SIGNAL SLICER
Four Tube Receiver Adapter for Improved Reception of AM, NBFM, CW or SSB Signals

Fig. 1: Front view of the Signal Slicer. The input cable is at the left of the unit.

Ever since the SSB, Jr. transmitters appeared in the G-E Ham News my readers have been asking whether it would be possible to design a simplified receiver adapter incorporating the same simple phase-shift network. The Signal Slicer described in this issue is W2KUL's answer to those questions.

—Lighthouse Larry

ANOTHER G-E HAM NEWS
SSB SPECIAL

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The Signal Slicer is a complete receiver adapter for converting the conventional communications receiver having 450-500 kilocycle I-F to a single-sideband receiver. The system utilizes one type 801 triode to mix single-sideband signals to a heterodyning frequency. The output from the mixer is fed to a discriminator which provides a square wave output for a single-sideband receiver. A second 801 triode is used in a cathode follower circuit to drive the 6C6 output amplifier. The 6C6 output is fed to a 2N2141 transistor which provides a single-sideband signal to the receiver. The 2N2141 transistor is used to provide a wider bandwidth and to reduce the gain of the system.

The complete circuit diagram for the Signal Slicer is shown in Fig. 3. As is the case for most equipment described in the Ham News, an effort has been made to utilize commercially available components wherever possible. The built-in power supply is a conventional voltage doubler with a selenium rectifier and a conventional resistance-capacitance filter. No further comment on this portion of the circuit is necessary except to point out that a transformer is used to isolate the circuits from the a-c line in order to prevent interference problems between the adapter and the communications receiver. The fixed-tuned type of adapter consists basically of two detectors (demodulators) supplied by a signal to be received and signals from an oscillator which acts as a local carrier source. The outputs of the adapters are fed to the mixer and the discriminator, respectively, to provide a single-sideband signal for the receiver.
CONSTRUCTION DETAILS

The Signol Slicer is a simple to build, especially if a commercial unit is used for the phase-shift networks.

The entire unit is built to a standard outline by five six-inch utility boxes. Most of the components are mounted on one of the five by six inch removable cover plates. This plate will be referred to as the "top." Refer to the circuit diagram, Fig. 2. Note that two groups of components are shown inside dotted line boxes. The components that are in these two boxes are those that are mounted on the utility boxes.

All the other components are mounted on the top plate, including the phase-shift network assembly which has been indicated in the circuit diagram inside a dotted-line box. This box is marked "P-S Network." Don't confuse this with the two dotted-line boxes in the diagram.

It may be seen that each of the two dotted-line boxes has connection points indicated by a circle with a large dot inside. There are ten of these points. These represent the connections that must be made when the wiring of the box is complete and the wiring of the top plate is complete, and you are assembling the two sections. The leads shown with the screw at each of these points indicate a length of wire which is left long so that the connection may be made after assembly. The photograph of the top plate in Fig. 3 shows these ten wires clearly. The wires are taken through the hole in the bottom of the box and connect to the corresponding points on the box inside. These wires are white and red, as shown in the diagram.

CIRCUIT CONSTANTS

<table>
<thead>
<tr>
<th>Component</th>
<th>Value Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>R1, R2, R3</td>
<td>10 kohm, 1/2 watt</td>
</tr>
<tr>
<td>C1, C2, C3</td>
<td>1000 pf, 0.001 pf</td>
</tr>
<tr>
<td>C4, C5, C6</td>
<td>0.1 mf, 0.01 mf</td>
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<tr>
<td>C7, C8, C9</td>
<td>10 pf, 1 pf</td>
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<tr>
<td>C10, C11</td>
<td>10 pf, 1 pf</td>
</tr>
</tbody>
</table>

Fig. 2. Typical circuit diagram of the Signol Slicer. The components are shown on the top plate, including the phase-shift network assembly which has been indicated in the circuit diagram inside a dotted-line box. This box is marked "P-S Network."
than the photograph shows. Make each one about 5 inches long, then cut them to length when assembling the adapter.

A drawing layout is shown in Figs. 6, 7, and 8 for those who wish to duplicate the original unit exactly. If another type of construction appeals to you, a reasonable duplication of the layout shown is sug-
gested.

With reference to Fig. 4, the power transformer, the selenium rectifier, condensers C1, C2, and resistor R2 are mounted on the rear apron of the utility box. This rear apron also has two grommets mounted on it to handle the a-c line and the input probe cables. On the front apron you mount the pilot lights, power switch S1, relays R1, R2, oscillator tuning control C1, C2, output jack, selector switch S2, condenser C2, and resistors R1 and R2. All the wiring involved with these components can easily be completed if the two removable plates are not in place. Because of tolerances on certain components, the particular 1.5-F of your receiver, it will be to mount C1, C2, and C3 directly to the front apron. To avoid the necessity of removing the hole, the top plate.

The one-inch diameter hole specified for the phase- shift network is used regardless of whether a metal unit or a home-made unit is employed. Details of the home-made unit will be given later.

It is desirable to remove the part from the top lip of the utility box, and from the four edges of the top plate, to ensure good electrical contact when the two parts are joined.

Cables L1, L2, L3, and L4 require explanation. Equal length of four cables are made by making some minor changes on a single National R-100 T.P. choke. This choke has four pins, and each pin becomes a coil. To make the necessary changes, refer to Fig. 3, and proceed as follows. Examine the coil and the individual pins. You will note that one lead on each pin comes off the out-
side of the pin, and the other lead comes from the part of the pin nearest the ceramic support. Open the choke in your hand until it is as shown in Fig. 5, and is that so that the lead from the right-hand end goes to the outside of the farthest-right pin, L4.

Carefully loosen two turns on the inside of L4 and then cut the wire to provide an inch or so of lead from the inside of coil L4. Remove the insulation and the enamel from the end of this lead. The two connect-
sions to coil L1 are now the original output and the inch or so of wire removed from the outside of coil L4.

Repeat this operation on coil L1 to provide leads for coil L1, as well as a connecting lead from L2 to L3. Continue as shown in Fig. 5 until you have L2 in series with L4 and L4, with L3 having separate, un-
connected leads. Tie the end of all wires and solder the connection between L4 and L2. Double-check to make certain that your leads are as shown in Fig. 5, that is, that the leads come from the top of the pin and from the bottom of the pin, where so indicated. This is important, because this determines the direction in which they wind through the form. The entire procedure probably will take less time to do if you have spent reading these instructions on the construction of each of the pin of the National R-100 choke is approximately 425 microinches.

For wiring details of the top of the Signal Stailer, refer to Fig. 6. The coil assembly (L3 through L4) is mounted with the L3 end fastened to a ceramic stand-
off post and the other end connected to one lug of a terminal strip. The common connection of L3 and L4 should be made to the end lug of the terminal strip near the V1, and the two connections from L4 to the next two lugs. Make certain that the coil will clear the lip on the box as the chassis is mounted. The remainder of the wiring is quite straightforward and should present no difficulty. Note that R1 and R2 are actually each made up of a 3000 and a 4000 ohm resistor in series, since 7000 ohm resistors were not immediately available.

Remember to leave several inches of hookup wire at each of the ten connection points, so that the final assembly consists in cutting these wires to length and fig. 3. Detail view of the wiring on the top panel of the Sigmal Stailer.
soldering them to the proper points on the box proper. Obviously, all wiring should be completed on the top plate before the final connections to the box are made. The probe cable should be made of approximately two feet of RG-58/U cable, and Cs soldered to the far end. The cable may be shorter or longer, but try to keep its length under six feet.

**PHASE SHIFT NETWORKS**

The Millen No. 7301 network is a complete and aligned pair of phase-shift networks. To use this unit in the Signal Slicer a slight modification is required to achieve optimum results. Each of the 100,000 ohm precision resistors (Rs and Rp in the circuit) should be parallelled with a 1.5 megohm five percent tolerance 1/4 watt carbon resistor. To do this the case must be taken apart to permit access to the resistors. The photograph (Fig. 5) shows where these resistors have been added to the Millen unit. Make no other changes or adjustments, since these units are pre-aligned at the factory.

The change mentioned is beneficial in taking account of the effective source impedance present by Vs and associated circuits.

If desired, you may make your own phase-shift network unit. The home-made unit pictured in Figs. 10 and 11 is made in a Millen No. 74400 plug-in shield can. The octal base pictured is a part of this unit. The components are supported on a vertically mounted piece of insulating material, such as bakelite, poly, etc. The size of this piece is 3 1/2 by 1 1/2 inches by 3 1/2 inch thick. This is secured to the mounting posts by two small right-angle brackets. The suggested terminal arrangement is pictured quite clearly in Figs. 10 and 11. The fixed mix condensers are mounted on one side of the insulating material, and the other the adjustable trimmers and side. Mount, but do not solder these components in place until the phase-shift networks have been aligned.

The suggested pin connections for a home-made unit are as follows: Pin 1, ground; pins 2, 3 and 4, network 1’s Rs and pins 7 and 8, network 7’s Rp. Electrically the two networks in this case are identical to the ones used in the SSR, Jr., except for the modification noted above for the Millen unit. (For convenience, the symbol numbers indicated in Fig. 2 in this issue are the same as were used in Figs. 1 and 1A of the Vol. 1, No. 6, Hand News describing the SSR, Jr.)*

After completing the phase-shift unit the cans cover off until the adjustments are made and the two 1.5 megohm resistors added across Rs and Rp. Rs and Rp are the wires from pin 1 on the phase-shift unit to one of the mounting posts inside the No. 74400 can to allow grounding. To prevent inadvertent short circuits, a stiff piece of insulating material (such as waxed Kraft paper) should be placed inside the can as is usually done in commercial L-F transformers.

If a home-made phase-shift network is used, an octal socket will be required on the top plate to accommodate the Millen No. 74400 unit. The alignment of the home-made phase-shift network will be discussed later.

**COMPONENT PARTS**

As is true with many equipment designs, there are some component parts in the Signal Slicer that must be chosen carefully. The precision resistors specified are important if optimum results are to be obtained. Continental “Nabisco” 1/4 ohm resistors were used in the original models of the Signal Slicer (where 1/8 ohm resistors are specified) although any other make of equal quality should work equally well.

Some of the other resistors are specified with tolerances of 3% or 10%. This has been done to ensure a piece of equipment which can be capable of being tuned up properly after you complete it. If you desire, use 20% tolerance resistors which you have measured to make certain that they are within the required tolerance. Certainly one or two of these values may vary as much as 20%, but if all the resistors varied this much, in the wrong direction, you might have a much harder job getting the unit to work properly.

The adjustable mix trimmers used in the phase-shift network may be any good grade of trimmer. Those actually used are EJ Mento: T23910 for Cs, and T22310 for Cu; and T22310 for Cs. It is important that you use a National R-160 2 1/2 inch dial for Cu, and Cu, but for the other chokes will undoubtedly work, but the National R-160 is uni-

versally available, and no attempt was made to check the suitability of other five 2 1/2 inch chokes.

Mix condensers should be used where only one is specified. In the other cases the specifications call for "micron" or "micron, ceramic or paper" condensers. In general, the ceramic condensers are smaller in size than the paper condensers and should therefore be used if feasible. Be certain to obtain condensers within the tolerances specified.

The selector switch, Rs, should be of the shorting type. Loud switching transistors will be produced unless this precaution is observed.

The minimum setting specified is capable of handling 150 volts R.M.S. with an aluminum electrolytic condenser rated for only 130 volts R.M.S., and these were not tested as far as the transformers were concerned, although they could handle more than 130 volts R.M.S., which would damage the lower-rated rectifier.

**CIRCUIT ADJUSTMENTS**

With the exception of alignment of the phase-shift networks, all build-up adjustments are minor. Some few adjust-
ments are required in the Signal Slicer. The two
Connect lead 1 (Fig. 12) to the left-hand end of \( R_b \) from \( C_u \). You are now ready to proceed with the alignment.

Connect lead M (Fig. 12) to the left-hand end of \( R_b \) and connect lead N to the left-hand end of \( C_u \). Connect leads 1 and 3 (Fig. 10) to terminal M. Adjust the horizontal and vertical gains on the oscilloscope to produce a line about 1.5 inches long plotted at 60 degrees when the oscillator is set to a frequency of 490 CPS. If the oscilloscope has multigonal internal phase-shift the display will be a slight twist instead of a narrow slanting ellipse. If the latter display appears it is necessary to correct the oscillo-
scope phase shift externally by using an adjustable series resistance (a 10,000 ohm potentiometer) mounted at either the vertical or horizontal input terminal, depending on what correction is necessary.

At any rate, the objective here is to get a straight line at 490 CPS. In some cases a series capacitor may be needed to provide the necessary correction. Try values from 0.05 to 0.005 uf. Now shift lead 1 from the left-hand end of \( R_b \) to the junction of \( R_b \) and \( C_u \).

Adjust the trimmer of \( C_u \) to obtain a circle on the oscilloscope. It will be noted that as this adjustment is made the display will shift from an ellipse "twisting" to one side through a circle or ellipse (with axes parallel to the deflection axes) to an ellipse which tends the other way. If desired or necessary, the appropriate gain control on the oscilloscope may be changed so that a circle instead of a "right" ellipse is obtained at the point of correct adjustment. After changing the gain control on the oscilloscope, check (and correct if necessary) the phase shift on the oscilloscope. Select lead 1 back again on the left-hand end of \( R_b \), and then repeat the setting of \( C_u \) with lead 1 back again on the right-hand end of \( R_b \) and \( C_u \).

In general, always make certain that the oscillo-
scope is used in a phase-corrected manner. A double-check of the deflection plates in the scope are shown, for instance connect lead 2 to the left-
hand end of \( C_u \). If the circle changes to a slanting ellipse, rotate \( C_u \) to produce an ellipse half-way between the ellipse (obtained by switching lead 2) and a circle. Changing lead 2 from the left-hand end of \( C_u \) to the left-hand end of \( R_b \) and back again should give identical skew line to the display when \( C_u \) is set correctly. Failure to get symmetrical ellipses (eg- shaped, or other display) is due to distortion, either in the oscilloscope, the oscillator, the transformer, or the line coupling. Conduct the test at as low a signal level as possible to avoid distortion.

Next, connect lead M to the left-hand end of \( R_b \) and lead N to the right-hand end of \( C_u \). Connect leads 1 and 3 to lead M, set the oscillator frequency to 1300 CPS and correct the scope phase-shift as before, and move lead 1 to the junction of \( R_b \) and \( C_u \). Adjust \( C_u \) for a circle as was done for \( C_u \), using the precautions outlined above.

Now connect lead M to the left-hand end of \( R_b \) and lead N to the right-hand end of \( C_u \). Connect leads 1 and 3 to lead M, set the oscillator frequency to 1320 CPS, correct the scope phase-shift as before, and move lead 1 to the junction of \( R_b \) and \( C_u \). Adjust \( C_u \) to obtain a circle or the oscilloscope, as before.

Repeat the above procedure for the remaining \( R_b \), \( R_a \), and \( C_u \). Use an oscillator frequency of 360 CPS. This completes the alignment of the phase-shift network. None of the preceding align-
ment instructions need be carried out if a Miller No. 70512 network is used.

Re-connect the phase-shift units, connecting the left-hand end of \( R_b \) to \( C_u \), and the left-hand end of \( R_a \) to \( C_u \). Connect the phase-shift units to the base pins of the plug-in can assembly and solder all con-
nections. Mount \( R_b \) and \( R_a \) with the 1.5 megohm resistance previously mentioned, then place the cover tightly in position. It is recommended to use some insulating material inside the can as mentioned pre-
viously.

>AUDIO OSCILLATOR CALIBRATION

It will be noted that the frequency ratio are such that the 13th harmonic of 490 CPS, the 8th harmonic of 1300 CPS and the 3rd harmonic of 360 CPS is produced.
Tune the oscillator (with C3) to zero beat with the received carrier, at which point good, clean audio reproduction should result. If the oscillator will not hold tune to zero beat within the range of C3, replace C3 with different values of capacitance until zero beat can be obtained with C3 near mid-range.

Next, detune the receiver until a beat note of about 1000 CPS is heard. Try detuning first on one side of the meter heterodyne, then on the other, moving the receiver set for the weaker heterodyne. Adjust the appropriate variable (the oscillator switch position) for a minimum heterodyne. Then detune the receiver to the other side of the meter heterodyne, then to the other sideband with the selector switch, and adjust the other potentiometer for a minimum heterodyne. Quite possibly neither minimum will be a complete null at this time.

Adjust C4 for a further reduction in heterodyne strength (reducing the oscillator frequency with C3 if necessary to maintain the same beat note). Adjust the potentiometer (R3 or R4) for still further reduction of heterodyne strength, switch to the other sideband, and listen for a clear carrier beat note of 1000 CPS on the other side of zero beat, and adjust the other potentiometer for a still further increase in heterodyne signal strength. You will find that the sharpness of the minimum becomes more pronounced each time the above process is repeated until C4 is set at the optimum point, just as in balancing a bridge.

Throughout the above adjustment procedure it is assumed that the Signal Slicer is in working order and can be used for the correct settings of the potentiometers just covered. If no signal is heard at any time, or if it is not clear what appears, a thorough trouble-shooting routine is indicated.

OPERATING INFORMATION
After a short time of familiarization the user of the Signal Slicer will find that he listens almost exclusively to one or the other of the sideband positions, rarely ever going back to normal reception. In most uses reception of AM, NBFM, CW and Single-Sideband signals will be greatly improved over conventional methods. Present the Slicer to friends, listen to the carrier with the receiver in the receiving mode, and see these others. Many who use the Slicer take it to conventions and shows, and they all come to the same conclusion — the Slicer is the best Slicer they ever heard.

Since extremely close tuning within 100 CPS is generally necessary, the receiver should have a good bad modulation and good selectivity for the best results. This will usually mean a good 6-volt battery. A total adjustment of the receiver should be made to suit each individual installation, and then your Slicer will be the best for your particular installation.

In general, operate the receiver with the lowest R3 gain control setting that gives comfortable audio output. A overloaded receiver merely overloads the transmitter (perhaps worse) as far as the listener is concerned. A well-calibrated receiver in the receiver may be used in the conventional manner.
Fig. 10. Internal view of the front of the home-made phase-shift network.

Fig. 11. Internal view of the rear of the home-made phase-shift network.

Fig. 12. Temporary layout required to test phase-shift networks.
Notes on the Application of the Signal Slicer

I asked the designer of the Signal Slicer, WIKUJR, to make some general comments on the characteristics and use of this new SSB unit. The following remarks are his.

—Lighthouse Larry

Many hams who do not operate single-sideband "phone stations feel that a single-sideband receiving system would be of no use to them. The fact is, it is probably more useful to them for receiving CW and AM "phone signals than it would be to a SSB enthusiast for receiving SSB signals (although the SSB ham has long since learned the usefulness of such a receiving system).

In other words, if the Signal Slicer is good for SSB "phone reception (I can assure you it is—Ed.) it should be dandy for CW, especially traffic nets, where one or more of the stations may slip away from the crystal filter and turn up missing on a few receivers.

Going a bit further in our thinking, an AM "phone station is just like two single-sideband stations (at the same carrier frequency) that just happen to be transmitting identical signals on opposite sidebands. Therefore, one isn't missing anything if he doesn't listen to one of the signals. The Signal Slicer allows the receiving operator to select which one of the signals he doesn't want to hear. This sounds ridiculous on the face of it, until you consider that one of these "stations is liable to be severely heterodyned, which is a polite way of saying that the QRM on that station is terrible.

If this QRM situation exists, the operator can flip the switch and select the other "phone side, where no heterodyne exists. Obviously, the operator isn't choosy about which side he listens to, as long as he can hear the same thing on either side. This is what is known as broad-banded selectivity with extremely steep side-slope—a rather valuable asset in many situations.

The Signal Slicer, however, goes one step beyond providing just usable selectivity as such. The demodulator is made as nearly distortionless as one could pray for, because all incoming signals are smaller by a factor of some 200 or better than the carrier signal that is supplied by the built-in oscillator to the detector system. This is excited carrier operation with a vengeance, but it certainly pays handsome dividends.

One dividend is the elimination of "mashing up" when receiving a failing signal; another is in reduction of the apparent volume range of a fading signal—so much so that loss of the AVC function in a receive using the Signal Slicer is actually a distinct gain. (But, don't take my word for it—try it yourself.) A word about the demodulator circuit is in order at this point. You might be tempted (even as I was) to use germanium diodes in place of the 6AL5 diode tube, and thus end up with a three-tube SSB Slicer. If you like to listen to noise this simplification is recommended. However, if you want a good SSB receiver adapter, use the 6AL5 or some other thorium diode tube. My physicist friends tell me that the effective noise resistance of germanium diodes is extremely high, compared to a tube like the 6AL5, when you operate at low frequencies with only a few microamperes of dc flowing in the circuit. My friends were correct. The tube is as quiet as a torch lighted with rock wool compared to the germanium diodes. For this particular application, a tube works out better than germanium diodes.

Somebody (perhaps it was Aemp or Confucus, I don't recall) said that the merit of a radio receiver was not in what it would receive, but in what it wouldn't receive. Of course, receivers have on-off switches, but what I mean is, aren't your present receiver receive too much?

I see that you will agree that many, many times, on a single frequency, you have received more signals than you knew what to do with.

So, if phase advance philosophers were right, the Signal Slicer is a mere improver, although it's not perfect. The frequency range over which you can expect to get at least 40 db. signal rejection is controlled by the phase-shift network, and its range is 5000 cycles. Thus, of course, more than covers the plane of most acute hearing, but what about the audio frequency range outside these limits?

At 4000 cycles the signal rejection due to the phase-shift is between 37 db., and at 8000 cycles it is about 30 db. The audio amplifier in the Signal Slicer is deliberately designed to have a response which is down 3 db. at 4000 cycles, 9 db. down at 8000 cycles, etc. (This is at a rate of about 6 db. for each octave.) Thus, at the slightest sacrifice of high fidelity it is far to say that the signal rejection is above 40 db. all the way along, because the audio response has been tailored in an identical way on the low-frequency end of the spectrum.

Add to all of this the 1/F selectivity curve of your receiver and you may begin to see why we think the Signal Slicer is really about as good as anyone might want when you consider the practical aspects of reception. —WIKUJR
Every amateur reading the current amateur radio magazine must be struck by the fact that a large number of manufacturers are advertising that they need engineers. Just why there is a shortage of en-
gineers at this time is a long story, and one that I am not going to discuss here; however, I thought that you, as amateurs, might be interested in the future outlook for engineers. Many of you are about to enter college. Many of you may be engineers that are not following your profession at this time.

Is it a good idea to enter upon a course of engineer-
ing study at this time—will it be profitable for you engineers to return to engineering work? The answer is a reassuring yes. To prove this you only need examine a few figures. In 1930 approximately 30,000 engineers were graduated with B.S. degrees. In 1951, 33,500 graduates are expected in the same category. For 1952, 31,000; for 1953, 17,000; and for 1954 only 13,500 graduates are predicted!

Experts in the field claim that there is need for at least 30,000 engineering graduates per year. The de-
ficiency we will face in 1952, 1953 and 1954 is stagger-
ing. I am giving these facts to encourage all of you who have engineering qualifications to think about taking an engineering course, and to convince those of you that are engineers that you should use your engineering ability where it will do you, and our country, the most good.

The figures quoted above for predicted graduates in engineering came from an editorial written by Mr. R. B. Lory, editor of General Electric Review, which appeared in the April, 1951 issue of this magazine. Of course you knew that General Electric publishes a regular monthly magazine. I have tried, in these columns, to give you a letter idea of our company, but perhaps I have never mentioned the Review.

This magazine has been serving the electrical industry for a good many years. In fact, it will shortly cele-
brate its fiftieth birthday. It is aimed for engineering men, and contains general-interest articles as well as articles dealing with specific design and application problems of current interest.

If you have been searching for something for another good magazine to add to your present technical library, you might consider subscribing to the General Electric Review. You would be in good company, as many of the top engineers in the country are subscribers. The rate, incidentally, is $1.00 per year or $5.00 for two years.

P fellows, believe it or not, the first run of the G-E
Ham News bound volume was a complete success.
So much so, in fact, that we have none left. We are
thinking of making more available, if there is sufficient
demand, but the boss wants me to tell him how many
more to prepare. It would help a lot if I could get an
expression of opinion from my readers. So, again, I
ask your help. If you would like to get a bound volume
of the G-E Ham News, drop me a postcard, and I’ll
see that one of the new batch is reserved for you.

Here are the details on the book, just as a reminder. It
is a cloth bound book containing 214 pages. Every
issue of the G-E Ham News, from Vol. 1 No. 1
through Vol. 1 No. 6, is included. In other words, all
issues from the very first, up to the November-Dec-
ember, 1950 issue. The price is $2.00 postpaid. To
reserve a copy send your postcard to Lighthouse
Lerry, Bldg. 267, General Electric Company, Schen-
ectady 5, New York.

I hope that all of you are familiar with the Civil
Defense organization in your community. Even if
some of us are unable to devote any time or equip-
ment to our local organization, we should be ac-
quainted with the overall plan so that we can act as
operators in time of actual emergency. Most organi-
zations are faced with an operator shortage. This
becomes apparent when you consider that such con-
trol posts, in time of actual trouble, must be manned
24 hours a day, for perhaps four or five days. Our
transmitter in one control point may therefore require
the services of at least three operators, each on
8 hour shifts. Multiply by three the number of trans-
mitters, including mobiles, that you have in your
organization, and you will see just how many opera-
tors really are needed one way or another, to defend
yourself in civil defense.

—Lighthouse Lerry

11
# GERMANIUM DIODES

## CONDENSED SPECIFICATIONS

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Note: For detailed, guaranteed specifications see bulletins X17-04-59 and X57-015.

## INTERCHANGEABILITY CHART

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