11

Mains/9 Volt Adapter

In the previous section of this book a charger for NiCad cells was described, and together with the appropriate batteries this can provide a low cost method of powering battery operated equipment in the long term. However, if portability is not of prime importance, a much cheaper method of powering battery operated equipment is via a mains adaptor.

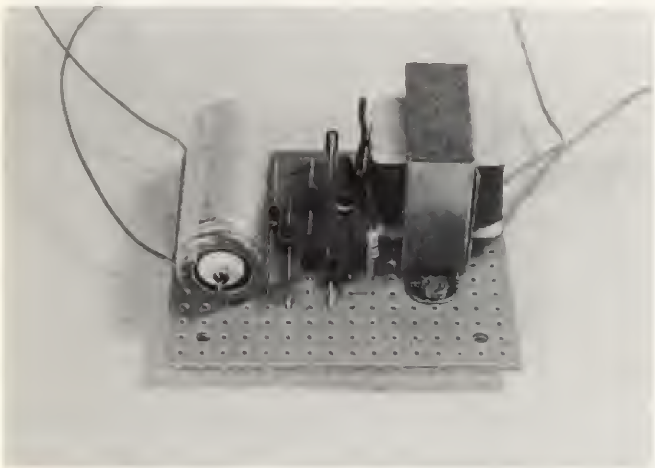

Figure 11.1

Mains/9V adapter

Units of this type consume only about 1W of power and thus have a negligible running cost of only about 1p per 400 hours use. The initial component cost is not very high and is soon recouped in saved battery costs.

This adapter can be constructed either as a separate unit which plugs into the main equipment, or as a compact assembly which fits inside the battery compartment of the powered equipment. The second method is only really practicable if the equipment takes a fairly large battery such as a PP9, but is the more convenient solution. In either case there is no loss of portability in that the equipment can still be battery powered if this should be desired at some future time.

The unit supplies a well smoothed and regulated 9V supply at a maximum current of 100mA. It is suitable for powering most 9V battery equipment such as transistor radios, signal generators, etc. There are several projects in this book which it could be used to power, such as the 'Auto Turn On/Off Switch' and the 'Rain/Water Level Alarm'. It is not suitable for powering cassette recorders and other items of equipment which have a fairly high current consumption.

A unit of this type is very useful to have around an electronics workshop when building or testing small battery operated apparatus.

The circuit

The circuit diagram of the Mains/9 Volt Adapter is given in Fig. 11.2. The mains supply is fed to the primary winding of T1 by way of on/off switch S1. T1 provides both voltage step down and safety isolation, and

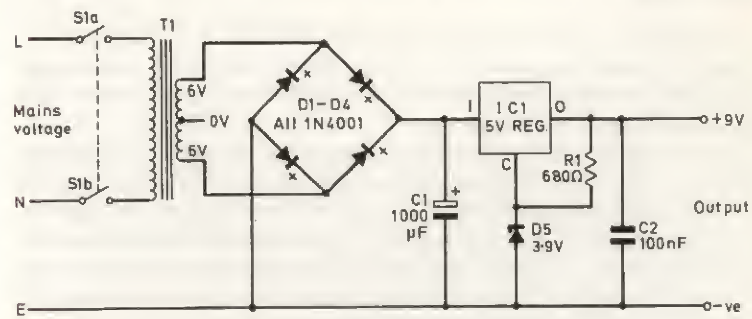

Figure 11.2

Circuit diagram of the adapter

its output is fullwave rectified by the bridge rectifier formed by D1 to D4. The pulsating d.c. output from the rectifier network is smoothed by C1.

It is virtually essential to incorporate a regulator circuit in equipment of this type since the output voltage varies over quite wide limits between no load and maximum load if no such circuit is employed. This could easily result in either an excessive voltage being applied to the powered circuit under low load conditions, or an inadequate voltage being supplied under high load conditions, depending upon the nominal output voltage chosen.

In this circuit a monolithic i.c. voltage regulator is used, and this provides a high degree of regulation. It also provides electronic smoothing of the output which has an extremely low ripple content in consequence. The regulator incorporates output current limiting and thermal overload protection circuitry, and so the unit is not easily damaged by output short circuits.

A regulator for an output potential of 9V is not readily available and so a 5V type in a suitably modified circuit configuration is used. I.C. monolithic voltage regulators are three-terminal devices: input, output, and a common terminal. By raising the common terminal 4V above the negative supply rail potential an output of 9V can be obtained.

In this circuit the common terminal of the regulator i.c. is connected to a simple zener shunt stabiliser circuit which uses R1 and D5 and produces a potential of 3.9V. This gives a nominal output voltage of 8.9 volts, which is sufficiently close to the required figure of 9V.

C2 helps to give the circuit a good transient response and also aids its stability.

Construction

A 0 15in pitch stripboard panel which has 16 holes by 15 copper strips is used as the constructional basis of the project, and all the components are mounted on this except for the on/off switch. Fig. 11.3 shows the component layout for this panel.

T1 is mounted on the panel using a couple of short M3 or 6BA bolts with nuts. The centre tap on the secondary of T1 is unused in this particular application and so this leadout wire is cut short and is otherwise ignored. The other components are next soldered into position and care must be taken to ensure that the rectifiers, zener diode, and i.c. are all connected with the correct polarity. Also be careful not to omit the three breaks in the copper strips as this could produce a short circuit across the unregulated supply lines.

If the unit is to be constructed as a separate unit from the main equipment it can be housed in any case of adequate dimensions. The front panel is drilled to accept S1, and a hole for the output lead must be made here as well. If a metal or hard plastics case is used it is advisable to fit this hole with a grommet. A hole for the mains lead is drilled in the rear panel, and the same point also applies to this hole. If a metal case is used it should be connected to the mains earth lead for reasons of safety. The negative supply rail must also be connected to the mains earth, as shown in Fig. 11.3.

Some pieces of equipment have a power socket so that they can be connected to a battery eliminator. If this is the case, the output lead from the adapter should be fitted with a power plug of the appropriate type. If a power socket is not fitted to the equipment it should not be too difficult to add one. In either case it is essential to ensure that the adapter is connected to the main equipment with the correct polarity.

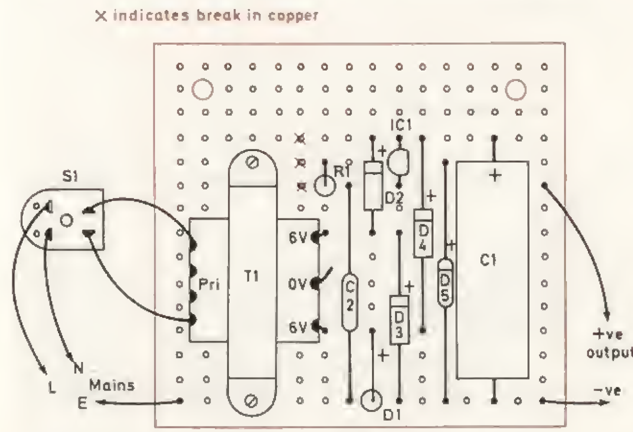

Figure 11.3

Component layout on the board

If the unit is to be fitted into the battery compartment of the main equipment it will be necessary to use one's initiative. S1 must be omitted and the L and N mains leads can be connected to the primary leads of T1 via a connector block. These are sold in 12 way lengths and a 2 way block must be cut from one of these using a sharp knife. It is recommended that the connector block is covered with several layers of insulation tape so that no mains wiring is exposed. The unit can either be switched on and off by simply plugging and unplugging it into the mains, or a better alternative is to use a switch inserted in the mains lead. Suitable switches are available from electrical shops.

It will probably be necessary to make a rough casing for the unit from hardboard, thin plywood, or sheet plastic material in order to ensure that none of the wiring comes into contact with the wiring of the main equipment, and to make the unit a reasonably good fit into the battery compartment. The output lead can be a battery connector of the same type as fitted to the main equipment, but remember that the positive battery connector lead connects to the negative output of the adapter, and vice versa. This is because the two positive battery connectors are of the same physical type, as are the two negative ones.

The two connectors therefore connect positive to negative, and so the leads connecting to the adapter must be the wrong way round, as it were, in order to correct this.

Components list for the mains/9 volt adapter

Resistor	
R1	680Ω ¼W, 5%
Capacitors	
C1	1000μF, 25V
C2	100nF, type C280
Semiconductors	
IC1	μA78LO5WC (or similar 5V 100mA regulator in TO92 case)
D1	1N4001
D2	1N4001
D3	1N4001
D4	1N4001
D5	BZY88C3V9 (3.9V, 400mW, zener)
Transformer	
T1	Standard mains primary, 6 – 0 – 6V 100mA, secondary
Switch	
S1	Two pole rotary mains switch
Miscellaneous	
Case	
0.15in pitch stripboard panel	
Mains lead and plug	
Control knob	
Wire, solder, etc.	