

A Top Band Transmitter using Power Transistors

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ALTHOUGH transistors are being widely used in portable receivers and test equipment, little attention seems to have been given to their use for transmitting. This may be due to the fact that the h.f. type transistors so far available have only low power ratings and the output from a transmitter using these types will be very small. With such low power many stations can be contacted but communication with the more distant stations requires an efficient radiating system. If a system of only moderate efficiency is available, as may be the case when operating from a temporary location, then a more powerful transmitter would be an advantage.

With this idea in mind the development of such a transmitter was commenced, the resulting circuit being that shown in Fig. 1.

Circuit

The oscillator stage (TR1) uses a Reinartz v.f.o. circuit but by removing the short circuiting link from SK1 and inserting a crystal instead it becomes crystal controlled. Output is taken to the following stage from the emitter tap.

The first amplifier (TR2) operates as a class B common emitter amplifier with pre-set tuning in the collector circuit. Output is taken by the low impedance link winding L4 to the input of the next amplifier, a pair of XA104 transistors (TR3, TR4) in parallel for increased power.

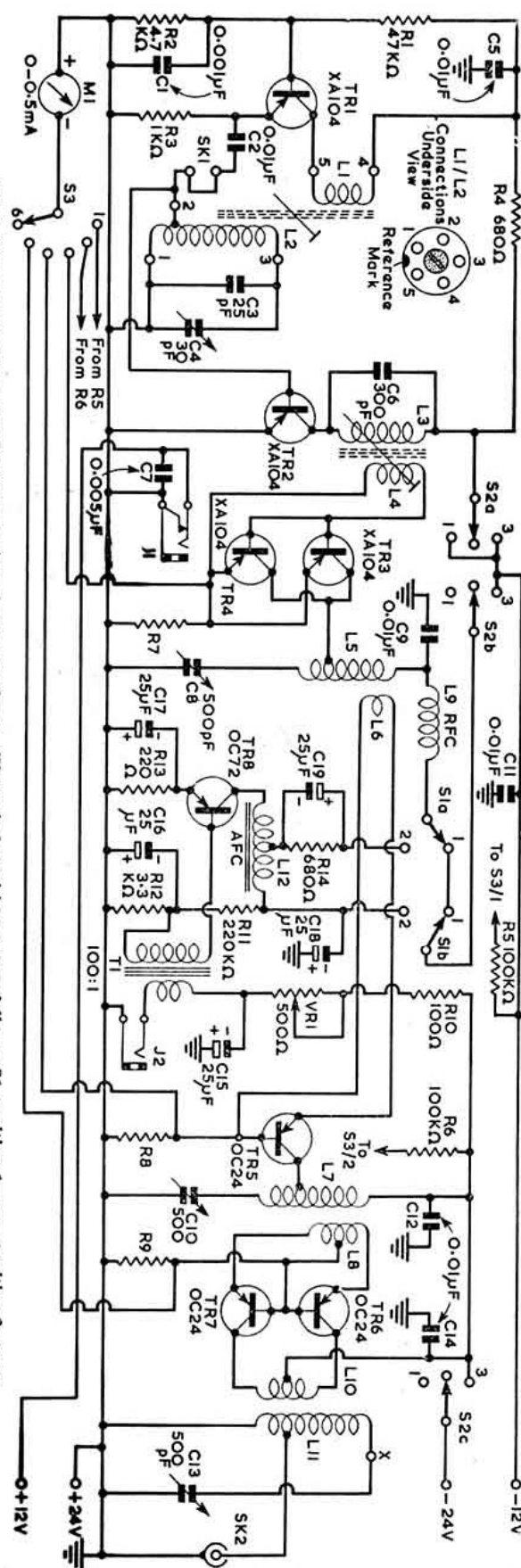
This stage in turn feeds the first power amplifier in which an h.f. power transistor is employed as a common base amplifier. Due to the f_x of this type of transistor being only 2.5 Mc/s best efficiency is obtained by using it in this manner. It will give higher output power if used as a common emitter amplifier but with a much increased drain on the power supply. As in the previous stages output is taken by a link winding, in this case centre tapped, to the final stage, which operates as a common base class B push pull amplifier employing a pair of h.f. power transistors (TR6, TR7). The collector coupling windings remove d.c. from the tank circuit, permitting direct connection to the load.

Modulation

Adequate amplitude modulation, of communication quality, is provided by TR8. This is a class A common emitter amplifier choke coupled to the collector circuit of TR3 and TR4 and is brought into circuit by S1. For simplicity a carbon microphone is used although with a suitable pre-amplifier other types could be used.

A simpler method of transmitting speech (eliminating the need for TR8 and S1) is by the use of frequency modulation

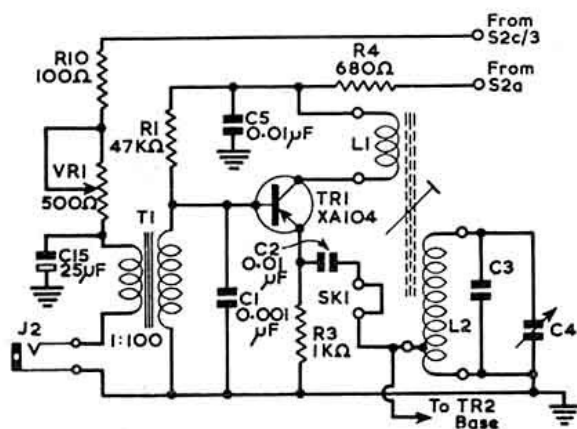
Fig. 1. The circuit of the transistor transmitter for c.w. and a.m. The switch positions are as follows: S1, position 1—c.w.; position 2—a.m.; S2, position 1—net, position 2—transmit; S3, position 1—supply 1 volts, position 2—supply 2 volts, position 3—second amplifier current, position 4—first power amplifier current, position 5—meter off. Details of the coils are given in Table 2.



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Whichever phone system is used the key must be removed from J1 while on c.w. the microphone must be removed from J2 to prevent unwanted f.m. and unnecessary drain on the power supply.

A system of switched metering has been incorporated, enabling battery voltages and currents through the last three stages to be easily checked. The values of the meter shunts and multipliers depend on the meter used and are best determined experimentally by comparison readings on a

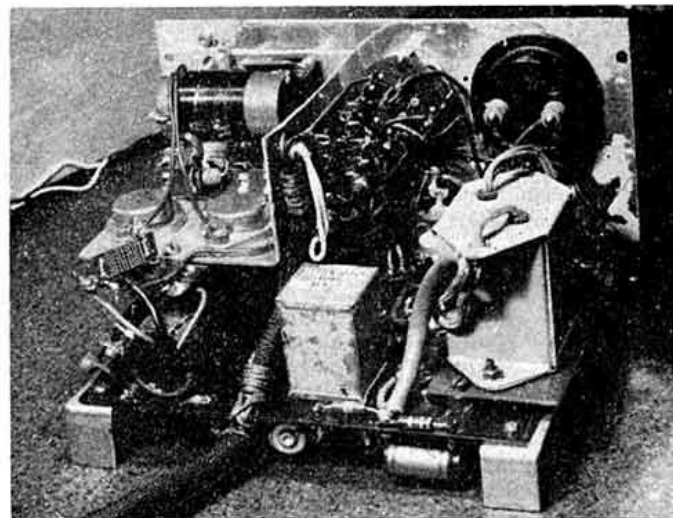


calibrated meter. It will be noted that R7-R9 are not decoupled.

An alternative method of metering would be to replace the meter shunts with closed circuit jacks and use a plug-in meter.

It will be seen that two separate supplies of different voltages are used. The first three stages have a common 12 volt supply, the maximum permissible for the type of transistor used. On c.w., keying is carried out in the positive side of this supply at J1.

The second, 24 volts maximum, supplies the power amplifier and microphone circuits. If only crystal controlled



The Top Band transmitter using power transistors.

operation is required then the whole transmitter may be operated from a single supply of 12 volts although output will be reduced.

Before commencing to tune up the transmitter, an artificial load comprising a 1 watt 75 ohm non-inductive resistor in series with a thermo-couple r.f. ammeter should

TABLE I
Typical current readings obtained when operating the transmitter
on 1900 kc/s into an artificial aerial.

Stage	Condition	
	A.M.	C.W.
Second amplifier	10 mA	16 mA
First p.a.	15 mA	30 mA
Final p.a.	40 mA	120 mA
75 ohm load	0.06 A	0.1 A

be connected across the output socket SK2. Currents up to 0.1A may be expected. Initial line up is carried out in the c.w. condition on 1950 kc/s. The second amplifier (TR3, TR4) should also be metered and the operating frequency monitored on a nearby receiver.

Providing the oscillator coil connections have been made correctly the circuit will oscillate. Using the values given, and with suitable adjustment of the dust core, complete coverage of the band will be obtained with tuning capacitor C4. (When using crystal control C4 should be adjusted for maximum output.)

Tuning of the first amplifier (TR2) is pre-set by means of the variable dust core of L3 and is adjusted to give maximum output at 1950 kc/s, indicated by maximum emitter current in the following stage.

The second amplifier is tuned by C8 for maximum dip, i.e. minimum meter reading.

The two power amplifiers, tuned by C10 and C13 respectively, are adjusted to give maximum output into the load.

To check operation on a.m. telephony the modulator is brought into operation by S1. Emitter currents of the last three stages will drop and the output will be reduced. A sustained whistle into the microphone should produce a noticeable increase in output. If the output decreases then the value of R14 may need adjustment, depending on the characteristics of the a.f. choke L12. In the transmitter described this choke is centre tapped but the tapped primary winding of an output transformer would also be suitable.

The important feature is that the d.c. resistance should be low in order to prevent excessive reduction of power.

Typical current readings are set out in Table 1. Having obtained a satisfactory alignment into an artificial load a radiating load can be substituted.

Aerials

The low impedance tap brought out at SK2 is suitable for link coupling to an aerial tuner or for direct connection to a quarter wave Marconi aerial. If an end fed aerial of about a half wavelength long is available it may be connected to the top end of the tuned circuit L11/C13 at the point marked X. A centre fed half wave aerial would require a separate link wound over the earthy end of L11. An r.f. indicator, or absorption wavemeter, placed near the aerial, is the most suitable means of adjusting for maximum output whatever type of aerial is used.

Construction

Whilst it is not intended to give a detailed account of the construction a few brief notes may be useful.

The transmitter is built on a sheet of paxolin measuring 6 in. by 4½ in. supported by two metal brackets which are fixed to the 6½ in. by 4½ in. metal front panel by clamping under the fixing bushes of J1 and J2. Paxolin was chosen in order to make possible a more convenient method of mounting components than if a conventional metal chassis were used. Anchorage points for the smaller components are necessary. In the interests of compactness, it is also useful to be able to mount components both above and below the paxolin sheet. An easy way of doing this is to push a short piece of 16 s.w.g. tinned copper wire into a ⅛ in. diameter hole drilled in the paxolin so that it projects above and

TABLE 2

Coil Winding Data

Coil	Turns	S.W.G.	Details	Diameter of Former
L1	—	—	} Teletron type FTO 4	—
L2	—	—		
L3	50	30	—	⅜ in. with dust core.
L4	12	26		
L5	50	26	over earthy end of L3 tapped at 10 turns	½ in.
L6	30	30	over earthy end of L5	⅜ in.
L7	40	26	tapped at 10 turns	
L8	15 + 15	30	over earthy end of L7	⅜ in.
L10	15 + 15	30	over earthy end of L11	
L11	40	26	tapped at 10 turns	

Wire is enamelled and turns are close wound

nection, must be insulated from the bracket by means of a mica washer. Connections to the base and emitter are by means of pins projecting through the case of the transistor and wires may be soldered directly to these pins but must be done very carefully. A more convenient method is to use small clips of the type intended for the anode connection of valves having a B3G type of base.

The bracket supporting the final stage is clamped on the front panel by the fixing bush of C13. Fig. 3 shows the positions of the larger components. Coil winding data is given in Table 2. Send/receive switch S2 has not been fitted on the transmitter, although this may be done, as it is intended to combine it with the aerial tuner when completed. The whole transmitter, excluding power supplies, fits into a metal case measuring 7 in. by 4½ in. by 4½ in. deep. In the writer's transmitter a case from an aircraft inter-com amplifier type A.1134 was used.

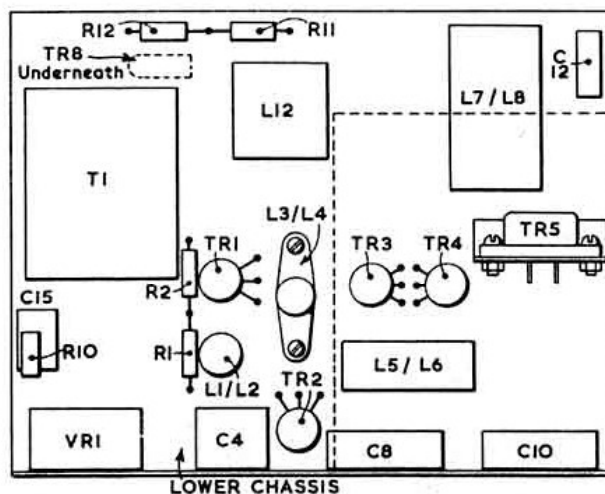
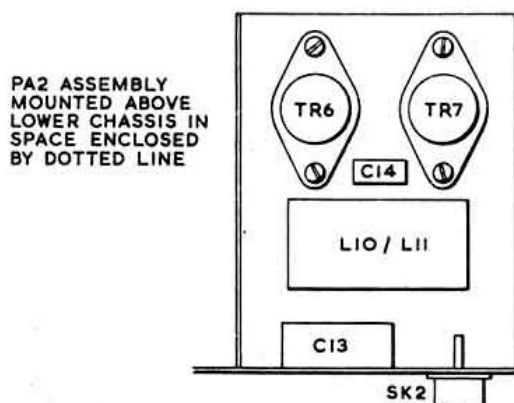


Fig. 3. The positions of the major components.

below. "Tags" made in this fashion can be used at any point where a soldered connection is to be made and will permit a layout similar to that found in printed circuit construction to be adopted. The oscillator coil has only short connection pins on the base and is intended for use in a printed circuit but if ⅛ in. paxolin is used and ⅛ in. diameter holes drilled in the same pattern as the pins, the coil will be a push fit and the pins will project sufficiently to enable soldered connections to be made.

The smaller transistors are soldered directly into the circuit but great care must be exercised when doing so to avoid damage by heat. Whilst soldering it is advisable to hold the transistor wires with a pair of pointed pliers to act as a heat shunt. Mounting of the power transistors should be carried out in accordance with the manufacturers' instructions. As the power dissipation is low the mounting brackets will act as small heat sinks. The mounting brackets are earthed so the transistor case, being the collector con-

The European Band Plan

The Plan, which is voluntary and supported by all I.A.R.U. Societies in Europe, is as follows:

Frequency Band	Type of Emission
3500—3600 kc/s	Telegraphy only
3600—3800 kc/s	Telephony only
7000—7050 kc/s	Telegraphy only
7050—7150 kc/s†	Telegraphy and Telephony
14000—14100 kc/s	Telegraphy only
14100—14350 kc/s	Telegraphy and Telephony
21000—21150 kc/s	Telegraphy only
21150—21450 kc/s	Telegraphy and Telephony
28000—28200 kc/s	Telegraphy only
28200—30000 kc/s	Telegraphy and Telephony

† 7100—7150 kc/s shared with broadcasting which has priority