OSCIILLATOR-MONITOR

Phone—CW Monitor and Code Practice Oscillator for Novice or Oldtimer

Fig. 1. Rear view of the Oscillator—Monitor removed from its case.

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This monitor enables the c.w. operator to hear his own keying, and it allows the phone operator to constantly listen to his modulated signal. Also, this device can serve as a receiver for audio signals which may be used for code practice work or for c.w. operation. This Oscillator-Monitor would be especially useful to the beginning amateur, as it could be used for code practice work in the beginning, and serve as either a phone or c.w. monitor after the station was built and on the air.

**ELECTRICAL DETAILS**

With reference to the circuit diagram, Fig. 2, it will be seen that a single 6BN6 tube is employed. This tube is a 2-phase miniature tube of recent design, and is known as a gated-tetrode tube. While similar in appearance to regular receiving tubes, the 6BN6 is actually a new species of tube, with several interesting characteristics. For example, this tube is capable of cutting off its own plate current with its own self bias.

In the Oscillator-Monitor circuit the 6BN6 is used in this manner. A portion of the tube operates as an audio oscillator. Another section of the tube is triggered by an incoming r.f. signal so as to allow the audio frequency note to pass through the tube to the output circuit. This action provides monitoring action for c.w. operators. For use as a code-practice oscillator, the keying circuit triggers the tube, rather than the r.f. signals, and again the output circuit receives the audio tone. For photo work, the oscillator section performs the work of action, and the tube acts as an audio amplifier.

For operation, see Fig. 3. When switch S is open, and no r.f. signal is present on grid 3, the following occurs. Grid 3 is supplied with approximately 80 volts through the transformer, T. The resulting current flows through the cathode bias resistor, R3, and the voltage drop across this resistor is a bias sufficient to stop the plate current flow. The bias on grid 1 is adjusted, by means of R5, until grid 1 and grid 2 form a negative-transconductance oscillator. The operating frequency is determined by the constants of C1, C2, and R2.

Now, even though this section is oscillating, no signal output will appear in the plate circuit because the tube is supplied with cutoff bias. However, we can trigger the oscillator by connecting the collector of the tube to grid 3. By placing a key between these two points the audio tone is passed on to the plate circuit and a code oscillator is formed. We can reproduce the same action and again overcome the cutoff bias by means of the r.f. signal. In this case the signal is picked up by the antenna post, is rectified by a germanium diode, and the resulting d.c. bias triggers the tube and passes the audio tone through to the plate circuit. If the r.f. signal picked up is a keyed signal, then the audio tone appearing in the output circuit is a faithful reproduction of the signal being transmitted. Note that this oscillator is actuated from the r.f. signal itself, so that if you hear an audio tone, you know that the transmitter is actually on the air.

For photo monitoring, switch S is closed, which allows the oscillation between grid 1 and 2. Now, the germanium diode, G, acts as a detector to remove the audio intelligence from a phone signal, and the 6BN6 acts as an audio amplifier.

**CONSTRUCTIONAL DETAILS**

The unit shown in the photographs contains no power supply. One could be built to use with the Oscillator-Monitor, if the power requirements are so low that most builders will want to supply power from a source already available, then a 9 to 12 volt battery is required, 80 to 200 volts, and the current drain is approximately 10 ma. For battery operation, 90 volts is recommended.

Referring to the photograph, the unit is built in a 4 by 6 by 8 inch cabinet. The case shown (IEC No. 315) has a handy shelf attached to the front panel which serves as the chassis. Parts placement is not critical, but the layout shown is a tried and tested mechanical arrangement. As shown in Fig. 3, the antenna post, the battery jack (J3), the output jack (J3) and the switch are placed on the front panel. Jack J1 is just below the antenna post.

![Electrical Circuit](image-url)
The cathode bias resistor, $R_b$, is mounted on the chassis and is provided with a screwdriver slot for adjustment. Once this control is set, no further changes are required in the setting unless another tube is used. Fig. 1 shows how the I.F. part of the circuit is mounted above the chassis. All other parts are mounted under the chassis. A hole must be provided in the rear of the cabinet to pass the three-wire power supply.

The antenna post and the keying jack must be insulated from the front panel. This may be accomplished with fiber washers. The output jack does not require insulation, but make certain that condenser $C_2$ connects to the ungrounded terminal of this jack.

The germanium diode, $G$, is connected as indicated. Most diodes are marked with a line around one end. This end is the cathode end, and should connect to $R_1$, as the circuit diagram indicates.

Transformer $T$ is a standard universal output transformer. The secondary is not used. The primary is connected as indicated, using the push-pull connection, with one plate end going to pin 5, the other plate end going to $C_3$, and $C_3$ and $R_1$ connected from the center tap to the plate end which connects to pin 3.

In the circuit diagram you will note that a maximum voltage of 56 volts may exist at the junction of $R_1$ and $R_2$. This is very important. If too much voltage is applied to grid 2, the tube will not operate in the intended manner, and it may be damaged. Resistor $R_5$ is intended to drop the voltage to approximately 40 volts when 500 volts is applied externally. If you intend to use an external source of voltage which is lower than 206 volts, then $R_5$ may be made smaller. For example, if you use 100 volts, $R_5$ could be 1500 ohms. Whatever the external voltage may be, use a value for $R_5$ which will reduce the voltage on the other end of $R_5$ to at least 83 volts, and you may go as low as 50 volts at this point if you wish.

CIRCUIT CONSTANTS

<table>
<thead>
<tr>
<th>Device</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>$C_1$</td>
<td>10 µF 50 volt electrolytic (Sprague TA 510)</td>
</tr>
<tr>
<td>$C_2$</td>
<td>6000 µF mica (see text)</td>
</tr>
<tr>
<td>$C_3$</td>
<td>0.05 µF paper</td>
</tr>
<tr>
<td>$G$</td>
<td>Crystal diode (G.E. 1N148)</td>
</tr>
<tr>
<td>$J$</td>
<td>Open-circuit phone jack</td>
</tr>
<tr>
<td>$R_1$, $R_2$</td>
<td>0.1 megohm, ½ watt</td>
</tr>
<tr>
<td>$R_3$</td>
<td>6.17 megohms, ½ watt</td>
</tr>
<tr>
<td>$R_4$</td>
<td>100-ohm potentiometer</td>
</tr>
<tr>
<td>$R_5$</td>
<td>33,800 ohm, 1 watt (see text)</td>
</tr>
<tr>
<td>$R_6$</td>
<td>21,000 ohm, 3 watt (see text)</td>
</tr>
<tr>
<td>$R_{PC}$</td>
<td>2.5 mA, +12 volts (Amitron No. 4410)</td>
</tr>
<tr>
<td>$S$</td>
<td>SPST toggle switch</td>
</tr>
<tr>
<td>$T$</td>
<td>Universal output transformer (Brooke A-3813)</td>
</tr>
</tbody>
</table>
TUNUP ADJUSTMENTS

After the unit is completed, connect 6.3 volts a. c. between grid and the filament connection wire. Next, connect the high voltage with the negative connection to ground and the positive connection to the load marked 89-300 volts. Make certain that switch 8 is open (in the c.w. position).

Plug a key in the key jack and close the key. Insert a pair of earphones in the output jack, and listen for an audio note. Adjust RC until you get a good, clear note. Try the key to make certain that the note can be transmitted.

If the note is the wrong tone, change the value of C3. A larger value will give a lower tone, and a smaller value will give a higher tone. The value specified will produce a satisfactory tone with the transformer specified, but if another type of transformer is used, it may be necessary to change the value of C3 until a pleasing tone is obtained.

If you do not obtain a tone with the key closed, change the value of R1 to a higher value, say 10,000 ohms. If you obtain a tone regardless of whether the key is closed or not, change R1 to a lower value, and keep decreasing the value of R1 until the tone no longer appears when the key is open.

The unit should now be in operating order. To check the operation as a monitor, place an antenna on the antenna post. This may be a piece of wire whose length depends upon the power of the trans- mittor being monitored. If you are using a low-power transmitter, you may need to run the wire near the antenna feedline in order to get enough energy to trigger the unit. Do not use any more wire for an antenna than is absolutely necessary because it is possible to overload the monitor. When the monitor is overloaded it will not oscillate. When you have the proper amount of pickup, an audio note will appear in the earphones when you key the transmitter.

If the transmitter does not seem to trigger the unit, you may have the germanium diode connected in backwards. Reverse the connections in this case.

In order to make the unit more sensitive to r.f. signals, the r.f. choke may be replaced with a fusel circuit. Generally this will not be necessary, and the circuit as shown should work on almost any amateur band.

For telephone monitoring you may test the unit by modulating your transmitter, and checking to see if the voice is heard. Switch 8 must be closed for telephone monitoring. If you live close to a local broadcasting station you may find that you will hear this station. This is to be expected, because the monitor is working as a monitor for the local broadcast station. If the station is loud enough it will be troublesome, you may have to put a wavert in the antenna circuit.

USING THE OSCILLATOR-MONITOR

When used as a telephone monitor, earphones must be employed. However, when the unit is used as a keying monitor the earphones may be replaced with a small speaker and matching transformer. A uni- versal output transformer with an output connected to the output jack will serve nicely. It is also possible to feed the output of the monitor directly into the audio input of the receiver in use, and thus take advantage of the audio amplifier and speaker in the receiver. In this way the received signal will be heard on the receiver when you are in contact with some amateur, and your own signal will be fed into the receiver through the monitor when you are trans- mitting. No switching is required, although some means must be used to make the receiver insensitive to your own transmitted signal.
How did you solve that last problem that almost had you stumped? Be it about tubes, antennas, circuits, etc., Lighthouse Larry would like to tell the story of the homes about it. Send it in for each "nick" published you win $1 worth of Q-3 Electrical Tools. Mark your turn "Entry Try-Links and Topics" and send it to Lighthouse Larry Tube Division, Bldg. 599, General Electric Company, Schenectady, New York. We Consume, Consume, Consume, General Electric Company, Ltd., Toronto, Ontario. The Company shall have the right, without obligation to publish, and at the above, to publish and use any material submitted to this column. No articles returned.

OLD TUBES AS BLEEDERS

Out-of-date transmitting triodes, or even surplus-purchased triodes can be made to serve quite easily as high-voltage bleeder resistors. A tube with a plate dissipation of fifty watts can be used as a fifty-watt bleeder resistor, for example.

Such tubes may be used as follows: Connect the filament center-top to a self-bias resistor and thence to 6.5 volts. Connect the plate to B plus, and the grid to B minus. Use a space filament transformer to supply the normal filament voltage. The value of the resistor should be such as to permit the tube to be drawn when the power supply is operated. If the current drawn by the plate is sufficient to cause the tube to come on without excessive dissipation, the voltage rating of the tube can be exceeded. For example, a GE-620-A tube has a plate dissipation of 100 watts (the maximum CCR dissipation rating), if used as a bleeder on a 1,500-volt power supply, a 15 ohm, 2-watt resistor will provide a bias of approximately 5 volts, and a current of 100 ma will flow. This is the maximum current which may be drawn and still keep the tube within the dissipation rating at 1050 volts. A larger value of resistance may be used if a lower current is desirable.

When the tube characteristics are unknown, the value of the bias resistor may be determined experimentally. Be sure to provide a resistor of sufficient power rating so that the bleeder current squared times the resistance is well within the resistor wattage rating.

HOMEMADE TOOL FOR TWINLEAD

A very handy cutting and stripping tool for twinlead can be made from a pair of old scissors. Refer to Fig. 6, procure a pair of old household scissors, or an inexpensive pair of children’s scissors. About one inch from the pivot point file or grind a V in each blade, so that when the blades are closed a little bit of light can be seen through the blades. Next, enlarge this area with a die or drill until you have a hole which is slightly larger than the diameter of the twinlead wire. Now, file or grind a slight angle on the sides of the V’s to form a good cutting edge. Finally, grind off the end of the scissors so that there is about one-half inch of blade from the center of the V’s to the end of the blades. The gash in the center of the scissors will act as a guide when you cut the twinlead wire. The front portion is used, with the V in mind, to cut the internal portion of the insulation and to strip the wire. The hole at the middle of the V portion straddles the wire and acts as the stripper. —WETIC

MICROPHONE JACK SHIELD

Here is a simple and economical way to completely shield the microphone input jack on speech amplifiers. Procure one of the small aluminum screw-top cans in which each 35 mm. camera film cartridge comes packed. Place the can on a flat surface and with a utility knife or pair of scissors cut the top of the can down so that the top is flat. Then, drill a hole in the center of the top and mount it directly on the rim of the microphone connector. If desired, a small hole can be punched out with a diamond in the side of the top near the top to permit the wire of a ground lead. If this is done, be sure the hole is above the threaded.

Finally, cut a hole in the center of the bottom of the can, insert a rubber grommet, and you are finished. Plenty of room is provided inside the can for the grid resistor, and the bottom is easily covered when access is desired.

The best way to make the holes in this 35 mm. aluminum stock and avoid jagged edges is to first drill a small hole and then enlarge it with a flat-tipped file. —WITU

CHASSIS LAYOUT TRICK

Here is a trick that I think will save you time when you do that next layout job. Procure a large sheet of graph paper, make a flow chart of your chassis story, and affix this paper to the bare chassis with transparent adhesive tape. Try to get the type of graph paper that is divided by inches and tenths of inches. The uniform markings on the paper act as a guide so that you can get a uniform layout. Also, you can visualize the size of the space occupied by various components, and avoid a crowded layout. The paper also protects the chassis from fingerprints and oil from your tools. —W1IQC

Fig. 6. Scissors arranged as per suggestion of WETIC.
This is not intended to be a day technical dis-
cussion, but merely a clear, easy-to-follow description of how to select the right components for a power supply. For the reasons behind the statements about to be made you are referred to any amateur handbook. A power supply circuit is relatively simple, but unless certain fundamental rules are observed, the results obtained will not always be satisfactory.

The first two questions to be answered are: 1) do I need exceptionally good regulation? and, 2) how much ripple voltage can I tolerate? Both of these questions can be answered simply if you know the use to which the power supply will be put. You will need good regulation if the current drain from the power supply is variable; that is, subject to change while in use. Examples of this sort of service would be power supplied to a class-B oscillator stage, to class-B linear amplifier stages, or to the stages in a.c. transmitter, including the finals stage. On the other hand, if you are supplying voltage to a certain stage in a “phone transmitter,” then regulation is not so important, because the current drain will be constant.

The question on ripple is just as easy to answer. For any stage in a c.w. transmitter, 3% ripple can be tolerated. For any stage in the t.f. section of a phone rig, except the modulated stage, 5% ripple is satisfactory. However, for the modulated stage itself, the power supply should have 0.25% ripple, or less. The audio stages should similarly have less than 0.25% ripple applied to them, except for the class-B modulator, where 5% ripple is satisfactory. In the case of high-gain audio amplifiers, as low as 0.1% ripple is desirable. This figure of 0.1% ripple applies also to power supplies used with rectifiers.

The ripple requirement determines the filtering necessary. A one-section filter ordinarily is used to reduce the ripple to 5%, but it is usually unsatisfac-
tory to try to get much more reduction than that with a one-section filter. Considering full-wave circuits, if the ripple frequency is 120 cycles, five-section ripple will be obtained when the product of inductance times capacity is 4,000 μμμμf. For example, a choke input filter with a 1000 cycle choke and a 50 μμμμf condenser will give 0.1% ripple. To reduce further ripple reduction a multiple-section filter is usually employed. A two-section filter of this sort might consist of an input choke, a condenser, a second choke and another condenser. For example, the choke may be 40 μμμμμμf and the condensers 0.05 μμμμμμf. The choke current then will be 0.8 μμμμμμamp, which is less than the ripple current given above, the overall filtering action will reduce the ripple to less than 0.2% percent. (Most handbook tell you how to calculate the ripple for other combinations of L and C.)

The output voltage should have little or no relation to the output voltage at load and at light load. This is true with regulation and may be obtained by proper selection of the input choke. The minimum value of Inductance at this point which prevents the d.c. output voltage from rising above the average value of the a.c. voltage being rectified is called the critical inductance. Conservative design indicates the use of a choke having a value at least twice the critical inductance. The critical inductance, in henrys, for 120 cycle ripple is determined by dividing the load resistance by 1000. For example, a load of 1000 volts at 40 ma (the bleeder current, or minimum current only) gives a load resistance of 25,000 ohms. In this case, an input choke of 50 henrys would give excellent regulation characteristics (twice the henrys critical inductance).

If you find that this value of inductance is too great a drain on the power supply, a lower value can be used if the bleeder current is increased. For example, an 80 mill bleeder will restrict in a critical inductance of 12.5 henrys, to a 25-henry choke would be desirable. Note that the input choke need have this high value of inductance only at the minimum (bleeder) current. Being chokes are widely used for this reason.

Check the value of the bleeder in your present power supply, and see if you have one which is drawing sufficient current.

At this point in your thinking you are ready to select components for your power supply. You select an input choke of the calculated value with sufficient current rating to handle both the bleeder current and the useful load current. Next, select a transformer to give the required reduction in ripple when used with the input choke already selected (choose these values to avoid resonance at the ripple frequency—your handbook gives details). A second section can be selected if ripple requirements demand it. The bleeder resistor is determined as mentioned in the previous paragraph.

Next, compute the voltage drop across the choke or chokes, and add to this the voltage drop across the rectifier tube. Now add the desired output voltage, and multiply by 1.1 to get the value of a.c. c.m. voltage required from center-tap one side of the transformer. For example, if the load current is 200 ma, the bleeder current 40 ma, and desired output voltage 1000 volts, compute the drop across the chokes due to 240 milliamp current (say this is 24 volts), add the 24 volts (say 15 volts for mercury-vapor tube), and you get 105 volts. Multiply by 1.1 and you get 115 volts. You then look for a transformer with a secondary voltage rating of 114-121-131, and with a current rating of approximately 250 ma. This transformer will supply a d.c. output voltage of 1000 volts and a current of 270 ma, in the power supply you just built.

Some transformers are rated for d.c. output volt-
age rather than for a.c. voltage. In this case the manufac-
turer has already calculated the transformer current. You must then make certain that you know how the transformer is rated before you use it.

—Lighthouse Larry
I recently received a very nice letter from WGCW, president of the Milwaukee Radio Amateurs' Club, in which Paul expressed his appreciation to G.E. for the film, And a Voice Shall Be Heard. To quote him: "The membership was thrilled over it and it certainly presents a vital message to all." This film, prepared by The March of Time for G.E., gives the story of civil defense in Oneida County, New York. The part of the radio amateurs is very well presented.

If you would like to arrange to show this film to your local club, a copy may be borrowed from one of the eighteen G.E. film libraries throughout the country. You can get the address of the nearest library by writing to your local G.E. office, or, by dropping me a note. The running time is approximately 20 minutes, and the film is 16 mm. sound. If you think your local civil defense office would be interested, ask one of the officials to drop in at your show-off—he might wish to arrange to borrow the film for a general civil defense meeting.

Have you seen any lampsheades around your town? The type I'm talking about wouldn't be inside a house, but would be mounted outside on a street pole in some clear area. If there aren't any lightshades inside these lampsheades, then the chances are that they are special radiation detectors, made to determine quickly and accurately the position of an atomic bomb explosion.

These radiation lampsheades have been designed by a group of people in Schenectady, many of them employed in General Electric Co. The Schenectady County Civil Defense authorities have already installed a complete system of these detectors in the County.

The lampsheade determines the height at which a bomb has exploded and the position on the ground near the point directly under the blast. The device is made of short metal tubes, a foot in diameter, smaller at the top than at the bottom, and painted white inside and out. On the inside, numbered vertical lines and horizontal lines are painted. A pointed brass rod projects upward inside the lampsheade.

During an actual bombing, intense heat radiation would search the inside painted surface in relation to the direction of the burst, forming an unshadowed arc, like a new moon. The position of the new moon gives information as to direction and height of the bomb burst. Readings taken from several lampsheades can be correlated to give exact information.

Why talk about lampsheades? Well, it seems to me that a couple of ham mobile rigs would be the ideal way to get the word out to the Civil Defense Center in a hurry, where the plotting can be accurately completed.

Speaking of red-hot temperatures, the engineers in the Schenectady vacuum-tube plant recently had a problem which electronics solved for them. In making transistors a special type of heavy-duty rectif- er) it is necessary to heat some of the tube parts to temperatures of 300° Fahrenheit. At this temperature the graphite is a dazzling white color. The copper unit is able to maintain temperatures in this range with an accuracy of 15 degrees. You probably never want to know the temperature of the pole in your front yard, but if they are running the circuit to tell the controller range, you can read and control this temperature by using this G.E. device.

A news release that passed over my desk recently told of the completion of a number of radar picket posts that have been installed by G.E. for the U.S. Air Force. The location and number of these posts is secret, according to G.E. officials, but some of the unclassified information is quite interesting.

These radar installations are capable of detecting aircraft at long range, and arc now protecting the U.S. and Canada against sneak enemy air attack. Installations in the Arctic regions are housed in rubberized "aerobins" supported entirely by air pressure, and resembling huge pumpkins.

An estimated 400 men are required to operate each installation, on a 24-hour basis. Imagine what a ham could do with an arrangement of that sort, especially if it was designed for DX work! With 400 helpers, one ought to be able to work at least 100 countries in an afternoon. Of course, you'd have to call it a multiple-operator station!

It's a comforting thought to know that these radar installations are now at work protecting our borders—as serving as the outputs of our civil defense organization. What are you doing for civil defense these days?
**GERMANIUM DIODE**

**IN48** is a general-purpose germanium diode which exhibits a medium reverse resistance character and has a medium inverse voltage rating. The mounting position is not specified.

**PHYSICAL DIMENSIONS**

![Diode Diagram]

**MAXIMUM RATINGS**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Peak Inverse Voltage</td>
<td>85 Volts</td>
</tr>
<tr>
<td>Continuous Inverse Voltage</td>
<td>70 Millivolts</td>
</tr>
<tr>
<td>Average Rectified Current</td>
<td>100 Milliamperes</td>
</tr>
<tr>
<td>Surge Current for 1 Second</td>
<td>400 Milliamperes</td>
</tr>
<tr>
<td>Ambient Temperature Range</td>
<td>-50 to +75 Centigrade</td>
</tr>
</tbody>
</table>

**IN48** is designed for most low-current power-rectification applications such as isolation, clipping, switching, and meter rectification.

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**GENERAL ELECTRIC**

**SOMERSET, N. J.**

**THE ELECTRICAL MANUFACTURER OF ELECTRIC TUBES, CIRCUIT BREAKERS, RELAYS, AND OTHER ELECTRICAL EQUIPMENT**

**DIO. R. FLOYD, W3EY**