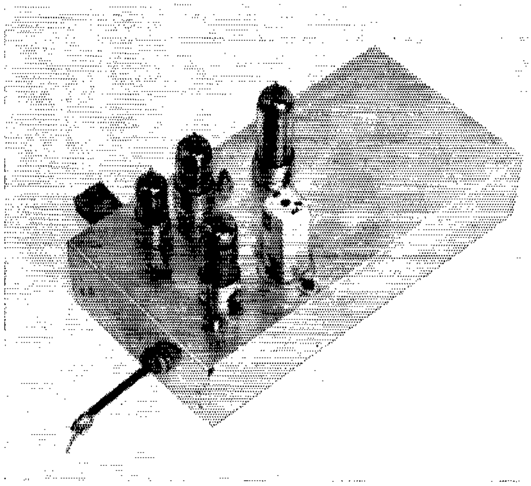
# A Simple S.S.B. Exciter for 7 Mc.



The mixer/amplifier chassis. At the rear, from left to right, are the conversion crystal, 6J6A, 6U8A, 6CL6, with the slugs of $L_3$ and $L_4$ on either side of the 6U8A. In front are $L_2$, the 6BA7, and $T_2$. The space at the right-hand end of the chassis may be used for the 6BQ5 output stage.

## *Step-by-Step Construction for a Filter-Type Unit*

BY CHARLES M. FULLINWIDER,* KØKVD

In looking over literature on commercial s.s.b. equipment, I couldn't find anything that would fit my needs at the price I wanted to pay. However, fellow hams were not encouraging about building single-sideband gear. "It's too complicated and expensive; the days of home-built transmitters are over," they said. But I went ahead anyway, with the hope that even if the signal quality was not the best, perhaps I could get by with it for a while. As it turned out, results were most gratifying. The generator works well (. . . "sounds like commercial equipment"), and was inexpensive to build with the use of old TV parts. It can be aligned without difficulty with simple equipment — a general-coverage receiver, a v.t.v.m., a pair of headphones, and a 7-Mc. novice crystal.

To keep the initial construction as simple as possible, I decided to stick to one band — 40 meters. However, I made provision for future expansion to other bands by splitting the exciter into two chassis units — one for a 9-Mc. s.s.b. generator, and the other for a mixer/amplifier system. The v.f.o. was also built as a separate unit. Its output (5.0 to 5.5 Mc.) is fed by coaxial cable to the mixer/amplifier chassis.

### *Circuits*

Fig. 1 shows the circuit of the 9-Mc. sideband generator. A 6C4 is used in the carrier oscillator, which has provision for switching the carrier to

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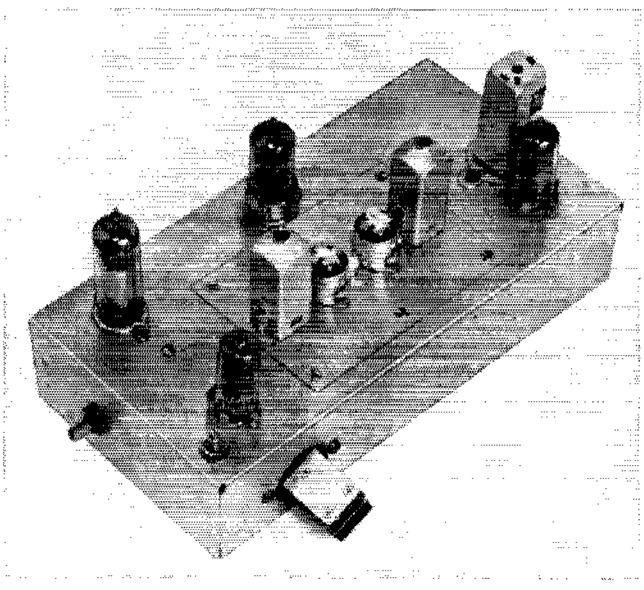


The sideband-generator chassis. The crystal-filter unit is set in a cut-out at the center. The carrier crystals plug into the octal socket in the foreground. The 6C4 (front) and the 7360 are at the left-hand end of the chassis. The 12AX7 is behind the filter unit, and the 6BA6 with its output transformer at the right-hand end. The adjusting screw of the tubular ceramic trimmer used for $C_3$ is between the 6C4 and the 7360.

either side of the passband of the sideband filter, depending upon whether upper- or lower-sideband transmission is desired. The audio signal is provided by a two-stage amplifier employing the two triode sections of a 12AX7. The carrier is suppressed in the 7360 balanced modulator. (This circuit is one recommended by the manufacturer of the sideband filter.) The 9-Mc. d.s.b. signal is fed to the crystal filter, $FL_1$, which filters out the undesired sideband, and feeds the desired sideband signal to the 6BA6 amplifier.

The circuits of the frequency-conversion and signal-amplifier stages are shown in Fig. 2. The 9-Mc. s.s.b. signal is fed to the triode section of a 6U8A where it is combined with a 5- to 5.5-Mc. v.f.o. signal. The difference frequency of 4 to 3.5 Mc. is selected in the output of the 6U8A mixer, and amplified in the pentode section of the same tube. The amplified 4- to 3.5-Mc. signal is then fed to the No. 3 grid of the 6BA7 mixer, while the signal from the 6J6A (only one triode section used) 11-Mc. crystal oscillator is fed to the No. 1 grid. The difference frequency of 7 to 7.5 Mc. is selected by $T_2$ in the output circuit of the 6BA7. The 7-Mc. s.s.b. signal is amplified in the 6CL6 stage before feeding it to the 6BQ5 r.f. output stage.

> ***Although the s.s.b. exciter described here is designed primarily for 40-meter operation, it can quite readily be adapted to other bands by simply providing a suitable conversion crystal and tuned circuits.***

The high-$C$ Colpitts v.f.o. circuit is shown in Fig. 3. To reduce frequency drift, the tuned-circuit components (shown enclosed in dashed lines) were mounted in an aluminum box, with the shaft of $C_1$ protruding from one side. The box was then installed at one end of a cabinet that formerly housed a tuning unit from a surplus

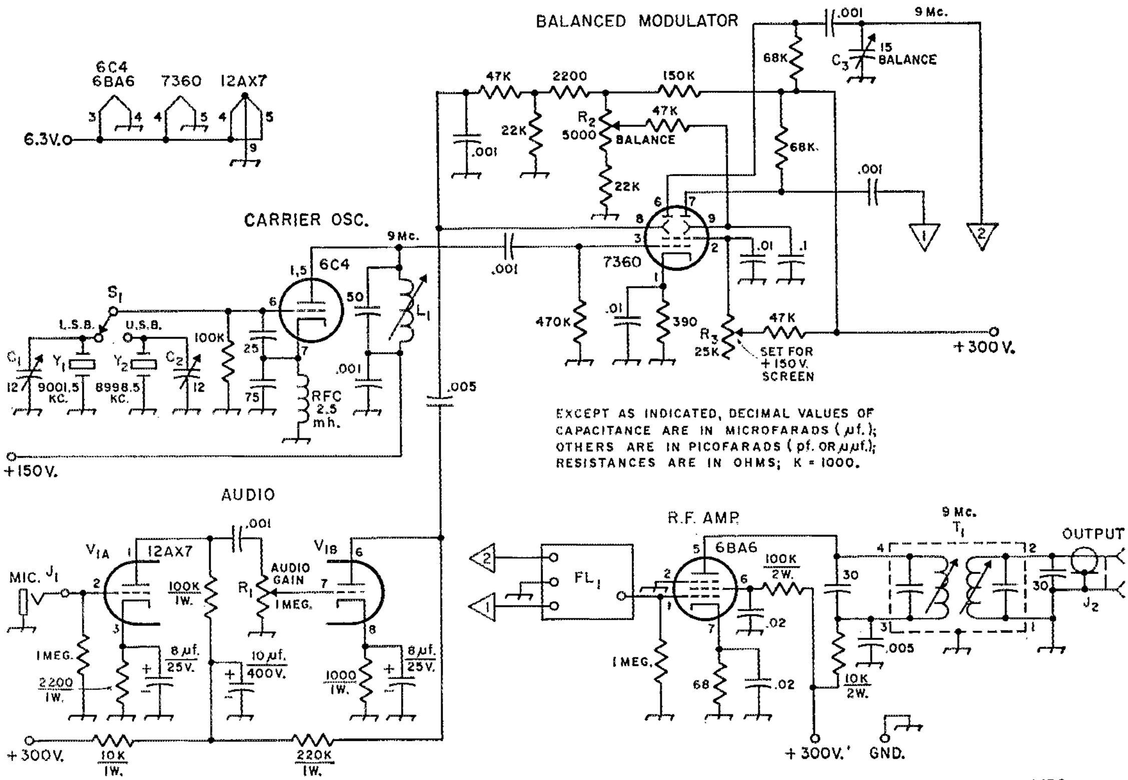



Fig. 1—Circuit of the s.s.b. generator. Fixed capacitors of decimal value are disk ceramic; others are mica or NPO ceramic, except where polarity symbols indicate electrolytic. Resistors are ½-watt, unless indicated otherwise. All r.f. chokes have a 50-ma. current rating.

$C_1$, $C_2$—3-12-pf. ceramic trimmer.
$C_3$—Ceramic or air trimmer.
$FL_1$—9-Mc. crystal sideband filter (International Crystal ACF-4).
$J_1$—Microphone jack.
$J_2$—Chassis-mounting coaxial receptacle.
$L_1$—26 turns No. 30 enameled wire, ⅜-inch iron-slug form. (Miller 4400, or equivalent, form).
$R_1$—Audio-taper control.
$R_2$, $R_3$—Linear-taper control.
$S_1$—Single-pole two-position ceramic rotary switch.
$T_1$—10.7-Mc. i.f. transformer, loaded with external capacitance as indicated (Miller 1463).
$Y_1$—9001.5-kc. crystal (International Crystal CY-6-9LO).
$Y_2$—8998.5-kc. crystal (International Crystal CY-6-9HI).

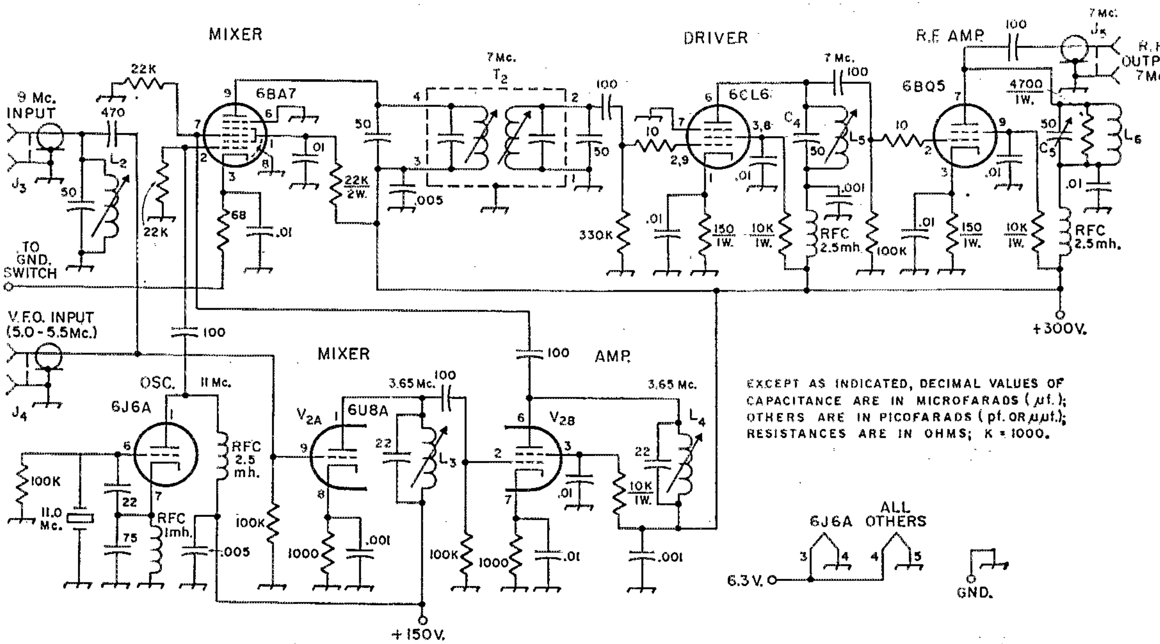



Fig. 2—Circuit of the mixer/amplifier section. Fixed capacitors of decimal value are disk ceramic; others are mica or NPO ceramic. Resistors are ½-watt unless indicated otherwise. R.f. chokes have a 50-ma. current rating.

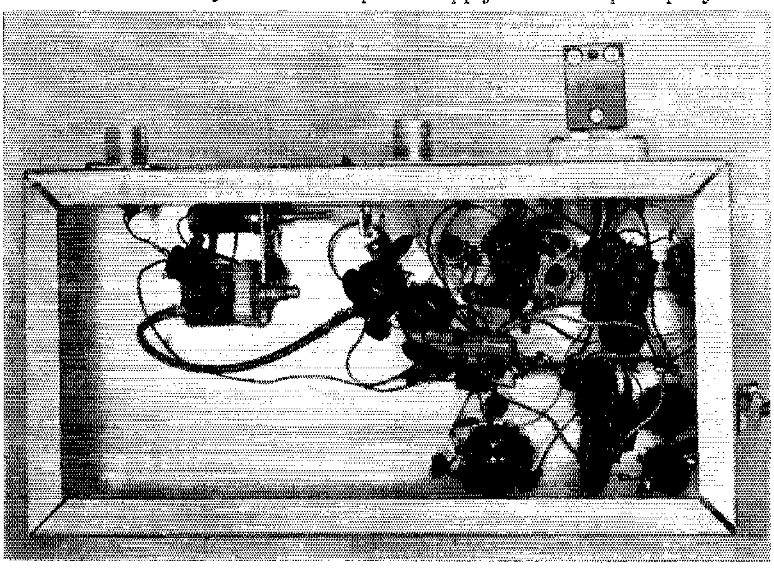
$C_4$—Silver mica.
$C_5$—Air trimmer.
$J_3$, $J_4$, $J_5$—Same as $J_2$, Fig. 1.
$L_2$—Same as $L_1$, Fig. 1.
$L_3$, $L_4$—66 turns No. 30 enameled wire, scramble-wound.
$L_5$—22 turns No. 24 enameled.
Above coils are wound on ⅜-inch iron-slug forms (Mille 4400 or equivalent).
$L_6$—22 turns No. 20, 1-inch diam., 16 turns per inch (B & W 3015 Miniductor, or Illumitronics 816 AirDux).
$T_2$—Same as $T_1$, Fig. 1.

BC-375E transmitter. The tube and remaining components were assembled at the other end of the cabinet. The tuned circuit was then connected to the tube through lengths of RG-58/U, as indicated in the diagram.

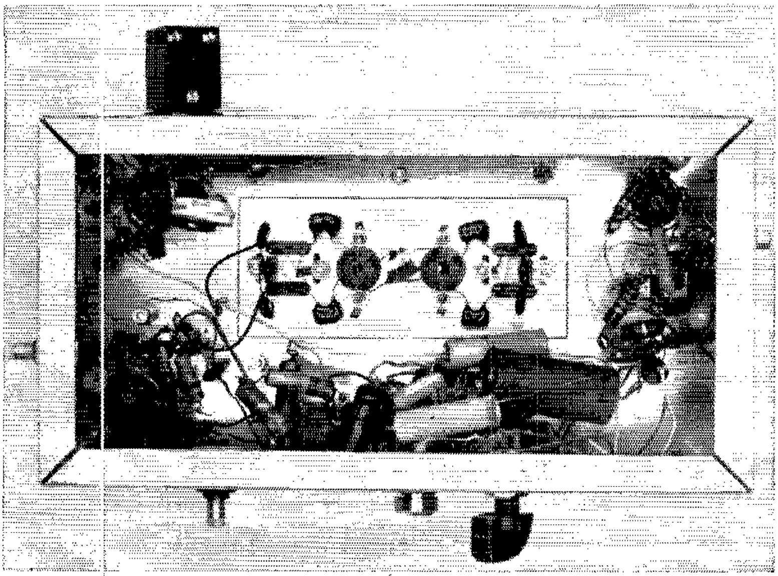
This arrangement follows the principle of the remotely-tuned v.f.o., several versions of which have been described in earlier issues of *QST*. If desired, the 6AU6 could be mounted on the mixer/amplifier chassis, with the tuned circuit in a separate box at the operating position. The lengths of the coax sections should be held to a minimum, however.

### *Power Supply*

The power supply was built principally from



Bottom view of the mixer/amplifier unit. Along the top edge are output connector, v.f.o.-input connector and the conversion crystal. The sideband generator feeds in at the right. Inside the chassis, at upper left, are the components of the 6CL6 output circuit.



**Bottom view of the generator chassis. The control ($R_3$) at the left-hand end of the chassis is for setting the screen voltage of the 7360. Along the bottom edge, from left to right, are the carrier balance control, microphone connector, and audio gain control.**

old TV components. The circuit is shown in Fig. 4. Regulated 150 volts is provided for the v.f.o., unregulated 150 volts for the crystal oscillators, and 300 to 350 volts for the remaining stages.

### *Construction and Adjustment*

The two main sections were constructed on identical chassis, each measuring 9½ by 2 inches. Sufficient detail of the component layouts is shown in the photographs. After the components had been mounted, and the heater wiring installed, stages were wired serially, checking each stage before proceeding to the next. Following this procedure makes it relatively easy to diagnose any trouble that may develop. Most of the checking was done with a vacuum-tube voltmeter fitted with the simple r.f. probe shown in Fig. 5.

The audio stages were wired first. This section was checked by connecting a pair of headphones between the output plate and ground through a blocking capacitor. When speaking into the microphone, speech should be heard in the headphones.

After the 6C4 carrier oscillator was wired, the 9001.5-kc. crystal was switched in and $L_1$ was adjusted for maximum deflection on the v.t.v.m. connected from plate to ground.

The 7360 balanced modulator was wired up next. $C_3$ was left disconnected temporarily. Upon speaking into the microphone, the v.t.v.m. indicated r.f. at both plates of the 7360.

After connecting $C_3$ into the circuit, the wiring of the sideband filter and 6BA6 amplifier was completed. The crystal-filter unit includes input and output transformers, each having one slug adjustment. $C_3$ was set at maximum capacitance, and the filter input transformer was adjusted for maximum deflection on the v.t.v.m. connected across the output of this transformer.

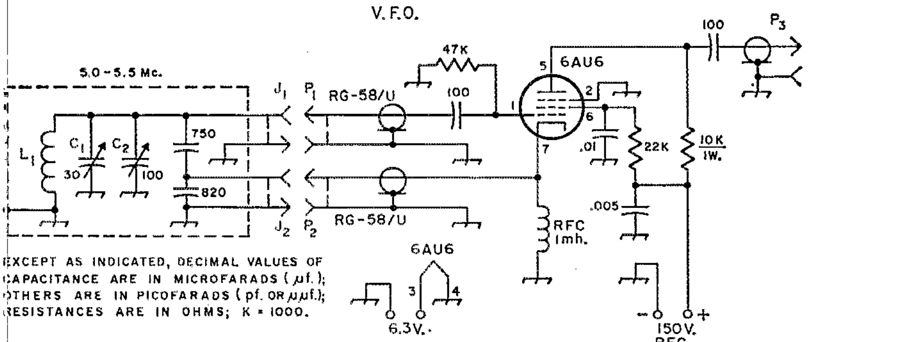



**Fig. 3—Circuit of the v.f.o. Fixed capacitors of decimal value are disk ceramic; others are silver mica. Resistors are ½-watt, unless indicated otherwise.**

$C_1$—Air-trimmer type variable.
$C_2$—Air trimmer.
$J_1$, $J_2$—Phono receptacle.
$L_1$—8¼ turns No. 18, 1-inch diam., 10 turns per inch (Illumitronics AirDux 810).
$P_1$, $P_2$—Phono plug.
$P_3$—Coaxial plug.

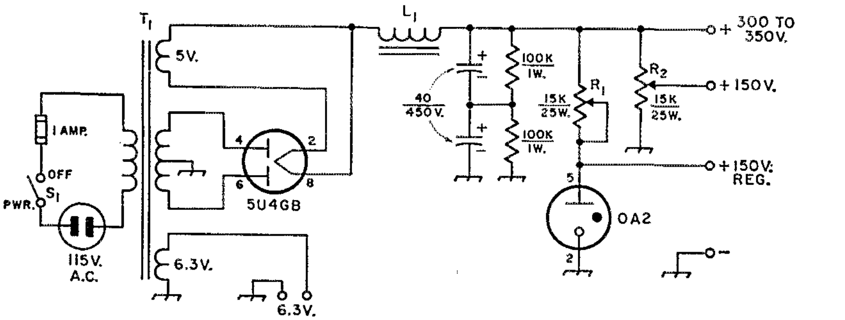



Fig. 4—Power-supply circuit. Capacitances are in µf.; resistances are in ohms. Capacitors are electrolytic.

$L_1$—Filter choke approx. 2 hys. (from TV chassis).

$R_1$—Slider adjustable. Adjust so that 0A2 stays ignited with load connected.

$R_2$—Slider adjustable. Adjust for 150 volts with load connected.

$S_1$—S.p.s.t. toggle switch.

$T_1$—Power transformer: 700 to 800 volts, r.m.s., c.t.; 200 ma; 6.3.volts, 3 amps. (from TV chassis).

The filter output transformer was peaked by coupling a signal from the carrier oscillator to the filter output transformer through a capacitor, and adjusting the second slug for maximum deflection with the v.t.v.m. connected from the filter output terminal to ground. The v.t.v.m. was then transferred to the terminals of $J_2$ while the slugs of $T_1$ were adjusted for maximum deflection, after which the coupling to the carrier oscillator was removed.

With the v.t.v.m. still connected across $J_2$, $C_1$ was adjusted for maximum deflection, and then readjusted for about one third of the maximum reading obtained. (The same procedure should be followed with $C_2$ and the 8998.5-kc. crystal switched in, if the unit is to be used on upper sideband.) $C_3$ and $R_2$ were then adjusted for *minimum* deflection. Speaking into the microphone then resulted in fluctuations of the v.t.v.m. needle, indicating a 9-Mc. s.s.b. signal.

### *Mixer/Amplifier Chassis*

Before starting the construction of the mixer/amplifier unit, the v.f.o. was built and adjusted to cover the desired frequency range (5 to 5.5 Mc.). The general-coverage receiver was used to check the frequency range.

Then the 6BA7 mixer and r.f.-amplifier stages[1] were wired. A 7-Mc. Novice-band crystal was plugged into the carrier oscillator, and the signal was coupled out to the No. 3 grid of the 6BA7 through a capacitor. In succession, the slugs of $T_2$ and $L_5$, and capacitor $C_5$, were adjusted for maximum v.t.v.m. deflection, with the meter connected across each output circuit in turn.

The 6J6A and 6U8A stages were wired as the last operation. When the wiring was complete, the 9-Mc. carrier oscillator was coupled to $J_3$ through a capacitor, while the slug of $L_2$ was adjusted for maximum indication on the v.t.v.m. connected across $L_2$.

Leaving the 9-Mc. oscillator coupled to $J_3$, the output of the 5-Mc. v.f.o. was connected to $J_4$. With the v.f.o. tuned to 5350 kc., the slugs of $L_3$ and $L_4$ were adjusted for maximum output at 3.65 Mc., with the v.t.v.m. connected across each in succession. The receiver helped to determine that $L_3$ and $L_4$ were peaking in the desired range.

Next (with the 9-Mc. signal still fed in at $J_3$), the 11-Mc. crystal was plugged into the conversion oscillator, and $L_2$, $L_3$, and $L_4$ were trimmed up for maximum 7-Mc. output with the v.t.v.m. connected across the output of $T_2$. The 9-Mc. oscillator coupling was then removed, and $J_2$ connected to $J_3$.

After connecting the linear amplifier and adjusting it for proper loading, final adjustment of $C_1$ and $C_2$ was made for best voice quality.

### *Control Circuit*

The transmit-receive control is a d.p.s.t. switch which, on transmit, grounds the cathode of the 6BA7 mixer, and applies voltage to the screens of the linear amplifier. For spotting frequency, a second switch is used which grounds the cathode of the mixer without applying screen voltage to the linear. With the microphone turned off, or the gain turned down, grounding of the mixer cathode provides sufficient carrier signal in the receiver to permit setting the output frequency. A third switch mutes the receiver and controls the antenna relay. These switches are mounted in a small Minibox near the operating position. The various functions could be combined in a single multiwafer switch if desired, of course. QST

[1] The 6BQ5 output stage does not appear in the photographs. This stage was added later when it was found necessary to obtain adequate drive for my 150-watt linear, which is patterned after the parallel-807 amplifier described by W5SQT in *QST* for February, 1963.

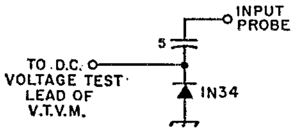



Fig. 5—Circuit of the r.f. probe mentioned in the text.