9v STABILISED P.S.U.

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ALTHOUGH car radios and tape players are fitted into some cars, many less endowed motorists would like to use their domestic battery-operated radios, radio/recorders or recorders in their cars at times such as during holidays, long journeys or more permanently and would prefer to use the car battery supply instead of the internal costly dry batteries. This article describes a unit which can be used for such a purpose.

Measurements have shown that under normal operating conditions the nominal 12V available from the car battery can vary from 10V to 14·5V, a tremendous variation, and means must therefore be provided to obtain from such a varying input voltage an output voltage which varies very little from the one required, such as 6V, 7·5V or 9V.

It is a highly desirable feature of any circuit but particularly one for constructors that excellent performance is designed in and no adjustments or tailoring of component values is necessary when it is made up. This circuit has this feature.

CURRENT LIMITING

The energy available from a car battery is very considerable indeed and it is not impossible for wiring damage to result from breakdowns or accidental short circuits in equipment connected to a car battery system unless safety measures are taken. This unit includes such measures and its outputs can be short-circuited indefinitely without any ill effects. Under such conditions the output current falls to a low value and remains almost cut off until the short circuit is cleared.

The components used are not critical and similar alternatives should be quite satisfactory. Silicon transistors and diodes should be used, however, because they operate satisfactorily at higher temperatures than germanium types.

THE CIRCUIT

The circuit is shown in Fig. 1 and may first of all be considered with D3 omitted and D2 short-circuited. It will then be seen to consist of a stabilised voltage provided by the Zener diode D1 fed from the unstabilised input via R1.

To this stabilised voltage point is connected a complementary emitter follower TR1 and TR2, the output being taken from the emitter of TR1 which is also connected to the collector of TR2. If the circuit was used in this form it would provide a stabilised output voltage of about 0·5V lower than that of the Zener diode, but if the output was overloaded, particularly if it was short-circuited, the transistors would be destroyed.

The inclusion of D2 prevents the output current rising beyond a chosen limit. For a given set of other components the maximum current is determined by the value of R2 and when this current is reached D2 becomes reverse biased and ceases to conduct. Even if the output is short-circuited the output current will not increase beyond the chosen value. However, under such conditions TR2 would have the full input voltage applied across it and as it would also be passing maximum current it would be dissipating maximum wattage. Unless means were provided to dissipate the heat generated by this wattage, TR2 would become overheated and damage result. Much more cooling would therefore have to be provided than necessary

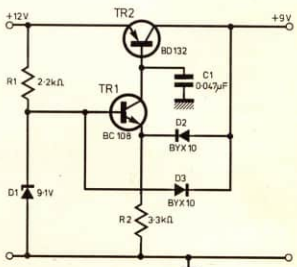

Fig. 1. Circuit of stabilised p.s.u.

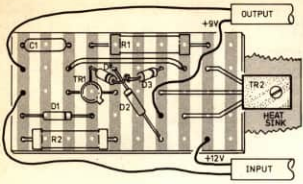

Fig. 2. Veroboard layout and track cutting details

under all conditions except severe overload such as a short circuit.

If D3 is included such a severe overload causes the diode to conduct, the Zener diode is almost shorted out, TR1 and TR2 become almost non-conducting and the short circuit output current is determined mainly by R1 in series with D3 and the output load or short circuit all across the battery circuit. This current is very small so under severe overload conditions the power dissipated in TR2 is negligibly small and cooling arrangements for normal output only need be provided.

CHANGING THE OUTPUT

In this circuit the output voltage is almost exactly that of the Zener diode used and an output of 6V, 7·5V or 9V may be obtained by merely fitting a Zener of the appropriate voltage. No meter is needed for setting-up purposes. The normal current required by the sort of load for which this unit was designed is up to 150mA and a current of at least 250mA has therefore been made available to provide an adequate margin.

There is a possible problem of starting current which in the case of brush type recorder motors is very much higher than the run current. It is this characteristic which makes them attain their running speed very quickly and is why they are so suitable for cassette recorders. However, the starting current can be up to ten times the run current and it is possible that with some recorders the unit as shown will not start up if the recorder is switched on before power is applied to the input of the stabiliser.

COMPONENTS . . .

Resistors

R1	2·2kΩ
R2	3·3kΩ
½W	10% carbon

Capacitor

C1	0·047μF polyester film

Semiconductors

TR1	BD132
TR2	BC108
D1	BZY88C9V1 9·1V 400mW Zener
D2, D3	BYX10 (2 off)

Miscellaneous

Veroboard, heat sink, nuts, bolts and lock washers.

If this is regarded as a drawback it can be overcome by putting another similar diode in series with D3. Although the short circuit current is then somewhat higher than when one diode is used it is very much less than with no diode and no starting problem will arise.

Capacitor C1 is included to eliminate any possibility of the circuit oscillating at high frequencies.

PERFORMANCE

The unit described has been used in a typical family car to operate a cassette recorder and has given no trouble. At an output of 100mA the voltage varies from 9·08V to 9·13V if the input voltage varies from 10V to 15V.

At a steady 12V input the output voltage varies from 9·1V to 9·05V if the output current varies from 100mA to 250mA.

The output current into a short circuit is 10mA.

CONSTRUCTION

The layout of this unit is not critical as indicated in Fig. 2.

It is not always realised just how difficult are the conditions in which the "electrics" in cars operate. Vibration and temperature variations are two of the real environmental hazards. Anything which can vibrate loose or break loose will do so. Leads, components and screws must be very secure, particularly with any sub-assemblies constructed.

The temperature in a car can vary from below freezing to 55°C or above during a year and due regard of this must be taken when choosing components.

Where no convenient connection, such as a cigarette lighter socket, is available it is quite simple to run a separate lead or leads to the car battery or fuse box, but a fuse should be incorporated somewhere in the "live" lead.

The easiest way of doing this is by means of a lead mounted fuse if a lead is taken directly to the battery. If the lead is taken to the fuse box it is best to choose the position, often marked "AUX", which connects to such things as the clock, roof lamp, heater, etc. Failure of wiring will not then put the car out of action. ★