UNIBOARDS

SIMPLE TRANSISTOR DESIGNS

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VOLTAGE CONVERTER

THE unit to be described here is a simple two-transistor circuit which is designed to operate a cassette player from a 12 volt car electrical system.

The majority of cassette players operate from either 6V or 7·5V batteries, and so cannot directly be connected to the car's electrics. The Voltage Converter reduces the 12V to that required by the cassette unit.

The Voltage Converter is short-circuit proof and automatically limits the output current to 500mA which is suitable for the vast majority of cassette machines. Also the output voltage is regulated; that is, no matter what the output current is, the output voltage remains virtually unchanged.

CIRCUIT DESCRIPTION

Fig. 1 shows the circuit diagram of the adaptor. D1 protects the circuit from a reversed supply connection, and +12V is applied to its anode. R2 and D2 form a stable reference voltage which clamps the base of TR2 to 8·2V. The emitter of TR2 is therefore at a voltage of 8·2V less the 0·6V or so which appears across the base-emitter junction of the transistor, i.e. approximately 7·5V. C2 serves to remove any spurious Zener noise which may be impressed upon the output.

Remembering that the maximum output current required is about 500mA, it would be impracticable to simply use a voltage-reducing Zener diode only (with series resistor) to provide this current. An emitter-follower transistor (TR2) is therefore utilised to greatly increase the peak current available. This means that the only "output current" the Zener needs to supply is the base current for TR2, 15 to 20mA or so.

Light-emitting diode D3 (with series resistor R3) is connected across the output and illuminates when the unit is operating.

CURRENT LIMITING

Components TR1 and R1, limit the maximum current which can flow through the load. Notice that the base-emitter junction is connected across R1 which is placed in series with the negative rail. As the current through the load (and hence through R1) increases, so the voltage drop across R1 will rise. When this voltage approaches 0·6V, TR1 will start to switch on because the base-emitter junction is forward biased.

With TR1 on, this diverts current away from TR2 base and causes TR2 to switch down, reducing the current through the load. The maximum current available to the load is, in fact, equivalent to 0·6V/R1, i.e about 500mA.

CONSTRUCTION

The circuit is built on a standard-sized piece of 0·1 inch matrix stripboard, 10 strips×24 holes as can be seen in Fig. 2. There should be no problems as assembly of the component board is straightforward.

Two 4BA clearance holes are required in the stripboard to take the mounting pillars. Also seven breaks are required in the copper strip; these can be made with a hand-held twist drill or the purpose-built Spot Face Cutter. Proceed now with the soldering of the two link wires and then the components themselves (according to Fig. 2).

The two wirewound resistors R1 and R2 should be "stood off" slightly to permit some circulation around them when they run warm. TR1 is fitted with a TO-5 push-on heatsink—fix this on *before* soldering the transistor into position.

As usual, take care not to overheat the semiconductors during soldering. A heatshunt clipped onto the lead being soldered may help prevent any thermal damage arising.

The prototype was built into an aluminium box of approximate dimensions 100×65×50mm. Any *metal* box of similar measurements should suffice. Using two 4BA threaded spacers, the circuit board is firmly fixed to one of the walls of the box. The power transistor TR2 is bolted down with a 6BA bolt to the removable lid of the box. A TO-126 mica insulating washer must be used to insulate the power transistor from the case: a smear of silicon grease or a similar compound will increase the heat transfer to the lid, employed as a heatsink, and so aid cooling of the transistor.

Wiring between board and other components is shown in Fig. 2. Mounted externally is a 4-way screw terminal block which forms the connector for the 12V input and 7·5V output. Flying leads should be taken from the circuit board and through a hole in the aluminium box adjacent to the terminal block; the hole must have a small grommet fitted.

Finally, the l.e.d. D3 can be mounted on the front of the box using the special black plastic clip and bush normally provided with it. All interconnecting can be made with stranded general purpose hook-up wire; try to ensure that none of the wiring touches either of the power resistors once the lid is in place.

Once completed, check out all wiring carefully. Particularly the flying lead connections to TR2 and D3. If a variable power supply is available then 12V d.c., of appropriate polarity, can be connected to the input of the unit (the l.e.d. should light) and the output can be measured on a 10V d.c. f.s.d. voltmeter.

The output should be seen to be between roughly 7·2V and 7·9V. If everything appears to be in order, the unit can be installed in the car and tested with the cassette machine.

It is desirable that the Voltage Converter be mounted carefully in the interior of the car, rather than under the bonnet where conditions in the engine bay are rather punitive. The box should be mounted with reasonably strong brackets.

6 VOLT OUTPUT

The unit can be modified to give a 6V output: R2 should be increased to 180 ohms wirewound, and D2 replaced by a BZX61C6V8 Zener diode. R3 is then reduced to 390 ohms.

COMPONENTS

Resistors
- R1 1·2Ω 3 watt wirewound
- R2 { 150Ω 3 watt wirewound (7·5 volt version); 180Ω 3 watt wirewound (6 volt version) }
- R3 { 680Ω ½ watt carbon (7·5 volt version); 390Ω ½ watt carbon (6 volt version) }

Capacitors
- C1 1μF 35V tantalum bead
- C2 0·1μF mylar or polyester

Semiconductors
- D1 1N4001 or similar silicon diode
- D2 BZX61C { 8·2 volt 1·3W Zener (7·5 volt version); 6·8 volt 1·3W Zener (6 volt version) }
- D3 TIL220 or similar light emitting diode
- TR1 2N1711 or BFY51 *npn* silicon
- TR2 BD135 *npn* silicon

Miscellaneous
Stripboard: 0·1 inch matrix size 10 strips × 24 holes; 4-way screw terminal block; TO-5 push fit heatsink for TR1; mounting clip for D3; TO-126 insulating kit for TR2; aluminium case type AB11 size 100 × 65 × 50mm or similar; small rubber grommet; 4BA 15mm long threaded spacers; 4BA and 6BA nuts, bolts and washers.

Approx cost **Guidance only**
£2.50 (see page 400)

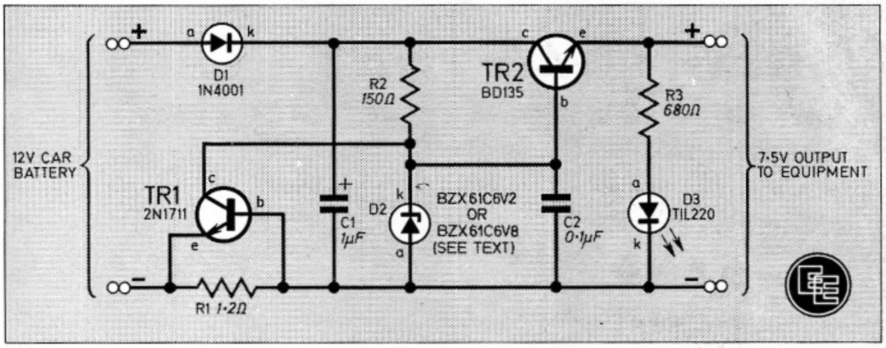
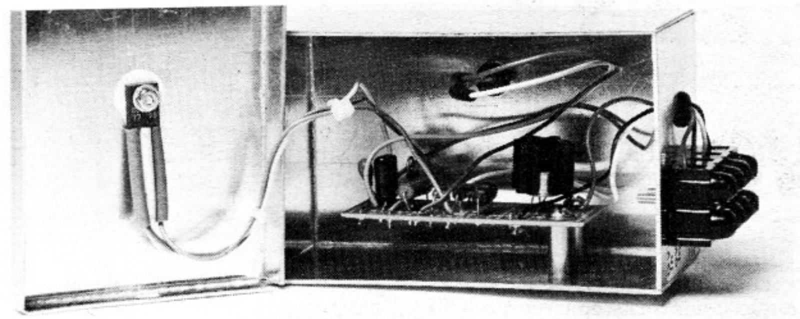


Fig. 1. The circuit diagram of the Voltage Converter. Note the Zener diode change for the 6V version.



The completed prototype with lid folded back showing method of mounting the board; spacers are used.

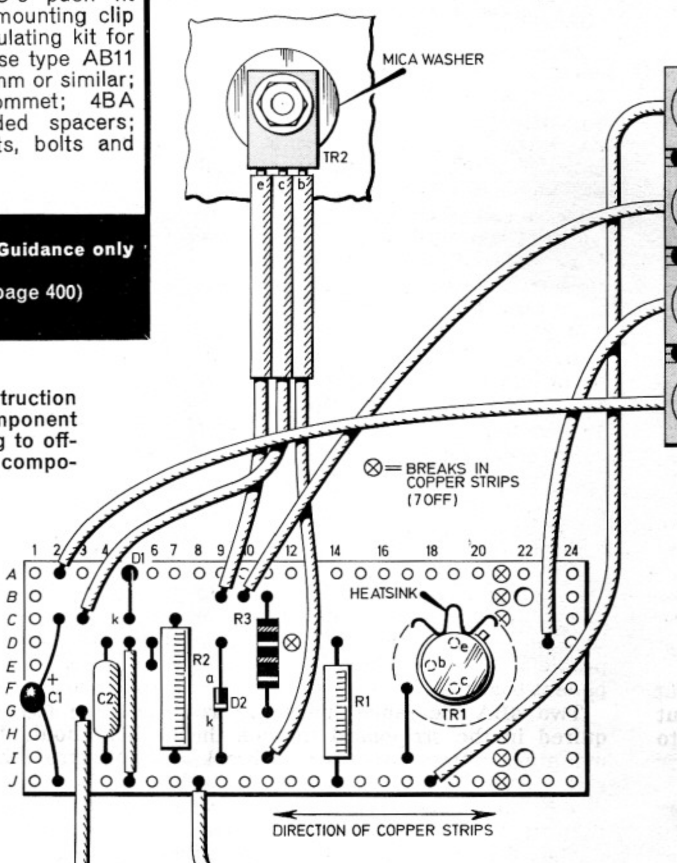
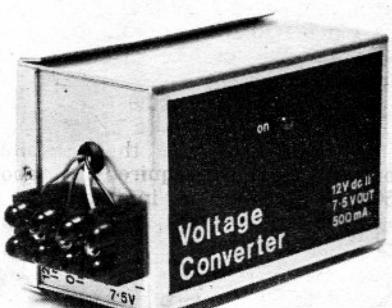


Fig. 2. Complete construction details showing component board layout and wiring to off-board case mounted components. Note the mica washer insulating TR2 from the case. D3 should be mounted in an l.e.d. panel clip. Attention is drawn to the number of breaks on the underside of the board. There are seven, see key. Fit TR1 heatsink before soldering TR1 in place.



The completed unit ready for installation.