STATION QRP
TUBE SHORTWAVE TRANSMITTERS

25 WATT GU-50 AM TUBE SHORTWAVE TRANSMITTER

(PART 3 of 5)

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Construction of the transmitter

Anyone intending to build this transmitter must be competent in working with, and the servicing of, high- voltage equipment and this project is not, therefore, for the novice. All circuits must be fused properly so that the HT supply is disconnected rapidly in the event of failure, and protection (typically a 2.5 mH, 500 mA RF choke from antenna connection to earth) must be incorporated to ensure that the HT voltage does not appear at the antenna output should the PA output coupling capacitor fail. It is vital that all modules within this transmitter are inter-connected with earthing straps, in addition to the normal 0 V returns.

Components must be rated for the job to be undertaken. Thus, it is important that capacitors are used well within their voltage ratings, and that constructors are aware that resistors also are rated for maximum working voltage. For this reason, resistors which are to be used in HT lines should be chosen with care. Similarly, the insulation on inter-connecting wiring must be able to withstand the voltage in the worst-case scenario, e.g. when the wire trails across the chassis or across other conductors. The transmitter described in this article gets hot, and the insulation must also be capable of withstanding the maximum temperature to which the wiring is likely to be exposed.

Above all, the constructor is warned about the risk to personal safety when working on equipment which is powered at 500 V, and on the AC supply circuits. Relays which switch power circuits can stick and so may not be fail-safe in disconnecting the supply when apparently de-energised, so it is important to check that circuits are ‘cold’ before working on equipment. These voltages are lethal and mains should only be applied to equipment when safety covers are fitted, or appropriate precautions have been taken to avoid contact with high potentials. A risk assessment should form part of the discipline of working with any equipment which uses high voltages.

Detailed construction

A series of photographs (**Figures 6-13**) illustrate the method of assembly. While it is not expected that prospective constructors would attempt exactly this realisation of the transmitter, the author’s design may help in deciding the individual’s approach.

It was decided to replace the steel front and rear panels by aluminium sheet for ease of working. Rather than attempt to drill and file a hole to fit an IEC panel plug, it is easier to use a flying lead terminated in an IEC plug and secure the lead with a panel clamp/grommet. With the relatively slim-line but tall case, it was appropriate to install the power supply section in the base for mechanical stability (**Figure 6**) and to use the detachable front and rear as runners on which to mount the RF stages and modulator. Broadly, the construction can be regarded as four areas of build: the rear panel (with die-cast box and MOSFET heat sink as shown in **Figures 7 and 8**), a sub-chassis runner in the base, the front panel and the horizontal sub-chassis on the inner of the front panel (**Figures 9 and 10**).

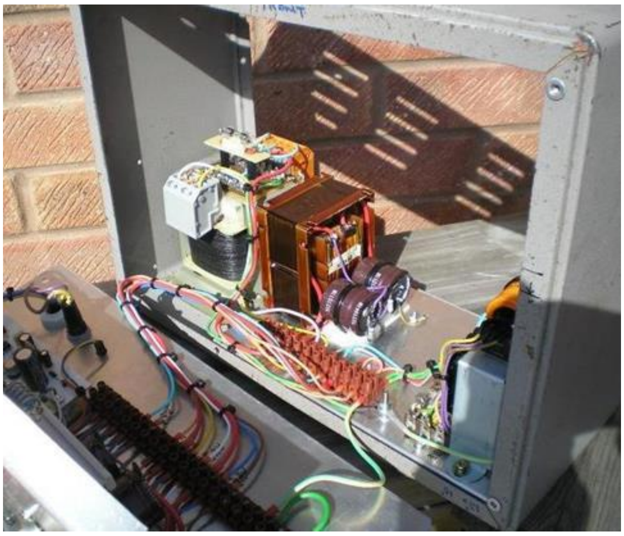

Figure 6. Power supply components in the base of the case. A shadow of the ventilation slots in the top is seen on the wall behind the case

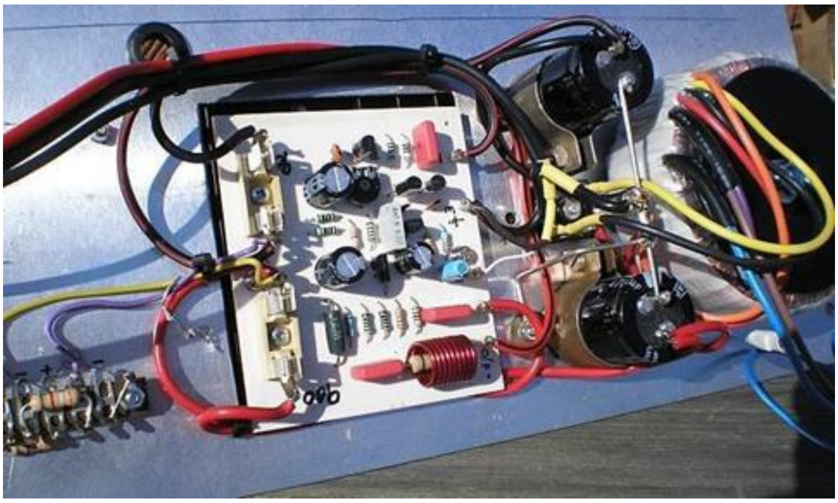

Figure 7. The MOSFET audio amplifier with associated power supply are mounted inside the rear panel

Figure 8. The heatsinks for the MOSFETS are mounted on the outside of the rear panel, together with the speech processor and MP3-player in a die-cast box

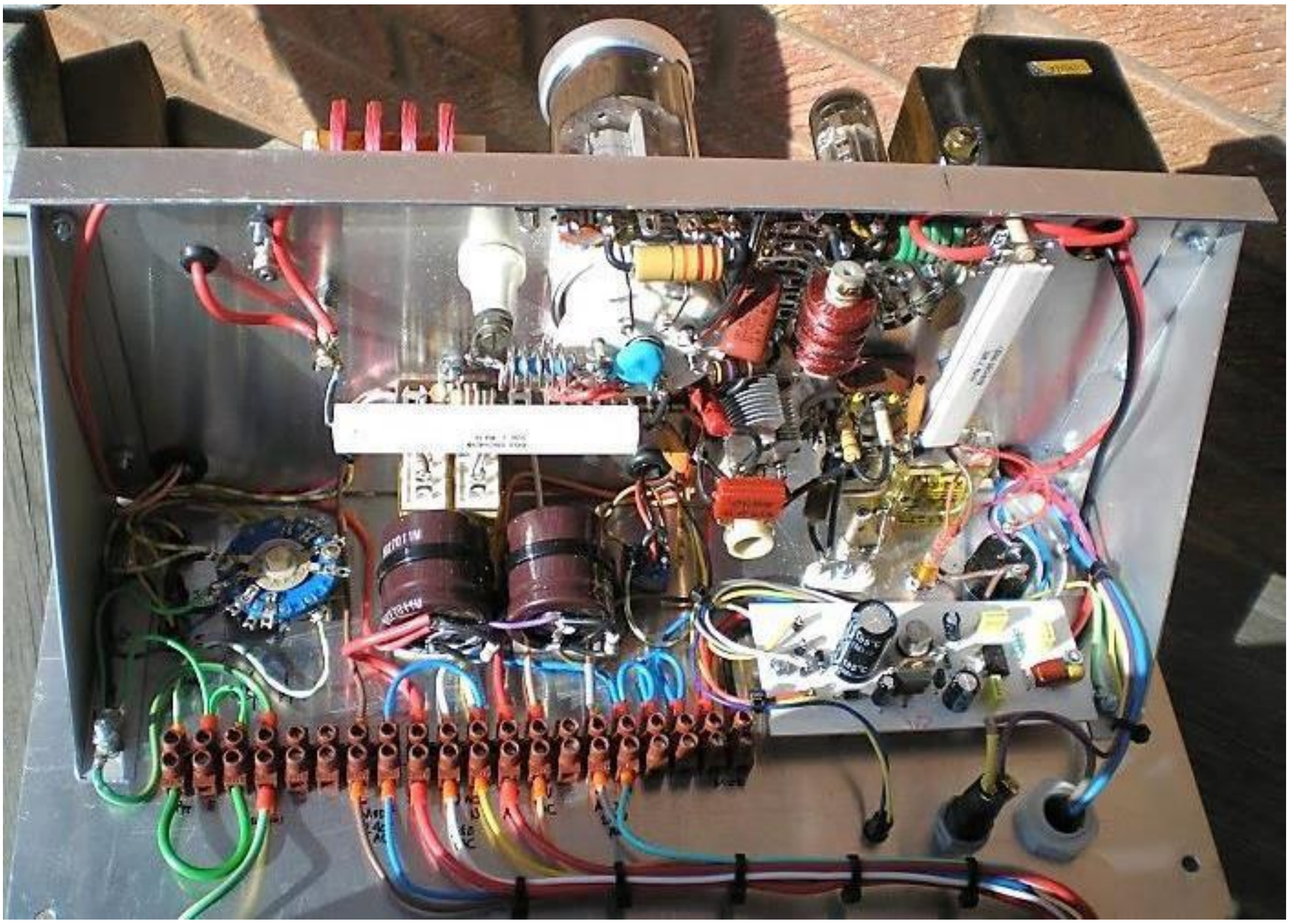

Figure 9. Underside of the RF deck

Figure 10. Top-side of the RF deck with the modulation transformer on the right hand side

The microphone input is via a 5-pin DIN 240° panel socket to suit the ex-equipment Philips PMR dynamic microphone. The PTT wiring is completely isolated from the microphone wiring but, otherwise, the socket is connected to the ‘FAT-MAX’ speech processor board (**Figure 11**) which also requires a nominal 12 VDC supply which is provided by a feed from the +36 V modulator rail. The rear panel became the modulator assembly, requiring only a minimum of connections to the rest of the unit (**Figures 7, 8 and 11**). Being self-contained, it was possible to build and test this unit into a high power 3.3 Ω resistor mounted on a heat sink prior to installation by simply applying mains to the toroidal transformer.

Figure 11. MP3-player (L) and the 'FAT-MAX'speech processor (R) and in their boxes

The base sub-chassis slotted into the wrap-round case and was secured to bare metal by two M3.5 countersunk screws into suitably countersunk holes that were kept un-painted. This arrangement ensured an additional mechanical earth connection while providing safety earth tails. It is important to ensure that, when using modular construction with separate chassis, all safety earths are in place to prevent an electric shock risk. There must be no situation where, for example, the outer screen of the microphone coaxial cable becomes the 500 V HT DC return to chassis, under fault condition. Also, with regard to inter-unit wiring in modular construction, all insulation on all wires must withstand at least 500 VDC as, in the final assembly, wires carrying low voltages can pass over connections having exposed high voltage.

The smoothing choke and reservoir capacitor, the 12 VAC, 50 VA filament transformer and the control unit 12 VDC power supply were all mounted on the base sub- chassis, the aluminium plate being a suitable heat sink for the 7812 regulator (**Figure 6**). A 16-way insulated screw terminal block was installed to make inter-unit connections. Consideration was given to mounting the CPT on the sub-chassis but, in the event, it was fixed directly on the base of the case. Here it neatly covered the two-inch diameter hole and gave another few spare millimetres of height; this extra space was useful as it allowed the main HT rectifier tagblock assembly and a 20 mm fuse holder to be accommodated on the transformer. What had been the original top of the case was now the bottom and the 16 slots became a useful cooling aperture above the tubes.

The horizontal sub-chassis for the inner of the front panel was made with two right angle supports and a flat 18 SWG aluminium plate (**Figure 9**). A small lip was bent at 90° to strengthen the chassis. This assembly was as wide and as deep as possible because on it were mounted the three valves and bases, driver stage anode components, modulation transformer, PA stage RF choke and coupling/decoupling capacitors, the second series pair of 220 µF, 400 VW smoothing capacitors and the two changeover relays for antenna and receiver switching. Double-sided sticky pads were used to secure all the 12 V relays to the chassis.

End of part 3