Build your own mains supply for that old receiver

Mains Power Supply for the Eddystone EC10 Receiver

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The EC10 covers 550kHz - 30MHz in five ranges, with a 465kHz intermediate frequency, the one I bought recently needed a mains supply.

I recently bought an Eddystone EC10 Mark II transistor receiver and it came fitted with the standard battery box. Second-hand, the EC10 seems to come equipped with this battery box quite often (I can see one on eBay at the moment and, again, it has the battery box fitted). I thought it would be a good idea to build a mains power supply to fit into the hole in the back of the case, emulating the Eddystone 924 'mains adaptor unit'. Eddystone also offered the 945 'voltage converter' for running from 12 or 24V DC supplies, which drops 12/24V DC to the -9V supply needed for the receiver.

Introduced in 1963, the EC10 stayed in production until 1969, overlapping the EC10 Mark II that had a long production life from 1967-1977. The EC10 covers 550kHz - 30MHz in 5 ranges, with a 465kHz intermediate frequency. The Mark II version of the receiver has a fine tuning control, standby switch, a low-level audio output and a signal strength meter, which are not fitted to the original model. The receiver met the need created in the early to mid-1960s for light, transistor receivers, especially when compared with the heavy construction of valve Eddystone receivers.

The EC10 uses early-1960s transistors, which means PNP germanium devices – specifically the OC171 for the RF and IF signal path – and OC71/OC83 for the audio section. This implies a negative supply rail and positive earth, so this needed to be replicated in my power supply.

The Eddystone EB37 (AM-only 150kHz - 22MHz) and EB35 (AM 150kHz - 22MHz and FM 88MHz - 108MHz) receivers are also capable of taking the same 924 mains adaptor. The EB37 is simpler than the EC10 (not having a BFO) and so should consume less current than the EC10 and the FM section of the EB35 shouldn't take too much more current than the EC10, so I'm pretty sure my PSU should be OK with these receivers.

The unit described here generates a current limited and fused supply at -9V (with positive earth) at up to about 300mA and it fits neatly into the back-panel hole on the EC10. I used components available from various suppliers to build the unit completely from new to be sure constructors would have no problems sourcing the 'bits'. The experienced constructor with a decent junk box should have many of the components to hand.

The EC10 I bought recently that needed a PSU.

The 924 Power Supply

The circuit of the 924 is shown in **Fig. 1**, as downloaded from the Eddystone User Group website **(http://www.eddystoneusergroup.org.uk/)**.

The circuit contains a standard bridge rectifier, followed by a smoothing capacitor, a 22Ω dropper resistor and an OAZ227 9.1V Zener diode. This Zener has a 10W power rating that implies a fairly hefty quiescent current flowing through it, which the EC10 'bleeds' away as its volume level is increased. Finally, further capacitor smoothing is followed by a 500mA fuse that feeds a McMurdo socket, supplying the -9V to the receiver via pin 1 on the socket. Note that the mains live lead also passes through the McMurdo socket to be switched by the switch ganged to the RF gain control on the front panel of the receiver.

I considered trying to replicate exactly the 924 circuit for the sake of authenticity but then I realised that you can't buy 10W Zeners any more and the circuit looked rather wasteful on power that, in the end, gets converted into heat inside the receiver – never a good idea.

The instruction manual specification for the EC10 gives the DC supply current as 36mA quiescent, plus 77mA at 50mW audio output and 180mA at 500mW audio output, giving a maximum current of about 260mA. To this has to be added about 90mA extra when the dial lamps are switched on from the front-panel push switch. I measured the current consumption of my EC10 when supplied with -9V from an external DC power supply. It consumed about 180mA at a comfortable listening level, so the currents given in the manual look a little pessimistic.

Then I considered using a fixed -9V

regulator but, again, it's not easy to find these fixed-voltage negative regulators these days. So I settled on using a LM337T adjustable negative regulator, which is capable of providing up to 1.5A output current and is available from several sources. Another design decision I made was not to route the mains live lead into the receiver but to switch the mains on the panel of the power supply itself (see the photos). I thought this was the best way to ensure that minimum mains hum got into the receiver and having built and tested the power supply, I certainly have not been troubled by this potential problem. It's not too inconvenient to have to reach round the back of the receiver to switch the mains on and off.

Circuit Description

The schematic for the DC power supply is shown in **Fig. 2**. The mains input to the unit is switched by SW1, which feeds the primary of the mains transformer T1. Diodes D1 and D2 form a full-wave rectifier and R1 limits the switch-on surge into C1 and also drops a little DC voltage during normal operation, saving a little dissipation in the regulator. The LM337T needs a minimum of about 1.6V between its input and output terminals at 200mA output current to maintain its regulating function. This meant that determining the value of R1 was a balancing act between giving it a high enough value to give some surge limiting action and low enough to maintain a reasonable voltage drop across IC1.

IC1 is an adjustable output voltage negative regulator whose output voltage is given by:

Vout = -1.25 (1 + R3/R2)

For this circuit, R2 = 120Ω and solving for Vout = 9V, we get 744ohm for R3, which is about mid-way between the standard values of 680Ω and 820Ω. I fitted a 1kΩ preset potentiometer rather than a fixed resistor so that this resistance value – and hence the output voltage – could be set accurately.

Note that D1, D2 and C1 look as if they are the 'wrong way round' but they are correct for a negative supply as needed here.

The regulator output also feeds a panel-mounted LED, D3, via current limiting resistor R4. You may think this is an unnecessary LED as it is on the rear panel of the receiver. This is true but it gives me some confidence that all is well, especially when testing the prototype and you can see the glow reflected from the wall behind the receiver.

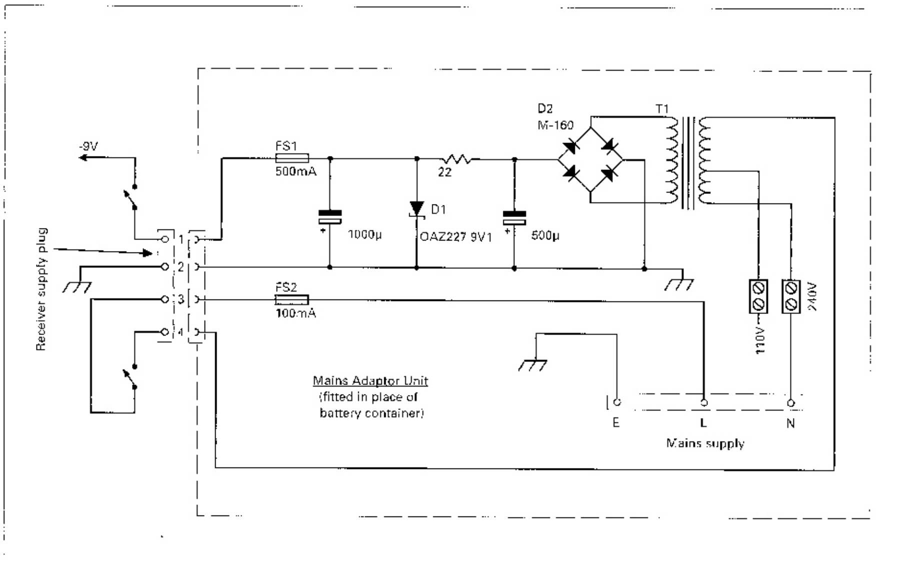


Fig. 1: Eddystone type 924 main adaptor unit.

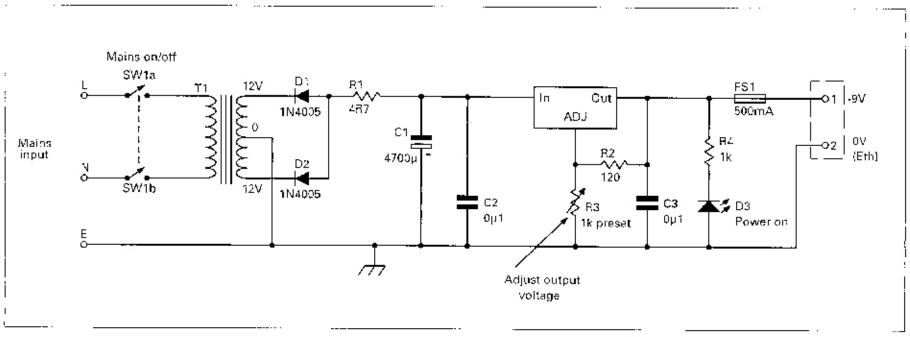


Fig. 2: The schematic of the E10 mains power supply.

Construction

The prototype unit was built on a 1.5mm thick aluminium panel size 250mm x 72mm, with 10mm x 10mm angle runners along each side to stiffen the overall chassis. This gives the same overall size as the original battery box and fits snugly into the cut-out on the EC10s rear panel. The corners of the panel were rounded to about 5mm radius on my prototype, again to emulate the battery case and 924 power supply.

The PCB tracking (at life size) and component layout for the board are shown in **Fig. 3a** and **3b**. Take care to orientate correctly the diodes, the electrolytic capacitor and IC1. The pin-out for the LM337T is also shown for reference. A short length of aluminium angle was bolted to IC1 as a heat sink, though this is hardly justified by the heat generated.

The PCB has been designed to take either radial or axial versions of the electrolytic C1, to suit what you might have to hand. There is one link on the PCB that can be made with bare tinned copper wire as there is no danger of shorting to other components. I always use 1mm terminal pins soldered into the holes for the inputs and outputs to the board to facilitate the wiring to and from the board, rather than trying to insert wires into the board itself.

The general arrangement of the major components mounted on the panel is shown in **Fig. 4**. The placement is not critical and so tag board construction, ugly construction or even Veroboard could be used if you don't want to invest in a PCB.

You can work out the drilling details of the panel from the photos of the prototype unit and **Fig. 4**. Make sure you have all the panel-mounted components before you start drilling because the exact dimensions of the mains on/off switch, the transformer, the LED and the fuse holder from different suppliers may vary. I obtained the McMurdo socket from the battery holder fitted into my EC10. This socket is polarised, therefore eliminating the risk of reversing the supply to the receiver. If you can't find the correct socket, you might have to use a different arrangement, being careful to supply the receiver with the correct polarity supply.

A rubber grommet should be used in the hole where the mains cable passes though the aluminium panel and the cable clamped to the chassis inside the unit so that it can't be accidentally pulled from the outside. The earth wire from the mains cable is connected to the metal chassis

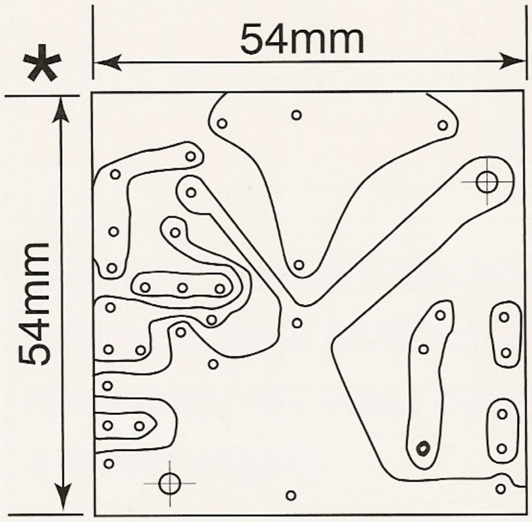
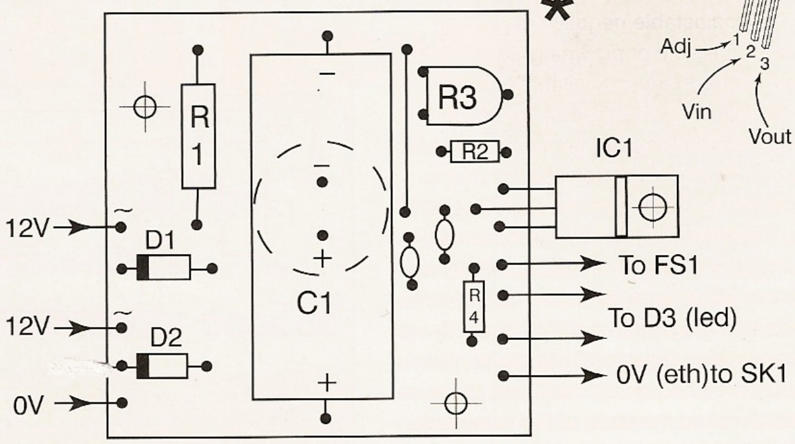
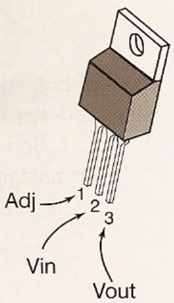


Fig. 3(a): Tracking of the PCB.

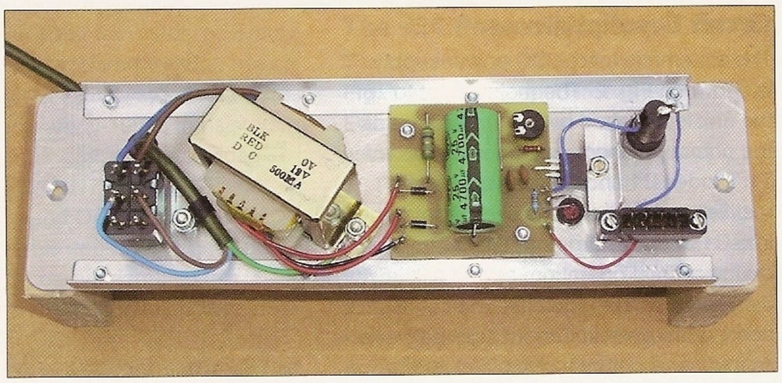
Fig. 3(b): Component placement on PCB.

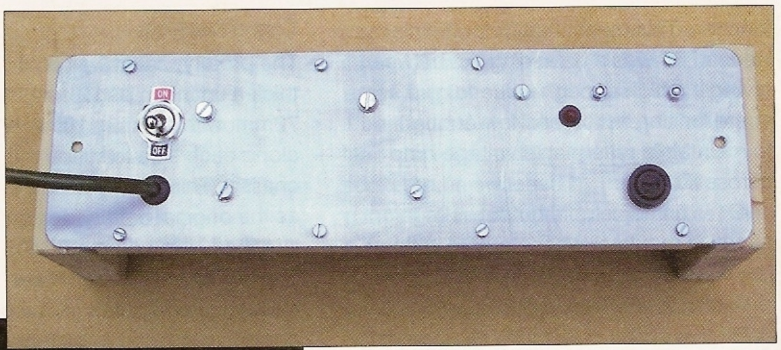




via an earth tag on one of the transformer mounting screws.

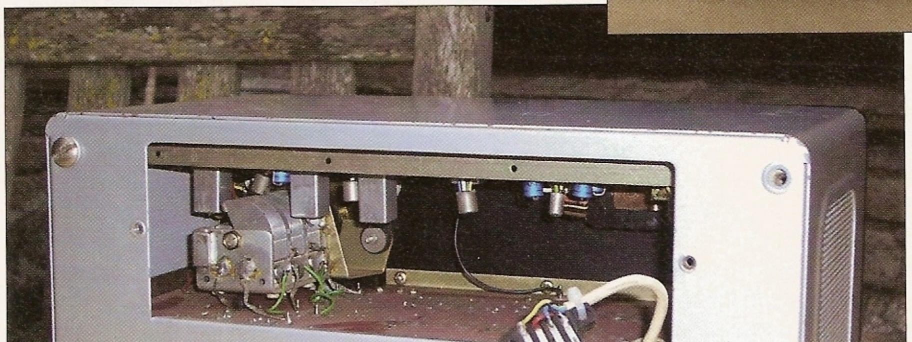
My unit only took about 3W from the mains with the receiver switched off and 4-5W with it switched on at a reasonably loud volume, so there seemed to be no need to drill any ventilation holes in the chassis panel.





Wiring up the Unit

Thoroughly check the locations and polarity of the component on the PCB and check that all the solder joints are good, with no solder bridges or shorts on the undersides of the board. Start by wiring the mains cable to SW1 and then wire the flying leads from T1 primary to SW1. Next, wire T1's three secondary leads from SW1 to the PCB, solder the LED leads to the correct pins on the PCB and the -9V output from the PCB to pin 1 on SK1 via FS1. Finally, wire the 0V (Earth) output from the PCB to pin 2 on SK2.



The back of the EC10 showing the space for the mains power supply unit.

Testing the Power Supply

Before switching on, double-check the internal wiring of the unit, especially the mains wiring. Set the preset potentiometer R3 to about mid-way. Don't forget to insert a 500mA fuse into the fuse holder – like I did – or you'll be puzzled why there was no output at all from the unit.

Now, plug the unit into the mains, switch on at SW1 and check that D3 (the power-on LED) lights. If D3 doesn't light, chances are that it's wired the wrong way round, so turn it round. Once this initial stage has been passed successfully, check that about 6V is present between pins 1 and 2 of the output socket, with pin 1 being negative with respect to pin 2. Now, adjust R3 to give 9V output.

If required, the supply can now be loaded to check its regulation under different loads. The DC output can be loaded up to 200mA by using a resistor of about 47Ω. The output voltage should change very little as this current is well within the capability of the LM337T regulator. You can let the power supply 'cook' for an hour or two and the transformer and IC1 should get warm – but definitely not hot.

When you are happy with these tests, switch off, unplug from the mains and mount the unit into the hole in the rear panel of the receiver, connecting the plug inside the receiver into SK1. The EC10 uses good old British technology, so two 4BA screws are used to fix the power supply to the back panel.

Component List

R1	4.7Ω 1W carbon film
R2	120Ω 0.25W carbon film
R3	1kΩ preset potentiometer
R4	1kΩ 0.25W carbon film
C1	4700µF 25V axial or radial electrolytic
C2,3	0µ1 50V ceramic decoupler
T1	Transformer, mains input, 12VA 12V-0-12V outputs at 500mA (ESR 311-512 or similar)
IC1	LM337T negative adjustable voltage regulator
D1,2	1N4005 diode
D3	Panel-mounting LED and mounting clip
SW1	Mains on/off double pole toggle switch (Maplin FH39N or similar)
SK1	McMurdo socket
FS1	Fuse holder (20mm) plus 500mA fast-blow fuse.

Printed circuit board. 1mm terminal pins. Aluminium panel 250 x 72mm, with 10mm x 10mm aluminium angle. 4BA screws to fix into EC10. Insulated connecting wire. Mains cable, grommet and cable clamp.
Screws and nuts for PCB and T1 mounting and aluminium angle fitting. Earth tag, screws and nuts.

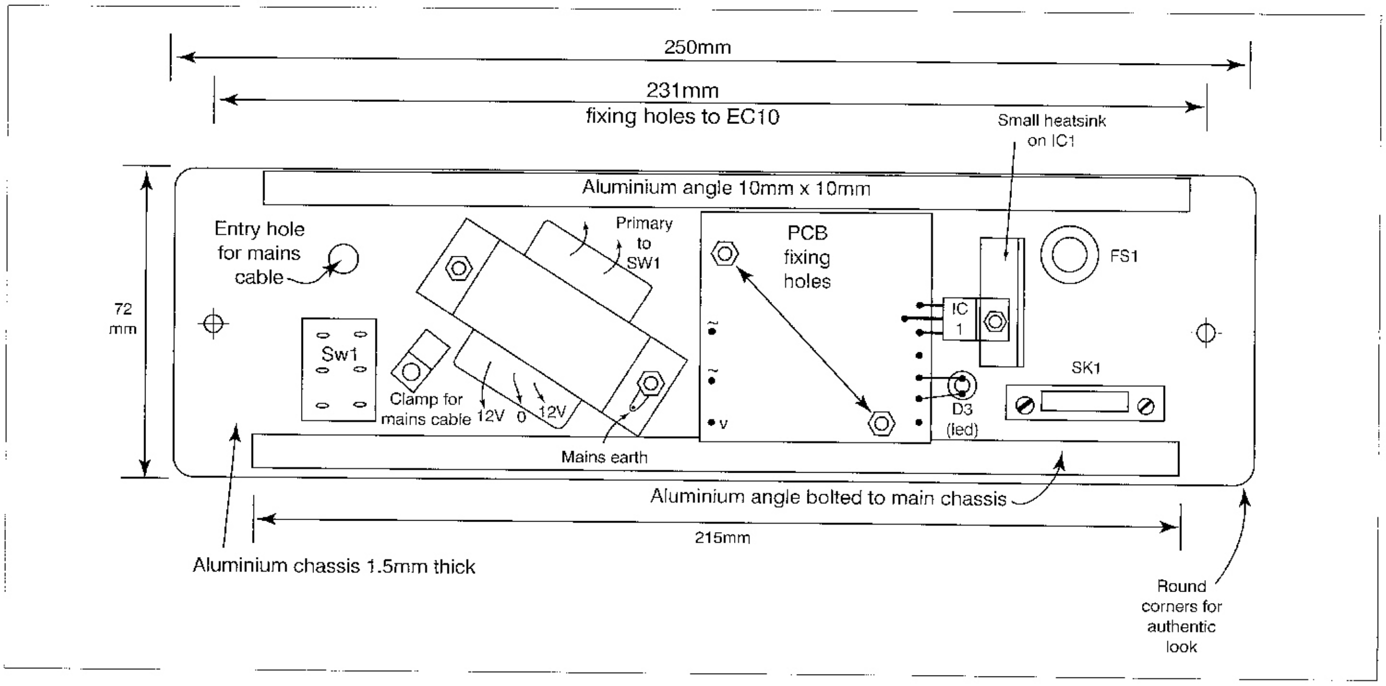
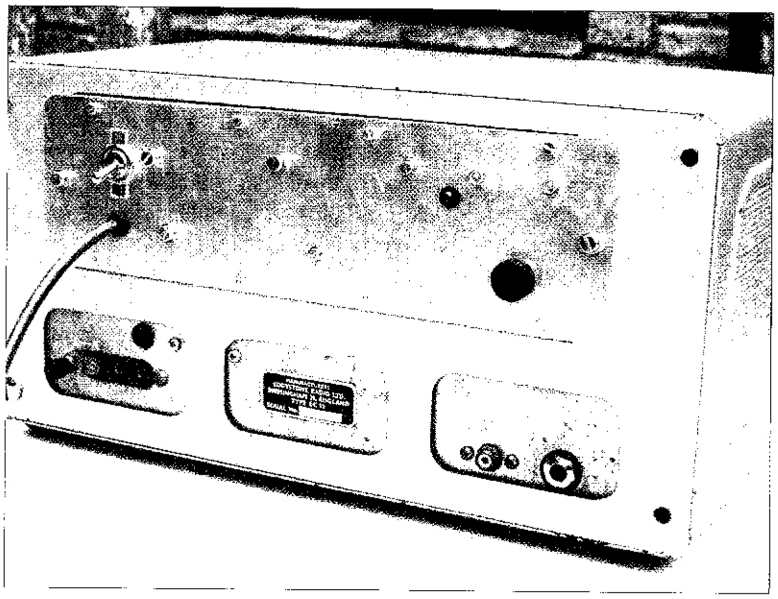


Fig. 4: General arrangements of the PSU components and chassis dimensions.

The Eddystone User Group

Most of the Eddystone-related information for this article comes from the Eddystone User Group's (EUG) website at: **http://www.eddystoneusergroup.org.uk/**. This is a great source of information on the history of the company and the Eddystone sets (transmitters as well as receivers) it produced. The EUG are very responsive to E-mail queries and the help of the group, especially **Chris Pettit** (G0EYO), is appreciated in the preparation of this article. ●



The EC10 when the mains power supply unit has been fitted.