The problem of visually monitoring your audio is solved by building a HAMSCOPE, as shown, between your amplifier grid and plate meters—or, if you prefer, in a separate unit constructed to suit your needs.

—Lighthouse Larry

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HAMSPECO

DESIGN CONSIDERATIONS

The "HAMSPECO" is a simplified cathode-ray oscilloscope—designed specifically for checking the operation of amplitude-modulated and single-sideband transmitters operating in the 1.8-30-megacycle frequency range. The screen patterns will tell a more complete story about linearity, distortion, percentage of modulation, than meters or similar indicators. Since a linear sweep, vertical and horizontal deflection amplifiers and other components are not needed for examining transmitter output, this scope is reduced to essentials—the cathode-ray tube; a tuned circuit for applying RF voltage to the vertical deflection plates; a 50-cycle or audio-frequency sweep on the horizontal plates; and a focused deflection system.

Choice of the cathode-ray tube determines other factors, with severe size and voltages, and will be considered first. Even though a late type, the 3KP1, was used in this circuit, older cathode-ray tubes—the 3AI, 3BP1, 3GP1, 3HP1, or the 3AI, 3BP1, etc.—should be suitable. Many variants already have these tubes stored away, with the intention of putting them to work in a unit of this type.

A cathode-ray tube is similar to other thomsonic vacuum tubes in that electrons emitted from the hot cathode are attracted toward a more positively charged anode. The main difference in C-R tubes is that the cathode and several disk or cylindrical-shaped elements, called the electron gun, concentrate the electron stream into a thread-like beam. These elements each have a small axially aligned hole through which the beam passes. The control grid, adjacent to and negatively charged with respect to the cathode, control the intensity of this beam. The next element is the focusing anode, operating at 30 to 35 percent of the total supply voltage. The accelerating anode, next in line and having a high positive charge, pulls the electron beam through the gun and bureau toward a phosphor-coated screen on the faceplate. A small spot appears on this screen when voltages applied to the elements have the proper relationship. Last element will be energized by this circuit, and a brief deflection of this spot traces a composite pattern of any varying deflection.

The electron beam will also be deflected by stray magnetic fields. Putting a paper clip near the tube neck will tell the operator the spot must be moved to its proper position. An alternating-current field, such as that which will be present when power is connected, will cause the spot to sweep back and forth at right angles to the plane of the field. For this reason, selecting a location for the power transformer which causes no stray beam deflections is usually the most critical mechanical problem encountered in constructing cathode-ray oscilloscopes. Since the transformer may be made to fit into a steel chassis if it is fastened directly to that chassis, an adjustable transformer mounting bracket helps overcome this difficulty.

Since current flow through a cathode-ray tube is quite small, voltages for the elements may be tapped from a reduced voltage divider connected across a power supply. Care must be taken, however, to avoid current drain, and the power supply must be designed against this. Resistance values in this voltage divider may be specified to cover all load on the power supply. Different values should not be necessary even with other cathode-ray tube types and higher supply voltages. Controlling controls for positioning the pattern were considered an unnecessary refinement, since most cathode-ray tubes are constructed to place the undeflected spot within 1/2 inch of the center of the screen.

If the cathode or control grid is operated near chassis potential (the "normal" method of connecting B-minus), the accelerating anode and deflection plates must have a high positive potential applied to them. This creates a dangerous shock hazard in circuits where the deflecting signal to be observed is connected directly to these plates. The danger is easily reduced by operating the lambda elements near chassis potential and applying a negative high voltage to the control grid. A different voltage divider network, and a system also avoids the necessity of using high-voltage coupling capacitors to isolate the deflection plates, the alternate method of reducing the shock hazard. Most 2- and 3-inch cathode-ray tubes will have sufficient power with brightness for this application if at least 400 volts appear across the voltage divider, although power will be reduced in the process.

A built-in negative high-voltage supply is pictured in the schematic diagram, rather than depending upon the transmitter being monitored to furnish positive high voltage. Thus, the 'scope will check even power-supplied transmitters. Even though special oscilloscope power transformers are available (Marte P3110 and Triad A-3-C-3), a conventional replacement-type power transformer delivering at least 600 volts across the entire secondary winding was used for T2. Because of the low current drain, a simple half-wave rectifier and capacitor input filter, which charges up to the peak AC transformer voltage, is suitable. Capacitors C1 and C2 should have a working voltage rating at least 11/2 times the transformer secondary voltage. As a 5-volt heater rectifier, voltage from this transformer was available as an option.

When a spot of 35 volts required by a 1X/4_rectifier tube is supplied by inserting dropping resistor in series with the heater, resistor of 35,000 ohm supplied by the 2KP2 full-wave rectifier tube may be inserted in circuit for this tube. The maximum AC voltage-per-plate insulation required for this tube is 2,000 volts. A voltage transformer is provided for tube; one section of a 3R-GY full-wave rectifier tube may be used in this circuit, and should not be removed by the user. A step-down transformer at the AC input 1:4 step-up ratio, will ensure that all the most cathode-ray tubes with 20-20 volts RMS applied to the primary. A horizontal sweep generator which needs would necessarily complete the circuit, since the center portion of a sine wave sweep is sufficiently linear.

The vertical deflection plates are connected across the grid and horizontal deflecting plates, and are connected across the frequency of the RF signal being checked. A small RF voltage fed through a coaxial plug into J1 is coupled to the tuned circuit through L1. Any combination of variable capacitance and inductance which will allow the desired frequency may be used in place of the parts specified for L1, C1, L2, and L3. The large capacity used for C1 enables the tuned circuit to cover all power bands with only 2 coils, a disadvantage of this circuit, and should not be removed by the user.

Since the grid and horizontal deflecting plates are not at chassis potential, but at a positive potential, it will be necessary to provide a ground connection for the receiver. This connection must be made to chassis, and not the chassis of the optional AC transformer.

Screen or coupling voltage is applied to the horizontal plates, and would be divided between the grid and the horizontal deflection plates by the voltage divider network. This network is wired so that the second potentiometer (C1) is connected directly to chassis ("OFF") in one position of the adjustable capacitance switch. In the other position, the arrangement is such that the grid is charged by a current, which is sufficient to pass through the grid resistor, and the horizontal deflection plates are charged by this current. Thus, a current for the angle of deflection which is equal to the grid current is delivered to the horizontal deflection plates. Part of this current flows through the grid resistor and is returned to the chassis, while the remainder is delivered to the horizontal deflection plates. A transformer with a large capacity is not needed with this method, since the grid current will exceed the grid current which would needlessly complicate the circuit, since the center portion of a sine wave sweep is sufficiently linear.

The screen voltage is applied to the horizontal plates, and coupling voltage is applied to the horizontal plates, and may be coupled to the screen voltage by an interstage audio transformer. This transformer may be used to limit the screen voltage to the value of the secondary winding connection, and may be used to suppress the screen voltage to the value of the primary winding connection. The primary coil of the interstage audio transformer is supplied by a 2X2A rectifier. The secondary coil is supplied by a 2X2A rectifier, and the rectifier output is supplied by a 2X2A rectifier. The rectifier output is supplied by a 2X2A rectifier, and the rectifier output is supplied by a 2X2A rectifier. The rectifier output is supplied by a 2X2A rectifier.
MECHANICAL DETAILS

Most relay rack panels have holes cut for three 3-inch meters having about 6 1/2 inches of space between the two outer meter holes, limiting one "HAMSOCPE" dimension to less than this figure. Over-all depth of the unit is regulated by the depth of the relay rack cabinet into which the 'scope will be mounted. Most cabinets are more than 14 inches deep, but the 6- by 14- by 3-inch chassis used on this model is the largest that may be safely accommodated. A chassis drilling diagram is not shown, since available transformers, capacitors, tubes, etc., may vary in size somewhat from the components pictured in Fig. 2. Instead, approximate dimensions for locating major parts have been marked on the side view illustration, Fig. 3. Actual parts to be used should be placed in and about the chassis to find locations which will not conflict with the cathode-ray tube, control shafts, brackets, etc.

Holes for the "SWEEP" potentiometer and B, are drilled as close as possible to the upper chassis corners, and corresponding holes for panel-bearing assemblies are drilled at the lower corners. On this model, the hole centers were three quarters of an inch each way from the outside chassis wall. The four control knobs will then form a rectangle about the tube face.

The faceplate end of the tube is not held in a clamp, but rests between two strips of rubber cemented to the underside of the chassis deck and bottom lip. A square hole in the panel end of the chassis for the tube is preferable to a round hole, since the bottom lip must

COIL TABLE

<table>
<thead>
<tr>
<th>No.</th>
<th>Type</th>
<th>Value</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1A</td>
<td>1-piece 1.5-600-3000-MEG</td>
<td>works on same 6-ampere heater input</td>
<td></td>
</tr>
<tr>
<td>2A</td>
<td>1-piece 1.5-600-3000-MEG</td>
<td>works on same 6-ampere heater input</td>
<td></td>
</tr>
</tbody>
</table>

PARTS LIST

C1-C5—0.1 to 0.1-mfd paper, working voltage 1.8 times secondary voltage of T2.
C6—Two-section variable, 10-400-ohm per section.
D2—Chassis-type fuse holder with 1-ampere fuse.
I1—Open circuit rectifier "phone plug.
I2—Chassis-type male 2-prong power connector.
I3—5-prong ceramic tube socket.
I4—Chassis-type coaxial cable connector.
I5—5-prong ceramic tube socket.

9-30 MEGACYCLES

L1—3 turns No. 20 insulated hookup wire at center of L1.
L2—2 turns No. 20 insulated hookup wire at center of L1.
L3—Commercially available coils which may be substituted for the above coils include the R & W MCL, JCL and JVL series.

R—5-ohm, 2-watt adjustable resistor.
S1—4-pole, 3-position single section non-shorting tap switch (Teleflex 32430).
T—Replacement type power transformer with a 600-750-volt, 40-ohm high voltage winding; 3 volt, 2-ampere and 6.3-volt, 0.6-ohm heater windings; 115-volt, 60-cycle primary.
S2—Single plate to push-pull grid interstage transformer having a step-up ratio of 1.6 or higher (Stanmar A-52-C, A-64-C).
V1—2X2A or 584-GF rectifier tube (see "CIRCUIT DETAILS").
Fig. 2. Bottom view of the "HAMSCOPE" showing the shape of the power transformer mounting bracket and position of components inside the chassis. The plug-in cell has been removed.

Fig. 3. Side view showing approximate capacities. Dimensions of the side bracket.

Fig. 4. View from rear of chassis with C-R tube removed to show 2-inch-square cutout in chassis front wall and ledge in bottom lip.

Fig. 5. Mounting bracket for C-R tube base made from 1/4-inch thick phenolic insulating board or similar material.

be bent down to clear the large end of the tube as shown in Fig. 4. With the tube in place, the chassis is positioned behind the panel so that the tube is centered in the meter hole. The chassis top deck measured about 1 inch down from the top edge of the rack panel in the correct position. The 3/4-inch diameter chassis holes for the control shafts are now marked on the back side of the panel with a scribe or pencil and matching holes are drilled through the panel in these locations. Large holes for the fuse holder and J2, and small holes for the chassis support brackets are also drilled. These brackets, shown in the side view, were made of 3/16-inch thick sheet aluminum and rigidly brace the chassis.

A clamp for the cathode-ray tube base end, pictured in Fig. 5, was fashioned from 3/16-inch thick phenolic insulating board. A hole 3/16-inch larger in diameter than the tube neck is bored, all small holes drilled, then the board is cut in half at the line indicated on the drawing. Finally, all holes are tapped, except the holes for the clamping screws on the top portion which are redrilled to clear the 6-32 by 1/2-inch-long machine screws which hold the clamp together. Then, cement two strips of 3/16-inch thick sheet rubber into the large hole to act as a cushion for the tube. A sheet aluminum bracket for fastening the power transformer may be fashioned after the proper transformer location has been
its tube neck. Mounting holes may be made to accommodate the "FOCUS" potentiometers, both of which are isolated from the chassis. Insulated couplings, a 3-inch flexible shaft, and a shortened 3-inch shaft and panel-bearing assembly permit operation of the "INTERNAL" control from the front panel. A length of fiber shafting extends the "FOCUS" control to the rear of the chassis, since it seldom requires adjustment. The voltage divider fixed resistances are fastened to a small terminal board suspended on machine screws, with extra nuts as spacers, just above the cathode-ray tube neck where they may be conveniently wired to the potentiometers.

**WIRING DETAILS**

Leads from the power connector, J5, on the rear of the chassis to B, are shielded wire, but all connections except the high-voltage leads are made with conventional hook-up wire. High-voltage wire was used on the rectifier anode, filter capacitor and voltage divider connections. Plastic insulating tubing was slipped over the transformer high-voltage and heater leads for added protection. Connections between the coil socket, variable capacitor and coaxial connector are made with tinned No. 14 copper wire. Leads to R2 and the "SWEET" control should be assembled before they are mounted in the rather restricted chassis corners. A 4-inch length of insulated wire is first passed through the chassis wall, then marked at half-inch intervals. The wire is then passed through the chassis wall and run to the panel -bearing assembly. Leads are clipped short and taped. Wiring to the face panel and J5, above the chassis, runs up through rubber grommets placed in yin diameter holes. Meters inserted in the outside panel holes are wired to the transmitter circuits by direct connections through the unoccupied terminals. The power leads to J5 may be connected to existing transmitter filament wiring.

**OPERATION**

After a final wiring check, set the slider on resistor R1 to 3.0 ohms with the filament connected. Lay the power transformer, which is hanging by its leads, about 1 inch inside the chassis in a position shown in Fig. 4. Insert the 2X1A rectifier tube, but do not connect its anode cap or plug in the cathode-ray tube at this time. Connect an AC millivoltmeter to pins 1 and 4 on the rectifier socket, turn R1 to the "EXT.," position and read the heater voltage. If 3.5 volts is not read, turn off the power and move the slider on R1 until this voltage appears across the 2X1A socket with power on. With the power off, connect anode cap to the 2X1A, insert the cathode-ray tube and clamp it in place. Again turn R1 to the "EXT.," position and turn

![Diagram of wiring and components](image-url)
nominations invited for
FIFTH ANNUAL EDISON AWARD

The 1956 Edison Radio Amateur Award again will honor an amateur who has rendered distinguished service. As before, the Award also will serve to acknowledge the generous help which all radio amateurs offer their communities and the nation when need arises.

For 1956, a new Award winner will be added to the call letter honor roll of the four previous winners (1952—W6PFP, 1953—W6PNZ, 1954—W6HY, 1955—W210H). He will receive the handsome Edison Award trophy, a $500 check, and nationwide recognition.

A committee of distinguished and impartial judges will select the winner from candidates who are nominated by letters from you and others. Since only names submitted in this way will be considered by the judges, your participation is vital.

Start now to choose your candidate for the 1956 Edison Award!

RULES OF THE AWARD

WHO IS ELIGIBLE. Any man or woman holding a radio ama-
tee's license issued by the F.C.C., Washington, D. C., who in 1956 performed a meritorious public service in behalf of an individual or group. The service must have been performed by the candidate in his capacity as an amateur within the continental limits of the United States.

WINNER OF THE AWARD will receive the Edison trophy in a public ceremony in Washington, D. C. Expenses of his trip to that city will be paid.

$500 GIFT. Winner will be presented with a check for this amount in recognition of the public service he has rendered.

WHO CAN NOMINATE. Any individual, club, or association familiar with the service performed.

HOW TO NOMINATE. Indicate in a letter these facts: (1) Name of nominee, (2) Mailing address of nominee, (3) Actual place of residence of nominee (if different from mailing address), (4) Amateur call letters assigned to the nominee by the Federal Communications Commission, (5) A full description of the public service performed by the nominee.

In addition, it is desirable—but not absolutely necessary—to supply additional general information such as the follow-
ing: (6) Age of nominee, (7) Occupation or profession, (8) Name and address of employer (if employed), (9) Telephone number (or telephones at which nominee can be reached), (10) Any other information about the nominee which may be available and which may assist the judges in evaluating the public service performed. (11) Newspaper clippings, letters of commendation, photographs, and other supporting docu-
maments are welcomed. Favors having personal value will be returned after the judging, upon request.

BASIS FOR JUDGING. All entries will be reviewed by a group of distinguished and impartial judges. Their decisions will be based on (1) the greatest benefit to an individual or group, (2) the amount of ingenuity and utility displayed in per-
forming the service.

Winner of the award will be announced on or before Thomas A. Edison’s birthday, February 11, 1957. Employees of the General Electric Company may nominate candidates for the Edison Radio Amateur Award, but are not permitted to receive the Award.

Awards for radio public services fall under the following four headings: 1. Emergency Communications, 2. Organizational Efforts, 3. Unique Individual Services, 4. Man-
page Handling. They all share equally important consider-
ations by the judges.

RIDGES WILL BE
E. BOLAND HARRMAN, Chairman, The National American Red Cross.

HERBERT HOVER, JR., W210H, The Under Secretary, U.S. Department of State

ROBERT H. HYKE, Commissioner, Federal Communications Commission.


HARMSCOPE— the "INTENSITY" control clockwise until a pattern appears on the tube screen. Next, adjust the "FOCUS" control until the pattern resolves into a sharp spot in the center of the line. If a line is observed, turn B, to the "OFF" position and note whether the line changes to a small spot before it fades from view. If it does, the stray field from the power transformer is deflecting the spot. With B, again in the "EXT" position, turn the transformer in various positions until the line reaches minimum length. Leave the transformer in this position and take measurements. The transformer used here is labeled under "MECHANICAL DETAILS." Tests with these transformers can indicate what the scope should be around 1 inch from the chassis.

The internal 60-cycle horizontal sweep now can be treated by setting B, in the "INT" position and turning the "W//S" control clockwise until a full-width line appears on the screen. With the sweep transformer speeded in the "PARTS LIST," it should be possible to extend the sweep far beyond the tube face. An external 60-cycle sweep can be applied to the "HARM-
SCOPE" by running a small coastal cable from J, to the sweep transformer speeded in the "PARTS LIST." A long cable should terminate in a small coil placed near the output tuned circuit in that devic. The loop also may be coupled to the antenna
turning network or hallon coils used with some trans-
mitters. For convenience in making connections, an external 60-cycle sweep can be added to the unit in which the coupling loop is placed.

After tuning C, to the output frequency, the RF voltage on the vertical deflection plates appears as a band across the C-R tube face. Maximum height of this pattern can be set by adjusting the coupling loops then the C—L, tank can be adjusted to reduce the vertical pattern if desired. A wide pattern is developed on a wide sweep from the low output of a grid-clip oscillator coupled to the tuned circuit, indicating good deflection sensitivity. The width of this pattern will vary in ac-
cordance with the modulation applied to the trans-
mitter. A detailed description of the patterns obtained from amplitude- or frequency-modulated, and single-
sideband-suppressed-carrier transmitters will be found in amateur radio handbooks and magazine articles cov-
ering this subject.

Finally dressing up includes: adding control knobs which match those in your station; marking these con-
trols with decals; cementing a brass slide from 12-inch-diameter plate, having the glass around the C-R tube opening; and fitting a perforated sheet aluminum chassis bottom plate to the underside of the "HARMSCOPE."
Sweeping the Spectrum

Counterfeit Tube Basket

Fellows—the story you are about to read is true—
only the brands have been changed to confuse the
counterfeiters.

Not so the brand! Electronic tube brands are
brand! Modern-day rustlers who change the brands
and wormily daily, often over minor tubes, giving
serious problem and important subject in the radio-telephone
service industry these days.

Before going into the corrective measures now being
taken by most tube manufacturers, let's trace the path
of a typical counterfeit reconditioned tube from one former
shop or tube distributor. Obviously, such a tube will
be very weak at best, or more likely, completely imopera-
tive. The brand counterfeiters usually obtain these
tubes for little or no cost, sometimes with the explaina-
tion that they are to be used as targets in a shooting
gallery. Old markings are removed and the tubes given a
cleaning before being rebranded, usually with the trade-
mark of a prominent tube manufacturer. The most
important step, stamping on a current warranty
code number, makes a skilled rebranders' finished
product almost identical in appearance to a new tube.

The rebranders rework tubes through several
channels, including turning them back to a
tube distributor handling that brand, claiming that the
tubes are impermissible—certainly a true statement.

New, operative tubes are received in exchange, and
these are sold to anyone who will buy them at below-
market prices. Some tube rebranders mix these new
with rebranded tubes when selling them to a
repair shop. Of course, the dimes are discovered when the
serviceman attempts to operate them in a set he is
repairing. These inoperative rebranded tubes are also
returned to a distributor by the repair shop, again in
exchange for new tubes, since the counterfeit warranty
code numbers indicate a recently-manufactured tube.

So far, our path has completed a cycle back to the
tube distributor for many rebranded tubes—but that's
not the end of the trail—since most tube manufacturers
have taken definite steps to run the rebranders out of
business. The most common of these is in-warranty defective tube replacements for the
manufacturer to extend to wholesale tube buyers a percentage discount at the time of purchase which compensates replacement tube costs. Now—to keep
worked or defective tubes out of the hands of rebranders,
most tube manufacturers offer a tube-for-tube replace-
ment policy. If a tube proves to be defective, the manufacturer then gives the distributor
a new tube for it.

In-warranty service in warranty serves a three-fold purpose. Each tube is checked for defects in it, or to
the plant, it isligeatime and ease
to determine the cause of failure. Thus, product quality
is constantly improved as a result of tube failure
studies. In addition, the manufacturer has an oppor-
tunity to destroy the tube to prevent it from falling
into the hands of counterfeiters. Finally, the dud tube
gives the authorities a clue to locations where counter-
feitters are at work.

Additional precautions against counterfeiting are
being taken by General Electric, which co-operates with
local law enforcement authorities wherever the
Corporation uncovers evidence of rebranding. Men from
our security staff are assigned to obtain legal evidence of
such illegal operations, recently resulting in the
conviction of one rebrander in an eastern city. This
tube counterfeit claimed that his counterfeiting in-
come could have reached $25,000 annually if he had not
been caught! Equipment required for these operations is
simple and easy to transport, greatly increasing diffi-
culties in obtaining the concrete evidence required for
successful prosecution.

These rebranded tubes should not be confused with
so-called seconds, which are not conform to
specifications, or with legitimate surplus tubes. Gen-
eral Electric destroys "seconds" at the plant, although
shady tube brokers at times have attempted to obtain
them from us. Surplus tubes, sometimes available at
low prices, usually are new tubes obtained from equip-
ment manufacturers who may have gone bankrupt,
out of business, or have changed the design of their
equipment, etc. Since these manufacturers buy new
tubes from tube makers in bulk and may select only
tubes which have certain desirable character-
istics, the remainder may be sold to surplus tube
dealers considerably below list price.

What about the supply of out-of-warranty discarded
tubes still available to rebranders? This is the area
where the co-operation of you, the radio amateur
synonymous with the military; where the rebranders
general public, counts heavily! Dispose of all such tubes
immediately by which they will no longer be available
to the illegal operators! Otherwise, they may again
appear on the market as rebranded tubes.

Nearly $300 million receiving and allied type tubes
were manufactured during 1955, with a considerable
percentage destined for the replacement tube market.
For such new replacement tube add, a dupe of that type
usually was discarded. The above figures reflect the
importance of cleaning every drop of fluid out of small
capacitors from this potentially huge source.

Obviously, our best answer to your personal tube supply problem is to deal with an authorized tube
distributor. His nationally-branded stock consists of
new, factory-fresh tubes. Low-priced tubes from other
sources may be bargains, but if a hard purchase con-
tains some inoperative tubes, cost of the tubes which
have been changed to confuse the electronic tube
counterfeiter is unnecessarily higher than their prima-
face. The old saying, "You pay your money and take
your choice," definitely applies to these purchases too!
USING THE HAMSCOPE

Two types of patterns, wave envelope and trapezoidal, are used for testing AM or SSB transmitters. The HAMSCOPE will present a wave envelope pattern simply by feeding the transmitter RF output into the vertical deflection circuit through J3, and turning S2 to the "INT." position. Modulation of the transmitter either by voice or an audio tone will cause the RF carrier band on the screen to vary in height. The pattern may move across the screen or remain stationary if the modulating frequency is an exact multiple of the 50-cycle horizontal sweep frequency.

If a trapezoidal pattern is desired, an amplitude-modulated transmitter output is applied to J2, but S2 is turned to the "EXT." position. An audio voltage which is in phase with the audio being applied to the modulated amplifier stage is fed into J3. With the transmitter unmodulated, no horizontal sweep appears, but the RF output is indicated by a vertical line. Applying 100-per cent modulation should result in the usual trapezoidal pattern. Any phase difference between the sweep and modulator audio will cause oval-shaped traces to appear along the upper and lower edges of the trapezoid. This condition may be corrected by inserting a 100-mf capacitor and a 10,000-megohm potentiometer in series with the ungrounded audio lead to the "HAMSCOPE." This modulation transformer secondary in place, screen or control-grid type modulators, and the plate of a clamp-type modulator, are suitable points to connect one end of a voltage divider from which the audio sweep voltage for the "HAMSCOPE" is obtained. This divider should include: (1) coupling capacitor, (2) fixed resistance and (3) potentiometer, series-connected in that order between the tap-on point and the chassis. Suitable values for these components are:

- Capacitor, 0.005-mfd per megohm of total divider resistance.
- Fixed resistance, 1 megohm per 1000 volts DC potential at the tap-on point.
- Potentiometer, 0.1 megohm. The capacitor should have a working voltage rating equal to 2.5 times the DC voltage, and the fixed resistance should have one resistor for each 300 volts at this point. An adjustable control for the potentiometer arm to J3 through a shielded cable is essential for obtaining a trapezoidal pattern on the HAMSCOPE as may be taken from the output of the separate audio amplifier stage for the voice-controlled break-in circuit with which most SSB receivers are equipped.

RANDOM IDEAS

A smaller chassis, 1 by 10 by 3 inches, may be chosen for a "HAMSCOPE" built around a 1/2-inch or one of the short 3-inch cathode-ray tubes (AMPI, 3UPI). In this narrower chassis, the tube should be placed 3 inches from the power supply wall of the chassis. The test pattern is then seen outside the chassis, preferably in a small box, which also could house the plug-in cork socket. The shorter chassis also permits locating the power transformer directly behind the cathode-ray tube base where it is less likely to cause stray deflection effects. Another variation is to select a chassis large enough to also enclose the meters on the panel, which gives the constructor space to add future accessories to the basic "scope circuit."

If your meter panel has three holes for 2-inch meters, a "HAMSCOPE" using a 2-inch cathode-ray tube may be constructed in a chassis up to 7 inches wide. The "HAMSCOPE" may also be adapted for table mounting by selecting a utility cabinet proportioned to house all components. Again, the principal design problem is locating the power transformer where its stray field does not affect the cathode-ray tube operation.

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