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Techni-talk
COMPLETE ELECTRONIC SERVICING INFORMATION
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# COLOR TELEVISION--NTSC STANDARDS-II

In the last issue the development of a high definition luminance signal was discussed. In this issue the NTSC standards for both luminance and color signals will be described.

## LUMINOSITY RESPONSE OF THE HUMAN EYE

Figure 4 shows the luminosity response of the human eye. This indicates that the eye's brightness response is not uniform. Instead, there is a definite peak around yellow and green. Thus for the same amount of light energy, a green object will appear to be brighter than a blue object. Monochrome television cameras respond somewhat in the same manner. To illustrate, when viewing a prize fight a green pair of trunks will always appear lighter than a blue pair.

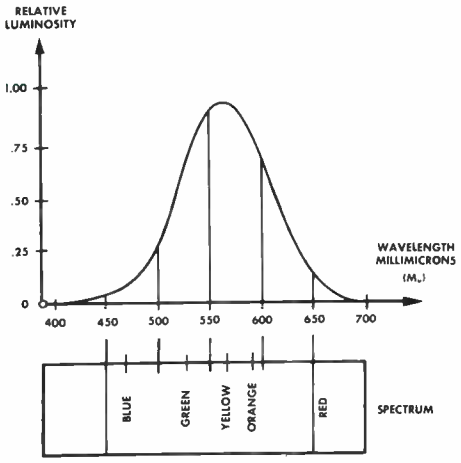



Fig. 4—Luminosity response of the human eye.

The signal that is to be made up from the red, green, and blue outputs must be made up in such a manner that the result will be as close as possible to that of a monochrome camera. Actually, the signal is derived by taking 30% of the red output, 59% of the green output and 11% of the blue output. Figure 5A shows how this will result in the same $E_Y$ output for white as the combination at voltages shown in Fig. 3A. This does not hold true in parts B and C, however, since the output for a green object (Fig. 5B) is almost twice that for a red object (Fig. 5C). Looking back at Figure 4, this compares favorably with the brightness level that would be expected by the eye for equal light emission of both colors. This can be expressed very simply with the following equation:

$$E_Y = .30E_R + .59E_G + .11E_B.$$

$E_Y$ is called the brightness signal. It corresponds very closely to the signal obtained from a monochrome camera scanning the same scene. This is the signal which will be transmitted in the manner used for monochrome transmission and will carry the high detail information.

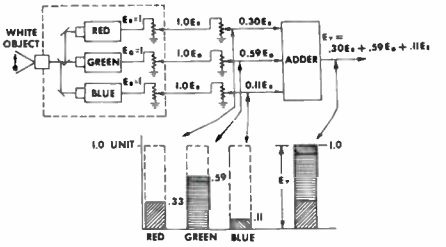



Fig. 5A—Luminance signal development using selected portions of color signals.

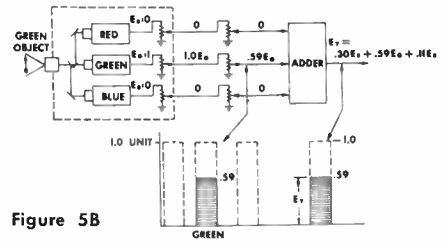



Figure 5B

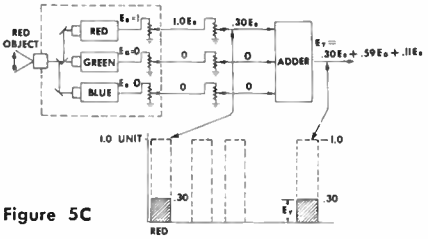



Figure 5C

Thus, two necessary steps have been taken. First, a portion of the color signal has been used to produce the high definition black and white signal. Second, if this signal is transmitted as a standard monochrome signal, it can be received by any current monochrome receiver. This fact has certainly aided in making the transition to color broadcasting less painful to both the broadcaster and the viewer. The compatible aspect of the color signal will work both ways of course. The present black and white receivers can handle the first part of the color signal as previously mentioned; but of equal importance, color receivers are able to reproduce standard monochrome transmissions with no adjustment of the receiver.

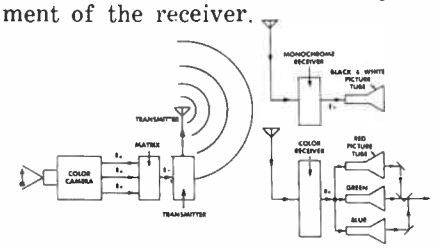
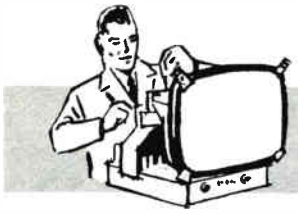



Fig. 6 — Use of $E_Y$ as compatible signal.

Figure 6 illustrates the compatibility feature of this system. On the transmitter side there is the same three-tube camera producing at its output three voltages, $E_R$, $E_G$ and $E_B$. As was previously mentioned, 30% of $E_R$, 59% or $E_G$ and 11% of $E_B$ are added together to give $E_Y$. $E_Y$ is that signal which simulates the output of a monochrome camera. This signal is then fed to the transmitter block which is nothing more than a standard monochrome television transmitter. Note on the receiver side, there are two receivers — a monochrome receiver and a color receiver. The monochrome receiver picks up the signal, handles it as any monochrome signal and applies $E_Y$ to the picture tube, resulting in a picture very similar to a monochrome picture.

The signal is, also, the first step in obtaining a color transmission, so the next problem is the method with which the $E_Y$ signal is handled within the color receiver. The color receiver picks up the signal, detects it in a similar manner to the monochrome receiver, and applies $E_Y$ simultaneously to the three picture tubes. What is the result of doing this? In the section on colorimetry it was learned that the proper mixture of red, green, and blue will result in white. Therefore, if the three tubes are set up so that equal voltages applied to the grids will give white, then the application of $E_Y$ simultaneously to all grids will produce changes in brightness only. Since $E_Y$ is handled as a monochrome signal, a monochrome transmission also will produce changes in brightness only. This results in countercompatibility. That is, the color signal affords a useable signal for a monochrome receiver, and at the same time, the receiver designed to pick up color information can receive a monochrome signal.

*(Continued next issue)*



# BENCH NOTES

## OLD CAPACITORS

Save those old wax coated capacitors as the wax can be handily used to secure a hex screw to a nut driver or a Phillips screw to the end of a screwdriver. The screw can then be placed in those inaccessible locations, which otherwise would be difficult to place with the fingers.

*Harold Jones*
*Harold's TV*
*810 College*
*Bowling Green, Kentucky*

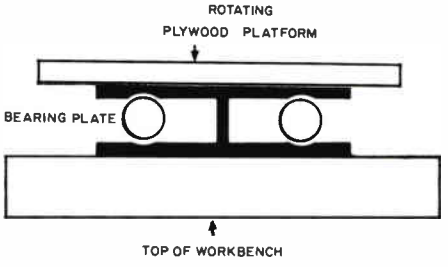
## REPAIRING COLOR CRT SOCKET

In the repair of electronic gear many tedious and time consuming jobs are encountered. How many times I've wished I had another hand; at least temporarily. Broken CRT pin connectors that require replacement have always presented a problem, especially the 14 pin color receiver sockets. About the time the 13th and 14th pin connectors are seated in the base of the socket, 4, 5 and 6 have popped out of their positions. One day, while looking over the shoulder of another technician, I discovered he had resolved the problem in seconds. He merely seated the base of the socket on the CRT and then connected the individual pin connectors to the proper pins on the CRT and secured the back plate to the CRT socket base. Simple!

*Tom Shaunnessey*
*R. Cooper, Jr., Inc.*
*836 S. Canal Street*
*Chicago, Illinois 60607*

## SHOP SERVICE AID

Servicing portable televisions and chassis of large sets require constant repositioning on bench to perform work and make adjustments. Constant lifting of sets can be back breaking, time consuming and sometimes destructive.




I have assembled a *Rotating Table* which consists of a two foot square piece of ¾" thick plywood mounted on a rotating bearing plate, which connects plywood platform to work bench top. Television to be serviced is placed on top of plywood platform and as required to reposition just rotate the set and it will turn on bearing with ease. The bearing plates are readily available and a six inch size is desirable.

*Bernard H. Serota*
*2502 S. Philip Street*
*Philadelphia, Pennsylvania 19148*

## LOW RESISTANCE

It often becomes necessary to replace a resistor of very low or odd value in a multimeter. Frequently the correct replacement is not available at the local supplier. In order that the multimeter be placed back in service until the proper resistor is acquired, a very short length of nichrome wire can be used as a substitute. This wire is widely available since it is used as a heating element in small electric heaters and can be cut to the desired length to match the resistance of the resistor. Since the temperature is relatively constant, the resistance will likewise remain relatively constant.

I have used this substitute on several occasions, and it works very well.

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*Physics Instructor*
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*Highway 301-A*
*Lumberton, North Carolina 28358*

## QUICK SIGNAL INJECTION

Run a quick signal injection test on a non-operating transistor radio by just connecting one end of a 100K resistor to the ungrounded side of the radio's battery. Touch the free end to the base of each transistor in turn from output back to input. If that stage, and the following stages are good, you'll hear a click in the speaker. When no click appears, that's the stage where the trouble lies.

If you get clicks all the way back to the antenna, and the set still doesn't work, check for the RF across the tank of the local oscillator.

*H. Mullen*
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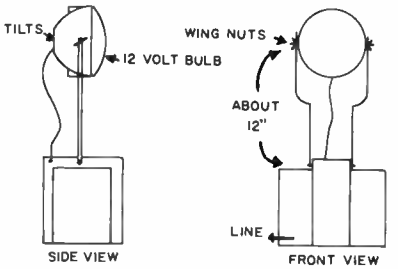
*Cleveland, Ohio 44104*

## ADJUSTABLE LAMP

Several years ago I built a service aid for working on T.V. Sets, Radios, etc. with etched boards and printed circuits, which has proven well worth the effort.

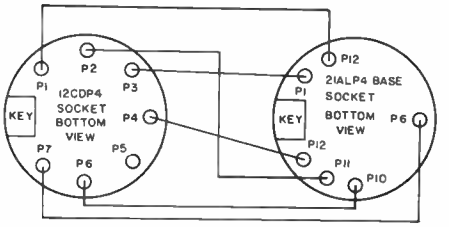



I took an old *heavy* transformer from a T.V. set with a twelve volt winding (or 2-6.3 V.) and mounted a 4 inch auto *spotlight* on it. This I set on a rack, or any handy place, and it sends a brilliant beam into every "Nook and Corner" of the unit being serviced. The light can be placed 4 to 8 feet away and it really lights up both sides of the board.

*E. H. Stuebe*
*1022 N. Second Street*
*Watertown, Wisconsin 53094*

## PIX ADAPTER

After having trouble checking the small pix tube (12CDP4 small base type) we decided to make an adapter that will work on any pix tube checker.

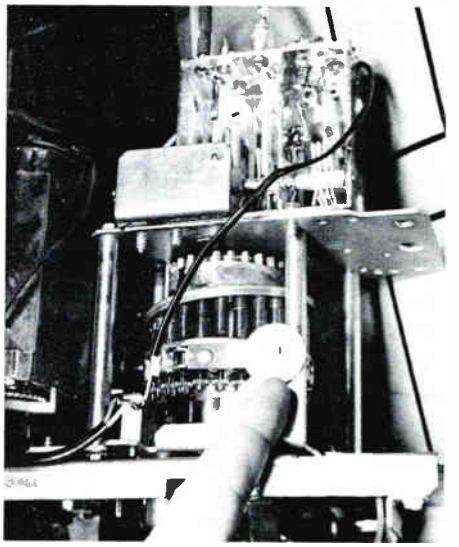



We wired it and checked a couple of these small type tubes. It worked fine.

*Robert Cornish*
*324 Lowry Lane*
*Lexington, Kentucky 40503*

## RCA CTC30

UHF picture would not hold on color. When the tumbler type UHF tuner was turned to the station and preset, sometimes the color would be there and the next time the fine tuning control would need to be set again.



The trouble was found to be not enough tension on the leaf spring holding the tumbler control on station. Since a better locking in, of the tumbler control was needed, a larger washer was put under the leaf spring screw. First start with a small washer and proceed to a half inch washer until correct tension is needed to hold the UHF station in on color.

*H. L. Davidson*
*2821 Fifth Avenue, South*
*Fort Dodge, Iowa*

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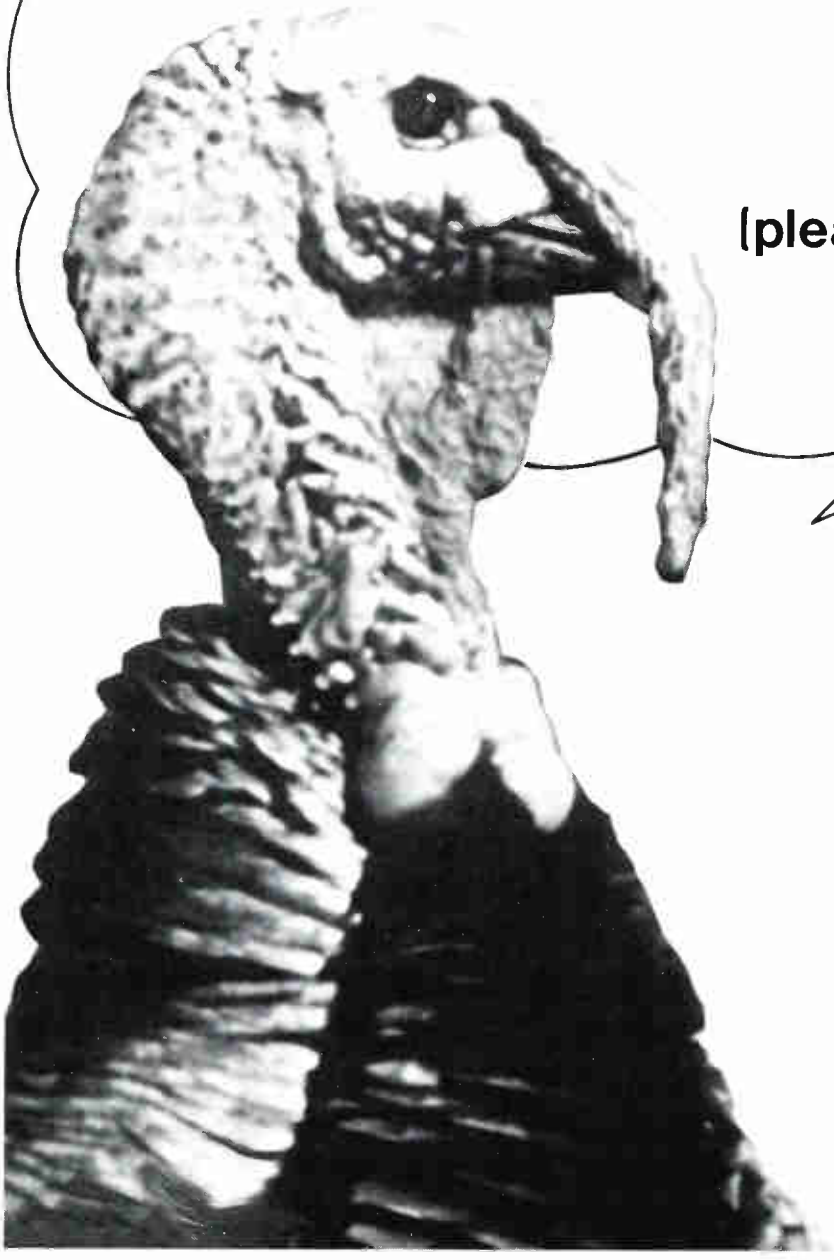

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GENERAL ELECTRIC

TUBE DEPARTMENT, OWENSBORO, KY.

# TUNER REPAIR SERVICE HINTS FROM STANDARD KOLLSMAN

This is a description of a number of service hints that may assist in the diagnosis and repair of television tuners. Many of the hints may be very familiar. Others may be new or offer a different viewpoint.

The tuners specifically mentioned are those Standard Kollsman VHF tuners bearing part numbers with the prefix letters ARS, ARC, SAR, SARC, AR, ARP, ARPC, SBR. This part number appears just below the television receiver manufacturer's part number on the rear of the tuner chassis. Most of the information would apply to any VHF tuner.

Most tuner faults can be found by thorough visual inspection. The reliability of the component parts used in modern tuners has improved to the point where an electrical breakdown or fault is rare. The faults are usually mechanical in nature and can be seen. Once the receiver trouble has been traced to the tuner, save time . . . look first.

## WHAT TO LOOK FOR

The most common symptom of trouble is either no picture or a weak snowy picture, either all the time or intermittently.

1. Try tapping the tuner chassis with moderate force.
2. Carefully rotate the channel selector shaft slightly out of its detented position in both directions. If a picture appears even momentarily, the oscillator may be faulty. Wiggle the tubes in their sockets. Poor tube socket contact is a frequent tuner trouble, especially when the fault is intermittent.
   There is a reason for this. To reduce lead inductance, connections to the socket must be kept very short, and this does not allow the contacts to "float" as freely as those in receiver sockets where lead inductance is not the factor it is at VHF. Thus, the tuner socket contacts may be deformed as tubes are changed.
3. Tap the tubes.
4. Try substituting tubes.
5. Is the trouble on more than one channel?
6. Look at the trimmer adjustment screws. Sometimes the nuts are loose.
7. Look at the feed through capacitors. Sometimes they break. Sometimes there is excessive solder which shorts the terminal to the outer conductive coating on the capacitor.
8. With the cover removed, rotate the channel selector while observing the stator contacts.
9. Look inside for poorly soldered connections, lead dress shorts or burned resistors.
10. Bypass the antenna input assembly. Connect the antenna transmission line to the output of the filter assembly.
11. Try a substitute channel strip—sometimes called arbors or sticks.
12. If the picture is weak or snowy, alternately touch each antenna terminal with each side of the transmission line. If this makes a significant change in the picture, the antenna input assembly may be at fault.
13. Remove the RF amplifier tube. If a reasonably strong signal is available, a picture will be present without the RF amplifier tube. On strong signals picture contrast may increase. If this happens it means the tuner AGC is functioning. Operating without the RF amplifier tube is often helpful in finding intermittents.
14. Short the AGC terminal to the chassis. Maybe there is too much AGC bias or not enough.
15. Move the channel selector shaft up and down and sideways. Does either end of the shaft easily move out of the slots in the tuner chassis? Sometimes the turret retaining springs don't do their job.

16 Is the detent spring loose?

## CLEANING CONTACTS

Intermittent tuner operation can be caused by dirt on the contacts. There are many tuner contact cleaning solutions available, but the one favored is the Standard Kollsman Conta Care Kit II, available from most electronic parts distributors. This kit includes a cleaning solution especially formulated for the cleaning of television tuner contacts, an applicator cloth and a proven tuner contact lubricant.

If a Conta Care kit II is not available, an excellent contact lubricant is American Oil Company's Rykon No. 2 EP. Other commercially available contact cleaners are satisfactory if their use is followed by contact cleaning with a cloth and adequate contact lubrication. Do not use a buffing cloth that is apt to leave lint in the tuner. It is best not to use a rubber eraser to clean contacts.

The use of aerosol spray cans containing various solvents to clean contacts, while convenient, presents disadvantages. First, wetting the contacts does not necessarily remove any dirt from the tuner, but just moves it around. Second, the lubrication of the contact is often inadequate. A dry, non-lubricated contact will generally become noisy in a relatively short time.

Before cleaning television tuner contacts, inspect to make certain there is a good mechanical contact on all channels. If there isn't, methods of contact repair are described below.

## INSTRUCTIONS FOR USE OF CONTA CARE II.

1. Remove sufficient channel strips or the complete rotor assembly to permit access to the stator contact springs.
2. Shake the solution well.
3. Moisten portion of applicator cloth with cleaning solution.
4. Gently rub stator contact springs with moistened applicator cloth until clean, being careful not to deform contacts.
5. Lightly buff contacts with dry cloth.
6. Replace strips or rotor assembly and clean all rotor contacts in the same manner.
7. Apply small amount of lubricant to each contact of at least four channel strips including the active channels. Lubricant is also excellent for use on mechanical bearing points.
8. Turn channel selector several times in each direction to spread lubricant.

## SERVICING CONTACTS

Standard Kollsman tuners have for many years used a preloaded cantilever stator contact spring. By preloading the contact spring (having the spring under tension before making contact with the rotor contacts), the amount of additional contact deflection is not critical. Most of the available contact pressure is available in the first small amount of deflection and additional deflection does not greatly increase contact pressure.

But, there must be some movement of the stator contact.

If there is no deflection of the stator contact, it may be that one or more rotor contacts has been mashed down. The individual rotor contacts can be raised in height by bending them. A small screwdriver can be used for this purpose. Use care.

Sometimes one or more of the stator contacts may be weak and not present enough pressure, even with adequate deflection. This can be detected by gently pressing the springs with the fingers or a small tool.

With care, the stator springs can be reformed to increase pressure. Using a tool with a hook on the end (a common paper clip can be re-bent for this purpose) gently lift the contact spring until the free end becomes disengaged from the plastic stator support board. Reform the contact and carefully tuck free end under plastic stator board.

*(Continued on page 6)*

# RECEIVING TUBE POPULARITY LISTING

Listed below are over 650 receiving tubes in alpha-numerical order. The figure, multiplied by 10,000 represents the estimated usage during 1968.

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0Z4/0Z4A | 35 | 5EW6 | 4 | 6BN8 | 11 | 6FH5 | 6 | 6LH6A | 2 | 11JE8 | 2 | 17AX3 | 1 |
| 1AD2 | 10 | 5FG7 | 6 | 6BN11 | 5 | 6FH8 | 2 | 6LJ6 | 2 | 11KV8 | 10 | 17AX4GTA | 10 |
| 1AY2 | 2 | 5GH8 | 4 | 6BQ5/EL84 | 63 | 6FJ7 | 3 | 6LJ8 | 10 | 11LQ8 | 5 | 17AY3A/17BS3A | 22 |
| 1BC2 | 25 | 5GJ7 | 4 | 6BQ6GA/6CU6 | 5 | 6FM7 | 22 | 6LM8 | 7 | 12AB5 | 5 | 17BE3 | 10 |
| 1G3GT/1B3GT | 105 | 5GM6 | 4 | 6BQ6GTB | 36 | 6FM8 | 2 | 6LN8 | 8 | 12AD6 | 10 | 17BF11 | 10 |
| 1K3/1J3 | 35 | 5GX7 | 5 | 6BQ7A/6BZ7 | 112 | 6FQ7/6CG7 | 380 | 6LQ8 | 3 | 12AE6A | 3 | 17BW3 | 1 |
| 1L6 | 1 | 5HG8 | 3 | 6BR8A/6FV8A | 17 | 6FS5 | 6 | 6LT8 | 12 | 12AE10 | 7 | 17C5/17CU5 | 4 |
| 1R5 | 11 | 5HZ6 | 2 | 6BS8 | 7 | 6FV6 | 5 | 6LU8 | 15 | 12AF3 | 7 | 17C9 | 3 |
| 1S2A/DY87 | 4 | 5J6 | 1 | 6BU8 | 26 | 6FW5 | 1 | 6LX8/LCF802 | 2 | 12AF6 | 2 | 17D4/17DM4A | 1 |
| 1T4 | 1 | 5JK6 | 1 | 6BV8 | 1 | 6FY5 | 3 | 6LY8 | 20 | 12AL5 | 3 | 17DE4 | 3 |
| 1U4 | 5 | 5KE8 | 15 | 6BW4 | 1 | 6FY7 | 6 | 6M11 | 3 | 12AL11 | 3 | 17DQ68/17GW6 | 30 |
| 1U5 | 5 | 5KZ8 | 2 | 6BW8 | 2 | 6G11 | 1 | 6MD8 | 4 | 12AQ5 | 5 | 17EW8/HCC85 | 2 |
| 1V2 | 50 | 5LJ8 | 11 | 6BW11 | 3 | 6GB5/EL500 | 3 | 6ME8 | 11 | 12AT6 | 7 | 17GJ5 | 2 |
| 1X2A/B | 35 | 5T8 | 3 | 6BX7GT | 5 | 6GC5 | 6 | 6N7 | 3 | 12AT7/ECC81 | 98 | 17GT5 | 3 |
| 2AF4 | 1 | 5U4GB/5AS4A | 155 | 6BY6 | 5 | 6GE5 | 23 | 6S4A | 18 | 12AU6 | 29 | 17GV5 | 1 |
| 2AF4B/2DZ4 | 6 | 5U8 | 24 | 6BY8 | 6 | 6GF5 | 1 | 6SA7 | 1 | 12AU7A/ECC82 | 110 | 17JB6A | 13 |
| 2AH2 | 3 | 5V3 | 3 | 6BZ6 | 125 | 6GF7A | 90 | 6SC7 | 4 | 12AV5GA | 5 | 17JM6 | 7 |
| 2AS2 | 7 | 5V4GA | 3 | 6C4 | 16 | 6GH8A | 220 | 6SF5 | 1 | 12AV6 | 52 | 17JN6 | 6 |
| 2AV2 | 40 | 5V6GT | 2 | 6C5 | 1 | 6GJ5A | 2 | 6SG7 | 1 | 12AV7 | 7 | 17JZ8 | 36 |
| 2BN4A | 7 | 5X8 | 3 | 6C9 | 2 | 6GJ7/ECF801 | 20 | 6SH7 | 1 | 12AX3 | 2 | 17X10/17AB10 | 2 |
| 2CW4 | 2 | 5Y3GT | 32 | 6C10 | 1 | 6GK5/6FQ5A | 37 | 6SJ7 | 9 | 12AX4GTB | 22 | 18FW6 | 2 |
| 2CY5 | 20 | 6AB4 | 8 | 6CA4 | 10 | 6GK6 | 15 | 6SK7 | 3 | 12AX7/ECC83 | 130 | 18FX6 | 1 |
| 2FH5 | 1 | 6AC7 | 3 | 6CA5 | 2 | 6GL7 | 4 | 6SL7GT | 13 | 12AX7A/7025 | 15 | 18FY6 | 1 |
| 2FS5 | 6 | 6AC10 | 5 | 6CA7/EL34 | 6 | 6GM6 | 38 | 6SN7GTB | 70 | 12AY3A/12BS3A | 2 | 19AU4GTA | 4 |
| 2GK5/2FQ5A | 12 | 6AD10 | 5 | 6CB5A | 5 | 6GM8/ECC86 | 1 | 6SQ7 | 4 | 12AZ7A | 15 | 19EA8 | 1 |
| 2HQ5 | 2 | 6AF3 | 13 | 6CB6A/6CF6 | 120 | 6GN8/6EB8 | 39 | 6T8A | 22 | 12B4A | 13 | 19HV8 | 2 |
| 3A3/3AW3/3B2 | 170 | 6AF4 | 20 | 6CD6GA | 22 | 6GT5 | 2 | 6T10 | 8 | 12BA6 | 70 | 19JN8/19CL8A | 1 |
| 3AF4B/3DZ4 | 5 | 6AF9 | 5 | 6CE5/6BC5 | 6 | 6GU7 | 80 | 6U8A/6KD8/5KD8 | 99 | 12BE3 | 3 | 19T8 | 6 |
| 3AL5 | 3 | 6AF4A/6DZ4 | 23 | 6CG3/6CE3/6CF6 | 19 | 6GV5 | 7 | 6U10 | 10 | 12BE6 | 66 | 20AQ3/LY88 | 5 |
| 3AT2 | 70 | 6AF11 | 12 | 6CG8A | 93 | 6GW8/ECL86 | 10 | 6V3A | 2 | 12BF6 | 2 | 21GY5 | 20 |
| 3AU6 | 4 | 6AG5 | 4 | 6CJ3/6DW4B/ | | 6GX7 | 10 | 6V4/EZ80 | 1 | 12BF11 | 2 | 21HB5A | 1 |
| 3AW2 | 6 | 6AG7 | 2 | 6CL3 | 295 | 6GY5 | 2 | 6V6 | 3 | 12BH7A | 45 | 21JZ6 | 4 |
| 3BL2 | 1 | 6AG9 | 3 | 6CK3 | 2 | 6GY6/6GX6 | 58 | 6V4GTA | 34 | 12BL6 | 5 | 21KA6 | 2 |
| 3BN2 | 2 | 6AH4GT | 3 | 6CK4 | 2 | 6GY8 | 1 | 6W4GTA | 4 | 12BQ6GA/12CU6 | 2 | 21LG6 | 1 |
| 3BN6 | 5 | 6AH6 | 7 | 6CL6 | 12 | 6H6 | 4 | 6W6GT | 12 | 12BQ6GTB | 3 | 21LR8 | 6 |
| 3BS2A | 2 | 6AH9 | 2 | 6CL8A | 25 | 6HB5 | 2 | 6X4 | 22 | 12BR7 | 3 | 21LU8 | 2 |
| 3BZ6 | 32 | 6AK5/EF95 | 16 | 6CM6 | 4 | 6HB6/6HA6 | 3 | 6X5GT | 11 | 12BY7A/12BV7/ | | 22BH3A | 3 |
| 3CA3 | 6 | 6AK6 | 12 | 6CM7 | 30 | 6HB7 | 26 | 6X8A | 35 | 12DQ7 | 85 | 22BW3 | 12 |
| 3CB6/3CF6 | 20 | 6AL3 | 14 | 6CM8 | 2 | 6HE5 | 12 | 6X9/ECF200 | 4 | 12CA5 | 7 | 22DE4 | 8 |
| 3CE5/3BC5 | 5 | 6AL5 | 49 | 6CN7 | 8 | 6HF5 | 14 | 6Y6GT | 2 | 12CU5/12C5 | 14 | 22JF6 | 10 |
| 3CN3A | 2 | 6AL11 | 5 | 6CQ8 | 11 | 6HF8 | 8 | 6Y9 | 3 | 12D4 | 3 | 22JG6A | 8 |
| 3CS6 | 2 | 6AM4 | 2 | 6CS6 | 8 | 6HG8/ECF86 | 3 | 6Z10/6J10 | 14 | 12DB5 | 3 | 22JU6 | 8 |
| 3CY5 | 5 | 6AM8A | 18 | 6CS7 | 7 | 6HJ8 | 1 | 7AU7 | 8 | 12DQ6B/12GW6 | 42 | 23Z9 | 20 |
| 3DG4 | 20 | 6AN8A | 24 | 6CU5 | 20 | 6HL8 | 2 | 7C5 | 1 | 12DS7 | 4 | 24BF11 | 1 |
| 3DK6 | 5 | 6AQ5A/6HG5 | 130 | 6CU8 | 5 | 6HM5/6HA5 | 40 | 7F7 | 2 | 12DT5 | 5 | 24JE6B | 2 |
| 3DT6 | 9 | 6AQ6 | 1 | 6CW4 | 11 | 6HQ5 | 22 | 7HG8/PCF86 | 3 | 12DT8 | 10 | 25AV5GA | 3 |
| 3EJ7 | 1 | 6AQ7GT | 1 | 6CW5/EL86 | 9 | 6HS5 | 9 | 7N7 | 2 | 12ED5 | 1 | 25BQ6GTB | 2 |
| 3ER5 | 1 | 6AQ8/ECC85 | 9 | 6CX8 | 14 | 6HS6 | 1 | 7V7 | 1 | 12EK6/12DZ6/ | | 25C5 | 8 |
| 3FS5 | 3 | 6AR11 | 5 | 6CY5 | 16 | 6HS8 | 21 | 8AR11 | 2 | 12EA6 | 4 | 25CD6GB | 5 |
| 3GK5 | 32 | 6AS5 | 15 | 6CY7 | 6 | 6HZ6 | 35 | 8AW8A | 15 | 12F8 | 1 | 25CG3 | 1 |
| 3GS8/3BU8 | 8 | 6AS8 | 8 | 6CZ5 | 8 | 6J5 | 8 | 8B10 | 11 | 12GC6 | 1 | 25DN6 | 5 |
| 3HM5/3HA5 | 10 | 6AS11 | 1 | 6DA4A/6DM4A | 5 | 6J6A | 17 | 8BA11 | 3 | 12GE5 | 5 | 25EH5 | 5 |
| 3HQ5 | 10 | 6AT6 | 3 | 6DB5 | 2 | 6J7 | 4 | 8BM11 | 1 | 12GN7A | 22 | 25L6GT/25W6GT | 10 |
| 3S4 | 1 | 6AT8A | 5 | 6DC6 | 2 | 6JB6A | 20 | 8BN11 | 2 | 12HE7 | 2 | 25W4GT | 1 |
| 3V4 | 7 | 6AU4GTA | 48 | 6DE4/6CQ4 | 15 | 6JC6 | 49 | 8BQ11 | 2 | 12HG7 | 8 | 27GB5/PL500 | 4 |
| 4AU6 | 2 | 6AU5GT | 3 | 6DE6 | 11 | 6JC8 | 3 | 8BU11 | 2 | 12HL7 | 5 | 31AL10 | 1 |
| 4AV6 | 1 | 6AU6A | 90 | 6DE7 | 6 | 6JD6 | 8 | 8CM7 | 1 | 12J5 | 1 | 31JS6A | 1 |
| 4BC8 | 3 | 6AU8A | 18 | 6DG6GT | 3 | 6JE6B | 280 | 8CS7 | 3 | 12JT6A | 2 | 32ET5A | 1 |
| 4BL8/XCF80 | 2 | 6AV5GA | 4 | 6DK6 | 10 | 6JE8 | 1 | 8CW5 | 4 | 12K5 | 1 | 32HQ7 | 1 |
| 4BQ7A/4BZ7 | 9 | 6AV6 | 26 | 6DN7 | 12 | 6JF6 | 5 | 8CX8 | 1 | 12L6GT | 2 | 33GT7 | 3 |
| 4BZ6 | 30 | 6AW8A | 88 | 6DQ5 | 35 | 6JG6A | 4 | 8EM5 | 1 | 12R5 | 1 | 33GY7A | 28 |
| 4CB6 | 7 | 6AX3 | 9 | 6DQ6B/6GW6 | 160 | 6JH6 | 30 | 8ET7 | 1 | 12SA7 | 4 | 34CE3 | 5 |
| 4CS6 | 4 | 6AX4GTB | 90 | 6DR7 | 14 | 6JH8 | 13 | 8FQ7/8CG7 | 80 | 12SJ7 | 1 | 35C5 | 25 |
| 4DK6 | 1 | 6AX5GT | 4 | 6DS4 | 12 | 6JK8 | 1 | 8JU8A | 2 | 12SK7 | 5 | 35EH5 | 3 |
| 4DT6 | 7 | 6AY3B/6BS3A | 55 | 6DS5 | 1 | 6JM6 | 19 | 8JV8 | 7 | 12SL7GT | 2 | 35L6GT | 5 |
| 4EH7 | 9 | 6AZ8 | 2 | 6DT5 | 3 | 6JN6 | 13 | 8KA8 | 4 | 12SN7GTA | 7 | 35W4 | 110 |
| 4EJ7 | 8 | 6B10 | 20 | 6DT6A | 30 | 6JN8 | 6 | 8LC8 | 2 | 12SQ7 | 7 | 35Y4 | 1 |
| 4ES8 | 1 | 6BA6/EF93 | 30 | 6DT8 | 2 | 6JS6B | 130 | 8LT8 | 10 | 12T10 | 1 | 35Z5GT | 17 |
| 4GK5 | 7 | 6BA7 | 1 | 6DX8/ECL84 | 14 | 6JT6A | 3 | 9A8/8A8/PCF80 | 8 | 12V6GT | 4 | 36AM3A | 4 |
| 4GS8/4BU8 | 3 | 6BA8A | 5 | 6E5 | 1 | 6JT8 | 17 | 9AU7 | 3 | 12W6GT | 5 | 38HE7 | 14 |
| 4HA5 | 1 | 6BA11 | 18 | 6EA8 | 210 | 6JU8A | 44 | 9GV8 | 1 | 12X4 | 2 | 38HK7 | 5 |
| 4HM6 | 2 | 6BC4 | 2 | 6EH4A | 5 | 6JV8 | 2 | 10CW5 | 11 | 13CW4 | 1 | 40KD6 | 2 |
| 4HS8 | 5 | 6BC7 | 1 | 6EH5 | 2 | 6JW8/ECF802 | 8 | 10DE7 | 19 | 13DE7 | 4 | 42KN6 | 3 |
| 4HT6 | 1 | 6BC8/6BZ8 | 13 | 6EH7/EF183 | 25 | 6JZ6 | 1 | 10DX8/LCL84 | 2 | 13DR7 | 8 | 45B5/UL84 | 2 |
| 4JC6 | 7 | 6BD11 | 2 | 6EH8 | 2 | 6JZ8 | 7 | 10EG7 | 4 | 13EM7/15EA7 | 8 | 50B5 | 2 |
| 4JD6 | 5 | 6BE3 | 5 | 6EJ4A | 2 | 6K6GT | 10 | 10EM7 | 1 | 13DF7 | 4 | 50C5 | 125 |
| 4LJ8 | 1 | 6BE6 | 20 | 6EJ7/EF184 | 44 | 6K7 | 1 | 10EW7 | 2 | 13GB5 | 1 | 50DC4 | 2 |
| 5AM8 | 7 | 6BF5 | 1 | 6EL4 | 1 | 6K11/6Q11 | 2 | 10GF7A | 2 | 13GF7A | 14 | 50EH5 | 17 |
| 5AN8 | 2 | 6BF6 | 2 | 6EM5 | 18 | 6KA8 | 33 | 10GK6 | 8 | 13V10 | 1 | 50HK6 | 6 |
| 5AQ5 | 17 | 6BF11 | 2 | 6EM7/6EA7 | 80 | 6KD6 | 13 | 10GN8 | 11 | 13Z10/13J10 | 4 | 50L6GT | 13 |
| 5AQ7A | 2 | 6BG6GA | 4 | 6ER5 | 7 | 6KE8 | 20 | 10HF8 | 5 | 14BL11 | 3 | 60FX5 | 1 |
| 5AR4/GZ34 | 7 | 6BH6 | 34 | 6ES5 | 2 | 6KM6 | 20 | 10JT8 | 5 | 14BR11 | 2 | 80 | 1 |
| 5AT8 | 5 | 6BH8 | 7 | 6ES8/ECC189 | 6 | 6KM8 | 1 | 10JY8 | 6 | 14GT8 | 2 | 5879 | 6 |
| 5B8 | 1 | 6BH11 | 9 | 6EU7 | 8 | 6KT6 | 2 | 10KR8 | 2 | 15AF11 | 1 | 6973 | 7 |
| 5BC3 | 4 | 6BJ6 | 14 | 6EU8 | 2 | 6KT8 | 36 | 10KU8 | 2 | 15BD11 | 6 | 7027A | 3 |
| 5BK7A | 2 | 6BJ7 | 1 | 6EV5 | 9 | 6KU8 | 1 | 10LE8 | 1 | 15CW5/PL84 | 8 | 7189A | 7 |
| 5BR8/5FV8 | 5 | 6BJ8 | 5 | 6EV7 | 1 | 6KV8 | 2 | 10LW8 | 1 | 15DQ8 | 1 | 7199 | 10 |
| 5BT8 | 1 | 6BK4B | 165 | 6EW6 | 65 | 6KY8A | 7 | 10LZ8/10JA8 | 3 | 15FM7/13FM7 | 4 | 7247 | 1 |
| 5BW8 | 2 | 6BK5 | 3 | 6EW7 | 10 | 6KZ8 | 40 | 11AR11 | 3 | 15KY8A | 17 | 7355 | 2 |
| 5CG8 | 21 | 6BK7B | 21 | 6EZ5 | 4 | 6L6 | 5 | 11BQ11 | 4 | 16AK9 | 2 | 7581A/KT66 | 2 |
| 5CL8A | 10 | 6BL7GTA | 12 | 6EZ8 | 1 | 6L6GC | 34 | 11BT11 | 3 | 16AQ3/XY88 | 11 | 7591A | 13 |
| 5DH8 | 1 | 6BL8/ECF80 | 34 | 6F6 | 1 | 6LB6 | 8 | 11CA11 | 1 | 16BQ11 | 1 | 7868 | 10 |
| 5DJ4 | 1 | 6BM8/ECL82 | 10 | 6FD7 | 3 | 6LC8 | 2 | 11CY7 | 1 | 16BX11 | 1 | 8426A/12AU6 | 2 |
| 5EA8 | 7 | 6BN4A | 11 | 6FG6/EM84 | 1 | 6LE8 | 9 | 11FY7 | 4 | 16GK6 | 2 | | |
| 5EU8 | 2 | 6BN6/6KS6 | 21 | 6FG7 | 17 | 6LF8 | 18 | 11HM7 | 2 | 16GY5 | 1 | TOTAL | 9,844 |

# SERVICE NOTES

## TUNER REPAIR HINTS

*(Continued from page 4)*

### SERVICING TUBE SOCKETS

Intermittent tube sockets can result from dirt or deformed contacts. Dirt can usually be removed with any one of many solvents. If the socket contact is loose, insert a sharp pick between the body of the socket and the contact. If only one or two contacts are adjusted, insert the pick equally on both sides of the contact. If all contacts are tightened, insert the pick on one side only and the same side for all contacts.

If one or two contacts seems beyond repair, it is usually easier to replace the contacts rather than the entire tube socket. Flatten the contact lug, using long nose pliers, and push the contact through the socket. Obtain spare contact from spare socket.

### CHANNEL STRIP TROUBLES

If is is determined that an individual strip is faulty, try to find out why. If the strip can be repaired, the alignment of the tuner is less apt to be disturbed than if a replacement strip is installed.

Take a good look at the solder connections on the channel strips. At times wire soldering can be improved by a touch of the soldering iron which will repair an otherwise weak, dead, or intermittent channel strip.

If the oscillator tuning screw is either too loose or binding, the screw and its holder can be repaired or replaced without changing the channel strip.

### PHONO JACKS

Phono jacks are used for the input from the UHF tuner and for the IF output on some tuners. It is often difficult to see if the phono jack contact is making a good contact to the plug. Take the center pin from a phono plug and make a gauge so the firmness of contact can be felt.

### DRUM RETAINING SPRINGS

The wire springs used to hold the drum or rotor assembly are sometimes overformed or bent when servicing tuner. Make certain the rotor assembly does not move easily when lateral pressure is put on the channel selector shaft. The spring must return the shaft to the bearing "vee." If it does not, reform the retaining springs, or better yet, replace them.

### HOT SOLDERING IRON

The leakage of some soldering irons is often great enough to damage transistors and diodes. Check with an AC voltmeter or milliameter. Use an isolation transformer after checking to make certain it is not leaky and/or ground the tip of the iron.

## TELEVISION

### H-1 CHASSIS RECEIVERS INTERMITTENT HUM BAR

An intermittent hum bar in the 10-inch H-1 Color chassis receivers may be caused by a poor connection at the black ground lead from the vertical output transformer.

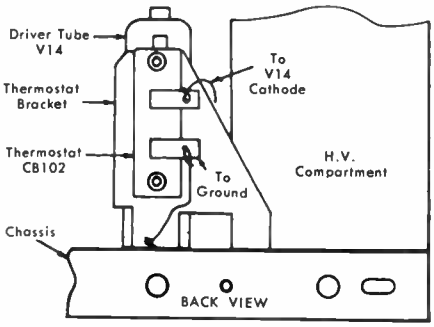
On some sets, this lead is grounded at the same terminal board as the AC line choke. Poor contact with chassis ground because of a loose or stripped screw can cause AC to modulate the vertical sweep, producing intermittent hum in the picture.

Move and solder this black ground lead to the lance located on the top right side of the high voltage transformer cage. The black lead from the convergence assembly is also connected to this point. Check the terminal board screw for tightness. If stripped, replace with a larger diameter screw or solder the lug and screw to the high voltage cage. Be careful not to change the lead dress or damage any wire insulation in this area while soldering.

### THERMOSTAT ADDED TO KD CHASSIS

Beginning with chassis date code OA2E, the KD Chassis features a new safety thermostat.

The thermostat CB102 is mounted adjacent to the glass envelope of the horizontal output tube V14 and directly above the rear apron as illustrated.




The thermostat is connected in series with the grounded cathode lead of V14. The cathode is connected to the top terminal of CB102 and the bottom terminal is connected to chassis ground.

Abnormal heat from the glass envelope of V14 will cause the thermostat to open and V14 will become inoperative due to its open cathode circuit. Abnormal heat would be due to excessive plate and/or screen current which in turn could be caused by either a failure of V14 itself or a malfunction in its input or output circuits such as loss of grid drive from the horizontal oscillator, a defective regulator tube, sweep transformer, etc.

When the temperature of V14 returns to normal, the thermostat will close and activate the horizontal output circuit. The thermostat will continue to cycle on and off until the trouble in the horizontal circuits is corrected.

Observe the precautions and suggestions listed below when troubleshooting a KD Chassis that has a thermostat.

1. To keep V14 cathode circuit closed while trouble-shooting, clip a jumper lead across the thermostat terminals. Do not try to manually reset an open thermostat, since this is a true thermostat and operates only on temperature changes. Any attempt to manually reset the thermostat will ruin the original temperature calibration and destroy the safety feature. Make sure the clip lead is removed after completing work on the set.
2. If an operating chassis is tipped up on its front edge, the thermostat will open since it will be oriented horizontally above V14 and receiving its full heat, even on a correctly operating chassis. When this happens, clip a jumper lead across the thermostat terminals to activate the horizontal circuit. Make sure the clip lead is removed after completing work on the set.
3. CAUTION—B+. When the thermostat is open, the terminal connected to the cathode of V14 has a DC potential to ground of 200 to 300 volts. This terminal should be treated with the same respect that other B+ points in the chassis receive.

Two thermostats are used in the KD Chassis:

ET10x62 Thermal Cutout (Thermostat) in 22 KV Chassis.

ET10x63 Thermal Cutout (Thermostat) in 25 KV Chassis.

NEITHER THERMOSTAT SHOULD BE SUBSTITUTED FOR THE OTHER.

### QUADRATURE COIL TUNING CAPACITOR

The Quadrature coil tuning capacitor used in all current General Electric portable television receivers, has a negative temperature coefficient to compensate for temperature produced drift in associated components. The schematic designations, by chassis, for this capacitor are:

S-2 Chassis — C308
P-2 Chassis — C308
V-2 Chassis — C308
H-2 Chassis — C307
G-1 Chassis — C307

Should this capacitor not track properly with temperature, the audio may distort with temperature changes.

The audio may be good initially and become distorted in a few hours or it could be poor initially and gradually get better as the receiver reached normal operating temperature.

When making repairs to any receiver using a quadrature grid audio detection system, it is good practice to check the audio quality at two temperature extremes; when the receiver is cold, and after it has reached normal operating temperature. If the audio is distorted at either of these points, it is possible that the capacitor is not tracking correctly and it should be replaced.

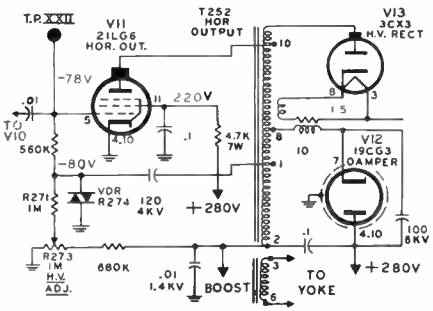
Replacement capacitors must have the proper temperature coefficient to insure reliable receiver operation. In the case of the chassis listed above, the capacitor should be 18pf, 10%, N470 (Cat. No. ET18x399).

After replacing the capacitor, the quad coil should be realigned and the receiver rechecked at both temperature extremes.

# SERVICE NOTES

## G-1 CHASSIS HIGH VOLTAGE REGULATION—CIRCUIT ANALYSIS

High voltage is regulated by automatically controlling the grid voltage of the horizontal output tube, V11. This negative control voltage is the result of a high amplitude positive pulse from the horizontal output transformer, T252, being detected by the voltage dependent resistor, R274. The amount of negative voltage developed is dependent upon pulse amplitude, —that is— as pulse amplitude increases, grid voltage becomes more negative, and as pulse amplitude decreases, grid voltage becomes less negative. Since the pulse amplitude is an indication of the loading on the transformer, it rises and falls directly with the high voltage.




Therefore an increase in the pulse amplitude, indicating increasing high voltage, results in more negative voltage being developed at the grid of V11. As the grid voltage goes more negative, the plate current is reduced and high voltage returns to normal.

High voltage adjustment R273 supplies a bucking voltage to the grid of V11 through R271 to prevent the negative control voltage from reaching too high a value which would seriously reduce both high voltage and sweep width. With 120 VAC applied to the receiver, R273 should be adjusted to produce 22,000 volts at the CRT second anode with zero beam current (minimum brightness).

## KC-KD CHASIS — RASTER SHADING, RETRACE SNAKE, VERTICAL BLANKING

Raster shading may appear on the KC or KD Chassis. This shading usually appears during periods of no video modulation (camera changes, etc.) the right half of the raster appears substantially darker than the left half, with a gradual shading, from the center toward the R.H. side.

This raster shading may or may not be accompanied by retrace "snake." In either case the following cure will be found very effective. (Refer to schematic in right column).

1. Change diode CR102 to an ET57x40 type. Move anode (ground) end of diode to + side (no code lug) of C-132 electrolytic capacitor.
2. Disconnect end of R153 (47K) going to junction of C136 and C138. Now connect the open end of R153 to lug 8 of J101.

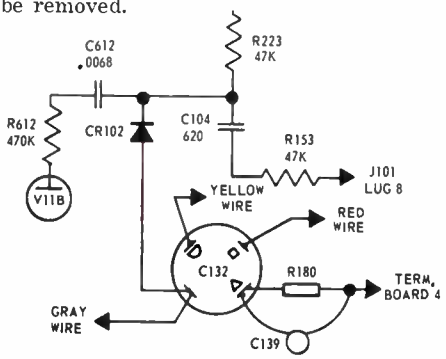
### Vertical Retrace Blanking

If vertical retrace lines appear, make the following changes:

1. Change R612 from 47K to 470K (½ watt). Disconnect wire going from circuit board terminal VB (or C-612) to R154. Disconnect at R154 end.

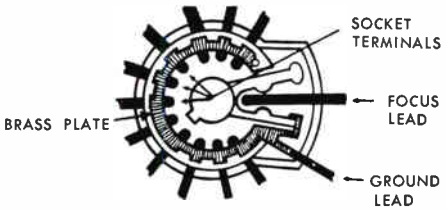
Reconnect wire to cathode side of CR-102.

NOTE: R154 is now excess and may be removed.




## G-1 COLOR CHASSIS CRT SOCKET WITH BUILT-IN SPARK GAP

The picture tube socket used in the G-1 Chassis color receiver contains a special built-in spark gap consisting of a grounded brass plate placed close to the socket terminals (see sketch below). An unusually high voltage on a socket terminal will arc to the brass plate rather than to an adjacent terminal, thus protecting the picture tube and its associated components. This is normal, and does not necessarily mean the socket is defective, but usually indicates a problem in associated circuitry.




REAR VIEW OF SOCKET (COVER REMOVED)

**G-1 Chassis Horizontal Output**

For example, we have had cases of a continuous arcing condition in the CRT socket caused by an open 47 Meg. resistor (R284) in the focus voltage divider circuit. To obtain best focus, this resistor is connected through a wire jumper to one of three points—B+ boost, +280V, or chassis ground. A bad solder connection at the jumper or an open R284 colud cause the voltage on the focus anode terminal (Pin 9) to rise, causing an arc inside the CRT socket.

Should you be called upon to service a G-1 Chassis receiver which has a continuously arcing CRT socket, compare the socket pin voltages to the voltages shown on the schematic diagram. The focus voltage (Pin 9) should be between +3000 volts and +5000 volts with respect to chassis ground. If it is more than 5000 volts, check for an open circuit somewhere between the focus control (R283) and the low potential end of the focus voltage divider circuit.

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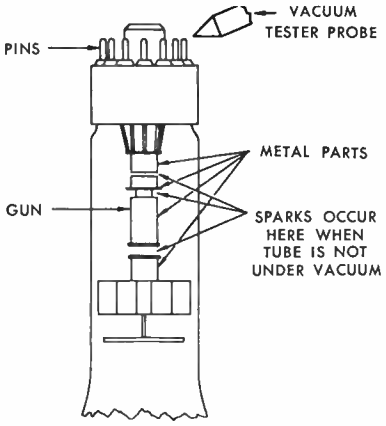
# VACUUM SPARK TESTER ETRS-5198

The new General Electric Vacuum Spark Tester, ETRS-5198 is a high frequency arc generator and generates about 50,000 volts at a frequency of three to four MHz. It is an effective tool in checking picture tube "duds" for loss of vacuum.

The voltage is adjustable and the approximate voltage can be determined by length of the spark. A one inch spark indicates approximately 50,000 volts, a half inch spark a proportional amount or 25,000 volts.




The Vacuum Spark Tester is used to check dud picture tubes to determine whether the tube has lost its vacuum.

A dud under vacuum will *not* show arcing between the metal parts *within* the neck of the tube while a tube that has lost its vacuum ("down to air") will have obvious arcs occurring between these metal parts (just as you observe when the probe is brought in close proximity to any metal object in the air).

The Vacuum Spark Tester, ETRS-5198, is available from your local General Electric Electronic Components distributor. If he is unable to supply you use order coupon on page 7. The price is only $10.95 each.

CAUTION—THE VACUUM TESTER *SHOULD NOT BE USED* TO CHECK GOOD PICTURE TUBES AS IT IS POSSIBLE TO DAMAGE THE TUBE'S CATHODES WITH THIS HIGH INTENSITY SPARK.

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