REPLACEMENT DC POWER PLUG FOR THE ZC-1 RADIO.

(H. Holden. March 2020.)

Introduction:

While it might be see as an easy task, this article demonstrates that 24 components (counting the wire, terminating lugs & heat shrink sleeving etc) are required to make a DC power connector cable suitable for this radio using the techniques & materials outlined in this article. Yes, 24 components, not a misprint. It surprised me too.

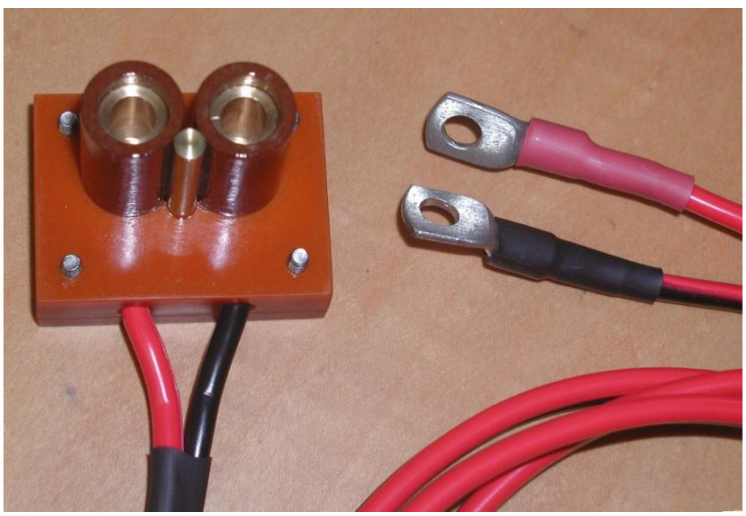
The famous ZC-1 radio is shown in the photo below:

Of note on the left hand side of the photo is the original 12V power connector, plugged into the panel socket on the ZC-1. These connectors now have become extremely rare, rarer in fact that any other spare part used in the ZC-1 radio itself.

I only had one of these connectors shown in the photo, but two ZC-1 Radios. So to power them both was awkward, with crocodile clips on the socket pins of one unit. So I decided to manufacture a suitable power connector. The task being to make a “quality reliable connector” suited to a mil spec radio, but not a dead replica of the original connector.

The Original Connector:

Replacement connector & power cord:



As can be seen the original connector is a line socket assembly, an extremely robust affair, it could have easily carried 20A or more yet in the ZC-1 application only just over 4A was required of it. This sort of thing was typical of the conservative design practices of the 1940's era. As a result of this conservative design though, it would seldom if ever give any trouble as it is massively "over-rated" and difficult to break even with mishandling. It is a polarized connector; note the indent on one side between the socket holes.

The rectangular size of the connector is just a little under 36m x 48mm and the projection from the body close to 1 inch or 25.4mm.

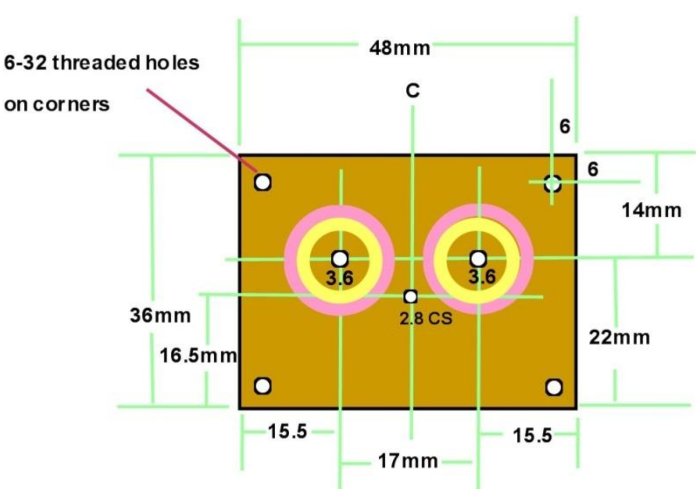
The holes which receive the pins are quite large (9/32" or close to 7.14 mm diameter) and the holes which receive the pins on the recessed panel socket and are about 20mm deep. However, the insulating material on the plug extends about 4mm forward of the brass sleeve. This is so that no connection is made if someone attempts to fit the connector in reverse.

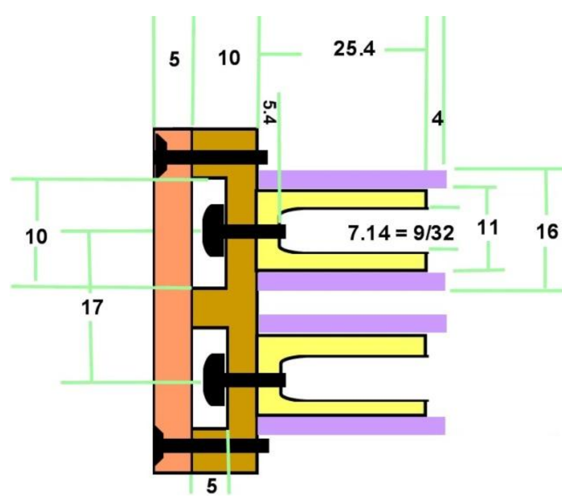
Designing the Plug:

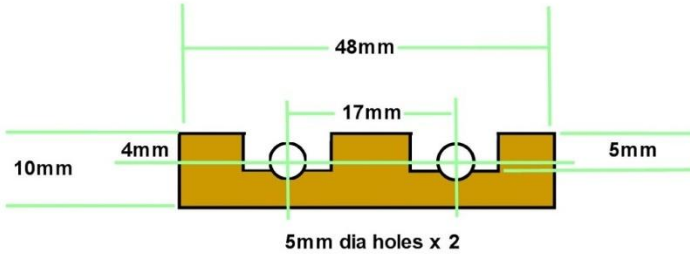
I decided to design the plug around what raw materials I had in the workshop. This included some brown Phenolic plate (5mm and 10mm thick). This is very much like vintage Paxolin or phenolic electrical panel. It takes a coarse thread well, such as 6-32 UNC.

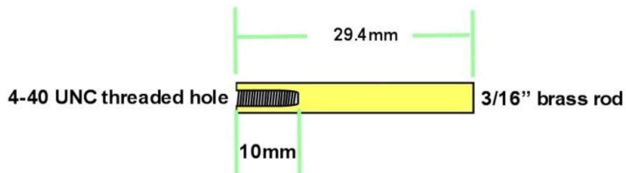
6mm OD and 10mm ID insulating tube was required (shown as purple in the diagram below) of the type used in the industrial electrical industry. As it turns out this size is commonly available in clear acrylic too, which would also have worked. The ID was drilled out to 11mm, though it could have been left at 10mm, if the brass sleeve (shown in yellow) external geometry was reduced from 11mm to 10mm. This may be easier for some constructors as 10mm round brass bar is easy to get, so these components would require less machining. I simply machined some 15mm brass bar down to 11mm to make the socket sleeves.

It always pays with a project like this to draw diagrams first:

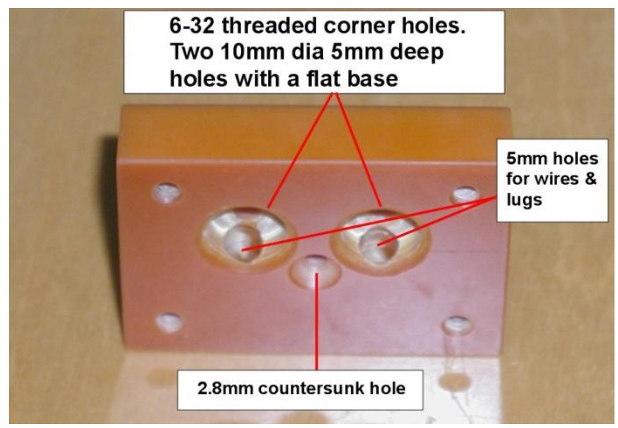




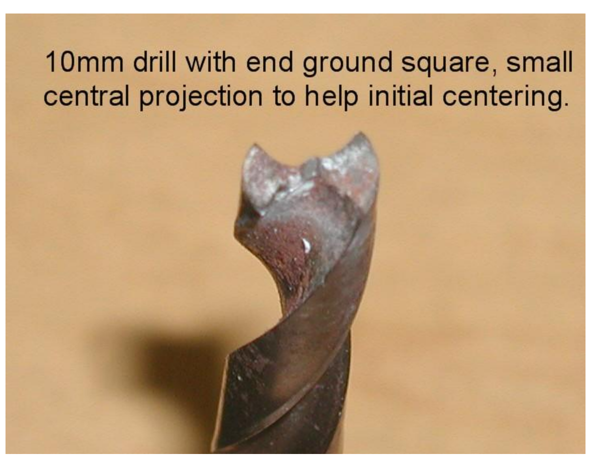


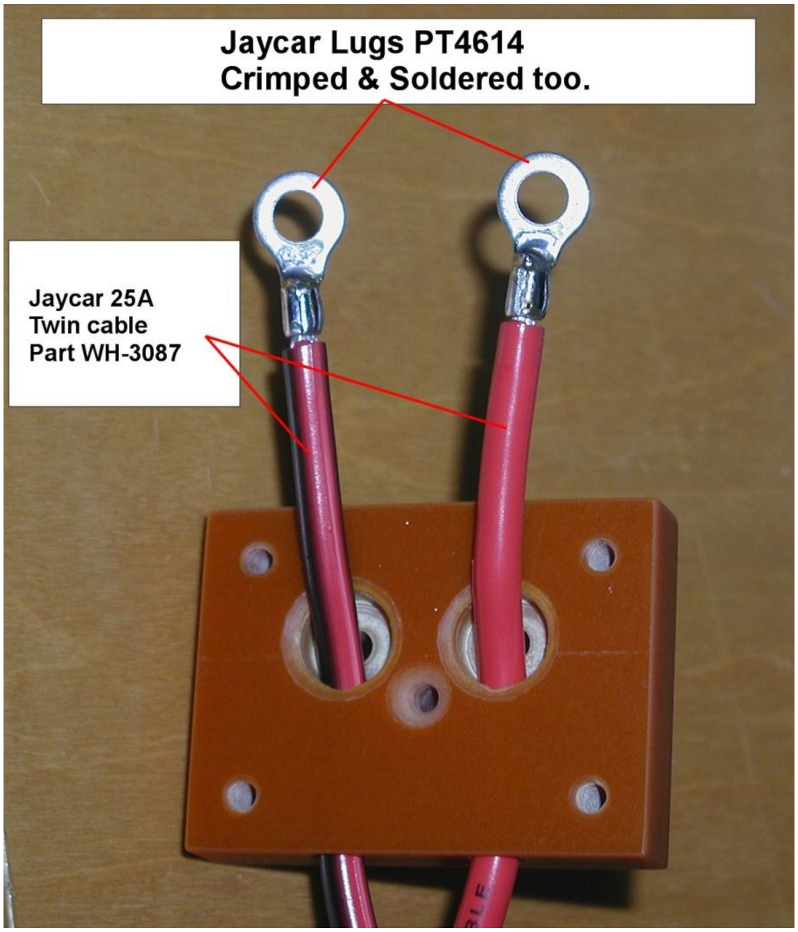


Once the basic diagrams were made it was a matter of preparing the components. The most complicated component being the 10mm thick block:



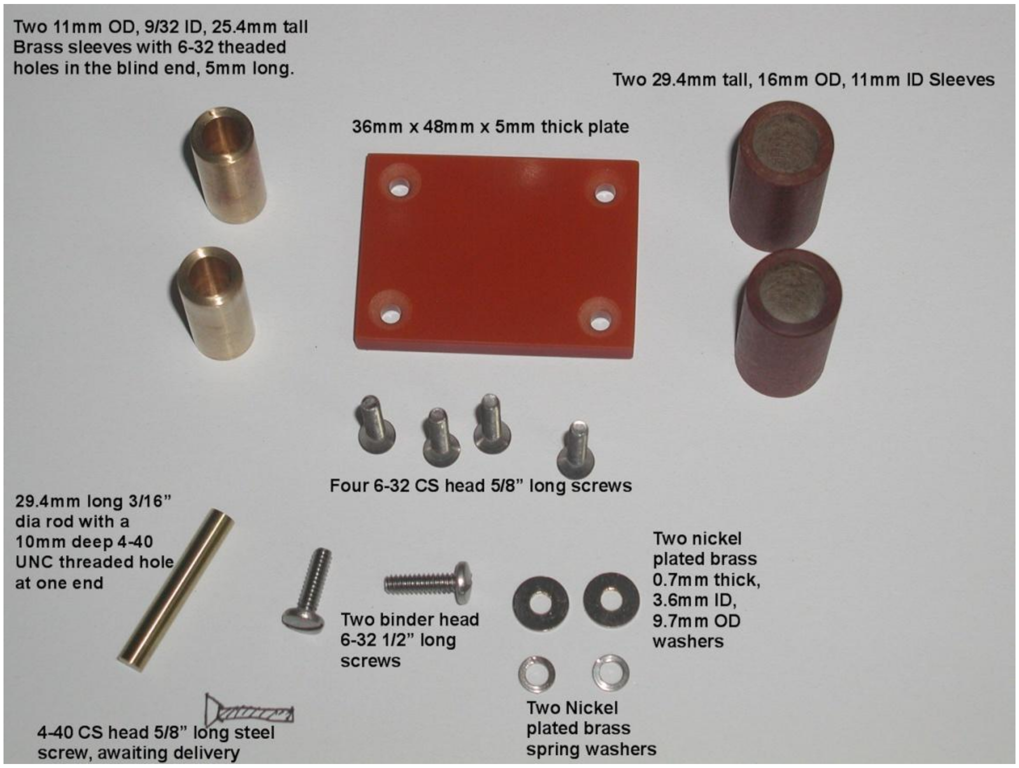
I did not have a 10mm milling tool on hand, so I simply used a drill I had ground down in the past to give a 10mm diameter flat base hole:



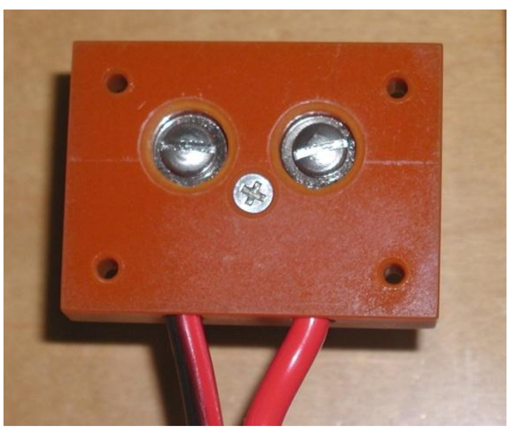


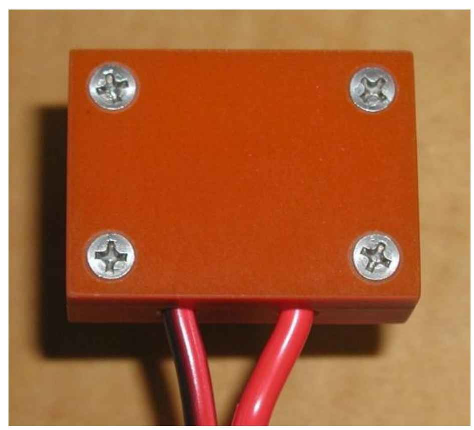
The 25A rated wire, is over-rated for the task, less than 5A being expected from it, but it is quite soft and flexible due to the multiple fine strands and the original ZC-1 cable was very heavy duty (everything being Mil Spec).This reduces voltage loss between the power supply and the ZC1 for a 2m long cable. For example, 15A rated wire (at Jaycar) is 0.0108 Ohms/m, so a total 4m length total at 4Amps (ZC-1 on transmit) the cable will drop 0.17V. Doesn't sound a lot, but it is not insignificant. With the 25A rated cable it is 0.0059 Ohms/m and will drop only 0.095V. The larger cable is also more physically robust, like the ZC-1 itself.

The diagram below shows the remainder of the required components. I did not have a steel 4-40 UNC countersunk head 5/8" long screw in my hardware, so I had to order those in slow post. This was the most suitable screw & thread for the task. The brass parts and the insulating sleeves were machined on my Mini-Lathe and the phenolic panels done on the drill press.



The following photos show the assembled plug. The push fit insulating sleeves were pushed on with a small amount of 24 hr epoxy resin so they won't slip off the brass connectors in the future. The 3/16" brass rod and the insulating sleeves were painted with marine spar varnish to moisture proof those surfaces:





Where to get the materials & alternative materials to make this plug:

The brown phenolic plate I used came from the electronic markets in Akihabara in Tokyo. However another very suitable material is readily available on ebay in 5mm & 10mm thickness, it is called:

“Circuit Insulation Board Epoxy Plate 3240”.

A product in the USA called “Garolite Micarta Linen(or canvas) Sheet” would also work, in ½” and ¼” thickness sheets instead of 10mm & 5mm. Another option would be Acrylic plate or polycarbonate plate, perhaps not quite as tough. Also Tufnol would work and is available from RS components, however it is expensive.

The brown 16mm OD x 10mm ID insulating tubing I used came from Atco Controls, I bought that some years ago, probably not easy to get now. However 16mm OD and 10mm ID clear Acrylic tubing is available on ebay and in this case it would be more convenient to start with 10mm round brass bar (rather than machining a larger bar down to 11mm as I did) and it slips inside the 10mm acrylic tubing as it is, without having to enlarge the ID.

Round brass bar is readily available on ebay.

The screws are available on ebay and are standard lengths with UNC threads.

The Lugs at the plug end, the heatshrink sleeving and the cable came from Jaycar Electronics. The Cabac lugs from Hayman’s Electrical supplies are a standard electrical part.

The 3/16” brass rod is readily available from a number of suppliers.

Tools required:

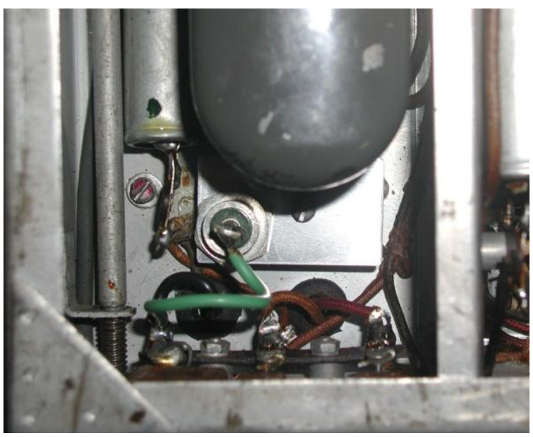
These are the general tools found in the Engineering workshop: Drill press & small lathe, 6-32 & 4-40 UNC taps, countersinking tool and various drills. Crimping tool not essential. Junior saw, Files & 360,600,800 & 1200 grade paper to smooth the cut edges of the material. Dial calliper for hole centre measurements and marking etc.

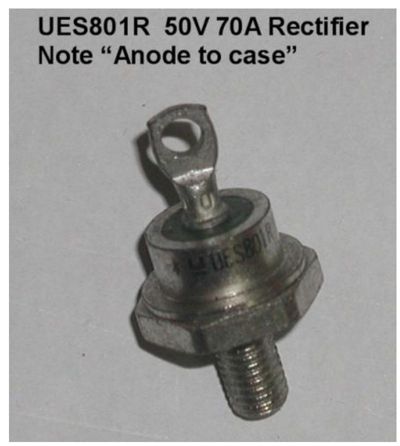
Other ZC-1 modifications relating to the 12V DC Power Supply:

Many ZC-1's, that are operating are running with electronic vibrator replacements. Mine is because they are quieter and also produce less interference. However, there is a risk, depending on the design of the electronic vibrator, if reverse voltage is applied.

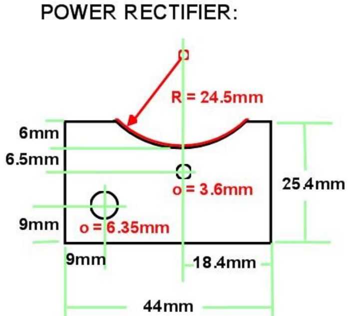
Although the ZC-1's DC plug is polarized, it is still possible to connect the other end of the cable in reverse to a power supply. With the standard ZC-1, with a V6295 vibrator, applying reverse polarity won't cause any damage to the set. To avoid the reverse polarity issue with an electronic V6295, it is better to add a power rectifier on the 12V feed ***after the fuse*** to ground (negative) so that if the power is applied in reverse, the potential is clamped to 1V or less and the fuse blows.

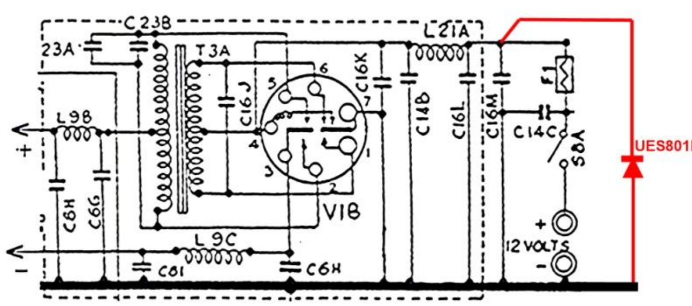
I found it very easy to add a DO-5 cased power rectifier by making an aluminium plate and wiring the diode's cathode connection to the tag where C16M connects, which is the input to the vibrator power supply. This way no holes need to be drilled in the radio and the added assembly simply mounts under an existing screw head:





1.2mm thick aluminium mounting plate for UES801R POWER RECTIFIER:





ZC1 MKII POWER PACK.

****