

- We have heard from quite a few "hams" (licensed amateur radio operators), who ask for some data on a good 50 mc . transmitter for R/C work-one that will have reasonably good power output and ample stability. Of course, there are lots of opinions as to what "good power output" may be, but we feel this unit has plenty of pep for most R/C uses.

The Mac II transmitter, which was based upon a two volt power supply, has proven so reliable and popular that we decided to convert our own Mac II, rather than make a whole new unit. While the supply of PE-157 power units around which this transmitter is built is not too good, you can, of course, use heavy-duty dry batteries, and there are several 2 V . power supplies now on the market that will serve. For full output of which the transmitter is capable, you will need a power supply that can furnish about 170 V . at 48 ma., which is what our version runs at, with a fully charged 2 V . cell.

The original power supply was used, but a few modifications were made to increase output. First, the rubber-covered lead from the cell was discarded, and the entire low voltage circuit from cell to

## Mac II Conversion for the Radio Amateur:

## "Mac 50" R/C TRANSMITTER

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pin 7 of the vibrator and to the red lead from the power transformer was reconnected with really heavy wire. Auto primary wire is ideal for this purpose. The original toggle switch was replaced with a low voltage job, made for airplane use at high current. No fuse is used.

Next step was to replace the filter choke that came with the PE-157 power supply, and which had been installed in the Mac II with a low resistance unit. A Stancor \#C-2327 was used here; it's a little job called a television replacement choke, and has very low resistance. These changes pepped up the power supply a lot (users of the Mac II on $271 / 4$ mc . might try the same, if they feel they are not getting full power output).

The RF portion of the transmitter must. be completely rebuilt, and very few of the original parts are usable in the new 50 mc . version. We wanted to retain the stability of crystal control, and tests were made with a 3S4 tube using a 50 mc . crystal, to drive the amplifier. This was pretty touchy, and left no margin of safety; 50 mc . crystals have very little output and must be lightly loaded. We decided, therefore, to go to the circuit shown here, which utilizes a 3A5 as a crystal oscillator and doubler. This is very economical on B power, and has plenty of output. In fact, the 3A5 runs at such low power input that it can be considered to be just loafing. R8 on the diagram serves to cut the output of V1, to give the proper amount of grid
current to V2.
In order to handle the full power of which the 2 V . supply is capable, we installed a 3B4 output tube, which is something like a 3A4, but more efficient at 50 mc . It does a nice job, but has to be neutralized (as do all other battery tubes that might be used in its place). Inductive neutralization is used; twisted hookup wire is connected across two turns of L4, and terminates in a twoturn loop that may be moved near the end of L2.

A drawing of the aluminum chassis is given, with the location of the main components marked. Both tubes have shields, mainly to keep them in their sockets, while the set is being transported. It was found convenient to use a slug-tuned coil at L1, but the conventional condenser and coil combination worked better for L2. Note that R5 must be a wirewound resistor, preferably of the make specified: Other makes will be larger. This resistor is a wirewound type, and also acts as a fairly good RF choke.

The 3B4 filament must be operated on 1.25 V., while V1 requires 1.5 V ., so two sliders must be used on R9. The voltages should be set with a fully charged cell, and it will do no harm to have them a little high, so that they are still reasonably close, when the cell voltage drops a bit.
In order to make tune-up easier, a 5 ma. meter has been installed, and a rotary switch allows it to be connected



Crystal here no longer available; one in transmitter has small sealed metal case. C8 is grounded to lug under socket rivet.


Underside of R.F. chassis. Filament dropping resistor has two sliders. R8 is at upper center, coil L2 directly below resistor.
across several circuits in the transmitter. The particular meter used came with a 50 ma . shunt; this range is used to measure V2 plate current, and the shunt is mounted right on the switch. Position 1 indicates doubler plate current, and for this we needed a 10 ma . range. The necessary shunt, R3, comes out to about 6 ohms for this particular meter. However, it must be measured for each meter. The shunt was made of resistance wire from an old wirewound rheostat. (The process is shown on p. 57 , Sept. '53 A.T.)

The entire transmitter is "keyed," to send out signals and cut them. A test switch is mounted on the front panel, and there is also a socket for a plug from the external pulser (not shown on the diagram). SW1 is mounted in the hole where the key jack used to be.

All RF parts except L5 and C10 are mounted on the chassis, and this unit should be completely wired before it is fastened on the panel. When you arrive at this point, temporarily connect a blue bead pilot lamp (No. 44) from the antenna terminal to the case. Having made sure that the filament voltage to both tubes is correct, set the rotary switch to position 1 and turn the core in L1, till you see the plate current wobble a bit. Then turn SW1 to position 2, and adjust L1 and C5 to get the highest reading. While making these adjustments, it is wise to open the screen grid circuit of V2, so that this tube won't draw excessive current, since it will be untuned.

With R8 at zero resistance, you should be able to get a reading somewhere around 2 ma., with SW1 in position 2. Be sure you have a good crystal; the crystal range is $26-27 \mathrm{mc}$. We used a Petersen Z9A unit here, with fine results. This takes a socket with small diameter pins, but some other types have large
pins, so make sure you get the right crystal socket.
Now comes neutralization, which is very simple. With the screen circuit of V2 still open, and L1 and C5 tuned for highest reading (SW1 still on position 2), rotate C 9 through its range. At some point you will doubtless find that the meter needle gives quite a kick. Try moving L3 nearer L2, and repeat. When L3 is in the correct position, you should be able to turn C9 to any setting, without seeing the slightest bit of meter movement. In our case, L3 is about $3 / 8^{\prime \prime}$ from the end of L2, and somewhat off center. L3 has to be the correct way around; if you find that the meter kicks no matter where you have L3, just flip it around so that the other side faces L2, and try again.

When fairly close neutralization has been achieved, you can put V2 into action; for normal operation, we find that a grid current reading of about 1.3 ma . is ample. Tune C9 to resonance (lowest plate current reading), and if it shows plate current lower than about 26 ma., readjust C10 and try again. We find that L5 has to be very closely coupled to L4, to get proper Ioading. It is impossible to get too much loading, since it can always be cut down by use of C10.

As with any other transmitter fitted with a quarter wave vertical antenna, this one has to be standing upon the ground, or some fairly large metallic object, to load up properly. Also, it loads better when fitted with a good sized "base plate," as recommended for the Mac II. Our base plate measures only $8^{\prime \prime}$ square, and could well be larger. A quarter wave at this frequency is about $41 / 2^{\prime}$, so your antenna should be at least this long, as measured from the top insulator, where it connects to L5. The
procedure for tuning C9 and C10 is exactly the same as was described for the Mac II, so will not be repeated here. Most hams are well acquainted with the necessary steps to take.

As a help in comparison of results, the voltage and current readings taken on this transmitter, when properly tuned up and loaded, are as follows: high voltage - 170; plate current of V2 (SW1 in position 3)-28 ma.; screen grid current of V2-7.25 ma.; grid current of V2 (SW1 in position 2)- 1.3 ma .; plate current of the doubler (second section of V1 SW1 in pos. 1)- -4.4 ma . The oscillator current will be about 3 ma ., with a good crystal. With the above readings, power into a pilot bulb is about 2 W., which represents pretty fair overall efficiency, considering the tubes used. We have found that the transmitter keys just as fast as required for pulse work, or to use with a fast beep box. Total current drain from the storage cell is about 7 A ., so it is wise to keep a close check on the charge, by watching the indicator balls. At that, current drain is only an amp. or so higher than it was with the old Mac II circuit, when the 3D6's were loaded up for highest output.

## Parts List

(Only parts needed to convert Mac II to 50 mc . are listed.)

1 new aluminum chassis, see dwg. 2 7-pin miniature sockets with metal shields to fit. M-5 ma. meter, $2^{\prime \prime}$ size, with 50 -ma. shunt (Electronic Spec. Supply Co.). 1 antenna, at least $5^{\prime}$ long. 1 socket for crystal (Control Research). V1-Raytheon 3S4. V2-Raytheon 3B4. C1- 15 mmf . ceramic, CRL D6-150. C2, C4, C7, C8-. 005 mf . ceramic, CRL DD502. C3- 500 mmf . ceramic, CRL (Continued on page 85)

TOP VIEW OF R.F. CHASSIS

## "Mac 50"

(Continued from page 39)
D6-501. C5, C9-15 mmf. miniature variable. C6-50 mmf. ceramic, CRL D6-500. C10- 50 mmf . miniature variable. R1, R2- 300,000 ohms, $1 / 2$ W. carbon. R3-Special meter shunt, see text. R4-Special meter shunt, comes with M. R5-10,000 ohm wirewound resistor, Ohmite 5 W . R6- 300 ohm $1 / 2 \mathrm{~W}$. carbon. R7-12,000 ohm 1 W. carbon. R8 $-10,000$ ohm variable resistor. R9-2 ohm adjustable wirewound resistor with two sliders, Ohmite 1002. CrystalPetersen Z9A, between 26 and 27 mc . L1 $-3 / 3^{\prime \prime}$ dia. slug coil form with tap, wound with $171 / 2 \mathrm{~T} \# 24$ en., tapped at 5T, ESSCO. L2- 8 turns No. 16 tinned bare wire, 7/16" ID, 13/16" L. L3-2 turns insulated solid hookup wire, $7 / 16^{\prime \prime}$ ID. L4 $-81 / 2$ turns No. 16 tinned bare wire, $1 / 2^{\prime \prime}$ ID, $1^{\prime \prime}$ L., tapped at 2 turns. L5- 7 turns insulated wire, $1 / 2^{\prime \prime}$ ID, close wound. SW1-3 position, double pole rotary switch, non-shorting. SW2-SPST toggle switch. 1 suitable antenna. Decals for front panel, Techni-Cal set \#108.

Note: Suitable low resistance replacement chokes for the one that comes in the $\mathrm{PE}-157$ are Stancor $\mathrm{C}-2327$ (preferred, since it is the smallest), Stancor C-2304, Merit C-2994. Heavy-duty aircraft type SPST toggle switch is available from Electronic Specialty Supply Co. 2 volt power supplies-if you don't have a PE-157 or Mac II-may be had from Gyro Electronics Co. and Electronic Spec. Supply Co.

