OCTOBER—NOVEMBER 1949
VOL. 1 No. 5

KEN-RAD RADIO TUBES

Techni-talk on AM, FM, TV Servicing

THE VIDEO DETECTOR, A.G.C. and VIDEO AMPLIFIER

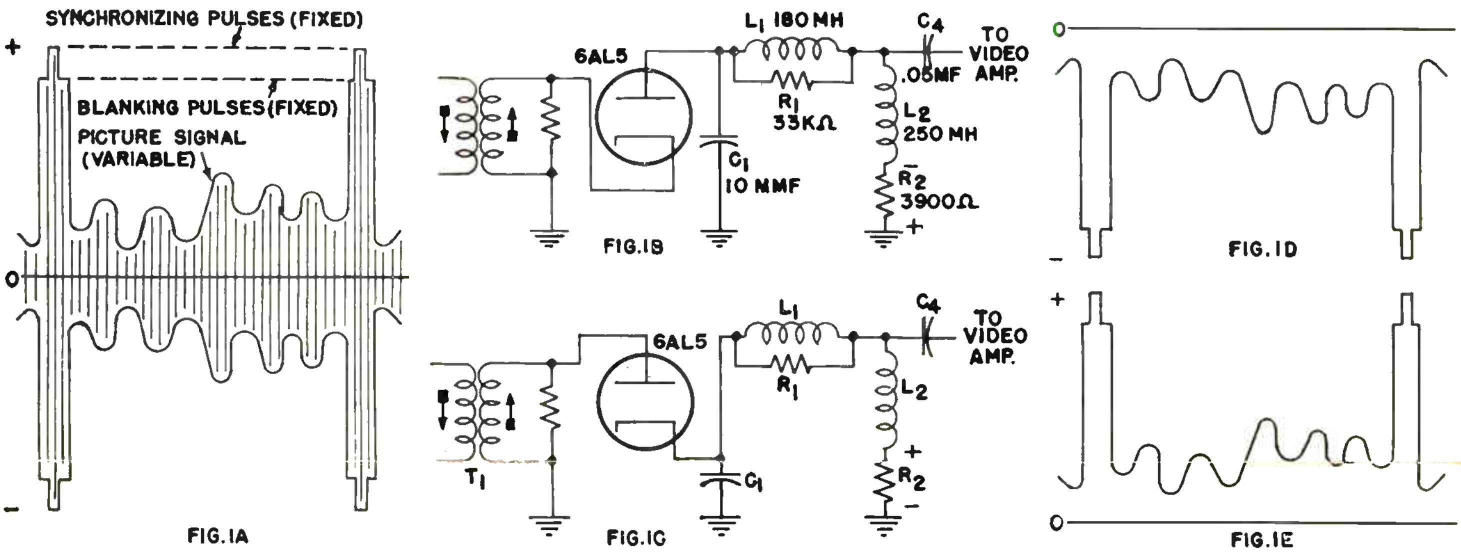


Fig. 1A. Illustrates a typical TV signal for one horizontal line as it would appear at the input to the video detector. Fig. 1B shows a typical video detector circuit with the signal fed into the cathode. Fig. 1D is the wave at the output of the circuit shown in Fig. 1B. Fig. 1C shows the same detector circuit with the signal being fed into the plate and Fig. 1E the resultant wave which has the reverse polarity from Fig. 1D.

In previous issues the television signal has been followed through the head-end and i-f stages up to the video detector. The signal at this point is similar in appearance to Fig. 1A which represents the video carrier modulated by the picture signal and the horizontal synchronizing and blanking pulses. Since this carrier is amplitude modulated, a detector circuit similar to those found in ordinary a.m. receivers is used to demodulate the picture carrier. Two typical detector circuits are shown in Figs. 1B and 1C with the resultant demodulated output signals in Figs. 1D and 1E.

The circuits shown use one half of a 6AL5 tube as the detector although earlier receivers used a 6H6 tube, and in some recent models germanium diodes are used. The signal at the input to the detector will cause current to flow thru the diode only when the plate is positive in respect to the cathode. In Fig. 1B variations of the carrier in a positive direction will make the cathode more positive than the plate, therefore no current will flow. The negative variations, however, will make the cathode more negative than the plate and conversely the plate will be positive in respect to the cathode. Current will flow from the cathode to the plate thru the L1, R1 combination, thru L2 then R2 and back through the secondary of the i-f transformer to the cathode. Any negative variation at the cathode will, due to the current flow, cause a negative variation across the load resistor resulting in the video signal shown in Fig. 1D. If the signal input is to the plate as shown in Fig. 1C only the positive variations will cause current to flow resulting in the video signal shown in Fig. 1E which has a polarity opposite to the one shown in Fig. 1D. Both circuits are used in TV receivers depending upon the number of video amplifier stages, and the point of injection into the picture tube. If the signal is inserted into the picture tube grid, the blanking pulses must be in a negative direction. This is required in order to bias the picture tube to cut-off during the retrace period. If the signal is fed into the cathode of the picture tube the blanking pulses must be in a positive direction as shown in Fig. 1E in order to obtain the same result.

As a signal passes through a vacuum tube there is a phase shift of 180 degrees. Therefore, the signal in Fig. 1D will look like the one shown in Fig. 1E after it passes through one stage of video amplification; and it will return to its original polarity after it passes through two stages. The polarity of the picture signal is ordinarily a design problem and not a service problem. It must be remembered, however, when replacing a germanium diode detector, that the original polarity must be maintained, otherwise white and black objects will be reversed similar to a photographic negative as shown on page 4. Also, synchronization will be extremely critical. The section of a germanium diode marked with a minus sign is similar to the cathode, and the section having a positive sign is equivalent to the plate of a diode tube. In circuit diagrams the arrowhead sign indicates the plate, and the bar represents the cathode.

One of the requirements of a video detector is that the level of its output be approximately flat for all frequencies from about 30 cycles up to 4.0 mc. This is accomplished by the use of a low value load resistor and peaking coils. These peaking coils usually resonate at a frequency slightly above the maximum frequency that it is desired to pass. Shunting resistors similar to R1 in Figs. 1B and 1C are used to prevent the peaking coils from overpeaking the high frequencies, thereby keeping the response curve linear.

The effect of different value load resistors is shown in curves 1, 2 and 3 of Fig. 2. Curves A, B, C and D also in Fig. 2 illustrate the effect of various amounts of peaking inductance added to the plate load. Curve C is sometimes used by manufacturers to overemphasize the higher frequencies, thereby compensating for reduced bandwidth in the r-f or i-f stages.

The result on the picture of changes in the load resistor as well as an open or short in the peaking coils can be visualized by referring both to the curves in Fig. 2 and the test patterns given on page 3.

The value of each component has been carefully selected by the manufacturer, and if replacement is necessary the technician should use resistors and particularly peaking coils of the same value.

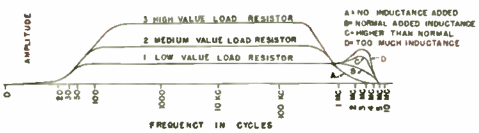


Fig. 2. Frequency response curves for different value load resistors used in video detector and video amplifier circuits. The low value load resistor is normally used in these circuits

AUTOMATIC GAIN CONTROL

Automatic gain control (a.g.c.) circuits in TV receivers serve the same purpose and are similar in operation to automatic volume control (a.v.c.) circuits in a.m. receivers. In areas where reception is possible from several different stations, the signal level of each station will usually vary considerably. Receivers without a.g.c. require readjustment of at least the contrast control and in some cases the horizontal and vertical hold controls, each time a station is changed. Receivers with a.g.c., however, do not usually have to be readjusted due to the gain of the r-f and i-f stages being controlled by the a.g.c. voltage.

The a.g.c. voltage required is one which will vary only when the maximum amplitude of the carrier changes, and not as a result of variations of the picture signal. The synchronizing and blanking pulses are fixed voltage levels to which the carrier returns at the end of each scanning line as illustrated in Fig. 1A. These pulses then can be used as a source of a.g.c. voltage.

There are a number of different types of a.g.c. circuits used in current receivers. Some of these are very simple and others quite complex. The circuit shown in Fig. 3 is one of the simpler types using one half of a 6AL5 tube. The modulated signal which is applied to the detector half of the 6AL5 is also coupled by C1 to the plate of the other half which is used as an a.g.c. rectifier. Current will flow through this part of the tube only during the positive excursions of the carrier. As a result, capacitor C1 charges up to the peak of the applied voltage. During the negative excursions of the carrier the plate is negative in respect to the cathode, and the charge on C1 will discharge through resistor R1 to ground. Due to the time constant of the R1, C1 combination (T = RC = 1000X.0000005 = .0005 sec.) the charge will, if allowed to discharge, remain for about ten horizontal lines. Only a small amount, however, will have discharged when the next pulse restores the original charge. The charge remaining on C1 prevents current from flowing except during the pulse peaks since this charge keeps the plate negative in respect to the cathode except during this period. The filter circuit R2, C2 removes the 15,760-cycle horizontal sync pulse frequency leaving a d-c bias voltage suitable for application to the controlled tubes. If the carrier level increases at the input to the a.g.c. rectifier, more negative voltage will be developed resulting in reduced gain. If the carrier level decreases, less negative voltage will be developed, thereby increasing the gain. The amount of signal which is applied to the picture tube will, therefore, be approximately the same regardless of the signal strength at the input to the r-f amplifier.

Fig. 4 illustrates another very simple but effective method of incorporating a.g.c. This circuit is found in some recent model G-E receivers. The contrast control is connected into the grid return of the sync clipper circuit which provides a source of high bias voltage varying directly with the amplitude of the video carrier. The other end of the contrast control connects to the video detector load resistor. This provides a lower potential bias voltage with the same characteristic and supplies a minimum a.g.c. voltage when operating at weak signal strengths. The a.g.c. voltage determined by the setting of the potentiometer arm is filtered by the C1, R2 combination and fed to the 1st and 2nd i-f amplifier tubes. As the amplitude of the signal decreases the bias also decreases which increases the gain and thereby compensates for the weaker signal.

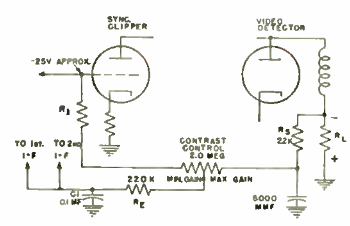


Fig. 4. A.G.C. circuit used in G-E Models 805, 806, 807 and 809 receivers.

VIDEO AMPLIFIERS

The signal at the output of the video detector is not strong enough to drive the picture tube and can be compared with the signal at the output of the ordinary a.m. detector which is not strong enough to drive the speaker. It must therefore, be amplified, and a resistance coupled amplifier similar to those used in a.m. receivers is used for this purpose.

The same frequencies which were so important in the output of the video detector must now pass through one or more stages of video amplification in order to reproduce the original camera signal on the picture tube. It is necessary therefore to amplify all frequencies from about 30 cycles to 4.0 mc linearly and without any appreciable phase difference. This is accomplished, as was the case in the detector circuit, by using low value load resistors and inserting both shunt and series type peaking coils into the plate circuits as shown in Fig. 5.

A low-frequency compensating network is also used in the plate circuit to compensate for loss of low frequencies. The impedance of any capacitor is inversely proportional to frequency. Therefore the impedance of coupling capacitor C3 increases as the frequency decreases, resulting in a reduction in the signal level at the grid of V2. The compensating network C2 and R4 compensates for this by effectively increasing the plate resistance and gain of V1 at low frequencies. As the frequency of the signal decreases the impedance of C2 increases, and the signal which was by-passed to the V1 cathode at the higher frequency must now flow through R4 before reaching the cathode. To clarify this, C2 and R4 can be considered parallel resistors with C2 being variable and R4 fixed. At high frequencies the impedance of C2 is negligible and the V1 load is the total resistance of L2 and R3. As the frequency decreases the impedance of C2 increases. As this impedance increases more and more of the signal voltage will appear across R4. The load resistance for V1 now becomes the total of L2, R3 and R4, thereby increasing the output signal.

At frequencies above 300 cycles the impedance of C3 is negligible and very little signal is lost across it. The low-frequency compensating network is also ineffective at frequencies below 300 cycles and the total load for V1 is L2 plus R3. As the frequency decreases the impedance of C3 increases. This means that C3 and R5 becomes a voltage divider and if we consider C3 as a resistor equal to its impedance the total signal voltage which appears between point "A" and ground will be divided in proportion to the total resistance of C3 and R5. As the impedance of C3 increases, the amount of signal between points "A" and "B" will also increase. Conversely the amount of signal between point "B" and ground will decrease. As it is the signal present at point "B" which is fed to V2, the response curve would fall off rapidly at about 300 cycles. Due, however, to the low-frequency compensating network boosting the amplification of V1 as the frequency decreases, the linearity is extended for the low-frequency end of the response curve. The use of this circuit to extend the low frequencies and

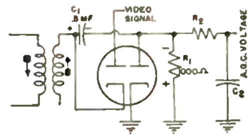


Fig. 3. Typical A.G.C. circuit used in TV receivers

peaking coils to extend the high frequencies results in a curve which is practically linear for all of the frequencies required for good picture detail.

TROUBLE SHOOTING

Trouble which occurs in a TV receiver can usually be recognized by the intelligent interpretation of visual and audible signals. A source of schematic diagrams such as the Rider Television Manuals is invaluable to the technician. These diagrams are important because of the many different types of circuits, as well as tubes, used sometimes by a single manufacturer, to perform a particular function.

In order to localize certain defects the technician must know where the audio and sync signals are taken off as well as whether intercarrier sound is used. As an example suppose that the audio signal is present with a normal raster but no picture and stable retrace lines. This would indicate that the trouble exists between the point where the sync pulses are picked off and the video input to the picture tube. If the sound is normal and the retrace lines cannot be stabilized the defect must be between the two points where *these* signals are taken off.

When the symptoms point to a defect in the detector, a.g.c. or video amplifier circuits the following tests are recommended:

(1) Check tubes and/or substitute new ones.

(2) Check voltages.

(3) Check oscilloscope wave forms with those given on schematic diagram or use VTVM to trace video signal through these circuits.

(4) Check peaking coils for an open circuit.

(5) Check resistors for a change in value.

(6) Check capacitors for:

- (a) shorts with ohmmeter.
- (b) opens by bridging.
- (c) change in capacity of paper or electrolytic types with a condenser tester.

The value of each component in the video detector and video amplifier circuits has been carefully selected to maintain a flat response curve and again if replacement is necessary components having the same values should be used. The technician should always look for trouble in these circuits when loss of either low or high-frequency response is indicated. This same condition can also result from misalignment.

In the next issue d-c restorers and the vertical sweep circuit will be discussed.

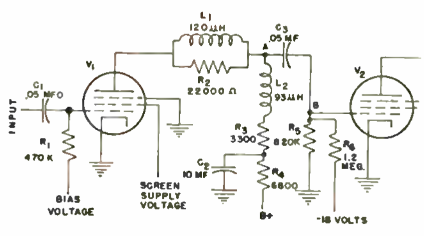
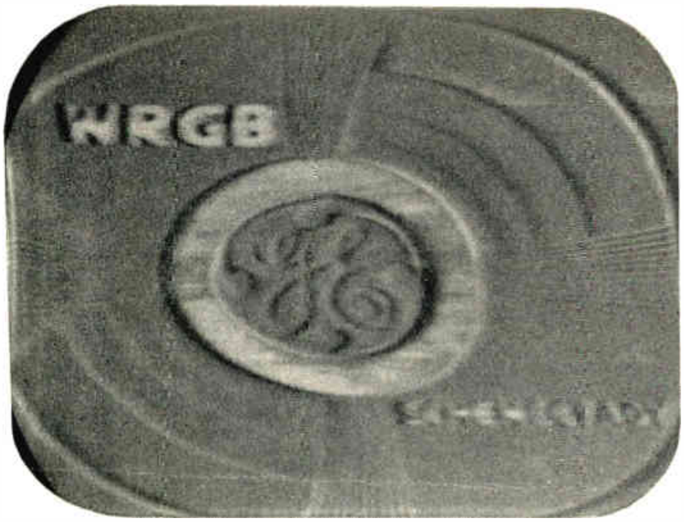
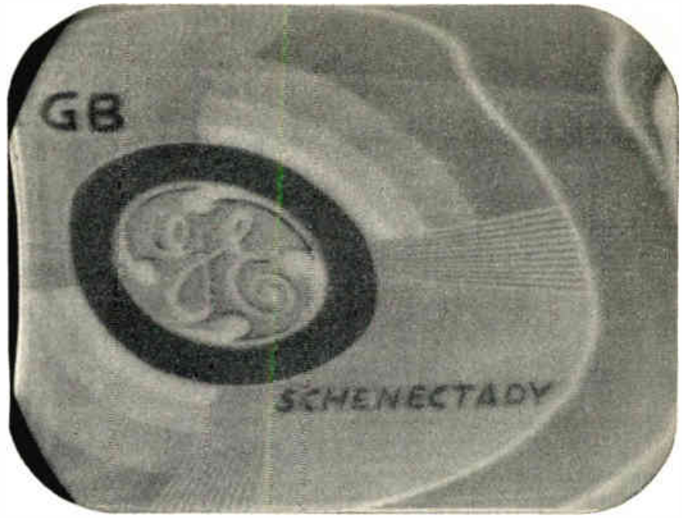


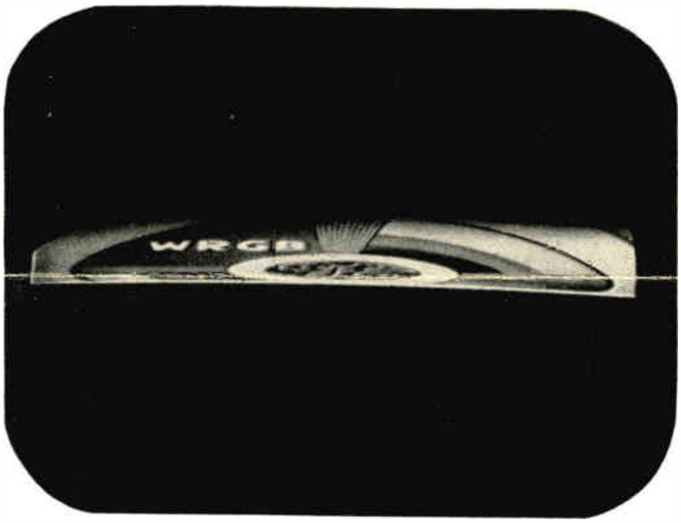
Fig. 5. Typical video amplifier circuit used in TV receivers



Tele-Clue No. 4. This photograph is practically a monotone due to R39 in the plate circuit of V7A in Fig. 2 being open. This supplies the plate voltage for this tube and the results are rather unusual. Due to the tube not amplifying there is a partial but not a complete 180° phase shift. This is evident in the word SCHENECTADY which changes from almost white at the left and center to black at the right. The signal is coupled by the internal grid to plate capacitance of V7A.



Tele-Clue No. 5. The above Tele-Clue illustrates a phase shift of 180° and is the result of leakage across C27 in Fig. 2. To simulate this condition a one megohm resistor was connected across capacitor C27 which resulted in the areas being black which should be white and vice versa. The photograph also indicates the instability of horizontal synchronization which was due to the absence of sync pulses caused by the polarity being reversed.



Tele-Clue No. 6. This photograph illustrates both loss in vertical size and linearity as a result of C297 in the cathode circuit of V10B in Fig. 3 being open. This reduces the amount of saw-tooth current as well as its linearity.

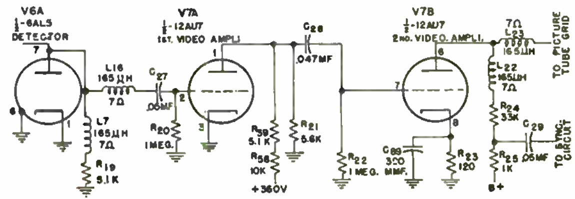
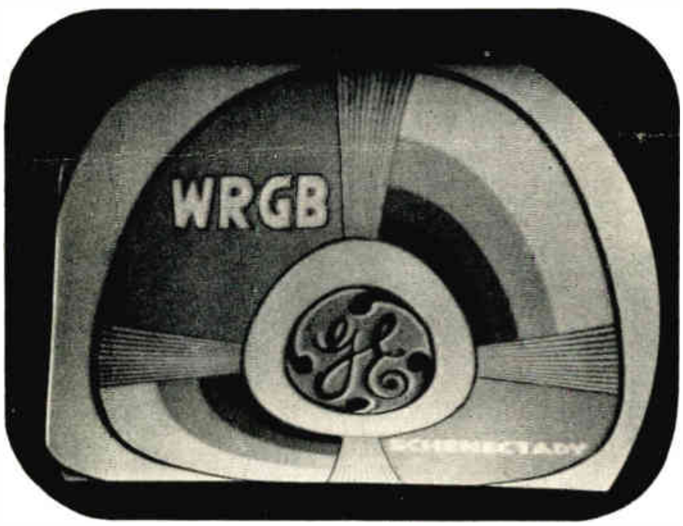
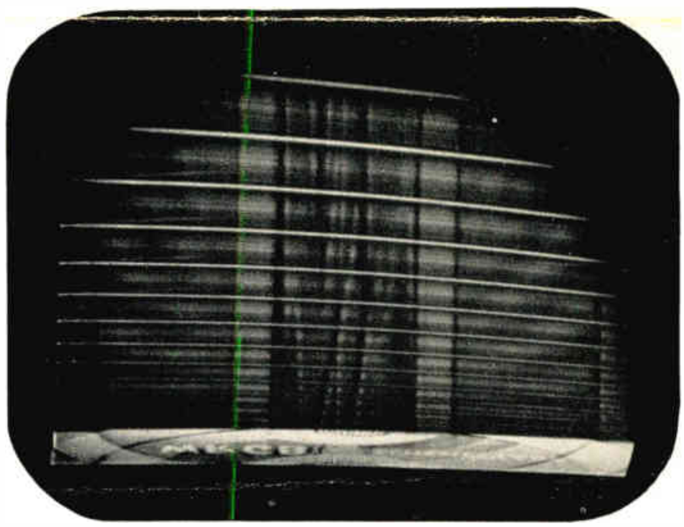


Fig. 2. Video amplifier circuit used in the G-E Model 810 line of receivers



Tele-Clue No. 7. This photograph is quite similar to Tele-Clue No. 6 and is due to the capacity of the same condenser C297 being reduced from 100 mfd to 20 mfd. This also has affected the vertical size and linearity.



Tele-Clue No. 8. The bottom of pattern is reduced in size with an overlap indicated by all letters being reversed. This condition is caused by C305 in Fig. 3 being open. This is the charging capacitor for the output half of the vertical sweep generator. A small amount of saw-tooth voltage is probably being developed by either the tube capacitance or the charge on capacitor C297.

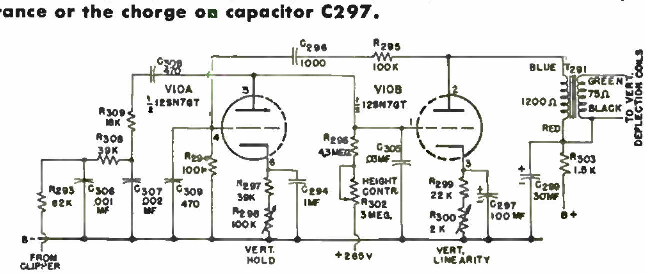
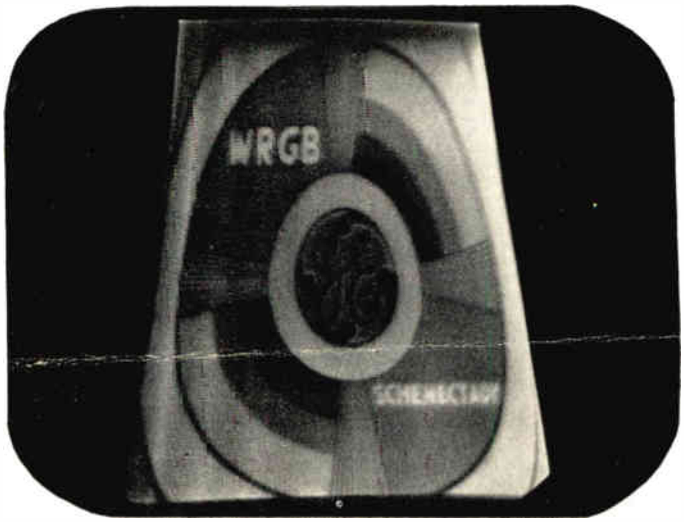


Fig. 3. The vertical sweep generator and output section of G-E Models 805, 806, 807 and 809 receivers

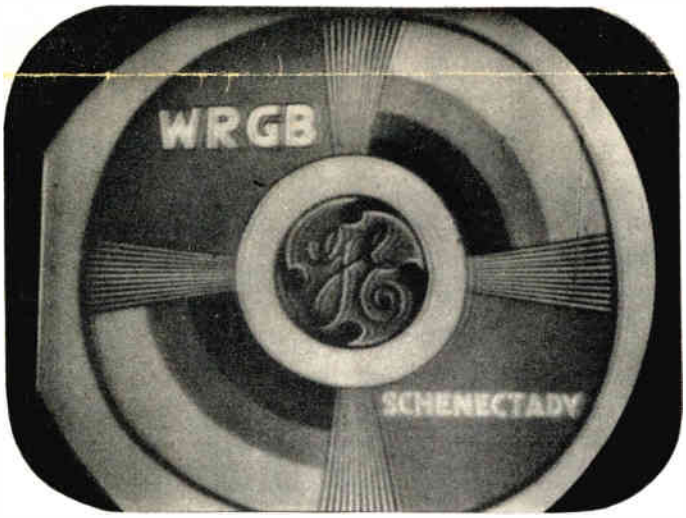
Tele-Clues

In this issue we are including the first of a series of picture Tele-clues indicating the more frequent TV circuit defects. The imperfections apparent in these unretouched photographs will normally be the result of components which are open, shorted or have changed value. In most cases the Tele-clues selected will indicate defects which apply to TV receivers in general and not to any one make. These photographs will help you to identify the circuit and in many cases the component which is defective. For future reference, we suggest that all issues of Techni-talk be filed in a three ring binder since the left-hand margin has been widened so that standard punching will not destroy the text.

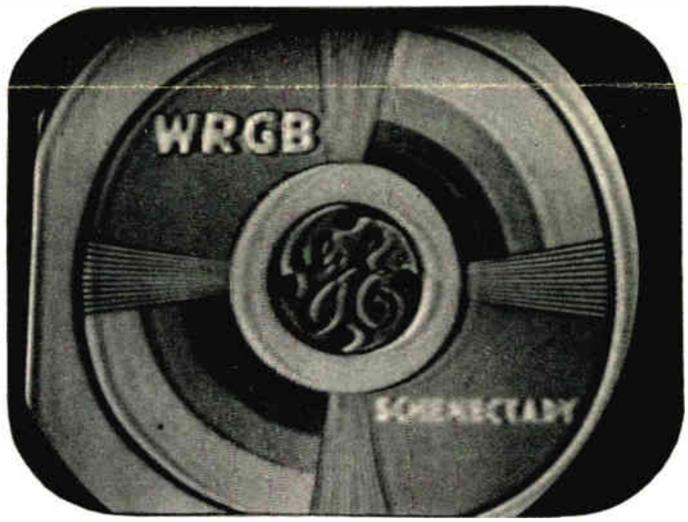
The three Tele-clues appearing on this page illustrate a short in the deflection yoke and two characteristic defects in the video detector and video amplifier circuits. On the top of Page 4 are two more Tele-clues indicating additional trouble in the video amplifier section. The other three are the result of defective components in the vertical oscillator section. These Tele-clues illustrate only a few defects which appear as a result of a change in, or the failure of a component within a specific circuit. Future issues will contain Tele-clues indicating additional defects in these same sections as well as other sections of TV receivers.



Tele-Clue No. 1. The keystone effect shown here illustrates a short in the deflection yoke. The width has been reduced to show the complete raster. A tapering of the sides indicates that the short is in one of the horizontal deflection coils. A tapering of the top and bottom would indicate a short in the vertical deflection coils. This condition is caused by one or more turns being shorted within the deflection yoke and probably will not be indicated by a resistance check. These shorts usually occur deep within the coil and cannot be repaired, therefore replacement of the complete yoke is necessary.



Tele-Clue No. 2. The white trailing reflections indicate phase shift and poor low-frequency response. This condition results from a reduction in the resistance of either the detector load resistor R265 or the video amplifier load resistance R275. This photograph was obtained by reducing R265 from 5100 ohms to 1000 ohms. Any reduction of the load resistance in these circuits will affect the amplification of all frequencies. However, due to the peaking coils, the higher frequencies will not be affected as much as the lower frequencies. This is illustrated in the load resistance curves appearing on page 2. Fig. 1 is a standard circuit which, except for slight variations in component values, is used in many TV receivers. This condition can also be due to misalignment caused by the picture carrier being more than 50% down. This condition could also be due to a defect in the transmitted signal. It is suggested therefore, that another channel or receiver be used for comparison.



Tele-Clue No. 3. The above photograph indicates phase shift and a loss of both high- and low-frequency response and is due to resistor R275 in Fig. 1 being changed to 20,000 ohms. The loss of high frequencies is indicated by a reduction in definition. The reflections and smearing indicate phase shift and loss of low frequencies.

The load resistor curves on page 2 also illustrate this condition. A very similar condition will result if R265 or R267 increases in value or if C257 is either open or loses capacity.

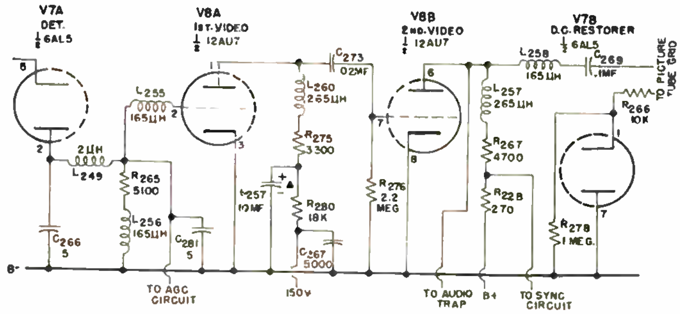


Fig. 1. This circuit, although specifically used in G-E Models 805, 806, 807 and 809 receivers, is typical of detector and video amplifier circuits used generally in TV receivers

HOW TO GET THE MOST OUT OF YOUR TEST EQUIPMENT

THE VACUUM TUBE VOLTMETER

The vacuum tube voltmeter is an instrument that is becoming more and more popular with the technician, particularly in servicing modern f.m. and TV receivers.

Basically the v.t.v.m. is an instrument which operates by virtue of the fact that a change in grid voltage applied to a vacuum tube causes a change in plate current. Thus we see that by applying the voltage to be measured to the grid of a vacuum tube we can measure the plate current change and in a properly calibrated instrument can so determine the voltage we wish to measure.

This method of voltage measurement has several very decided advantages over more conventional methods, particularly in electronic work. The v.t.v.m.'s outstanding advantages are (a) high input resistance, which means that negligible power will be drawn from the circuit under test, (b) ability to measure in some instruments both a-c and d-c by means of the rectification in the tube, and (c) ability to measure with accuracy voltages ranging in frequency from d-c to r-f voltages extending up through the f.m. and TV spectrum. One additional advantage that the v.t.v.m. has over conventional instruments is that overloads of many times the full-scale value are not usually harmful due to the limiting action of the amplifiers. This of course does not mean that ordinary care should not be used as other parts such as range switches, condensers, etc. may be harmed even though the meter movement itself is not damaged.

There are several basic types of v.t.v.m.'s which are illustrated below. The circuit in Fig. 1 is a simple shunt diode v.m. useful for measuring peak alternating or pulsating d-c voltages and has little application in service work. The circuit in Fig. 2 is similar but has the added advantage of the amplification properties of the triode tube making it possible to use a less sensitive meter. The slide-back v.t.v.m. illustrated in Fig. 3 is useful for measuring the peak value of an a-c voltage up through the lower radio frequencies as well as d-c voltages. It is an instrument which can be set up breadboard fashion and which will give good accuracy. Any low mu triode may be used with a plate voltage of from 100 to 200 volts d-c. E_1 then should be approximately 5 to 10 volts and E_2 should be equal to or slightly greater than the maximum voltage to be measured. A 0–10 ma meter may be used in the plate circuit. To use the instrument, set E_1 by means of R_1 to a value that nearly biases the tube to cutoff, in other words causes the plate current to read not more than 0.5 ma when V is set at zero and the input is shorted out. Then making sure that E_2 is set at the maximum value, apply the voltage to be measured to the input and decrease R_2 until the plate current again reads the original value of 0.5 ma. The reading of V, which may be any d-c voltmeter, will then be equal to the peak value of the unknown voltage. This arrangement can often be used to advantage to measure receiver a.v.c. voltages and other voltages from a high impedance source when your regular v.t.v.m. is not available.

The balanced d-c amplifier circuit shown in Fig. 4 is often encountered in commercial v.t.v.m.'s of the type most suitable for service work. Briefly this circuit consists of two triodes, or in some cases a single dual triode such as a 6SN7, adjusted so that the plate current is equal in both tubes and the d.c. voltage from plate to plate is zero when no voltage is applied to the test prod. When a d.c. voltage is impressed between the probe and the ground or common lead it changes the bias on one tube and thus changes the plate current drawn by that tube, making the voltage drop across R_1 different from that across R_3 and therefore places a voltage difference between the two plates, causing meter M to register. The variable resistor, R_2, usually a potentiometer, is used to balance the instrument to zero by compensating for any slight differences in R_1 and R_3 and in the tubes. R_4 is a calibrating resistor which needs adjusting only after changing tubes or making other repairs. The voltage range multiplier consisting of R_9 and R_{10} is usually of from 10 to 20 megohms in resistance and this determines the load that the v.t.v.m. places on the circuit under test. R_{10} is built into the hot probe to help minimize the capacity effect of the long test lead and thus allows the instrument to be used to make dynamic voltage measurements in circuits carrying oscillator or signal voltages. The instrument may be used to measure either positive or negative voltages by reversing the polarity of meter M in the circuit, usually accomplished by means of a selector switch making it unnecessary to reverse the test leads. A variation of this in use on some instruments is to use a zero center meter at M with the polarity marked on the face. This is advantageous when measuring voltages of unknown polarity and in lining up discriminator circuits in f.m. receivers but has the disadvantage that the scale is compressed to half of the meter face unless twice the number of ranges are provided.

In addition to the fundamental circuit shown in Fig. 4, the instruments are provided with a-c and r-f probes to allow these voltages to be measured. These probes may consist of a germanium crystal or a diode tube which acts as a rectifier. In the usual type these are designed on the end of a test lead to provide a low capacity to ground and serve to rectify the a-c voltage so that the v.t.v.m. functions as described above by measuring the rectified d.c. provided by the probe. The modern probe using a crystal or special diode rectifier is capable of providing good accuracy up to 100 mc. and sometimes higher with a capacity to ground of only 3 or 4 mmfd. making them suitable for signal tracing and other applications as described below. The commercial v.t.v.m. also provides a wide range ohmmeter circuit by making use of its sensitivity and light circuit loading features. This may be accomplished by placing the unknown resistance in series with a small battery and a standard resistance and measuring the voltage drop across the unknown. In this manner accurate measurements may be made from a fraction of an ohm to 1000 megohms and higher which is a considerably greater range than the usual ohmmeter is capable of.

So we see from the above description that the v.t.v.m. is capable of performing tests that are not possible by any other simple means. As mentioned under the slide-back v.t.v.m. it is possible to measure the a.v.c. voltages in receivers quite accurately, a measurement not possible with conventional voltmeters due to the several megohms of resistance in most a.v.c. circuits. This incidentally makes a convenient point for obtaining an output reading when lining up the r-f and i-f stages of receivers.

Another very useful check which can be made in receivers is the strength of the local oscillator signal. This can be determined in relative terms at least by measuring the value of the grid voltage at the oscillator tube socket while tuning the receiver across the band. This check will often point to the source of trouble in a receiver that is dead over part of its tuning range. Try replacing the oscillator tube if there is any wide variation in the oscillator grid voltage when making the above test. As explained in Vol. 1—No. 2 of Techni-talk some types of checkers will not always tell the true merit of a tube for certain applications.

Since the high impedance of the vtvm. allows it to be placed directly on the grid of a tube without seriously disturbing the circuit, it is possible to tell whether or not a tube is gassy. A gassy tube will cause a positive voltage to appear across the grid resistor instead of the usual negative voltage. This same condition can exist however, due to a leaky coupling condenser so don't go discarding all your tubes without first checking that condenser for leakage which can be done by using the high resistance range of your v.t.v.m. ohmmeter.

The v.t.v.m. can also help you line up a TV antenna by using it as a signal strength measuring device connected across the load resistor of the video detector in the TV set.

If you get a receiver in the shop that lacks pep and the tubes check OK, connect your signal generator to the input of the receiver and use your v.t.v.m. with the r-f probe as a signal tracer. A rough check can be made of the gain of each stage by measuring the voltage of the signal input to the grid and the signal voltage out of the stage. This may be difficult in the first stages unless a very sensitive meter is used or high signal levels are available from the generator. This is often a time saver in localizing the trouble when regular signal tracing equipment is not available.

As with any other piece of test equipment, the v.t.v.m. should be used with caution to protect both the instrument and yourself. Remember that when measuring unknown voltages, always start with the range switch in the highest position and then decrease it in steps until you get a suitable reading. High voltages in receivers can be dangerous. Always turn the receiver off and discharge the condensers before making connections to the wiring, then turn the set on and read the meter. Keep one hand in your pocket and remember that even if a shock isn't fatal, when you jump you may pull the set off the bench and have a real repair job on your hands that won't bring in any profits.

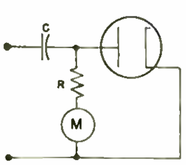


Fig. 1. Simple shunt diode Type VTVM

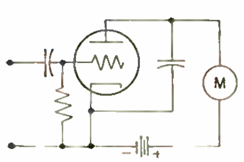


Fig. 2. Simple triode Type VTVM

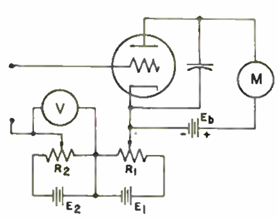


Fig. 3. Slide-back Type VTVM

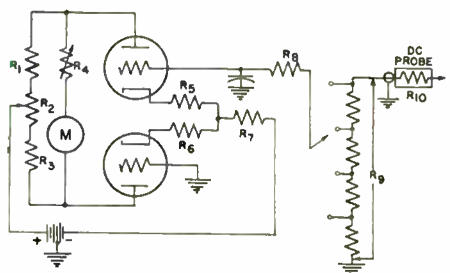


Fig. 4. Balanced d-c amplifier Type VTVM

BENCH NOTES

Contributions to this column are solicited. For each question, shortcut 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.

SOCKET REPAIR

If you've ever lost fifteen or twenty minutes of valuable time replacing an octal bakelite tube socket because one of the pins broke off, this will save your time: Most octal bakelite tube sockets have inserted in the eight slots a flat lug-shaped metal contact. The tube pins fit in one end, the soldered connections go on the other end. They break easily if bent too often. Instead of replacing the entire socket, push out the broken contact through the top with a small knife blade, and insert a new one. Twist slightly at the bottom to keep it in place. Where do you get the new pin? . . . from vacant pins on the same socket, or from other equipment. More than likely there'll be an old one in the junk box. This method is much easier than digging into a compact AC-DC set to replace the socket.

W. S. Candler, Fredericksburg, Va.

MULTIPLE TV ANTENNA CONNECTION

A standard 3-way light plug (female) as used on 110 volt extension cords makes an excellent terminal block for a multiple t v antenna installation. A short piece of 300 ohm lead is attached from the set or booster to the plug. Up to 3 antennas can be connected together at one time by attaching standard male light plugs to their ends. This switch or plugging arrangement does not have the capacity effect of a wafer switch and is ideal for experimental purposes and for quick change in balancing several antenna leads in fringe area installations.

H. L. Crawford, South Bend, Indiana

PLASTIC STUD REPAIR

When a General Electric Model 160 radio has been handled roughly, frequently the speaker grille will become loose. When this happens, it generally can be attributed to the small plastic mounting studs having been broken off. Usually the break will occur at the point where the retaining clip contacts the stud, leaving a stud that is just barely too short to fasten the clip to. A speedy repair is to touch the remaining portion of the stud with the soldering iron, thereby melting it to a putty-like consistency, and a gentle pressure toward the center of the speaker grille will cause the plastic to overlap the grille frame. The plastic hardens almost immediately with the removal of the heat and makes a neater, faster repair than cement. In the event a stud is too short, merely take one of the broken pieces (many are still held by the clips) and use it to increase the mass of the stud. Be sure to heat sufficiently so the two pieces run together.

Henry C. Gates, San Antonio, Texas

DENT REMOVAL

An easy way to take dents out of delicate tinfoil diaphragms on mikes and some types of speakers is to use scotch tape. You will find the dents will pop out very easily. Use very lightly though.

O. Quatrella, Hatry & Young
Bridgeport, Connecticut

PICTURE TUBES
Handle with Care

The following bulletin on the handling of picture tubes has recently been prepared and released by the RMA Cathode Ray Safety Committee. Because of the importance of this subject we suggest that every television technician carefully study and follow each of the seven safety rules given.

"Servicemen who install or service television receivers have a great responsibility both to the public and to the industry, as well as a personal interest, in seeing to it that no accident due to carelessness or negligence will occur to arouse fear of this new instrument of home entertainment.

"The television receiver, largely because of the presence of the picture tube, contains certain potential hazards that were not in the radio set. But these hazards need not cause anyone apprehension providing a few simple precautionary rules are observed by the servicemen. *The picture tube is not dangerous if properly handled.*

"There are two ways in which injury can occur if a picture tube is carelessly handled either in a service shop or at a set owner's home. One is from the breakage of the picture tube possibly resulting in flying glass, and the other is from high voltage shock. Most trained servicemen know how to guard against shocks, but the breakage of picture tubes can result from carelessness regardless of the serviceman's experience.

"Any serviceman can be sure that he will neither injure himself nor cause injury to someone else by following a few simple safety rules. These are:

1. Don't expose picture tube until you are ready to use it.
2. Always wear goggles when handling a naked tube.
3. Keep people away at a safe distance when a picture tube is exposed.
4. Place the used tube in the carton which contained the new tube and *take it away.*
5. Always keep the picture tube in the protective container whenever possible. Always place an exposed tube on some sort of clean soft padding when necessary to set it down.
6. Don't leave any picture tubes lying around. There are two safe ways of disposing used tubes:
   (a) Place the old tube in a shipping carton properly sealed and then drive a crowbar or similar instrument through the closed top of the container.
   (b) An alternative method in the disposing of more than one tube is to use a metal ash can with a plunger operated through the closed top.
7. Don't use regular picture tubes for display-ing purposes. Contact your supplier for special display tubes."

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