DEC.-JAN. 1956-57
Vol. 8, No. 6

Electronic TUBES
# Techni-talk
## on AM, FM, TV Servicing


# GENERAL ELECTRIC ST-16A COLOR ALIGNMENT GENERATOR


**Fig. 1. The General Electric ST-16A color alignment generator.**

The General Electric Color Alignment Generator, Type ST-16A, shown in Fig. 1 is a precision-type instrument designed for use in the service shop as well as the development laboratory or TV station. This instrument is entirely self-contained and does not require external synchronizing sources or additional power supplies, other than connection to the AC line. Since it develops a standard NTSC color signal, the ST-16A may be used to align the sweep, color and convergence circuits in color TV receivers or monitors as well as many other developmental, servicing or manufacturing applications.

This unit is actually two instruments in one, since it produces a dot or cross-hatch signal as well as color bar presentations. Both I and Q as well as R-Y and B-Y, plus any combination of these or several other color signals may be selected.

The features, electrical specifications, and mechanical specifications of the ST-16A are listed on page 2.

Before describing the operation of the ST-16A, it might be advisable to briefly discuss those circuits which must be properly aligned so that the color signal is available at the chroma section of the receiver. Obviously, if due to alignment the color signal is lost or sufficiently reduced in amplitude to properly actuate the color circuits. the finest color alignment generator will have little value.

### COLOR TV ALIGNMENT

Since color television receivers require much more accurate sweep alignment than monochrome (black and white) receivers, the service dealer's need for dependable, accurate, easy-to-use sweep alignment equipment is greatly increased.

Because of the very critical I.F. adjustments involved, it is estimated that a far greater number of color receivers will have to be realigned after service repairs than monochrome. Customers may tolerate a monochrome picture that is lacking in detail, but they will be extremely critical of poor color pictures.

Therefore, as you can see, the desirability of having the best available alignment equipment such as the General Electric ST-2A Oscilloscope, ST-4A Sweep Generator, ST-5A Marker Generator, and ST-16A Color Alignment Generator, for service work becomes self-evident. The extreme accuracy of the General Electric ST-5A Marker Generator makes it especially adaptable to color servicing.

Let us first examine the procedures you now follow with your test equipment on a monochrome set, as illustrated in Fig. 2,

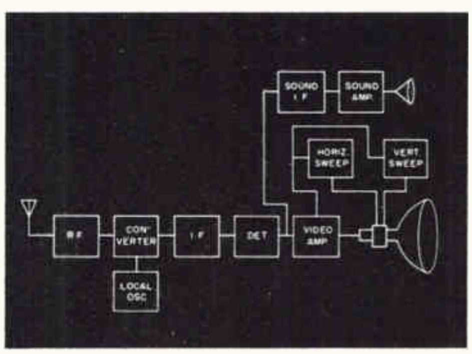



**Fig. 2. Block diagram of monochrome receiver.**

and then compare them to the procedures which must be followed on a color set, as shown in Fig. 3.

You will immediately notice the similarity of the color set to the black and white set. The only difference between the two is found in those blocks which are enclosed in the dotted lines. Basically, the rest of the color set is the same as the monochrome set.

The alignment procedures followed on present monochrome sets are:

1. Alignment of head end for proper frequency and band pass (R.F. converter and oscillator block).
2. Alignment for proper frequency and band pass of the I.F.
3. Alignment of the Sound I.F. and discriminator frequency (4.5 MC).
4. Checking of sound traps in video amplifier and checking of band pass of video amplifier for proper response.
5. Checking miscellaneous wave forms throughout the set.

The same procedures must be followed on color sets *but they must be followed much more accurately.*

For instance, in a black and white set the head-end alignment might look something like Fig. 4.

This sort of alignment would not do in a color set. If this response were to be used in a color set, the color sub-carrier would lie in the saddle on a sloping portion of the response. The result would be that the color information would be down compared to the picture and sound.

Also, because of the slope, the color information would be distorted. The ideal color response for the head end would have a flat top. But since this response would have sharp corners, and therefore ringing, the proper response is slightly rounded, as shown in Fig. 5.

This "rounding" has the added desirable effects of increasing color gain over

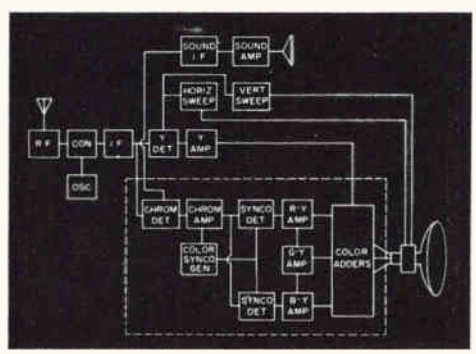



**Fig. 3. Block diagram of color receiver.**

## FEATURES

- Develops NTSC composite color signal.
- Crystal-controlled picture and sound carriers (any one channel 2 to 5).
- Crystal-controlled horizontal and vertical sync (fully interlaced with vertical blanking).
- Only three bars, plus black level, presented at one time.
- 75 different color bar patterns available (each bar individually controllable). Generates dot and cross-hatch signals both at RF and video.
- 3.58 MC color subcarrier available at front panel (adjustable level), can be used as a marker in conjunction with sweep and marker generators.
- Adjustable burst level.
- Plus or minus video output.
- Presents the following signals:
  - a. Picture carrier with composite colors.
  - b. Picture and sound carriers with composite colors
  - c. Picture carrier with chroma only (adjustable burst)
  - d. Picture carrier with "Y" signals only
  - e. Picture carrier with dot or cross-hatch
- High output.
- Easy to operate and maintain.
- Accurate color phases.
- Extreme mechanical stability.
- Portable—provisions for rack mounting.

## ELECTRICAL SPECIFICATIONS

INPUT: 117/234 volts, 50/60 cps, 250 watts.

SIGNALS: **A.** Cross-Hatch (White)

1. Eight vertical stripes and six horizontal stripes are presented, as a composite signal. The vertical and horizontal stripes are of equal width, being 3 to 4 lines wide.
2. Application of the cross-hatch signal is as follows:
   a. Linearity—greatly aids in establishing vertical and horizontal linearity over the face of the tube.
   b. Convergence—after initial triad setup is accomplished with the dot pattern, convergence is then adjusted over the entire face of the tube with cross-hatch pattern. This function applies to electrostatic or magnetic convergence-type picture tubes.

**B.** Dot (White)

1. 48 dots—8 horizontally, 6 vertically.
2. Dots are small, yet large enough for easy convergence, being the intersection of the above mentioned cross-hatch.

**C.** Composite Color

1. A composite color signal including burst, sync, and proper chroma to pedestal amplitude relationship (certified saturated colors).
2. Combination of any three color bars and black reference are presented simultaneously.
3. Black reference signal is wide enough to act as a good reference when using an oscilloscope for studying detector outputs or for matrixing.
4. The bars may be chosen by means of three switches, as follows:

| FIRST BAR | | SECOND BAR | | THIRD BAR |
|---|---|---|---|---|
| R-Y | Blue | B-Y | Red | Green/G-Y |
| I | Magenta | Q | Yellow | Cyan |
| | White | | White | White |

*NOTE:* A wide combination of simultaneous presentations are available without confusion to the operator since switch positions are marked with the presentation being used.

5. Color bar signals are presented as a composite signal or as pedestals only for gray scale adjustment or as chroma only for checking chroma circuits.
   a. During "chroma only" presentation, the burst amplitude is adjustable from front panel to determine the "lock-in" stability or sensitivity of the sub-carrier generator and operation of color killer circuits.

OUTPUTS: Video: Positive or negative polarity. Adjustable from 0 to approximately 1.5 V.P. to P. into 95 ohms. The attenuator is in the load of the supplied output cable.

Chroma signal (3.58 MC cw signal) ½ volt P. to P. variable to zero for markers or checking chroma circuits.

RF: Crystal-controlled single channel (2 to 5), any one channel. (When ordering, specify channel desired—an unused channel in your reception area is best.)

Attenuator control (50 to 1 attenuation).

Output Z equals 300 ohms. Crystal-controlled sound channel with on-off switch for receiver fine tuning reference.

**MECHANICAL** Height: 9", Depth: 13", Width: 19¼", Weight: 40 lbs.

picture gain and therefore giving the customer added "Chroma" control. In obtaining this response, the sides are considerably steeper, thus placing the adjacent channel sound much farther down.

The I.F. Amplifier in a color set must be aligned much more accurately than in a monochrome set. The normal I.F. response curve for a black and white set is shown in Fig. 6.

The ideal spacing between points A and B is 4 MC, but in many cases in monochrome sets this spacing was found to be 2 MC as shown in Fig. 7.

The latter case would still produce a fair monochrome picture somewhat lacking in detail. However, if a color set were misaligned in this fashion, it too would lack detail, but more important, it would have very little, if any, color.

The color I.F. Amplifier must be aligned to have the proper color and picture response and the proper relationship between them, as illustrated in Fig. 8.

Aside from maintaining the proper relationship between the picture carrier and color sub-carrier the sound traps must be adjusted accurately. If they are not, a nominal 920KC beat note between the 4.5 MC and 3.58 MC carriers will be visible on the picture.

It is also important that the Chroma Amplifier in a color set be accurately aligned for proper color display. This amplifier presents a problem which is technically very similar to that of the sound I.F. amplifier, but it requires markers of different frequencies. In general, the Chroma Amplifier in either the R-Y, B-Y receiver or the I and Q receiver deals with frequencies in the range of 100 KC to 4.5 MC. Your sweep generator must be able to cover these frequencies with negligible distortion.

Many sweep generators now in use are not capable of working down to these frequencies and in these cases the dealer must purchase a video sweep generator. The General Electric ST-5A Sweep Generator covers the required range of frequencies and is an excellent video sweep generator for this purpose. In aligning the Chroma Amplifier of a color TV receiver you will find it necessary to use a crystal probe to detect the information which is passed by the amplifier. This is because there is no detecting circuit following the Chroma Amplifier.

The General Electric ST-18A Chroma Probe is designed specifically for this application. It is a special type of crystal probe which is designed to be flat over the range of frequencies passed by the Chroma Amplifiers, 50KC-5MC.

The frequencies used as a guide for adjusting Chroma Amplifiers in different makes of television sets will vary. For this reason, special marker crystals are not included in the General Electric ST-5A Marker Generator. A much better approach is for the service dealer to use a conventional RF Signal Generator. (Because almost every service dealer possesses such a generator, we felt it un-

*(Continued on page 3)*

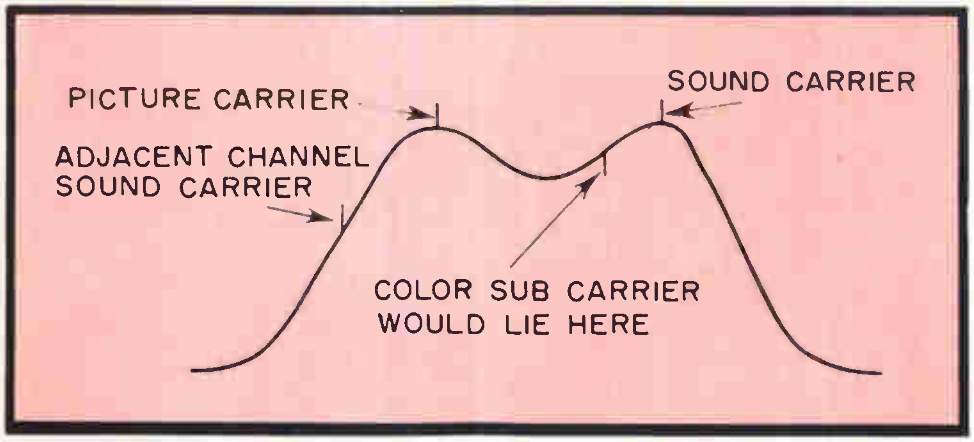



**Fig. 4. Typical head-end alignment curve for monochrome receiver.**

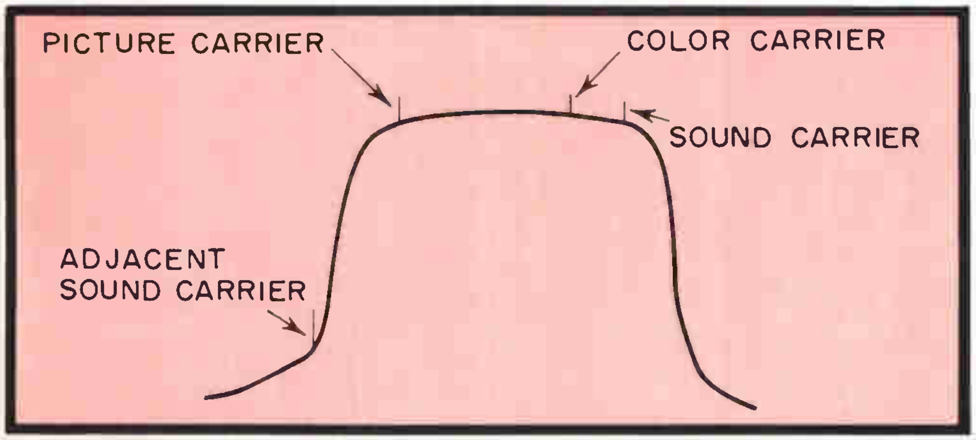



**Fig. 5. Ideal head-end alignment curve for color receiver.**

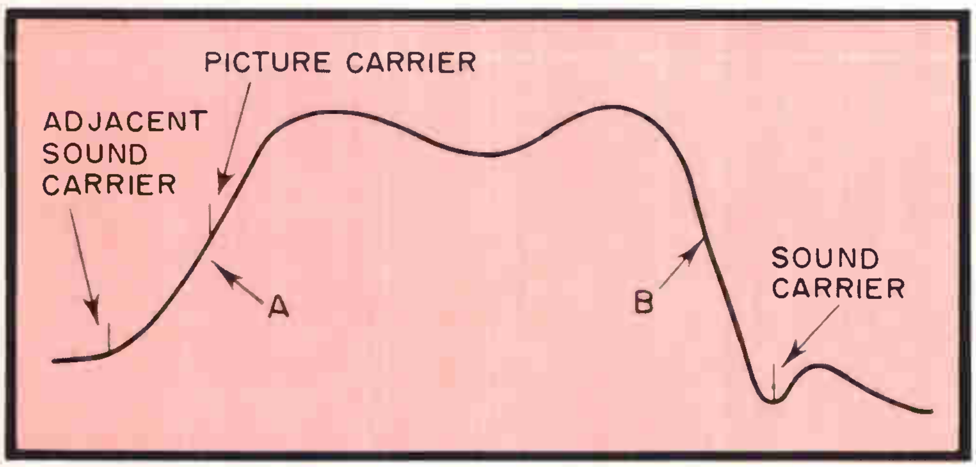



**Fig. 6. Ideal I.F. alignment curve for monochrome receiver.**

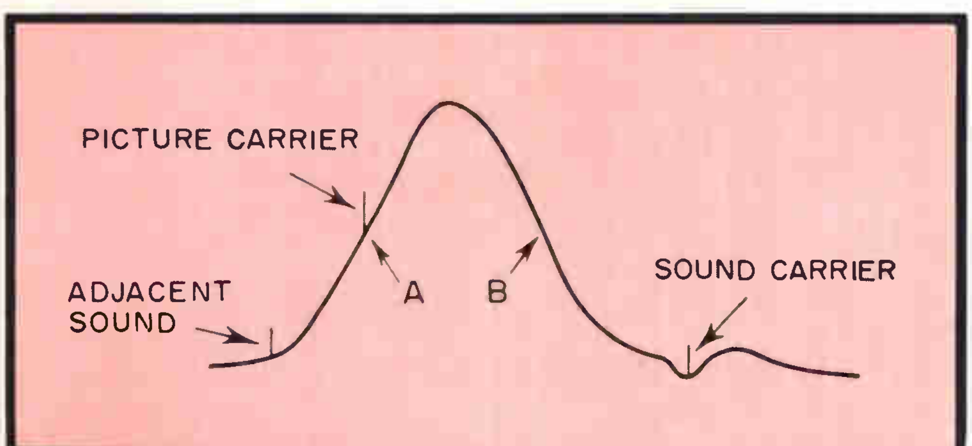



**Fig. 7. I.F. alignment curve used in some monochrome receivers.**

necessary to duplicate the features in the ST-5A Marker Generator.) The RF Signal Generator is connected by means of a "T" connector to the "sweep input" jack of the ST-5A Marker Generator. A marker can then be obtained over the entire range of the RF Signal Generator. In addition, the accuracy of the RF Signal Generator can be checked by beating its output against the 1.5 and 4.5MC crystal output of the ST-5A Marker Generator.

You are constantly hearing that an oscilloscope must be absolutely flat in frequency response up to 3.58MC in order to be usable for color TV alignment. This is not the case. In servicing color sets, as in monochrome sets, all the technician really needs to know is whether or not the high frequency information is present at the proper points. He is no more concerned with the minute detail of the wave form in color sets than he is in black and white sets, with the exception of the phasing and color adder circuits (matrixing circuits). And in this case the ST-2A suffices nicely. In fact, it is the oscilloscope recommended by the General Electric Television Receiver Department for matrixing adjustments.

The only operation that requires viewing a high-frequency wave form in the presence of a low-frequency wave form is setting the burst gate. When trouble-shooting a color set it is necessary to view the relative position of the burst with respect to the gate pulse.

Because the gain of a 500KC scope is not the same at 15KC as it is at 3.58MC, you may have difficulty in positioning the presentation so that the burst is visible. This is not a serious problem, however, and is easily overcome by preceding the ST-2A Oscilloscope with the ST-17A Color Compensator. The ST-17A Color Compensator attentuates the low-frequency signals (15KC) and allows high-frequency signals to pass easily (3.58MC). This technique can be used with the ST-2A Oscilloscope because, unlike some 500KC scopes, it does not become paralyzed in the presence of high frequencies. You can readily see that for color TV servicing the ST-2A is the outstanding value available to the servicing industry.

In addition to the present General Electric TV Service Package, a dealer must have a color bar generator for phasing and matrixing adjustments. He will also need a dot or cross-hatch generator to adjust the convergence of the tri-gun picture tube.

The General Electric Company has recently announced the ST-16A Color Alignment Generator. This instrument is designed and manufactured to the same high quality standards as the ST-2A, ST-4A and ST-5A. It has the same fundamental purpose of providing an accurate, stable, dependable instrument with maximum protection from obsolescence. The ST-16A Color Alignment Generator is, in fact, a small compact instrument which generates an almost exact replica of a standard NTSC Color Television Signal.

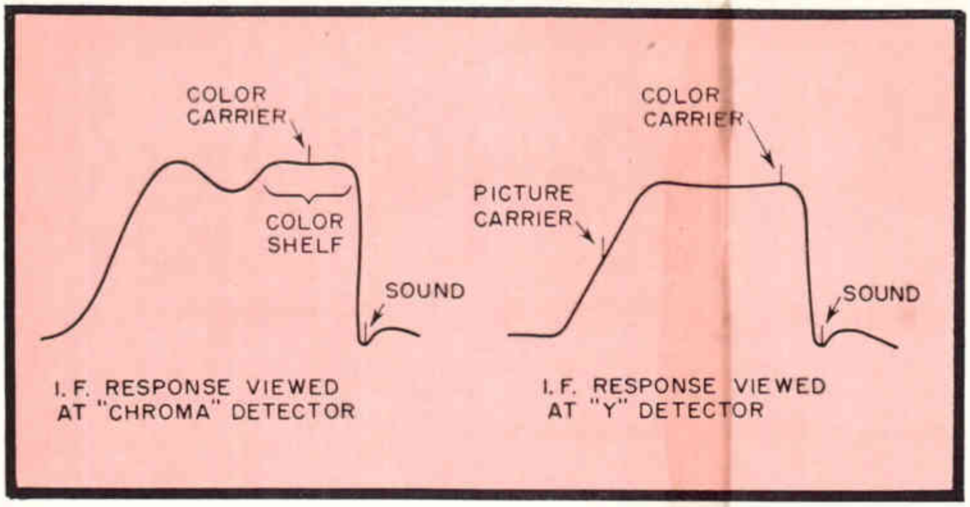



**Fig. 8. Typical I.F. response curves as observed on General Electric ST-2A oscilloscope.**

As long as the present F.C.C. approved NTSC standards are used there can be no obsolescence of the ST-16A.

The ST-16A is designated as a "Color Alignment Generator" rather than a "Color Bar Generator" because it not only produces color bar information but cross-hatch and dot information as well. You should be sure when you compare the ST-16A against other instruments that you do not overlook this fact.

The cross-hatch signal consists of eight vertical stripes and six horizontal stripes as a composite signal. The vertical stripes and the horizontal stripes are of an equal width, the horizontal stripes being three to four lines wide. This type pattern is shown in Fig. 9. The cross-hatch signal is used to establish horizontal and vertical linearity over the face of the tube. The cross-hatch is also used to adjust convergence of the color tube after the initial triad setup is accomplished with the dot pattern. Convergence is then adjusted over the entire face of the tube with the cross-hatch pattern. This applies to either electrostatic or magnetic-convergence type picture tubes.

The dot signal consists of 48 dots, 8 horizontal and 6 vertical. The dots are small, yet large enough for easy convergence, being the intersection of the above mentioned cross-hatch signal, as illustrated in Fig. 10. It is interesting to note that the dots produced by some dot generators are too small to be seen in a mirror when adjusting convergence controls at the back of a color receiver. Both the cross-hatch and the dots may be used as video information or as modulation of the R.F. carrier.

A composite color signal is generated which includes crystal-controlled horizontal and vertical interlaced sync, thus insuring a completely stable presentation with complete video blanking during the vertical retrace interval. The 3.58MC burst signal plus the chroma signal with proper chroma-to-pedestal amplitude relationship (certified saturated colors) are also included.

A combination of three selected bars and a black reference bar are presented

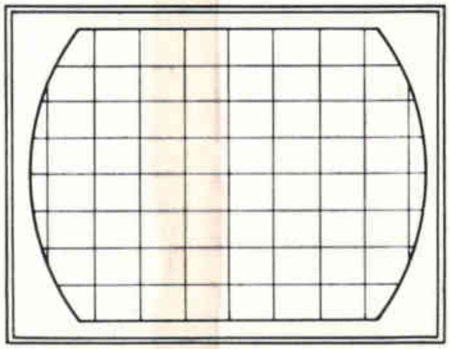


**Fig. 9. Cross-hatch pattern.**

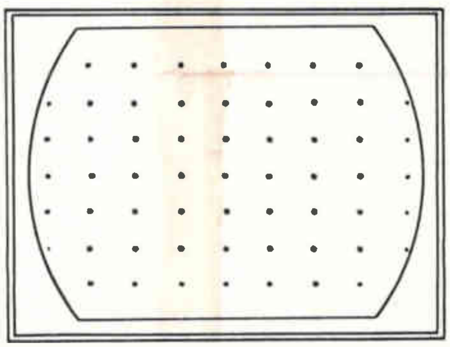


**Fig. 10. Dot pattern.**

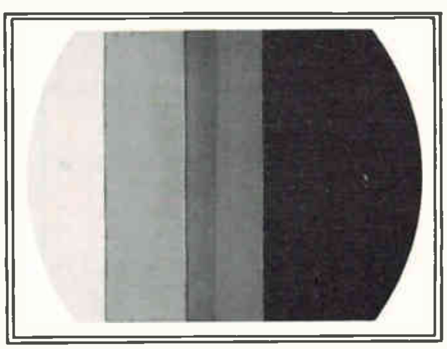


**Fig. 11. Location and size of color bars and black reference bar as produced by ST-16A.**

simultaneously, as shown in Fig. 11. It is felt that less than three color bars is insufficient and more than three leads to difficulty in identification of the various bars when observing the information on an oscilloscope.

Some color bar generators present as many as seven bars plus sync and burst. The pattern observed on an oscilloscope looks something like Fig. 12 when observing the wave form at a matrix point. This amount of information is difficult to work with because of the "picket fence" effect.

The ST-16A presents the kind of pattern shown in Fig. 13 on an oscilloscope.

This is a very simple presentation and completely eliminates the possibility of error. The black signal is wide enough to serve as a good reference when using an oscilloscope to observe detector outputs, or for matrixing.

The first, second and third bars may be changed individually, without affecting the remaining two bars, by means of three switches on the front panel. The switches are marked as follows:

| First Bar | Second Bar | Third Bar |
|---|---|---|
| R-Y | B-Y | Green/G-Y |
| I | Q | Cyan |
| Blue | Red | |
| Magenta | Yellow | White |
| White | White | |

The fourth bar is always the black reference signal.

Seventy-five different combinations of simultaneous presentations are available without confusion to the operator, since switch positions are marked with the presentations being used.

As an example, suppose a dealer is adjusting the I detector of an I&Q type color receiver. He will select I for the first bar, Q for the second, and white (to eliminate confusion) for the third. He will then adjust the I detector for zero Q output. Similarly, observing the output of the Q detector, he will adjust it for zero I output. On an R-Y, B-Y type receiver he should select R-Y on the first bar, B-Y on the second, and white on the third, proceeding in the same fashion.

A new approach in receiver design uses Q and R-Y. These sets can be serviced in exactly the same way with the ST-16A. There are few color alignment generators on the market capable of doing this.

Another receiver design, which can also be serviced by the ST-16A, utilizes R-Y and G-Y. The third knob allows G/G-Y to be selected. Since there is a phase difference of only approximately 4° between Green and G-Y, we have set the color phase of the G/G-Y output half way between Green and G-Y. Although on either Green or G-Y the output will be approximately 2° in error, this is well within the specification tolerances of the NTSC system.

When matrixing the set the service technician proceeds as follows: He observes the signal at the grid of the red gun with an oscilloscope, sets the first bar on white, the second on red and the third on white. He then adjusts the red level to be equal to the white level and the adjustment for red is matrixed. Similarly, for the blue gun he will set the first bar on blue and the second and third bars on white. For the green gun he will use the first and second bar on white

*(Continued on page 5)*

and the third on green. With this type of presentation the only change in the oscilloscope presentation during matrixing is the level of the color being matrixed, the white and black levels remain fixed. All possibility of confusion is eliminated.

Some newer receivers actually matrix in the television picture tube itself, and as a result there is no point where matrixing may be observed with an oscilloscope. The technique employed to matrix this type of receiver is quite different from that used to matrix standard receivers. A special device, consisting of three suitable filters (red, green and blue), is used to observe the color bars. Blue, magenta and white bars are selected and matrixing controls are adjusted so all three of these colors have the same degree of brilliance when viewed through the blue filter. Similarly, red, yellow, and white bars are matrixed, using the red filter; and green, cyan and white are matrixed, using the green filter. This device has been designated by General Electric as the ST-19A Matrix Filter and it is available as a part of the complete G-E service package.

The color bar signals may be presented as composite signal, or as pedestals only for gray scale adjustment, or as chroma only for checking chroma circuits.

In the "chroma only" function the burst amplitude is adjustable from the front panel to determine the "lock in" stability or sensitivity of the sub-carrier generator and operation of the color killer circuit. To the best of our knowledge, the ST-16A is the only instrument incorporating this feature.

The video output may be of either polarity, and is adjustable from 0 to 1.5 volts peak-to-peak at a nominal impedance of 95 ohms. The output cable is RG/62U, properly terminated in an attenuator to prevent standing waves on the cable.

The sub-carrier signal (3.58MC cw signal) at approximately 0.5 volt peak-to-peak is also adjustable from zero. It is used as a 3.58MC marker in conjunction with the ST-4A Sweep Generator and the ST-5A Marker Generator, or as a signal for signal-tracing of chroma circuits.

The R.F. output is crystal-controlled on a single channel (2, 3, 4 or 5 optional). It is very important that the R.F. signal be crystal-controlled at the picture frequency in order to prevent staggering between the tuner and the I.F. strip. Some color bar generators have tunable oscillators which control the R.F. output frequency. Such oscillators create the possibility of adjusting the head end at the wrong frequency. As you know, the the fine tuning of a color receiver must be tuned very accurately to insure reception of color.

Fig. 14 shows the correct alignment of the head end and the correct alignment of the I.F. strip as related to the head end.

Now, suppose that a color bar generator is tunable, there would be a strong possibility that the wrong picture frequency could be selected. In this case

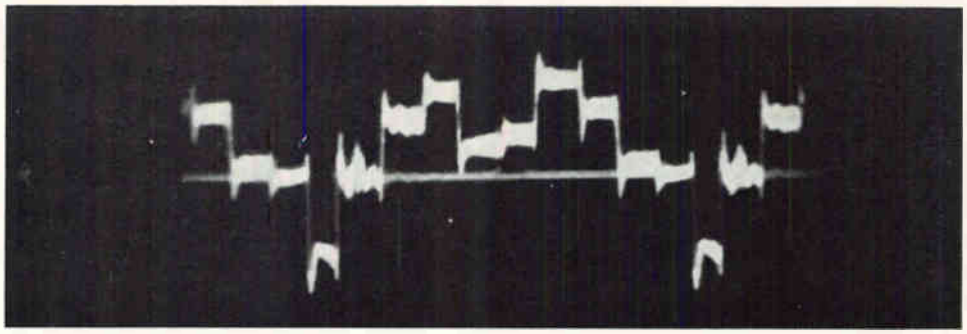


**Fig. 12. Oscilloscope pattern produced by some color bar generators. (This is an unretouched photograph.)**

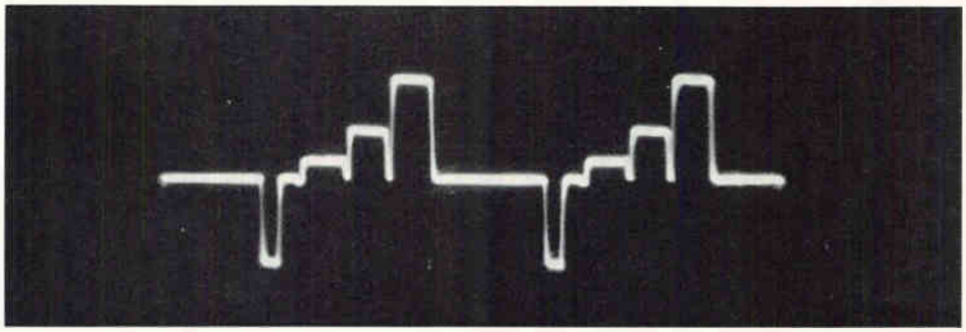


**Fig. 13. Oscilloscope pattern produced by the ST-16A color alignment generator. (This is an unretouched photograph.)**

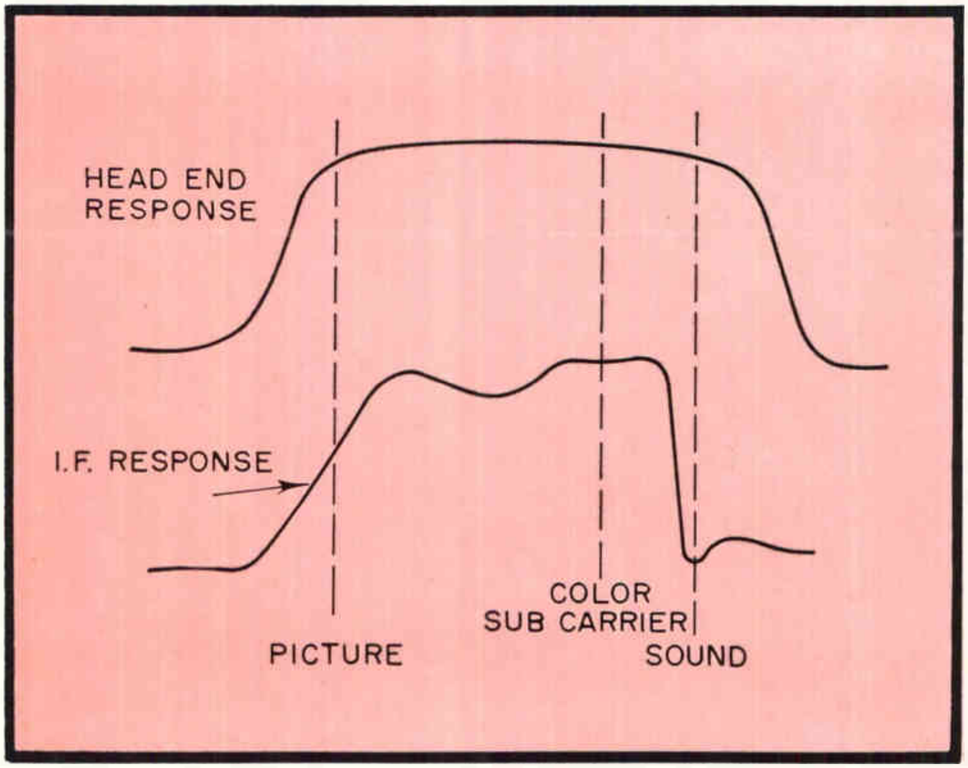



**Fig. 14. Correct head-end and relative I.F. alignment curves.**

the local oscillator would have to be tuned incorrectly to obtain apparently correct color bars. If the set was used to observe a transmitted picture, however, it would not function properly (due to RF-IF staggering) and realignment on the correct frequency would be necessary.

Associated with the crystal-controlled picture carrier is a crystal-controlled sound signal removed 4.5MC from the picture carrier. The sound, which can be switched on or off at will, is used as a head-end oscillator tuning reference since it is essential that the various signal carriers be properly located on the I-F response curve before any color circuits are aligned.

It can be seen from the foregoing description that the ST-16A is a versatile as well as a precision instrument. Since it generates an NTSC signal with a complete selection of the various color signals which may be used in color receivers, the ST-16A like the other General Electric alignment equipment should serve you accurately and dependably for many years to come.

# 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. The Company shall have the right without obligation beyond the above to publish and use any suggestion submitted to this column. Send contributions to The Editor, Techni-talk, Tube Department, General Electric Company, Schenectady 5, New York.**

### IDENTIFYING CRT SHORTS

Here is some information that may prove valuable for those servicemen who own a Heath-Kit CRT Checker, Model No. CC-1.

When checking for shorted elements in a CRT, should the tube be shorted, the NE-51 glows on both poles on various numbers and combinations 1, 2, 3, and 4, but the operating chart does not specify what elements are shorted. The serviceman, therefore, only knows that the tube is no good, but does not know exactly where the short is.

I have gone through extensive experimentation and have found and guarantee the list below to be accurate showing a 10-meg short or better between the following elements. Owners may want to make a copy and keep it with the instrument.

Both poles on the NE-51 must glow for the following checks on the short switch 1, 2, 3, and 4.

- Heater to cathode short—only on No. 4
- Heater to grid No. 1 short—only on No. 3
- Heater to grid No. 3 short—only on No. 2
- Grid No. 1 to cathode short—must show on No. 3 and No. 4
- Grid No. 3 to cathode short—must show on No. 2 and No. 4
- Grid No. 1 to grid No. 2 short—must show on No. 2 and No. 3
- Focusing grid to grid No. 2—must show on No. 1 and No. 2
- Focusing grid to grid No. 1—must show on No. 1 and No. 3
- Focusing grid to cathode—must show on No. 1 and No. 4

*Miguel Koty*
*440 East 22nd St., Apt. 4-B*
*Brooklyn 26, N. Y.*

### PAPER STETHOSCOPE

A piece of paper rolled up in a cone-shape form which acted as a stethoscope directed me to an arcing resistor.

After the TV set was turned on, the brightness was turned up to maximum brilliance. Arcing could be heard (at maximum brilliance only) from the speaker as well as seen in the picture. All the tubes and the yoke were replaced. The arcing continued and the oscilloscope could detect a spike (arc) on most any point in the HV circuit with approximately the same amplitude. By rolling a sheet of paper and placing one end to my ear and the other end to the components, one by one, I found a resistor that was arcing internally. The sound (arc) from this resistor was more noticeable than any other component and, therefore, it was changed. No more arcing was present.

This paper cone was very valuable in saving time for this set and also one other since.

*Mr. F. Northrop*
*Northrop Radio-TV Service*
*1728 Linden Ave.*
*N. Tonawanda, N. Y.*

### HV INSULATOR

In several models of Packard-Bell Television, there is trouble with the Hi-Voltage jumping over to the cage and ground, resulting in shorting out of the Hi-Voltage transformer.

This can be overcome by simply inserting a piece of window glass between the cage and the Hi-Voltage transformer at the point where the short would otherwise occur.

*Louis L. Grisham*
*Grisham Radio Service*
*1412 Selby Ave.*
*Los Angeles 24, Calif.*

### REMOVAL OF CRT BASE

Use a piece of No. 20-22 solid conductor copper wire (tinned) and make one turn around each of the pins used. Heat each pin with a soldering iron or gun, then hold the iron on the copper wire—the base is then easily taken off. This is a very simple job and may save the customer a CRT replacement.

*Sam J. Falco*
*Glendale T. V. & Radio Service*
*Lot No. 17, Glendale*
*Newark, Delaware*

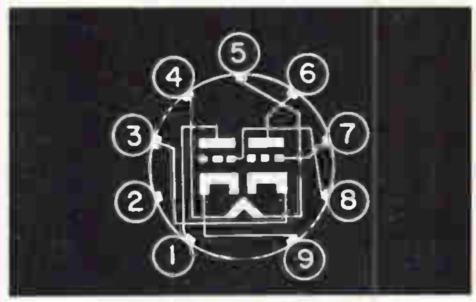
# What's new!

## 6CM7
## DISSIMILAR DOUBLE TRIODE

The 6CM7 is a miniature tube which contains two dissimilar medium-mu triodes in one envelope. It is intended for use as a combined vertical-deflection oscillator and amplifier in television receivers. In this application, section one may be used as a conventional blocking oscillator, while section two is particularly adapted for vertical amplifier service as a result of its high-perveance characteristics and its 5-watt plate dissipation ratings.

In addition the 6CM7 features a controlled heater warm-up characteristic which makes it especially suited for use in television receivers which employ 600-milliampere series-connected heaters.

| | |
|---|---|
| Heater Voltage, AC or DC | 6.3 Volts |
| Heater Current | 0.6 Amperes |
| Heater Warm-up Time | 11 Seconds |




### CHARACTERISTICS AND TYPICAL OPERATION

| CLASS $A_1$ AMPLIFIER | Section 1 (Oscillator) | Section 2 (Amplifier) | |
|---|---|---|---|
| Plate Voltage | 200 | 250 | Volts |
| Grid Voltage | −7 | −8 | Volts |
| Amplification Factor | 21 | 18 | |
| Plate Res., approx. | 10500 | 4100 | Ohms |
| Transconductance | 2000 | 4400 | μmhos |
| Plate Current | 5.0 | 20 | ma |
| Plate Current, approx. $E_c = -10$ Volts | 1 | .... | ma |
| Grid Voltage, Approx. $I_b = 10$ Microamperes | −14 | .... | Volts |

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Vol. 8 No. 6
TECHNI-TALK
on AM, FM, TV Servicing
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