WHEN, in the March 1966 edition, we introdued the *RCM&E Single Channel Transmitter*, we were trying to offer the non-electronically qualified novice R/C enthusiast a circuit which could be built with ease, without recourse to any special setting-up apparatus. In fact we were trying to offer a circuit which could be built and set in working order by anyone who could read and wield a soldering iron with reasonable effect.

There can be no doubt that this transmitter was a success – we still receive constant requests for photocopies of the article, since the March 1966 edition has long since been well and truly sold out. The fact that the editor's secretary is at the point of striking over the continuous photocopy requests has made the introduction of a new single channel transmitter imperative!

Some basic lessons were learned with the original circuit, most notable being that the biggest problem for constructors is the winding of the coils and construction of the centre loaded aerial. Judging from enquiries and requests for help received over the past two years, faulty coils and aerial have been the main cause of trouble, while the use of substandard or substitute transistors also accounted for a fair amount of bother.

Consequently, this new offering has been designed to use commercial, ready wound coils and aerial which should eliminate that problem, in the same way we did with the RCM&E Simpl-Simul Tx, recently published. The aerial itself has been given a considerable amount of thought. Originally we intended to use a base loaded type but this would have demanded a field strength meter for setting-up, which, of course, complicates matters more than is desirable for the novice. Consequently, we have maintained the use of a centre loaded aerial which can be bought ready tuned, and the circuit now requires setting-up equipment no more technical than a small electric bulb.

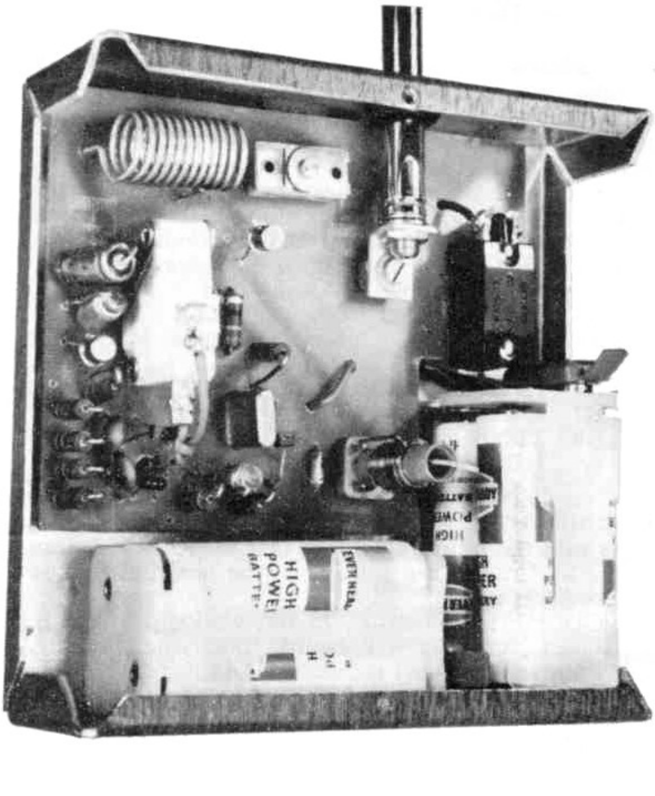
Simpletone

By
Rex Boyer

A single channel tone transmitter with 'constant carrier wave' design specially for the novice R/C enthusiast

We have also gone to some pains to be sure that the components, particularly transistors, are types which have manufacturer guaranteed maximum and minimum tolerances. The circuit has been designed to cope with these tolerances, and provided the specified components are used, and the circuit built as per instructions, success is assured.

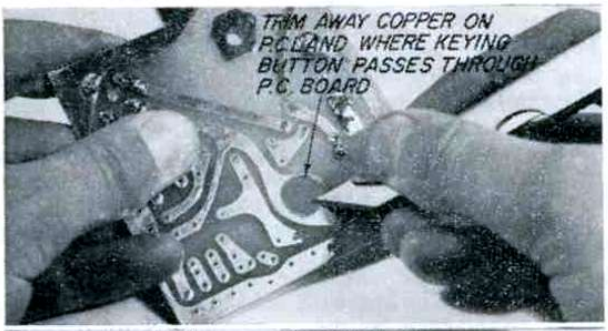
Our original intention had been to develop a circuit which employed only four transistors. However, the cost of the four transistors would have been greater than that for the five now selected, so there seemed little point in using four. Three types of transistor are now used, the P346A plus the 2N4292 and 2N4290 by Piher, and each should be readily obtainable.

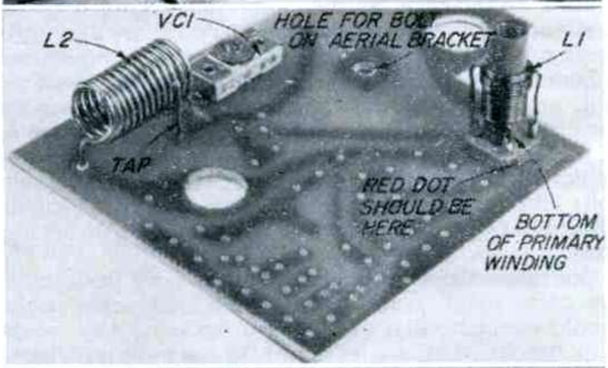


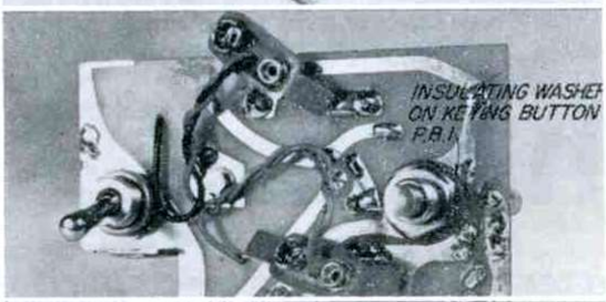
Components and materials

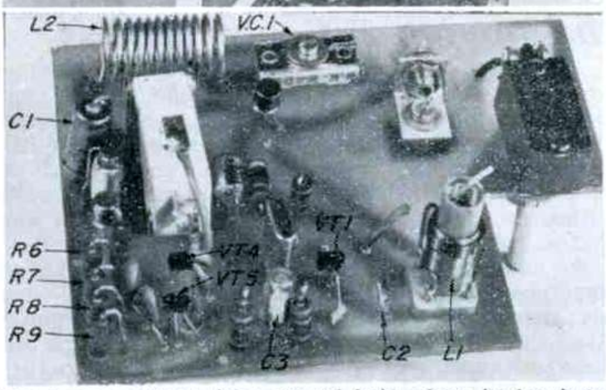
Component substitution is, as far as the average R/C enthusiast is concerned, the cardinal sin. DO NOT ACCEPT ANY COMPONENT SUBSTITUTIONS

Top: prototype Simpletone transmitter, with case covered in wood grain Fablon. MonoKote would be a good alternative covering. Left: rear of case removed to reveal internal layout and battery clips.









Top: remove copper from around hole where keying button P.B.1. passes through, to prevent neck shorting on copper. Second down: Coil identification, showing tap on P.A. coil and bottom of primary winding on oscillator coil. Orientate oscillator coil as shown. Third down: view of copper side of p.c. board identifying insulating washer on keying button P.B.1. Above: general view of component layout. Note solder tags on keying button.

whatsoever, no matter how technically qualified your adviser may be.

If you are going to make your own pc board you can take a print from the full size illustration Fig. 4. If, on the other hand you buy a ready drilled and etched circuit board, we strongly suggest you check to make sure it is made of 1/16 in glass fibre. This is important because the aerial is supported on the pc board and we found the paper type of board just did not stand up to general wear and tear in this respect. The glass fibre board also has far better insulative properties and is therefore doubly desirable.

Assembly of P.C. Board

Start assembly by making sure the keying button and switch pass through their respective holes in the pc board. Be sure also that the copper around the hole through which the neck of the keying button passes is relieved to prevent the copper land from shorting out onto the button (see photograph). The retainer nut for the keying bıtton should be insulated from the lands by an insulative washer. The on/off switch however, should make good contact with the pc board as this earths the live rail to the case.

Tick off the components as you solder them into the board by placing your "job done" mark in the brackets by each assembly stage instructions.

Coils

The first parts to be put on the board are the coils. Refer to Fig. 2 and photographs opposite.

( ) Oscillator coil (L1) Teleradio type 88/0. Solder in position using the red dot for orientation. Before doing so however, check to see that the red dot is adjacent to the correct pin, which should be the one which connects to the bottom of the primary winding (the longest winding wound up against the body of the coil former). See photograph for clarifications.

( ) PA coil (L2) Teleradio type 88/PA. This should have the ends cleaned. However, if as is likely, you have a coil with enamelled wire you will have to use a modelling knife to bare the wire to within ⅛ in of the coil windings. If you have a tinned copper coil you only have to clean the ends and the taping lead. Push the coil into its holes. You will notice the hole spacing is such that the coil will be expanded when finally fixed in position. To position the coil correctly, take a piece of ⅛ in scrap balsa and place between the board and the coil, to obtain the necessary stand off distance. Press the coil down onto the balsa and cut off the leads 3/16 in long on the copper side of the board. Bend the leads over to lay flat on the board and with an assistant to hold the coil in place, solder. Then space out evenly.

Resistors

Take all resistors (10 per cent tolerance, ½ watt) and thoroughly clean the leads by drawing them through a slit in a rubber eraser so that the solder will take easily. Referring to Fig. 2, solder as follows identifying by coloured band sequence indicated below. Note that the first three colour bands are mentioned, the fourth will be the silver 10 per cent tolerance indication.

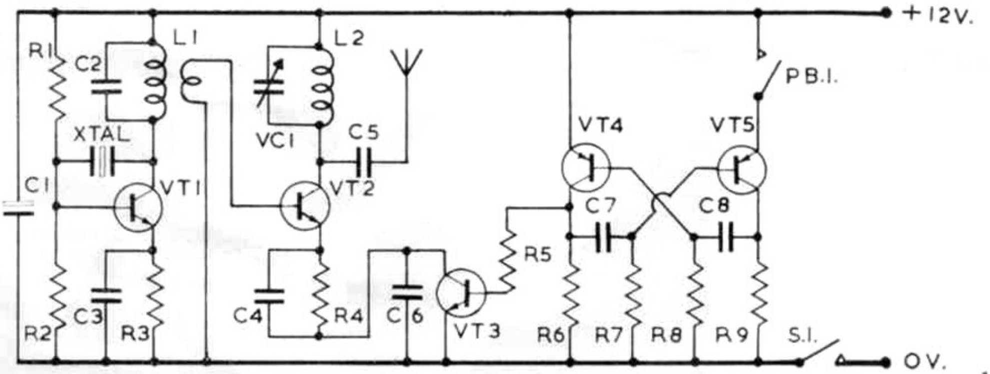
( )	R1	47KΩ	Yellow	Mauve	Orange	Vertical
( )	R2	4.7KΩ	Yellow	Mauve	Red	Vertical
( )	R3	330Ω	Orange	Orange	Brown	Vertical
( )	R4	27Ω	Red	Mauve	Black	Horizontal
( )	R5	2.2KΩ	Red	Red	Red	Vertical
( )	R6	1.5KΩ	Brown	Green	Red	Vertical
( )	R7	22KΩ	Red	Red	Orange	Vertical
( )	R8	22KΩ	Red	Red	Orange	Vertical
( )	R9	1.5KΩ	Brown	Green	Red	Vertical

Capacitors

As with the resistors, be sure that the leads are clean before soldering. Then solder into the board as follows referring to Fig. 2:

( ) C1: 25 μF electrolytic, 25 volt working (Mullard). Insert vertically on board, observing polarity. Positive (+ve) end is 'waisted' and there is a black insulator in the end where the +ve lead protrudes (see Fig. 3). Capacitor stands vertically on –ve end with +ve end uppermost.

Fig. 1: Theoretical circuit



Component values

R1 : 47K Ω
R2 : 4.7K Ω
R3 : 330 Ω
R4 : 27 Ω
R5 : 2.2K Ω
R6 : 1.5K Ω
R7 : 22K Ω
R8 : 22K Ω
R9 : 1.5K Ω
All resistors ½ watt 10 per cent Radiospares
C1 : 25 uF 25v. electrolytic Mullard.

C2 : 22pF Radiospares
C3 : 1000 pF Radiospares
C4 : 1000 pF Radiospares
C5 : 1000 pF Radiospares
C6 : 1000 pF Radiospares
C7 : 47K pF Radiospares Disc Ceramics
C8 : 47K pF Radiospares Disc Ceramics
VT1 : 2N4292 Piher
VT2 : P346A SGS Fairchild
VT3 : P346A SGS Fairchild,

VT4 : 2N4290 Piher (supplied in G.B. by Waycomb)
VT5 : 2N4290 Piher (supplied in G.B. by Waycomb)
VC1 : 140 pF Radiospares flat trimmer
Xtal 3rd Overtone Miniature. 27 MHz band
S1 : Radiospares Light Duty S.P.S.T.

P.B.1. (Keying button) : Micro Push Button. MacGregor Industries or Radiospares
Aerial : D. Olley or Horizon Systems
L1 : Teleradio type 88/0
L2 : Teleradio type 88/PA
Case : 20 s.w.g. Aluminium

Fig. 2: Component placement diagram

Note: tuning bulb, top right is removed after tuning operation

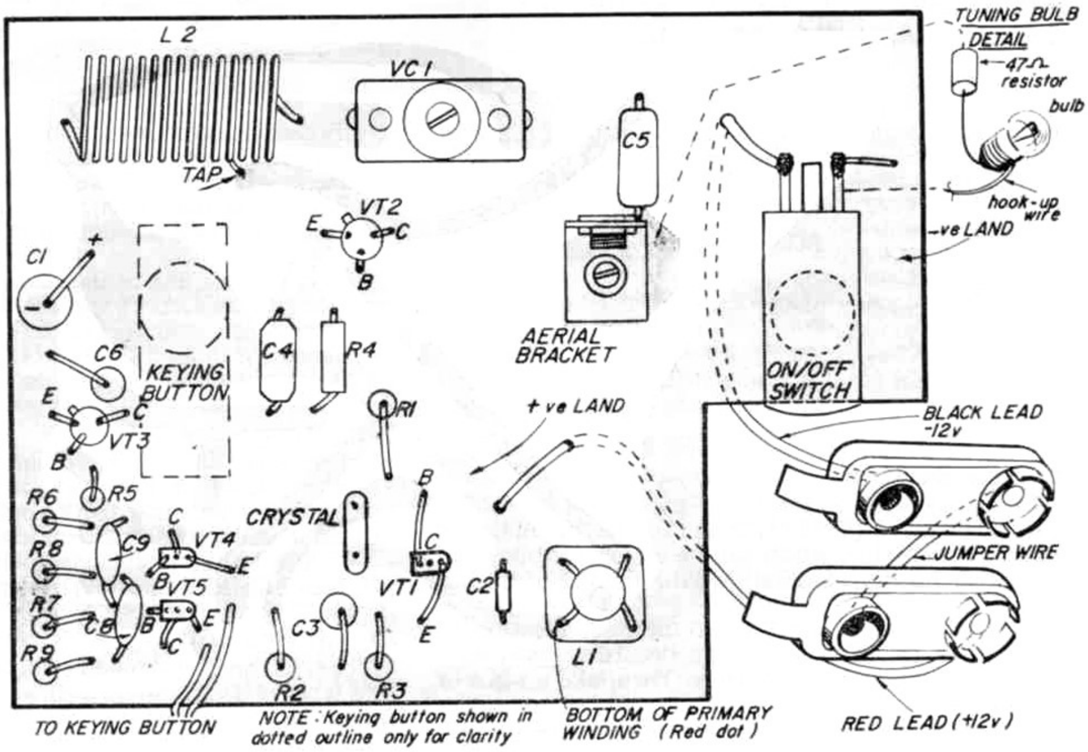
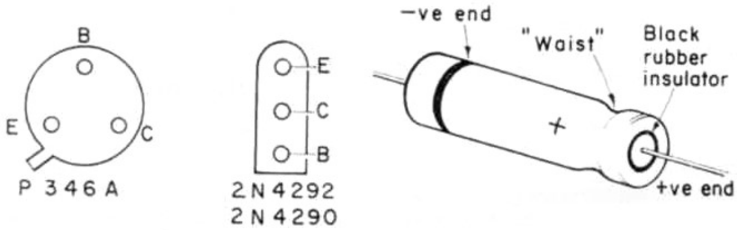


Fig. 3: lead identifications for transistors and capacitors C1



( ) C2: 22pf Radiospares Polystyrene Horizontal
( ) C3: 1000pf Radiospares Polystyrene Vertical
( ) C4: 1000pf Radiospares Polystyrene Horizontal
( ) C5: 1000pf Radiospares Polystyrene Horizontal
( ) C6: 1000pf Radiospares Polystyrene Vertical
( ) C7: 47K pf Radiospares disc. ceramic Vertical
( ) C8: 47K pf Radiospares disc. ceramic Vertical

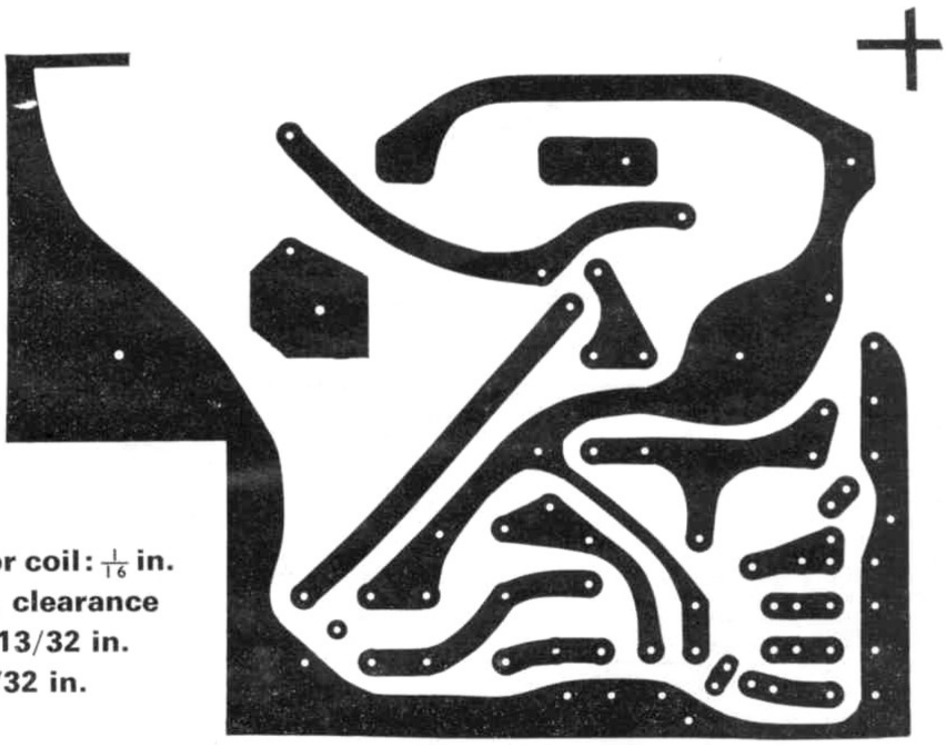
Transistors

Refer to Fig. 3 for corrected identification of emitter (e), collector (c) and base (b) connection which *must* be observed.

Then solder in transistors as follows (referring to Fig. 2), using a heat shunt on each lead as it is soldered,

Fig. 4

Printed Circuit layout



Drilling details:
Small holes: 1 mm.
P. A. coil and oscillator coil: $\frac{1}{16}$ in.
Aerial bracket: 6 B. A. clearance
Keying Button P.R.I.: 13/32 in.
On/off switch S.1: 15/32 in.
VC1: $\frac{1}{8}$ in.

so that no damage is done to the transistor. If a proper heat shunt tool is not available, use a pair of tweezers, gripping the lead to dissipate the heat.

( ) VT1: 2N4292 Piher
( ) VT2: P346A SGS Fairchild
( ) VT3: P346A SGS Fairchild
( ) VT4: 2N4290 Piher
( ) VT5: 2N4290 Piher

Crystal (Xtal)

( ) The crystal (xtal) is also a delicate component and the leads to this should also be heat shunted when soldering. (See Fig. 2).

On/off Switch

The on/off switch S1 is a Radiospares, light duty single pole, single throw (SPST) type and the Keying Button is a micro action type, which can be obtained from MacGregor Industries, Station Wharf, Langley, Bucks., price 9s. 6d.

( ) Fit the on/off switch S1 onto the component board with its solder tags pointing toward the top edge (longest side). Tighten firmly. Then take a piece of excess wire lead from one of the resistors and solder from the tag facing the outer edge of the board into the –ve land just below this tag. The –ve land is the one which passes round the edge on three sides of the board, and is identified on Fig. 2.

( ) To the other tag on S1, solder a 9 in length of *Black* 14/.0076 hook-up wire and pass this through the supporting hole above and to the left of this tag.

Keying Button

( ) The keying button must not short on any of the copper pc lands, so check again that the neck of the button does not short on the copper where it passes through the board, referring once again to the photograph showing how the copper is carved away from the periphery of the hole.

Fit onto the board and tighten into position, insulating the nut from the copper lands with an insulative washer.

( ) Take two short lengths of 14/.0076 *Red* hook-up wire and solder, one each to the two solder tags on the keying button. Take the free end of one lead (it does not matter which), bare the end and solder into the unused hole adjacent to the emitter of VT5. (see Fig. 2).

( ) Bare the free end of the remaining wire and solder into hole adjacent to the emitter of VT4 in the +ve land. Again refer to Fig. 2.

( ) Solder a 9 in length of red 14/.0076 hook-up wire to the +ve land as indicated in Fig. 2.

Checking

( ) Before you connect the circuit up to a battery, check every detail of the work completed so far. Pay particular attention to the orientation of the transistor leads, coils and the electrolytic capacitor C1.

Also be sure that none of the copper lands have been bridged with excess solder.

Aerial Bracket

The aerial bracket should be constructed as per Fig. 5. Two types of aerial can be used with this transmitter, the D. A. Olley Fleet Aerial or the Horizon Systems aerial. Each works well and can be obtained ready tuned, provided that a specific frequency is requested. Mount the aerial bracket using a 6 BA bolt and nut.

Batteries and wiring up

This circuit works off a 12 volt power supply, comprising eight pen cells. For convenience we have used two plastic type battery clips for these. Connections to the batteries are effected by small battery clips and the wiring system can be found in Fig. 2.

Tuning up

The beauty of this circuit is that it requires no expensive setting-up equipment. This did not just 'occur' of course, we designed it specifically for the novice who cannot afford to pay more for a test meter than he does for his transmitter.

Your transmitter circuit board is now complete and the circuit can now be tuned before final assembly into its case. Tuning before fitting the circuit board into the case has no ill effect.

You should be in a position to just switch on for instant success, but before you do so let us take a look at the tool we need for tuning. This is a non-magnetic and preferably non-metallic screwdriver which will fit both the slug in the oscillator coil (L1) and the screw in VC1. Such can be easily made from an old knitting needle.

Also required are a 6 volt .04 Amp bulb, a 47 Ω resistor (not wire wound) and a short length of thin, round section rubber to lock the slug in the oscillator coil. Alternatively, this can be locked with a blob of wax.

Start by connecting a short piece of wire about 2 inches long to the side of the bulb, and solder one end of the 47 Ω resistor to the bulb tip. Now, solder the other end of the resistor to the copper land that carries the aerial bracket and touch solder the free end of the 2 in. wire to one of the tags of the on/off switch (either tag will do). See Fig. 2.

Adjust VC1 using the tuning tool until the plates are just lightly compressed. Also, interpose the short piece of rubber between the slug and former of the oscillator coil L1.

Switch on.

The bulb may or may not light. Commence to screw the slug into the oscillator coil (clockwise) until the bulb lights. If you continue to screw the slug into the former, the bulb will become brighter, and will then go out abruptly. This indicates that the oscillator has stopped working, so unscrew the slug two or more turns until the bulb again lights and continue to unscrew a further ¾ turn.

Now, turning to VC1, tighten the centre screw to achieve maximum brilliance.

Once this is achieved return to the oscillator coil for final peaking. Screw the slug further into the former again (clockwise) until once more the bulb goes out. At this point unwind anti-clockwise until the bulb relights. From here continue to unwind ¾ turn.

Key the tone a few times. The bulb should dim somewhat each time. Finally, switch the Tx on and off several times and make sure that the bulb lights up every time the Tx is switched on.

Your Tx is now on tune.

Remove the bulb from the circuit, together with its relative resistor and tag wire, and if you do not trust the piece of rubber interposed between the slug of L1 and the former to provide effective locking, use a drop of wax.

Case

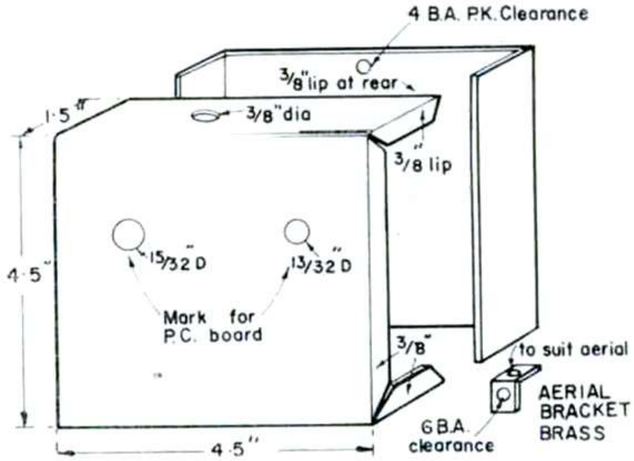
The case is made from 20 swg aluminium. It measures only 4½ x 4½ x 1½ in and has been designed to use a minimum of unsightly PK screws. To this end, the pc board is held in place by the on/off switch and keying button, and the only screws visible are the two which retain the rear cover.

The arrangement is simplicity itself and should present no problems. Fig. 5 provides full details. It is suggested the centres for the holes for the on/off switch and keying button be marked using the pc board to achieve complete accuracy.

Two distance pieces are required to prevent the pc lands from shorting on the case, and extra nuts on the keying button and on/off switch are ideal here.

Having assembled the pc board in the case check to be certain that the distance pieces prevent the cooper pc lands from shorting on the case. You can mark out the drilling point for the aerial hole. This is done by measuring the distances from centre of the bracket to the front of the case and from the side. These measurements are

Fig. 5: case details



then transferred to the top of the case where a hole is drilled to clear the insulating aerial grommet.

When the pc board is put back in the case, check to see that the aerial stands vertically. If not, you adjust by slotting the hole for the aerial bracket.

Finally, you can consider decorating the case of your Tx. We used wood grain Fablon with reasonable effect.

Strictly for the more expert modeller

If you have a field strength meter you can check the output of your transmitter. You may find that a slight adjustment to VC1 and the slug in the aerial coil will give a slight increase in output. The total current drawn on 12 v. with tone off should be approximately 70 mA dropping to 50 mA when tone signal is keyed. The tone frequency is approximately 600 c.p.s. and the tone modulates the carrier wave 100 per cent.

Final points

This transmitter has been designed to enable the absolute novice to build his own unit and expect first time success. Provided the instructions are religiously followed, there should be no problems.

The unit should make an ideal club project – why not give it a try. Remember that RCM&E Technical Department is at your disposal and any help you may need will be readily given. We are anxious to hear of your experiences with this circuit – so let's be hearing from you.

Next month . . .

June R.C.M. & E. will feature the Simpletone receiver, which can be built in either relay or relayless versions. Complete and explicit instructions will be provided, and there will also be details for an add-on switcher for galloping ghost.

Superhet to follow

Looking for a single channel superhet? R.C.M. & E. will shortly present "Supertone", a really first class unit for home construction to match the Simpletone transmitter.