PACKAGED
VHF EXCITERS

SINGLE CHANNEL
28 OR 50 MEGACYCLES, 3 WATTS

FOUR CHANNELS
144 MEGACYCLES, 6 WATTS

28 OR 50 MEGACYCLES, 3 WATTS

The old saying, "Good things come in small packages," was the watchword in designing these simple, compact exciters for 28-, 50- and 144-megacycle amateur transmitters. Try the circuits—and utilized construction ideas—in your next transmitter for one or more of these bands.

—Lighthouse Larry

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PACKAGED VHF EXCITERS

It's smart to build new equipment for your amateur station in small units for improved flexibility, shielding, and ease of making modifications. This concept is demonstrated in packaged units for transmitters operating in the 28-, 56- and 144-megacycle amateur bands. The circuits are designed for output levels of about 3 watts, and the 144-megacycle exciter about 6 watts of output power. This power is sufficient to drive most potentiometer Class C power amplifiers in the 100-watt power class: or, for certain amplifier tubes capable of handling several hundred watts input.

CIRCUIT DETAILS

The basic single-channel exciter unit for the 28- and 50-megacycle bands, as shown in the main schematic diagram, Fig. 1, has three stages, but only two tubes. All stages are biased for Class C operation. The triode section of a 6J3A r-f triode is an oscillator for crystals in the 6- to 9-megacycle frequency range. TABLE 1 lists the choice of crystal frequencies for each band, and the frequencies to which the resonant circuits in each stage are tuned for output on the 28-, 50-, and 144-megacycle bands.

There may be a few eyebrows raised over our selection of a fundamental frequency type crystal oscillator instead of an overtone circuit, naturally since the recent trend has been to operate the oscillator at high in frequency as possible. However, the fundamental type oscillator, operated at low power level, assures the excellent frequency stability necessary for double sideband and both suppressed carrier transmitters—and even for CW operation, without the "chips" and "yoops" which readily identify so many VHF transmitters using overtone type oscillator circuits.

Some amateurs may prefer the convenience of a multi-channel type oscillator, rather than having to plug in a different crystal for each operating frequency. This is made possible by the four-channel oscillator circuit shown in Fig. 9. This may be of interest to amateurs who desire to utilize several frequencies, for instance, 7, 14, 21, and 28 megacycles. As shown in Fig. 7, the output from the 2JE4 is divided to operate the four separate Class C linear amplifiers.

The PE bullet section of the 568 tube presents the basic crystal oscillator circuit which is the fundamental frequency type, utilizing a specific band of crystals for a specific band, as listed in TABLE 1, with a separate plate circuit for each band. Table 2 lists the choice of crystals for the 568 oscillator for each band. All crystals for a specific band are within a fraction of a megacycle of each other. table 2. Thus, 3,530 to 3,530 or 9,900 megacycles for a 50-megacycle exciter—only a single crystal is needed for each band. Crystals are placed in plate circuits for each band. Any crystal may be placed in the plate circuit for any band. The basic pattern of the crystal oscillator is shown in Fig. 10, which shows the basic pattern of the crystal oscillator circuit. The tuning through the plate circuit is accomplished by adjusting the trimmer capacitor. The plate voltage is adjustable by the trimmer capacitor, and all tubes have been brought out to separate connections on the panel, so that this circuit can be used as a separate power source, for example, for a graphite relay, for example, for CW operation.

MECHANICAL DETAILS

Suites were prepared as a completely finished chassis for the VHF exciters, since they provide nearly complete shielding for the various components. The 4 x 5 x 6-inch Minibet has adequate space for the various components for the 28-, 50- and 144-megacycle bands. All components are mounted on the back of the Minibet which forms a frame for the tubes, as shown in the drawing diagram, Fig. 5.

TABLE 1—OPERATING FREQUENCY CHART

<table>
<thead>
<tr>
<th>OUTPUT BAND</th>
<th>CRYSTAL AND Ll—C1</th>
<th>2ND STAGE L2—C2</th>
<th>3RD STAGE L3—C3</th>
<th>4TH STAGE L4—C4</th>
<th>5TH STAGE L5—C5</th>
<th>6TH STAGE L6—C6</th>
</tr>
</thead>
<tbody>
<tr>
<td>28 MC.</td>
<td>7.00—7.435 MC.</td>
<td>14.0—14.850 MC.</td>
<td>28.0—39.70 MC.</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>50 MC.</td>
<td>6.25—6.75 MC.</td>
<td>21.0—27.2 MC.</td>
<td>50.0—54.0 MC.</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>50 MC.</td>
<td>8.334—9.0 MC.</td>
<td>21.0—27.2 MC.</td>
<td>50.0—54.0 MC.</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>144 MC.</td>
<td>6.00—6.166 MC.</td>
<td>24.0—24.666 MC.</td>
<td>48.0—49.333 MC.</td>
<td>144.0—146.0 MC.</td>
<td>144.0—146.0 MC.</td>
<td>144.0—146.0 MC.</td>
</tr>
<tr>
<td>144 MC.</td>
<td>8.00—8.222 MC.</td>
<td>24.0—24.666 MC.</td>
<td>48.0—49.333 MC.</td>
<td>144.0—146.0 MC.</td>
<td>144.0—146.0 MC.</td>
<td>144.0—146.0 MC.</td>
</tr>
</tbody>
</table>
Fig. 5. Top and bottom view photographs of the exciter for 28 and 50 megacycles. Left—the single channel exciter. Right—the four-channel exciter. On both models the 1-inch diameter socket hole for the power connecter, L, was punched 1/16 inches down from the chassis deck, and 3 inches in from the exciter end of the chassis.
A similar parts layout was followed for both the single- and four-channel exciters; the principal difference being that the tube socket locations were shifted slightly on the four-channel exciter to allow more room for the crystal sockets and oscillator plate circuit coils, L4 to L6. Comparison of the top and bottom view photographs of the exciters, Fig. 6, will show that the four-channel exciter appears more complex than it actually is, largely due to the use of a two-wafer tap switch for R8.

Boats were provided for the machine screw bolts that secure the crystal sockets for the crystals in place; this allows the sockets to be replaced if necessary. The crystal sockets themselves mount on a set of tapped holes having 0.094-inch diameter pins spaced 0.48 of an inch. Four identical crystal sockets may be substituted, particularly if crystal sockets having 0.030-inch diameter pins will be employed, by drilling the chassis differently.

The RF output connector, J1, was mounted on the chassis deck, above L6, in the single-channel exciter. This permitted the link coil, L5, to be suspended from the lugs on J1. In the four-channel exciter, J1 was located on the rear of the chassis. A single length of insulated hookup wire was wound around L5 to form L6, and the excess wire was twisted and run back to J1. The power connector, J2, also mounts on the rear of the chassis in the location shown in the bottom view. A larger Minibay, 3 x 7 x 3 inches in size, provides the additional space required for the push-pull 6CL6 tripler stage in the 164-megacycle exciter model. The parts layout for the first three stages, as shown in the drilling diagram for the four-stage rectifier, Fig. 7, is essentially similar to the four-channel, three-stage exciter previously described. The bottom view photograph shows that somewhat more space is available for the oscillator plate coils on the 5-inch-wide chassis. In this model, a separate socket for the 6CL6 tripler is used.

Sockets for the 6CL6 tubes and other components in the triple stages were intentionally permitted very short connections. The coils in the bandpass coupled, L1, and L2, mounted on a small single bracket, marked "A," instead of being fastened to the front wall of the chassis. Another single bracket, marked "B," supports the plate tuning capacitor, C2. The dimensions and drilling details for both brackets are shown in Fig. 8.

Shafts which extend these three tuning adjustments out through the front panel were made from 1/4-inch diameter brass rod. Drill and tap a hole for a 1/4-inch machine screw in one end of the 1 1/2-inch long shafts for L1 and L2, and saw a slot for a screw on the other end. After the coils have been mounted, first assemble a 4-40 nut on the slugway end, then install the extension shaft onto this screw about six turns and tighten the lock nut against the end of the shaft. This shaft may be run through a 1/4-inch diameter hole in the chassis, or through a panel bearing, as illustrated. Since C1 has a 1/8-inch diameter shaft, a special extension shaft was necessary for drilling a 1/8-inch diameter hole through a 1/8-inch length of brass rod 1/2 inch in diameter. Then, about one-sixth of the rod is enlarged to 1/8 inch in diameter, and a 1/8-inch length of 1/16-inch diameter brass rod is soldered to the 1/8-inch diameter end, as shown in the bottom view. This extension shaft should be run through a 1/8-inch diameter hole in the chassis, or panel bearing, before C1 and its mounting bracket is installed.

The tie points which support the resistors and other small parts are located in the positions indicated in the drilling diagram for each exciter. Most resistors are mounted on the main chassis which is fastened to the deck -- except for the resistors which they are connected. All disc ceramic by-pass capacitors and other small parts should be soldered to the printed circuit sheets if possible; those which bypass the screen grid tubes in the second, third and fourth stages should be connected between the screen grid and cathode logs on the tube sockets. All grid and plate leads are No. 16 tinned copper wire, also as short as possible. Power leads are insulated No. 10 stranded hookup wire, run close to the chassis wherever possible to reduce RF pickup. Most other constructional details should be apparent after studying the illustrations.

FIG. 7. Drilling diagram for the 3 x 7 x 3-inch Minibay in which the four-channel exciter for the 164-megacycle band was constructed. Brackets "A" and "B" are located in the positions shown with the vertical portions of both brackets away from the chassis front wall. Solderable chassis boxes are.

FIG. 8. Detail drawing of the angle brackets used to secure the following components in the 164-megacycle exciter:

- "A"--coils L1 and L2 and "B"--capacitor C2. Holes on the angle brackets should be marked for location from these brackets.

OPÉRATION

To make the type-up process more meaningful, we'll assume that a four-channel, 50-megacycle exciter is being adjusted for broadband operation between 50 and 51 megacycles (crystal frequencies between 8.334 and 8.508 megacycles). Two crystals, one each at ap-
proximately 0.33 and 0.45 megacycles (exciter output frequencies of 10.25 and 14.45 megacycles, respectively) should be plugged into positions “A” and “B” in the crystal sockets.

After the usual final wiring check, plug in the 6518 oscillator tube and apply heater power. If the tube heater lights properly, plug in 6.5–1 milliamperes into the exciter supply, and turn the switch, S2, to position “A” (6.65-megacycle crystal); the meter, C1, to 6–14.5 megacycles. Figure 9 illustrates the complete circuit. If the oscillator fails to light, change the voltage to the exciter. Turn the tuning dial in J12 through its complete range, starting around 0.3 milliamperes of grid current in the second stage should be measured on 0–4–1 milliamperes. Adjust the grid so that the oscillator starts immediately on the plate voltage is applied.

Next, plug in the 6CL6 doubler tube, turn S2 to position “B” (8.55-megacycle crystal), set S4 on positive “B,” and turn the slug in L4 for maximum grid current—about 1.3 milliamperes—in the 6CL6 stage. Connect a suitable dummy load to J6, reset to position “A,” and turn the slug in L6 for maximum output. A Res. 40 or 47 resistor, soldered with short leads to a midget phone plug, is a nicely dummy load for test purposes. The pilot lamp should light to full brilliance if the oscillator is delivering adequate power output.

The exciter should now be capable of delivering nearly constant power output over the range of 59 to 31 megacycles. Finally, adjust the slug in L6c and L6d for maximum grid current with B4 in position “A,” with crystals plugged between the remaining two crystal sockets.

When the 6518 exciter is coupled to the grid circuit of a switching Class C power amplifier stage through a short length of coaxial cable plugged into J4, the exciter circuit is again be checked in the same manner. Maximum grid current is read in the power tank circuit to be tuned for maximum grid current with the exciter driving it at 10.5-megacycle grid current

When tuning up the 144-megacycle exciter, switch position “C” is in use to meter the grid current in the second stage when adjusting the oscillator coil L4; position “D” readies the 6CL6 doubler grid current; and position “E” meters the grid current in the push-pull 6CL6 tripler stage. The procedure outlined for tuning L4 and L6 in the 10- to 14-megacycle exciter is again followed: thus the meter is switched to position “D” and L6g is tuned for maximum grid current at a frequency of 11.5 megacycles (crystal, 8.65 megacycles). The grid L6g, L6 is tuned for maximum grid current at a frequency of 14.9 megacycles (crystal, 11.13 megacycles). This final adjustment results in little variation in grid current in the tripler stage over the range of 49.2 to 49.3 megacycles.

The tripler plate circuit tuning capacitors, C5, may be tuned to 144.1 megacycles if modulating will take place in the 144- to 145-megacycle range. However, if the entire power output of the exciter is required to drive a succeeding power amplifier, C5 probably will have to be retuned each time a shift in operating frequency greater than 200 kilocycles is made.

Any of the popular twin-tube pentode power tubes designed for operation in the VHF spectrum—815, 829B, 848—are available at 516.5 megacycles to push-pull circuits, many excellent power amplifiers to follow these exciters. Circuits and construction ideas for amplifiers using these tubes may be found in the lit published below.

829B and 848:

![](image-url)
Looking for still other VHF exciter construction ideas! Here's how the designer of the potted tube exciter, K2DBS, has combined two exciters on a single flat metal plate for his own VHF station. The schematic (fig. 4) shows how the exciters and a Miller No. 90381 high frequency power amplifier unit, share an 8 1/2 x 11-inch relay rack panel.

Both exciters have single channel oscillator circuits; the three-stage exciter for 28 and 50 megacycles occupies the lower portion of the plate, and the 144-megacycle four-stage exciter runs up the right side, ind across the top. A 4350 tube and plate tube was used in the 144-megacycle tripler, instead of the two 6550 tubes shown in Fig. 3.

The underchassis view (fig. 4) shows the constructional details and principal differences between this exciter and the potted exciters built in Michigan (fig. 6 and 9). A better terminal strip for the 120-step decade decade was used for connections, transfer power from one exciter to the other (50 in 914), and insulated phone jack leads (L, J, and J, instead of A, in Fig. 7) for plugging in 1/4 inch test meter to measure the grid current in each stage.

If you want further details on this moded send a postage card to me, and I'll send a full-size chassis drilling diagram, any schematic showing the exact circuit used, to you.

-Lighthouse Barry