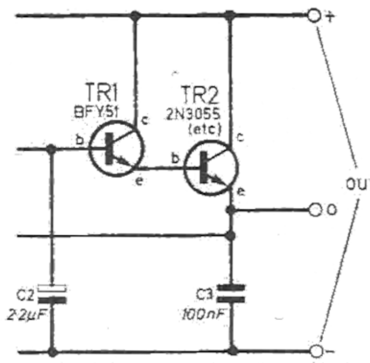

Fig. 2. The addition of a power transistor (TR2) for higher output currents.

CONSTRUCTION

A small piece of 0·1-inch matrix stripboard (such as given free with the March, 1979 issue of this magazine) forms a convenient baseboard. Four breaks in the conductor strips are required, below the 741 integrated circuit, which is in the 8-pin DIL format. Otherwise no preparation is needed.

The finished board can be mounted inside an existing power supply unit or (as here) put in a small plastics box such as the Norman Type PB1. No special mounting arrangements are required: the board can be hung on the input and output terminals by its own leads so long as these are of reasonably thick wire. (See Fig. 3.)

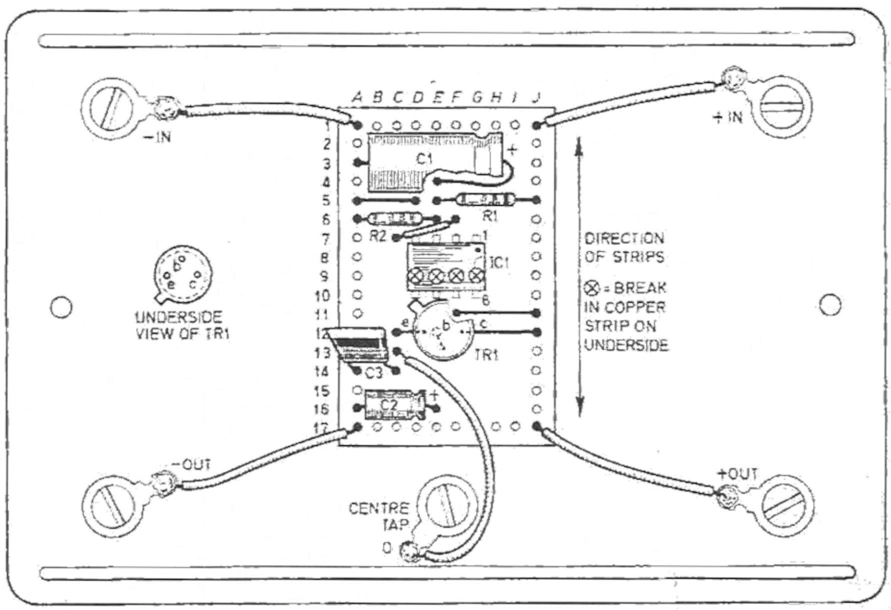

Fig. 3. The completed stripboard assembly mounted inside the plastics box.

COMPONENTS

Resistors
R1 10kΩ
R2 10kΩ
All carbon film, 5% tol. ¼W

Capacitors
C1 4·7μF 25V elect.
C2 2·2 or 3·3μF 25V elect.
C3 0·1μF met. polyester

Semiconductors
IC1 741 operational amplifier in 8-pin DIL package
TR1 BFY51 *npn* transistor

Miscellaneous
Stripboard (10 strips × 17 holes). Plastic case (Norman PB1). Five screw terminals. Five earth tags. Heat sink for TR1 (TO-5 cooler).

OPERATION

Connect the input and outputs. Take care not to exceed the maximum output currents shown on Fig. 1. Remember that only one terminal at a time may be earthed; if for instance the centre-tap is earthed it is not permissible to earth also the negative or positive terminal.

OUTPUT OPTIONS

The maximum output current is limited by the permissible collector power dissipation of the BFY51. This is 600mW and gives the currents shown on the chart. A small increase (50 per cent) is obtainable by fitting a good cooling cap to the BFY51 (a useful thing to do anyway).

For larger currents a proper power transistor must be added, on an adequate heat sink (Fig. 2). The collector dissipation, with a centre-tapped output arrangement, is half the input voltage times the whole of the output current. Thus a 20V input arranged for 10-0-10V out at 1 ampere gives a dissipation of 10W.

The power transistor (a 2N3055 or similar TO-3 device) must then be mounted on a heat sink whose thermal resistance is low enough to prevent the transistor temperature from rising to a dangerous level when dissipating 10W. (Articles on the choice of heat sinks appear from time to time in magazines like this one.)

Another common requirement is for a stabilised negative rail, between output terminals "0" and "—". This can be arranged by exchanging R2 for a Zener diode, D1, whose operating voltage is the required stabilised negative output voltage.

If, instead of a centre-tap, some unequal division of the input voltage is required this is easily arranged by changing the relative values of R1 and R2.

For example, if the input is 18V and an output of 12-0-6V is required, R2 should be half R1 since it will then drop one third of the input voltage. In other words the usual voltage-divider rule applies:

$$R1/R2 = (V_{in}/V_{out}) - 1$$

where V_{out} is the tap voltage.

Next month: Electronic Swanee Whistler.