

TR.2002 CONVERSION FOR TWO METRES

DISCUSSING A USEFUL TRANSMITTER/RECEIVER COMBINATION

C. G. MOLLOY (G8BUS)

The TR.2002 is as yet not very well known as surplus equipment but, as this article shows, it is of considerable interest for easy conversion as a low-power Tx on two metres, with associated receiver. At most VHF stations, its prime use would be as a stand-by rig, or for local working. It would in any case be an instructive conversion exercise for anyone looking for a quick and not too difficult start on Two Metres.—Editor.

A FURTHER release recently to the surplus market of the TR.2002 Aircraft Transreceiver presents the opportunity to get going quickly on the two-metre band. Designed to operate on 121.5 MHz from an emergency 24-volt DC supply, the TR.2002 comprises a crystal controlled transceiver complete with modulator, crystal controlled superhet receiver, 24-volt dynamotor with switching and changeover relay. Twin-chassis construction is used—the receiver is the upper, removable one—to make a compact unit measuring only $7\frac{1}{2} \times 4\frac{1}{2} \times 12$ in. A control input socket (Fig. 1) gives access for the microphone, low impedance headphones and changeover switch. The power consumption is 3 amps. at 24 volts and the input to the PA is approximately 5 watts.

Transmitter

The transmitter (Fig. 2) is easily adapted for 2 metres. A 10-125 MHz mc crystal oscillator/tripler (V5) produces 30-375 MHz to drive a doubler (V6) which in turn drives a second doubler (V7) to produce RF at 121.5 MHz into the PA (V8). Replace the crystal with one from the 8 MHz range. Wire a 10 pF silver mica capacitor in parallel with C10 to resonate the anode tuned circuit of V5 at 24 MHz. V6 now functions as a tripler. Remove L3 (it is fixed to the chassis by a single bolt), reduce the number of turns from $5\frac{1}{2}$ to $3\frac{1}{2}$ and refit, peaking the anode tuned circuit of V6 to 72 MHz. V7 then doubles to 144 MHz when the

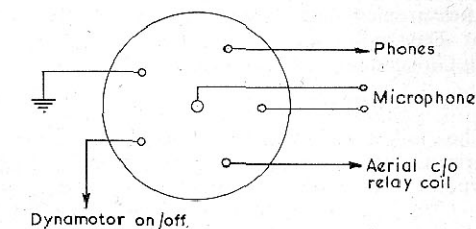


Fig. 1

Fig. 1. Control socket as fitted on the TR.2002.

number of turns on the self-supporting coil L4 is reduced from $3\frac{1}{2}$ to two. Remove $2\frac{1}{2}$ turns from the end of the PA coil (L5) remote from the aerial tap, to resonate the PA anode circuit at 145 MHz. The Tx modifications are now complete. The valve and trimmer designations used in Fig. 2 are those engraved on the chassis beside the respective components, preceded in the case of the transmitter section by the symbol 1.

A number of test points are brought out to the rear of the transmitter chassis. Those marked TP1 to TP4 in Fig. 2 are connected to the grid circuits of V5 to V8 respectively; a 5 mA meter connected between one of these points and chassis gives sufficient indication of grid drive for peaking. The anode current of the PA valve is monitored by connecting a low range milliammeter between TP6 and TP7 which will measure the voltage drop across the 10-ohm resistor in series with the HT feed to the PA anode. A calibrated absorption wavemeter should be used to ensure that the correct harmonic has been selected at each stage.

The modifications described above are on the underside of the lower chassis and can be carried out without any dismantling. The upper chassis is very easy to take out. Pull the 12-pin Paignton plug and coax plug out of their sockets on the receiver. Loosen four instrument-type screws on the front panel, remove a single bolt from the rear supporting plate and lift out the receiver.

Table of Values

Fig. 2. Transmitter section of the TR.2002 (top right)

C1 = 15 μ F	R2, R3,
C2 = 175 μ F	R6, R7,
C3, C7,	R10, R14 = 1,000 ohms
C12 = .002 μ F	R5, R9 = 150,000 ohms
C4, C5,	R8, R12 = 27,000 ohms
C8, C9,	R11 = 470 ohms
C13, C14,	R13 = 39,000 ohms
C17, C18,	R15 = 12,000 ohms
C19, C21 = 330 μ F	X1 = 10-125 MHz, as fitted (see text)
C6, C11,	
C16 = 100 μ F	L1, L6 = RF chokes
C10, V15,	L2, L3,
C20, C24 = var., as fitted	L4, L5 = as fitted (see text)
R1, R4 = 100,000 ohms	V5, V6,
	V7, V8 = 6F17

Table of Values

Fig. 3. Modulator as fitted TR.2002 (opposite)

C1, C2,	R7, R9 = 10 ohms
C3 = 330 μ F	R8 = 1,000 ohms
C4 = .002 μ F	R10 = 150,000 ohms
C5 = .01 μ F	T1 = Mic. xformer
R1, R2 = 4,700 ohms	T2 = Mod. xformer
R3, R4 = 220,000 ohms	V1, V2 = 6BR7
R5 = 2,700 ohms	V3, V4 = 6F17
R6 = 1.1 megohm	

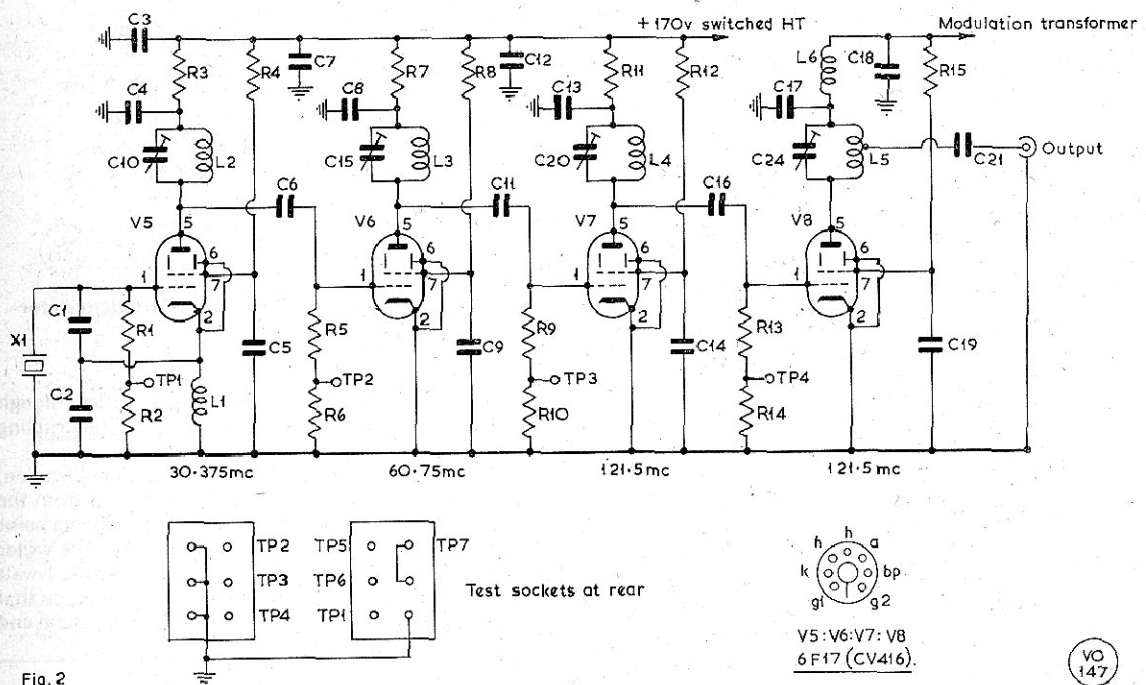


Fig. 2. Transmitter section of the TR.2002.

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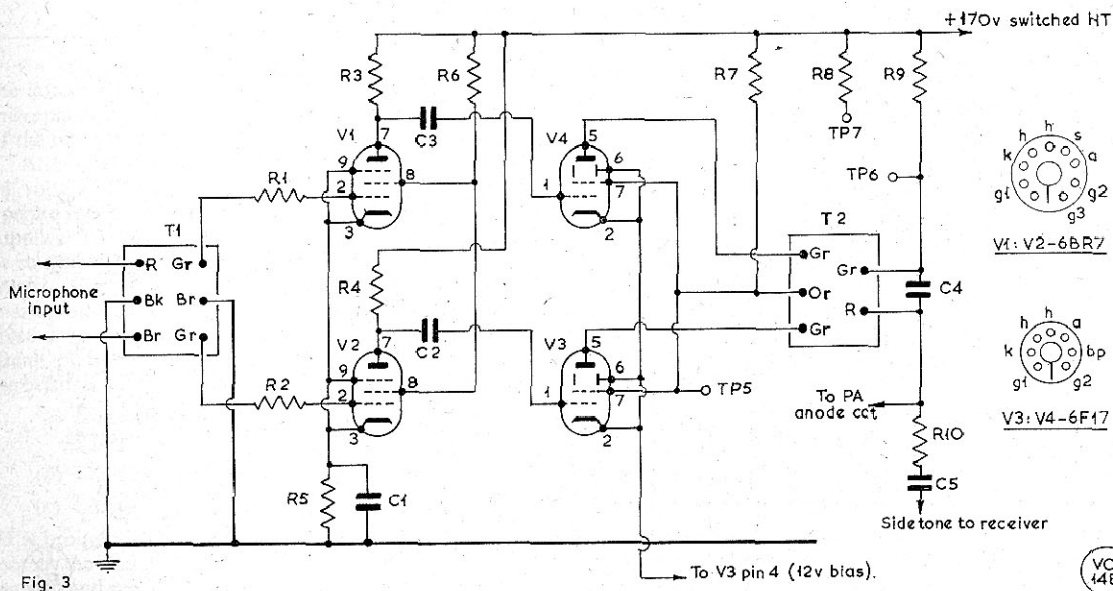


Fig. 3. Modulator as fitted in the TR.2002.

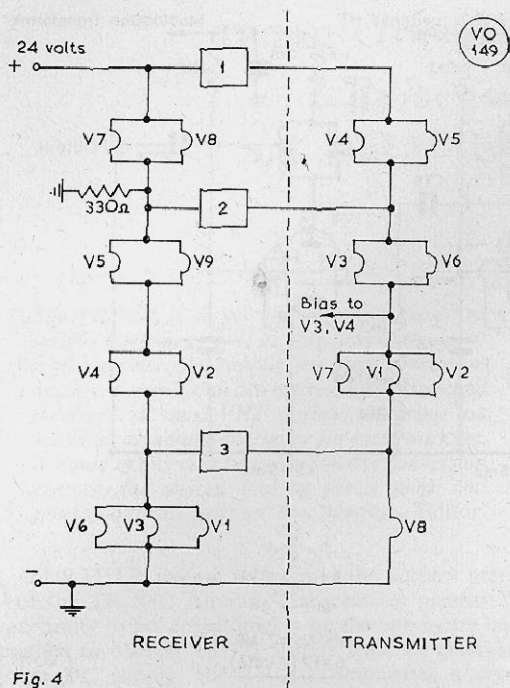


Fig. 4

Fig. 4. Heater wiring as in the original.

The crystal holder is a HC6U type which will have to be changed if popular 10XJ surplus crystals are used. Remove the spigot and adjacent "mod" label for easy access to the chassis beneath the crystal holder. Enlarge the holes left by the HC6U holder to take wander sockets at $\frac{1}{2}$ in. spacing and solder on the wires removed from the old holder. Crystals in the 6 mHz range can be used

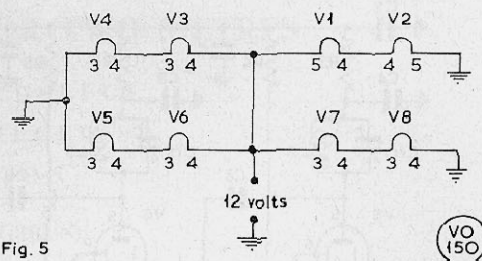


Fig. 5

Fig. 5. TR.2002 Tx heaters as modified for 12-volt input.

without further modification to the transmitter, though the drive to V6 will be lower since V5 is now quadrupling instead of tripling.

The modulator (Fig. 3) does not require modification, but it should be noted that the common lead from the cathodes of V3 and V4 is taken to a 12-volt tapping point on the heater chain to provide bias (Fig. 4). The writer removed the tapping and connected a 820-ohm 1-watt resistor from the commoned cathodes to chassis, so that the biasing would be independent of the heater chain and

Table of Values

Fig. 6A. Main receiver circuit, TR.2002

C1 = Ae. trim	R3, R7,
C2, C3,	R8, R12 = 2,200 ohms
C6, C7,	R4 = 27,000 ohms
C8, C11,	R5 = 47,000 ohms
C13 = 330 μ F	R6, R9,
C4, C5 = trimmers	R10 = 100,000 ohms
C9, C17 = 100 μ F	R11 = 190 ohms
C10, C12,	T1, T2 = as fitted
C14, C15,	L1, L2,
C16 = .01 μ F	L3 = as fitted
R1 = 150,000 ohms	V1, V2 = 6AK5
R2 = 220 ohms	V3 = 6EF92

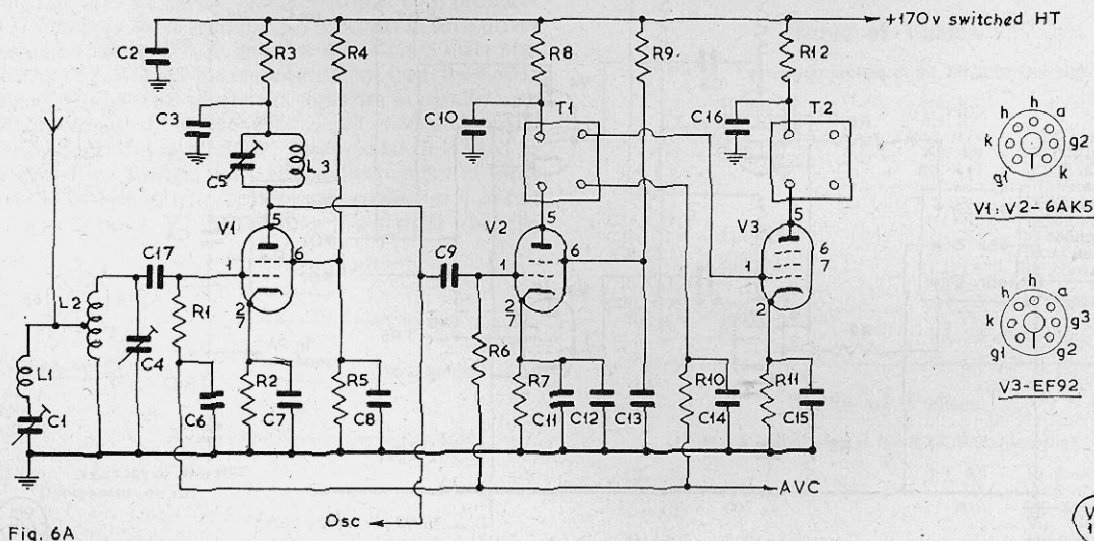


Fig. 6A

Fig. 6A. Main receiver section, TR.2002.

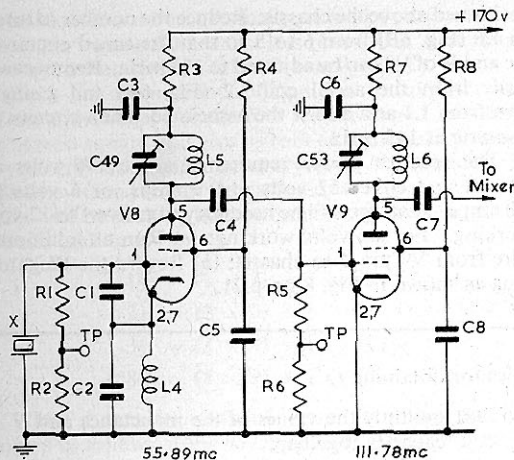


Fig. 6B

Fig. 6B. The receiver oscillator-amplifier—see text.

Table of Values

Fig. 6B. Oscillator-amplifier, Rx side, TR.2002

C1 = 15 μ F	R4 = 47,000 ohms
C2 = 170 μ F	R8 = 68,000 ohms
C3, C5, C6, C8 = 330 μ F	L7 = RF choke
C4 = 100 μ F	L5, L6 = see text
C7 = 1 μ F	X = 13.972 mHz (see text)
R1, R5 = 100,000 ohms	V8, V9 = 6AK5
R2, R3, R6, R7 = 2,200 ohms	

the latter could be run from AC. A magnetic type of microphone connected to one half of the primary winding of the input transformer gives satisfactory results.

Although the complete transceiver works from 24 volts DC it will probably be more convenient to operate the Tx side alone from external HT and heater supplies. The power requirements are 170 volts at 100 mA or so and either 12 volts at 1.05 amps. or 6 volts at 2.1 amps. Fig. 4 shows the series-parallel heater interconnections between the transmitter and receiver. Fig. 5 gives a conversion to 12-volt working for the heater circuit of the transmitter alone, which utilises some of the existing wiring. To convert from 12 volts to 6 volts:

- Join together V2 pin 4, V4 pin 4, V6 pin 3, V7 pin 4,
- Transfer supply from V1 pin 5 to V1 pin 4,
- Connect V1 pin 5 to chassis.

HT is brought from the dynamotor *via* a red lead running beneath the chassis to a centrally positioned tag. Remove this lead and replace by one from the external HT supply. The relay fixed to the underside of the chassis controls the dynamotor. The writer took out the relay, dynamotor,

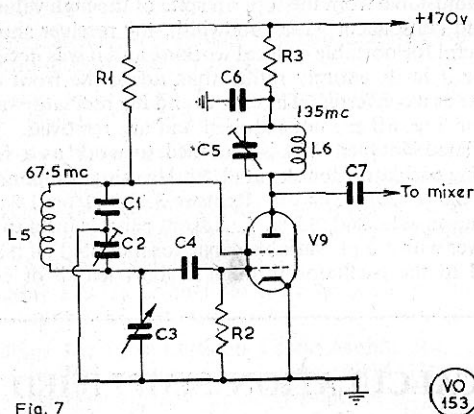


Fig. 7

Fig. 7. Modification for circuit Fig. 6B. Values are: C1, 50 pF; C2, C5, as fitted; C3, 5 pF, main tuning; C4, 100 pF; C6, 330 pF; C7, 1 pF; R1, 68K; R2, 100K; R3, 2.2K; L5, L6, see text and refer Fig. 6B; and V9, as V9 in Fig. 6B.

associated chokes and wiring, clearing a large area of surplus components. The send/receive relay, mounted on the front panel adjacent to the aerial socket, will operate from 12 volts DC. Alternatively, the relay may be replaced by a manually-operated switch.

Receiver

The circuit of the front-end of the receiver is shown in Figs. 6A and 6B. A 13.972 mHz crystal oscillator/quadrupler (V8) drives a doubler (V9)—see Fig. 6B—to supply 111.8 mHz to the mixer (V2), Fig. 6A. Incoming signals from the aerial are amplified by a single RF stage (V1) before they are applied to the mixer to produce an IF of 9.7 mHz. Three IF stages are followed by detection and a single stage of LF amplification (V7) to feed a transformer which gives an output suitable for low impedance phones. Delayed AVC is applied to the RF, mixer and IF valves. LF gain is controlled by a preset

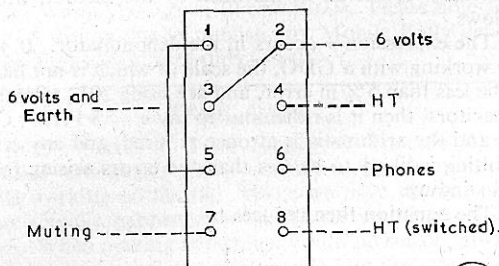


Fig. 8

Fig. 8. Modification connections for the Paignton socket on the TR2002—see below.

Connections to the Paignton plug are: Pins 1, 2, 3—Heaters (see Fig. 4); Pin 4—170 volts HT for output valve only; Pin 5—Chassis (Earth); Pin 6—Phones; Pin 7—Muting; Pin 8—170 volts switched HT.

pot, adjustable from the top. In spite of the high value of IF and consequent wide bandwidth, the receiver should be useful for portable or local working and it was decided to use it in its entirety rather than adapt the front end for use as a converter. The crystal and the oscillator valve (V8) in Fig. 6B are not required and are removed. The associated doubler (V9) is modified to work as a free-running oscillator/doubler at 67.5 MHz using components from the crystal oscillator. Remove 3 turns from L5 and wire up as indicated in Fig. 7. A front panel is fixed to the receiver with a 5 pF variable capacitor mounted on it and wired to the oscillator through a short length of coax

positioned above the chassis. Reduce the number of turns on L6 (Fig. 6B) from 6 to 5 so that the tuned circuit in the anode of V9 can be adjusted to 135 MHz. Remove two turns from the aerial coil L2 (Fig. 6A) and a single turn from L3 and adjust the associated tuned circuits to resonate at 145 MHz.

The receiver power requirements are 170 volts at 60 mA and either 12 volts at 0.9 amps. or 6 volts at 1.8 amps. A rewire will be necessary to convert to 12-volt working. For six volts working: (a) Run an additional wire from V9 pin 4 to chassis; (b) Rewire the Paignton plug as shown in Fig. 8 on p.21.