[redacted]

JUNE—JULY, 1950
VOL. 2—NO. 3

Techni-talk on AM, FM, TV Servicing

KEN-RAD RADIO TUBES

Copyright 1950 by General Electric Company

DEFLECTION CIRCUIT WAVEFORMS AND RF POWER SUPPLIES

A previous article discussed the ways in which a sawtooth wave of voltage can be produced in both vertical and horizontal oscillator circuits. In receivers using electrostatic type picture tubes (usually seven inch types), this sawtooth wave is amplified and applied through coupling capacitors to the deflection plates of the picture tube.

WAVEFORM REQUIRED IN DEFLECTION YOKE

In receivers using electromagnetic type picture tubes, deflection is obtained by placing a deflection yoke containing two sets of coils around the neck of the tube. The magnetic flux, which is developed in these coils, is the result of the current flow. This varies directly with the flow of current through each coil.

If a sawtooth voltage wave is applied to a resistor as shown at the top of Fig. 1A the current through the resistance is in phase with the voltage and the waveshape will remain the same as shown at the bottom of Fig. 1A. If this same sawtooth voltage is applied to a pure inductance as shown in Fig. 1B, the current lags the voltage which results in the current waveform shown below.

In order to obtain a sawtooth waveform of current, through a pure inductance, it is necessary to apply a rectangular voltage wave as shown in Fig. 1C. As we know any coil must have a certain amount of resistance as well as inductance. It is necessary therefore, to combine the sawtooth voltage wave with a rectangular voltage wave similar to that illustrated at the top of Fig. 1D in order to produce the required sawtooth current waveform necessary for linear deflection.

This type of waveform may be obtained by using a resistor in series with the charging capacitor in the plate circuit of either the horizontal or vertical oscillator. Another method is by biasing the output tube so that it is operating near Class B. This causes the sweep output tube to cut off during the most negative excursions of the sawtooth voltage on its grid, and produces the desired modified waveform of voltage in its plate circuit. This waveform will vary in different receivers due to a varying amount of inductance or resistance designed into the circuit.

R-F POWER SUPPLY

Some current model receivers use a separate R-F power supply similar to that shown in Fig. 2. The 6V6-GT tube is a conventional plate tuned oscillator.

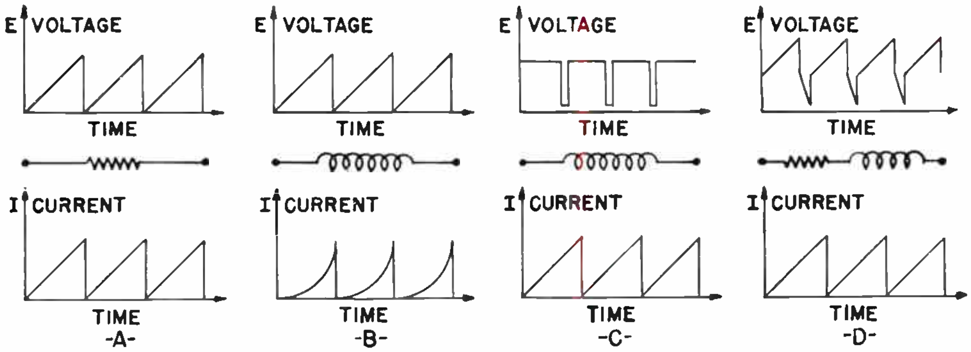


Fig. 1. Different types of voltage waveforms are shown at the top with the resultant current waveforms at the bottom after being applied to either a resistance as in A, an inductance as shown in B and C or a combination of both as shown in D.

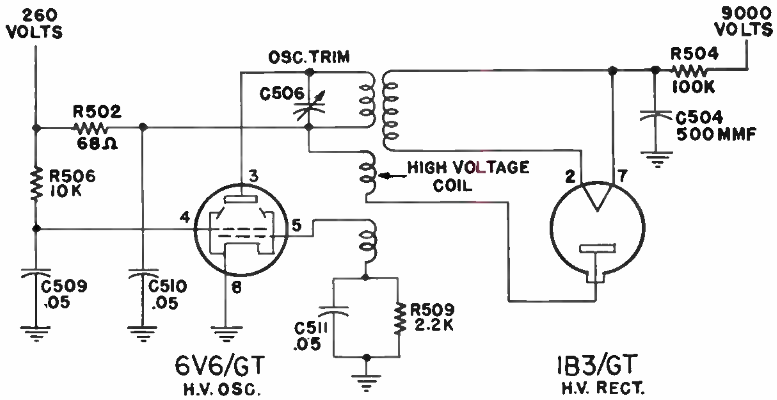


Fig. 2. Typical RF high voltage power supply as used in some receivers.

Due to the high voltage coil containing many more turns than the plate coil, a voltage is developed through autotransformer action of about 9000 volts. This voltage is applied to the plate of a 1B3 type half wave rectifier tube for rectification. The R-C filter composed of C504 and R504 provides sufficient filtering due to the high frequency of the oscillating voltage.

One component which may give a considerable amount of trouble in the r-f type of power supply is the oscillator trimmer, which if leaky may cause flashes or streaks across the screen. Due to the breakdown occurring at a point usually not visible and also only when a high voltage is applied, it may be advisable to try substituting a new variable or a fixed capacitor having approximately the same value whenever this capacitor is suspected.

GERMANIUM DIODES— THEIR GROWING USE IN TV RECEIVERS

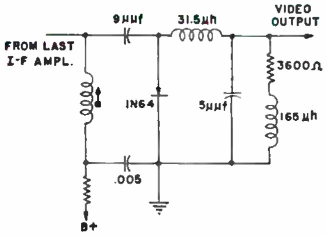


Fig. 1. Type 1N64 germanium diode used as video detector connected across the detector load.

The recent widespread use of germanium diodes in television receivers as well as in a multitude of test circuits and commercial equipments seems to warrant saying more about what they are, how they perform, and how to check them. There's no basic difference between the germanium diode used today and the cat's whisker and galena crystal used on the first radio receivers built to hear the Dempsey-Tunney fights way back when. It's a rectifier. Now, however, germanium is used instead of galena and since the processing of the germanium is controlled, one doesn't have to hunt for a sensitive spot. Hence, the whole works, including the crystal and whisker, is sealed in a tiny case and used as easily as a carbon resistor.

In the process of refining the crystal rectifier, distinction is made between various types so that the right diode can be used for each application. There are four main characteristics which vary between units and their limits determine the various grades. These are: (1) the resistance to forward current flow; (2) the resistance to back current flow; (3) the peak reverse voltage which will cause "breakdown"; and (4) the rectification efficiency of the unit. Ideally, of course, the best unit would be one with zero forward resistance and infinite back resistance. Practically, germanium diodes have resistances of the order of 200 ohms in the forward direction at +1 volt and 30,000 ohms to several megohms resistance in the reverse direction at −50 volts. It should be pointed out, however, that these resistances are a function of the voltage applied to the diode. As an example, a unit with 200 ohms resistance at +1 volt may have a resistance of 500 ohms at +0.5 volts, and 10,000 ohms at +0.1 volt. The back resistance increases as the back voltage is increased from zero until at −10 or −20 volts it reaches a peak and then decreases with a further increase in voltage.

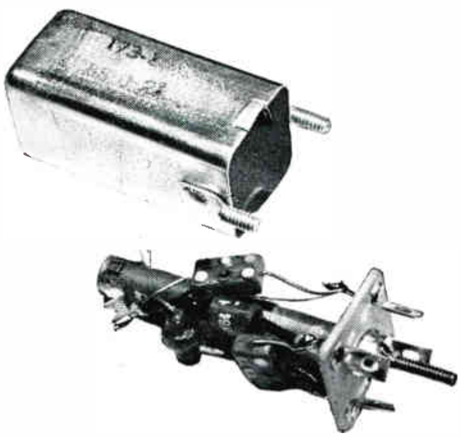


Fig. 3. A typical installation located in tne last video IF transformer can.

As the back voltage is increased, a point is eventually reached at which the current flow rapidly increases and the unit appears to be almost short circuited. This is known as the "breakdown" point. It is interesting to note, however, that a unique feature of germanium is its ability to withstand this breakdown and recover to normal characteristics when the breakdown voltage is removed.

Classifying the diodes according to limits of forward and back resistance and peak inverse voltage is sufficient for the general purpose type of diode used at low frequencies or d-c. The G-E general purpose types listed in order of increasing back resistance and voltage rating are 1N51, 1N48, 1N52, and 1N63. One other type selected for similar characteristics but with special limits to make the diode generally suitable for most TV restorer, clipper, AGC, and sync separating circuits is the 1N65 designated as a television type.

It has been found, however, that such limits do not define a diodes' operation as a high frequency rectifier such as a video detector. That is why Type 1N64 or video detector diode is selected in a 44 mc test circuit similar to an actual TV receiver video detector. Hence, the efficiency of these units is the most important characteristic. The accompanying table lists the above types with their characteristics and includes two JAN types, the 1N69 and 1N70.

In using germanium diodes, it is of course important to observe the correct polarity. One system of marking the units is with a plus and minus sign. The plus sign represents the anode and the minus sign the cathode if they are thought of in terms of vacuum tubes. A newer system being generally adopted is to mark the cathode end with a solid bar. In addition, on G-E types the circuit symbol is imprinted on the case. The arrow therefore represents the anode and the bar the cathode.

The most common application of germanium diodes in television receivers has been as a video detector. Here the diode is applied either in shunt or in series with the detector load as illustrated in Figs. 1 and 2 respectively.

The operation of such circuits has been described in previous issues and there is no basic difference in the theory of operation between the germanium diode and the vacuum tube. Physically, however, the germanium diode is generally located inside the last IF shielding can in order to reduce feedback. Fig. 3 shows a typical installation.

In servicing a television receiver with poor sensitivity or no picture at all, the serviceman, after checking the tubes, may isolate the trouble to the second detector. In order to determine if the germanium diode is the cause of no picture, one lead of the diode should be disconnected and an ohmmeter may be used for a rough check. A relatively low resistance

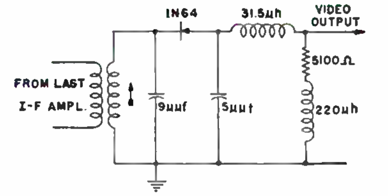


Fig. 2. Type 1N64 germanium diode used as a video detector connected in series with the detector load.

should be noted in one direction (several hundred ohms) and a relatively high resistance (several thousand ohms) noted with the ohmmeter leads reversed. Such a check will *not* determine anything about the diode except whether or not it is rectifying. In order to check for a weak output or low contrast picture, a known good 1N64 diode should be substituted. This, of course, can only be done by soldering the replacement unit in place so that no extra leads or clips are hanging on the circuit. It might also be well to note at this point that while germanium diodes are not "fresh egg fragile," reasonable care should be observed so as not to apply excessive heat to the unit during soldering.

The 1N65 diode as used in d-c restorer, clipper, AGC, or sync separating circuits can easily be checked for actual characteristics. It is only necessary to have a source of d-c voltage, a voltmeter, and a milliameter. To check the back resistance against the specifications, apply −50 volts to the diode (+ to the cathode and — to the anode) and measure the current. The specifications are generally given as a maximum current. The voltage divided by the current read of course is the resistance. Apply 1 volt d-c with the opposite polarity to check the forward resistance. The specification in this case is given as a minimum current.

It should be emphasized here that an ohmmeter should not be used to measure the resistance of the diodes. As explained earlier, the resistance of the diode varies with the voltage applied. An ohmmeter will apply a voltage which will vary depending on the resistance level of the diode. Therefore, the resistance measured will not be measured at the normal 50 volt measuring point in the back direction or 1 volt point in the forward direction and wider variations between units may be apparent than actually exist due to varying voltages being applied.

More and various applications are being found for germanium diodes each day. They are an extremely useful component and should occupy a front drawer in the replacement part cabinet.

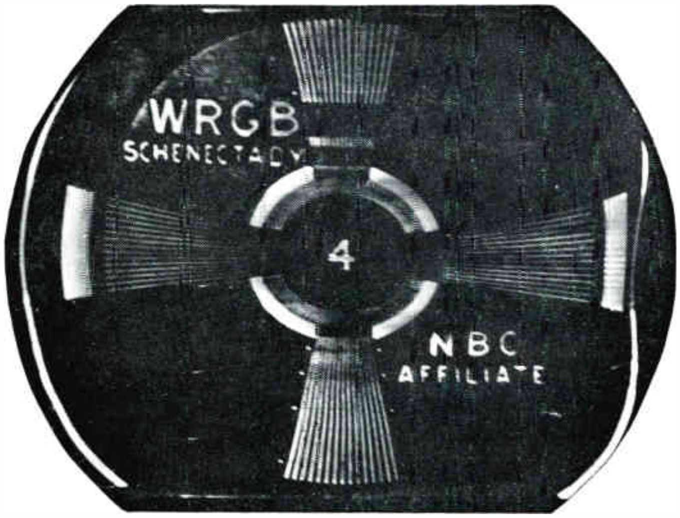
Table 1
GERMANIUM DIODE SPECIFICATIONS AND RATINGS

Type	Specifications at 25 C		Maximum Ratings at 25 C			
	Max. Reverse Current (MA) at −50 V	Min. Forward Current (MA) at +1 V	Peak Inv. Voltage	Av. Rect. Current (MA)	Peak Rect. Current (MA)	Ambient Temp. Range
1N51	1.667	2.5	50	25	100	−50 to +75 C
1N48	.833	4.0	85	50	150	−50 to +75 C
1N52	.150	4.0	85	50	150	−50 to +75 C
1N63	.050	4.0	125	50	150	−50 to +75 C
1N64	Tested for efficiency in 44 MC video detector circuit					
1N65	.250	2.5	85	50	150	−50 to +75 C
*1N69	.850	5.0	75	40	125	−50 to +70 C
*1N70	.410	3.0	125	30	90	−50 to +70 C

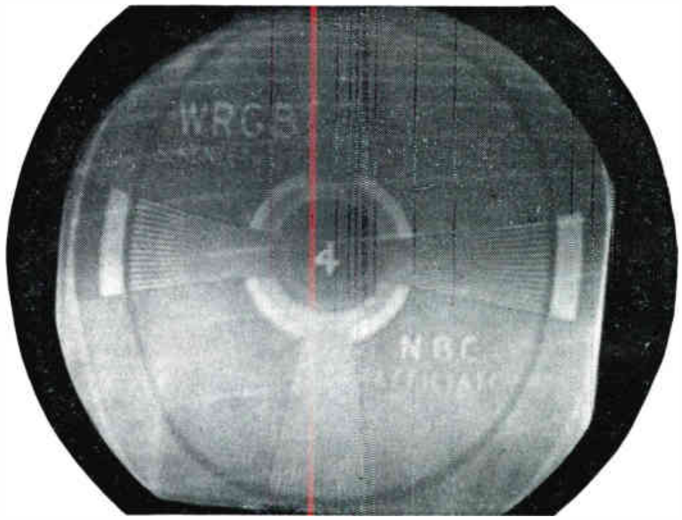
* JAN types.

Tele-Clues

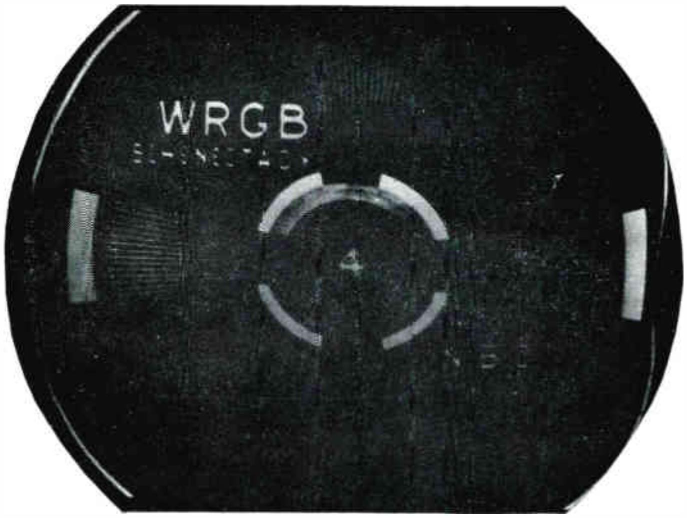
The Tele-Clues in this issue indicate eight more defects which may occur in various circuits of a TV receiver.



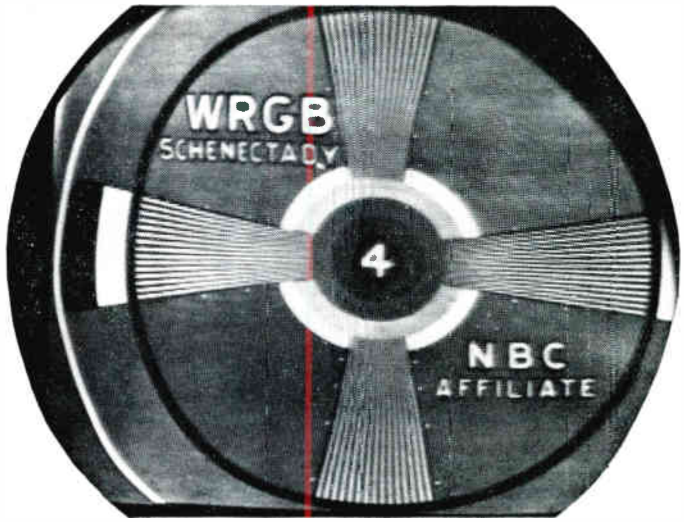
Tele-Clue No. 33. If an open circuit develops in the cathode lead or base connection of the picture tube, the picture will appear dark with retrace lines visible. Rotatian of the brightness control has no effect on the brightness level. The retrace lines are visible because the bias which establishes the blanking level has been removed.



Tele-Clue No. 34. A short between cathode and filament of the picture tube results in a light faded picture with visible retrace lines. The light and dark horizontal areas are caused by the 60 cycle modulation of the cathode voltage. This upsets the normal bias on the picture tube resulting in the brightness control having no visible effect. The reason the retrace lines are visible is also because of the change in bias which establishes the blanking level.

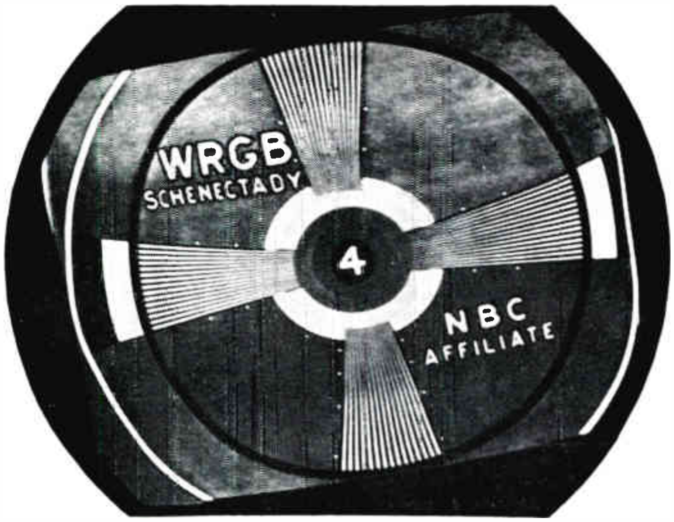


Tele-Clue No. 35. If open circuit develops in the grid No. 2 lead or base connection on the picture tube, the picture will appear dark as shown in this photograph. With B+ removed from this element the number of electrons attracted toward the screen is greatly reduced. The result is either a very dark picture or none at all.

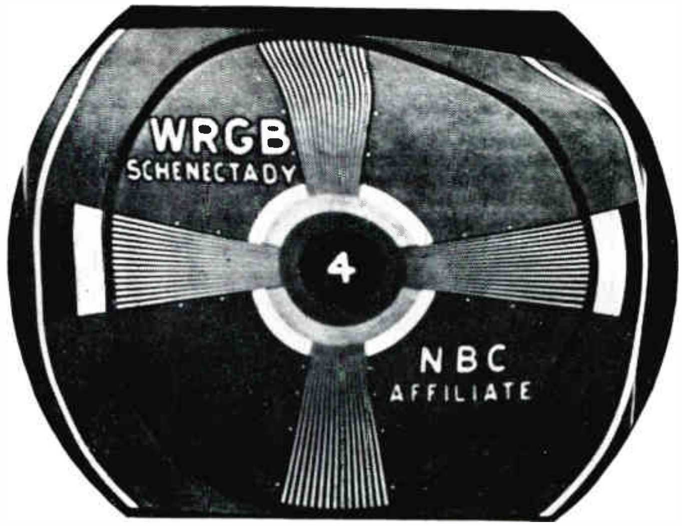


Tele-Clue No. 36. The neck shadow shown in this photograph may be due to:

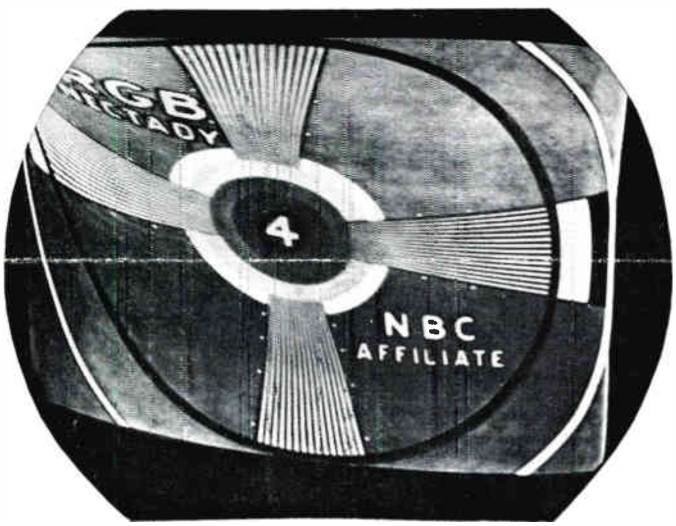
1. The deflection yoke being too far back on the neck of the picture tube. This should be as close to the bell as possible.
2. Ion trap not properly adjusted.
3. Improper positioning of the focus coil.
4. Electron gun which is part of the internal structure of the picture tube improperly positioned. This may be due to damage during shipment and can, in some cases, be corrected by using another ion trap possessing slightly more magnetic flux. Rotating the picture tube may in some cases also help.



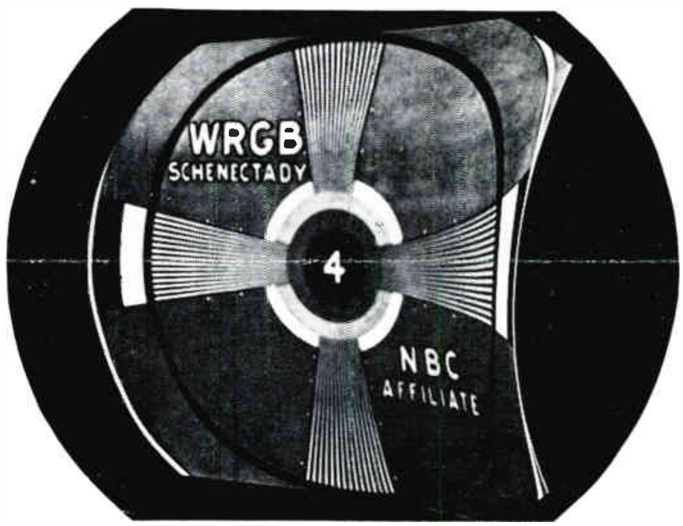
Tele-Clue No. 37. The tipping shown in this photograph is due to the deflection yoke not being properly adjusted. In electrostatic type picture tubes it is necessary to rotate the picture tube, whereas only the deflection yoke need be rotated in electromagnetic types in order to correct this condition.



Tele-Clue No. 38. This illustrates the effect of an external magnetic field, in this instance a 60 cycle transformer, being located too close to the deflection yoke of the picture tube. The top right corner has been pushed down and a waviness is apparent in varying degrees throughout the picture.



Tele-Clue No. 39. This is similar to Tele-Clue No. 38 except that the permanent magnet was located too close to the left side of the picture tube.



Tele-Clue No. 40. A permanent magnet located too close to the right side of the bell of a picture tube will cause a distortion of the sweep and will vary according to the position and strength of the magnet.

TELE-TIPS

11. Arrow on ion traps always points toward face of picture tube.

12. Audio buzz may be due to an arc developing between the contacts and the graphite coating on the bell of the picture tube. This can be remedied by fastening a piece of tinfoil two or three inches square over the contact area using Scotch or adhesive tape.

13. When the correct position of the ion trap is not known, keep the brightness control at as low a setting as possible. Never turn the control full on if a raster isn't visible as the picture tube may be permanently damaged. Try reducing the exterior illumination instead.

14. Sound bars on G.E. receivers or other receivers with a similar type focus control circuit may be caused by the 5000 mfd capacitor between one end of the focus control and B— being open or losing capacity.

15. Audio buzz in G.E. model 800 and 805 receivers having two separate B— buss connections, may be due to capacitor C-278 connected between B1— and B2— being either open or losing capacity.

HOW TO GET THE MOST OUT OF YOUR TEST EQUIPMENT

THE CATHODE-RAY OSCILLOGRAPH—PART 1

The cathode-ray oscillograph or oscilloscope is a versatile instrument that has found its way into practically every service shop. Its advantages over other types of electrical indicating instruments are due to the fact that its only moving part is an electron beam, which having no inertia, is capable of extremely rapid movement and therefore allows the display of actual waveshapes of alternating voltages on its fluorescent screen.

The instrument is composed of five basic units, the cathode-ray tube, power supply, sweep or timing axis oscillator, vertical amplifier and horizontal amplifier. As with all test equipment a thorough understanding of the principles involved in its operation is essential to using it to its best advantage.

CALIBRATING THE OSCILLOGRAPH

As mentioned in paragraph 1, the cathode-ray oscillograph shows on its screen the shape of the voltage wave under test. While the actual shape of the wave is very important it is usually necessary to know something of the amplitude of the voltage as well. Since it is possible to vary the physical size of the picture on the screen merely by turning the vertical and horizontal gain controls of the scope it becomes evident that in order to effectively measure the amplitude of the voltage present we must calibrate the scope for the particular gain setting employed. This may be done by temporarily connecting the vertical plates of the scope to a known value of alternating voltage. It might be well to mention here that for the following examples the scope is set up using its internal linear sweep for the horizontal time base and that the vertical amplifier is connected through its AC or capacitor input terminals and not through its direct coupled input in case your scope is so equipped. A convenient source of AC voltage for calibrating purposes is the 6.3 volt filament circuit of the receiver under test. This may be measured with your AC voltmeter to determine its exact value. Now since we are primarily concerned with peak voltages on our scope it is necessary to convert this 6.3 volts to peak values or, for convenience in measuring, peak-to-peak values. Fig. 1 shows two complete cycles of a 60 cycle alternating voltage. Our AC voltmeter when placed across this voltage source will read 6.3 volts AC. This voltage as read on the meter is the effective or RMS value of the sine wave and in order to convert this to the E peak value as shown in Fig. 1 it is necessary to multiply the meter reading by 1.414 or to obtain the peak-to-peak value multiply the meter reading by 2.828. This gives a value of approximately 17.8 volts.

It is now possible to calibrate the screen in terms of actual peak voltage. Assume that with the particular setting of the vertical gain control being used that the calibrating voltage extends from peak-to-peak over just 10 vertical divisions on the screen. It is then easily seen that if we divide the peak-to-peak voltage of 17.8 volts by the 10 divisions that the voltage per division is 1.78 volts. Then to find the peak value of any other voltage applied to the vertical terminals of the scope for the same gain control setting, and it is important not to change this setting or it will be necessary to repeat the calibration procedure, it is only necessary to count the number of screen divisions over which the unknown voltage extends and multiply it by the volts per division.

This may sound complicated and seem like a lot of trouble, but it is actually very simple and after a bit of practice can be done in much less time than it takes to read about it.

HUM CHECKING

One use of the cathode-ray oscillograph that can with a bit of practice become quite a time saver, is in checking receivers for the ever common complaint of hum. It might be well to emphasize again that it is considerable more difficult to explain the procedures for using a scope than it is to actually do it, and after using one for a time it becomes as easy as using a voltmeter or ohmmeter.

The first place to check for hum troubles is the power supply filter circuit. Use a shielded lead connected to the AC vertical input terminals of the scope and set the sync control so that it will show two or three complete 60 cycle waves, then connect the test leads across the input filter condenser of the power supply. If everything is working properly a picture similar to Fig. 2 should appear on the screen. The actual amplitude of this voltage may vary somewhat from the 30 volts peak shown depending on how widely the filter and power supply differs from the one shown in Fig. 6, on which these tests were made, but will be of a similar shape. If the input filter is open a picture similar to Fig. 3 will appear. It is immediately evident that there is a tremendous difference in the amplitude of these two waves so that exact values are relatively important.

If the input condenser looks OK next connect the scope leads across the output condenser. Here if everything is as it should be, a picture similar to Fig. 4 will result. It may be necessary to increase the vertical gain of the scope in order to satisfactorily inspect this voltage as it should be of a low value. The peak value of this voltage is the most important one as far as hum is concerned and for satisfactory receiver performance should not exceed approximately one per cent which for a 300 volt supply is equal to 3 volts. If the output filter condenser is open, the ripple voltage will be similar to Fig. 5 and again we see that it is widely different from Fig. 4 so that a quick inspection will immediately reveal the condition of the components.

The above checks show the result when the filter components are either in good condition or completely bad. More often the filter capacitors will be somewhere in between these extremes or perhaps have a high leakage current. Any of these conditions will impair the filtering action and the waveshapes will fall in between those shown in the illustrations for the extreme cases. Here experience is the best teacher, but by keeping in mind the characteristics of a good filter it will be apparent when the components deviate from perfect.

In order to perform the above tests in a rapid manner it is well to calibrate your scope before hand and paste a tag on it showing the values of voltage per division for various settings of the vertical gain control. Then it is merely necessary to do a little rapid figuring in your head to know what you are looking at.

While defective power supply filter components are perhaps the most common cause of hum trouble in receivers, there are several other relatively common causes which can be checked and isolated with the aid of the scope. If after checking the power supply the trouble still exists, connect the vertical input of the scope across the voice coil winding of the output transformer. In the usual low impedance winding none or an extremely small amount of A-C voltage should show on the screen when the receiver is operating properly and the AF volume control is wide open. Here it is well to short the antenna terminals or the grid of the mixer tube to ground to prevent RF signals from getting through. Now inspect the waveshape of the hum voltage as seen on the scope and then proceed stage by stage towards the front of the audio system until the hum disappears on the scope. The most convenient place for checking this is across the plate load resistor of each stage. After locating the stage where the hum starts the trouble is very likely to be found in one of the following spots:

1—Heater-cathode short or leakage in the tube itself, particularly where the heater and cathode are at different potentials.
2—Defective stage decoupling components.
3—Defective grid resistor.
4—Defective grid coupling condenser.

These are by no means all the possibilities but should serve as a guide. Remember that the oscilloscope picks up where the ear leaves off in this case and it is much more effective particularly in noting small changes in hum level when you are up against a tough one where more than one trouble is causing the complaint.

Look for further dope in this space on checking AC-DC type power supplies and voltage doubler circuits as well as other uses for your cathode-ray oscillograph in the next issue.

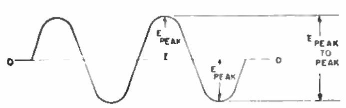


Fig. 1. 60 cycle sine wave calibrating voltage

Fig. 3. 120 cycle ripple voltage at input of condenser input filter—input condenser open

Fig. 5. Riple voltage at output of condenser input filter—output condenser open

Fig. 2. 120 cycle sawtooth ripple voltage at input of condenser input filter—normal operation

Fig. 4. Ripple voltage at output of condenser input filter—normal operation

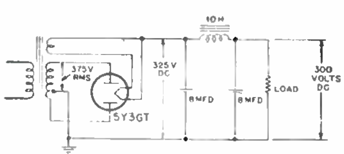


Fig. 6. Circuit on which preceding tests were made

BENCH NOTES

Contributions to this column are solicited. For each question, short cut or chronic-trouble note selected for publication, you will receive $10.00 worth of electronic tubes. In the event of duplicate or similar items, selection will be made by the editor and his decision will be final. Send contributions to The Editor, Techni-Talk, Tube Division, General Electric Company, Schenectady 5, New York.

USE OF CATWALK AS TILE WALK

Here in Southern California we have a lot of homes with tile roofs and it is quite a job to get on one to install a TV antenna, without breaking several of the tile.

One way to get over tile roofs to install TV antennas is to make a catwalk, using one 1 in. x 12 in., with a 2 in. x 4 in. nailed to each outside, lay the 2 x 4 in the valleys of the tile and the use of the 1 x 12 gives you a wide path to walk on, as a rule, two 10 ft. lengths will be sufficient to do the job, connect the mast to a vent pipe.

Grisham Radio Service
1412 Selby Avenue
Los Angeles 24, Calif.

VOLUME CONTROL LIFE EXTENSION

Many sets brought into our shop have had noise in the volume or tone controls. Rather than replace the control we have found the following treatment will generally clear up the noise. First tip the chassis to place the lugs on the control in an upward position. Then, with an eyedropper, put about twenty drops of service cleaner (carbon tetrachloride) on the lugs so that it will run into the control. Immediately rotate the control and continue to turn it for about 30 seconds. We have found that this treatment will smooth the resistance surface and will restore the control for many more hours of playing time. Of course, if the control is badly worn, this treatment will not cure the noise and the control should be changed.

Henry Patton
218 S. Fairview Street
Lansing, Michigan

SOLDERING GUN AS SIGNAL SOURCE

For technicians who use a Weller soldering gun or a similar soldering iron here is a fast method of checking an output transformer and speaker. If the gun is operated very close to the output transformer, it will induce a voltage in the output transformer which will give an audible hum in the speaker.

Arthur C. Tamborini
4275 42nd, St.
San Diego, California

PAPER CLIPS AS COVER FASTENERS

This little trick has solved many a small setback cover problem. On small AC and DC receivers where the card-board back cover screw holes are broken off or cut away, and the backs don't stay properly. Merely take paper clips and fasten them over the card-board corners and run the screws through the tops of the paper clips. I have found this to make a very neat job and the backs really do stay on properly.

Forrest Knaack
502 Park Avenue
Beaver Dam, Wisconsin

OVERCOMING LANDLORD OBJECTIONS

If the landlord won't allow a television antenna on the roof but will allow a radio antenna, that's all you need. A friend of mine was in such a predicament. He was using the built-in antenna with not much success on the high channels. So I got 300 ohm double dipole; the leads were twisted and enough left so that the old glass insulators could be connected, it was then tapped in the center and the lead ran down to the television set. In this case the double dipole was suspended between two clothes-line poles on an apartment roof in the Bronx.

The results were gratifying, Channel 13 and 9 came in very good and 7 and 11 came in much better than before, the low channels also came in good with the exception of Channel 4.

A low channel dipole could be also made and mounted in this way.

Henry R. Ebeling
5501 Bergenline Avenue
West New York, N. J.

MECHANICAL MODULATION

I have noted in a few TV sets the existence of what I would call, *Mechanical Modulation.* In lots of sets there is a lead weight placed over the converter tube in the *Head-End Unit* to prevent a squeal or howl due to loose elements inside the tube. This I found, has worked very well, but in some cases I found that vibration set up by the sound waves coming from the speaker has caused this tube to vibrate with the frequency of the sound waves and in doing so caused the picture to quiver somewhat in the same fashion as when the picture begins to pull out of Horizontal Sync. I find that if you rubber-mount the speaker if possible or use rubber spacers, it was possible to eliminate this condition. In some cases I found it was necessary to relocate the speaker if space permitted. The lead weight did not help at all on the the sets I found this particular trouble in.

Milton A. Kennedy, Jr.
Service Manager
Sadler, Inc.
4506 Freret St.
New Orleans, La.

Build a BIGGER Service Business with

Ken-Rad's all-new fluorescent indoor sign, and

heavy steel outdoor sign.

Available now from your distributor—and ask him to show you the many additional eye-catching items in Ken-Rad's *big* program of business-building aids.

Electronics Department
GENERAL ELECTRIC
Company
Schenectady 5, N. Y.

Sec. 34.66, P.L. & R.
U. S. POSTAGE
PAID
Schenectady, N. Y.
Permit No. 148

Boyd's Radio Service
411 Fredericksburg Rd.
San Antonio 1, Texas
E-223/J-75

6-13-49

POSTMASTER: If addressee has moved and new address is known, notify sender on Form 3547, postage for which is guaranteed. When Form 3547 is sent abandon this mailing. Return only if no correct address is available.