A.M. For The Heathkit

SB-110 6-meter Transceiver

BY WILFRED M. SCHERER*, W2AEF

In our review of the Heathkit SB-110 6-meter s s b transceiver [1] mention was made that it could be used on a.m.; however, we neglected to point out that there are no built-in provisions for such operation. The equipment manual does not specify a.m. operation nor how it can be accomplished. As a consequence, many inquiries have been received on the matter, particularly since a.m. operation still is the predominant mode on the 50 mc band.

Our original method for providing a.m. type transmission using a single sideband with carrier (s.s.b.c.) was to unbalance the "balanced" modulator to provide the necessary carrier. This did not always work out, because the degree of available carrier was dependent on the proximity of the carrier-crystal frequency to the passband of the sideband filter. This was found to vary in some cases.

Besides this, received a.m. signals had to be demodulated with the product detector by zero-beating the a.m. carrier, but due to the fact that so many 6 meter a.m. signals drift, have low modulation or "fm" badly due to frequency instability with modulation, reception of such signals with the product detector was difficult. It thus became evident that envelope detection also should be provided for a.m. reception.

We therefore decided to work out a permanent modification whereby satisfactory a.m. type operation can be instantaneously obtained on both transmit and receive by switching from the panel, with the alterations made without "butchering" the equipment.

The modified circuitry is shown at fig. 1. At first glance it may appear complicated, but it actually is a simple arrangement that can be easily installed as described below.

References made to pictorial diagrams and their associated pages are those shown in the Heathkit SB-110 Assembly Manual.

*Technical Director, *CQ*.

[1] "*CQ* Reviews the Heathkit SB-110 6-meter S.S.B. Transceiver," *CQ* May '66, page 59.

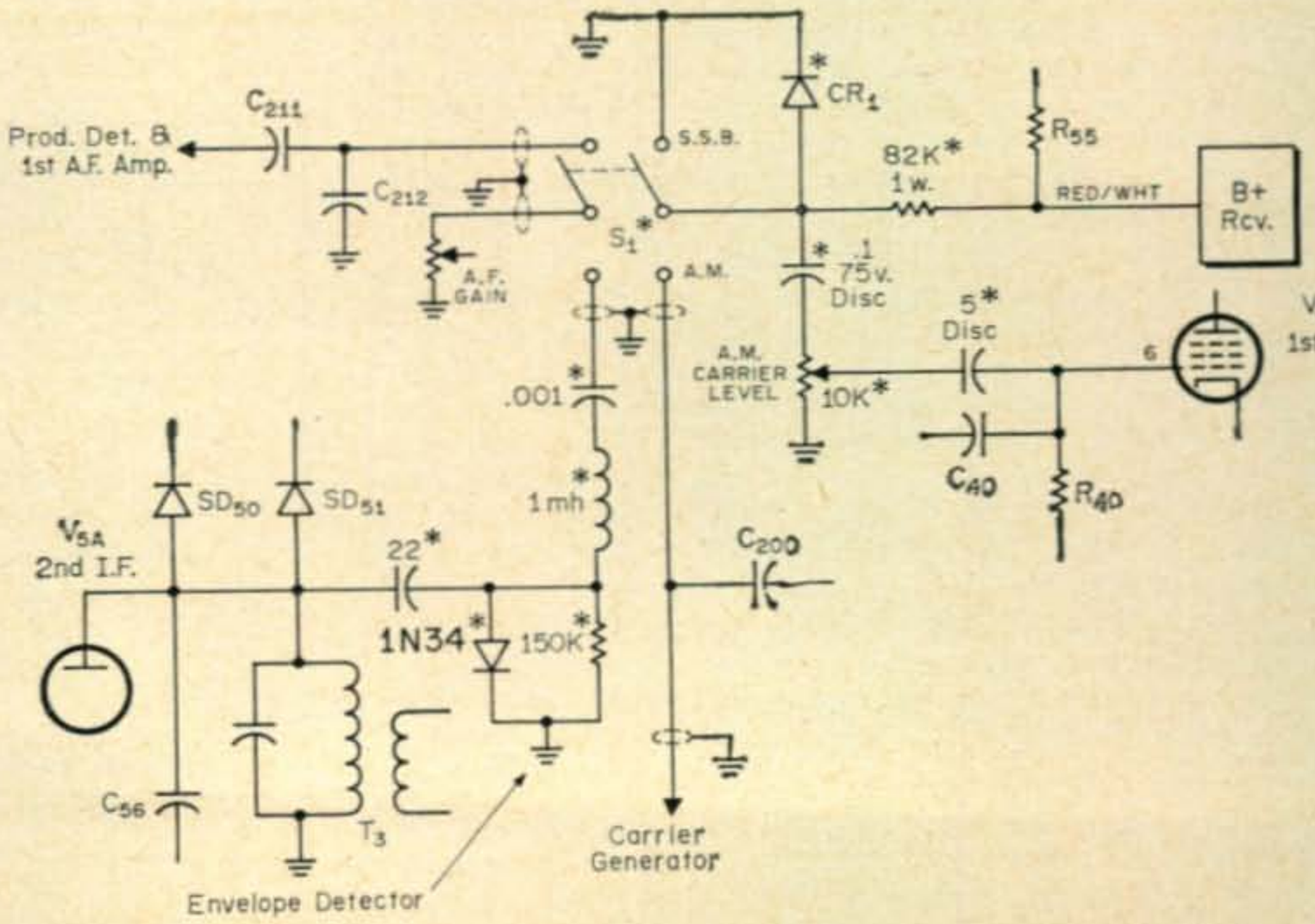


Fig. 1—Modified circuitry for a.m. transceive operation with the Heathkit SB-110. New parts are marked with an asterisk. The d.p.d.t. switch should be a slide type and one that operates easily and smoothly. CR_1 may be any type diode that has a very low forward resistance and a high back resistance (including silicon-rectifier types). The 1 mh r.f.c. is a miniature type, Millen 34300-1000 or J300-1000. Additional parts required are: approximately 5 feet of small diameter coax, two 4-terminal tie strips, one 2-terminal tie strip, one piece of aluminum 3" × 3½" × 1/16", one foot of #14 bussbar or wire from a coat hanger, one 7/16" diameter cone-shaped knob, Heathkit part No. 462-175.

In the first three steps, apply heat with a soldering iron at the indicated points on the bottom of the receiver i.f. board and push the designated lead so that it protrudes ⅛"-¼" above the top side of the board (additional insulation might have to be removed from each lead in order that it also will remain soldered to the board foil).

☐ 1. Pictorial 3-16, page 50—Point A, either red-white wire.

☐ 2. Pictorial 3-17, page 51—lead from 0.005 mf disc capacitor at point T.

☐ 3. Pictorial 3-24, page 58—inner lead from red coax cable at point 1 and its shield connection also.

☐ 4. Mount a two-terminal tie strip, TSB, as shown at fig. 2. Fasten it with the middle screw that holds the variable tuning capacitor that is located above the chassis. Do not connect leads to TSB at this time.

☐ 5. Solder components to a four-terminal tie strip, TSA, as shown at fig. 3. Do as much of the work as possible before mounting the tie strip. Do not install the 0.005 disc capacitor at terminal 1 until later, as indicated in step 19.

☐ 6. Mount tie strip TSA underneath the chassis using the screw and nut that fasten the i.f. board at the indicated point.

☐ 7. Solder the free end of the 22 mmf disc capacitor to point *X* at the base of the noise-limiter board. (See fig. 3 and pictorial diagram 1-8, page 12.)

☐ 8. Drill two holes for 6-32 screws (#26 drill) in the left side brace of the SB-110 as shown at fig. 4(A).

☐ 9. Bend and drill a bracket as shown at fig. 4(B).

☐ 10. With the bottom of the bracket resting on the edge of the top side of the i.f. board and held by hand against the SB-110 side brace (opposite T_2-V_3), mark the bracket to match the holes just drilled in the side brace. Then drill #26 holes at the points marked on the bracket.

☐ 11. Drill a 1/16" diameter hole crosswise through the lever of a d.p.d.t. slide switch.

☐ 12 Mount the slide switch, a 10K potentiometer and a four-terminal tie strip, TSC, on the bracket as shown at fig. 5.

☐ 13. Connect and solder components and leads as indicated at fig. 5. Solder the diode (*CR*1) in place last, making sure to connect the cathode end as shown.

☐ 14. Mount the bracket to the SB-110 side brace using 6-32 screws and nuts.

☐ 15. Route leads *C*, *D* and *E* along the top edge of the receiver i.f. board, under the meter and through the rubber grommet under the left dial lamp. The leads will be connected later.

☐ 16. Solder lead *B* to the protruding lead on top of the i.f. board at point *A*. (See step 1.)

☐ 17. Solder the inner conductor of lead *A* to the lead protruding on top of the i.f. board at 1. (See step 3.) Also, solder the shield of lead *A* to the protruding shield connection of the cable at 1.

☐ 18. Solder the free end of the 5 mmf disc

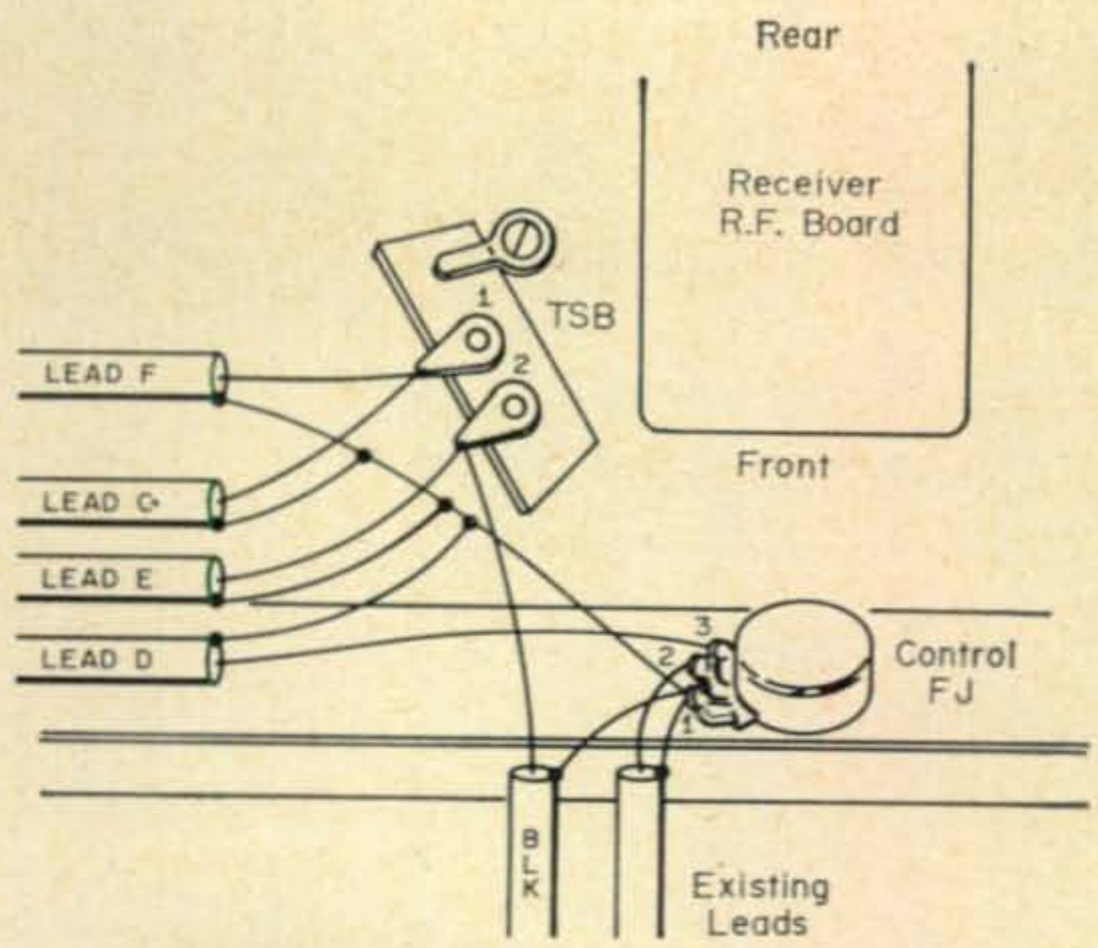


Fig. 2—A.f. shielded connections on tie strip TSB and control FJ. Dress lead F towards rear of rec. r.f. board.

capacitor to the lead of the 0.005 mf capacitor that protrudes above the board at point *T*. (See step 2.) Route the capacitor leads so that they easily clear the shield of V_3.

☐ 19. Pictorial 3-19, page 53—remove the 0.005 disc capacitor leads from the solder lug and terminal 3 at control FJ. Solder one lead of the capacitor to the underside of the i.f. board at point 2, as identified in Pictorial 3-24, page 58. Solder the other lead of the capacitor to terminal 1 on TSA as shown at fig. 3.

With steps 20-25 also refer to Fig. 2.

☐ 20. Pictorial 3-25, page 59—remove inner lead of the black coax cable from terminal 3 on control FJ and connect it to terminal 2 on TSB (NS).

☐ 21. Connect inner conductor of lead *F* (from terminal 4 of TSA) to terminal 1 on tie strip TSB (NS). The cable shield is not to be connected at this time.

☐ 22. Connect inner conductor of lead D (from terminal 5 of the new slide switch) to terminal 3 on control FJ (S). Do not connect shield at this time.

☐ 23. Connect inner conductor of lead E (from terminal 6 on the slide switch) to terminal

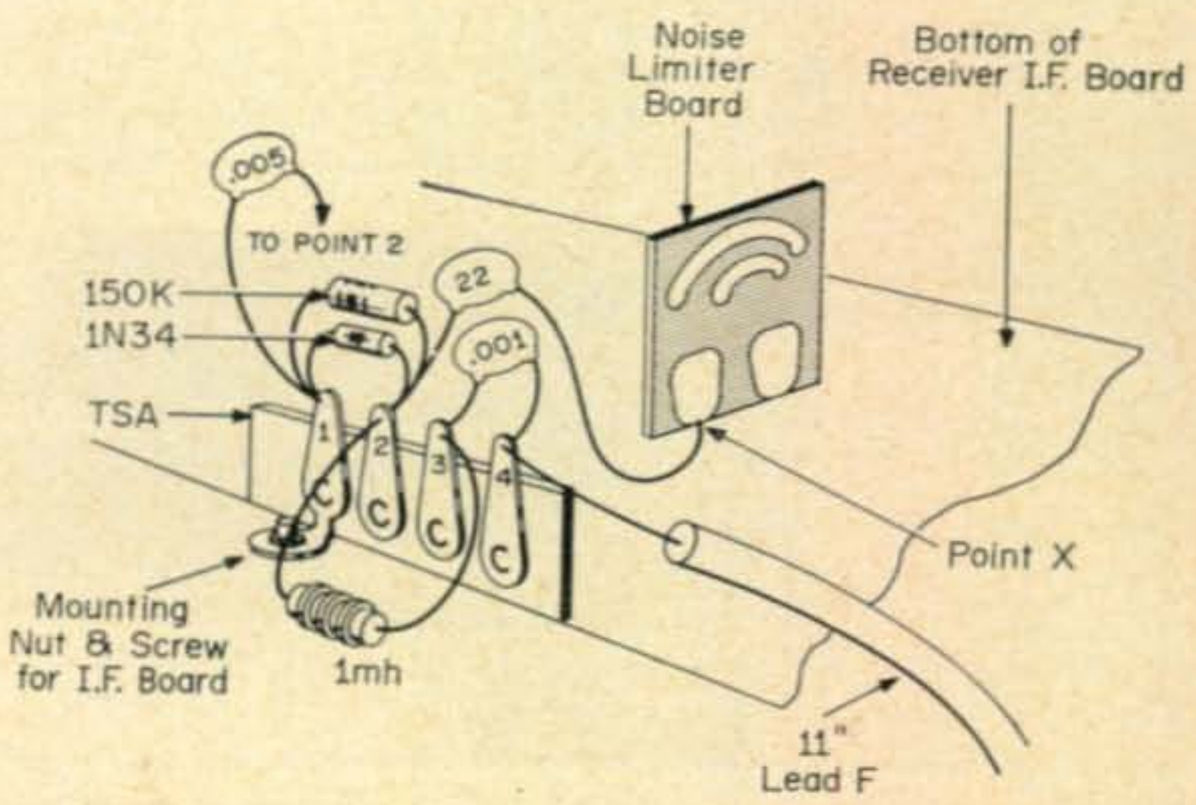
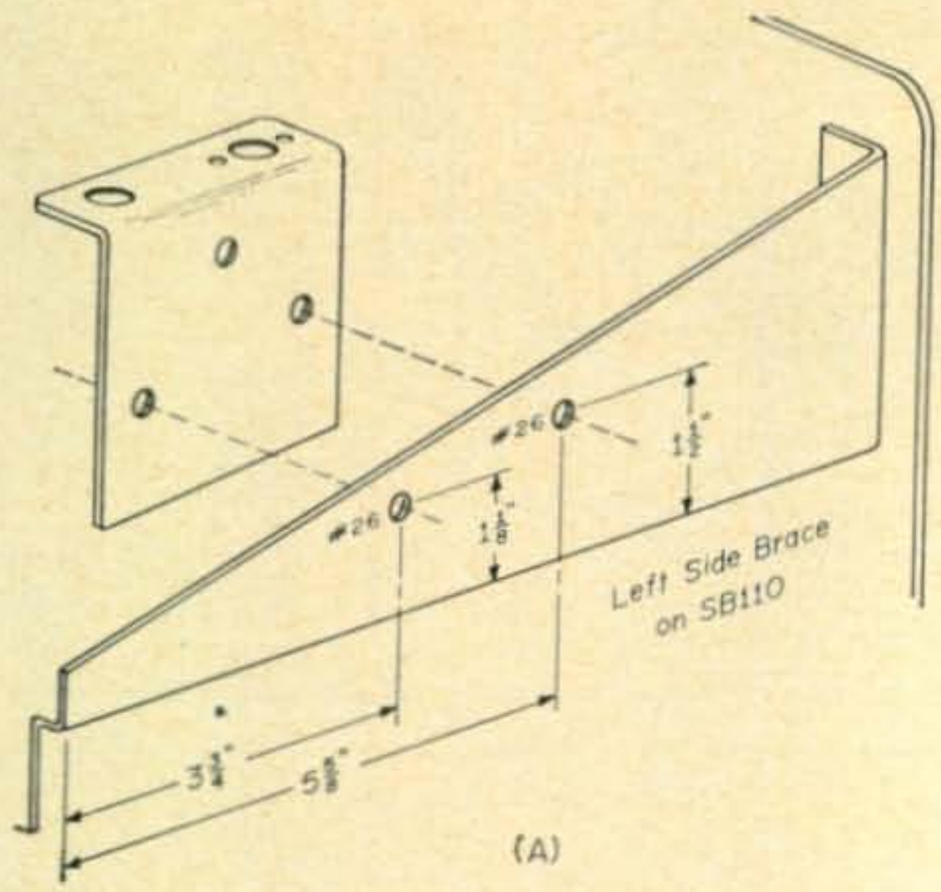
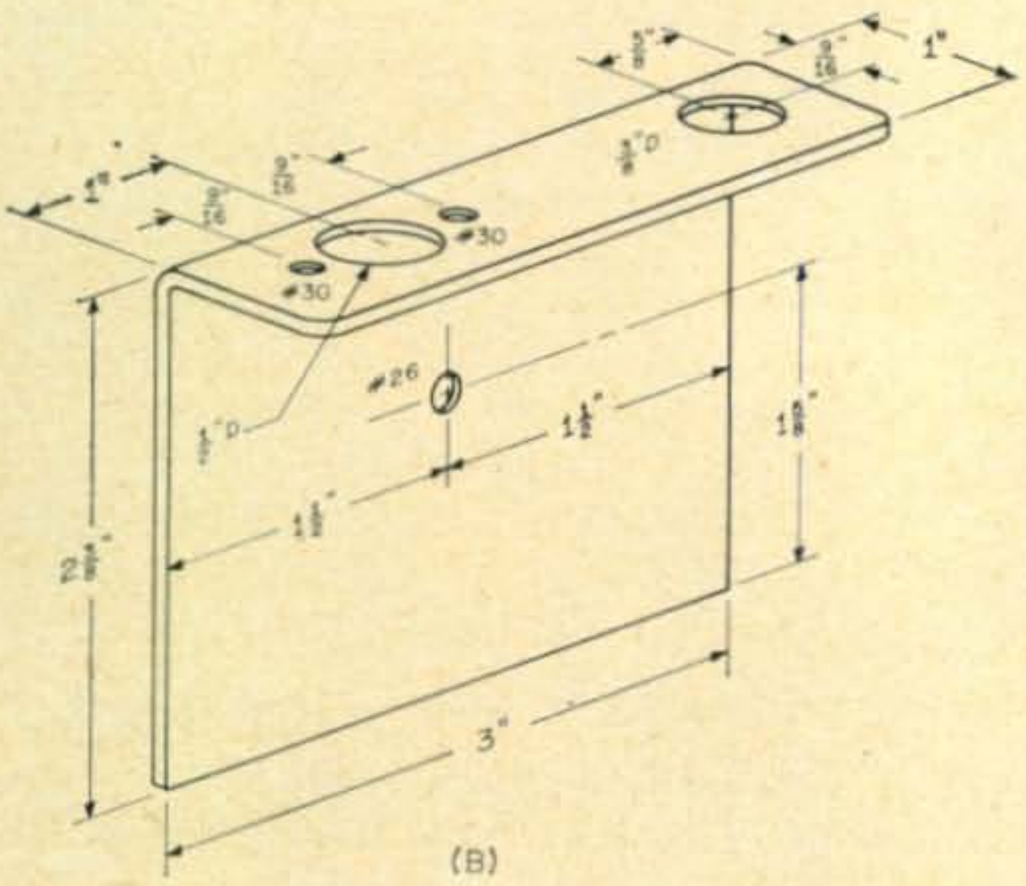


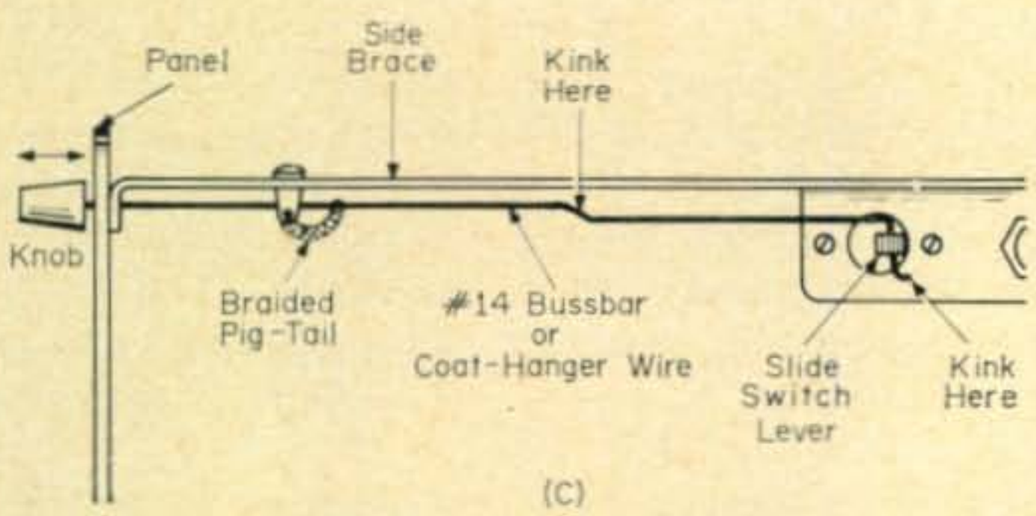
Fig. 3—Components for envelope detector as assembled underneath receiver i.f. board.



(A)



(B)



(C)

Fig. 4(A)—Dimensions for holes to be drilled in left side brace of the SB-110. Also drill a hole 1⅞" from the panel and 3" from the bottom of the side brace (for step 30). (B)—Dimensions for bending and drilling bracket to be mounted on side brace as shown at (A). (C)—Method of linking the switch lever with bussbar.

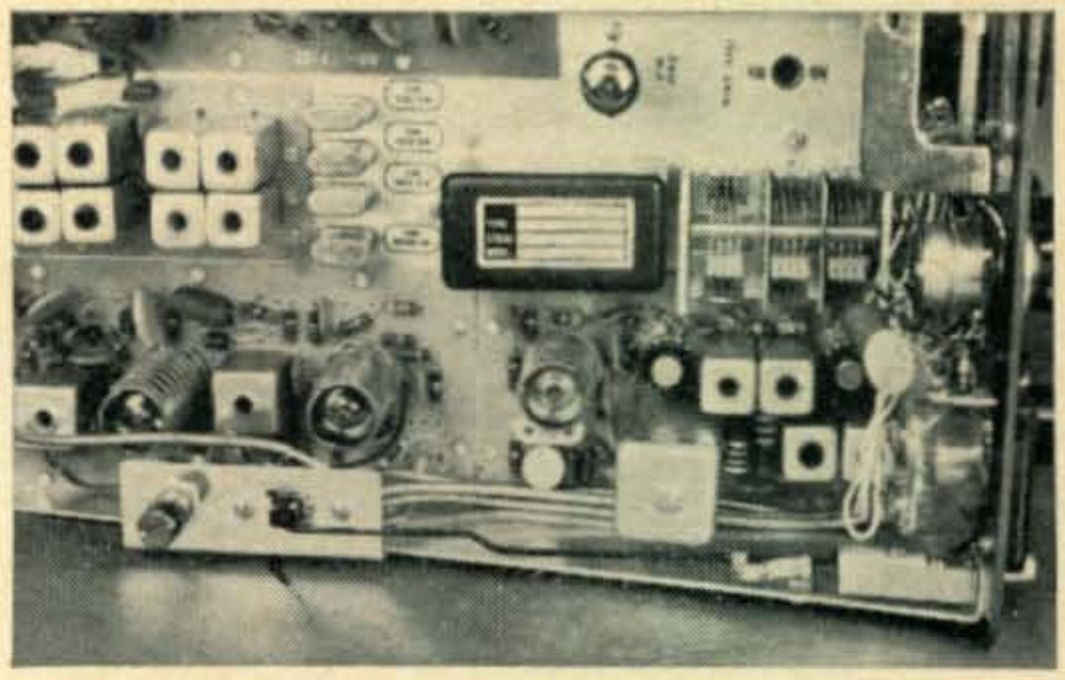
2 on tie strip TSB (S). Do not connect shield yet.

☐ 24. Connect inner conductor of lead C (from terminal 4 of the slide switch) to terminal 1 on tie strip TSB (S). Do not connect shield yet.

☐ 25. Connect shield leads from all the cables together and to terminal 1 on control FJ (S).

☐ 26. Drill a 1/16" diameter hole in the SB-110 panel at the left of the meter, locating it 5/8" from the left edge of the panel and 1½" from the top.

☐ 27. At one inch from one end of a 12" piece of #14 bussbar (or a piece of coat-hanger wire), bend the bussbar to form a right angle. From the rear of the panel, slide the other end of the bussbar through the panel hole.



Topside view of the SB-110 showing the completed modifications along the bottom edge. The bracket is to the left with the bussbar link running to the front panel on the right.

☐ 28. Referring to fig. 4C, slip the right-angle end of the bussbar through the hole in the slide-switch lever. Make a slight kink near the middle of the bussbar so that each half lines up evenly with the switch lever and the side brace of the set. Kink the end of the wire so it will not slip out of the lever, taking care not to exert pressure that may split the lever (instead of the kink, you can place a glob of solder at the end of the wire).

☐ 29. At the front of the panel, cut off all but about ½" of the bussbar and mount the cone-shaped knob referred to in fig. 1.

☐ 30. Drill a #26 hole near the top and toward the panel-end of the SB-110 left side brace and fasten a solder lug at this point.

☐ 31. Solder a flexible "pigtail" (made of a piece of braided shield from coax cable) between the solder lug and a nearby point on the bussbar.

This completes the modification.

Operation

A.m. type transceive operation is obtained by pulling the A.M. knob out; the s.s.b. mode is restored by pushing the knob in. The procedure for setting up a.m. is as follows:

☐ 1. With the A.M. knob *pushed in* (s.s.b. position), tune up the SB-110 in the normal manner for maximum output.

☐ 2. Note the relative output-power reading on the meter.

☐ 3. Set the *mode* switch at either LSB or USB.

☐ 4. *Pull out* the A.M. knob.

☐ 5. With the FUNCTION switch set for PTT, press the push-to-talk mic button and adjust the internal CARRIER-LEVEL control (located on the newly installed bracket) for a relative power-output reading equal to *half* that noted during tuneup.

[2]The bussbar should pass perpendicularly through the panel.

Front view of the top left corner of the SB-110. The new push-pull control can be seen to the left of the meter. The matching knob is Heathkit part No. 462-175. Decals add the finishing touch.

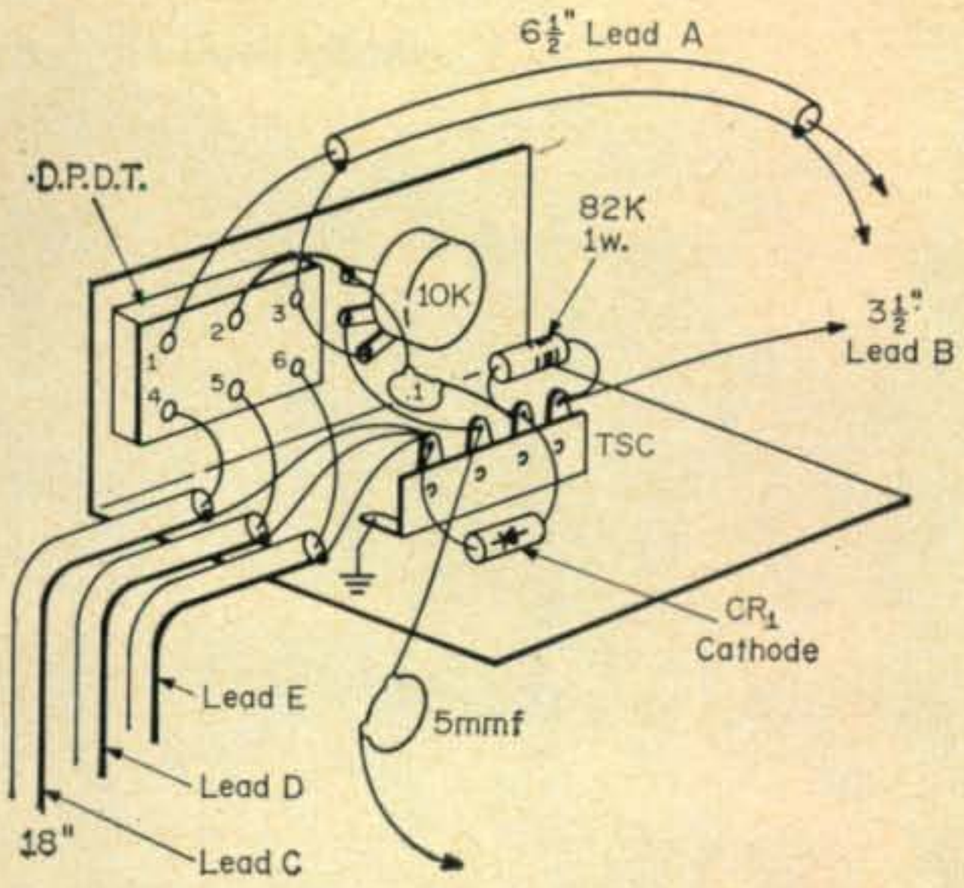


Fig. 5—Bottom view of side bracket showing installation of components and leads.

☐ 6. Adjust the MIC GAIN so that with voice the relative-power meter kicks upward very slightly. You're now on the air with a.m. or s.s.b.c. (25 watts carrier output, 100 watts p.e.p.).

A.m. signals may be received normally; however, due to the narrow bandwidth of the sideband filter, the signals will be quite sharp to tune and some loss of high-frequency a.f. response may be experienced. The latter can be minimized a bit by tuning slightly to one side of the passband. Reception of the s.s.b.c. signal also is best obtained when the receiver is tuned to one side of the signal, or close to the carrier frequency.[3] [4]

[3]It also should be kept in mind that the tranceive operation puts both the receiver and the transmitter on the same frequency. If you call CQ and a reply is received on another frequency, you'll have to tune back to the original frequency and tell the calling operator that you'll then QSY to his frequency, in which case the QSO can then be conducted without your having to tune back and forth between transmit and receive.
[4]The noise limiter is designed only for s.s.b., and thus may introduce distortion on a.m.

[*Continued on page 103*]

be connected directly to ground as shown or across the coupling capacitor. This coupling capacitor can be varied from 5 to 20 mmf and a fixed unit of optimum value substituted since these are less bulky in space requirements.

Alignment

Any of these converters can be aligned on received signals but a v.h.f. signal generator and diode noise generator are a definite help in proper alignment. The oscillator, when functioning, always produces a noticeable noise increase in the i.f. receiver output. Once oscillation is present, all circuits should be peaked up for best n.f. and weak signal reception. ■

A.M. For SB-110 [*from page 13*]

Before going on the air with normal s.s.b. operation, another initial adjustment should be made. *Push in* the A.M. knob and readjust the s.s.b. CARRIER-NULL control according to the manual instructions. Once set, the CARRIER-LEVEL control for a.m. and the CARRIER-NULL control for s.s.b. should seldom require readjustment.

Initial receiver realignment also should be made by adjusting T_3 as indicated in step 5 on page 88 of the manual.

Theory of Operation

Referring to fig. 1: with the switch set at the A.M. position and during transmit, the output of the carrier generator goes to the A.M. CARRIER-LEVEL control to provide a carrier (at half the maximum normal tuneup-output level) injected at the 1st i.f. amplifier, V_{4A}, following the sideband filter. On receive, B plus is applied to the diode switch, CR_1, which grounds the output of the carrier generator and removes this signal from the CARRIER-LEVEL control and V_{4A}. At the same time, the switch connects the output of the envelope detector to the A.F. GAIN control.

A small size coupling capacitor (0.001 mf) at the output of the detector is used to reduce the low-frequency a.f. response and thus minimize a "muddy-sounding" a.m. signal caused by the narrow bandwith of the sideband filter.

With the new switch at the S.S.B. position during transmit, the CARRIER-LEVEL control is disconnected from the carrier generator and is grounded to prevent carrier leakage through V_{4A}. At the same time, the receiver A.F. GAIN control is disconnected from the envelope detector and is connected to the product detector via the 1st a.f. amplifier. ■

30 Again [*from page 15*]

as it was the standard code for wire telegraphy on the continent of Europe). All *radio* telegraph communication controlled by the United States would henceforth use the characters of the International code. Look at what happened to "30"; in the International code; it became, "dit dit dit dah dah—dah dah dah dah dah." Try to say *that* one fast and make it sound rhythmic! To make the same characters as the old Morse "30", in International code, came out as the *letters* "SK"

not removed, for several inches and a length of bare hookup wire is inserted underneath the shield and spot soldered. A piece of heat shrinkable tubing is then formed over the slit in the cable jacket so the entire assembly is sealed. If shrinkable tubing is not available, insulating tape can be wrapped around the jacket. The completed cable is simply taped to the whip as shown in the photographs.

Additional solder lugs are used at the suction cups for the hookup wire leads for the coil tap and ground clip connection.

Operation

As shown in the photographs, the antenna is mounted on the window pane of the author's VW. The ground connection is made to a metal clip inside the car which is screwed into the car body. One could also make the ground connection to the rain gutter if a clean contact were made by removing the paint. The ground connection, in any case, for an automobile should be made to a large metal surface of the car and not to one which is effectively electrically insulated by means of rubber stripping or other means. Some experimentation in this area will pay good dividends in terms of better antenna performance as it is surprising how many metal surfaces of an automobile have relatively high resistance electrical contacts between them.

An s.w.r. meter is used to find the proper loading coil taps for each band, starting with minimum inductance loading on each band. Once the proper tap points have been found they will remain the same as long as the antenna is installed in the same position on the vehicle each time. The tap points for each band can be marked with a magic-marker pen on the coil or small wire stubs can be soldered to the coil at each tap point. The rest of the coil and assembly should be sprayed with Krylon or a similar plastic spray to protect the assembly from weather deterioration.

On 10 meters there are several modes of loading which may produce proper tuning and low s.w.r. In general, the one which involved the least amount of inductive loading (with either the ground connection at the antenna removed or in place) will prove the most efficient. ■

A.M. Operation With The Heath SB-110A

BY WILFRED M. SCHERER,* W2AEF

THE a.m. modifications for the Heathkit SB-110 6-meter S.S.B. Transceiver, as described in *CQ* some time ago,[1] have proved to be quite popular. In addition, inquiries have been received about whether or not the changes can be made in the same manner on the later model, the SB-110A. Happily the answer is yes, the only difference being in the SB-110A manual diagram and page numbers referred to in the text of the article.

For SB-110A

In the steps set forth on page 11 of Nov. '66 *CQ* the pictorial numbers and pages should be related to the SB-110A manual as follows:

1—Pictorial 3-19, page 51.
2—Pictorial 3-20, page 52.
3—Pictorial 3-28, page 60.
19—Pictorial 3-22, page 54, as identified in Pictorial 3-28, page 60.
20—Pictorial 3-29, page 61.

For SB-110 and SB-110A

Relating to *both* the SB-110 and SB-110A, an error should be corrected in the circuit diagram at fig. 1 of the modification article. The right-hand arm of the d.p.d.t. switch should go to the *bottom* end of the 0.1 mf 75 v. discapacitor, instead of to the top end. This is *correctly* shown in the pictorial wiring diagram at fig. 5 on page 13 of the article.—*W2AEF*

*Technical Director, *CQ*.

[1]A.M. for the HeathKit SB-110 6-Meter Transceiver, *CQ*, November '66, page 10.