Tech-Two Receiver

For "Extra Channel" Radio Control

It's double fun when you can operate second R/C job on Technician's Band with this set

By HOWARD G. McENTEE

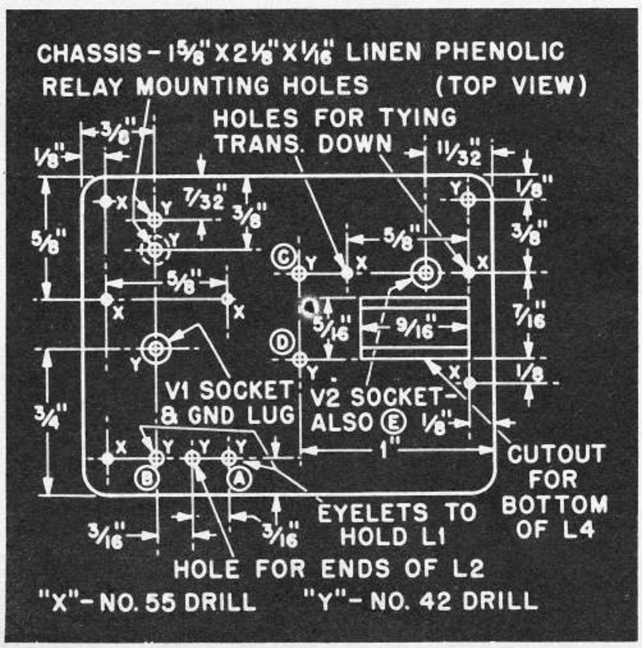
■ As a long-time champion of hard tube receivers, we have used such types as the Mini-50 (ATH 7-54) and the Mac III AES (ATH 6-55) and its forerunners for years, with fine results. When word reached us of a hard 2-tuber being used in New Zealand, it looked like a good compromise between the above two receivers; it had no sensitivity control, so was a cinch to operate, and it was considerably simpler and lighter than the AES, as there were only two tubes. We got in touch with Doug Halligan of Auckland, N. Z., who sent all the data he had. Doug does not claim to have "invented" this circuit, and we don't know who should really get the credit; the receiver seems to be in wide use in both Australia and New Zealand.

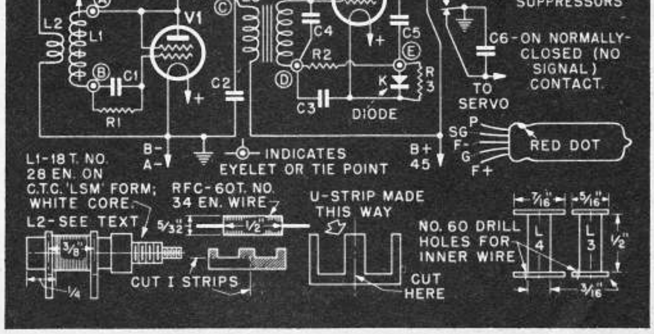
A glance at the circuit shows that the "rig" is quite simple, having the usual super-regen detector tube V1, transformer coupled to another tube; a feedback circuit is used on V2, which picks off some of the audio this tube amplifies, rectifies it, and applies it to the grid. Looks very simple, and it is—but it is actually a bit deceiving. After struggling with the set for some time, we appealed for further help to Doug, and he shipped us one of the receivers he uses. With this as a basis, things moved faster. Figuring that it would be toughest to get a 50 mc version going (we usually develop a circuit for 50 first, since it is almost always quite simple to convert a successful 50 mc receiver to 27¾ mc) we stuck to that frequency, and eventually had the very satisfactory receiver shown in the photos flying nicely. Unfortunately, when we tried to put the set on 27¼, a few bugs arose, which have not been cleaned up yet. So rather than wait till they are, we decided to print the dope on the 50 mc job; it should be widely used just now, if there are as many new Technician ham licensees rarin' to go on 50 mc everywhere, as we have in our particular area. We'll give the dope on the 27¼ receiver in a later issue.

The heart of the receiver is the interstage transformer, L3-L4, which cannot be just the usual sub-min AF transformer for the following reasons. The receiver operates by virtue of the hiss produced by V1, just as does the AES. The hiss is at a high frequency but quite audible —you can hear it with a pair of phones across L3. We want the hiss to go through the transformer, but we don't want the quench frequency to pass; this is higher than audibility around 20 kc. The transformer is thus made to pass a band of frequencies that include the hiss, but to cut off just above audibility; also, since we are working with very high AF, there is no reason to pass anything below about 5 kc. Cutting off the low frequencies means less transformer weight, as not much iron is required, and has a big bonus in that the set isn't bothered by low frequency vibrations that give many hard tube receivers a tough time.

Much of our time on the receiver has been spent trying to find ready-made coils that will do for L3 and L4; there are some possibilities, particularly in small relay coils, but we have not been able to pry what we want out of the manufacturers as yet. Again—rather than wait any longer, we felt it best to print the data on the set we have used, along with instructions on a homemade transformer. The latter is wound with No. 42 wire—now don't stop reading at this point! We were a bit wary when Doug told us this, but after we tried it, we found it wasn't hard to work with at all. Fortunately, a low cost source of wire for the two coils has been located (see parts list); to get proper results from the transformer, you cannot use just any old iron for the core—even iron used in most commercial AF transformers will not do. Again fortunately, the wire source mentioned has plenty of the proper grade of iron for this use, this core material being called "Mumetal."

Everything fits nice and neat in this plastic box which measures a scant 2⅛ x 1⅝ x 1 inch! Tubes used in this rig are one CK533 and one CK5857. This "hard" two-tuber was developed in New Zealand.





To go back to theory for another moment—the hiss from V1 goes through the transformer, and is stepped up by the approximately 1-4 winding ratio. V2 amplifies the hiss, and some of it is picked off the plate circuit via C5, put through the diode rectifier to turn it into DC, and the resultant negative voltage is applied to the grid of V2, through L4. V2 is thus biased down to a low plate current with no signal, and Ry remains open. An incoming signal will stop the hiss from V1, V2 loses its bias, and its plate current rises, closing Ry.

Advantages of the receiver are: low plate current with no signal, simple circuitry, fairly good range of current change to the relay (this receiver gives about .35-2 ma. with the tubes specified); moderate A battery drain, ability to work on dropping A and B batteries, not particularly sensitive to "electrical noise" in the plane, high sensitivity with no sensitivity control of any sort, not at all fussy as to antenna length, fairly sharp tuning (considerably sharper than the Mac 50, when latter is set at comparable sensitivity—not as sharp as the AES), long-life non-critical hard tubes used. As for disadvantages, there are a few (aren't there always), the main one probably being the necessity for a special transformer. We haven't a doubt that a commercial unit will soon be available, to take care of this angle. The receiver will pulse quite fast, though not as fast as the Mac 50, which has practically no upper limit, within reason.

Since you can't make a receiver without the proper transformer, let's start on this item. Having procured the specified commercial transformer to provide the iron and wire, clip the leads off the unit and peel off the outer covering till you reach the top layer of fine wire. Lay this aside for the moment and make yourself a couple of coil forms; our were fabricated of discs cut from 1/32" fibre, and tubes of rolled paper. The end pieces had holes made with a 3/16" punch, and one of each size has a #60 drill hole for the inner lead. The tubes were rolled from about 3 layers of ordinary pad paper, smeared with Duco cement, and inserted into the spool ends with more cement to hold the latter. The overlength tubes were sanded flush with the ends, after the whole works had dried.

It pays to make a few preparations before you start the winding, which can then be finished in a fairly short time. The primary L3 is wound first, and requires 1500 turns. We clamped a hand drill in a vise, and the coil spool was held in the chuck with a nut and bolt. The ex-transformer coil from which the wire was to come was mounted on a ¼" dia. brass bushing, which in turn had a #6 screw through it, the latter being held in a portable machine vise. A magnifying glass was mounted over the coil spool, with a piece of white paper under it for better background, and a desk lamp provided plenty of light. A lot of fuss, perhaps, but it did make winding quick and sure. The #42 wire was cleaned of insulation and soldered to a piece of the finest flex wire we could find, the latter then being bound to the coil form tube with a piece of cellophane tape. The wire was "jumble wound," the only care we took being to try and keep the winding roughly level over the whole length of the spool. After each 100 turns of the drill knob, a mark was made on a piece of paper. Our drill has a gear ratio of about 4.3-1, so we had to twist the knob about 350 times. Another piece of thin flex was attached to the outer end of the #42 winding, and a layer of Scotch electrical tape put over the winding for protection.

The secondary L4 was wound the same way, but took lots more turns, of course. All the rest of the #42 wire on the original transformer was put on L4, coming to about 6200 turns. The inner winding of slightly heavier wire is not needed for this receiver (save it to make RF chokes for 27¼ receivers).

Cut two of the large E pieces of the core metal in half, as illustrated, and also make 20 small I strips. The four U's you have made link the two coils together—two inserted from each. Then, 10 of the I pieces are put into L3 and L4. If the core seems a bit loose, wedge it with small strips of wood. Bend the protruding ends of the U's down against the spool ends. An outer coating of radio coil dope (or regular model plane dope) holds the transformer together, and gives a bit of moisture protection.

The chassis is cut as shown in the drawing; there are only two sizes of holes needed, all the small ones but the two indicated being used to pass leads from one side of the chassis to the other. A slot is cut for the lower edge of L4 to fit in, but the transformer should not be attached till the socket for V2 is in place. The two tube sockets must be drilled for 2-56 screws, and a small lug is used on each screw as a tie point. That on the V1 socket is a "ground" lug (connected to A and B minus) while the lug on V2 socket is indicated as E on the circuit. The other circled letters show eyelets on the chassis that are used as tie points for circuit components, and are also indicated on the chassis drawing. Note that several of the "Y" holes are counter sunk, for flat-head mounting screws.

L1 is soldered into two of the eyelets, and the nut and washer that come with it are used to hold a piece of music wire against the threaded end of the adjusting screw, to keep it from moving under vibration. L2 is a single turn of thin insulated wire around the center of L1; both ends go through the "Y" hole indicated, one being attached to the V1 socket ground lug.

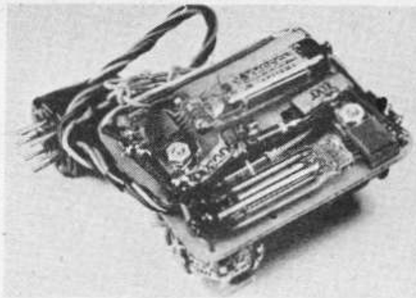
Directions are given for making RFC, such as we used. Later tests showed that a Miller #6152 "Video Peaking Coil" —which is actually a tiny 20 microhenry RF choke, works fine, too.

When soldering the diode into the circuit, have an assistant clamp a pair of long nose pliers on the diode lead between the soldering point and the diode body, to prevent heat from damaging this tiny unit.

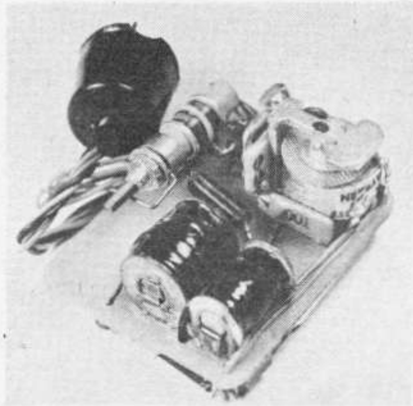
There is a possibility that you might have audio oscillation due to interaction between L4 and the relay coil. It did not occur in the receiver shown, but has been noticed in others we have made. The leads from L3 may be cut short and wired permanently in place, but leave L4 leads a couple of inches long temporarily.

Wire up the receiver to the batteries, with a 0-5 ma meter in series with the B plus lead. Insert only V1 in the socket, and tune L1 to your transmitter. V1 should draw about .4 ma, and the current will drop slightly, when the transmitter is keyed on. The antenna should be about 18-24" long.

Now install V2 and the total plate current drain for the two tubes will be around 1 ma. It should go above 3 ma on signal. If the no-signal current is around .5-.6 ma, you probably have the low frequency oscillation mentioned above, and all you have to do to discourage this is to reverse the two leads to L4 (do not change L3 connections). That's about all there is to "tuning up" the receiver. Should your V1 current come out radically different than specified, you can get it to the proper value by changing R1, but this should seldom be necessary. For very high pulse rates, R3 can be reduced somewhat (to .5 meg, for example) but this will raise the idling current a bit.



Removed from its protective plastic box cover the "Tech-Two" is a model of simplicity. Proven in use over two year period, many units are in operation.



Complete instructions are given for winding coils which are not available commercially. Modelers are reminded this 50 mc unit can be used only by licensed ops.

The tubes specified are the ones we have used most, and strongly recommend. Quite a few others will work fine, however. Good detector V1 tubes, with the value of R1 they require are: 2E36—1.2 meg; 1AG4—1 meg; DL66 (a 15 ma tube available from Polk's)—1.2 meg, CK502—1.3 meg. V1 current will vary a bit among these types from the .4 ma that the CK533 draws; incidentally, the CK536 is just the same electrically as the 533, but has a metal shield painted on it. Both work equally well in this receiver, and they have been found the most desirable tubes for V1. The old faithful 1AG4 makes a good output tube, but it should not be used without a screen grid limiting resistor; we found a resistor of 25,000 ohms, and a condenser of .01 mf from SG to ground gave good results, giving a plate current change of .6-3 ma, with a 533 at V1. No matter what the output tube, a fair amount of current has to be wasted on the screen grid; with most tubes this amounts to about .8 ma with full signal. The SG current drops to .1 ma or so when idling.

The chassis shown was made to go into a plastic box, which is 1 3/16" high outside; there is just enough room inside for the set fitted with the Neo-

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matic relay. Other relays will work, of course, but even the smallest and lightest ones, such as the Gem, are too high to mount as we did the Neomatic, and still fit in the specified case. Since relay current is about .4-2 ma, the relay is set to pull in at 1.5 ma and open at 1 ma. The receiver will give good results down to about 1.2 V on the filaments; in fact, the tubes are designed to work on 1.25 V, and if you use ordinary flashlight cells, or Silvercels, for filament, a dropping resistor ought to be utilized to cut the voltage at the receiver a bit. Most users of sub-min tubes don't bother with such a resistor, though, and tube life seems ample. The receiver weighs 2½ oz. with relay, case and plug.

We strongly suggest that builders do not deviate from the parts specified; they have been found to work well. You can try others, but you'll be on your own then! While this is a simple receiver to build and get going, we don't claim it is a "beginner's" job—but if you expect to use it on 50 mc., you should have had some electronics experience, and can't be called a beginner anyhow.

PARTS LIST: V1—Raytheon CK533; V2—Raytheon CK5854. Two flat-type sockets for tubes (Polk's). L1 and L2—wound on CTC type LSM coil form, white core. RFC—RF choke per drawings, or Miller #6152. L3, L4-special transformer; core material and wire taken from surplus transformer (Gyro). Ry—Neomatic 7250 ohm relay. Diode—Int. Rectifier type 1T1. C1—50 mmf.; C2, C5—.001 mf.; C3—.003 mf.; C4—100 mmf.; C6—500 mmf.; all CRL type DD ceramic. R1—1.8 meg.; R2—.5 meg.; R3—1 meg.; all 10% carbon, ½ watt. 1/16" thick linen base material. Plastic box, 2⅛ x 1⅝ x 1" high—Gyro.