THE SIMPLE SIDEBANDER

COVER STORY

Suppressed-carrier transmitter uses few components

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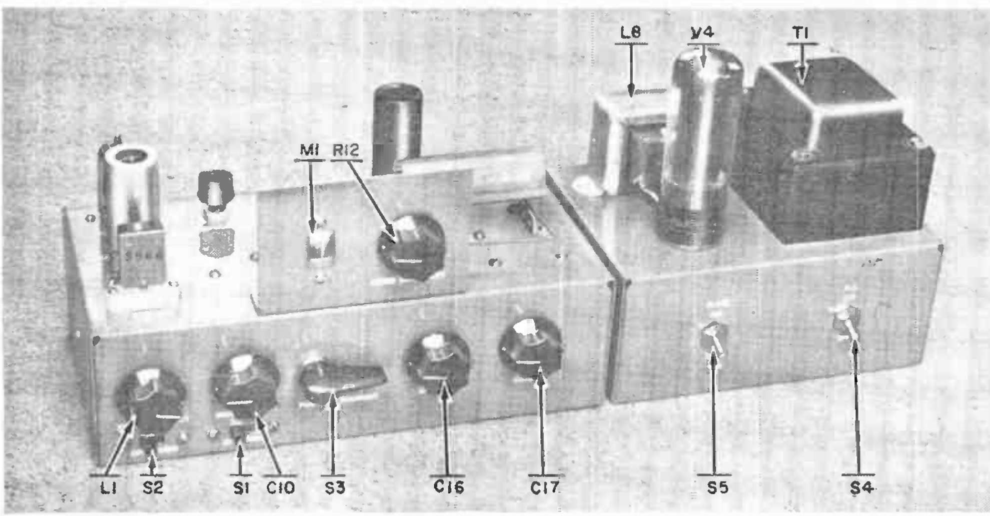
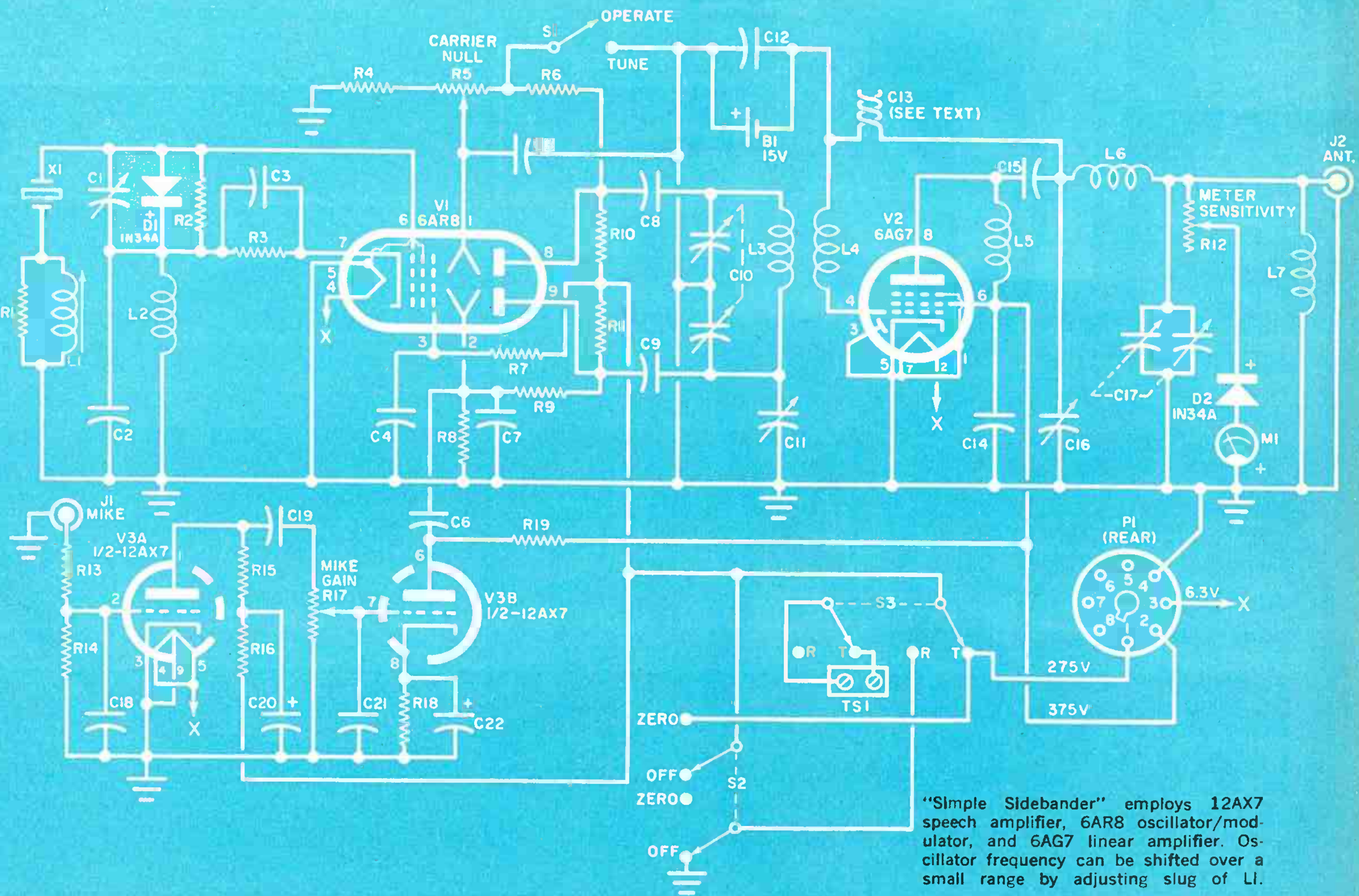
HERE'S a rig that proves you don't have to build complicated circuits or spend a great deal of cash in order to experiment with sideband transmission. Surprising as it may seem, the "Simple Sidebander" needs only three tubes to produce a 40- or 75-meter signal with "talk power" better than that of the average 25-watt AM phone transmitter.

How can this unit be so simple and inexpensive when the usual sideband rig is loaded with tubes and carries a purse-flattening price tag? The answer lies in the fact that it generates a *double-sideband* suppressed carrier signal.

The "double-sideband" signal occupies twice the spectrum space as the more common "single-sideband" signal and, on a selective ham receiver, is about half an "S"-unit weaker. With these minor exceptions, DSB and SSB are equivalent. Over the air, they sound almost identical, and receiver adjustment is the same for either mode of transmission. As a

Completed transmitter (left), with companion power supply, is a neat-looking rig.





"Simple Sidebander" employs 12AX7 speech amplifier, 6AR8 oscillator/modulator, and 6AG7 linear amplifier. Oscillator frequency can be shifted over a small range by adjusting slug of L1.

matter of fact, very few people contacted with the Simple Sidebander have noticed the extra sideband.

Construction. First prepare coils *L1*, *L3*, *L4*, and *L6*. These coils should be constructed for the specific band on which the transmitter is to operate (40 or 75 meters), and complete specifications will be found in the Parts List.

In building the transmitter proper, follow the parts layout illustrated in the photographs as closely as possible. Since the area around tubes *V1* and *V3* is rather crowded, wire as much of this portion of the transmitter as you can before installing either coil *L1* or capacitor *C10*.

Orient *V1*'s socket with pins 8 and 9 nearest *C10*. Put ground lugs under both mounting nuts and place a 1-lug terminal strip on the side wall of the chassis near the socket; it should be positioned about ¾" down from the chassis top. This tie point supports the junction of resistors *R7*, *R10*, and *R11* and the B-plus line. Be sure, incidentally, that you ground heater pin 5, rather than heater pin 4, on *V1*; pin 5 not only carries heater current, but is also internally connected to a shield and focus electrode.

Orient *V3*'s socket with pin 2 nearest jack *J1*, and put a ground lug under the mounting screw nearest potentiometer *R17*. A 4-lug (one grounded) terminal strip, mounted between terminal strip *TS1* and jack *J1* on the rear wall of the chassis, serves as a support for the capacitors and resistors associated with *V3*. Locate capacitor *C6* well away from *J1* in order to prevent feedback from the plate of *V3b* to the grid of *V3a*.

Fasten a 1-lug terminal strip under the crystal-socket mounting nut nearest *C10* and put a ground lug under the other nut. Use this terminal strip to make the junction between choke *L2*, capacitors *C1*, *C2*, and *C3*, diode *D1*, and resistors *R2* and *R3*. Connect the other end of choke *L2* to the ground lug, keeping the choke close to the chassis where it won't interfere with the later installation of *L1*. Support *C1* on 1½" leads so that it, too, will be positioned out of *L1*'s way.

Coil *L1* is mounted in a ⅜" hole drilled in the front panel. Push the coil through this hole until the ears spring out to hold it in place. Turn the coil adjusting screw

HOW IT WORKS

A conventional AM transmitter generates a carrier with two sidebands. Each of the sidebands is separated from the carrier frequency by an amount equal to the modulating frequency (or frequencies). Thus, a transmitter with a 4000-kc. carrier, when modulated by a 1-kc. tone, has a lower sideband at 3999 kc. and an upper sideband at 4001 kc.

But ordinary speech contains many frequencies and, when modulating an AM transmitter, creates "clusters" of signals separated from the carrier by varying amounts. These clusters, or sidebands, contain all of the intelligence we wish to transmit.

The carrier supplies no information, wastes two-thirds of the power generated by the transmitter, and causes severe heterodyne interference to signals on nearby channels. If the carrier is suppressed, however, heterodyne interference is eliminated and transmitter cost is cut.

In the "Simple Sidebander," a radio-frequency carrier is generated by *V1*'s cathode and control and accelerator grids, which are connected as a crystal-controlled Colpitts oscillator. Capacitor *C1* adjusts the drive voltage applied to the control grid. Diode *D1* prevents the grid from swinging positive, thus holding down accelerator current and improving modulation quality. The oscillator frequency can be shifted a maximum of approximately 1 kc. by adjusting coil *L1*'s slug.

A positive voltage applied to the plates of *V1* causes a beam of electrons, varying in intensity at the carrier frequency, to flow through the tube. When the d.c. voltages applied to *V1*'s deflectors (pins 1 and 2) are balanced by adjusting potentiometer *R5*, an equal amount of current flows through each plate. Since equal plate currents produce equal voltage drops across resistors *R10* and *R11*, the voltage difference between the plates is zero and the carrier is suppressed. Capacitor *C11* insures maximum carrier suppression by providing a means for balancing out stray capacities in *V1*'s plate circuit.

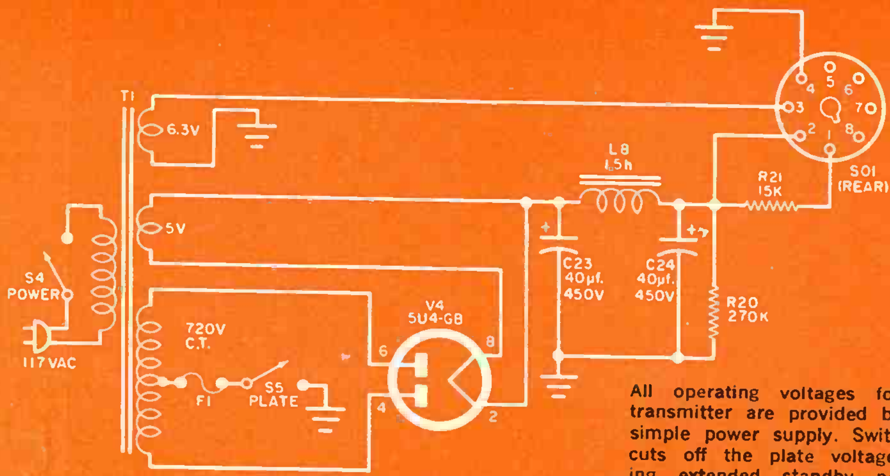
Since the carrier is required for tuning the transmitter, switch *S1* is provided. With this switch closed, the voltages on *V1*'s deflectors become unbalanced, allowing carrier energy to pass through.

A speech amplifier using tubes *V3a* and *V3b* applies an audio voltage, via capacitor *C6*, to one deflector of *V1*. This causes the d.c. voltage already on the deflector to vary at an audio rate, forcing the electron beam to swing back and forth between *V1*'s plates. The net effect is that upper and lower sidebands are produced, and appear at the plates of *V1*.

The sideband energy (minus the carrier) passes through capacitors *C8* and *C9* to tuned circuit *L3/C10*. Coil *L4*, inductively coupled to *L3*, transfers the sideband energy to the grid of tube *V2*. This tube is biased as a linear amplifier by battery *B1* and neutralized by capacitor *C13*. Greatly amplified, the sidebands appear at the plate of *V2* and are fed to antenna jack *J2* via pi-network tuning circuit *C16/L6/C17*.

Switch *S3* is the "Transmit-Receive" switch, controlling both the transmitter and any external relays connected at terminal strip *TS1*. Switch *S2* is provided for "zero beating"; in the "Zero" position, it activates tubes *V1* and *V3*, but leaves *V2* disabled. Meter *M1*, the sensitivity of which is controlled by potentiometer *R12*, serves as an r.f. output indicator.

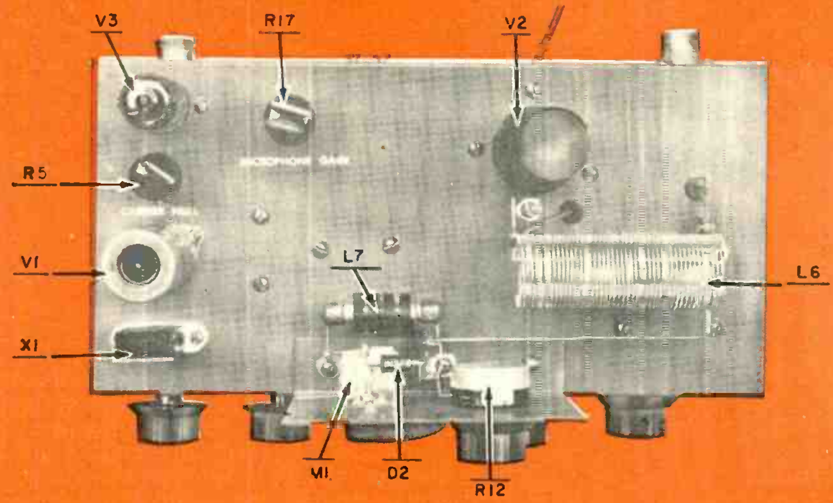
Operating voltages for the Simple Sidebander come from a separate power supply. The transmitter's power cable terminates in plug *P1*, which mates with socket *SO1* on the supply chassis. Switch *S4*, controlling the line voltage to transformer *T1*'s primary, is the main power switch. Switch *S5* is used to cut off the high voltage during extended standby periods.

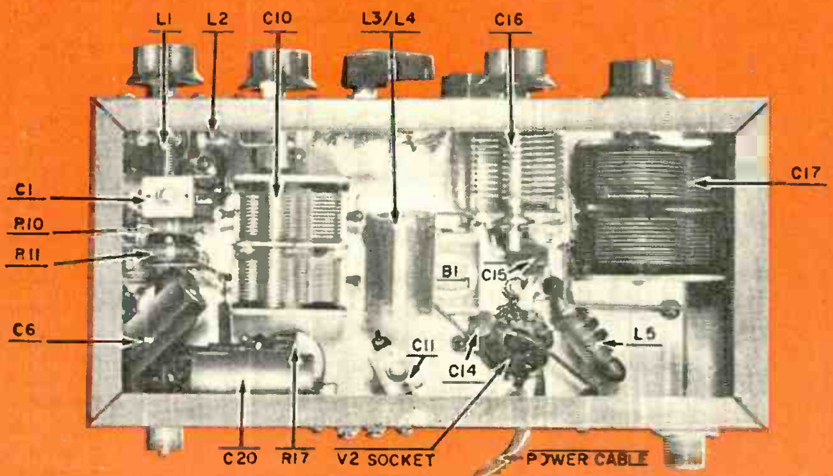


All operating voltages for the transmitter are provided by this simple power supply. Switch S5 cuts off the plate voltage during extended standby periods.

PARTS LIST FOR TRANSMITTER AND POWER SUPPLY

B1—15-volt battery (Burgess U10 or equivalent)
C1, C11—3-30 µµf. mica trimmer capacitor
C2, C21—150-µµf. mica capacitor
C3, C5, C15—0.01-µf., 1000-volt ceramic disc capacitor
C4, C7, C12, C19—0.001-µf., 1000-volt ceramic disc capacitor
C6—0.1-µf., 600-volt paper capacitor
C8, C9, C14—0.0047-µf., 1000-volt ceramic disc capacitor
C10, C17—2-gang variable capacitor, 467.8 µµf. per section (Allied Radio 61 H 059 or equivalent)
C13—Two 3½" lengths of insulated hookup wire twisted tightly together—see text
C16—140-µµf. variable capacitor (Bud 1856 or equivalent)
C18—100-µµf., 1000-volt ceramic disc capacitor
C20—12-µf., 450-volt electrolytic capacitor
C22—10-µf., 25-volt electrolytic capacitor
C23, C24—40-µf., 450-volt electrolytic capacitor
D1, D2—1N34A diode
F1—¼-ampere, 3AG fuse
J1—Chassis-type mike receptacle (Amphenol 75-PC1M or equivalent)
J2—Chassis-type coax receptacle (Amphenol 83-1R or equivalent)
*L1—*For 75 meters: *68 turns of #32 enameled wire close-wound on Superex C-3 coil form (Form available from Radio Shack Corp., 730 Commonwealth Ave., Boston 17, Mass.)*
For 40 meters: *25 turns of #32 enameled wire close-wound on Superex C-3 coil form*
L2, L5, L7—2.5-millihenry, 250-ma. r.f. choke (Millen 34103 or equivalent)
*L3—*For 75 meters: *34 turns of #24 tinned wire, ¾" in diameter, spaced 32 turns per inch (cut from B&W 3012 "Miniductor" stock)*
For 40 meters: *Same as above, but 22 turns*
*L4—*For 75 meters: *50 turns of #24 tinned wire, 1" in diameter, spaced 32 turns per inch (cut from B&W 3016 "Miniductor" stock)*
For 40 meters: *Same as above, but 34 turns*
*L6—*For 75 meters: *48 turns of #20 tinned wire, 1" in diameter, spaced 16 turns per inch (cut from B&W #3015 "Miniductor" stock)*
For 40 meters: *Same as above, but 24 turns*
L8—1.5-henry, 200-ma., filter choke (Stancor C2327 or equivalent)
M1—Miniature "AM-Tuning" type meter (Lafayette TM-12 or equivalent)
P1—Octal plug, cable type (Amphenol 86-PM8 or equivalent)
R1, R13—150,000-ohm, ½-watt resistor
R2—470,000-ohm, ½-watt resistor
R3—330-ohm, ½-watt resistor
R4, R8, R10, R11, R19—56,000-ohm, 1-watt resistor
R5—25,000-ohm potentiometer, linear taper
R6—100,000-ohm, 1-watt resistor
R7—33,000-ohm, ½-watt resistor
R9—120,000-ohm, 1-watt resistor
R12—100,000-ohm potentiometer, linear taper
R14—2.2-megohm, ½-watt resistor
R15, R16—75,000-ohm, ½-watt resistor
R17—500,000-ohm potentiometer, audio taper
R18—1000-ohm, ½-watt resistor
R20—270,000-ohm, 2-watt resistor
R21—15,000-ohm, 10-watt resistor
S1—S.p.s.t. slide switch
S2—D.p.d.t. slide switch
S3—D.p.d.t. spring-return switch (Centralab 1464 or equivalent)
S4, S5—S.p.s.t. toggle switch
SO1—Octal socket (Amphenol 78S8 or equivalent)
T1—Power transformer; primary, 117 volts; secondaries, 720 volts CT @ 120 ma., 5 volts @ 3 amperes, 6.3 volts @ 3.5 amperes (Stancor PM-8410 with center tap of 6.3-volt winding unused, or equivalent)
TS1—2-lug, screw-type terminal strip
V1—6AR8 tube
V2—6AG7 tube
V3—12AX7 tube
V4—5U4-GB tube
X1—Quartz transmitting crystal, ground for operating frequency
1—3" x 10" x 5" aluminum chassis for transmitter (Bud AC-404 or equivalent)
1—3" x 7" x 5" aluminum chassis for power supply (Bud AC-429 or equivalent)
2—Octal sockets for V2 and V4
1—9-pin miniature tube socket
1—9-pin miniature tube socket with 2⅜" shield
Misc.—Extension shaft for C10, crystal socket, ceramic or crystal mike, grommets, knobs, holder for F1, assorted terminal strips, etc.





Views of top and bottom of transmitter chassis (above) show locations of most of the major components. Photograph below illustrates placement of parts on the back panel.

as far counterclockwise as you can. Next, cut a piece of scrap brass volume control shafting to a length of exactly 3/8" and drill out its center with a 1/8" bit. The shafting is then pushed over the coil adjusting screw and sweat-soldered in place. A conventional knob can now be installed over the shafting. For smooth operation, lubricate the threads of the coil adjusting screw with heavy oil or grease.

Remove and discard the mica trimmers on the sides of capacitors *C10* and *C17* before installation. It's necessary to

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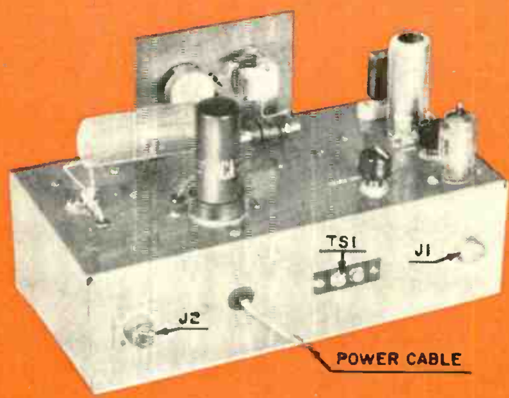

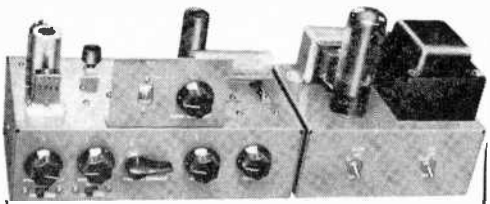

Simple Sidebander

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mount *C10* about 1⅓" back from the front panel, so this capacitor must be provided with an appropriate extension shaft.

A 2-terminal tie point located midway between *C10* and *C16* supports coil *L4*. Slip coil *L3* inside *L4*, being careful to prevent shorts between the turns of the two coils. After soldering 1¼" leads to battery *B1*, connect it between the *C12* end of *L4* and ground (positive lead grounded).

Mount *V2*'s socket with terminals 3 and 4 nearest the rear wall of the chassis. Install ground lugs close to terminals 1, 3, 5, and 7. Very short leads are used for the connections between the socket and the lugs. The power cable enters the chassis through a grommet-lined hole in the rear wall above the socket and terminates at a nearby 4-lug (one grounded) terminal strip.

A couple of 1-lug terminal strips support coil *L6* above the chassis. Leads to the coil pass through ¼" holes drilled near the terminal strips and lined with grommets. An "L"-shaped bracket, the front dimensions of which are 2¾" x 4", is fabricated from scrap aluminum to support meter *M1* and potentiometer *R12*. Choke *L7* is connected between a 1-lug terminal strip near *R12* and a ground lug fastened under one of the bracket mounting screws.

The construction of the Simple Sidebander's power supply is not critical and needs no special comment. Just follow the schematic diagram and use the photograph as a guide for the parts layout.

Adjustments. Meter *M1*, the r.f. output indicator, is the only instrument needed to make all tests and adjustments. When *R12*, the meter sensitivity control, is set at minimum resistance, even a slight amount of unsuppressed carrier will deflect *M1*'s needle. By increasing the resistance of *R12*, the sensitivity can be set at a point where the full transmitter output can be safely handled. From time to time during the tune-up process, you'll find it necessary to adjust *R12* in order to keep *M1*'s needle near mid-scale, the position where changes in output are most readily noted.

To ready the transmitter for testing, set *R12* and *R17* for minimum resistance and gain, respectively, set *C1* and *C11* for maximum capacitance, and turn *L1*'s adjustment control fully counterclockwise. Then switch *S1* to "Tune" and *S2* to "Off," and connect the coaxial feedline from a dipole antenna to *J2*.

Now turn on *S4* and, after a 1-minute warm-up, turn on *S5* and depress the push-to-transmit switch (*S3*). Holding *S3* down, tune *C10, C16,* and *C17* for maximum indication on *M1*. As the tuning progresses, you will undoubtedly have to increase the resistance of *R12* to prevent the meter needle from going off scale.

With *C10*, *C16*, and *C17* tuned, throw *S1* to the "Operate" position and, continuing to hold down *S3*, set *R5* for minimum carrier output (minimum deflection of *M1*). Then reduce the capacity of *C1* and again adjust *R5* for minimum deflection. Continue the process until *R5* can be set at a position where there is little or no reading on meter *M1*.

To achieve this degree of carrier suppression, you will probably have to reduce the capacity of *C1* to a point where the crystal just goes into oscillation whenever *S3* is pushed. A reduction in the capacity of *C11* may also help to cut down the amount of residual carrier. If you should discover that minimum carrier occurs when the arm of potentiometer *R5* is at the *R4* end, reduce *R4* to 33,000 ohms. If the minimum occurs at the *R6* end, increase *R4* to 82,000 ohms.

To check for correct neutralization of *V2*, leave *S1* and *S2* at their previous settings, remove both the crystal and antenna, and set *R12* at maximum sensitivity. With *S3* depressed, no combination of the settings of *C10*, *C16*, and *C17* should produce a reading on *M1*.

If *M1*'s needle moves off zero during

the test, change the capacity of *C13* by untwisting the wires a bit. Should this fail to help, replace the capacitor with one made from longer wires twisted together over a greater distance. Changing the position of *C13* relative to *C16* will also affect the neutralization.

During the above operations, play it safe! Disconnect the a.c. plug and discharge the filter capacitors before you make an underchassis adjustment.

Operation. You're ready to go on the air. Plug in the crystal, reconnect the antenna, connect a ceramic or crystal mike at *J1*, and wire any external receiver-muting or antenna-changeover relays to *TS1*.

As before, peak *C10*, *C16*, and *C17* for maximum output, and null the carrier with *R5*. Then, while whistling loudly into the mike, advance *R17* until maximum r.f. output is obtained. Next, set *R12* for a full-scale reading on *M1* and stop whistling. Finally, adjust *R17* to the point where *M1* "kicks" up to a maximum of half-scale as you speak in a normal tone.

Now call CQ or, if you hear someone near your frequency with whom you'd like to chat, set *S2* to "Zero" and zero-beat the desired station by adjusting *L1*.

While operated at the author's southern Michigan QTH, the Simple Sidebander provided many solid-copy 75-meter QSO's with stations in Wisconsin, Illinois, Indiana, Ohio, and Kentucky. Even though its output drops a bit on 40 meters, the unit does an excellent job locally and has produced a number of 1000-mile contacts. It can't be adapated for 20, 15, or 10 meters, however. -30-