Power Supply For the Movie Mixer

Although this little power supply has been designed specifically for use with the author's movie mixer, as described in September 1978, it would be just as suitable for operating preamplifiers and other low-power circuitry requiring a well-filtered supply of 18V DC. It is easy to build and low in cost.

by JAMIESON ROWE

If you built up the Movie Mixer design I described in the September 1978 issue, you've probably found as I have that there are decided disadvantages in having a battery power supply. Not that the Movie Mixer has a heavy current drain (it draws only 9mA or so); nor is it particularly critical in terms of battery voltage. It's simply that the batteries always seem to reach the end of their working life halfway through a recording session, at 8.30 one night or at 4.30 on a Saturday afternoon when all the shops are shut!

After this had happened to me a couple of times I decided to add a "battery test" button to the mixer so that the condition of the batteries could be read on the inbuilt meter. This turned out to be quite easy, involving only a resistor and a low-cost pushbutton switch (see Fig. 1). Although the meter is a level meter with inbuilt diode bridge, this does not significantly affect the test facility.

Note that the battery test button will only operate when the mixer on-off switch is turned "on". This ensures that the battery test function only operates when it is required; it also ensures that the batteries are tested under load — i.e., with the mixer drawing its normal current.

The series resistor value has been chosen so that the meter reads above the 0dB or "100%" mark when the batteries have an acceptable output voltage under load. Or if you like, the batteries are in need of replacement when the meter reads less than 100%. Logical enough, I think you'll agree!

This little addition to the basic mixer design certainly allows you to monitor battery performance, and replace them when they're tired. But it can still be a nuisance having to replace them — particularly if you do a fair amount of your mixing at home with the projector, and within arm's reach of a power point.

Replacing the batteries altogether with a mains supply is a little drastic, as this means that you can't use the mixer with your camera away from the mains. So it seems to me that the answer is to retain the batteries, and simply fit a switching-type power inlet socket so that an external power supply may be used when desired. This allows the battery life to be extended without sacrificing the mixer's flexibility.

I have been using this approach now for quite a few months, and it seems to work very well. The little power supply I made to power the mixer produces a well-regulated and smoothed output of 18V DC, and runs the mixer with no discernable difference in performance compared with the batteries. So if you have a Movie Mixer and the idea of a power supply appeals to you, it may be of interest.

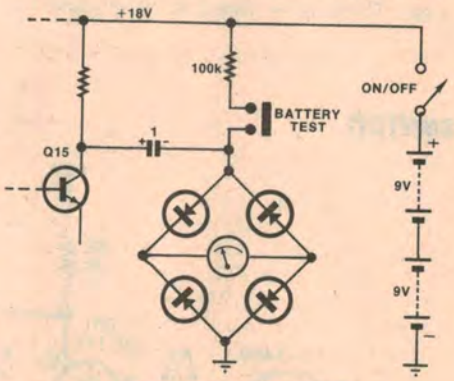


FIG. 1 : BATTERY TEST MODIFICATION

The author's first attempt at solving the battery problem was to fit a simple test button, as shown above. But this only solves part of the problem. At right is the wiring for the power supply input connector.

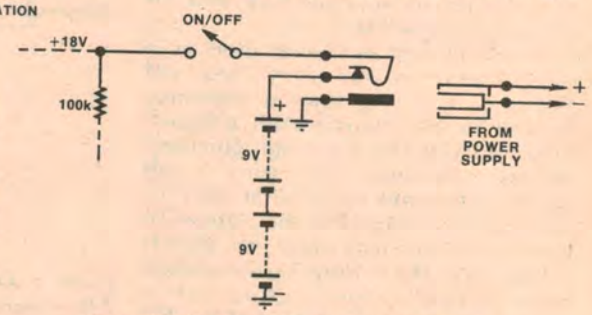


FIG. 2 : WIRING OF POWER SUPPLY INPUT SOCKET

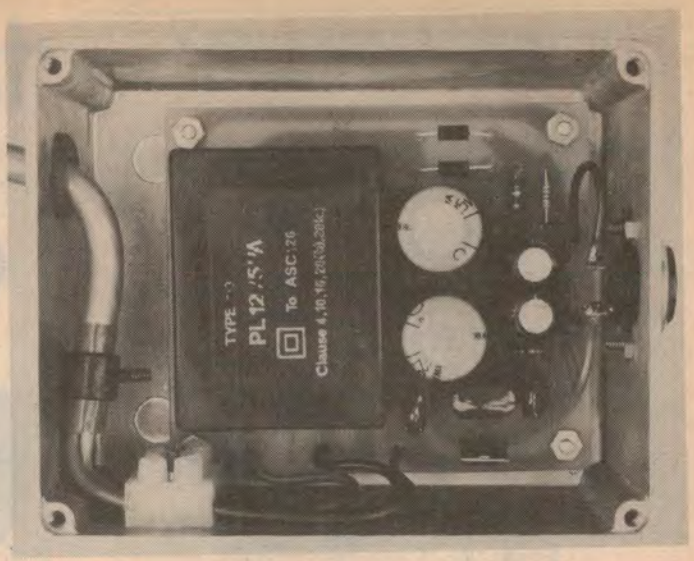
In passing I should perhaps add that the supply would also be suitable for powering any other equipment which requires 18V DC at low current (say up to 50mA or so). It has good regulation (0.16% at 18mA) and low ripple (4mV p-p at 18mA), making it very suitable for use with preamps, active filters and similar audio equipment. Its output is also floating with respect to mains earth, to avoid earth loop hum troubles.

There is nothing particularly special about the supply, as you can see from the circuit diagram. It consists of a standard voltage-doubler rectifier, running from a readily-available 12.6V transformer. The output from the rectifier is then passed through a regulator circuit using a 12V three-terminal IC regulator, with resistive "bootstrapping" to produce the desired 18V output.

It may seem strange that I have used a 12V regulator IC, when the supply is designed to produce an output of 18V. Why not use an 18V regulator? Simply because 12V regulators are much more readily available, and it is quite easy to use one to get 18V output by using the resistive bootstrapping circuit shown.

In effect the resistive voltage divider across the output of the supply causes the regulator IC to raise its own "ground reference" above the negative rail — in this case, by an extra 6V. And because the divider is across the output, this reference voltage is regulated by the IC itself, so that the regulation is not seriously degraded.

More exactly, the regulator produces its normal 12V output across the 1k resistor which forms the upper leg of the divider. This establishes a known current through the resistor, and the same current together with the

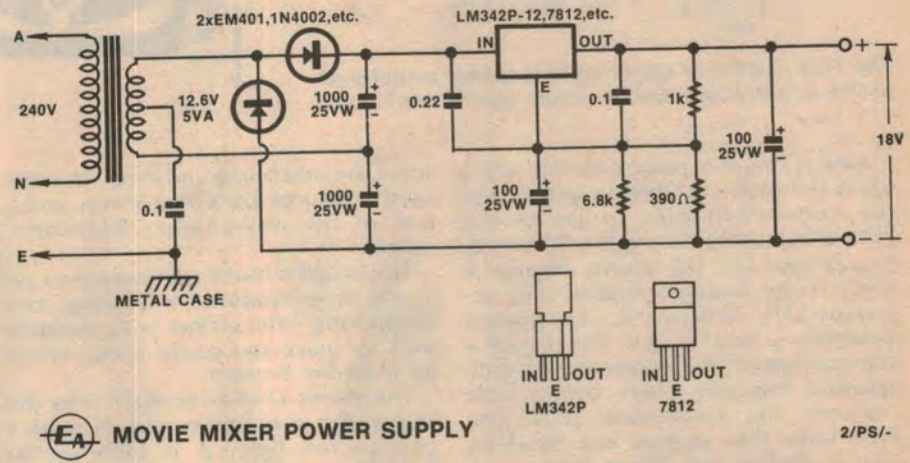


Outside and inside views of the power supply.

We estimate that the current costs of parts for this project is approximately

$26.50

This includes the cost of the output cable and plug/socket combination for connection to the Movie Mixer. It also includes sales tax.



The circuit of the power supply, which as you can see is quite straightforward. It uses a readily-available IC regulator.

regulator IC's common lead current flows through the lower leg of the divider (the 390 ohm and 6.8k resistors in parallel). By choosing the values in the lower leg so that they develop a drop of 6V, the overall output becomes 18V.

The reason for using two resistors in parallel as the lower leg of the divider is that this makes it easier to adjust the output voltage by a small amount if desired, to compensate for spread variation of the IC output voltage. In fact you can regard the 6.8k resistor as a "padder", whose value may be altered as necessary to set the supply output to 18V.

Actually the Movie Mixer is not all that critical when it comes to supply voltage; it can operate from 17V or 19V just as happily as from the nominal 18V. This is likely to be the case with other pieces of equipment also — particularly if they have been designed to operate from batteries.

So if you want to save the price of a resistor, you could replace the 390 ohm and 6.8k resistors with a single one of say 330 ohms, and put up with the voltage you get. It will probably be near enough. The only reason I have provided the second resistor is to allow the output to be set to exactly 18V for those applications which are more critical.

The 100uF capacitor across the lower leg of the divider is to minimise output ripple, by allowing the regulator IC to sense the ripple across the entire output. The second 100uF capacitor across the output is to improve the supply's transient performance, ensuring that it can deliver current peaks under signal conditions. The 0.22uF and 0.1uF capacitors around the regulator IC are the usual bypasses to ensure stability.

Note that as mentioned earlier, the output of the supply is left floating with respect to mains earth to avoid earth loop problems. This allows the power supply and Movie Mixer to be connected to a projector or tape recorder without producing hum due to double earthing.

The only reference back to mains earth within the supply circuit is via a 0.1uF capacitor connected from the centre-tap of the transformer. This represents a relatively high impedance at mains frequency (about 30k), but acts as a bypass to any noise which may tend to be coupled into the supply via primary-secondary capacitance.

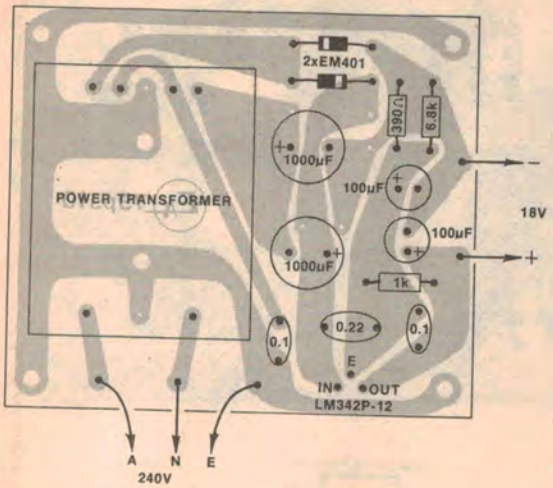
Needless to say the case of the power supply is also connected to the mains earth, for safety.

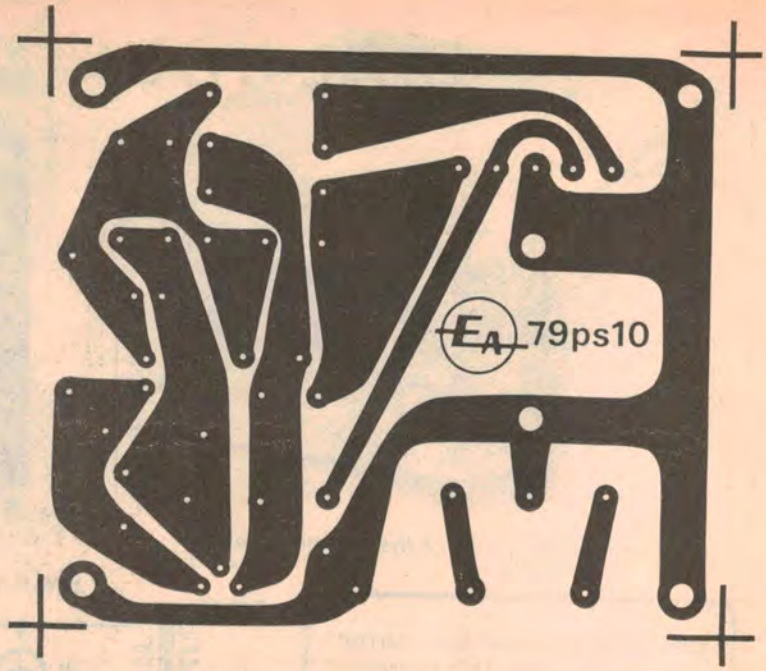
In view of the fact that the output is floating it is also desirable to use a transformer whose primary-secondary isolation and other parameters conform to the ASC126 safety specification. With this in mind I used a Ferguson type PL12/5VA transformer in the prototype, and would suggest that you use the same type.

Actually if you want to copy the physical construction of the prototype, you will more or less have to use the Ferguson unit because it is a PC-mounting type and we have designed the PC board to suit it!

The board measures 77 x 90mm, is coded 79PS10, and has been produced by our draftsman Bob Flynn. The pattern is reproduced in this article for the benefit of those who may wish to make their own board, although transparencies are being sent to the various board makers so that ready-made boards should be available shortly from the usual suppliers.

As you can see from the inside photograph and the PCB overlay diagram, the board wiring is quite straightforward and should present no problems. There are only a couple of points which should perhaps be noted.





The PCB pattern at upper right is shown actual size. In the wiring diagram above, note the unused holes.

One is that it is unwise to rely solely upon the melt-over plastic spigots and the connection pins to fasten the PL12/5VA transformer to the PC board, in a project like this where the unit is likely to be bumped around and occasionally dropped. Ferguson themselves recommend the use of a self-tapping of "PK" screw at each end, screwed into the blank centre hole between the connection pins. The screw size they suggest is a No. 5 by ⅜in (approximately 10mm long).

The other point is that you'll find a few unused holes on the PC board. These were included because I had planned to use the same board for a second power supply, a 9V unit to power movie cameras. However, there have proved to be a few problems with this, so for the moment it has been deferred. So just ignore the additional holes — or more precisely, make sure that you don't use them inadvertently.

Apart from these points the only things to watch are that you wire in the diodes, the electrolytic capacitors and the regulator IC the correct way around. Providing you do this, the supply should work correctly as soon as you power it up. Note that the regulator IC does not need any additional heatsinking, if you are using the supply with the Movie Mixer or equipment with a similarly low current drain.

Incidentally, to prevent accidental contact with the "live" PCB conductors associated with the transformer primary connections, while testing the board outside the case, I covered them with a strip of plastic insulating tape. You may care to do the same.

As you can see, the PC board for the prototype supply was housed in one of the small diecast aluminium cases. This produces a rugged unit, well able to stand the odd bump and drop. The case used measures 120 x 95 x 57mm, and is one of the well-known "Eddystone" range.

The board is mounted inside the case in the time-honoured way, using four 20mm-long ⅛in screws with multiple nuts to space the board about 10mm up from the bottom.

The mains cord is brought into the case at the transformer end, through a grommetted hole. It is then passed through a clamp, to prevent strain on the connections. The connections themselves are made via a three-way section of "B-B" connector strip, which is attached to the inside of the case by two 20mm x ⅛in screws and mating nuts. From the connector strip three short lengths of insulated wire connect to the adjacent PCB input points.

Note that the earth wire connects to the PCB along with the other two; this ensures that the outside copper track of the PCB is earthed even if the board is being tested outside the case. At the same time the case becomes reliably earthed when the board is mounted inside, via all four of the mounting screws.

I used a polarised two-pin socket for the 18V output from the supply, mounted on the opposite end of the case from the mains input. This allows the output cable to be separate from the supply — I tend to prefer this to having it "captive". On the other end of the cable I used one of the small coaxial-type power plugs, as used on many other "battery saver" DC supplies. This mates with a switching-type socket which has been added to the Movie Mixer.

The mixer socket is wired into circuit as shown in Fig. 2. This allows the mixer to be operated from its internal batteries as before, when the supply plug is withdrawn. Note that if you wire in the battery test facility mentioned earlier, this can be used to check the output from the power supply as well. It should read just a little short of the "+1dB" point on the meter scale, if all is well.

LIST OF PARTS

1 Diecast aluminium case, 120 x 95 x 57mm
1 PC board, 77 x 90mm, code 79PS10
1 PL12/5VA PC-type transformer
2 EM401, 1N4002 or similar diodes
1 LM342P-12 or 7812 regulator IC
2 1000uF 25VW PC-type electrolytic
2 100uF 25VW PC-type electrolytic
2 0.1uF LV plastic capacitors
1 0.22uF LV plastic capacitor
3 ¼-watt resistors: 390 ohms, 1k, 6.8k
Mains cord and plug, entry grommet, cord clamp, 3-section length of B-B mains connector strip, polarised 2-pin socket (panel mounting) and mating plug (cable type), output cable, plug and switching-type socket for mixer end. Nuts and bolts, solder, connecting wire, etc.

NOTE: Resistor wattage ratings and capacitor voltage ratings are those used for our prototype. Components with higher ratings may be used providing they are physically compatible.